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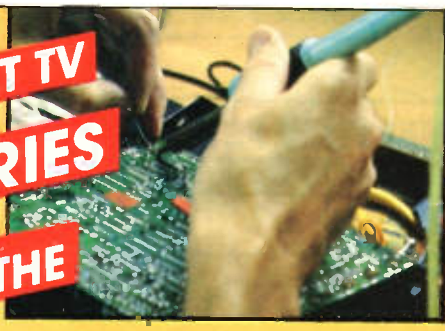

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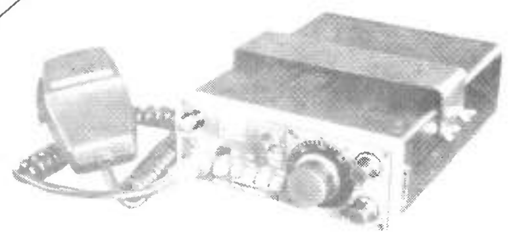

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Radio & Electronics World

The communications, electronics & computers magazine

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REGULAR FEATURES

New Publishers

Welcome to the new improved ***Radio & Electronics World.***

We are pleased to announce that we have bought ***Radio & Electronics World*** from its previous owners, Broadercasting Ltd.

Our policy is to produce the most innovative, absorbing and best selling magazine embracing the fields of communications, electronics and computers and the interaction of these areas.

Our aim is to continually improve the magazine and provide you the reader, with what you want. We will be pleased to receive your comments which will be invaluable in helping us to plan future issues.

Free supplement

The second and third parts of the Amateurs Handbook, forming a comprehensive compilation of data for everyone using the airwaves, will be included completely free of charge, with the January and February issues of ***Radio & Electronics World.***

Publication date change

For production reasons we have altered the publication date of ***Radio & Electronics World*** to the 2nd Friday of the month — so the January issue will be on sale from 9th December.

Don't miss the next issue

Do not risk being disappointed by not being able to obtain your copy. Place a regular order at your newsagent or take advantage of our post-free subscription offer.

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NEWS

Highways of The Future

British Telecom has notched up yet another world first in the field of optical fibre communications, this time with the first commercial single-mode optical fibre 140Mbit/sec link. The cable in question runs between Luton and Milton Keynes, a distance of some 17 miles, and the losses are so low that the data signal does not need to be boosted by any of the intermediate regenerators that have to be installed every 4—6 miles along multimode cables. This represents yet another step towards a system that should (in the long run, at least) bring significant savings in capital and operating costs. Each 140Mbit/sec system, by the way, could carry nearly 2000 simultaneous phone calls or two colour TV pictures.

These and other similarly influential developments were the subject of a recent IEIE national lecture given by Mr C A May, Director of Research at British Telecom. Modern technology has not only provided us with optical fibres with all the advantages of size, weight and cost over coax for handling the same number of telephone calls — and communication via pulses of light: it has also given us the opportunity for 'digitalisation' of our communication services. 'Digitalisation' may be a bit of a horrible word but transmission of information in digital rather than analogue form has two very important advantages. The first is negligible distortion and so legibility is readily maintained: the second is compatibility with computerised systems. The latter opens up a whole new world for communications and already the telephone network is beginning to be used for the transmission of computer data, electronic mail, facsimile and visual images.

The drive behind all these developments is towards a totally integrated service network offering the customer maximum choice over transmitter, receiver and form for the information exchange. Much of the technology for this is incorporated in the hardware and software of modern telephone exchanges, with the principal problems being ones of finding methods of handling both analogue and digital signals and of finding appropriate switching algorithms. Mr May pointed out that there was some useful research on the latter to be done, probably in some university computer science department. The software is obviously the more flexible component here and so the new concepts of the future will probably be incorporated via this medium.

Another major area of recent progress is satellite-based communications. Their disadvantage is that the route via a satellite takes around 0.25sec, but this is easily outweighed by their power (in terms of the number of communications channels that can be supported and the fact that it takes a maximum of two satellite hops to get anywhere round the world) and the flexibility offered through satellites essentially being a broadcast medium. The latter has the advantage that a suitable receiver can be set up almost anywhere, the only problem being pointing it in the right direction to 'see' the geostationary satellite. Indeed the common 3m dishes can be used mounted on a trailer. However, its broadcast nature does cause problems of security though these can readily be overcome with the use of encryption techniques.

One aspect of all this development that is not yet clear is whether the *pattern* of the exchange network will change. (We are already seeing a reduction in the number of exchanges with the present 400 or so analogue exchanges due to give way to about 60 digital ones by 1988.) One possible leader in any such change is cellular radio, although how influential this will be could depend on its overall success. This particular network could well find itself in trouble through running out of available spectrum.

An event to remember

Members of the Farnborough and District Radio Society made intensive use of the airwaves from 14th October until the 22nd, working the bands both CW and SSB in the hope of making contact with radio amateurs all over the world. The reason for all this activity was a scheme to commemorate the 75th anniversary of Colonel SF Cody's first sustained powered flight in Britain on 16th October 1908 over Laffans Plain, an area now accustomed to the rather more sophisticated machines that feature biennially at Farnborough Air Shows. And the arrangements made included the use of a special callsign – GB2CDY – and a special QSL card, pictured here.

The station operated from the local Railway Enthusiasts' Club, where the radio society meet and the site for an Open Day on the 15th attended by the local mayor and Colonel Cody's grandson. The event also featured displays set up by some of the sponsors of the commemoration, three amateur radio stations and an amateur TV station, as well as a number of individual displays.

The flight 75 years ago, by the way, came to a somewhat undignified end when the left wing struck the ground as Colonel Cody banked to avoid a clump of trees. The flying machine – though, fortunately, not Colonel Cody – was substantially damaged.

A story of a sponsorship

Back in 1982, which you may remember was Information Technology Year, BP Oil announced that it was issuing another in its sequence of Challenges to Youth. This time the problem was to design and construct a robot to perform a simple but realistic task – 'sniffing out' a small cube, picking it up and returning to base.

The Buildarobot Competition attracted more than 400 enquiries from schools, of which just 21 were chosen as finalists, after convincing the judges that they had the ideas and the enthusiasm to grasp and extend the science of robotics. And one of these was the Royal Latin School, Buckingham, whose team is pictured here. They unfortunately didn't win

anything in the Final – held on 24th October at the Army's

NEWS

School of Electronic Engineering, Arborfield, Berkshire – indeed, they were one of a number of teams whose robots did not fulfil the task on the day. What *was* special about them was that *R&EW*, together with Ambit International, had given them support following an initial request for help with components. The story of their design, which involved a robot controlled by a BBC Micro responding to signals from dual scanning light sensors made from bicycle lamps, will be told in the near future in *R&EW*.

The winner of the competition was Hinchingbrooke School, Huntingdon, who steered their robot by pulse width modulated (PWM) signals fed to the kind of servo you would find on a radio controlled model aircraft or car: it took just 4.7sec for this robot to complete the task. Their prize of £500 and the Buildarobot trophy was presented by Kenneth Baker, who emphasised in his address the value of new technology in creating the wealth of the future and expressed his delight at the interest and inventiveness shown by all the finalists.

In the eye of the beholder

According to Alex Durrant, quality control manager at Protronic 24, some purchasers of custom-designed PCBs place more emphasis on the appearance of the board than on its inherent quality. This opinion accompanied the announcement that Protronic 24, an independent designer and producer of PCBs, had been granted BSI approval, a step that called for the building of a suitable secure area to serve as a bonded materials store and in-depth documentation of procedure: good customer references, it seems, were not enough.

But it's not the BSI that Mr Durrant feels strongly about; his concern is based on instances when buyers have sought to reject jobs as defective because certain contacts had not been gold plated when there was, in fact, no need for them to be so. At the same time, he has been made aware of other PCB manufacturers that have produced boards high on appearance but low on functionality with plating through the hole well below the required thickness, for example.

Protronic 24 has long used sophisticated process controls and test procedures, and so its products should always come up to standard and may often be better than those of its competitors. However, Mr Durrant may well have a valid point about the way a typical customer views the product he is intending to pay good money for.

The latest fashion accessory at Harvey Nichols – an Apricot microcomputer. Today's shoppers at certain stores within the Debenham's empire can – given suitable financial resources – buy one of these ACT machines from the shop-within-a-shop there known as Greens Business Systems. The sales campaign is designed with the executive in mind and is said to reflect the current state of affairs whereby 'Microcomputers are no longer the preserve of a commercial elite: they've hit the High Street.' Training sessions will be held in-store through which most users should pick up the basics of microcomputing in a couple of hours. The branches of Debenhams in question are, by the way, Oxford, Guildford, Harlow, Staines, Romford and Southampton.

Company News

The American Company of **Dielectric Communications,** a recognised leader in the field of RF technology, has picked out **Chapman Electronics (TCE)** of Epping, Essex, as a key element in its present drive to improve product availability and associated back-up services in Europe. TCE already handles a number of Dielectric's lines which extend from the proven to the novel, e.g. diplexers. It now incorporates in its range the coaxial switches and patch panels that facilitate fast RF switching with maximum isolation and low VSWR.

Axiom Electronics is attempting to give the lie to the opinion that 'ROMs have unacceptably long lead times'. In conjunction with **Motorola**, it has established a service whereby a 64K ROM could be taken to prototype level (150—200 pieces) in six weeks and to the 10,000-piece production level just eight weeks after approval. Axiom sees the products of this service as representing a competitive alternative to EPROMs.

Ferranti Computer Systems has signed an agreement with **Advance Technology (UK)** whereby it produces the new Advance 86 microcomputer—which, it is no surprise to learn, is designed around a Ferranti ULA. The agreement covers PCB assembly, board testing, general assembly, burn in and full functional testing. Ferranti's testing facilities are said to be among the most advanced in Europe.

Racal Electronics has recently come to an agreement with **Thorn Ericsson Telecommunications** whereby the latter develops the system that will form the basis of the cellular radio service Racal is hoping to get into operation in 1985. Equipment for telephone exchanges, signal processing, radio channel handling and base stations 'meet' the UK Total Access Communications System (TACS) specification is to be supplied by Thorn Ericsson in a deal involving as much as £100 million before the end of the decade.

RFI Shielding, believed to be Britain's only manufacturer of shielded windows, is to start offering custom designed (and manufactured) units in addition to its standard range. These will encompass the customer's requirements with regard to choice of materials as well as his electrical, environmental and other physical specifications. Applications for RF shielded windows include instrument panels, computers, communications equipment and sensitive measuring devices.

Oric Products—father of the Oric 1, a familiar sight in your local Lasky's or Dixon's—had an eventful month in October. On the 5th, it was acquired by **Edenspring Investments** in a move to have sufficient financial backing to accelerate its programme of R & D aimed at developing 'a number of new products to expand Oric's product base, not solely in the computer field'. Then its main assembly plant, Kenure Plastics at Feltham, suffered a major fire on the 13th—but production was able to start the following day in a new factory, making everyone confident that they would fulfil all the October orders by the end of that month. A few days later, Oric announced that Oric 1's were to be sold in all branches of the **Comet** and **Rumbelow** chains.

Dawne Instruments and Electronics has achieved its first major distributorship in becoming North-East Stockist/Distributor for **GEC Measurements**. The firm already handles a wide range of laboratory equipment (including Apple microcomputers) which it backs up with data, appropriate guarantees and the assembly of prototypes. It has now taken on GEC's range of multimeters and portable test equipment.

PRODUCT NEWS

Featured on these pages are details of the latest products in communications, electronics and computers. Manufacturers, distributors and dealers are invited to supply information on new products for inclusion in Product News
Readers, don't forget to mention ***Radio & Electronics World*** when making enquiries

ELECTRONICS RESINS

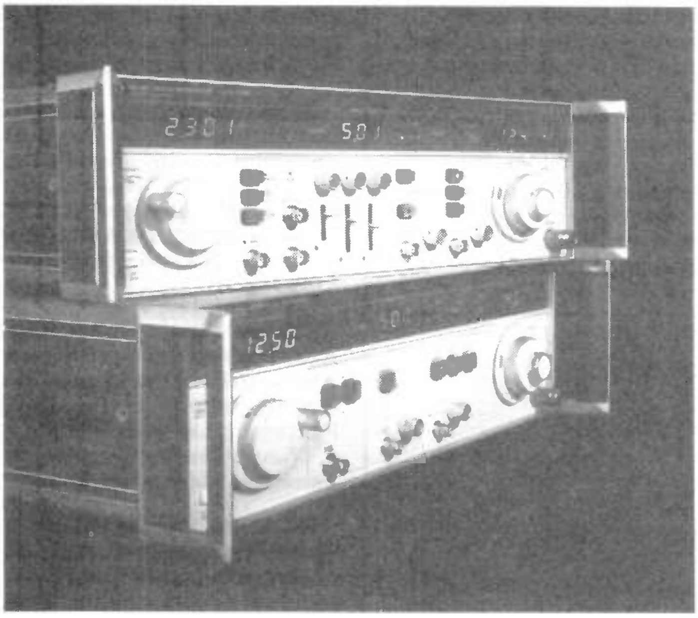
Ciba-Geigy has announced a new range of epoxy resins that have been specially formulated for the electronics industry.

The Araldite 1300 range comprises 16 formulations, developed individually with the intention of providing a product to suit almost every application. As a result, the resins are either hot or cold setting and include filled and

unfilled systems, resins that offer a considerable degree of flame retardancy, flexible resins and low viscosity impregnation systems.

Many of the formulations within the range are supplied in preweighed quantities to ease mixing, while two systems are available in 0.5kg sachets designed for use in less extensive applications. A wallchart detailing the complete Araldite 1300 range in terms of processing information and physical properties is also available from Ciba-Geigy.

Plastics Division, Ciba-Geigy, Duxford, Cambridge. CBZ 4QA



EXTENDED FREQUENCY GENERATION

Hewlett-Packard has announced that its HP 8683D and 8684D cavity-tuned signal generators now include an internal doubler system that extends the available frequency bands and provides doubled FM deviation.

The internal pulse generator within these models (and their forerunners, the 8683B and 8684B) generates pulses at 10Hz–1MHz, with pulse widths of 100nsec–100msec and pulse delays of 50nsec–100msec. These signals can readily be amplitude modulated at depths of up to 70% and rates of up to 10kHz. The new models offer DC – 10MHz modulation and +10MHz deviation, making them suitable for satellite-video applications. They also feature high performance pulse modulation in both the main and the doubled bands for use in radar and EW applications which require rise/fall times shorter than 10nsec and an on/off ratio of more than 80dB.

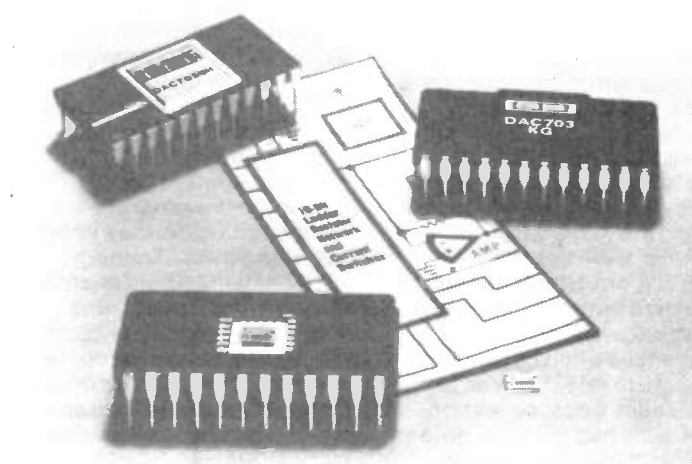
Cavity-tuned generators generally offer a number of advantages, including a spurious signal level of less than −80dB(C), a SSB phase noise below −72dB(C)/Hz at an offset of 10kHz in the X-band and a broadband noise floor of −135 to −150dB(C).

Hewlett-Packard Ltd, Eskdale Road, Winnersh, Wokingham, Berks. RG11 5DZ

16-BIT MONOLITHIC DAC

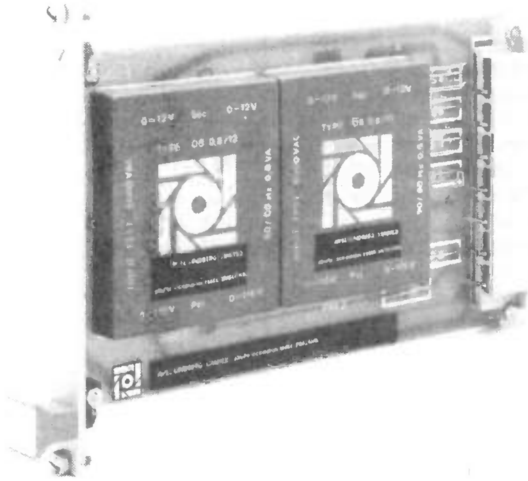
The DAC701 and DAC703 are both versions of what is believed to be the first 16-bit monolithic digital-to-analogue converter that also incorporates a precision Zener voltage reference and a low-noise fast-settling output op-amp. Both of these devices accept binary-coded TTL and LS TTL input signals and employ current switching in providing a monotonic (to 14 bits) output over the specified temperature range of either 0–70°C or −25 to +85°C: the difference is in their output voltage range which is 0 – 10V for the DAC701 and −10 to +10V for the DAC703.

Burr-Brown has designed the new converters to be pin compatible with the industry standard DAC70, 71 and 72 families, so that they can be used to upgrade existing systems. Applications are envisaged in a wide range of mini/microcomputer-based industrial control systems and other instrumentation, including that operated by the Military as the devices pass the leak requirements of the appropriate standard. Other advantages include a maximum linearity error of 0.003%, a settling time of



8μsec following a fullscale input change and drifts of no more than 18ppm of FSR/°C.

Burr-Brown International Ltd, Cassiobury House, 11-19 Station Road, Watford, Herts. WD1 1EA.



ULTRATHIN TRANSFORMER

The OB range of transformers supplied by Avel-Lindberg includes one said to be the thinnest transformer yet. The 0.8VA model shown here is less than 10.5mm thick and so can fit even the smallest card frames.

The facilities offered by these transformers include dual primaries for 240 or 120VAC 50/60Hz mains operation, together with twin centre-tapped secondaries that give 10V (80mA)–48V (17mA) in series and 5–24V in parallel. The windings are on separate bobbins to give maximum isolation and low inter-winding capacitance. The normal method of fixing them to a PCB is to direct solder the connecting pins, but they can also be screwed to the board if extra mechanical strength is required. The advantage of having transformers of this level of power rating (the other members of the range have ratings of 2–14VA) is that they offer the option of extra power capacity actually on the board, for example, as a modification to an existing design.

The transformers are proof-tested at 5kVAC and 120° C, and they conform to IEC 65, BS415 and VDE 0550 regulations.

Avel-Lindberg Ltd, South Ockendon, Essex. RM15 5TD

SOLID STATE 'TAPE RECORDER'

Johne & Reilhofer's Universal series of PCM data acquisition equipment has gained a new member — a high capacity semiconductor storage memory system known as the 32KS13. In common with other members of the series, each module within this system receives up to eight analogue signals, samples them and uses this data to represent each sample by a 12-bit word, the individual data streams being multiplexed on a time division basis.

Normally the resulting PCM serial bit stream is then transmitted to a 4-track tape recorder where it is recorded on one track. The solid state system mimics this through having four modules, each handling eight channels and each storing up to 2^{18} (~ 256,000) measurement values. This data can subsequently be accessed via a RS232-driven memory controller and output either via a RS232 port or to a computer by using the DMA handshake.

The 32KS13 should not be seen as just part of the Universal series; it is also electrically compatible with

PRODUCT NEWS

Johne & Reilhofer's other PCM data acquisition systems. Its main role will be where the moving parts of a tape recorder are at risk, for example where there is much vibration or high dust levels. Its other advantage is its zero start-up time, which is particularly beneficial where transients are of interest.

Johne & Reilhofer (UK) Ltd, Oddstones House, Thompsons Close, Harpenden, Herts. AL5 4ES

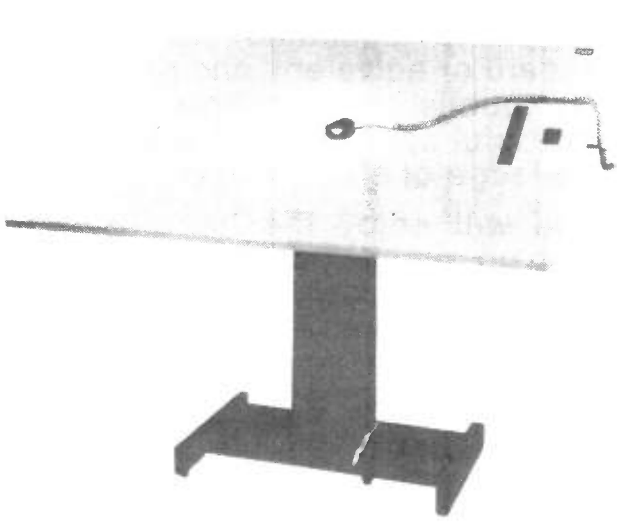
GRAPHICS TABLET

Terminal Display Systems (TDS) has announced the first series of graphics tablets to be both made and marketed by the firm. The top of the range tablet shown here — the HR48 — is intended for professional use by such people as cartographers, seismologists and engineering designers.

Of more interest to readers of *R&EW* should be the 'baby' of the series, the TDS12, which is said to be 'compact, easy to use, lightweight, portable and — most of all — low cost'. This device offers a highly accurate and linear method of inputting *x,y* coordinates from graphic data, the operating principle involved being that of phase-sensitive electromagnetic induction with both the cursor and the stylus containing an energised coil. The tablet's active area is square with a side of 12" enabling it to take A4 documents either landscape or portrait. Thus a grid representing a standard form can be used to facilitate data entry into your microcomputer.

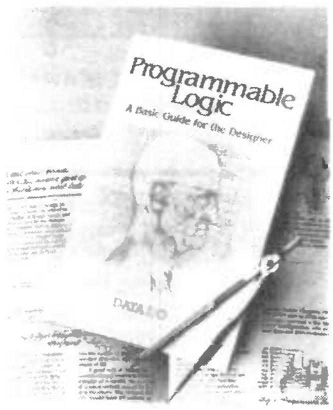
TDS has put all the experience it has acquired in the past as a distributor for Applied Systems, Megatech, Ramtek and Gould among others (a role that it still performs) into the design of these tablets. The micro that drives the tablet is programmed to provide the interface to any popular microcomputer, making the system very easy to incorporate into an established system.

Terminal Display Systems Ltd, Philips Road, Whitebirk Estate, Blackburn, Lancs, BB1 5TH



LOGICAL CHOICE

DATA I/O has recently published a 32-page booklet covering all aspects of programmable logic including comparisons with fixed function LSI/MSI and custom logic. *Programmable Logic — A Basic Guide for the Designer* also takes the reader through a specific



T.V. SOUND TUNER BUILT AND TESTED

In the cut-throat world of consumer electronics, one of the questions designers apparently ponder over is "Will anyone notice if we save money by chopping this out?" In the domestic TV set, one of the first casualties seems to be the sound quality. Small speakers and no tone controls are common and all this is really quite sad, as the TV companies do their best to transmit the highest quality sound.
Given this background a compact and independent TV tuner that connects direct to your Hi-Fi is a must for quality reproduction. The unit is mains operated.
This TV SOUND TUNER offers full UHF coverage with 5 pre-selected tuning controls. It can also be used in conjunction with your video recorder. Dimensions: 11¾" x 8½" x 3¼".

£24·95 + £2.00 p&p.
E.T.I. kit version of above without chassis, case and hardware. **£12.95** plus £1.50 p&p.

PRACTICAL ELECTRONICS STEREO CASSETTE RECORDER KIT

£32.95 + £2.75 p&p.

• NOISE REDUCTION SYSTEM • AUTO STOP • TAPE COUNTER • SWITCHABLE E.Q. • INDEPENDENT LEVEL CONTROLS • TWIN V.U. METER • WOW & FLUTTER 0.1% • RECORD/PLAYBACK I.C. WITH ELECTRONIC SWITCHING • FULLY VARIABLE RECORDING BIAS FOR ACCURATE MATCHING OF ALL TAPES.

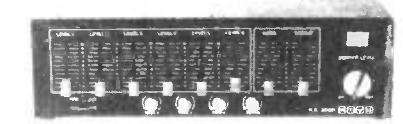
Kit includes tape transport mechanism, ready punched and back printed quality circuit board and all electronic parts i.e. semiconductors, resistors capacitors, hardware top cover, printed scale and mains transformer. You only supply solder and hook-up wire.
Featured in April issue P.E. Reprint 50p. Free with kit.
Self assembly simulated wood sleeve £4.50 + £1.50 p&p.

SPECIAL OFFER! £31.00 plus £2.75 p&p. Complete with case.

MONO MIXER AMP

Ideal for Church halls & Club houses. **£45.00** + £2.00 p&p.

50 WATT Six individually mixed inputs for two pick ups (Cer. or mag.), two moving coil microphones and two auxiliary for tape tuner, organs, etc. Eight slider controls six for level and two for master bass and treble, four extra treble controls for mic. and aux. inputs. Size: 13¼"x6½"x3¾" app. Power output 50 watts R.M.S. (cont.) for use with 4 to 8 ohm speakers. Attractive black vinyl case with matching fascia and knobs. Ready to use.



Matching AKG Microphone to suit (with speech and music filter). Complete with lead. ONLY **£9.95** plus 75p p&p.

VHF STEREO TUNER KIT

• SPECIAL OFFER! •
£13.95 Plus £2.50 p&p.

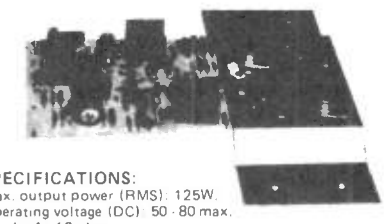
This easy to build 3 band stereo AM/FM tuner kit is designed in conjunction with Practical Electronics (July '81 issue). For ease of construction and alignment it incorporates three Mullard modules and an I.C. IF. System.
FEATURES: VHF, MW, LW Bands, interstation muting and AFC on VHF. Tuning meter. Two back printed PCB's. Ready made chassis and scale. Aerial: AM - ferrite rod, FM - 75 or 300 ohms. Stabalised power supply with 'C' core mains transformer. All components supplied are to strict P.E. specification, Front scale size 10½" x 2½" approx. Complete with diagram and instructions.

125W HIGH POWER AMP MODULES

KIT	BUILT
£10.50	£14.25
+ £1.15 p&p	+ £1.15 p&p

The power amp kit is a module for high power applications disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, result, a high powered rugged unit. The PC board is back printed, etched and ready to drill for ease of construction and the aluminium chassis is preformed and ready to use.
Supplied with all parts, circuit diagrams and instructions.

ACCESSORY: Stereo/mono mains power supply kit with transformer. **£10.50** plus £2.00 p&p.



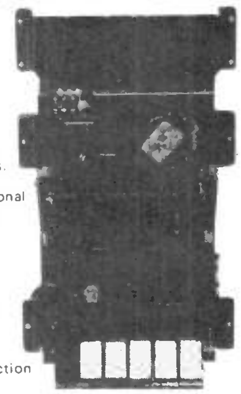
SPECIFICATIONS:
Max. output power (RMS): 125W.
Operating voltage (DC): 50 - 80 max.
Loads: 4 - 16 ohms.
Frequency response measured @ 100 watts: 25Hz - 20KHz.
Sensitivity for 100 watts: 400mV @ 47K.
Typical T.H.D. @ 50 watts, 4 ohms: 0.1%.
Dimensions: 205 x 90 and 190 x 36 mm.

STEREO CARTRIDGES

PHILIPS
Magnetic cartridge with diamond stylus. Model No. GP-397 III. Output 2mV. Separation 22dB. Stylus 0.6mm diameter. **£3.95 each** plus 60p P&P.

GARRARD
Sonotone Garrard Ceramic cartridge. 75mV. With turnover Sapphire stylus. **£2.95** plus 60p p&p.

STEREO CASSETTE DECK



Stereo cassette tape deck transport with electronics. Manufacturer's surplus
– brand new and operational
– sold without warranty.

£11.95
plus £2.50 p&p.

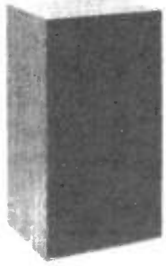
Just requires mains transformer and input/output sockets and a volume control to complete.

Supplied with full connection details.

HI-FI TWEETER BARGAIN

GOODMANS TWEETERS
8 ohm soft dome radiator tweeter (3¾"sq.) for use in up to 40W systems; with 2 element crossover.
£3.95 each (p&p £1) or
£6.95 pair (p&p £1.50)

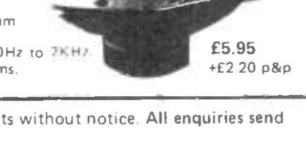
SPEAKER KIT 2 WAY 10 WATT



8" bass/mid range and 3¼" tweeter. Complete with screws, wire, crossover components and cabinet. Cabinet comes in flat pre-mitred D.I.Y. form. Finish - chipboard covered wood simulate, size 14½"x 8¾"x 4". PAIR for ONLY
£12.50 plus £1.75 p&p.

AUDAX 8" SPEAKER

HIGH QUALITY 40 WATTS RMS BASS/MIDRANGE



Ideal for either Hi-Fi or Disco use this speaker features an aluminium voice coil a heavy 70 mm diameter magnet.
Frequency res. 20Hz to 7KHz.
Impedance: 8 ohms.

£5.95
+£2.20 p&p

AUDAX 40W FERRO-FLUID HI-FI TWEETER

X/over on 5kHz ·22kHz. 60mm square. 8 ohm.
£5.50
+60p p&p

All mail to:
21A HIGH STREET, ACTON W3 6NG.
Note: Goods despatched to U.K. postal addresses only. All items subject to availability. Prices correct at 30/9/83 and subject to change without notice. Please allow 14 working days from receipt of order for despatch. RTVC Limited reserve the right to update their products without notice. All enquiries send S.A.E.

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picks out the functional ones
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DEWSBURY G4CLX ELECTRONICS

APPROVED TRIO DEALER

APPROVED TRIO DEALER

UHF ALL-MODE TRANSCEIVER TR 9500 TRIO

The TR 9500 is a lightweight compact 70cm FM/USB/LSB/CW transceiver with advanced and convenient functons and many accessories at an affordable price.
The transceiver is designed for FM, SSB, and CW modes, utilizing a microcomputer which permits frequency selection in 100Hz, 1kHz, and 5kHz, 25kHz steps by means of two digital VFOs. The microcomputer also permits memory, scanning, searching, and other features.

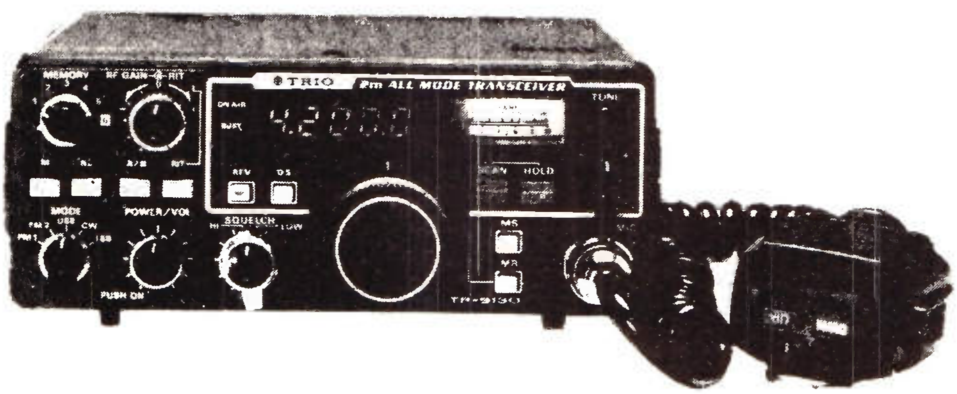
SP 120 TR-9500 BO-9 PS-20

£395 + carriage £5.00

The TR9130 is the new all mode VHF mobile or base station rig from Trio giving 25 watts output on 2 metres FM, USB, LSB and CW and now having a green LED display to make for easier mobile operation.

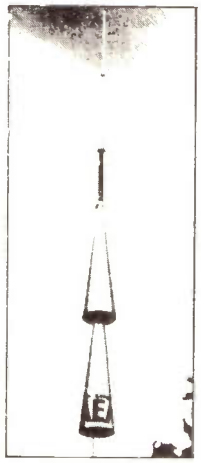
- 25 watts output on FM, SSB and CW.
- FM/USB/LSB/CW all mode operation.
- For added convenience in all modes of operation, the mode switch, in combination with the digital step (DS) switch, determines the size of the tuning step, and the number of digits displayed.
- Six memories. On FM, memories 1 through 5 for simplex or +600kHz offset, with the OFFSET switch. Memory 6 for non-standard offset. All six memories may be operated simplex, any mode.
- Memory scan. Scans memories in which data is stored. Stops on busy channels.
- Internal battery memory back-up. With Ni-Cad installed (not Trio supplied), memories will be retained approximately 24 hours, adequate for the typical move from base to mobile. A terminal is provided on the rear panel for connecting an external back-up supply.
- Automatic band scan. Scans within whole 1MHz segments (ie 144.0-144.999MHz), for improved scanning efficiency.
- Dual digital VFOs. Incorporates two built-in digital VFOs, selected through use of the A/B switch and individually tuned.
- Squelch circuit on all modes (FM/SSB/CW).
- Repeater reverse switch. For checking signals on the repeater input, on FM.
- CW semi break-in circuit with sidetone. Built-in, for convenience in CW operations.
- Digital display with green LEDs.
- Transmit offset switch for repeater shift.
- High performance noise blanker.
- RIT (Receiver Incremental Tuning) circuit. Useful during SSB/CW operations.
- HI/LOW power switch. Select 25 or5 watts RF output on FM or CW.
- A four-pin accessory terminal is provided for use with a linear amplifier or other accessory.
- Includes quick release mobile mounting bracket and up/down microphone.

TR 9130 TRIO



TR9130 ALL MODE TRANSCEIVER £433 + car: £5.00

Access/Barclaycard accepted. Licenced credit broker



ISOPOLE 144

A.E.A ISOPOLE TM 2M AND 70cm VERTICAL ANTENNAS

These antennas simply put your signal where you want it – on the horizon. Most other VHF verticals radiate at 10-15 above the horizontal but the Isopole's unique (aesthetically pleasing) decoupling cones stop *any* feeder radiation and ensure a proper 0 radiation pattern. All users report dramatic improvement over previous, similar sized, antennas they have used. One of the hottest selling antennas in the U.S.A.

Isopole 144 **£36.00**
(£2.50 P&P & Insurance)
Isopole 440 ...... £59.00
(£2.50 P&P & Insurance)

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FOR SALE

● 100 watt 70cm linear microwave modules 177ml 432/100 cost £229 one hour's use only £190 o.n.o. George G6VS 4 Partridge Avenue, Thornton Cleveleys, Blackpool, FY5 2HJ. Tel: 0253 823541.

● Heathkit SB101, PSU, Speaker Digital freq read-out. All manuals and cables £200 o.n.o. Creed envoy data printer 110 baud, serial ASC11 £50. Two LF/HF signal generators, AVO, TAYLOR £10 each. Tel: 02372 4564 evenings.

● Pye PF2 SU8 fitted including two batteries £45 MM 144/28 converter £20 o.n.o. Simple homebrew HF receiver including approx. 15 denco coils, radiomobile 8 track LW/MW radio, three channel sound light controller, stereo pre-amp TUAC SVA01. Offers or swap VHF UHF ATV gear or WHY. Tom Crosbie G6PZZ, 18 Holmer Lane, Holmer Lake, Telford, TF3 1QJ. Tel: 0952 597506.

● Mizuho MX2. Two metre SSB hand-held complete with speaker mic. Offers or W.H.Y. (circa £85). (G8BXO) John Stacey, 3 West Park, South Molton, Devon, EX36 4HJ. Tel: 07695 3382.

● CBM 2032 computer printer dot-matrix perfect condx. First offer over £250. Taken copy of print sent on receipt of S.A.S.E. complete with IEEE cable, full H/BK and box paper also for £400 o.n.o. Sharp PG1500 computer, case, printer 8KRAM P.S.U. case. Two H/BKS pristine condx. Will swop or W.H.Y. the perfect portable computer. Ron Broadbent, 94 Herongate Road, London, E12 5EQ. Tel:(day) 01-987-5864.

● Trio TR2200G NI-Cads charger Mic. Case all Xtals £70. Want Datong Woodpecker Blanker. Trowell, "Hamlyn", Saxon Avenue, Minster, Sheerness, Kent. ME12 2RP. Tel: (0795) 873100.

● Microwave modules MMA144V preamp with RF switching for two metres FM or SSB. Uses 3SK88 device. Good condition. Bargain £10 o.n.o. Contact Chris G8PKM (not QTHR). Tel: Chelmsford (0245) 323323 after 5.30 or weekends.

● Datong PC1 50KHZ to 30MHZ receive converter uses 2 mtr transceiver to listen to all HF bands £90 o.n.o. R.S.Blyth, 36 Mickleburgh Hill, Herne Bay, Kent, CT6 6DT. Tel: H/Bay 63799.

● Trio VF0120 for TS120 and TS130 transceivers only £50 o.n.o. Also Jaybeam 12XY with harness for 70cms at £38. DPCO 12v relays with 130R or 280R coils only 75p each. Limited number of 74LS series I.C.'s 20's at 10p, 27's at 10p, 47's at 30p, 373's at 45p, 161's at 30p, 193's at 30p, 92's at 24p, 374's at 65p, and 08's at 10p each. All carriage at cost or buyer collects. G. Caselton, 19 Cowden Road, Orpington, Kent, BR6 0TP. Tel: 0689 29230.

● TONO 9000E £520 GEC High band TX/RX £20. Brookes MBR6 RTTY TU £40. ORIC electron BBC programs morse tutor £4.50. Locator £4.50 BBC RTTY £5. FT-290R with NICADS HELICAL £200. MML 144/30 LS £55. T. Tugwell, 11 The Dell, Stevenage, Herts. Tel: 0438 354689.

● C432 70 CMS hand- held case. Handbook. Ext.mic. RBO RB11 RB13 SU8 SU20 no mods £85 o.n.o. G4AWY not QTHR. R.A. Mekka, 57 St. Johns Road, Caversham, Reading, RG4 0AL. Tel: (0734) 482559.

● YAESU FT 902 DM FM filter mint condition £625. Tel: 0272 873691, Clevedon, Avon.

● AR88D fine condition, some spare valves, £40 o.n.o. Tel: Reading 65013.

● FX-1 wave meter. As new, never used £30. Tel: 0903 753102.

● Marconi Marina Atlanta Receiver. Full 10 bands to 28 MEGS. Excellent condition. £75. Palm 4 40 channel 2mtr. hand-held with charger. £80. Leonard Davies GW4 HAW 46 Maes Glas, Rhos-on-Sea, Clwyd, North Wales, LL28 4AZ. Tel: 0492 40920.

● Yaesu FRG770M little used £200. Wanted manual or circuit for telequipment S51 scope. Can copy if required. Howden G6JUP QTHR. Tel: 0977 662706.

● Creed 7BRP teleprinter, immac. condition £15. Creed 656 tape reader as new £15, Pye base station transmitter £5, Homebrew 2M transceiver, valved, works off 12v £7, ICOM 1050 converted to 10M but deaf £25, 25W PA for ICOM 1050 £15. Tel: 061 773 8824.

● YAESU FL101 TX, 100% OK, with new spare pair PA valves. £100. Tel: Roy G3LBT 0268 22822 Ext. 3252 business hours or 0268 412177 evenings.

● Plessey ICs Motorola RF power devices. RCA linear ICs etc. etc. S.A.E. list. All new guaranteed devices. G3VFP 17 Laleham Green, Bramhall, Stockport, SK7 3LJ. FT707 inc. narrow CW filter, immac. condition £400. No offers. Address as above.

● FRG 7 Radio receiver, brand new in box 150HZ to 30MZ with full guarantee. A. Slark, 43/45 Thicketford Road, Bolton, Lancs. Tel: Bolton 26684.

● Codar T28 RX cheap. Also power supply and accessories for base and mobile operation. Delivery by arrangemnt inclusive. Also wanted Codar AT5 TX cheap. For sale small portable tape recorder £5 plus carriage. Two small scope tubes AOR Z03 and CDU 3-FP7 £5 each plus carriage. Mr. D.F. Thompson, Four Winds, 131 St. Johns Road, Exmouth, Devon, EX8 4EW. Tel: 265059

● Optiscan SBE-12SM 12/240v AM/FM scanning receiver. Daiwa search 9 12U(CAR) FM manual tune. £10 Switched xtal Marine bands. I.M. Tasker, Colsterworth Road, Stainby, Nr. Grantham, Lincs. Tel: 078 081 315.

● Yaesu FT290R as new 8 months old boxed complete with case and Bremi 3 amp P/S. No mods £210. Buyer to collect. H.F. Barker G4BXY, 372 Gosbrook Road, Caversham, Reading, Berks, RG4 8EG.

● ZX81 plus 16K RAM pack, also seven games tapes including flight simulation, 3D Defender, Fantasy games and scramble £50 o.n.o.Tel: Wisbech (0945) 61946

● IC22A F.M. 2MTR Trans. 1 watt/10 watt Simplex S18, S19, S20, S21, S22, Repeater, R1, R3, R4, R5, R6, R7 fitted. Space for 12 more channels complete with mic and mobile fixing bracket, excellent working order £95. R Stevenson, 39 Croftway, Selby, North Yorkshire YO8 9DD. Selby 706057.

● Creed 7E Teleprinter and spares and 656 Tape reader. Will sell or swap for an unmodified ZX81 with its PSU and 16K ram. Given up RTTY. Space is required. Must be got rid of. Please contact for arrangement to collect, Ian Ruddock G8NCZ, 46 High Road, Stapleford, Hertford, Herts. SG14 3NW, Telephone Ware 871486 Saturdays only.

● Bearcat 220 AM/FM VHF/UHF Scanner. Faulty band — switching circuit. Full service and owners manuals, mobile bracket, original packing, £90. No offers. Please write to S. Langlois/GJ40DX, Merchant Navy College, Greenhithe, Kent, DA9 9NY. Can deliver within 40 miles of Dartford.

● Professionally alligned Wood and Douglas 70cm T.V. tx, 10w P.A. and Microwave Modules Up-Converter £90, RO390 Printer, 20mA, RS232 and Apple II interfaces £70, Feranti UDU 80 x 25 character green screen, manual, spares £50, muiltirail computer PSU £15, 32K Nascon 22K of EPROM lots of software £250, all o.n.o. Phone Philip, Guildford 573871.

● Trio 7800 5 and 25 watt as new, boxed with manual and mobile mount. Dave G4NDJ QTHR, telephone Skelmersdale 21814 £200 ono.

● FT480 2m Multimode 9 months old, used only as base station £300. Phone Bradford-on-Avon (02216) 3600.

● Drae Morse Tutor, mains operated current model, little used as new £30, Whitstable 274947.

● Collins S Line 3253 Transmitter 75S3 receiver, good condition and working order with PSU. Revalved, well worth seeing £625, Worcester 421908.

● FDK multi Palm II for sale xtaled S20, S21, S22, 15, R4, R5, complete with ¼wave aerial charger. Tone burst fitted, good condition, price £75 or ono. Contact Dave Drizen G8UUO, 40 Gilbert Way, Braintree, Essex.

● Binatone Video Game £25 ono, Merlin electronic game £10, power supply for both £3, all in good condition still guaranteed, will sell or swap for a Spectrum or ZX81 or a Rotator to turn a HQ1 eg HR40, 9502, 9523 or even a Morse Tutor. Please contact Mr. A. Buckton, 17 Drake Close, Marske/Sea, Redcar, Teeside, TS11 7JG, telephone (0642) 471331.

● Eddystone High Stability Professional Solid State general coverage Receiver model EC958 10kzL to 30mhz in mint condition, handbook and history £500. Datong FL3 Audio Filter £99. FT102 5 months old as new, handbook, £650. A P Davis G41ZG, 88 Goring Road, Goring-by-Sea, Worthing, Sussex, BN12 4AB, telephone Worthing 41109.

● Yaesu FRG7 receiver with handbook and battery power supply module, excellent condition, £135. Alec J. Mitchell (G4ICE), 11 Poplar Lane, Cannock, Staffs, WS11 1NQ, Tel: 05435 2836.

● R & EW Airband receiver. Assembled and wired all voltages correct, needs BPF 274 transistor and alignment, no case, £45. Sony 2001 as new with wave book £120, perfect condition. Radiotelephone Pye Vanguard Cat. AM25B/V/6 12 volt, used as airfield fixed base VHF R/T £25. J T Grant, Bank House, Reepham, Norfolk NR10 4JJ, Tel: 0603 870852.

● Cushcraft TR1 band vertical with data sheet (unused) £30 ono. Tel: Larkhall 883982.20-15-10.

● N1500 Video Head and Electronics for spares or repair, all working o.k. Will exchange for audio cassette recorder, small oscilloscope, ultrasonic transducers, W.H.Y. or £15 ono each, Ring 0742 311191 after 4.30 pm.

● Racal 801R frequency conner including service manual, offers? phone Royston 71160.

● Nascom IMP Printer 80 chars. second RS232 input with full documentation in good order. 01 399 4177 after 7 pm. £100 ono.

● Marconi SIG GEN TF2006 10-500 megs £350 spare one £90, Marconi SIG GEN TF2604 £50, Marconi watt meter CT44 £6, Marconi SIG GEN TF1066 fixed output £75, advance SIG GEN SG62B £20 Scope Ex-min CT 436 £60, spare £20, KT88s GEC £5, T/former 1K,0,1KV 235ma £10, Scope advance 0S15A £30. Scope, Service Scope, S51A £40, AR88D tuning gang and switch £6, Sanyo receiver RP 888OG, 9 bands crystal marker, double conversion £85, OSC tubes Hewlett Packard 6IN 5083 — 0353 £15, GEC 1074H two gun £5, ACR 10 with screen and base £4, Mullard DG7/6 Screen and base £6, Marconi valve V/meter TF 2604 £75. Mr P Baylis, 42 King Edward Ave, Dartford, Kent DA1 2HY, Tel: Dartford 72913.

● ICF 2001 general coverage receiver, as new. Reason for sale — going back on air so need rig. Offers around £95. Ring Pip G8NOP on Great Cubley 506 evenings. Also Creed 7ERP Teleprinter £5 or free with above receiver.

● Nascom Two, 48K RAM, KIB, PSU, bare holmes colour PCB, all documentation. A few games, cassette player, £200 ono, Eastleigh 617214 Hants.

● Workshop clear out. Several B/W TVs, some work or could be used for spare parts or components including tubes and valves, reasonable offer would not be refused. Would suit young enthusiast. Van is adviseable for collection. Phone after 7 pm 0702 78178 Southend-on-Sea area.

● RS232 interfaces for Epson and Seikusha Printers. Unused. £25 each. UK101 computer and software £60. 16K RAM boards £20 each. Honeywell qwerty keyboard, unused, £25. Dr P D Coker, 23 Darwin Close, Orpington, Kent, Tel: 0689 58510.

● Ex-BT Modem. Full Duplex or half Duplex up to 1200 B/S Assyncronous, full working order and reprint of data diagrams P.C.B. layouts etc. £50 ono. B. G. Oldford, 4 Field Close, Malinslee, Telford, Shropshire, TF4 2EH. Tel: Telford 507312.

● William Stuart Speech system new and unused, cost over £100, want £80. Includes all documentation and interface leads. Speech Synthesiser and speech recognition 'Big Ears'. John Taylor, 47 Spur Road, Orpington, Kent, BR6 0QT, tel: Orp. (0689) 35353.

● Mizuho MX-2 144mhz SSB hand held transceiver, NI-CAD battery £60. VHF VMOS power FET 20w £8. Colchester 572685.

● Trio 3R 500S £60 also old valves, D. Hardy, 12 Fyfield Road, Walthamstow, London, E14 3RG.

● Hams and SWL's are you interested in frame loop antennas, sae for details, write F G Rylands, 39 Parkside Avenue, Millbrook, Southampton SO1 9AF

● Hatfield R.F. Bridge LE300A £20, Hustler mobile aerial 5 resonators Q.D. mount £40, 3WP1 tube £3, DG7-5 tube unused £10, Lumb, 14 Linton Gardens, Bury St.Edmunds, Suffolk. Tel: (0284) 4318.

● Clear-out sale. As new Scopex dual-beam 10mhz 'scope, £125, various S-100 boards: 12-slot motherboard, and 8v @ 15A PSU £35, ADS 6809 CPU (2 monitor eproms) £60, Z80A CPU (3 monitor Eproms inc CP/M B105) £80, 64 K dram with many options £50, 4 channel SI/O 1 CH populated £30,

FREE READER SMALL ADS

floppy disk controller for 8in Shugart £60, 2 x prototyping cards, 1 with RTC and Z8-pin prom SKt. I.T.T.2020 (Apple look-alike) £300 cased, 2 x Apple disk drives £125 each, green phosphor 20mhz monitor £60, 2 x ASCII keyboards £25 each, 80 column card £25, floppy disk card £25, language card £30, Z80/CPM card £35. Full original documentation supplied. 50+ disks of software available KIM-1 system £50, FT207R £80, also lots of PPSUs, meters, junk box components, odds and ends, books and mags. A Thring, 142 Kennel Lane, Great Burstead, Billericay, Essex, CM11 2SU, tel: 027-74-52325 (eve).

● DTXV Converter: receives VHF bands 1,2,3 on UHF TV. Plugs into aerial socket.£28.00. Phone 0702-8858

● 13ft 6ins Ski boat inboard eng. exchange for any general coverage transceiver. Mr James Cushen, 42 Wallace Road, Bodmin Cornwall. PL31 2EX Tel: Bodmin 4681

● RA17 as new £150 AR88mint £!00 HRO Restored 9 coils £90 Codar £25 6MEG 2 beam Scope £75 Heathkit Scope £25 old Cosser 2 beam Scope £40 Taylor valve voltmeter £25 Marconi valve voltmeter £35 Airmec same £35 dozens old domestic radios o'hauled. Ring anytime. Tons of spares, values etc. Ashley James, The Mount, High Street, Chalford, Stroud, Glos. GL6 8US. Tel: 0453 882164

● IBM 3982 'golfball printer with parallel port interface. Requires software to run off ASCII-Z80 program supplied. Complete with IBM manuals and a few spare and several typeheads. Has mechanical fault that requires attention. (runs, but letters not aligned properly.) £50 to knowledgeable enthuisast, carriage extra (probably £15. Porthlowan 890688. (Cornwall)

● Datong UC1 up converter £70. UK101 6502 based computer, 8k memory, wemon centromics printer interface, fan, cased, £80. Prefer buyer collects UK101. Tel: Witney (0993) 4890 evenings

● ICOM IC202S £115. FDK multi 700 EX £125. 10GHz FM transceiver with dish X-coupler wavemeter £70. All ono. Ring 0453 833411

● Eddystone receiver 840A very good condition with manual £60. Trio 2200G FM Nicads Charger carrying case £70. Buyer collects. Collectors item 1928 edition Practical Television by Larner forward by John Baid offers G2HKU Trowell 'Hamlyn' Saxon Ave, Minster, Sheerness, Kent. Phone (0795) 873100

● Radio and television servicing books 1974 to 1982 8 volumes mint condition unused cost £172.50 sell £112 inc postage to you Thandar SC110 Scope new in box with re-chargeables and switchables probe X1-X10 cost over £200 £140 inc post. Telephone monitor built & tested £8. Digital multimeter £30 Tel: Durham 719400 evenings/weekends

● Loads of new components for TV Radio etc clearing out due to retirement too much stuff to list send sae 9x6 for free catalogue of all my equipment & spares. 6 Rydal Close, Sacriston, Durham DH7 6DG

● TRS800 level one computer 4k with monitor and tape recorder. All itmes boxed £150 ono Dave Lucas, Ĝ6HLQ 62 St Austell Avenue, Macclesfield, Cheshire. SG10 3NN

● VDU keyboard interface unit, with proffesional quality keyboard, R5232, 64 Char/line, 16 lines, £25. Heathkit H14 line printer, RS232,excellent condition, with manuals, £130. Phone 01-751 2262 after 6pm

● Heathkit model 10-12U laboratory oscilloscope complete with data and construction details etc. Bargain at £35. Telephone Sheffield (0742) 664453

● Xerox Hy-type daisy wheel printer. Full connection details for this very proffesional unit. £95 Tel: 0272 717424

● Ferrograph series 5 reel to reel tape rcorder faulty £25, collect. J-beam six element quad 2-mtr aerial £10, collect. 40 chnl 29 MHz txceiver 4W with mic as new £20, postage £2. Smith, No 1 Barton Drive, Paignton, Devon.

● Exchange Radio Shack for SX200-N and R1000. Shack list FT290R, Nicads, 144/432mm UHF transceiver 2m SmeP/A FM/SSB 25W lin SP400 Welz, Daiwa CN620N, Ae switches many cables HB9CU AE DA1WA search 9 RX + UFO, 8A PSU all fits into cabinet, value £760+ bargian of the year. Ring Sick of Amateur Radio. John 047-385 526 anytime.

● 32k Dynamic ram card, nearly new cond. £25 ono. Industrial F8 system CPU CARD ROM card and V.DU card in frame £25 ono. Wanted Texas 'Speak and Spell', damaged unit considered. Chris S Warwick, 118 Sise Field Road, Kings Norton, Birminham. B38 9JA

● Intel 8086 developement system offers WHY several S100 boards including microplois FD controllers wanted 49Hz satellite equipment and micopolis disk drive. Also wanted schematics for spring B+W 310 portable TV — Bridge, 175 Crofton Rd, Orpington, Kent. BR6 0JX

● Sony MX-610 mixer 6 in to 2, mic, line or phono. Turn UK meters, head phone output etc, £50 or exchange for compressor/limiter. MJ Gamley, 4 Walnut Grove, Trowbridge, Wilts. BA14 0HR

● Vernier slow motion drive type D ref 10A/8510 brand new neon power indicator complete set radio communication mags. 1982 variable condenser 1 toggle switch DX. Foreign listings callbook Guy wires brand new Japanese BM3 desk nic, £30 cot absolute bargain pack will sell mic, separate at £15 phone G3XWV 0564 822280 evenings

● 1KW out 432mKZ Linear amplifiers for SSB and CW and ATV contact Geoff Brown Lemnos, Longueville Rd, St Helier, Jersey CI

WANTED

● Manual for Tektronix 502A Dual Beam Oscilloscope.Mr Richard Coull, 113 Westmorland Ave, Luton, Beds, LU3 2PT. Tel: (0582) 581256

● Non Working Transmitters, Receivers or W.H.Y. D.H. de Souza Kirby, 17, Laleham Green, Bramhall, Stockport, SK7 3LJ. Tel: 061 439 2377.

● Eddystone 770U VHF/UHF or AR2001 Receivers. Microwave Modules ATV and 136 MHZ Receive Converters. Will collect reasonable distance. Phone Middlesborough (0642) 318451 after 6.pm.

● Light to medium duty aerial rotator for VHF Beam. Tel: Wisbech (0945)61946

● Radio gear offers in exchange for American Super 8 Cine and Projector. Both zoom. Richard Stacey, 3, Westpark, South Molton, Devon, EX36 4HJ Tel: 07695 3382

● Exchange Kleinshmidt Tele-Printer, Perforator-Transmitter for any TV gear, Test gear, W.H.Y. Phone Mac (G6 PPW) on Mansfield (0623) 640626.

● C B Rig wanted working or not. Please give complete details and price. After 6.pm if phoning, can collect if local. R. Moores, 117 Horton Road, Brighton, BN1 7EG Tel: (0273) 503869

● Linear Amp 2 Meter 50-100w Microwave Modules or similar. Also heavy duty Rotator with control box. Phone Dave (Eve only) Cardross (Scotland) 841452

● Up to twenty pounds for a vertical high frequency Aerial. Mr G Nash, 530 Archer Road, Stevenage. Tel: Stevenage 62554

● Circuit Diagram for PSU for 19 set or pin out for DC input lead to 19 set supply unit No 2 (Dynamo Vibrator.) Circuit Diagrams for add ons to Texas T199/4A Computer I E R5232, RTTY, RAM, D.O.S. boards. Also exchange ideas etc with other radio amateur users of T199/4A. M. Austin G6UKP. 15,Bursley Way, Bradwell, Newcastle-U-Lyme, ST5 8JQ Tel: Stoke on Trent 639406

● Members wanted no experience req! Top band and VHF direction finding club. Write Hon. Sec. Dartford D.F. Club, 49 School Lane, Horton Kirby, Dartford, Kent, DA4 9DQ. Subs £3 yr.

● Wanted any information on Mods or Conversions to Murphy B40D receiver. M.F.Turvey, 106 Foxwell Street, Worcester, WR5 2ET.

● Stanford Le Hope and District Amateur Radio Club Welcome new members. Monday nights 2000 at Parish rooms, St Joseph's School, Stanford. Come along and join a friendly club. John Allan (GALTH) 13, Vincent Close, Corringham, Essex, SS17 7QL Tel: Stanford Le Hope 674301

● Wanted Clandestine 'Spy-Set' Radios, A.P.4. A Mk II, 3Mk III, B.P.3. etc Compact or unusual, military surplus Receivers Transmitters. Also, early Amateur Radio Equipment, Short-Wave Receivers up to late thirties. Anything early with values in it considered. W.H.Y. Please Tel: John 01-450 6449.

● Surplus Data Manuals especially Motorola RF Semiconductor Manual. D.Bieber (G4Air QTHR) Sandale Lodge, Rosslyn Lane, Cuddington, Northwich, Cheshire. CW8 2JZ. Tel: 0606 882949

● Wanted any info on servicing ZX81 any reas. expense paid. Wanted Service Sheet for Berry 510 CTV. 1973 Hire Loan? to R. Norean, 67, Wilson Road, Boscombe, Bournemouth, Dorset. 0202 303798.

