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<tr>
<th>YAESU MULTIMODE - HANDHELD</th>
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<td>[3] YAESU FT290R MULTIMODE</td>
<td>£369.00</td>
<td>£14.00</td>
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<td>[9] FT203R + FNB3 2MTR SUPER HANDHELD</td>
<td>£255.00</td>
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<td>[4] FT209RH + FNB4 2MTR 5 Watts H/H.</td>
<td>£315.00</td>
<td>£12.00</td>
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<td>[16] ALINCO ALM203E H/H C/W 30W AMP</td>
<td>£239.00</td>
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<td>[19] FT709R + FNB3 70CMS KEYBOARD H/H.</td>
<td>£319.00</td>
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<td>[7] FT2700R 25W 2+70CMS MOBILE</td>
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<td>[13] IC3200E 25W 2+70CMS MOBILE</td>
<td>£499.00</td>
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<tr>
<td>[20] IC290D 25W 2MTR MULTIMODE</td>
<td>£599.00</td>
<td>£21.00</td>
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<td>[2] NEW IC28E 25W FM MOBILE (Rwc mod)</td>
<td>£349.00</td>
<td>£14.00</td>
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<tr>
<td>[12] FT726 ALL MODE MULTI BAND V-UHF</td>
<td>£999.00</td>
<td>£42.00</td>
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<td>[17] IC271H 2MTR MULTIMODE 100 WATTS</td>
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<tr>
<td>[5] IC735 ALL BAND 100W SUPER-RIG.</td>
<td>£925.00</td>
<td>£34.00</td>
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<tr>
<td>[6] FT757GX ALL BAND (C/W RWC MOD)</td>
<td>£949.00</td>
<td>£33.00</td>
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<td>[15] IC745E ALL BAND HF TRANSCEIVER</td>
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<td>[11] FRG8800 ALL MODEL ALL BAND RX</td>
<td>£625.00</td>
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<td>[1] FRG9600 MK2-RWC SCANNING V-UHF</td>
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<td>[14] ICOM ICR71 ALL MODE HF SUPER RX</td>
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<td>[10] ICOM ICR7000 25-1300MHZ SCANNING RX.</td>
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<td>[18] BEARCAT NEW 100XL H/HELD SCANNER.</td>
<td>£219.00</td>
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<tr>
<td>[8] BEARCAT DX1000 SW 10-30MHZ ALL MODE</td>
<td>£329.00</td>
<td>£13.00</td>
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THIS IS JUST A SMALL SELECTION OF THE STOCK WE HAVE AVAILABLE AT RWC YOU WILL GET THAT BETTER DEAL, WE ALSO HAVE THE BEST UPDATED WEEKLY USED LIST FULL OF BARGAINS ALL OF WHICH CARRY OUR FAMOUS THREE MONTH WARRANTY. Plus our VERY SPECIAL package Deals!

Please call us by telephone for a free brochure, Creditcard application leaflet or any other information. You may also order any of the above goods by AMERICAN EXPRESS, VISA, ACCESS, Diners Club on our 24hr answerphone. RWC Ltd are licenced Credit Brokers. Full written details on request.

OR POP INTO OUR HAGLEY RD. SHOP FOR A NO-OBLIGATION DEMONSTRATION OF ANY OF THE ABOVE PRODUCTS. PLUS THE THOUSANDS OF OTHER LINES IN STOCK... (Junc. 3 MS.) DON'T FORGET!!! CHRISTMAS IS JUST AROUND THE CORNER.

Tel: 021 421 8201 (24hr answerphone)
Telex: 334303 G TXAGWM
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please mention RADIO & ELECTRONICS WORLD when replying to any advertisement
**SCOPE/DVM/COUNTER**

New from Thruby Electronics is the Hitachi V1150 oscilloscope with 'smart' measurement features.

The V1150 has a bandwidth of 150MHz, producing a rise time of better than 2.3 nanoseconds on all four of its input channels, and a guaranteed maximum time delay difference of 0.5ns.

In addition to its operation as a widebandwidth real-time oscilloscope, the V1150 incorporates a sophisticated digital measurement system, which comprises an ac/dc digital voltmeter, a 150MHz timer counter and full vertical and horizontal cursor measurement facilities.

The DVM can measure dc or ac voltage with the latter being optionally displayed in dB relative to a user-set memorised value. The counter/timer can measure frequency from 0.01Hz to 150MHz and period from 99.990ns (10μs resolution) up to 99.999ms. A further mode allows trigger events to be counted up to a maximum of 500,000 events.

The cursor measurement system provides for on-screen measurements of voltage and time related quantities via two horizontal or two vertical movable cursors which can be positioned on the waveform with very high precision. An on-screen read-out of a variety of parameters can then be obtained including absolute voltage, relative voltage, voltage difference ratio, decibels, time, equivalent frequency (1/T), time difference ratio, and phase.

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

---

**CLAMP METER**

Now available from Electronic & Computer Workshop is an economically priced and simple to use clamp meter, the Panetec CT3101, with nine ac voltage and current measurement ranges.

Using a taut-band meter movement, the analogue CT3101 is a heavy duty design able to accommodate cable diameters of up to 28mm. Current ranges are up to 6, 15, 60, 150 and 300 amps ac with voltage ranges of 15, 300 and 600 volts. Resistance from 0 to 1k can also be measured.

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

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**COLOUR DECODER**

Brabury Limited has launched a self-contained automatic multi-standard colour decoder unit, the T510, suitable for a range of applications where colour television signals are received in more than one coding standard.

The decoder accepts composite video inputs in 625-line PAL or SECAM format or 525-line NTSC with either 3.58MHz or 4.43MHz subcarrier. In normal operation it senses the subcarrier frequency and the coding characteristics of the incoming signal and automatically configures to the appropriate decoding circuit. No manual switching or adjustment is required.

In addition to the normal RGB video and mixed sync pulse outputs, the Brabury decoder provides chroma component signals (R-Y and B-Y) together with the luminance component (Y), principally for use with Sony Betacam and Panasonic M1 video cassette recorders.

Brabury Ltd, Units 10/11, Pipers Industrial Estate, Pipers Lane, Thatcham, Berks RG13 4NA. Tel: (0635) 68830.

---

**BENCH MULTIMETER**

Black Star Limited has announced the latest addition to its range of instruments, the 3225 digital multimeter.

The 3225 meets users' needs for a mains-independent 3½-digit bench multimeter which is fully portable, yet avoids the problems posed by pocketable instruments in many applications.

Operating economy has been a prime consideration in the design of the 3225, resulting in a DMM which gives typically 7,500 hours use from one set of alkaline batteries. A low-battery indicator gives warning of the end of battery life before operation of the instrument suffers.

The 3225 offers 28 measuring ranges with 3½-digit resolution and basic dc accuracy of 0.25%. There are also diode test and audible continuity functions. Measurement features include ac and dc voltage in 5 ranges from 200mV to 1000V full scale, maximum resolution 100μV (ac voltage maximum 750V rms); ac and dc current in 6 ranges from 200μA to 10A full scale, maximum resolution 0.1μA; and resistance in 6 ranges from 200Ω to 20MΩ full scale, maximum resolution 0.1Ω.

The 3225 is housed in a tough grey plastic case, shielded against electromagnetic and radio frequency interference. Readings are presented on a high contrast 0.5 inch liquid crystal display, with polarity, range and low battery indication.

The 3225 digital multimeter is supplied complete and ready to use, with a set of safety test leads, alkaline batteries and a comprehensive user manual. The UK price is £89 plus VAT.

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

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FEBRUARY 1987
MULTIMETER

The UDL 44 digital multimeter from Rohde & Schwarz features waveform-independent RMS measurement of dc voltages and ac currents up to a crest factor of 3 (TRMS), as well as measurement of frequency or period from 10Hz to 100kHz. The wide display range of 24,999 steps or 99,999 steps for frequency measurement has the advantage that commonly encountered values such as 220V ac or 24V dc voltages can be measured with highest resolution. The dc voltages, ac voltages, dc and ac currents as well as resistance values determined in a total of 17 measurement ranges are indicated on the 4½-digit display. The basic error limits are ±0.04% for dc voltage measurements, ±0.5% for ac voltage and ±0.06% for resistance measurements up to 250kΩ (±0.25% with 2.5MΩ) with a maximum resolution of 10μV for voltage measurements, 10μA for current measurement and 10nΩ for resistance.

In addition to these basic functions the UDL 44 also allows continuity checking of electrical connections (R <20Ω), with acoustic signaling, and testing of diodes.

Rohde & Schwarz, Mühldorffstrasse 15, D-8000 München 80, W Germany. Tel: (0 89) 41 29 26 25.

LOGIC PROGRAMMER

A new type of programming system which will transform any IBM PC or PC 'look-alike' into a full logic programming system, has been launched by GP Industrial Electronics. The system will be of particular interest to PC users who require a low cost method of programming bipolar PROMs, single-chip microprocessors and PALs.

The system hardware is called the XU-620 universal programmer module. The software is called XUDRIVE. The software will permit the IBM user to enter the appropriate editing and programming commands for full remote control of the XU-620 programming module, which simply plugs into the parallel port of the host PC. The IBM screen displays the information and instructions entered. The XU-620 costs £395, the XUDRIVE software, £245.

GP Industrial Electronics Ltd, Unit E, Huxley Close, Newham Industrial Estate, Plymouth PL7 4JN. Tel: (0752) 342961.

DF PROCESSORS

Fieldtech Heathrow Ltd has announced availability of Techcomm's TC-586 portable direction finder system. The TC-586 system includes a DF processor receiver unit installed in a standard briefcase. The system provides reception demodulation and line of bearing information for AM and FM signals in the 25-550MHz and 800-1300MHz range.

The receiver includes a 20-channel memory scan and F1 and F2 search capability. Power is supplied by an internal rechargeable battery pack or by external 110/240V ac or +12V dc power source.

A variety of small low-profile antennas are available for ground, mobile or airborne applications. The associated antenna (also supplied) is designed to be stowed in a matching attach case.

Fieldtech Heathrow Ltd, Hantavia House, 420 Bath Road, Longford, Middlesex UB7 0LL. Tel: (01) 897 5446.

SPECTRUM ANALYSER

Hewlett Packard's new spectrum analyser is now available ex-stock from Livingston Technical Sales. This is the first HP spectrum analyser to be made available through a distributor.

The HP 8590A RF spectrum analyser offers advances in 240V features in a lightweight, sturdy package weighing 13.5kg.

The instrument covers the 10kHz to 1.5GHz frequency range (1.8GHz optional), with -115 to +30dBm amplitude range. Designed for easy manual operation, the 8590A is the first HP spectrum analyser to have both dedicated push-buttons, for frequently-used functions, and menu-based softkeys, which access more than 80 additional functions. Most measurements require only frequency, span and amplitude selection, the analyser automatically adjusting remaining parameters for an optimised CRT display. Optional HP-IB, HP-II and RS232C interfaces enables full programmability, and direct output of results to printer or plotter.

Coupled with the HP 8444A tracking generator the HP8590A performs evaluations such as stimulus response measurements, eg frequency response and insertion loss. Further addition of the HP 10855A broadband amplifier and the new HP 11940A close-field probe gives a swept broadband system for EMI troubleshooting.

The unit is available for sale ex-stock from Livingston Technical Sales or on short term rental from Livingston Hire.

Livingston Technical Sales Ltd, Livingston House, 2-8 Queens Road, Teddington, Middx TW11 0LH. Tel: (01) 977 0055.

CHARGER/PSU

The ability to supply electronic equipment from the mains, and from a float charged battery if there is a mains failure, is provided by the Supercharge 3 from Avel-Lindberg. The unit can be used as a nominal 27V dc 43A max power supply, or as a battery charger with 10 to 39A adjustable charging current; and also in combination of these roles as long as the input current of the 240V ac supply does not exceed 7.5A, using the charge current limit to set the total load. The basic elements of a dc UPS system are available in the Supercharge 3, with the options of additional switching circuits for changeover and maintenance if required.

The efficiency is between 85% and 90%; the output regulation is better than 0.5% from no load to full load, which provides fast battery recharge; and the 50kHz switching frequency enables magnetic components to be reduced considerably in weight and size. The total weight is only 7kg.

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

**AMSTRAD MODEM**
Miracle Technology have produced a new WS4000 dedicated modem and interface package for the Amstrad PCW8256 world processor.

Autodial, autoanswer, full Hayes intelligence and a special Amstrad serial interface where all cables are brought together in this package for £169.95 exclusive.

Developed from Miracle’s WS4000 modem, this new package offers full upgradeability from the standard V21/V23 to V22 and even V22bis. This means speeds from 300bps to 1200/75bps as standard, with 1200 and 2400bps full duplex as optional additions.

Operation is simple and requires no specialist knowledge, and a comprehensive list of UK and international databases is supplied free with every WS4000 dedicated modem.

There is no software to buy for those using Amstrad’s built-in MAIL232 communications suite. For others wanting additional general purpose software the WS4000 package is available complete with ChitChat comms software for £259.90 exclusive. The modem works with both the PCW8256 and PCW8512 machines.

Miracle Technology (UK) Ltd, St Peters Street, Ipswich IP1 1XB. Tel: (0473) 216141.

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**RF MATRIX SWITCH**
Wavecom’s latest switch development is an RF coaxial matrix switch that offers up to 45 selectable I/O paths. Available in the UK from Anglia Microwaves, the matrix switch is guaranteed for 1,000,000 switching cycles for each position, in versions with from four to ten I/O channels. This option allows from six to 45 RF paths, selected by a TTL-compatible control port. The switching capability is claimed to be unique, in that no other type can offer so many alternative switch paths together with the ability to connect any port to any port. Models can be specified with frequency ranges up to 18.5GHz.

Typical applications for this new product include the selection and interconnection of multiple receive and transmit antennas, filters, amplifiers, spectrum analysers and other instrumentation in development or test laboratories. Other features of the Wavecom matrix switch include latching/reset operation, a typical switching speed from 15 to 20ms and a choice of solenoid operating voltages of 6, 12, 24 or 28V dc.

Anglia Microwaves Ltd, Radford Business Centre, Radford Way, Bitterne, Hampshire, SO31 2BW. Tel: (0277) 630000.

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**DIGITISED PICTURES**
Commodore’s new digital picture storage system, Digiview, allows any subject captured by a video camera to be stored permanently on computer disc.

The Digiview system, exclusive to the Commodore Amiga, uses any black and white video camera with 221 interlace. The computer/digitiser adds colour as part of the picture enhancement process. The software makes one scan with each red, green and blue filter then combines all three scans for a full colour picture.

The digitising system together with a Panasonic WV 1410 camera sells for £368.

Commodore Business Machines (UK) Ltd, Commodore House, The Switchback, Gardner Road, Maidenhead, Berkshire SL6 7XA.

---

**LINE MATCHING**
New from Kenton Research is the 01110, a miniature line isolation transformer designed to meet the interface requirements between British Telecom lines and subscriber apparatus. The device has been successfully used in equipment approved by BABT and Teleprove.

The transformer meets the requirements of British Telecom Technical Guide 26 as well as BS6305, BS6328, and BS6301 and optimises performance for 600Ω impedance circuits. It is also suitable for matching network impedance in accordance with BS6305 (Class A).

Kenton Research Ltd, Unit 16, Europa Trading Estate, Erith, Kent DA8 1QL. Tel: (03224) 41933.
ITT Consumer Products (UK) is now supplying its 14-inch monitor-style colour portable unit, the CP3128, with the ITT-developed Multipage teletext system as standard. This system is also standard in the whole Digivision range, and is available as a retrofit upgrade for earlier models of the CP3128.

Each time a page of text is selected the Multipage system automatically collects the subsequent seven, giving users much-reduced access time to pages of related information. In addition, a rolling page facility is provided to collect up to eight sub-pages for scanning at the viewer's own pace.

The new set's features include frequency synthesis tuning with 40 programs, colour transient improvement for optimum colour contours and infra-red remote control. Full monitor/receiver facilities are provided via a Peritel (SCART) socket, giving RGB input, A/V and audio input/output. The chassis in the CP3128 is one of ITT's Monoprint series, integrating all components and controls onto a single PCB.

ITT consumer Products (UK), Paycooke Road, Basildon, Essex. Tel: (0268) 27788.

POCKET MAGNIFIER

A new pocket magnifier is now available by mail order from E. Leitz (Instruments) Ltd. The Optipak features a high quality glass (rather than plastic) magnifier, offering 3x magnification, housed in a robust plastic holder. The case has an extendable millimetre scale for map work and aerial photos etc.

The Optipak costs £12.95 including p&p.

E. Leitz (Instruments) Ltd, PO Box 10, Buntingford, Herts SG9 9BT. Tel: (0582) 404040.

QUARTZ CRYSTALS

Now available from Online Distribution is a range of quartz crystals by the Korean manufacturer, Sunny. The crystals (HC 18/u, HC 33/u and UM-1 type) cover all TV, microprocessor and frequency synthesizer requirements. They range from 1MHz to 48MHz, with a tolerance of ±0.0025 per cent or ±0.005 per cent at 25°C. Temperature range is −20°C to +70°C. Shunt capacitance is no greater than 7pF; ageing rate ±5ppm; seal by solder or resistance weld.

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

POWERS SUPPLY CASE

A new plastic enclosure incorporating a three-pin 13A plug and meeting the latest British Standard specification is available from enclosures company West Hyde. The live and neutral pins are sleeved, in line with the latest requirements of BS1363, thus preventing accidental contact with live conductors if the housing is partially withdrawn from a socket.

A separate internal moulding serves as a cradle to support a standard size £148 (No74) transformer, or as a mounting plate for other components. This moulding also secures the earth pin in position and keeps wiring at mains potential away from the low voltage circuitry.

The housing is suitable for small power supplies, spike suppressors or other devices where the equipment can conveniently plug directly into the mains supply. The case is available in either black or white and has a non-conductive earth pin as standard. Brass earth pins will be available shortly.

West Hyde Developments Ltd, 9-10 Park Street Industrial Estate, Aylesbury, Bucks HP20 1ET. Tel: (0296) 20441.

10mW LASER DIODE

New from Sharp, and now available from Hero Electronics, is a low cost addition to the extensive Sharp line-up of semiconductor laser diodes. The LT027 is a 10mW maximum output laser operating at 780nm, and having a typical threshold current of 45mA. Normal operating current is typically 65mA. The device package, which is available in two case styles, also incorporates a photodiode for use as a feedback element to control the laser output. The LT027 is suitable for use with both of the Sharp laser diode driver ICs, the IR3C01 and IR3C02.

Hero Electronics Ltd Dunstable Street, Ampthill, Beds MK45 2JS. Tel: (0525) 405015.
Wire-Wound Resistors

The HSV series metal-housed resistors from CGS save space by performing the added function of taking a connection through a bulkhead or casing, at the same time using the metalwork as a heatsink.

The HSV variant comes in two dissipation ranges, 15 and 25W at 25°C, and owes its dual function to a modified body style – part of the aluminium housing is threaded for fixing through the casing, and terminations are solder tags. The resistors are part of CGS’ high stability H5 range, components which are capable of dissipating high power in a limited space while maintaining a relatively low surface temperature. The power is dissipated rapidly as heat through the housing to the metalwork.

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

Gate Arrays

Motorola has announced the HCA62A00 series of advanced 2-micron HCMOS gate arrays with 100% input/output flexibility and 100% programmable power and ground pins. These features provide the designer with simplicity to use semi-custom solutions and the ability to use any pin as an input, output bidirectional, ground or power pin. Motorola offers seven configurations with densities of 600 to 8,600 gates.

The 62A00 series arrays simplify board layout and the conversion from circuit schematic to semi-custom chip by providing the customer with the flexibility to decide where to place all signal and power pins. For high output drive up to six output cells can be paralleled on-chip for 24mA through a single pin. The cells paralleled to obtain this high output drive can still be used as inputs to the array, providing high drive without reducing the number of usable pins.

Motorola Inc.
PO Box 52073,
Phoenix
Arizona 85072.
Tel: (602) 821 4426.

A great, NEW ANTENNA for the ‘UP-MARKET’ AMATEUR requiring...

SIGNAL PENETRATION

the Western

DX-24Q

QUAD

It pays to deal with people with “user-experience”. Designed by G3NMG, 2nd in world-wide SSB contest!!

Built by Western No problems associated with lack of spares as on imported antennas. (Send SAE for details)

NOW IN USE

FROM VK7 TO VE7!

PRICES (INC CARR & VAT)

ANTENNAS

<table>
<thead>
<tr>
<th>Cat No</th>
<th>Price</th>
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<td>1075 DX-7/2 7MHz 2 ele Yagi/ Gamma matched 20 boom</td>
<td>£402.50</td>
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<td>1076 DX-7/3 7MHz 3 ele Yagi/ Gamma matched 40 boom</td>
<td>£545.25</td>
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<tr>
<td>1077 DX-51 Rotary dipole for 28 24 18 &amp; 14 MHz</td>
<td>£145.25</td>
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<td>1080 DX-61/68 10/20MHz Multi and Vertical plus 30m</td>
<td>£125.50</td>
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<td>1081 DX-31 Dipole 10 20 30MHz 24kW p/p</td>
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<td>1090 DX-40K Circular kit with 40MHz dipole</td>
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<td>1091 DX-40K Circular kit with 27MHz dipole</td>
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<td>1092 DJ=3/2.3 ele beam for 27MHz gamma matched</td>
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<td>1093 DX-22/3 2 ele quad for 2, 10, 15, 20m</td>
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FEBRUARY 1987
DSP CHIPS

Now available from RR Electronics are details of three new chips in Motorola's digital signal processing (DSP) family. All are fabricated in HCMOS.

The DSP56000 is a 56-bit general purpose, user-programmable DSP. It comprises three execution units in parallel: the data ALU, the address ALU and the program controller.

