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Radio & Electronics World

The communications and electronics magazine

JANUARY 1986 £1.20

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R WITHERS

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Safety in the shack

Some of the constructional projects featured refer to additions or modifications to equipment; please note that such alterations may prevent the item from being used in its intended role, and also that its guarantee may be invalidated.

When building any constructional project, bear in mind that sometimes high voltages are involved. Avoid even the slightest risk – safety in the shack please, at all times.

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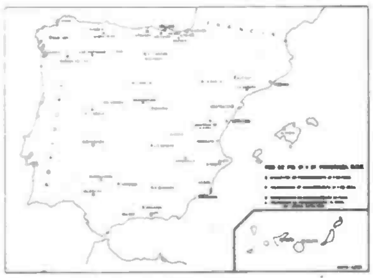
Cover date Febuary 1986 on sale Thursday, 9 January

☐ **Publication Date**
Second Thursday of the month preceding cover date



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Happy Christmas!
Yes, I know the cover says January, but this issue's on sale in December (silly Isn't it?). As you will have noticed if you've gotten this far, the price is now a whopping £1.20. I'm supposed to say something about increased production costs, still good value etc, but I'm sure you've seen it all before so I won't bore you. I'll leave it to you to decide whether or not we're still offering value for money. In the mean time, may I wish all of you a very happy Christmas (even if this is the last copy you ever buy!).

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

HAND-HELD DSO

Now available in the UK exclusively from Advance House of Instruments is the Soar Model 1000, a hand-held, battery operated, 3.2MHz digital storage oscilloscope.

Weighing only 2.1kg with dimensions of 264 × 214 × 60mm, the Model 1000 features a dual-trace liquid-crystal display (LCD). The display unit comprises a 128 × 160 dot matrix LCD with an effective display area of approximately 76 × 95mm, and a dot size of 0.55 × 0.55mm.

A built-in battery back-up memory allows storage of the waveform for later analysis and a waveform alarm function ensures correct operation.

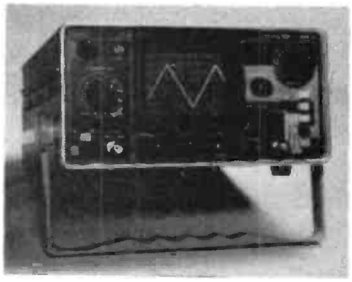
Features of the Y-axis operation include a scale of four vertical divisions for each channel, a nine-range sensitivity from 10mV/div to 5V/div, and a frequency characteristic of ±3dB or less for dc to 200kHz.

The X-axis operation has 10 divisions, a 20-range sweep speed of 5μs/div to 5s/div, continuous sweep and single sweep measurement modes, and positive, negative and switchable trigger slopes.

The Model 1000 also incorporates a separate 7-function 27-range DMM with auto and manual ranging.

Advance House of Instruments,
Raynham Road,
Bishop's Stortford,
Herts CM23 5PF.
Tel: (0279) 55155.

OSCILLOSCOPE



Today's electronic projects make the oscilloscope an essential part of any hobbyist test equipment, enabling the user to both measure and evaluate the waveform of the signal under test. As fast ICs become more prevalent in the market, higher performance will be demanded from the scope.

To meet this demand Crotech have come up with two new single trace oscilloscopes, the 3031 and 3036.

Both models have a bandwidth of dc-20MHz, coupled with a maximum sensitivity of 2mV/div. The timebase of both models is specified from 40ns to 0.2s/div, with triggering to 25MHz in both auto and level modes, which means that low voltage high frequency signals can be displayed and evaluated.

The well-proven Crotech component tester is incorporated in the 3031 and 3036, which allows the in or out of circuit testing of semiconductor and passive components, with the characteristics displayed on the CRT. There is also a choice of display size as the 3031 has a rectangular 9.5cm CRT while the 3036 has a 13cm display area. On both models the graticule is divided into 10 × 8 divisions.

The 3031 is £195.00 and the 3036 is £216.00 (excluding VAT).

Crotech Instruments Ltd,
2 Stephenson Road,
St Ives,
Huntingdon,
Cambridgeshire PE17 4WJ.
Tel: (0480) 301818.

TRACE MULTIPLIER

Up to eight analogue or digital signals can be observed simultaneously on a single channel oscilloscope by using the new oscilloscope multiplexer from MS Components.

Each 35MHz channel will accept input signals of up to ±6 volts and exhibit an input impedance of 1Mohm/20pF. The input sensitivity can be reduced by means of a standard X10 oscilloscope probe and/or the internal precision attenuator calibrated to give a choice of 2V, 5V or 10V per division.

Triggered from any one of the eight input signals, the display can be selected for all channels, top four or bottom four only, or any single channel, allowing sensitivity to be increased for more detailed examination as necessary. Flicker-free operation at any timebase speed is assured by variable multiplex rate control, and trace sharpness can be improved by means of a beam-blanking output for use with Z-modulation facilities.

MS Components Ltd,
Zephyr House,
Waring Street,
West Norwood,
London SE27 9LH.
Tel: (01) 670 4466.

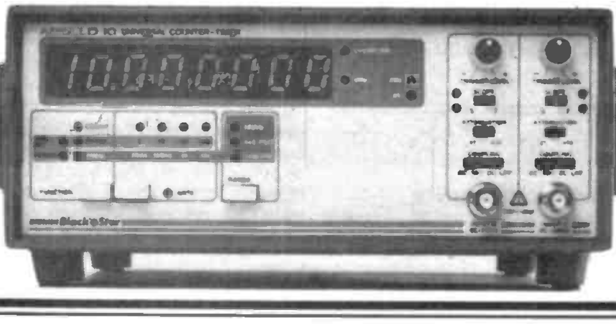
COUNTER-TIMER

The new Apollo 10 is a high-performance universal counter-timer with push-button function selection and LED indication of frequency dc-10MHz, ratio, single and average period, time interval and totalise.

Both inputs provide full signal conditioning, including attenuation, edge selection, variable trigger level and low pass filter.

Applications include the calibration of signal sources, video recorders, disc drives and musical instruments. The Apollo 10 is ideal for pulse counting and pulse width measurement and event counting, while applications in physical science include velocity measurement and ballistics.

The Apollo 10 is a bench instrument with bright ½in LED displays. A 10MHz external reference facility is provided and a temperature compensated crystal oscillator is available as an option.



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

RF MONITOR

The sensitivity of computer-based electronic equipment to RF interference has led instrument manufacturers to devise a means of carrying out long-term monitoring of interference levels. Unattended, completely automatic monitoring is now possible with the modular Universal Disturbance Analyser, the Dranetz 626, and a recently announced broadband RF monitor plug-in, available in the UK from Euro Electronics Ltd.

Significant RFI field strengths can be generated by a wide range of equipment – broadcast systems, car ignitions, heavy machinery, CB radio, etc and this energy can couple into electronic circuits through metal enclosures and power lines. These can act as antennas at RF and this can cause equipment malfunction. Monitoring and identifying RFI can be very difficult, due to the random and intermittent nature of this type of interference.

The 626-PA-6020 broadband RF monitor plug-in offers a convenient method of correlating the occurrence of RFI fields with computer-based equipment problems. Monitoring can be carried out on bursts as short as 1μs.

The system uses an omni-directional antenna to measure the field strength that connects to the RFI monitoring plug-in. If the RF field exceeds user-selected limits for CW or burst signals, then the 6020 will record the electric field strength, the duration and time of occurrence. These events are also summarised for later print-out using the 626's built-in daily summary printing capabilities.

Euro Electronics Ltd,
Lancaster Gate House,
319 Pinner Road, Harrow,
Middlesex HA1 4HF.
Tel: (01) 863 0811.

POCKET MICROSCOPE

The self-illuminated pocket microscopes from Cobonic Ltd are about the size of a long slim pack of cigars. They weigh 4½ ounces and provide a clear 30-power magnification (the Spirig-30, £18.90) or a 100-power magnification (the Spirig-100, £27.90) of any surface on which they are focused.

Cobonic Limited,
32 Ludlow Road,
Guildford,
Surrey GU2 5NW.
Tel: (0483) 505260.

PORTABLE THERMOMETER

A new portable infra-red thermometer that can make spot temperature measurements of targets as small as 2mm in diameter has been introduced by Land Infrared Ltd.

The Minolta/Land Infrared Cyclops 33CF is a close-focus instrument that can measure temperatures from −50°C to +600°C. Accuracy is within±1%K of the reading. There are applications in electronics for locating faulty components, in medical research, veterinary medicine, pharmacology, and plastics and rubber processing. Other Cyclops instruments cover the temperature ranges −50°C to +1000°C, 250°C to 800°C and 600°C to 3000°C.

Reflex fixed-focus optics and a digital viewfinder display give a simultaneous view of target and temperature. Once the emissivity control has been set, the instrument is simply moved until the target comes into sharp focus, at a distance of 170mm.

The instrument has microprocessor-based electronics and produces a reading within half a second. The four-digit LCD viewfinder display holds the reading for 30 seconds after switch-off. The display gives a warning if the target temperature rises above 300°C or moves out of range.

Land Infrared Ltd,
Dronfield,
Sheffield S18 6DJ.
Tel: (0246) 417691.

5½-DIGIT MULTIMETER

A sophisticated 5½-digit multimeter with in-built computing and data storage functions is now available from Levell Electronics. Measurement ranges cover ac and dc voltage and current, resistance and diode test. The resolution is 1μV, 1nA and 1 milliohm with basic dc accuracy of 0.5%.

Percentage deviation and limit functions permit the user to enter known values that are then used for comparison in subsequent measurements. A linear scaling function permits a scaling factor and offset to be entered so that the output of a sensor can be scaled directly in terms of a physical parameter.

A dB function displays voltages in logarithmic form relative to a set reference level. Null, hold and store keys are used to select reference conditions and store data. A logger key permits storage of up to 100 readings that can be brought back to the display by a simple recall sequence. It is also possible to display the average value and highest value of a set of stored readings.

Options are available which provide true RMS ac ranges, RS232 output and IEEE-488 interface.

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

SHORTS LOCATOR

Antron Electronics has launched a new version of the Toneohm shorts locator. Made by Polar Instruments Ltd, the Toneohm 550 is designed to help semi or unskilled operators find the physical location of PCB short circuits diagnosed by an automatic tester.

Short circuits make up typically 60% of PCB faults. The causes include solder bridges, poor PCB etching and device failure. Conventional test equipment and ATE are usually limited to diagnosing the presence of the fault down to a node; to find the physical fault requires close visual inspection and perhaps track-cutting and component desoldering.

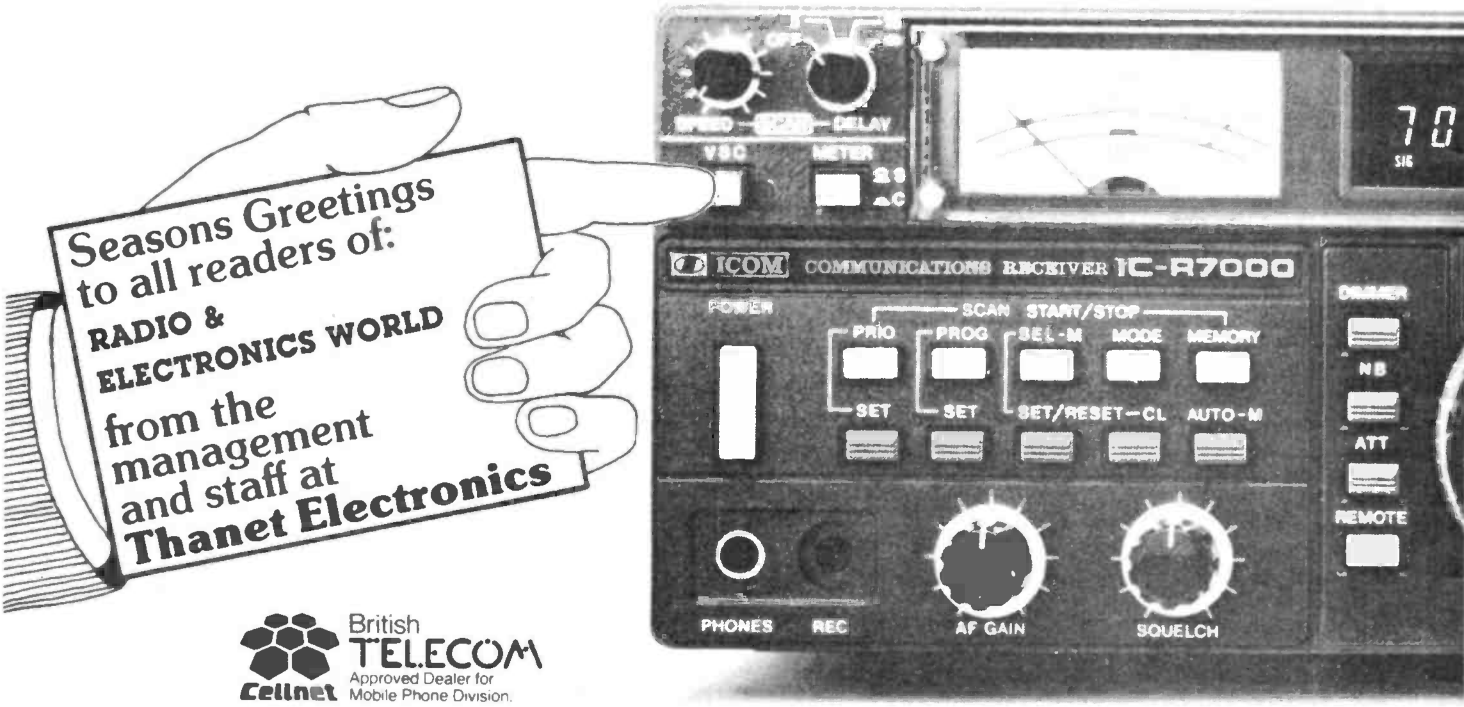
The Toneohm 550 contains a sensitive milliohmeter with an audio output. When the Toneohm probes are placed on shorted tracks it produces an audio tone and a meter reading. One probe is moved along the track – if the tone frequency rises then the probe is moving closer to the fault.

The operator simply moves each probe in turn until the tone is at the highest pitch, corresponding to the lowest meter reading. The sensitivity of the Toneohm is such that the probes will then be within 2 to 3mm of the physical short circuit. The price of the Toneohm 550 is £219.

Antron Electronics Limited,
Hamilton House,
39 Kings Road,
Haslemere,
Surrey GU27 2QA.
Tel: (0428) 54541.

ICOM

SO GOOD TO RECE
AND DURING T



At this special time of year, when Christmas Greetings will be jamming the airwaves worldwide, Thanet Electronics send this message to you. During 1986 the ICOM range of equipment will continue its upward trend in the design and production of sophisticated amateur radio equipment.

Typical of the innovation one expects from ICOM is the new 'ultimate' receiver the IC-R7000. To whet your appetite, a brief specification is featured here.

You can visit our premises at 95 Mortimer Street, Herne Bay, telephone (0227) 369464 for demonstration, advice & sales of ICOM Amateur equipment. No matter what your requirements, base, mobile or handheld, ICOM have the answer.

Attention all Amateurs & SWL's. If you are thinking of buying an ICOM radio call us. Just pick up the 'phone and dial **FREE** Linkline No. **0800 521145**, for retail enquiries about ICOM Amateur equipment & the address of your nearest authorised ICOM dealer. N.B. No trade enquiries via this special free link, thank you.

The ICOM IC-R7000 is the receiver that every discerning amateur would love to receive at Christmas. The IC-R7000 is able to give high frequency coverage up to 1300MHz without sacrificing SSB stability, which is maintained throughout the IC-R7000's entire frequency range, another example of ICOM's superb design.

For simplified operation & quick tuning, the IC-R7000 features direct keyboard entry. Precise frequencies can be selected by pushing the digit keys in sequence of the frequency or by turning the main tuning knob. FM/AM/SSB modes, frequency coverage 25 – 1000MHz and 1025 – 2000MHz (25 – 1000MHz and 1260 – 1300MHz guaranteed specification).

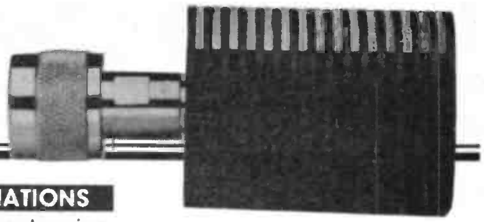
The IC-R7000 has 99 memories available to store your favourite frequencies including the operation mode. Memory channels may be called up by simply pressing the memory switch, then rotating the memory channel knob, or by direct keyboard entry.

MODULATOR

The Dutch cable and satellite manufacturer Tratec has brought out a low cost modulator aimed at the customer who hesitates to buy, for example, a complete satellite or video text system because of the expensive modulator which is needed to modulate the signal into the IF or a VHF channel.

Features include: a crystal-controlled vision IF carrier oscillator; IF section with SAW filter; vestigial sideband suppression; and a group delay pre-correction of 170ns. The complete modulator is mounted in a standard half 19-inch housing.

Tratec BV,
PO Box 385,
3900 A J Veenendaal,
Holland.
Tel: 8385-21984.



50 OHM TERMINATIONS

Tony Chapman Electronics, exclusive UK distributors for Indianopolis attenuation specialist JFW Industries, has introduced a new range of low cost, high power 50 ohm terminations for under £65.

This, says Tony Chapman Electronics, is as much as £20 less than competitive terminations, despite identical specification and delivered performance ratings.

The new JFW terminations are designated 50T-XXX, and have a frequency range of dc to 1200MHz, a VSWR of less than 1.2:1, and are fitted with N, BNC or TNC male or female connectors.

Delivery times are four-to-five weeks, and units come with a one year warranty.

Tony Chapman Electronics Ltd,
Electron House,
Hemnall Street,
Epping,
Essex CM16 4LS.
Tel: (0378) 78231.

SATELLITE RECEIVER

Aerial manufacturers Halbar have produced a BBC-based weather satellite receiving station comprising an aerial, receiver, digitiser and software, complete with test signals on tape and sample pictures on disc.

The receiver is designed to receive the 137MHz NOAA series transmissions via the double inverted turnstile aerial, with a 50kHz bandwidth and high sensitivity, and is supplied crystalled for NOAA9. Further crystals can be fitted for reception of up to 6 channels. The unit will also accept Meteosat signals if a suitable aerial and frequency converter is available.

The digitiser processes the analogue audio APT (Automatic Picture Transmission) signal for subsequent inputting to a BBC computer.

Menu driven software is provided on a 40 track disc, which also contains two weather map images, one NOAA and one Meteosat.

The cassette tape provided, containing a sample APT signal, is intended to allow familiarisation with the APT signal before the satellite makes its pass.

The complete outfit retails for £200 + VAT and p&p, although all the items are available separately. Full details are available in return for an SAE and £1 (redeemable on purchase).

Halbar,
Unit 1,
Bury Walk,
Bedford MK41 0DU.
Tel: (0234) 44720.

CHARGE!

Radio-controlled model enthusiasts *(androids? – Ed)* often experience the frustration of being unable to recharge Nicad batteries when a mains derived supply is not available. This is particularly the case when combining a camping or caravan holiday with model operations. An apparent alternative source of current is the car battery.

However, this source has not hitherto been satisfactory because the nominal 12 volt car supply is not only insufficient but is also widely variable in voltage, and so cannot be employed directly to provide the requisite constant current for ideal battery charging. This difficulty has now been overcome, claim Saeco, and Tx and Rx batteries can now be recharged using the car cigar lighter socket.

Novel circuitry ensures the maintenance of safe currents for the simultaneous recharge of one 500mA/h transmitter and up to two receiver batteries. The two receiver outputs may be individually switched between 500mA/h and 225mA/h and LEDs indicate how charging is proceeding. The system is protected against inadvertent reversal or short circuit of output leads and the reversal of the car battery voltage.

The unit as supplied includes a lead fitted with a car cigar lighter plug (negative earth) and one Tx and two Rx leads, each with one end unterminated. A 240V mains adaptor is also available as an extra.

Saeco Ltd,
Gable House,
40 High Street,
Rickmansworth,
Herts WD3 1ES.
Tel: (0923) 721030.

NEW MOTOR DESIGN

Among the new 900 Series of dc motors recently introduced by Papst, two models employ a fundamentally different design concept than the usual Papst motor products.

The GIA 21.27 and GIE 31.28 have an ironless and coreless rotor that uses a coil winding which is manufactured flat and formed into a cylinder to form a rotor with a concentricity accurate to 2 microns. Unlike other Papst motors, this forms an internal rotor which is connected to an impact extruded end-plate through which the drive shaft passes via top and end plate bearings.

The extremely low inertia of the ironless rotor allows the development of very high starting torques.

The very low power consumption inherent in this design means that the 900 Series will suit applications such as belt drive turntables, data recording instrumentations and capstan drive motors for video machines. Both motors can also be incorporated as dc servo motors.

Papst Motors Ltd,
East Portway, Andover,
Hampshire SP10 3RT.
Tel: (0264) 53655.

SOUND-METER

Cambridge Kits recently introduced a sound-meter with a logic output which can be used for sound-triggered flash photography.

This budget-priced meter has a dial calibrated in sound levels from 40dB to 120dB. An LED flashes and the logic output registers as 'high' when the dialled sound level is exceeded.

The sound-meter can be used to check that the legal limits in factories and residential areas are not transgressed, or to measure the effects of sound-proofing or double glazing.

The meter is available as a kit for £27.20 including VAT and p&p.

Cambridge Kits,
45 Old School Lane,
Milton,
Cambridge CB4 4BS.
Tel: (0223) 860150.

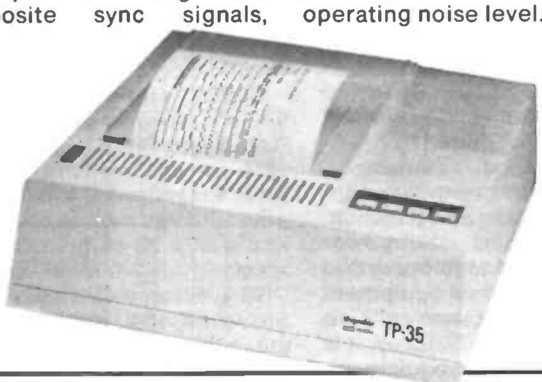
VIDEO PRINTER

Thandar Electronics recently announced the launch of a new video printer. Designated TP35, it provides high speed print-out of graphic and text CRT images from a composite video signal, separate video signals or composite sync signals, requiring no interface.

The TP35 prints both positive and negative copies and features a 6 dots/mm printing pitch offering either low or high resolution. High definition is achieved by the use of thermo-sensitive heads which also minimise the operating noise level. A built-in self test facility ensures reliability.

The TP35 is priced at £1085 + VAT.

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



PC ADD-ONS

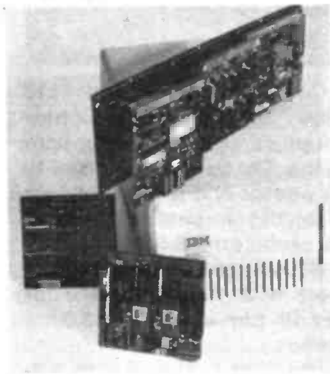
Burr-Brown have introduced a new generation intelligent instrumentation front-end which converts the IBM series of personal computers (and compatibles) into a powerful system for data acquisition, test, measurement and control.

Known as PCI-20000, the system consists of a mother board (carrier), which plugs into an expansion slot in the host PC, and daughter boards (instrument modules) which connect piggy-back style to the carrier.

Each PCI-20000 carrier provides mounting space for up to three modules and includes the Intelligent Instrumentation Interface Bus (I^3Bus) and PC bus interface and logic circuits. Additionally, the carrier also provides 32 fully buffered digital input/output points.

A wide variety of instrument modules for analogue and digital applications are available. These can be regarded as building block components that will find wide application in the design of systems of other manufacturers.

An extensive range of software support packages is available for the PCI-20000 system, including versions to support Basic, C and Pascal languages.



Burr-Brown International Limited,
Cassiobury House,
11-19 Station Road,
Watford,
Herts WD1 1EA.
Tel: (0923) 33837.

MW AMP

D J Stanton (Radio) have announced the availability of their new DLA1 medium wave loop differential amplifier for DXing. It features a high Z FET input balanced amplifier for high 'Q' in the loop aerial, giving sharper nulls when DXing very weak stations; a balun coupled output; and a variable gain 2 transistor output amplifier, with gain variable over 2-20dB giving complete control over any loss in the Rx system. It has a nominal 50-75 ohm output to suit today's modern rigs.

This compact amplifier system is battery powered (9V) giving freedom from mains borne noise and TV line timebase interference in the amplifier system. A 12 volt option is available on request. The amplifier is housed in a compact case with screw terminals for connection to the loop and comes complete with 2 metres of low loss 50 ohm coaxial cable, already fitted with PL259 plug.

The DLA1 will work with all sizes of loop, including ferrite rods and can improve the smaller types of loop. DLA1 should be attached directly across the loop, usually at the terminals of the loop tuning capacitor. The normal coupling turn is not required.

The DLA1 costs £25 including postage.

D J Stanton (Radio),
16 Addison Road,
Worcester WR3 8EA.

SIGNAL GENERATORS

Two new signal generators from MS Components cover the frequency spectrum from 10Hz to 450MHz in overlapping ranges. The dials are geared for easy and accurate frequency selection.

The audio frequency model has an accuracy of ±3%, generating sine waves from 10Hz to 1MHz and square waves from 10Hz to 100kHz with a rise time of 200ns. Output voltage is fully variable 0-5 volts, flat to within ±1.5dB with an output impedance of 600 ohms. An external sync input is provided, having an input impedance of 10kohms and a sync range of 1% per volt.

The RF model covers six frequency bands from 100kHz to 150MHz on fundamentals, extending to 450MHz on harmonics, and producing a continuously variable output of 0-0.1 Vrms. Modulation is by an internal 1kHz tone or from an externally generated tone of 50Hz to 20kHz by switch selection. Spot frequency calibrations are simplified by provision of an external crystal socket.

Both instruments are mains powered and housed in matching bench mounted cabinets measuring 238 × 150 × 130mm.

MS Components Ltd,
Zephyr House,
Waring St, West Norwood,
London SE27 9LH.
Tel: (01) 670 4466.

SPECTRUM ADD-ON

The ZX Spectrum, in common with other home computers, can be used to measure a wide range of analogue signals using an appropriate analogue-to-digital converter. Providing this feature an easy-to-build kit, the Velleman K2610, offers Spectrum owners an effective 'window' onto the outside world.

The kit, available from Electronic and Computer Workshop Ltd, enables the Spectrum to collect information from temperature sensors, humidity sensors, pressure transducers and any sensor or source that varies between 0 and 5.1V. Suitable input units can be supplied to adjust the voltage levels if required.

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

DISC DRIVE INTERFACE

RCS Computer Services, who a little while ago announced a very low cost disc drive for the BBC microcomputer for £66 (inc VAT), is now offering a BBC disc interface upgrade for £75 for customers who purchase a drive at the same time.

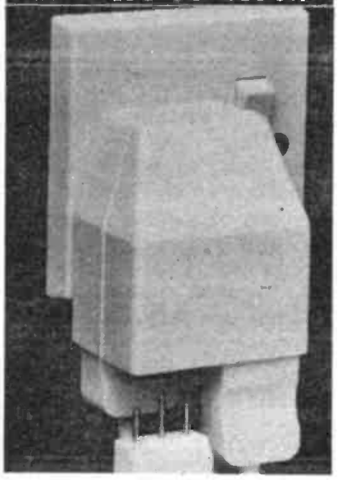
In order to run a disc drive on the BBC an interface needs to be added, which until now has far exceeded the cost of the drive itself.

Incorporating the Acorn DNFS ROM, the interface is supplied in kit form at this special price to purchasers of the RCS disc drive, or fitted for £5 extra to callers at their Feltham facilities.

RCS Computer Services,
Enterprise House,
Central Way,
North Feltham Trading Estate,
Feltham,
Middlesex TW14 0RX.
Tel: (01) 844 1200.

PRODUCT NEWS

LET'S PLUG CONBLOCK



Conblock Electrical Ltd have announced two new adaptors, complete with plugs. These are designed to be neater and more compact than other similar devices currently on the market. Both products are supplied complete with plugs and are for use in any standard 13 amp socket.

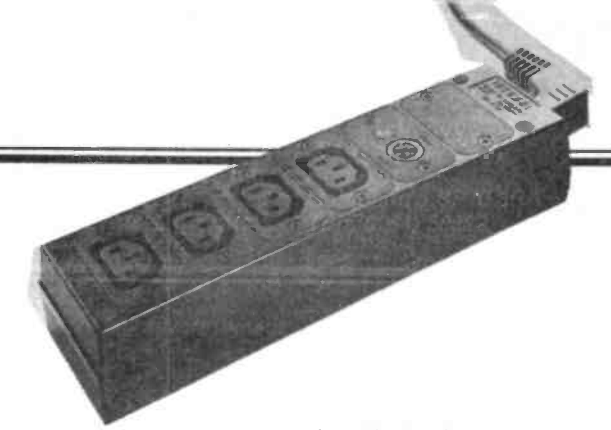
The first is the in-line six-into-one mains adaptor with full 13 amp capacity and six plugs, each having a maximum 6 amp capacity. The unit is 60% lighter and 30% smaller than the in-line four-into-one adaptor currently in general use.

The unit enables the end-user to have any number up to six individually plugged appliances connected safely, neatly and economically into one mains outlet socket.

It can be supplied complete with 13 amp mains flex and plug, neon 'on-off' indicator and fixing screws. Moulded in polycarbonate, it is virtually impossible to break or chip. The sockets are fully shuttered, thereby giving complete safety.

The second new adaptor is a four square wallplug capable of simple connection to any 13 amp outlet. It possesses similar attributes to the six-way in-line connector and accepts the same 6 amp plug – simply disconnect from one unit and plug into the other when required.

Conblock Electrical Ltd,
Mochdre Industrial Estate,
Newtown, Powys SY16 4LF.
Tel: (0686) 27100.



STRIPBLOC

A mains input filter version of Rendar's popular Stripbloc is now available. This version is particularly suited to sensitive electrical equipment, where 'clean' power is essential for optimum performance.

The Stripbloc multi-power outlet can connect four or five items of electrical equipment safely and economically to one mains power source. It is suitable for office equipment, laboratory instruments, lighting, personal and mini-computers, small domestic appliances and hi-fi/audio units.

Moulded in rugged black ABS and incorporating BEAB accepted components, the Stripbloc is designed to comply with the CEE 22 European Standards and meet BS5733 requirements.

CEE 22 straight and right angle re-wireable plugs, R473.2 and R473.3, are available for use with the Stripbloc. A standard 13A moulded plug with two metres of cable and a CEE 22 plug are available.

The filtered Stripbloc is based on the original free-standing Stripbloc, while there is also a panel-mounted version providing up to six outlets.

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

32-BIT MICROPROCESSOR

National Semiconductor Corporation recently announced that it has started shipping samples of its second generation 32-bit microprocessor CPU. The device, the NS32332, offers users three times the system speed of National's first generation computing cluster based on the NS32032 CPU.

The device includes a full 32-bit address register, which allows the CPU to address up to 4 gigabytes (4 billion bytes) of memory.

Other new on-chip features include dynamic bus sizing, which means the 32332 can be used with 8, 16 or 32-bit data buses. The 32332 also has burst mode memory addressing capability which speeds up the execution of data moves by 60 per cent. Extensive support for external cache memories, another system speed enhancement, is also provided by the 32332.

National Semiconductor,
Industriestrasse 10,
D-8080 Fürstenfeldbruck,
West Germany.

CRYSTAL CLEAR

The latest addition to IQD's 150-page catalogue of frequency control devices is a range of surface mount crystals from 4.0MHz to 20MHz. Maximum measurements are only 13.5mm × 5mm × 4.5mm.

Somerset-based IQD claims it now has the most comprehensive selection and largest stockholding of frequency control devices in the UK.

IQD Limited,
North Street,
Crewekerne,
Somerset TA18 7AR.
Tel: (0460) 74433.

INMOS TRANSPUTER

Rapid Recall have taken delivery of their initial stocks of the INMOS Transputer in the form of a variety of board level products.

The Transputer is a 32-bit CPU with a processing speed of ten million instructions per second (mips) and the capability to perform concurrent communications with other Transputers at ten megabytes per second. It contains 250,000 devices fabricated in an advanced two micron CMS process and dissipates less than one watt.

Two versions of the Transputer are currently available from Rapid: the T414 has 2K bits of fast on-chip memory and is available with 64K bytes, one megabyte or two megabytes of system memory; the T404 is identical except that it does not have any on-chip memory. Both versions have a 32-bit multiplexed interface with configurable timing which can provide direct access to up to four gigabytes of memory with a maximum data rate of 25 megabytes/sec.

The architecture of a Transputer is such that several Transputers can be used together in a system. One Transputer provides 10 mips performance, two Transputers provide 20 mips and so on.

Software development can be carried out on an IBM PC, a VAX or MicroVAX under VMS or on a Stride computer. In all cases the development language is OCCAM.

Board level products include a Transputer plug-in board for the IBM PC with one megabyte or two megabytes of memory.

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

SOLAR PANEL

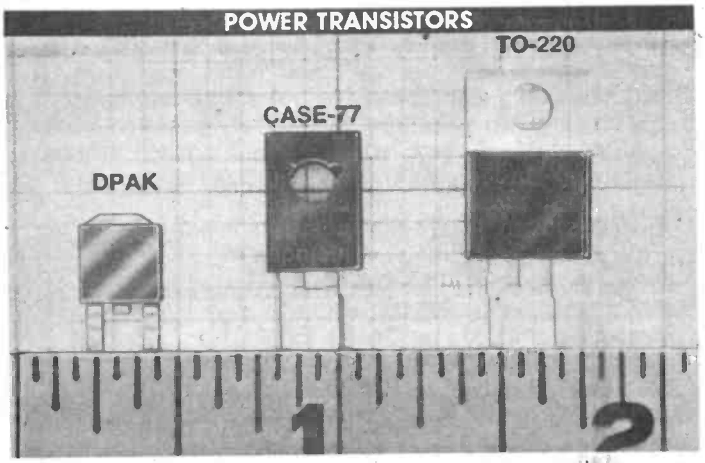
Solar Electronics has developed a portable solar panel which supplies power without the use of batteries.

The solar panel measures 8¾ins × 5¾ins × ¼in and produces 6.5 volts open circuit at .470 amps.

It works in sunlight, normal daylight or with the aid of electric lights and can be used to power many appliances including CB car and home receiver/transmitters and small portable computers.

Solar Electronics
(International) Ltd,
284 Weyhill Road,
Andover,
Hampshire SP10 3RA.
Tel: (0264) 58822.

POWER TRANSISTORS



Motorola Semiconductor Products Sector has announced ten new bipolar and three new TMOS power MOSFETs. These new transistors come in the DPAK, the first power package designed for surface-mount applications. The DPAK offers a number of cost reducing features for power control applications, including a reduction of the size of the printed circuit board, the use of both sides of the PCB, the elimination of PCB through-holes, and the ability to reliably handle power levels of over 1 watt.

Developed by Motorola Inc, the DPAK resembles a miniature TO-220. It will allow a large selection of power devices to be available in a surface-mount package.

Motorola Semiconductor Products Inc,
PO Box 20912,
Phoenix,
Arizona 85036,
USA.

IC & TEST SOCKETS

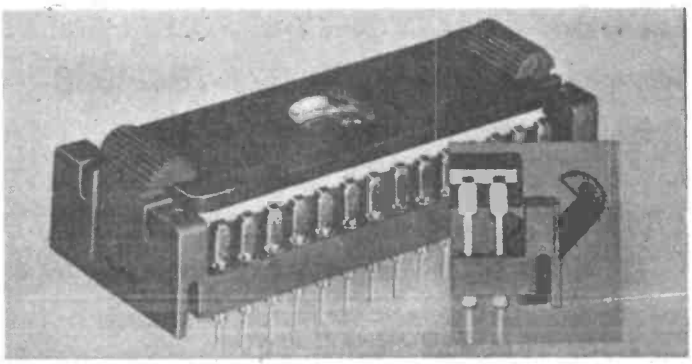
Aries Electronics has expanded its range of Collet Eject-A-DIP sockets with the introduction of several additions to its family.

One of these is a 28-pin socket on 0.600 centres offering gold collets and tin shell for 28pcm ICs, while another is a new locking arm which is the correct height for most IC packages. The new arm height also takes the previously introduced 24 and 40pcm versions on 0.600 inches.

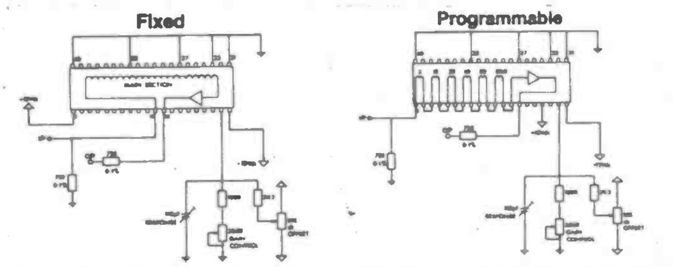
Also new from Aries is a universal test socket, designed to accept all devices from 6 to 40 pins on 0.300, 0.400 or 0.600 inch centres.

These test sockets accept leads from 0.015 through to 0.045 inches wide and mount onto PCBs on either 0.300 or 0.600 centres. Contact materials are beryllium copper, available with gold or tin plating. Other platings and base metals are available for burn-in applications above 150°C.

Aries Electronics (Europe),
Alfred House,
127 Oatlands Drive,
Weybridge,
Surrey KT13 9LB.
Tel: (0932) 57377.



VIDEO DELAY LINE



Aimed at video electronics assemblies, BAL Components Limited are introducing the first video delay line to have its own built-in amplifier in thick film technology. The delay line is fully equalised up to 5.5MHz at 75 ohms impedance.