● Wanted complete E.H.T Unit for Marconi Oscilloscope Model TF1331. Any reasonable price plus carriage. W. Mawson, 8, Elsdon Drive, Forest Hall, Newcastle upon Tyne, NE12 9RH Tel: Newcastle 662082

● Wanted Handbook, Circuit, Diagram, Mods for Belcom Liner Two SSB Transcur copies, loan, purchase, anything considered. Contact John G6UGU 12 Ingram Crescent, Dunscroft, Doncaster. Tel: 0302 841530

● Wanted by desperate enthusiast, a Valve Amplifier using Power Triodes like, PX25, V503, PA40 etc. Also any HIVAC miniature valves for my collection? To Mr N Covington, 25 Ridge Road, Letchworth, Herts SG6 1PW

● THE VALVE SET CLUB. I intend to start a club with a monthly news sheet, with information, for sale, wanted, swap etc. If you would like to contribute or just be a member, please write to me so as I can colate a list of interested people. This hobby (Valve) is growing very fast!. To: Mr N Covington, 25, Ridge Road, Letchworth, Herts, SG6 1PW

● Radio Valves wanted, must be unused. ECC40, EL41, X78, N78, NR44, NR47, CV1040, 6B4G, P27/500, PP5/400, AC/HL, AC2/HL, PX25, PX4, V503, ELL80, ACO44, 12AH8, EL34, UY41, MH4, or what have you? to Mr Covington, 25, Ridge Road, Letchworth, Herts, SG6 1PW. Tel: (04626) 79681

● Wanted FR50B or FRG 7 in good condition. Niall Reilly, 6 Windsor Avenue, Portadown. Phone Portsmouth 333412.

● Wanted: Heath RA1 RX. KW E-ZEE Match. Joystick antenna. Write Marris, 35 Kingswood House, Farnham Road, Slough, Berks.

● Datong Woodpecker Blanker. HF Vertical new condition only. G2HKU Trowell Hamlyn Saxon Ave, Minster Sheerness, Kent. Phone (0795) 873100.

● Eimac SK606 Chimney to complete project. Ediswan B8F base and chimney, UHF type screen bypass capacitor at about 1000PF to start next linear or WHY? QRO VHF UHF bits also 2C39's for 23cm. If you can help phone Alastair G4RUL on (0323) Eastbourne 53618 eves and Sundays only please or QTHR as G6EWL

● Good quality compressor limiter, stereo if possible also any other signal processing equipment. M J Gamley, 4 Walnut Grove, Trowbridge, Wilts. BA14 0HR

● Wanted either Trio TS120V, TS520 or Racal RA17 with SSB adaptor, as applicable, mike PSU and hand book req'd to: LCPL Booker, 54 Lodge Hill Lane, Rochester, Kent. ME3 8NR

● 4CX250B sockets, type SK620A, SK600, SK610, etc must be new condition. Write CJ4ICD, SMC, Belmont Rd, St Helier, Jersey, CI

FREE SMALL ADS

We are pleased to be able to offer readers this free Small ad Service to enable you to sell unwanted equipment or advertise for your 'wants'.

Simply complete the order form enclosed, although we will accept ads not on our order form. Feel free to use an extra sheet of paper if there is not enough space on the order form. Send to: ***Radio & Electronics World,*** Free Ads, Sovereign House, Brentwood, Essex CM14 4SE.

DEADLINE

We will endeavour to include all ads received by 16 November 1983 in the January issue. Ads received after this date will be included in the next available issue.

CONDITIONS

We will not accept trade advertisements. We reserve the right to exclude any ad.

APPOINTMENTS

We are pleased to be able to offer employers and their agencies the advantage of **FREE** 1/8 page appointment ads

Readers, don't forget to mention ***Radio & Electronics World*** when applying

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THE UK's No 1 ELECTRONICS AGENCY

If you have HNC/TEC or higher qualifications and are looking for a job in design, test, customer service, technical sales or similar fields:

Telephone now for our free jobs list
We have vacancies in all areas of the UK
Salaries to £15,000 pa

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RADIO/RELAY TECHNICIANS

over £22,700 tax free
for 2 years in Saudi Arabia

Locheed need experienced technicians to join their training teams working with the Royal Saudi Air Force.

Minimum C&G (or forces equivalent) + 7 years experience in:

Ground Radio
HF (SSB), VHF/UHF & SHF, Multiplexers
Radio Relay
Microwave, Troposcatter
& Multiplexers

Top benfits include free accommodation, food, flights etc.

Contact **Jim Macfarlane, IAL,**
Aeradio House, Hayes Road
Southall, Middx UB2 5NJ
Tel: 01-574 5000. Please quote ref L210

Medical Physics Technician
c£20,700 pa tax free
Saudia Arabia

The National Guard King Khalid Hospital in Jeddah is a new hospital which is managed by International Hospitals Group (IHG) in liasion with the British Government and supported by IAL.

We are looking for a Biomedical Engineer with 10 years experience including six years spent in the maintenance of medical equipment **or** in the design, construction and testing biomedical equipment in a university or manufacturing environment.

A tax free salary of SR108,000 will be paid in Saudi Riyals (the conversion to sterling has been effected at the rate of SR5.2=£1). Excellent benefits and facilities are provided.

For more details telephone:

JOHN CALLOW on 01-574 5432 or write to him at **IAL, Aeradio House, Hayes Road, Southall, Middx UB2 5NJ.**

Please quote Ref M158

ASSISTANT EDITOR

We are looking for an Assistant Editor for ***Radio & Electronics World***, the communications, electronics and computers magazine.

Ideally we want an amateur radio enthusiast, educated to degree standard or eqivalent, and preferably with publishing experience. The successful applicant will also have a knowledge of electronics.

You will enjoy the benefits of a young go-ahead company including a good salary, flexitime, profit sharing, pension scheme and free life insurance.

Please write to **Kevin Bond, Radio & Electronics World, Sovereign House, Brentwood, Essex CM14 4SE**

SONY BROADCAST LTD
FIELD SERVICE ENGINEER
Broadcast TV Industry

An excellent opportunity has arisen within the service department of Sony Broadcast, one of the world's leaders in professional broacast television equipment. The successful candidate will be engaged in the service and repair of our extensive range of equipment. This will involve travel throughout our marketing territory which covers, Europe, Africa and the Middle East. Training on our range of products will be given where necessary. Applicants should have several years engineering experience gained in the broadcast television industry and knowledge of VTR'S and video cameras is essential.

This position carries an excellent remuneration package which includes company car and relocation expenses if appropriate. If you are interested please contact:

David Parry
Assistant Personnel Officer
Sony Broadcast Ltd, City Wall House
Basing View, Basingstoke, Hants
Tel: 0256 55011

SYSTEMS PROJECT ENGINEER

To be responsible for the manufacture and commissioning of complex static and mobile television systems. Candidates for this challenging and responsible position should have direct experience of sound and television principles gained in operational television or its' allied manufacturing industry.

SENIOR ENGINEER — QUALITY ASSURANCE

To join a department for the evaluation of product performance. Key activities will include conducting customer acceptance tests, the provision of engineering support to our inspectorate and an involvement in the establishment and maintenance of ATE. There will be a significant involvement with customers and the ability to effectively maintain this interface is essential.

We offer attractive salaries and first class conditions of employment. If you are interested please contact:

David Parry
Assistant Personnel Officer
Sony Broadcast Ltd, City Wall House
Basing View, Basingstoke, Hants
Tel: 0256 55011

NOTICE TO ADVERTISERS!

Please make copy as legible as possible, preferably typewritten, in order to minimise printing errors.

FREE SMALL AD ORDER FORM

Send to: Radio & Electronics World Small Ads · Sovereign House · Brentwood · Essex CM14 4SE

Classification:

For Sale ☐ Wanted ☐

USE BLOCK CAPTIALS (One word per box)

USE SEPARATE SHEET FOR MORE WORDS

Name .... Address ....

....

Postcode .... Telephone ....

CONDITIONS: Your ad will be published in the first abailable issue. We will not accept trade advertisements. We reserve the right to exlude any advertisement. RE1283

NEW IMPROVED **Radio & Electronics World**
The communications, electronics & computers magazine

SMALL ADS

ALTAI MULTICHARGER £7.95. **GOULD NI-CAD's 'C TYPE' 1.2 Ah** £2.25 ea. **'Fast Charge Vented AA TYPE' 500mAh** 85p ea. **2½" 8R SPKR** 80p ea. **SWITCHES MOM-MAKE PUSH** 30p ea. **10 x VARIOUS NEW SW** £2.60. **10 x VARIOUS NEW KNOBS** £1.60. **10 x VARIOUS NEW POTS** £2.40. **CASSETTES VIDEO VHS BASF E120** £5.50 ea. **E180** £6.50 ea. **CASSETTES AUDIO TDK-AD C60** £1.10 ea. **C90** £1.30. **C120** £2.25 ea. **IN4007 DIODES** 7p ea. **TIS 43** 32p ea. **7805 REGS** 39p a. **RED LEDS** £1 for 10.
All above prices include VAT, please add 60p towards p&p if order less than £3.00.
We hope to open a component shop in the next few weeks in the South Birmingham area, please watch press for details.

AUTRONICS LIMITED
23 Regency Gardens, Yardley Wood
Birmingham B14 4JS. Tel: 021 474 4638

HANTS

CALBRESCO LTD
258 Fratton Road
Portsmouth
Tel: 0705 735003
Open 10.30am-6pm 6 days
COMMUNICATIONS EQUIPMENT
COMPONENTS, BOOKS, ACCESSORIES

LINCS

J R W COMMUNICATIONS
15 New Street, Lough, Lincolnshire
Tel: 0507 606973
Open Mon-Sat 9am-6pm
Authorised Tandy Dealers.
ICOM, Marine, PMR Dealer. Also YAESU supplied.
Telephone & communications equipment.

LONDON

THE CQ CENTRE
10 MERTON PARK PARADE
KINGSTON ROAD SW19
Tel: 01-543 5150
Open: 6 days 9am-6pm (late night Weds until 8pm)

PERTH

A X DON
32 Atholl Street, Perth
Tel: 0738-23753 **Open: 6 days**
ICOM, YEASU, J-BEAM, SUN, BANTEX, TONO, RSGB Books, Maps & Log Books. Full range of components. Mail order available — send for price list, quoting Radio & Electronics World.

SUSSEX

SOUTHDOWN **RADIO** SUPPLIES
40 TERMINUS RD
EASTBOURNE
Tel: (0323) 639351
(opp. Railway Stn.)
Open: Mon-Sat 10-6 (Closed Tues)
Stockist of: Amateur Radio Equipment YAESU, ICOM, STANDARD, TONNA, DRAE.

WEST MIDLANDS

HEWARDS'S HOME STORES LTD (Est 1963)
822/4 Kingstanding Rd, Birmingham
B44 9RT. Tel: 021-354 2083
G4RJM with 38 years in The Radio Trade
Ham Equipment urgently wanted!
Open: Mon-Sat 9-6

AERIAL BOOSTERS

Next to the set fitting
B45H/G-UHF TV, gain about 20dbs, Tunable over the complete UHF TV band. **PRICE £8.70**
BII-VHF FM RADIO, gain about 14dbs, when on the off position connects the aerial direct to the radio. **£7.70.**
All Boosters we make work off a PP3/006p/6F22 type battery of 8v to 18v DC. **P&P 30p PER ORDER.**

ELECTRONIC MAILORDER LTD,
62 Bridge St, Ramsbottom,
Lancs BL0 9AG. Tel (070682) 3036
Access/Visa Cards Welcome SAE Leaflets

Advertising used Equipment is fast and easy with List-a-rig. Send £1 for every 40 words or less for immediate entry. For a copy of the latest list send 2 First Class Stamps.

G3RCQ, 63 Cecil Avenue
Hornchurch, Essex

IC TESTER

Computer controlled. Just plug in an IC, enter the type number and press return. Tests most common 8 to 24 pin digital IC's and can also identify unmarked IC's. Includes software on cassette or disc (for VIC) £39.95 inc P&P for 16k VIC 20, ZX81, Spectrum & BBC.

MORLEY ELECTRONICS
1 Morley Place, Shiremoor,
Tyne & Wear NE27 0QS

MORSE CODE PREPARATION

RECEIVING
Cassette A: 1-12 wpm for amateur radio examination.
Cassette B: 12-25 wpm for professional examination preparation.
Each cassette is C90. Price of each cassette (incl booklets) £4.75.

SENDING
Morse key with separate battery (PP3) — driven solid-state oscillator and sound transducer produces clear tone for sending practice; optional light (solid state) signal included. Price of key with electronic unit £9.95.
Price includes postage etc. Europe only.

M H ELECTRONICS (Dept RE)
12 Longshore Way, Milton,
Portsmouth PO4 8LS

NEW IMPROVED **Radio & Electronics World**
The communications, electronics & computers magazine

SMALL ADS

This method of advertising is available in multiples of a single column centimetre — (minimum 2cms). Copy can be changed every month.

RATES
per single column centimetre: 1 insertion £9.65, 3 — £9.15, 6 — £8.65, 12 — £7.75.

RADIO & ELECTRONICS WORLD SMALL AD ORDER FORM

TO: **Radio & Electronics World · Sovereign House**
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:........ £ —

Cheques should be made payable to Radio & Electronics World. Overseas payments by International Money Order

CHARGE TO MY ACCOUNT........☐

COMPANY ....

ADDRESS ....

SIGNATURE .... TELEPHONE..............................

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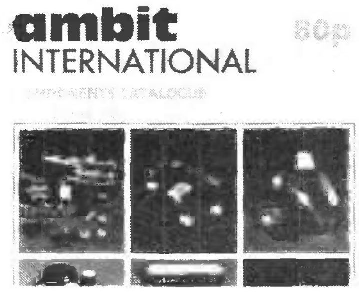
C	P	I							

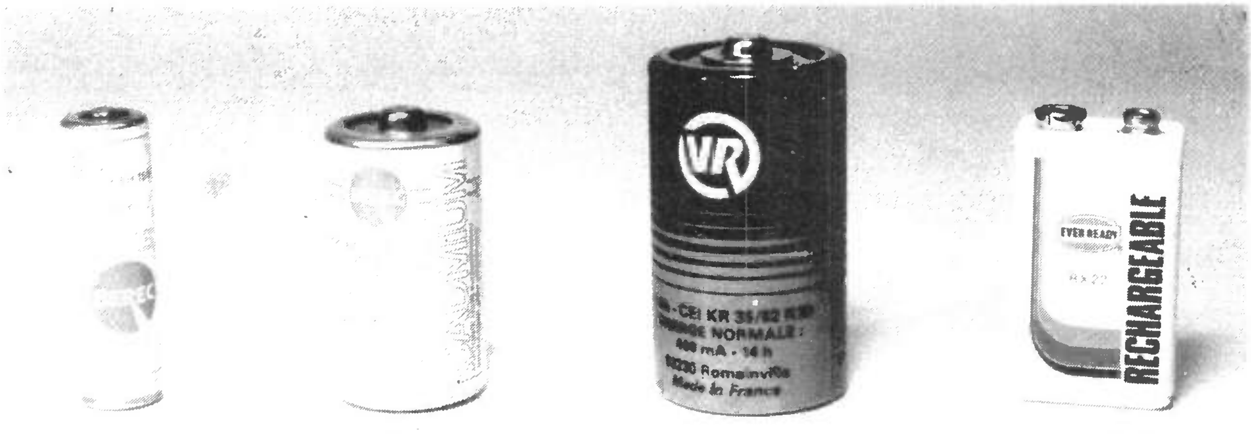
ambit INTERNATIONAL

A topical selection from the current ambit parts and equipment catalogue — 148 pages plus 3 £1 discount vouchers! Send 80p for your copy now!

★ mix quantity prices apply for callers to our sales counters



NiCad battery bonanza time



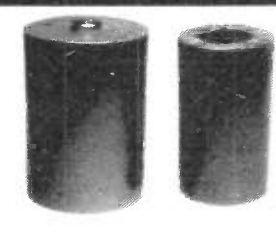
	AA	C	D	PP3
	0.5Ah	2.2Ah	4.0Ah	0.11Ah
1-9	80p	£2.35	£3.05	£3.70
10-49	74p	£1.99	£2.65	£3.50
Stockcode	01-12004	01-12024	01-12044	01-84054

CHARGERS

CH4/RX4
£7.49
01-02204

CH4/50
£4.95
01-00409

BATTERY ADAPTORS
01-12001



A unique battery sleeve adaptor set that converts AA to C or D dimensions, and C to D. Ideal for emergencies.

1-9	10-24
96p	65p

The ideal Christmas Gift!

200 North Service Road, Brentwood, Essex CM14 4SG
Tel: (0277) 230909

CALL AT OUR SALES COUNTERS AT
SOLENT COMPONENT SUPPLIES, 53 Burrfields Road, Portsmouth, Hants
BROXLEA ELECTRONICS, Park Lane, Broxbourne, Herts.
& at Brentwood, of course!

REMEMBER to add 15% VAT & 60p postage to all orders — THANKS!

NEW IMPROVED Radio & Electronics World
The communications, electronics & computers magazine

ADVERTISING RATES & INFORMATION

DISPLAY AD RATES

depth mm x width mm	ad space	1 issue	3 issues	6 issues	12 issues
			series rates for consecutive insertions		
61 x 90	⅛ page	£91.00	£86.00	£82.00	£73.00
128 x 90 or 61 x 186	¼ page	£160.00	£150.00	£145.00	£125.00
128 x 186 or 263 x 90	½ page	£305.00	£290.00	£275.00	£245.00
263 x 186	1 page	£590.00	£560.00	£530.00	£475.00
263 x 394	double page	£1140.00	£1070.00	£1020.00	£910.00

COLOUR AD RATES

depth mm x width mm	ad space	1 issue	3 issues	6 issues	12 issues
		colour rates exclude cost of separations	series rates for consecutive insertions		
128 x 186 or 263 x 90	½ page	£420.00	£395.00	£375.00	£335.00
297 x 210	1 page	£810.00	£760.00	£730.00	£650.00

SPECIAL POSITIONS

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

DEADLINES

*Dates affected by public holidays

issue	colour & mono display ad	small ad	mono artwork	on sale
Jan 84	9 Nov 83*	15 Nov 83*	16 Nov 83*	9 Dec 84
Feb 84	8 Dec 83*	14 Dec 83*	16 Dec 83*	13 Jan 84
Mar 84	12 Jan 84	18 Jan 84	20 Jan 84	10 Feb 84
Apr 84	9 Feb 84	15 Feb 84	17 Feb 84	9 Mar 84

CONDITIONS & INFORMATION

SERIES RATES
Series rates also apply when larger or additional space to that initially booked is taken.
An ad of at least the minimum space must appear in consecutive issues to qualify for series rates.
Previous copy will automatically be repeated if no further copy is received.
A 'hold ad' is acceptable for maintaining your series rate contract. This will automatically be inserted if no further copy is received.
Display Ad and Small Ad series rate contracts are not interchangeable.
If series rate contract is cancelled, the advertiser will be liable to pay the unearned series discount already taken.

COPY
Except for County Guides copy may be changed monthly.
No additional charges for typesetting or illustrations (except for colour separations).
For illustrations just send photograph or artwork.
Colour Ad rates do not include the cost of separations.

Printed — web-offset.

PAYMENT
All single insertion ads are accepted on a pre-payment basis only, unless an account is held. Accounts will be opened for series rate advertisers subject to satisfactory credit references.
Accounts are strictly net and must be settled by the 15th of the month following invoice date.

FOR FURTHER INFORMATION CONTACT
Radio & Electronics World, Sovereign House, Brentwood, Essex CM14 4SE. (0277) 219876

Overseas payments by International Money Order.
Commission to approved advertising agencies is 10%.

CONDITIONS
A voucher copy will be sent to Display and Colour advertisers only.
Ads accepted subject to our standard conditions, available on request.

THE NEW ANTEX TCSU-D

At last–a digital soldering unit for £67·50

THE NEW ANTEX TCSU-D gives you total control over production soldering temperatures

Again Antex research and development pays off — with this new high-value high-performance unit. It's simple design incorporates an LED display and a unique ULA integrated circuit, specially designed and produced for Antex by Ferranti. Tight temperature control can be maintained by setting the station — then removing the knob, preventing any further alteration.

For laboratory, for workshop, for production-line — TCSU-D is the station.

Let it figure in your soldering specifications.

- Temperature range — ambient to 495°C.
- Working temperature reached in under 1 minute.
- Detachable sponge-tray — no drips or spillage.
- Includes the world-famous Antex iron.
- Bit temperature maintained to ±5°C.
- Conforms to BS 3456 and CEE 11.
- Zero crossing switching.

Look into the future of soldering technology - send for the TCSU-D fact-pack now.

ANTEX

ANTEX (Electronics) Ltd.,
Mayflower House, Plymouth, Devon. Telephone: 0752 667377 Telex: 45296

design example. This illustrates how appropriate Boolean equations are generated, how the fuse tables are prepared, actual device programming and testing to ensure that the result meets the original design specification.

The booklet is available free of charge from Microsystem Services.

Microsystem Services, PO Box 37, Lincoln Road, Cressex Industrial Estate, High Wycombe, Bucks. HP12 3XJ

NOVEL HANDHELD MULTIMETER

Fluke recently launched a new range of low-cost handheld multimeters which is said to break new ground by having both an analogue and a digital display. The manufacturers believe that this 70 Series should therefore capture a large share of the analogue market, whilst maintaining their place in the digital part of the

market.

The range consists of three fully autoranging models incorporating proprietary CMOS ICs, the only control being an eight-position function switch. The analogue display is a fast-moving 32-segment LCD bargraph and its digital equivalent a 3½-digit LCD display but with 3200 counts and therefore 4½-digit resolution for readings up to 3200. Other advantages include an estimated 2000-hours battery life and 0.7%/0.5%/0.3% accuracy (depending on the model). The deluxe model also features Touch-Hold which enables the user to concentrate on the test probes rather than continuously watching the display. The Model 77 bleeps when it detects a stable reading and then holds that until a new stable reading is detected or the user changes test points.

All models measure DC voltages to 750V, AC voltages to 1kV, current to 10A and resistance to 32MΩ.

Fluke (GB) Ltd, Colonial Way, Watford, Herts. WD2 4TT

FELD STRENGTH METER

Sadelta's TC40, available from House of Instruments, is designed to measure the performance of aerials in their current location. Its readings will therefore suggest the best position in which to install the aerial.

The signals from the aerial are fed to the TC40's 75Ω coaxial-type input connector, whereupon the meter indicates the RMS voltage and dB's/microvolt on one of seven scales covering 100μV fullscale to 100mV fullscale (lowest reading 20μV). Coarse and fine tuning controls enable Band I TV (45–88MHz), Band II FM (87—108MHz), Band III TV (163—230 MHz) and Bands IV and V TV (470—862MHz) to be fully covered. In addition, there are facilities for audio monitoring of AM and FM, and for

continuity and short-circuit testing.

The TC40 is both compact and lightweight which, together with its internal power supply of two 4.5V batteries and its carrying case, makes it fully portable.

House of Instruments, Clifton Chambers, 62 High Street, Saffron Walden, Essex. CB10 1EE

EMERGENCY-STOP BUTTON

Quiller Components has added a new push-button switch that could be used as an emergency-stop button to the range of Breter control switches it stocks. The new switch — the M206SR — has a 35mm diameter mushroom head, either a thermoplastic or a metal body and a 'turn to release' action. The use of snap-on contact blocks gives it flexibility in circuit arrangement, while the contact block can also be wired separately from the operator if so required. The contacts are of high conductivity silver alloy to give resistance to wear.

The switch conforms to all major European and International standards and regulations, and is suitable for use in the control of industrial equipment.

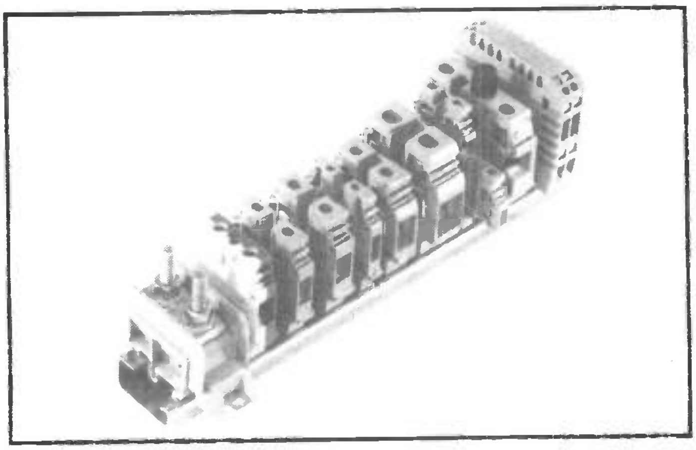
Quiller Components Ltd, 85 Stanley Road, Bournemouth, Dorset. BH1 4SD.

DIN RAIL-MOUNTED TERMINALS

The Entrelec Series 500 range of DIN rail-mounted terminals illustrated here is a recent addition to the Verospeed catalogue. There are five sizes of standard terminals within the range, with nominal current ratings between 35 and 138A, as well as 'fused', 'space-saver' and 'interruptable' types of terminal.

All the terminals fit DIN 1, 2, 3 and Cenelec rails and are manufactured from a material known as super polymide that gives them a non-brittle and flexible construction over the temperature range −55°C to +130°C. The Series 5000 also features locked-in parts, individual terminal locking and a unique kind of preformed jumper bar.

Verospeed, Stansted Road, Boyatt Wood, Eastleigh, Hants. SO5 4ZY



WATFORD ELECTRONICS

34/35 CARDIFF ROAD, WATFORD, HERTS, ENGLAND
MAIL ORDER, CALLERS WELCOME
Tel. Watford (0923) 40588. Telex: 8956095

ALL DEVICES FULLY GUARANTEED. Send Cheque, P.O.s, Cash or Bank Draft with orders. **TELEPHONE ORDERS BY ACCESS/MASTERCHARGE ACCEPTED.** Government & Educational Establishments official orders welcome. P&P add 60p to all CASH orders. Overseas orders, postage at cost. Prices correct at the time of going to press.

VAT

Export orders no VAT. Applicable to U.K. Customers only. Unless stated otherwise, all prices are exclusive of VAT. Please add 15% to the total cost including P&P.
We stock thousands more items. It pays to visit us. We are situated behind Watford Football Ground.
Nearest Underground/BR Station: Watford High Street.
Open Monday to Saturday: 9.00 am to 6.00 pm. Ample Free Car Parking space available.

ELECTROLYTIC CAPACITORS: (Values in µF) 500V 10µF 52p, 47 78p; 63V 0.47, 1.0, 1.5, 2.2, 3.3, 4.7 8p, 10 10p, 15, 22 12p, 33 15p, 47 12p, 68 20p, 100 19p, 220 26p, 1000 70p; 2200 99p, 50V 68 20p; 100 17p, 220 24p, 40V 6.8 15p, 22 9p, 33 12p, 330, 470 32p, 1000 48p, 2200 90p; 25V 1.5, 4.7, 10, 22, 47 8p, 100 11p, 150 12p, 220 15p, 330 22p, 470 25p, 680, 1000 34p; 1500 42p, 2200 50p, 3300 76p, 4700 92p, 16V 47, 68, 100 9p, 125 12p, 330 16p, 470 20p, 680 34p; 1000 27p, 1500 31p, 2200 36p, 4700 79p.

TAG-END CAPACITORS: 64V 2200 139p, 3300 198p, 4700 245p, 50V 2200 110p, 3300 154p; 40V 4700 180p, 25V 2200 90p; 3300 98p; 4000, 4700 98p, 10,000 320p; 15,000 345p, 16V 22,000 360p

POLYESTER CAPACITORS: Axial Lead Type
400V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8 11p, 10n, 15n, 18n, 22n 12p, 33n, 47n, 68n 16p, 150n 20p, 220n 30p, 330n 42p, 470n 52p, 680n 1µF 68p, 2µ2 82p.
160V; 10nF, 12n, 39n 11p, 150n, 220n 17p, 330n, 470n 30p, 680n 38p; 1µF 48p, 1µ5 45p, 2µ2 48p, 4µ7 58p.
1000V; 1nF 17p, 10nF 30p, 15n 40p, 22n 36p, 33n 42p; 47n, 100n 42p.

POLYESTER RADIAL LEAD CAPACITORS 250V
10n, 15n, 22n, 27n 6p; 33n, 47n, 68n, 100n 7p; 150n, 220n 10p; 330n, 470n 13p; 680n 19p; 1u 23p; 1u5 40p; 2u2 46p

FEED-THROUGH CAPACITORS
1000pF/450V 10p

SIEMENS pcb Type Miniature poly Capacitors
250V
1nF, 1n5, 2n2, 3n3, 4n7, 6n8, 10n, 15n 7p
18n, 22n, 27n, 33n, 39n, 47n 8p
39n, 56n 12p
82n, 100n 11p
100V
100n, 120n 10p
150n, 180n 12p
220n, 270n 16p
330n, 390n 20p
470n 560n 28p
680n 30p
1uF 34p 2u2 50p

TANTALUM BEAD CAPACITORS
35V 0.1µF, 0.22, 0.33 15p; 0.47, 0.68, 1.0, 1.5 16p, 2.2, 3.3 18p; 4.7, 6.8 22p; 10 28p; 16V 2.2, 3.3 16p; 4.7, 6.8, 10 18p; 15 36p; 22 36p; 33, 47 50p, 100 95p, 10V: 15, 22 26p; 33, 47 50p; 100 80p, 6V: 100 55p

POTENTIOMETERS: Rotary, Carbon, Track 0.25 W Log & Lin values.
500 Ω, 1 KΩ & 2 KΩ (Linear only) Single-Gang 34p
5 KΩ-2 MΩ Single Gang Log & Lin 34p
5 KΩ-2 MΩ Single Gang D/P Switch 80p
5 KΩ-2 MΩ Double Gang 90p

MYLAR FILM CAPACITORS
100V 1nF, 2, 4, 4nF, 10 6p; 15nF, 22n, 30n, 40n, 47n 7p; 56n, 100n, 200n 9p. 50V 470nF 12p.

SLIDER POTENTIOMETERS
0.25 W log and linear values 60 mm
5 KΩ-500 KΩ single gang 70p
Self Stick Graduated Bezel 45p

CERAMIC CAPACITORS 50V
Range 0.5pF to 10nF 4p 15nF 22nF 33nF, 47nF 5p 100nF/30V 7p 200nF/6V 8p.

PRESET POTENTIOMETERS
0.1W 100Ω 5MΩ Miniature Vertical or Horizontal 7p
0.25W 100Ω 3.3MΩ horiz. larger 12p
0.25W 200Ω 4.7MΩ vert 12p

POLYSTYRENE CAPACITORS
10pF to 1nF 8p; 1.5nF to 12nF 10p

ACCESS

Orders
Just phone your orders through.
We do the rest
Tel: 0923 50234

SILVER MICA (Values in pF)
2, 3.3, 4.7, 6.8, 8.2, 10, 12, 15, 18, 22, 27, 33, 39, 47, 50, 56, 68, 75, 82, 85, 100, 120, 150, 180pF 16p each
200, 220, 250, 270, 300, 330, 360, 390, 470, 800, 800, 820 21p each
1000, 1200, 1800, 2200 30p each
3300, 4700pF 60p each

MINIATURE TRIMMERS Capacitors
2.6pF, 2.10pF 22p, 2.25pF, 5.60pF 30p, 10.88pF 35p

RAM FOR BBC MICRO 4816AP 100ns 250p

RESISTORS Carbon Film Hi Stab 5%, miniature

	RANGE	Val	1-99	100+
0.25W	2Ω2-4M7	E24	3p	1p
0.5W	2Ω2-4M7	E12	3p	1p
1W	2Ω2-4M7	E12	6p	4p
1% Metal Film		E24	8p	6p

100 + price applies to Resistors of each type not mixed

RESISTORS Network S.I.L.
7 Commoned (8 pins) 100Ω, 680Ω, 1K 2k2, 4K7, 10K, 47K 100K 25p
8 Commoned (9 pins) 150Ω, 180Ω, 270Ω, 330Ω, 1K 2k2, 4K7, 10K, 22K, 47K & 100K 28p

DIODES

AA119	15
AA129	20
AAY30	15
BA100	15
BAX13	20
BY100	24
BY126	12
BY127	14
CRO33	250
OA9	40
OA47	12
OA70	12
OA79	15
OA81	20
OA85	15
OA90	8
OA91	8
OA95	8
OA200	8
OA202	8
1N914	4
1N916	5
1N4001/2	5
1N4003	6
1N4004/5	6
1N4006/7	7
1N4148	4
1N5401	15
1N5404	16
1N5406	17
1N5408	19
1S44	9
1S921	9
6A/100V	40
6A/400V	50
6A/800V	65

BRIDGE RECTIFIERS

1A 50V	18
1A 100V	20
1A/400V	25
1A/600V	34
2A/50V	30
2A/200V	40
2A/400V	46
2A/600V	65
6A/100V	83
6A/400V	95
10A/200V	215
10A/600V	298
25A 200V	240
25A/600V	395
BY164	56
VM18 DIL	50

ZENERS

Range 2V7 to 39V 400mW 8p each
Range 3V3 to 33V 1.3W 15p each

TRIACS

3A 200V	54
3A 400V	56
8A 100V	80
8A 400V	80
8A 800V	115
12A 100V	78
12A 400V	82
12A 800V	135
16A 100V	103
16A 400V	105
16A 800V	220
25V 500V	220
25A 800V	295
T2800D	120

VARICAPS

BA102	50
BB105B	40
BB106	40
BB109B	45
MVAM2	105

75 SERIES

75107/8	95
75110	90
75114/5	150
75121/2	130
75150	125
75154	125
75159	195
75182/3	99
75188/9	55
75322	140
75324	360
75365	150
75450	86
75451/2	52
75454	70
75491/2	65

SCR THYRISTORS

5A 40V	32
5A 400V	40
5A 600V	48
8A 300V	60
8A 600V	90
12A 100V	78
12A 400V	95
12A 800V	180
BT106	150
BT116	180
C106D	38
TIC44	24
TIC45	29
TIC47	35
2N5062	32
2N5064	38
2N4444	130

DIAC

ST2	25

COMPUTER ICs

2114L-200n	130
2147	395
2532	300
2564	£6
2708	285
27L08	450
2716 5V	270
2732-250	320
27L32	550
2764-250	425
27128	£20
27128-4	£18
3242	590
4027	100
4116L 120	498
4116-150n	100
4116 200n	90
4118-250	325
4164-200n	425
4334-3	CMDS
4416-2	475
4532-3	220
4816-100n	250
5101 450	220
6116-150n	340
6116L 120	525
6117-110n	490
6502A	450
6502CPU	325
6503	600
6504 250	550
6505	600
6520 PIA	100
6522 VIA	285
6530	£11
6532	570
6545 RTC	899
6551 ACIA	650
6800	220
6802	250
6803	850
6804	160
6805	670
6808	520
6809	630
6810	115
6821	100
68B21	220
6840	375
6843	£12
6845	750
6846	625
6847	650
6850	110
6852	250
6854	599
68B54	890
6875	500
68000	£68
8035	600
8080A	250
8085A	350
8088	£18
8118-10	250
8123	125
8155	350
8156	350
81LS95	120
81LS96	120
81LS97	120
81LS98	120
8202	£25
8212	150
8214	425
8216	100
8224	150
8225	£11
8226	250
8228	220
8243	270
8250	850
8251 A	250
8253	400
8255	225
8256 AC	£36
8257 A	400
8259	395
8271	£36
8272	£17
8279	410
8282	450
8283	00
8285	365
8287	00
8288	£10
DP8304	250
8T26A	99
8T27	150
8T28A	120
8T31	350
8T95	90
8T97N	90
9364AP	550
9602	220
AM26LS31C	125
AM26LS32A	125
AM26LS33A	125
AY 5 1013	300
AY 5 2376	600
COM8017	275
COM8116	700
DM8131	275
DS3691N	320
DS88LS120N	275
DS8820	110
DS8830	110
DS8831	125
DS8832	250
E9365	£38
E9366	£38
FD1691	£15
FD1771	£15
FD1791	£22
FD1793	£23
FD1795	£28
FD1797	£28
FD1799	£28
HD26501	75
IM6402	380
INS8060N	1050
INS8154N	£9
MC1488	55
MC1489	55
MC14411	690
MC14412	725
MC3446	250
MC3447P	315
MC3486	225
MC3487	225
MC6845	625
MC6846	625
MK3886-2M	£7
MM5280D	695
MM5303	635
MM5307	1275
MM5387A	475
MM58174	700
MM74C922	420
RO-3-2513L	550
RO-3-2513U	650
SFF9634E	800
SPO256AL2	950
TMS2716-3V	725
TMS4164	395
TMS4500	£14
TMS5100	600
TMS9927	£14
TMS9928	£20
TMS9929	£20
TMS9995	£12
UPD7002	425
WD1691	£14
Z80CPU 2.5M	285
Z80ACPU4M	300
Z80 CTC	250
Z80A CTC	260
Z80B	£8
Z80 DART	698
Z80ADART	690
Z80 DMA	695
Z80 PID	260
Z80A PID	275
Z80 SID 1	850
Z80A SID	£9

LINEAR ICs

555CMOS	80
702	75
709C 8 pin	35
710	48
741-8 pin	14
747C 14pin	65
748C 8 pin	36
753 8 pin	185
810	159
9400CJ	350
AY-1-1320	225
AY 1-5050	99
AY-1-5051	160
AY-1-6720	210
AY-3-1270	730
AY-3-1350	350
AY-3-8910	438
Booklet for AY-3-8910	200
AY-3-8912	625
AY-5-1230	450
AY-5 1317A	630
AY-5 1350	388
CA3011	130
CA3012	175
CA3014	275
CA3018	86
CA3019	80
CA3020	210
CA3023	210
CA3028A	95
CA3035	255
CA3036	270
CA3043	275
CA3045	385
CA3046	70
CA3048	220
CA3059	285
CA3075	213
CA3080E	70
CA3081	190
CA3086	48
CA3089E	215
CA3090AQ	375
CA3123E	165
CA3130	90
CA3140	40
CA3160	95
CA3161	160
CA3162E	450
CA3189	200
HA1336W	240
HA1388	255
ICL7106	690
ICL7107	975
ICL7204	550
ICL7611	99
ICL7660	248
ICL8038CC	300
ICL8211A	175
ICM7205A	1150
ICM7207	475
ICM7215	1050
ICM7216AJ	£22
ICM7216B	£22
ICM7216C	£22
ICM7217A	750
ICM7224	785
ICM7240	300
ICM7555	80
ICM7556	150
LA3350	250
LA4031P	340
LA4032	295
LA4400	350
LA4422	320
LC7130	340
LC7120	300
LC7137	395
LF347	150
LF351	48
LF353	95
LF355	85
LF356	95
LF357	110
LF398	475
LM10	325
LM301A	24
LM307	45
LM308T	95
LM311	70
LM318N	150
LM319	195
LM324A	30
LM334Z	90
LM335Z	128
LM339	47
LM348	64
LM349	115
LM358	60
LM377	175
LM379	480
LM380	75
LM381N	145
LM382	115
LM384	160
LM386	90
LM387	120
LM389	95
LM393	100
LM558	75
LM725CN	325
LM733	70
LM1458	45
LM1871	325
LM2917	195
LM3302	75
LM3900	50
LM3909N	85
LM3911	125
LM3914	250
LM3915	250
LM3916	225
LS7220	280
M515:3L	230
M51515L	320
M51516L	475
M706 81	125
MB3712	220
MB3756	440
MC1204	250
MC1301	79
MC1303	98
MC1304P	260
MC1310P	150
MC1445	250
MC145106	695
MC1455	60
MC1469	300
MC1494	694
MC1495	350
MC1496L	70
MC1596	225
MC1648	290
MC1709G	90
MC3302	90
MC3401	65
MC3403	75
MC3405	150
MC3423	80
MC4016	00
MF10	350
MFC6040	75
MK50398	635
ML924	275
MSM5576	820
NE515	275
NE529	225
NE531	160
NE534	150
NE543K	225
NE544	210
NE555	16
NE556	45
NE560	325
NE561	398
NE562B	410
NE564	420
NE565A	120
NE566	155
NE567V	140
NE570	410
NE571	400
NE5532	145
NE5534A	150
DM335	750
RC4136D	60
RC4558	45
S566B	225
SAB3209	425
SAB3210	325
SAB3271	485
SAB4209	595
SG3402	295
SL490	350
SL6270CD	150
SN76013	350
SN76023ND	240
SN76131	125
SN76227N	95
SN76477	420
SN76488	480
SP0256AL2	£9
SP8629	350
TA7120	125
TA7130	150
TA7204	150
TA7205	90
TA7222	150
TAA621AX1	295
TAA661A	190
TAA700	275
TAA900	395
TAD100	159
TBA120S	70
TBA540Q	275
TBA550Q	330
TBA641BX or BX11	290
TBA651	190
TBA800	80
TBA810	95
TBA820	80
TBA920Q	200
TBA950	225
TBA990Q	350
TBA540	275
TC9109	750
TCA220	350
TCA270D	350
TCA280A	220
TDA1004	290
TDA1008	310
TDA1022	499
TDA1024	115
TDA1034	350
TDA1490	350
TDA2002	325
TDA2003	250
TDA2004	495
TDA2006	330
TDA2020	320
TDA2030	295
TDB0701	420
TL170	50
TL430	90
TL507	110
TL509	110
TL061CP	40
TL062CP	60
TL064CN	98
TL071CP	25
TL072CP	45
TL074CN	100
TL081CP	24
TL082CP	45
TL083CP	75
TL084CN	90
TL091CP	55
UA2240	120
UA78540	230
UAA170	170
UAA180	180
UGN3020T	160
ULN2001	80
ULN2003	75
ULN2004	75
ULN2283	100
UPC575	275
UPC1025H	375
UPC1156H	270
UPC1182	320
UPC1366	195
XR2206	300
XR2207	375
XR2211	575
XR2216	675
XR2266	360
ZN414	80
ZN419E	180
ZN423E	130
ZN424E	130
ZN425E	345
ZN426E	300
ZN427E	600
ZN428E	410
ZN429E	210
ZN459	570
ZN1034E	200
ZN1040E	665
ZNA234E	850

TRANSISTORS

AC126/7	36
AC141/2	30
AC176	28
AC187	32
AC188	32
ACY19/21	75
ACY22/41	75
AD142	120
AD149	79
AD161	42
AD162	42
AF115/6	60
AF118	80
AF124/26	70
AF139	40
AF178	75
AF186	70
AF239	55
BC107	10
BC107B	12
BC108	10
BC108B	12
BC109	10
BC109B	12
BC109C	12
BC114/5	22
BC117/8	20
BC137/9	40
BC142/3	30
BC147	9
BC147B	10
BC148	9
BC148B	10
BC149	9
BC149C	10
BC153/4	27
BC157/8	10
BC159	11
BC160	46
BC167A	10
BC168C	10
BC169C	10
BC170	15
BC171/2	11
BC173	11
BC177/8	16
BC179	20
BC181	20
BC182/3	10
BC184	10
BC182L	10
BC183L	10
BC184L	10
BC186/7	28
BC212	10
BC212L	10
BC213	10
BC213L	10
BC214	10
BC214L	10
BC237/8	14
BC307B	14
BC308	16
BC256B	30
BC318	30
BC327/8	15
BC337/8	15
BC441/61	34
BC477	40
BC516/7	40
BC547/8	12
BC549C	14
BC556/7	15
BC558/9	15
BCY45	50
BCY58/59	36
BCY70/71	16
BCY72	20
BCY78	24
BD121	96
BD124	115
BD131/32	48
BD133	70
BD135	46
BD136/37	40
BD138/39	40
BD140	40
BD144	190
BD158	55
BD205/6	110
BD245	45
BD378	70
BD517	75
BD645	80
BD695A	125
BD696A	125
BF115	36
BF154/8	25
BF184/5	38
BF194/5	12
BF198/9	18
BF200	80
BF224A	25
BF224B	29
BF245	30
BF256A	36
BF256B	46
BF257/8	32
BF259	35
BF336/7	40
BF494/5	30
BF594/5	30
BFR39/40	23
BFR41/79	23
BFR80/81	25
BFR98	106
BFX29	28
BFX81	45
BFX84	28
BFXP5/6	28
BFY50/51	23
BFY52	23
BFY53	32
BFY55/6	32
BFY64	35
BFY81	120
BFY90	80
BRY39	40
BSX20	20
BSX26/29	34
BU105	170
BU205	190
BU206	200
BU208	200
BUY69C	225
E421	250
MD8001	250
MJ2955	70
MJE170	150
MJE180	150
MJE340	54
MJE370	100
MJE371	100
MJE520	96
MJE521	96
MJE2955	99
MJE3055	70
MPF102	40
MPF103	30
MPF104	30
MPF105	30
MPF106	40
MPSA05	25
MPSA08	25
MPSA12	32
MPSA55	30
MPSA56	30
MPSA70	30
MPSU02	58
MPSU05	56
MPSU06	56
MPSU52	65
MPSU55	50
MPSU56	60
MPSU56	60
OC26	170
OC28/35	220
OC36/41	75
OC42	50
OC70	40
OC71/72	40
OC75/76	40
OC81/82	50
OC83/84	40
OC170/71	50
TIP29A	32
TIP29C	38
TIP30A	35
TIP30C	37
TIP31A	38
TIP31B	39
TIP31C	39
TIP32A	36
TIP32C	42
TIP33A	65
TIP33C	78
TIP34A	74
TIP34C	88
TIP35A	110
TIP35C	128
TIP36A	130
TIP36C	140
TIP41A	50
TIP41B	52
TIP42A	55
TIP42B	58
TIP120	73
TIP121/2	78
TIP141/2	106
TIP147	120
TIP2955	60
TIP3055	60
TIS43	32
TIS44/5	50
TIS /74	50
TIS88A	50
TIS90/91	30
UC734	65
VK101	99
VN10KM	70
VN46AF	95
VN66AF	110
VN88AF	99
VN89AF	120
ZTX300	13
ZTX301	16
ZTX302	16
ZTX303	25
ZTX304	17
ZTX314	25
ZTX326	30
ZTX341	30
ZTX451	23
ZTX500	14
ZTX501/2	15
ZTX503	18
ZTX504	25
ZTX531	25
ZTX550	25
2N697	23
2N698	40
2N699	48
2N706A	19
2N708	19
2N918	35
2N1131/2	21
2N1671B	160
2N160	295
2N2219A	28
2N2220A	26
2N2221A	26
2N2222A	26
2N2368	25
2N2369A	18
2N2483/4	27
2N2646	46
2N2904/5	26
2N2906/7	26
2N2907A	26
2N2926G	10
2N3053	25
2N3054	58
2N3055	40
2N3252	46
2N3441/2	140
2N3614/5	199
2N3663	15
2N3702/3	10
2N3704/5	10
2N3706/7	10
2N3708/9	10
2N3710/11	10
2N3713	140
2N3771	179
2N3772	196
2N3773	210
2N3819	22
2N3820	36
2N3822/3	45
2N3824	66
2N3866	90
2N3903/4	15
2N3905/6	15
2N3906	17
2N4037	46
2N4058	10
2N4061/2	10
2N4064	115
2N4234	48
2N4264	24
2N4286	15
2N4289	18
2N4314	78
2N4400	18
2N4427	80
2N4871	55
2N4898	135
2N5135/6	20
2N5138	18
2N5172	18
2N5179	45
2N5180	45
2N5190/1	75
2N5194	80
2N5305/8	30
2N5457/8	30
2N5459	30
2N5485	36
2N5777	46
2N5879	190
2N6027	32
2SA671	250
2SA715	60
2SC495	70
2SC496	70
2SC1061	250
2SC1096	85
2SC1162	30
2SC1173	125
2SC1306	100
2SC1307	150
2SC1449	85
2SC1678	140
2SC1679	190
2SC1923	50
2SC1945	225
2SC1963	90
2SC1957	90
2SC1969	140
2SC2028	85
2SC2029	210
2SC2078	170
2SC2091	85
2SC2314	85
2SC2166	195
2SC2335	225
2SC2547	30
2SC2612	225
2SD234	74
2SK45	90
2SK288	225
2SJ83	225
2SJ85	225
3N128	112
3N140	112
40315	90
40316	95
40324	100
40326/7	70
40347	90
40348	120
40360	80
40361/2	70
40407/8	75
40411	285
40412	90
40467A	130
40468	85
40594	105
40603	110
40673	75
40871/2	90

RF CHOKES
Miniature PCB type

1uH, 2u2, 4u7, 10u, 22u, 33u, 47u, 100u, 220u, 330u, 470u 30p
1mH, 1m5, 2m2, 4m7, 10mH 35p
22m, 33m, 43m 60p
100m 75p

TTL74

7400, 7401, 7402, 7403, 7404, 7405, 7406, 7407, 7408, 7409, 7410, 7411, 7412, 7413, 7414, 7416, 7417, 7420, 7421, 7422, 7423, 7425, 7426, 7427, 7428, 7430, 7432, 7433, 7437, 7438, 7440, 7441, 7442, 7443, 7444, 7445, 7446, 7447, 7448, 7450, 7451, 7453, 7454, 7460, 7470, 7472, 7473, 7474, 7475, 7476, 7480, 7481, 7482, 7483, 7484, 7485, 7486, 7489, 7490, 7491, 7492, 7493, 7494, 7495, 7496, 7497, 74100, 74104, 74105, 74107, 74109, 74110, 74111, 74112, 74116, 74118, 74119, 74120, 74121, 74122, 74123, 74125, 74126, 74128, 74132, 74136, 74141, 74142, 74143, 74144, 74145, 74147, 74148, 74150, 74151, 74153, 74154, 74155, 74156, 74157, 74159, 74160, 74161, 74162, 74163, 74164, 74165, 74166, 74167, 74170, 74172, 74173, 74174, 74175, 74176, 74177, 74178, 74179, 74180, 74181, 74182, 74184, 74185, 74188, 74190, 74191, 74192, 74193, 74194, 74195, 74196, 74197, 74198, 74199, 74221, 74246, 74247, 74248, 74249, 74251, 74259, 74265, 74273, 74276, 74278, 74279, 74283, 74284, 74285, 74290, 74293, 74297, 74298, 74351, 74365, 74366, 74367, 74368, 74390, 74393, 74490

74C

74C244	195
74C245	195
74C373	240
64C374	245
74C922	400
74C923	500

74S

74S00	30
S02	30
S03	30
S04	30
S05	60
S08	60
S20	40
S32	70
S74	75
S86	65
S112	80
S114	80
S132	110
S133	60
S138	100
S139	115
S157	225
S158	210
S188	140
S189	140
S194	295
S195	275
S201	250
S225	240
S241	250
S244	290
S251	225
S257	225
S262	850
S287	225
S288	210
S289	200
S301	350
S365	250
S412	380
S470	325
S471	620
S472	1150
S475	800
S571	620

74LS

74LS00	15
74LS01	15
74LS02	15
74LS03	16
74LS04	18
74LS05	18
74LS08	18
74LS09	18
74LS10	18
74LS11	18
74LS12	18
74LS13	22
74LS14	36
74LS15	18
74LS20	18
74LS21	18
74LS22	18
74LS24	75
74LS26	20
74LS27	18
74LS28	20
74LS30	18
74LS32	18
74LS33	19
74LS37	19
74LS38	19
74LS40	20
74LS42	32
74LS47	37
74LS48	40
74LS49	38
74LS51	18
74LS54	18
74LS55	18
74LS63	120
74LS73	22
74LS74	22
74LS75	32
74LS76	22
74LS78	22
74LS83	34
74LS85	45
74LS86	28
74LS90	25
74LS91	48
74LS92	25
74LS93	25
74LS95	44
74LS96	60
74LS107	36
74LS109	36
74LS112	28
74LS113	28
74LS114	30
74LS122	50
74LS123	60
74LS124	80
74LS125	32
74LS126	32
74LS132	35
74LS133	35
74LS136	24
74LS138	34
74LS139	34
74LS145	46
74LS147	98
74LS148	82
74LS151	40
74LS153	40
74LS154	200
74LS155	27
74LS156	27
74LS157	25
74LS158	25
74LS160	36
74LS161	36
74LS162	36
74LS163	36
74LS164	40
74LS165	49
74LS166	72
74LS168	85
74LS169	100
74LS170	85
74LS173	70
74LS174	37
74LS175	30
74LS181	90
74LS183	88
74LS190	40
74LS191	38
74LS192	40
74LS193	40
74LS194	33
74LS195	33
74LS196	40
74LS197	40
74LS221	66
74LS240	53
74LS241	53
74LS242	68
74LS243	68
74LS244	53
74LS245	80
74LS247	43
74LS248	43
74LS249	43
74LS251	30
74LS253	30
74LS257	30
74LS258	30
74LS259	66
74LS260	24
74LS261	125
74LS266	24
74LS273	51
74LS275	125
74LS279	34
74LS280	140
74LS283	37
74LS290	32
74LS293	32
74LS295	52
74LS298	52
74LS299	115
74LS320	120
74LS323	135
74LS324	175
74LS325	295
74LS326	240
74LS327	240
74LS347	60
74LS348	96
74LS352	60
74LS353	60
74LS356	180
74LS365	36
74LS366	36
74LS367	36
74LS368	36
74LS373	56
74LS374	56
74LS375	28
74LS377	57
74LS378	65
74LS379	80
74LS384	375
74LS385	145
74LS386	33
74LS390	47
74LS393	46
74LS395	65
74LS398	75
74LS399	55
74LS447	30
74LS464	90
74LS467	90
74LS490	60
74LS540	66
74LS541	66
74LS670	85
74LS673	785
74LS674	785

SWITCHES

Toggle: 2 A, 250 V	
SPST	35p
DPDT	48p

SUB-MIN TOGGLE

SPST on/off	54p
SPDT c/over	60p
SPDT centre off	85p
SPDT biased both ways	105p
DPDT 6 tags	75p
DPDT centre off	88p
DPDT biased both ways	145p
DPDT 3 positions on/on/on	185p
3-pole 2-way	205p

SLIDE 250 V:

DPDT 1 A	14p
DPDT 1 A c/off	15p
DPDT ½ A	13p

PUSHBUTTON 6 A
with 10 mm Button

SPDT latching	110p
DPDT latching	160p
SPDT moment	110p
DPDT moment	145p

Mini Non Locking

Push to Make	15p
Push to Break	25p

DIL SWITCHES
(SPST) 4 way 65p 6 way 80p
8 way 85p 10 way 100p
(SPDT) 4 way 190p.