This DSP has MCU-style on-chip peripherals, program and data memory, plus memory expansion port. Other features include: 10.25 million instructions per second (MIPS); single-cycle ALU; 24 x 24 56-bit parallel multiply/accumulate; 2K x 24-bit program ROM.

The DSP56001 chip is identical except that it includes

SURGECTORS

Now available from VSI is RCA's new range of surge suppressors. RCA developed these devices to protect sophisticated electronic equipment from rapid high voltage power surges.

The monolithic device consists of an SCR-type thyristor whose gate region contains a special diffused section that acts as a Zener diode. Because it combines the continuous voltage protection of the Zener with the thyristor's ability to handle high current, the Surgector provides protection against pulses which may be too rapid or too powerful for conventional devices.

VSI Electronics Ltd, Roydonbury Industrial Park, Horsecroft Road, Harlow, Essex CM19 5BY.
Tel: (0279) 35477.

GE SIPS

Now available from RR Electronics is range of space-saving SIP power transistor/ Darlington arrays made by GE Semiconductor. They are designed for high power switching, hammer drive, pulse motor drive and inductive load drive applications.

Ten different configurations are available in 8 10 or 12-pin packages, with power dissipation from 3W to 5W.

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

RAM instead of ROM for user flexibility.

The third chip, DSP56200, is a cascaded adaptive finite impulse response (CA FIR) digital filter. It's a DSP peripheral for computationally-intensive tasks associated with digital filtering. It fulfills two main functions, FIR filtering and adaptive FIR filtering using the least mean square (LMS) algorithm.

All three devices will be sampled by the first quarter of 1987. Design-in software packages are available now to run on VAX and IBM PC computers.

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

D CONNECTOR COMBO

A new combination of D subminiature connectors and a flexible jumper is now being manufactured by St Cross Electronics. Known as the Flexi D, this product is designed to give total flexibility in the application of D connectors to PC boards and panels. It also allows greater freedom in the PC layout, as the pin-out may be taken to 2 (or 3 in the case of 50-way) completely different locations on the PC board or to separate boards.

Flexi D features polyester constructed plug and socket insulators with connector shells of steel plated with zinc/yellow passivate. Conductor spacing is 0.1 inches with jumper conductors pre-bonded stranded 26awg, with length and various permutations to customer requirements.

St Cross Electronics Ltd, Unit 14, Mount Pleasant Industrial Park, Southampton SO2 0SP.
Tel: (0703) 227636.

RIBBON CABLE

Amphenol has developed a ground-plane ribbon cable that uses a quick stripping technique to save time on preparation for termination. Designed for computer and communications equipment using high speed switching and data transmission, Quik-Strip incorporates an integrally laminated copper mesh ground-plane with optional drain wire, affording proven crosstalk and EMI/RFI control.

The added refinement is a labour-saving method of peeling back the lamination for connector assembly. The edge of the cable is notched at the appropriate strip length and the laminate is simply peeled back with the fingers to the notch.

This cable is available with 20 to 60, 28awg 7/36 strand tinned copper conductors on a 0.05 inch pitch. Voltage rating is 300V, current rating 1A. Maximum operating temperature is 105°C.

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

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**High capacity CD**

Incomtel are to launch what is thought to be the first professional compact disc player in Europe. Incomtel see enormous potential for this machine, which has the capacity for up to 100 discs or 1000 tracks, from national and local radio stations as well as from users as diverse as clubs, leisure complexes, restaurants, hotels, etc.

The Audio-Metrics AMCD5 programmable compact disc player, approximately 80% smaller than the conventional music centres it supersedes, incorporates a Japanese-developed transport system with US electronics. It measures just 22 x 17.5 x 17.5 inches and weighs 80 pounds. The unit, once loaded with 100 compact discs to provide around 50 hours of music, gives instant automatic random access to disc and cut, either through its self-contained eight-step memory or by connecting to an external programmer or computer.

**Roll up, roll up!**

If you hurry (and if you've got any money left after Christmas) you can still take advantage of Comex Systems' Christmas specials.

Until 31st January Comex are offering satellite TV receivers with tunable sound, S-meter and RF modulator for £220 including VAT. They are also offering full systems comprising receiver, 16m GRP dish, polar mount and STS LNB (plus scalar horn) for £634 including VAT.

If you're in the market for a satellite system you'll find it hard to beat the quality and level of service from Comex (remember the satellite TV tuner project in last August's RAEN?), so give Paul Elliott a ring on Leicester (0533) 25084.

**Satellite conference**

The fifth Financial Times Cable Television and Satellite Broadcasting Conference, arranged in association with New Media Markets, will be held in London at the Inter-Continental Hotel on 18th and 19th February, 1987.

This two-day conference will be chaired by Lord Thomson of Monifieth, Chairman of the Independent Broadcast-
Mass market CAD
Robotechnic Limited have announced what is claimed to be the lowest cost, most complete computer aided design software system yet to be made available. Known as Generic CADD 2.0, the new system software will run on a standard IBM PC with graphics card and is priced at $99.00.

Generic CADD was first announced in the USA in June 1986, and by October had sold over 20,000 copies. Generic CADD 2.0 competes with products like AutoCAD, a widely accepted CAD entry level system.

Generic CADD 2.0 is the base module for a family of Generic CADD tools. Two of these have also been announced. The first, Auto-Convert, enables an AutoCAD user to swap files back and forth between AutoCAD and Generic CADD 2.0. The second add-on software tool is DotPlot, a facility that gives a standard dot matrix printer the capabilities of a simple pen plotter.

The basic hardware required is an IBM XT/AT or compatible with 384K RAM using DOS2.0 or later; two floppy disk drives or one floppy and a hard disk; and a graphics card providing EGA or CGA facilities.

Generic CADD 2.0 enables the user to draw a wide variety of objects - circles, arcs, rectangles, polygons, ellipses and true B-spline curves. Rubber banding and point and grid snapping techniques are also provided. The use of colour is encouraged by the provision of 256 colours and layers. Drawn objects can 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.

For more info contact Robotechnic on (01) 499 9746.

RRD report
On 18th December the Department of Trade and Industry published the first report of the Radio Regulatory Division (RRD), the DTI’s frequency allocation and enforcement section.

The division is effectively the only UK dispenser of radio spectrum, and the report is designed to familiarise current and potential spectrum users with the RRD's work. It covers the activities of the division during the financial year 1985/86 and includes details on the future plans for the spectrum and background material on the international framework.


Publication of the report coincides with a change of name for the RRD to Radiocommunications Division.

Copies are available from: The Library, Radiocommunications Division, Room 605, Waterloo Bridge House, Waterloo Road, London SE1 8UA.

London trunked system
During November, British Telecom Baselink launched its first trunked two-way radio service to provide extensive coverage over the Greater London area.

The London Trunked System allows both ‘base to vehicle’ and ‘vehicle to vehicle’ conversations. A desktop unit installed at the user's base is linked by radio to the Telecom Tower and enables mobile units in the company's vehicles to be contacted by the base or by another vehicle from virtually anywhere within the M25 ring.

Because the new trunked system is multi-channelled, calls coming onto it are automatically allocated a free channel. If all channels are being used, a queue is set up and callers are automatically directed through a free channel when one becomes available.

Depending on how busy the system is, the length of calls is limited in relation to total usage. This ensures that a user will rarely have to 'queue' for longer than 20 seconds. Typically, calls will be set to last between one and two minutes and a tone will warn users before time-out.

In addition to the London Trunked System, British Telecom Baselink can already provide dedicated or community repeater systems throughout mainland Britain. There are plans to introduce further trunked systems by September, with the launch of a national trunked service intended for the early 1990s.

SUMMER JOBS IN THE USA FOR 1987
American children's summer camps are seeking bright, enthusiastic young people (aged 19½-35) to live with and teach amateur radio skills to children from mid-June to mid-August. Return flight, special visa, food and accommodation arranged PLUS $300-$350 pocket money for the season. A challenging and rewarding programme for those who don't mind hard work and who have a genuine interest for children. If you have the relevant experience, and would like further details of this fantastic opportunity to work and travel in the USA (for up to 6 weeks after camp), please contact:

Roy Eldridge
BUNACAMP
232 VAUXHALL BRIDGE ROAD, LONDON SW1V 1AU
Tel: 01-630 0344

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Made to the very highest spec the TEC Starwriter FP1500-25 features a very new, very fast, high-quality cassette and DIABLO type printer mechanism, giving superb registrations and print quality. Microprocessor directed, the DIABLO/GUIME command compatibility and full control via CPM Wordstar ETC. Many other printer features include: 120 character 12 pitch, full width 311 mm paper handling with up to 163 characters per line, friction feed rollers for single or continuous paper, internal buffer standard RS232 serial interface standard, RS232 data interchange. Supplied absolutely BRAND NEW with 90 day guarantee and FREE data sheet and dust cover. Order Notional extra RS232 £10.00, Tech manual £7.50. Tract Freight £140.00. Spare data sheet £3.50. Caius & Ins. £10.00.

Summer offer only £399.99!!

DIY Printer mech

Brand new surplus of this professional printer chassis gives an outstanding opportunity for the Student, Retiree or Retired - any constructor to build a printer - plotter - digitiser etc, entirely to their own specification. The printer mechanism is supplied ready built, aligned, tested and tested but WITHOUT electronics. Many features include all metal chassis, phosphor bronze bearings, 132 character optical shaft position encoder, NINE needle head, 2 x 2 phase stepper motor for carriage and paper control, 9.5 volt paper platen etc. Even a manufacturer's print sample to show the unit's capabilities. Overall dimensions 90 x 125 x 75 cm.

Sold BRAND NEW at A FRACTION of its original cost.

£27.50. 500 sheet

£49.95. Large Spare paper roll for AE71 etc. 2 x 27 Col. + Ribbon

£65.00. £28.00 Std 10 x 80 Col.

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Cabbage and insurance £7.50.

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MAG TAPE DRIVES

All in one quality computer cabinet with integral switched mode PSU, mains filtering, and twin fan cooling. Usually made for the famous DEC PDP8 computer system costing thousands of pounds. Made to run 24 hours per day the psu is fully screened and will deliver a massive +4.5 DC at 17 amps, +15 DC at 1 amp and +15v DC at 5 amps. The complete unit is fully enclosed with tamper proof for filtering, trip switch, power and run leds mounted on all front panel, rear cable entries, etc. Units are in good but used condition - supplied for 24v operation complete with full circuit and tech man. Give your system that professional finish for only £49.95 + carr. 19" wide "16" deep 10.5" high. Useable area 18" wide.

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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 allow real time printing of worldwide NEWS, TELEX and RTTY services.

Supplied TESTED in second hand operation for the Stuure complete with DATA, 12 and 75 baud sxtas and large paper roll.

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£185.00. ASCII/BAUDOT

Cabbage and insurance £7.50.

Computer/Systems cabinet & PSU

Many EX stock computer tape drives and spares by PERCIPHER, EX, WANGO, DIGITAL, KENNEDY, etc. Special offer this week on DEI Cartridge tape drives only £450.00 each.

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The amazing SOFTY 2 the Complete Toolkit for copying writing, modifying and logging. £5.95. Also sold in sets £11.25, £16.25, 2327 range. Many other functions include special keyboard and cassette interface, parallel and serial i/o, low cost controller. £399.99.

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SPECTRUM WATCH

NIGEL CAWTHORNE G3TXF

Some time in late October the UK’s cellular subscriber base eased past that of Sweden to become number one in Europe and second only to the USA. In mid-November Cellnet were claiming 54,000 subscribers and Vodafone 58,000, making the UK total 112,000 against Sweden’s mid-November total of 107,000. It has taken the UK just 20 months to become Europe’s number one cellular country.

However, before the UK’s two cellular operators start the celebrations they should take a look at the cellular penetration figures measured in terms of numbers of cellular sets per 1,000 inhabitants. At 2.0 cellular sets per 1,000 inhabitants the UK is still only seventh in Europe behind the four mainland Scandinavian countries (Norway: 20.3, Sweden: 12.8, Denmark: 10.7, Finland: 9.0), Iceland (7.0) and Austria (2.2).

It is perhaps a sobering thought for cellular planners that if the UK subscriber base ever reached the penetration figure currently achieved in Norway there would then be over a million cellular subscribers in the UK!

Icelandic cellular

The prize for rapid cellular growth has to go to Iceland, where in four months the NMT-450 network achieved a customer base of 1,825 subscribers. With a population of 240,000 inhabitants this corresponds to a penetration of more than 7 per 1,000.

There appear to be two major reasons for this rapid cellular radio growth in Europe’s most northerly outpost. Firstly, as Olafur Ingridsson of the Icelandic PTT told Spectrum Watch, “Icelanders like new things, and the Icelandic fishing fleet has taken cellular in a big way.”

Iceland is unique in cellular radio because three of the 20 base stations are on small islands in the sea, specifically to provide good coverage for fishing vessels. The three offshore base stations are connected into the main network by a microwave link.

October’s USA-USSR summit in Iceland set a new record for the number of Intelsat satellites carrying coverage of a single event. Seven Intelsat satellites (five over the Atlantic and two over the Indian Ocean) were used in covering the two day Gorbachev-Reagan meeting. Some ten ‘flyaway’ C-band and Ku-band Earth terminals were in operation in Reykjavik, including Marconi-supplied Newshawks. Intelsat say that the previous record for the largest number of Intelsat satellites used in a single event was six, during the World Cup football finals held in Mexico earlier this year.

Olympic broadcasts

Preparations for the 1992 Barcelona Olympics will be the occasion of a major spending spree on broadcast and communications equipment. As part of their promotional build-up to the October decision by the International Olympic Committee, the Barcelona lobbyists had prepared a detailed study, called BIT ’92, of the technological requirements of the Games, which included an outline of the broadcasting needs.

The BIT ’92 study aimed to identify ways of making the most for Spain’s electronics industry as a whole out of the telecommunications and information technology investments that will have to be made as part of the project. The £0.24 million study has identified 99 IT and telecommunications projects which could be included in the Olympics. Of these, forty-four have been identified as being indispensable to the holding of the Games, and among these are the radio and TV broadcast requirements.

£130 million projects

According to the BIT ’92 study, if all the radio and TV projects were implemented the total spend in this area alone would be £130 million. The study concludes that in total some £500 million will have to be invested if all the proposed IT and telecommunications projects were to go ahead. Apart from broadcasting, the other key area for the Olympics is data processing.

For telecasting, the Olympics will require 5 six-camera outside broadcast (OB) vans, 20 four-camera OBs and 18 two-camera OBs, one new large studio complex, a few new medium sized TV studios and eighteen small studios. The Olympic shopping list also includes 50 ENG units, eight radio OBs and facilities for nearly 900 commentators.

Apart from the facilities required for international radio and TV coverage of the 1992 Olympics, there are also plans for the construction of special Olympic radio and TV channels for athletes and visitors in the Barcelona area. The Olympics are also likely to give Barce- lona the excuse to go ahead with a project that it has needed for some time: a new TV and communications tower. It was on the back of the 1982 football World Cup that the Spanish TV in Madrid got their new Torrespaña TV tower and studio complex.

Communications are a vital part of an operation such as the Olympics. However, one service that the Spanish will want to dramatically expand before 1992 will be the cellular car telephone service in the Barcelona area. Currently there are less than 150 cellular users in this area. In fact there are still less than 2,000 in the whole of Spain.

Telefónica, which operates Spain’s cellular telephone network, is planning to add a further eight cities to the network during 1987. Currently the NMT-450 Spanish car telephone service is available only in Madrid, Barcelona, and in parts of southern Spain. Even by the end of 1987 the total capacity of Spain’s Teléfono Móvil Automático will be only 5,000. The selection of Barcelona for the 1992 Olympics will give a major boost to both broadcasting and telecommunication projects in Cataluña, the Spanish region of which Barcelona is the capital.

Tunisia Telecomms

The world-wide calendar of telecommunications and broadcast exhibitions and conferences never ceases to get fuller and fuller. The latest

---

**Country** | **System** | **Subscribers** | **Market penetration per 1,000 inhabitants**
---|---|---|---
UK | TACS-900 | 112,000 | 1.98
Sweden | NMT-450 | 107,200 | 12.76
Norway | NMT-450 | 85,100 | 20.26
Denmark | NMT-450 | 55,700 | 10.71
Finland | NMT-450 | 47,000 | 9.79
Austria | NMT-450 | 16,300 | 2.14
Germany | C-Netz | 16,000 | 0.26
Netherlands | NMT-450 | 11,800 | 0.81
France | RC 2000 | 7,500 | 0.14
Iceland | NMT-450 | 1,825 | 7.60
Spain | NMT-450 | 1,450 | 0.04
Ireland | TACS-900 | 900 | 0.26
Luxembourg | NMT-450 | 85 | 0.23

European cellular subscriber total (November 86): 462,860

Source: European Mobile Communications Report, EMC Publications
newcomer to the international telecommunications exhibition world is Tunis, which held the first Tunisia Telecomms exhibition and forum in early December.

Forty international companies exhibited telecommunications products at the show, which was attended by visitors from several North African countries. There was no presence at the Tunisia Telecomms forum from any UK company, even though many of their rivals from Scandinavia (Ericsson, Storno, Danabili), France (Alcatel), Germany (ANT) and Austria (ITT) were present and flying the flag for their products in the Tunisian telecommunications market-place.

The three-day conference which accompanied the exhibition brought together several key figures from the Arab broadcasting and telecommunications world, including Mr Chakroun, head of the Arab States Broadcasting Union (ASBU), the Arab equivalent of the EBU, and Mr Bairi, head of Arabsat.

Tunis is an important centre of broadcast and telecommunications activity in the Arab world. Not only does it house the ASBU headquarters but it is also the site of the second control station for the two Arabsat satellites. The primary control station is in Riyadh, Saudi Arabia.

Second generation Arabsat

Arabsat's Director General Bairi told the Tunisian conference that the time was fast approaching when the 22-nation Arabsat organisation would have to start taking major decisions concerning the next generation of satellites. Arabsat currently has two satellites in orbit (Arabsats 1A and 1B). A third (Arabsat 1C) is built and waiting to be launched.

The two Arabsats currently in orbit are not expected to be operational beyond 1992. If a second generation of satellites is to be planned then decisions will have to be made in early 1987. According to Mr Bairi a full five years will have to be allowed between the initial 'go' decision and the putting into operation of the second generation of Arabsats. One year is needed for a detailed study of the requirements, a second year is needed for the issuing of tenders and contract negotiations with suppliers, and then three further years have to be allowed for the satellites to be built and launched.

The Arabsat network is currently used for TV broadcast programme exchanges between Arab countries as well as for telecommunications traffic. There is also now a project to use the S-band (2.5GHz) transponder on one of the Arabsat birds for a pan-Arab commercial broadcast TV channel. Five transponders on one Arabsat satellite have been leased for five years to the Arab Space Scene Corporation, who are paying $40M for them. Only one (the S-band transponder) will be used for broadcasting.

According to Arabsat's own predicted coverage map this new programme, once operational, should be receivable by those in southern Britain equipped with a 2.5 GHz satellite receiver and a 3m dish. Transmissions for up to three hours a day are expected to start by next April.

The use of the S-band for satellite broadcasting is relatively rare. The only other satellite currently doing this is the Indian Insat. However, it is hoped that the single S-band transponder will give good coverage over all the 22 nations of the Arab league from Mauritania on the west coast of Africa through to the Gulf States, as well as much of Africa and southern Europe.

Tunisian cellular

Tunisia can claim to be the first country in Africa to have a cellular car telephone network. The original small network was installed in the Tunis area by Ericsson in 1982. However, the network is now being expanded to cover both Sousse and Sfax and the capacity is being increased from the present 100 subscribers to about 1,000.

The only other North African country to have made a firm decision on a cellular car telephone network is Egypt, which has opted for a Japanese system. The contract for the Egyptian system with National (Matsushita) was signed in April 1984 and the installation work of the 14-base station is currently under way, with a target opening date of May 1987.

The Egyptian cellular network will cover Cairo, Alexandria and the desert road between these two main cities. The system will operate at 800MHz and will initially use 150 radio channels and have adequate capacity for 2,500 subscribers.

There are now operational cellular car telephone networks on all five continents.
**ELMASET INSTRUMENT CASE**

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<td>LM377T Plastic T0202 variable</td>
<td>£1.00</td>
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<td>LM317 Metal</td>
<td>£2.20</td>
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<td>7812 Metal 12V 1A</td>
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<td>7805/12V plastic</td>
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<td>7805/12V/20 plastic</td>
<td>50p 1000 + 17p</td>
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<td>CA3085 T098 variable regulator</td>
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<td>LM308 5A variable</td>
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**COMPUTER ICS**

Used Eproms are erased and verified

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<td>New £3.50 10 - £5.20</td>
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<td>2746 Intel8150-300s</td>
<td>£2.50 Used £1.60</td>
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<td>2716 Ex EQPT</td>
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<td>1702 EPROM ex equip</td>
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<td>626LPL 15K static ram</td>
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<td>6116 2 T0517AP g</td>
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**POWER TRANSISTORS**

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<td>TIP141, 142, 147 £1 ea, TIP112, 125, 42B</td>
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<td>2N3773 NPN 25A 16V £1.00</td>
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**DISPLAYS**

Futaba 4 digit clock, fluorescent display 5-7/16

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<th>Part Number</th>
<th>Description</th>
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<tr>
<td>Large LCD clock display 1 digits</td>
<td>£1.50</td>
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**QUARTZ HALOGEN LAMPS**

A1/16 24v 150w | £2.25 |
H1 12v 50w (car spot) | £1.25 |

**MISCELLANEOUS**

12v relay 2 pole c/o 6A contacts | £1.25 |
ELECTRET MICROPHONE INSERT | 90p |
MMP MODERN LINE TRANSFORMER | £1.50 |
| 230V 100+1 1k 80p | 100+1 £1.00 |
| 230V 1200W 2A | £1.25 |
| 230V 1500W | £1.50 |
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| 240V 3A | £1.50 |

**OSCILLOSCOPE PROBE KIT**

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1µF 50V | 100+1 50p |
10µF 100V | 100+1 50p |
100µF 250V | 100+1 50p |

**MULTI TURN PRESETS**

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**MULTI TUNING DEVICES**

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**IC SOCKETS**

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One of the organisations which does much for amateur radio and yet gets very little publicity for its efforts is the International Amateur Radio Union (IARU), which was founded in 1925. It came about through a feeling in the ARRL - the American Radio Relay League, the organisation which represented American radio amateurs of that time (and still does, of course) - that there was need for a body in which the ARRL could join with the other national amateur radio societies "in a common effort to promote and co-ordinate communication between amateurs the world over; to represent their interests at international communication conferences and to encourage international fraternisation."