The active video delay lines save space over conventional passive delay lines plus separate amplifiers, coming in a dual-in-line package just 52.6mm by 15.24mm on the PCB (a standard 40-pin DIL format). Video signals are delayed without problems due to insertion loss of amplitude, and both fixed and programmable video formats are possible. In fixed format the delay range is 50 nanoseconds to 500 nanoseconds, and in programmable the range is 155 to 235 nanoseconds. The units operate on an ordinary ±12 volt dc, 50 milliamp regulated supply.

BAL Components Ltd,
Bermuda Road, Nuneaton,
Warwickshire CV10 7QF.

LCD MODULES

The 1:1.4 aspect ratio of the new 640×200 dot liquid crystal display (LCD) module from Epson allows it to use graphics software originally written for cathode ray tube (CRT) displays.

This facility will make the EG-7003A-AR module useful in applications such as desktop and hand-held computers, industrial control equipment, control panels and word processors.

It is currently the largest LCD module in Epson's range, with a viewing area of 266×119mm. The different aspect ratio is a result of using rectangular dots as opposed to the usual square ones. Other features include an 80 character × 25 line display capacity, and a thickness of only 11.5mm. Power consumption is 120mW.

The EG-7003A-AR is compatible with the Epson E1330 LCD controller, a single chip IC which handles the interface between the LCD, the video RAM and Z80 or 6800 series microprocessor.

Epson (UK) Limited,
Dorland House,
388 High Road,
Wembley,
Middlesex HA9 6UH.
Tel: (01) 902 8892.

RFI-SCREENED HOUSINGS

Small areas of circuitry can be screened against RFI using BICC-Vero's new KM6 range of RFI-screened modules. They are available in a range of single or double Eurocard sizes, up to a maximum width of 21hp (4.2in).

Previously, designers have had to make their own custom screening for this small size of equipment, or utilise an expensive fully-screened rack.

The modules are supplied as kits with sealing strips incorporating Monel which provides good electrical contact yet is neutral on the galvanic scale, reducing risk of corrosion. The standard stock sizes are 3U × 160mm × 6, 12 or 21hp, 3U × 220mm × 6hp, and 6U × 160mm × 12 or 21hp.

Test results show that the modules achieve 28 and 45dB attenuation for magnetic field tests at 1 and 10MHz respectively, and better than 66 and 87dB respectively for electric fields at the same frequencies.

BICC-Vero Electronics Ltd,
Unit 5,
Industrial Estate,
Flanders Road, Hedge End,
Southampton SO3 3LG.
Tel: (04892) 5824.

NEWS DESK

Cable TV

Cable TV Supply (UK) Ltd, a subsidiary of Cable TV Industries, has opened its new warehouse and will supply cable television systems throughout the United Kingdom and on the Continent with materials used to build and maintain cable television systems. The UK sales office in Epsom has been moved and consolidated with the new warehouse, which is located seven miles from London in Leatherhead, Surrey.

Sixteen cable systems have been granted franchises. Eight of these have begun construction this year, prompting the company's expansion. In future years, 10 to 15 franchises are expected to be granted annually.

Cable TV Industries is one of the largest distributors of cable products in the United States and has four wholly-owned subsidiaries: Cable TV Supply (UK) Ltd, Cable TV Supply Company Inc, Home Satellite Systems TM, and Aberdeen Company Inc. The company also markets electronics products and satellite communications products, systems and service through the Startron Systems TM division of Cable TV Supply Company.

Palette

At the British Medical Ultrasound 17th Annual Scientific Meeting and Commercial Exhibition on 17 – 19 December, Polaroid are demonstrating a range of products including Palette, their computer image recorder. This is compatible with most personal computers but is shown at the exhibition in the recently introduced BBC Model B version.

Palette is a small unit, measuring no more than 16 × 8 × 6 inches. It connects to the PC by a black and white video line plus a communications line, and is used in conjunction with a 35mm single lens reflex camera body. Hence it can make its images on both conventional 35mm and Polaroid instant 35mm films. The addition of a special 3¼×4¼ inch format film back also enables the preparation of images on instant print and overhead transparency materials.

Driven by its own software, which actually gives the system an intelligence above that of the host computer, Palette records images on film, straight from the PC, rather than from its VDU screen, guaranteeing superb image quality without the risk of degraduation through distortion, reflections or flare.

Palette works by taking computer-generated images and breaking them down into grey-scale elements that are displayed in turn on an integral mono screen and photographed through a tricolour wheel of red, green and blue. In this way, a full range of up to 72 colours can be simulated on film. It also fills in the raster lines created by any TV monitor, producing a purer, more saturated image on print or transparency.

Optical fibre contract

Telecom Australia has signed a 3-year supply agreement with Plessey for 565Mbit/s optical fibre communications systems for its transcontinental network connecting Melbourne, Sydney, Perth and other major cities.

The initial contract is for the Melbourne – Sydney route. Plessey will supply 565Mbit/s, 1300nm optical fibre terminal equipment and regenerators, operating with single mode fibre cables, to provide a capacity of up to 7,680 voice channels (or the equivalent in data or video) per fibre pair.

The Melbourne/Sydney route will include six line systems, with twelve terminals and seventy-four regenerators. Route protection switching systems will also be supplied.

Deliveries are scheduled to start in late 1986 and installation early in 1987, and all systems are planned to be ready for service in 1988 – to coincide with the bicentenary of the first landing in New South Wales.

Plessey was awarded the first commercial 565Mbit/s system contract in October 1983 by British Telecom, and this equipment is being installed on the Nottingham-Sheffield route and was due to enter service by the end of 1985.

Animal crackers

Greenwood Electronics, in what is described by their PR department as 'a fit of madness on behalf of management', have come up with a scheme to adopt an oryx at London Zoo (all together now – aaaah! How sweet...).

For those of you who don't read the *Product News* pages *(yeah, I just like looking at the pics, too – Ed)*, Greenwood produce the Oryx range of soldering equipment. Further additions to the range will sport a new logo in 1986, which also happens to be Greenwood's Silver Jubilee year.

So, Greenwood are due congratulations both on contributing to the survival of an attractive and rare animal and on reaching the ripe old age of 25. With a management prone to fits of madness, that should be one hell of a party...

What a horny beast!

Telconsult in Nigeria

British Telconsult, the overseas consultancy division of British Telecom International, has won a £3 million contract to assist in creating Nitel – a new telecommunications administration for Nigeria.

The deal follows a Telconsult study last year of the existing national and international telecommunications organisations in Nigeria.

This study recommended major reforms of these organisations, and the Nigerian Government has now asked British Telconsult to help it set up Nitel to run both national and international services.

One of British Telconsult's major tasks will be to draft a five year business plan for Nitel, pinpointing areas for future investment, ways in which external funding can be attracted, and how new technology can be most effectively introduced.

The Network

The Network is a sophisticated way for European firms to source electronic parts and components from thousands of distributors in the US with a single phone call.

The Network wires a hard copy listing of a customer's needs to over 3,000 distributors, all over the US. Because of a unique electronic mail system, The Network ensures that all distributors receive the enquiries no more than 24 hours after the Amsterdam office has been contacted. Every request is treated on a 'priority' basis, with no minimum order requirements.

The Network provides a 100% guarantee; products that do not meet the standards can be returned. The system has been successfully available in the US for over three years. Now a European office has been established in Amsterdam.

The service is not charged to the buyer.

To try the service contact: *The Network, PO Box 15703, 1001 NE Amsterdam, The Netherlands. Tel: (+31) 20-233227.*

Elusive electronics

A component supplier has written to indicate that he is prepared to supply non-stock or difficult to obtain items for projects. The price lists included were not unreasonable, so if you're having trouble he might be worth a try at the following address: *CPL Electronics, 8 Southdean Close, Hemlington, Middlesborough, Cleveland TS8 9HE. Tel: (0642) 591157.*

Testing, testing...

Repro Electronics Services, a company formed earlier this year to produce electronic equipment, recently extended its range of products with the addition of two new pieces of test equipment.

Most interesting of these is a novel transistor tester, which as well as allowing the usual checking of discrete npn and pnp transistors also offers the ability to check these devices in-circuit (and is therefore probably unique in the area of pocket test equipment). A faulty component is indicated by an LED, and the compact unit is powered from a 9V battery. It has already aroused much interest on mainland Europe as well as in Britain.

The other new product is a microphone tester to allow the testing of a combination of different microphones. These products add to a range which already includes a speech processing unit, a microphone switcher box, a 24V to 12V voltage reducer and a 25W linear amplifier for the amateur market.

Repro Electronic Services began production at their Gravesend factory earlier this year, the company having been formed by Ray and Pauline Littleboy, previously importers of electronic equipment. Their products are assembled entirely from British components, and with the promised success of the new units they should soon be releasing further designs.

DC to light

A new manufacturer, trading under the name of DC to Light, aims to produce finished products to fill the parts of the amateur market which are not well catered for or are very highly priced.

The initial product range includes a 50MHz transverter with 144MHz IF, 70cm ATV transceiver, power supply, demodulator/VSWR bridge/ power meter, and a range of stacking units to hold all the individual units.

New products will be available shortly, with 24cm FM ATV and a dedicated 2 metre FM talk-back transceiver in the pipeline.

A shortform catalogue is available, on receipt of an SAE, from: *DC to Light, 15 Bursley Way, Bradwell, Stoke-on-Trent ST5 8JO. Tel: (0782) 639406.*

EMC seminar

ERA Technology is organising a technical seminar and exhibition on electromagnetic compatibility (EMC), a complex subject which has become something of a nightmare for the electronics engineer. The seminar, 'Suppression Components, Filters and Screening for EMC' will be held on Thursday 6 February 1986 at the Heathrow Penta Hotel, London.

The purpose of ERA's seminar is to review the range of suppression devices in current use and to comment on their suitability for particular applications. It will also examine new products which have been specially developed to give the engineer improved methods of achieving electromagnetic compatibility.

Industries principally concerned include radio and television, aerospace, the computer industry, data processing, information technology, the household appliances industry, industrial electronics and defence.

To book a place at the seminar or to reserve exhibition space, please contact: *Miss Laura Christie, Seminar Organiser, ERA Technology Ltd, Cleeve Road, Leatherhead, Surrey KT22 7SA. Tel: (0372) 374151 ext 290.*

Space communications

Student communication engineers are to be offered an opportunity to gain practical experience of the latest information technology systems. Microwave satellite aerials are currently being installed on the top of the tower block in the Holloway Road complex of the Polytechnic of North London.

It is also hoped that this new communications system, which can be used to transmit telephone, video and digital data, will be used by the polytechnic to link its widespread North London sites.

Dr Richard Meadows, of the Department of Electronics and Communications Engineering, believes that it is essential that undergraduate engineers be provided with the facilities to test components and systems which they have designed in their seminars and practical sessions, as well as having the opportunity to operate complete systems.

To further help the students, the Department of Electronics and Communications Engineering is producing video training programmes to show how to operate the test equipment.

The Department of Electronics and Communications Engineering will in future be able to provide technical help and a handbook for anyone thinking of installing satellite receivers.

Power '86

The Power Supply Manufacturers Association (PSMA) is again sponsoring Power UK '86 *(again? – Ed)*, an exhibition/conference on the specialised field of power supply and alternative power sources, organised by TCM Expositions Ltd.

Applications for space at the exhibition are expected to be 40% up on last year. Power UK '86 will provide a good opportunity to discuss specific requirements with manufacturers and examine many competing products.

The venue this year is the Kensington Exhibition Centre and the exhibition will run from 4-6 March 1986.

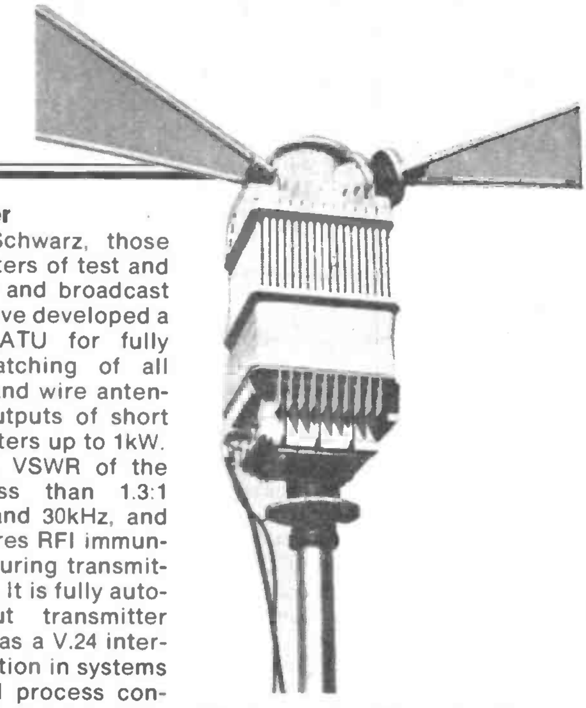
TCM Expositions are also organising a similar event in West Germany, Power Europa '86. This will be staged from 3-5 June 1986.

Contact: *TCM Expositions Ltd, Exchange House, 33 Station Road, Liphook, Hampshire GU30 7DN.*

Teutonic tuner

Rohde & Schwarz, those Teutonic masters of test and measurement and broadcast equipment, have developed a rather nice ATU for fully automatic matching of all types of rod and wire antennas to the outputs of short wave transmitters up to 1kW.

The quoted VSWR of the FK859 is less than 1.3:1 between 1.5 and 30kHz, and the unit features RFI immunity to neighbouring transmitting antennas. It is fully automatic without transmitter control, and has a V.24 interface for operation in systems with a central process controller as well as a programmable 8-bit parallel interface. Tuning times are typically 2 seconds for starting up and 50ms for normal operation.



Mind you, it still looks like something that would give a Dalek or Robbi the Robot restless nights and a desperate need for a cold shower.

No bulls--t: the British Safety Council's tongue in cheek way of reminding us that from 1 January 1986 all safety signs in workplaces must conform to BS5378

SPECTRUM WATCH

NIGEL CAWTHORNE G3TXF

Radio Avui in Barcelona, HQ station of the Cadena 13. Note the tape recorder for off-air logging

Spain's entry this month into the EEC (along with that of its neighbour Portugal) brings the EEC's population to some 318 million, which is larger than both the USA (227m) and the USSR (265m).

Spain has a long tradition in broadcasting, and especially in commercial broadcasting. It was from EAJ1 Radio Barcelona that some of the world's first ever radio commercials were broadcast in 1924.

Broadcasting

Broadcasting in Spain has gone through some major changes in recent years. The creation of 17 autonomous regions such as Catalonia and the Basque country has meant that entirely new regional TV networks are being built where none existed before.

For example, TV3 in Barcelona is the regional network for Catalonia. TV3 has six main transmitter sites to cover Catalonia and is currently working on completing the TV transponder network. Over 50 UHF transponders are in service so far, and TV3 expects to be installing a total of about 90.

The TV3 network is entirely on UHF. The main Barcelona transmitter station has two 10kW transmitters in parallel feeding into a 16-panel antenna, giving an ERP of 300kW on Ch 44. The other main transmitters are either 5kW or 10kW. TV3 uses its own network of microwave links to carry its programme signals to the transmitter sites.

Makeshift studio

The first test transmissions from TV3 were in December 1983, and the official on-air date was 16 January 1984. TV3 is therefore one of the newest TV networks in Europe. For the first two years of operation TV3 has been using makeshift studios, but a large new purpose-designed studio complex is being completed on the outskirts of Barcelona. The new studios, which cost £50M, were inaugurated in late 1985.

Catalonia is not the only autonomous region of Spain to have its own TV channel. There is Euskadi Television in the Basque country of Northern Spain and TV Gallega in the Galician region.

The new regional TV channels are funded by local government. At the national level Spain has two TV channels run by RTVE, the central Spanish TV organisation.

National TV channels

RTVE's two national TV channels are carried by a network of VHF and UHF transmitters. The majority of the first programme main transmitters are on VHF Bands I and III, whereas all but one of the second programme main transmitters are on UHF.

Band I transmitters still play an important role in TV transmission in Spain, whereas in other countries (such as the UK) Band I transmissions have been or are being dropped. There are about ten high-power Band I transmitters operating in Spain. Madrid is on Ch E2 (250kW ERP), and the second major city, Barcelona, is on Ch E4 (150kW ERP). The most powerful Band I station is Izaña in the Canary Islands on Ch E3 with 350kW ERP.

Although Barcelona's first programme is on Band I Ch 4 (150kW ERP), the second programme (Ch 31) and the regional TV channel TV3 (Ch 44) are both on UHF. The three TV transmissions for the Barcelona area are all from the same Tibidabo mountain-top site. The mix of TV transmission bands that is found all across Spain means that Band I, Band III and UHF TV antennas can often be seen all stacked together on the same roof.

Sound radio

Unlike most other European countries where private sound radio broadcasting is a comparative novelty, private radio stations have been a feature of Spanish broadcasting ever since the early days. Cadena SER, whose first station was EAJ1 in Barcelona, is one of the largest private radio organisations in Spain with over 50 stations. Each station in the network has both an MW and a VHF FM outlet in a similar way to the BBC local radio and ILR stations in the UK. For example, SER's Radio Madrid has parallel programming on 810kHz (MW) and 93.9MHz (VHF FM).

Private TV

Although privately run radio stations are an important part of Spanish sound broadcasting, there are no private TV broadcasters (other than a number of local TV pirates). There is currently a lot of discussion and speculation in Spain on the possibility of private national TV networks.

A key technical argument concerns who would be responsible for transporting the private TV network programmes around the country. RTVE have their own microwave network which is used to carry the programme signal to main transmitters. A private TV channel providing a national service would need the same sort of microwave facilities to carry their programmes to the transmitter sites. But who should provide this link? Should it be RTVE, who already have their own microwave network infrastructure? It would be cheapest to use the RTVE facilities because they already have the sites, but the future owners of the private TV channels may not want to depend on RTVE for the networking of their programmes.

Alternatively, should Telefónica, Spain's telephone company, be responsible for networking the private TV channels? Telefónica are reportedly keen to implement new digital microwave transmission techniques, and the private TV operators would be convenient and lucrative customers for them.

Or, finally, should the private TV network operators do their own networking by building, at enormous cost, their own independent national microwave network? A possible compromise solution to the problem of who is to network private TV programming in Spain would be the creation of a new national body (similar to the TDF in France), to take over the running of RTVE's microwave distribution network and to provide similar facilities for the new private TV channels.

Spain's world service

Radio Exterior de España (REE) is Spain's short wave international broadcasting service. REE provides two types of international service: firstly a Spanish world service for expatriates and mariners, and secondly a more general international service for listeners interested in following events in Spain.

REE transmits from mainland transmitter sites at Arganda and Noblejas. There is also a secondary offshore REE transmitter site at Santa Cruz de Tenerife in the Canary Islands, with two 50kW transmitters for South American services.

Antena 3, one of Spain's several networks of private broadcasting stations, used a mobile sound studio for live programming from the national Spanish electronics show, Sonimag

Of the two mainland transmitter centres Arganda is the oldest, and first came into service in 1954. Arganda today has five 100kW transmitters. The REE's largest transmitter centre is the 220 acre Noblejas site south of Madrid, where there are six Thomson 350kW transmitters. The station was originally designed to house eight transmitters, but the last two have never been purchased. Construction of the Noblejas site commenced in 1969.

The SW antenna array at Noblejas consists of two long rows of bi-directional and slewable curtain antennas. Slewing is the technique which allows a seemingly fixed SW curtain antenna to fire at an angle other than in the direction of the main beam. This is achieved by altering the feeder lengths to the different parts of the antennas.

At Noblejas the two main arrays are firing at 230° and 290°. The use of slewing permits coverage of all of North and South America from these two arrays. By reversing the direction of fire through 180°, the same antennas with beam centres of 50° and 90° can be used for Europe, Australia and the Middle East. The antenna installations at Noblejas, which consist of sixteen curtains suspended from eighteen towers, total some 2.5km in length.

REE provides 35 hours of programming daily, of which 25 are in Spanish, two each in French and Arabic and five in English.

Radio Nacional de España

Radio Nacional de España (RNE), which is part of the public broadcasting organisation RTVE, provides three national radio channels, one of which (Radio 1) is carried on medium wave and two (Radios 2 and 3) on VHF FM.

Main transmitters in RNE's medium wave network are the 250kW transmitters at Seville (684kHz) and Barcelona (738kHz) and the 200kW transmitter in Madrid (585kHz). Other RNE medium wave transmitters range from 5kW to 125kW, with a total of twenty MW transmitters in the network. On VHF there are 50 main transmitter stations carrying Radios 2 and 3.

The RNE-run Catalan speaking Radio 4 was inaugurated for listeners in the Barcelona area. This was a significant break from the long tradition that all broadcasting in Spain was in Castilian Spanish and not regional languages such as Catalan. Radio 4 uses a 1kW transmitter on 100.8MHz, and has now been joined by several other Catalan radio stations.

Cadena 13

Cadena 13, for example, is a network of Catalan speaking private radio stations. Thirty-four private radio broadcast licences were granted in the Catalonia region, and a group of 13 licence holders have formed themselves into the Cadena 13 network.

Radio Avui in Barcelona, which came on air in December 1983, is the headquarters station of the network. Radio Avui transmits on 100.0MHz with a 10kW transmitter located at the Tibidabo site. The same transmitter site is shared by a large number of broadcasters, including RTVE (two TV channels and three FM) and TV3, as well as by many other services such as police, taxis and ambulances.

From the roof of Radio Avui's downtown studio building there is a clear view of the Tibidabo transmitter site some 5km away. The programme feed between the two is carried by an 800MHz link.

Cadena 13 operates a microwave link network across Catalonia which allows programmes to be networked to all thirteen stations, directly from Barcelona. Inside the Radio Avui studio building there are three sound studios and a control room. In order to provide a transmitter back-up facility in case of failure of the main transmitter at Tibidabo, Radio Avui have a 250W standby transmitter at the downtown studio which feeds into a roof-mounted four element circularly polarised array.

Mobile radio

Spain has been keeping a low profile in mobile radio. Spain's NMT 450 cellular network, which came into service in 1982, was one of the first on-air cellular systems in Europe. But despite being one of the first in the field the network has been slow to develop. The present system covers Madrid and Barcelona only and has around 600 subscribers (for comparison, the UK cellular networks which came on-air just one year ago now have close to 40,000 subscribers).

Today's carphone fleet in Spain totals less than 1,000. There are still some 350 subscribers on the 1972 Motorola-built 150MHz system, which is being phased out as the Ericsson NMT 450MHz cellular network is expanded.

Telefónica have major plans for extending the coverage of the cellular network. Additional cellular systems were added in Cadiz, Seville and Malaga in late 1985. The new Southern Spain network will be in service in early 1986.

The number of cells in operation, including the new areas, are: Madrid (3), Barcelona (2), Segovia (1), Toledo (1), Cadiz (2), Seville (1) and Malaga (3). The three separate networks have the following channel capacities: Madrid/Toledo/Segovia (57), Barcelona (12) and Southern Spain (35). Telefónica plan to add further new cellular areas, but even with current plans, coverage by 1988 is not expected to exceed 50% of the population nor 15% of the surface area of Spain. Present cellular population coverage is less than 20% (in the UK the two cellular operators are racing towards the 90% population coverage by 1989 goal set by their licences).

Market liberalisation in Spain means that in 1986 cellular mobile sets will be available from sources other than Telefónica, who up until now have had a monopoly. This should lead to increased demand for a service which so far has only been accessible to the ministerial and industrial elite of Spain. REW

The Barcelona DX Association's demo station at last September's Sonimag

AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

Every so often something occurs on one or other of the amateur bands which is distinctly anti-social, if the number of moans it provokes is anything to go by. One of the perennial moans is the question of contests. Like most folk we have no grumble with contests as such. In fact they are quite useful if they stimulate activity on a band which is otherwise under-used.

However, when they are run on a band like 80 metres on a Sunday morning, which is traditionally used at that time for well-established nets, there can be little wonder that the users of these nets raise a howl of protest at those who organise and those who participate in such thoughtlessness.

Anti-social

Surely a contest would be more useful, more enjoyable and less anti-social if it was run on a band where increased activity would be welcomed, not on one where it only adds to the QRM?

The other moan is about those folk who use repeaters for long chats without finding out first if anyone else wants to get a look in. Having arranged for a friend to use a local repeater in order to direct him to one's QTH, it is pretty annoying to have the arrangement completely nullified by some visitor to the area in a caravan down on the seashore hogging the repeater for a full three-quarters of an hour preventing any other mobiles, including the writer's friend, from so much as getting a call into the repeater.

Repeaters are meant for mobile operators, not static ones, and if you must use them for an extended QSO, do please check at short intervals that no one else is trying to get in, with a message of considerably more importance than just nattering!

Increasing activity on 70MHz

David Dodds GM4WLL writes: 'For some time I have believed it to be a considerable pity that so many British amateurs fail to take advantage of our allocation at 70MHz, as it is a band which can be every bit as interesting as any other VHF or UHF band, despite the lack of Continental activity. As someone who is quite active on 4 metres I think the time has come to encourage more activity on the band.

'But before people can be persuaded to build or purchase equipment an improvement in the present level of activity outside the south-east is necessary. In my opinion the problem does not lie as much in the lack of people equipped for 4 metres, but in the lack of co-ordination of those who are. The success of 6 metres is due largely to the "outside TV hours" rule, ensuring that most of the permit-holders are on the air at the same time of the day. There are many more people equipped for 4 metres than there are 6 metre permit-holders!

'For some time Monday evening has been recognised as activity time for 2 metre CW activity and this is very successful. In the early 1970s an attempt was made to make Wednesday evening 4 metre activity evening. Although this seems to have long since fizzled out, I think it would be an excellent idea to resurrect it.

'If as many people as possible come onto 4 metres on Wednesday evenings then there is every chance of turning it into an extremely enjoyable band to use, as well as saving it from the greedy eyes of the PMR lobby!

'As a small attempt at getting the ball rolling I am making a point of being on the air on 4 metres every Wednesday evening, either from my home QTH in Dunfermline or from my university QTH in Glasgow. If you could do your utmost to publicise a link between Wednesday evenings and 4 metre activity then it will be the first move towards giving this band the activity it undoubtedly deserves'.

May we compliment David on his offer to stimulate 4 metre activity in this way and express hope that it will prove successful.

Six metre beacons

With interest in 50MHz increasing, it is good to note from the *VHF/UHF Newsletter* that there are now three six metre beacons in operation, which will be useful indicators of propagation conditions. It is encouraging to hear that GB3SIX on 50.020MHz and GB3NHQ on 50.050 have been heard in the USA on a few occasions, so there do seem to be possibilities for DX working on this band, if only very occasionally. GB3RMK is on 50.060MHz. Any of our overseas readers, particularly those in the USA, who hear these beacons should notify the editor of *VHF/UHF Newsletter*, at PO Box 73, Hereford HR2 9EW.

AMRAC

AMRAC, the Amateur Radio and Computer Club, was formed earlier in the year to promote the use of computers in amateur radio and to encourage the use of digital communication techniques. A regular newsletter is produced entitled *AMRAC User* and members have a net on 2 metres. Those in the south Hampshire area, where the club originated, meet every 4 weeks.

Further information is available from: *Trevor Tugwell, 50 Mayridge, Fareham, Hants PO14 4QP. Tel: (0489) 581032.*

The space scene

There has been talk by the planners of future amateur radio satellites of the possibility of creating a geosynchronous amateur radio satellite for quite some time now.

Geosynchronous satellites, frequently referred to as Phase 4 satellites in the amateur radio satellite field, have again been the subject of keen interest recently as a result of several unrelated developments, according to AMSAT President Vern Riportella WA2LQQ. This was reported in a recent issue of *Amateur Satellite Report*, AMSAT's newsletter.

These developments are along three fronts. First, NASA announced its Advanced Communications Technology Satellite program (ACTS), in which the suggestion arose that this could conceivably include some amateur radio project.

Secondly, Jan King W3GEY learned of the possibility of AMSAT flying its own transponders aboard the ACTS spacecraft. Thirdly, Arianespace has told AMSAT that it is developing a so-called 'piggy-back' pricing policy for small payloads on its Ariane launchers.

NASA is anxious that if the technical difficulties etc can be overcome in bringing such a scheme to fruition the project should have a slant towards providing a scheme beneficial to society or give some technical advancement of value to future satellite development. Accordingly AMSAT is now asking for suggestions as to how radio amateurs might benefit society either directly through communication services or indirectly through technical innovation in connection with ACTS.

Aboard the shuttles

Dr Ron Parise WA4SIR has been selected by NASA to fly with the Astro 1 space shuttle mission in March 1986. He is a member of AMSAT and was formerly AMSAT's UoSAT science advisor. Formerly an employee of the Systems Science Division of Computer Sciences Corporation, he is an astronomer with a PhD from the University of Florida. He will operate some of the unique astronomical instruments aboard Astro 1, which he himself has designed.

The flight of WA4SIR will be the fourth 'ham in space' mission aboard a shuttle. So far W5LFL and W0ORE, and the German and Dutch radio amateur astronauts aboard Spacelab D1 have flown.

UoS ground station

Last summer and autumn some disruption occurred in the UoSAT 1 operations, due to work going on in constructing a new satellite control station at the University of Surrey. This was directed at providing upgraded facilities for the control of, and data collection from, the UoSAT 1 and UoSAT 2 spacecraft.

Although the new ground station was assembled alongside the old one, the checking out and commissioning of the new equipment caused only occasional problems in the operation of the old station. By the time you read this, it is hoped all will be working smoothly once again.

UoSAT 1 was launched at the Vandenberg Air Force Base in California on 6 October 1981 from a Delta launch vehicle into a 550km polar sun-synchronous orbit. Early difficulties were soon overcome and the spacecraft continues to perform extremely well, with no signs of degradation so far.

During these four years, the spacecraft has travelled nearly 600 million miles circling the Earth, decreased in orbit height by nearly 100km and transmitted around nine billion characters to listening ground stations world-wide!

Some camera!

Space quotes from a TASS report that the world's largest satellite tracking camera has been installed at the Zvenigorod Station of the Astronomical Council of the USSR Academy of Sciences. It weighs 25 tons and has an orbital axis which enables it to track a satellite flying in any direction.

The camera makes it possible to record the influence of the sun, moon and other space bodies such as an artificial Earth satellite. It is currently being used to take pictures of Halley's Comet as it approaches the sun.

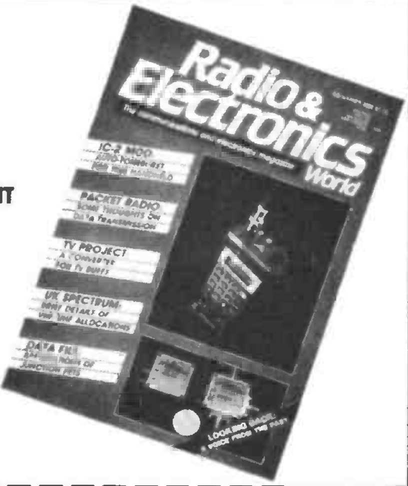
The two Soviet probes moving in the direction of the comet have had their path corrected on the basis of photometric information obtained with the camera.

Prosecutions

Figures for prosecutions taken out under the Wireless Telegraphy Act show that 242 persons were prosecuted during the first three months of 1985 and 332 during the second three months.

GB2RS news

The Department of Trade and Industry has agreed to a request from the Repeater Management Group to run, as an experiment, the reading of the RSGB GB2RS news bulletins from six repeaters, as follows: GB3SL, S London, 145.650MHz at 1700 UTC; GB3PY, Cambridge, 433.350MHz at 1730 UTC; GB3SK, Canterbury, 433.150MHz at 1800 UTC; GB3HO, Horsham, 433.350MHz at 1830 UTC; GB3NI, Belfast, 145.725MHz at 1830 UTC; GB3CF, Leicester, 145.600MHz at 1900 UTC. REW



£1 BAKERS DOZEN PARCELS

(all £1 each 13 for £12)

All parcels are brand new components price £1 per parcel – if you order 12 then pick another free

BD115 – 1 Wall mounting thermostat with thermometer
BD116 – 3 pairs small and 2 pairs medium insulated croc clips
BD117 – 4 pairs large croc clips (car battery type)
BD118 – 1 Teak look 5" extension speaker cabinet with back
BD119 – 2 fibreglass fire fronts log effect & coal effect
BD120 – 2 component boards with 2 amp 400v bridge rectifier and 15 other recs
BD121 – 4 push push switches for table lambs etc
BD122 – 10 mtrs twin flex, screened and outer pvc covered
BD123 – 100 staples for thin flex white plastic and hardened nail
BD124 – 25 clear plastic lenses 1¾" diameter
BD125 – 4 items: rev per hour mains motor, counter, coin switch and srbp panel
BD126 – 4 pilot bulb lamp holders bakelite batten type
BD127 – 4 pilot bulb holders metal clip on type
BD128 – 10 very fine drills for pcbs etc
BD129 – 4 extra thin screw drivers for instruments
BD130 – 2 centre zero panel meters 100-0-100 uA
BD131 – 1 100 uA edge wise balance meter
BD132 – 2 plastic boxes with windows, ideal interrupted beam kits
BD133 – 1 Microsonic radio case in leather case
BD134 – 10 model aircraft motors – require no on/off switch, just spin
BD135 – 10 large and 20 small Screwit porcelain connector/insulators
BD136 – 2 car radio speakers 5" round 4 ohm made for Radiomobile
BD137 – 1 5" 4 ohm speaker 5 watts & 1 matching tweeter
BD138 – 1 9" × 4" 8 ohm 5 watt speaker
BD139 – 4 600 ohm microphone/speaker inserts
BD140 – 1 waterproof metal cased plug and socket 3 pin
BD141 – 10 miniature slide switches 2 pole c/o
BD142 – 10 4 ba spanners 1 end open, other end closed
BD143 – 5 100k multi turn pots with knob
BD144 – 10 chassis mounting fuse holders for 5 mm fuses
BD145 – 2 4 reed relay kits 3v coil can be normally open or c/o
BD146 – 20 pilot bulbs 6.5v ·3a Philips
BD147 – 1 Secret switch kit with data
BD148 – 1 Printed circuit kit with data and 100 circuits
BD149 – 4 socket covers (protect inquisitive little fingers) for twin 13A
BD150 – 5 socket covers (protect inquisitive little fingers) for single 13A
BD151 – 20 4 way terminal blocks 3A 250v
BD152 – 1 Air or gas shut off valve – clockwork
BD153 – 1 Air or gas shut off valve – thermostatic
BD154 – 1 12v drip proof relay – ideal for car jobs
BD155 – 3 Varicap push button tuners with knobs
BD156 – 2 pairs Ferrite cores Neosid 56 × 18 mm
BD157 – 6 2 circuit micro switches – Licon ideal for Joystick
BD158 – 5 12 way connector blocks 2A 250v
BD159 – 3 12 way connector blocks 25A 250v
BD160 – 6 pairs 3 way connectors plug in, terminal block type
BD161 – 1 13A panel socket MK ref 735 WH1
BD162 – 1 13A fused and switched spur for surface mounting or can be removed from box for flush mounting
BD163 – 3 13A sockets good British make but brown
BD164 – 2 13A switched sockets good British make but brown
BD165 – 1 13A switched socket on base for surface mounting
BD166 – 1 30A panel mounting toggle switch
BD167 – 1 8 pin flex terminating plug and chassis mounting socket (s.h.)
BD168 – 2 50 tag component mounting strips
BD169 – 4 Short wave air spaced trimmers 2 – 30pf
BD170 – 2 Hivac numicator tubes neon type
BD171 – 1 Shocking coil kit with data – have fun
BD172 – 10 12v 6w bulbs Philips m.e.s.
BD173 – 1 6v d.c. solenoid with plunger 1" travel
BD174 – 2 end of travel c/o switches – very robust mounted on heavy metal plate 10A 250v
BD175 – 1 200 rpm motor mains operated 2 watt
BD176 – 4 heavy duty push switches – ideal for foot operation 3A 250v
BD177 – 5 Lilliput bulbs 12v
BD178 – 3 Oblong amber indicators with lilliputs 12v
BD179 – 3 Oblong amber indicators with neons 240v
BD180 – 6 round amber indicators with neons 249v
BD181 – 100 p.v.c. grommets ⅜ hole size
BD182 – 1 short wave tuning condensor 50 pf with ¼" spindle
BD183 – 1 two gang short wave tuning condenser with ¼" spindle 2 × 50 pf
BD184 – 1 three gang tuning condenser each section 500 pf with trimmers and good length ¼" spindle
BD185 – 4 ferrite rod aerials 8" × ⅜" rods with long and medium wave coils
BD186 – 1 3 wafer switch: 18 pole 2 way, 12 pole 3 way, 9 pole 4 way, 6 pole 6 way, 3 pole 12 way, your choice
BD187 – 2 2 wafer switches 12 pole 2 way, 8 pole 3 way, 6 pole 4 way, 4 pole 6 way, 2 pole 12 way, any 2 your choice
BD188 – 1 plastic box sloping metal front, size 160 × 95mm average depth 45mm
BD189 – 2 double pole 20 amp 250v flush mounting switches – white

Ex-Electricity Board. Guaranteed 12 months.

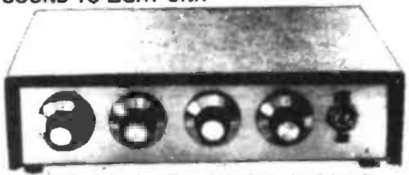
VENNER TIME SWITCH

Mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only £2.95 without case, metal case – £2.95, adaptor kit to convert this into a normal 24hr. time switch but with the added advantage of up to 12 on/offs per 24hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2.30.

12 volt MOTOR BY SMITHS

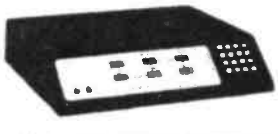
Made for use in cars, etc. these are very powerful and easily reversible. Size 3½" long by 3" dia. They have a good length of ¼" spindle –
1/10 hp £3.45
1/8 hp £5.75, 1/6 hp £7.50

SOUND TO LIGHT UNIT



Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an anractive two tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special price is £14.95 in kit form.