ROTARY SWITCHES:
(Adjustable Stop type)
1 pole/2 to 12 way; 2 p/2 to 6 way;
3 pole/2 to 4 way; 4 p/2 to 3 way 48p

ROTARY: Mains DP 250V 4 Amp on/off 68p

ROTARY: (Mak-a-switch) Make a multiway switch Shafting assembly has adjustable stop Accommodates up to 6 wafers (max 6 pole/12 way · OP switch)
Mechanism only 90p
WAFERS: (make before break) to fit the above switch mechanism
1 pole/12 way; 2 pole/6 way, 3 pole/4 way; 4 pole/3 way; 6-/2 way 65p
Mains DP 4A Switch to fit 48p
Spacers 4p. Screen 8p

ROCKER 5A/250V SPST	28p
ROCKER 10A/250V SPDT	38p
ROCKER 10A/250V DPDT c/off	95p
ROCKER 10A/250V DPST with neon	85p

THUMBWHEEL

Mini front mounting	
Decade Switch Module	250p
B.C.D. Switch Module	275p
Mounting Cheeks (per pair)	75p

VEROBOARD 0.1in

	clad	plain
2½ x 3¾	85p	—
2½ x 5"	100p	—
3¾ x 3¾	100p	—
3¾ x 5"	115p	—
3¾ x 17"	390p	198p
4¾ x 17"	495p	275p
Pkt. of 100 pins		55p
Spot face cutter		150p
Pin insertion tool		185p

VERO WIRING

PEN + spoool	340p
Spare spool	75p
Combs	8p

FERRIC CHLORIDE
1 lb bag Anhydrous 195p + 50p P&P

VQ Board	195p
DIP Board	395p
Vero Strip	95p

PROTO DECs

Veroblock	405p
S-Dec	380p
Eurobreadboard	520p
Bimboard 1	575p
Superstrip SS2	1380p

DALO ETCH RESIST PEN
Plus spare tip 100p

ULTRASONIC TRANSDUCER
40 kHz 350pr

IDC CONNECTORS

	PCB Plugs with latch Pins Strt	PCB Plugs Pins Angle	Female Header Plug	Female Card Edge Connect
10 way	90p	99p	85p	120p
16 way	130p	150p	110p	—
20 way	145p	166p	125p	195p
26 way	175p	200p	150p	240p
34 way	205p	236p	160p	320p
40 way	220p	250p	190p	340p
50 way	235p	270p	200p	395p
60 way	—	—	230p	495p

EURO CONNECTORS

	Female Socket Strt. Pins	Female Socket Angle Pins	Male Plug Strt. Pins	Male Plug Angle Pins
DIN41617 31way	170p	—	—	175p
DIN41612 2x32 A+B	275p	320p	220p	285p
DIN41612 2x32 A+C	295p	340p	240p	300p
DIN41612 3x32A+B+C	360p	385p	260p	395p

PANEL METERS

FSD
60 x 46 x 35mm
0-50μA
0-100μA
0-500μA
0-1mA
0-5mA
0-10mA
0-50mA
0-100mA
0-500mA
0-1A
0-2A
0-25V
0-50V AC
0-300V AC
"S"
"VU"
425p each

RELAYS

Miniature, enclosed, PCB mount.
SINGLE POLE Changeover
RL6-91 205Ω Coil; 12 V DC (10V5 to 19.5 V). 10 A at 30 V DC or 250 V AC 185p
DOUBLE POLE Changeover. 6 A 30 V DC or 250 V AC
RL6-100 53 Ω Coil, 6 V DC (5V4 to 9V9) 190p
RL6-111 205 Ω Coil, 12 V DC (10V7 to 19V5) 195p
RL6-114 740 Ω Coil, 24 V DC (22 V to 37 V) 200 p

AMPHENOL PLUG

	IDC	Solder
24way IEEE	475p	450p
36way Centronics	525p	485p

ASTEC UHF MODULATORS

6 MHz Standard	325p
8 MHz Wideband	450p

COPPER CLAD BOARDS

	Fibre glass	Single-sided	Double-sided	S.R.B.P. 9.5" x 8.5"
6" x 6"		100p	125p	110p
6" x 12"		175p	225p	

DIL SOCKETS

	Low Prof	Wire Wrap
8pin	8p	25p
14pin	10p	35p
16pin	10p	42p
18pin	16p	52p
20pin	20p	60p
22pin	22p	65p
24pin	25p	70p
28pin	28p	80p
40pin	30p	99p

EDGE CONNECTORS 1

2 x 18 way	180p
2 x 22 way	199p
2 x 23 way	175p
2 x 25 way	225p
2 x 28 way	190p
2 x 30 way	245p
2 x 36 way	295p
2 x 40 way	315p
2 x 43 way	395p
2 x 75 way	550p

DIL PLUG (Header)

	Solder	IDC
14pin	40p	90p
16pin	40p	105p
24pin	80p	170p
40pin	250p	255p

RIBBON CABLE
price per foot

	Grey	Color
10 way	15p	28p
16 way	25p	40p
20 way	30p	50p
24 way	40p	65p
34 way	60p	85p
40 way	70p	90p
50 way	85p	110p
64 way	100p	135p

ZIF DIL SOCKETS

24 pin	565p
28 pin	775p
40 pin	975p

BUZZERS, miniature solid-state 6V 9V & 12V 70p
PIEZO TRANSDUCERS PB2720 55p

LOUDSPEAKERS
Miniature, 0 3W 8Ω
2in, 3¼in, 2½in, 3in 80p
2½in 40Ω, 64Ω or 80Ω 80p

ELEKTOR PROJECTS
We stock most of the parts

JUMPER LEADS (Ribbon Cable Assembly)

Length	14 pin	16 pin	24 pin	40 pin
Single ended DIP (Header Plug) Jumper				
24 inches	145p	165p	240p	380p
Double ended DIP (Header Plug) Jumper				
6 inches	185p	205p	300p	465p
12 inches	198p	215p	315p	490p
24 inches	210p	235p	345p	540p
36 inches	230p	250p	375p	595p
IDC Female Header Socket Jumper Leads 36"	20 pin	26 pin	34 pin	40 pin
Single ended	180p	200p	280p	300p
Double ended	290p	370p	480p	525p

ANTEX SOLDERING IRON

C-15W	495p	CS17W	495p
G-18W	520p	XS25W	525p
Spare tips, assorted sizes			85p
Spare Elements			225p
Iron stand with sponge			175p

SIL SOCKET
0.1" pitch
20 way
85p

'D' CONNECTORS miniature

	9 way	15 way	25 way	37 way
MALE				
Solder lugs	80p	105p	160p	250p
Angle pins	150p	210p	250p	365p
PCB pins	120p	130p	195p	295p
FEMALE				
Solder lugs	105p	160p	200p	335p
Angle pins	165p	215p	290p	440p
PCB pins	150p	180p	240p	420p
COVERS	85p	80p	80p	100p
IDC 25way 'D' Plug				385p
Socket				450p

CRYSTALS

32.768KHz	100
100KHz	235
200KHz	288
455KH	370
1MHz	275
1.008M	275
1.28MHz	382
1.6MHz	395
1.8NHz	395
1.8432M	200
2.0MHz	225
2.4576M	200
3.278M	160
3.5794M	98
3.6864M	300
4.0MHz	150
4.032MHz	290
4.80MHz	200
4.194304M	200
4.433619M	100
5.0MHz	160
5.185MHz	300
5.24288M	390
6.0MHz	140
6.144MHz	150
6.5536MHz	225
7.0MHz	160
7.168MHz	250
7.68MHz	200
8.0MHz	160
8.08333M	395
8.86723M	175
9.00MHz	150
10.0MHz	175
10.24MHz	200
10.7	150
12.0MHz	175
12.528M	300
14.31814M	170
16.0MHz	200
18.0MHz	180
18.432M	150
20.0MHz	200
19.968MHz	150
24.0MHz	170
24.930MHz	325
26.69M	150
27.648M	170
27.145M	190
38.66667M	175
48.0MHz	170
100.0MHz	295
116.0MHz	250

MONITORS

- ZENITH — 12" Green, Hi-Resolution Popular £ 75
- MICROVITEC 1431 14" Colour RGB input. Connecting cable incl £ 250
- KAGA 12" Med-Res. RGB Colour. Has flicker-free characters Ideal for BBC, Apple, VIC, etc £ 219 (car 7)
- KAGA 12". As above but Hi-Resolution £ 259 (car 7)
- Connecting Lead for KAGA £ 5

TRANSFORMERS

3-0-3V; 6-0-6V; 9-0-9V; 12-0-12V; 15-0-15V @ 100 mA 98p
pcb mounting. Miniature, Split Bobbin
3VA: 2x6V-0.25A; 2x9V-0.15A; 2x12V-0.12A 2x15V-0.1A 200p
6VA: 2x6V-0.5A; 2x9V-0.3A; 2x12V-0.25A; 2x15V-0.2A 270p
Standard Split Bobbin type
6VA: 2x6V-0.5A; 2x9V-0.4A; 2x12V-0.3A, 2x15V-0.25A 250p
12VA: 2x4.5V-1.3A, 2x6V-1A; 2x9V-0.6A; 2x12V-0.5A; 2x15V-0.4A; 2x20V-0.3A 325p (35p p&p)
24VA: 2x6V-1.5A, 2x9V-1.2A; 2x12V-1A; 2x15V-0.8A, 2x20V-0.6A 365p (60p p&p)
50VA: 2x6V-4A; 2x9V-2.5A; 2x12V-2A, 2x15V-1.5A; 2x20V-1.2A; 2x25V-1A; 2x30V-0.8A 465p (60p p&p)
Specially wound for Multirail Computer PSUs 50VA: Outputs +5V/5A, +12V, +25V, −5V, −12V at 1A 575p (60p p&p)
100VA: 2x12V-4A; 2x15V-3A, 2x20V-2.5A; 2x25V-2A; 2x30V-1.5A; 2x50V-1A 920p (75p p&p charge to be added over and above our normal postal charge).

VOLTAGE REGULATORS

1A	TO220 +ve	Plastic	TO220 −ve	Casing
5V	7805	40p	7905	45p
12V	7812	40p	7908	60p
15V	7815	40p	7912	45p
18V	7818	40p	7915	45p
24V	7824	40p	7918	45p
			7924	45p
100mA TO92 Plastic package				
5V	78L05	30p	79L05	50p
6V	78L06	30p	—	
8V	78L08	30p	—	
12V	78L12	30p	79L12	50p
15V	78L15	30p	79L15	50p

ICL7660	248p	TAA550	50p
LM309K	135p	TDA1412	150p
LM317K	250p	78H05 + 5V/5A	560p
LM317KP	99p	78H12 + 12V/5A	640p
LM323K	450p		
LM337	175p	78HG +5V to +25V 5A	599p
LM723 Var	30p		
RC4194	375p	79HG +2.25V to 24V 5A	685p
RC4195	160p		

SOLDERCON PINS
Ideal for making SIL or DIL Sockets
100 pins 75p
500 pins 350p

ALUM BOXES

3 x 2 x 1"	65p
4 x 2½ x 2"	85p
4 x 2½ x 2½"	103p
4 x 4 x 2"	105p
4 x 4 x 2½"	120p
5 x 4 x 1½"	98p
5 x 4 x 2½"	120p
5 x 2½ x 1½"	90p
5 x 2½ x 2½"	130p
6 x 4 x 2"	120p
6 x 4 x 3"	150p
7 x 5 x 3"	180p
8 x 6 x 3"	210p
10 x 4 x 3"	240p
10 x 7 x 3"	275p
12 x 5 x 3"	260p
12 x 8 x 3"	295p

25way 'D' CONNECTOR RS232
Jumper Lead Cable Assembly

18" long, Single end, Male	495p
18" long, Single end, Female	525p
36" long, Double Ended, M/M	1025p
36" long, Double Ended, F/F	1050p
36" long, Double Ended, M/F	995p

● SPECIAL OFFER ●
2764-250 ns 399p
6522 .... 275p

NEW NEW NEW
BROTHER 8300 DAISY WHEEL PRINTER/TYPEWRITER

Provides very high quality type in any of six interchangeable styles including Italics, Script and 4 conventional typefaces It is therefore ideal for business use It connects directly to a BBC Micro via standard centronics interface or can be used as a stand alone typewriter. As typewriter, it has a built in timing function to measure the operator's speed making it ideal for teaching or invoicing jobs correctly. Friction feed, 11 CPS; 12" max width, 5 different colour ribbons. Portable. Supplied complete with hard cover carrying case.
(£7 carr) Only: £399

CMOS

4000	14	4075	18	4541	140
4001	14	4076	50	4543	70
4002	14	4077	18	4544	150
4006	50	4078	18	4548	40
4007	15	4081	18	4549	375
4008	32	4082	18	4553	246
4009	24	4085	50	4554	190
4010	24	4086	80	4555	36
4011	15	4089	125	4556	36
4012	18	4093	20	4557	320
4013	20	4094	70	4558	120
4014	46	4095	95	4559	396
4015	40	4096	70	4560	160
4016	20	4097	290	4561	104
4017	32	4098	75	4562	495
4018	45	4099	110	4566	165
4019	25	4160	95	4568	250
4020	42	4161	99	4569	175
4021	40	4162	90	4572	36
4022	40	4163	99	4580	460
4023	15	4174	90	4581	260
4024	32	4175	105	4582	99
4025	16	4194	105	4583	90
4026	80	4408	790	4584	40
4027	20	4409	790	4585	60
4028	38	4410	725	4597	330
4029	46	4411	675	4599	290
4030	15	4412	775	40085	90
4031	125	4415	480	40097	45
4032	80	4419	280	40098	42
4033	125	4422	770	40100	215
4034	140	4435	850	40101	130
4035	46	4440	900	40102	140
4036	275	4450	350	40103	175
4037	115	4451	350	40104	95
4038	110	4490	350	40105	105
4039	250	4500	875	40106	35
4040	40	4501	28	40107	80
4041	40	4502	80	40108	198
4042	40	4503	60	40109	80
4043	40	4504	75	40110	225
4044	40	4505	185	40114	240
4045	105	4506	35	40161	194
4046	46	4507	35	40163	50
4047	40	4508	130	40174	45
4048	40	4510	46	40175	50
4049	25	4511	40	40181	220
4050	25	4512	50	40182	90
4051	46	4513	199	40192	75
4052	80	4514	115	40193	70
4053	50	4515	115	40194	70
4054	85	4516	55	40195	75
4055	85	4517	275	40244	196
4056	85	4518	40	40245	196
4057	1916	4519	30	40257	196
4059	435	4520	60	40373	160
4060	46	4521	90	40374	160
4061	1195	4522	125	45106	596
4062	985	4526	70		
4063	85	4527	85		
4066	24	4528	70	**OPTO**	
4067	245	4529	150	LS400C	255
4068	18	4530	90	OCP71	120
4069	16	4531	130	ORP12	86
4070	18	4532	70	ORP61	85
4071	20	4534	400	2N5777	45
4072	18	4536	275	BPX25	195
4073	20	4538	80	BPW21	295
		4539	90		

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LETTERS to the EDITOR

Do you have an opionion to air? Do you know the answer to something which puzzles, or a tip that might help, fellow enthusiasts? Have you something to add to a feature or review?
Your letters are invaluable in helping us to develop the magazine for you
Write to Letters to the Editor, ***Radio & Electronics World,*** Sovereign House, Brentwood, Essex, CM14 4SE. £2 will be paid for each letter published

Improvements

Refering to the letter in *R&EW* (September '83) from Mr Dudley of Guildford and the Editor's reply, here are some improvements made to the Cybernet 134 board in my 'Oscar' rig.

Oscillator Buffer: Two versions of the following circuit *(Figure 1)* were made up on pieces of veroboard and inserted in the oscillator outputs to both the 1st and 2nd mixers, to provide a buffer against the effects of oscillator blocking.

It was found that as the input to the 1st mixer is a balanced type, the circuit used here gave best results at a quiescent current of about 4.5mA. Using this value for direct injection into the base of the second mixer proved too much, so the current was dropped to about 1.8mA: hence the two sets of resistor values. Positive voltage is taken from the ON/OFF switch, and R3 is used to drop the excess voltage, decoupled by C1.

Both circuits were soldered to convenient RF/IF coil cans using the earth tracks. This method not only provides an earth return but also mechanical stability.

Links J13 and J15 are removed and the holes used for the buffer's input/output connections.

Two Pole Crystal Filter: Matching the 10MO8AA 10.695MHz crystal filter turned out to be a matter of assumption. It was assumed that the input/output impedance of the ceramic filter was 300R, and that the output of T9 and the input to Q10 were matched to this impedance. The following resistive potential divider circuit *(Figure 2)* was used to match the 1k8 impedance of the crystal filter.

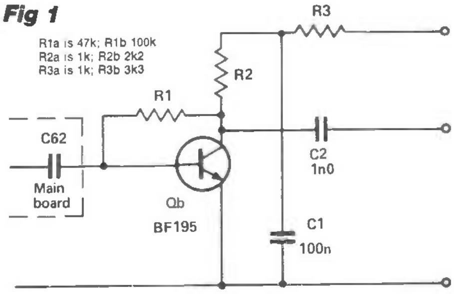
The circuit can be made up on a small piece of veroboard and the same mounting method used as for the oscillator buffer. Connections can be made using the holes left by the removal of the ceramic filter, or using the holes left by removing link J14. A link between the first and third holes of the original filter position would then have to be made.

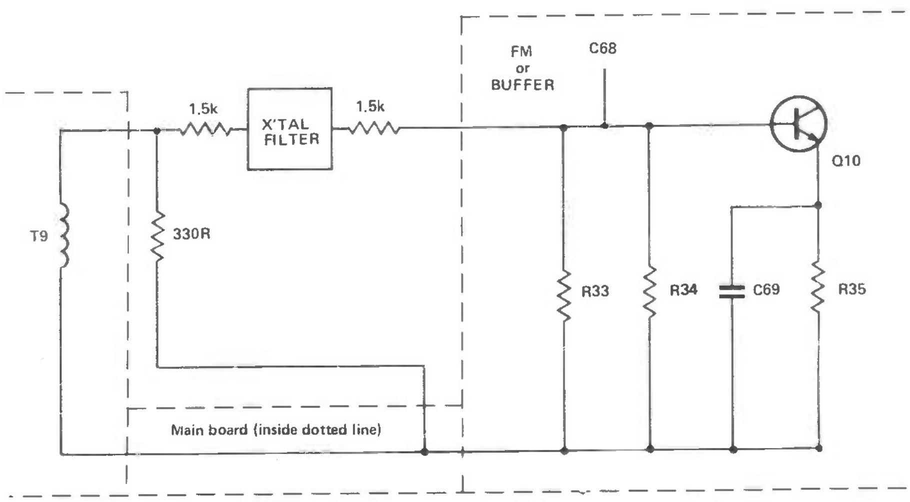
Not having the appropriate equipment to take quantitive measurements, all RF/IF coils were peaked for maximum S-meter reading, and a listening test carried out.There appeared to be no degradation in audio quality, and instead of loosing the signal completely to oscillator blocking effects, it now just drops by an 'S' point or two, even on very strong off-channel transmissions. Cross modulation effects (sorry — third order IMD) are also way down on what they were.

All in all a vast improvement for a moderate cost, and well worth the effort involved. In fact the rig now compares favourably with the Magpie Autoscan 5000, which I have had pleasure in listening to.

RF Millington, Cheltenham

Fig 1





Satellite prediction

Following on from the recent articles in *R&EW* about polar orbiting satellites, I thought readers who own a 16K ZX81 personal computer might be interested in the orbit-prediction program presented herewith.

The program, when fed with reference orbit data of a polar satellite, will give accurate predictions for about one month ahead with orbit number, date, time and longitude west at which the satellite crosses the Equator. The writer of this program ran it for more than a year and was well satisfied with it's accuracy and troublefree performance.

Some explanations about the logic employed should prove helpful to those readers wishing to try the program, particularly if they envisage making changes to it later to fit specific needs. These follow:

Lines 40–230 feed the computer with reference orbit parameters. These parameters usually can be found in Radio Amateur magazines such as QST (for the OSCAR satellites in particular) or can be requested from the National Oceanic and Atmospheric Administration in the US in the case of the NOAA 7 and 8 weather fax satellites.

Lines 290–320 arrange the way the expected data will be displayed and printed.

Lines 340–570 instruct the computer how to calculate the exact orbit number, date, time and longitude west at which the satellite crosses the Equator.

Depending on the particular location of the user, he should add the time the satellite will need to reach his location after crossing the Equator (the satellite speed is approximately 3.5° per minute).

```
   6 REM WRITEN BY
   7 REM ARGYRIS ADAMIDIS
  10 FAST
  20 REM SATELLITE ORBIT PREDICT
ION PROGRAM
  30 REM SATELLITE DATA
  40 PRINT "1.INPUT NAME OF SATE
LLITE(EG,NOAA 7)"
  50 INPUT N$
  60 PRINT "2.INPUT REF.ORBIT NU
MBER(EG,3975)"
  70 INPUT O
  80 PRINT "3.INPUT DAY OF REF.O
RBIT(EG,1)"
  90 INPUT D
 100 PRINT "4.INPUT MONTH OF REF
.ORBIT(EG,4)"
 110 INPUT M
 120 PRINT "5.INPUT YEAR(EG,1982
)"
 130 INPUT Y
 140 PRINT "6.INPUT HRS TIME OF
REF.ORBIT(EG,1)"
 150 INPUT H
 160 PRINT "7.INPUT MINUTES TIME
 OF REF.ORBIT(EG,12.60)"
 170 INPUT A
 180 PRINT "8.INPUT W.LONGITUDE
OF REF.ORBIT(EG,156.11)"
 190 INPUT L
 200 PRINT "9.INPUT LONGIT.INCRE
MENT PER ORBIT IN DEGREES(EG,25.
5100)"
 210 INPUT I
 220 PRINT "10.INPUT ORBIT PERIO
D IN MINUTES (EG,102.0010)"
 230 INPUT P
 270 CLS
 290 PRINT TAB 12;N$
 300 PRINT
 310 PRINT TAB 0;"DATE";TAB 6;"O
RBIT";TAB 12;"EQX TIME";TAB 24;"
W,LONGIT"
 320 PRINT TAB 0;"D/M";TAB 6;" N
O ";TAB 12;"H  MIN(GMT)";TAB 24;
"DEGREES"
 330 PRINT
 340 LET A=A+P
 350 GOSUB 4100
 360 IF A>=60 THEN LET H=H+1
 370 IF A>=60 THEN LET A=A-60
 380 IF A>=60 THEN GOTO 360
 390 IF H>23 THEN LET D=D+1
 400 IF H>23 THEN LET H=H-24
 430 GOSUB 3000
 460 REM EQX LONGITUDE CALC
 470 LET L=L+I
 480 GOSUB 5100
 490 IF L>=360 THEN LET L=L-360
 500 IF L>=360 THEN GOTO 490
 520 LET O=O+1
 530 IF L>130 AND L<190 OR L>300
 AND L<360 THEN PRINT TAB 0;D;TA
B 2;"-";TAB 3;M;TAB 6;O;TAB 12;H
;TAB 15;A;TAB 24;L
 540 GOTO 340
 570 REM DAYS OF MONTH CALC
3000 IF M=1 OR M=3 OR M=5 OR M=7
 OR M=8 OR M=10 OR M=12 AND D>31
 THEN GOTO 3030
3010 IF M=4 OR M=6 OR M=9 OR M=1
1 AND D>30 THEN GOTO 3060
3020 IF M=2 THEN GOTO 3100
3030 IF D>31 THEN LET M=M+1
3040 IF D>31 THEN LET D=D-31
3050 RETURN
3060 IF D>30 THEN LET M=M+1
3070 IF D>30 THEN LET D=D-30
3080 RETURN
3090 REM DAYS OF FEBR. CALC. FOR
 BISSEXTILE YEAR
3100 LET Z=Y/4
3200 IF Z-INT (Z)=0 THEN LET X=2
9
3300 IF Z-INT (Z)<>0 THEN LET X=
28
3400 IF D>X THEN LET M=M+1
3500 IF D>X THEN LET D=D-X
3800 RETURN
4000 REM TIME AND LONGITUDE ROUN
D OFF
4100 LET A=(INT (10000*(A+.00005
)))/10000
4200 RETURN
5100 LET L=(INT (10000*(L+.00005
)))/10000
5200 RETURN
```

At the writer's location, for instance, (Thessaloniki, Northern Greece), it will take five minutes for the satellite to travel the distance between the Equator and the southern edge of the Mediterranean Sea, which is when the satellite signal can first be heard. This is valid for the ascending node in the evening, when the satellite moves from south to north.

The program provides information on a selected group of orbits every day. This limitation is essential if one wants to save time and printer paper. With the parameters given to this program (line 530), the predicted orbits cover the area from the Caspian Sea to Gibraltar and from the Mediterranean coasts of Africa to the North Sea. Of course, these parameters can be changed to fit requirements of other areas of the world.

The subroutines in lines 3000–3800 arrange for the changing number of days in each month (including February), while lines 4000–5100 round off the long decimals of times and longitudes.

Argyris Adamidis, Thessaloniki

NOAA 7

DATE D/M	ORBIT NO	EQX TIME H	MIN(GMT)	W.LONGIT DEGREES
1 -6	4837	2	34.1547	177.76
1 -6	4842	11	4.1282	305.26
1 -6	4843	12	45.1229	330.75
1 -6	4844	14	26.1176	356.26
2 -6	4850	0	43.0656	149.26
2 -6	4851	2	22.0605	174.76
2 -6	4856	10	52.054	302.26
2 -6	4857	12	34.0487	327.76
2 -6	4858	14	16.0434	353.26
3 -6	4864	0	28.0116	146.25
3 -6	4865	2	10.0063	171.76
3 -6	4871	12	21.9745	324.76
3 -6	4872	14	3.9692	350.26
4 -6	4878	0	15.9374	143.26
4 -6	4879	1	57.9321	168.76
4 -6	4885	12	9.9003	321.76
4 -6	4886	13	51.895	347.26

Sample of the printed data

The way forward

In the Editorial in the October '83 issue of R&EW, we challenged our readers to come up with suggestions as to how they would create wealth and employment, using new technology as a catalyst. ***John de Rivaz*** *of Truro took up our challenge, and we present his ideas here.*

The problems of today are due to insufficient creation of wealth, a situation accentuated through the way the profits of manufacturing, construction and other such wealth-creating industries are consistently reduced through vast sums of money being paid to people who create no wealth at all, for example, chartered accountants. Members of these professions are on a kind of chain-letter rip-off: they write laws that other members of this elite get paid £100 per hour or so to interpret to lesser mortals. For instance, the solicitors' and estate agents' bills associated with moving house are comparable with the cost of a colour TV with a VCR to go with it. And it is impossible for manufacturing industry — or the general public — to avoid paying out for these services, directly or indirectly, which pushes up the price of manufactured goods; and so it continues.

Inflating the currency is no solution as this only pushes the debt into the future. Moreover, these problems cannot be solved through more governmental control: as Hitler demonstrated, extreme forms of control only bring disaster. Indeed, various Acts of Parliament have themselves added considerably to the overheads to be borne by industry.

A possible way that new technology could ease matters is through being more substantially incorporated into the production of *essential* consumer goods, instead of just those designed for entertainment such as televisions, video cassette recorders, hi-fi and computers. As the prices of the latter group have been steadily falling over the past few years, surely the technology employed here can be incorporated in the manufacturing procedures of such equipment as washing machines, the quality of which has not increased in line with their cost!

Unfortunately, this would probably just put pressure on those self-same manufacturing industries that are already suffering from the bureaucracy problems mentioned above.

Perhaps a better solution is to ask that the new technology be used to make machines that self-employed people could use to make these essential consumer goods. In that case, not only would the production costs themselves be so much cheaper but so would the overheads. There would be nothing to pay either in time or money, in travelling to work nor would there be great cost in distribution or advertising as each person's market would be close to home.

Moreover, such an arrangement would do a lot for the self-esteem and general satisfaction of each worker, their time would be their own and there would be no bosses or trade unions to order them about. In addition, the automatic nature of the processes used would give these people plenty of spare time. How much better their lot than that of the present factory worker! To cap it all, this scheme should provide increased employment at reduced costs.

A present example of this basic idea is given by the home computer with its owner earning money by writing and selling programs. Unfortunately, these generally — at least, so far — have had purely an entertainment value.

In essence, what is suggested is that, instead of designing another *entertainment* product to replace the VCR once that market has been saturated, the same technology be used to design a *wealth-creating* product. Considering that VCRs find their way into homes other than those of the very rich, surely the latter product could similarly find its way into such homes and start creating wealth for us all.

MICRO MANIA

Your editorial in *R&EW* in October has prompted me to produce the following verse on the subject of Technology.

As I travel life's great computer buss,
I ask myself what's all this fuss?
My watch plays tunes and entertains,
The fridge and cooker rack their brains,
The washing machine beats me at chess,
While washing out my new string vest.

My car tells me the tyres are thin,
It phones the garage to book me in,
I cannot go to work this way,
It thinks that it will snow today.

My summer holiday in Corfu
Is booked and cancelled by VDU,
The Great God IT is in control:
That's what we are told when on the dole.
The bills arrive and don't get paid,
The bank's computer is badly made.

At work my terminal greets me with a grin,
'You're late again, please log in'.
The day's work is neatly planned,
I must learn to type with either hand.
The jobs around us disappear,
The people cry out in doubt and fear:
'How can we fight what we cannot see'
'Will a micro replace me?'

E Jordan, Wickford, Essex

INSIDE THE SINCLAIR FLAT TV

Rod Greenaway presents an inside view of the flat screen pocket TV project

In a hotbed of innovation and dynamic new technology such as exists at Sinclair Research, the rule about information is 'Need to Know'. In other words, the various participants in the project tend only to know what is pertinent to their specific participation in the design. At least, that was the excuse given when the questioning got too intense at the press launch.

There obviously must be some managers who possess a general overview, or the radiated output from the line hold circuit could serve to obliterate the RF input to the tuner among other such minor disasters. The net result of the development (estimates range between 5 and 6 years and between 4 and 5 million pounds) is the most magnificent piece of all-British consumer technology since Sinclair's last effort with the Spectrum. The man is a veritable one-man national face-saver, working against some pretty daunting odds in terms of our national attitude towards people who want to spend money developing high technology products.

The innovative technology of the set itself breaks down (forgive me) into two major features: the tube and the chip. There is, as you can see from *Photo 1*, little else to it other than a couple of TOKO 10P coils (these people really know what they are doing), and a disturbingly large number of presets which I am advised are actually 'not a problem' in production. The interior view presented in the photograph is dominated by the flat tube, so we'll start our technical appreciation there.

Down the tubes

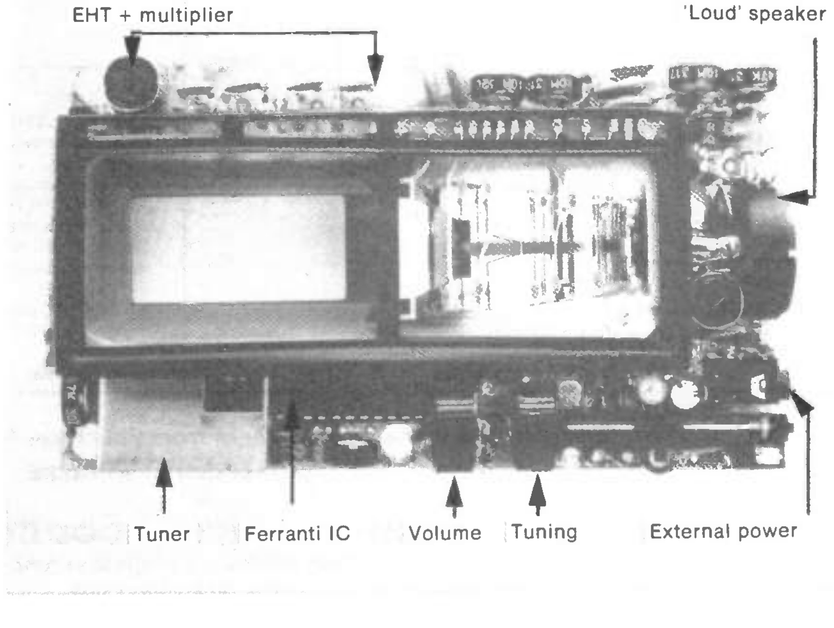
The problem when designing a tube with a side entry electron beam is really quite simple and does not involve rewriting the laws of physics. You just need to bend the beam a bit harder, that's all. The tubes in use in the prototypes on show are remarkably similar to those first leaked to the press and appearing in features as long ago as summer 1981.

The actual receiver itself isn't much like that proposed on the cover of *Radio-Electronics* back in 1981 *(Photo 2)*. This 'kite' was quite widely flown with a projected price of $100 (check), but including VHF FM radio (definite pass) and VHF TV (pass so far). The tube is one of the most 'sensitive' areas of the design, being subject to many patents and much secrecy. Nevertheless, it's fairly obvious how the basic principle works with two sets of electrostatic deflection plates in the gun assembly to provide the horizontal and vertical scanning, and a third set between the phosphor screen and the front face (a transparent tin oxide coating on the latter acts as the focusing electrode) — see *Figure 1*. This third set provides focusing by preventing the angle of incidence of the electron beam spreading into an ellipse at the edges of the tube.

The information supplied by Sinclair states that 'If uncorrected, folding the electron optics would distort the raster scan to produce a keystone-shaped frame, in which the vertical edges are curved and the horizontal edges form the side of a trapezium. Both electronic and optical techniques are used to correct for this distortion'.

When is a 2″ TV screen not a 2″ TV

Photo 1



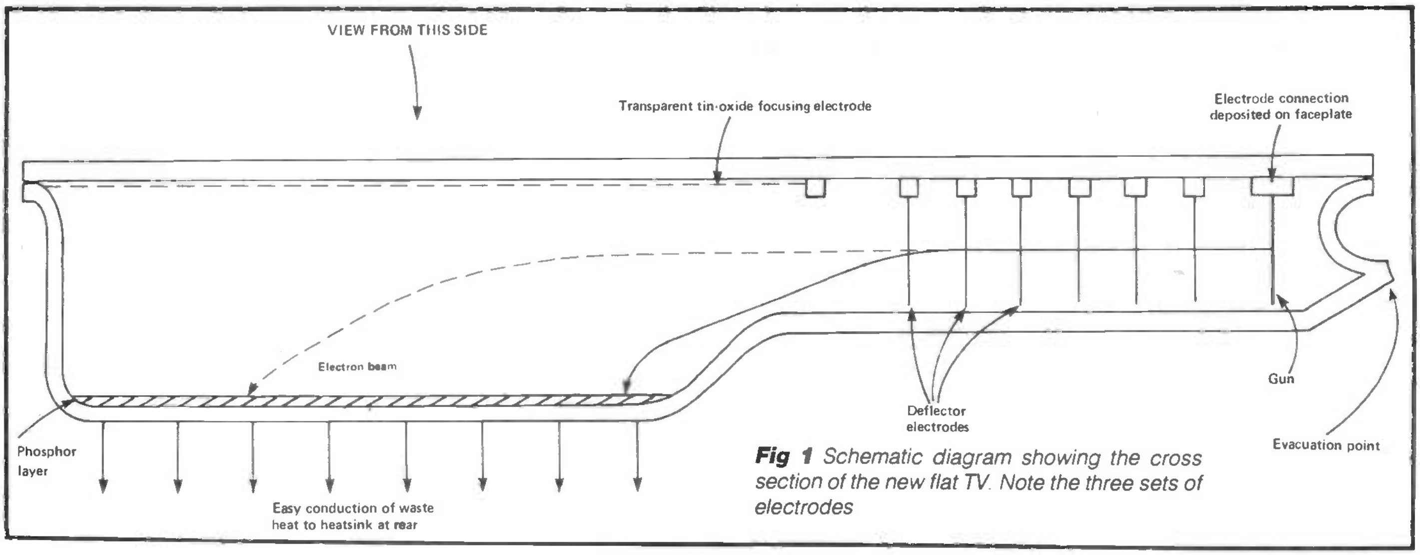


Fig 1 *Schematic diagram showing the cross section of the new flat TV. Note the three sets of electrodes*

screen? It would seem that the answer is slightly vexed in that the Sinclair set uses an optical magnification/correction process prior to that dimension being measured. This aspect is potentially as tricky as the 'when is RAM not RAM' argument that has caught up with many of the personal computer makers.

The aspect ratio of the tube phosphor area shown in the internal photograph (*Photo 1*) is nothing like that of a conventional TV tube. In fact, it's only about two thirds the height, and the correction is applied using a Fresnel screen built into the faceplate. The reason for using this approach is to simplify the problems of distortion and power consumption arising from scanning an electron beam too far off the gun axis. No specific side effects (pardon the pun) are apparent to the viewer, and most viewers will never actually notice the effect.

The trapezium distortion is corrected electronically via the waveform used to scan the vertical plates — more of which anon when we come to look into the IC.

Constructing the tube is one of the project's major technical problems/achievements since it involves a vacuum-formed backplate with a flat front plate on which the electrode connections are screen printed (much as in an LCD). The art of spreading the phosphor evenly across the display area, coupled with trimming the glass and frit sealing the electron gun and deflection assemblies, is one that has taken a lot of time and money to perfect — and it must be said that it is yet to be proven to the satisfaction of us cynics that the yield rate is acceptable.

Is it idle to speculate that a good many of these specific problems are likely to have been encountered by fluorescent display makers such as Futaba and Itron? If so, just how long will it take them to perform a passable emulation of the present technology? Let's hope Sir Clive has employed a sound patent agent.

The NRDC has stumped up around £1 million of the stake money for the tube project, which has been used to install a manufacturing facility at Timex's Dundee factory. This would appear to mean business, and it is to be hoped that other applications of the tube and its technology will emerge: not the least of which is likely to be instrument displays. Who said 'oscilloscope'?

Chips from Chadderton

They make chips in Oldham that are nothing to do with mushy peas. Whilst the Ferranti custom device process is not the most sophisticated in terms of the capability of CAD for interactive design and emulation, the flat TV project was not deflected from pursuing this line of development. The suitability of the CDI (collector diffusion integration) process to an application that mixed high frequency linear and TV logic with scanning functions seems unequalled — especially in view of the low power involved. And, by thunder, it's British.

Peering out from the gloom beneath the tube in the photo, you may be able to make out the presence of the Ferranti IC. Reference to the block diagram (*Figure 2*) supplied with the launch information reveals what goes on therein. This receiver is one of the first examples of genuinely single-device TV sets. A Motorola development we mentioned in *R&EW* some months ago does nearly as much (at the expense of greater power consumption) but it certainly doesn't provide automatic sound IF selection, nor the field correction DAC that provides the necessary tweak to the scanning waveforms to accommodate the tube requirements.

Listed amongst the IC's special features are 'integrated sound selectivity, video innovations to eliminate image problems in the UHF channel, and an advanced synthesised scan generator to control the complex waveforms needed

Photo 2 *The Microvision 2700, Sinclair's earlier kite in the world of flat TV*

Photo 3 *Internal view of the Microvision 2700*

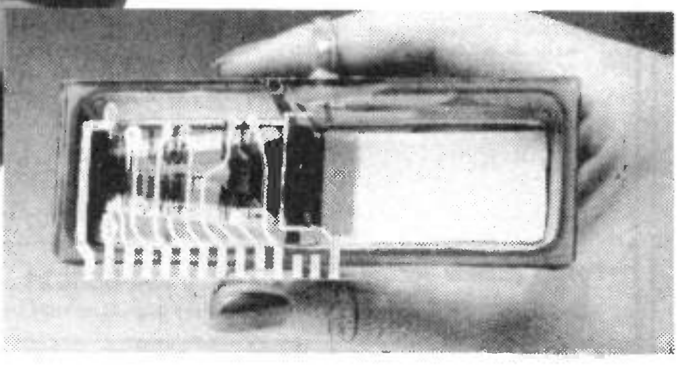
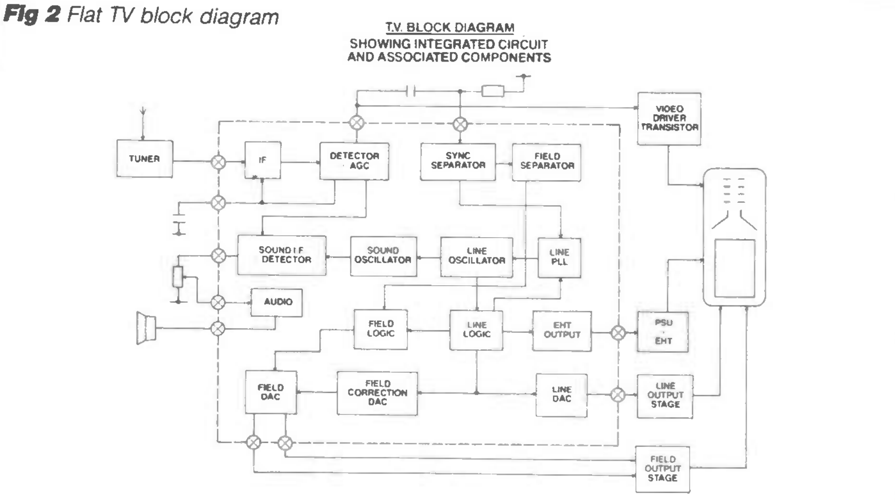


Fig 2 *Flat TV block diagram*



to scan the flat CRT. It runs a check 50 times per second to ensure picture hold'. All coupling, decoupling and phase shift networks are integrated on the chip.

The really nifty aspect of the IC is its ability to select the local sound IF standard by looking at the line rate. This piece of innovation was being explored long ago in the days when the Sinclair HQ was still the Mill in St Ives and it's nice to see a practical application emerge that works so effectively. The technique is deceptively simple, since with 625-line transmissions the sound IF is either 5.5MHz or 6MHz, so mixing the intercarrier FM signal with 5.75MHz (derived from the line oscillator — see *Figure 2)* always gives a difference frequency of 250kHz. Neat stuff.

When the set discovers 525 lines are being received then the sound VCO is switched to 4.75MHz as 4.75−4.5=250kHz again. No clue was given by the literature (or personnel) supplied as to the technique used on the 250kHz IF, but this is likely to be reminiscent of the pulse counting techniques exploited in the erstwhile Sinclair Micro FM receiver.

The Ferranti wonderchip, then, may have gone over the top and spoilt itself through attempting to provide a viable sound output stage on top of everything else. If you thought the sound output from the original Microvision was rather mean, then have a listen to this one. The 'loud' speaker (pictured towards the right edge of the PCB on axis with the tube centre) is not adequate. Old cynics like me who have had experience of multifarious ICs that do everything, including class AB output and putting the cat out, wonder if the current fluctuations on volume peaks have caused the same impossible on-chip power supply decoupling problems that have sunk many a lesser project. Watch these pages for a Sinclair TV combined NiCad battery pack, charger and sound booster project!

The Noise Abatement Society should endorse this product as it is unlikely to upset the tranquillity of the average Sunday afternoon on Brighton's promenade.

Synthesised scanning

The major technical problem in trying to present an orthogonal picture on the flat tube was in generating scan waveforms that compensated for the differing path lengths travelled by the electron beam. It could be done by analogue techniques, but only in a way that required vast setting-up complexities and additional circuitry and power.

The Ferranti ZN401E device uses a high frequency VCO that is locked to a multiple of the received line sync pulses to provide both standard 'recognition' and a single master clock source for the entire set. The VCO centre frequency is set by a single external resistor and is counted down to the field rate. On-chip logic determines reception of a 625- or 525-line picture, setting the count number and VCO accordingly. Noise immunity of the field and line lock is aided by additional on-chip processing.

DACs (digital to analogue converters) derive line scan, field sweeps and correction signals from the countdown system. It must be assumed (hoped?) that the tubes are sufficiently repeatable that these waveforms do not require tweaking on test.

Tuning

The tuner lives in the small screened box to the left of the Ferranti IC. It uses printed line techniques, varicap control and surface mounted components for compactness. It is not generously dimensioned in the UHF-only version, so heaven knows how tight the VHF/UHF model will be. The UHF model uses the relatively high IF frequency of 230MHz (it's a good job CB never went so high as far as this project is concerned).

Quite why the IF is 'up there' is not obvious from the words supplied by Sinclair, but perhaps we can speculate that the rule of 'the higher the frequency, the easier it is to produce compact LC filters, came into play and, in this case, the trade off between *Q* and signal image still leaves a performance worthy of comparison with the usual alternative of 39MHz. It may also have something to do with the possibility of up-converting the lower VHF bands. Sinclair wouldn't let on.

To tune 45MHz to 900MHz in the combined VHF/UHF version is good fun indeed. Sir Clive's own words were that it would be using a single range tuner, in which case up-conversion to 1GHz and a SAW device would appear to be on the cards. Maybe there's some very innovative thinking going on in Cambridge at this moment.

The set uses a four-stage AGC controlled amplifier at 230MHz, and implies from the literature supplied that this is actually in the Ferranti IC. Video detection uses a 'novel low level envelope detector' with no sign of any tuned circuit in sight. Hmmm. Shades of the coil-less radio devices described in October's *R&EW*.

It will be interesting to see if Ferranti is persuaded to put any of this experience to work in other radio and communications circuitry. It's about time it followed up the ZN414.

POOR MAN'S SPECTRUM ANALYSER - Part 2

The second part of this feature, based on an article written by Frank Perkins in Wayne Green's '73' magazine, describes the testing and alignment of this spectrum analyser and illustrates its performance

TESTING AND ALIGNMENT

The minimum test equipment needed to align and test the HF spectrum analyser includes a high-impedance volt ohmmeter, a 350MHz frequency counter, and a 5MHz bandwidth, single-channel, DC-coupled oscilloscope with a triggered sweep. A grid-dip oscillator is also useful. You should make up several two-foot RG-58 cables with BNC connectors. These will be used during testing. For best results, testing and alignment should be done in the order listed below.

Power supply testing

Check the resistance between primary and secondary of the wallplug transformer before use. It should show an open circuit. Check the secondary AC voltage. It should be 12VAC to 15VAC with no load. Hook the 12VAC to the power supply and check the 12VDC, 24VDC, and −6VDC outputs. They should be within 0.5V.

Sweep generator testing

Connect the power supply to the sweep generator and turn the power supply on. Check pin 2 of the 555 IC with your oscilloscope. You should find a 10–12Hz ramp waveform. The bottom of the waveform should be at 4V and the top of the waveform at 8V. The front of the ramp (log slope) should appear straight. You should find a similar ramp at the *X*-axis output connector. This ramp will be between −0.6V and 3.4V.

Check pin 8 of the TLO84C op-amp. You should find a pulse train with a 10–12Hz repetition rate. The pulse train should be high (20V) about 20% of the time and low (−3V) about 80% of the time.

Turn the frequency-span pot fully clockwise (no ramp) and set the centre-frequency pot mid-range. You should find 6–12VDC on pin 7 of the TLO84C op-amp (VCO-tuning voltage). Vary the setting of the centre-frequency pot. The VCO-tuning voltage should vary from −3V to 21V. Set the centre-frequency pot for a 10V output. Turn the frequency-span pot counter-clockwise until you have a ramp waveform from 2V to 20V (re-adjust the centre-frequency pot as needed). This completes preliminary sweep generator testing.

If your sweep generator fails to act as above, re-check component values and circuit hook-up for problems. Refer to the section on the theory of operation (*November issue of R&EW*) for additional hints.

VCO testing

Connect the VCO-tuning voltage from the sweep generator to the VCO. Ground the RG-58 shield at the VCO enclosure. Connect 12VDC from the power supply to the VCO power input. Disconnect one side of the oscillator coil for a moment. Power up and check the MRF901 (*KV1210*) collector voltage. It should be about 6–8VDC. If it is too high, reduce the value of the 100k bias resistor: if it is too low, increase the value of the bias resistor. You can't use a pot here! Once the collector voltage is verified, power down and reconnect the coil.

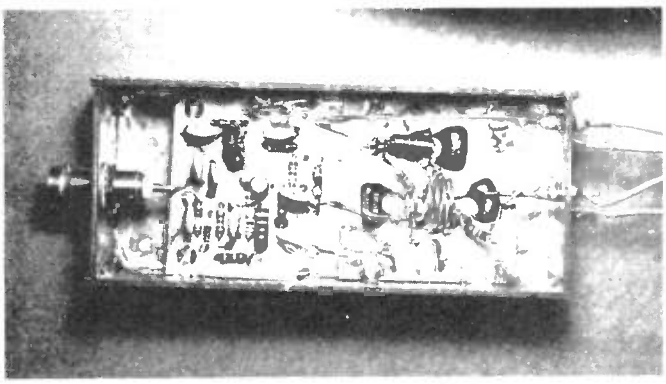
Power up and connect your counter to the VCO RF test jack. Turn the frequency-span pot fully clockwise (no ramp) and adjust the centre-frequency pot for a 3V output. Your counter should read about 90MHz. Adjust the VCO coil spacing to get the VCO in the 89.5–90.5MHz range. Check the DC output from the RF detector of the VCO amplifier output for a 0.8–1.3VDC level. Adjust the spacing between the VCO coil and the amplifier pick-up loop, if necessary, to obtain the proper detector output.

Set the centre-frequency pot for a 150MHz oscillator output. You should have a tuning voltage of about 18VDC. Check the RF detector output voltage again to be sure it's still between 0.8 and 1.3VDC. Monitoring the DC voltage from the RF detector with your scope, tune the centre-frequency pot back and forth between 3V and 18V. The detector output voltage may vary a little but smoothly; it certainly should not 'jump'. An abrupt voltage change indicates a parasitic oscillation. If this should occur, work on your oscillator layout (aiming for very short leads in particular) to get rid of it.

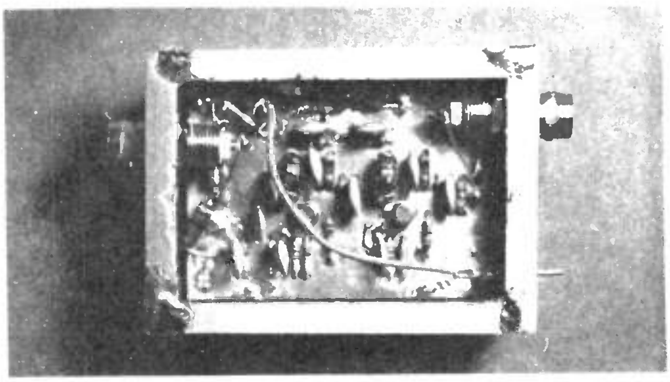
A tuning voltage of less than 1V may cause the oscillator output to be erratic in frequency and amplitude. This is not a problem. Once the VCO oscillator and amplifier are operating properly, install the VCO enclosure top.

Pre-amplifier and Log Amplifier Testing

Connect 12VDC to the pre-amplifier and log amplifier circuits and power up. Turn the frequency-span pot fully clockwise (ramp off) and adjust the centre-frequency pot for 90MHz at the VCO RF test jack. Disconnect the frequency counter. Hook the attenuator box to the VCO RF test jack with a two-foot RG-58 cable. Hook the output of the attenuator



VCO layout



Pre-amplifier layout

Specifications for HF Spectrum Analyzer

Frequency range	0 to 60 MHz
3-dB bandwidth	220 kHz
30-dB bandwidth	1,100 kHz
3:30-dB shape factor	1:5
Dynamic range	60 dB
Spurious responses	60 dB below full-scale
Noise floor	65 dB below full-scale
Full-scale input	−8 dBm ±2 dBm
Y-axis output	0 to 2.5 volts
X-axis output	−0.5 to +3.5 volts
Y-axis calibration	10 dB/division
X-axis calibration	6 MHz/division (approximate)
0 to 8 MHz	4 MHz ± 0.75 MHz/division
8 to 24 MHz	8 MHz ± 1 MHz/division
24 to 60 MHz	6 MHz ± 1 MHz/division

to the input of the pre-amplifier with another two-foot cable.

Set the bias pot on the log amplifier about mid-range. Monitor the DC output of the RF detector on the log amplifier buffer. Tune the buffer transformer slug for peak output. Use the attenuator to set the detector output to 0.2VDC. Now adjust the bias pot of the log amplifier for peak output. Adjust the attenuator for a just-detectable output at the log amplifier buffer. If all seems well with the pre-amplifier, install the top on its enclosure. Prepare the top for the log amplifier section. Drill ⅛-inch-diameter holes in the top over each IF transformer location and over the bias pot. (Use drafting vellum as a template.)

Hook the oscilloscope to the video output of the log amplifier. Adjust the slugs in each log amplifier stage for peak video output. The tuning of each stage should be smooth, and the tuning of the bias pot should also be smooth. If the video output from the log amplifier jumps suddenly whilst tuning, you may have self-oscillation in the log amplifier. If this happens, work on your layout. Ferrite beads, extra bypass capacitors, and small copper shim stock shields can be used to eliminate the problem.

If you live near a commercial FM station, it may interfere with your tuning efforts. Tape the shield top on the log amplifier during initial tuning to help reduce this problem. As soon as it appears that the log amplifier is working, solder on the top. Once the top is soldered on, it will totally eliminate the interference.

BANDPASS FILTER TUNING

Set the VCO to 90MHz. Hook the attenuator between the VCO RF test jack and the bandpass filter input. Hook the bandpass filter output to the pre-amplifier and log amplifier. Monitor the video output of the log amplifier on your oscilloscope. With the tops off the bandpass sections, you should get some signal. If not, temporarily bridge the input and output sections with a 1pF capacitor tack-soldered at the input and output tap points. Tune the input and output stages for peak response; then remove the 1pF capacitor. Now peak the two middle stages. You probably will get an overcoupled response (double-hump). Just centre the tuning between the humps.

Now install the shield tops, one at a time. Tune all bandpass stages after each top is installed. Tuning will become very sharp, especially if you are using air-variable tuning capacitors instead of piston trimmers. When the last top is installed, carefully peak all stages.

Set up your oscilloscope for *X–Y* operation, using the *X*-axis output of the sweep generator for the oscilloscope horizontal input and the log amplifier video output for the vertical input. Gradually turn the frequency-span control counter-clockwise until you get a sweep display of the filter bandpass. Make fine adjustments for a smooth bandpass shape. Stagger-tune the two middle bandpass filter sections just a bit to sharpen the nose of the filter. Be sure to put in enough attenuation to keep the video output from the log amplifier under 2V during the bandpass filter tuning procedure.

If it seems that you have an over-coupled response in your filter, narrow the aperture between the two middle bandpass filter sections. If the filter tunes sharply but exhibits high loss, then widen the aperture between the two middle sections.

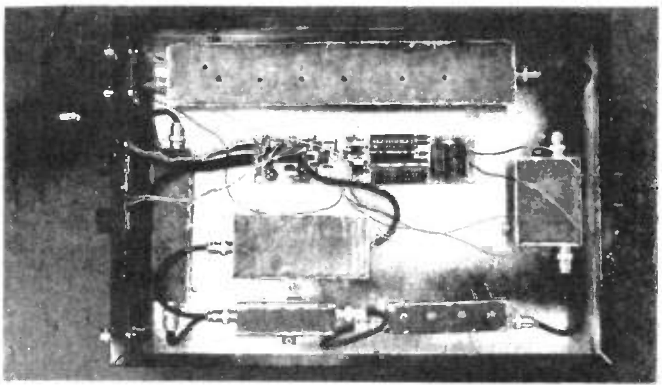
FINAL SET-UP

Install all circuitry on your chassis and complete all wiring and coaxial cable hook-up. Set the analyser upside down in front of your scope. Connect your oscilloscope to the analyser *X*- and *Y*-axis outputs. Set up the oscilloscope again for *X–Y* operation. Turn the analyser on (no signal). Turn the frequency-span pot fully clockwise (no ramp). Using your frequency counter, adjust the VCO for 90MHz operation with the centre-frequency pot. You should see two horizontal lines about 2V apart. Rotate the frequency-span pot counter-clockwise a little. You should see the bandpass-filter response again. This is due to mixer leak-through and is normal.

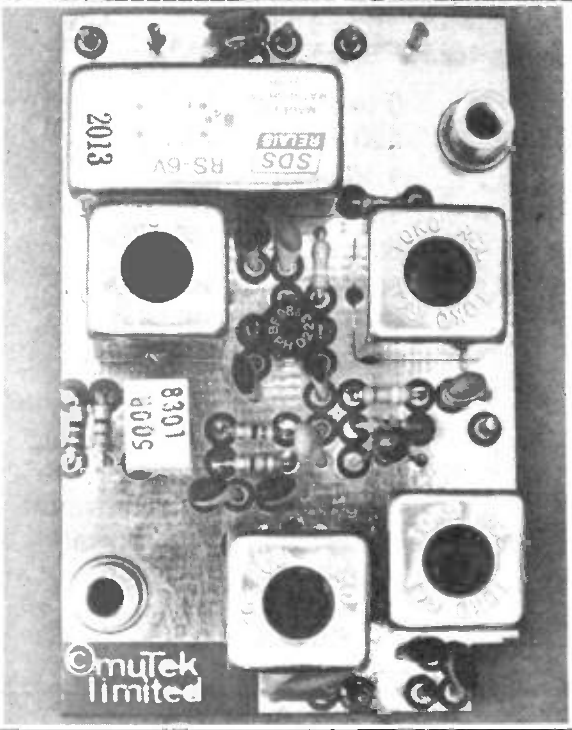
Set the retrace line (lower straight line) under the bandpass response curve at the bottom of the CRT screen. Widen the trace with the oscilloscope controls to reach across the screen. Turn the frequency-span pot fully clockwise again. Set the VCO frequency to 120MHz. Now turn the span pot counter-clockwise until the zero-frequency half-spike appears on the left side of the screen. There should also be some grass above the retrace line along the bottom on the screen. The analyser should now be scanning 0—60MHz.

Feed a small 30MHz signal from a grid-dip oscillator (use a pick-up loop as shown in *Photo 1*) or a low-power-signal generator through the attenuator to the analyser. You should now see the 30MHz

Above: *Log amplifier layout*



Right: *Bottom view of spectrum analyser chassis*



Bigger Ears Than Dumbo!

— the SLNA 145sb preamplifier
for the FT290.

£27.40 + 1.20 p&p inc. vat

There are usually two reasons for the less than adequate sensitivity of current 144MHz transceivers. Firstly, the receiver designer's brief includes a dynamic range specification which leads him to balance large signal handling with sensitivity. With devices currently available at prices the transceiver manufacturer is prepared to pay, the balance comes-out to around 4dB noise figure and 70dB intermodulation-free dynamic range in ssb bandwidths.

The second point is that, also to save money, designers shy away from the use of electromechanical relays for antenna change-over switching and tend to use various forms of diode switch. These inevitably introduce greater insertion losses than suitable relays, approaching 4dB in some circumstances. Thus it's not unusual for the overall noise figure of a transceiver to reach 8dB.

At 144MHz sky-noise limits the maximum usable sensitivity of a receiver used for terrestrial communications to about 2dB noise-figure. (This about the same as 0.05μV for 10dB s+n/n in ssb bandwidths). Lower noise figures are easily obtainable with modern devices, but they won't let you hear any more! However there is a distinct advantage in using a very low-noise preamp to improve the sensitivity of a transceiver — if it has been designed properly.

Overall (or system) noise-figure depends not only upon the noise figure of the preamplifier, but also on its gain and the noise figure of the subsequent stage (the transceiver, in this case). By adjusting the gain of the preamplifier it is possible to set the system noise-figure to any wanted value greater than that of the intrinsic noise figure of the preamplifier.

Why bother to adjust the gain? Because any preamplifier will degrade the strong-signal performance of the receiving system. The name of the game is to use as little gain as possible ahead of the receiver; just enough low-noise gain to set the overall sensitivity to a level where external noise is the limiting factor is all that is required. Use any more and the dynamic performance of the receiver will suffer unduly. A very low noise preamplifier will minimise the gain needed ahead of the transceiver and hence the degradation of the dynamics.

The SLNA 145sb is a preamplifier which has been designed using the principles summarised above specifically for incorporation in the FT290. It will also complement other 144MHz transceivers for which no complete front-end modification is available. Ask us about FDK 700's and 750's for example.

A low-loss nitrogen-filled relay provides a same alternative to diode switching. This is followed by a BF981 in an input noise-matched, output conjugately matched configuration for a very low noise-figure and optimum dynamic performance. Following the output matching a variable attenuator provides gain control without compromising the dynamic performance, which would be the case if the normal amateur practice of providing gain control by varying the bias on G_2 of the BF 981 was followed.

After the attenuator, a properly designed Butterworth bandpass filter provides substantial rejection of out-of-band signals.

The preamplifier is constructed and tested to very high standards. A plated-through-hole epoxy fibreglass pcb is employed and bushed mountings are provided for mounting in the FT 290R. A cable kit utilising high quality ptfe dielectric cables is also provided.

muTek limited — the rf technology company

Dept RW, Bradworthy, Holsworthy, Devon EX22 7TU (0409 24) 543 signal spike about mid-screen. You may also see the 2nd harmonic of the 30MHz signal on the right edge of the screen. Adjust the attenuator so that the 30MHz signal is about the same height as the zero-frequency half-spike. If things have gone well so far, you are getting a signal through the low-pass filter and mixer, so you can now install their enclosure tops.

Set the frequency-span control so that the 30MHz signal spike is about two scope divisions wide. Now fine-tune the bandpass filter again and re-peak the log amplifier. Switch the 10dB attenuator section in and out whilst adjusting the vertical gain of the oscilloscope so that the signal height changes one CRT division. Now switch a 20dB section in and out. The signal height should change by two CRT divisions. Re-adjust the frequency span control for a 0—60MHz analyser tuning range.