A meeting in April 1925 in Paris was called to which were invited prominent personalities in the amateur radio scene and representatives of radio societies of that time. Some twenty-three countries were represented.

Growing pains
Since those days the IARU has grown in line with the great growth of amateur radio itself. Many famous pioneers of amateur radio were involved in this process. There are now three Regions covering the whole of the world.

As a member of the IARU, the RSGB has the right to nominate observers to attend International Telecommunication Union conferences. These are of great importance to the radio amateur as it is here that the allocation of radio spectrum frequencies is negotiated. This was particularly so when amateur radio reassembled after World War 2, following its close-down during the 1939-45 period.

There were significant conferences of this nature staged by the ITU in the years 1947, 1959, 1963 and 1971, at all of which matters concerning the occupation of the radio spectrum by amateurs came up for discussion. Amateur radio representatives were present at all these conferences, and in spite of their inexperience in such deliberations they were able to make their needs felt. It was soon realised, however, that if amateur radio was going to hold its own in the ITU decision-making process a much stronger representation had to be prepared for future activities of this sort. It was very much a world in which 'professionalism' was essential.

The IARU had meanwhile built up its organisation. Its HQ was at the ARRL HQ in America. The President of the ARRL in 1964 was also President of the IARU, Herbert Hoover Jr W6ZH, and it was he who set the IARU on the right track in its preparation for the forthcoming ITU conference in 1979. To his name must be coupled that of our own Roy Stevens G2BVN, whose views on the matter closely followed those of Herbert Hoover, and who was Honorary Secretary of IARU Region 1 at the time.

An intensive program of travel to IARU societies around the world was drawn up, in which IARU officers and staff encouraged them to establish better relations with their radio administrations and to foster the concept that amateur radio was a valuable service to their communities and deserved the support of their administrations. This task met with more difficulties than had been expected. Many of these radio administrations proved particularly difficult to convince!

However, by the time the next ITU conference came along in 1979 an encouraging amount of support had been generated, so much so that the WARC-79 conference approved the granting of new facilities for amateur radio - the 'new' bands of 10, 18 and 24MHz.

There is much more to be done in the IARU sphere of activity for the future of amateur radio, and the more publicity that can be given to the IARU and its work the better. Readers are referred to an article in the November 1986 issue of Radio Communications by the current President of the IARU, Richard Baldwin W1RU, entitled The International Amateur Radio Union - Yesterday, Today and Tomorrow for a much more detailed exposition of this very important matter.

The International Short Wave League

The ISWL was one of the established organisations for the short wave listener which had for the past forty years or so provided the SWL with the services which make his hobby so much more enjoyable than it otherwise might be. It was renowned for its countries and callsign lists; it ran a good QSL service and the periodical, Monitor, was much respected and could be relied upon to keep the SWL up to date.

Unfortunately, just recently it became caught up in the problems which have befallen many of the smaller organisations these days, and in June 1986 had to close down.

Your scribe was much involved in the ISWL in its early days and its demise was sad news indeed. At its peak it was the largest SWL organisation in the world, and it was very efficiently governed by an elected council. The logo included a banner with the caption 'We Span The Globe', which just about summed up the ISWL!

However, its resilience was admirable and it was good to hear from Frank Baldwin that it is to be revived as the ISWL 87. Frank will resume the office of President, to which he was appointed in September 1985. Jim May G1GWG will become its Honorary Secretary, Mrs Evelyn May G1OFCC its Assistant Honorary Secretary, Mike Gater G41CC Treasurer and Dick Rugg G2BRR, Bernard Hughes and Ivor Davies council members.

The total refloatation costs and immediate working capital have been generously donated by the new council. The QSL bureau has been reactivated and services resumed; the journal Monitor will reappear early in 1987.

It is hoped that old members will rejoin and that there will be a good influx of new members. Further information from ISWL 87 HQ, 10 Clyde Crescent, Wharton, Winsford, Cheshire CW7 3LA.

Hampshire packet digipeater

The packet radio digipeater GB3HP at Oliviers Battery near Winchester, Hants, is now operational. It was constructed by members of AMRAC (Amateur Radio and Computer Club) and operates on 144.650MHz using the AX25 packet protocol. The hardware consists of a standard PK-80 terminal node controller supplied at a discount by ICS and a 25 watt FM PMR rig generously donated by Pace Mobile Radio. The antenna is an Isopole supplied by ICS. It is hoped to add an IBM PC clone to the repeater at a later date to provide a mailbox/bulletin board service.

The digipeater is expected to provide good coverage of Hampshire, and AMRAC would welcome any reception reports from amateurs and SWLs. They
The satellites

Congratulations to Nico Janssen PA0DLO who has been awarded the 'Radio Amateur of the Year' award by the Dutch Scientific Radio Foundation, on the recommendation of VERON. This was for his outstanding contribution to the amateur satellite service over many years. He is well-known on the AMSAT-UK net on 3780kHz on Sunday mornings as well as on the international AMSAT net. He has been a vital intermediary in information flow between AMSAT societies in Eastern Europe and the West.

The 25th anniversary of the first amateur radio satellite was celebrated during December. The occasion was marked by a number of organisations. The USA Project Oscar held a celebration on December 13th in the Space Science Centre at Foothill College, Los Altos Hills, California, when an opportunity to meet some of the builders of Oscar-1 took place. QST ran a two-part article on 25 years of OSCAR, including some information on future projects such as Phase 4.

A new magazine, Air and Space, published by the Smithsonian Institute, Washington, is planning an article based on interviews with such experienced AMSAT contributors as Dick Daniel W4PLU and Jim McKim W0CY. The Institute of Electrical and Electronic Engineers, Aerospace and Electronic Systems Society magazine plans to run a group of pictures of Oscar satellites on its cover. AMSAT-UK still has some souvenier mugs of the occasion left over from its colloquium held last July, which are available for sale.

UoSAT-1 is five years old and is now the longest-serving satellite in the amateur radio satellite service. It was launched on 6th October 1981 by NASA, from the Vandenberg Air Force Base, California aboard a Delta launch vehicle. It has proved a remarkable success and continues to perform extremely well with no significant degradation.

The Harris Corporation of Melbourne, Florida has agreed to supply AMSAT with special memory modules for its Phase 3C spacecraft. These are of a special radiation-hardened type which it is hoped will prevent the radiation damage which OSCAR-10 has suffered. Their cost is said to be in the region of $80 – a gift indeed! A new IHU memory board for the Phase 3C spacecraft is being built which will be operationally identical with the one already installed in the satellite, but will use the Harris ICs. The current launch date for Phase 3C is August 1987.

At the time of writing, OSCAR-10 is still functioning but in a very 'shut down' mode. Some QSOs are permissible through it, but on limited power. Only very limited transmission power must be used in attempting QSOs. The transponder and the beacons are not usually on together and even when on give very weak signals.

The Japanese FO-12 has been subjected to some schedule interruptions due to the testing of some of the other systems being brought into use.
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FEBRUARY 1987

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THE ICOM IC-48E

Examined by Ken Michaelson G3RDG

The IC-48E is the second very compact mobile transceiver from the Icom stable that I have handled, the only difference being in the frequency range covered. The first one, the IC-28E, operated in the 144 to 146 MHz band, while the IC-48E covers 430 to 440 MHz.

There are, in fact, three versions of the transceiver, the IC-48A for the USA which covers 440 to 450 MHz, the Australian unit, also designated the IC-48A, and the European one. Both the Australian and European versions cover the same frequency band, the difference between all three being the channel resolution. The IC-48A has programmable channel separations of 5, 10, 15, 20 or 25 kHz whereas the IC-48E has only 12.5 or 25 kHz. It is the smallest mobile unit that I have ever seen, and weighs only 1.2 kg (approximately 2.5 pounds).

Anatomy

The speaker is on the underside of the unit, with the finning for the final transistors, the power cable socket and the 'N'-type antenna socket at the rear. I must comment favourably on the method of connection for the power lead and antenna. Icom use a flexible lead coming from the unit in each case, terminating in a female connector for the power lead and the 'N'-type socket for the antenna. This method of connection is, in my opinion, the best and simplest way of doing the job that I have come across. I have tried with other manufacturers' mobile rigs to fiddle the power plug into the back of the set with it installed in its mount, and also tried to connect the PL259 plug from my antenna into the chassis-mounted SO239 socket. Both these operations are very difficult if there is no room behind the set, but in the case of the Icom rig there is no difficulty at all; one can get hold of both ends and insert the necessary plug into its socket. There is also a 3.5mm socket on the rear for an extension speaker.

The illustration does not really give readers an idea of the size of the unit, so here are the dimensions: 140 x 50 x 171mm (5.5 x 2 x 6.75 inches). I think you will agree that it will fit in the smallest type of vehicle.

The front panel has all the controls mounted on it. An indicator at the top left shows green when receiving with the squelch circuit open and red when transmitting. The indicator is off when the squelch circuit is closed and the receiver is muted. To its left is the Duplex switch, marked 'DUP'. As this is repeatedly pressed it will show on the LCD 'DUP+' when the transmitting frequency is programmed higher than the receive frequency, 'DUP-' when the transmitting frequency is lower than the receive frequency, and nothing when the unit is in the simplex mode.

The switch to the right of the LED is different for the two models available. In the USA version it is labelled 'TONE' and switches the UT-29 subaudible tone encoder on or off. When the encoder is on the word 'tone' appears on the display. However, since the unit I am describing is the European version, the switch is labelled 'CALL' and its operation selects whatever frequency has been programmed into channel 21. The letter 'C' then appears in the display.

Next is the switch marked 'WRITE'. This operates in two different ways depending upon the setting of the switch below it, labelled 'VFO/MR'. When in the 'VFO' mode the WRITE switch stores the frequency displayed on the read-out in the memory channel number also displayed. In the 'MR' mode the WRITE switch transfers into the VFO whatever frequency is displayed in the memory channel. After the transfer, the rig reverts to the VFO mode.

Ups and downs

Below the VFO/MR control is a similar type of switch marked 'DOWN/UP'. This also produces different results depending upon the setting of the VFO/MR switch. In the VFO mode the operating frequency is changed by 1 MHz increments. In the MR mode the operating frequency changes the memory channels by one-channel increments.

To the left of these switches is the tuning control. This operates normally in the 'VFO' mode, and there are other options which I shall explain later. Approximately in the centre of the panel is the LCD read-out. This will display a line of five words at top (four in the case of the European model) which in addition to those mentioned already include 'OW', standing for 'offset write', and 'AQS', which flashes when either version is ready to have a group code programmed when using the optional UT-28 digital code squelch unit. This unit was not supplied with the review transceiver so I cannot pass judgement on it. However, the option allows a 'personalised' squelch to be programmed, giving a range of 100,000 different code numbers.

If the UT-28 is installed the UT-29 subaudible tone encoder cannot be used as there is insufficient room in the unit.

Under the word 'AQS' is the term 'D.SQL', which appears when either the optional digital code squelch or the optional tone squelch system is activated. It flashes in sympathy with the word 'TONE' when the unit is ready to have the subaudible tone number programmed for the tone squelch.

Remember this

To the right of the main frequency read-out is the memory number display for '1' to '21'. When the memory is brought into action by pressing 'MR', the letter 'M' is shown below the number, but a number (the last memory used) is always shown. The tuning control in this mode acts as a memory control, each click being a different channel.

To the left of the 'M' there is the word 'SKIP'. This is very small, but serves as an indicator to show that a certain memory channel must be skipped when scanning the 21 memories. One does this by calling up that particular channel and pressing 'SET'. A beep is heard and that channel will be ignored when scanning takes place.

On the bottom line of the display is the S-meter/RF power indicator. This is a line of vertical segments growing higher towards the right as the relative signal/RF power increases. To the left of this are the final two indicators of operation, 'TS' (tuning step) and 'LOW'. 'LOW' shows that the unit is operating on low power (5 watts) which is achieved using the push-button switch marked 'HI/LOW' on the bottom of the front panel.

The last two controls on the IC-48E are two rotary knobs to the right of the HI/LOW switch. They both have double functions, the left-hand one being the gain control and on/off switch and the right-hand one the squelch/check control. The latter when turned clockwise brings in the squelch circuit and quiets the receiver, while pushing it allows the operator to check the transmit frequency when the duplex mode is used. Useful facility this.

Reverting back to my mention of the tuning control and its extra functions, if when in the VFO mode the SET switch is pressed once, the OW (offset write)
The output of the transmitter in high power is 25 watts and in low power 5 watts. The modulation system is a variable reactance frequency type with a maximum frequency deviation of ±5 kHz.

The microphone supplied with the unit is a 600 ohm electret condenser type. It has push-to-talk and scanning switches with an on/off switch on the back bringing them into circuit, and in the case of the 48E there is also a 1750 Hz tone-burst switch. The receiver is a double-conversion superheterodyne with intermediate frequencies of 23.15 MHz and 455 kHz and a selectivity of more than 12.5 kHz at -6 dB and less than 25 kHz at -60 dB. The sensitivity is quoted as being less than 0.18 μV for 12 dB signal and noise, and although I was unable to confirm this figure the performance of the unit was quite good.

**Plugging it in**

The IC-48E was installed in my car quite easily. The power line, a thick red/black length with a 15 amp fuse in each head, was attached directly to the battery (do not use the cigar lighter outlet for the power connections; the current drawn by the unit is too high when operating on full power, some 7.5 amps on transmit).

I must emphasise that the very well written owner’s manual (complete with humorous pictures) should be read in detail before attempting to operate the unit.

The unit worked perfectly while in the car, and while driving around north-west London. I accessed BN RB0, BV RB1, NK RB3 and LW RB6 without the slightest difficulty. I also had several simplex contacts using the FM calling frequency of 433.500 MHz. In each case the report on speech quality was good. The operation of scanning was a great help, being controlled from the microphone, on the back of which was a switch marked ‘UP/DN’ and ‘OFF’. This switch had to be in the UP/DN position and the squelch in circuit before scanning would commence. It worked in two ways, either VFO or memory scanning, and could be carried out either in single steps or, if the ‘UP’ or ‘DN’ button on the top of the microphone was held down for about half a second, continuously.

When a signal opened the squelch the scan would stop and the unit would monitor the signal. If the signal ceased the receiver would continue scanning after about three seconds. Otherwise, scanning would resume after about fifteen seconds. It required one push on whichever button was being used to stop the scan. Having got used to this method of tuning when mobile I would not like to be without this facility in any mobile rig in the future.

The **bottom line**

The prices are as follows: IC-48E, £449; AH-32 dual-band whip, £34; and the SMC SOMM magnetic mount, £12.74. All the prices are inclusive of VAT and carriage. Thanks are due to Thanet Electronics Ltd for the loan of the equipment.

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*please mention RADIO & ELECTRONICS WORLD when replying to any advertisement*
ERROR CORRECTION IN DATA-ON-RADIO SYSTEMS

Bob Redding G3VMR proposes some simplifications for use with data broadcasting.

One advantage of the letter mail over any electronic system is that information doesn't get corrupted during transmission. At present error correction is probably the main topic in data communication circles. It is strongly allied to security, particularly where business and fiscal information is concerned. The other end of the scale is broadcasting-by-data, which has barely started and in which although errors can be tolerated, their avoidance is more a matter of prestige than a necessity.

Amateur communications would tend towards this end of the scale, but a main attraction of the radio packet system which has grown so fast recently is the error-free copy that it provides. However, the premium for such clean copy is considerable.

The hardware, although now down to £200, represents a considerable addition to the normal transceiver equipment and computer.

It operates only one-to-one and anyone else 'listening' will probably get screenfuls of repeats, and only one side of the conversation. The latest equipment does enable one to link with a number of users, but any conversation requires a firm discipline if it is to remain coherent!

A long file monopolises a channel, and is slower than plain text.

If we consider the origins, the reason will be clear. The essence of packet is the use of the X25 protocol, which was developed with the international telephone 'packet switched system' for multiplexing telephone calls on trunk circuits. It is basically a one-to-one system, and although we might adapt it for other radio purposes, alternative approaches are worth consideration.

Below is a brief outline of the subject of error correction, with a view to evolving something appropriate for radio in the context of 'one-to-many', ie broadcasting, where there is no return channel on which to say 'I don't understand'.

An overview

The earliest form of error detection was 'parity' - the addition of an extra digit according to whether the number of 1s or 0s is odd or even. One has to know what parity is being sent, and there are a surprising number of variations. However, it is now generally agreed that this is of little use for bulletin boards or radio operation and so 'no parity' is becoming standard.

The number of bits used for each character can be 5, 6, 7 or 8 and with ASCII one must be careful to distinguish between '7-bit even' and '8-bit none', for some computers will print out graphic symbols rather than text. For keyboard (asynchronous) working we also need one or more start bits and stop bits. The latter can be 1, 1½ or 2 and so the number of choices provided on equipment (and which one has to get right) in order to talk to another machine is considerable.

For packet the protocol for operating over the air is set (AX26), but one still has to get the correct setting for the protocol on the TNC to suit the local computer. So unless you are a dedicated amateur, there are many pitfalls and/or scope for the Fixit-Widget to provide a special item designed for each usage. I think we have new opportunities in 'data on radio', and so we should keep an open mind on whatever we are trying to do, and consider how we can best do it as simply as possible.

Detecting an error is only part of the process and the aim should be to correct it. There are a number of codes and techniques that do this, and find usage in data transfer within computers, eg floppy disc control and so on. Basically the data is monitored and a 'checksum' is accumulated and sent with the data. The received data is similarly counted and unless it agrees with the checksum an error is indicated.

This is the basis of packet operation, and the size of the packet of course is pertinent to how many repeats one has to send in any given circumstance. Error correction is possible to a degree dependent upon the tolerable complexity. One performs a number of mathematical functions on the raw data to provide further digits which are also transmitted. On receipt and reversal of the process, the faulty digits can be identified and often corrected. This poses a philosophical question, 'How do you check a checker?' and having no answer I propose a different approach on the basis of 'If it isn't there it can't be wrong'. That might apply to some other pitfalls, like protocols, as well.
The basis of AMTOR is the Moore code which uses 35 characters, these being with all the possible combinations of four mark (or ones) and three spaces (or zero bits). Thus it is easy to recognise whether or not a code is valid, and if not to ask for a repeat. Each of the 35 characters has two possible values — either letters or figures — chosen by means of a shift key.

No shift necessary

I propose a different but very simple rule. namely that the seven bits shall have no more than two ones or zeros adjacent. This makes it easy to test if the received signal is a valid one. There are 42 possibilities, as listed in the table together with the corresponding ASCII number. This is enough for letters and figures without the need for a shift. I suggest we reserve two symmetrical ones—numbers 85-1010101 and number 122-1100110 for control purposes. This leaves scope for a full character set of letters and numbers plus four for punctuation, eg space, full stop, comma and quotes.

Incidentally, we could reduce the number of punctuation symbols by simple logic, easily built into a computer, eg a symbol for space. One off means a space, two off means a comma, three off means full stop (period) and the next letter to be a capital so that we get upper and lower case without bothering about shift. However, these are minor tricks of detail which are best settled by practical experience in each usage.

For fast data it is wasteful to operate a keyboard 'on-line'. Better practice would be to accumulate a message and then dump it at a fast rate. Of course this is done in packet, but I suggest that with an error-obvious code we could make the packets or messages any length we like, from a few characters to a few thousand, preferably with a checksum at the end so that we can know for certain if we have error-free transmission.

Eliminating start/stop bits

If we use such an accumulation/forwarding technique, then the operation should be synchronous to obviate the need for start and stop bits for each character. We need only a distinctive message start and finish signal, hence the ASCII codes 85 and 102 reserved above. Perhaps instead we could use even more distinctive ones, being all the ones and all the zeros, i.e ASCII 0 and ASCII 127.

The rules for validation which would need building into the computer are very simple. They are:

- Detect the start and stop signals, and for these, numbers 0 and 127 ASCII would be advantageous!

- Observe that the digit sequence changes at least once in each three received. If so, go to a look-up table and print a character.

- If it does not, look at the check digit and refer to a look-up table for the correction procedure.

**Check digit**

Conventional parity will tell little of value in this case, but we could send a useful kind of parity based on the number of double digits in the character. There can be 0, 1, or 2 double zeros (or ones) and we can send this as a 1 for odd (1 or 3) and a zero for 2. This number is shown in the third column together with a check digit based on whether or not that is odd or even. If we can extend the rule about doubles to this check digit, we find that it applies to all the eight-digit codes except 8, which are listed at the bottom of the table. Therefore we know what the last three digits are, so we have some check if there is any doubt about the check digit.

Although I haven’t found a method of proving it, it appears that this check digit can correct most of the single-digit errors in the seven-bit code, as well as showing that the check digit was received correctly. We could use a further check digit to provide more information to be more certain, eg whether the character is split 5/2 or 4/3 in its formal.

Perhaps the biggest bonus of all is that, because of the form of coding, the data is symmetrical and therefore it is very easy to extract a clock frequency from the data stream to assist synchronous operation, without necessarily knowing intended speed or keeping it constant. It also means that the data looks like a frequency (for bandwidth considerations) which is desirably high — approximately half the baud rate.