PRESTEL UNITS



These are brand new and we understand tested, came with manufacturer's guarantee now void as the manufacturer no longer trades. These originally sold for over £150. We offer then complete, except for 7 plug in i.c.s and price is only £14.95 (less than the value of the modem included).

TANGENTIAL BLOW HEATER

by British Solartron, as used in best blow heaters. 3Kw £6.95 complete with 'cold' 'half' and 'full' heat switch, safety cut out and connection diagram.

Please add post £1.50 for 1 or 3 for £20 post paid
2.5 Kw KIT Still available: £4.95 + £1.50 post
or have 3 for £16 post paid.

FROZEN PIPES

Can be avoided by winding our heating cable around them – 15 mtrs connected to mains costs only about 10p per week to run. Hundreds of other uses as it is waterproof and very flexible. Resistance 60 ohms/metre. Price 28p/metre or 15m for £3.95.

CORDLESS TELEPHONES

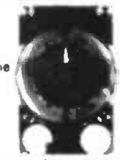
"IT'S FOR YOU-OU" even if you are in the bath, its an infinite extension any room and even in the garden – have one on approval or come and try one here. BT approved £120 not yet approved £80, plus £2 post.

SOCKETS PLUGS ETC for BT phones

Master socket (has surge arrestor – ringing condenser etc) and takes B.T. plug £3.95
Extension socket £2.95
Dual adaptors (2 from one socket) £3.95
Cord terminating with B.T. plug 3 metres £2.95

Kit for converting old entry terminal box to new B.T. master socket, complete with 4 core cable, cable clips and 2 BT extension sockets £11.50

25A ELECTRICAL PROGRAMMER



Learn in your sleep. Have radio playing and kettle boiling as you wake – switch on lights to ward off intruders – have a warm house to come home to. You can do all these and more. By a famous maker with 25 amp on/off switch. Independent 60 minute memory jogger.
A beautiful unit at £2.50

THE AMSTRAD STEREO TUNER

This ready assembled unit is the ideal tuner for a music centre or an amplifier, it can also be quickly made into a personal stereo radio – easy to carry about and which will give you superb reception.

Other uses are a "get you to sleep radio", you could even take it with you to use in the lounge when the rest of the family want to view programmes in which you are not interested. You can listen to some music instead.

Some of the features are: long wave band 115 – 170KHz, medium wave band 525 – 1650KHz, FM band 87 – 108 MHz, mono, stereo & AFC switchable, fully assembled and fully aligned. Full wiring up data showing you how to connect to amplifier or headphones and details of suitable FM aerial (note ferrite rod aerial is included for medium and long wave bands). All made up on very compact board.

Offered at a fraction of its cost **only £4.95**

COMPUTER DESKS

Few still available

Computer desks – size approx 4' × 2' × 2'6" high formica covered, cost over £100 each. Our price only £9.50 – you must collect – hundreds supplied to schools.

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MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £20 add £1 service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted day or night. Haywards Heath (0444) 454563. **Bulk orders**: phone for quote. Shop open 9.00 – 5.30, Mon to Fri, not Saturday.

TWO POUNDERS

Following the popularity of our BAKERS DOZEN £1 PARCELS, we are now introducing some BAKERS DOZEN £2 PARCELS. We feel that you will agree that most are exceptional bargains but you can still get a bit extra, as with the £1 parcel, if you buy 12 you get another free!

2P1 – 24 hour time switch with 2 on/offs, an ideal heating programmer
2P2 – Wall mounting thermostat, high precision with mercury switch and thermostat
2P3 – Variable and reversible 8-12v power supply, ideal for model control
2P4 – 24 volt psu with separate channels for stereo made for Mullard UNILEX Amplifiers.
2P5 – 12 volt psu 750 ma output – plastic cased
2P6 – 100 watt mains to 115 volts auto-transformer with voltage tappings
2P7 – Mini key, 16 button membrane keyboard, list price over £12, as used on PRESTEL
2P8 – Mains motor with gear box and variable speed selector. Series wound so suitable for further speed control
2P9 – Time and set switch. Boxed, glass fronted and with knobs. Controls up to 15 amps. Ideal to program electric heaters, battery chargers etc
2P10 – 12 volt 5 amp mains transformer – low volt winding on separate bobbin and easy to remove to convert to lower voltages for higher currents
2P11 – Power amp module Mullard Unilex EP9000 (note stereo pre-amp module Unilex 9001 is BD216
2P12 – Disk or Tape precision motor – has balanced rotor and is reversible 230v mains operated 1500 rpm
2P13 – Sun Lamp switch stays on for ½ hr or 1 hr depending on setting of grub screw
2P14 – Mug Stop kit – when thrown emit piercing squawk
2P15 – Interupted Beam kit for burglar alarms, counters, etc
2P16 – Lockable metal box with 2 keys, ideal for your tools
2P17 – 1 rev per minute mains driven motor with gear box, ideal to operate mirror ball
2P18 – Liquid/gas shut off valve mains solenoid operated
2P19 – Disco switch-motor drives 6 or more 10 amp change over micro switches supplied ready for mains operation
2P20 – 20 metres extension lead, 2 core – ideal most Black and Decker garden tools
2P21 – 10 watt amplifier, Mullard module reference 1173
2P22 – Motor driven switch 20 secs on or off after push
2P24 – Clockwork operated 12 hour switch 15A 250V with clutch
2P25 – 1000 watt flasher mains motor driven
2P26 – Counter resettable mains operated 4 digit
2P27 – Goodmans Speaker 6 inch round 8ohm 12 watt
2P28 – Drill Pump – always useful couples to any make portable drill
2P29 – 24 position Yaxley switch contacts rated 5A – ¼ spindle
2P30 – 15 metres 6 way telephone or interconnecting wire
2P31 – 4 metres 98 way interconnecting wire easy to strip to use the cores separately
2P32 – Hot Wire amp meter – 4½ round surface mounting – old but working and definitely a bit of history
2P33 – 0-30 amp meter 2" round panel mounting with shunt ex ministry equipment
2P34 – Solenoid Air Valve mains operated
2P35 – Battery charger kit comprising mains transformer, full wave rectifier and meter, suitable for charging 6v or 12v
2P36 – 20 Amp meter, with shunt unused but ex-equipment
2P37 – 0-100 micro amp meter, 2" square flush mounting good make
2P38 – 200 R.P.M. Geared Mains Motor' 1" stack quite powerful, definitely large enough to drive a rotating aerial or a tumbler for polishing stones etc.
2P39 – Gear train size approx. 6½" × 3½", 2 brass pillars for motor mounting (1.9" fixing centres), first wheel made of fibre, 3 other steel and brass wheels. 80 turns of fibre wheel give one turn of final drive shaft which is ¼" dia. rod
2P40 – 12 volt motor – can be fitted to 2P39 gearbox

IONISER KIT
Refresh your home, office, shop, work room, etc. with a negative ION generator. Makes you feel better and work harder – a complete mains operated kit, case included.
£11.95 plus £2.00 post.

MORE BAKERS DOZEN £1 PARCELS

BD189 – 2 double pole 20 amp 250v flush mounting switches – white
BD190 – 2 double pole 20 amp 250v surface mounting switches with neon indicators – brown
BD191 – 6 B.C. lamp holder adaptors white
BD192 – 3 B.C. to 2 pin lamp holder adaptors
BD193 – 6 5 amp 3 pin flush sockets brown
BD194 – 3 5 amp 3 pin switched sockets surface mounting, brown
BD195 – 5 B.C. lampholder bakelite threaded entry
BD196 – 1 in flex simmerstat for electric blanket soldering iron etc
BD197 – 2 thermostats, spindle setting – adjustable range for heaters ovens etc
BD198 – 1 rod thermostat for water heater etc 11" rod
BD199 – 1 mains operated solenoid with plunger
BD200 – 1 10 digit switch pad for telephones etc
BD201 – 8 computer keyboard switches, with knobs, pcb or vero mounting
BD202 – 1 solenoid mains operated air valve 110v coil
BD203 – 2 8 push button switch banks 6 interlocking and two independent locking less knobs or one with knobs your choice
BD204 – 1 3 push mains voltage switch with knobs
BD205 – 1 ultra small 12v relay 3A gold-plated contacts normally open
BD206 – 20 metres 80 ohm coax, off white
BD207 – 20 metres high voltage flex 14.0075
BD208 – 1 Photo multiplier tube RCA 4555
BD209 – 1 Metal box approx. 7½ × 4½ × 1½
BD210 – 4 Transistors type 2N3056
BD211 – 1 Electric clock mains driven, always right time – not cased
BD212 – 1 Double 8v ½ amp mains transformer ideal for dimming or strobing fluorescent tubes
BD213 – 2 Curly 5 core leads for mobile telephones, transmitters etc
BD214 – 3 sub-miniature toggle switches spdt
BD215 – 5 miniature slide switches dpdt with chrome dolly
BD216 – 1 Stereo preamp Mullard EP9001
BD217 – 100 push on tag connector ¼ straight
BD218 – 100 push on tag connector ¼ right angled
BD219 – 100 soldercon terminals make IC sockets any length and width
BD220 – 3 Heat sinks for flat ICs predrilled size 40 × 40 × 25mm matt black, four sided

CONSTRUCTING POWER SUPPLIES

In the last instalment of his series Roger Alban GW3SPA puts the final touches to the PSU

I decided to provide front panel metering to read the power supply terminal voltage and to measure load current. The junk box provided a 100μA fsd meter which was used in conjunction with a multiplier to read voltage. The multiplier consisted of a 100k fixed value resistor in series with a 220k preset potentiometer. The meter was calibrated using the method previously described and the preset tweaked to give an accurate reading.

The ammeter was constructed from a meter with an fsd of 1mA. A 15mm length of 0.6mm diameter wire was soldered across the terminals and with the aid of the dummy load illustrated in *Figure 25* the meter was calibrated using the method previously described.

The completed circuit diagram of the power supply is shown in *Figure 35*. It should be noted that the voltage regulator is fed from the unregulated output of power unit 1.

Power unit 2 supplies the feed to the over-voltage protection relay. Unit 3 feeds the over-voltage sensing LED, and unit 4 supplies an LED which is illuminated when the power supply 'output' switch is in the 'on' position. The circuitry was constructed on four separate tag boards mounted on a sheet of aluminium. The four modified transformers are mounted underneath the tag strips on another piece of aluminium. The LM338 voltage regulator is attached with a mica washer to a vertical piece of aluminium. The mechanical construction is shown in *Figure 36*. The four capacitors are mounted on the aluminium base plate alongside the transformers.

When the circuit has been constructed and tested it is mounted inside a metal instrument case, found on the bring-and-buy stand at the local rally (*of course! – Ed.*). The front panel was constructed from a piece of aluminium.

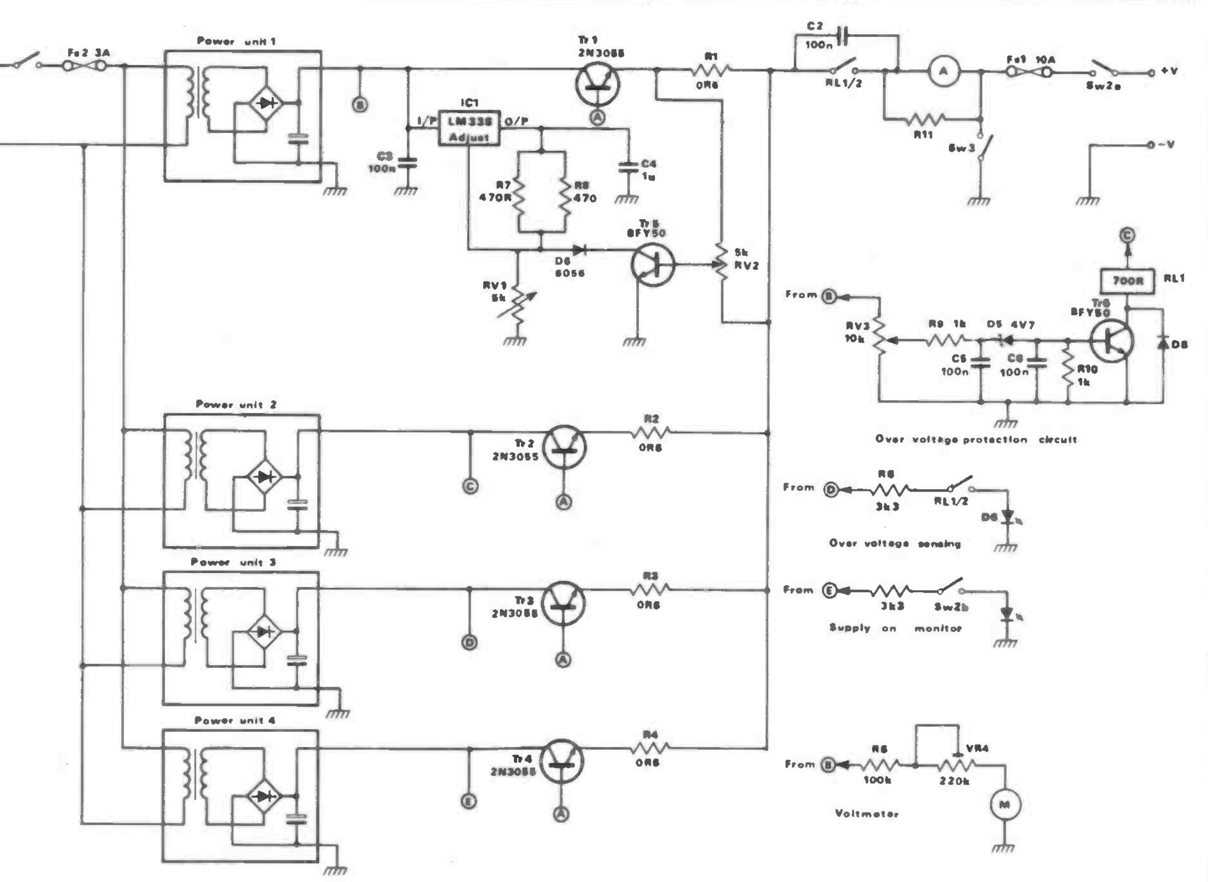
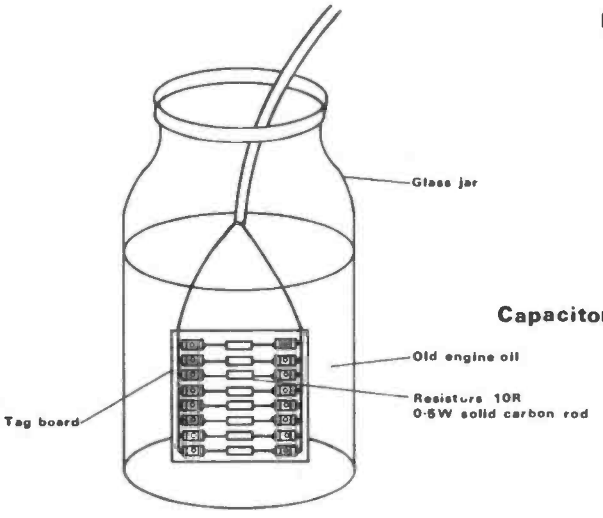


Fig 35 The complete circuit of the 10 amp power supply



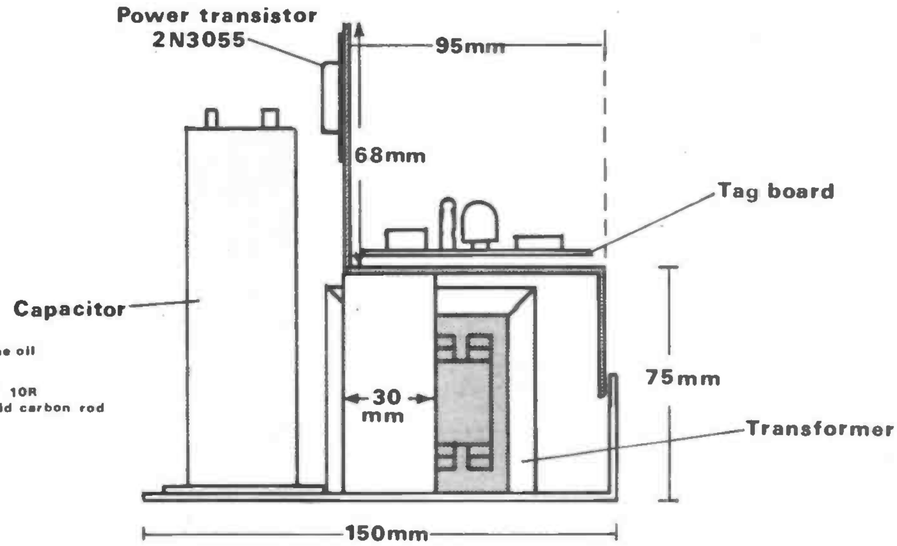


Fig 25 *(left) Dummy load*

Fig 36 *(above) Mechanical construction*

Testing

Prior to switching on the supply, re-check all the connectors and ensure that the circuit has been connected up correctly.

Adjust the voltage control knob to minimum, turn the over-voltage control to maximum and place the current limit knob to maximum. Now switch on the power supply.

The voltmeter should indicate a reading of approximately 0.6V. Adjust the voltage control and observe the voltmeter reading. The voltage adjust control should be able to adjust the meter reading to read a maximum voltage of approximately 26V off-load. Now check the over-voltage adjust control for various different voltage readings and observe the over-voltage warning LED being illuminated when the relay is energised.

Turn the voltage control to minimum and set the current limiter to minimum. Press and hold in the set current limit switch. Slowly increase the voltage and note the ammeter reading.

It should hold steady at between 4 and 6 amps depending upon the current limiting transistor selected. Adjust the current limiter control and note the changing ammeter readings. Do not exceed 10A and do not keep the set current limit switch pressed for a long period.

If the power supply has passed these tests connect the dummy load to the output terminals, and with the voltage adjust control set to minimum switch on the supply.

Note the different ammeter readings for different voltage settings. A good soak test is to run the power supply into a dummy load of 1.40 ohms at an output voltage of 13.8V, which should produce a load current of just under 10A. As the dummy load heats up the resistance of the load will increase and the load current will fall slightly.

The power supply was tested for approximately half an hour and then checked for excessive heat. The instrument case remained cool, the heatsinks having done their job and kept the four pass transistors cool.

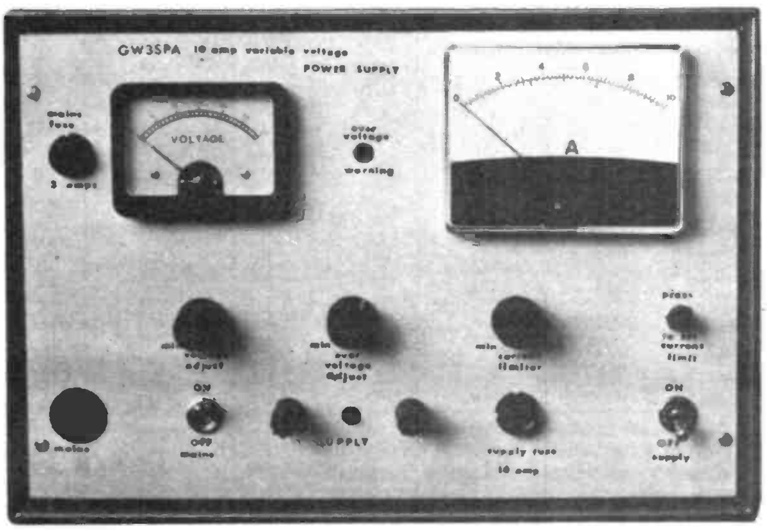
Conclusions

The power supply has been in use in my shack for approximately 6 months and has proved to be a very useful addition to the existing test equipment. In practice when fault finding on equipment the over-voltage adjustment control has been set to be approximately 2 to 3 volts above the operating voltage of the piece of equipment being repaired. The current limiter control is always set to minimum, unless the current consumption of the load is already known. The voltage control is always set at minimum before the output supply switch is turned on, and the ammeter reading observed as the supply voltage is slowly increased up to the operating voltage of the equipment being repaired.

The information in this series of articles has been intended to show how you can scavenge components from rallies and your junk box in order to tailor your power supplies to particular requirements.

To conclude, I hope that you are able to successfully construct power supplies at a fraction of the price offered by 'black box' merchants. REW

If you have missed any of this series don't worry – all issues from May 1985, in which we published the first instalment of Power Supplies, are available from the Back Issues Department



CALCULATING INDUCTANCE

Why strain your brain and exhaust your calculator batteries with tedious number juggling? That's what computers are for, as Derek Guy G3IBH demonstrates . . .

Most amateur constructors at some time need to wind small coils. In practice this is not difficult, but calculating the number of turns required can be tedious and will often have to be repeated several times to achieve the correct value of inductance.

The most commonly used formula for calculating the inductance of a single-layer coil is:

$$L = \frac{r^2N^2}{9r + 10l}$$

where L = Inductance (μH)
r = Coil radius (inches)
N = Number of turns
l = Coil length (inches).

As it is not easy to wind a coil evenly to a particular length, most amateur-wound coils are close wound. However, the problem is that the length l varies depending upon the number of turns and the wire gauge used.

This article shows how the formula can be transposed to provide the number of turns for a given inductance, radius and wire gauge and describes a short computer program to do the calculations.

Altering the formula slightly gives:

$$L = \frac{r^2N^2}{9r + KN}$$

where K = 10 times the inches-per-turn value for the wire gauge used.

Transposing:

$$r^2 N^2 = L(9r + KN)$$
$$= 9rL + KLN$$

This can be rearranged to form a quadratic:

$$r^2 N^2 - KLN - 9rL = 0$$

Now, a quadratic of the form:

$$aN^2 + bN + c = 0$$

can be solved for N using the standard equation:

$$N = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

In our example:

$$a = R^2$$
$$b = -KL$$
$$c = -9rL$$

A quadratic will always have two roots (positive and negative), but in our case only the positive root has any meaning. Taking this into account and substituting our constants for a, b and c gives:

$$N = \frac{KL + \sqrt{(KL)^2 + 36Lr^3}}{2r^2}$$

Listing 1 is a short computer program which solves the above equation and yields the number of turns for a given inductance, former diameter and standard wire gauge.

Lines 70 and 80 dimension and fill an array with turns-per-inch data for enamelled copper wire from 16 to 36swg. This can be extended if required by adding further data and increasing the size of the array.

Lines 90 to 120 clear the screen and print the heading.

Lines 130 to 150 ask for inputs of inductance, former diameter and swg respectively. Line 140 divides the diameter by 2 to give the radius. Line 160 traps values of swg which are out of range.

Line 170 sets up K according to the swg chosen and line 180 calculates the number of turns, N.

Lines 190 and 200 print out the number of turns and the length of the coil, both rounded to one decimal place.

For those of you who prefer to work in metric, the easiest thing to do is to input as metric, convert to imperial then execute the program, and finally convert coil length back to mm. To do this change line 140 to:

```
INPUT "Input former diameter (mm)",
      D:R=D/50.8
```

and line 200 to:

```
PRINT "Length of coil is";
      INT(N*K*25.4+.5)/10;" mm"
```

The program was written for the BBC Micro but should run on most others, although the INPUT statement delimiter will need changing to a semicolon for most machines. REW

```
>L.
   10 REM Inductance Calculator
   20 REM by Derek G K GUY
   30 REM February 1985
   40 REM
   50 REM
   60 REM
   70 DIMA(20)
   80 FOR L = 0 TO 20:READ A(L):NEXT
   90 CLS
  100 PRINTTAB(7)"INDUCTANCE CALCULATOR"
  110 PRINTTAB(7)"---------------------"
  120 PRINT:PRINT
  130 INPUT"Input required inductance (uH)      ",L
  140 INPUT"Input former diameter (inches)      ",D:R = D/2
  150 INPUT"Input SWG (in range 16 to 36 SWG) ",S
  160 IF S < 16 OR S > 36 GOTO 150
  170 K = 10/A(S-16)
  180 N = (K*L + SQR((K*L)^2 + 36*L*R^3))/(2*R*R)
  190 PRINT:PRINT:PRINT"Number of turns is ";INT(N*10+.5)/10
  200 PRINT"Length of coil is ";INT(N*K+.5)/10;" inches"
  210 DATA 14.81,16.95,19.72,23.47,25.97,29.15,33.33,38.91,42.37,46.51,51.55
  220 DATA 56.5,62.5,67.57,74.63,79.37,85.47,91.74,100,109.9,120.5
```

The march of technology has reached the control towers of our airports, whose weather broadcasts are being updated . . .

Readers who listen in to the aeromobile wavebands will be familiar with the Volmet channels. These provide airline pilots with a continuous broadcast of weather reports from a number of airports, and consequently reduce the loading on the already very busy air traffic control channels.

What most listeners – and many pilots – do not realise is that they are not listening to the voice of the duty operator but to a computer system in one of the most successful applications of automation employing speech technology.

For many years the United Kingdom has transmitted three broadcasts, Volmet-North on 126.6MHz, Volmet-Main on 135.375MHz and Volmet-South on 128.6MHz, each of which provides the latest weather information for about nine airports, thus ensuring a reasonably short cycle time between reports.

Many other countries radiate Volmet broadcasts, some of which are transmitted in the HF bands on the 4.8, 11 and 17MHz aeromobile bands. The most easily audible of these in this country is Shannon, which radiates on 4722 and 11700kHz.

Relieving the boredom

It would obviously be highly undesirable for a duty operator to sit at a microphone for hours on end just reading the reports from a script, so from the inauguration of the service in the mid 1960s, recordings were used. These utilized Assman continuous tape loop recorders in which the report for each station was recorded on a separate loop, so arranged that as one loop completed its transmission the next was started.

This technique was reasonably successful and was used in the UK until 1981, and still remains in use in air traffic control centres in many countries even today. It had, however, several disadvantages, which included regional accents evident from some broadcasters, inferior transmissions due to variable recording quaility, and delays in updating broadcasts due to the necessity of decoding the incoming meterological reports.

Each message is similar in format, giving first the airport name followed by the wind direction in degrees and speed in knots. This is followed by a description of the cloud by height and cover in 'oktas' (eighths). The temperature in degrees Celsius and pressure in millibars are then given, and the transmission is completed with general comments or trends, 'no sig' meaning no significant difference expected with 'gradu' meaning gradual change.

The most noticeable feature of the automated UK Volmet broadcasts is the exceptional clarity of the transmitted voice. This is not synthesised, but is a combination of digitally recorded individual words, drawn by the computer from memory as required.

Although a female voice is normally considered to give greater penetrating power, a male voice was chosen in this instance for the lower vocal pitch, giving greater clarity for less digital storage.

The vocabulary software was built up by recording each word in its context in a typical sentence. The word in digital form was then 'cut out' of the sentence by means of a computer working to an accuracy of a few milliseconds and fitted by an iterative technique to every other word with which it might be associated.

If a word might occur at either the middle or the end of a sentence, it was recorded twice to ensure that the necessary cadence could be used.

The reports from which the broadcasts are prepared, known as METARS, are circulated by the meteorological office via teleprinter. The teleprinter lines are connected directly to the computer, which decodes and reassembles the information into the format which will be broadcast. When required for transmission, the necessary words are called from store and used to modulate the transmitter.

Several advantages accrue from automation of the system: decoding or 'slips of the tongue' errors are avoided, the transmissions are of high quality, clarity and consistency and the time delays inherent in the manual system due to decoding and recording are now absent, saving at least ten minutes for each report. Finally there is a significant saving of manpower costs.

Made in Britain

The system, which was developed and manufactured by Marconi Secure Radio Systems Ltd, has been in use for London Volmet since 1981 and has been the subject of considerable praise from airline pilots. In this period, it is claimed, there has only been one complaint – from a pilot who was worried that they were overworking the operator, who always seemed to be on duty!

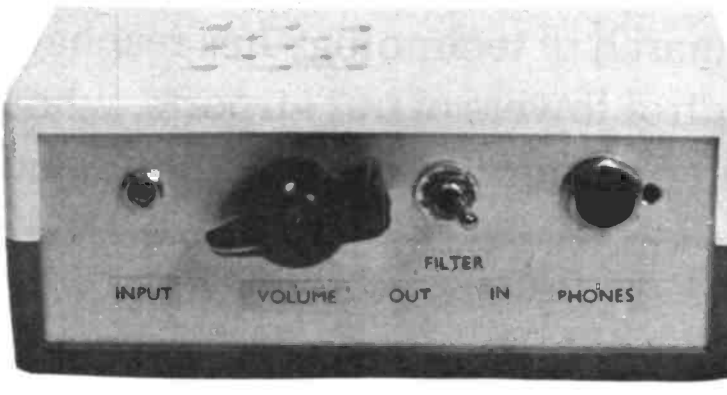
Two other countries, France and Germany, have automated their Volmet systems and many others are planning to phase out their continuous loop systems in favour of automation. Italy has decided to buy a Marconi system and by early 1986 the same voice which is heard over the United Kingdom will also be heard giving the four Volmet broadcasts from Milan, Pisa, Rome and Brindisi. REW

Marconi are understandably pleased about the interest aroused internationally by their Volmet system. On a different level, they are applying this speech storage technology to ATIS (Automatic Terminal Information Service) equipment.

ATIS broadcasts are provided at many airports, and resemble Volmet in that they provide pilots with weather reports and generally use tape loop recordings. The new Marconi ATIS equipment will provide the same benefits for this system as it does for Volmet.

ACTIVE AUDIO BANDPASS FILTER

For an elegant design to meet a simple requirement you'd have to go a long way to beat Lionel Sear G3PPT's filter



Seasoned readers of ***R&EW*** could be excused for barely stifling a yawn at the prospect of reading about 'yet another' audio filter, as there have been many designs published over the last few years. This one however is a little different, producing a genuine bandpass response by a novel technique.

The responses of two identical active filters when tuned to slightly staggered frequencies around 1kHz are shown in *Figure 1.* Clearly, under the respective peaks there is a large difference between the two responses, whereas further away from the peaks they are very similar. Thus the electrical difference between the two functions (which will also take into account phase) will be a bandpass response. This works so long as the two frequencies are not too far apart, which would result in an unacceptable trough in the middle of the response.

In the circuitry to be described, a well shaped steep-sided passband with a bandwidth of up to 300Hz at 1kHz is obtained. A further advantage of this approach is that because the difference between relatively low Q functions is used, the 'ringing' associated with high Q circuits on the verge of oscillation is not suffered and the filter is not tiring to use for long periods.

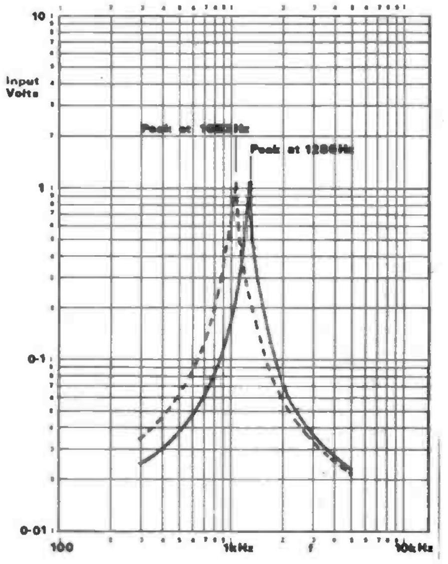
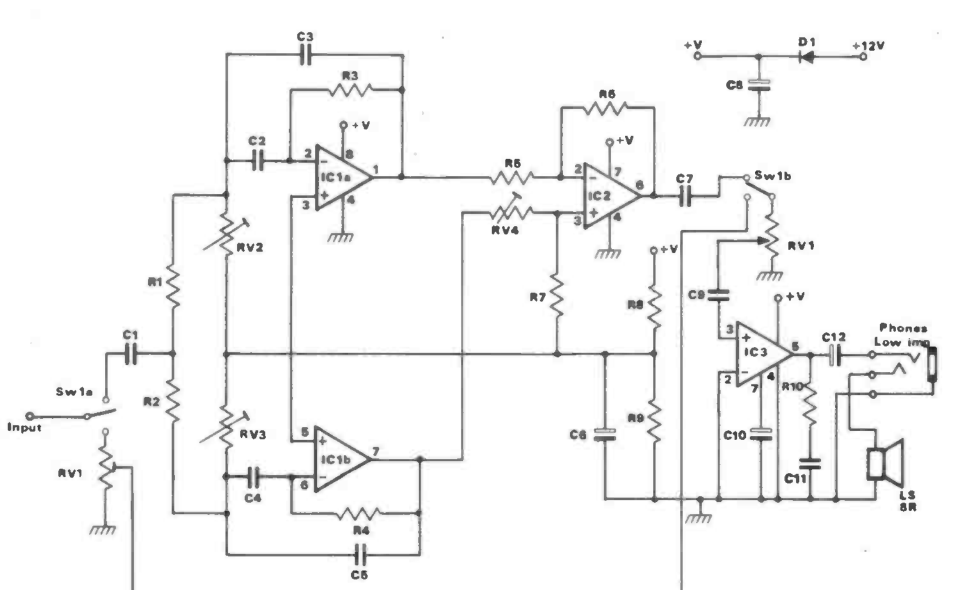


Fig 1 *The responses of two identical active filters tuned at slightly different frequencies*

Fig 2 *The bandpass filter circuit diagram*



The circuit

The circuit is shown in *Figure 2.* The two constituent op-amps in IC1 are used in two identical tunable bandpass filters

COMPONENTS

Resistors

R1, 2, 3, 4	220k ¼W carbon
R5, 6, 7	22k ¼W carbon
R8, 9	220R ¼W carbon
R10	10R ¼W carbon
P1	10k skeleton preset
P2, 3	470R skeleton preset
P4	47k skeleton preset
RV1	10k pot, ALPS VM10R

Capacitors

C1, 7, 9, 11	0.1μF 50V disc ceramic
C2, 3, 4, 5	4.7nF 100V mylar
C6, 8, 12	100μF 63V electrolytic
C10	20μF 25V tantalum

Semiconductors

IC1	LF353
IC2	CA3140
IC3	LM386
D1	1N4001

Miscellaneous

Printed circuit board
Vero case 125 × 65 × 50mm
Toggle switch, DPDT miniature
2.5mm jack plug and socket
¼in mono jack socket with n/c switch
2in 8Ω loudspeaker

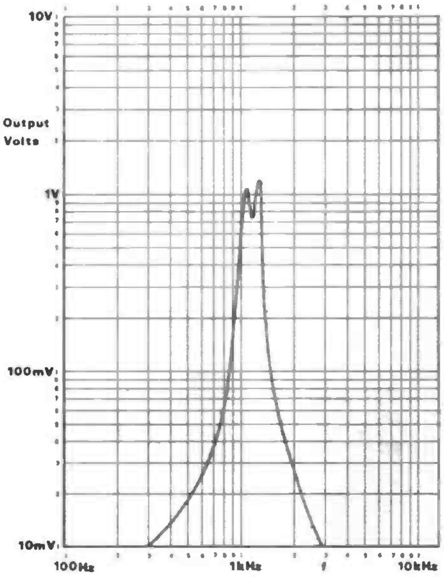


Fig 3 *The response of the Figure 2 circuit when adjusted to give a 300Hz bandwidth*

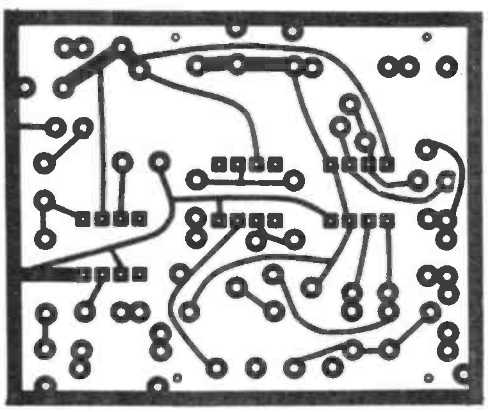
fed in parallel from the input; these are tuned by presets P2 and P3 to frequencies around 1kHz, staggered so as to produce the desired bandwidth. The actual difference function is produced by IC2, a CA3140 working in the differential mode with unity gain, balance being achieved by adjustment of P4.

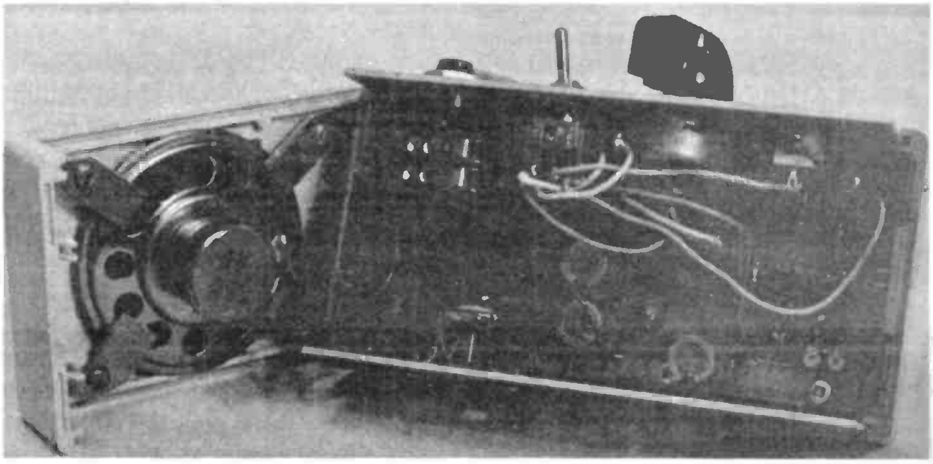
To avoid the use of a dual voltage power supply, IC1 and IC2 are referred to the decoupled voltage divider circuit formed by R8,9 and C6. To make good the slight losses inherent in the filtering process and to raise the output to loudspeaker/low impedance headphone level, an LM386 is used. A double-pole double-throw switch allows the filter to be switched in or out, the volume level being equalised by P1.

Circuit response

Figure 3 shows the response of the circuit when adjusted to give a bandwidth of 300Hz. The unit requires a reasonable quality power supply giving 12 volts at 100mA.

Fig 4 *The PCB foil pattern*





Construction

The circuitry is not in any way critical and Veroboard or similar may be used in its construction. However, by following the printed circuit layout used by the author (*Figures 4* and *5*) the whole assembly, complete with a 2 inch loudspeaker, will fit into a standard Verocase of 125mm x 65mm x 50mm.