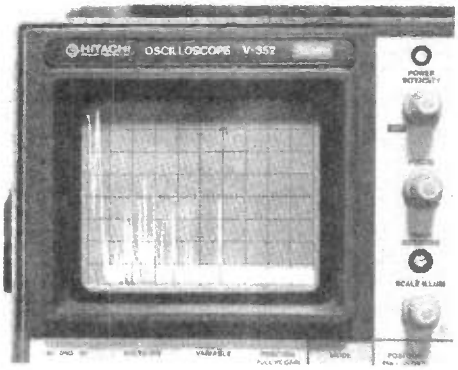
Increase the signal strength until the first small spike pops out of the grass between the 0 and 30MHz signals. This is slightly above the overload point of the analyser. The 30MHz signal spike should be near the top of the CRT screen (8th vertical division). Full-scale inputs should be the next (7th) CRT division down. Touch up the oscilloscope controls if necessary. The zero-frequency half-spike will be about six divisions tall. Switch all attenuation out and reduce the signal generator output so that the 30MHz test signal is seven divisions tall. Check the vertical calibration of the analyser over the attenuator's 59dB range.

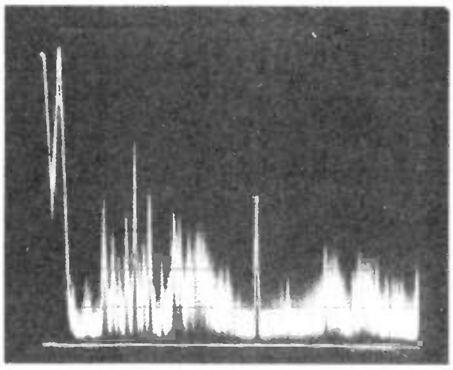
Using your signal generator and frequency counter, make notes on the horizontal calibration of your analyser. This is done by centring a signal from your signal generator on each CRT horizontal division (vertical line) and recording its frequency. Your analyser is now ready for use. But first, test the L-pad carefully!

Hook up your L-pad to your transmitting equipment. Be sure everything is grounded properly. The author suggests mounting the L-pad and attenuator on an aluminium plate which is in turn wall-mounted. Ground the plate! Do not connect the attenuator to the L-pad yet. Connect your transmitter to an SWR meter, the SWR meter to the L-pad and the L-pad to your dummy load. The L-pad should introduce little, if any, SWR. Starting with low power (100W or less), apply power for 30sec. Power down your transmitter completely and quickly inspect the inside of your L-pad. The 'fuse' should be OK and nothing should be hot. Continue testing to full station power.

If everything has gone well, then power down your transmitter completely and connect the attenuator to the L-pad. Switch in all attenuation and connect the attenuator to the spectrum analyser. Remember that the analyser and the oscilloscope cases should be solidly grounded. Starting again with low power, apply power and adjust the attenuator for a full-scale spectrum analyser display. How does your spectrum look? Always switch in full attenuation before increasing power. Remember, do not go over 1kW continuous output (2kW p—p). Do not attempt to use the spectrum analyser system where your SWR is greater than 2:1. Be sure you are using an L-sampler with a high enough power rating!

Left: *The finished spectrum analyser*





Below left: *0–60 MHz spectrum taken from a long wire antenna*
Below right: *The same but with an adjacent computer turned on*

COMPONENT SOURCES AND SUBSTITUTIONS

It often is lamented that home-brewing projects is difficult these days because of poor component availability. The author started seriously experimenting with electronics 20 years ago in the good old days of component availability. The difference between now and then is that we have about a thousand times more components to experiment with!

It's simply a matter of motivation and tenacity. You can get any component that you need. True, the local TV component place doesn't carry everything, but they may be able to order it for you.

Best of all, look at the ads in this magazine. There are many mail-order distributors which market primarily to the experimenter.

The high frequency spectrum analyser should be fairly tolerant of component substitutions except in the VCO circuit and the L-pad. For example, the 'hotter' 3SK88 could substitute for the 40673 if you crank its gain down a bit with the log amplifier bias pot. You could use MRF901s in place of the 2N5179s (don't try to go the other way!). Any decent electrolytics of the proper capacitance and voltage rating could be used in the power supply and sweep generator circuits. Electrolytics could also be used in place of the tantalum capacitors at a pinch. Try to get close-tolerance parts in this case.

USEFUL ACCESSORIES

You could duplicate the two-stage wideband pre-amplifier circuit for use as an accessory ahead of the attenuator. This will allow you to view the 0—60MHz radio spectrum on a long-wire antenna and quickly judge the band conditions up to 6m. VCO frequency tuning is somewhat non-linear, which is typical of simple wideband oscillators.

A 6MHz crystal oscillator driving a TTL Schmitt trigger makes a useful calibrator. The output of the TTL gate contains every harmonic up to 60MHz. Lightly couple the TTL gate to the spectrum analyser input with an insulated wire antenna placed near the analyser input connector. A momentary-on pushbutton can be used to activate the calibrator.

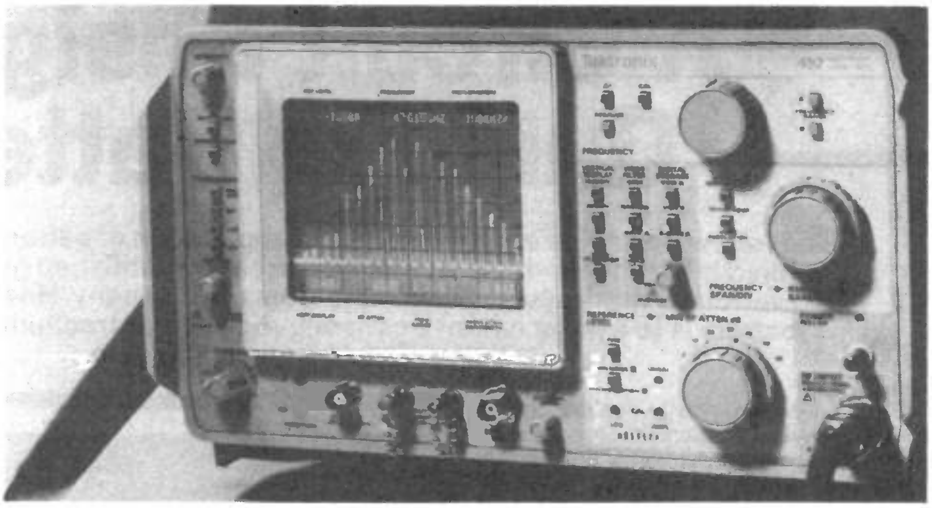
ANALYSER APPLICATIONS

We have talked about using the HF spectrum analyser to monitor transmitting equipment. This was the primary application the author had in mind when he designed the analyser. It is especially useful to hams who are home-brewing their own HF transmitters or linears. It is also useful for checking low-pass filter performance and band conditions. Doubtless you will find other applications.

The analyser has a 50Ω input impedance and is DC-coupled. Be sure to add a blocking capacitor ahead of the attenuator if you are going to look at a RF signal that is riding on a DC level. Stay away from high-voltage DC circuits.

The bandpass of this analyser is too wide for looking at SSB modulation linearity. However, this can be judged

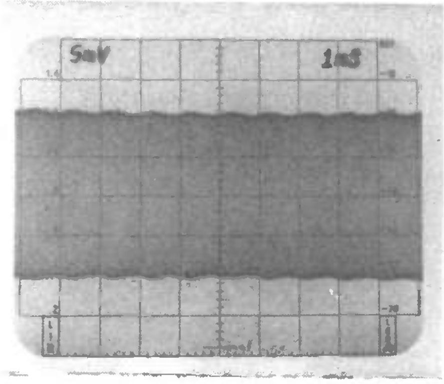
adequately from a two-tone pattern on a normal oscilloscope.


The Tekronix 492 spectrum analyser

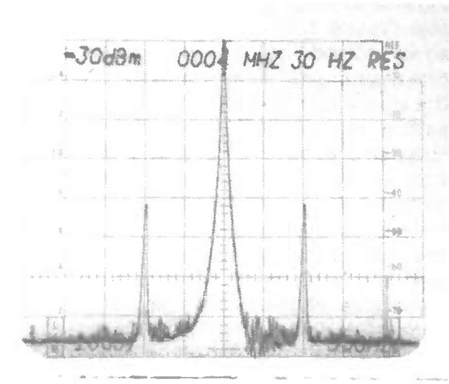
FROM HERE

This project demonstrates that a useful spectrum analyser can easily be built from relatively common and inexpensive components. Avid experimenters should treat this design as a starting-off point and be ready with the matching tracking generator — or possibly a version engineered onto PCBs using commercial helical filters so that this admittedly advanced project can be made more accessible to the less experienced constructor. Meanwhile, let's get those transmitter spectra cleaned up!

If you've enjoyed this feature and would like to get to the source, then remember that you can subscribe to '73' by sending a $40 bankdraft to: '73' Magazine, PO Box 931, Farmingdale, NY 11737, USA. Ed



Received signal



Its spectrum on the 492

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A Circuit Designer's Guide to Batteries

The following advice on the choice and application of batteries is based on information supplied by Duracell – in particular on a recently published guide that gives full details of the various battery systems available from the company. However, the performance of a battery is to a great extent a consequence of electrochemistry, making this advice generally applicable

The first commercially available battery employed the zinc/carbon system in which the zinc container is the anode and the electrolyte is an acidic solution of ammonium chloride and zinc chloride, infused into a core of manganese dioxide and carbon black (the cathode) – see *Figure 1*. However, this system was soon found to have a number of disadvantages. For instance, because the container takes part in the reaction as the anode, the highly acidic electrolyte can corrode its way out of the casing and so can readily damage electrical circuits. Moreover, World War II demonstrated that these batteries were unable to cope with either tropical conditions or extreme cold, in the latter case proving incapable of producing any significant current. It was this set of circumstances that in fact led Duracell to develop the battery system that has since evolved into its well-known range of alkaline batteries with the familiar copper-coloured tops.

Modern battery types

The alkaline system mentioned above (and shown in *Figure 2*) takes its name from the electrolyte, which is a highly conductive aqueous solution of potassium hydroxide. The electrodes are of highly pure manganese dioxide and granulated zinc. This combination gives a 'superior, yet economic, battery capable of operating efficiently at high as well as low rates and over a wide range of duty cycles'. For a start, the discharge curve is considerably flatter than that for the zinc/carbon system – in other words, an alkaline battery produces a more stable output voltage-wise. Moreover the case does not take part in the electrochemical reaction and so there is little or no risk of leakage, an important consideration in these days of delicate ICs. This also permits the energy density that can be stored to be higher than would otherwise be the case: hence the Duracell claim that its batteries last up to six times as long as conventional

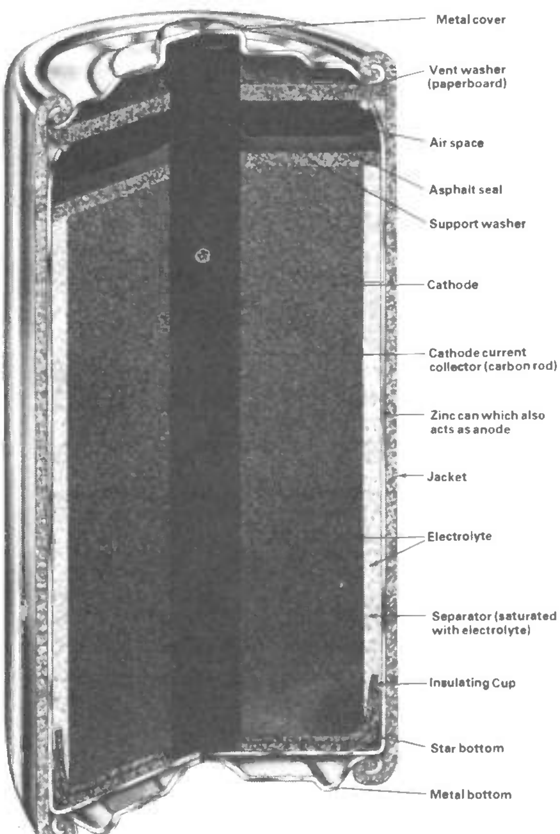

Fig 1 *Zinc/carbon cell*

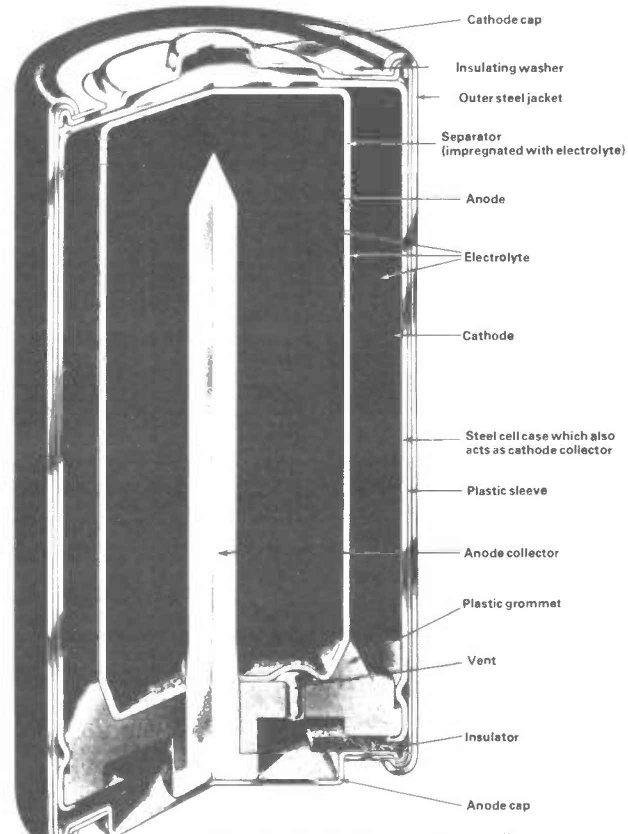

Fig 2 *Alkaline/manganese cell*

zinc/carbon cells – which, being electrically and mechanically similar, they increasingly replace.

Lithium, being a highly reactive metal, makes one half of a number of potential electrochemical couples, two of which have become quite well developed within the Duracell range (see *Figure 3*). These are lithium/sulphur dioxide (Li/SO_2) and lithium/manganese dioxide (Li/MnO_2) cells, both of which have a nominal voltage of 3.0V permitting one lithium cell to replace two conventional 1.5V cells. The former is based on a lithium anode in close contact with liquid sulphur dioxide as the cathode, the electrolyte being acetonitrile to which lithium bromide has been added to increase the conductivity. This combination makes for a very powerful battery, capable of efficient operation down to very low temperatures (–50°C), a property that leads to their wide usage in military applications. The Li/MnO_2 system combines a lithium anode with a manganese dioxide cathode in lithium perchlorate as the electrolyte. The latter is dissolved in an organic solvent, making the cell totally non-aqueous to preclude the potentially catastrophic evolution of hydrogen gas. Li/MnO_2 cells are particularly suited to applications that require low quiescent currents and short pulses of up to a few hundred milliamps on demand. Other advantages of this system include a long shelf-life (in excess of six years) and an ability to function at temperatures as low as – 20°C.

A third lithium system that has been considered incorporates a lithium anode, a lead/lead iodide/lead sulphide cathode and an electrolyte that is a dry mixture of lithium iodide, activated alumina and lithium hydroxide. It relies for its operation on ionic conduction in the solid state, making it a very unusual electrochemical system indeed. The current supplied would be only a few microamps at room temperature but it would increase with temperature, making this type of battery highly suitable for memory protection applications. However, its future is uncertain at present.

Further systems

Another system supported by Duracell is based on a zinc/mercuric oxide couple in an alkaline electrolyte (*Figure 4*). The principal properties of this 'mercury' system are stable voltage, high energy density and a reasonably long storage life, making it 'the first choice' in applications where voltage stability and/or space is at a premium. At present these cells are most commonly found in hearing aids.

While the monovalent silver oxide batteries to be found in digital watches and certain photographic applications are another Duracell product, a recent development is that of the zinc/air system (*Figure 5*) which uses atmospheric oxygen at one of the electrodes. The concept is simple, drawing on the basic electrochemical reaction of the cathode liberating oxygen and the anode becoming oxidised as the means of transferring charge between electrodes.Thus to use atmospheric oxygen just as though it has been liberated by the cathode should give the cathode almost infinite life. The voltage characteristic of the zinc/air system remains stable between 1.2 and 1.3V during most of the discharge and this system too is being used for hearing aids (where it is directly interchangeable with mercury cells) and other such specialised applications. However, it is still subject to development as there are several factors that can interfere with its functioning – for example, impurities in the air.

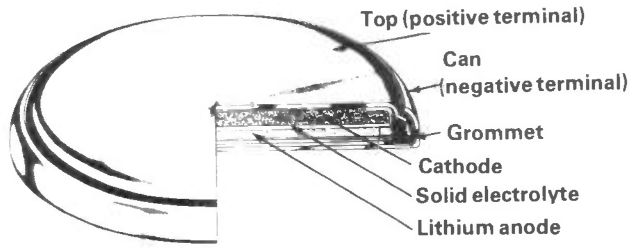

Fig 3 *Construction of a lithium cell*

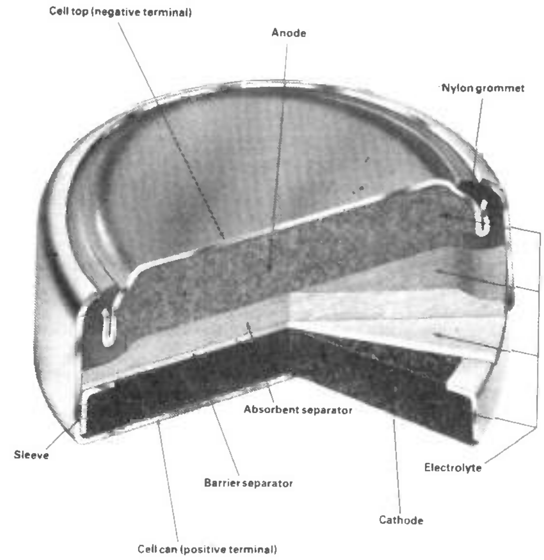

Fig 4 *Mercury button cell*

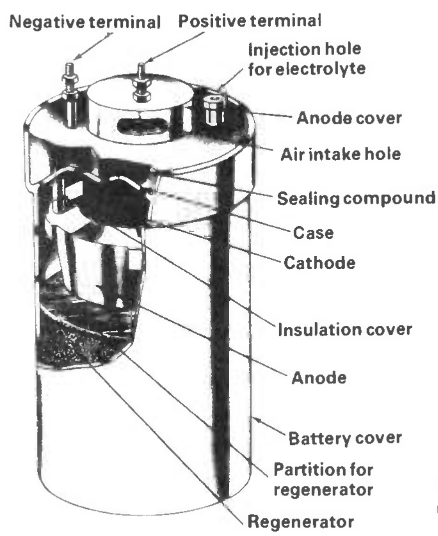

Fig 5 *Zinc/air cell*

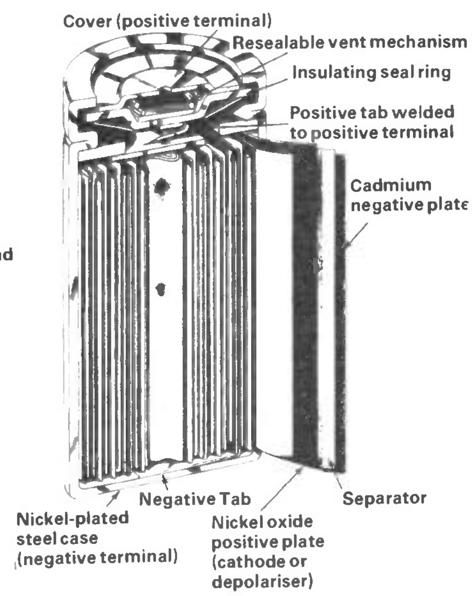

Fig 6 *Construction of a NiCad cell*

COMTECH ELECTRONICS

TRANSISTORS

BC107B	12p	BC546	10p	BF195	12p	MPSA55	20p	2N2907A	25p
BC108C	12p	BC546B	10p	BF196	12p	MPSA56	20p	2N3053	23p
BC109C	10p	BC547B	9p	BF197	12p	MPSA63	22p	2N3054	56p
BC113/4	16p	BC548B	9p	BF198	10p	MPSA64	22p	2N3055	50p
BC115/6	17p	BC548C	9p	BF199	12p	MPSA92	24p	2N3055H	75p
BC119	28p	BC549C	9p	BF200	40p	MPSA93	24p	2N3440	58p
BC139	32p	BC550C	10p	BF224	15p	TIP29A	30p	2N3441	120p
BC140	28p	BC556	10p	BF244C	22p	TIP29B	33p	2N3442	120p
BC141	29p	BC556B	10p	BF245	25p	TIP29C	33p	2N3702	10p
BC142	27p	BC557B	9p	BF256C	32p	TIP30A	30p	2N3703	10p
BC143	27p	BC557C	9p	BF256LC	35p	TIP30B	33p	2N3704	10p
BC160	30p	BC558B	9p	BF257	32p	TIP30C	36p	2N3705	10p
BC161	32p	BC558C	9p	BF258	32p	TIP31A	33p	2N3706	10p
BC169C	8p	BC559C	9p	BF259	35p	TIP31B	35p	2N3707	10p
BC171B	9p	BC560C	10p	BF336	36p	TIP31C	37p	2N3708	10p
BC172C	9p	BC637	20p	BF337	39p	TIP32A	33p	2N3771	170p
BC173C	9p	BC638	20p	BF338	40p	TIP32B	35p	2N3772	170p
BC177B	15p	BC639	23p	BF457	32p	TIP32C	37p	2N3773	190p
BC178C	15p	BC640	24p	BF458	32p	TIP33A	55p	2N3819	20p
BC179	15p	BCY70	18p	BF459	37p	TIP34A	60p	2N3823	50p
BC182	9p	BCY71	18p	BF494	12p	TIP41A	46p	2N3866	95p
BC182B	9p	BCY72	17p	BF595	16p	TIP41C	60p	2N3903	10p
BC183B	8p	BD115	50p	BF596	20p	TIP42A	46p	2N3904	10p
BC183C	9p	BD131	45p	BFX29	28p	TIP42C	60p	2N3905	10p
BC184B	9p	BD132	48p	BFX30	28p	TIP110	45p	2N3906	10p
BC184C	9p	BD133	70p	BFX84	28p	TIP115	45p	2N4030	30p
BC212	9p	BD135	30p	BFX85	28p	TIP120	70p	2N4033	30p
BC212B	9p	BD136	30p	BFX87	27p	TIP121	70p	2N4037	40p
BC213B	8p	BD137	30p	BFX88	23p	TIP122	70p	2N4058	7p
BC213C	8p	BD138	35p	BFY50	23p	TIP126	70p	2N4059	10p
BC214B	9p	BD139	35p	BFY51	22p	TIP127	70p	2N4060	10p
BC214C	9p	BD140	35p	BFY52	22p	TIP2955	70p	2N4061	10p
BC237	7p	BD203	70p	BSY95A	23p	TIP3055	70p	2N4062	10p
BC238	9p	BD204	70p	BU205	140p	TIS44	20p	2N4400	15p
BC239	9p	BD205	70p	BU206	150p	TIS90	24p	2N4401	15p
BC251	9p	BD206	70p	BU208	140p	TIS92	20p	2N4402	15p
BC300	40p	BD239A	40p	MJ2500	230p	2N1613	30p	2N4403	15p
BC301	35p	BD239C	50p	MJ2501	245p	2N1711	30p	2N5400	18p
BC302	35p	BD240A	42p	MJ2955	90p	2N1893	30p	2N5401	20p
BC303	35p	BD240C	50p	MJ3000	210p	2N2218	24p	2N5457	28p
BC304	35p	BD241A	42p	MJ3001	225p	2N2218A	25p	2N5458	27p
BC307	10p	BD241C	54p	MJE340	48p	2N2219	24p	2N5459	25p
BC308	10p	BD242A	42p	MJE350	70p	2N2219A	25p	2N5460	38p
BC309	10p	BD242C	54p	MJE370	80p	2N2221A	20p	2N5550	18p
BC327	12p	BD243A	55p	MJE371	84p	2N2222	18p	2N5551	20p
BC328	12p	BD243C	68p	MJE520	60p	2N2222A	20p	2N6027	23p
BC337	12p	BD244A	64p	MJE521	68p	2N2368	23p	2N6028	23p
BC338	12p	BD244C	78p	MJE2955	80p	2N2369A	15p		
BC413C	10p	BF180	30p	MJE3055	68p	2N2484	24p		
BC414C	10p	BF181	30p	MPSA05	20p	2N2646	48p		
BC415C	10p	BF182	30p	MPSA06	20p	2N2904	22p		
BC416C	10p	BF183	30p	MPSA12	22p	2N2904A	23p		
BC477	25p	BF184	30p	MPSA13	22p	2N2905	23p		
BC478	23p	BF185	30p	MPSA42	23p	2N2906A	22p		
BC479	24p	BF194	12p	MPSA43	23p	2N2907	23p		

ZENERS

400 mW 2V7-36 V 6p
1.3 W 4V7-51 V 10p

THYRISTORS

C106D	28p
C116D	70p
C126D	90p
C126M	98p
MCR101	30p
MCR102	34p
T2800D	110p
T2800M	165p
2N4443	120p
2N4444	130p
2N5060	23p
2N5061	24p
2N5062	29p
2N5064	32p

TRIACS

C206	55p
C225D	60p
C226D	70p
C226M	90p
C236	90p
C236M	120p
C246D	98p
C246M	140p
BR100	30p

BRIDGE RECTIFIERS

W005	18p
W01	20p
W02	22p
W04	24p
W06	28p
W08	32p
3A/50V	40p
3A/100V	42p
3A/200V	44p
3A/400V	46p
6A/50V	75p
6A/100V	80p
6A/200V	88p
6A/400V	94p
25A/100V	185p
25A/200V	198p
25A/400V	220p

LED's

3mm red	7p
5mm red	7p
3mm green	10p
5mm green	10p
3mm yellow	10p
5mm yellow	10p
clips	3p
rectangular Red	10p
Green	14p
Yellow	14p

CMOS

4000	14p	40162	52p
4001	14p	40163	52p
4002	14p	4501	16p
4006	50p	4502	55p
4007	16p	4503	34p
4008	50p	4504	98p
4011	14p	4506	70p
4012	15p	4508	145p
4013	24p	4510	50p
4014	54p	4511	52p
4015	46p	4512	48p
4016	24p	4513	98p
4017	42p	4514	110p
4018	47p	4516	55p
4019	30p	4517	180p
4020	46p	4518	52p
4021	42p	4520	55p
4022	46p	4522	65p
4023	14p	4526	64p
4024	38p	4528	56p
4025	14p	4529	72p
4026	84p	4530	92p
4027	29p	4531	70p
4028	42p	4532	88p
4029	48p	4541	70p
4030	18p	4544	120p
4035	56p	4551	88p
4040	48p	4553	180p
4041	48p	4554	148p
4042	42p	4555	48p
4043	44p	4556	48p
4044	44p	4557	160p
4046	55p	4558	110p
4048	30p	4559	390p
4049	25p	4560	170p
4050	25p	4566	120p
4051	52p	4568	270p
4052	52p	4569	140p
4053	54p	4572	42p
4066	28p	4573	198p
4068	15p	4574	198p
4069	15p	4575	198p
4070	15p	4580	280p
4071	15p	4584	38p
4072	15p	4585	74p
4073	15p	4599	178p
4074	15p		
4075	15p		
4077	15p		
4078	15p		
4081	15p		
4082	15p		
4093	32p		
4098	78p		
40161	52p		

CPU IC's

6800	395p
6802	550p
6808	520p
6810	250p
6820	250p
6821	190p
6840	595p
6850	180p
6852	360p
6880	140p
6885	130p
6889	140p
68000	POA
8T26A	140p
8T28	120p
8T95	140p
8T97	140p
8T98	140p
8080A	400p
8085A	500p
8156C	600p
8212C	198p
8216C	140p
8224C	220p
8228C	450p
8251AC	495p
8253AC	800p
8257C	750p
8259C	900p
8288	£16
TMS9980A	£22
TMS9981N	£25
TMS9901N	590p
TMS9902N	550p
Z80A 4M	580p
Z80A P10	500p
Z80A DMA	£16
2101 4A	350p
2114 4	120p
2147 70nS	600p
2147 45nS	700p
2716	400p
4164 150nS	£10
4016 200nS	£7
5101LC	340p
5101LC 1	395p

VOLTAGE REGULATORS

Positive 100mA

78L05	30p
78L12	30p
78L15	30p
78L18	45p
78L24	45p

1 A TO220

7805	36p
7808	55p
7812	36p
7815	36p
7818	36p
7824	40p

5 A TO3

78H05	540p

Negative 100 mA

79L05	50p
79L12	50p
79L15	50p

1 A TO220

7905	45p
7906	65p
7908	65p
7912	55p
7915	55p
7924	65p

– Variable –

LM309K	120p
LM317K	250p
LM317T	98p
LM337T	180p
LM350T	395p
LM723CN	35p
78H05	540p

OPTO

TIL32	55p
TIL38	40p
TIL78	50p
TIL100	100p
TIL111	85p
2N5777	50p
4N25	80p
4N28	70p
4N33	128p
4N35	150p
4N37	100p
BPX38	390p
BPX43	340p
TIL221	20p

(high output clear red)

IC SOCKETS

8 pin	7p	28 pin	16p
14 pin	8p	40 pin	20p
16 pin	9p	SPECIAL OFFERS	
18 pin	11p	25 x 22 pin	270p
20 pin	14p	25 x 28 pin	340p
22 pin	14p	10 x 40 pin	185p
24 pin	16p	25 x 40 pin	440p

LINEAR IC's

CA3046	72p	LM565	100p	SAA5041	£25
CA3065	190p	LM567	150p	SAA5050	£10
CA3080	72p	LM709	35p	SAA5052	£10
CA3086	56p	LM710	70p	SL490	300p
CA3089	170p	LM711	60p	SN76115	98p
CA3090AQ	300p	LM733	75p	SN76660	90p
CA3130E	95p	LM741	14p	TBA120S	70p
CA3140E	40p	LM747	50p	TBA520Q	200p
CA3160E	100p	LM748	35p	TBA550	240p
CA3161E	140p	LM1458	36p	TBA570Q	200p
CA3240AE	165p	LM3900	47p	TBA625	100p
CA3240E	110p	MC1455	16p	TBA800	70p
CA3260E	100p	MC1458	34p	TBA810AS	95p
CA810QM	250p	MC1496	70p	TBA810S	95p
LF347	160p	MC1748	35p	TBA820	75p
LF351	45p	MC3302	72p	TBA820M	78p
LF353	80p	MC3401	68p	TBA920	195p
LF355	85p	MC3403	65p	TBA950	210p
LF356	88p	NE529	220p	TCA270	120p
LF357	110p	NE531	160p	TCA800	250p
LM301A	26p	NE532	56p	TCA940	180p
LM307	54p	NE544	200p	TDA1022	550p
LM311	60p	NE550	160p	TDA1024	130p
LM318	120p	NE555	16p	TDA2002	100p
LM324	40p	NE556	45p	TDA2003	150p
LM339	46p	NE558	170p	TDA2004	295p
LM348	60p	NE565	140p	TDA2005M	395p
LM358	48p	NE560	150p	TDA2006	240p
LM380	68p	NE567	110p	TDA2020	250p
LM380B	80p	NE570	350p	TDA2030	220p
LM381	140p	NE571	320p	TDA2040	450p
LM381	120p	NE644	P.O.A.	TDA2054M	130p
LM384	125p	NE645	P.O.A.	TL061	40p
LM386	68p	RC455B	48p	TL062	80p
LM387	135p	SAA1027	550p	TL064	120p
LM393	70p	SAA1056	495p	ULN2001	80p
LM555	16p	SAA5000	350p	ULN2003	80p
LM556	45p	SAA5010	580p	ULN2004	80p
		SAA5020	620p		
		SAA5030	£10		
		SAA5040	£18		

CAPACITORS

Electrolytic radial/axial.

Value/V		price
0.47	25	5p
0.47	63	6p
1µF	63*	6p
2.2	16	5p
2.2	63*	6p
4.7	25	6p
4.7	63*	6p
10µF	10	5p
10µF	16	6p
10µF	25*	6p
10µF	63*	7p
22µF	16	6p
22µF	25	6p
22µF	63*	9p
47µF	10	7p
47µF	25	8p
47µF	63	12p
100	10*	6p
100	16	8p
100	25	10p
100	63	18p
220	10*	8p
220	16	10p
220	25*	14p
220	63	24p
470	10	14p
470	25*	20p
1000	10	18p
1000	25*	28p
2200	10	32p
2200	25*	45p

* axials only available these values, radial available on all of above.

Tantalum bead.

Value/V		price
0.1µF	35	12p
0.22	35	12p
0.33	35	12p
0.47	35	12p
0.68	35	12p
1µF	35	12p
2.2µF	35	16p
3.3µF	35	18p
4.7µF	25	20p
6.8µF	25	20p
10µF	16	20p
15µF	16	28p
22µF	16	35p
33µF	16	60p
33µF	10	36p
47µF	10	60p
68µF	10	80p
60µF	6.3	60p
100µF	6.3	70p
100µF	3	38p
150µF	6.3	90p

Ceramic Plate 63/100 V 1.8 pF to 4N7 5p.

Polystyrene 5% 63 V 10 pF to 1 nF 9p each. 1n2 to 10 nF 12p each.

Polyester C352 series 250 V 0.01, 0.015, 0.022, 0.033, 0.047 6p. 0.068, 0.1 8p. 0.15, 0.22 10p. 0.33, 0.47 12p. 0.6B 18p. 1 µ 22p.

Disc Ceramic: 10 N 4p.

DIODES

AA119	9p
BAX13	5p
BAX16	6p
OA47	9p
OA90	7p
OA91	7p
OA95	8p
OA200	7p
OA202	8p
1S44	6p
1S921	9p
1N914	3p
1N916	4p
1N4148	3p
1N4149	4p
1N4001	3p
1N4002	4p
1N4003	4p
1N4004	5p
1N4005	5p
1N4006	6p
1N4007	6p
1N5401	11p
1N5402	12p
1N5403	13p
1N5404	13p
1N5405	14p
1N5406	14p
1N5407	15p
1N5408	16p
6A/100V	25p
6A/200V	28p
6A/400V	30p

HEATSINKS

TO5 push on 6mm (80°C/W) 16p each. 12mm (60°C/W) 28p each. TO3 14°C/W 30p each. TO3 10°C/W 110p each. TO126/220 18°C/W 25p. All in matt black finish.

RESISTORS

¼ Watt Carbon film 5% E24 series 4.7R-2M2 1p each. ½ Watt Carbon film 5% E12 series 1R-10M 2p each. ¼ Watt Metal film 1% E24 series 10R-1M 4p each. 250p per 100, one value only 280p per 100 mixed values. 2.5 Watt wire-wound OR22-10 ohms E12 series 25p each. Presets: miniature horizontal & vertical 8p each 100R-500K. Multiturn cermet trimmers 100R-500K 88p each. Potentiometers: Single gang 1K to 1M 32p each. Single gang with DPST switch 68p each. Dual gang 80p each.

VEROBOARD

2½ x 1"	25p
2½ x 3¾"	90p
2½ x 5"	110p
3¾ x 3¾"	110p
3¾ x 5"	115p
Pkt of 100 pins	55p
Spot face cutter	150p

HARDWARE

each

4xTO3 mounting kits 20p 64 mm Loudspeakers 8R 70p 4xTO66 mounting kits 20p 64R 78p each 300mW rating. 5 xTO126 bushes/washers 14p PP3 battery snaps 6p each. 10xTO220 bushes/washers 22p 4xHP7 battery holder 22p 5 xTO3P bushes/washers 14p 6xHP7 battery holder 32p 20mm panel fuseholder 32p 20mm chassis fuseholder 7p 4mm plugs 12p. 4mm sockets 20p. 4mm insulated terminals 30p. 3.5mm jack socket 15p. 3.5mm jack plug 15p Phono sockets 15p. Switches: miniature toggle, SPST 60p, SPDT 68p, DPDT 78p each. Miniature push buttons: 1A/250V push to make 16p push to break 23p. Midget rotary switches, pcb terminals 2P6W, 4P3W, 3P4W 39p each. Slide switch 1A/250V DPDT (22 x 12 x 8 mm) 16p.

BRAND NEW COMPONENT PACKS

CP100 60 IC sockets, 8, 14, and 16 pin, 20 of each	440p
CP101 20 BC182/BC212 transistors, 10 of each	130p
CP102 20 BC183/BC213 transistors, 10 of each	100p
CP103 20 BC184/BC214 transistors, 10 of each	130p
CP104 20 BC549C/BC559C transistors, 10 of each	130p
CP105 20 BC550C/BC560C transistors, 10 of each	160p
CP106 100 1N914 switching diodes, 75-100V/75mA	240p
CP107 100 1N916 switching diodes, 75/100V/75mA	280p
CP108 100 1N4148 switching diodes, 75-100V/75mA	160p
CP109 500 1N414B switching diodes, 75-100V/75mA	680p
CP110 30 1N4002 1A/400V rectifiers	100p
CP111 10 MC145B Dual op amps (741 type)	320p
CP112 100 400mW zeners, 4 of each 2V7 to 33V	450p
CP113 100 1.3W zeners, 4 of each 4V7 to 51V	850p
CP114 4 LF351 JFET op amps, Low noise	170p
CP115 4 LF353 JFET op amps, dual low noise	300p
CP117 50 mixed LED's 3mm/5mm/rect/red/green/yellow	400p
CP119 100 1N4002 1A/100V rectifiers	270p
CP120 10 C106D 400V/4A thyristors	250p
CP121 10 NE556 dual timer IC's	400p
CP124 100 mixed electrolytic capacitors 10-63V/1 1000µF	£6
CP125 5 LM317T 1A/TO220 variable regulators	440p

SPECIAL BULK PURCHASE

C106D 400 V 4 A Thyristor 28p each. 10 for 250p. 25 for 475p. 100 for £20. 300 for £54. 500 for £85. 1000 off POA. LM317T 1A/adj. Regulator 98p each. 10 for 880p. 25 for £21. 100 for £68. 300 for £195. 500 for £295. 1000 off POA. 1N414B switching diodes 3p each. 100 for 160p. 500 for £6.80. 1000 for £11.50. Larger quantities please enquire. 1N914 switching diodes 3p each. 100 for 240p. 500 for £11.00. 1000 for £17. Larger quantities please enquire. Generous quantity discounts available on most lines.

ORDERING INFORMATION: Please add 40p P&P to all orders under £6, then VAT to total order. Cheques or postal orders made payable to Comtech Electronics. Official orders welcome, trade please enquire. All items held in stock despatched same day. SAE brings full list. Data sheets 10p each.

COMTECH ELECTRONICS

DEPT.REW12.
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LEICESTER
LE2 9FY
Telephone: (0533) 779578

★SAME DAY DESPATCH★
★COMPETITIVE & RELIABLE★

The movement of oxygen discussed above has been essentially the crucial factor in ruling out recharging for all the above-mentioned battery systems. Unfortunately the anode cannot be simply restored to its metallic state because it swells up in becoming oxidised. Moreover, anode particles may break up or shift about, with the result that the original structure is largely destroyed. The only system to date to circumvent this difficulty whilst at the same time being compact enough to be competitive with small primary cells is the nickel/cadmium rechargeable. Here both the anode material (cadmium) and the cathode material (nickel oxide) are contained in porous plates that prevent the anode structure from being seriously distorted as the cadmium is oxidised (*Figure 6*). The cathode structure is similarly maintained and so it is safe to recharge the cell. However, their cost, along with that of the recharging unit, and the frequency with which they need to be recharged have so far limited NiCads to a relatively small share of the consumer market.

Putting batteries into circuits

A number of 'golden rules' are stressed by Duracell, their aim being to aid any circuit designer in establishing a design that operates with a satisfactory power source, in terms of both performance and cost. These are:

1) Always select the battery or cell type before finalising either the circuit parameters or the mechanical design. In an extreme case, it might not be possible to find any battery – however expensive – that meets your requirements.

2) Select the circuit parameters so that the equipment operates within the desired specification over as much as possible of the available voltage range of the chosen battery as indicated by diagrams such as those shown in *Figures 7 and 8*. In other words, reconcile the requirements of the equipment with the battery's ability to deliver current: any mismatch can cost a lot in lost energy particularly in the case of those battery systems that deliver their energy over a considerable voltage range.

3) Design the equipment to be able to accept the battery's open-circuit voltage which may exceed the nominal voltage by as much as 15%.

4) Always aim to use standard rather than special batteries; not only are the former less expensive but they are also much more widely distributed, offering the promise of cost-efficient service for many years.

5) Aim for the lowest system voltage compatible with the power requirement at the lowest specified temperature, particularly where cells are connected in series; this is generally regarded as good practice.

6) Where cells are connected in parallel, ensure that the current passed by any cell stays within the range stipulated on its data sheet.

7) Never mix cells of different brands, types or ages as this will almost certainly lead to the weakest cell being at some stage driven in reverse with consequent gassing, leakage or even rupture.

Practicalities

Of course, not all of these aims are particularly easy to implement. For example, while data sheets can generally indicate well enough the acceptability of a proposed load at 20°C, the detailed rate capability is a complex function of temperature, duty cycle and previous storage history and so it is rarely, if ever, fully documented. However, special tests that give a good indication of performance at low temperatures, say, can be performed and data relating to performance at specific temperatures either side of normal ambient conditions can generally be provided by the manufacturer. There is further guidance on this in the Duracell guide.

Even taking all that into consideration is not enough, for one must also remember that the reliability of any battery decreases as the number of cells increases (as there is a greater risk of the weakest cell being driven in reverse) and that, when connecting Li/SO_2 cells in parallel, series diodes must be added to each parallel path. (In fact the latter action generally increases the reliability of cells under parallel connection.) Another point to consider is the use of lithium cells with their nominal output of 3V in place of conventional 1.5V cells where space and/or weight is at a premium.

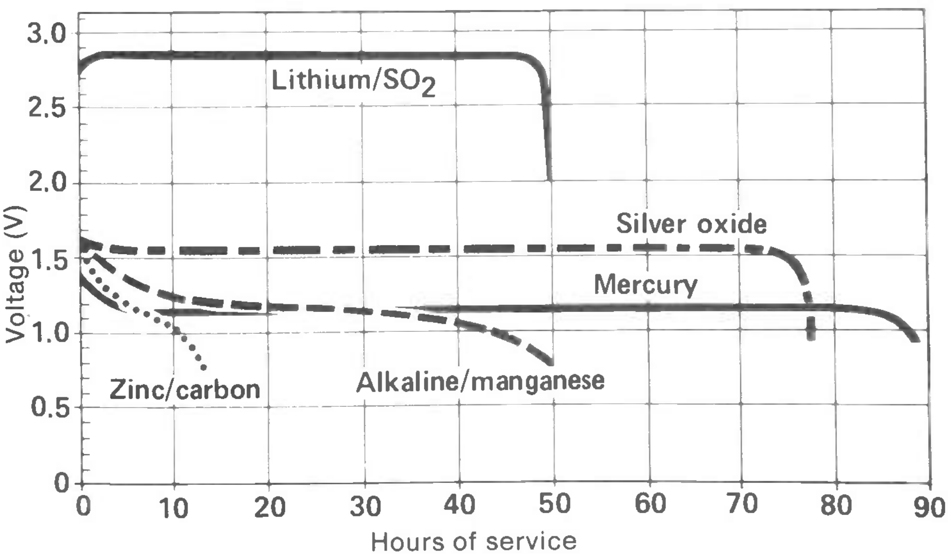

Fig 7 *Typical voltage characteristics on medium load of some Durcell batteries*

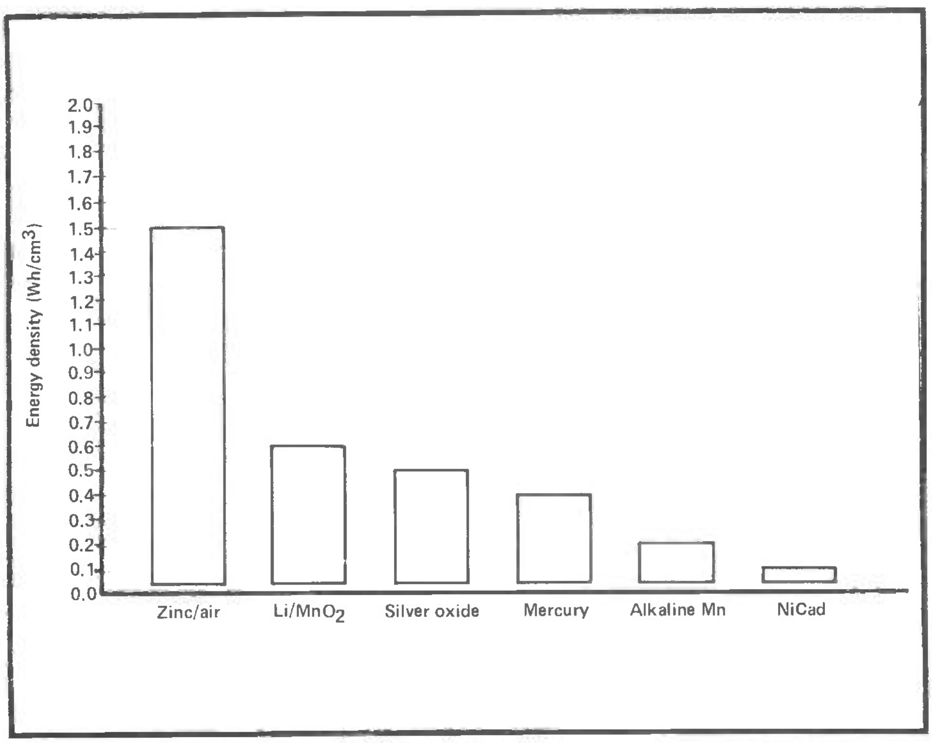

Fig 8 *Typical energy densities for a number of battery systems*

Ultimately, the best source of advice is a specialist battery manufacturer and indeed Duracell offers a free battery consultancy service. The company might even be able to oblige with a custom-designed battery, exactly right for the purpose.

The battery housing

The other major area of advice is concerned with the battery compartment. Not only should this keep the cells clear of any metallic battery jacket but it should also be able to accommodate cells individually, allowing for all sizes up to the maximum size each cell could be, appropriate contact springs taking up the difference between this and the actual dimensions.

The springs themselves should in turn conform to certain standards. For example, the pressure they apply should be just enough to mark the cell and, still more importantly, they should be made of a compatible material i.e. one that won't encourage galvanic corrosion following a cycle of temperature and humidity that leads to condensation. The materials recommended include austenitic 18/8 stainless steel, steel with an 8μm thick layer of nickel-plating, and inconel: copper alloys are definitely not recommended. By the way, the white deposit that can develop on the contacts does not affect the performance of the cell itself but it will, of course, increase the circuit resistance: however, it can readily be removed with a dry cloth.

Other points to note regarding these contacts are: that the contact should be single-point for low currents but multiple-point for larger ones; that screw terminals are unacceptably restrictive and so should not be used; and that there should be no conductive path between the battery jacket and the equipment. Duracell also recommends the use of polarised battery contacts and that the compartment be designed to make it impossible to insert the batteries the wrong way round. This is particularly important where more than one Li/MnO_2 cell is being used either in series or parallel as one of these driven in reverse could explode!

Apparently, an increasing number of applications are side-stepping the insertion problem by making use of Duracell's new Flat-Pak. This is essentially a number of high performance alkaline cells welded together and sealed into a flat cassette only 9mm thick. This cassette is so designed that it cannot be inserted incorrectly: moreover it reduces the size, complexity and cost of the battery compartment as only two contacts are needed instead of multiple springs, etc. In addition, users should note that it is Duracell policy only to supply Li/SO_2 cells in packaged form complete with fuses and protective diodes.

And finally.....

Questions of storage, recharging and disposal come up as a matter of course when handling batteries. Duracell recommends storage at 10–25°C and where the relative humidity is less than 65%: other conditions are certain to encourage a quicker deterioration in battery performance. With regard to recharging, most of the cells considered here are not designed for this: any attempt to recharge them will induce an inbalance in the cell which could lead to gassing and ultimately to an explosion. Duracell, naturally, does not accept responsibility for injury or damage resulting from this or other abuse – and it is highly unlikely that any other manufacturer would.

Last, but not least, don't dispose of them in the fire!

Characteristics of Duracell Batteries

Type	Open-circuit voltage	Voltage on load	End voltage	Operating temp	Shelf life indication
Alkaline manganese	1.56V	1.5V	0.8V[1]	−30 to +70°C	>85% retention after 2½ years at 20°C
Mercury (two forms)	1.35–1.36V 1.36-1.55V	1.3–1.4V	0.9V	−30 to +70°C	≤95% retention after 1½ years at 20°C
Monovalent silver oxide	—	1.5V	1.2V	—	~90% after 1 year at room temperature
Lithium/ sulphur dioxide	3V	2.8 – 2.9V[2]	2V[3]	−50 to +70°C	10 years
Lithium/ manganese dioxide	3.3V	3V	~1.4V	−20 to +50°C	6 years at room temperature
Zinc/air	1.4V	1.2–1.3V	0.9V	—	2½ years sealed 3 months unsealed

[1] 1V per cell when 6 or more cells used in series
[2] 2.55 – 2.8V at −30°C
[3] 1.5V in high rate applications: must not be allowed to go below 0V

Alkaline Manganese

- No defined upper limit but it is suggested that no more than 2A is drawn on intermittent load at room temperature.
- These batteries are unaffected by high pressure, high vacuum or high relative humidity but they shouldn't be used for more than short periods above 45°C.
- Available in all common (ie international) sizes.
- Storage at temperatures above 20°C will lead to progressive deterioration in both capacity and high rate capability

Mercury

- The difference between the two forms of cell is only important a) during the first 5 – 0% of the discharge and b) when maximum voltage stability is required.
- Energy can be taken from these batteries at up to the 20hr rate at 20°C without significant loss of efficiency.
- These batteries are unaffected by high pressure, high vacuum or high relative humidity.

Li/SO_2

- Open circuit voltage modified in time through formation of a passivation layer of lithium dithionite on the anode but this is rapidly stripped on discharge.
- Operation above 70°C risks accidental venting.
- Tolerant of high vacuum but high pressure can inhibit the safety vent.
- Can supply up to 30A intermittently but the energy should not be dissipated at more than the 8hr rate over longer periods.

NB: The transportation of those batteries containing more than 0.5g of lithium are subject to international regulations.

Li/MnO_2

- Maximum load that can be taken is a function of the particular cell type.
- The voltage characteristic is substantially flat.
- These cells all contain less than 0.5g of lithium and so are not subject to restrictions over their transportation.

Duracell's 86-page guide for designers of electrical circuits and equipment is available free of charge from Duracell UK (Technical Division), Duracell House, Gatwick Road, Crawley, West Sussex RH10 2PA (Tel: Crawley [0293] 517527), which is also the address to write to for further information.

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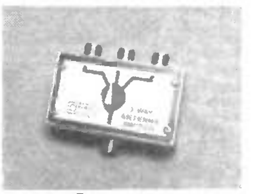

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COMMUNICATIONS BUILDING BLOCKS

Front ends for all –Part 2

Before making an attempt within this series at quantifying mixer and front-end performance, we offer some practical insight — and a choice of different active mixer configurations for experimenters and building block users.

As already discussed in this series, the section of the receiver most likely to make or break the design when judged in terms of conventional standards of performance is the first mixer. Dynamic range is the thing — and whereas valves provided a comparatively easy route to wide dynamic range, semiconductor systems do not.

The requirement is simple. If a receiver has a 'free range' sensitivity of one microvolt for 12dB SINAD, then it should be able to handle a strong signal in the passband of the RF stage that is 90dB 'up' on one microvolt — approximately 30mV — without cross modulation, intermodulation or other manifestations of non-linearity in the RF amplifiers or the mixer.

Now there's nothing mystical or magical about dynamic range. Despite the problems it creates, it is a simple concept to grasp: *Figure 1* illustrates the basic reasoning. But the solutions are not so simple in semiconductor technologies where the maximum rail voltages are between ten and thirty times less than those used with valves. And there are other considerations, the major one being the old chestnut about the influence of impedance levels on power levels with respect to available voltage swing. Read on.

Low Z

In terms of power, one microvolt into 50 ohms translates into 4.47μV into 1000 ohms. (Power = [volts.volts]/resistance.) A bipolar transistor junction rejoices in a voltage difference between base and collector of some 300mV. A 100mV input signal presented to the base of a transistor RF amplifier will cause it to overload quite hopelessly. However, the input impedance is very low, and a signal of 100mV at 1000 ohms will drop significantly as a result of the impedance presented by the transistor base.

A transformer is used in tuned RF amplifier stages to match both the input from the antenna, and the output to the ensuing active circuitry. *Figure 2* illustrates this. One side effect of this method

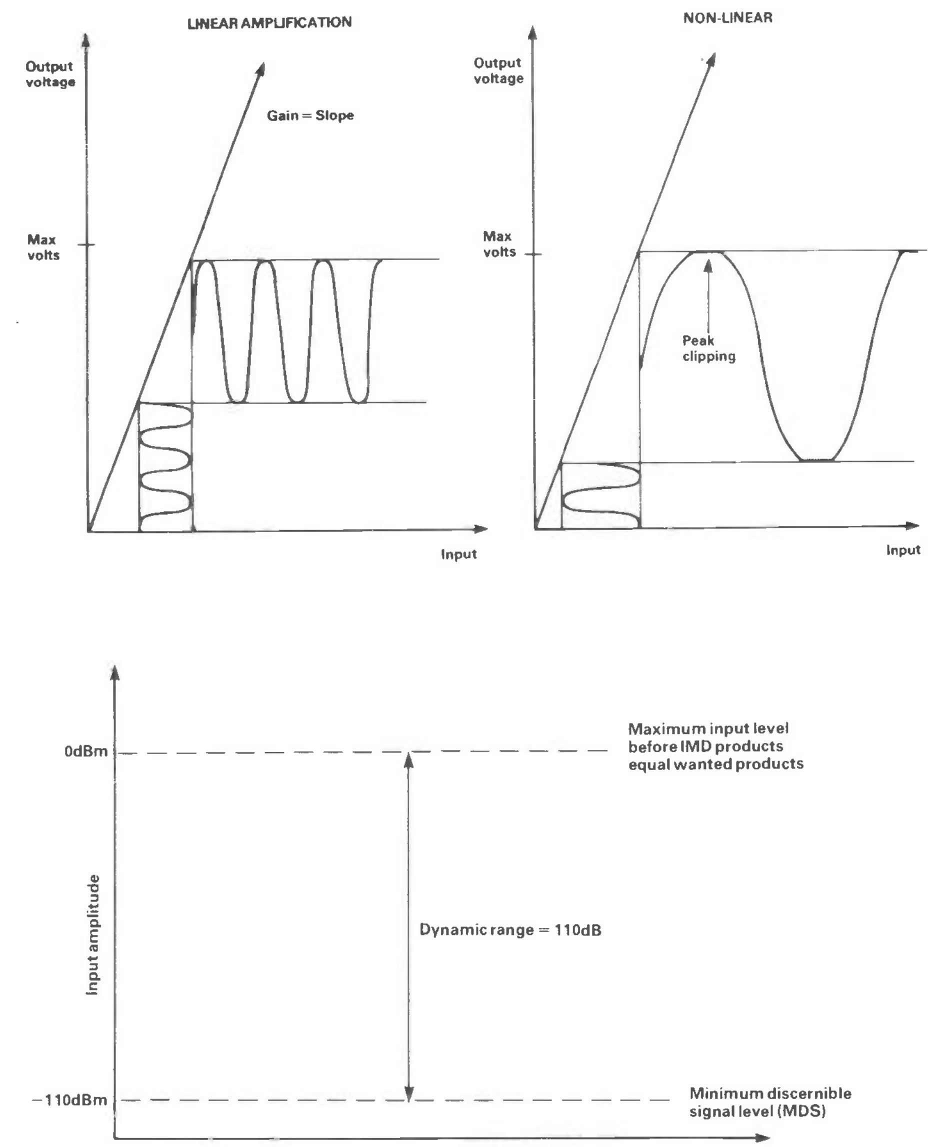
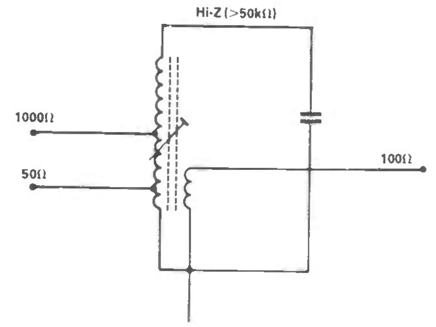


Fig 1 *a) Demonstration of why the dynamic range of an amplifying stage is limited by the available voltage swing at the output. b) Receiver dynamic range. NB for* ***in band*** *signals, the maximum input level can be considerably greater due to AGC effects.*



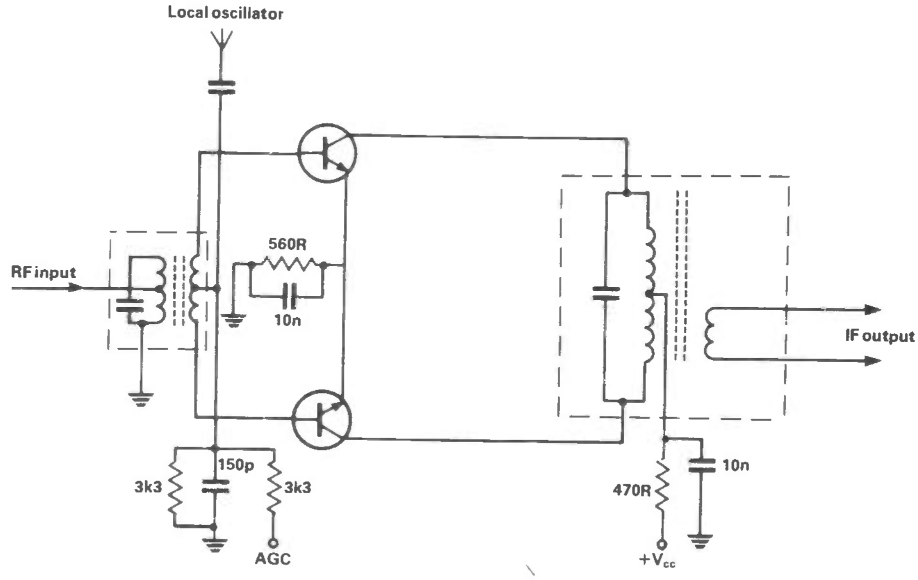


Fig 2: *Typical input stage transformation*

Fig 3: *Cybernet balanced mixer stage*

of matching is the way in which the impedances of an amplifier alter across its tuning range: it's not possible to design a variable capacitance tuned circuit to have constant input/output impedance over a broad tuning range.