**Qualification**: Please regard the above as illustrative only and not necessarily absolute or final. Obviously tests on data will usually use ASCII and operate asynchronously, but the advantages inherent in a fresh code are a good reason for looking at it carefully before adopting a traditional one.

---

**SPECTRUM OWNER?**

For aficionados of data transmission who use a Spectrum, we still have some PCBs for S Dean’s RITY project. These are available complete with full documentation for £9.20 including p&p from R&EW, Sovereign House, Brentwood, Essex CM14 4SE.

If you’re reluctant to spend ages thumping away on the delightful Spectrum keyboard the software is available on tape from the author (please make cheques for this tape payable to S Dean and send to the address above).
MENDACIOUS METERS?

For an analogue meter it could be the inherent accuracy of the movement, the physical position of the meter, deterioration of the internal magnet, corrosion, variation of internal resistor values, dirty contacts in range switches or ageing of the hairspring.

At school and college many of us were taught that in reading a meter we should carefully interpolate between the dial calibrations in order to gain a further order of measurement accuracy. Whilst this may be acceptable when comparing a meter reading with a subsequent one, such accuracy is invalid when comparing with another meter, for manufacturing tolerances are such that even when new, few if any meters are accurate to that degree.

The normal standard in the UK for good quality analogue instruments calls for an accuracy of 2.5% of full-scale indication. This means, for example, that a voltmeter with a full-scale indication (fSD) of 100 volts will be accurate to 2.5 volts. This applies equally whether the input voltage is 90 volts, at which the indication could be between 87.5 and 92.5 volts, or if the applied voltage is 10 volts, in which case the indication could be between 7.5 and 12.5 volts – a possible error of 25%. Furthermore, due to manufacturing tolerances the accuracy will not necessarily be consistent across the scale.

Lesson 1

Here, therefore, comes the first lesson in reading meters: for reasonably accurate indications, ensure that the needle is in the upper half of the scale.

Meters intended for ac measurements almost invariably make use of a rectifier circuit to permit a moving coil movement to be used. In modern meters this will invariably be a semiconductor bridge, which will deteriorate little with age, but unfortunately many instruments used by amateurs are of indeterminate age and may make use of the old-fashioned copper oxide rectifiers – which do. Furthermore, many also incorporate inductive components in their design, which makes them frequency sensitive.

The ac ranges of most meters are calibrated with a 50Hz sinusoidal waveform and may well give wildly inaccurate readings if any other waveform or frequency is applied.

The physical position of the meter is also of importance. For example, AVO meters are designed to be used face upwards, whilst panel meters are intended for use in the vertical plane. Some are calibrated for use on ferrous and others for non-ferrous panels.

Although the errors generated from this cause are likely to be unimportant, the only comparative measurements are being taken, allowance must be made when accurate quantitative measurements are necessary.

As a meter ages so its accuracy
FEBRUARY 1987

Observe with care

In addition to the inherent inaccuracies of the meter, care must also be taken in the actual observation. The meter must be viewed from directly in front of the needle otherwise parallax error may occur, and this may amount to the equivalent of one or two dial divisions.

Better quality meters have a mirror mounted below the scale so that, by aligning the needle with its reflection, the correct viewing position can be verified.

Digital meters also suffer from inherent inaccuracy and, with age, corrosion and deterioration of internal components.

It is, perhaps, inevitable that as even a relatively inexpensive digital meter will indicate to 0.1% many users will believe that it is accurate to that degree, but in practice only the more expensive instruments are accurate to even one tenth of that and most are worse. Furthermore, almost invariably the accuracy is quoted as plus or minus one count, which means that if the last digit displayed is, for example, five, the true figure is just as likely to be four or six!

From the foregoing it may be thought that it is impossible to trust any meter but, in fact, once the limitations of metering are realised, far more consistent results are possible.

More accurate readings can also be ensured by checking the meter calibration whenever possible, such as when a colleague purchases a new high grade meter. Compare indications from a number of different voltage and current sources, note the differences on an adhesive label and attach to your own meter for future reference.

Use and abuse

Apart from the inherent inaccuracies in meters, even greater errors can arise from their method of use. With the exception of electrostatic voltmeters, all draw some power, no matter how small, from the circuit to which they are connected. Analogue meters are worse than digital meters in this respect, for sufficient power must be drawn to energise the movement. Nevertheless even the low power consumed by digital meters may be sufficient to cause misleading indications in very low power circuits.

As an example of this, consider the case of a simple transistor voltage amplifier which is fed from a 13.5V supply via a 6kΩ resistor in the collector circuit.

decreases, for the magnet and hairspring will weaken, the shunt and series resistors vary in value due to the occasional inadvertent overload, which is inevitable in normal use, and the switch contacts will corrode due to the action of pollutants in the atmosphere.

be less and the indicated voltage would be about 6.6 volts.

If, in turn, the AVO 8 was replaced by a digital instrument with an impedance of 10 megohms or more the error due to loading of the circuit would be far less, although it would still be present, and the indication, all other factors being equal, would be very close to the correct figure.

This must not be taken as an argument that digital meters are invariably superior to analogue instruments, for in other circumstances the latter can give far more useful indications than the former. The most important lesson to be learned from this example is that the application of test equipment always affects the circuit under examination and that allowance must be made for this whenever such tests are made.

And finally ...

The final major source of measurement error is when, although the meter readings may be accurate, external factors cause the indications to be misinterpreted.

The most common example of this in the amateur station is the measurement of voltage standing wave ratio (VSWR) and the effect of feeder loss.

Supposing, for the sake of example, that an amateur had been unwise enough to feed an aerial with a length of inferior feeder with a loss of 6dB and that the aerial was incorrectly dimensioned and
itself gave a mismatch of 4:1. If his transmitter was giving an output of 10 watts, due to the feeder loss only 2.5 watts would reach the aerial. Due to the 4:1 aerial mismatch, 36% of the power reaching the aerial would be reflected, i.e. 9 watts. This in turn would be attenuated by 10 dB on its return journey and by the time it reached the transmitter its level would be 0.225 watts. If a VSWR meter was fitted adjacent to the transmitter, in this situation it would indicate a VSWR of about 1.35 to 1.

At this VSWR, and being unaware of the extent of the feeder loss, the unfortunate amateur would believe that he had a good installation with an excellent radiation efficiency.

Experience tells

The VSWR meter can also give misleading indications on HF for a different reason. I have often heard less experienced amateurs (and others who should know better) say that their aerial had a poor VSWR, but by using a Bloggs antenna tuner the VSWR is now tuned out.

Nothing could be further from the truth. In practice, the VSWR meter is normally fitted between transmitter and ATU, and what the antenna tuner has achieved is to match the impedance presented by the aerial and feeder system to the output of the transmitter so that the transmitter ‘sees’ the correct impedance. The standing waves which were present on the feeder line before will still be there and will remain until the antenna is correctly matched to the feeder.

Where lies the fault?

In each of these cases the VSWR meter was giving a perfectly correct indication, but because the user did not realise the implications of the measurement the conclusions drawn were totally misleading.

Although I have given two examples of misleading VSWR indications, this can apply equally to almost every other type of measurement.

So far I have mainly dealt with normal panel and test meters, but the same considerations also apply to all other equipment. Some, notably RF power meters, are notorious for their inaccuracy, with few bettering 10%. Others, such as RF signal generators, can give inaccurate output levels if terminated with the wrong impedance.

For most amateur purposes absolute accuracy is not essential, for provided that consistent results can be obtained much valuable work can be achieved. Whenever possible, comparison checks should be performed between similar types of equipment.

For example, I possess three signal generators which between them cover all frequencies between audio and 450MHz. Where the ranges overlap their output levels have been compared, and although there is no way of knowing the absolute accuracy, consistent measurements can nevertheless be obtained right across the spectrum.

Similarly, I have four test meters: an AVO 7; an AVO 8; a Heathkit VVM; and a home-built meter. Although each will show a slightly different reading on a given input, these differences are known and can be allowed for when accurate measurements are necessary.

A pinch of salt

The moral of this article is not that meter readings cannot be believed, but that when a reading has been taken consideration must be given to the accuracy of the reading, the effect of the meter upon the circuit and the possible influence of outside factors on the conclusions drawn from the measurement.
Most digital systems are based on two-state devices, since it is easy to design a switch which is either open or closed, Figure 1, giving an output when it is closed and no output when it is open. These two states can be called, for want of anything better, '1' and '0' respectively.

In practice two kinds of semiconductor are used to implement such switches. One is the transistor-transistor logic (TTL) and the other the metal oxide semiconductor (MOS). The difference between these two devices is that TTL operates off a 5 volt supply and a logical '1' output is anything above 2 volts, with a logical '0' anything below 0.8V. MOS operates from supplies of 3V to 15V and a logical '1' is obtained when the output is lifted above 70% of the supply voltage, while logical '0' is below 30% of supply.

Systems based on two states are called binary systems and the digits '0' and '1' are known as binary digits, abbreviated to bits. As you've guessed, this system can count only up to 2 and would therefore seem to be rather limited. However, there is nothing to stop us from stacking switches to give the required output. Figure 2 shows three switches which can count up to seven as shown by Table 1; the number 7 is obtained when all three switches are closed.

To count to decimal 7 we need three switches. Four switches will enable us to count to $2^4 = 16$, five switches to $2^5 = 32$ and so on.

Logic circuits are used extensively in computers and particularly in control engineering to control factory processes. For instance, we may be manufacturing something which requires various ingredients, and referring to Figure 3 we could have an AND gate and an OR gate.

When either of the signals A or B is present at the OR gate, there is an output voltage X which opens the hopper to drop material into the melting pot. But the AND gate operates only if there are both inputs present and the voltage Y opens another hopper. Since these gates control logical operations, they are called logic gates.

**AND gates**

Let us not concern ourselves with circuits at the moment but only examine the symbols. The symbols for a two-input AND gate appear in Figure 4. The British Standards symbol is $\text{AND}$, but manufacturers still use the other two.

Table 2 is called a truth table since it verifies the truth of Figure 4, ie for all combinations of the input the output is proved, and we can see there is an output only when there is a voltage on both inputs (since this is an AND gate).

Using Boolean algebra, a two-input AND gate can be described as $A \cdot B = S$, ie $A$ and $B$ equals $S$.

**OR gates**

This is another important logical operation and the symbols are shown in Figure 5. Once again $\text{OR}$ is the British Standards symbol. The truth table for two inputs is given in Table 3, and there is an output when there is a voltage on either of the inputs. This would also be true for any number of inputs - a voltage on any one of them would produce an output. In Boolean algebra this is expressed $A + B = S$. The use of the plus sign is unfortunate since it implies 'and', but here it stands for 'or', ie $A$ or $B$ equals $S$.

**Inverter or NOT gates**

In many logical operations it is necessary to invert an output from one stage of circuitry before feeding it to the next stage, ie change a '1' to a '0' or a '0' to a '1'. The symbol for an inverter is shown in Figure 6, and $\overline{S}$ is the BS symbol. Note that it has only one input and the inverse is expressed with a bar above it, ie if we feed $S$ in we get $\overline{S}$ out, as seen in Table 4.

---

**Fig 1** single switch

**Fig 2** Three switches (see truth table overleaf)

**Fig 3** Logic gates in manufacturing

**Fig 4** AND gate symbols

**Fig 5** OR gate symbols
**LOGIC CIRCUITS**

**NAND gates**

This is an abbreviation of NOT AND and therefore the output of such a gate will be the exact opposite of an AND gate, as can be seen in Table 5. The symbols are shown in Figure 7 and the Boolean expression is \( A \cdot B = S \), ie not (A and B) equals S. The expression below the bar is assumed to be in brackets and must be evaluated before being inverted.

**NOR gates**

The NOR operation is an abbreviation of NOT OR so once again the output will be the opposite of that for an OR gate, as in Table 6. The symbols are given in Figure 8 and the Boolean expression is \( A + B = S \). Once again the expression under the bar is to be evaluated first and then inverted. \( A + B \) is not the same as \( \overline{A} + \overline{B} \). Similarly for the NAND expression, \( \overline{A} \cdot \overline{B} \) is not the same as \( \overline{\overline{A} \cdot \overline{B}} \). These can easily be proved by means of truth tables:

\[
\begin{array}{ccc|ccc|ccc|ccc}
 A & B & \overline{A} & \overline{B} & A \cdot B & \overline{A} \cdot \overline{B} & A + B & \overline{A} + \overline{B} & S \\
 0 & 0 & 1 & 1 & 0 & 1 & 0 & 1 & 1 \\
 0 & 1 & 1 & 0 & 0 & 1 & 0 & 1 & 1 \\
 1 & 0 & 0 & 1 & 1 & 0 & 0 & 1 & 1 \\
 1 & 1 & 0 & 0 & 1 & 1 & 0 & 0 & 1 \\
\end{array}
\]

Since A and B can have only one of two values (0 or 1), we can summarise the rules for Boolean arithmetic from the above tables:

- \( 0 \cdot 0 = 0 \)
- \( 0 \cdot 1 = 0 \)
- \( 1 \cdot 0 = 0 \)
- \( 1 \cdot 1 = 1 \)
- \( 0 + 0 = 0 \)
- \( 0 + 1 = 1 \)
- \( 1 + 0 = 1 \)
- \( 1 + 1 = 1 \) (not 2!)

By comparing Tables 5 and 6 it can be seen that one is the inverse of the other. Therefore any logic requirement can be designed using either NAND gates only or NOR gates only, and if the final output is of the wrong polarity then we just use one more gate as an inverter. This is the principle of duality, ie one form is the mirror image of the other.

**Exclusive-OR**

This is an important logic function and is used in random generators and in error-checking data streams. The truth table is given in Table 7 and the symbols in Figure 9. It gets its name from the fact that it excludes the case where both inputs are 1, and in Boolean algebra the expression is written \( A \oplus B = S \). The two switches that operate the light on the stairs follow the exclusive-OR logic, ie either switch will operate the light but not both together.

**Boolean algebra**

Very often when designing a whole string of logic requirements for some complex function like opening and closing hoppers in a factory process, controlling traffic lights at crossroads, working out priority commands for a lift in an office block etc, one arrives at a complex expression, say:

\[
\overline{A} \cdot \overline{B} \cdot \overline{C} + A \cdot B \cdot \overline{D} + A \cdot B \cdot \overline{C} = S
\]

Before implementing this in terms of hardware it may be possible to reduce the expression, hence saving hardware. Even if it is not reduced it will still work, but why implement a complex expression when a simpler one will do? In order to reduce the expression one must know the rules below:

- \( A \cdot 1 = A \) (1)
- \( A \cdot 0 = 0 \) (2)
- \( A + 1 = 1 \) (3)
- \( A + 0 = A \) (4)
- \( A \cdot \overline{A} = 0 \) (5)
- \( A + \overline{A} = 1 \) (6)
- \( A + A = A \) (7)
- \( \overline{\overline{A}} = A \) (8)
- \( A \cdot B = B \cdot A \) (9)
- \( A + B = B + A \) (10)
- \( A \cdot \overline{B} = \overline{A} + B \) (11)
- \( A + \overline{A} \cdot B = A \) (12)
- \( A \cdot (A + B) = A \) (13)
- \( A \cdot \overline{B} \cdot \overline{C} = B \cdot \overline{A} + A \cdot C \) (14)
- \( A + B + C = (A \cdot B) + (A \cdot C) \) (15)
- \( A \cdot B = (A + B) \cdot (A \cdot B) \) (16)
- \( A \cdot B \cdot C = (A \cdot B) \cdot (A \cdot C) \) (17)
- \( A + B + C + D + E + F = S \) (18)
- \( A + B + C + D + E + F = S \) (19)

(18 and 19 are known as de Morgan's Theorem).

Some of the above need explaining.

Remembering that the quantities A, B, C etc can have one of two values, 0 or 1, then looking at equations (1) and (4) they will equal 0 if A is 0 or 1 and if A is 1.
Similarly the other equations up to (8) illustrate the logic operations AND and OR we discussed earlier. Equation (9) merely says that if we invert a quantity twice we get the original quantity, and equation (17) implies that we can operate on any of the two quantities first before association with the third.

Any of the above equations can be proved by means of a truth table, and by far the most useful is de Morgan's Theorem which is used to convert NOR into NAND and OR into AND and vice versa. Let us prove that $A \cdot B = A + B$.

$$
\begin{array}{c|c|c|c}
A & B & A \cdot B & A + B \\
\hline
0 & 0 & 1 & 0 \\
0 & 1 & 1 & 1 \\
1 & 0 & 1 & 1 \\
1 & 1 & 0 & 1 \\
\end{array}
$$

Comparing the final column of each table, we can see that one does indeed equal the other. So if we have only NAND gates and we need to implement the OR function $A + B = S$ we simply invert it twice, which does not change the function. Then we apply de Morgan's Theorem to $A + B$ to give

$$
\overline{A \cdot B} = S
$$

which is then implemented as in Figure 10.

Just as we have built a circuit to obtain a required output, we can do the reverse. Given a circuit we can derive the output just by starting at the left (the inputs) and writing the outputs at each successive gate until we reach the final output. Given a circuit as in Figure 11 we pencil in the output of each gate, and this can extend to any size of circuit except that the expression will get more complex at each stage.

### Venn diagrams

To explain the concepts of the combinational logical OR, AND etc. Venn diagrams were invented, and some of the more common ones are given in Figure 12. These are fine for two variables, but what happens if there are three or four variables? The shading and colouring of overlapping circles could get quite complicated. Karnaugh maps could simplify matters.

#### Karnaugh maps

These are used to simplify Boolean expressions, and there is no need to understand how they work in order to use them. All we need is a few simple rules on how to group the variables. A map representing two variables is shown in Figure 13 and it can be seen that each square represents a unique combination of the variables.

A three-variable Karnaugh map is shown in Figure 14, and those inputs producing an output are marked with a '1'. The others are all '0'. A layman will state his requirements to an engineer in the form of a truth table, i.e., for certain inputs an output is required. The engineer then uses Boolean algebra or a Karnaugh map to simplify the expression by grouping all the 1s with the following rules in mind:

- Form the largest groups
- Include all the 1s
- Form the smallest number of groups
- A 1 should not be included in more than one group unless it replaces a small group by a larger one.

### Truth Tables

Switch states: 0=open, 1=closed

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Table 1 | Table 2 | Table 3 | Table 4 | Table 5 | Table 6 | Table 7 | Table 8
So, to return to Figure 14, a layman would state his requirements as in Table 8, ie an output when B, C are 0, when B, C are 1 or when all A, B and C equal 1.

Using Boolean algebra and pairing and factoring the first two terms and last two terms, A.C + A.B.C + A.B.C = S

Using the Karnough map of Figure 14, the top grouping shows that B changes so we are not interested in B. But A remains A and C remains C, so the group is A.C. Similarly with the bottom grouping A changes from 0 to 1 but B and C remain 1, so the bottom grouping is B.C. This gives the same simplification as using Boolean algebra.

Figure 15 shows a grouping on a four-variable Karnough map. The corners are grouped together because the map is considered to fold over. Similarly with the grouping of the sides of Figure 16.

There is one other matter before we say goodbye to Karnough maps. These are unspecified states or 'don't care' conditions.

For instance, in a factory process one might be controlling the pressure while manufacturing a product. Suppose we want to control it between 30 pounds and 50 pounds or between A and B. The situation A and B = 1 can never arise, so it is a don't care condition which we mark with an X on a Karnough map. For grouping purposes an X can be treated as a 1 or a 0, so it can be treated as a 1 if it helps to increase the size of the group or reduce the number of groups. Figure 17 shows how X can be included or ignored, whatever is convenient.

Continued next month
P r i c e s  i n c l u d e  V A T  a n d  P & P ,  1 s t  C l a s s  i n l a n d ,  a i r m a i l  o v e r s e a s ,  n o r m a l l y  b y  t h e  e a s i e s t ,  f a s t e s t  w a y  t o  l e a r n  m o r s e .

p u n c t u a t i o n  m a r k s  t o  t h e  v o c a b u l a r y  a n d  4 0  p r e - r e c o r d e d  p l a i n  l a n g u a g e  t e x t s  f o r .  C om p r e h e n s i v e  f a c i l i t i e s  f o r  t e a c h i n g  t h e  c h a r a c t e r s  b y  s o u n d ,  p o s s i b i l i t y  O u r  f i l t e r s  f o r  i m p r o v e d  r e c e p t i o n ,  a n d  t r a n s m i t  o u t p u t s  f o r  M IC ,  P T T  a n d  K E Y .  K i t  a n d  R T T Y .  T a p e  £ 2 5 .

h a r d w a r e ,  s o f t w a r e  f o r  t h e  S W L  ( a n d  a  l o t  o f  l i c e n s e d  h a m s  a l s o ! )  o n  4  m o d e s ,  s w i t c h  m o d e s  a t  a  k e y p r e s s  t o  c a t c h  a l l  t h e  a c t i o n .  T e x t  a n d  p i c t u r e  T h i s  i s  s t i l l  a  b e s t - s e l l i n g  p r o g r a m  a n d  i t ' s  e a s y  t o  s e e  w h y .  S u p e r b  p e r f o r m a n c e  £ 2 0 .

s a v e / l o a d  m e m o r i e s ,  r e v i e w  s t o r e  a n d  s t a t u s ,  R T T Y  a u t o  C R / L F ,  CW  s o f t w a r e  S p l i t - s c r e e n ,  t y p e - a h e a d  o p e r a t i o n ,  r e c e i v e  s c r e e n  u n w r a p ,  2 4  l a r g e  m e m o r i e s ,  A l l  t h e  f e a t u r e s  y o u ' v e  e v e r  w a n t e d  i n  t h i s  r e a l l y  t o p  c l a s s  p r o g r a m .  P r e v i o u s  r e a l  t i m e  c l o c k ,  r e v i e w  s t o r e  w i t h  o u t p u t  t o  s c r e e n  o r  p r i n t e r ,  c a l  l s i g n  c a p t u r e ,  f r o m  £ 2 9 5 + V A T .