Close observation of the board, together with the fact that two links have had to be used, might lead those more experienced with PCB design to feel that the author is to PCB artwork what Quasimodo was to deportment. The author used a 2.5mm jack plug and socket for input and a .25 inch jack plug and socket plus switch for output, together with a 2.5mm power plug/socket to get dc power into the unit. No doubt the prospective constructor will have his own ideas on this.

Alignment

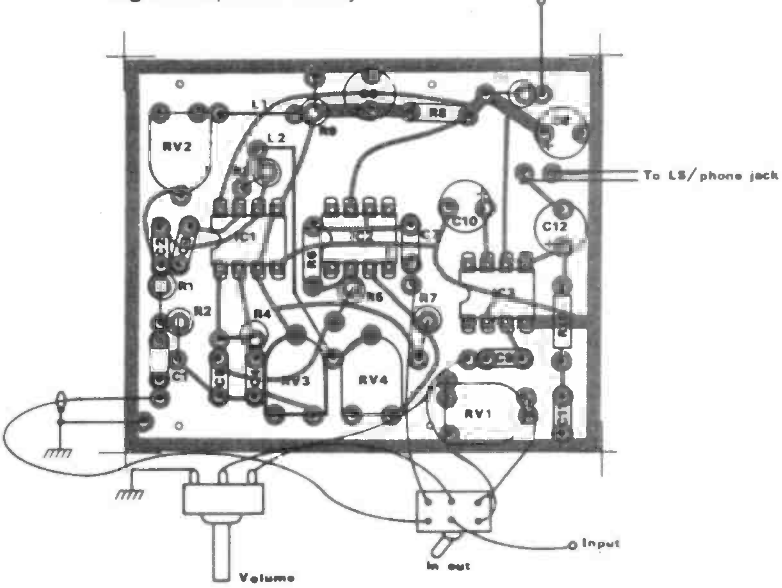
Alignment may be accomplished without instrumentation as follows. Set P4 to mid-travel, feed in a tone of approximately 1kHz and peak one of the tuned circuits with P2 or 3 as appropriate. Raise the input frequency by the bandwidth required and peak the other tuned circuit to this, then feed in a tone greatly removed from the passband, say 3kHz, and carefully adjust this to a minimum with P4, thus balancing the differential amplifier. Finally adjust P1 so that the output volume is equal with the filter switched in or out with S1.

Uses

The circuitry associated with IC1 and IC2 may be incorporated into any equipment where narrow-band filtering would be useful. A good example of this is RTTY equipment, where the two tuned circuits may be easily peaked on the two tones. However, it may be necessary to increase the gain of the differential stage IC2 by increasing R6 and 7 in tandem. The circuit will also prove very beneficial if built into a direct conversion receiver.

The author gratefully acknowledges the help of Bob Currell G4EIK in producing the photographs. REW

Fig 5 *Component overlay*



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TBA540Q	1.35
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TBA560Q	1.45
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CME1431W	30.00
CME202GH	45.00
CME2024W	45.00
CME2325W	45.00
CME3128W	45.00
CME3132GH	45.00
CME3155W	45.00
CRE1400	28.00
CV429	80.00
CV1450	35.00
CV1526	19.00
CV2185	18.00
CV2191	19.00
CV2193	18.00
CV5119	65.00
CV5320	65.00
CVX389	65.00
D9-110GH	39.50
D10-210GH	45.00
D10-210GH68B	65.00
D10-230GH	35.00
D10-230GM	35.00
D10/293GY/90	65.00
D13-30GH	40.50
D13-47GH/26	60.00
D13-47GH	58.00
D13-51GL/26	65.00
D13-51GM/26	65.00
D13-450GH/01	65.00
D13-471GH/26	55.00
D13-600GM	59.00
D13-610GH	59.00
D13-611GH	59.00
D13-611GM	59.00
D13-630GH	59.00
D14-150GH	75.00
D14-150GM	75.00
D14-172GH/84	80.00
D14-172GR	65.00
D14-172GV	65.00
D14-173GH	55.00
D14-173GM	53.00

D14-173GR	55.00
D14-181GH/98	65.00
D14-181GJ	65.00
D14-181GM	53.00
D14-181GM50	59.00
D14-182GH	59.00
D14-200BE	89.00
D14-200GA/50	65.00
D14-200GM	75.00
D14-210GH	75.00
D14-270GH/50	75.00
D14-310W	110.00
D14-320GH/82	55.00
D14-340GH/KM	45.00
D14-340KA	45.00
D16-100GH	65.00
D16-100GH/65	69.00
D16-100GH/67	65.00
D16-100GH/79	69.00
D16-100GH97	65.00
D18-160GH	69.00
D21-10GH	65.00
DB7.36	35.00
DB7.36	65.00
DG7.5	55.00
DG7.32	45.00
DH3.91	55.00
DH7.91	45.00
DP7.5	35.00
DP7.6	35.00
DN13.78	35.00
F16-101GM	75.00
F16-101LD	75.00
F21-130GR	75.00
F21-130LC	75.00
F31-10GM	75.00
F31-10GR	75.00
F31-10LC	75.00
F31-10LD	75.00
F31-12LD	75.00
F31-13GR	75.00
F31-13LD	75.00
F31-13LG	75.00
F41-123LC	185.00
F41-141LG	185.00
F41-142LC	155.00
M7-120W	19.00
M14-100GM	45.00
M14.100LC	45.00
M17-151GVR	175.00
M17-151GR	175.00

M19-103W	65.00
M23-110GH	65.00
M23-112GM	65.00
M23-112GV	65.00
M23-112GW	65.00
M23-112KA	65.00
M23-112LD	65.00
M24-120GM	59.00
M24-120LC	59.00
M24-120WAR	59.00
M24-121GH	55.00
M28-12GH	55.00
M28-13LC	40.00
M28-13LG	40.00
M28-13GR	40.00
M28-131GR	65.00
M28-133GH	65.00
M31-101GH	55.00
M31-182GR	55.00
M31-182GV	53.00
M31-184W	65.00
M31-184GH	65.00
M31-184P31	65.00
M31-186W	60.00
M31-190GH	65.00
M31-190GR	65.00
M31-190LA	55.00
M31-191GV	65.00
M31-220W	59.00
M31-270GY	65.00
M31-271P31	65.00
M31-271GW	65.00
M31-271W	65.00
M36-141W	75.00
M36-170LG	75.00
M38-103GR	65.00
M38-120W	65.00
M38-120WA	65.00
M38-121GHR	65.00
M38-121LA	65.00
M38-122GW	65.00
M38-140LA	65.00
M38-142LA	65.00
M38-341P31	65.00
M38-344P39	65.00
M40-120W	60.00
M43-12LG/01	65.00
M44-120LC	65.00
M44-120GR	65.00
M50-120GH	65.00
M50-120GR	65.00

M50-120GV	65.00
M50-120LC	65.00
M61-120W	75.00
S6AB	45.00
SE4/D-P7	45.00
SE42BP31AL	65.00
SE42BP31	65.00
SE5Fp31	55.00
T937	65.00
T948N	65.00
T948H	65.00
V4150LC	55.00
V5004GR	59.00
V5004LD	59.00
V6001GH	65.00
V6007DP31	59.00
V6008GH	59.00
V6034WA	59.00
V604CLA	59.00
V6048J	40.00
V6052GR	65.00
V6064BP31	55.00
V6064CLA	65.00
V6069GH	65.00
V6070P31	40.00
V7016A	65.00
V7030	59.00
V7031GH	59.00
V7031/67A	59.00
V7035A	40.00
V7037GH	45.00
V8004GR	65.00
V8006GH	65.00
V8010A	65.00
VCR139A	11.50
2BP1	13.50
3BP1	11.50
3DP1	11.50
4EP1	30.00
3H/OBM	55.00
3WP1	18.50
5BP1	9.00
5BHP1	30.00
5BHP1FF	30.00
5BHP31	30.00
5CP1	10.00
6EP7/S	39.00
13BP1	13.50
13BP4	17.50
17DWP4	28.00
32J/1085	69.00
88D/88B/89D/89L	15.00
1273	30.00
1564	30.00
1844	45.00
55451GM	75.00
9442E1	80.00
95447GM	75.00
95449	75.00
7709631	79.50

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3HSS £29.50	Suitable for Ferguson 3V00, 3V01, 3V06, 3V16, 3V22, 3V23, 3V24, 3V29, 3V30, 3V31, 8903 and many JVC, Akai, Nordmende, Telefunken.
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PS35 £39.50	Suitable for Sony C5, C6, C7, 8000, 8080 Toshiba V5470, V8600, V8700.

Sony DSR-10R BETA £35.00
Suitable for SLC5, SLC6, SLC7

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Akai VS 9300/9500/9800	£3.75
Ferguson 3V 16	£4.50
JVC HR 3330/3600	£4.50
JVC HR 3360/3660	£4.50
Panasonic NV 300	£4.00
Panasonic NV 2000B	£3.75
Panasonic NV 3000B	£3.75
Panasonic NV 7000	£3.50
Panasonic NV 8600B/8610B/V011	
Sanyo VTC 5500	£3.75
Sanyo VTC 9300	£3.75
Sanyo VTL 9300P	£3.90
Sharp VC 6300	£3.75
Sharp VC 7300	£3.75
Sharp VC 8300	£3.75
Sharp VC 9300	£3.75
Sony SL 3000B	£3.75
Sony SL 8000/8080	£4.50
Sony SL C7/J7	£4.00
Toshiba V7540	£4.50

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Mono Head	1.90
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P4231BAM	19.00
XP1002	29.00
XP1117M	24.00
XP42040	35.00
9524H	29.00

SEMICONDUCTORS

AAY12	0.25
AC126	0.45
AC127	0.20
AC128	0.28
AC128K	0.32
AC141	0.28
AC141K	0.34
AC142K	0.45
AC176	0.22
AC176K	0.31
AC187	0.25
AC187K	0.28
AC188	0.25
AC188K	0.37
AD142	0.79
AD143	0.82
AD149	0.70
AD161	0.39
AD162	0.39
AD161/2	0.90
AF106	0.50
AF114	1.95
AF121	0.60
AF124	0.65
AF125	0.35
AF126	0.32
AF127	0.65
AF139	0.40
AF150	0.60
AF178	1.95
AF239	0.42
AU106	4.50
AU107	3.50
AU110	3.90
AY102	2.95
BC107A	0.11
BC107B	0.11
BC108	0.10
BC108A	0.11
BC108B	0.12
BC109	0.10
BC109B	0.12
BC109C	0.12
BC114A	0.09
BC116A	0.15
BC117	0.19
BC119	0.24
BC125	0.25
BC139	0.20
BC140	0.31
BC141	0.25
BC142	0.21
BC143	0.24
BC147A	0.12
BC147B	0.12
BC148A	0.09
BC148B	0.09
BC149	0.09
BC153	0.30
BC157	0.12
BC158	0.09
BC159	0.09
BC161	0.28
BC170B	0.15
BC171	0.09
BC171A	0.10
BC171B	0.10
BC172	0.10
BC172B	0.10
BC172C	0.10
BC173B	0.10
BC174	0.09
BC174A	0.09
BC177	0.15
BC178	0.15

BC182	0.10
BC182LB	0.10
BC183	0.10
BC183L	0.09
BC184LB	0.09
BC204	0.10
BC207B	0.13
BC208B	0.13
BC212	0.09
BC212L	0.09
BC212LA	0.09
BC213	0.09
BC213L	0.09
BC214	0.09
BC214C	0.09
BC214L	0.09
BC237B	0.09
BC238	0.09
BC239	0.12
BC251A	0.12
BC252A	0.15
BC258	0.25
BC258A	0.39
BC284	0.30
BC300	0.30
BC301	0.30
BC303	0.26
BC307B	0.09
BC327	0.10
BC328	0.10
BC337	0.10
BC338	0.09
BC347A	0.13
BC461	0.35
BC478	0.20
BC527	0.20
BC547	0.10
BC548	0.10
BC549A	0.10
BC550	0.14
BC557	0.08
BC557B	0.08
BC558	0.10
BC639/10	0.30
BCY33A	1.60
BD115	0.30
BD124P	0.59
BD131	0.42
BD132	0.42
BD133	0.40
BD135	0.30
BD136	0.30
BD137	0.32
BD138	0.30
BD139	0.32
BD140	0.30
BD144	1.10
BD150C	0.29
BD159	0.65
BD160	1.50
BD166	0.55
BD179	0.72
BD182	0.70
BD201	0.83
BD202	0.65
BD203	0.78
BD204	0.70
BD222	0.46
BD223	0.59
BD225	0.46
BD232	0.35
BD233	0.35
BD234	0.35
BD236	0.49
BD237	0.40

BD238	0.40
BD242	0.65
BD246	0.75
BD376	0.32
BD410	0.65
BD434	0.65
BD437	0.75
BD438	0.75
BD520	0.65
BD538	0.65
BD597	0.95
BD701	1.25
BD702	1.25
BD707	0.90
BDX32	1.50
BF115	0.35
BF119	0.65
BF127	0.39
BF154	0.20
BF158	0.22
BF160	0.27
BF167	0.27
BF173	0.22
BF177	0.38
BF178	0.26
BF179	0.34
BF180	0.29
BF181	0.29
BF182	0.29
BF183	0.29
BF184	0.28
BF185	0.28
BF194	0.11
BF195	0.11
BF196	0.11
BF197	0.11
BF198	0.16
BF199	0.14
BF200	0.40
BF241	0.16
BF245	0.30
BF257	0.28
BF258	0.28
BF259	0.28
BF271	0.26
BF273	0.18
BF336	0.34
BF337	0.29
BF338	0.32
BF355	0.37
BF362	0.38
BF363	0.65
BF371	0.25
BF394	0.19
BF422	0.32
BF423	0.25
BF457	0.32
BF458	0.36
BF467	0.68
BF595	0.23
BF597	0.25
BFR39	0.23
BFR40	0.23
BFR81	0.23
BFR88	0.30
BFR90	1.50
BFR91	1.75
BFT42	0.35
BFT43	0.35
BFW61	0.60
BFW92	0.85
BFX29	0.30
BFX84	0.26
BFX85	0.32
BFX86	0.30

BFX88	0.25
BFY50	0.21
BFY51	0.21
BFY52	0.25
BFY90	0.77
BLY48	1.75
BR100	0.26
BR101	0.40
BR103	0.55
BR303	0.95
BRC4443	1.15
BRY39	0.45
BT100A/02	0.85
BT106	1.49
BT116	1.20
BT119	3.15
BT120	1.65
BU105	1.95
BU108	1.69
BU124	1.25
BU125	1.25
BU126	1.60
BU204	1.55
BU205	1.30
BU208	1.39
BU208A	1.52
BU208D	1.95
BU326	1.20
BU326S	1.50
BU407	1.24
BU500	2.25
BU508A	1.95
BU526	1.90
BU807	2.25
BUY20	2.15
BUY69B	1.70
MJ3000	1.98
MJE340	0.40
MJE350	
MJE520	0.48
MJE2955	
MPSA13	0.29
MPSA92	0.30
MRF237	4.95
MRF450A	13.95
MRF453	17.50
MRF454	26.50
MRF455	17.50
MRF475	2.95
MRF477	10.00
OC16W	1.50
OC23	1.50
OC29	2.25
OC36	2.25
OC42	0.75
OC44	0.75
OC45	0.65
OC70	0.45
OC71	0.55
OC75	0.55
OC81	0.50
OC16W	2.50
R2008B	1.45
R2010B	1.45
R2322	0.58
R2323	0.66
R2540	2.48
RCA16334	0.90
RCA16335	0.80
S2060D	0.95
SKE5F	1.45
TIP29	0.40
TIP29C	0.42
TIP30C	0.43
TIP31C	0.55

TIP32C	0.42
TIP33C	0.95
TIP34B	0.95
TIP41A	0.45
TIP41C	0.45
TIP42C	0.47
TIP47	0.65
TIP120	0.60
TIP125	0.65
TIP142	1.75
TIP146	2.75
TIP161	2.95
TIP2955	0.80
TIP3055	0.55
TIS91	0.20
TV106/2	1.50
ZRF0112	16.50
2N1100	6.50
2N1308	1.35
2N1711	0.30
2N2219	0.28
2N2905	0.40
2N3053	0.40
2N3054	0.59
2N3055	0.52
2N3702	0.12
2N3703	0.12
2N3704	0.12
2N3705	0.20
2N3706	0.12
2N3708	0.12
2N3733	9.50
2N3773	2.75
2N3792	1.35
2N4280	3.50
2N4427	1.95
2N4444	1.15
2N5294	0.42
2N5296	0.45
2N5298	0.60
2N5485	0.45
2N5496	0.95
2SA329	0.95
2SA715	0.95
2SC495	0.80
2SC496	0.80
2SC931D	0.95
2SC1096	0.80
2SC1106	2.50
2SC1172Y	2.20
2SC1173	1.15
2SC1306	1.40
2SC1307	1.75
2SC1364	0.50
2SC1449	0.80
2SC1678	1.25
2SC1909	1.45
2SC1945	2.65
2SC1953	0.95
2SC1957	0.80
2SC1969	1.95
2SC2028	1.15
2SC2029	1.95
2SC2078	1.45
2SC2091	0.85
2SC2098	2.95
2SC2166	1.95
2SC2314	0.80
2SC2371	0.35
2SC931D	0.95
1SD234	0.60
2SD325E	1.65
3N211	2.95
3SK88	0.95

DIODES

AA119	0.08
BA115	0.13
BA145	0.16
BA148	0.17
BA154	0.06
BA156	0.15
BA157	0.30
BAX13	0.04
BAX16	0.06
BB105B	0.30
BT151	0.79
BY126	0.10
BY127	0.11
BY133	0.15
BY164	0.45
BY176	1.20
BY179	0.63
BY182	0.55
BY184	0.35
BY199	0.40
BY206	0.14
BY208-800	0.33

BY210-800	0.33
BY223	0.90
BY298-400	0.22
BY299-800	0.22
BYX10	0.20
BYX36-150R	0.20
BYX38-600R	0.60
BYX55-600	0.30
BYX71-600	1.10
BZX61	0.15
BZY88	0.10
BZY95C30	0.35
CS4B	1.80
CS10B	8.45
OA47	0.09
OA90	0.06
OA91	0.06
OA95	0.06
OA202	0.10
1N21DR	2.95

1N23B	2.95
1N23C	2.95
1N23ER	2.95
1N23WE	2.95
IN4001	0.04
IN4003	0.04
IN4004	0.05
IN4005	0.05
IN4007	0.05
IN4148	0.02
IN4448	0.10
IN5401	0.12
IN5402	0.14
IN5403	0.12
IN5406	0.13
IN5407	0.16
IN5408	0.16
ITT44	0.04
ITT923	0.15
ITT2002	0.10

BASES

B5D	0.80
B7G	0.25
B7G SKTD	0.25
B8G	0.35
B8H	0.70
B9A	1.50
B9ASKTD	0.40
B9G	0.75
B10B	0.20
B13B	0.80
B14A	0.40
12 Pin CRT	0.95
Nuvistor	2.95
Octal	0.35
SK610	38.00
UX5	1.75
Valve Can	0.35
8 Pin Dil	0.14
14 Pin Dil	0.15
16 Pin Dil	0.17
18 Pin Dil	0.18
Socket for 813	8.50

WIREWOUND RESISTORS

4 Watt 2R4-10K	0.30
7 Watt R47-22K	0.30
11 Watt 1R5-15K	0.35
17 Watt 1R-15K	0.30

ZENER DIODES BZX61 0.15

6V2 7V5 8V2 9V1 10V 11v 12V 13V 15V 16V 18V 20V 22V 24V 27V 30V 33V 36V 39V 47V 51V 56V 68V 75V

BZY88 0.07

2V7 3V 3V3 3V6 3V9 4V3 4V7 5V1 5V6 6V2 6V8 7V5 8V2 9V1 10V 11V 12V 13V 15V 18V 20V 24V 27V 30V

THERMISTORS

VA1040	0.23
VA1056S	0.23
VA1104	0.70
VAT8650	0.46
VA1097	0.25

BATTERIES

7V Power Mike batteries TR175 £2.25 ea other prices on request

LINE OUTPUT TRANSFORMERS

DECCA 100	7.95
DECCA 1700 MONO	9.95
DECCA 1730	8.95
DECCA 2230	8.25
GEC 2040	8.95
GRUNDIG 1500	15.45
GRUNDIG 5010-6010 2222, 5011-6011	13.45
ITT CVC20	8.20
ITT CVC30	8.25
PHILIPS G8	8.50
PHILIPS G9	8.99
PHILIPS G11	13.30
PYE 725	10.95
RBM T20A	12.40
TANDBERGE 90°	11.15
TELEFUNKEN 711A	11.15
THORN 1590	9.50
THORN 8000	23.50
THORN 9000	9.95
THORN 9800	22.40
THORN MAINS TRANSFORMER 3000/3500	9.70

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ITT CVC30	6.35
PHILIPS G8 550	6.96
RANK T20A	6.91
THORN 3000/3500	7.57
THORN 8500	5.80
THORN 9000	8.00
UNIVERSAL TRIPLER	5.45

REPLACEMENT ELECTROLYTIC CAPACITORS

DECCA 30 (400-400/350V)	2.85
DECCA 80/100 (400/350V)	2.99
DECCA 1700 (200-200-400-350V)	3.55
GEC 2110 (600/300V)	2.25
ITT CVC20 (220/400V)	1.80
PHILIPS G8 (600/300V)	2.25
PHILIPS G9 (2200/63V)	1.19
PHILIPS G11 (470/250V)	2.35

POTENTIOMETERS

STANDARD VERTICAL POTS	0.12
MIN. VERTICAL POTS	0.12
STANDARD HORIZONTAL POTS	0.12
MIN. HORIZONTAL POTS	0.12
CONVERGENCE PRE-SETS	0.30
SLIDERS LOG	0.45
SLIDER LINEAR	0.45

SOLDERING EQUIPMENT

25W Antex Iron	4.59
Weller Instant Heat Gun	11.30
240V Weller Marsman	4.74
1/2 Kilo Solder 60/40	6.95

SPARES & AIDS

HEAT SINK COMPOUND	1.00
FREEZE IT	0.95
SOLDA MOP	0.64
SWITCH CLEANER	0.95
WD40	1.25
PUSH PUSH MAINS SWITCH (DECCA, GEC, RANK, THORN ETC)	1.02
PYE IF GAIN MODULE	6.95
ANODE CAP (27KV)	0.60

PUSH BUTTON UNITS

DECCA, ITT, CVC20 6 WAY	7.95
ITT CVC5 7 WAY	10.19
PHILIPS G8 (550) 6 WAY	14.49

VARICAP TUNERS

ELC1043/05 MULLARD	8.65
ELC1043/06 MULLARD	8.65
U321	8.25
U322	8.25
U324	8.25

20MM ANTI SURGE FUSES

100MA-800MA	15p each
1A-5AMP	12p each

20MM QUICK BLOW FUSES

100MA	8p each
200MA-5AMP	5p each

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GRAVESEND, KENT DA11 8HD

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TELEX 966371 TOS PM

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A1714 24.50
A1998 11.50
A2087 11.50
A2134 14.95
A2293 6.50
A2426 29.50
A2599 37.50
A2792 27.50
A2900 11.50
A3042 24.00
A3283 24.00
AC/THI 4.00
ACT22 59.75
AC/S2 PEN 8.50
AH221 39.00
AH238 39.00
AL60 6.00
AN1 14.00
ARP12 0.70
ARP34 1.25
ARP35 2.00
AZ11 4.50
BL63 2.00
BS450 67.00
BS810 55.00
BS814 55.00
CIK 19.00
C3JA 39.50
C6A 9.00
C1112G 70.00
C1108 65.00
C1134 32.00
C1148A 115.00
C1150/1 135.00
C1534 32.00
CCA 2.60
CC3L 0.90
CL33 2.00
CV Nos Prices on request
D3a 29.50
DG3 1.20
DA41 22.50
DA42 17.50
DA90 4.50
DA100 125.00
DAF91 0.45
DAF91 0.70
DAF96 1.00
DC70 1.75
DC90 1.20
DCX4-1000 12.00
DCX4-5000 25.00
DET16 28.50
DET18 28.50
DET23 35.00
DET24 39.00
DET25 22.00
DF91 0.70
DF92 0.60
DF96 0.65
DF97 1.00
DH63 1.20
DH77 0.90
DH79 0.56
DH149 2.00
DK91 0.90
DK92 1.20
DL35 2.50
DL63 1.00
DL70 2.50
DL73 2.50
DL91 1.50
DL92 0.95
DL93 1.10
DL94 2.50
DL96 2.50
DLS10 13.50
DLS16 10.00
DM70 1.95
DM160 2.75
DY51 1.50
DY86/87 0.65
DY802 0.72
E80CF 11.00
E80F 16.50
E81CC 3.15
E81L 12.00
E82CC 3.50
E83CC 3.50
E83F 5.50
E86C 9.50
E88C 7.95
E88CC 1.50
E88CC Siemens Special 5.95
E90CC 7.95
E90F 7.95
E91H 4.50
E92CC 3.95
E99F 6.95
E130L 25.00
E180CC 9.50
E182CC 8.00
E180F 6.50
E186F 6.50
E188CC 7.50
E280F 19.50
E283CC 10.00
E288CC 13.50
E55L 42.00
E810F 25.00
E1148 1.00
E1524 6.95
EA50 1.00
EA76 1.95
EA79 1.95
EAA91 0.60
EABC80 0.70
EAC91 2.50
EAF42 1.20
EAF801 2.00
EB34 1.50
EB41 3.95
EB91 0.85
EBC33 2.50
EBC41 1.95
EBC81 1.50
EBC90 0.90
EBC91 0.90
EB91 0.60
EBF80 0.65
EBF83 0.65
EBF85 0.95
EBF89 0.70
EBF93 0.95
EBL1 2.50
EBL21 2.00
EC52 0.75
EC70 1.75
EC80 9.50
EC81 7.95
EC86 1.00
EC88 1.00
EC90 1.10
EC91 5.50
EC92 1.95
EC93 1.50
EC95 7.00
EC97 1.10
EC157 439.50
EC8010 12.00
ECC32 3.50
ECC33 3.50
ECC35 3.50
ECC81 1.15
ECC81 Special quality 1.95
ECC82 0.65
ECC82 Mullard 1.50
ECC82 Philips 1.95
ECC83 0.65
ECC83 Brimar 1.35
ECC83 Philips 1.95
ECC84 0.50
ECC85 0.75
ECC86 2.75
ECC88 0.95
ECC91 2.00
ECC180 0.72
ECC189 1.95
ECC801S 3.50
ECC803S 4.95
ECC804 0.60
ECC2000 12.00
ECF80 1.15
ECF82 1.15
ECF86 2.25
ECF200 1.85
ECF202 1.85
ECF801 0.85
ECF805 2.50
ECF806 10.25
ECH3 2.50
ECH4 3.00
ECH35 3.50
ECH42 1.50
ECH81 0.65
ECH83 0.75
ECH84 0.69
ECH2000 1.50
ECL80 0.60
ECL82 0.65
ECL81 0.55
ECL83 2.50
ECL84 0.74
ECL85 0.69
ECL86 0.80
ECL805 0.69
EF22 2.50
EF37A 2.00
EF39 1.10
EF40 4.50
EF41 3.50
EF42 3.50
EF50 2.50
EF55 4.95
EF70 1.20
EF71 1.50
EF72 1.20
EF73 1.00
EF80 0.55
EF83 3.95
EF85 0.50
EF86 2.25
EF86 Special quality 3.15
EF89 1.50
EF91 1.95
EF92 2.15
EF93 0.95
EF94 0.90
EF95 1.50
EF97 0.90
EF98 0.90
EF183 0.65
EF184 0.65
EF730 1.50
EF731 3.50
EF732 3.50
EF800 11.00
EF805S 13.50
EF812 0.65
EFL200 1.50
EH90 0.72
EK90 0.95
EL32 0.95
EL33 4.00
EL34 2.25
EL34 Mullard/Philips 4.50
EL36 1.95
EL37 9.00
EL38 4.75
EL41 3.50
EL42 2.00
EL81 6.95
EL82 0.58
EL83 5.95
EL84 0.75
EL85 4.50
EL86 0.65
EL90 2.15
EL95 1.75
EL153 12.15
EL183E 3.50
EL183P 3.50
EL90 1.75
EL500 1.40
EL504 1.40
EL509 5.25
EL519 6.95
EL802 3.65
EL821 8.50
EL822 12.95
EM1 9.00
EM4 9.00
EM80 0.70
EM81 0.70
EM84 1.65
EM85 3.95
EM87 2.50
EN32 16.50
EN91 1.50
EN92 4.50
ESU150 14.95
ESU872 25.00
EY51 0.90
EY81 2.35
EY83 1.50
EY84 5.95
EY86/87 0.60
EY88 0.50
EY91 5.50
EY500A 1.50
EY802 0.70
EZ35 0.75
EZ40 2.75
EZ41 2.15
EZ80 0.75
EZ81 0.75
EZ90 1.50
F6064 2.95
FW4/800 2.95
G55/1K 9.95
G180/2M 6.95
G232 Mullard 3.95
G240/2D 9.00
GC10B 17.50
GC10D 17.50
GC10/4B 17.50
GC10/4E 17.50
GC12/4B 17.50
GD86W 6.00
GDT120M 6.00
GN4 6.00
GN10 15.00
GR10G 4.00
GS10C 16.50
GS10H 12.00
GS12D 12.00
GT1C 14.00
GT1C S/S 13.00
GTE175M 9.00
GTR150W 1.00
GU20 35.00
GXU1 13.50
GXU3 24.00
GXU50SS 14.50
GY501 1.20
GY802 1.00
GZ30 1.00
GZ31 1.00
GZ32 1.00
GZ33 4.50
GZ34 2.50
GZ37 4.50
HAA91 1.50
HABC80 0.90
HBC90 0.80
HBC91 0.80
HF93 0.75
HF94 1.50
HK90 1.50
HL2K 4.95
HL23DD 4.95
HL90 0.70
HL92 1.50
H133/DD 3.50
HR2 4.00
HY90 1.00
HVR2 3.00
K3118 39.00
KR6/3 45.00
KT6C 7.00
KT33C 3.95
KT36 2.00
KT44 4.00
KT45 4.00
KT61 4.00
KT63 2.00
KT66/CV1075 special yellow sss pot 10.50
KT66 USA 6.95
KT66 GEC
KT77 Gold Lion 10.95
KT81 7.00
KT88 USA 10.95
KT88 Gold Lion 18.95
KTW61 2.50
KTW62 2.50
KTW63 2.00
KTZ63 2.50
L63 1.50
L102/2K 6.95
L120/2K 12.50
LB7-20 96.00
LS9B 6.95
M502A 60.00
M537A 60.00
M5143 155.00
M8079 6.00
M8082 7.50
M8083 3.25
M8091 7.50
M8096 3.00
M8098 5.50
M8099 5.00
M8100 5.50
M8136 7.00
M8137 7.95
M8161 6.50
M8162 5.50
M8163 5.50
M8190 4.50
M8195 6.50
M8196 6.50
M8204 6.50
M8223 4.50
M8224 2.00
M8225 3.50
ME1401 29.50
ME1402 29.50
ME1501 14.00
MH4 3.50
MHLD6 4.00
ML4 4.00
MS4B 5.50
MU14 3.50
N37 12.50
N78 9.95
OA2 0.95
OA2WA 2.50
OA3 2.50
OB2 0.85
OB2WA 2.50
OC2 2.50
OC3 1.50
OD3 1.70
OM4 1.00
OM5B 3.00
OM6 1.75
ORP43 2.50
ORP50 3.95
P61 2.50
P41 2.50
PABC80 0.60
PC86 0.75
PC88 0.75
PC92 3.50
PC97 1.10
PC800 1.10
PC900 1.25
PCC84 0.40
PCC85 0.54
PCC88 0.70
PCC89 0.70
PCC189 0.70
PCC805 0.70
PCC806 0.80
PCE82 0.80
PCF80 0.65
PCF82 0.60
PCF84 0.65
PCF86 1.20
PCF87 0.40
PCF200 1.50
PCF201 1.50
PCF800 0.40
PCF801 1.35
PCF802 0.60
PCF805 1.25
PCF806 1.00
PCF808 1.25
PCH200 1.50
PCL82 0.65
PCL83 2.50
PCL84 0.75
PCL85 0.80
PCL86 0.85
PCL800 0.80
PCL805 0.90
PD500 3.50
PD510 3.65
PEN25 2.00
PEN40DD 2.50
PEN45 3.00
PEN45DD 3.00
PEN46 2.00
PEO5-25 39.50
PEO5-40N 42.50
PFL200 0.95
PL21 2.50
PL36 0.95
PL38 1.50
PL81 0.72
PL81A 0.72
PL82 0.60
PL83 0.52
PL84 0.75
PL88 1.00
PL95 1.75
PL302 1.00
PL345 12.50
PL500 0.95
PL500 1.10
PL504 1.15
PL508 1.75
PL509 4.95
PL519 4.95
PL802 6.95
PL802T 3.50
PL820 2.95
PL5557 29.50
PL5727 2.50
PY32 0.80
PY33 0.50
PY81 0.70
PY82 0.70
PY83 0.70
PY88 0.65
PY500A 1.25
PY800 0.79
PY801 0.79
QB3-300 64.95
QB5-1750 139.50
QBL5-3500 405.00
QEO3-10 4.96
QE08-200 £145.00
QF40 65.00
QP25 1.00
QQEO2/5 19.50
QQEO3-12 7.95
QQEO3-20 35.00
QQEO6/40 45.00
QQVO2-6 19.50
QQVO3-10 Mullard 15.00
QQV03-10 5.50
QQVO2-6 19.50
QQVO3-10 Mullard 15.00
QQVO3-20A 28.00
QQVO3-20B 32.00
QQVO6-40A 27.50
QQVO7-50 63.50
QQZO3-20 42.50
QS75/20 1.50
QS75/40 3.00
QS92/1D 6.00
QS95/10 4.65
QS108/45 4.00
QS150/15 6.95
QS150/30 1.15
QS150/45 7.00
QS1200 3.95
QS1202 3.95
QS1203 4.15
QS1205 3.95
QS1206 3.95
QS1208 1.05
QS1207 0.90
QS1208 0.90
QS1209 3.15
QS1210 1.50
QS1211 1.50
QS1212 3.20
QS1213 6.00
QS1215 2.10
QS1218 5.00
QU37 9.50
QU37 11.50
QVO3-12 4.95
QVO5-25 1.75
QVO6-20 28.50
QV2-250C 45.00
QVO8-100 145.00
QY3-125 65.00
QY4-250 70.00
QY4-400 75.00
R10 4.00
R16 12.00
R17 1.50
R18 2.50
R19 2.50
R20 1.20
R1169 85.00
RG1-125 4.95
RG1-240A 14.50
RG3-250A 3.50
RG3-1250A 35.00
RK2K25 62.50
RK-20A 12.00
RL16 1.50
RPL16 12.00
RPY13 2.50
RPY43 2.50
RPY82 2.50
RR3-250 16.00
RR3-1250 35.00
RS613 45.00
RS685 54.95
RS686 52.15
S6F17 5.95
S6F33 2.95
S11E12 35.00
S30/2K 12.00
S104/1K 10.00
S109/1K 15.00
S130 5.95
S130/P 6.95
SC1/800 6.00
SC1/1100 6.00
SC1/1200 6.00
SC1/1300 6.00
SC1/2000 9.00
SD6000M 48.00
SP4B 4.95
SP41 6.00
SP42 3.00
SS501 35.00
ST11 1.50
STV280/40 11.95
STV280/80 19.95
SU42 4.95
TB2.5/300 85.00
TB2-300 45.00
TB3/2000 395.00
TBL-2-300 275.00
TBL2-500 395.00
TD1-100A 25.00
TD3-12 4.00
TP25 1.50
TSP4 7.00
TT11 1.50
TT21 45.00
TT22 45.00
TT100 87.00
TTR-31MR 85.00
TY2-125A 85.00
TY4-400 85.00
TY6-600W 365.00
TYS2/250 375.00
U18-20 2.75
U19 11.95
U24 2.00
U25 0.90
U26 0.90
U37 9.00
U41 6.95
U50 2.00
U82 3.00
U191 0.70
U192 1.00
U193 0.65
U251 1.00
U801 0.75
UABC80 0.65
UAF42 1.00
UBF80 0.60
UBC41 2.95
UBC81 1.50
UBF89 0.60
UBL21 1.75
UC92 1.20
UCC84 0.70
UCC85 0.60
UCF80 1.00
UCH21 1.20
UCH41 2.50
UCH42 2.50
UCH81 0.65
UCL82 1.75
UCL83 2.50
UF85 1.20
UF41 1.15
UF42 1.15
UF80 0.80
UF89 2.50
UL44 3.50
UL84 0.85
UU5 3.50
UU7 6.00
UU8 9.00
UY41 3.50
UY85 0.70
V235A/1K 250.00
V240C/2K 225.00
V241C/1K 195.00
V246A/2K 315.00
V339 3.50
VLS631 10.95
VP133 2.00
VR75/30 3.00
VR101 2.00
VR105/30 1.50
VR150/30 1.15
VT52 2.50
VU29 4.50
VU39 1.50
W77 6.00
W729 1.00
W739 1.50
X24 1.00
X66/X65 4.95
X76M 1.95
XC24 1.50
XC25 0.50
XFW47 1.50
XFW50 1.50
XG5-500 22.50
XL1-5V 1.50
XL626FT 7.50
XNP12 2.50
XR1-1600A 49.50
XR1-3200A 79.50
XR1-6400A 99.50
Y65 6.95
Y503 25.00
Y602 12.00
Y4070 130.00
YD1100 75.00
YJ1060 265.00
YL1000 9.50
YL1020 29.00
YL1030 59.50
YL1060 95.00
YL1070 195.00
YL1071 195.00
YL1290 59.50
Z77 1.20
Z303C 9.00
Z359 9.00
Z505S 15.00
Z520M 4.00
Z521M 6.00
Z700U 3.00
Z749 0.60
Z759 19.95
Z800U 3.00
Z803U 16.95
Z900T 3.50
ZA1000 12.50
ZA1001 1.50
ZA1002 1.50
ZC1040 8.00
ZM1005 6.00
ZM1020 8.95
ZM1021 8.00
ZM1023 7.95
ZM1041 14.00
ZM1082 9.00
ZM1084 10.00
ZM1177 9.00
ZM1202 55.00
ZM1263 4.00
ZM1612 3.00
1A3 4.50
1AC6 1.20
1B3GT 1.95
1B22 10.00
1B27 55.00
1B35A 29.50
1C5GT 2.50
1FO1 2.50
1G3GT 2.50
1K3GT 2.50
1N1 4.00
1N2 4.50
1P28 25.00
1N5GT 2.50
1P26 25.00
1S2 0.55
1S5 0.70
1T4 0.70
1U5 1.00
1X2B 1.40
1Z2 5.95
2B22 69.50
2C39A 32.50
2C39BA 39.50
2C40 37.00
2C42 29.50
2C51 0.75
2C53 32.00
2CY5 1.50
2B7 1.50
2D21 1.50
2D21W 2.50
2E22GY 45.00
2E26 7.95
2J42 93.00
2K25 27.50
2K25 Ray 75.00
2K26 95.00
2K29 250.00
2K56 250.00
3A108A 9.00
3A/107B 12.00
3A/109B 11.00
3A/110B 12.00
3A/141K 11.50
3A/147J 7.50
3A/167M 10.00
3A2 3.95
3A3A 3.95
3A4 1.10
3AL5 0.95
3AT2 3.35
3AU6 0.65
3B2 3.00
3B4 7.00
3B7 4.50
3B24 10.00
3B26 24.00
3B28 12.00
3BZ6 1.50
3C4 2.50
3C45 24.00
3CB6 1.50
3CN3A 2.50
3CS6 0.95
3CY5 1.50
3CX3 2.50
3D6 4.50
3D21A 29.50
3E22 49.50
3EH7 1.95
3EJ7 1.95
3W4GT 2.50
4B32 35.00
4B551B 115.00
4BQ7A 1.75
4BZ6 1.95
4-65A 59.00
4-125A 72.50
4-250A 79.50
4-400A 87.50
4C27 25.00
4C28 25.00
4CB6 1.95
4CX250B 49.00
4CX250B EIMAC £59.50
4CX250BM 75.00
4CX250K EIMAC 95.00
4CX350A 95.00
4CX350F 79.50
4CX1500B 395.50
4GS7 2.25
4GV7 2.25
4JC6A 2.95
4J52 75.00
4KT6 1.50
4X150A 35.00
5A/102D 9.50
5A152M 9.00
5A163K 10.00
5A170K 6.25
5A-208K 10.00
5A-180M 9.00
4AM8 4.15
5AM8 2.15
5AN8 1.20
5AR4 2.00
5AU4 1.50
5B.110M 10.00
5B-254M 14.50
5B-255M 19.50
5B255M 19.50
5B/256M 9.00
5B-257M 9.00
5B-258M 14.50
5C22 125.00
5R4GB 3.50
5R4GY 3.50
5T4 5.95
5U4G 2.95
5U4GB 3.50
5V4G 2.50
5Y3GT 1.95
5Z4GT 0.65
6/30L2 0.70
6A/203K 9.00
6A7 4.95
6A8G 1.50
6AC7 2.00
6AF4A 2.50
6AG5 1.50
6AG7 1.95
6AH6 2.50
6AJ4 2.00
6AJ7 2.00
6AK5 1.50
6AK6 2.50
6AL5 0.60
6AM4 3.25
6AM5 6.00
6AM6 1.50
6AN5 2.65
6AN8A 2.65
6AQ5 2.15
6AQ8 0.85
6AR5 5.95
6AR8 3.95
6AS5 1.50
6AS6 2.50
6AS7G 4.50
6AT6 0.75
6AT8 1.75
6AU4 2.00
6AU6 0.95
6AV6 0.75
6AW8A 2.50
6AZ8 5.95
6B7 2.50
6B8G 1.50
6BA6 0.95
6BA7 4.50
6BA8A 3.50
6BC8 1.00
6BE6 0.72
6BG6G 3.00
6BH6 1.95
6BH8 1.50
6BJ6 1.20
6BK4 4.00
6BK7A 1.95
6BL8 1.15
6BM8 0.58
6BN4 1.65
6BN6 1.65
6BN7 4.50
6BN8 3.95
6BQ5 0.75
6BQ7A 0.72
6BL7GTA 3.95
6BL8 1.15
6BR5 0.70
6BR7 4.95
6BR8 2.15
6BR8A 2.15
6BS7 5.50
6BW4 1.50
6BW6 5.35
6BW7 1.50
6BW8 4.00
6BX6 0.48
6BX7GT 3.50
6BZ6 2.50
6BZ7 2.95
6C4 1.10
6C5 1.95
6C6 2.50
6C8G 1.50
6C11 2.50
6C18 2.50
6CA4 4.95
6CA7 3.50
6CB5 3.95
6CB6 1.95
6CD6GA 4.50
6CF8 1.50
6CG7 2.25
6CH6 6.95
6CL3 3.95
6CL6 3.25
6CL8A 2.00
6CM5 2.95
6CM7 2.95
6CS6 0.75
6CS7 0.95
6CW4 6.50
6CY5 1.00
6CY7 2.95
6D6 2.50
6DC6 2.50
6DJ8 0.95
6DK6 1.15
6DQ5 5.95
6DQ6B 2.50
6DW4 2.15
6EA4 4.95
6EA7 2.50
6EA8 2.50
6EB8 1.75
6EM5 2.50
6EM7 2.50
6EU7 £1.95
6EU8 1.75
6EV7 2.95
6EW7 4.50
6EW6 1.50
6F1 2.00
6F5 4.95
6F7 5.50
6F6G 2.00
6F12 1.50
6F13 3.00
6F14 1.00
6F17 2.75
6F21 2.50
6F23 0.60
6F24 1.25
6F25 1.25
6F28 1.25
6F32 1.25
6F33 17.00
6FH8 12.50
6G6G 5.50
6GH8A 0.80
6GK5 1.50
6GK6 1.95
6GM6 0.95
6GS7 2.15
6GV7 2.50
6GW8 0.80
6H1 9.50
6H3N 1.10
6H6 1.95
6H6GT 1.95
6HB7 0.95
6HF5 5.50
6HF8 2.50
6HS8 1.95
6HZ6 2.65
6J4 2.15
6J4WA 3.15
6J5 2.50
6J6 2.05
6JB6A 3.95
6JE6C 4.95
6JM6 3.95
6JS6C 4.95
6JU8 2.50
6J7 2.50
6K7G 2.00
6K8Y/G 3.00
6KD6 5.50
6KM8 2.50
6KT8 2.95
6KZ8 1.95
6L1 2.50
5L19 3.95
6L6GC 2.95
6L6GC (GE) 4.50
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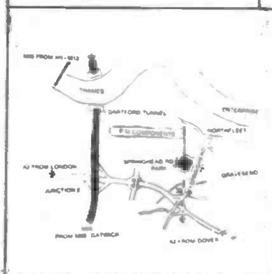