Virtually regardless of the rail voltages available, a given configuration of bipolar transistor amplifier (or mixer) will tend to produce similar dynamic ranges (assuming the bias currents are adjusted to remain the same). The situation is not helped by operating the stage at low collector currents, since the relatively high collector impedance will increase the collector voltage swing for a given power level. Thus a higher collector current is generally synonymous with improved dynamic range.

One popular method of extracting more performance from bipolar mixer stages is to use the 'balanced' configuration. This approach relies on a similar principle to that used in class B audio power amplification: each transistor can devote its entire 'dynamic range' to only half of the waveform. The (singly) balanced mixer used in a number of CB sets within the Cybernet range *(Figure 3)* seems particularly commendable, judging by the result of various equipment reviews, yet it's relatively simple and unexotic.

Mixing it with FETs

Ever since the FET and MOSFET were introduced into radio design, they have tended to displace bipolar alternatives in areas where high level signal performance is required. There was a large element of fashion involved in the early days of FETs, and quite a few designs sporting FETs simply plugged them in where the bipolar devices once lived. A FET is basically a high impedance device like a valve — but unlike a valve it doesn't enjoy a lot of headroom in the anode voltage. It nevertheless provides an excellent transformation between high input impedances and the relatively lower impedance of the drain, and is more forgiving of biasing. By the same token, a single ended FET amplifier with a tuned input is prone to instability as a result of the input and the output 'seeing' each other 'in phase'.

The Sony ICF2001

The FET does not provide inherently much better dynamic range than a correctly biased and matched bipolar RF stage — but it does provide better performance in service as a mixer, and it is a great deal more forgiving of inaccurate design and matching. An FET mixer with the signal applied to the gate and the oscillator supplied via the source is a popular solution, although the oscillator feed to the source must be well buffered, since strong RF input signals are not at all isolated from the source. One or two designs have been known to collapse completely when the oscillator has been effectively turned off in this way.

The singly balanced FET mixer has been thoroughly explored in a number of Japanese designs. All yield an IMD performance in the region 85—95dB with respect to the minimum discernible signal (MDS), with anything from 5 to 20dB of gain. One of the more interesting manifestations occurs in the Sony ICF2001 where the HF input stage *(Figure 4)* also embodies an 'active' antenna pre-amplifier in the shape of Q52 and Q50. The legendary propensity to overload exhibited by the ICF2001 is not prompted by this aspect of the circuit but the very wide first IF and the less than razor sharp selectivity afforded by the input tuned stages formed across L6 through L10.

The signal in the ICF2001 is fed to gates of the balanced mixer stage via a source follower buffer stage. Local oscillator injection is onto the source via Q21 and T3, whose properties are regrettably not defined in the parts list. It seems reasonable to make an initial guess of a centre tapped 1:1 broadband transformer wound on a small dual aperture ferrite core.

The tuned drain circuit is conventional enough (centre tapped, don't forget), and you can forget Q18, Q23 and their associated components, since these are used in the FM/AM switching. One slightly curious aspect of the design is the size of the source resistors: at 4k7 and a voltage drop of 300mV, the current flowing is (0.3/4k7)=65μA — which is barely using the FET at all. In applications where the cautious use of supply current isn't a problem, it seems likely that dropping their value to 470 ohms would improve the performance. The basic consideration in these matters is that the power levels biasing and operating the active circuitry should not be swamped by the power derived from the signal.

A similar style of stage occurs at the front end of the highly regarded NRD515 *(Figure 5)*. Here the source resistors are effectively 1k0, and the local oscillator is fed from a local buffer stage (TR7), whose output level is controlled by the AGC loop fed from C180 round to TR6.

The ubiquitous Ulrich Rhode has been known to favour the passive FET mixer of *Figure 6*, which can provide an intercept of +40dBm when correctly matched. If you choose this approach, you'll be in the excellent company of the Racal RA6790. The catch is the requirement for a 23dBm drive signal, along with two of the most obscure FET types yet seen in these pages. No, a 2N3819 won't do!

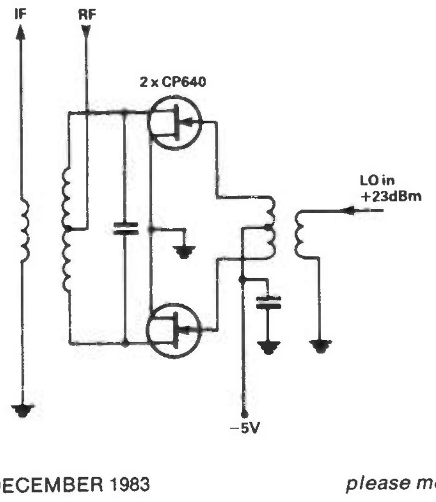
The input to the ICF2001 is resistively terminated: another look at a similar configuration (from Yaesu) with a tuned input (in this case a second conversion stage) is provided by *Figure 7a*. The R1000 does a similar thing with dual gate MOSFETs *(Figure 7b)*, taking advantage of the control gate to inject the local oscillator and add to the effectiveness of the AGC control. Purists, however, don't hold with that sort of thing, since AGC on the mixer will cause the dynamic characteristics to be modified, thus altering the matching between the mixer and the filter stage. It's a pedantic point that shouldn't really concern any enthusiast prepared to try out some of the designs suggested herein.

Mixing it with Plessey

The Plessey SL6440 is widely used as a 'convenience' product because it provides good dynamic range with relatively low oscillator drive levels. The device is based on the classic among double balanced mixers — the MC1496 *(Figure 8)*. A similar transistor tree configuration occurs in a large number of radio ICs, doing service as mixers and product detectors (SL1640, ULN2242, TDA1083, KB4412/3 etc).

The Plessey implementation uses this same basic transistor tree arrangement,

Fig 6 *Passive FET mixer*



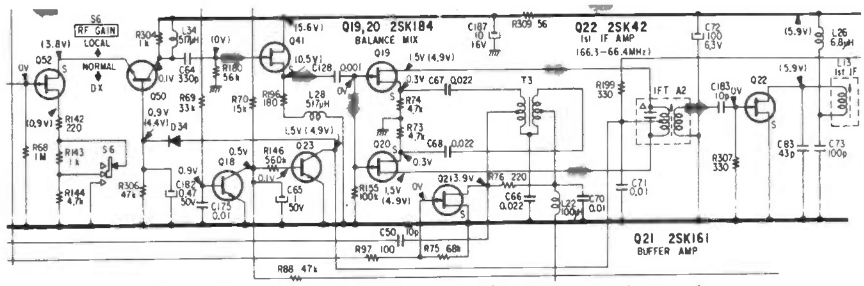


Fig 4 *HF input stage of the Sony ICF2001 — an interesting manifestation of the singly balanced FET mixer*

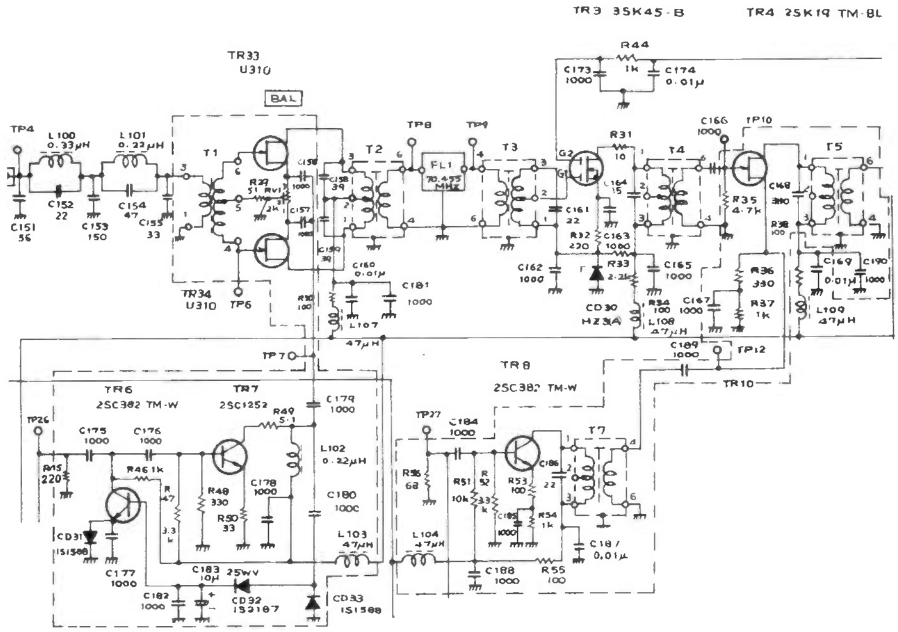
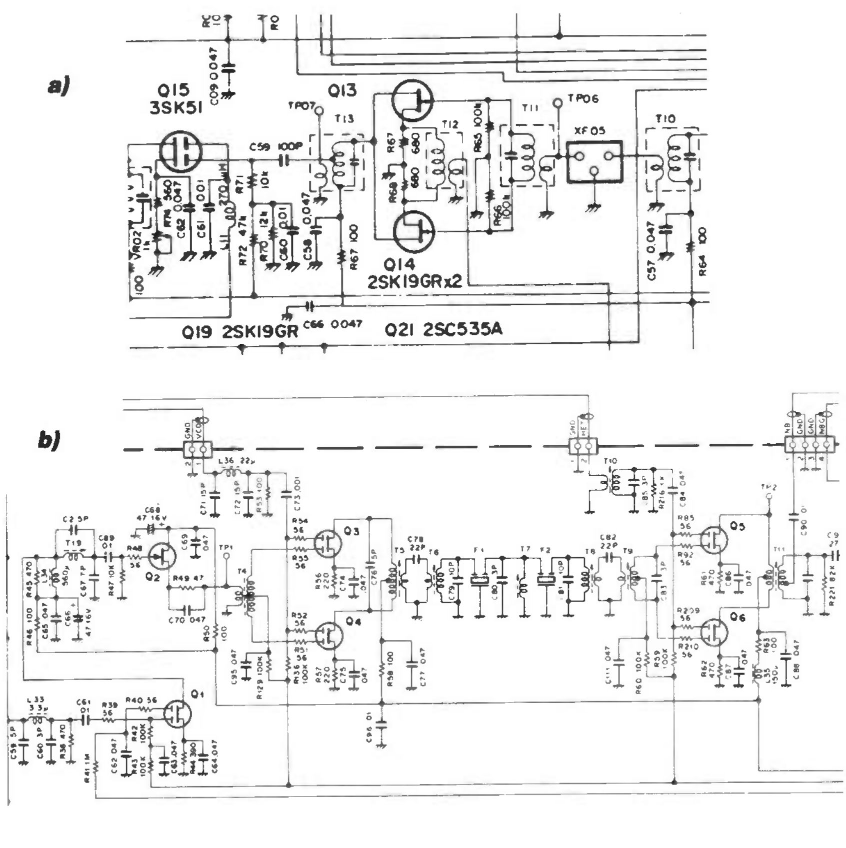


Fig 5 *Front end of the NRD515*

Fig 7 *a) Yaesu mixer configuration, and b) Equivalent circuit from the R1000, this time using dual gate MOSFETs*



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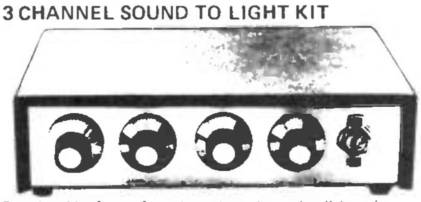

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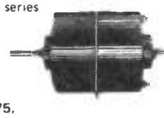

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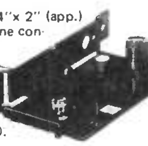

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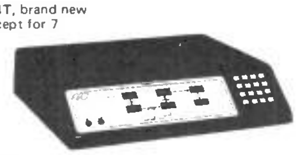

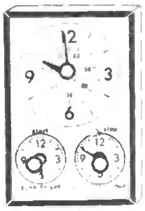

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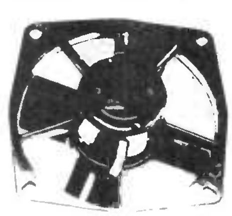

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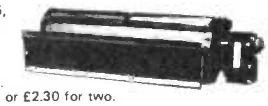

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Drill control kit	£3.95
Drill control kit — made up	£6.95
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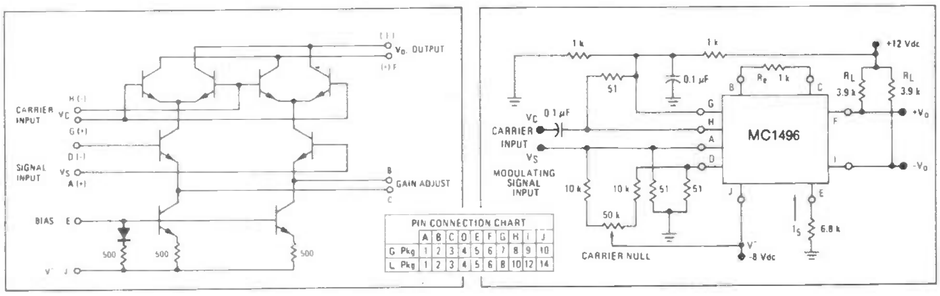


Fig 8 *a) Schematic representation and b) Typical modulator circuit for the MC14196*

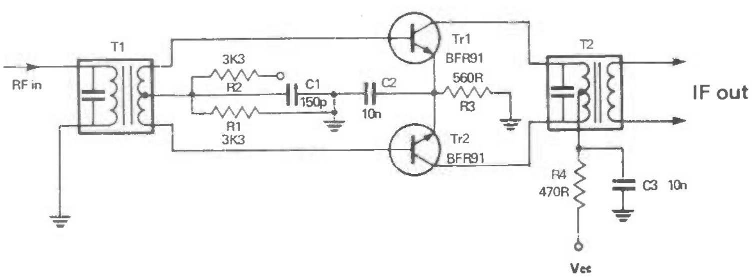


Fig 9 *High performance SL6440-based mixer circuit*

optimised through the use of large multiple-emitter transistors and careful selection of emitter resistance values. In the application circuit shown in *Figure 9*, the SL6440 returns a performance that represents probably the best available to the home experimenter without an array of sophisticated test equipment to tweak and optimise discrete alternatives.

Sensitivity is −113dBm for 15dB S+N/N in a 3kHz bandwith; the third order IMD ratio with two signals of −4dBm is a high 70dB; only 30μW of LO required; and a gain of 10dB is available — countered by the only drawback of this approach, a noise factor of 11dB. However, Plessey and Peter Chadwick argue with considerable justification that, within the HF spectrum, such a noise figure is not the factor limiting the overall performance.

In Conclusion

Mixer designs provides a lot of scope for experimentation. A number of communications buildings blocks may be derived from the types described herein, and next month we'll be catching up with some PCB designs and performance results for the active antenna system discussed last month, along with those for a couple of the mixers described in this instalment.

Fig 10a: *PCB for the SL6440-based mixer circuit shown in Figure 9. Bottom plane foil pattern*

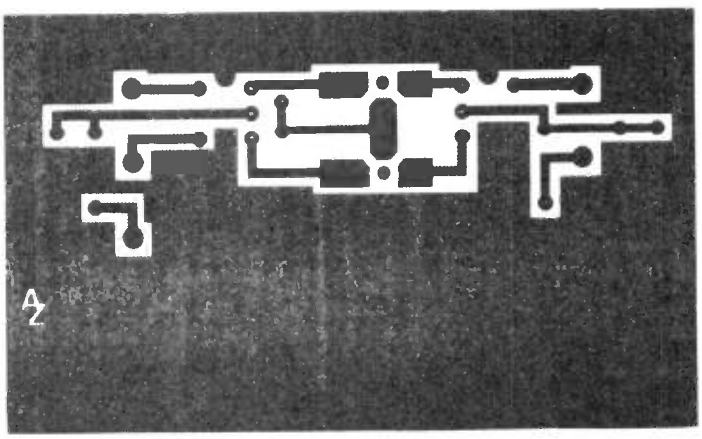


Fig 10b: *PCB top plane*

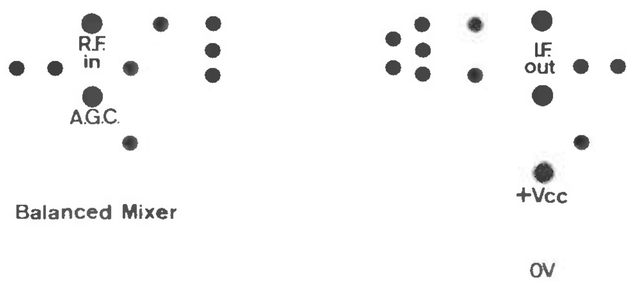
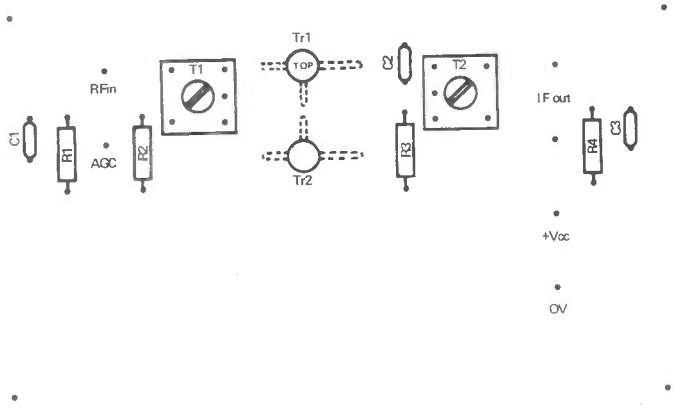


Fig 11: *Component overlay*



DATA FILE

Ray Marston presents the first of a four-part in-depth survey of op-amp principles and applications. This month he concentrates on basic principles and configurations

A conventional operational amplifier (op-amp) can be simply described as a high-gain direct-coupled voltage amplifier 'block' that has a single output terminal but has both inverting and non-inverting input terminals, enabling the device to function as either an inverting, non-inverting or differential amplifier. Op-amps are very versatile devices: when coupled to suitable feedback networks they can be used to make precision AC and DC amplifiers and filters, oscillators, level switches and comparators, to name but a few.

Three basic types of operational amplifier are currently available. The most important of these is the conventional 'voltage-in voltage-out' op-amp (typified by the 741 and the 3140), and in this and the next three editions of 'Data File' we'll take an in-depth look at the operating principles and practical applications of this type of device. The other two are the current-differencing or Norton op-amp, and the operational transconductance amplifier or OTA; we've already taken in-depth looks at both of these types of device in earlier editions of 'Data File' (April—June 1983).

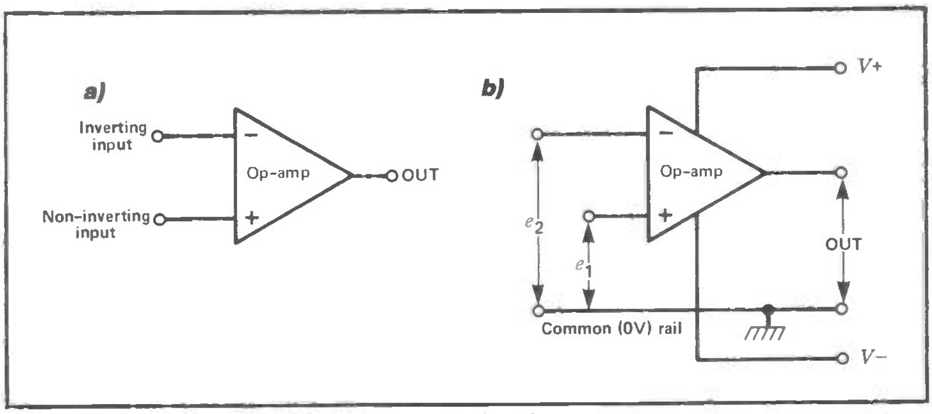


Fig 2 *a) Basic symbol and b) Supply connections for an op-amp*

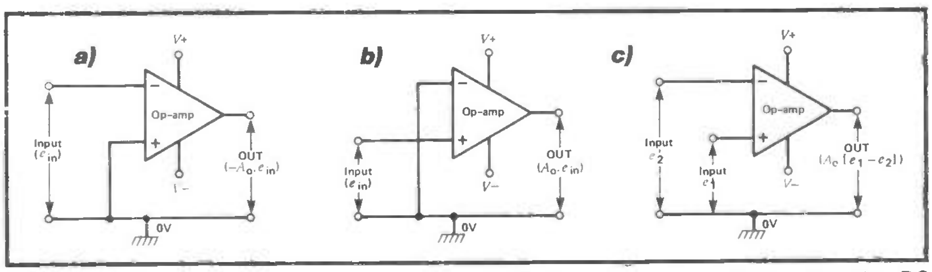


Fig 3 *Methods of using an op-amp as a high gain, open-loop, linear amplifier. a) Inverting DC amplifier; b) Non-inverting DC amplifier, and c) Differential DC amplifier*

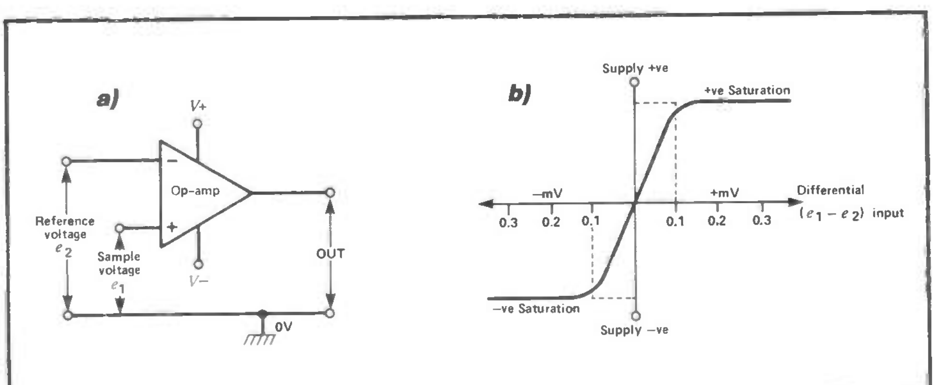


Fig 4 *a) Circuit and b) Transfer characteristics of a simple differential voltage comparator*

Op-amp basics

In its simplest form, a conventional op-amp consists of a differential amplifier (bipolar or FET) followed by offset compensation and output stages, as shown in *Figure 1*; all of these elements are integrated on a single chip and

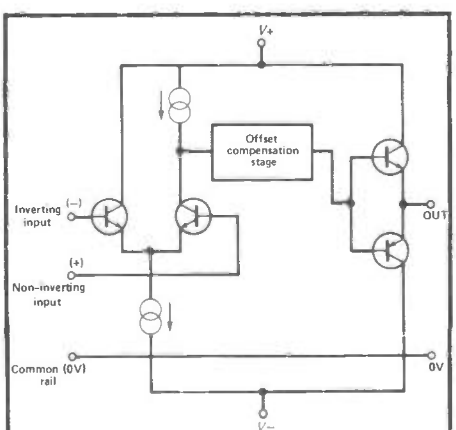


Fig 1 *Simplified op-amp equivalent circuit*

housed in an IC package. The differential amplifier has inverting and non-inverting input terminals and has a high-impedance (constant-current) tail to give a high input impedance and a high degree of common-mode signal rejection. It also has a high-impedance collector (or drain) load, to give a large signal-voltage gain (typically about 100dB).

The output of the differential amplifier is fed to the circuit's output stage via an offset compensation network, which causes the op-amp output to centre on 0V when both input terminals are tied to 0V. The output stage takes the form of a complementary emitter follower and gives a low-impedance output.

Op-amps are represented by the standard symbol shown in *Figure 2a*, and they are normally powered from split supplies, as shown in *Figure 2b*. This arrangement provides +ve, −ve and common (0V) supply rails, enabling the op-amp's outputs to swing either side of zero and to be set at 0V when the differential input voltage is zero.

Basic configurations

We have seen that the op-amp is a high-gain direct-coupled voltage amplifier with a high input impedance and a low output impedance. In practice, the output signal voltage of an op-amp is proportional to the *differential* signal voltage between its two input terminals, and is given by

$$e_{out} = A_o\,(e_1 - e_2)$$

where A_o is the open-loop voltage gain of the op-amp (typically 100 000), e_1 is the signal voltage at the non-inverting input terminal, and e_2 is the signal voltage at the inverting input terminal.

Thus an op-amp can be used as a high-gain inverting amplifier by grounding the non-inverting terminal and feeding the input signal to the inverting terminal (see *Figure 3a*). Alternatively it can be used as a non-inverting amplifier by

continued on page 46

OP-AMP PARAMETERS

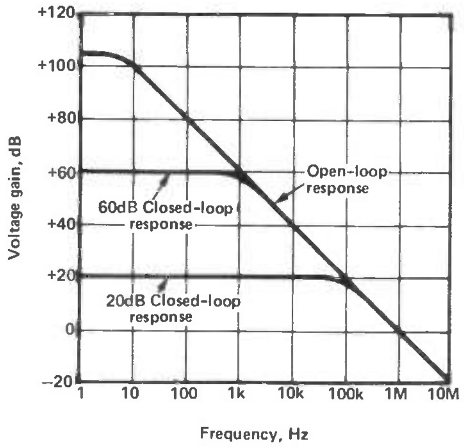


Fig A *Typical frequency response curve for the 741 op-amp*

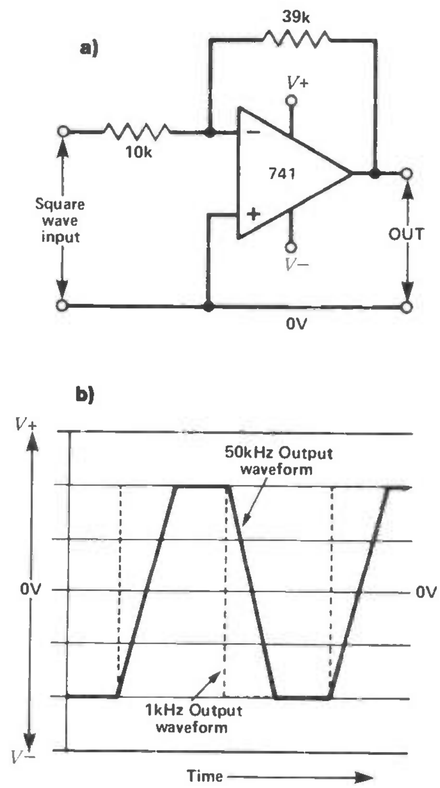


Fig B *Effect of slew-rate limiting on the output of an op-amp fed with a square-wave input*

An ideal op-amp would have infinite values of input impedance, gain and bandwidth, as well as zero output impedance and the ability to execute perfect tracking between input and output. Practical op-amps fall short of all these ideals. Consequently, various performance parameters are detailed in op-amp data sheets that indicate the 'goodness' of a particular device. The most important of these parameters are detailed below.

A_o (Open-loop voltage gain):
This is the low-frequency voltage gain that appears between the input and ouput terminals of the op-amp, and may be expressed in direct terms or in terms of dB. Typical figures are 100 000 or 100dB.

Z_{in} (Input impedance):
This is the resistive impedance looking directly into the input terminals of the op-amp when used open-loop. Typical values are 1Mohm for op-amps with bipolar input stages and a million megohms for FET-input op-amps.

Z_o (Output impedance):
This is the resistive output impedance of the basic op-amp when used open-loop. Values of a few hundred ohms are typical of most op-amps.

I_b (Input bias current):
The input terminals of all op-amps sink or source finite currents when biased for linear operation. The magnitude of this current is denoted by I_b, and it is typically a fraction of a microamp in bipolar op-amps or a few picoamps in FET types.

V_S (Supply voltage range):
Op-amps are usually operated with split (+ve and −ve) supply rails, and these have both maximum and minimum limits. If voltages are too high the op-amp may be damaged, but if they are too low the op-amp will not function correctly. Typical limits are ±3V to ±15V.

$V_{i\,(max)}$ (Input voltage range): Most op-amps will only operate correctly if their input terminal voltages are below the supply line values. $V_{i\,(max)}$ is typically one or two volts less than V_S.

V_{io} (Differential input offset voltage):
In an ideal op-amp, perfect tracking would exist between the input and output terminals and the output would register zero with both inputs grounded. In practice, slight imbalances within the op-amp cause the device to act under these conditions as though a small offset or bias voltage exists on its inputs. Typically, this 'differential input offset voltage' has a value of only a few mV, but when this voltage is amplified by the gain of the circuit in which the op-amp is used, it may be sufficient to drive the op-amp output well away from the 'zero' value. Because of this, most op-amps have some facility for externally nulling out the effects of this offset voltage.

CMRR (Common mode rejection ratio):
An op-amp produces an output proportional to the difference between the signals on its two input terminals. Ideally, it should give zero output if identical signals are applied to both inputs simultaneously, i.e. in common mode. In practice, such signals do not entirely cancel out within the op-amp and so there is a small output signal. The ability of an op-amp to reject common mode signals is usually expressed in terms of its 'common mode rejection ratio', i.e. the ratio of the op-amp's gain with differential signals to the gain with common mode signals. CMRR values of 90dB are typical of most op-amps.

f_T (Transition frequency):
An op-amp typically gives a low-frequency voltage gain of about 100dB and, in the interest of stability, its open-loop frequency response is internally tailored so that the gain falls off as the frequency rises. That frequency at which it falls to unity is known as its transition frequency and it is denoted by f_T. The response usually falls off at a rate of 6dB per octave or 20dB per decade. *Figure A* shows a typical response curve for a type 741 op-amp, which has an f_T of 1MHz and a low frequency gain of 106dB.

It should be noted that when the op-amp is used in a closed-loop amplifier circuit, the bandwidth of the circuit depends on the closed-loop gain. Thus, in *Figure A*, if the amplifier is used to give a gain of 60dB its bandwidth is only 1kHz, but if it is used to give a gain of 20dB its bandwidth is 100kHz. The f_T value can thus be used to represent a gain–bandwidth product.

Slew Rate:
As well as being subject to normal bandwidth limitations, op-amps are also subject to a phenomenon known as slew rate limiting which has the effect of limiting the maximum rate of change of voltage at the output of the device. *Figure B* shows the effect that slew rate limiting can have on the output of an op-amp that is fed with a square-wave input. Slew rate is normally specified in terms of volts per microsecond, and values in the range 1–10V/µs are usual with most popular types of op-amp. One effect of slew rate limiting is to make a greater bandwidth available to small output signals than is available to large output signals.

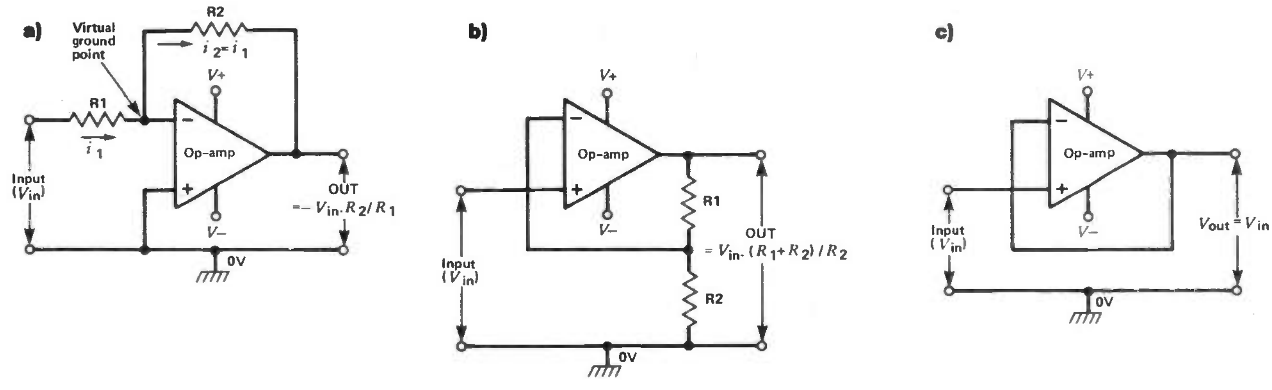


***Fig 5** Closed-loop linear amplifier circuits. a) Inverting DC amplifier; b) Non-inverting DC amplifier; and c) Voltage follower*

reversing the two input connections (*Figure 3b*), or as a differential amplifier by feeding the two input signals to the op-amp (*Figure 3c*). In the latter case, note that if identical signals are fed to both input terminals the op-amp should, ideally, give zero signal output.

The voltage gains of the above circuits depend on the open-loop voltage gains of the individual op-amps that are used, and are thus subject to wide variations. Consequently, op-amps are rarely used in open-loop mode as linear amplifiers.

One special application of the 'open-loop' op-amp is as a differential voltage comparator, one version of which is shown in *Figure 4a*. Here, a fixed reference voltage is applied to the inverting terminal and a variable test or sample voltage is fed to the non-inverting terminal. Because of the very high open-loop voltage gain of the op-amp, the output is driven to positive saturation (close to the +ve rail value) when the sample voltage is more than a few hundred microvolts above the reference voltage, and to negative saturation (close to the –ve supply rail value) when the sample is more than a few hundred microvolts below the reference value.

Figure 4b shows the voltage transfer characteristics of the above circuit. Note that it is the magnitude of the input differential voltage that determines the magnitude of the output voltage, and that the absolute values of input voltage are of little importance. Thus, if a 2V reference is used and a differential voltage of only 200μV is needed to swing the output from a negative to a positive saturation level, this change can be caused by a shift of only 0.01% on the 2V signal applied to the sample input. The circuit thus functions as a precision voltage comparator or balance detector.

Closed-loop amplifiers

The most useful way of using an op-amp as a linear amplifier is to connect it in the closed-loop mode, with negative feedback applied from the output to the input, as portrayed in the circuits of *Figure 5*. This technique enables the overall gain of each circuit to be precisely controlled by the values of the external feedback components, almost irrespective of the op-amp characteristics (provided that the open-loop gain A_o is large relative to the closed-loop gain A).

Figure 5a shows how to wire the op-amp as a fixed-gain inverting DC amplifier. Here, the gain (A) of the circuit is dictated by the values of R1 and R2 and equals R_2/R_1, while the input impedance of the circuit equals R_1. Thus the circuit can readily be designed to give any desired values of gain and input impedance.

It should be noted, however, that although R1 and R2 control the gain of the complete circuit, they have no effect on the parameters of the actual op-amp. Thus the inverting terminal still has a very high input impedance and negligible signal current flows into the terminal. Consequently, virtually all of the R1 signal current also flows in R2, and signal currents i_1 and i_2 can be regarded as being equal, as indicated in the diagram. Also note that R2 has an apparent value of R_2/A when looked at from the inverting terminal, making the R1—R2 junction a low-impedance 'virtual ground' point.

Figure 5b shows how to connect the op-amp as a fixed-gain non-inverting amplifier. In this case the voltage gain equals $(R_1+R_2)/R_2$ and the input impedance is approximately $(A_o/A)Z_{in}$, where Z_{in} is the open-loop input impedance of the op-amp. The above circuit can be made to function as a precision voltage follower by connecting it as a unity-gain non-inverting amplifier. This is shown in *Figure 5c*, where the op-amp operates with 100% negative feedback. In this case the input and output signal voltages are identical but the input impedance of the circuit is very high, being approximately A_oZ_{in}.

The basic op-amp circuits of *Figure 5* are those for DC amplifiers, but they can readily be adapted for AC use.

Practical op-amps

Op-amps also have many applications other than as simple linear amplifiers. They can be made to function as precision phase splitters, as adders or subtractors, as active filters or selective amplifiers, as precision half-wave or full-wave rectifiers, or as oscillators or multivibrators, for example.

Practical op-amps are available in a variety of IC technologies (bipolar, MOSFET, JFET, etc), and in a variety of types of packaging (plastic DIL, metal-can TO5, etc). Some of these packages house two or four op-amps, all sharing common supply line connections. *Table 1* lists the parameters, while *Figure 6* gives the corresponding outline details of eight popular 'single' op-amp types, all of which use 8-pin DIL (DIP) packaging.

Among the bipolar types, the 741 is a general purpose op-amp featuring internal frequency compensation and overload protection on inputs and output, while the NE531 is a high-performance

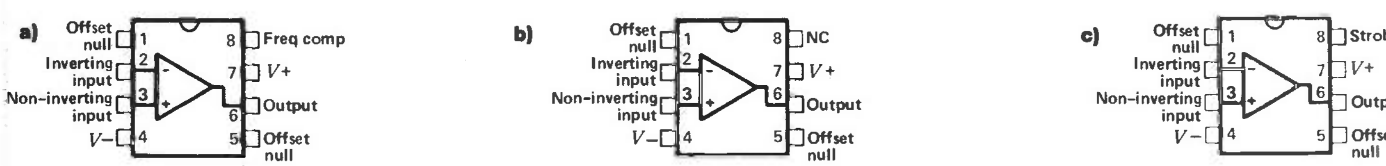


***Fig 6** Parameter and outline details of eight popular 'single' op-amp types*

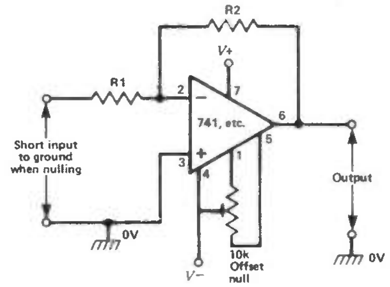


Fig 7 *Typical offset nulling system*

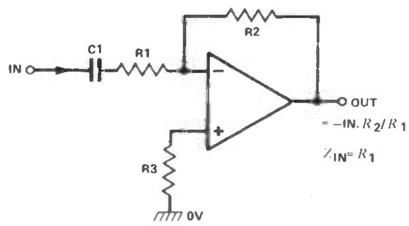


Fig 8 *Inverting AC amplifier*

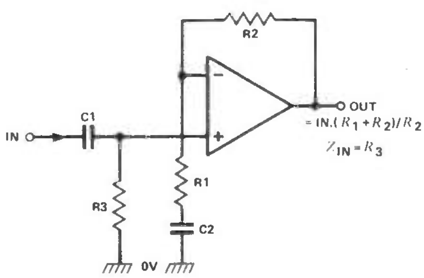


Fig 9 *Non-inverting AC amplifier*

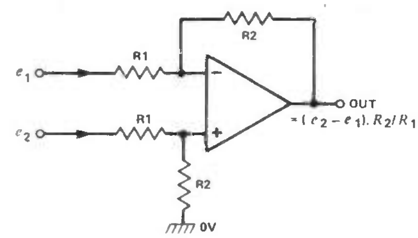


Fig 10 *Differential amplifier or analogue subtractor*

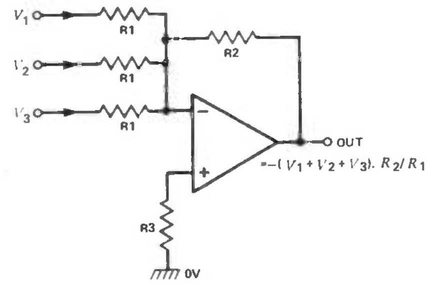


Fig 11 *Inverting analogue adder or audio mixer*

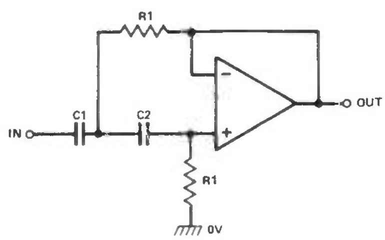


Fig 12 *High-pass second-order active filter*

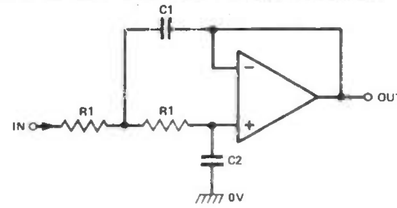


Fig 13 *Low-pass second-order active filter*

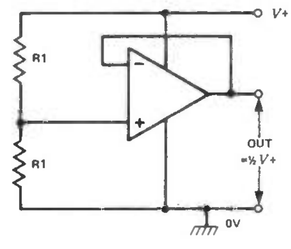


Fig 14 *Supply-line splitter*

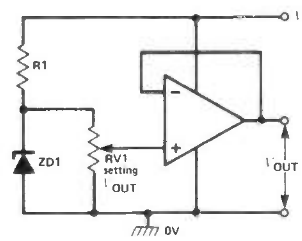


Fig 15 *Adjustable voltage reference*

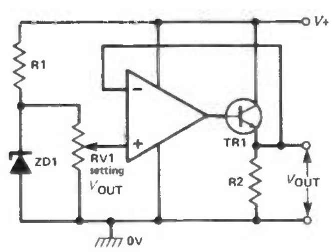


Fig 16 *Adjustable voltage power supply*

type which can handle a very high slew rate. In the latter case, an external compensation capacitor (of, say, 100pF), wired between pins 6 and 8, is needed for stability, but this could be reduced to a very low value (say 1.8pF) if a very wide bandwidth at high gain is desired.

The CA3130 and CA3140 MOSFET-input type op-amps can operate from either single or dual power supplies, can sense inputs down to the negative supply rail value, have very high input impedances (1.5Tohms, i.e. 1.5×10^6Mohms) and have outputs that can be strobed. The CA3130 has a CMOS output stage, and an external compensation capacitor (typically 47pF) between pins 1 and 8 permits adjustment of bandwidth characteristics. The CA3140 has a bipolar output stage and is internally compensated.

The LF351, 411, 441 and 13741 are JFET type op-amps with very high input impedances. The LF351 and 411 are high performance types, while the LF441 and 13741 are general purpose devices that can be used as direct replacements for the very popular 741. Note that the LF441 quiescent current consumption is less than one tenth of that of the 741.

Offset nulling

All of the above op-amps are provided with an offset nulling facility to enable the output to be set precisely to zero when the input is zero. In most cases, offset nulling is achieved by wiring a 10k pot between pins 1 and 5 and connecting the pot slider to the negative supply rail (pin 4) either directly (as shown in *Figure 7*) or via a 4k7 'range limiting' resistor. In the case of the CA3130, a 100k offset nulling pot must be used.

Applications roundup

Operational amplifiers are very versatile devices, and can be used for a wide variety of linear and switching roles. *Figures 8—22* show a small selection of the basic 'applications' circuits that can be used. In most of these diagrams, the supply line connections have been omitted for the sake of clarity. We shall be looking at these circuits in greater detail in the next three editions of the 'Data File', but for now just a flavour of how they operate.

Figures 8 and 9 show how op-amps can be used to make fixed-gain inverting and non-inverting AC amplifiers, respectively. In both cases, the gain and the input impedance of the circuit can be precisely controlled by suitable component value selection.

Figure 10 shows how to make a differential or difference amplifier with a gain equal to R_2/R_1; if R1 and R2 have equal values, the circuit acts as an analogue subtractor.

Figure 11 shows the circuit of an inverting 'adder' or audio mixer; if R1 and R2 have equal values, the inverted output is equal to the sum of the input voltages.

Op-amps can be made to act as precision active filters by wiring suitable filters into their feedback networks. *Figures 12 and 13* show the basic connections for making second-order high-pass and low-pass filters, respectively; these circuits give roll-offs of 12dB/octave. We'll look at more sophisticated versions of these circuits next month.

Figures 14—16 show some useful applications of the basic voltage

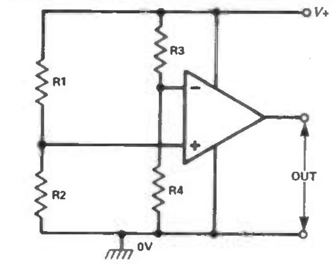


Fig 17 *Bridge-balance detector/switch*

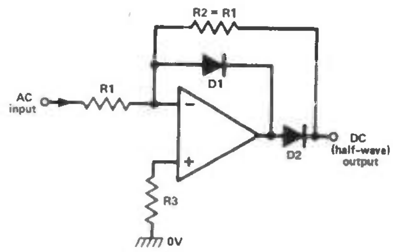


Fig 18 *Precision half-wave rectifier*

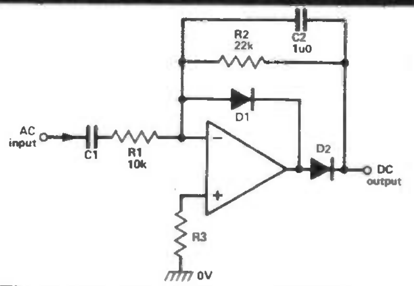


Fig 19 *Precision half-wave AC/DC converter*

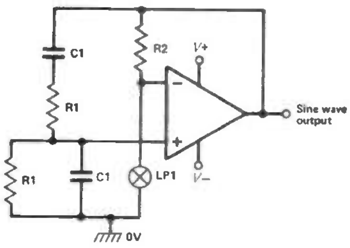


Fig 20 *Wien Bridge sine-wave generator*

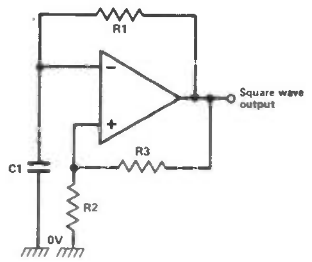


Fig 21 *Free-running multivibrator*

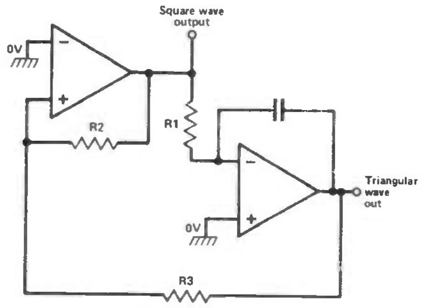


Fig 22 *Sine-/square-wave function generator*

follower or unity-gain non-inverting DC amplifier. The first of these circuits acts as a supply-line splitter and is useful for generating split supplies from single-ended ones, while the second acts as a semi-precision variable voltage reference. The last member of this group shows how the output current drive can be boosted so that the circuit acts as a variable voltage power supply.

Figure 17 shows the basic circuit of a bridge-balance detector, in which the output swings high when the inverting pin voltage is above that of the non-inverting pin, and vice versa. This circuit can be made to function as a precision opto- or thermo-switch by replacing one of the bridge resistors with an LDR or thermistor.

Figures 18 and 19 show how to make precision half-wave rectifiers and AC/DC converters. These are very useful instrumentation circuits.

Finally in this edition of the 'Data File', *Figures 20—22* show some useful waveform generator circuits. The first of these designs uses a Wien Bridge network to generate a good sine wave, amplitude stabilisation being obtained via a low-current lamp, while *Figure 21* is a very useful square-wave generator circuit in which the frequency can be controlled via any one of the passive component values. The frequency of the last function generator circuit (*Figure 22*) can also be controlled via any one of its passive component values, but this particular design generates both square and triangular waveforms.

Parameter	**Bipolar op-amps**		**MOSFET op-amps**		**JFET op-amps**			
	741	**NE531**	**CA3130E**	**CA3140E**	**LF351**	**LF411**	**LF441**	**LF13741**
Supply voltage range	±3V to ±18V	±5V to ±22V	±2.5V to ±8V or 5V to 16V	±2V to ±18V or 4V to 36V	±5V to ±18V			
Supply current	1.7mA	5.5mA	1.8mA	3.6mA	800μA	1.8mA	150μA	2mA
Input offset voltage	1mV	2mV	8mV	5mV	5mV	0.8mV	1mV	5mV
Input bias current	200nA	400nA	5pA	10pA	50pA	50pA	10pA	50pA
Input resistence	1MΩ	20MΩ	1.5TΩ	1.5TΩ	1TΩ	1TΩ	1TΩ	0.5TΩ
Voltage gain, A_o	106dB	96dB	110dB	100dB	88dB	106dB	100dB	100dB
CMRR	90dB	100dB	90dB	90dB	100dB	100dB	95dB	90dB
f_T	1MHz	1MHz	15MHz	4.5MHz	4MHz	4MHz	1MHz	1MHz
Slew rate	0.5V/μs	35V/μs	10V/μs	9V/μs	13V/μs	15V/μs	1V/μs	0.5V/μs
8-pin DIL outline (referred to *Figure 6*)	b	a	c	c	b	b	b	b

Photo 1: *The 156 PMD mine detector in use. The aerials (two transmitting, one receiving) and the transmission lines are mounted on a laminated glass cloth plate in a search head 22cm square.*

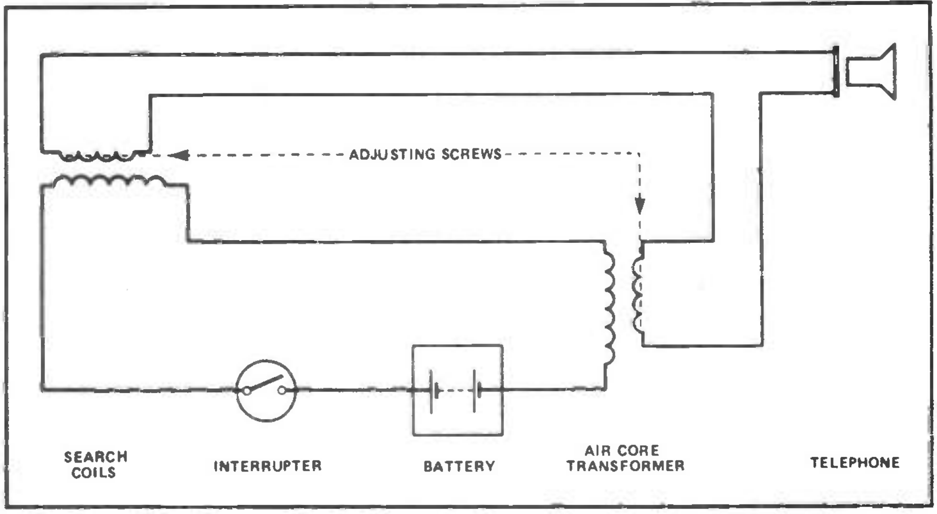
METAL DETECTORS IN WARFARE

Richard Turner describes the various military applications to which metal detectors have been put over the last 100 years

On 15th May 1879, Professor David Edward Hughes demonstrated his latest discovery to the Royal Society in London, and in closing his address he invited inventors to exploit his 'Induction Balance' to the full in physics, medicine and metal detection. As was described earlier in *R&EW* (April '82), the attempted assassination of America's 20th President, James Garfield, in July 1881 led Alexander Graham Bell to build an instrument for locating bullets and other metal objects within the human body, based on the induction balance principle (see *Figure 1*) — though he called on a different phenomenon in developing his second medical metal-detecting device, the Telephonic Probe.

The use of the induction balance for military purposes was apparent just as quickly, with a British Patent being

Fig 1: *The basic circuit of Alexander Graham Bell's 1881 induction balance metal detector.*



granted in December 1881 for a 'Submarine and shipwreck finder. This was soon followed by a 'Metal shell and land mine locator' and an 'Automatic sea mine using the Hughes induction balance as sentinel'. In 1885 the Royal Army Medical Corps developed their own metal detector — quite distinct from those of Alexander Graham Bell — specifically for locating bullets and shrapnel in wounded servicemen.

These very much set the pattern for the way metal detection has contributed to military strategy. However it is interesting to look more closely at the applications themselves and at the way metal detection is achieved in each case.

Finding bombs

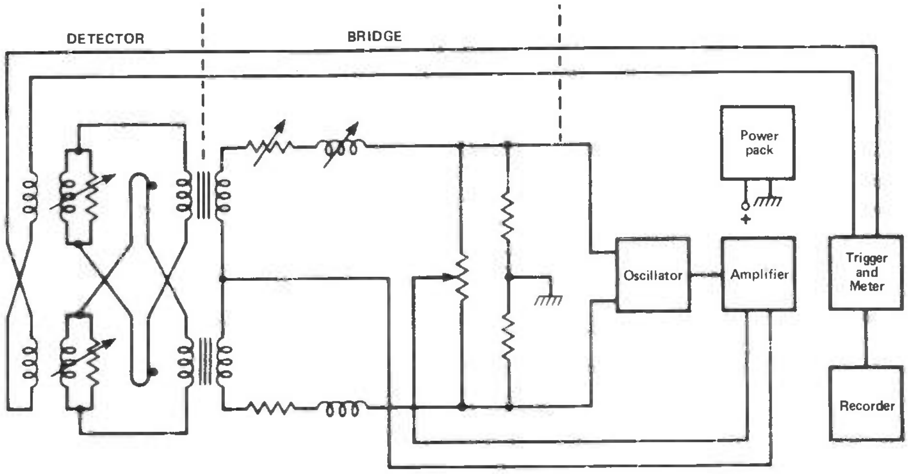
One of the prime movers (as far as the UK was concerned) in the development of ways of locating bombs was the intensive bombing of our cities in the spring of 1940. There was an urgent need for devices that could seek out the many bombs that failed to explode — some having faulty mechanisms, others incorporating delay fuses. The alternative was perpetual fear of imminent explosions.

Locating bombs beneath city streets is complicated by the nature of the subsurface: pipes and sewers can readily deflect any bomb off its course. A good example is the bomb which fell on 11th September 1940 in St Pauls Churchyard in London. It penetrated to a depth of eight feet from the point of impact before changing its course, only to be found later at a depth of 27½ feet lodged in the foundations of the Cathedral!

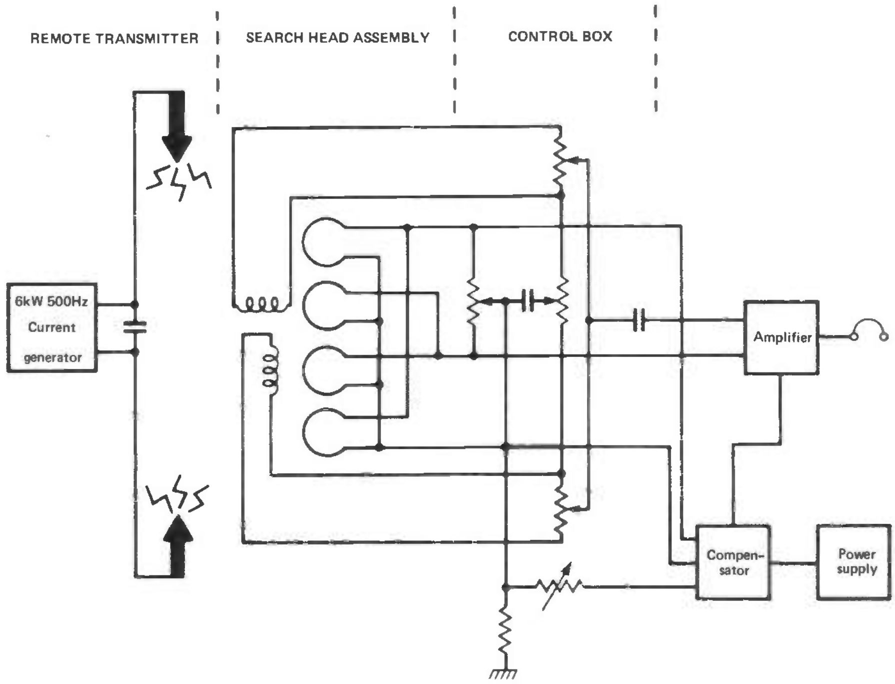
Naturally Winston Churchill gave high priority to the development of bomb and mine locators, and by August 1940 no fewer than nine laboratories had assigned their top scientists and engineers to the task. The locator adopted for the task was that designed by Mr A Butterworth and developed at ERA Laboratories by a team led by Mr L H Daniel.

The ERA bomb locator was basically a differential magnetometer, an appropriate choice since bombs contain very large amounts of ferromagnetic material. Briefly it consisted of a Maxwell impedance-measuring bridge with two adjacent arms both in the detector unit but separated in the vertical plane by about three feet. These arms incorporated mu-metal wires as the sensors because their inductance and resistance varies with the magnetic field along the axis of the wire.

The equipment consisted of a search unit, mounted on a pole and connected by a cable to the case containing the electronics, and two borehole probes. The former was only used to confirm the presence and the general location of the bomb, its precise position being established by the borehole probes. The latter procedure involved at least three holes being dug and measurements being plotted on a chart that gave the location, depth and size of the bomb to the nearest inch. This enabled a shaft to be dug directly over the bomb, facilitating defusing and subsequent disposal.

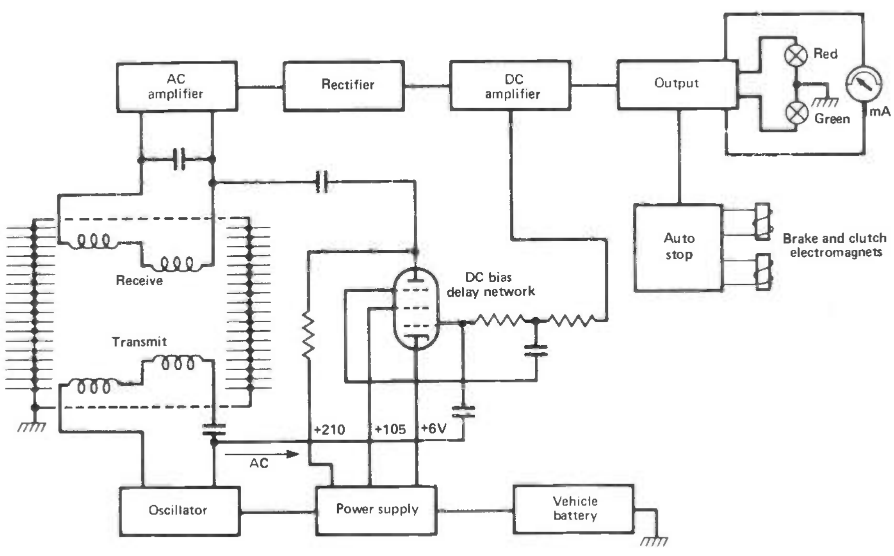


Above *ERA Bomb Locator. The mu-metal elements are shown as variable R-L elements*



Above *No 7 deep seeking mine locator*

Below *Vehicle-mounted transmit/receive mine detector, dating back to World War II*



The prototype was capable of detecting a 1000kg bomb at a depth of 20 feet and it was brought into service in March 1941, its manufacture being assigned to British-Thomson-Houston.