E x t e n d e d  w i d t h  v e r s i o n s  w i t h  o n  b o a r d  p o w e r  s u p p l y
T h e  c o m p u t e r  c h o s e n  b y  p r o f e s s i o n a l s  a n d  O E M  u s e r s .
T o p  q u a l i t y  b o a r d  w i t h  4  p a r a l l e l  a n d  2  s e r i a l  p o r t s ,  b a t t e r y  b a c k e d  C M O S  R AM ,  E P R O M ,  2  c o u r l e t e r - F o r m e n i a l  m e m o r y  e x t e n s i o n  c a r d s .
T h e  A r c h e r  Z 8 0  6 1 3 C
T h c  n o w m a n  6 8 0 0 0 MC
T h e  B o w m a n  6 8 0 0 0 S B C
T h e  S D S  B A R C H E R  —  T h e  Z 8 0  b a s e d  s i n g l e  b o a r d  c o m p u t e r  c h o s e n  b y  p r o f e s s i o n a l s  a n d  O E M  u s e r s .
★ T o p  q u a l i t y  b o a r d  w i t h  4  p a r a l l e l  a n d  2  s e r i a l  p o r t s ,  c o u n t e r - t i m e r s ,  p o w e r - f a i l  i n t e r r u p t ,  w a t c h d o g  t i m e r ,  5 5 5 t i m e r ,  r e v i e w  s t o r e  w i t h  o u t p u t  t o  s c r e e n  o r  p r i n t e r ,  c a l  l s i g n  c a p t u r e ,  &  a n  o p t i o n a l  z e r o  w a i t  s t a t e  h a l f  m e g a b y t e  D - R A M .
★ E x t e n d e d  w i d t h  v e r s i o n s  w i t h  o n  b o a r d  p o w e r  s u p p l y  a n d  c a s e .
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Opto-electronics can be regarded as including any devices that produce an electrically-induced optical (visible or invisible light) output or an optically-induced electrical output, and the electronic techniques and circuitry used for controlling such devices. Opto-electronics is obviously a fairly large subject; in this edition of 'The File' we present a brief survey of some of these devices and techniques.

The best known types of 'light-generating' opto-electric devices are the ordinary tungsten filament lamp, the LED (light-emitting diode), the multi-segment LED array and the 'neon' or gas-discharge lamp; other types of light generator include the cathode ray tube and the laser. An associated device is the liquid crystal display (LCD), which does not in fact generate light but produces variations in the intensity of reflected ambient light.

Light-sensitive devices include photo-diodes and phototransistors (which have opto-sensitive conductivity), LDRs or 'light-sensitive resistors' (which have opto-sensitive resistivity), and so-called 'solar' or 'photo-voltaic' cells (which are opto-sensitive voltage generators). Some specialist devices such as opto-isolators and opto-reflectors combine both light-generating and light-sensitive units in a single package.

Opto-electronic devices have many practical applications. They can be used to generate a wide variety of stationary or moving visual displays. They can be used to give an automatic switching or alarm action in the presence or absence of a visible or invisible light source, or to give a similar action when a person or object moves within range of a generated light source. They can be used to give remote control action via an infrared light generator and a remotely placed detector. In some applications, fibre-optic cables can be used to form a low loss closed-circuit connecting link between a code-modulated light generator and a matching remotely placed light-sensitive device, thus forming an interference-free data link.

Filament lamps

The simple filament lamp or 'light bulb' is the best known type of light generator. It is widely used in the home, the car and in industry, can be powered from either ac or dc voltage sources, and uses the standard circuit symbol of Figure 1a. It usually consists of a coil of tungsten wire (the filament) suspended within an evacuated glass envelope and connected to the outside world via a pair of metal terminals; the filament runs white hot when connected to a suitable external voltage, thus generating a bright white light.

The filament lamp has two notable characteristics. One of these is that its resistance varies with filament temperature. Thus the resistance of a 12V 12W lamp is 12 ohms when the filament is operating at its normal 'white' heat, but is only 3 ohms when the filament is cold. This 4:1 resistance variation is typical of all filament lamps, and causes them to have switch-on 'rush' current values about four times greater than the normal 'running' values.

The other notable feature of the filament lamp is that it has a fairly long thermal time constant, so that power has to be applied to (or removed from) the filament for a significant time (tens or hundreds of milliseconds) before it has any appreciable effect on light output. This characteristic enables the device to be powered from either ac or dc voltage sources, and enables the lamp brightness to be varied by using highly efficient switched-mode 'pulsing' techniques.

Light-emitting diodes

Another well-known type of light-generating device is the light-emitting diode, or LED. Figure 1b shows the standard circuit symbol of this solid-state device, which has electrical characteristics similar to those of a normal diode, ie it passes current in one direction and blocks it in the other, but emits light when biased in the forward direction. 'Standard' types of LED emit a red coloured light, but other types are available that emit orange, yellow, green, or infra-red types of light (and blue now, with an SiC diode from Siemens – Ed).

LEDs require typical forward operating voltages of about 2 volts and forward currents of 10 to 20mA. They are widely available in single-LED packages, but are also available in multi-LED styles. 2-LED packages housing a pair of red and green LEDs are, for example, available in either 'bi-colour' or 'tri-colour' forms, as shown in Figures 2 and 3. In the bi-colour device only one LED can be illuminated at a time, so the device emits either red or green, but in the tri-colour device both LEDs can be illuminated at the same time, generating a yellow colour in addition to red and green.

Multi-LED packages are also available in 'bargraph' form, in 5 x 7 dot matrix form, and in 7-segment 'digital' form.

In use, the operating current of an LED must be limited to a safe value; this can be achieved via a series resistor connected to either the anode or the cathode. Note that LEDs have very short opto-electric response times, and can easily be used to transmit coded 'remote control' light signals etc.

Neon lamps

Neon 'gas discharge' lamps can also be used as light-generating devices. They comprise neon gas and a pair of electrodes housed in a glass envelope.
When a suitably high 'striking' voltage is applied to the electrodes the gas becomes conductive, producing a red glow on the electrodes; if the voltage is further increased the glow spreads through the neon gas.

In use, a resistor is wired in series with the neon lamp so that the neon voltage self-limits to slightly above the 'striking' value. Figure 1c shows the symbol for the neon lamp, which can be powered from either an ac or dc voltage.

Fluorescent displays

Another type of light-generating device is the fluorescent or phosphorescent display, which is shown in basic form in Figure 4. Here, an incandescent filament (typically using a 2 volt supply) acts as a source of free electrons, which can be accelerated into a phosphor-coated anode via a suitable grid-to-anode voltage (typically about 24 volts), thus generating a visible green or blue fluorescent glow. This type of device is available in 7-segment display form.

Liquid crystal displays

The four basic types of opto-electric display devices that we have just looked at inevitably consume substantial electrical power, since they actually generate light. Liquid crystal displays (LCDs), on the other hand, are used to reflect existing ambient light, and can thus operate with negligible power consumption. Figure 5 illustrates the basic structure of an LCD device designed to display either a blank or the digit ‘1’.

The display device consists of a very thin layer of liquid crystal sandwiched between two glass covers which have the transparent character ‘1’ etched onto them in the form of an externally available pair of electrodes. Normally the liquid crystal molecules are randomly aligned, and the complete unit appears as a simple 'blank' block of transparent glass.

When an ac voltage (usually 40-100Hz) is applied across the ‘1-shaped’ electrodes the molecules within the intervening layer tend to become aligned, taking up a mirror-like optical density that vividly reflects the character ‘1’ from any existing ambient light source. The device reverts to its ‘blank’ state when the ac excitation voltage is removed.

In reality, the etched character shape (or shapes) of an LCD device can take any desired form, and in practice they are most widely used in the form of 7-segment displays. Note that LCDs are voltage-operated devices, and consume near-zero quiescent power.

7-segment displays

A very common requirement in modern electronics is that of displaying alphanumeric characters; digital watches, pocket calculators and digital instruments are all examples of devices that use such displays. The best known display of this type is the so-called '7-segment' display; it comprises seven independently-accessible photo-electric segments (eg LED, LCD, gas-discharge, fluorescent, or filament-type segments) arranged in the form shown in Figure 6.

The segments are conventionally noted from 'a' to 'g' in the manner shown in the diagram, and it is possible to make them display any numeral from '0' to '9' or alphabetic character from 'A' to 'F' (in a mixture of upper and lower case letters) by activating these segments in various combinations, as shown in the truth table of Figure 7. A wide variety of digital IC types are available for providing suitably decoded driving signals for 7-segment displays.

Photo-detectors

Photo-detectors are devices that provide a change in electrical characteristics in the presence of a change in 'light' input. The best known of these devices are the LDR (light-dependent resistor), the photodiode and the phototransistor, and Figure 8 shows the symbols for these three devices.

The LDR is also known as a cadmium sulphide (CdS) photocell; it is a passive device that simply changes its electrical resistance in the presence of external light. Figure 9 shows the typical photo-resistive graph that applies to an LDR with a face diameter of about 10mm.

A photodiode is a normal silicon diode that is either mounted in a translucent case or has its semiconductor junction
mounted beneath an optical lens. If any silicon diode junction is reverse biased in the circuit of Figure 10, its reverse current value will depend on the amount of illumination on the junction face, being near-zero under dark conditions and tens or hundreds of nA under bright conditions.

Similarly a phototransistor is a normal silicon transistor with a photo-sensitive junction. It has a far greater sensitivity than the photodiode, and can be made to act as a sensitive light-to-voltage converter by wiring it in either of the configurations shown in Figure 11.

**Solar cells**

So-called 'solar' cells are actually photo-voltaic units that convert light directly into electrical energy. Figure 12 shows the symbol used to represent a single solar cell.

An individual solar cell generates an open circuit voltage of about 500mV (depending on light intensity) when active. Individual cells can be connected in series to increase the available terminal voltage, or in parallel to increase available output current; banks of cells manufactured ready-wired in either of these ways are known as solar panels. Figure 13 shows how a bank of 16 to 18 cells can be used to auto-charge a 6 volt nicad battery via a germanium diode.

The available output current of a solar cell depends on the light intensity, on cell efficiency (typically only a few per cent), and on the size of the active area of the cell face. Note that available sea level light energy is typically in the range 0.5kW to 2kW per square metre on a bright sunny day, so there is plenty of 'free' energy waiting to be converted!

**Opto-couplers**

An opto-coupler is a device containing an infra-red LED and a matching phototransistor, mounted close together (optically coupled) within a light-excluding package, as shown in the basic circuit of Figure 14. Here S1 is normally open, so zero current flows through the LED; Tr1 is thus in darkness and also passes zero current, so zero output voltage appears across R2. When S1 is closed, however, current flows through the LED via R1, thus illuminating Tr1 and causing it to generate an R2 output voltage. The R2 output voltage can thus be controlled via the R1 input current, even though R1 and R2 are fully isolated electrically.

In practice, the device can be used to opto-couple either digital or analogue signals, and can provide hundreds or thousands of volts of isolation between the input and output circuits.

Figures 15 and 16 show two useful variants of the basic opto-coupler. The first of these is the 'slotted' opto-coupler, which has a slot moulded into the package between the LED and Tr1. The slot houses transparent windows so that the LED light can normally freely reach the face of Tr1 but can be interrupted or blocked via an opaque object placed within the slot. The slotted opto-coupler can thus be used as an object detector.

The second device is the 'reflective' opto-coupler. Here the photo-active faces of the LED and Tr1 both point outwards (via transparent windows) towards an imaginary point that is roughly 5mm beyond each window, so that the LED light can only reach Tr1 via a reflective surface that is placed at or near this point. This device can thus also be used as an external-object detector.

**Light-beam systems**

One of the most important applications of the infra-red LED/phototransistor combination is in the making of 'light beam' systems, which can include light-beam alarms, infra-red remote control systems, and (with the aid of fibre-optic cables) infra-red data links. The basic principles of these systems are illustrated in Figures 17 to 21.

Figure 17 shows the basic operating principle of the simple light-beam alarm. Here the transmitter feeds a coded signal (usually a fixed-tone square wave) into an infra-red LED, which has its output focused into a 'beam' that is aimed at a matching infra-red phototransistor mounted on the remotely placed receiver. The circuit action is such that when the light-beam is operating the receiver output is normally off but automatically activates an external alarm, counter, or relay if the beam is interrupted by a person, animal or object. This type of system can have an effective 'detection' range of up to 30 metres.

The above system works on the pinpoint 'line-of-sight' principle, and can be activated by any 'bigger-than-a-pin' object that enters the line of sight between the transmitter and receiver.
lenses. Thus a weakness of this system is that it can be falsely triggered by a fly or moth (for example) entering the beam or landing on one of the lenses. The dual light-beam system of Figure 18 does not suffer from this defect.

The Figure 18 system is basically similar to that already described, but transmits the infra-red beam via two series-connected LEDs that are normally spaced about 75mm apart, and receives the beam via two parallel-connected phototransistors that are also spaced 75mm apart. Thus each phototransistor can detect the beam from either LED.

The receiver will not activate if one or other of the beams is broken, but only if both beams are broken simultaneously, and this will normally only occur if a large (greater than 75mm) object is placed within the composite ‘beam’.

Figure 19 illustrates the operating principle of an infra-red remote control system. Here the hand-held unit transmits a broad beam of coded infra-red light, and can remotely control a receiver that is placed anywhere within the active area of this beam. Note that the transmitter and receiver do not need to be pointed directly at each other to effect operation, but must be in ‘line-of-sight’ contact; also note that an object placed within the beam can create a ‘blind’ area in which line-of-sight contact cannot exist.

**Code waveforms**

Infra-red LEDs and phototransistors are very fast-acting devices. Consequently the effective range of an infra-red ‘beam’ system is determined by the peak current fed into the transmitting LED, rather than by the mean transmitting current. These are important points to note when designing beam code waveforms, as illustrated in Figure 20.

The simplest type of ‘code’ waveform is the fixed-tone square wave signal, as shown in Figure 20a. Here the mean transmitting current is half the peak value, so this system is not very efficient. Better efficiency is shown by the ‘pulse’ system of Figure 20b, which transmits a 100μs pulse once every 1100μs and thus has a mean current consumption that is only one-tenth of the peak value. Finally, the most efficient system of all is the tone-burst system (Figure 20c) which, in the example shown, consumes a mean current that is only one two-hundredth of the peak value. Note that this latter system transmits a 1ms ‘sample’ burst of 10kHz tone once every 100ms (eg ten times per second), and is used mainly in infra-red ‘intruder detecting’ systems.

Most multi-channel remote control systems use a fairly complex beam coding system in which a number of ‘bits’ of data are sequentially transmitted within a repeating ‘frame’, which also repeats many times per second. Thus in each frame the first bit may contain data for channel 1, the second for channel 2, the third for channel 3, and so on.

32-channel infra-red remote-control systems are readily available.

**Fibre-optics**

Fibre-optic cables can, in very simple terms, be regarded as flexible ‘light pipes’ that can efficiently carry modulated or unmodulated ‘light’ signals from one point to another (even if the journey involves bends and loops) with little signal loss and complete immunity from electromagnetic interference.

The simplest application of such cables is in distributing the visible light of a single source to many different ‘point’ locations, as in (for example) a vehicle’s instrument panel. In this instance the cables need no special treatment, and can simply be cut to length with a sharp knife. In more complex applications, such as the coded data link of Figure 21, the cable needs to be united with the light source and the distribution point via special connectors in order to cut down signal losses.

Two distinct types of fibre-optic cable are in common use. One of these is an inexpensive type made from polymer cable; it is easily cut, ideally suited for use with visible red light, and is best suited to short distance applications (up to ten metres). It gives a maximum attenuation of 200dB per kilometre of cable. The other type of cable uses a glass fibre construction; it is expensive and difficult to cut, but can efficiently handle infra-red signals and exhibits a typical transmission loss of only 5dB/km.

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**Fig 18** Dual light-beam alarm

**Fig 19** Basic IR remote control

**Fig 20** Basic types of IR-beam code waveform

**Fig 21** Basic fibre-optic link
The AOR series of scanners, the AR2001 and 2002, have proved immensely popular, and in my own humble view the 2002 is probably the best all-round scanner you can buy at the price. The addition of what’s called an RC-Pack brings either of these machines under computer control and adds a whole new dimension to scanning.

First, though, a look at the two scanners themselves. The 2001 was the first receiver to appear on the market that allowed ‘no-gaps’ coverage from 25 to 550MHz. It also scored over some of its earlier competitors in that far fewer spuri appeared across its tuning range.

The 2002 (which also appears as the Regency MX8000) is a revamped version with the addition of an 800 to 1300MHz tuning range, a bargraph 5-meter, proper keypad buttons and a manual tuning knob. Interestingly the case is exactly the same shape and size as its predecessor. Either machine offers 20 memory channels and each channel can be individually programmed for mode and delay.

**Tapping into the micro**

The optional computer interface certainly is not much to look at; a plain grey box with an LED power light and a push-on/push-off switch. It comes with a short length of ribbon cable terminated in DUC plugs which connect directly to a socket on the back of the AR2002.

In the case of the AR2001 an additional adaptor is required and connecting up is slightly more complicated. The set has to be opened up and the plug carrying the keyboard connection has to be disconnected from the main PCB. This means that the AR2001 can then only be used under computer control. There is no such drawback with the 2002 as switching the RC-Pack on automatically puts the scanner under computer control.

On the rear apron of the RC-Pack is a 25-way D socket which provides a standard RS232 connection (8-bit, no parity, 1 stop bit) to the computer which can either remote control the scanner directly under constant control or can act as a dumb terminal just to get the RC-Pack programmed. Baud rates are set within the RC-Pack using DIP switches. The factory-set rate is 9600 baud but this can be changed to 4800 or 2400.

The pack contains its own 8-bit CPU and non-volatile memory (capacitor style power cell that will retain memory for around a month without power applied). Using the internal software a host of additional facilities are available. Now 50 memory channels can be used and notes can be written to identify the frequency user; these appear on screen when a signal is received. Additionally 10 banks of search ranges can be set up and recalled at any time.

**Additional features**

Preset step rates for searches on the set are limited to hops of 5, 12.5 and 25 kilohertz, but under computer control virtually any step rate from 100Hz upwards can be programmed. During search sequences the plus and minus keys on the computer (assuming they generate standard ASCII codes) can be used for up/down tuning at a nominal 70 millisecond step rate (this can be altered).

It is interesting to note that under computer control it is also possible to search outside the specified limits of the receiver. The frequency can be set to anything below 25MHz, but performance tails off sharply around 10MHz. The highest limit is 1355MHz. It is not possible to program frequencies between 550 and 800MHz (TV frequencies). Naturally reception of stations between 10 and 25MHz is far from perfect because of the relatively wide bandwidth of the IF filters in the set.

When it comes to scanning proper, a range of features is available which includes as many priority channels as you want and the ability to set the rate at which they are checked. Delay on scan channels is adjustable from 1-127 seconds.

**Software**

So far my own experiments have been conducted solely with a BBC-B computer. On receiving the RC-Pack my first problem was to find a suitable 25-way plug to hook it to the RS432 terminal on the Beeb, as one is not supplied. Fortunately I had one, plus a suitable Domino DIN plug for the computer, and a few minutes with a soldering iron meant I was able to plug the pack to the Beeb.

With the RC-Pack switched on the AR2002 went dead and just the time showed. I booted up the only communication software I had, Mini Office II, selected 9600 baud from the available rates and then typed in ‘EC’, the command that ‘kick-starts’ the interface.

The system fired up perfectly. I will not go into detail on how things work from then on as it is simply a question of using a few new commands or following prompts. A ‘Help’ facility fires up a description of all the available commands.

Once frequencies have been program-
med into the memory channels, and such things as priorities and delays have been set, then the computer's break key can be hit. The scanner will carry on working and the computer can be returned to normal usage or even switched off.

Having used a commercial communications package to try out the equipment, I decided to develop a simple basic program to do the job (it was a bit tedious having to set up the various options and protocols on the Mini Office II package).

**Practical programs**

Program 1 is about the simplest possible software you can use to get the computer to act as a dumb terminal. It is fractionally slower than a proper communications program in machine code but in practice this does not cause any drawbacks.

The program automatically sets the response time between the RC-Pack and computer and once 'run' you just type in 'EC' followed by return. 'EC' will not appear on screen but that is perfectly normal. The RC-Pack is then in 'Echo' mode and will start to write to the screen. The only point to watch is that the FC-Pack has already been used with faster software it may not respond properly at first. Try giving it a slower response speed such as 'RS50' and then re-run the software.

That simple program will allow full programming of the RC-Pack, and again once the scanner is under way the Beep can be returned to normal usage. The beauty of this program is that the thousands of buffers like myself who cannot program in machine code can now start adding a few extras.

Program 2 is a slightly modified version that simply uses the internal cassette switching relay of the Beep to turn a tape recorder on when a signal is received. This idea could be taken a stage further by using a stereo cassette deck so that audio is recorded on one track and screen information is stored as a file on the other track. This obviously allows the scanner to be left unattended and later playback will show who was transmitting what and on which frequency. Used in search mode it also allows new stations to be found.

Having said all that, do note the laws concerning recording of transmissions.

**Commercial programs**

There is only one program specifically designed for the AOR RC-Pack, and that is supplied as a plug-in ROM by Lowe Electronics, who are the importers of this equipment. It is much faster to use than a conventional communications package and bypasses much of the internal software of the RC-Pack, so giving more control to the Beep. Once memory channels have been selected these are stored on disc (channels stored in the non-volatile memory of the RC-Pack remain unaffected by use of the Lowe program) and the various functions are assigned to the programmable keys on the computer (keystrip provided).