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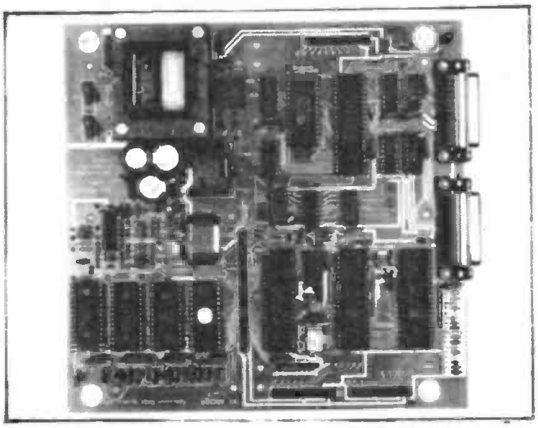

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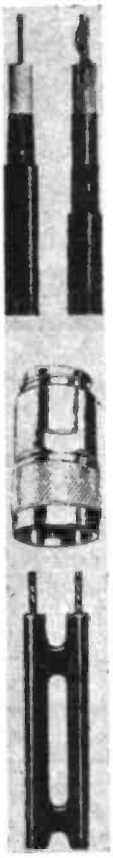

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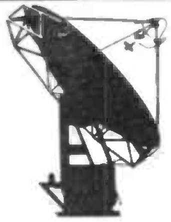

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Fig 1 *Symbols of 3-pin and 4-pin n-channel depletion mode MOSFETs*

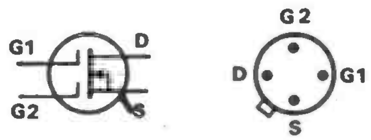


Fig 2 *Symbol and TO72 outline of the 3N140 and 40673 dual-gate MOSFETs*

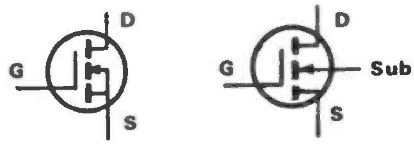


Fig 3 *Symbols of 3-pin and 4-pin enhancement mode MOSFETs*

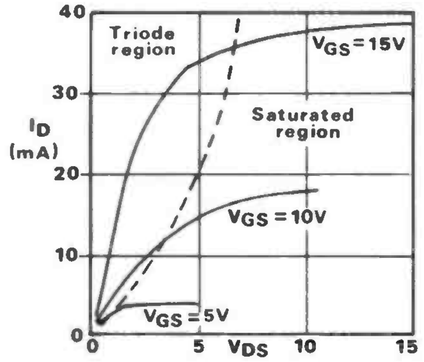


Fig 4 *Transfer characteristics of the 4007UB*

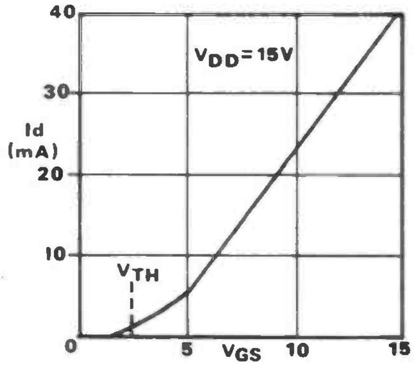


Fig 5 *V_{GS} /I_D characteristics of the 4007UB*

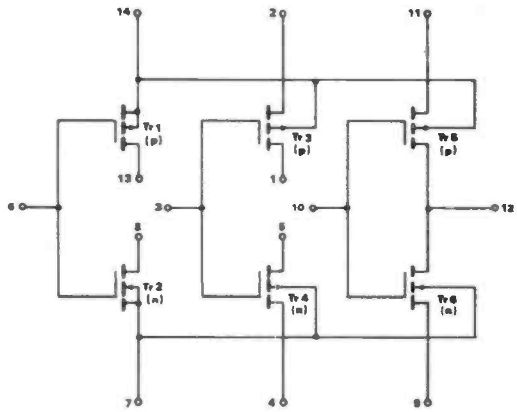


Fig 6 *4007UB dual CMOS pair plus inverter*

In the last two editions of *Data File* we discussed the basic principles of the field-effect transistor (FET), and then went on to take an in-depth look at 'usage' information and applications of the junction-type field-effect transistor, or JFET. In the present edition of 'The File' we continue the FET theme by taking an in-depth look at those low-power devices that are generally known as IGFETs or MOSFETs.

IGFET/MOSFET basics

The IGFET/MOSFET is basically a low-power general purpose '3-terminal' (gate, source, and drain) amplifier device featuring a near-infinite input impedance between its gate and source terminals. Signal voltages applied between the gate and source terminals control the magnitude of signal currents flowing between the drain and source terminals of the device. Typical device 'gain' or 'transconductance' sensitivity is of the order of a few milliamps of output current per volt of input signal.

In these 'near-infinite impedance' types of FET the gate terminal is actually insulated from the semiconductor body by a very thin layer of silicon dioxide, hence the title 'insulated gate field effect transistor', or IGFET. The devices generally use a 'metal-oxide silicon' semiconductor material in their construction, and are thus also known as 'MOSFETs'. It should be noted that IGFET and MOSFET are simply alternative names for the same device. Throughout the rest of this article, therefore, we will refer to these devices simply as MOSFETs.

In practical MOSFETs the semiconductor substrate of the device is sometimes made externally available, making a '4-terminal' device. In most cases, however, the substrate is internally connected to the source, and the MOSFET is thus produced as a '3-terminal' device, as already described.

Many early types of MOSFETs were designed to operate in the 'depletion' mode, like a JFET, and *Figure 1* shows the symbols that are used to represent the 3-pin and 4-pin n-channel versions of these devices (arrowhead directions are reversed to represent p-channel types). Depletion mode MOSFETs are used in precisely the same way as the JFET devices described last month and, with one exception, offer no significant advantages over the JFET. This one exception is the 'dual-gate' or 'tetrode' MOSFET, in which the drain-to-source currents can be controlled via either or both of a pair of input terminals. The best known examples of these devices are the 3N140 and 40673 n-channel types, which use the symbols and TO72 outlines shown in *Figure 2*.

The vast majority of modern MOSFETs operate as enhancement mode devices, in which the drain-to-source conduction path or channel is normally (with zero gate bias applied) closed, but can be opened by applying forward bias to the gate terminal. This 'normally open-circuit' action of the enhancement mode MOSFET shows in the standard symbol of the device, as shown in *Figure 3*, by the 'gaps' between the source and drain. This diagram shows the symbol for an n-channel device; the arrowheads are reversed to indicate p-channel devices.

Characteristics

Figure 4 shows the typical transfer characteristics of an n-channel enhancement mode MOSFET, and *Figure 5* shows the V_{GS} /I_D curves of the same device when powered from a 15 volt supply. Note that no significant I_D current flows until the gate voltage rises to a 'threshold' (V_T) value of a few volts, but that beyond this value the drain current rises in a near-linear fashion.

Also note that the *Figure 4* graph is divided into two characteristic regions, as indicated by the dotted line, these being the 'triode' region and the 'saturated' region. In the triode region the device acts like a voltage-controlled resistor. In the saturated region it acts like a voltage-controlled constant-current generator.

One very important practical point to note about MOSFET devices is that, because of their very high input impedances, they are very vulnerable to damage from even very low power electrostatic discharges; for this reason MOSFETs are often (but not always) provided with internal protection via integral diodes or Zeners.

The 4007UB

The easiest way to learn about any electronic device is to get actual 'hands-on' experience of it, and the cheapest way to get hands-on experience of enhancement mode MOSFETs is to buy a 4007UB chip. This device is the simplest member of the popular CMOS digital IC range, and actually houses six useful MOSFETs in a single 14-pin DIL package.

Figure 6 shows the functional diagram and pin numbering of the 4007UB, which contains two complementary pairs of independently accessible MOSFETs, plus a third complementary MOSFET pair that is connected in the form of a standard CMOS inverter stage. Each of the three independent input terminals of

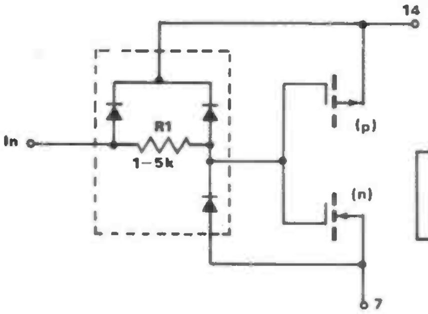


Fig 7 *Internal input protection network (dotted) on each 4007UB input*

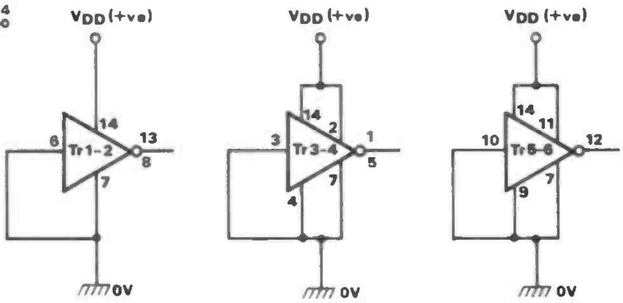


Fig 8 *4007UB complementary pairs can be disabled by connecting as inverters and grounding their inputs*

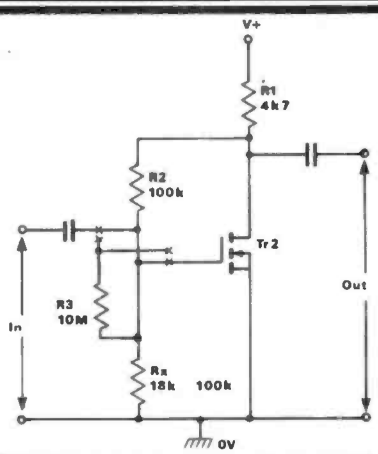


Fig 9 *Medium input impedance linear inverting amp (reconnect between crosses for high impedance)*

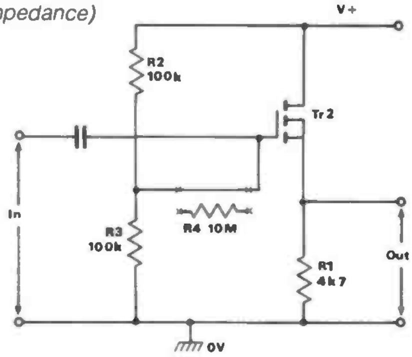


Fig 10 *Unity gain non-inverting amplifier*

the IC is internally connected to the standard CMOS protection network shown in *Figure 7*. Within the IC, Tr1, Tr3 and Tr5 are p-channel MOSFETs, and Tr2, Tr4 and Tr6 are n-channel types. Note that the 'performance' graphs of *Figures 4* and *5* actually apply to the individual n-channel devices within this CMOS IC.

Usage

The term 'CMOS' actually stands for 'complementary metal oxide silicon' field-effect transistors, and it is fair to say that all CMOS ICs are designed around the simple basic elements shown in *Figure 6*. It is thus worth getting a good basic understanding of these elements, and this subject will be discussed in depth shortly. First, however, let's discuss the basic 'usage' rules of the 4007UB.

These rules are quite simple. In any specific application, *all* unused elements of the device must be disabled. Complementary pairs of MOSFETs can be disabled by connecting them as standard CMOS inverters (ie, gate-to-gate and source-to-source) and tying their inputs to ground, as shown in *Figure 8*. Individual MOSFETs can be disabled by tying their source to their substrate and leaving the drain open-circuit.

In use, the input terminals must not be allowed to rise above V_{DD} (the supply voltage) or below V_{SS} (zero volts). To use an n-channel MOSFET, the source must be tied to V_{SS}, either directly or via a current-limiting resistor. To use a p-channel MOSFET the source must be tied to V_{DD}, either directly or via a current-limiting resistor.

Linear operation

To fully understand the operation of CMOS circuitry it is vital to understand the linear characteristics of basic MOSFETs. *Figure 5* shows the typical gate voltage to drain current graph of an n-channel enhancement mode MOSFET. Note that negligible drain current flows until the gate voltage rises to a 'threshold' value of about 1.5 to 2.5 volts, but that the drain current then rises almost linearly with further increases in the gate voltage.

Figure 9 shows how to connect an n-channel 4007UB MOSFET as a linear inverting (common-source) amplifier. R1 serves as the drain load of Tr2, and potential divider R2-Rx biases the gate so that the device operates in the linear mode. The Rx value must be selected to give the desired quiescent drain voltage; it is normally in the range 18k to 100k. This circuit can be made to give a very high input impedance by wiring a 10M isolating resistor between the R2-Rx junction and the gate of Tr2, as shown.

Figure 10 shows how to connect the n-channel MOSFET as a unity gain non-inverting (common-drain) amplifier or 'source follower'. The MOSFET gate is biased at half-supply volts by the R2-R3 potential divider, and the source terminal automatically takes up a quiescent value that is slightly more than V_T below the gate value.

Higher impedance

The basic *Figure 10* circuit has an input impedance equal to the paralleled values of R2 and R3 (= 50k), but this value can easily be increased to greater than 10M by wiring R4 as shown. Alternatively, the input impedance value can be raised to several hundred megohms by using the 'bootstrapped' source follower configuration shown in *Figure 11*, in which the Tr2 output signal is coupled back to the R2-R3 junction via C1 so that near-identical 'input' signals appear at each end of R4, which thus passes near-zero signal current and appears (to the input signals) as a near-infinite impedance.

Note from the above descriptions that the enhancement mode MOSFET performs like a conventional bipolar transistor, except that it has an ultra-high input impedance, a self-limiting drain-to-source current, and a substantially larger input-offset voltage than the bipolar transistor (the base-to-emitter offset of a bipolar is typically 600mV, while the gate-to-source offset of a MOSFET is typically 2V). Allowing for these differences the enhancement mode MOSFET can thus be used as a 'plug-in' replacement in virtually any small-signal bipolar transistor circuit.

The most important practical application of the enhancement mode MOSFET is in the basic 'complementary' or CMOS inverter stage of *Figure 12a*, in which an n-channel and a p-channel pair of MOSFETs are wired in series but share common input and output terminals. This simple looking circuit is specifically intended for use in digital applications, and forms the basis of the entire family of CMOS ICs. The circuit can, however, also be used in linear applications.

Figures 12b and *12c* show the 'truth' table and the circuit symbol of the basic CMOS inverter when used in the 'digital' mode, in which the input signal is at either a logic 0 or a logic 1 level. Here, with a logic 0 input applied Tr1 is shorted (fully on), so the output is firmly tied to the logic 1 (positive rail) level, but Tr2 is open (fully off) and the inverter thus passes zero quiescent current via this transistor. With a logic 1 input applied Tr2 is shorted and the output is firmly tied to the logic 0 (zero volt) state, but Tr1 is open and the circuit again passes zero quiescent current. This 'zero quiescent current' characteristic of the CMOS inverter is one of the most important features of the CMOS range of digital ICs.

Note that although the CMOS digital inverter consumes zero quiescent current, it *can* source (feed) or sink (absorb) significant current into or from external loads. Thus when the input is at logic 0 the output is effectively shorted (via Tr1) to the positive rail, so substantial current can feed (via Tr1) into a load connected between the output and the zero volt rail. When the input is at logic 1 the output is effectively shorted (via Tr2) to

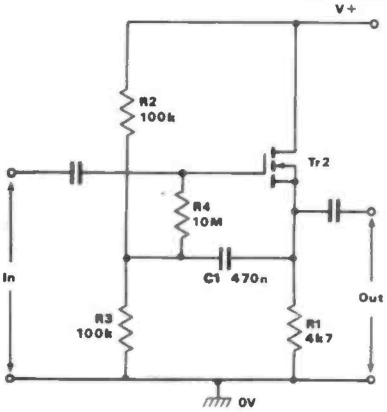
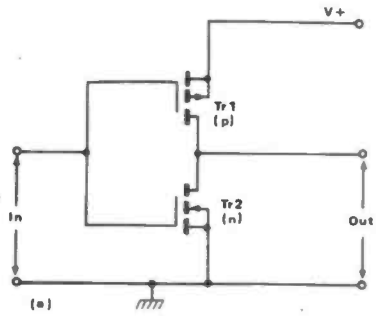


Fig 11 *Ultra-high input impedance bootstrapped source follower*



IN	OUT
0	1
1	0

(b)

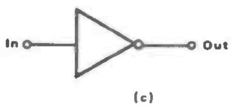


Fig 12 *Circuit, truth table and symbol of the basic CMOS digital inverter*

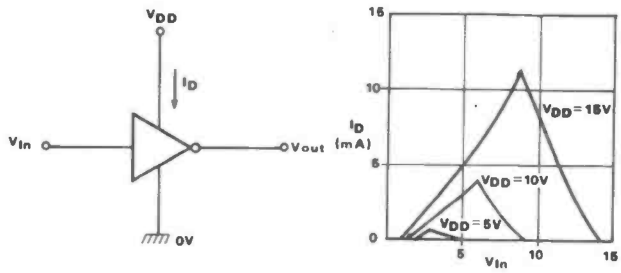


Fig 13 *Drain current transfer characteristics of the simple CMOS inverter*

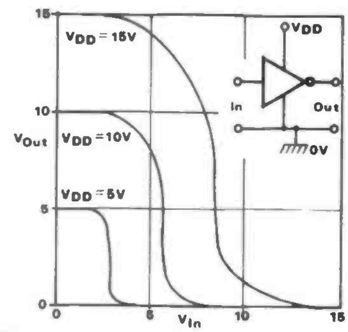


Fig 14 *Typical input to output voltage characteristics of the 4007UB*

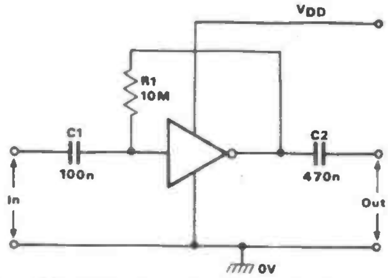


Fig 15 *Biasing the simple CMOS inverter for linear operation*

the zero volt rail, so substantial currents can be absorbed (via Tr2) from a load connected between the output and the positive supply rail. This is another very important feature of the CMOS digital inverter circuit. Note that Tr5 and Tr6 of the 4007UB IC are fixed-wired in this inverter configuration.

The CMOS inverter stage can be used in the linear 'inverting amplifier' mode by simply biasing its input terminal at a suitable value that is part way between the logic 0 and logic 1 levels. Under this condition Tr1 and Tr2 are both biased partly on, and the inverter thus passes a significant quiescent current. *Figure 13* shows the typical drain current transfer characteristics of the circuit under this condition. Note that the drain current is zero when the input is at zero or full supply volts, but rises to a maximum value (typically 0.5mA at 5 volts supply, or 10.5mA at 15 volts supply) when the input is at approximately half-supply volts, under which condition both MOSFETs of the inverter are biased on equally.

Figure 14 shows the typical input-to-output voltage transfer characteristics of the simple CMOS inverter at different supply voltage values. Note (on the 15V V_{DD} line, for example) that the output voltage changes by only a small amount when the input voltage is shifted around the V_{DD} and 0V levels, but that when V_{IN} is biased at roughly half-supply volts a small change of input voltage causes a large change of output voltage: under this latter condition the inverter typically gives a voltage gain of about 30dB when used with a 15 volt supply, or 40dB at 5 volts.

Practicalities

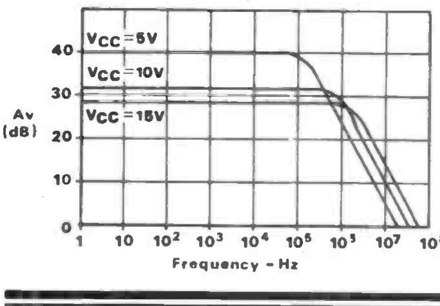
Figure 15 shows the practical circuit of a linear CMOS inverting amplifier stage. This circuit is biased automatically by wiring 10M resistor R1 between the input and output terminals, so that the output self-biases at approximately half-supply volts. *Figure 16* shows the typical voltage gain and frequency characteristics of this circuit when operated at three alternative supply rail values. This graph assumes that the amplifier output is feeding into the high impedance of a 10M/15pF 'scope probe etc, and under this condition the circuit has a bandwidth of 2.5MHz when operated from a 15 volt supply.

As would be expected from the voltage transfer graph of *Figure 14*, the distortion characteristics of the CMOS linear amplifier are not outstandingly good. Linearity is quite good with small amplitude signals (output amplitudes up to 3 volts peak to peak with a 15V supply), but the distortion then increases progressively as the output approaches the upper and lower supply limits. Unlike a bipolar transistor circuit the CMOS amplifier does not 'clip' excessive sine-wave signals, but progressively rounds off their peaks.

Figure 17 shows the typical drain current versus supply voltage characteristics of the CMOS linear amplifier. The current typically varies from 0.5mA at 5 volts to 12.5mA at 15 volts supply.

In many applications the quiescent supply current of the 4007UB CMOS amplifier can usefully be reduced, at the cost of reduced amplifier bandwidth, by wiring external resistors in series with the source terminals of the two MOSFETs of the CMOS stage, as shown in the 'micropower' circuit of *Figure 18*. This diagram also shows the measured effects that different resistor values have on the drain current, voltage gain and bandwidth of the amplifier when it is operated from a 15 volt supply and has its

Fig 16 *Typical Av and frequency characteristics of the linear mode CMOS amplifier (shown right)*



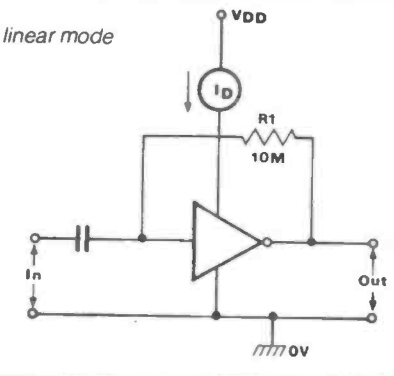
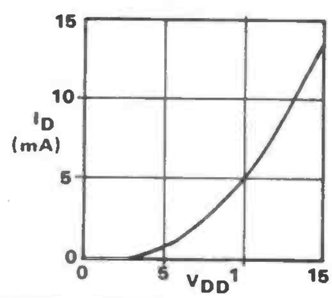


Fig 17 *Typical I_D/V_{DD} characteristics of the linear mode CMOS amplifier*



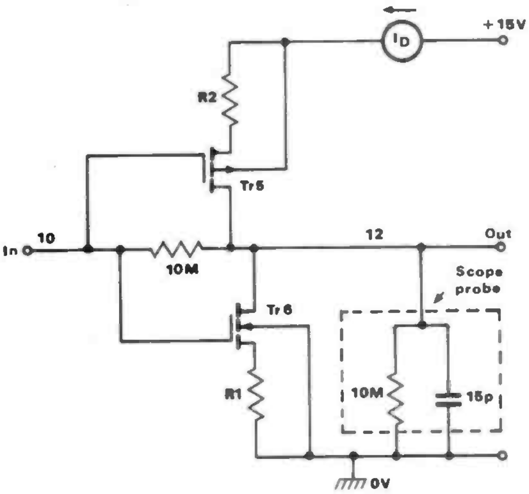


Fig 18 *Micropower 4007U6 CMOS linear amplifier*

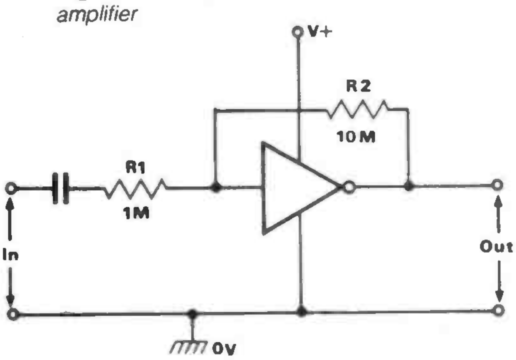


Fig 19 *Linear CMOS amplifier wired as a ×10 inverting amplifier*

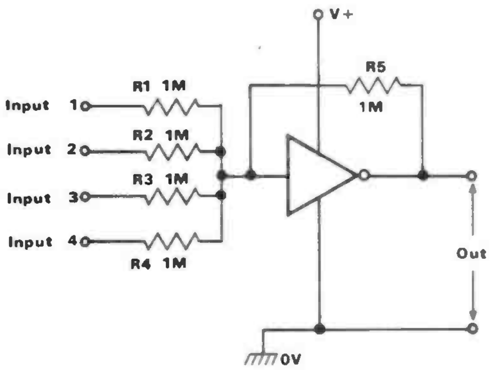


Fig 20 *Linear CMOS amplifier wired as a unity-gain 4 input audio mixer*

output loaded by a 10M/15pF oscilloscope probe.

It should be noted that the additional resistors of the *Figure 18* circuit increase the output impedance of the amplifier (the output impedance is roughly equal to the R1-Av product), and this impedance and the external load resistance/capacitance has a great effect on the overall gain and bandwidth of the circuit. When using 10k values for R1, for example, if the load capacitance is increased from 15pF to 50pF the bandwidth falls to about 4kHz, but if the capacitance is reduced to 5pF the bandwidth is increased to 45kHz.

R1	I_D (mA)	Av (V_{IN} / V_{OUT})	Upper 3dB bandwidth
0	12.5mA	20	2.7MHz
100R	8.2mA	20	1.5MHz
560R	3.9mA	25	300kHz
1k0	2.5mA	30	150kHz
5k6	600μA	40	25kHz
10k	370μA	40	15kHz
100k	40μA	30	2kHz
1M0	4μA	10	1kHz

Performance details for Figure 18

Similarly, if the resistive load is reduced from 10M to 10k, the voltage gain falls to unity. For significant gain, the load resistance must be large relative to the output impedance of the amplifier.

The basic (unbiased) CMOS inverter stage has an input capacitance of about 5pF and a near-infinite input resistance. Thus if the output of the *Figure 18* circuit is fed directly to such a load, it will show a voltage gain of about 30 and a bandwidth of 3kHz when R1 has a value of 1M; it will even give useful gain and bandwidth when R1 has a value of 10M, but will consume a quiescent current of only 0.4μA!

Practical CMOS

The CMOS linear amplifier can easily be used, in either its standard or micropower forms, to make a variety of fixed-gain amplifiers, mixers, integrators, active filters, oscillators etc. A short selection of such circuits is shown in *Figures 19* to *23*.

Figure 19 shows the practical circuit of a ×10 inverting amplifier. The CMOS stage is biased by feedback resistor R2, and the voltage gain is set at ×10 by the R2/R1 ratio. The input impedance of the circuit is 1M, and equals the R1 value.

Figure 20 shows how the above circuit can be modified for use as an audio 'mixer' or analogue voltage adder. The circuit has four input terminals, and the voltage gain between each input and the output terminal is fixed at unity by the relative values of the 1M input resistor and the 1M feedback resistor. *Figure 21* shows how the basic CMOS amplifier can be used as a simple integrator.

Figure 22 shows how the linear CMOS amplifier can be used as a crystal oscillator. Here the CMOS amplifier is linearly biased via R1 and provides 180° phase shift, and the Rx-C1-Xtal-C2 pi-type crystal network provides an additional 180° of phase shift at the crystal resonant frequency, thereby causing the circuit to oscillate. If the user simply wants the crystal to provide a frequency accuracy within 0.1% or so, Rx can be replaced by a short and C1-C2 can be omitted. For ultra-high accuracy, the correct values of Rx-C1-C2 must be individually determined (the diagram shows the typical range of values).

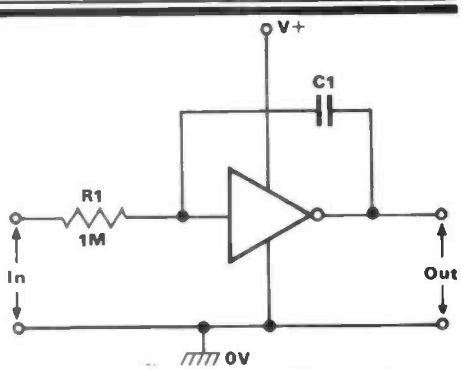


Fig 21 *Linear CMOS amplifier wired as an integrator*

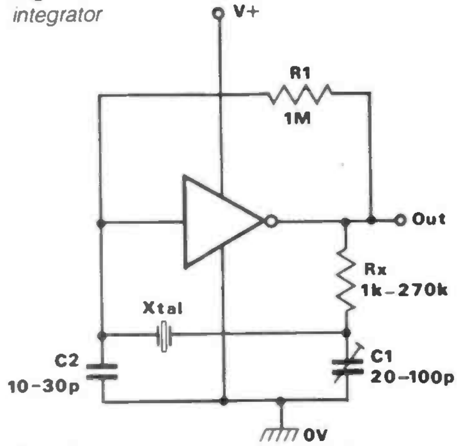


Fig 22 *Linear CMOS amplifier wired as a crystal oscillator*

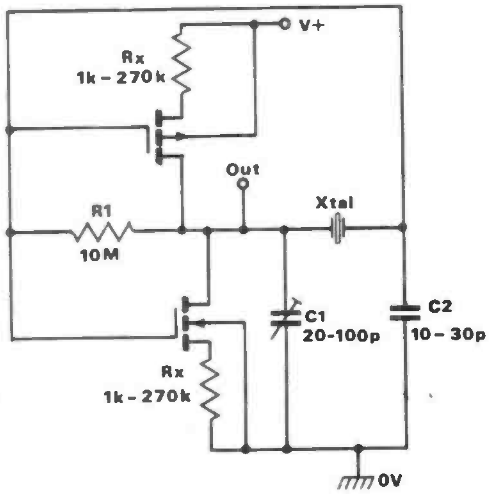


Fig 23 *'Micropower' version of the crystal oscillator*

Finally, to complete this edition of *Data File*, *Figure 23* shows a 'micropower' version of the CMOS crystal oscillator. In this case Rx is actually incorporated in the amplifier. If desired, the output of this oscillator can be fed directly to the input of an additional CMOS inverter stage for improved waveform shape/amplitude.

Next month

In next month's edition of *Data File* we conclude the present FET mini-series by looking at practical VMOS power amplifier circuits.

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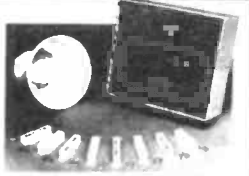

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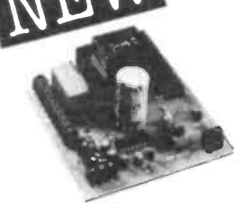

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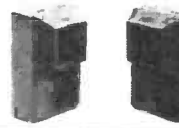

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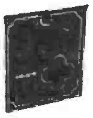

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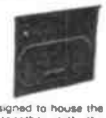

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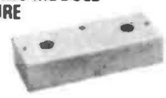

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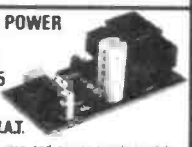

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When this ATU was built, it was decided to incorporate a dummy load, SWR meter, watt meters, outlets for several aerials, and an outlet so that the transmitter output could be monitored on an oscilloscope. The result is shown in *Figure 1*, none of the circuits being original. For descriptive purposes, the circuit is divided into sections as they are basically independent.