Finding mines

Deep seeking land mine detectors were also developed by ERA, in particular the No 7 locator designed by ERA's then Director, Dr Stanley Whitehead, and Mr Benjamin Rosenblum. (The No 1 locator had been developed in 1938 by the Signals Experimental Establishment, while those most widely used at the time — numbers 3 and 4 — were designed by Mr Stanley Spencer West of Cinema-Television Ltd).

The operating principle of this device was as follows:

A heavy duty current was established by a petrol-driven generator, tuned to 500Hz (audio) by a capacitor and injected into the ground by means of a two-turn 150x300-yard induction loop. Several operators would then use balanced coil search units to seek out deeply-buried land mines.

This method produced very rapid and positive results, and it was mainly used in clearing mines from beaches and marshy areas where the mines often sank out of the range of conventional detectors.

If anti-personnel or AC-sensitive mines were suspected, a 'probe injection' method would be used first, whereby probes would be inserted into the ground and the search team would take cover before the main current was switched on. Any AC-sensitive devices in sufficiently close proximity to the probes would explode, and the search coils could then be used in the normal way to pick out the remaining mines because they do not themselves transmit any AC fields.

Tank- and other vehicle-mounted mine detectors are typically based on the transmit/receive (T/R) technology that came with the advent of 'Wireless'. Here the search coils are mounted on a boom and electrostatically screened to prevent the generation of false signals by vegetation or minerals within the ground. The presence of a mine is either indicated on a meter or turned into an audio signal heard through headphones. An automatic braking system is often an adjunct to these detectors.

The current 'mainstay' of the British and NATO forces is the No 4C mine detector manufactured in England by United Scientific Instruments. This operates on the principles established by Professor Hughes and has two modes of operation — normal mode and 'pave' mode for use where there is significant contamination by ferrous metals. This device is capable of operating over a very wide temperature range and has proved itself on active service throughout the world.

Over the years, many electronic innovations have made their appearance on mine detectors, some of the more important ones being temperature and frequency compensation, non-inductive search coils and phase angle discrimination.

Photo 2: *The No 4C mine detector. This operates on the induction balance principle and has a 28.5cm search head and solid state electronics.*

Airborne and marine applications

Detecting enemy submarines through their metal content has always been well exploited by the Royal Navy, the induction balance being the first method to be used here. However, the advent of the transmit/receive technique gave a much greater range. The transmitters were mounted on one ship or aircraft while the receivers were on other ships or aircraft. As a result, several miles of sea could be scanned at any one time.

The induction coil principle has also been used for detecting submarines, a good example of this being the construction of the world's largest ever metal detector — an induction coil laid across the Straits of Gibraltar. Its purpose was to spot German U-boats which would otherwise avoid detection through turning off their engines and floating out of the Mediterranean Sea into the Atlantic Ocean with the aid of the tide. Similar devices — but on a smaller scale — made a significant contribution to the defence of Singapore.

Nowadays both ships and aircraft are equipped with magnetometers for the purpose of spotting submarines as this system's high level of sensitivity enables, for example, just one aircraft to cover several cubic miles of sea.

An interesting application of metal detection technology is for the ignition of anti-aircraft shells, the philosophy being that an explosion near to an aircraft is better than a complete miss. A near explosion will often result in a piece of shrapnel lodging in a vital part such as a fuel tank or some control, thus doing as much damage as a direct hit. The 'Aerial mine' (or 'Proximity fuse', as it is now known) was developed in the early days of World War II. This is based on the transmit/receive technique and the power for the electronics is supplied by a wind generator. This means that the shell has to be fully airborne before it has sufficient velocity to generate the necessary current and so premature explosion triggered off by objects on the ground can be avoided.

But perhaps the least known application of a metal detector is its use as a sensor to explode a sea mine. The general idea is to lay the mine in enemy territory with the sensitivity preset to a level at which small unimportant ships do not trigger it, giving the enemy a false sense of security, while a cruiser or a battleship certainly would.

Conclusion

As it can be seen from this brief survey, metal detection has contributed a great deal to warfare technology both in the past — and the present. The recent events in the South Atlantic have proved once again that mine warfare is a very lethal weapon. The indiscriminate mining of huge areas of the Falklands by the Argentinians has once again focussed attention on mine detecting devices. Due to the nature of the terrain and the type of mines used, their clearance is a very dangerous and slow process.

But technology has met the challenge in the form of the British made 156 PMD mine detector from the USI Group of companies. Using T/R technology, this detector emits an RF field in the 300—500MHz band; it is thus able to detect plastic and metal mines in any terrain at any temperature between −32 and +52°. Lithium batteries provide the power for the 16-bit microprocessor-controlled electronics that generate and receive signals via aerials contained in the search head. In the null condition, one click is emitted per 2.5 seconds, indicating correct operational setting, while on detection the pulse rate varies from 3 to 150 clicks per second depending on the proximity and size of mine.

Photo 1 shows this detector being used in the crawler mode employed by commandos sussing out enemy defences. It can be equally used in the conventional walk and sweep mode by extending the handle to 1.2m and clipping the electronics box to the operator's belt. The latest reports from Falkland Islands indicate that the 156 PMD is making a great contribution towards the return of life to normal in those islands.

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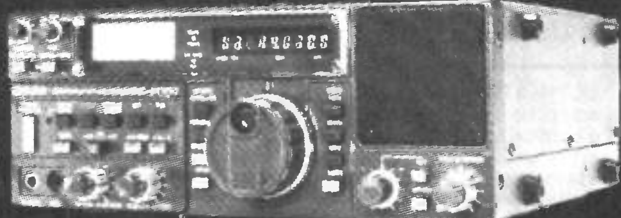

The R-70 covers all modes (when the FM option is included), and uses 2 CPU-driven VFO's for split frequency working, and has 3 IF frequencies: 70MHz, 9MHz and 455KHz, and a dynamic range of 100dB. It has a built-in mains supply.

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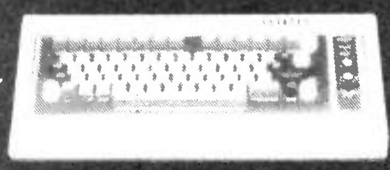
RTTY, Morse & ASCII

Shortwave listeners and amateurs are able to take more interest in other modes of transmission than speech with the latest range of decoders and senders available. As well as amateur transmissions, there is an abundance of news and other interesting broadcasts which can be read using these space-age devices.

Some models in our range are the Tono 550, 9000E and the Telereader CWR-670, CWR-685E and CWR-610E. There is now available a professional version of the Tono 9000E, the PRO-1, which has a built-in scrambler. The Telereader CWR-670 is also available with a built-in VDU which can include a 40 column printer.

TONO 9000E Sender/Decoder £669.



CWR-610E, Decoder £189.

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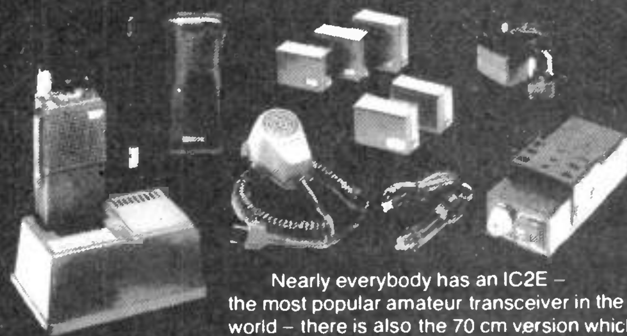
IC-290D, VHF. £433. Multimode Mobile

The recently introduced IC-290H has proved so popular that we have decided to concentrate on this (25W) model 2m multimode. With its bright green display, 5 memories, scan facilities on either memories or the whole band, tone-call button on the microphone and instant listen input for repeaters, this little box really is a beauty. The 70cm version, the IC-490E has similar features (although the output is only 10W in this case).

IC-2E, VHF/FM, £179. IC-4E UHF, £199.



Nearly everybody has an IC2E – the most popular amateur transceiver in the world – there is also the 70 cm version which is every bit as good and takes the same accessories.

IC-25H/25E, £329/£369. VHF, FM Mobiles

The FM mobile choice has to be the Icom IC-25E. It is so small yet boasts a powerful 25 Watt voice and a sensitive receiver. The new 25H now available has a green display and 45 Watts output. There are five easily programmable memories, and facilities for changing the repeater shift from the default value of 600kHz.

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BARCLAYCARD VISA

LM1821S Video IF PLL synchronous detector

Despite recent rationalisation of its linear IC range (which has resulted in the loss of, amongst others, the LM373/374 families), National Semiconductor still has a storehouse full of interesting linear devices. The magnitude of the National Linear Data Book bears witness to this fact: it's easily the biggest book on the *R&EW* databook shelf.

The LM1821S featured here is one of National's cornucopia of TV circuits. It wasn't easy to actually lay hands on the device from a National distributor, but since they sent us a press release implying they would welcome promotion, we trust that readers wishing to explore some of the promise of this circuit will not have too much trouble persuading their National distributor to cough up the goods.

The device is a combination video IF, with a PLL synchronous detector, an automatic fine tune circuit, a video output for sound extraction and a main video output with white spot noise inversion. The most interesting point on the data sheet is the fact that operation to 70MHz is cited as a feature. Satellite TV IFs are thus within its grasp — as well as applications in up-conversion communications receivers.

You can see from the simplicity of the external circuitry built around the block diagram *(Figure 1)* that National has paid

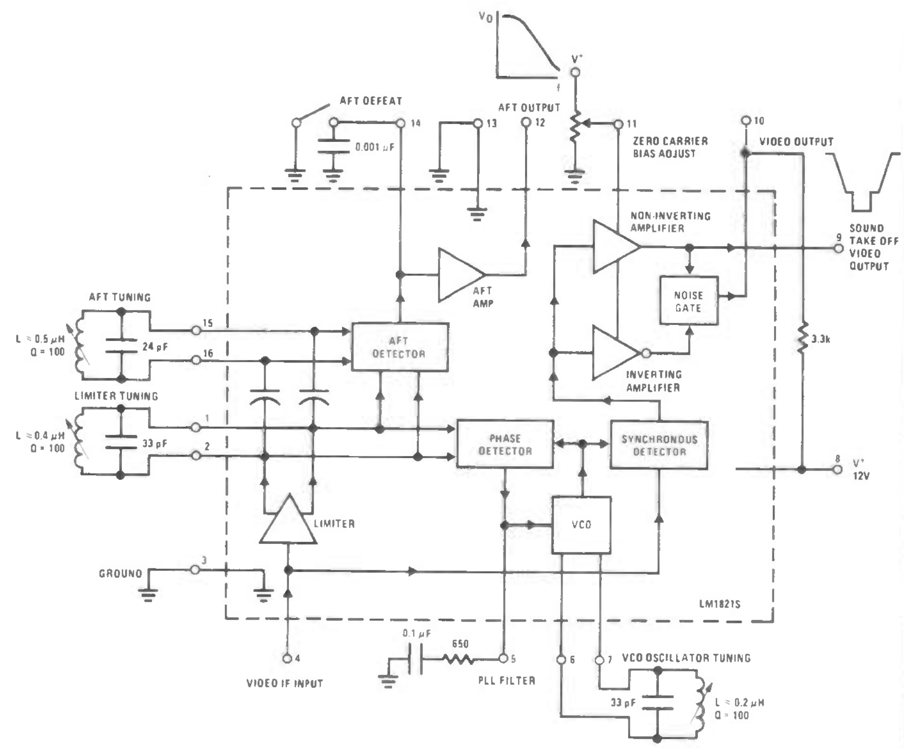


Figure 1: *Block diagram*

DC Electrical Characteristics (Reference Test Circuit, all SW position 1 unless noted)

Parameter	Conditions	Min	Typ	Max	Units
Supply Current, I8 + I10		35	55	75	mA
0 Carrier Adjust Voltage, V11	SW 1 Position 2	7.9	8.5	9.0	V
0 Carrier Output Voltage, V9	SW 1 Position 2	6.8	8.5	10.2	V
0 Carrier Bias Difference, V11–V9	SW 1 Position 2		0	± 1.3	V
0 Carrier Output Voltage, V10	Adjust V11 for V9 = 7.0V	6.0	6.3	6.5	V
AFT Output Reference, V12		2.5	3.0	3.5	V

AC Electrical Characteristics (SW 2 position 2, V_{IN} = 100 mVrms, see Set-Up Procedure)

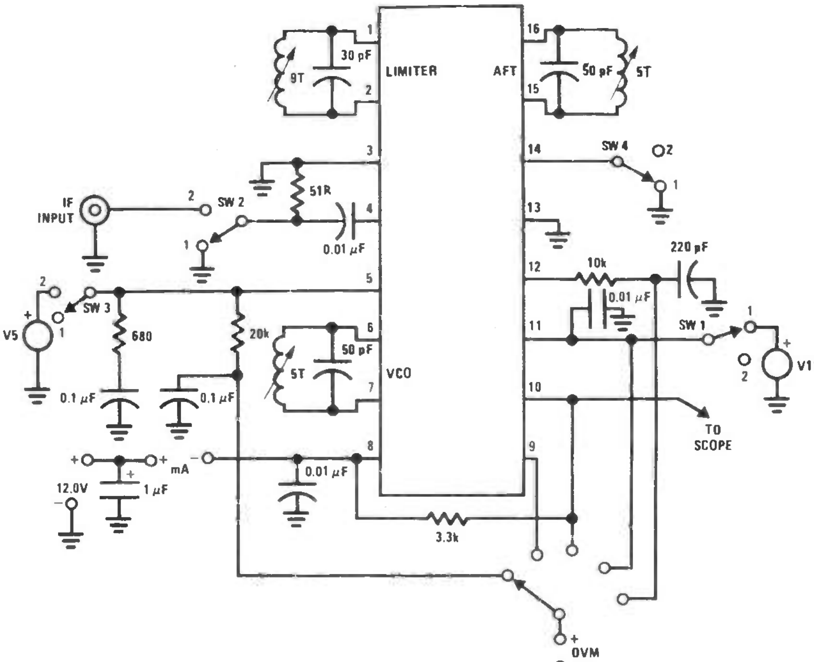
Parameter	Conditions	Min	Typ	Max	Units
Detector Gain, V10		2.3	3.6	4.4	V
Output Capability, V10	V_{IN} = 500 mVrms		1	2	V
AFT Maximum Output, V12	SW 4 Position 2, f_{IN} = 44.5 MHz	9	10		V
AFT Minimum Output, V12	SW 4 Position 2, f_{IN} = 45.5 MHz		0.4	1	V
APT Pull-In Range	Difference Between Upper and Lower Lock Frequencies	1	3		MHz
Noise Inversion Defeat Voltage	SW 3 Position 2, Adjust V5 for Beat Frequency at Pin 10, Measure Difference in (−) Peaks		0.3	± 0.6	V

heed to the TV manufacturers' desire to minimise component count. The adjustments required are also a bare minimum, and it seems reasonable to expect that the PLL system will help in ensuring long-term stability and easy detector alignment.

The power supply requirement at 12V is fairly high at 55mA — a consequence of the high frequency of operation — so this device is not for battery-powered portable applications.

The AC parameter specification of this device is distinctly vague by National Semiconductor's usual standards, but a brief dabble with samples reveals that this device has potential at frequencies in the 10.7MHz range as well as at TV IF frequencies. Used in shortwave applications, the effects of synchronous demodulation on signals suffering from selective fading are usually worthwhile. The output at pin 5 is a representation of the FM on the signal. A little more time might reveal the effects of the noise inversion process on received noise.

The first two readers to send letters promising faithfully to have a good dabble with these useful devices, and to report their findings for other *R&EW* readers, get the spare samples we have in the office. First come, first served and no other correspondence can be entered into without an SAE.



T indicates # turns on 1/8" form

High frequency operation requires tight layout

Fig 2: *Test circuit*

Absolute Maximum Ratings

Power Supply Voltage	15V
Power Supply Current	100 mA
Input Signal Voltage	1 Vrms
Device Dissipation	1.5W
Thermal Resistance, θ_{JA}	55°C/W
Operating Temperature Range	0°C to +70°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	265°C

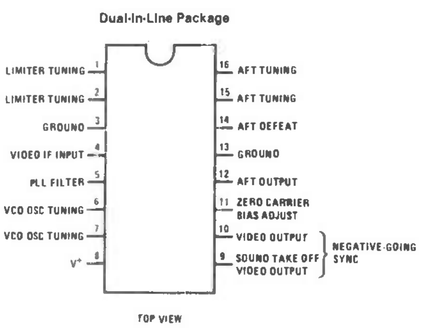
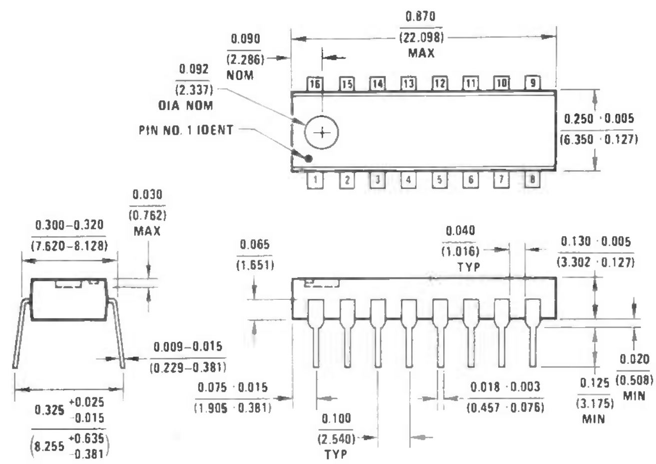


Fig 3: *Connection diagram*



Molded Dual-In-Line Package (S)
Order Number LM1821S
NS Package Number S16A

Fig 4: *Physical dimensions*

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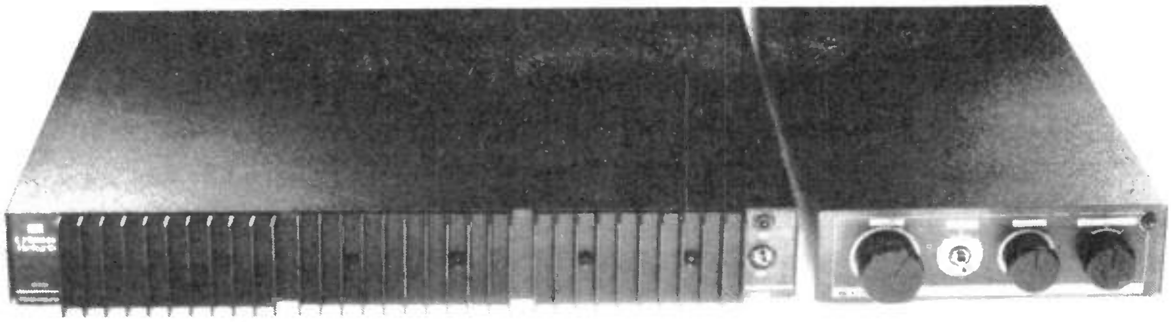

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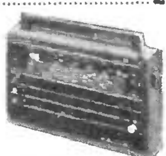

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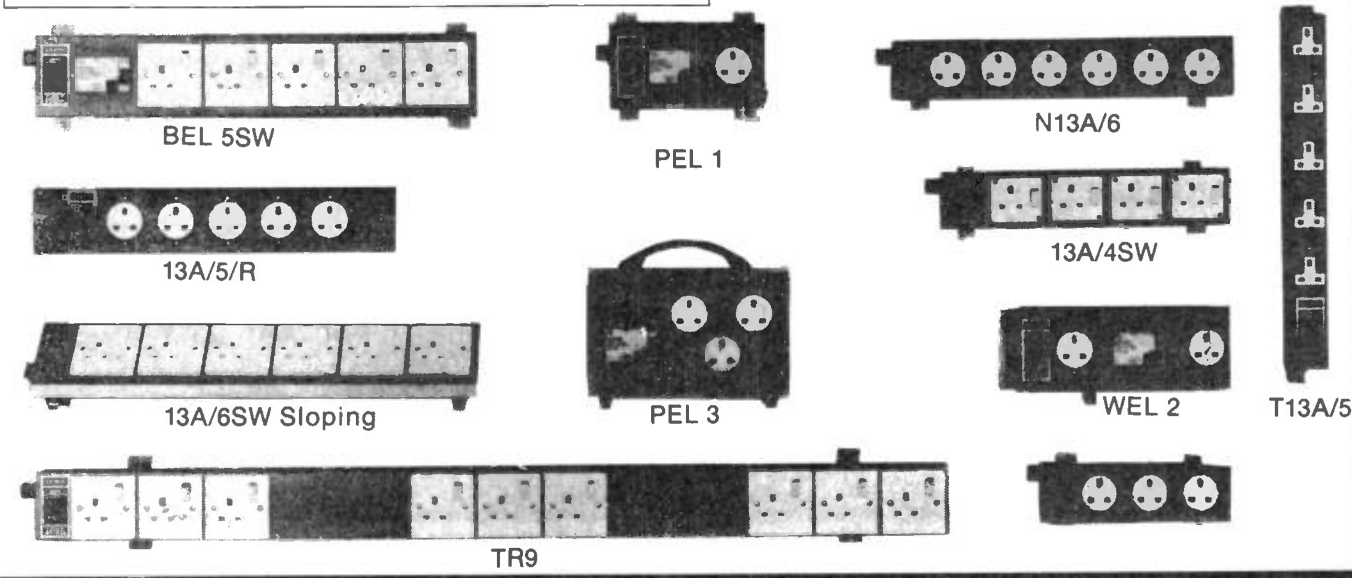

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ONE NIGHTS WORK

A 4001/4011 tester developed by Stephen Ibbs that can be built and tested all in one evening.

Few people can get far in electronics without encountering the 4001 quad NOR gate and the 4011 quad NAND gate ICs. They are housed in 14 pin dual in line (DIL) packages and are used in a great many projects. Having been given a batch of untested and unmarked devices I needed a circuit that would give a simple go/no-go check, and separate the different devices. The result is given below.

How it works

This tester is based on a warbling alarm circuit.

Two gates are connected together as a square wave oscillator, while the output gates another square wave oscillator whose output is in the audio spectrum.... i.e. we can hear it. As all four gates are used, it should be obvious if one gate is 'duff'; it either won't work at all or it produces a non-warbling note when SW2 is pressed.(NB: It may produce a note when the supply is turned on. This should be ignored as it is the note produced when SW2 is closed that is important.)

Because the 4001 and the 4011 are opposite in their logic outputs, if a 4001 is inserted, SW2 when pressed will stop the warble, but if a 4011 is inserted, SW2 will start the warble. Thus the two devices can be easily differentiated. SW1 is included so that the supply can (as it should) be disconnected when a device is being plugged in.

Construction

Either veroboard or a PCB can be used, and a PCB design is given in *Figures 2 and 3*. First mount the resistors, capacitors, and PCB socket. It might be wise to use a wire-wrap socket which stands proud of the PCB so that the unit can be housed in a shallow handheld case with the socket protruding through the front panel. Connect the switch(es), transducers and a battery, and then insert a good sample of both a 4011 and 4001 to check that the unit is functioning. So little current is taken in normal use that a PP3 battery should last several months.

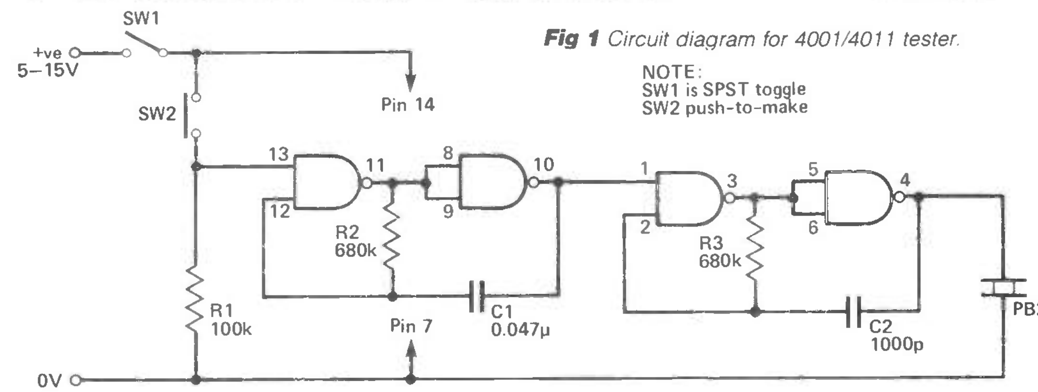
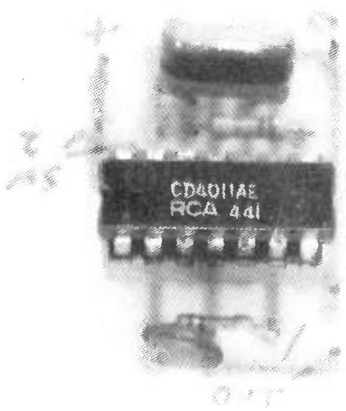


Fig 1 *Circuit diagram for 4001/4011 tester.*



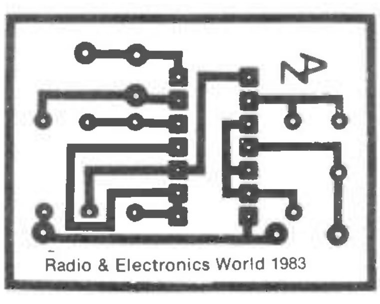


Fig 2 *Foil pattern for PCB.*

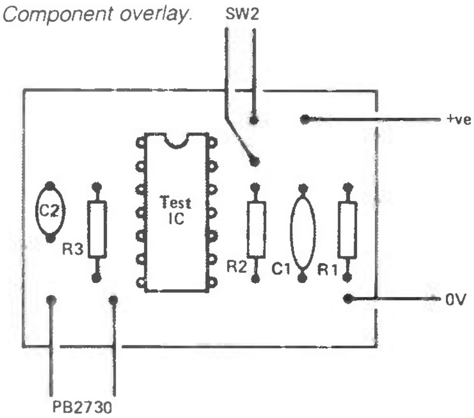


Fig 3 *Component overlay.*

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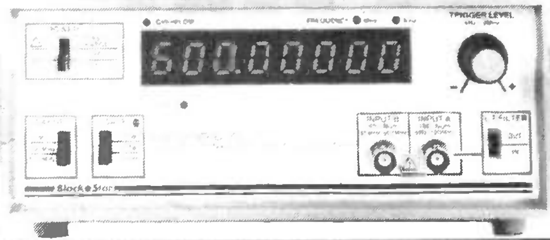

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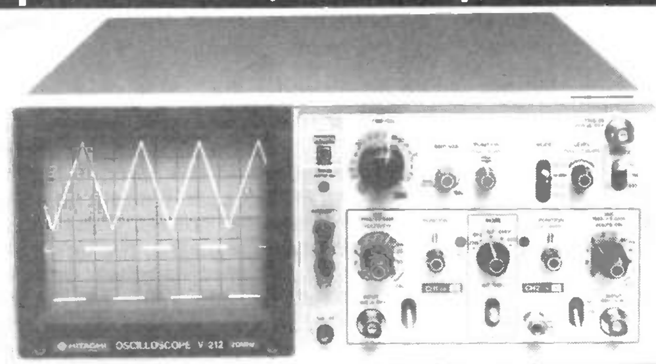

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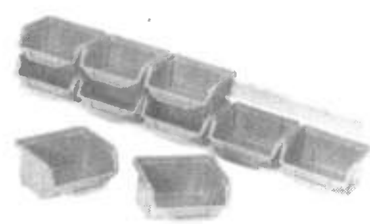

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David Francis takes an in-depth look at these compact — yet powerful — devices

Although it had been known for many years that tantalum was a highly suitable material for the manufacture of capacitors, it wasn't until the end of the 1950's that processing techniques and production methods were sufficiently refined to allow the large scale manufacture of reliable units.

The first production tantalum capacitor was based on knowledge gleaned from the manufacture of aluminium capacitors and so, naturally, resembled that type of component. Since then the tantalum foil capacitor has evolved and developed its own constructional techniques, as is evidenced by the gelled and solid tantalum slug units available today. Equally obvious is the fact that each style of capacitor has its own relevant attributes and drawbacks, and it is the intention of this article to enumerate some of the major differences between the models.

Gelled tantalum capacitors

The construction of a typical component of this type is shown in *Figure 1*. The anode is formed by mixing tantalum powder with an organic binder and pressing the mixture into a pellet. It is then sintered in a vacuum oven, which boils off all the organic products and leaves a pellet of high porosity and mechanical strength. After electrochemical treatment, anode leads are attached to the pellets, which are then sealed into cases filled with electrolyte. At this stage it should be noted that the most common form of electrolyte is a gelled form of sulphuric acid. Should one of these capacitors be ruptured, it is important that care be taken in handling the remains.

The gelled tantalum capacitor gives the highest concentration of capacitance per unit volume of all the available varieties and also gives the lowest leakage ratings. Both of these properties are demonstrated in *Table 1* which compares the three basic types of construction.

Regrettably it is not possible to make a non-polar version of a tantalum capacitor since, if reverse potential is applied, it causes destructive breakdown that ruins the component beyond redemption. It will, however, withstand very short intermittent reverse polarities, but

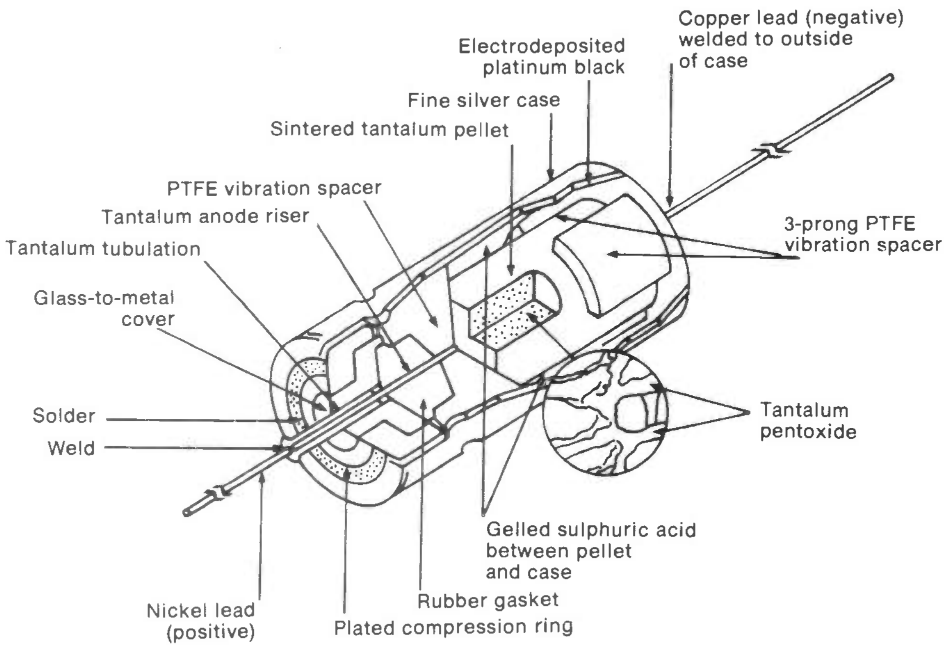

Fig 1 *Structure of the gelled type of tantalum capacitor*

it is not recommended that this factor should be relied on for obvious reasons.

On the advantageous side, these capacitors have extremely low self inductance and are capable of handling high ripple voltages — two factors which make them the ideal choice for use in the output filter of switch-mode power supplies. To verify this aptitude, tests were conducted whereby a number of capacitors were subjected to a 37VDC potential with a 15.5VRMS ripple content. This was run for 2000 hours at a temperature of 85°C. As can be seen from *Table 2*, this only resulted in a small decrease in both the capacitance and the dissipation factor of each of the units under test.

Although these gelled capacitors are renowned for their longevity, they do eventually fail. However the mode of doing so is not immediately obvious

Table 1: *Basic properties of tantalum capacitors*

	Foil	Gelled	Solid
Maximum voltage	300	125	125
CV product	Flexible	Inflexible	Inflexible
Max temperature	125°C	175°C	125°C
Volume efficiency	Least	Highest	Next
DC leakage current	Next	Lowest	Highest
Reverse VDC permissible	3V max	0	5% of rated VDC
Parametric change	Highest	Next	Least
Mode of failure	Degradation	Degradation	Hi Z degradation Low Z catastrophic
Reliability	Least	Next	Highest

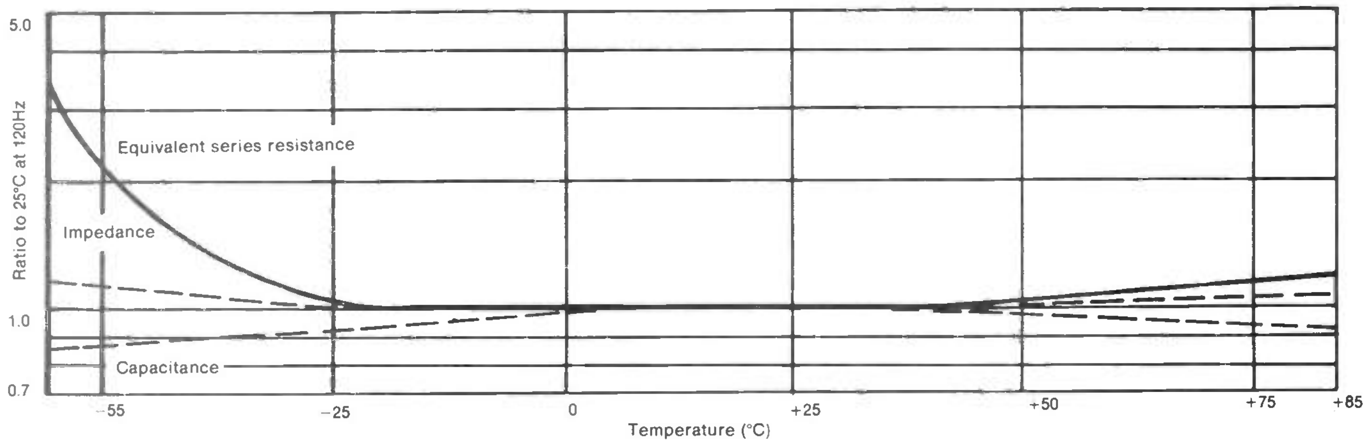

Fig 2 *Typical temperature dependence of the characteristics of a 6V plain-foil capacitor*

since it involved a gradual degradation in performance brought about by evaporation of the electrolyte through the end seal of the capacitor. Early models (and to some extent many of the cheaper models available today) suffered from a secondary mode of failure brought about by the migration of silver from the cathode; the result was a short circuit between cathode and anode. Fortunately most manufacturers use newer processing methods which have, to a very large extent, removed this problem. Despite this, many governments (including our own) have banned the use of silver-cased gelled tantalum capacitors in critical applications. The direct alternative is to use tantalum cased models which are very much more expensive.

Table 2: *Results of long term testing of gelled tantalum capacitors*

Rating	Unit number	Initial			2000 hours		
		Capacitance (μF)	Dissipation factor (%)	Leakage current[1]	Capacitance (μF)	Dissipation factor (%)	Leakage current[1]
20μF,60V	1	21.3	1.90	0.1μA	21.0	1.60	0.1μA
	2	20.8	1.45	0.1μA	20.4	1.20	0.1μA
	3	21.0	1.42	0.1μA	20.5	1.28	0.1μA
	4	21.5	1.60	0.1μA	21.2	1.50	0.1μA
	5	21.2	1.36	0.8μA	20.9	1.12	0.1μA
	6	21.3	1.36	0.1μA	21.0	1.12	0.1μA

All measurements at 120Hz.
[1]Leakage current was measured after five minutes at rated direct voltage at room temperature.

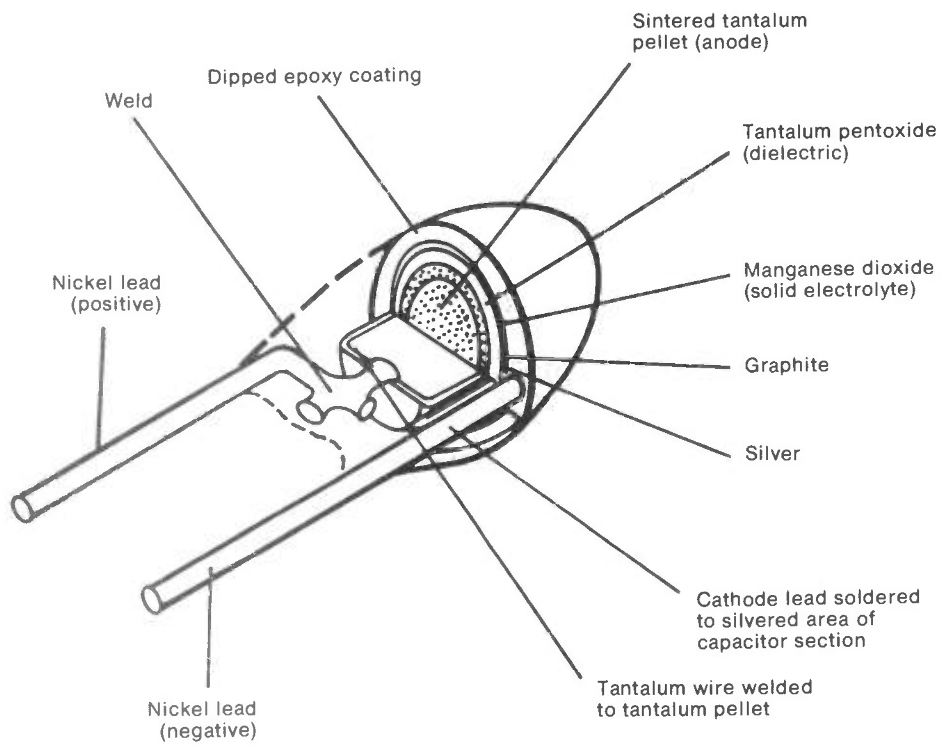

Fig 3 *Bead style of tantalum capacitor*

Foil tantalums

This type of capacitor consists of two thin tantalum foil electrodes with tantalum wire leads spot welded to them. Since the capacitance is proportional to the surface area, the foils are usually etched to increase that area. The anode foil is then oxidised by voltage polarisation and both foils are assembled, along with a porous spacer material, and rolled into a cylindrical form with an axial wire on each end. The rolled section is now impregnated with an electrolyte and then sealed into a suitable container.

One of the major advantages of this type of capacitor is that the capacitance value and the impedance are relatively unaffected by temperature variations (*see Figure 2*). On the other hand the equivalent series resistance increases 3—8 times as the temperature drops below zero. However this factor is not critical in most applications. Environmentally, the type of construction is well able to withstand extreme shock and vibration, as well as being able to operate at altitudes up to 100,000 feet.

The foil construction is also ideal when it comes to manufacturing non-polar capacitors. The normal polar type is capable of taking 3V in the reverse direction but, after adding an oxide coating to the cathode foil, the capacitor may certainly be treated as a non-polar type.

Despite these advantages, the foil type is not the most popular type of tantalum capacitor since it tends to be relatively expensive.

Solid tantalums

The solid tantalum is the lowest cost and the most popular of the three types. It is also the most flexible in terms of variations in form available, with (for example) the bead style (*Figure 3*), the chip style and, of course, the metal cased type (*Figure 4*). Since the construction of all types is basically the same and since the bead style constitutes 80% (by quantity) of all sales, we shall consider here just how this style is made.

The first stage in the process of manufacture is the formation of a pellet of compressed tantalum powder around

Table 3: *Back-to-back operation of solid tantalum capacitors under various test conditions*

Test	Rating	Before test: Capacitance (μF)	Before test: Dissipation factor (%)	Before test: Leakage current (μA) A	Before test: Leakage current (μA) B[1]	After test: Capacitance (μF)	After test: Dissipation factor (%)	After test: Leakage current (μA) A	After test: Leakage current (μA) B
Rated DC voltage applied continuously in one direction for 1000 hours at +85°C	7.5μF — 20VNP	High 7.53 Low 6.89 Av 7.18	3.1 2.2 2.7	3.0 0.5 1.0	2.5 0.1 0.8	7.60 6.84 7.20	3.4 2.6 3.0	5.0 0.5 1.5	4.5 0.1 1.0
Rated DC voltage, polarity reversed every 168 hours. Test duration 1000 hours at +85°C	7.5μF — 20VNP	High 7.56 Low 6.88 Av. 7.25	3.0 2.3 2.8	5.0 0.5 1.5	2.5 0.5 1.0	7.75 6.82 7.30	3.5 2.9 3.2	4.0 0.5 1.3	4.0 0.1 1.3
AC voltage of 6VRMS. 60Hz applied continously for 1000 hours at +85°C	30.0μF — 6NNP	High 35.2 Low 30.9 Av. 33.3	7.5 5.0 6.3	2.0 0.5 1.5	3.0 0.5 1.6	33.4 29.8 31.7	8.4 6.4 7.3	1.8 0.5 1.2	2.0 0.5 1.0
AC voltage of 10VRMS, 400Hz applied continously for 1000 hours at +85°C	7.5μF — 20VNP	High 7.68 Low 7.03 Av. 7.30	4.4 3.7 4.1	2.0 0.1 0.9	3.0 0.5 0.9	7.65 7.05 7.33	5.5 3.1 4.3	2.6 0.1 0.7	3.0 0.1 0.9

Capacitance and dissipation factor measured at 120Hz
[1]Leakage current in microamperes on both polarities.

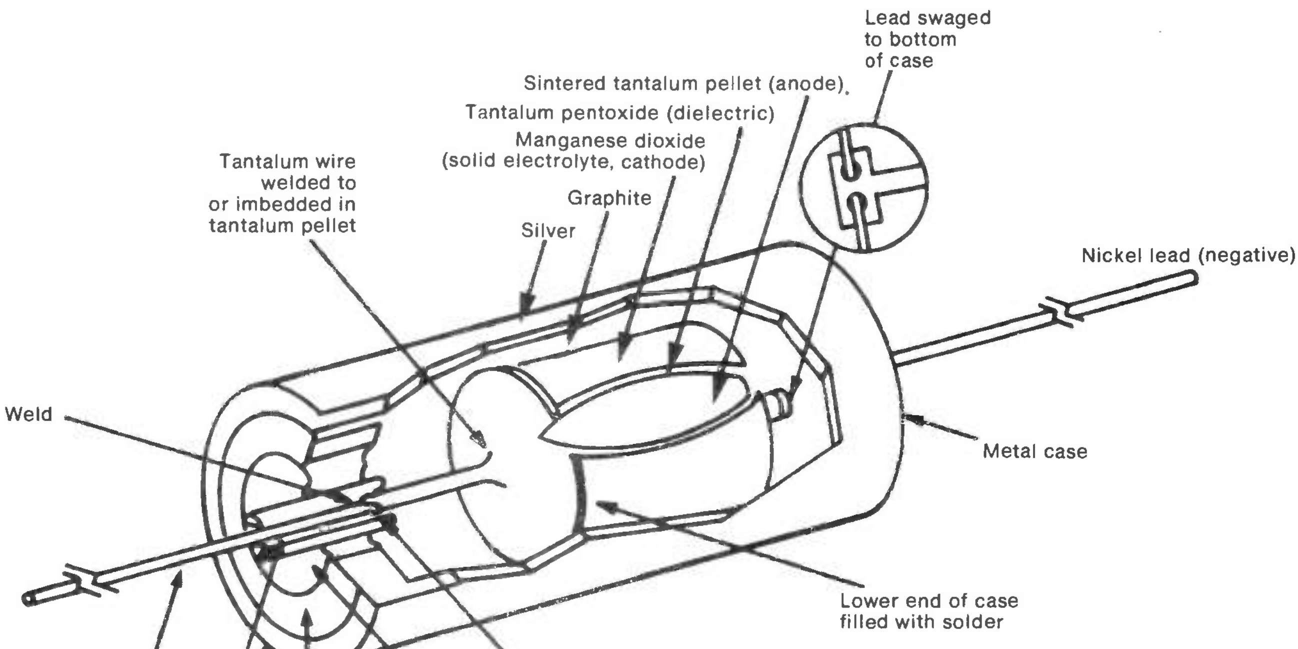

***Fig 4** Structure of the metal-cased type of capacitor*

a solid tantalum tab. The pellet is sintered in a furnace and electrochemically treated so that a dielectric oxide (tantalum pentoxide Ta_2O_5) is formed on the surface.

Next we impregnate the pellets with manganese nitrate and then heat treat the assembly so that the nitrate pyrolyses and generates a surface layer of manganese dioxide. The cathode is now applied in the form of a thin film of a carbon paste followed by a film of silver paste, to which is attached the cathode lead.

The anode connection is the tantalum tab previously referred to, onto which a lead is welded. The complete assembly is coated with a resin based material and, before leaving the factory, subjected to an ageing process. Finally it is inspected for mechanical and electrical defects.

Solid tantalum capacitors have evolved into highly reliable units that will give excellent performance when properly used. It is highly stable (of the order of 1500ppm/C) in comparison with other types of electrolytic. At low temperatures it has no peer since all other electrolytics rely on liquids which, when approaching freezing, become sluggish: this sluggishness has a very drastic effect on their characteristics.

The solid tantalum will not accept reverse voltages exceeding 5% of the working voltage; however if it does occur, the breakdown will not be catastrophic. In fact the capacitor exhibits many of the characteristics of a diode, albeit a rather slow one. Thus if a non-polar capacitor is required, it is acceptable to connect two of these capacitors back to back (connecting the negative leads together and using the positive leads as the connections for the composite capacitor). *Table 3* shows the results of using such a configuration under various user conditions. As can be seen little or no effect is apparent.

Postscript

The past few years has seen significant increases in the prices of materials, which have forced component manufacturers to find ways of cutting costs. In the field of tantalum capacitors, powders with high *CV* values have been developed which have helped to make the capacitors smaller, electronic products lighter and tantalum as popular in this role as it was before the first price rises. The new devices not only lead to high component packing densities and lower costs, but they are also compatible with LSI technology and automatic insertion. Thus there has been a great upturn in demand for tantalum capacitors in line with recent growth in video cassette recorders, portable stereo, optical cameras and the like.

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SL6270
Gain controlled audio amplifier

Amongst the various RF IC's available from Plessey are hidden some useful IC's that function at audio frequencies. One such IC is the SL6270, available in an 8-pin DIL package (CDP) or in an 8-pin metal can (CCM).

The SL6270 is a gain controlled audio amplifier that incorporates a voice operated gain adjusting device (VOGAD). It is designed to accept low-level audio input and to provide an essentially constant output over a 60dB range of input signal. Numerous uses include transmitter audio, tape recorders, receiver audio etc.

Device details

Figure 1 illustrates the internal circuit of the SL6270. The input will accept either single-ended or differential signals via pins 4 and 5. When used single-ended, the other input should be decoupled to ground: moreover, the signal should ideally be AC-coupled.

Up to approximately 1mV, input signals are amplified with little or no AGC action. Above 1mV the output will remain essentially constant at 90mVRMS over a 50dB increase in input. If required, the dynamic range and sensitivity of the input may be reduced by connecting a resistor between pins 7 and 8. A 1k resistor will reduce both parameters by approximately 20dB. However the choice of a value below 680Ω is not recommended.

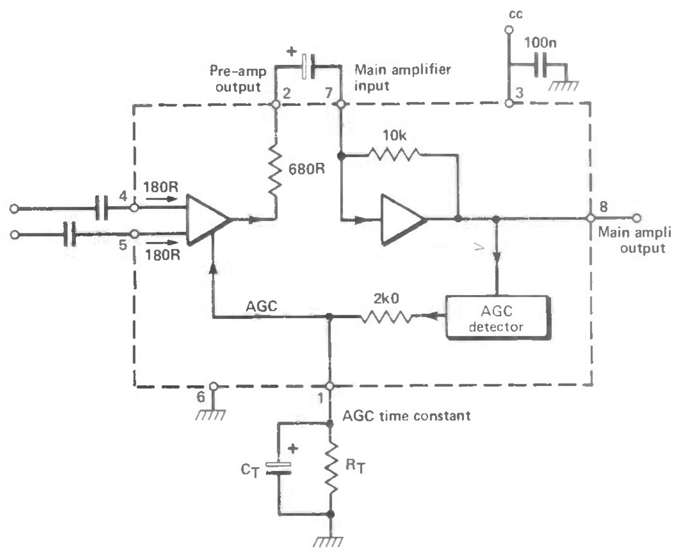


Fig 1 *SL6270 Block diagram*

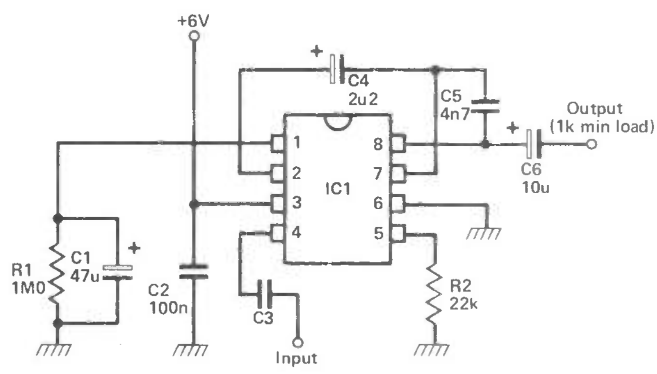
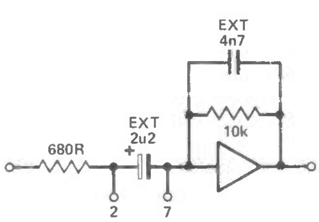


Fig 2 *Application circuit (see over)*

Fig 3 *Explanation of frequency response*



Voltage gain = 10kΩ/680R

Upper frequency response = 10k/4n7 = 3kHz

Lower frequency response = 680R/2μ2 = 300Hz

Characteristic	Min	Value Typ	Max	Units	Conditions
Supply voltage	4.5	6	10	V	
Supply current		5	10	mA	
Voltage gain	40	52		dB	72μVRMS pin 4
Output level	55	90	140	mVRMS	4mVRMS pin 4
THD		2	5	%	90mVRMS pin 4
Ambient temp	−30	+20	+85	°C	

The design of the SL6270 is such that both the low and the high frequency response is decided by two capacitors. The LF −3dB point is, in fact, determined by all three of the input, output and coupling capacitors. But for most communications purposes, the coupling capacitor between pins 2 and 7 is treated separately and it is usually chosen to be 2.2μF as this gives the −3dB point at 300Hz: the input and output are chosen to ensure a response to frequencies of 100Hz or less. Typically, the open-loop upper frequency response extends to several MHz, and the capacitor between pins 7 and 8 gives the required response. A 4n7 will give a typical HF point of 3kHz.

The attack and decay times are tailored to individual requirements through a suitable selection of the capacitor and resistor connected to pin 1. The 'attack time' — i.e. the time taken for the output to return to within 10% of original level following a 20dB increase in input — will be approximately 20ms when the values recommended are used (47μF and 1MΩ). It is principally determined by the value of C used and can be treated as 0.4ms/μF. The decay time is determined by the discharge rate of the capacitor via the parallel resistor. 1MΩ gives a rate of approximately 20dB/second.

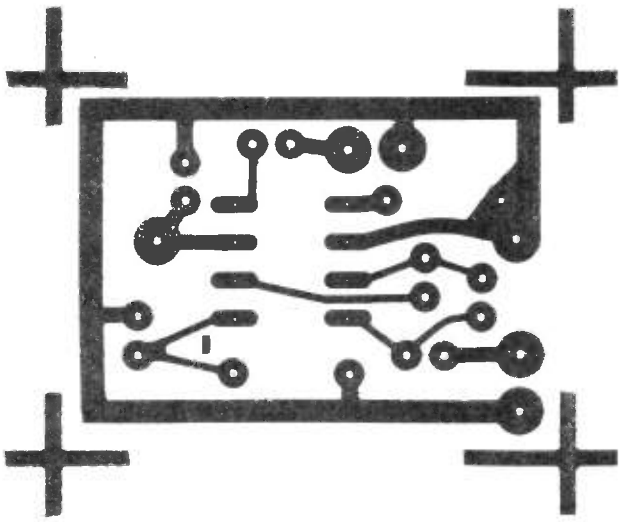


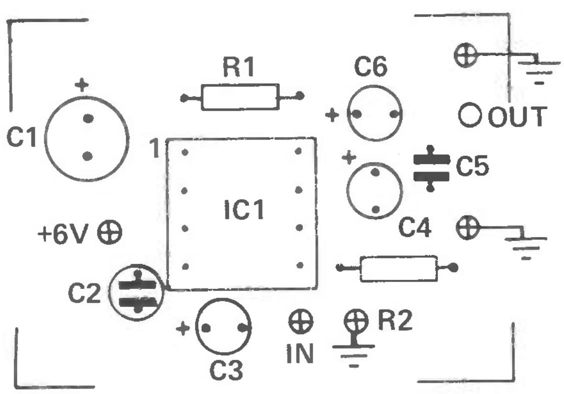
Fig 4 PCB foil pattern for a general purpose audio applications circuit using the SL6270

Application for the SL6270

To give the reader some idea of the ways in which the SL6270 can be used, we present here the PCB foil pattern (*Figure 4*) and the associated component overlay (*Figure 5*) for a general purpose audio applications circuit, which would be incorporated where constant output levels are required from widely fluctuating input levels.

This circuit has been designed with communications particularly in mind. It has a tailored frequency response of (nominally) 300Hz—3kHz, and it should prove easy to insert between the volume control of the receiver and the existing audio amplifier/output stage.

Fig 5 Component overlay



C1 is 47μ 16V
C2 is 100n mono
C3, C6 are 10μ 16v
C4 is 2μ2 16V
C5 is 4n7 ceramic
R1 is 1MΩ
R2 is 22kΩ
IC1 is SL6270 CDP

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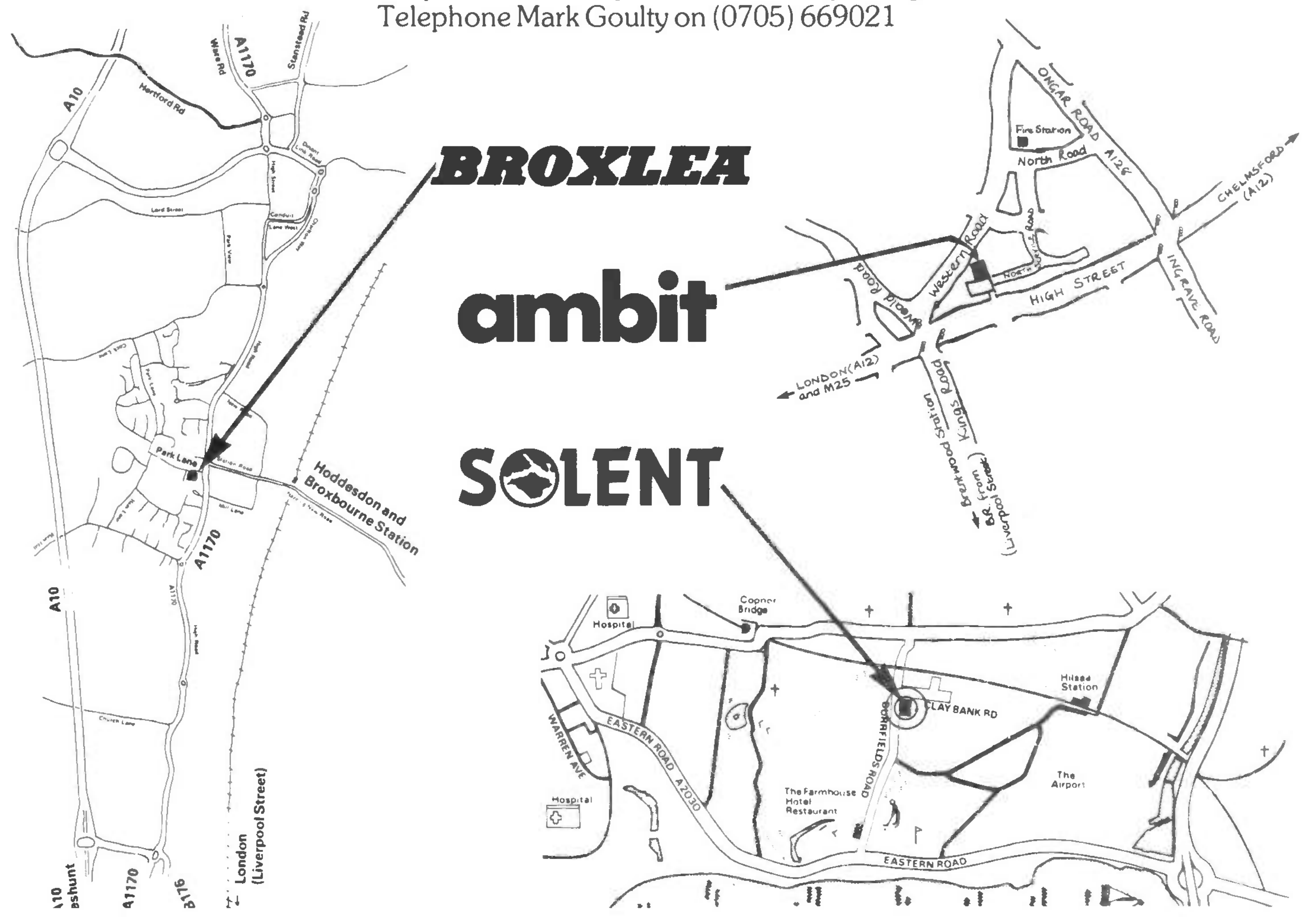
The Southern England Ambit Sales Counter operates under the auspices of Solent Component Supplies to provide the South Coast with a wide selection of Ambit components, kits, modules etc., supplemented by tools, components and equipment from the Solent Component Supplies catalogue. Access from the local motorway network is simple — and there's parking outside.
Telephone Mark Goulty on (0705) 669021



'NOTES FROM THE PAST'

Twenty-seven years ago, people were starting to probe some novel ways of communicating round the world. While some were trying to receive the BBC in the States, others were speculating about the facilities offered by satellites

A number of British TV receivers have been shipped over to America where it is hoped to receive something of our BBC transmissions. The attempt is being made by the National Broadcasting Company, who are installing the receivers at their Riverhead Station, Long Island, hoping to relay any images received (duly filmed) in the 'Wide, Wide World' programme. By the time this appears in print the hoped for 'peak period' will have passed and perhaps something of the results will have appeared in the daily press. In any case we shall know something of the conditions, if they prove to be abnormal, by the interference affecting our own domestic receivers!