A pleasing colour graphic display provides a clock and a mock-up of a conventional moving-coil type S-meter. The ROM is accompanied by a tape which contains an instruction file and a sample program of what can be done to

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Lowe's graphics on the ROM software for the BBC micro.

Comedian Rouse's mentality revealed (read the notes to the right).

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provide extra features. These include tape recorder switching and hard copy log on a printer of the details and time of signals received.

The program is written in assembly language and a detailed description is included of what is doing what, so that with the necessary programming skills can start adding their own features.

Other computers

Any computer which either has or can have added to it an RS232 interface can be used with the RC-Pack. It is simply a matter of using communications software which has selectable baud rates. Many computers such as the Dragon 64, Sinclair QL etc have suitable ports, and their handbooks give details on how to receive and send via them. It should not be difficult to develop suitable basic programs along the lines of the one shown here for the BBC B.

Conclusions

First the means. There is a bug in the internal software of the RC-Pack which manifests itself as one of the information lines being overwritten on the screen and then reappearing in the wrong place. It does not affect the performance, but it is annoying and on a piece of equipment as expensive as this it should not happen.

The command to kill delay is supposed to be 'DL X' which in fact has no effect whatsoever, and it is necessary to use 'DL 1' and put up with a 1 second delay as minimum.

AOR provide no information at all on what order the data is sent back and forth nor on how to use the RC-Pack in any way other than with the computer acting as a keyboard. The result is that it will be difficult for someone with only the basic programming abilities to write software that does away with such things as the unnecessary refreshing of the entire screen every time a signal is received. Without some better means of control, setting up the RC-Pack is rather tedious as instructions have to be entered one at a time with a complete screen refresh sequence between each one.

Many scanner users, I suspect, will find little benefit in paying a fairly hefty price for the additional features contained solely within the control box. It therefore seems likely that the set-up will appeal to two groups of scanner users, the first being those scanner buffs who want to be able to do such things as auto-log, and the second being those people like myself who are compulsive fiddlers.

I must confess to having had hours of fun finding out what I could and could not do with the computer hooked to the scanner. I suspect I have only just scratched the surface and hours more fun are in store as I play around with different programs.

Practical problems

Nearly all home micros generate dreadful signals from their internal clocks, and the harmonics from these stretch well up into the VHF bands. The system I have been reviewing is unusable if the antenna system is anywhere near the computer, and in fact even with the aerial 10 metres away from the Beeb the squelch has to be set slightly harder than normal. The obvious answer to this is to fit the computer into an earthed metal case, and that might not be as silly as it sounds.

There is no reason why a cheap computer should not be permanently connected to the scanner. Older computers and ones that have failed commercially can often be obtained quite cheaply either second-hand or even new. I have seen MSX machines being sold new at bargain basement prices of less than thirty pounds, and according to the AOR manual these machines can be hooked directly to the RC-Pack and the computer's internal software for communications can be called up with just a few simple commands. The added advantage of all this is that you need not then tie up an expensive machine like a BBC B on a dedicated operation.

One final tip is to try earthing different items of equipment. For some strange reason I noticed that hash levels dropped when I tried jumper wires between the casings of things like the disc drives, monitor and RC-Pack; it was just a case of finding the right combination.

Spectrum dumb terminal software

The following program was written by Peter Stonebridge GB2QA for the 48K Spectrum and operates via the optional ZX RS232 adaptor. Peter says it suffers a minor problem in that because the RS232 is operated directly under the control of the Spectrum's CPU it occasionally locks up. This is no major problem, as typing-in 'continue' will get the process going again.

```plaintext
3 REM AOR 2002 BY GB7QA
5 LET LINE=0
10 OPEN H4:4*"P"
20 OPEN H5:4*"P"
25 PRINT H5:"S'rs35"
30 GO SUB 100: REM send
40 GO SUB 200: REM receive
50 GO TO 30
100 LET K$=INKEYS
110 IF K$="": THEN RETURN
120 IF K$=">": THEN GO SUB 500
200 LET K$=INKEYS
210 IF K$=CHR$ 13 THEN LET LINE =LINE+1: POKE 23492,2255: REM to keep scrolling
240 PRINT K$;
250 RETURN
500 IF K$="1": THEN LET K$="ML";
501 IF "A" THEN LET K$="EC";
502 IF K$="C": THEN LET K$="CL";
503 IF K$="S": THEN LET K$="GC";
504 IF K$="D": THEN LET K$="DL";
505 IF K$="P": THEN LET K$="PR";
506 IF K$="A": THEN LET K$="PA L";
507 IF K$="M": THEN LET K$="H";
508 IF K$="h": THEN LET K$="SE"
1000 PRINT H5:K$;
1010 GO TO 200
```

MSX commands

According to the manual supplied with the RC-Pack, connection can be made direct to those MSX machines which have a communications port. The following commands and program lines are all that are necessary to get the set-up working.

SCREEN 0
WIDTH 39
10 CALL COMMIN ("O.BNNNNNN",9600,9600)
20 CALL COMTERM ("0:1")

Once you have run the above, type in 'EC' followed by return and then 'RS 5', again followed by return.

Much to

I am indebted to Lowe Electronics of Matlock in Derbyshire not only for supplying equipment for review but also for much useful back-up information. Their software designer is working on new ideas for the AOR system and has already had some success with such things as a slow but effective spectrum analyser. They will make all software developments available in the future.

VAT-inclusive prices are currently £487.30 for the AOR2002, £255.63 for the RC-Pack and £10 for the BBC ROM and sample program tape. Note that prices do not include carriage and are subject to the regular fluctuations of the pound on world currency markets.

FEBRUARY 1987 please mention RADIO & ELECTRONICS WORLD when replying to any advertisement
THE MF10 FILTER CHIP

James Dick describes an IC containing two switched capacitor filters which simplifies design and eliminates the problems of critical component values.

Active filtering took a quantum leap forward with the introduction of a new chip a few years ago by National Semiconductor, the MF10. Given that amateur radio — and, indeed, many other areas of hobby interest — is very much concerned with filtering, this device should prove popular with the hobbyist as well as the professional engineer.

Fig 1 A typical op-amp filter design

Fig 2 An outline of the switched capacitor technique

has been available to the digital designer since TTL became widely used oh-so-long-ago. The same functional building block approach has slowly spread throughout the analogue world (phase-locked loops, op-amps and voltage regulators) and is making its mark in filtering.

Problem solvers
In a typical op-amp filter design (Figure 1), the accuracy of the filter's frequency characteristics depends on the accuracy and tolerance of the passive components used. The designer will frequently find him or herself using one per cent tolerance capacitors — or even tighter tolerances as the filter's frequency rises. To obtain exact filter characteristics, non-standard component values often have to be used.

The MF10 has been designed to completely eliminate critically-valued components and to reduce the component count to a minimum while still allowing the filter to be tuned, a feature which is difficult to achieve with conventional designs.

Apart from simple tuning, the MF10 may be configured to act as two second order filters, or cascaded to form a single fourth order type with Butterworth, Bessel, Chebyshev or Cauer characteristics.

How it works
The MF10 is based around the idea that a capacitor and a couple of switches can be made to look like a resistor. Figure 2 is used to illustrate this principle. When S1 is closed, S2 is open and C1 charges up to the input voltage V1. When the clock signal's polarity changes, S2 closes and S1 is opened and the charge on C1 is transferred by the op-amp to C2. Hence during one clock cycle a charge of C1×V1 is moved from the circuit input to the op-amp's inverting input.

Since current is measured as charge divided by transfer time, the equivalent current passed by the two switches is \( V_1 \times C_1 \times F_{\text{clk}} \) where \( F_{\text{clk}} \) is the clock frequency. Because we know the voltage across the two switches (V, at one end, and the op-amp's virtual-ground level at the other) and the current passed, we can calculate that the switches and their capacitor look like a resistor with a value of \( V_1 / I \) where I is the current passed. Hence the 'resistor' value is \( 1/(C_1 \times F_{\text{clk}}) \).

So, by substituting 'switched capacitors' into the filter design instead of resistors, a general purpose filter may be made in which the awkward-value resistors are replaced by a digital clock signal and an on-chip capacitor.

Because a digital clock signal is easy to generate for a given frequency and stability, and the on-chip capacitor can be accurately fabricated, a solution to the filter component problem has been found.

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February 1987
Applications

Just to show how easy it is to design with the MF10. Figure 3 shows a simple telephony filter. The filter has a second order high-pass section set at 400Hz and a second order low-pass section set at 2kHz. Because the MF10 contains two independent sections, only one chip is required.

The discrete component values are calculated using the simple equations in the manufacturer’s data sheet—a pocket calculator is optional!

The digital clock signal can be either 50 or 100 times the filter’s design frequency. Since we have two filters here, two clock signals are required, one at 40kHz and the other at 200kHz. These have both to have a symmetrical duty cycle, which is why the crystal-generated signals are passed through divide-by-two flip-flops.

Another simple example is shown in Figure 4. This time it’s a band-pass filter that might find a use as a morse-tone filter. By varying the input clock frequency from 50kHz to 300kHz, the filter may be tuned from 500Hz to 3kHz. Since the clock has to be varied in frequency, a simple oscillator based around a CMOS inverter chip might be used. Although fairly basic, with a stabilised supply such a simple oscillator will be quite suitable.

Notes

The MF10 does have its limits. The maximum clock frequency that may be used is 1.5MHz, thus limiting filtering to around 30kHz. This means that the MF10 is purely for audio applications. The Q obtainable (Q is a measure of the passband width in band-pass filters) must not exceed 300,000 divided by the passband centre frequency (in Hz). A band-pass filter centred on 5kHz should not have a Q greater than 60, for instance.

The device runs off ±7 volts and the outputs may swing to within 1 volt of either supply; output currents are limited to less than 1.5mA. A single supply of up to ±14 volts may also be used, so any circuit built using an MF10 should be able to work off a mobile transceiver’s PSU!

One of the more complicated limits is that aliasing must be avoided. Aliasing occurs because the switching nature of the filter effectively samples the incoming signal at the clock frequency. This produces a mixing effect which will transfer any signals near the clock frequency down into the audio band. Because the clock signal is typically many tens of kilohertz, this is unlikely to be a problem in operation but should be guarded against in circuit design.

None of the above features should detract from the ease with which the MF10 can be used. At a cost of less than £5, this excellent and exciting analogue building block is certain to be warmly welcomed by anyone designing audio filtering equipment.
Got a new diary? Well here's something to fill it up with, plenty of TV contests throughout the new year!

The Winter Cumulative are for all modes (TV, that is) and all bands, from 1900 to 2359 local time each session. The dates are Thursday 8th January, Friday 16th, Saturday 24th and Sunday 1st February.

Next on the roster is the Easter Extravaganza on Tuesday 21st April. For 70cm only, it lasts from 0001 to 2359. The May Day Microwave is what's cooking on Monday 4th May (after the BATC rally at Crick—can you stand the pace???). Again running from 0001 to 2359, this contest is for 24cm and above.

Summer Fun comes from 1200 Saturday 21st June to 1600 the next day, and covers all bands. Next is the International ATV Contest, which we must win. For fast-scan TV on all permitted bands it runs from 1900 Saturday 12th September to 1300 on Sunday. The Autumn Vision contest is on Sunday 25th October, running from 0001 to 2359. All bands and all modes are encompassed. Finally, there is a slow-scan day on Sunday 29th November, from 0001 to 2359. Mark all these dates in your diary now: all times are local, ie BST if in force, otherwise GMT.

There are two sections in all of these contests. Section A is for all transmitting amateurs, whether transmitting vision on this occasion or not. Category B is for SWL stations who are not in direct contact with entrants to section A. The bands open to fast-scan ATVers are 70cm, 24cm, 13cm, 9cm (3.4GHz), 5cm (5.6, 5.7 and 5.8GHz), 3cm (10GHz), 1.25cm (24GHz), 0.5cm (47GHz), 0.3cm (75GHz), 0.2cm (142GHz) and 0.1cm (248GHz). Well, that's the complete list—i wonder whether we'll have any 0.1cm entries this year...

Contest fun?

Yes please. Contests are supposed to prove that the people who win are those with the best operating practice. Who said "Whoosh, over the top"?

Talkback is generally on two metres, with calling on 144.750 (FM) and 144.170 (SSB). These are recognised ATV calling frequencies, and 144.800 seems to be used outside Britain as well. Please try to QSY from these calling channels as soon as possible to give others a chance. The last thing we want is aggro on the air; this is supposed to be a hobby and contests ought to be stimulating and enjoyable, not a slanging match!

Ignorant operators

Talking of slanging matches (writes R&EW's own Mr Angry), there still seems to be some discontent about at least one pig-headed ATVer up north who insists on transmitting high power colour TV and 70cm. This operator lives on a hilltop, not too far from Manchester, and causes untold havoc both on the 70cm band and to neighbouring broadcast TV viewers. Apparently, polite deputations have failed to make him change his ways, and he is now being reported to the Radio Investigation Service. I could name his callsign here but what's the point? He has already proved what a wally he is. Operating colour TV on 70cm is antisocial and plain illegal. I know of no amateur who has installed adequate filtering to prevent out-of-band radiation from double-sideband colour TV, and the harmonic products of the colour sub-carrier ext. court. MacDougall, add to this recipe a non-linear power amplifier and what have you got? Wideband crud and ill-feeling for miles around from the rest of the amateur fraternity. I suppose this (so-called) amateur thinks this is clever, but it's certainly not in the 'ham spirit'. I hope he has his licence revoked!

Captain Midnight again

I feel a lot better having got that off my chest! Now let's stick with silly billies and clever dicks for a moment and wind up the story of Captain Midnight. Yes, OK, perhaps you heard he was caught but I bet you don't know how, so for the hitherto untold story read on.

Captain Midnight was the pseudonym of an American amateur who was fed up with Home Box Office's plans to scramble its satellite TV transmissions of films. Captain Midnight and several thousand other home satellite viewers had been watching these films for nothing, while HBO had not been receiving subscriptions from them. To cut out these freeloaders HBO decided to scramble its signals, and by renting out descramblers it could also collect subscriptions from the freeloaders.

This action was ruining Midnight's two and a half year old satellite business in Florida, so one night he went 'whoosh, over the top' and substituted a protest message for HBO's uplink signal. Midnight (real name John MacDougall) was caught and was fined $5,000 by a Californian court. MacDougall said he was aware of the illegality of his action but hoped his actions would bring to public attention a problem which affected millions of Americans. In addition to the fine, Judge Howard Snyder placed MacDougall on probation for a year. The hearing lasted just 10 minutes, and the relatively lenient fine resulted from plea bargaining by MacDougall.

Fine, so far so good, but how do you trace the culprit after the event? In this case an amateur with TV knowledge was able to give the authorities some valuable assistance. For obvious reasons I cannot name the amateur in question.

Applying common sense, the uplink station had to be a teleport with the capability of beaming at the satellite and it had to be equipped with more power than HBO's own uplink. These details are known to the Federal Communications Commission, and narrowed the search down to a few sites. What clinched it was the fact that this amateur recognised the character generator used to make up Midnight's message as a Chyron 3, and this together with the other facts narrowed the hunt down to just three sites in the USA.

Identifying the culprit

But to find the culprit, how do you identify him? Well, the betting is that he's an amateur, isn't it? After all, he must have the technical knowledge and be sufficiently motivated and self-assured to try a stunt like this. Yes, and he probably has the same sort of mentality as a repeater jammer; from many years of hunting repeater jammers, our hero drew up a psychological profile of Captain Midnight. He's probably a bit of an introvert, on the short side and portly, short of funds and has a technician class licence—and a grudge. Most of all he is looking for attention.

Well, I can only take this on the word of my contact, but I'm told this profile fitted Captain Midnight to a tee, right down to the technician class licence!

Obviously there were other factors which contributed to his arrest—some reports say he was overheard by a scanner enthusiast while bragging about his achievement on a mobile phone—but every bit helped.

In case you wonder how MacDougall achieved his takeover, it was because he worked nights on a freelance job at a teleport, and this gave him the opportunity to wipe out HBO. Of course, you may well have a sneaking admiration for the guy. I think I do a bit, but rules are for the benefit of us all. Aren't they? Write in if you disagree...

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FEBRUARY 1987
Well, we certainly had quite a good autumn as far as lifts were concerned, much better in fact than the previous year. I hope you managed to join in the activity, as I did (to some extent!). Being in the centre of the country I cannot hope to match the DX records some of the other operators were apparently breaking.

I heard that stations in the south-west were once again working Northern Ireland, and certainly Jersey was a popular destination for quite a few people. As ever, watch out for the signs: sustained high pressure, not much wind and a rapid temperature drop in the evening. Warnings on TV about foreign interference – which they gave this time – are a dead giveaway!

Phonpatching on 934

Phonpatches are a fascinating addition to a mobile radio system. A switch, which may be manually or automatically operated, can connect the base station through to a telephone line (which may be a normal public exchange line or a works internal extension). Mobile radio users who have this facility can then make and receive phone calls from their vehicle, using a normal two-way radio, just as if they had a proper car phone. Unlike cellular radio, though, it only works from your own base station, so you have to be in range for the phonpatch to work.

To make outgoing phone calls you need to fit your rig with a new microphone which incorporates a 'touch-tone' keypad, similar to the ones on the new 'tone-dialing telephones. As well as the numbers 1 to 9 and 0, you also have buttons marked with a star and square (also known as hash or octothorpe), and each of the buttons makes a particular combination of two tones when you press it.

When you need to make a phone call you hit a secret code combination. If you are in range of your base station you will now get the dial tone and you can dial (or rather tap out) your call as normal. As you are in a simplex circuit you will still have to key the mike with the PTT switch as normal and say 'over' each time you are handing the conversation to your telephone partner. It is as well to explain you are on a radiophone, too! When finished you touch the hash button and the whole thing clears down and resets.

Incoming calls are heard as a ringing tone from the base station and you hit the star (or something similar) to accept the call.

Good news

Sounds great? Yes, it is a useful facility and has been available to some business users for some years. In the States (but not here) phonpatches are legal on amateur radio, and since local calls are included in the phone rental over there lots of ham repeaters incorporate a phonpatch which all can use. Well, the good news is that phonpatches are now legal on 934MHz too, and I must admit I was quite surprised when I read that the Dept of Trade and Industry and British Telecom had agreed to their use.

There are, of course, some conditions to be observed, and a number of disadvantages. Most obvious is the lack of privacy for your phone conversations, and the fact that lengthy phone conversations will tend to jam up the airwaves (and perhaps make you unpopular with other band users). Some devious people may even tape record your calls and analyse your secret access code – then they can make merry with calls charged to your phone bill.

The equipment described in the following, however, is effectively cheat-proof. More importantly, the equipment is not cheap when you consider the complexity and limited demand for it, you will realise that this kind of apparatus cannot be knocked up in a back-street workshop for a couple of pounds. 934MHz rigs will also need additional circuitry to make them compatible.

If you want to switch between a beam and collinear antenna, a remote-controlled switch at the masthead will save the cost of two separate downleads. A small switch beside the rig will then do the business for you, with LED lights to show which antenna is connected. Just one wire is needed between the switch and the masthead unit, and this is supplied with the control unit. Check out prices at your local 934MHz dealer.
However, for business purposes the idea is a lot cheaper than cellular or other forms of radiophone, and if you need to make phone calls and don't intend to venture far from base, this would be the answer.

**IQD is the answer**

The manufacturer of this clever equipment is a company called IQD, well-known in the telephone interconnect business. They hail from Crewkerne in the Wessex region (that's what they call it in Bristol) and their address is given at the end of this article. The following is from their technical description.

The system is configured around the Cybernet Delta One transceiver. A collaborating company, CTVR Communications Ltd of Grantham, has developed scanning equipment which for transmission finds and locks onto a vacant channel. This sends a so-called sub-audible CTCSS tone which identifies the caller as legitimate (this would in fact be impossible to imitate without very special facilities). When not transmitting, the scanner tests the channels in turn until it identifies a transmission (from your base station) with the correct sub-audible signal, which it then locks onto.

The base station radio is connected to a PABX (private switchboard) or to a normal telephone line through IQD's 'Smartpatch'. This phonepatch device decodes DTMF (dual-tone multi-frequency, or touch-tone) signals, makes a connection to the exchange, and generates dialling pulses.

The Smartpatch controls the connection at all stages. Each mobile rig is fitted with an IQD Micropad microphone with touch-tone keypad, which encodes telephone number digits into DTMF tones.

**Smartpatch in use**

To initiate a call the mobile user first operates the PTT switch long enough for the transmitter to find a vacant channel and for the base station to lock onto it. He then enters an access code to obtain the dialling tone from the base station; after five seconds the dial tone is interrupted to enable the caller to dial the digits of the telephone number required.

Mobile and base station lock onto a channel so long as there is transmission in either direction; if the parties wish to change to another channel at any time they can do so by maintaining radio silence for five seconds.

**Smart, huh?**

If this appeals to you then you will need to know the price. The Smartpatch 5700 costs £38 and the Micropad 630R keypad makes cost £48. For the price of the modified Delta One you'll have to ask CTVR. IQD Ltd is at North Street, Crewkerne, Somerset TA18 7AR, telephone (0460) 74433. CTVR Communications Ltd can be found at Unit A3, Dysart Road Industrial Estate, Grantham, Lincs, telephone (0476) 64545.

That's it for this time: try and find time to drop me a line care of the Editor with details of any DX you worked recently. I am ready to start a league table for the best DX contacts, but you'll have to stake your claims!

Don't miss the only 934MHz column published monthly. Take out a post-free subscription using the form on page 61.
The prices quoted in my Catalogue are below normal trade prices — so only one tenth of manufacturers quantity trade. Just send large 26p stamped addressed envelope for free copy.  