Tuning unit

This comprises L, CV1, CV2, C1 and switch S1 and is based on a circuit published in an old ARRL handbook (1). The variable capacitors CV1, (two gang) and CV2, (single) were obtained at a rally: they came out of the old T1154 transmitter and measured 150pF per section. Unfortunately there was insufficient capacity for 80 metres, so C1, also obtained at a rally, is switched into circuit for this band. This will not be required if CV2 is at least 200pF.

The coil is 2 inches in diameter with 19 turns at 4mm centres (6.35 turns per inch) tapped at ⅞ turn (28 and 24MHz), 2 turns (21 and 18MHz), 3 turns (14 and 10MHz) and 8½ turns (7MHz) from the earth end of the coil. Switch S1 is the band switch, which also allows for switching out this circuit for direct connection to the aerial and also connection to the dummy load. A dummy load was incorporated, but S4 allowed the choice of using an external dummy load. S4 should be a slide switch to minimise switch capacitance.

SWR meter

Many circuits have been published for the RF sampling. Any of them will be suitable as long as they have a toroidal core transformer. Strip line circuit output varies with frequency as well as power and cannot be used if power measurements are required. Transformer T1 comprises 16 double turns of 28swg enamelled wire wound on a small toroid such as Amidon T-50 2-Mix Red (1 to 30MHz), with the end of one winding connected to the start of the other winding to form the centre tap. The primary is a short length of coaxial cable through the centre with the screen earthed at one end only to form a Faraday screen. The OA91 diodes must be a matched pair. Switch S3a selects 'forward' or 'reflected'.

To adjust this circuit, switch S1 to dummy load and S3 to SWR forward. Adjust RV3 for full scale deflection on the meter. Switch S3 to reflected and adjust CV3 for zero reading on the meter. In practice it may not be quite zero as there may be a very slight SWR on the dummy load.

Switching arrangements

All the switches in *Figure 1* are shown in position 1, and their functions, starting from that position, are:

S1 3.5; 7; 10/14; 18/21; 24/28MHz; antenna direct; dummy load.

S2 Antennas 1; 2; 3; 4.

S3 Low PEP watts; low watts; SWR forward; SWR reflected; high watts; high PEP watts.

S4 Internal dummy load; external dummy load.

Wattmeter

Although the meter is calibrated in watts it actually measures voltage, which is proportional to wattage as long as the RF head 'sees' an impedance of 50 ohms, which it will do as long as the SWR is 1:1. S3 selects scales of either 100 or 500 watts.

PEP wattmeter

Many circuits have been published but this is probably the simplest. Voltage from the RF head is used to charge up C8, D3 preventing any return. R5 allows C8 to

COMPONENTS

Resistors

R1	50R dummy load
R2	68R 2W
R3	560R ½W
R4	10k ½W
R5	2M2 ½W
R6,7	220R ½W
RV1,2,4,5	22k preset pot
RV3	25k panel mounting pot
RV6	10k preset pot

Capacitors

C1	33pF 4kV
C2	10pF 4kV
C3	220pF mica
C4,5	1000pF ceramic
C6,7	10nF ceramic
C8	3.3μF tantalum
C9,10	100μF 25V electrolytic
CV1	150+150pF transmitting type
CV2	150pF transmitting type
CV3	450pF compression preset
CV4	50pF small variable

Semiconductors

D1,2	OA91 matched pair
D3	1N4148
D4,5	1N4002 or equivalent
ZD1,2	9V1 400mW Zeners
IC1	LM741

Miscellaneous

Inductors	see text
T1	toroidal transformer – see text
T2	12V6 1A mains transformer
M1	500μA meter
S1	7-way 3-pole rotary ceramic
S2	4-way 1-pole rotary ceramic
S3	6-way 3-pole rotary ceramic
S4	SPDT slide switch

Co-ax sockets (SO239), 8-pin DIL socket, ¼in perspex 4×2½in for coil, 4oz 16swg tinned copper wire for coil, etc.

discharge, but as it is a very high value the discharge will be slow. The values of C8 and R5 can of course be varied to suit any required delay. The LM741 has a very high input impedance and prevents C8 from discharging through the meter. The power supply for the LM741 is a standard circuit. No switch has been shown as the ac mains is taken from the transceiver on/off switch.

Before connecting any input, the LM741 has to be adjusted for 'null'. Temporarily connect a meter to pin 6 (which is connected to pin 2) and earth. Switch on ac mains and adjust RV6 for zero output on the meter. Initially it may show either positive or negative output.

The table overleaf shows the calibration of the meter as percentage of full scale deflection. It can of course be calibrated for different wattage. The easiest way of preparing the new scale is to draw it out on a self-adhesive label, which can then be fixed to the existing scale. No adjustments are required for the SWR scale.

Meter calibration

To calibrate the wattmeter scales, an RF ammeter or RF voltmeter is required. Switch S1 to dummy load and S3 to low wattage (position 2). Apply power from the transmitter. Measure the voltage or current and calculate the power from the formula $W=I^2R$ or $W=V^2/R$ as appropriate, where R is 50 ohms. Adjust RV2 so that the meter reads this power.

***Fig 1** Circuit diagram of the ATU with dummy load and meters*

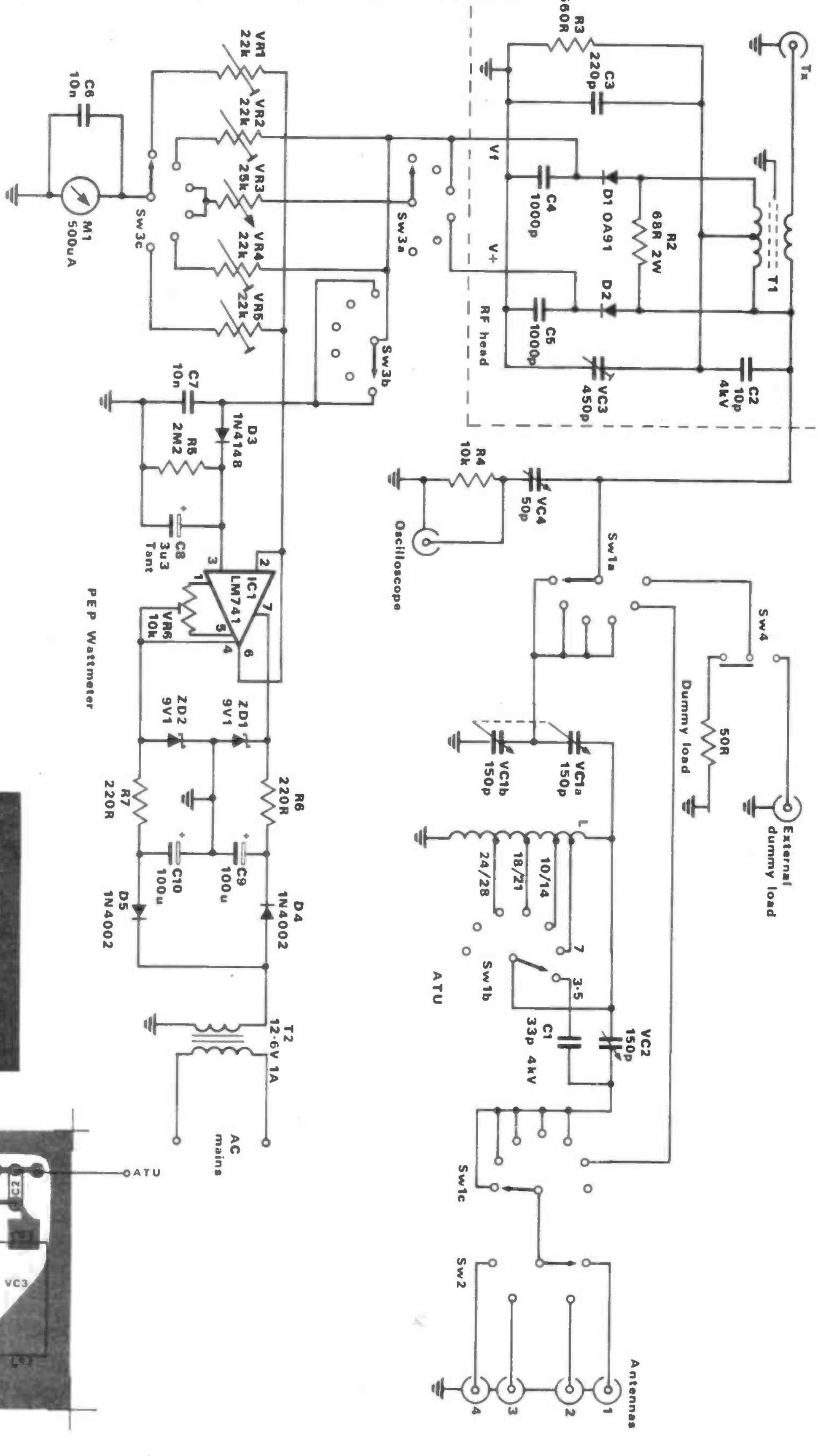
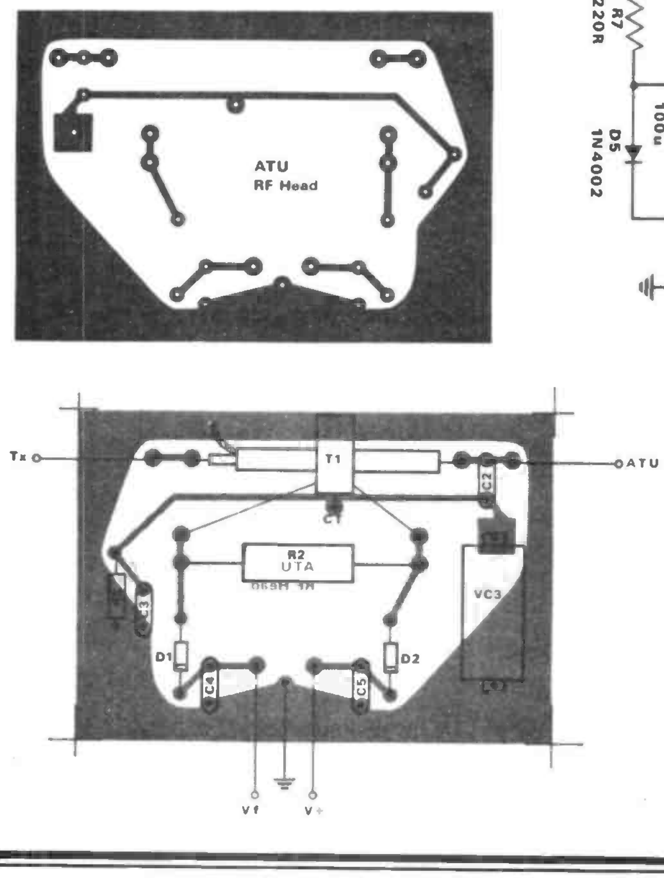


***Fig 2** RF head foil pattern and overlay*



With S3 switched to high wattage (position 5) repeat the process, but this time adjusting RV4. It is better to do this second calibration using a linear amplifier if one is available, but this is not essential.

Wattage and SWR scales as a percentage of the full scale deflection of the meter

Watts		% fsd	SWR	% fsd
5	25	22.5	1.0	0
10	50	31.5	1.1	5
15	75	38.5	1.2	9
20	100	44.5	1.3	13
25	125	50	1.4	16.5
30	150	55	1.5	20
35	175	59	1.6	23
40	200	63	1.7	26
45	225	67	1.8	28.5
50	250	70.5	1.9	31
55	275	74	2.0	33.5
60	300	77.5	2.5	43
65	325	80.5	3.0	50
70	350	83.5	4.0	60
75	375	86.5	5.0	66.5
80	400	89.5	10	82
85	425	92.5	Inf	100
90	450	95		
95	475	97.5		
100	500	100		

Numbers underlined are figured on the scale, the other points being marked

To calibrate the PEP wattmeter, a two-tone oscillator is required in addition to the RF voltmeter or ammeter. Connect this oscillator to the microphone input of the transmitter, which will be in the SSB mode instead of CW, switch S1 to dummy load and S3 to low PEP watts (position 1). Adjust RV1 for the calculated watts reading in a similar manner to the procedure for the wattage scale. Then with S3 switched to high PEP watts (position 6) adjust RV5, using a linear amplifier if available.

CV4 and R4 provide an outlet for connecting to the 'Y' plates of an oscilloscope in order to monitor transmissions. CV4 controls the height of the trace.

Construction

The coil was constructed using the method previously described in ***R&EW*** (2). It was mounted on two small aluminium brackets. The position of the taps have been found suitable for the many different types of aerials tried at one time or another, some of them being rather unusual.

The frames of CV1 and CV2 have to be insulated from the chassis. A simple way is to mount them using a nylon bolt with a nylon nut as a spacer. The shafts require insulated flexible couplers.

If difficulty is experienced in obtaining high voltage capacitors C1 and C2, they can be made out of double-sided copper-clad board. The usual paxolin based type measures about 15pF per square inch. The fibreglass board may differ slightly due to the different dielectric constant.

The RF head can be a printed circuit board as in *Figure 2*, but should be checked with the actual components to be used as they may be different in size, particularly CV3. Alternatively it can be built on a piece of Veroboard. It has to be shielded by mounting in an aluminium box and the connections to S3 should be in screened cable.

The PEP wattmeter circuit was constructed on a piece of Veroboard with the transformer mounted separately.

The whole ATU, including a 10¾ inch dummy load, was built into a case 12 × 12 inches and 4 inches high, the height matching that of the transceiver. And, of course, it cuts out individual pieces of equipment and their connecting cables.

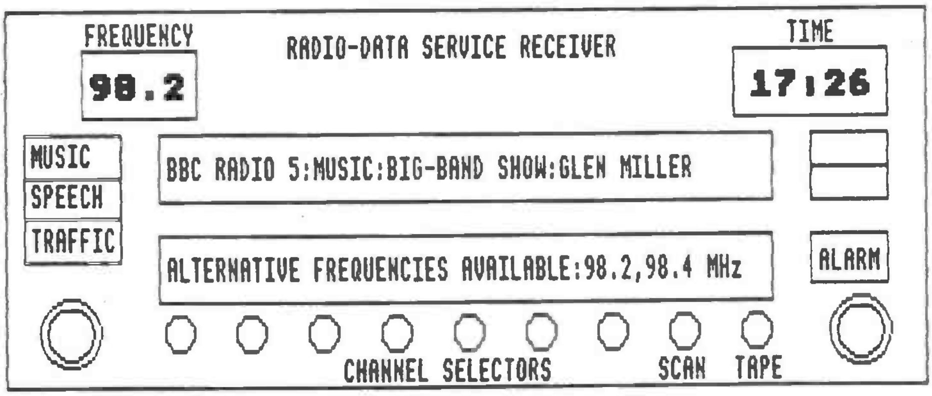
Bibliography

(1) ARRL Handbook, 51st Edition, 1974.

(2) *Radio & Electronics World*, September 1985.

RADIO DATA SYSTEMS

Before long it won't be just computer literate radio amateurs and businesses who transmit binary digits over the air. J N Slater describes plans for data transmission by broadcast companies

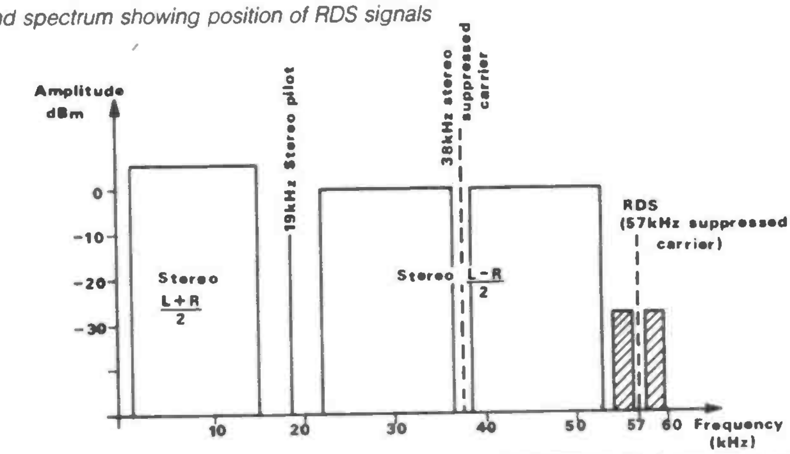


A statement by the BBC earlier this year that they are looking for partners to built a whole new generation of radio receivers, incorporating a wide range of facilities designed to make listening easier and to provide new services along with radio programmes, has turned the spotlight onto Radio Data Systems.

The Swedish Telecommunications Administration originally developed a Programme Identification System (PI), and after much discussion and several modifications the European Broadcasting Union has agreed on an extended Radio Data System (RDS) standard for Europe based on the Swedish system. In order to encourage manufacturers to make suitable receivers, 'RDS' is free of patents.

RDS uses digital data pulses which are inserted into the normal VHF/FM mono or stereo sound radio broadcasts, so that they are carried 'piggy-back' fashion on the radio programmes, rather as teletext signals are carried along with conventional television broadcasts. Unlike teletext signals, however, the RDS digital signals are carried by a low level 57kHz subcarrier (three times the frequency of the 19kHz pilot tone) which is amplitude modulated by the carefully shaped bi-phase coded data signals. The actual subcarrier is suppressed before transmission, giving rise to what is effectively a 2-phase, phase shift keyed signal with a phase deviation of ±90°. The RDS signals are completely inaudible to radio listeners, great care having been taken to ensure that the addition of the digital data does not interfere in any way with the normal high quality FM broadcast signals.

Baseband spectrum showing position of RDS signals



So what does it do?

The major features which the new system provides are automatic tuning to the stations of your choice, and the ability for the receiver to try various alternative frequencies carrying the wanted programme in order to ensure that optimum reception is always obtained. It has even been suggested that some receivers will be equipped with two separate front-ends, so that one of these can be feeding the received signal to the loudspeaker whilst the other is searching for the same programme on alternative channels, the switch-over to the best signal occurring automatically and inaudibly. Information about other networks can also be received at will.

RDS receivers will also have a small calculator-type display which can be used to give information about the station to which the radio is tuned, and even to give information about the actual programme. The system has been left flexible so that broadcasters should be able to send various types of message to suit the needs of the listener.

Programme type codes suggested by the EBU include:

0 No programme type is indicated
1 News
2 Current affairs
3 Magazine
4 Sport
5 For children
7 For young people
8 Religious
9 Drama, literature and feature
10 Pop and rock music
11 Light music
12 Serious music
13 Jazz
14 Folk music
15 Variety

Other codes have been left free to accommodate services that may be developed in the future, and code 31 has been reserved for 'emergency announcements made under exceptional circumstances to give warning of events causing danger of a general nature'. Could it be that 'thirty-one' will come to have a domesday ring about it?

Perhaps the fact that it is 13 reversed had something to do with the choice!

RDS provides for a two-state music/speech identifier code to be broadcast, so that an 'intelligent' receiver can be told to scan the broadcast bands for either music or talk programmes.

Time and date transmissions form part of the code, and together with the programme-item number code will provide listeners with the facility of being able to listen to or record a preselected programme.

Still more to come

Future extensions of RDS could include a nation-wide radio paging system to allow codes to be transmitted over the air which will alert your receiver, and only your receiver, to the fact that a message is waiting for you. The whole design of RDS has been arranged to provide the maximum possible flexibility.

The range of permitted options is wide, and data that can be transmitted includes:

- Programme identification (PI)
- Programme service name (PS)
- Programme type (PTY)
- Traffic programme identification (TP)
- Traffic announcement (TA)
- Alternative frequency available (AF)
- Music/speech code (M/S)
- Programme item number (PIN)
- Radiotext messages (RT)

Radiotext messages can be up to 64 characters long, and the coding is arranged so that if the display device on the receiver is less than 64 characters long the information will be displayed sequentially in a 'newsreel' fashion. Radiotext could be used to carry notes about the programme, such as the gramophone record number or the name of the orchestra, or special announcements about programme schedules. The BBC has even suggested that in the long term librettos could be transmitted along with the opera. Sufficient capacity has been reserved to transmit other forms of data, such as computer programs, which will probably not be intended for display on the receiver, but might be in a form suitable for providing a display on a television rather like a teletext display.

In car radios, where it might be undesirable for safety reasons to have a visual display, the radiotext transmissions could eventually be used to control a speech synthesiser; the mind boggles at the thought of a computer generated voice barking out instructions to terrified drivers!

Traffic news

RDS provides for a sophisticated set of traffic programmes and traffic announcements, and codes can be radiated to indicate one or more of three possible states:

1/ The station carries traffic announcements when they are required, but is not radiating an announcement at the moment.

2/ A traffic announcement is being carried on this station at present.

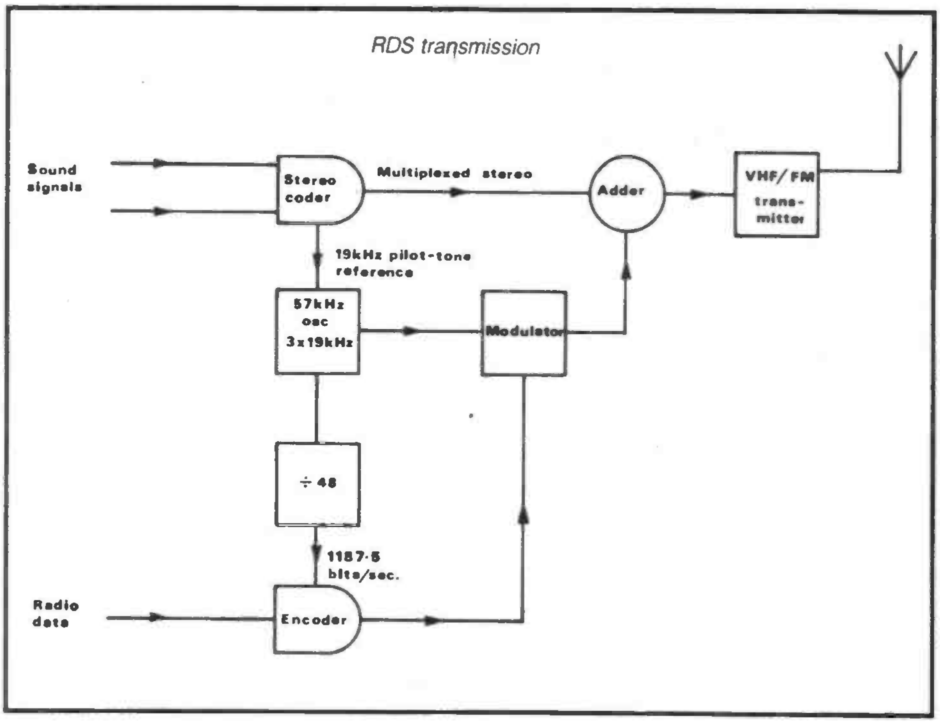
3/ This station does not carry traffic announcements.

This form of traffic information is fully compatible with the existing German ARI system of broadcast information for motorists, but has a much wider range of applications. The RDS coded signals could be used to automatically switch a car radio from its cassette playing mode to radio mode whenever a traffic announcement is made, and to restore the cassette programme at the end of the announcement, or even to switch on a 'switched-off' radio for the announcement. The designers of the RDS specification have tried to allow the system to cope with any future requirements, which makes it likely that all sorts of exciting new features will appear on the next generations of radio receivers.

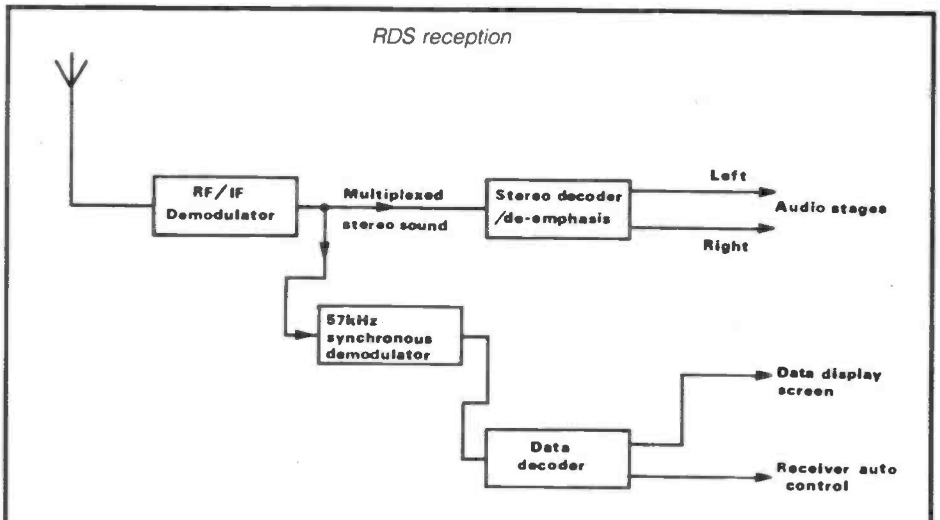
Coming soon

Several manufacturers, including Philips, are known to be developing receivers to make use of RDS transmissions, and it seems likely that only a few of the features will be incorporated on early models. Eventually there should be a whole range of RDS receivers available, with different radios offering a choice of various features at a choice of prices.

One thing seems certain, however; the injection of RDS data into our radio signals is going to put new vitality into the radio industry and should provide exciting new opportunities for the retail trade. REW

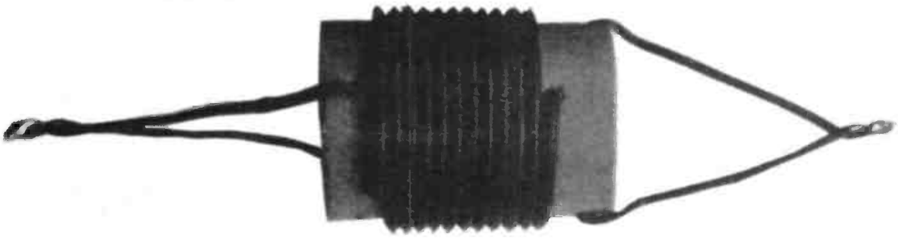


RDS transmission



RDS reception

TRAPS IN COAXIAL CABLE



G N Roberts G3ENY

with a novel approach to making traps for your aerials

For the mathematically minded, other equations used are as follows:

Equation 1
Total capacitance of a coaxial cable given the capacitance per foot, C_0

$$C_T = \frac{C_0 \pi N(D+T)}{12} \text{ (pF)}$$

where D=diameter of the former
T=diameter of the co-ax cable
N=number of turns

Equation 2
The standard formula for inductance

$$L = \frac{(D+T)^2 N^2}{18(D+T)+40NT} \text{ }(\mu H)$$

Equation 3
The resonant frequency

$$F_0 = \frac{1000}{2\pi\sqrt{LC_T}} \text{ (MHz)}$$

The trap dipole is a popular antenna used by many amateurs which enables multi-band working with a modest wire aerial, often an inverted Vee, supported in the centre and fed with co-ax and a balun. It can be designed to offer a good match to a modern bandswitched transmitter over a limited segment of two, three or four ham bands.

Simple but efficient

The purpose of this article is to show how simple but efficient traps can be made using readily available materials, and with the help of a home micro do the complicated sums involved.

The standard trap consists of a coil and discrete capacitor, a high voltage component, sealed against the weather, and this forms a simple parallel resonant circuit tuned to the trap frequency. The useful bandwidth over which the parallel resonant impedance is high enough to isolate the outer sections of the aerial is limited, and is proportional to the reactance of each element (both L and C) at the resonant frequency.

Co-ax for use in traps

Type	Capacitance per foot (pF)	OD
RG58/U	28.5	0.195
UR43	29.0	0.195
UR76	29.0	0.195
RG174/U	30.8	0.105

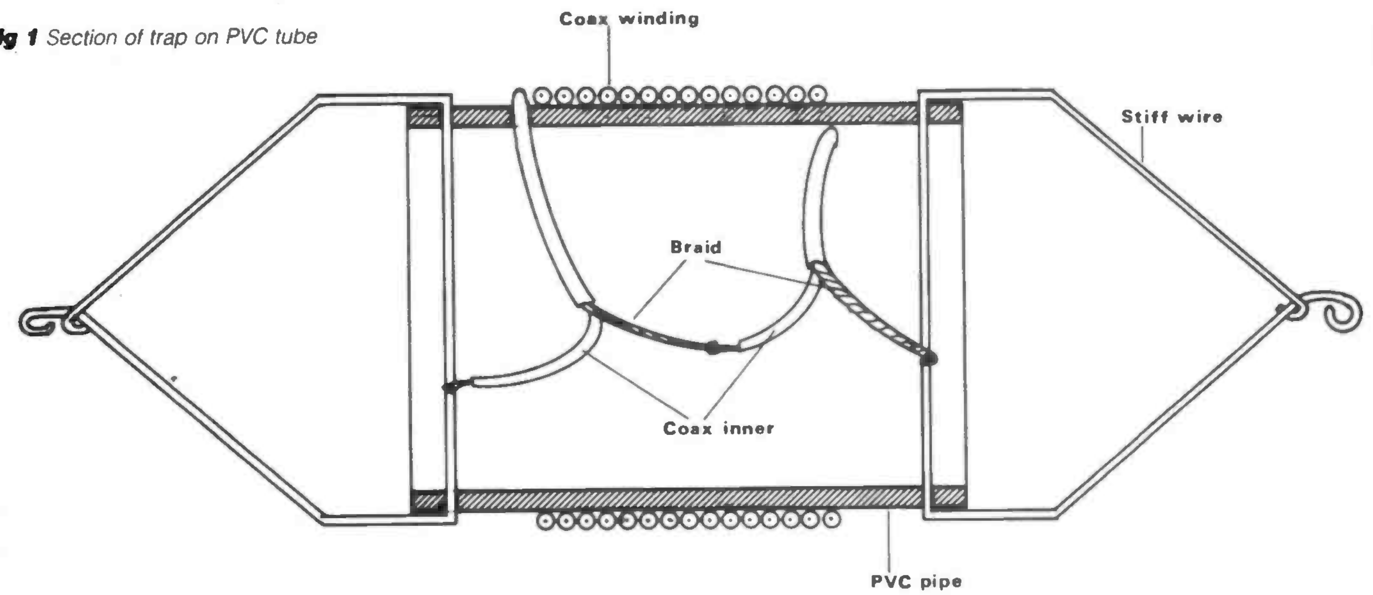
In the traps to be described those wound with miniature coaxial cable have a slightly greater bandwidth than those using standard UR43, and in each case the optimum design is that which uses the shortest length of cable to achieve resonance.

What a good idea

The clever idea of using a length of co-ax to act as both the inductance and capacitance of a resonant circuit is comparatively new to trap design, and the maths involved are quite formidable. You can resort to cut and try methods, but a micro will do the sums in seconds and you can design many more traps than you'll ever make!

Because the length of cable used not only determines the number of turns (inductance) of the coil but also the value of capacity in parallel, and hence the

Fig 1 Section of trap on PVC tube



frequency of resonance, the maths requires a cubic equation to be solved.

The cubic equation takes the form of:

$$ax^3 + bx^2 + cx + d = 0$$

where x= N (the number of turns)

$$a = (2\pi F)^2 (D + T)^3 \pi C_0$$

$$b = (2\pi F)^2 (D + T)^2 C_0$$

$$c = -480{,}000{,}000T$$

$$d = -216{,}000{,}000\ (D + T)$$

Given the diameter of the coil (D), the diameter of the co-ax (T), the capacity per unit length of the cable (C_0) and the frequency of operation (F), the cubic equation will solve for N, the number of turns. The coil diameter is limited to a certain extent by the available size of suitable formers, and a list of PVC pipe sizes is given for reference.

PVC pipe sizes

mm	in
22.5	0.88
33.0	1.3
34.6	1.36
41.0	1.6
50.0	1.96
54.0	2.12
63.0	2.48
75.0	2.59
82.6	3.25

Having selected the diameter of the former and determined the number of turns, the total length of cable can be found from:

$$L_T = N\pi(D+T)+1.25$$

adding an inch or so for tuning and wiring.

Not all values of D will solve in the cubic equation and as a general rule choose D to give a coil a little shorter than its diameter. Provision is made in the program to let you watch the micro working and if it gets stuck for an answer try another value.

Finishing touches

Having designed your trap (some examples are given), drill the former to take the exact number of turns and close-wind the co-ax cable as tightly as possible. Make off the ends as shown in *Figure 1*, the inner of one end to the outer of the other, and check the frequency with a GDO and a receiver tuned to the exact spot. Any adjustment can be made by trimming back the braid to decrease the capacity.

Seal with lacquer or your favourite potion and check again. It must be on frequency to work well. Working out the length of wire required beyond the trap to make the antenna resonate on the next lower frequency band is a problem which can also be solved on a micro, but that's another story! REW

```
10 REM COAXTRAP FOR SINCLAIR  BASIC BY G N Roberts.G3ENY FEB   85.
50 CLS
60 POKE 23658,8: REM Lock upper case
70 DIM A$(8,31)
75 PRINT AT 0,10;"* COAX-TRAP *"
80 PRINT "WHICH BAND IS THE TRAP FOR?"
90 FOR N=1 TO 8 STEP 1
100 LET A$(1)="1.) 3.5 MHz BAND ": LET A$(2)="2.) 7.  MHz BAND": LET A$(3)="3.) 10. MHz BAND ": LET A$(4)="4.)14. MHz "
: LET A$(5)="5.)18. MHz ": LET A$(6)="6.)21. MHz": LET A$(7)="7.)24  MHz ": LET A$(8)="8.)28. MHz"
110 LET A$(4)="4.) 14. MHz BAND ": LET A$(5)="5.) 18. MHz BAND ": LET A$(6)="6.) 21. MHz BAND": LET A$(7)="7.) 24  MHz
BAND ": LET A$(8)="8.) 28. MHz BAND"
120 PRINT AT 1+N+N,3;A$(N): NEXT N
125 INPUT "ENTER REQUIRED BAND 1 TO 8 * ";TR
126 IF TR>8 THEN  GO TO 125
130 PRINT '"MINIATURE COAX (APPX .1 DIA)'M' OR STANDARD    (APPX .2 DIA)'S'"
135 INPUT "ENTER 'M' OR 'S' ? * ";D$
136 IF D$<>"S" AND D$<>"M" THEN  GO TO 135
140 IF D$="S" THEN  CLS : PRINT AT 0,0;"STANDARD COAX.": GO SUB 895+(TR*10)
143 IF D$="S" THEN  GO TO 150
145 CLS : PRINT AT 0,0;"MINIATURE COAX": GO SUB 890+(TR*10)
150 INPUT "ENTER O/D OF YOUR FORMER                              IN INCHES * ";d
160 PRINT '"O/D OF FORMER= ";d;" INCHES"
170 LET d1=d
180 INPUT "ENTER O/D OF COAX IN INCHES                                    * ";t
190 PRINT '"O/D CABLE= ";t;" INCH"
200 LET T1=T
210 INPUT "ENTER CAPACITY IN PF PER FOOT    OF YOUR COAX.      * ";co
220 PRINT '"CAPACITY PER FOOT= ";co;" PF "
230 INPUT "ENTER FREQUENCY OF TRAP IN MHz          * ";fo
240 PRINT '"FREQUENCY= ";fo;" MHz"
245 REM Do the number crunch!
250 LET p=2*PI*fo
260 LET q=d+t
270 LET d=-216E6*q
280 LET c=-48E7*t
290 LET b=p^2*q^2*co
300 LET  a=p^2*q^3*PI*co
310 LET b=b/a
320 LET c=c/a
330 LET d=d/a
340 LET x=0
350 LET g=2*x*x*x+b*x*x-d
360 LET h=3*x*x+2*b*x+c
370 IF h=0 THEN  GO TO 410: REM x=x+1
380 IF ABS (x-(g/h))<1.e-8 THEN  GO TO 430: REM x=INT (xetc
390 LET x=g/h
395 PRINT AT 21,10;"WORKING= ";X
400 GO TO 350
410 LET x=x+1
420 GO TO 350: REM g=2*x*xetc
430 LET x=INT (x*100+.5)/100: LET N=X
440 IF x<1 THEN  CLS : PRINT "NO ANSWER TO THIS ONE.          PLEASE TRY ANOTHER SIZE FORMER.": GO TO 620
450 PRINT AT 15,3;N;" TURNS"
500 REM Find Total Length Coax
510 LET TL=INT ((PI*N*(D1+T1)+1)*1000+.5)/1000  : REM INS
520 PRINT AT 17,1;"  TOTAL COAX= ";TL;" INCHES."
530 PRINT AT 13,0;"   O/ALL LENGTH OF TRAP= ";INT ((T*N+1)*100)/100;""""
580 REM Find Inductance
590 LET ZI=(D1+T1)*(D1+T1)*N*N/(18*(D1+T1)+40*N*T1)
600 LET ZI=INT (ZI*100+.5)/100
610 PRINT AT 19,1;"  INDUCTANCE ";ZI;" MICROHENRYS"
620 INPUT "ANOTHER CALCULATION? Y/N  * ";B$: IF B$<>"Y" AND B$<>"N" THEN  GO TO 620
630 IF B$="Y" THEN  GO TO 1
640 IF B$="N" THEN  STOP
730 STOP
900 PRINT "FOR THE 3.5MHz BAND RECOMMENDED FORMER ABOUT 2.2 IN (55MM) DIA": RETURN : REM 900
905 PRINT "FOR THE 3.5MHz BAND RECOMMENDED FORMER ABOUT 3.2 IN (83MM) DIA": RETURN : REM 900
910 PRINT "FOR THE 7 MHz BAND RECOMMENDED  FORMER ABOUT 1.6 IN (41MM) DIA": RETURN
915 PRINT "FOR THE 7 MHz BAND RECOMMENDED  FORMER ABOUT 2. IN (50MM) DIA": RETURN
920 PRINT "FOR THE 10 MHz BAND RECOMMENDED FORMER ABOUT 1.3 IN (33MM) DIA": RETURN
925 PRINT "FOR THE 10 MHz BAND RECOMMENDED FORMER ABOUT 2.0 IN (50MM) DIA": RETURN
930 PRINT "FOR THE 14 MHz BAND RECOMMENDED FORMER ABOUT 1.3 IN (33MM) DIA": RETURN
935 PRINT "FOR THE 14 MHz BAND RECOMMENDED FORMER ABOUT 1.6 IN (41MM) DIA": RETURN
940 PRINT "FOR THE 18 MHz BAND RECOMMENDED FORMER ABOUT 1.1 IN (28MM) DIA.": RETURN
945 PRINT "FOR THE 18 MHz BAND RECOMMENDED FORMER ABOUT 1.36 IN (35MM) DIA.": RETURN
950 PRINT "FOR THE 21 MHz BAND RECOMMENDED FORMER ABOUT .87 IN (22MM) DIA.": RETURN
955 PRINT "FOR THE 21 MHz BAND RECOMMENDED FORMER ABOUT 1.36 IN (35MM) DIA.": RETURN
960 PRINT "FOR THE 24 MHz BAND RECOMMENDED FORMER ABOUT .7 IN (18MM) DIA.": RETURN
965 PRINT "FOR THE 24 MHz BAND RECOMMENDED FORMER ABOUT1.36 IN (35MM) DIA.": RETURN
970 PRINT "FOR THE 28 MHz BAND RECOMMENDED FORMER ABOUT .7 IN (18MM) DIA.": RETURN
975 PRINT "FOR THE 28 MHz BAND RECOMMENDED FORMER ABOUT 1.36 IN (22MM) DIA.": RETURN
1000 STOP
9000 CLS : SAVE "2" LINE 1
```

ATV ON THE AIR

Andy Emmerson G8PTH puts you in the picture

Two pieces of misinformation last time, neither intentional ... GB3UD, the Stoke-on-Trent TV repeater, did not come on air as predicted. Confidence is high, however, so watch this space for details of imminent switch-on. And straight from the horse's (or G4HCL's) mouth is an update on GB3PV, the proposed video box for Cambridge and the fenny areas surrounding. First of all, to clear up the misunderstanding, they have not applied for a kilowatt ERP licence. No, the initial application is for the normal 25 watts (in order not to prejudice the application), but subsequently they will request permission to run 1kW as an experiment. This latter may or may not be granted: if not, nothing has been lost, but there are indications that it may well be granted.