Attempts to pick up BBC signals in America were unsuccessfully made in 1953, at the time of the Coronation, but some years earlier, during a period of high sun-spot activity, successful reception of BBC signals was reported. At that time, of course, no attempt was made to re-broadcast them. What a spot for ITA to achieve this in reverse. A huge audience sitting agog waiting to see one of America's star programmes — and a couple of adverts slipped in!

Listener watch

Several readers, especially Mr Alex P Buchanan of Carrick Park, Ayr, have written about next year's launching of artificial satellites — particularly of the electronic equipment and of organised amateur reception of the radio signals they will send back to earth. While suggestions have from time to time been put forward that the services of amateur observers may be of value, as far as I can make out no practical steps have yet been taken to enrol their help. As the work is under the direction of the US Naval Research Laboratory it is doubtful that the initiative in seeking such help will come from the official side. Nor are the Russians likely to ask for co-operation. Indeed, they are revealing no details of their project at all.

However, for visual observation, the Smithsonian Institution in Washington have arranged for (and are still organising) a world-wide chain of knowledgeable amateur observers to man posts to track the sphere, so as to make sure (if it gets lost) that we shall know something of what happened to it. As I mentioned when the project was first announced, it should be visible in the reflected light of the sun to watchers armed with quite ordinary binoculars, and under favourable conditions even with the naked eye.

As I see it, it is rather doubtful whether amateur radio observation would be of much value with our present unreliable maps. Errors of several miles occur in the charted positions of many of the smaller islands and even in the distances of continents from each other. Accurate measurement, for radio purposes is far beyond the scope of amateur equipment. Even the loss of signals, should the satellite wander off into outer space, could hardly be accurately plotted or timed without elaborate equipment. There is, however, one aspect scheduled for official investigation, in which a corps of widely spaced amateur listeners might be able to help. That is the problem of propagation for VHF working and the effects of the ionosphere in reflecting and refracting radio signals, with the view of making wide-coverage TV an early possibility.

First shot

I am not normally a pessimist but I have wondered just how many satellites will have to be launched before one can be made to circle in the planned orbit. The lay mind seems to take it for granted that it is already as good as done, quite overlooking the amount of experimental work history teaches us is required for such ventures. And this is a stupendous step involving many unknown factors. Remember the early German V2 rockets? — only one in the first twenty or so worked and even *after* the war, development was brought only to a 60% successful launching stage. It is doubtful whether we can yet claim to be through the growing-pains stage, and we glibly talk of a three-stage tandem rocket reaching the right altitude and finally kicking the satellite off to an 18 000mph start. If its velocity is too slow it will sink back into an increasingly heavier atmosphere and burn up, perhaps even before completing one circuit. If it travels too fast it will fly off into space. The world's leading rocket engineers are confident that one day we shall get a satellite in the right orbit, but they won't quote how many firings they think may be needed before it is achieved.

Nor is there any agreement among scientists on how long it will stay up. Some think a few hours (it will circle the Earth from west to east every 90 minutes). Some venture to suggest perhaps for months. Either guess might be right. The satellite will approach within 200 miles of the Earth and wing out to 1400 miles at each revolution, moving about 1500 miles west at each circuit, and our present knowledge of atmospheric density at these heights is so slender that either conjecture might well prove right.

Remember, that even as a first effort, the engineers are building twelve satellites (not just one) and hope to get *one* into the planned orbit, if only for a short spell. When that has been achieved perhaps we shall be in a better position to evaluate just how a corps of skilled amateur radio enthusiasts might usefully be of service.

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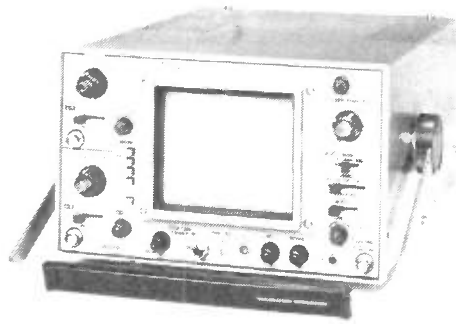

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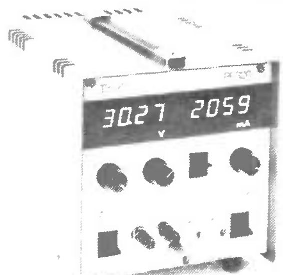

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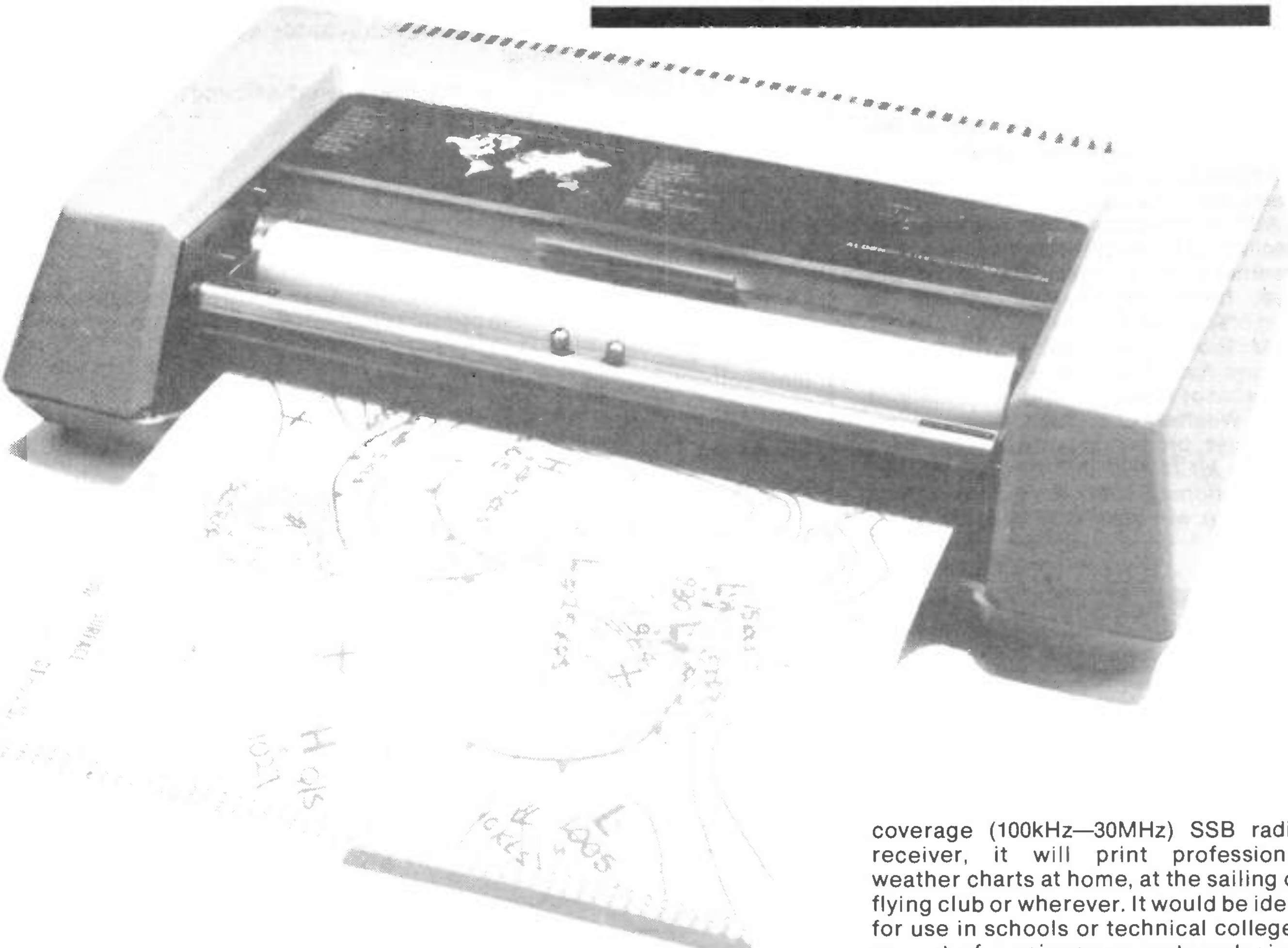
The Alden Weather Chart Recorder

A kit for the home constructor — given an introductory review here by Arthur C Gee



One of the difficulties facing those interested in receiving weather maps (whether from HF radio stations or satellites), FAX and similar radio transmitted graphics, is the non-availability of suitable mechanical recording equipment. Some real enthusiasts have succeeded in building their own FAX machines, and some useful descriptions of such efforts have appeared in electronics journals in the past. But these are few and far between; moreover, one really needs workshop facilities to make a good job of such a project. For the most part enthusiasts have had to make do with obsolete or surplus professional machines, which are usually expensive and require a lot of work done on them before they can handle the characteristics of weather maps and FAX pictures for which they were not originally designed.

At last a low cost facsimile recorder has become available, which is specifically intended for the radio amateur, SWL and weather buff. ALDEN Electronics of Westborough, Massachusetts, USA, has recently brought out an excellent Weather Chart Recorder in kit form, thus permitting the price to be kept at an affordable level for the type of customer they have in mind. It is a single speed, single IOC recorder, running on 115VAC. The firm specialises in equipment for professional marine use, for example its Marinefax Recorders, but this Kit Recorder is specifically for the radio amateur/home constructor/etc market.

Coupled into a stable HF general coverage (100kHz—30MHz) SSB radio receiver, it will print professional weather charts at home, at the sailing or flying club or wherever. It would be ideal for use in schools or technical colleges as part of a science or meteorological project. Indeed, it is proving very popular in the States for just such applications.

Facsimile Weather Chart transmissions are broadcast worldwide and are available free of charge to anyone having the equipment to receive them. Moreover, all weather charts use international symbols, so one can easily interpret charts whether they are transmitted from sites in the USA, Canada, Japan, Russia or from other countries throughout the world.

Constructional comments

The ALDEN Weather Chart Recorder Kit is easily assembled, the time for doing so being about five hours, I reckon. An excellent Assembly Manual is provided. Complete illustrated step-by-step instructions are given for assembling, checkout and operation, while pre-assembled and tested circuit boards and mechanical assemblies are provided for the more difficult sub-assemblies. An attractive moulded case gives a professional appearance to the completed unit. The solid-state circuitry and a simple electro-mechanical design should ensure long, trouble-free operation.

Electrically sensitive paper in disposable cassettes, 11" wide, is used, so no tricky threading procedures or processing will be required. Another welcome feature is that the printing process is quiet and free from smoke, fumes or smell. The overall size of the unit is approximately 17" x 10" x 4" and the weight is 10lbs.

A very nice feature of the recorder is its auto start and stop facility. The unit can be left in an operational state until a transmisson starts, whereupon the machine automatically starts up because the transmission itself provides all the necessary start and stop signals as well as framing pulses that automatically frame the picture.

ALDEN produces a number of books dealing with weather forecasting and weather chart interpretation, one of the best being *'A Mariner's Guide to Radiofacsimile Weather Charts'* by Dr J M Bishop. Another — *'Worldwide Marine Radiofacsimile'* — gives a complete list of stations along with details of their Weather Chart transmissons, frequencies, broadcast times, etc.

The kit is available through ALDEN International SA, 117 North Main Street, Brockton, MA 02403-0860 at $1100.

Weather Chart Recorder Kit Model 9321

SPECIFICATIONS

Recording rate:	120spm (scans per minute)
Index of Cooperation:	10C 576 CCIR; 169 lines per inch
Control signals:	Auto start, stop, frame; manual start and frame
Start:	Signal shifting between 1500Hz and 2300Hz at a rate of 300Hz for five seconds
Frame:	A 1500Hz signal interrupted by a short burst of 2300Hz each scan line. Duration — 20-30s immediately following start signal
Stop:	Signal shifting between 1500Hz and 2300Hz at a rate of 450Hz for five seconds
Circuitry:	Solid state
Input impedance:	600Ω balanced
Input frequencies:	FSK 1500Hz black; 2300Hz white
Scanning electrode:	Stylus belt
Recording paper:	Alfax electrosensitive paper in throw-away cassettes with built-in printing electrode. Each cassette contains 35feet of 11-inch wide paper
Input voltage:	115VAC 10%, 50/60Hz
Maximum power:	Standby mode — 10W; operating mode — 30W
Net weight:	10.1 pounds
Dimensions:	3⅜" H, 17¹⁄₁₆" W, 10½" D

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EXPANSION BUS

In the second of our continuing series about personal computer add-ons, Roland Perry examines the Digithurst range of image analysis equipment

Most personal computers available these days have a bash at so-called 'pixel' graphics. These pixels are dots on the screen smaller than a whole character cell. Indeed their size will normally be that of the dots used to make up alphanumeric characters displayed on the screen, and this dimension thus corresponds to the maximum resolution provided. Depending on the sophistication of the particular machine it may be possible to display grey levels (that is, to control the brightness of each dot more specifically than just on and off) or colours.

Drawing pictures in graphics mode is normally limited to constructing them by putting together lines, blocks, parts of circles and any other available building blocks. However, the equipment that Digithurst offer allows the user to enter pictures directly from a TV camera and once in the computer the image can be processed in a number of ways. For example, measurements of particular areas may be made with the aid of an optional software package.

The review model provided fitted straight into the back of our favourite personal computer (BBC model B: what else?) and within seconds we were seeing pictures of the Editor's pen-tidy on the screen. The grey levels for such pictures are treated on the BBC computer by sacrificing resolution and turning on between one and four pixels arranged in a square. The more that are turned on, the brighter the 'dot' appears. We found this scheme worked very well even when viewed on a high resolution monitor, the individual pixels apparently merging to produce grey levels. The same principle is used when printing black-and-white photographs (half-tones).

The standard black-and-white version — the MicroSight 1 — may optionally be upgraded to colour (for another £100) via a colour vision system known as MicroSight Colour. This combination showed us a very convincing picture of an apple (the fruit rather than the computer!) and a section from one of *R&EW's* front covers.

The system

The system is basically in three parts. The first is a small black-and-white camera producing CCTV signals. Digithurst are reluctant to supply the system without a camera, even if you have one already. Understandably they are wary of the inevitable support problems. The camera plugs into a box of electronics called a MicroEye. Inside the MicroEye lies the scanning logic and the analogue-to-digital converter. It does not have any memory, and is certainly not a cheap frame-store. The philosophy of the whole MicroSight system is that the memory to store the picture is inside the micro. The MicroEye is accessed via a parallel port on the host microcomputer.

The MicroEye interface runs essentially continuously, digitising all the incoming video signals. On receipt of a master reset signal, the unit begins to digitise the set of video image signals within this first frame that corresponds to the far left-hand side of the chosen image area, producing a column of pixels. When the interface starts to receive the second frame from the camera the timing circuitry steps one pixel horizontally along each line and digitises a column of pixels from that position. This process (illustrated more fully in *Figure 1*) continues until the whole image has been digitised. To capture the whole image takes 256 frames, or a little over five seconds.

The third and key part of the set-up is the software which runs in the microcomputer. The standard MicroSight 1 software handles all the data transfer from the MicroEye and converts the images into dots on the screen. Disk storage and retrieval of images is taken care of by BASIC programs, whereas the processing is performed by six machine code routines. The number of pixels and grey levels available will vary depending on the actual machine used. The options for the currently supported machines are shown in the accompanying table.

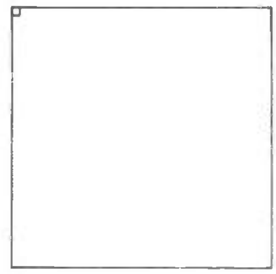
An optional extra package called MicroScale, available with certain systems, permits further, more sophisticated, image analysis. This allows the display to be created from a 'window' in the captured TV image, and edge-enhancement to be performed within that area. Other facilities include measurement of boundaries, areas and distances on the image. These measurements are aided by an on-screen cursor which is manipulated via keystrokes at the user's micro. In addition, there is an MSDOS version of MicroSight which enables images to be filtered and to be merged within memory.

Overall

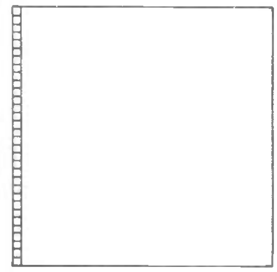
The MicroSight system is compatible with any microcomputer with an 8-bit parallel port and appropriate graphics, and it comes with two comprehensive manuals which give all the details of both the hardware and the software. Digithurst are very helpful and appear willing to support users attempting to apply the equipment to new applications and even to other micros.

Digithurst outline a number of applications for MicroSight from text recognition to robot vision systems. Its use for computer demonstrations, advertising and graphic design is obvious, but there are many additional applications as a piece of laboratory equipment, particularly where measurements are to be made on irregular areas. Medical studies, microscopy and satellite image processing come to mind.

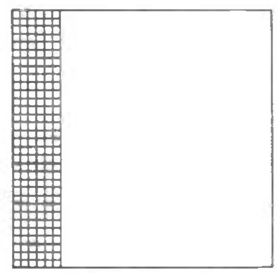
After 0.5sec: *25 columns of pixels have now been created from the image and have been transferred to RAM as 25 columns of data. If a pulse was now sent from the computer along the master reset line the unit would start to digitise a new image from the top left hand corner again. This technique can be useful when a rapid frame grab rate is required; in this case, a 256x25 pixel image would have been captured.*



After 5sec: *If a full 256x256 pixel frame is required, then the master reset is not activated until the full frame has been read.*



After 20msec: *The first column of pixels have been created from the incoming video, and the unit is now waiting for the next line pulse before digitising the next column of pixels. The computer will also be waiting for the EOL pulse before reading in more data.*



After 64μ: *The first pixel has been digitised and has been transferred to the microcomputer's RAM and placed at the top of the first data column.*

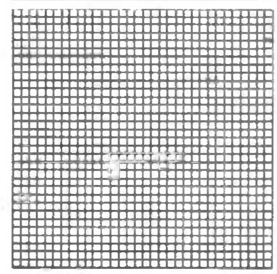


Table 1: *MicroSight 1 systems*

	Grey scales held in memory	Grey scales displayed	Mode Used	MicroScale available	Other software
BBC MODEL B					
High res. (256x256)	3	3	ø	—	MicroSight system with printer dump, disk dump, etc. Options include animation image editing
Medium res. (128x100)	16	5	4	√	
Colour high res. (256x200)	8 colours	8 colours	2	—	
Colour medium res. (128x100)	8 colours	8 colours	2	—	
ACT Sirius 1					
High res. (256x256)	255	7	768x400	√	Vectoring package for turning images into CAD drawings. Contrast enhancement for X-ray analysis
Research Machines					
High res.	128x90	5	256x192	—	—
Medium res.	128x90	16	128x90	√	—
Colour	128x90	8 colours	128x90	—	—
CBM 4032,8032					
Medium res.	128x100	5	256x300 (Supersoft Board)	√	Histograms for image analysis
Apple II 48K					
Medium res.	128x100	5	256x192	—	Windows, area and boundary calculations included in MicroSight 1 system software

ONE NIGHTS WORK

A continuity tester designed by Stephen Ibbs that is quick and simple to build, as well as extremely useful.

This is the first thing I ever built, way back in 1979, and its usefulness has been proved time and time again. It checks fuses, lightbulbs, broken leads, as well as possible PCB track breaks etc. The original was mounted in an old transistor radio case, and a couple of nails with leads attached were — and are still — used as the probes. Eyebrows may rise when the circuit *(Figure 1)* is examined, but transistors and an audio transformer were used because they are so cheap and most readers should be able to get hold of an old transistor radio. The latter is often a valuable source of components; indeed all of the items for this tester, except the preset and transistors, were 'rescued' from one. The miniature transformer in such a radio is almost invariably red and to be found right next to the radio's speaker leads.

How it works

The transistors are used as switches, and the easiest analogy for the way they operate is that of three interconnected cog wheels, whereby if A goes anticlockwise, B goes clockwise, and C goes anticlockwise (*Figure 2*). Similarly, if transistor TR1 is turned on, as a result of the emitter being connected to ground through the probes, the base of TR2 will go to 0V, turning it off. This makes its collector (and the base of TR3) go virtually to the potential of the positive rail, thus turning on the oscillator constructed around TR3 and the transformer. RV1 adjusts the point at which TR1 turns on, the technique being to choose that setting at which the alarm just sounds when the probes are shorted. With the probes not connected, TR1 turns off and so TR2 turns on, turning off TR3 and the oscillator.

Construction

This tester may be built either on veroboard or a PCB, a design for the latter being given in *Figures 3 and 4*. None of the components are critical, so you could experiment with nearby values if the ones suggested are not available. Any npn general purpose transistor will work, but check the 'pin out'. I in fact used unmarked BC109 types in the original, having bought 150 untested ones for 30p... Ah! those were the days.

Check for solder joins or dry joints, and if all is well, switch on, adjust RV1 as mentioned above, and mount the unit in a suitable enclosure... verobox, cigarette packet, tobacco tin...

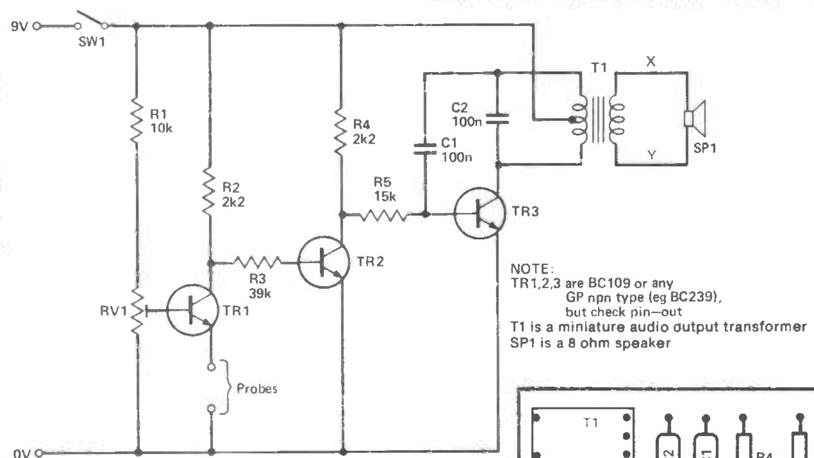


Fig 1: *Circuit diagram*

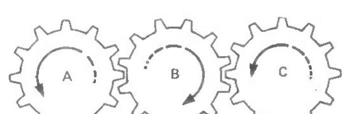


Fig 2: *The principle of operation*

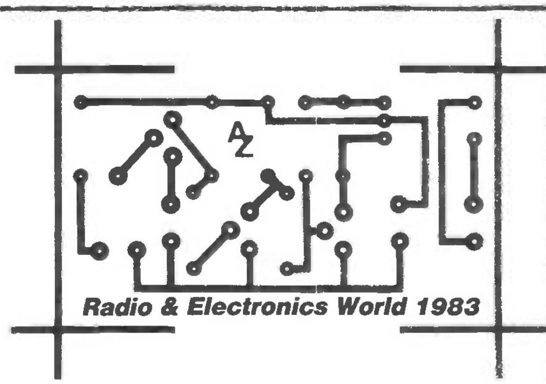


Fig 3: *PCB foil pattern*

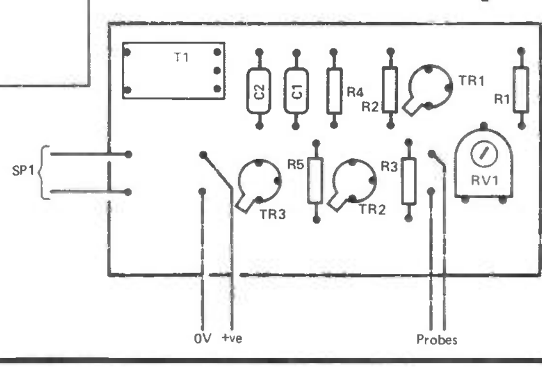
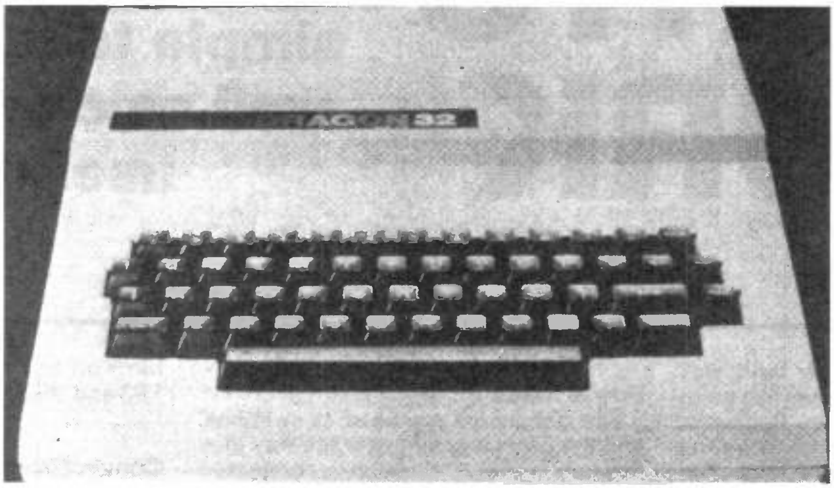


Fig 4: *Component overlay*

AN RS232C INTERFACE FOR YOUR DRAGON 32

David Thomlinson of Cotswold Computers gives details of the interface that has been developed jointly by his firm and CP Engineering

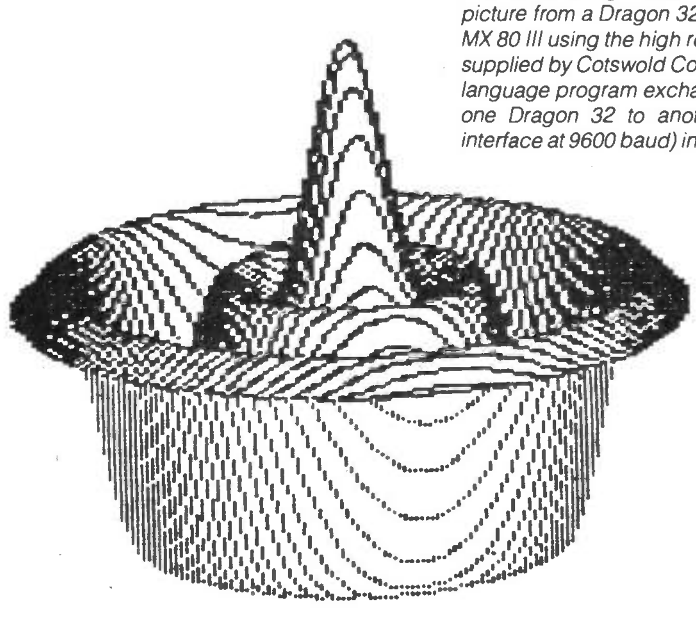


The Dragon 32 has been described as 'The Affordable Sensible Computer'. Indeed, for its price, it is a remarkably complete micro: it does not require additional expansion boxes for the use or control of such devices as printers, joysticks or disk drives. Why then go to the trouble of designing and marketing an RS232C interface for the Dragon? To what uses can such an interface be put?

At Cotswold Computers, we believe that one of the next major developments for the home personal computer user will be in the area of communication. This will mainly be over telephone networks and will probably have as its object either accessing public databases such as REWTEL, placing orders for equipment or simply calling up other friendly micros. Such communication needs a modem and modems need RS232C interfaces. And in that lies the reason for our joint venture with C P Engineering on an RS232C interface and a following modem.

To date we have supplied RS232C interfaces to both multinational and national companies, universities, private individuals and even the Police Force. The variety of uses to which their Dragons can now be put includes:

1) As a direct terminal to a large computer system
2) As a word processor, transmitting through a data modem to a larger computer system.
3) As a serial printer
4) As a terminal connected to a speech synthesis unit
5) As a terminal connected to a liquid scintillation spectrometer
6) To control a teletype
7) To control a graph plotter



A pmode 4 high resolution graphics screen picture from a Dragon 32 printed by an EPSON MX 80 III using the high resolution dump routine supplied by Cotswold Computers. An assembly language program exchanged this screen from one Dragon 32 to another (via the RS232C interface at 9600 baud) in less than six seconds.

In addition the interface is being used to connect one Dragon with another.

So just what is an RS232C interface and how does it process data? To understand this we must first examine the way data is conventionally encoded.

A few basics

As you probably know, bits – or binary digits, each a 1 or a 0 – are combined into groups of eight called bytes when they are used to represent characters. The alphabet, all the Arabic numerals plus the various punctuation marks require a total of 72 characters. The bit code commonly used for this is that known as ASCII or the American Code for Information Exchange. When transmitting text via an RS232C link, it is usual to represent the letters and symbols by the ASCII code. And since the Dragon 32 has the required ASC$ instruction, it is a simple matter to communicate text between the Dragon 32 and any other ASCII compatible computer or peripheral.

To display the ASCII code on your Dragon, load and run the following program:

```
10 FOR I = 1 TO 255
20 TIMER = 0
30 POKE 1500, I
40 IF TIMER <25 THEN GO TO 40
50 NEXT I
```

In addition to this character set, ASCII also includes a number of control codes; for example, CHR$(10) sent to most printers will produce a line feed. A complete listing of the ASCII codes is shown in *Table 1*.

Having thus briefly discussed the codes for representing letters and numbers, we now turn to how they are transmitted.

The RS232C standard

RS232C is a common bit serial data transmission standard. Data is communicated as a sequence of bits on a single transmission line, preceded by a start bit and followed by a stop bit (or bits). The bit rate (and so similarly the baud rate) must be the same for both the transmitter and the receiver to allow the receiver to synchronise.

To understand how the interface operates, it is best to look at this in conjunction with a specific example. The waveform shown in *Figure 1* is that resulting from the transmisson of a single 8-bit data word (in fact, decimal 74 in 8-bit format). The line is in a 'marking' state corresponding to logical zero (below −3V) until the data word is transmitted. A start bit of logic one (greater than +3V) signals the presence of a data word and is used by the receiver to synchronise its testing of the following eight time periods which together represent the 8-bit data word being transmitted.

A number of transmission formats are in use which include the addition of an extra stop bit and/or the addition of (or alternatively, the use of d_7 as) a parity bit. The parity bit attempts to detect the occurrence of data corruption by ensuring that all data words sent contain an even number of logic ones (EVEN parity) or, alternatively, an odd number of logic ones (ODD parity). If a data word is received with incorrect parity, it may be assumed to have been corrupted in the transmission process. Obviously, 8-bit data (which can be thought of as taking any value from 0 to 255) may be transmitted except when the most significant bit is used as a parity bit when only 7-bit words (0–127) are allowed.

A further two lines are provided in addition to the data transmission line. These lines provide a means of exchanging information on the condition of the devices that are communicating, such as 'printer busy' or 'ready'. The accepted nomenclature for these control lines comprises 'Request to send' (RTS) for the line set by the transmitter and 'Clear to send' (CTS) for the line set by the receiver.

The time taken to transfer a single data word is set by the baud rate but the rate of data transfer can be significantly slower if the peripheral controls the transfer rate via the CTS line.

The CP RS232C interface

Our interface is designed for operation under program control and is arranged to appear to the user as two locations in memory. Since the only BASIC instructions which allow memory operations are PEEK and POKE, these are the instructions used to communicate with the interface. When programming in assembly language, however, all instructions which involve memory can be used. One of the memory locations (DATA : ADDRESS — 65370) is used to transmit and receive data while the other (CONTROL/STATUS : ADDRESS – 65354) is used to send control words to and receive status words from the interface.

The exact form of the communication made using the interface will depend to some extent on the device involved but will in general consist of a sequence of steps as described below:

TRANSMISSION

1) The required format is ascertained and the corresponding control word POKED to 65354. The code will set the RTS line as required.

2) The status word may optionally be PEEKED from 65354 to ensure that the receiver is ready.

3) Data transmission is begun by POKING the first word to 65370. The status word is then PEEKED from 65354 until it indicates that the interface is ready for the next data word. The next data word is then POKED to 65370 and the status word again checked. This process is then repeated until the data transmission is complete.

RECEPTION

1) The control word for the required format is POKED to 65354.

2) The status word may optionally be PEEKED until the transmitter indicates that it is ready.

3) The control word may optionally be POKED to instruct the transmitter to begin data transfer.

4) The status word is PEEKED from 65354 until the interface indicates that it has received a data word.

Table 1: *The meaning of the ASCII code words*

0 Null	1 Start of heading
2 Start of text	3 End of text
4 End of transmission	5 Enquiry
6 Acknowledge	7 Alarm/Bell
8 Backspace	9 Horizontal tabulation
10 Line feed	11 Vertical tabulation
12 Form feed	13 Carriage return
14 Shift out	15 Shift in
16 Data link escape	17 Device control 1
18 Device control 2	19 Device control 3
20 Device control 4	21 Negative acknowledge
22 Synchronous idle	23 End of transmission block
24 Cancel	25 End of medium
26 Substitute	27 Escape
28 File separator	29 Group separator
30 Record separator	31 Unit separator
32 Space	127 Delete

33	!	34	"	35	£	36	$	37	%
38	&	39	'	40	(	41	)	42	*
43	+	44	,	45	–	46	.	47	/
48	0	49	1	50	2	51	3	52	4
53	5	54	6	55	7	56	8	57	9
58	:	59	;	60	<	61	=	62	>
63	?	64	@	65	A	66	B	67	C
68	D	69	E	70	F	71	G	72	H
73	I	74	J	75	K	76	L	77	M
78	N	79	O	80	P	81	Q	82	R
83	S	84	T	85	U	86	V	87	W
88	X	89	Y	90	Z	91	[	92	\
93	]	94	^	95	_	96	'	97	a
98	b	99	c	100	d	101	e	102	f
103	g	104	h	105	i	106	j	107	k
108	l	109	m	110	n	111	o	112	p
113	q	114	r	115	s	116	t	117	u
118	v	119	w	120	x	121	y	122	z
123	{	124	|	125	}	126	~		

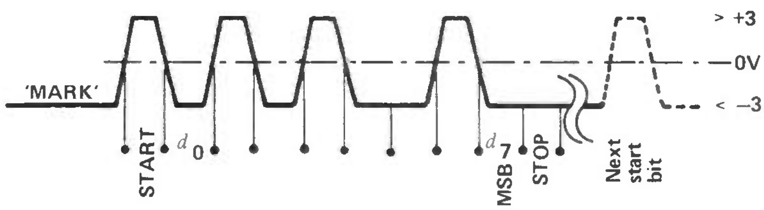


Fig 1 *RS232C transmission waveform*

CONTROL AND STATUS WORDS

Baud rate: Bits 0, 1 of the control word
Normal mode provides the baud rate indicated by the switch table

Bit pattern Bit 1	Bit 0	Decimal contribution	Resulting baud modes
0	0	0	16 times Normal
0	1	1	Normal
1	0	2	¼ times Normal
1	1	3	Master Reset

Format: Bits 2–4 of the control word

Bit pattern Bit 4	Bit 3	Bit 2	Decimal contribution	Format Bits	Parity	Stop
0	0	0	0	7	even	2
0	0	1	4	7	odd	2
0	1	0	8	7	even	1
0	1	1	12	7	odd	1
1	0	0	16	8	no	2
1	0	1	20	8	no	1
1	1	0	24	8	even	1
1	1	1	28	8	odd	1

Line control:Bits 5, 6 of the control word
These bits give control over the logic level of the 'Request to send' output line from the interface. The bit patterns which result in RTS=high cause the peripheral to sense a 'Request to send' from the interface.

Bit pattern Bit 6	Bit 5	Decimal contribution	Function
0	0	0	RTS = high
0	1	32	RTS = high
1	0	64	RTS = low
1	1	96	RTS = high plus TRANSMIT DATA = high

For example:
Suppose the following communication format is required — 8 bits/No parity/2 stop bits/RTS low at a transmission rate of 1200 baud: what is the control word? Using the normal mode (decimal contribution = 1), the 8 bit/No parity/2 stop bits format (decimal contribution = 16) and RTS low (decimal contribution = 64) makes the control word 1+16+64 = 81 giving the program line:

```
1 POKE 65354,81
```

A table of baud rate switch positions gives the switch pattern 'off', 'on', 'off', 'off' for 1200 baud. With that switch pattern set and 81 POKED to 65354, the interface will operate with the required format until a new value of the control word is POKED.

Make-up of status word

Bit number	Decimal equivalent	Function of bit
0	1	Data word received
1	2	Data word transmitted
2	4	Data-Carrier-Detect
3	8	Clear to send
4	16	Framing error
5	32	Receiver overrun
6	64	Parity error

5) A control word may optionally be POKED to 65354 to inhibit the transmitter while the data word is stored.
6) The first data word is PEEKED from 65370 and stored or processed as required. The process is repeated from '4' until all the data has been received.

There are a couple of additional points to note about communication via this interface. Firstly, it should be noted that, although the address of both control and status words is 65354, they are separate registers. Secondly, the required baud rate should be set via the switches on the interface before the Dragon is switched on. The make-up of the control and status words is described in the box on this page.

The more technically minded reader may be interested to know that the interface uses a memory mapped 6850 ACIA with the baud rate generated by a crystal-controlled 4702, whilst half of a 1488 together with half of a 1489 provide the 232C driver/receiver. The –ve supply for the 1488 is generated from the Dragon 32 +12V line. All the relevant lines from the 6850 are brought out to the interface edge connector to facilitate their connection to the modem.

The interface may (by making appropriate modifications to the board) provide RS232C on one interface cable and TTL levels on another. Moreover, the interface status word can provide a means of sensing the $\overline{\text{CTS}}$ and $\overline{\text{DCD}}$ TTL compatible inputs to the interface and the control word may be used to set $\overline{\text{RTS}}$ which is also TTL compatible. Thus the interface may be used to perform limited sense and control functions.

Interface output connections

A standard 'D' type subminiature connector is used to connect signal lines to and from the interface. Pins 1 to 7 are used for RS232C connections and are arranged conventionally. The other pins

Table 2: *Pin-out for the interface connector*

Pin	Description	
2	Transmit data	RS232C
3	Receive data	RS232C
4	Request to send	RS232C
5	Clear to send	RS232C
7	Ground	
8	RxData	ACIA
9	$\overline{\text{DCD}}$	ACIA
10	$\overline{\text{CTS}}$	ACIA
11	TxData	ACIA
12	RTS	ACIA
13	+5V	ACIA
17	$\overline{\text{CTS}}$'	ACIA
18	RxData'	
19	Baud clock output	-- TTL
24	+12V	
25	–9V	-- Low current

All pins not mentioned are *not connected* however are used for connection to the CP modem. *Under no circumstances should connections be made to the interface connector pins other than Nos1-7.* This requirement restricts the use of 25-way ribbon or other connectors. The user is advised to refer to the range of standard cables available from the manufacturer. The full pin-out is shown in *Table 2*.

Input, by the way, is via the cartridge slot on the Dragon.

In conclusion

The CP RS232C interface has been designed to allow your Dragon 32 to transmit to, and receive data from, any RS232C compatible device. The interface features all the common formats and bit rates under program and switched control respectively. In addition the bit rate may be multiplied by 16 or divided by 4 under program control.

It is supplied by Cotswold Computers in a sturdy case complete with a recess to allow access to the baud selector switches from the outside. The company can also supply software support in the form of a tape of the programs documented in the interface manual and a range of specialist software (and interface cabling). Parts are guaranteed for twelve months and the retail price for the interface is £49.50. Trade distribution enquiries are welcomed.

A program to communicate the graphics screen

The following program listings allow the transfer of graphics from one Dragon to another. The transmitting Dragon generates a random graphics pattern which is then transferred to the receiving Dragon. Both interfaces must be set to the same baud rate, a high rate reducing the transmission time.

Program to be entered into transmitting Dragon

```
10 TIMER=0
20 PMODE4:SCREEN1,1::PCLS1
30 X=RND(255): Y=RND(192)
40 LINE-(X,Y),PRESET,B
50 IF TIMER<300 GOTO30
60 POKE65354,3
70 POKE65354,17
80 A=B AND PEEK(63354)
90 IFA= 0 GOTO 80
100 FORI=1536TO7679
110 A=2ANDPEEK(65354)
120 IFA=0 GOTO 110
140 POKE65370,PEEK(I)
150 NEXTI
```

Program to be entered into receiving Dragon

```
10 POKE65495,0
20 PMODE4:SCREEN1,1:PCLS1
30 POKE65354,3
40 POKE65354,81
50 A=PEEK(65354) AND 8
60 IF A=O GOTO 50
70 POKE65354,17
80 FORI=1536TO7679
90 A=1ANDPEEK(65354)
100 IF A=0 GOTO90
110 POKEI,PEEK(65370)
120 NEXTI
130 POKE65494,0
```

Stop Press: The CP RS232C Interface has just seen a couple of further enlargements. These have given it the capability for data handling at 19200 baud and full compatibility with the Tandy Colour Computer.

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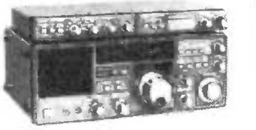
YAESU FRG7700 Gen Cov Receiver £335 inc VAT & Carriage



YAESU

		£	c&p
FT1	H.F. Transceiver – Gen. Cov. Receive	1395.00	(—)
FT102	Amateur Band H.F. Transceiver	685.00	(—)
SP102	Matching speaker	49.00	(2.00)
FC102	Matching A.T.U. 1.2kW PEP/AV	225.00	(2.00)
FC902	All Band A.T.U.	135.00	(1.50)
SP901	External Speaker	31.00	(1.50)
FT77	HF mobile transciever 9 band	459.00	(—)
FP700	Power supply/speaker	110.00	(—)
FC700	A.T.U.	99.00	(1.00)
FT757GX	H.F. Amateur Bnd Tx Gen. Cov. Rx	POA	
FC757AT	Automatic A.T.U.	POA	
FP757GX	Power Supply	POA	
FT726R(2)	Multimode multiband base station C/W 2M	675.00	(—)
FT230R	Transceiver 2M 25W F.M. mobile	239.00	(—)
FT290R	Transceiver 2M 2.5W Multimode portable	249.00	(—)
FT790R	Transceiver 70cm 1W Multimode portable	299.00	(—)
NC11C	Trickle Charger (240V ac)	9.20	(0.75)
MMB11	Mobile mount	24.90	(1.00)
CSC1A	Soft carrying case	3.85	(0.75)
FL2010	Linear Amp. 2M 10W	59.00	(1.20)
FT480R	2M Multimode mobile transceiver	POA	(—)
FT780R	70cm Multimode mobile transceiver	POA	(—)
FT208R	Handheld 2M F.M. transceiver	199.00	(—)
FT708R	Handheld 70cm F.M. transceiver	209.00	(—)
NC9C	Trickle charger (240V ac)	8.00	(0.75)
NC8C	Base Fast charger	50.00	(1.50)
PA3	Battery eliminator and charger (12V dc)	14.20	(1.00)
FRG7700	H.F. Receiver 0.15–30MHz all mode	335.00	(—)
FRG7700M	FRG7700 c/w 12 channel memory	389.00	(—)
MEMG7700	Memory Unit	98.00	(1.00)
FRT7700	Antenna tuner/switch	42.50	(1.00)
FRA7700	Active Antenna	38.70	(1.00)
YM34	Stand mic 500/50K 8 pin	23.40	(1.50)
YM38	Stand mic 500/50K 8 pin + SCAN	27.20	(1.50)
YD148A	Stand mic 600/50K 4 pin	22.60	(1.50)
MD1B8	Stand mic 600/50K 8 pin + SCAN	49.80	(1.50)
FF501DX	Low pass filter	25.70	(1.00)
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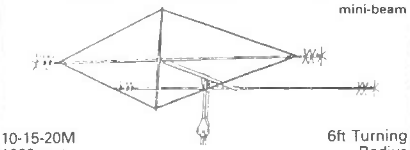

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AMATEUR RADIO WORLD

Compiled by Arthur C Gee, G2UK

Those readers of this magazine, who, whilst not being radio amateurs, find this page of sufficient interest to read in its entirety, may like to know more about Amateur Radio. They may have had their interest sufficiently stimulated to make them feel they would like to extend their knowledge of electronics into becoming radio amateurs.

If so, they will be interested in a brochure recently produced by the Radio Society of Great Britain. It is entitled *Amateur Radio — An Introduction*. It gives a very good synopsis of amateur radio as a hobby and will enlighten the reader on much about this activity which it is not possible to convey in a short feature like this article.

If you would like further information about amateur radio and the Radio Society of Great Britain contact:

David Evans, G3OUF, General Manager and Secretary, Radio Society of Great Britain, Alma House, Cranborne Road, Potters Bar, Hertfordshire, EN6 3JW.

10m FM Activity

Mention has been made in this feature on several occasions recently of the desirability of keeping as much activity going on the 10m amateur band as possible during the next few years, when the solar cycle will be such as to make any but local contacts unlikely. If this is not done and the band appears empty, others will soon move into it! No prizes for guessing who! FM activity on the band by radio amateurs is on the increase however, and it is to be hoped this mode will gain favour for local QSO's. There is some nice ex-CB gear around which can be bought for very reasonable prices and is easily modified for 10m FM amateur band use. So how about getting a 10m FM net going in your area? The preferred frequency for FM seems to be from 29.440 to 29.700MHz, with 29.600MHz being the calling frequency.

Worldwide 14MHz Beacon Network

A worldwide beacon network has been set up as a contribution to this World Communications Year, using eight beacons on 14100kHz transmitting in sequence. They each transmit for one minute every ten minutes, commencing on the hour, and there is a two-minute break at the 8-minute point in each 10-minute period. The location and sequence of the beacons is as follows:

1) 4U1UN/B at United Nations, New York.
2) W6WX/B at Stanford University, California.
3) KH60/B at Honolulu Community College, Hawaii.
4) JA1IGY, Tokyo.
5) 4X6TU/B, Israel.
6) OH2B at Espoo, Finland.
7) CT3B, Madeira.
8) ZS6DN/B, Transvaal.

Each beacon transmits in morse code throughout its minute of the sequence, sending 'QST' followed by its callsign and four long dashes of nine seconds each, concluding with a repeat of its callsign. The power levels of the dashes decrease from 100 to 0.1W

For further information regarding operation and listener reports write to: *Al Lotze, W6RQ, 46 Cragmont, San Francisco, CA 94116, USA.*

This beacon net is working well and is an excellent indicator of propagation conditions on 14MHz. It is quite fascinating to follow the sequence throughout the day and observe how conditions change.

The Satellites

OSCAR 10 appears to be getting into its stride quite nicely. Lots of folk are having lots of fun with it. However the same problem is arising as has happened with previous OSCARs; those with big aerials and high power are spoiling things for everyone else. The sort of power some people are using simply blocks the satellite, so that the majority of would-be users, operating at more reasonable power levels, cannot get in at all following the attenuation which comes into action when the satellite is subjected to too much power. To counter this, as much publicity as possible is being given to the problem and Mondays have been designated as 'QRP' days, as was done for earlier satellites.

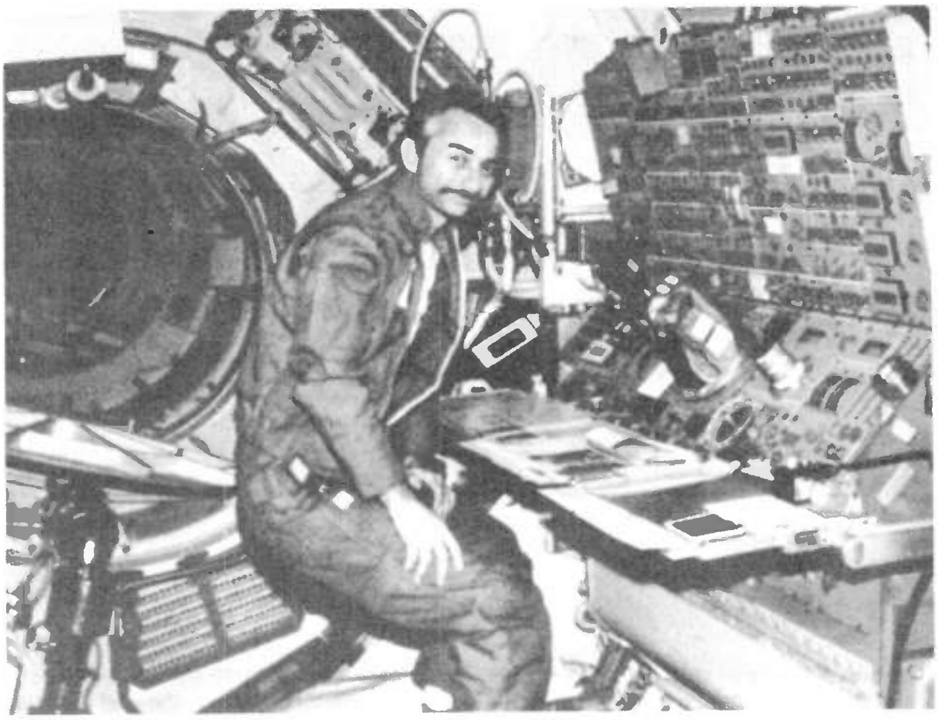
Mode 'L' — 23cm up, 70cm down — was turned on on Wednesday 21st September. The responder response was considerably below what was expected, signals being well below those from the 70cm beacon. At the time of writing, the problem seems to be with a sticking relay. Mode L will also be on at various unspecified times, in addition to Wednesdays.

The next Space Shuttle trip should have a radio amateur aboard, as has already been publicised pretty widely. He is Dr Owen Garriott, W5LFL, who is an electrical engineer as well as an Advanced Class radio amateur. If all had gone to plan, the Space Shuttle '*Columbia*' would have carried the European Spacelab into orbit at the end of October. Its scheduled flight path would have taken it over most of the more heavily populated areas of the world. The intention was (and still is) that the Shuttle would orbit at an altitude of 155 miles and at a speed of 17,000 miles per hour. This would give line-of-sight communication for up to eight minutes over most of the flight path. Normal QSO's cannot be engaged in under these conditions; instead — to enable as many folk as possible to 'get a look in' — W5LFL is to transmit on a number of pre-arranged frequencies and listen for replies on a number of other frequencies. Earth amateur stations participating in this exercise would simply give their callsigns, which would be acknowledged by W5LFL.

The list of frequencies to be used is fairly complex, varying with the particular area of the world under consideration. Those interested in participating once the Shuttle is in orbit are advised to consult the specialist literature, or listen into the AMSAT-UK nets on 3780kHz on Sunday mornings at 1015hrs local time, for details of these 2m transmissions.

UOSAT is now working to a definite daily schedule, with different activities being arranged for each day; for instance the CCD camera is on on Wednesdays. Details and orbit times can be obtained by phoning the Satellite Control Centre at the University of Surrey's recorded message facility on *Guildford 61202*.

There is a possibility that another amateur radio satellite may be launched next year. A launch opportunity has become available through an existing satellite having 'gone sick'! A replacement for it is to be launched prematurely and there will be spare space — and weight — on the launch vehicle being used for this. So if anyone can get another amateur radio/experimental satellite built by then, we may get a replacement for OSCAR 8 in the not too distant future.



Dr Owen Garriott, W5LFL, at the console of Skylab in a photograph taken in 1973. He is shown controlling a battery of telescopes pointed at the Sun. Notice that, while he appears to be sitting, zero-gravity means that he doesn't need a chair.

When the Space Shuttle next goes up, taking the European Spacelab with it, Dr Garriott will again be aboard – and able to communicate with radio amateurs around the world on a number of pre-arranged frequencies.

ATV on the Air

Presented by Andy Emmerson, G8PTH

We're back to activity reports again this month, justifying the 'on the air' title. So if you want to find out what's been going on in the 70cm band, higher up, or possibly in the world of slow-scan, sit back and enjoy.

70 centimetres

Seventy centimetres is where we start and it seems like we had some pretty good trops (tropospheric conditions) this summer. John G8UWS in Folkestone, Kent, had a field day with some Belgians on 14th July, working Harry ON1AHT, Gerd ON1AGC, Jean-Paul ON6PD and Jean-Marie ON7ZR. RX only were ON7CI in central Brussels and Georges F6GOZ.

The name of Roger Bunney is well known in DX-TV circles, but Roger is into ATV as well. He uses a domestic UHF TV aerial at 58ft AGL, with plenty of low-noise pre-amplification and a modified Teleng bandpass filter (to cut out Group A broadcast QRM) to a Fortop converter. Good DX has been F6AGY (Blois, 325 miles) with P3 pix on 16th January and F1EDM (Bordeaux St Clair, 25km from Le Havre) P5 on the same day. Roger hopes to be transmitting from his Romsey location with a Fortop unit later this year. Activity in the Southampton area is high, thanks to a transmitter the Southampton club loans out. Roger also mentioned a scout demo station some time ago which operated for half the contest day of 18th June with no callsign and no 144.750 talkback. Demos are no excuse for inconsiderate operation; as it was, it largely wiped out Roger's chances.

Norrie Macdonald GM4BVU and three friends enjoyed the Leicester BATC exhibition, taking back a record of it on video to transmit later to less fortunates in central Scotland who could not make the trip. 1900hrs GMT on Monday is the local activity period up there; stations to find include GM6AOR (George, Longridge), GM6JUV (Bill, Motherwell), GM6UFJ (Andy, East Kilbride) and of course Norrie in Hamilton. Norrie recently went portable 2000ft above Peebles and succeeded in working 40 miles to George GM3RVK in Kennaway, Fife with P5 pix. Norrie adds a final note: an appeal for tape swaps got a better response from USATV Society members than from UK ATVers!

Jack G8ZWM in Crawley has become G4TVC! TV Crawley, I suppose — I wonder how much he had to bribe someone for that! (Ted G6CTV is another ATVer who managed to get a 'TV' call.) Anyway, Jack writes that activity in his neck of the Sussex woods is almost nightly with Andy G6LMU, Bob G6LVN, John G4SFP, Mick G6IPP and Mick G6COQ. Also Doug and Dave G3HYV and G4PFX in Horley, and an operator known as 'Pirate Pete' (BATC member and twice failed RAE!).

The Home Counties ATV Group (G6HCT) went /P for its July meeting to a spot known as Old Redding near Harrow Weald. Pix were exchanged with several locals, also with Mike G8LES/P in Petersfield, Hants, which sounds like a good haul to me.

24 centimetres

Moving up the spectrum to 24cm, or the growth band as we call it, we have more news from Jack G4TVC. He has built an experimental 24cm TX and has had some duplex QSOs. It is due for a rebuild now as soon as time can be found. Still in Sussex, the Worthing repeater mob put on a 24cm demo for the Brighton rally this year. John G6MPE provided a signal for reception at the Racecourse site from his home not far away. John has also had success working France: F1EDM was worked as a two-way with just 2W on 1255MHz. On 17th August John worked Georges F3LP in Le Havre, while Martin G8KOE had a two-way and Roy G6AIW saw them all P5. G6MPE and G8KOE are on the air almost every night with sound and colour vision over a 6km path on 1255. Pix are better than on 70!

John uses a 24cm Tonna, while Martin has a similar homebrew device with one extra element. John's transmitter is to a KOE design, using a *RadCom* microwave drive source (FM modulated) which passes the signal to a varactor and an interdigital filter built to the *VHF Handbook* design (in CQ-TV 120). The filters were made by Roy, who also made some for the GB3WX repeater: these are silver plated and perform well. Martin's TX is the Wood and Douglas FM oscillator (latest design): this too performs well. Output is to a MHW-710 'blue brick' and varactor tripler, producing 2 or 3W on 1255. Both stations employ the CQ-TV122 design RX. Roy speaks for all the Worthing area stations when he says 'I am really chuffed with 1255. I think more people ought to have a go. RX can be critical but you get good results with just a few watts'.

Gary G4CRJ called in at the Woburn rally to tell us about 24cm activity in the London area. Apart from the stations mentioned last time, there are Mike G8LES in Thames Ditton (TX/RX) and Gary with 550ft ASL in High Wycombe (currently RX only). He sees Mike P2 with no pre-amp, the path being 15km. Gary is planning a transmitter, possibly a power oscillator and a phase-locked loop at 24cm. Although it is not an exceptional problem, radar interference from Heathrow is quite strong at two spots in the band, white spots appearing on the screen even with no aerial!

By the way, if you want a copy of the latest printout of 24cm stations on the air, just drop me a line — and an SAE — care of the editor.


Norrie Macdonald GM4BVU in his shack in Hamilton

Three centimetres

We haven't covered 10GHz before but Gary G4CRJ has been out trying portable operation on this band. On 13th August he took his gear to Blunsdon near Swindon in Wiltshire. Grade 3 pictures were received over a 14km path from G4CRG/P who was also out portable — at Barbury Castle 268m above sea level on the top of the Marlborough Downs.

The link was established for an hour (with some fading occasioned by passing cars), while Gary tried to find a way of making a video recorder work from a flat battery. Poking 12V from the car battery into the VCR camera socket had no effect, so in desperation Gary put jumper leads from the car battery across the VCR's NiCad! It worked and Gary came away with visual proof of the contact as well as being able to show G4CRG how the pictures had come across.

Gary's transmitter was G4CRG's design of varactor-tuned 15mW Gunn oscillator feeding a 10-inch dish aerial. The receiver was a G4CRJ design using a hybrid-tee mixer down to 500MHz, then a TV tuner down to 38MHz IF and a quadrature detector. An 18-inch dish aerial was used at the G4CRJ/P end. This equipment was built five years ago and apart from displays at exhibitions has never made a 'real' contact. Success, at last . . . .

Slow-scan

Not much SSTV news this time — just Jack G4TVC (he gets three mentions this time!). He explains that all the morse

How GM3ULP comes into Norrie's shack

bashing was to get his SSTV gear on HF. Hectic activity has resulted in contacts with VK3DUJ and VK6ES in Australia; he cannot find any SSTVers in New Zealand. He adds that suitable filters for SSTV are Kodak Wratten Nos 25, 47B and 58. These are £3.43 each from *Allphotos Ltd, Tarring Road, Worthing, Sussex.*

Finally a note on our photos. If you're curious about how the other guy sets out his shack, the picture of Norrie Macdonald's place will be of interest; looks like a loft conversion to me. Norrie is in Hamilton (see the namecheck in the 70cm section above) and the other pic displays how GM3ULP comes in there.