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**BI-PACK**

February 1987

Please mention RADIO & ELECTRONICS WORLD when replying to any advertisement.
When at least five unusual signals, all of the best day for sporadic-E was the 9th occasion. October was no exception, and the best day for sporadic-E was the 9th when at least five unusual signals, all of the low power distinctive electronic test pattern opened from the south-east.

Tropospheric DX continued from the previous month and was present for most of the first half of October. Switzerland, Denmark, France, Belgium, the Netherlands, West Germany and East Germany were all represented during the period in Band III and at UHF.

**Sporadic-E reception**

Activity was noted on seven days during the month with many of the openings favouring central European countries. Iceland was an exception with two appearances – on programmes and a week later on the Philips PM5544 test pattern. Without a doubt the most productive day for signals was the 9th, when five exotic signals were resolved in Band I within the space of twenty-five minutes.

Kevin Jackson of Leeds was monitoring Italian programmes on channel IA shortly before 1250 GMT (there were, in fact, two stations on the same channel), and on checking E2 a similar programme appeared at 1252. This is actually a relay of RAI (Italy) situated at Mt San Salvatore in the Ticino region of southern Switzerland. Its ERP is a mere 42W and it beams RAI 1st network programmes over Lake Lugano to the Italian town of Campione d’Italia. It’s been a few years since it was last received in the UK.

The RAI reception on channel IA was replaced by transmissions from Radio Tele-Uno which were, fortunately, showing their distinctive electronic test pattern. We have at present no exact idea of its power but it’s assumed to be 1KW or less. A check on E4 revealed the Yugoslavian PM5544 sporting the identification ‘JRT BGRD’ at 1308 GMT. We mentioned the sighting of this card on E4 in a previous column and suggested it may have been a switching error, since there isn’t a high power outlet listed for the Beograd (Belgrade) network on this channel. As this is the second sighting it can only be assumed that a new transmitter has been introduced or the output of a low power relay has been increased.

Tuning to E3, Kevin discovered another unusual Yugoslavian signal, that of Pisvir at 25W ERP showing the ‘JRT SA-1’ FuBK card at 1315 GMT. The final surprise came when a PM5534 card was resolved as a co-channel signal to Yugoslavia bearing the identification ‘CON’ in the upper left corner. This originated from the low power Greek outlet at Akarnaiaka. Needless to say, the rest of the opening seemed rather mundane with only Spanish DX present.

**Tropospheric activity**

October 1st was a day to celebrate in Derby. For the first time in almost two decades of TV DXing the Sender Freies Berlin channel E39 outlet was noted transmitting the 3rd network FuBK test pattern. Reception was in good colour and an unusual feature of the pattern was the inclusion of the time and date. A snapshot of the test pattern is shown in this month’s Photofile.

On the same morning the East German ‘DDR F1’ colour test card was seen on E11 from the Schwerin transmitter, which is a little over 100km north-west of Berlin. Danish transmitters in Band III on E5, E6 and E7 were also present carrying the ‘DR DANMARK’ PM5534.

The 4th was another impressive day for tropospheric reception, especially for Kevin Jackson and Mark Dent of Leeds. The 500W Belgian relay of RTBF2, located at Brussels, was noted on channel E45, while lower down the band at channel E34 a 525-line system M transmission from the American Forces Network at SHAPE was resolved. The French ‘La Cinq’ transmissions, which may be doomed for closure in the near future, appeared on channels E32 and E49 during the same day.

Conditions over the Alps were again good with strong Swiss Band III and UHF signals until late afternoon. DX from Switzerland at UHF was also present on the 9th but at a lower level.

**DX-TV log for October**

This month we are featuring the log report sent in by Simon Hamer of New Radnor in Powys.

1/10/86: NOS 1 (Netherlands) E4 (Lopik); TDF (France) Canal Plus L5, 7 and 9, TDF Antenne 2 E22, 23, 39, 48, 55, 56, 62 and 65 – all tropo DX.

2/10/86: NOS 1 E4; RTBF1 (Belgium, French language network) E3 (Liege); TDF Canal Plus L5, 7 and 9 – all tropo DX. RAI (Italy) I A via sporadic-E.

4/10/86: NOS 1 E4, 5 (Roermond), 6 (Smilde) and 7 (Markelo); DR (Denmark) E10 (Vestjylland); West Germany WDR1 (Westdeutsches Fernsehen) E9 (Langelberg), E11 (Teutoburger Wald) and 30 (Fremersdorf); SPDZ (Zweites Deutsches Fernsehen) E4, 35 and 37; NDR3 E57 (Flensburg); HR3 E52 (Angelberg); DFF1 (East Germany) E5 (Inselsberg); TDF Canal Plus L5 (Lille). All signals via tropo DX.

7/10/86: SRG1 (Switzerland) E2 (Banti-Krug) with ‘+PTT SRG1’ FuBK test pattern; RUV (Iceland) E4 (Skalafell) on Frettir news programme – sporadic-E.

8/10/86: SRG1 E2 on test pattern; RAI IA programmes – both signals via SpE.

9/10/86: West Germany E2 (transmitter unknown) with ‘Videotext’ pages; RAI IA programmes; JRT (Yugoslavia) E3 and 4 on programme schedules for the Zagreb network – all sporadic-E.

10/10/86: SVE (Sweden) E4 on ‘TV1 SVERGE’ PM5534 test pattern; RUV E4 on ‘RUV ISLAND’ PM5544. All via SpE.

21/10/86: CST (Czechoslovakia) R1 and 2 with cartoons – SpE.

21/10/86: TVE2 (Spain) E2 (Santiago); ORF1 (Austria) E2a (Jauerling); EVP R1 and 2 – all signals via sporadic-E.

New DX-TV book

The long-awaited Babani publication entitled A TV-DXers Handbook is now available. Written by Roger Bunney, it is an extensively revised and enlarged edition of his previous pocket-book named Long Distance Television Reception (TV-DX) for the Enthusiast.

Virtually every aspect of the hobby is covered, including an expanded section on satellite TV. This book really is a must for all DX-TV enthusiasts or, indeed, anyone interested in this subject. It’s available, price £5.95, from bookshops or direct from Babani Publications, The Granpains, Shepherd’s Bush Road, London W6 7NF. Sufficient postage should be added if ordered direct.
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**PHOTO FILE • PHOTO FILE • PHOTO**

**Fig 1** West German FuBK pattern from Sender Freees Berlin on E39

**Fig 2** American Forces Radio and TV Service ident caption received on A25 in Berlin

**Fig 3** Exotic PM5544 from Singapore Broadcasting Corporation on Band III

**Fig 4** Hong Kong test card as used by ATV-E, the English channel

**Fig 5** Hong Kong test card, as used by HK-TVBI, the Chinese channel

**Fig 6** American test pattern spotted by Tony Harris in Florida

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FEBRUARY 1987 please mention RADIO & ELECTRONICS WORLD when replying to any advertisement
Kevin Jackson of Leeds has received confirmation that he did indeed see the Norwegian PM5534 test pattern carrying the transmitter location 'NORDHUE' on channel E4 during the summer. We speculated (wrongly, of course!) that it might have been the 9W relay at Tregthen relaying the Nordhue transmissions which originate on channel E5. NRK suggest that the most likely outlet would be Brumunddal at 8W or Vering at 3W.

They also point out that the recently introduced UHF transmitter at Gulen, radiating 1000kW, is in fact undergoing field tests by the Norwegian PTT. This is why programmes aren't aired over this channel. Testing is on an intermittent basis, so the possibility of the signal appearing on the screen. One suggestion is that it was a relay of Wesel on channel E5. This would explain why all the other ZDF transmitters had closed down the ones on channels E42 and E35 were still active. Mark thinks they may be relayed. Two out of ten for that joke, Mark!

Canal Plus in Band I

With the rapid expansion of French Canal Plus transmissions into Band I now under way, the possibility of DX reception should be even greater during the upcoming sporadic-E season. The Carcassonne transmitter, situated close to the Spanish frontier, and the one at Ajaccio, on the island of Corsica, have already been widely received during the 1986 season.

To recap, the French Band I channel allocations are as follows: L2 25.25MHz vision, 49.25MHz sound; L3 60.50MHz vision, 54.00MHz sound; L4 63.75MHz vision, 57.25MHz sound. The following Band I transmitters are known to be operating (see also Service Information). Transmitter ERP and polarisation are included where known: chl2 Bastia (Corsica); L3 Besançon (Franche-Comte); L3 Carcassonne (Languedoc-Rous); L3 Lé Plessis Robinson (Paris-Nord) 16W ERP horizontal polarisation; L4 Etampes (Paris-Nord) 15W ERP horizon; L4 Ajaccio (Corsica); L4 Monte Brian (Rhône-Alpes) 70W ERP horizon; L4 Clermont Ferrand-Ville (Rhône-Alps) 75W ERP horizon.

Our thanks to Kevin Jackson of Leeds for supplying the above information.

Service Information

Jordan: All Jordanian transmissions may eventually be moved to UHF according to recent EBU information. Latest listings show 45 channels allocated throughout UHF bands IV and V with provision for a third network to supplement the existing two. It is expected that the new transmitters will replace the greater part of the present VHF allocations in the very near future. This is bad news for DXers because the 100kW E3 outlet at Suwailih will be taken out of service.

USSR: The trend for regional or transmitter identification being included on the UEIT test pattern continues. The transmitter location 'KLAIPEDA' is now used on channels R8 and R29 which can be received in the UK during intense tropospheric openings.

Hungary: Some of the old monoscopic test cards are surviving thanks to the spread of cable television in Hungary. There are approximately 22 regional cable systems in operation. One of them at Pecs uses the good old-fashioned Marconi Resolution Chart No 1 with the service name 'VAROSI TELEVISION' in lieu of the upper grey scale and 'PECs' in lieu of the lower one. It is interesting to note that there are no transmissions from the state-owned MTV1 and MTV2 services.

Luxembourg: Two services exist in Luxembourg. RTL transmits in SECAM colour using the French System L standard on channel E21 and in PAL colour using CCIR system B/G on E27. Both transmitters are located at Dudelange with ERPs of 1000kW. RTL Plus transmits in PAL colour on channel E7 from Dudelange with an ERP of 140kW and at UHF on channel E24 from Marnach/Clerveaux with 20kW ERP.

France: Privatisation seems to be the 'in' thing at the moment, especially in France where the present state-owned TDF service will go private as from January 1st 1987. The TV5 (La Cinquième) and TV6 services will finish, although these will probably be replaced by a new commercial network. Antennas 2, FR3 and Canal Plus are expected to remain unchanged.

Several new Canal Plus transmitters have recently been brought into service. These are La Rochelle-sur-Yon 12W ERP L4, Quimperle 1W ERP L4, Mulhouse 300kW ERP L5, Metz-Luttagne 33kW ERP L5 (vertically polarised), Niort 400kW ERP (vertically polarised), Bayonne 1.5W ERP L7, Strasbourg 20kW ERP L10 (vertically polarised) and Forbach 2kW ERP on channel E28.

Our thanks to Gosta van der Linden (Rotterdam) and the Benelux DX Club (Netherlands) for supplying this month's service information.

The best DX-TV reports can be found in Radio & Electronics World every month. Don't miss them!
Circumstance would have it that since last month’s column some of the information provided has already become out of date. The medium wave band can hardly be described as standing still!

This month I have news from the Voice of America in Europe, the return of the offshore station Laser, plus some more details on special event radio in the UK. But firstly, following on from comments made by a couple of readers, I intend to take a look at what you’ll hear when you tune to those North American DX stations.

**Formats**

If there is one thing that characterises North American radio it is the dominance of very strict station formats. A format describes the station’s programming style and, using the United Kingdom as an example, BBC Radio 3 operates a classical format whereas Radio 4 is a news and talk format station.

On the other side of the Atlantic there are over a dozen widely used formats, and it is extremely rare to hear a station that tries to mix more than one. Stations such as the ILR stations in the UK, which mix news, talk, and every musical style under the sun, are virtually unheard of.

It is not very difficult to see the reason for this segmentation; it all comes down to the sheer number of stations competing for radio audiences, each station trying to construct an individual identity for itself so that it will be recognised by the listener tuning down the radio dial. In contrast, in the UK, where very few listeners can hear more than two ILR stations or two BBC local stations, it doesn’t really matter if they all sound the same, lacking imagination or individual identity.

For example, compare New York with its 17 MW stations and 20 FM stations against London with a total of just 7 stations (pirates excluded). The difference is further enhanced by the fact that, unlike in Britain, FM radio in N America does not merely carry relays of MW stations.

A brief look at popular formats follows, together with some examples of stations on which the DXer is likely to hear them.

*Album Oriented Rock:* a music format that stresses the most popular cuts from current and past hit rock albums. Little news and talk. Very few on MW these days.

*Progressive Rock:* a variant of AOR playing ‘music for music’s sake’ rather than for large audiences and commercial gain. Most stations are small low power college stations.

*Contemporary Hit Radio:* formerly Top 40, eg CJXY St John’s on 939kHz.

*Rock Oldies:* music, generally former hits in the era from the ‘60s, ‘70s and ‘80s, eg WWKB Buffalo on 1520kHz.

*Adult Contemporary:* the catch-all for adult audiences. Adult contemporary stations vary more widely in their music selection than any other format and often play mixes of country, pop and rock. Music is usually selected to avoid any ‘rough edges’, eg WNBC New York on 660kHz.

*Adult Standards:* tries to appeal to all adults but succeeds best with older audiences. Emphasis is on non rock music such as swing, big band and ballads, eg WMRE Boston on 1510kHz or WNEW New York 1130kHz.

*Jazz:* the only link between Jazz stations is their music, otherwise formats and styles vary radically. Most stations on FM.

*Easy Listening:* relaxing, unobtrusive music also known as ‘beautiful music’ or ‘good music’, but not to be confused with ‘muzak’ or other mood-control background music.

*Classical:* basically a fine arts format similar to our BBC R3, eg WQXR New York 1560kHz.

*Urban Contemporary:* includes sub-formats such as soul, disco, R&B and black music.

*Country:* format based on other adult formats but playing country artists. Sometimes split into ‘traditional country’ and ‘modern country’, eg WHN New York on 1050kHz.

*Religious/Gospel:* an adult format based on traditional gospel, contemporary Christian programming or pre-recorded preaching programmes, eg Caribbean Beacon from Anguilla on 1610kHz.

*News/Talk:* an information-based format including specialized programmes and phone-ins, no music, eg WINX on 1010 and WCBS on 880kHz, both in New York, and WCAU Philadelphia on 1210kHz.

*Ethnic:* a ‘non-format’ based on multi-lingual brokered programmes for small, non-English audiences, eg WNYM/W-POWER on 1330 in New York, which carries Hebrew and Eastern European languages.

*Spanish/French:* an important subset of Ethnic. Spanish stations are a major force in US radio, eg WKDM 1380 in New York or WIND on 560kHz from Chicago. French radio plays an important part in Canadian broadcasting, eg CKLQ Quebec on 1570kHz, which is really an Adult Contemporary station in French.

In addition there are some rather rare formats (which may turn out to be passing fads); for example there is All Weather Radio, Comedy Radio, All Horse Radio (no kidding!) and Children’s Radio. Finally, as regards sport programmes this tends not to be a format in itself since many stations, of all formats, break to carry sports events.

**News headlines**

**VOA Europe:** Last month we reported the forthcoming closure of this station due to cutbacks in the budget allocated by the US Information Agency. Now, after some debate in Washington, funding for 1987 has been agreed and VOA Europe is to continue its programmes targeted specifically at a European audience. Although the existing English programmes are largely unchanged, budgetary restrictions have forced plans for a French and German service to be shelved for the time being.

**VOA Europe** can be heard on 1197kHz at 0000-0200, 0700-1100 and 1300-1700GMT (one hour earlier in the summer). Programmes are also carried for up to twenty-four hours per day by many FM stations (Paris, Geneva, Brussels) and cable networks.
Lasers is back on the air calling itself Laser Hot Hits (formerly Laser 558), with a programme format similar to before. At 0300 on 16th November the mv Communicator set sail from Harwich, where she has been moored for the past year, leaving with full supplies on board for a 'destination of Gibraltar'. However, the Communicator soon took up a position close to her former moorings off the Essex coast.

The ship is now equipped with three new studios, a news room and two working 20kW transmitters, although when Laser started test transmissions on 1st December they seemed to be distinctly low powered, judging by reception here in Ipswich. Look for Laser (if you haven't heard them yet) on 576kH.

**Special event radio:** Further to the item in last month's column I have received information from the Home Office indicating that the closing date for applications for special event licences will be 31st January 1987. The same licensing rules as applied last year will govern the 1987 applications. The licences, which cost £450, will permit very local stations to operate for up to a fortnight at outdoor events such as festivals, county shows and sporting events.

**BBC:** Although BBC World Service programmes are aimed firmly at an overseas audience, they have a dedicated audience of around 250,000 people mainly in southern England where reception of the Orfordness 648kH transmitter is possible. BBC Radio 3 has now announced that it will be relaying World Service news twice a day in addition to normal R3 news items.

This year the BBC will spend £100M on its external services, which includes a sum of £11M for the BBC monitoring services – namely those professional DXers located at Caversham near Reading.

Finally, it is interesting to compare the amount of money being spent on new transmitters by the BBC with, for example, VOA. £100M of external service money has been earmarked for new relay stations in Hong Kong and the Seychelles, whilst VOA is spending $2 billion on over 100 new transmitters worldwide – a big difference.

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FEBRUARY 1987
On these pages we present details of interesting contacts from clubs and individuals. We would be happy to receive any similar items from readers.

Magazine exchange

There is lots of activity at the South Bristol Amateur Radio Club in the coming weeks, beginning with a photography activity evening on 28th January.

Jim G4VBU presents a lecture called 'Can I repair it?' on 4th February, followed on the 11th by a 70cm activity evening. February 18th is the time to drag out those dusty old boxes of radio magazines (you just can't throw them out, even though you'll never read them again) and take them to the club for a 'swap shop'.

An HF activity evening on the 25th winds up the club's event schedule for February.

The South Bristol ARC meets every Wednesday at the Whitchurch Folk House, East Dundry Road, Whitchurch, Bristol BS14 0LN. For more information contact Len Baker G4RZy on Whitchurch 834282.

A classic

The Rolls Royce Amateur Radio Club (G3RR) is holding a social evening with Harry Garlick on 4th February at 8.00pm.

A month later, on 4th March, a construction contest is scheduled, so get cracking on your next piece of wonder gear.

Additionally, morse classes run every Monday at 7.30pm. The venue is the same for all events: The Rolls Royce Social Club, Barnoldsweck, Colne, Lancs. Further details are available from L Logan G4ILG on (0262) 812288.

New repeater

The Stoke-on-Trent microwave repeater/beacon, GB3SE (RM3), became operational on 21st November 1986. It can be found on 1297.075MHz, and its receive input frequency is 1291.075MHz.

When not in use as a repeater the transmitter stays on air as a beacon. Identification is by frequency shift keying at a rate of one callsign every 35 seconds, each eighth callsign being transmitted using MCW.

Repeater use is obtained by the usual method of transmitting a 1750Hz toneburst. To acknowledge the fact that GB3SE has switched from beacon to repeater, a letter 'T' in morse code is transmitted. Alternatively a letter 'H' or 'L' is transmitted if the carrier frequency on the input is more than ±5kHz from the nominal input frequency. This is followed by the repeater callsign, GB3SE, in MCW. For an indication of when the repeater mode has finished (ie the through audio is inhibited), a tone of 1 second duration and 400Hz audio frequency is transmitted. The carrier will, of course, continue to radiate and the next identification callsign will be sent using FSK.

Apart from the beacon facility a number of other unusual features are incorporated. Frequency stability at 1.3GHz can be a problem, so with this in mind it was necessary to develop and build an electronic oven to house the crystal, making it possible to maintain the crystal temperature to better than ±0.2°C regardless of the exterior air temperature.

The transmit and receive frequencies are separated by 6MHz, but are frequency locked together. Thus only one crystal is used, this being shared between both Tx and Rx. Therefore, the 6MHz difference is always exact. Should the transmitter move in frequency, the receiver would move by the same amount and in the same direction, making split frequency operating much easier.

The repeater uses a phase locked loop type of audio discriminator, which has the useful feature of following off-channel signals and reproducing the recovered audio with minimum distortion (restricted only by the sides of the receiver bandpass IF filter).

At the moment GB3SE is running 6 watts ERP. The aerials in use are two Alford slots (horizontal polarisation omnidirectional). During the first 24 hours of use a total of 12 different callsigns were monitored using the repeater facility.

More information can be obtained from G0DZJ QTHR.

Packet relay stations

The DTI has given the go-ahead for the establishment of ten experimental packet relay stations.

One of the characteristics of packet transmission is that any radio station can be used as a repeater, the packets being 'labelled' with the address of the message's ultimate destination. This allows communication beyond the immediate range of a particular radio set-up, and is used in other countries. However, this particular aspect of packet communication is not allowed under the terms of the UK amateur transmitting licence, hence the need for permission from the DTI to establish experimental stations.

The project is to be administered by the RSGB, whom interested parties should contact for more details.

Mid Devon Rally

The Tiverton Short Wave Radio Club plans to hold its 1987 Mid Devon Rally on 22nd March, at the Pannier Market in Tiverton.

The doors open at 10.00am and talk-in will be on S22. Parking facilities are described as 'excellent'.

All enquiries concerning this event should go to G4TSW, PO Box 3, Tiverton, Devon EX16 6RS.

A bonny idea

The Aberdeen Amateur Radio Society kicks off its February schedule with a junk sale on the 6th, followed on the 13th by a debate:'Amateur radio would improve if all amateur repeaters were closed down tomorrow'.

Speakers for and against the motion are invited.

A useful lecture, 'DXing on UHF/VHF with a less than average station', will be presented on February 20th by Graham Sanger GM4OBD. Last but not least, Alan Dun can take the club's regular Beginners' Night with a talk, 'A newcomer's guide to 4m'.