Apart from this, the proposal (to the repeater group's specifications, not the RSGB's) has now been fully approved by the RSGB and passed forward to the DTI for licensing. It is hoped that switch-on will be agreed before the middle of next year. G4GND, G4HCL and G4XHM have been out making propagation tests which indicate that the Madingley site initially proposed would be less than ideal. Concurrently a much better aerial site has been offered to the group in northern Cambridge, and this may turn out to be very good news!

In the mean time work is progressing on the construction of the repeater. G4XHM has been busy with the receiver and G4HCL is handling the transmitter and diplexing arrangements. G1MZI has donated a ZX-81 computer to generate text messages in the repeater. Thanks to the 'Hot Curry Lover' for this info – you can ring him on (0354) 740672 if you need more info or wish to join the Cambridgeshire Repeater Group.

Sundries from Solent

Constructors looking for a short cut to getting a 24cm transmit and receive system operational may appreciate being made aware of some commercial offerings. A little while back we dealt with some new goodies from Wood & Douglas, and it's time we took a closer look at established products from Solent Scientific (tel: (0703) 464675).

Alan Latham G8CMQ, who runs this outfit, offers four transmitter modules and one receiver kit. I have examined all of these and can recommend all as excellent value. There is a 10mW micro-transmitter (£34.95) for testing purposes, a 200mW transmitter (also £34.95) intended for 'creepy-peepy' portable use, a 1W sound and vision transmitter (£64.95), and a power amplifier to take the 1W up to 10W (£54.95). On the receive side there is a UHF FM receiver (£69.95) which goes with the 24cm converter I reviewed a few months back.

Comprehensive kits

All the kits are complete except for connectors and housing, and are designed to fit in die-cast boxes. The microtransmitter comes ready-made, however, and is essential for testing aerials, pre-amps and receivers. It is beautifully compact, and everyone I know who has seen one has bought one! The advertising says that it is the single most useful item that any 24cm TVer can have in the shack, and I would not disagree. It is not tunable and is supplied tuned on 1255MHz, but this is adjustable.

The 200mW job is vision only, but could have a Wood & Douglas sound modulator added – it is easy to assemble, following the instructions supplied.

The one-watter is in use at many stations and is deservedly popular. It is a little trickier to assemble but gives the stated output, which is very clean. Unlike another similar product this transmitter does not rely upon tripling a 70cm signal. Instead it produces a signal on the final frequency (which is adjustable internally), and the one I built was tested on a spectrum analyser and pronounced more than adequate.

While there is no frequency locking, stability is in fact very good. There is a fixed video pre-emphasis incorporated, and while this does not conform to the CCIR standards favoured by the BATC it seems to work. For the PA Alan guarantees 8 watts output and most examples achieve ten. This is without doubt the lowest cost 23/24cm PA on the market.

A different approach

Like the transmitter, the receiver takes a different approach from the rival Wood & Douglas product. In this case the complete 23/24cm band is converted to the UHF broadcast band as a block and the Solent FM receiver demodulates this to baseband sound and vision. This is a valid approach if no broadcast breakthrough occurs, and I can confirm this was not a problem on my sample. Plus points are switchable video de-emphasis, tunable audio subcarrier, adjustable video contrast, external audio volume control and provision for an S-meter. All these features work very well, except the tunable audio which I and others have found distinctly 'touchy'. Vision quality is better than a 'plain vanilla' W&D and identical to a W&D fitted with their new de-emphasis board.

Obviously people are going to question whether to buy the Solent or W&D receiver: neither is 100 per cent perfect, and in truth I do not believe the ultimate FM TV receiver has been built yet. In the mean time your choice will depend on price, features and your preference for technical principles and assembly of modules or everything on one board!

Incidentally, the Solent converter and receiver fit nicely inside the largest die-cast box in the STC Components range. Don't do as I did and place the S-meter dead centre on the side panel, with switches arranged symmetrically either side. After I had drilled all the small holes I realised there was a rib right behind where the meter was due to go! I don't enjoy metalwork at the best of times, and that was a pig of a job . . .

All the Solent kits use good quality components and come with comprehensive instructions: Alan also offers advice at the end of the phone line. Only the drawings let the products down: they are legible but they don't do justice to the quality of the kits.

Spooks and subversion

In the trade press two companies are now advertising micro TV cameras smaller than a pack of cigarettes. They run off 12 volts and employ CCD sensors instead of vidicons. The total size of one camera head (Micam) is 47×26×38mm, while the Regisbrook offering is 30×40×30mm. Any suitable D-mount lens can be used. These cameras are intended for industrial inspection in confined places, and are clearly ideal for discreet surveillance as well. They would also go nicely in radio-controlled helicopters and creepy-peepies, and the only thing militating against them is the price, which starts around £1000. For professional applications this is by no means excessive, but it does mean that we amateurs may have to wait a long time before these appear on the surplus market. I wonder what new miracle cameras will be devised by then!

From Germany comes a catalogue of all sorts of electronic bugs and gadgets. One is a combined micro TV camera and transmitter. The complete unit measures 120×200×60mm (excluding rubber duck antenna) and can be concealed in a brief-case or what have you. Range is up to 5km and frequency of operation is in the 200MHz range above Band III.

Japanese black boxes

Yes, they are now making TV transmitters, and I wonder how long it will be before some dealer imports them to the UK. They look very attractive in the pictures, but in fact they are out of step with our requirements. All the same, here are some details.

Adonis, best known for microphones, have a superbly styled 1W transceiver switchable between 1277.5 and 1286.5MHz for 79,800 yen. A receive-only converter to UHF-TV channels costs 14,800 yen. Another firm who make all manner of microwavey transverters and converters are offering a similar transceiver (1279.0+1285.0MHz) for 78,000 yen (300 of these to the pound). This latter transmitter comes complete with a VHS camera socket, so presumably these items are intended for mobile use. Finally the new Icom IC-1271 23cm multimode transceiver (FM/SSB/CW) has an optional ATV adaptor. All of this is for ancient modulation, so I hope no get rich quick importer brings them in here.

Sign-off

Look in your local Tandy store for a new 5 inch screen black and white portable TV. This covers all VHF and UHF TV bands and is switchable between UK and French systems. The price is around £89 and its styling is unusually smart, very similar to the JVC CX-610 to which it forms a logical partner. Sensitivity seems good and it may tune 70.

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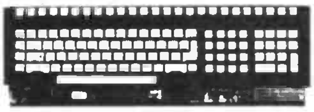

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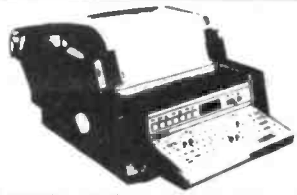

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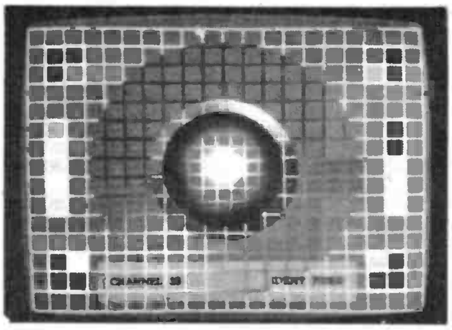
DX-TV RECEPTION REPORTS



Compiled by Keith Hamer and Garry Smith

The amount of sporadic-E activity decreased rapidly during September, indicating that the 1985 season was drawing to a close. There were, however, at least two days when the band really buzzed with DX; these were the 6th and 20th. The openings on both days were prolonged and certainly as good as any during the main part of the season.

The opening on the 6th produced signals via sporadic-E from Spain and Italy which lasted well into the evening. Tropospheric activity towards the middle of the month resulted in an interesting, although rather limited, display of signals in Band III and at UHF. Another period of enhanced trop conditions at the end of the month brought in very strong DX from West Germany. Reception was noted in East Anglia but very little was seen elsewhere in the UK according to reports.

DX logs for September

This month we are featuring two DX-TV logs. The first is from William Maries of Studley in Warwickshire. At the moment William has only a VHF Band I aerial, but even so he has managed to log several French stations on UHF.

1/9/85: NOS-1 on test with the PM5544 on channel E4 from Lopik (Netherlands).
5/9/85: TVE-1 (Spain) radiating the GTE colour test card on channels E2 and E4 at 1035 via sporadic-E.
7/9/85: TF-1 (France) with programmes, received on channels 22, 23 and 51 via enhanced tropospheric conditions; Antenne 2 (France, 2nd Network) with tennis from the USA during the late evening on E28 and E57; FR-3 (France) on E28 with programmes until close-down at 2230 BST; Canal Plus (France) with scrambled programmes on channels L5, L6 and L8 during the late evening.
8/9/85: NOS-1 on E4 with the PM5544 electronic test card.
9/9/85: Canal Plus during the evening with scrambled transmissions on L6 and L8.
10/9/85: Canal Plus on L6 via trop conditions with various programmes.
12/9/85: Canal Plus received for much of the day on channels L5, L6, L8 and L10; RTBF1 (French-language network in Belgium) on test with the PM5544 pattern on channels E8 and E11; NOS-1 on E4 from Lopik with the PM5544 test card; CST on R1 and R2 with the 'RS-KH' electronic test card via sporadic-E; unidentified French TV station on L22 at 1851 via trops.
22/9/85: Canal Plus noted at 1130 with very weak signals on channel L6.
27/9/85: Canal Plus during the early morning via trops on L6 and L8; TVS (UK) on E27 during the morning via improved trop conditions.
30/9/85: Antenne 2 on E43 floating with another station; unidentified French transmissions on channels E26 and E39.

Our other DX-TV log has been sent in by Kevin Jackson of Leeds. He too has noted quite a lot of French reception.

7/9/85: TDF (France) tf1 channel E46; TDF Antenne 2 E43; Canal Plus L9; RTBF1 (Belgium) E8.
8/9/85: Canal Plus L5, 7 and 9; RTBF1 E8; NOS2 (Netherlands) E27; BRT1 (Belgium) E10.
9/9/85: TDF tf1 E42; Canal Plus L5, 7 and 9; RTBF1 E8; NOS1 E5.
10/9/85: TDF Antenne 2 E34; Canal Plus L5, 6 and 9; RTBF1 E8 and E52; RTBF2 E49; NOS1 E6 and E39; RTE1 (Eire) IH; West Germany ZDF E34; W Germany HR1 E8.
11/9/85: TDF Antenne 2 E39; TDF tf1 E42; Canal Plus L5, 6, 7 and 9; RTBF1 E8 and 52; RTBF2 E49; BRT1 E43; BRT2 E46; West Germany ZDF E34, 35 and 37; West Germany HR1 E7 and 8; HR3 E37; West Germany WDR1 E9; West Germany NDR1 E10; NDR3 E43 and 53; West Germany BR3 E49; NOS1 E6 and 7; East Germany DDR: F1 E6; DDR: F2 E31 and 34.
12/9/85: TDF Antenne 2 E21, 34, 39, 43 and 48; TDF tf1 E27, 37, 42 and 46; TDF FR3 E40; Canal Plus L5, 7 and 9; NOS1 E29 and 39; NOS2 E27, 31, 45 and 53; RTBF1 E8 and 52; RTBF2 E42, 45 and 49; West Germany ZDF E21, 32, 34 and 37; West Germany WDR1 E46; West Germany WDR3 E48; West Germany HR1 E7; HR3 E54.
16/9/85: TDF Antenne 2 E39; Canal Plus L5, 7 and 9; RTBF1 E8.
17/9/85: TDF tf1 E42; Canal Plus L5 and 9; RTBF1 E8.
18/9/85: TDF tf1 E42; Canal Plus L5; BRT1 E10; RTBF1 E8.
19/9/85: TDF Antenne 2 E21, 34, 39 and 46; TDF tf1 E27, 42 and 43; TDF FR3 E40; Canal Plus L5, 7 and 9; RTBF1 E8.
20/9/85: Canal Plus L5; BRT1 E43; BRT2 E46.
23/9/85: TDF tf1 E27; Canal Plus L5, 7 and 9; RTBF1 E8; NOS1 E39; NOS2 E27; West Germany BR3 E49; W Germany HR3 E52.
24/9/85: TDF Antenne 2 E46; TDF FR3 E40; Canal Plus L7; BRT1 E43; BRT2 E46; NOS1 E6.
25/9/85: TDF tf1 E43; Canal Plus L5, 6, 7 and 9; RTBF1 E8; BRT1 E43; BRT2 E46; NOS2 E27.
26/9/85: TDF Antenne 2 E39; TDF tf1 E42; Canal Plus L5, 7 and 9; RTBF1 E8; NOS1 E39; BRT1 E10 and 43; BRT2 E46; West Germany NDR1 E53; NDR3 E43.
27/9/85: TDF Antenne 2 E39 and 48; TDF tf1 E42 and 43; TDF FR3 E45; Canal Plus L5, 7 and 9; RTBF1 E8; RTBF2 E42; BRT1 E43; BRT2 E46; NOS1 E39; NOS2 E27 and 45.
28/9/85: TDF Antenne 2 E34, 39 and 48; TDF tf1 E27, 42 and 54; Canal Plus L5, 7 and 9; RTBF1 E8; NOS2 E27.
29/9/85: TDF Antenne 2 E34, 39, 43, 48 and 57; TDF tf1 E27, 41, 42, 46 and 63; TDF FR3 E37, 45 and 60; Canal Plus L5, 6, 7 and 9; West Germany ZDF E30, 34, 35 and 37; West Germany WDR1 E9, 11 and 46; WDR3 E45, 48 and 50; West Germany SWF3 E56; West Germany HR1 E8; NOS1 E5, 6, 7, 39 and 50; NOS2 E27, 45 and 53; RTBF1 E8; RTBF2 E42; BRT1 E10 and 43; Channel TV IBA (UK) E41.
30/9/85: TDF Antenne 2 E21, 34, 39, 43, 46, 48 and 57: TDF tf1 E27, 42, 43 and 63; Canal Plus L5, 7 and 9; NOS1 E39; BRT1 E10, 43: BRT2 E42; RTBF2 E42.

Our thanks to William and Kevin for passing on details of their DX-TV reception during September.

New test cards

In a recent issue of ***R&EW*** we mentioned that the 'Nederland 1' outlet of NOS at Lopik on channel E4 was radiating the FuBK test card at random periods throughout the day. The rest of the network apparently radiated the usual PM5544 test pattern. Although the FuBK hasn't been seen in recent times we have noticed that the transmitter at Lopik has been screening colour bars prior to the morning PM5544 period. The other stations have been broadcasting the familiar monochrome EBU Bar.

John Bray of St Neots in Cambridgeshire has noticed a multiburst test pattern (frequency gratings) on channel E4 several times recently. It has prompted him to ask whether the Dutch transmitter at Lopik is using this particular pattern. Reception has taken on the characteristics of tropospheric activity, namely slow fading.

The Swedish PM5534 test pattern has been noted carrying an extra line of identification towards the bottom just prior to the start of programmes. Unfortunately reception hasn't been clear enough to read the new inscription but it may well be details about the accompanying music. Until recently the same idea was used by NRK in Norway, but now the information is only used when the clock caption is radiated during the station opening sequence.

Reception reports

Andy Webster (Billinge, near Wigan) has been experimenting again with Continental teletext reception using a Grundig TV. He has had limited success with sporadic-E propagated signals, although at times the teletext page heading could be deciphered, thus giving an indication of its origin.

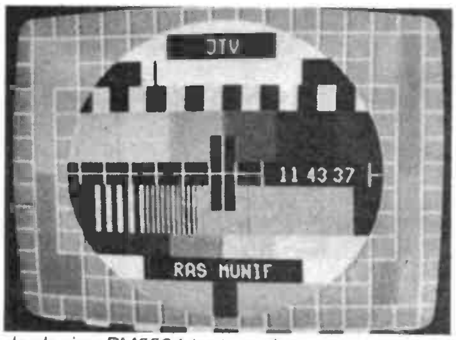
During recent trop activity Andy managed to receive a teletext display from the RTBF1 outlet at Wavre on channel E8. He's tried French signals too but without success due to the Antiope system used. In case you were wondering, the French system L signal is first inverted using a form of external converter which is plugged into the aerial socket of a standard receiver.

The converter consists of a tuner fed into a vision IF module which features a TDA 4421 IF demodulator IC. The device has two vision outputs; one negative-going, the other positive. The appropriate output, depending upon the TV standard being received, can be switched manually and re-modulated to a spare UHF channel. There are, however, a few problems with the gain. Attempts to build an IF preamplifier haven't been too successful so far, but Andy's working on it!

A few surprises

The 11th brought in a few surprises. Apart from a West German station on channel E7, Andy noted a programme on E6 which was identified as originating from the Brocken transmitter – one of East Germany's 1st network outlets. A flick through the UHF channels rewarded him with the DDR:F2 test card from the 2nd network transmitter at the same location.

Kevin Jackson of Leeds has sent in an excellent log for September. The most productive days for sporadic-E reception were the 4th and 6th. The opening on the 4th consisted mainly of Spanish test transmissions with a variety of patterns on channels E2, E3 and E4. Reception lasted from early morning until mid-afternoon. The opening on the 6th occurred around mid-morning with several central European stations in evidence. Among these were Poland on R1 with the 'dark background' PM5544, Austria on channels E2a and E4 radiating the 'ORF FS1' PM5544, and CST from Czechoslovakia on R1 with the 'RS-KH' electronic test pattern. Teletext pages from West Germany were noted towards the end of the opening on channel E2. The signal probably originated from the Bayerischer Rundfunk outlet at Grünten.



Jordanian PM5534 test card. (Pic Charles Hage)

Similar reception took place on channel E3 from the 100kW BR transmitter at Kreuzberg.

Most other DX reception during the month at Kevin's location consisted of trop DX. The most startling event happened on the 10th when he picked up Radio Telefis Eireann (RTE) on channel H from Eire. Why was it so unusual? Well, Kevin uses an indoor aerial and the signal has to pass through a block of flats! Tuning through the FM radio band he noted several pirate stations operating in and around Dublin. These included 'Sunshine Radio' on 101MHz, Q-102 on 102.25MHz and 'Magic 103' on 103.5MHz.

The 11th produced the best DX-TV opening of the month for Kevin with the NDR (Norddeutscher Rundfunk, West Germany) channel E10 outlet radiating the FuBK test pattern. Somewhat unusual identification was used, namely 'LFHS-NDS'. Does anyone know what this means?

Later in the day an FuBK test card from the Rhön transmitter was seen on channel E37 carrying 'HR 3' identification. On channel E49 the inscription was 'BR-MCHN'. Floating with the E37 'HR 3' test card was a ZDF pattern from Amberg. East Germany made an appearance with 2nd network programmes from DDR:F2 on channel E31 (Inselsberg). The Brocken E34 outlet was also logged. On E6, the 1st network was resolved from Brocken. Kevin has commented that the trop conditions at the end of September were very poor and that the best reception must have been confined to the south.

Another DXer in Leeds, Mark Dent, received no fewer than eleven RTE channels from six transmitters on the 9th and 10th. These were RTE-1 on channels B, D, F, H, 29 and 40, and RTE-2 on channels G, I, J, 43 and 33. The channel J outlet, incidentally, is RTE-2 from Mt Kippure with 1kW ERP. This was the first time it had been received by Mark. After close-down, conditions were good enough to allow the reception of colour bars, complete with the 'RTE-1' logo in colour, from Cairn Hill. Unlike Kevin Jackson's location, Mark enjoys an unobstructed path from the west. However, a block of flats to the south prevents good reception from France. If anyone knows the address of a good demolition expert, he'd like to know! Their second task would be to remove the mast at Emley Moor from the skyline . . .

Worthy of note

Sporadic-E activity worthy of note at Mark's location consisted mainly of Spanish DX. On the 5th he logged the standard GTE colour test card on channels E2 and E4, while on E3 the electronic bar pattern was present with the identification 'LA MUELA 3'. The low-power TVE-1 outlet at Madrid on E4 also came through on a bar pattern with the inscription 'MADRID 4'.

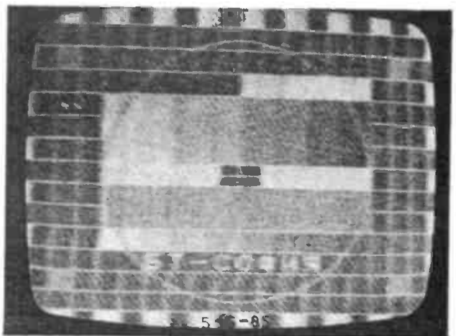
Yet another DX-TV enthusiast in Leeds, C Melia, has received transmissions from all over Europe this summer. Spurred on by Kevin Jackson and Mark Dent's successes, he has received many stations using nothing more than a Band I dipole, mounted horizontally, and a Waltham Minister 416 TV. The receiver is causing a few problems, however. Due to its wide bandwidth it's difficult to differentiate between channels which are close to each other, such as E2 and R1 or IA and E3. During hectic openings with DX on all channels the signals tend to merge and float over one another.

Success

John Bray of St Neots has succeeded in logging RAI (Italy) on channel IA almost daily throughout September. CST-Czechoslovakia on channel R1 was also a frequent visitor in Band I. Tropospheric DX was in abundance too with many West German and French stations in evidence. On the 11th a West German FuBK test card was resolved from Südwestfunk (SWF) on channel E9. The identification read 'SWF HGR 9' and the signal originated from the Hornisgrinde outlet located in the south of the country, close to the French border. The Westdeutsches Fernsehen FuBK pattern appeared on E9 from the Langenberg transmitter carrying the identification 'WDR 1 LA9'. On E7 and E8 the FuBK pattern was present without any form of identification. We feel that these could have been aired over the Hessischer Rundfunk (HR) network from Brotjacklriegel and Grosser Feldberg on E7 and E8 respectively.

Resolving French system 'L' transmissions presents no problem for John nowadays. He's had a 12-inch mono portable modified to display negative or positive video, and with the flick of a switch he can watch the French Canal Plus programmes practically on a daily basis. John is feeding the portable from a D-100 DX-TV converter, which provides a very sensitive and compact DX set-up.

Bob Brooks (South Wirral) has submitted a detailed log for the month under review. He was pleased to note sustained


Bulgarian TV test card received on R3 by Ryn Muntjewerff

reception of RTE-1 on channel H from Kippure. For much of the time during the period of enhanced tropospheric conditions programmes were viewable for long spells. Bob's greatest rewards were via sporadic-E in Band I with ORF (Austria) on E2a, CST on R1 and SR/SVT-1 (Sweden) on E2 with test cards on most days. Several Norwegian transmitters were logged throughout the month. The 'KONGSBERG' identification was seen on the PM5534 on channel E4 on the 11th, 'GAMLEM' E3 on the 12th and 'NORGE TELEVERKET' on the 22nd on channel E2. The latter inscription appears just before programmes commence, thus making the actual transmitter location difficult to identify. The most impressive DX took place during the late afternoon of the 29th when the 'RUV ISLAND' PM5544 appeared on channel E4 from Skalafell in the far west of Iceland.

Simon Hamer (New Radnor, Powys) received several countries during September. On the 6th he noted TVP (Poland) on channel R1 via sporadic-E. Also received during the month were RAI, TDF (via trops), ARD (West Germany) E2, TSS (Russia) on R1, SR/SVT-1 on E2 and Czechoslovakia (CST) on channel R1.

Finally, Ryn Muntjewerff of Beemster in the Netherlands has written to say that during the sporadic-E season he received Bulgarian TV (BT) in Band II on channel R3. Fortunately he resolved the electronic test card which provided positive ident-reception confirmation of this extremely rare TV service.

New DX-TV books

TV Bildkatalog Europa (Catalogue of European TV Pictures) is an impressive book which should appeal to all DX-TV enthusiasts. It's written by Norbert Kaiser, an active TV DXer in West Germany.

There are basically two main sections. The first comprises 60 pages which deal with a variety of subjects associated with identifying European TV stations. The second section (111 pages) presents a comprehensive catalogue of test cards, clock and identification captions, etc. The book confines itself to the European area, thus making it an ideal companion to the famous *Guide to World-Wide Television Test Cards – Edition 2*. The text is written in both German and English. It costs £5.50 (including UK p&p) and is available from: *HS Publications, 17 Collingham Gardens, Derby DE3 4FS.*

We understand from Babani Publishing that a new edition of *Long Distance Television Reception (TV-DX) For The Enthusiast* should be available from next February. It will cost £2.95 (including postage) and will also be available from HS Publications.

Service Information

West Germany: BFBS have changed their identification on the PM5544 test pattern and programme captions. The test pattern now carries 'SSVC' at the top and 'GERMANY' in the lower black rectangle. 'SSVC' is the abbreviation used for 'Sound Service & Video Corporation'. BFBS have also changed their name to SSVC in Cyprus.

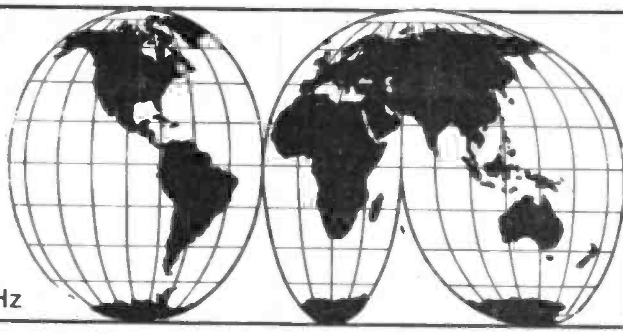
East Germany: The second TV network (DDR:F2) has opened a new transmitter on channel E38. It is located at Dietlas in the Suhl region.

India: Doordarshan TV now broadcasts programmes using the 'twin sound' system. Imported films are shown with dubbed Hindu sound on the first network while the original soundtrack is transmitted on the second.

Teletext has also been introduced using the French 'Antiope' system.

This month's service information was kindly supplied by Gösta van der Linden (Rotterdam, Netherlands) and Alexander Wiese (Munich, West Germany). REW

SHORT WAVE NEWS FOR DX LISTENERS



By Frank A Baldwin

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

On that favourite band of most DXers, the 60 metre band (**4750** to **5060**), it should now be possible to log some of the Asian stations. Reference here is made particularly to those transmitting from India, Pakistan and Sri Lanka. Although conditions are currently at an almost all-time low, if memory serves me aright, there should hopefully be occasions when such signals filter through.

The three countries mentioned above are regarded by the writer as being 'middle-ground', the far horizons being represented by those of the Far East, South-East Asia and the Pacific. Nevertheless there is some choice DX to be logged by winkling out from under the utility and co-channel QRM (interference) some of the signals emanating from the Central Asian area.

India

Indian regional stations can often be logged on the 60 metre band during our afternoon periods here in the UK. They may conveniently be heard from around 1515 to 1730 and not so conveniently from around 0025 to 0200 – assuming the prevailing conditions for reception of this area of the world are reasonably fair to good.

Not often heard by UK based DXers is All India Radio Gauhati on **4775** with the East Regional Service (HQ Calcutta). This 10kW regional transmitter radiates Gauhati B programmes from 0100 to 0200 and from 1030 to 1215. It should be noted here that all schedules may be extended when transmitting sporting commentaries – cricket test matches in particular.

Often listed in the SWL press is AIR Hyderabad operating on **4800** at 10kW. The schedule is from 0025 to 0215 and from 1200 to 1741 with newscasts in English from 0032 to 0035, from 1230 to 1235, from 1530 to 1545 and from 1730 to 1735. It is the 1530 to 1545 session that is most often reported in SWL club journals. This transmitter radiates Hyderabad A programmes in the South Regional Service (HQ Madras). Hyderabad often comes through quite well to the UK on this channel, often being heard during news transmission periods except that from 1230 to 1235.

Logged several times per 'season', but not so frequently as the above station, is AIR Calcutta on **4820** at 10kW with the East Regional Service timed from 0025 to 0210 and from 1230 to 1732. There is an English newscast from 0032 to 0035 in these Calcutta A transmissions.

Suffolk greenery

Often heard here amid the Suffolk greenery is AIR Bombay on the **4840** channel. With a power of 10kW it radiates Bombay B programmes from 0025 to 0215 and from 1230 (Saturday from 1200) to 1741 in the West Regional Service (HQ Bombay). There is a news bulletin in English from 0032 to 0035, from 1430 to 1435 and from 1730 to 1735. News in English of sporting events is particularly featured in the 1430 to 1435 slot.

AIR Delhi on **4860** at 10kW operates in the External Service of All India Radio with programmes in Nepali from 0130 to 0215 and in the domestic North Regional Service (HQ New Delhi) from 0215 to 0345 and from 1233 to 1741. There are English newscasts from 0240 to 0250, from 1530 to 1545 and from 1730 to 1735. Sports news in English is from 1430 to 1435.

Tuning to **4920** may possibly result in the reception of AIR Madras. Featuring Madras A programmes in the South Regional Service, this transmitter is on the air from 0025 to 0215 and from 1200 to 1736. At 10kW, it broadcasts the news in English from 0032 to 0035, from 1230 to 1235, from 1530 to 1545 and from 1730 to 1735. This one is regularly logged here.

The comparatively low-powered (2kW) AIR Ranchi on **4960** is, as the reader will realise, regarded as quite a DX 'catch'. Rarely heard by Western European or UK DXers, it transmits Ranchi A programmes in the North Regional Service from 0100 to 0200.

News bulletin

On **5050** is the 50kW AIR Aizwal radiating programmes in the East Regional Service from 0030 to 0200 and from 1230 to 1630 (Saturdays until 1741). There is a news bulletin in English from 1530 to 1545. In spite of its 50kW it is rarely featured in DXers' lists. The nominal frequency is **5050** but that often reported is **5050.5** , most likely being affected by side-splash from the 50kW Radio Singapore on the nearly adjacent **5052** channel. To date the writer has signally (*groan – Ed*) failed to log AIR Aizwal here amongst the yellow of the Anglian rape seed crops.

AROUND THE DIAL

It is under this heading that information is provided on some of the stations logged during recent weeks. A few forays on some of the frequencies quoted, at the times mentioned, may possibly produce similar results.

AFRICA

Botswana

Radio Botswana, Gaborone on **4820** at 1856, drama in English entitled *The Hero*, which ended with an identification as 'BBC African Service'. At 1900 OM with the station identification and announcements in SeTswana then YL with local and world news in English at 1910.

The published schedule indicates that Radio Botswana radiates the Home Service on this channel from 0400 to 0630 and from 1425 to 2100 (on occasions to 2300) in SeTswana with English news bulletins at 0510 (Monday to Friday inclusive), 0600 (BBC relay), 1610 and 1910. The drama in English logged at 1856 is therefore at variance with the schedule, probably representing the introduction of an English language session. Radio Botswana is rated at 50kW.

Cameroon

Radio Yaounde on **4850** at 2125, OM with a talk in French. The schedule of Radio Yaounde is from 0400 to 0700 and from 1630 to 2400, this being the National Service in French and English. Newscasts in the latter language are timed for 0530 (Sunday at 0600), 1830 and at 2100. Newscasts in French and English are at 1700 and 2200. The power is 100kW.

Madagascar

Radio Madagasikara, Antananarivo on a measured **3286** at 2005, YL with a song in Malagasy complete with local style orchestral backing. This was a programme in the Home Service, which is radiated on this channel from 0300 to 0500 and from 1500 to 1845 in Malagasy and in French from 1845 to 2100. The power is 100kW.

Malawi

Blantyre on **3380** at 1934, OM with a talk in Chichewa followed by a few announcements in English then back into the local language. Blantyre is on the air from 0253 to 1110 and from 1300 to 2210 (September to May 0253 to 0530 and 1750 to 2215) with the Home Service in Chichewa and English. The power is 100kW.

Mali

Radiodiff TV Malienne, Bamako on **3380** at 2235, OM and YL with announcements in French during a programme of African pops. This one had me guessing for some weeks until a clear station identification was logged a few days ago. Bamako on this new channel signs off at 2400, power not known – nor the schedule. Wait until Blantyre is off the air at 2215 for a clear signal from Bamako.

Morocco
Rabat on **17595** at 1524, YL with songs in vernacular complete with local style musical backing in a relay of the Domestic Service to Europe, the Middle East, West Africa, southern Morocco and Mauritania, scheduled from 1400 to 1700 on this channel.

Senegal
Dakar on a measured **4892** at 1917, OMs with a ballad, OM with announcements in French. ORTS Dakar is scheduled from 0600 (Sunday from 0700) to 0800 and from 1800 to 2400 with the Home Service in vernaculars and French and reportedly an English slot from 1845 to 1900, not logged here as yet.

South Africa
Johannesburg on **3320** at 1924, OM with a talk in Afrikaans. The Home Service in Afrikaans is radiated on this frequency from 0350 (Saturday from 0353, Sunday from 0400) to 0510 and from 1635 to 2200 with a power of 100kW.

Johannesburg on **4990** at 0328, OM with a talk in English about Mexico, its economy and the earthquakes. This 250kW transmitter broadcasts English programmes from 0258 to 0456 and in Chichewa from 1658 to 1756. From November to March inclusive there is a programme in Portuguese from 1858 to 1956.

Swaziland
TWR (Trans-World Radio) Mpangela on **4760** at 0327, OM with a talk in the Shona programme listed as being on this channel from 0300 to 0345 from November to May, but obviously this period has been amended. The power is 25kW, and after YL with some announcements and musical chimes it signed off at 0330.

CENTRAL AMERICA

Costa Rica
Faro del Caribe (Lighthouse of the Caribbean), San Jose on **5055** at 0532, OMs with a ballad in Spanish with guitar backing, OM with announcements.

This Costa Rican operates from 1030 to 2000 and from 2300 to 0600 which includes an English programme timed from 0300 to 0400. The power is 5kW.

NORTH AMERICA

USA
WYFR Family Radio, Okeechobee, Florida on a measured **15566** at 1845, YL with the station identification and announcements during the Italian transmission for Europe timed from 1800 to 1900.

SOUTH AMERICA

Brazil
Radio Difusora do Amazonas, Manaus on **4805** at 0128, OM with a sports commentary in Spanish.

This 5kW transmitter was reactivated in May of this year and signs off around 0200, but occasionally works around the clock.

Radio Clube do Para, Belem on **4885** at 0147, OM with announcements in Portuguese then OM with a ballad in Portuguese. RC do Para is scheduled from 0800 to 0300 but sometimes around the clock, the power being 5kW.

Radio Marajoara, Belem on **4955** at 0137, OM with a sports commentary in Portuguese. This one operates from 0830 to 0300 with a power of 10kW.

Colombia
Radio Super, Medellin on **4875** at 0603, OM with full station identification, frequency and location then promos, all in Spanish. Radio Super is listed as being on the air from 1100 to 0500 with a power of 2kW. The time reported here is at variance with the published details, the station either being on an extended transmission for a special occasion or on an amended schedule.

Ecuador
Radio Popular de Cuenca, Cuenca on **4800** at 0345, OM with a talk in Spanish about internal affairs. The transmission period is from 1000 to around 0700 and the power is 5kW.

Radio Quito, Quito on **4920** at 0118, OM with a talk in Spanish about national industries. R Quito is on the air from 1000 to 0500 and is part of the Red Informativa Nacional network. It identifies as 'Radio Quito, La Voz de la Capital' and has a power of 5kW. This one is logged on an almost regular basis.

Venezuela
Radio Valera, Trujillo on **4840** at 0026, OM with a talk in Spanish, a short light music interlude then more talk. The schedule is from 1000 to 0400 with a power of 1kW.

ASIA

China
Gansu PBS (People's Broadcasting Station), Lanzhou on **4865** at 2306, YL with a talk in Chinese. Gansu radiates the Home Service in Chinese from 2130 to 0130, from 0330 to 0620 and from 0900 to 1600.

There is an English language lesson timed from 1330 to 1400.

Radio Beijing on **9945** at 1456, YL with announcements during the Vietnamese programme for Vietnam, scheduled from 1300 to 1550.