Oscar and ATV

To close, I must mention I have heard the first report of QRM between ATV and Oscar operators on 70cm. (No names but the Oscar SSB 'killed' the TV; not what you might have expected...) Despite what some space operators say about ATV's band occupancy on 70cm, just consider the following:

- With the 70cm band being whittled down by PMR, MOLD and SYLEDIS (and in Belgium, by direct confiscation), we amateurs need justification for ten whole MHz at 70cm. Wideband modes like ATV are just such a justification.
- ATV is still an experimental mode and on those grounds cannot be swept under the carpet.
- All amateur radio modes have an equal right to the bands, and ATV has been established on 70cm since the 1950s. No single mode has the right to take precedence.

Let's all work together to achieve peaceful coexistence between all modes and sort things out ourselves. The last thing we need is intervention by the official authorities, which is what has happened in Germany.

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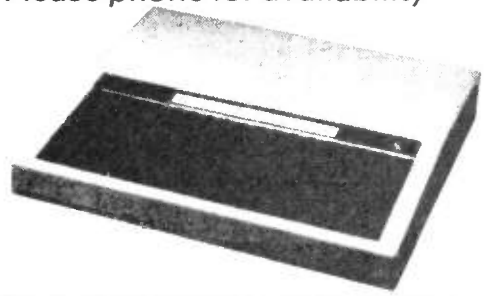

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A superior quality data recorder with dedicated computer output and monitoring facility on both record and play
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MICROVITEC 2031 20in Colour Monitor **£319+£8** carr
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Lead for KAGA/SANYO RGB **£10**
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Basic on BBC **£5.95**
30 House Basic **£5.95**
Programming the BBC Micro **£6.50**
BBC Micro An Expert Guide **£6.95**
Assy Lang Prog. for BBC **£8.95**
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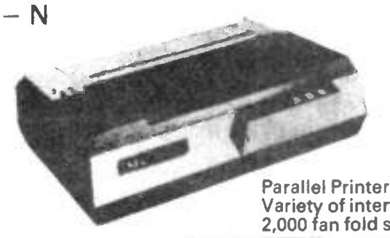

SEIKOSHA
GP 100A **£175**
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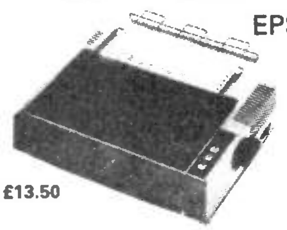
GP 700A **£425**
Silver Reed EX44 Daisy Wheel with Serial Interface **£365**, with PARALLEL Interface **£385** Carriage/Printer **£8**



EPSON
RX80FT **£310**
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Parallel Printer lead for BBC/Atom to most printers **£13.50**
Variety of interfaces, ribbons in stock.
2,000 fan fold sheets 9½″×11″ **£13.50**+£3 p&p

SIDEWAYS ROM EXPANSION BOARD

SREB provides 8 additional sockets for expanding the computer's sideways ROM capacity by a further 128k (2764s consume 40mA on standby and in our opinion 8 ROMs will not overload the computer psu). The board is dimensioned ensuring clearance of components with adequate ventilation. Fully assembled and tested board with fitting instruction. With TI sockets **£25**. With turned pin sockets **£30**. P. & P. £2.

TORCH Z-80 PACK

Your B.B.C. computer can be converted into a business machine at a cost slightly higher than an 800k disc drive. The Torch pack with twin disc drive and a Z80A processor card greatly enhances the data storing and processing capability of the computer. (NOTE! In BBC mode the disc pack functions as a normal BBC drive.). Z80A card comes with 64k of RAM and a CP/M compatible operating system. The system is supplied complete with a BBC owner's user guide, a Systems/Demo disc, a PERFECT software package and COMANEX, a business management game. The PERFECT software package comprises of a DATABASE, CALC, WORDPROCESSOR and SPELLER commercially valued at over £1,000. The complete package for only £730. Installation £20. Carr. £8.

CONNECTOR SYSTEMS

I.D. CONNECTORS

(Speedblock Type)

No of ways	Header Plug	Receptacle	Edge Conn.
10	90p	85p	120p
20	145p	125p	195p
26	175p	150p	240p
34	200p	160p	320p
40	220p	190p	340p
50	235p	200p	390p

JUMPER LEADS

24″ Ribbon Cable with Headers

	14-pin	16-pin	24-pin	40-pin
1 end	145p	165p	240p	350p
2 ends	210p	230p	345p	540p

24″ Ribbon Cable with Sockets

	20-pin	26-pin	34-pin	40-pin
1 end	160p	200p	280p	300p
2 ends	290p	370p	480p	525p

Ribbon Cable with D. Conn.
25-way Male 500p Female 550p

AMPHENOL CONNECTORS

36-way plug Centronics Parallel Solder £5.25 IDC £4.95
36-way socket Centronics Parallel Solder £5.50 IDC £5.20
24-way plug IEEE Solder £5 IDC £4.75
24-way socket IEEE Solder £5

RIBBON CABLE

(Grey/meter)

10-way	40p
16-way	60p
20-way	85p
26-way	120p
34-way	160p
40-way	180p
50-way	200p
64-way	280p

D CONNECTORS

No. of ways	9	15	25	37
MALE				
Solder	80p	105p	160p	250p
Angled	150p	210p	250p	385p
FEMALE				
Solder	105p	160p	200p	335p
Angled	185p	215p	290p	440p
Hoods	90p	85p	90p	100p

IDC 25-way plug 385p. Socket 450p

TEXTOOL ZIF

SOCKETS 24-pin £5.75
28-pin £8.00 40-pin £9.75

DIL SWITCHES

4-way 70p 8-way 90p
6-way 85p 10-way 140p

RS 232 JUMPERS

(25-way D)

24″ Single end Male £5.00
24″ Single end Female £5.25
24″ Female-Female £10.00
24″ Male-Male £9.50
24″ Male-Female £9.50

DIL HEADERS

	Solder Type	IDC Type
14pin	40p	100p
16pin	50p	110p
24pin	100p	150p
40pin	200p	225p

EURO CONNECTORS

DIN 41617	Plug	Skt.
21-way	160p	165p
31-way	170p	170p
DIN 4161Z		
2×32-way St. Pin	220p	275p
2×32-way Ang. Pin	275p	320p
3×32-way St. Pin	260p	300p
3×32-way Ang. Pin	375p	350p

TEST CLIPS

14-pin 275p 16-pin £3 40-pin £6

EDGE CONNECTORS

	0.1″	0.156″
2×18-way	–	140p
2×22-way	190p	240p
2×23-way	175p	–
2×25-way	225p	220p
2×28-way	190p	–
1×43-way	260p	–
2×43-way	365p	
1×77-way	600p	
5100 Conn		600p

BBC EPROM PROGRAMMER

A fully self-contained Eprom Programmer with its own power supply, able to program 2516, 2716/32/32A/64/128 single rail Eproms.
★ Personality selection is simplified by a single rotary switch.
★ Programming voltage selector switch is provided with a safe position.
★ Warning indicator to show programming in progress.
★ Programmer can read, blank check, program and verify at any address/addresses on the EPROM.
★ Simple menu driven software supplied on cassette (transferable to disc).
★ Full editor with ASCII disassembler.
Programmer complete with cables, software and operating instructions: **£79.50** + £2 p. & p.

PRODUCTION EPROM PROGRAMMER Type P8000

It will blank check, copy and verify up to 8 Eproms at a time. Eprom types 2716 to 27128 can be selected by a single rotary switch.
£695 + £6 carriage.

★ SPECIAL OFFER ★

2532	£3.50
2732	£3.50
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27128-3	£18
4164-2	£4.50
6116P-3	£3.50

SMARTMOUTH

The 'infinite vocabulary' self-contained speech synthesiser unit. Uses only 5-10 bytes per word – no ROMs required – simply plugs into the user port. (Has Aux. Audio output skt.). Supplied with Demo/Development programs and simple software instructions, **£37** + £2 p. & p.

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UV1B up to 6 Eproms **£47.50**
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WW-12

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7417	38p
7420	25p
7421	25p
7422	30p
7423	30p
7425	30p
7426	30p
7427	30p
7428	30p
7430	25p
7432	30p
7433	25p
7437	25p
7438	60p
7439	36p
7440	25p
7441	70p
7442A	50p
7444	70p
7445	90p
7446A	90p
7447A	75p
7448	90p
7450	25p
7451	25p
7453	25p
7454	25p
7460	30p
7470	36p
7472	30p
7473	30p
7474	40p
7475	40p
7476	35p
7480	48p
7481	120p
7482	120p
7483A	75p
7484A	90p
7485	90p
7486	36p
7489	170p
7490A	45p
7491	60p
7492A	50p
7493A	45p
7494	90p
7495A	48p
7496	60p
7497	120p
74100	120p
74104	50p
74105	55p
74107	45p
74109	45p
74110	60p
74111	55p
74112	170p
74116	120p
74118	120p
74119	100p
74120	100p
74121	40p
74122	45p
74123	90p
74125	50p
74126	50p
74128	70p
74132	43p
74136	45p
74141	70p
74142	175p
74143	200p
74144	200p
74145	90p
74147	120p
74148	120p
74150	150p
74151A	60p
74153	60p
74154	120p
74155	55p
74156	55p
74157	55p
74159	150p
74160	55p
74161	55p
74162	55p
74163	55p
74164	60p
74165	75p
74166	90p
74167	200p
74170	150p
74172	250p
74173	65p
74174	60p
74175	60p
74176	55p
74177	50p
74178	90p
74179	90p
74180	55p
74181	140p
74182	50p
74184	120p
74185A	120p
74190	60p
74191	60p
74192	60p
74193	60p
74194	50p
74195	50p
74196	48p
74197	48p
74198	120p
74199	120p
74221	100p
74251	60p
74259	150p
74265	55p
74273	150p
74276	120p
74278	100p
74279	55p
74283	50p
74285	160p
74286	160p
74290	150p
74293	90p
74298	120p
74351	150p
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74LS11	20p
74LS12	20p
74LS13	28p
74LS14	45p
74LS15	20p
74LS20	20p
74LS21	20p
74LS22	20p
74LS26	20p
74LS27	20p
74LS28	20p
74LS30	20p
74LS32	25p
74LS33	20p
74LS37	20p
74LS38	20p
74LS40	20p
74LS42	45p
74LS47	60p
74LS48	60p
74LS51	20p
74LS54	20p
74LS55	20p
74LS73A	20p
74LS74A	30p
74LS75	36p
74LS76A	27p
74LS83A	46p
74LS85	60p
74LS86	30p
74LS90	32p
74LS91	60p
74LS92	40p
74LS93	32p
74LS95B	50p
74LS96	90p
74LS107	33p
74LS109	33p
74LS112	33p
74LS113	30p
74LS114	32p
74LS122	60p
74LS123	60p
74LS124/629	150p
74LS125	45p
74LS126	45p
74LS132	42p
74LS133	30p
74LS136	30p
74LS138	42p
74LS139	42p
74LS145	90p
74LS147	120p
74LS148	120p
74LS151	50p
74LS153	50p
74LS154	150p
74LS155	40p
74LS156	40p
74LS157	40p
74LS158	35p
74LS160A	60p
74LS161A	60p
74LS162A	75p
74LS163A	90p
74LS164	60p
74LS165A	75p
74LS166A	120p
74LS168	140p
74LS169	110p
74LS170	100p
74LS173A	120p
74LS174	60p
74LS175	54p
74LS181	120p
74LS183	120p
74LS190	60p
74LS191	60p
74LS192	60p
74LS193	60p
74LS194A	50p
74LS195A	50p
74LS196	60p
74LS197	54p
74LS221	90p
74LS240	120p
74LS241	120p
74LS242	75p
74LS243	75p
74LS244	140p
74LS245	175p
74LS247	70p
74LS248	70p
74LS249	70p
74LS251	45p
74LS253	45p
74LS256	200p
74LS257A	45p
74LS258A	45p
74LS259	120p
74LS260	35p
74LS261	80p
74LS266	25p
74LS273	140p
74LS275	175p
74LS279	35p
74LS280	180p
74LS283	50p
74LS290	55p
74LS292	900p
74LS293	50p
74LS295	70p
74LS297	900p
74LS298	90p
74LS299	200p
74LS321	240p
74LS323	200p
74LS324/624	150p
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74LS353	70p
74LS356	175p
74LS363	180p
74LS364	180p
74LS365A	36p
74LS366A	36p
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74LS368A	36p
74LS373	120p
74LS374	120p
74LS375	60p
74LS377	120p
74LS378	85p
74LS379	120p
74LS390	75p
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74LS395A	100p
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74S113	90p
74S114	90p
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74S132	110p
74S133	60p
74S138	110p
74S139	120p
74S140	60p
74S151	180p
74S153	180p
74S157	250p
74S158	195p
74S163	300p
74S174	250p
74S175	320p
74S188	150p
74S194	300p
74S195	300p
74S196	300p
74S200	450p
74S201	320p
74S225	650p
74S240	250p
74S241	300p
74S244	300p
74S251	250p
74S257	250p
74S258	250p
74S260	70p
74S261	300p
74S262	850p
74S283	300p
74S287	225p
74S288	150p
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4045	105p
4046	50p
4047	45p
4048	50p
4049	24p
4050	24p
4051	45p
4052	60p
4053	50p
4054	90p
4055	90p
4046	90p
4059	450p
4060	55p
4063	90p
4066	27p
4067	225p
4068	14p
4069	14p
4070	14p
4071	14p
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4073	14p
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4078	16p
4081	14p
4082	15p
4086	55p
4089	125p
4093	24p
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4095	75p
4096	70p
4097	290p
4098	90p
4099	100p
4500	575p
4502	60p
4503	45p
4504	75p
4505	400p
4506	35p
4507	35p
4508	130p
4510	45p
4511	45p
4512	48p
4514	120p
4515	110p
4516	55p
4518	40p
4520	50p
4521	90p
4522	120p
4526	60p
4527	60p
4528	50p
4532	70p
4534	400p
4536	270p
4538	90p
4539	70p
4543	75p
4553	245p
4555	35p
4556	35p
4557	300p
4560	120p
4566	160p
4568	250p
4569	170p
4572	30p
4583	90p
4584	40p
4585	75p
40014	40p
40085	90p
40097	45p
40102	140p
40103	170p
40105	110p
40106	40p
40109	100p
40110	275p
40163	60p
40174	50p
40175	75p
40193	75p
40244	160p
40245	180p
40257	160p
40373	160p
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LC7137	350p
LF347	150p
LF351	48p
LF353	95p
LF355	95p
LF356P	95p
LF357	110p
LF13331	350p
LM10C	325p
LM301A	25p
LM307	45p
LM308CN	75p
LM310	120p
LM311	70p
LM318	150p
LM319	160p
LM319N	160p
LM324	30p
LM334Z	90p
LM335Z	140p
LM339	40p
LM348	65p
LM358P	60p
LM377	225p
LM380	75p
LM381AN	180p
LM382	120p
LM386	90p
LM387	120p
LM389	95p
LM391	150p
LM392N	80p
LM393	100p
LM394CH	300p
LM709	38p
LM710	50p
LM711	70p
LM725C	300p
LM733	80p
LM741	18p
LM747	70p
LM748	35p
LM1011	480p
LM1014	150p
LM1801	300p
LM1830	250p
LM1871	300p
LM1872	300p
LM1886	500p
LM1889	350p
LM2917	200p
LM3302	75p
LM3900	50p
LM3909	85p
LM3911	125p
LM3914	250p
LM3915	250p
LM3916	250p
LM13600	110p
M51513L	230p
M51516L	500p
MB3712	200p
MB3730	400p
MC1310P	150p
MC1413	75p
MC1458	38p
MC1493	100p
MC1495L	350p
MC1496	70p
MC3340P	160p
MC3401	50p
MC3403	65p
MF10CN	360p
MK50240	900p
MK50398	790p
ML920	800p
MM57160	620p
MN6221A	600p
NE531	140p
NE544	190p
NE555	16p
NE556	45p
NE564	420p
NE565	120p
NE566	155p
NE567	140p
NE570	410p
NE571	400p
NE592	80p
NE5532	180p
NE5533	140p
NE5534P	110p
NE5534AP	120p
PLL02A	500p
RC4136	60p
S566B	225p
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SAD1024A	1150p
SFF96364	800p
SN76488	500p
SN76489	400p
SN76495	400p
SP0256AL2	£10
TA7120	150p
TA7130	180p
TA7204	150p
TA7205	90p
TA7222	150p
TA7310	150p
TBA231	120p
TBA800	80p
TBA810	100p
TBA820	80p
TBA950	225p
TC9109	750p
TCA210	350p
TCA220	350p
TCA270	350p
TCA940	175p
TCA965	120p
TDA1004A	£4
TDA1008	320p
TDA1010	250p
TDA1022	500p
TDA1024	120p
TDA1170	300p
TDA2002	325p
TDA2003	325p
TDA2004	400p
TDA2006	360p
TDA2020	320p
TDA7000	350p
TL061CP	40p
TL062	65p
TL064	100p
TL071	25p
TL072	45p
TL074	100p
TL081	25p
TL082	45p
TL083	75p
TL084	90p
TL094	200p
TL170	50p
TL430C	70p
UA1003-3	936p
UA2240	120p
UAA170	170p
ULN2003A	75p
ULN2004	75p
ULN2068	290p
ULN2802	200p
ULN2803	200p
ULN2804	200p
UPC575	275p
UPC592H	200p
UPC1156H	275p
UPC1185H	500p
XR210	400p
XR2206	400p
XR2211	575p
XR2240	120p
ZN414	100p
ZN419C	190p
ZN423E	130p
ZN424E	130p
ZN425E	350p
ZN426E	300p
ZN427E	600p
ZN428E	450p
ZN429E	210p
ZN450E	750p
ZN459CP	250p
ZN1034E	200p
ZN1040E	670p
ZNA134J	£23
ZNA234E	950p

VOLTAGE REGULATORS

FIXED PLASTIC

1A	+ve		-ve	
5V	7805	40p	7905	45p
6V	7806	40p	7906	45p
8V	7808	50p	7908	50p
12V	7812	40p	7912	45p
15V	7815	40p	7915	45p
18V	7818	50p	7918	50p
24V	7824	40p	7924	45p
5V 100mA	78L05	30p	79L05	45p
6V 100mA	78L06	30p		
8V 100mA	78L08	30p		
12V 100mA	78L12	30p	79L12	50p
15V 100mA	78L15	30p	79L15	50p

OTHER REGULATORS

LM309K 1A 5V	140p	78P05	900p
LM317K T03	250p	78H12	650p
LM317T	130p	78HGKC	600p
LM337T	225p	78HO5KC	550p
LM323K 3A 5V	450p	78GUIC	200p
LM350T	350p	79GUIC	225p
LM723N	30p	79HGKC	700p
TL494	300p	ICL 7660	250p
TL497	300p	LM305AH	250p
78S40	225p	SG3524	300p

OPTO ELECTRONICS

2N5777	40p	TIL32	55p
OCP71	180p	TIL78	55p
ORP12	120p	TIL31A	120p
ORP60	120p	TIL81	90p
ORP61	120p	TIL100	75p

OPTO ISOLATORS

ILD74	130p	TIL111	70p
MCT26	100p	TIL112	70p
MCS2400	190p	TIL113	70p
MOC3020	150p	TIL116	70p
ILQ74	180p		

LEDS

0.125"	
TIL209 Red	10p
TIL211 Gr	12p
TIL212 Yel	15p
0.2"	
TIL220 Red	10p
TIL222 Gr	12p
TIL228 Yel	15p
Rectangular LEDs (R,G,Y)	30p
FND357	120p
FND500	140p
FND507	140p
MAN4640	200p
MAN8910	250p
NSB5881	570p
TIL311	600p
TIL312/3	110p
TIL321/3	130p
TIL330	140p
7750/60	200p
Bargraph	225p

DISPLAYS

DL704	140p
DL707 Red	140p

DRIVERS

9368	250p
9370	300p

TRANSISTORS

AD161/2	45p
BC107/8	13p
BC109C	14p
BC169C	12p
BC172	12p
BC177/8	17p
BC179	18p
BC182/3	10p
BC184	11p
BC187	30p
BC212/3	11p
BC214	12p
BC237	15p
BC327	16p
BC337	16p
BC338	16p
BC461	25p
BC477/8	30p
BC516/7	40p
BC547B	14p
BC548C	12p
BC549C	16p
BC557B	14p
BC559C	16p
BCY70	18p
BCY71	22p
BD131	75p
BD132	80p
BD135/6	40p
BD139	40p
BD140	40p
BD189	60p
BD232	60p
BD233	75p
BD235	85p
BD241	60p
BD242	60p
BD379	60p
BD380	60p
BD677	40p
B[illegible]14B	35p
BF256B	50p
BF257/8	32p
BF337	30p
BFR39	25p
BFR40/1	25p
BFR79	25p
BFR80/1	25p
BFR96	180p
BFX29	40p
BFX30	27p
BFX84/5	40p
BFX86/7	27p
BFX88	27p
BFX89	180p
BFY50	24p
BFY51/2	24p
BFY56	33p
BFY90	80p
BRY39	45p
BSX19/20	24p
BU104	225p
BU105	190p
BU108	250p
BU109	225p
BU126	150p
BU180A	120p
BU205	200p
BU208	200p
BU406	145p
BUX80	600p
BUY69C	350p
E310	50p
MJ802	400p
MJ2501	225p
MJ2955	90p
MJ3001	225p
MJ4502	400p
MJE340	60p
MJE2955	100p
MJE3055	70p
MPF102	40p
MPF103/4	30p
MPF105	30p
MPSA06	30p
MPSA12	50p
MPSA13	50p
MPSA20	50p
MPSA42	50p
MPSA43	50p
MPSA56	32p
MPSA70	50p
MPSA93	40p
MPSU06	63p
MPSU07	60p
MPSU45	90p
MPSU65	78p
TIP29A	35p
TIP29C	40p
TIP30A	35p
TIP30C	40p
TIP31A	40p
TIP31C	45p
TIP32A	45p
TIP32C	40p
TIP33A	70p
TIP33C	80p
TIP34A	90p
TIP34C	120p
TIP35A	120p
TIP35C	140p
TIP36A	140p
TIP36C	150p
TIP41A	50p
TIP41C	55p
TIP42A	60p
TIP42C	65p
TIP54	160p
TIP120	75p
TIP121	75p
TIP122	80p
TIP142	120p
TIP147	120p
TIP2955	78p
TIP4055	70p
TIS93	30p
VN10KM	50p
VN66AF	90p
VN88AF	£1
ZTX108	12p
ZTX300	13p
ZTX452	45p
ZTX500	15p
ZTX502	18p
ZTX504	18p
ZTX552	55p
ZTX652	60p
ZTX752	70p
2N697	25p
2N698	45p
2N706A	30p
2N708	30p
2N918	45p
2N930	18p
2N1131/2	36p
2N1613	25p
2N1711	25p
2N2102	70p
2N2160	350p
2N2219A	25p
2N2222A	25p
2N2369A	17p
2N2484	25p
2N2646	40p
2N2904/5	25p
2N2906A	25p
2N2907A	25p
2N2926	9p
2N3053	25p
2N3054	55p
2N3055	35p
2N3442	140p
2N3553	240p
2N3584	250p
2N3643/4	48p
2N3702/3	10p
2N3704/5	10p
2N3706/7	10p
2N3708	10p
2N3773	200p
2N3819	20p
2N3823	30p
2N3866	90p
2N3902	700p
2N3904	15p
2N3906	16p
2N4037	65p
2N4056	65p
2N4123/4	27p
2N4125/6	27p
2N4401/3	25p
2N4427	90p
2N4871	50p
2N5087	27p
2N5089	27p
2N5172	27p
2N5191	90p
2N5245	40p
2N5401	60p
2N5459	30p
2N5460	60p
2N5485	36p
2N5875	250p
2N6027	30p
2N6052	300p
2N6059	325p
2N6107	65p
2N6247	190p
2N6254	130p
2N6290	65p
2SC1306	100p
2SC1307	150p
2SC1957	90p
2SC1969	150p
2SC2028	80p
2SC2029	200p
2SC2078	160p
2SC2335	200p
2SC2612	200p
3N128	120p
3N140	120p
3N141	110p
3N201	110p
3N204	200p
40290	250p
40361/2	75p
40408	90p
40409	100p
40410	100p
40594	120p
40595	120p
40673	75p
40871/2	100p

COMPUTER COMPONENTS

CPUs

1802CE	650p
2650A	£12
6502	360p
6502A	500p
6800	225p
6802	250p
6809	650p
68705P35	£25
68B09E	£16
8035	360p
8039	300p
8080A	250p
8085A	350p
8086	£22
8088	£18
8748	£18
INS8060	£11
TMS1601	£12
TMS9980	£20
TMS9995	£12
Z8	£24
Z80A	300p
Z80AS10/0/1	£9
Z80AS10/2/9	£9
Z80B	£9

SUPPORT DEVICES

2651	£12
3242	800p
3245	450p
6520	280p
6522	310p
6522A	550p
6532	550p
6551	650p
6821	100p
68B21	220p
6829	£12.50
6840	375p
68B40	600p
6850	110p
68B50	220p
6852	250p
6854	700p
68854	800p
6875	570p
8154	950p
8155	360p
8156	350p
8205	225p
8212	110p
8216	100p
8224	110p
8226	250p
8228	270p
8243	280p
8250	850p
8251	250p
8253	390p
8255	250p
8256	£36
8257	400p
8259	400p
8271	£36
8279	440p
8284	360p
8288	£11
8755	£16
9901	£10
9902	£3
TMS4500	£14
TMS5220	£12
TMS9909	£9
TMS9911	£18
Z80P10	250p
Z80AP10	280p
Z80CTC	250p
Z80ACTC	280p
Z80ADART	700p
Z80ADMA	900p
Z80SI 0/1/2	£9

MEMORIES

2102-3L	120p
2111A	300p
2112A	300p
2114-2L	100p
2147	450p
2764-25	500p
27128-30	£16
27128-25	£20
4027-3	300p
4116-15	120p
4116-20	90p
4118-3	450p
4164-2	400p
4164-15	450p
4416-15	500p
4532-20	250p
4816AP-3	300p
5101	300p
5516	750p
6116-3	420p
6116LP-3	550p
6514-45	200p
6810	120p
74S189	150p
74S201	350p
74S289	150p
93415	600p
93425	600p
93L422	950p

ROMs PROMs

74S188	140p
74S287	200p
74S288	140p
74S387	225p
74S473	850p
74S474	650p

EPROMs

2532	350p
2532-30	700p
2564	600p
2708	300p
2716	250p
2732	350p
2732A-35	450p
2764-25	450p
27128-25	£22

CRT CONTROLLER

CRT6545	900p
CRT5027	£18
CRT5037	£18
EF9365	£36
EF9366	£36
MC6845	650p
MC6845SP	£12
MC6847	650p
SFF96364	£8
TMS9918	£60
TMS9927	£14
TMS9928	£20
TMS9929	£16

INTERFACE ICs

AD558CJ	775p
AD561J	£20
AM25S10	350p
AM25LS2521	200p
AM26LS31	125p
AM26LS32	125p
D7002	390p
DAC80	£28
DM8131	275p
DP8304	250p
DS3691	300p
DS8830	150p
DS8831	140p
DS8832	250p
DS8833	225p
DS8836	150p
DS8838	225p
DS8880	170p
LF13201	450p
MC1488	55p
MC1489	55p
MC3418	950p
MC3446	250p
MC3459	450p
MC3470	650p
MC3480	850p
MC3486	500p
MC3487	300p
MC4024	325p
MC4044	325p
MC14411	675p
MC14412	750p
75107	90p
75110/12	160p
75114/15	160p
75121/22	140p
75150P	120p
75154	140p
75159	220p
75365	150p
75451/2	72p
75453/4	72p
75491/2	65p
8T26	120p
8T28	120p
8T95/6	90p
8T97/8	90p
81LS95/6	120p
81LS97/8	120p
88LS120	360p
9602	220p
9637AP	180p
ZN425E-8	360p
ZN426E-8	350p
ZN427E	600p
ZN428E-8	450p

DISC CONTROL ICs

8271	£36
8272	£20
FD1771	£20
FD1791	£22
FD1793	£23
FD1795	£28
FD1797	£28
FD2793	£42
FD2797	£42
WD1691	£15
WD2143	550p

CHARACTER GENERATORS

RO3-2513	
U.C.	750p
L.C.	700p
DM86S64	£12
MC66760	750p
SN74S262AN	£10

KEYBOARD ENCODER

AY5-2376	950p
74C922	500p
74C923N	500p

BAUD RATE GENERATORS

MC14411	700p
COM8116	800p
4702B	750p

UARTs

AY-3-1015P	300p
AY-5-1013P	300p
COM8017	300p
IM6402	360p
TR1602	300p

ZIF SKTS

(TEXTOOL)

24 pin	575p
28 pin	800p
40 pin	975p

MODULATORS

6MHz UHF	375p
8MHz UHF	450p

CRYSTALS

32.768KHz	100p
100KHz	325p
200KHz	325p
Freq in MHz	
1.0	325p
1.008	275p
1.8432	300p
2.00	250p
2.45760	210p
2.5	250p
2.662	250p
3.276	150p
3.5795	120p
3.686	300p
4.00	150p
4.194	200p
4.43	125p
4.608	250p
4.915	250p
5.0	175p
5.068	£2
6.0	150p
6.144	175p
7.0	150p
7.168	175p
8.00	175p
8.86	175p
10.00	175p
10.5	250p
10.7	200p
12.00	150p
14.318	175p
14.756	250p
15.00	200p
16.00	200p
17.7	200p
18.00	200p
18.432	150p
19.968	150p
20.00	200p
24.00	200p
26.690	150p
38.6667	175p
48.0	175p
55.5	400p
116	300p
145.80	250p

REAL TIME CLOCK

MC6813P	560p
MK3805	£TBA
MM58174AN	800p
MSM5832RS	350p

TELETEXT DECODER

SAA5020	600p
SAA5030	700p
SAA5041	£16
SAA5050	900p

LOW PROFILE SOCKETS BY TI

8 pin	9p	18 pin	16p	24 pin	24p
14 pin	10p	20 pin	18p	28 pin	26p
16 pin	11p	22 pin	22p	40 pin	30p

WIRE WRAP SOCKETS BY TI

8 pin	30p	18 pin	50p	24 pin	75p
14 pin	42p	20 pin	66p	28 pin	100p
16 pin	45p	22 pin	75p	40 pin	130p

DIODES

BY127	12p
BYX36300	20p
OA47	8p
OA90/91	9p
OA95	9p
OA200	9p
OA202	10p
1N914	4p
1N916	7p
1N4148	4p
1N4001/2	5p
1N4003/4	6p
1N4005	6p
1N4006/7	7p
1N5401/2	12p
1N5403/4	14p
1N5404/5	14p
1N5404/7	19p
IS920	9p

BRIDGE RECTIFIERS

1A	50V	19p
1A	100V	20p
1A	400V	25p
1A	600V	30p
2A	50V	30p
2A	100V	35p
2A	400V	45p
3A	200V	60p
3A	600V	72p
4A	100V	95p
4A	400V	100p
6A	50V	80p
6A	100V	100p
6A	400V	120p
10A	400V	200p
25A	400V	400p

TRIACS PLASTIC

3A 400V	60p
6A 400V	70p
6A 500V	88p
8A 400V	75p
8A 500V	95p
12A 400V	85p
12A 500V	105p
16A 400V	110p
16A 500V	130p
T2800D	130p
TIC 206D	60p
TIC 226D	75p
TIC 246D	110p

THYRISTORS

3A 400V	46p
8A 600V	180p
12A 400V	160p
16A 100V	180p
16A 400V	160p
C106D	45p
MCR101	36p
2N3525	130p
2N4444	180p
2N5060	30p
2N5061	32p
2N5064	35p

PCB MOUNTING RELAYS

6 or 12V DC Coil SPDT 2A 24V DC	160p
6 or 12V DC Coil DPDT 5A 24V DC 240V AC	200p
6 or 12V DC Coil SPDT 10A 24V DC 240V AC	225p

ZENERS

2.7V-33V	
400mW	9p
1W	15p

WW-5

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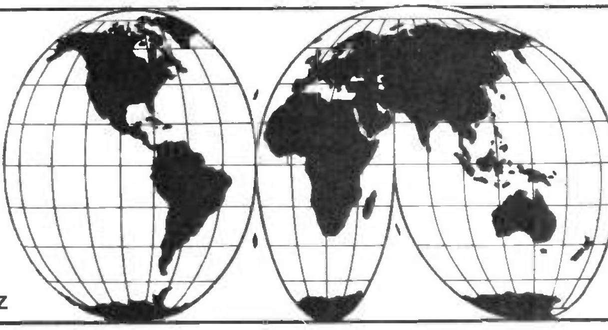
SHORT WAVE NEWS FOR DX LISTENERS



by Frank A Baldwin

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

Keeping to the promise made in the last issue of this journal, we deal now with some of the Latin American stations that may be logged on one of the difficult bands — the 90m Tropical Band (**3200 — 3400**) which is difficult in that commercial QRM (man-made interference) abounds and one therefore needs to be equipped with a highly selective receiver and, preferably, an outdoor long-wire aerial system. On this occasion I offer a selection of the more easy-to-receive transmitters.

Belize: Belmopan operates on **3285** and identifies as 'Radio Belize'. It opens at 1100 (Sundays from 1200) and closes at 0510, the power is 1kW, and the programme languages are English and Spanish. Probably the best times for UK listeners to log this one would be during the English language sessions which are scheduled from 0030 to 0510. Newscasts in this period are at 0100, 0200 and 0300, the latter being a relay of the BBC World Service. The full announcement in English is 'This is Radio Belize, Voice of the new Central American Nation of Belize in the Heart of the Caribbean Basin'. If you do manage to log this one and wish to QSL, the address for reports is Radio Belize, PO Box 89, Belize City, Belize, Central America.

Brazil: Two stations located in Brazil are most often reported as operating on this band, one being Lins Radio Clube which operates on **3225** from 0730 to 0400 with a power of 1kW. The callsign is ZYG859 and the address is CP 310, 16400 Lins, Sao Paulo, Brazil. The second easy-to-receive Brazilian is Radio Ribeirao Preto operating on **3205** from 0800 to 0400 with a power of 1kW. The address is listed under ZYG861 as CP 814, 14100 Ribeirao Preto, Sao Paulo, Brazil.

The best time for UK listeners to log either of these Brazilians would be from around 0100 to their closing times. Have I logged them? Yes, many times over the past few years.

Ecuador: HCYD4 Radio Iris in Esmeraldas Province can often be heard on **3380** at which point on the dial it is scheduled from 1000 (Sundays from 1100) to 0400 with a power of 10kW. The port of Esmeraldas, on the river of the same name, is noted for exports of bananas, tobacco, rubber and cacao (cocoa to you and me). Having set the scene, the address for reports is Casilla 8, Esmeraldas, Ecuador or Casilla 1018 Quito.

Another one to log is the 12.5kW transmitter of Radio Zaracay, Santo Domingo de los Colorados on **3395** from where it produces programmes for local consumption from 1000 to 1400 and from 2000 to 0500. The address is Casilla 31, Santo Domingo de los Colorados, Ecuador. Have I heard them? Yes, indeed most DXers have.

Guatemala: Probably the easiest of the Guatemalans for UK-based listeners is undoubtedly Radio Chortis Jocotan on **3380** with its schedule from 2100 to 0300 with a power of 1kW. Quite often logged when conditions on the band are good, the address for reports is Centro Social Jocotan, Chiquimula, Guatemala and this is one of the few in this country that does reply with a QSL — if you are lucky!

Another Guatemalan is Radio Cultural on **3300** with a 5kW signal which is on the air from 1100 to 1500 and from 2245 to 0430. The address is Apartado 601, Guatemala but the station is owned by Central American Mission, Box 28005, Dallas, Texas 75228, USA.

For Guatemala listen from 0130 onwards. Have I? Yes.

In the next issue, a change of scene as we will be dealing with some of the relatively easy-to-receive stations site in Indonesia and operating on the 60m band (**4750 — 5060**) simply for the reason that it is now the 'season' for European DXers to log these transmitters. We shall return to 90m band Latin Americans at a later date.

AROUND THE DIAL

In which are listed some of the transmissions recently logged and thought to be of interest both to the short wave listener and the DXer — a mix for the attention of both types of reader and sorted this month by computer!

AFRICA

This continent, is not so 'dark' as it once was; there are many stations in Africa that can be heard by UK listeners roving over the 60m band.

Benin

Radio Parakou on **5025** at 0429, orchestral music African style, YL's with a song in vernacular, OM with station identification at 0431. Schedule 0400 to 0900 and from 1700 to 2300. The power is 20kW.

Cameroon

R Bertoua on **4750** at 1948, YL with a local pop song complete with African musical backing. Operating with a 20kW transmitter, this one is on the air from 0430 to 0800 and from 1600 to 2208. There is an English programme from Monday to Friday from 1800 to 1840 and on Sunday from 0615 to 0645.

Central African Republic

Bangui on **5037** (listed **5035**) at 2022, OM and YL with a discussion in vernacular. Bangui operates from 0430 to 0700 and from 1630 to 2300 in French and the local language Sango. Not an easy one to log owing to the surrounding QRM. The power is 100kW.

Guinea

Conakry on **4910** at 0413, OM with a news review in French. No sign of Lusaka on the same channel. The schedule is from 1230 through to 0730 and the power is 18kW.

Kenya

Nairobi on **4934** at 1900, African drums, YL with a song in Swahili. This is the North Eastern and Coastal Service which is timed on this channel from 0250 to 0630 and from 1420 to 2010 with a power of 20kW.

Nigeria

Kaduna on **4770** at 1947, OM announcer with a programme of local pops on records. Kaduna is on the air from 0400 to 2400 according to the listing but I have recently heard them closing at 0100. The power is 50kW.

South Africa

Johannesburg on **4880** at 2016, when radiating a programme of classical orchestral music with announcements in Afrikaans. This is the Home Service in Afrikaans and is scheduled here from 0348 (Saturday from 0427, Sunday from 0457) to 0550 and from 1520 to 2120 (Saturday until 2200) with a power of 100kW.

Senegal

Dakar on **4890** at 2019, OM with a news review in French. This is the National Service (Chaine Nationale) which operates from 0600 to 0900, from 1155 to 1600 and from 1715 to 0100.

(LATIN) AMERICA

Plenty of stations to choose from in this part of the world.

Brazil

Radio Dragao do Mar, Fortaleza on **4925** at 2349, OM with an exciting sports commentary — in Portuguese of course. Listen for this one anytime between the opening of the evening session at 2130 and the closing time of 0300. The power is 5kW but wait for the identification — R Difusora Taubate — as another Brazilian is also on channel but with a 1kW signal.

Radio Globo on **11805** at 0038, OM with announcements in Portuguese, OM with a sorrowful ballad. With a 10kW transmitter in Rio de Janeiro, this one is timed from 0800 to 0330, the latter time being variable.

Radio Bandeirantes, Sao Paulo on **11925** at 0042, OM with a *futebol* (football) commentary — a review of past matches. R Bandeirantes is on the air from 0800 to 0400 and has a power of 10kW.

Colombia

Emisora Nuevo Mundo, Bogota on **4755** at 0447, YL with a ballad in Spanish, OM with station identification at 0450. Often heard around this time, it has a 24-hour schedule and a power of 1kW.

Radio Super, Medellin on **4875** at 0456, OM with station identification which was followed by a trumpet fanfare. This one also has a 24-hour schedule and has a power of 2kW. A regular 'visitor' to my shack!

Cuba

Havana on **4765** at 0224, OM with a talk in Russian which was a relay of the Moscow 'Mayak' (Lighthouse) domestic programme, presumably for the benefit of the Russian merchant marine etc, based in the general area. Bad news for DXers as this powerful transmitter effectively blocks other more interesting LA stations.

Dominican Republic

Radio Clarin, Santo Domingo on **11700**, OM with station identification and announcements in Spanish, then into a programme of local pops. Radio Clarin is on the air from 1100 to 0500 with a power of 50kW.

Ecuador

Radio Luz y Vida, Loja on **4851** at 0435, OM with a love song in Spanish and a guitar backing. The schedule is from 1045 to 0430 with a 2kW signal. Oviously running late or extended schedule on this occasion.

Honduras

La Voz Evangelica, Tegucigalpa on **4820** at 0449, YL's with a religious pop-type song with guitar backing, OM with announcements in Spanish. LV Evangelica has an English programme from 0300 to 0500 according to the list but deviated on this occasion for some reason or included a Spanish announcement on the tape.

Peru

Radio Andina, Huancayo on **4996** at 0442, guitar music in local style, OM with *noticias*. This one operates from 1000 to a variable closing time of 0500 with a 1kW signal. Take care, however, as this channel is now also occupied by a new station on the air based in Ecuador and logged here at 0212, identifying as 'Radio Bahai' at 0215.

Radio Eco, Iquitos on **5112** at 0356, OM with a long talk (or so it seemed) in Spanish. Rather difficult to log, this one operates from 1000 to 0500 and has a power of 1kW.

Venezuala

Radio Tachira, San Cristobal on **4830** at 0231, OM with a programme of local pops. Scheduled from 1000 to 0500 at 10kW. An easy one to log.

ASIA

The world's largest continent with a correspondingly large number of stations.

Afghanistan

Kabul on **4740** at 1843, OM announcer and music in the local style. This is the Home Service 1 which is timed from 0125 to 0330 and from 1230 to 1930.

China

Xizang PBS on **4735** at 2334, OM with the programme in Uigher. The best time to hear this one is during the scheduled 2230 to 0200 transmission. Also on **4750** at 2330, OM with a talk in Chinese during the 2230 to 0200 part of the schedule. Xizang was formerly Lhasa in Tibet.

India

AIR (All India Radio) Delhi on **9665** at 2001, OM with a newscast in English during the English transmission for the UK and West Europe, timed from 1845 to 2230 on this channel. Also on **11755** at 2015, OM with a newscast in the English programme for North and West Africa, scheduled from 1945 to 2230.

AIR Delhi also on **17387** at 0958, interval signal and YL with station identification in English at the start of the English transmission directed to North East Asia and Australasia, scheduled from 1000 to 1100.

Japan

Tokyo on **21610** at 0800, OM with station identification and frequencies at the start of the English programme for Europe, followed by a newscast of both world and Japanese events. The English transmission is timed for Europe from 0800 to 0830. Also logged in parallel on **17870.**

Kuwait

Radio Kuwait on **11675** at 2049, a programme of UK-made pop records during the English transmission to the Arabian Gulf, North Africa, South Africa, Europe and North America and timed from 1800 to 2100. Also on **11990** at 0802, local style music and songs in the Domestic/External Service which is on this frequency from 0600 to 2105.

Pakistan

Karachi on **17660** at 0813, YL with announcements in Urdu during a World Service transmission to the UK scheduled from 0715 to 1100 (news in English from 1005 to 1010).

Saudi Arabia

Riyad on **9870** at 1904, OM with songs in Arabic in a Domestic Service programme, this service being timed on this channel from 1700 to 2130.

South Korea

Seoul on **15575** at 1857, YL with a talk about internal affairs in the English programme for Europe, scheduled from 1845 to 1945.

EUROPE

The easiest of all to receive and mostly of interest to those just starting in the hobby.

Bulgaria

Sofia on **17825** at 1843, YL with station identification and a talk about trade, all during the English transmission for Africa, timed from 1830 to 1930.

Finland

Helsinki on **15430** at 1850, OM with a talk about local theatres during an English programme for Europe, scheduled from 1830 to 1855.

Hungary

Budapest on **6110** at 2004, OM with a newscast in the English programme for Europe, on this channel from 2000 to 2030.

CLANDESTINE

Just for a change, try the following:

'La Voz del CID' on **5106** at 0446, OM with a ballad in Spanish, OM with station identification at 0447. CID stands for Cuba Independiente Democratica, and the programmes are anti-Castro.

'La Voz de Sandino' on **6220** at 0405, OM with station identification and then OM with a tirade in Spanish, all about El Salvador and Nicaragua.

'Radio 15th September' ('Radio Quince de Septiembre'), OM harangue about Nicaragua in Spanish. This one is anti-Nicaraguan, and thought to be located in Honduras.

NOW HEAR THESE

'Radio Los Andes', Tarija, Bolivia on **4775** at 0203, OM with ballad in Spanish, OM with announcements; 'Radio Tezulutlan', Coban, Guatemala on **4835** at 0152, OM with talk in Spanish about Guatemala; 'Radio Pampas', Tayacaja, Peru on **4854** at 0224, OM with pop song in Spanish, promos; 'Radio Madre de Dios', Puerto Maldonado, Peru on **4951** at 0123, YL with songs in Spanish, OM with announcements and local promos.

DX–TV RECEPTION REPORTS

Compiled by Keith Hamer and Garry Smith

Sporadic-E activity dropped dramatically and unexpectedly during early August; however this wasn't the end of DX reception. Anticyclonic conditions produced excellent tropospheric DX in Band III and on UHF from the 8th onwards and at the end of the month several rare transmitters were received in parts of the UK.

Band III MS (Meteor Shower) activity due to the Perseids around the 10th proved to be disappointing, but on the 30th the 100kW outlet at Pardubice on the Czechoslovakian channel R6 was noted here in Derby, showing the familiar EZO electronic test card.

Reception reports

Mike Allmark (Leeds) managed to log almost every transmitter in Europe, judging by his reception report. The highlights are as follows:

1/8/83: Several Eastern-bloc countries on channels R1 and R2; NRK (Norway) on E2 with the 'STEIGEN' PM5534 pattern; ORF (Austria) with the test card on E2a. All reception via Sporadic-E (SpE).

2/8/83: SR-1 (Sweden), NRK and DR (Denmark) all on channel E4 via SpE.

3/8/83: TVP (Poland) on R1 and R2 relays; DDR: F (East Germany) E4; Spain (RTVE); RAI (Italy) via SpE on channel IB.

8/8/83: Excellent strength UHF trops from Northern Germany (mainly ZDF, i.e. Zweites Deutsches Fernsehen) on channels E23, 30, 31, 32, 33, 34, 35 and 39; NDR (Norddeutscher Rundfunk) 3rd network on E40 42 and 43; NDR 1st Network on E50 53 and 56. The DR channel E10 Vestjylland transmitter was also received.

10/8/83: DR on E5, 7 and 10; NRK from Halden on E11; NDR on E7 and 10 plus many NDR and WDR West German UHF outlets.

19/8/83: DR on E7, 10; WDR on E11; ZDF on E21, 22, 24, 30, 34, 37 and 39 plus NDR-1 on E40.

25/8/83 and 26/8/83: Similar to the 19th but with BRT (Belgium) on E10, NOS (Netherlands) on UHF and several TDF (France) UHF stations.

28/8/83: NOS on E6; NDR on E5, 7, 9, and 10; DR on E5, 7, 10; BRT on E10; SR on E9; NRK on E6 from Bjerkreim; SR-2 on E30; several ZDF and NDR outlets on UHF.

29/8/83: Band III stations similar to the 28th but also SFB (Sender Freies Berlin) on E7 and DDR:F on E5; SR-2 on E30; ZDF on E34, 35 and 39; NDR-1 on E53 and 56; NDR-3 on E43. NOS-1 and NDR-1 were also noted on channel E4.

30/8/83: DDR:F on E6; DR on E6, 7; SR on E5 and 10; HR-1 (Hessischer Rundfunk in West Germany) on E7; NDR-1 on E10; RTL (Radio-Tele-Luxembourg) on E7; SR-1 on E43.

31/8/83: Tropospheric conditions declined but ducting brought in SR on channel E31, DR on E10, NOS in Band III and UHF plus a few ZDF and NDR signals on UHF. RTE-1 (Radio Telefis Eireann) on channel H was noted with very strong video.

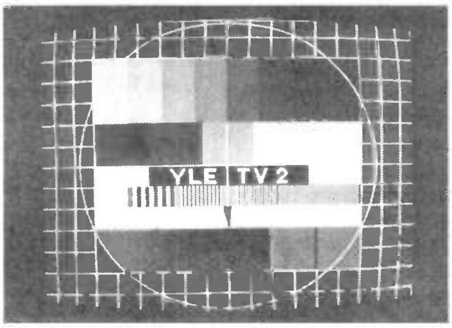


Fig 1 Finnish second network FuBK test card. (Photograph courtesy of Petri Poeppoenen, Finland)

Mike comments that the 1983 DX season has been a 'short, sharp affair' with several exotics being in evidence although Band III SpE activity has been lacking. Towards the end of July (21st), Mike noted a prolonged opening to Jordan (JTV) on channel E3. JTV initially radiated frequency gratings from 0800 BST going on to the PM5544 test card which he resolved in colour. Tropospheric ducting was also present and he saw TSI-Switzerland (Italian-language network) on E34 from the La Dôle transmitter, SWF (Südwestfunk, West Germany) on E10 from Donnersberg, BR (Bayerischer Rundfunk based in Munich) on E10 from Wendelstein, BR-1 on E10 (Würzburg), SDR (Süddeutscher Rundfunk) from Heidelberg on E7 and Stuttgart on E11 plus ZDF on E40 (Raichberg) and E35 (Rottweil).

Kevin Jackson (Leeds) similarly did well with reception. His August SpE successes included ORF (Austria) on E3 from the 100kW transmitter at Birkfeld and several instances of strong and prolonged reception of the TVR-Rumania channel R2 outlet at Bucuresti. Tropospheric ducting on the 29th at 1102 GMT produced the Norwegian PM5534 pattern on E9 displaying the 'VEGA' transmitter identification. This is situated on an island just off the Norwegian coast some 80 to 100km south of the Arctic Circle. The transmitter power is 30kW and the reception path is about 1500km.

Equipped with a Wolsey Colour King UHF array and a Labgear CM7060 amplifier, Derek Fenton (Mickleover, Derbyshire) has received several continental television signals recently. These include Belgium on E28 from Wavre and the E52 Riviere outlet radiating the 'Profondeville' PM5544, West Germany with the 'WDR 1' FuBK test card plus several IBA regions. His clear take-off to the west enables daily reception of HTV Wales on Channel E49 in colour from Moel-y-Parc.

Simon Hamer (New Radnor, Powys) has sent a very descriptive reception report detailing signals from TVE-Spain, RTP-Portugal, JRT-Yugoslavia, RAI, ORF, ARD (West Germany) with the news programme 'Tagesschau', TSS-USSR, DR-Denmark, Czechoslovakia and MTV-1 Hungary. One of his unidentified signals was one featuring Arabic writing on 4th August at 1900 BST from an E3 transmitter. This could well have been JTV-Jordan although one must not jump to conclusions every time Arabic script is received — it could well have originated from a West European country.

Armed with a Russian-made 'Vega' CCIR portable, Roger Bunney (Romsey) noted excellent SpE reception at his cliff-top holiday location on the Isle of Wight. Belgian E8 and E10 plus French UHF signals were present all the time — 'a good DX-TV location' comments Roger. Once back on the mainland he noted a strange Russian clock caption with the time exactly the same as in the UK!

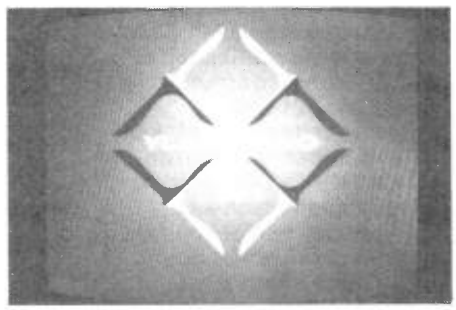


Fig 2 Identification caption radiated by the first network of Yleisradio, Finland

Service Information

United Kingdom: The BBC and IBA have advised officially that the ultimate close-down of the VHF 405-line service will be on 6th January 1985 despite rumours that January 1984 would be the date.

West Germany: A new 500kW outlet on channel E56 has been opened at Hamburg.

Yugoslavia: The authorities have installed relay stations in the north of the country at Lakos and Lendava for the redistribution of programmes from the state-owned Hungarian service Magyar Televizio (MTV).

Sweden: A new regional television service was inaugurated last Spring, covering the Smaland area of southern Sweden. The studios are located at Växjö and the regional news programme is called 'Smalandnytt'. It is broadcast each weekday between 1815 and 1830 BST via the following TV-2 transmitters: Nässjö(1000kW, E22), Västernik (1000kW, E26),

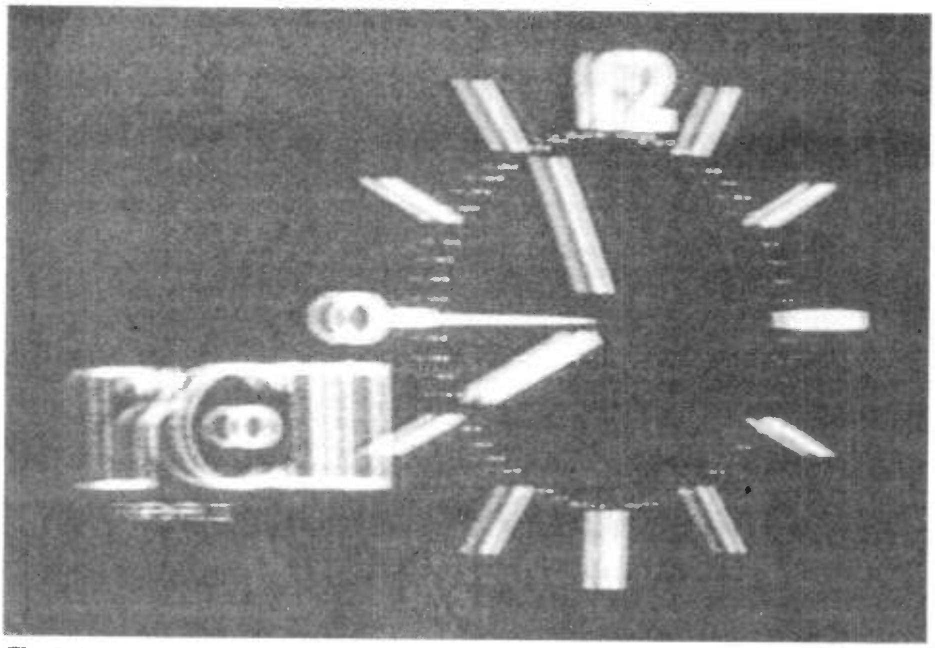


Fig 3 *Clock caption received via Sporadic-E propagation from RAI-Italy. Note the typical SpE ghosting effect.*

Jönköping (15kW, E28), Emmaboda (1000kW, E31), Vislanda (1000kW, E32) and Finnveden (1MW, E48).

Spain: A new regional test card has been seen on E4 during the month. We hope to have further details shortly.

Information this month courtesy of Roger Bunney (Romsey), Goesta van der Linden (The Netherlands), Alexander Wiese (West Germany) and Clive Athowe (Norwich).

Euro-TV List

Roger Philips (Cobham, Surrey) has pointed out a few omissions from the 'Euro Broadcast TV Services' list which we included in the August edition of *R & EW*. The UK Channel 4 was missing as was TV Koper Capodistria under the Yugoslavian section. The latter service beams a programme in the Italian language to Northern Italy, which is ultimately relayed via private stations. However, an earlier test card used by JRT carried the identification 'RTV LJUBLJANA' at the top and 'STUDIO KOPER CAPODISTRIA' at the bottom implying that it is part of the RTV-Ljubljana network. We would be pleased to hear from other readers with any comments on this subject.

In his letter, Roger suggests that Bands I and III should be reserved for a re-engineered UK service (for example, local TV) rather than being simply handed over for PMR etc. He points out that the interference problems created within Europe will be devastating for Continental television services during periods of enhanced propagation, if current whims and ambitions go ahead. Home Office take note!

German DX Club

This club's magazine, called '*Tele-audiovision*', should prove of great interest to DX-TV enthusiasts with a good technical knowledge of German. All subjects associated with TV and VHF radio are covered in the magazine which is published bi-monthly. Full details can be obtained from the editor, Alexander Wiese, by sending an IRC to *TAV, Postfach 801965, D-8000 München 80, West Germany.* A brief summary in English is sent with each edition.

EVENTS: MOBILE RALLIES

15th November	The Workings of BBC Radio News	Biggin Hill	Ian Mitchell G4NSD
29th November	Advanced Manufacturing Technology	Carlton House Terrace, London	Royal Society, 01-839 5561
30th November	CAD Modelling	Southampton	Computational Mechanics Centre, 042129 3223
1st December	Holography and Holographic Measurements	SEEBOARD HQ, Hove	IEEIE, 01-836 3357
6th December	Electronic Aids for the Disabled	Granville College, Sheffield	IEEIE, 01-836 3357
6th December	IEE Wiring Regulations (15th edn)	SEB Offices, Reading	IEEIE, 01-836 3357
7th December	World Communications — Tomorrow's Trade Routes	Royal Lancaster Hotel, London	British Computer Society, 01-637 0471
7—8th December	Technology in the 1990s	Carlton House Terrace, London	Royal Society, 01-839 5561
10th December	RSGB AGM	IEE, Savoy Place, London	RSGB, Potters Bar 59015
11th December	Leeds & DARS 3rd Annual Christmas Rally	Civic Centre, Pudsey	G6CJI
12th December	Electrical aspects of the APT	IEE, Savoy Place, London	IEEIE, 01-836 3357
13th December	Sale of surplus equipment	Biggin Hill	Ian Mitchell G4NSD
14th January	RSGB Presidential Installation	Cardiff Castle, Cardiff	RSGB, Potters Bar 59015
5th February	Bury Radio Society Ham Feast	The Mosses Centre, Cecil Street, Bury	MHS Bridge G3VC
18th March	4th Annual Components Fair	Carleton Community Centre, Pontefract	A Mason G4TGU
			N Whittingham G4ISC
1st April	White Rose ARS Rally	University of Leeds	AN Bramley G4NDU
28—29th April	RSGB National Amateur Radio Exhibition	National Exhibition Centre, Birmingham	RSGB, Potters Bar 59015