The society is responsible for the WASR (Worked All Scottish Regions) award, which has been running since 1975. It is available to all amateurs showing proof of 2-way contact with one station in each Scottish region (Borders, Central, Dumfries and Galloway, Fife, Grampian, Highlands or Islands, Lothian, Strathclyde, Tayside). Contact with the Aberdeen Amateur Radio Society, GM3BSO, may be used as a substitute for any one region.

There is also an award for SWLS.

The award costs £1 or the equivalent in IRCs.

For more details of the award contact Don GM4GXD on (04676) 251.
COMPETITION REMINDER

YOUR LAST CHANCE TO WIN A CROTECH OSCILLOSCOPE!

Don't despair if you missed Brian Kendal GSGDU's history quiz last month - it's another opportunity.

The marks for each question are given in brackets, the highest possible score being 220. Entries are invited for estimates of scores of 100 or more.

In the event of more than one winner, we shall arrange a special, even more difficult tie-break.

The closing date is 31st January 2018.

1. What had Heinrich Hertz to do with pitch? (5)
2. What was the significance of Lavernock Point and Steephope Island? (3)
3. Why did the coherer fail? (2)
4. Who was G Kemp’s employer? (3)
5. What was and who invented the ‘Telemobiloscope’? (5,5)
6. Which famous doctor had cause to regret the invention of wireless? (3)
7. What ever happened to the Wireless Society of London? (2)
8. What was the ‘Grid Audion’ and who invented it? (3,3)
9. Who was the first man to transmit a wireless signal from an aeroplane in flight to ground and where? (5,5)
10. What wavelength did Marconi use for his Salisbury Plain demonstration? (4)
11. What is a Nickpock disc? (2)
12. What was a ‘Round’ valve? (3)
13. For what was Paul Godley famous? (3)
14. What was and who now holds the callsign of Hiram P Maxim? (3,3)
15. Who lived at ‘Combe Dingle’ and how did he affect British broadcasting history? (2,2)
16. A man whose name is well known in modern semiconductor terminology developed a four-electrode valve during World War 1; who was he? (5)
17. Who or what was ‘Armstrong’s nightmare child’? (3)
18. Alan Blumlein, one of the greatest geniuses in radio history, patented a device in about 1930 which did not become generally available until nearly ten years after his death, but is now used in almost every home. What was it? (5)
19. Under what circumstances did Blumlein die? (5)
20. Who is normally credited with the invention of the superheterodyne receiver? (3)
21. What was a ‘Catkin’ valve? (5)
22. The Marconi-Osram KT series of valves were well known - what did ‘KT’ stand for? (3)
23. Who manufactured the ‘Melody Maker’ receiver? (2)
24. Which is the odd one out: ML4, PM2, UX4, PX4? (3)
25. In what context was Mazda not international? (3)
26. Why would the Baird high definition TV system, which competed with that of EMI, have had problems giving time-checks? (5)
27. Where did the experiment take place which demonstrated to the British Government that radar was feasible? (3)
28. Before World War 2, what condition was specifically associated with amateur transmitting licences in the G2 + 3 letters series? (3)
29. Who developed what radio device at Birmingham University in 1940? (3,3)
30. When and why did World War 2 British bomber crews play with cat and mouse? (4,4)
31. Who or what were VIs? (3)
32. Who or what was Colossus? (3)
33. Why did British World War 2 bomber crews find that if Monica failed they might have to get assistance from Walter and if so then Rebecca was no help? (10)
34. We’ve all heard of a Drake TR4 – but what was a TR9? (4)
35. Why should Crowborough have been proud of its Aspidistra? (5)
36. Which amateur band was the first to be withdrawn after World War 2? (3)
37. Which is the odd man out and why: Dynatron; Magnetron; Phantastron; Sanatron? (3)
38. What was Taylor Supermodulation? (3)
39. In the late 1940s, many amateurs built the ‘Inexpensive Television’ from wartime equipment. Which equipment was used and what was its original purpose? (4,4)
40. The Clapp oscillator was developed independently by a British engineer. What was his name and company? (4,4)
41. What were the operational limitations placed on a newly licenced radio amateur in the United Kingdom in 1950? (2,2)
42. What was the 80 metre ‘Pond’? (3)
43. What is, or was, a Wobblulator? (3)
44. What are ½th second echoes? (2)
45. Using ‘Q’ code, encode: ‘The time is’; ‘What is the tone of my transmissions?’ and decode: QBA?; QTE. (2,2,2)
46. Name two heads of state who hold radio amateur transmitting licences. (2,2)
47. What is a ‘red spot’? (3)
48. The term picofarad has been in use for many years, but what was it called before? (2)
49. Loran disappeared from Top Band several years ago. What frequency does the latest version use? (5)
50. Experiments by Canadian scientists using a amateur satellite led to a major United States/USSR co-operative space venture. For what purpose is this and what is the name of the system? (4,4)
CONTINUITY TESTER
Jeff Howell and Brian Kendal take a break from their usual computer articles with this versatile piece of equipment

THE TRIO TS440
Ken Michaelson plays with another high tech transceiver

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Having completed our survey of some of the Indonesian stations currently on the air within the limits 4719 to 5500.5 in the two previous issues, we will now move on to those operating between 3204 and 4002.7 inclusive.

The Indonesian radio scene is divided into five nusantaras (networks), each comprising a handful of RRI and several local transmitters covering various areas of the country. All stations are required to relay news bulletins in the Programa Nasional from RRI Jakarta.

**Nusantara 1:** Medan, Banda Aceh, Bengkulu, Bukittinggi, Jambi, Padang, Pangkalpinang, Palangkaaru, Pekanbaru, Sibolga, Tanjung Karang and Tanjung Pianing.

**Nusantara 2:** Yogyakarta, Bandung, Bogor, Denpassar, Jember, Kupang, Madiun, Semerang, Singaraja, Surabaya, Surakarta and Sumbep.

**Nusantara 3:** Banjarmasin, Palangkaraya, Polianak and Samarinda.

**Nusantara 4:** Ujung Pandang, Dili, Jambi, Kendari, Mentado and Pulu.

**Nusantara 5:** Jayapura, Ambon, Biak, Fak-Fak, Manokwari, Merauke, Nabire, Soru, Sorong and Ternate.

The first named in each nusantara is the main RRI transmitter.

**90 metre band**

DXing Indonesia on the 90 metre Tropical Band (3200 to 3400) is a much more difficult proposition than operating on the 60 metre band. Commercial utility interference abounds, the DXer having to constantly pit his or her operating skill against the machinations of gremlins who seemingly delight in ensuring that unintelligible noises mar many of the wanted signals. A highly selective communications receiver together with an exterior aerial array are a must if any degree of success is to be achieved on this band.

**Making a start**

Set the receiver on or around 3204 at 1600 when it may be possible to hear the signals from RRI (Radio Republik Indonesia) Bandung in Java (Java). With a power of 10kW, it is scheduled from 2230 to 0300 and from 0900 through to 1700. RRI Bandung is not often heard by listeners here in the UK, but that is all the more reason to regularly visit this channel during the season for Indonesian reception here in Western Europe, which is from September through to March.

RRI Menado in Sulawesi (Celebes) is on 3215 and is regularly logged world-wide. It is on the air with a power of 10kW from 2100 to 0150 and from 1330 to 1520 but has been reported operating irregularly around the clock.

On 3222.7, on which frequency RRI Mataram operates from Lombok-Sumbawa in the Lesser Sundas, the schedule is from 2000 to 0400 and from 0930 to 1520 with a power of 5kW. RRI Mataram appears to alternate this channel with that of 2901. Oh well, there is nothing quite like a conundrum enclosed within a riddle!

Frequently heard here are the transmissions emanating from RRI Bukittinggi in Sumatera (Sumatra). Nominally on 3232, on which channel it is timed from 2300 to 0300 and from 0930 to 1655, it has a power of 10kW, but it has been reported on 3231.8 on several occasions.

In Java, RRI Banjarmasin radiates on 3249.6 (nominal 3290): it is listed on the air from 2030 to 0215 and from 0800 to 1520 (Sunday from 2300 to 0715 and from 0900 to 1520), but has been heard programing from 1900 to 2040. With a power of 10kW, this one is certainly frequently heard here in the UK.

**Seldom logged**

RRI Gorontalo, Celebes on 3265 radiates from 2100 to 0030 (Sunday from 2300 to 0500) and from 0830 to 1330 with a power of 10kW. The best chance of hearing this one, if such a chance exists, would be around 2200. Needless to say it is seldom heard here in the UK or Western Europe. RRI Jakarta, Java on 3274 carries Programa Khusus (municipal, i.e. locally originated programmes) from 2158 to 0100 (Sunday until 0200) and from 0758 to 1500. Programa Nacional broadcasts are timed from 1500 to 1700. The power is 1kW, hence a rating of rarely heard in the logging stakes.

In Timur (Timor), RRI Dili works to the schedule 2055 to 0030, from 0455 to 0730 and from 0855 to a variable sign-off around 1545. The power is 10kW and the frequency 3306. A chance of logging this one will put you at the receiver controls some time between 2200 onward or from 1530 to sign-off.

RRI Jember has a power of 1kW on 3320 and works to the schedule 1900 to 0100, 0500 to 0700 and from 1900 to 1600. It has been heard transmitting on 3320.8.

In Kalimantan (Borneo), RRI Palangkaraya at 10kW works to the schedule 2100 to 0100 and from 0900 to 1600 on 3325. It is only seldom reported by UK DXers.

In Maluku (Moluccas), RRI Ternate on 3345 nominal, 3344.8 actual, is scheduled from 2000 to 0300, 0900 to 0630 and 0800 to 1500 with a power of 10kW. Again, a 2200 onward vigil may be necessary for this one, but beware! Co-channel with RRI Ternate – well, almost – is RRI Pontianak on 3345. With a power of 10kW, it is on the air from 2200 to 0100 (Sunday from 0100 to 0400), from 0700 to 0730 (Sunday from 0730 to 0900) and from 0900 to 1520.

RRI Jambi, Sumatra, listed on 3356 is on an actual 3355.3 with a power of 7.5kW from 0500 to 0900 and from 1700 to 2000.

RRI Padang on 3366 (ex 3355) is on the air from 1730 to 2230 and from 0300 to 0600 with a power of 10kW.

**Better chances**

RRI Kupang, Timor with a power of 10kW is listed on 3385 from 2130 to 0015 (Sunday until 0600) and from 0900 to 1520 but is in fact on 3384.9. Kupang on this latter frequency provides one of the best chances (but see below) of logging Indonesia on the 90 metre band, and is regularly reported by DXers worldwide.

More frequently logged than Kupang by Western European DXers are the transmissions of RRI Tanjungkarang – in Sumatra. Nominally on 3396, actual frequency 3394.9, from 2200 to 0200 (Sunday until 0400) and from 0800 to 1700 (Sunday until 2200), the power is 10kW.

**AROUND THE DIAL**

Sitting comfortably? Then note the times mentioned below and tune around to the frequencies listed, whereupon some of the stations mentioned may be logged.

**AFRICA**

**Algeria**

RTA (Radiodiffusion-Television Algerienne), Algeria on 15215 at 2014, OM with a newcast of both home and world events during the English programme for North Africa and the Middle East scheduled from 2000 to 2030. On this channel Algiers radi-
.timed from 0400 to 1800. From scheduled from 0300 to 0600. Songs and music in the local 2300 in French, Zulu and religious talk in Spanish. galpa on Honduras power is 500 kW. relay of the Home Service Broadcasting, Tripoli on 15415 at 1324, OM (old man – female) with a talk in Arabic in a relay of the Home Service timed from 1100 to 1500 and directed to Europe. The power is 100kW.

Cairo on 11665 at 1337, songs and music in the local style during the Arabic transmission for the Middle East timed from 0400 to 1800. From 1900 to 0030 there are programmes in Arabic for South Africa. The power is 100kW.

Cairo on 11905 at 0530, YL (young lady = female) with the station identification and the news in the Arabic programme for the Middle East, scheduled from 0330 to 0600. The power is 100kW.

LJBB (Libyan Jamahiriya Broadcasting), Tripoli on 15415 at 1324, OM (old man – female) with a talk in Arabic in a relay of the Home Service timed from 1100 to 1500 and directed to Europe. The power is 100kW.

La VoZ Evangelica, Tegucigalpa on 4820 at 0311, OM with a religious talk in Spanish. This 5kW transmitter is on the air in Spanish from 1600 to 0500 but the closing time can vary up to 0700. The programmes are mostly religious in content.

AFRTS (Armed Forces Radio and Television Service), Greenville, North Carolina on 15430 at 1321, YL with the station identification then OM with a news review in a transmission beamed to the North Atlantic area and scheduled from 1100 to 2200. All broadcasts by AFRTS are in English and are intended for US military personnel and their families, keeping them informed on both US and world news.

Radio Relogio Federal, Rio de Janeiro on 4905 at 0457. OM with some announcements in Portuguese, two pipetime signals, sambas. Better known as Radio Relogio, this 5kW transmitter is scheduled on the air from 0800 to 0400, the minute time signals being superimposed throughout this period. Presumably the extended transmission period reported here was occasioned by a public holiday or some other special event. See also below, logged the same morning.

Radio Marajoara, Belem on 4955 at 0509, OM with a talk in Portuguese then a programme of songs and local-style music. This one radiates from 0800 to 0300 variable sign-off with a power of 10kW.

Radio Atlantida, Iquitos on 4790 at 0216, OM with a political talk in Spanish with mentions of Cuban and campesinos (rural dwellers, ie peasants) and still talking at a 0252 return. Logged on another occasion at 0425. OM with some promos (promotions) then the announcement “Musica Romantica” followed by music in keeping with the programme title. Radio Atlantida is often heard here in the UK and is by far the easiest of the Peruvian stations to log on the 60 metre band. The schedule is from 0900 to 0400 (Sunday from 1100 to 0430) and the power is 5kW.

Xinjiang PBS, Urumqui on 4330 at 1504, OM with announcements then some music and songs in the local style during a Home Service programme in Kazakh. The schedule is from 0000 to 0230, from 0530 to 0700 and from 1200 to 1700.

Yunnan PBS, Kunming on 4760 at 1540, a programme of orchestral music in the European style, heard more frequently from Chinese stations in the last few years. The Home Service 1 in Chinese is carried by Yunnan PBS on this frequency from 2150 to 0100 (Sunday until 0800), from 0250 to 0600 and from 0720 to 1800 with a power of 50kW.

Radio Padang on 4003 at 1530, OM with announcements in Indonesian, chimes then OM with a newscast relayed from Jakarta. At 10kW, RRI Padang is on the air from 1000 to 1700 and from 2300 to 0130.

RRI Bandao Aceh on a measured 4954.7, OM with what I can only describe as chants accompanied by pipe music then YL with a song in Indonesian, complete with local-style music and its occasional sound of gongs. The schedule is from 2200 to 0200 (Sunday 0200 to 0500), from 0500 to 0800 and from 1000 to close at 1600 but sometimes up to 1805. The power is 10kW.

Radio Pyongyang on 9960 at 1400, OM with a talk in the Korean programme for Africa timed from 1400 to 1450. The English transmission for Africa is on this channel from 1500 to 1550.

Radio Singapore on 5010 at 1530, OM with a pop song in the English language Home Service, radiated on this channel from 2200 to 0100 and from 1000 to 1630 with a power of 10kW. Also logged in parallel on 5052 (50kW).

Radio Australia, Melbourne on 11945 at 0450, OM with a programme of pop records in the English programme directed to South Africa from 0300 to 0500.

Kuching, Sarawak, Malaysia on 4835 at 1550, YL with a song, presumably, Bahasia Malaysia (Malay) together with music in the local style. The Home Service in Malay and Melanau is carried on this frequency from 2200 to 0130 and from 0800 to 1600. The power is 10kW. The sign-off ceremony was wiped out by the sudden appearance of co-channel utility interference.
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SILVER PLATED COPPER WIRE

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Test Equipment

Check your 56B power output and linearity with our two-tone test oscillator type 730. Kit £28.50 Built £39.50

Built in watch-dog timer.

Send a large (44) SAE for full Cat.

Please add VAT at the current rate.

Access Barclaycard (VISA) welcome.

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SPECIALIST IN 934 MHz

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Brentwood Essex CM14 4SE · England (0277) 219876

PLEASE RESERVE ......................... centimetres by .......... columns

FOR A PERIOD OF ................. 1 issue .......... □ 3 issues .......... □ 6 issues .......... □ 12 issues .......... □

COPY enclosed .......... □ to follow .......... □

PAYMENT ENCLOSED: ........... £ □

CHARGE TO MY ACCOUNT ........... □

COMPANY ........... □

ADDRESS ........... □

SIGNATURE ........... □

TELEPHONE ........... □

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SPECIAL POSITIONS

DEADLINES

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CONDITIONS & INFORMATION

SERIES RATES

Series rates also apply when larger or additional space is required to that initially booked is taken.
All ad space to be returned to us within 10 days of publication date.
All series rates are for consecutive insertions only and applied to same section or month, unless otherwise stated.

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For all advertising copy, submitted on a standard format sheet, please ensure that all text and images are clearly visible.

TECHNICAL

All advertising copy is subject to the technical requirements outlined in the Advertising Guidelines.

PAYMENT

Payments are due within 30 days of publication date.

ACCOUNTS

All accounts are due within 30 days of publication date.

CANCELLATION

Cancellation of advertising space must be made in writing at least 10 days prior to the date of publication.

ADDITIONAL INFORMATION

For further information, please contact us at the address below.

RADIO & ELECTRONICS WORLD

The communications and electronics magazine

Address: Sovereign House, Brentwood, Essex CM14 4SE

Tel: 0277-20970

Printed by: E. R. Webster

Dress: by international Money Order Commission to approved advertising agencies is 10%.

CONDITIONS

10% discount if advertising in both Radio & Electronics World and Amateur Radio. A voucher copy will be sent to Display and Colour advertisers. All acceptance subject to the above conditions.

February 1987

Download the complete PDF for full content.
TELECOMMUNICATIONS BUMPER CATALOGUES

CB ............. £1
AMATEUR .... £1
934 MHz .... £1

Each catalogue is packed full of info and includes a £2 voucher.

2 MTR HANDHELD

CT1600 A superbly sensitive new handheld covering 144MHz - 440MHz:
- Repeater shift
- Highpower 1500W Watt
- Thumbwheel selection
Each unit supplied w/c re-chargeable battery pack and wall charger (large unit)

WE MOBILE AMP

B10 144/220MHz 15W WpAmp, CB £64.88
B42 144/432MHz 40 Watt £69.77
LAB1800 144/432MHz 45 Watt £99.77
Full range of 144MHz mobile amplifiers in stock see full hand catalogue

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All amplifiers except broadband models are tuned for 29.6MHz centre freq. Should you require a lower freq. i.e. 28.5MHz please state when ordering. Export models available for 26-30MHz.

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C.T.E.: MOD 767
N WATTS FM
INPUT : 0.5-10 Watt
SWITCHABLE: Class AB, Class C
SUPPLY : 138 Volt
REMOTE CONTROL FACILITY

C.T.E.: MOD 718 50W FM AM/SSB/CW
C.T.E.: MOD 757 150W FM Broadband
C.E.: MOD 757 150W FM Broadband
ZETAGI B35 25W FM 26-30MHz £29.95
ZETAGI B36 70W FM 28-30MHz £68.75
ZETAGI B300 150W FM 26-30MHz £108.00
ZETAGI TC5 30W FM 26-30MHz £99.77

MAIN OPERATED AMPLIFIERS

C.T.E.: OCR Split Stack 150W FM (Broadband)
ZETAGI B135 90W FM (Stack Broadband)

NEVADA AMATEUR PRODUCTS

HIGH QUALITY BRITISH MADE
25MHz FM PRODUCTS

NEVADA TC52 3/4 WAVE
This top class half wave uses high grade aluminium and a low loss coil complete with small shock absorber. It is popular amongst the 29.6MHz ham community.

NEVADA TC58 5/8 WAVE
Using high grade aluminium and a low loss coil complete with small shock absorber. It is popular amongst the 29.6MHz ham community.

SALIGUT 3/4 WAVE
Using a unique base hoop this antenna offers exceptional ground wave coverage on 10 MHz.

TEST EQUIPMENT

ZETAGI DL150 RF DUMMY LOAD AND POWER METER
A very accurate instrument and ideal for the service dept. or discerning enthusiast.
POWER : 150 Watts Max in 3 ranges 0.3, 0.5, 1 Watt
FREQUENCY : 144MHz

ZETAGI 500 SWR AND POWER METER
For the enthusiast who wants the very best. A rear meter unit with push button control for
either 250W or 50 Watts
FREQUENCY : 29.6MHz POWER : Up to 25 Watts

FD 1350 1.3GHz FREQUENCY COUNTER
FREQUENCY : 1350MHz
SENSITIVITY : 1mV at 10dB DISPLAY : 8 Digit SUPPLY : 12 Volt DC

TELECOMS

HIGH QUALITY BRITISH MADE
25MHz FM PRODUCTS

NEVADA TC52 DX
RF POWER AMP WITH HARMONIC FILTER
INPUT : 1 Watt OUTPUT : 25 -50 Watts SUPPLY : 138 Volt
FREQUENCY : 29.6MHz
Can be cabled on 28.5 or 29.6 MHz (race width). A top spec quality amp which now includes harmonic free to 900MHz harmonic C.P.

NEVADA TC27 RX RECEIVER PRE-AMP FOR 26-30MHz
A superior low noise pre-amplifier for 29MHz FM reception
Variable gain +6dB to -10dB suitable
with transceivers up to 25 Watts output

TELECOMMS

WORLDWIDE DISTRIBUTORS OF AMATEUR & PERSONAL RADIO EQPT.

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HANTS, PO2 9AE.
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