India
Bombay on **7260** at 0147, YL and OM with a duet in Hindi then OM with some announcements in the West Regional Service, Vivadh Bharat (Commercial Service) which operates from 0130 to 0300 on this channel.

Pakistan
Islamabad on **9465** at 1840, YL with some songs, local style music then OM with announcements in the Urdu transmission for Europe, scheduled from 1645 to 1700 and from 1730 to 1900.

NEAR AND MIDDLE EAST

Iraq
Baghdad on **9635** at 1435, YL and OMs with a song in Arabic during a 'Voice of the Masses' transmission for expatriates in Europe, timed from 1400 to 2200 on this frequency.

Israel
Jerusalem on **9009** at 1441, OM and YL with the Persian programme directed to Europe, the Middle East and North America, scheduled from 1430 to 1525.

Kuwait
Radio Kuwait on **7120** at 2146, OM with a song in the main Arabic programmed Domestic/External Service which may be heard on this channel from 1830 to 2105.

Oman
BBC Relay on **7160** at 1740, OM with sports news in the English transmission for Iran and southern Asia, scheduled from 1700 to 1830.

PACIFIC

Australia
Melbourne on **7205** at 1603, OM with a newscast in English followed by the station identification. The schedule here is thought to be from 1430 to 1800.

CLANDESTINE

A Voz da Resistencia do Galo Negro on **4950** at 1840, OMs with a discussion in Portuguese. The Voice of the Resistance of the Black Cockerel supports the UNITA movement and is hostile to the Angolan government and Cuban involvement in that country. It is scheduled on the air with programmes in Portuguese from 0430 to 0630 on Monday, Wednesday and Friday and from 1730 to 1930 on Tuesday, Thursday and Saturday.

A Voz de Verdade (The Voice of Truth) is another UNITA transmitter that operates on this channel in Portuguese from 0300 to 0415 and from 2000 to 2045 daily.

NOW HEAR THIS

Radio Mozambique, Maputo on a measured **4752** at 2110, OM with announcements in Portuguese, a four-note chime, then OM with a talk in Portuguese. This one was logged a few weeks ago on **4738** . The power is 25kW and it signs off at 2210.

NOW LOG THIS

AIR (All India Radio) Hyderabad on **4800** at 0038, OM with a newscast in English followed by a YL with announcements in Hindi then YLs with songs.

Hyderabad is on the air from 0025 to 0215 and from 1200 to 1741 with a power of 10kW. There are news bulletins in English at 0032, 1230, 1530 and 1730. REW

MEDIUM WAVE DXING

by Steve Whitt

As you read this there are only a few days left before Christmas, so if you are hoping for a new receiver or even for some good DX isn't it about time you let Santa Claus know?

If, while still in a festive mood, you feel like giving yourself a present, how about a new aerial, since this month we are starting to look at this aspect of MW-DXing?

Basic aerials

The simplest aerial that an MW-DXer is likely to use (apart from the internal ferrite rod of portable radios) is a random length of wire run up to the end of the garden. Such an aerial probably started life on the short wave bands but in many cases will give acceptable performance on MW with a good receiver. Although often known as a 'long-wire', a random length aerial is seldom long when compared with the wavelengths associated with the MW band (200-600 metres), and consequently it has minimal directional properties on MW.

Generally a long-wire is broadband, picking up signals over the entire MW and SW spectrum, and while this can be a useful feature for the SW listener it can cause interference problems for a less than sophisticated MW receiver.

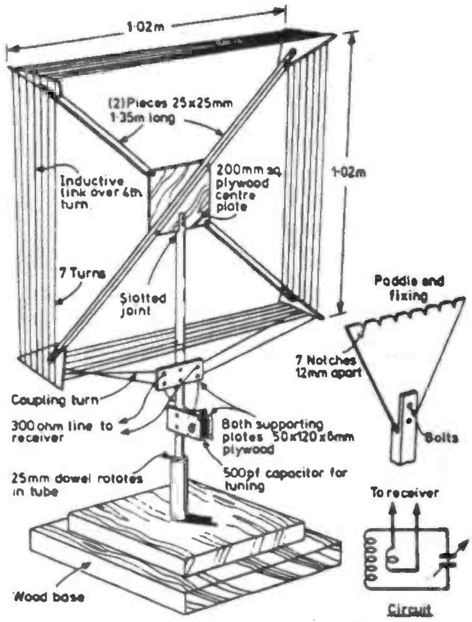


***Fig 2** Constructional details of standard 40in box loop for MW*

There are many receivers around that suffer from poor image rejection and overload effects (eg cross-modulation) when presented simultaneously with many strong signals, and generally speaking a random wire aerial is likely to give better performance with valve receivers than with run of the mill transistorised equipment.

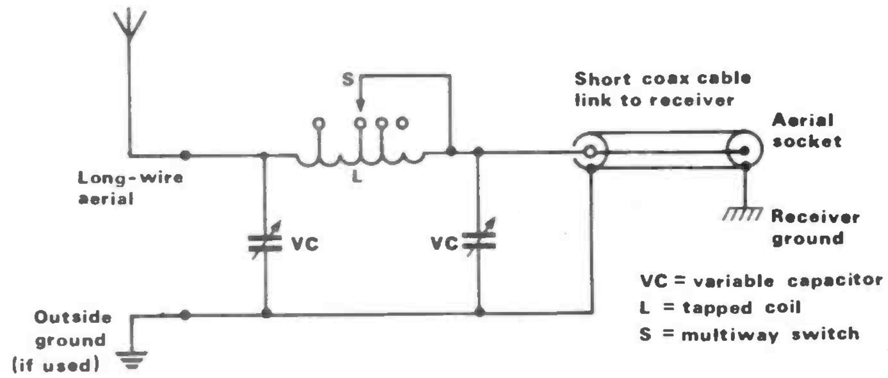


***Fig 1** Circuit diagram of a typical ATU*

Aerial tuning unit

The first improvement to a long-wire aerial is the addition of an aerial tuning unit (ATU), a device that is connected between the aerial and receiver. An ATU 'matches' an aerial to a receiver, a process that ensures that all the energy picked up by the aerial is efficiently transferred to the receiver.

Normally a different matching arrangement is required at different frequencies and typical aerial tuning units therefore have a number of manually controlled adjustments.

Figure 1 shows the circuit of a typical easy to make ATU comprising two variable capacitors and a switched or variable inductor, adjusted by trial and error to give the maximum received signal strength.

Each variable capacitor should be about 1000pF, which can be realised by paralleling both halves of a dual 500pF unit. The exact value is not critical, but care should be taken to see that the moveable plates form the ground connection of the capacitor.

The coil is made from a single layer solenoid winding of enamelled wire

DX FILE

This month we welcome back A Walmsley from Blackpool who reports hearing the following on his Realistic DX400 receiver plus long-wire aerial (all heard around midnight at the end of October):

590kHz VOCM St Johns NF Canada
850kHz WHDH Boston MA USA
1030kHz WBZ Boston MA USA
1130kHz WNEW New York NY USA
1220kHz CKCW Moncton NB Canada
1220kHz R Globo Rio de Janeiro Brazil
1510kHz WMRE Boston MA USA

He also notes hearing CJYQ (Q Radio) on 930kHz at 0738hrs on 4 November, which is interesting because it had been daylight at Blackpool for about half an hour. This again reflects the good propagation conditions that can be found at this time of year. I can report hearing the following around 0100hrs during the month of November using my R390A receiver and loop aerial:

1050kHz WHN New York NY USA with country and western music
1100kHz ZDK Antigua with reggae music
1470kHz R Vibracion, Curupano, Venezuela in Spanish
1580kHz Voice of America Antigua relay with usual VOA news
1610kHz Carribean Beacon Anguilla with gospel programmes

as well as the almost regular Q Radio outlets on 610, 670, 680, and 930kHz (generally CKYQ on 610 has been the most reliable).

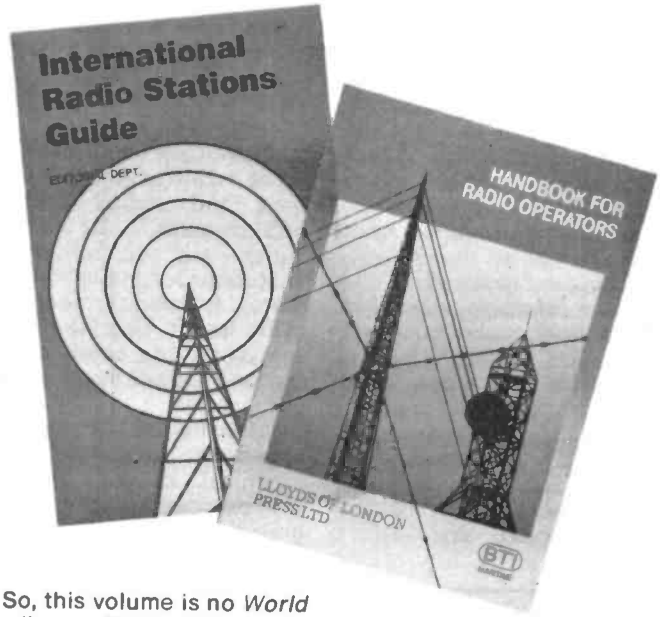
LATEST LITERATURE

Clubs, manufacturers, publishers and agents are invited to send details of new books, catalogues, data sheets, etc for inclusion on this page

INTERNATIONAL RADIO STATIONS GUIDE

This is an extensively revised version of an earlier Babani publication, and presents basic information about frequencies and powers of radio stations world-wide. It is split geographically, with sections covering European long wave stations, European, Near East and North African medium wave stations, worldwide short wave AM stations, broadcast band stations in the USA, Canada, the Caribbean and Latin America. There are further sections covering programmes in English, UK local radio stations and wavelength/frequency conversion.

These lists are sure to prove useful, but it must be borne in mind that they are neither comprehensive nor entirely accurate. Inconsistencies are noticeable: short wave stations, although nominally listed by station site and country, are sometimes entered under the station name with no mention of the site; a few stations appearing under the English language heading just do not appear in the other lists under the appropriate frequency; the British local radio stations are listed by site, not by station name and site, and there are transmissions missing from this list.



So, this volume is no *World Radio TV Handbook*. However, for the price it provides a good value pocket reference guide, and with stations listed by frequency and English programmes by time of transmission, is very quick and easy to use.

Bernard Babani (publishing) Ltd, £2.95. ISBN 0 85934 130 5

HANDBOOK FOR RADIO OPERATORS

BTI Marine

This handbook is the replacement for the marine operator's handbook produced by HMSO in 1975. The new volume was written by British Telecom International Maritime & Aeronautical Services, and incorporates the ITU regulations which became effective in January 1985.

The handbook is intended for radio operators using the international marine mobile bands, and the coverage is, unsurprisingly, fully comprehensive. All the regulations and conditions are described (including the use of amateur stations), plus frequencies, procedures, emergency services etc, right down to an outline of the wonderful vocabulary used by nautical types.

The coverage of this handbook is obviously of limited appeal, but it is an excellent example of how to produce a comprehensive and informative reference manual.

Lloyd's of London Press, £9.95 ($20). ISBN 1 85044 050 6

AN INTRODUCTION TO COMPUTER PERIPHERALS

By RA and JW Penfold

The choice of peripherals for a computer must be at least as important, and as difficult, as the choice of the computer itself, and is a subject equally bewildering to the newcomer because of the unfamiliar terms and concepts. This book aims to provide an outline of the various gadgets that are connected to a computer, and is written as an explanatory text for those who are not overly familiar with computerspeak.

The first chapter deals, logically enough, with monitors, and includes a good explanation of the difference between monitors and ordinary television sets. Printers and plotters are covered next. All the different types are described (with a brief mention of recent technology

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(0.8 – 1.0mm diameter) on a plastic former 2-3cm in diameter and about 10cm long. Wind 36 turns, equally spaced, along the former and create taps every 3 turns which are then connected to a 12-way switch – again the construction is not very critical.

This particular configuration has a further desirable property in that it behaves as a low pass filter between aerial and receiver, meaning that it will prevent undesirable SW signals picked up by a long-wire aerial from reaching, and perhaps overloading, the receiver. Since they can lead to a marked improvement in reception and are simply made by the DIY constructor, no long-wire aerial should be without an antenna tuning unit.

Special aerials

The serious MW-DXer will undoubtedly have a more advanced aerial than the basic long-wire, although the latter aerial will often have given sterling service. Included in the list of more sophisticated aerials are MW tuned loops, cardioid arrays and Beverages. Of these three, the MW loop is the most practical proposition since it is a fairly compact indoor arrangement that is readily home-made (*Figure 2*). As a consequence quite a number of constructional articles have appeared in electronics hobby magazines.

The cardioid array is a more sophisticated enhancement of the MW loop that requires both a loop and a non-directional aerial such as a long-wire.

Thirdly, the Beverage aerial (as used by the Scottish MW-DXpedition reported last month) is often thought to provide the best DX performance within the limitations of a DXer's budget. Unfortunately the Beverage is not really for the city dwellers among us since the aerial consists of a straight wire over one wavelength long (at least 200 metres) mounted about 3 to 5 metres above ground level. Next month I hope to look at these aerials in more detail.

such as laser printing), and there is a useful section about ribbons and stationery.

Alternatives to keyboards are covered (mice, touch screens, etc), then data storage (although no mention of CD ROMs), modems, and interfaces.

This book isn't a guide to what's on the market, restricting itself to what peripherals are and how they work. The descriptions do not go into any great depth technically, which is an advantage in an introductory volume such as this, and their clarity will be appreciated by those computer illiterates who adopt a glazed expression at the mere mention of bytes and floppies.

Bernard Babani (publishing) Ltd, £2.50. ISBN 0 85934 144 5

THE PROPAGATION OF RADIO WAVES

By K G Budden

This is one of those wonderful textbooks the like of which I always love reading and which invariably leave me wishing I had the intelligence to understand fully. It is, to quote the cover notes, 'for final year undergraduates and . . . a reference book for research'.

Subtitled 'The theory of radio waves of low power in the ionosphere and magnetosphere', this book covers the sections of the atmosphere which include the regions known to most readers as the E and F layers. It necessarily includes a fair amount of maths, but only as this concerns those ideas of practical use, and is intended to be of use to radio engineers who want to understand the principles of propagation. To quote the preface, 'the reader is assumed to be familiar with calculus, the theory of complex variables, vectors including the differential vector operators, matrices, and electromagnetic theory as far as Maxwell's equations and Poynting's theorem.'

The text is very well written, and even a numb-nut like me can follow it. If you're happy with the maths there is a lot to be gained from this volume – get someone to buy it for you as a Christmas present.

Cambridge University Press, £60 ($89.50). ISBN 0 521 25461 2

LINEAR/DIGITAL IC EQUIVALENTS AND PIN CONNECTIONS

By Adrian Michaels

Each of these two recent publications is an update of a previous similar volume. The format is similar for both, with the first part of the book listing country of origin, manufacturer, case/package and European, American and Japanese equivalents. After these tables, all the pin connections are illustrated.

These reference works are not comprehensive, but cover those ICs deemed by the author to be those most commonly used and/or useful to hobbyists, designers etc.

Bernard Babani (publishing) Ltd, £4.95 each. ISBN 0 85934-116 X (linear) and -115 1 (digital)

CATALOGUES ETC

Harris Semiconductor

A new 76-page shortform data book, *Products '85*, describing analogue, digital, gallium arsenide and custom integrated circuit products, is now available from Harris Semiconductor.

Each section of the book provides an individual product description including technical specifications and pin-out.

Standard products highlighted in the book include CMOS digital products (8-16 bit microprocessors and peripherals, RAMs, PROMs, communication ICs, bus drivers, programmable logic, and standard cell capability); bipolar PROMs; analogue products (op amps, voltage references, comparators analogue switches, DAS signal processors, A/D and D/A converters, sample and hold amplifiers and multiplexers).

Communication products include SLICs, PCM codecs, PCM monolithic filters, and speech synthesis ICs. Also in the book are analogue and digital user cross references providing a handy guide for designers.

Harris-MHS Semiconductor Sales Ltd, Eskdale Road, Winnersh, Wokingham, Berkshire. Tel:(0734) 698787.

House of Instruments

New from Advance House of Instruments is a 16-page, two-colour shortform catalogue on the company's range of electronic test and measurement instruments.

The catalogue include real-time and digital storage oscilloscopes, LCR meters, digital and optical power multimeters, function generators, frequency counters, cable length checkers, logic analysers, line conditioners, dc bench power supplies and accessories.

For each product range the catalogue provides basic technical details together with part numbers and photographs.

Copies of the shortform catalogue are available free of charge.

Advance House of Instruments, Raynham Road, Bishop's Stortford, Herts CM23 5PF. Tel:(0279) 55155.

Texas Instruments

A valuable reference work for a wide range of analogue circuit and system designs has been published by Texas Instruments as *The BIFET Design Manual*.

It features sections on amplification, sampling, filter and oscillator circuits, as well as data on individual devices and a section on miscellaneous circuits.

For each application it gives a full circuit diagram, design equations and a description of the circuit operation. In many cases the derivation of the design equations has been provided to help understanding of the circuit operation.

An introduction outlines the production of BIFET devices, which feature both JFET and bipolar transistors on a common substrate.

The book is available from Texas Instruments Limited at £3.95 per copy, plus £1.50 for postage and packing.

Texas Instruments Limited, PO Box 50, Market Harborough, Leicestershire.

Coutant

Coutant Electronics Ltd, one of the UK's largest manufacturers of both linear and switch mode power supplies, has just published a new illustrated short form catalogue.

The twenty-page publication contains descriptions and specifications for over fifteen power supply families. These include fan cooled, modular, Eurocard and encapsulated switch mode power supplies; encapsulated hybrid power supplies; programmable, enclosed unregulated, pluggable, open frame and encapsulated linear power supplies.

Also included are dc input power supplies – fan cooled and modular; switching regulators; encapsulated and semi-regulated converters. A further section is devoted to laboratory power supplies and racking systems.

The catalogue is available free of charge from the company.

Coutant Electronics Ltd, Kingsley Avenue, Ilfracombe, Devon EX34 8ES. Tel:(0271) 63781.

Motorola Semiconductor

Motorola's new 76-page selector guide (SG96) includes summary data on all current linear and interface integrated circuits, including a new section on telecommunications devices. This guide has been revised to include updated information on Motorola's line of linear integrated circuits, including analogue, power supply, interface, consumer, automotive and communications circuits.

Motorola Semiconductor Products Inc, PO Box 20912, Phoenix, Arizona 85036, USA.

QSO

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

Duplex and crossband

The method by which licensed radio amateurs transmit and receive on different frequencies – known as duplex or crossband working (involving one or two amateur bands) – has been clarified after talks between the Department of Trade and Industry and the Radio Society of Great Britain. The following guidelines have been agreed to assist operators:

(a) A licensed UK amateur may receive any other properly authorised amateur transmission, but may only transmit on frequencies for which he/she is licensed;

(b) Each station must be identified but the identification of the second station should not be retransmitted by the first. Details of the receiving and transmitting frequencies should be given at the beginning and end of the establishment of communication and at every 15 minutes throughout a long contact;

(c) Class B licensees may use space satellite transponders which transpond from a frequency band in which they are licensed to transmit, to any band authorised for the amateur satellite service.

If you want more information, contact: *The Department of Trade and Industry, 1 Victoria Street, London SW10 0ET.*

A good idea

The members of Chelmsford Amateur Radio Society have come up with a rather good idea in light of the recent changes in the Radio Investigatory Service (it will now cost £21 to call out the RIS to investigate any interference problems).

Attached to their November newsletter was a survey form concerning details of interference. The aim is 'to collect information so that we are able to help each other to solve the most important problem we are likely to encounter (other than increased licence fees!)...'

The newsletter itself produced a real gem: apparently the AGM on 1 October was completed in just one hour. Beat that!

If you want to join these Great Men of our Time (who knows, might rub off), contact Ian G4BYR at 40 Great Leylands, Harlow, Essex CM18 6HR.

Sprat-catching

The G-QRP Club has sent us the autumn '85 issue of their journal, *Sprat*, which is full of technical tips and news about the club's activities during the year.

If you want to know more, contact: *Reverend George Dobbs G3RJV, St Aidan's Vicarage, 498 Manchester Road, Rochdale, Lancs OL11 3HE.*

BDXC

The British DX Club has sent us the fifth edition of its publication *Radio Stations of the United Kingdom*, compiled by David Kenny and Colin Wright.

It consists of a comprehensive list of stations plus their location and frequency. The publication costs 75p or 3 IRCs and is available from: *British DX Club, 54 Birkhall Road, Catford, London SE6 1TE.*

Hands across the airwaves

Ham radio operators are pioneering a new 'hands across the airwaves' scheme. Regulations have been relaxed to allow non-licence holders to use the amateur radio network to pass messages overseas.

First to benefit was Britain's scout movement, in its 'Jamboree-on-the-air' in October. With supervision by a licensed amateur operator, scouts were able to talk directly to each other both in this country and Canada, the United States and the Falklands, where the Department of Trade and Industry recently reached agreement to waive the rule barring non-licensed people from using ham radio.

Non-amateurs will now be able to operate special event stations – specially licensed ham stations set up at country fairs, shows, exhibitions, displays, etc.

Singapore sked

Glenrothes and District Amateur Radio Club meets at 7.30pm on Wednesdays and the third Sunday of every month at their club at the rear of the library in west Leslie.

The club transmits slow Morse every Thursday after 7.00pm on 145.550 (S22) at 3 – 15 words per minute. If you are interested and have any comments or suggestions to offer, they would be appreciated by the club organisers.

Another piece of information which caught our attention in the latest newsletter is that GDARC has a contact in Singapore. This is Graham Smith (GM3SNO at home), the 'man from the BBC', who now has the callsign 9V1WL. A sked with Graham can be had on 14-343MHz every Monday at 1500Z. Graham uses a G5RV and 100 watts. His address is 11 Swiss Chalet Road, Singapore 1128.

For further details about the club's activities contact: *Anne Edmonson GM4TCW 94 Prinlaws Road, Leslie, Fife KY6 32W. Tel: (0592) 744449.*

Loony line

You can't teach an old dog to suck eggs (from GDARC's newsletter).

WAB mobile run

Terry Dansey G0BIX and Bill Gerrard G4ZRB made a Worked All Britain mobile run on 28 and 29 September.

As you may already be aware, the idea of WAB working is to make contact with as many different Ordnance Survey squares as possible, and they decided that a way of giving as many stations as possible a chance to work new squares was to attempt to activate the whole 100 squares to be found within the 100kms square known as 'SU', while running mobile.

To complicate things further, they decided to work two bands (2 metres and 70cms) not often associated with long distance mobile operation, and as a further challenge it was decided to complete it within twenty-four hours.

The Worked All Britain group helps to promote further knowledge of the geographic details of Britain, and also donates to radio charities such as the RAIBC. It also helps to create interest in the VHF/UHF bands when conditions are not too good.

Further information can be obtained from: *Brian Morris G4KSQ, 22 Burdell Avenue, Sandhills Estate, Headington, Oxford OX3 8ED.*

RAE helpers

Following an appeal on RSGB news GB2RS, several people have come forward offering to help RAIBC members who need assistance with study at home.

However, more are still needed. If you are willing to help please write to RAIBC HQ as soon as possible so that you can either be put in touch with a member in your area, or put on file for future reference. No qualifications are needed, just a little time to help sort out queries or problems.

The address of the Radio Amateur Invalid and Blind Club is: *9 Conigre, Chinnor, Oxon OX9 4JY.*

75 and still alive!

The Derby and District Amateur Radio Society will be celebrating its seventy-fifth anniversary next year, and is reputedly one of the oldest radio societies in the world.

The society, originally called the Derby Wireless Club, was established in 1911 by S Grimwood-Taylor and A Trevelyan-Lee, two local wireless experimenters, and was so successful that by 1912 the club was giving advice to amateurs in various parts of the world through the pages of *English Mechanic*.

Over the next few years the club continued to flourish and encourage the formation of similar organisations, although World War I reduced its activities somewhat and World War II caused them to cease altogether, when all transmitting equipment was confiscated by the authorities.

In 1947 it was decided to reform as the Derby and District Amateur Radio Society with the aim of catering for those with an interest in all aspects of radio and electronics.

An exhibition was staged in 1971 at the Derby Museum to commemorate the society's sixty years in amateur radio. Many of the items constructed by the club members in the early days have been preserved, together with original documents and photographs.

The society's original callsign was G3ERD (Experimental Radio Derby) and this is still used, along with G2DJ, formerly held by an early member, A T Lee, and G8DBY.

The society is planning many events for its anniversary year, details of which will be announced at a later date.

Meetings are held on Wednesday evenings, beginning at 7.30pm, at 119 Green Lane, Derby.

Biggin Hill repeater

The Biggin Hill Amateur Radio Club has informed us that progress is at last being made with plans for its 70cm repeater, GB3KB.

The site originally proposed was at the top of Westerham Hill, but this was rejected by the RSGB. Now a site has been proposed at Farnborough and tests have already shown that it will provide a good signal in the difficult areas of Chislehurst and Orpington, as well as serving the valleys of Biggin Hill.

There is apparently no interference to other users nearby, and RSGB and DTI approval is awaited.

Further information is available from Robert Senft G0AMP, QTHr.

Across the pond

The Irish Radio Transmitters Society has been computerised and is now tightening up its rules. In the past, subscription payment was a little casual so a couple of changes have been made. Now, when subscriptions have not been renewed after 2 months from the due date, the newsletter and QSLs will no longer be sent.

While most subscriptions remain due on 1 January, the subscriptions of new members only will become due each year on the first of the month following the date of their election. The society suggests that perhaps other clubs might benefit from similar reforms.

The society's address is: *PO Box 462, Dublin 9, Eire.*

South Bristol AGM

The South Bristol ARC have started to plot their course for the next year starting with a cure-all 'Hair of the Dog' night on 1 January.

Make a note of the Annual General Meeting on 27 January where you can find out more about the organisation.

For more information, telephone Len Baker G4RZY on Whitchurch 834282.

Morse lessons

Abergavenny & Nevill Hall ARC is a registered examination centre for the May 1986 Morse examination session and holds Morse classes every week on club nights.

The club meets every Thursday at 7.30pm in Pen-y-Fal Hospital above Male Ward 2. JB Davies GW4XQH, the club secretary, will supply more details. Write to: *109 Croeson Parc, Abergavenny, Gwent NP7 6PF.*

NOTES FROM THE PAST

Some interesting comments from the 1950's...

I remember as a small lad our maths master, in giving us our introduction to trigonometry, asked how else one could manage to measure heights of hills, distances between mountain peaks, etc, without its use. Eager to prove such a loathsome subject had little practical value, but was merely a form of torture devised by a sadistic educational authority for the sole purpose of making the otherwise carefree lives of small boys miserable, all sorts of ingenious methods were suggested by my hopeful class-mates. In fact, some of their alternatives seemed so plausible that even today I find myself instinctively groping for some way of finding the answers to sticky problems rather than do it by mathematical calculation!

Maybe it is bad psychology to try to induce reluctant schoolboys to take an interest in detestable subjects simply to find out facts about things they are not likely to want to know. I remember I felt it would be far more reliable (and exciting) if, when I wanted to know the height of a steeple, I could shin up it and drop out a plumbline, rather than depend on squaring the hypotenuse and juggling with tricky little sums.

Echoes

Among the ingenious ways of solving some of the problems he exampled, several of the lads suggested the use of echoes. Not that there was anything original in that. It had been thought of by our early ancestors and, no doubt, as soon as man learned to sail he used the echoes from the cliff to find out how far he was from the shore when it was dark. That may well have been the first application of the basic idea of radar. Of course, my clever school-fellows never thought of doing it by radio, nor had any adult for that matter, but then there were no cathode ray tubes in those days.

The first use of radio echo-sounding was, I believe, made by Appleton in measuring the height of the Heaviside layer – and thus discovering the Appleton layer in the process. As with radar, they used a short interval pulse and obtained a continuous record on a cathode ray tube of the reflected signals. It was RA Watson-Watt who first proved the possibilities of radar. He used the 50 metre Empire Broadcasting beam from the Daventry Station for the purpose in February 1935, when reflections from aircraft were obtained over a range of up to eight miles.

FREE CLASSIFIED ADS

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■ Early crystal sets, wireless sets, early valves, books, catalogues, valve charts. Also keen on early wind-up gramophones, old tin trains, toys. Jim Taylor, 5 Luther Road, Winton, Bournemouth. Tel: (0202) 510400.

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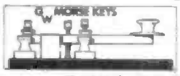

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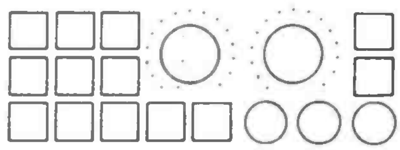

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	double	£94.00	£176.00	£316.00

RADIO & ELECTRONICS WORLD COUNTY GUIDE ORDER FORM

TO: Radio & Electronics World · Sovereign House · Brentwood · Essex CM14 4SE · England · (0277) 219876

print your copy here ....
....
....
....
....

NUMBER OF INSERTIONS REQUIRED

Single County Guide	3 .... £47.00 ☐	6 .... £88.00 ☐	12 .... £158.00 ☐
Double County Guide	3 .... £94.00 ☐	6 .... £176.00 ☐	12 .... £316.00 ☐

PAYMENT ENCLOSED £ —

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

Conditions — Payment must be sent with order form. No copy changes allowed. Ads accepted subject to our standard conditions, available on request.

Registered No 2307667 (England)

C P I

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Radio & Electronics World
The communications and electronics 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	1/8 page	£91.00	£86.00	£82.00	£73.00
128 x 90 or 61 x 186	1/4 page	£160.00	£150.00	£145.00	£125.00
128 x 186 or 263 x 90	1/2 page	£305.00	£290.00	£275.00	£245.00
263 x 186	1 page	£590.00	£560.00	£530.00	£475.00
263 x 394	double page	£1140.00	£1070.00	£1020.00	£910.00

COLOUR AD RATES

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	1/2 page	£420.00	£395.00	£375.00	£335.00
297 x 210	1 page	£810.00	£760.00	£730.00	£650.00

SPECIAL POSITIONS

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

DEADLINES

*Dates affected by public holidays

issue	colour & mono proof ad	mono no proof and small ad	mono artwork	on sale thurs
Jan 86	14 Nov 85	20 Nov 85	22 Nov 85	12 Dec 85
Feb 86	9 Dec 85*	13 Dec 85*	17 Dec 85*	9 Jan 85
Mar 86	16 Jan 86	22 Jan 86	24 Jan 86	13 Feb 86
Apr 86	13 Feb 86	19 Feb 86	21 Feb 86	13 Mar 86

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
Above rates exclude VAT.
All single insertion ads are accepted on a pre-payment basis only, unless an account is held.
Accounts will be opened for series rate advertisers subject to satisfactory credit references.
Accounts are strictly net and must be settled by publication date.

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
10% discount if advertising in both Radio & Electronics World and Amateur Radio. A voucher copy will be sent to Display and Colour advertisers only.
Ads accepted subject to our standard conditions, available on request.

EAST CORNWALL COMPONENTS

NEW 1986 Catalogue is now available – range of components greatly increased – over 136 pages fully illustrated. Price £1.00 per copy (free upon request with orders over £15.00). Includes 50p Credit Note, Special Offer Sheets, Order Form and Pre-Paid Envelope. Order your copy now – will be despatched within 7 days.

We wish you a happy and successful 1986

PLUGS & SOCKETS

Metal Co-ax Plug	0.18
Plastic Co-ax Plug	0.14
Metal Line Socket	0.32
Single Junction Socket	0.80
Plastic Phono	0.10
F M Plugs	0.20
PL259 Plugs	0.38
Reducer	0.15

FUSEHOLDERS

20mm Panel Mounting	0.28
20mm Chassis Mounting	0.06
1¼" Panel Mounting	0.35
1¼" Chassis Mounting	0.12
Carline 1¼ Holder	0.10

TELEPHONE SPECIAL

BT App Telephone Plug - 3m Lead	1.25
BT App Master Socket Inc. Wiring Instrns	2.85
BT App Secondary Socket	1.95
4 way plug	0.58ea 10/£5.50
BT 4-Core Cable per metre	.15
100 metres	12.00
Cable clips for above	100/75p

NI-CAD

Universal Ni-Cad charger charges PP3, AA, C D
Price £5.10

RECHARGEABLE BATTERIES

AA (HP7)	0.95 ea	10/0.85 ea.
C (HP11)	2.14 ea	10/0.98 ea.
D (HP2)	2.30 ea	10/2.10 ea.
PP3	3.75 ea	10/3.65 ea.

SPEAKERS

4" round 1.6W, 4ohm	£1.50 pr
4" round 1.6W, 4ohm. Plus Mounting Bracket	£1.00 ea
2¼" round 0.4W 8ohm	£0.85 ea

SPECIAL OFFER – JAN ONLY

Antex soldering stand **£1.50, available with orders over £5.00.**

Look for our 'Special Offer' for each month

SANYO DYNAMIC MICROPHONE

c w 1 metre of cable - plug on off switch and stand Imp 500 ohm model no HM95 **£1.50 ea**

ZENER DIODES

400mW Plastic 3V-30V **8p each 10/70p**
1/1 3W Plastic 4 7V-120V **12p each 10/£1.10**
*1.5W Plastic 11V-75V **1.25 each 10/11.50**
*2.5W Plastic 75V-75V **0.75 each 10/7.00**
*15W Plastic 12V-30V **85p each 10/8.00**
*20W Metal 7.5W-68V **1.32 each 10/11.60**
*Only Available while Stocks Last

*Zener Diode Pack-400mW-5 each-value-11 values-individually packed & marked
55 Zener Diodes **3.50 per pack**

MIN 'D' CONNECTORS

		9way	15way	25way	37way
PLUGS	Solder Lug	.52	65	.88	1.45
	R. Angle	.89	1 34	1.98	3.48
SOCKETS	Solder Lug	.78	98	1.33	2.48
	R Angle	1.18	1.78	2.70	4.15
COVERS		95	95	.98	1.00

POTENTIOMETERS

Carbon Track, Rotary 0.25W Log & 1 in values. All ¼in Spindle, 20ml body dia. Shaft 2" long.

4K7-2M2 Single Gang Log	.40	10/3.80
1K — 2M2 Single Gang Lin	.38	10 3.50
5K — 2M2 Single Gang DP Switch Log	1.05	10 9.50
5K — 2M2 Double Gang Log & Lin	1.25	10/10.50

RESISTORS — CARBON FILM 5%

¼W 1RO to 10M (E12 Range)	2p each. 15p/10. 75p/100
½W 1RO to 10M (E24 Range)	2p each. 15p/10. 75p/100
1W 10R to 1OM (E12 Range)	7p each. 40p/10. 3.50/100
2W 10R to 1OMm (E6 Range)	8p each. 60p/10. 5.00/100

RESISTOR KITS — each value individually packed

¼W pack 10 each value E12—10R—1M 610 pieces	5.75
¼W pack 5 each value E12—10R—1M 305 pieces	3.35
½W pack 10 each value E12—2R2—2M2 730 pieces	7.95
½W pack 5 each value E12—2R2—2M2 365 pieces	4.75
1W pack 5 each value E12—1OR—1OM 365 pieces	15.00
2W pack 5 each value E6—10R—1OM 365 pieces	18.50

RESISTORS — WIREWOUND Generally 5%

2.5W 0.22 to 270R	15p each 1.40/10
4W 1RO to 10K 1RO to 680R	14p each
1K—3K3	15p each
4K7—6K8	18p each
10K	22p each
7W 1RO to 22K. 1RO to 5K6	15p each
6K8—12K	16p each
15K—22K	17p each
11W 1RO to 22K. 1RO—4K7	18p each
6K8—10K	19p each
15K—22K	22p each
17W 1RO to 22K. 1RO—10K	24p each
15K—22K	25p each
Support pillars for 4W/7W/11W/17W/	4p each 30p/10
25W 0.47R—47OR	1.48 each 12.50/10
50W 0.47R—47OR	1.85 each 13.00/10

CHART RECORDER SPECIAL

Brand new 3 channel pen recorders complete with charts. Full spec upon request: once only price **£40** + **£10 p&p** + **VAT**

Terminal Blocks

2 amp 12 way **0.20**
5 amp 12 way **0.24**
15 amp 12 way **0.42**
32 amp 12 way **0.88**

CAPACITORS

Mixed Dialectic.

.01mf 1000V	0.30
.022mf 1000V	0.20
.1mf 1000V	0.48
.47mf 1000V	0.78

CERAMIC CAPACITOR PACK

50V. Ceramic Capacitors – 5 each value
25 values – each value individually marked and packed – 125 total. **£3.50** per pack.

D C MOTORS (Min)

35/086 6-12 volts 25mmx38mm	75p each	10/£6.00
35/552 9 volts 35mmx42mm	85p each	10/£7.00
35/129 6-12 volts - m/bracket 25mmx38mm	80p each	10/£6.50
35/016 6-12 volts - m/bracket 38mmx42mm	82p each	10/£6.70
SPDC 12 volt Fujiya - Speed Control Board 32mmx38mm	£2.50 each	£10/£22.00

Soldering Section

XS25W Iron Kit/complete with stand & plug attached	10.00
CS 18W as above	9.90
Antex 15W iron	5.25
Antex 18W iron	5.50
Antex 25W iron	5.75
Antex elements	2.75
Antex bits	0.90
Antex stands	2.10
Soldersucker	4.50
Spare nozzles for Soldersucker	0.65

SERVICE AIDS

Switch Cleaner	1.18
Circuit Freezer	1.34
Foam Cleanser	1.16
Aero Klene	1.10
Plastic Seal	1.28
Excel Polish	1.12
Antistat Spray	1.18
Aero Duster	1.40
Super 40	1.82
Video Head Cleaner	1.06
Fire Extinguisher	3.06
Silicone Grease Aer	1.42
Ditto Tube	1.64
Heat Sink Compound	1.08
Solda Mop 0.12mm	0.74
Ditto 0.06mm	0.76

PRESETS

0.25W Type 100R-4m7 V&H **10p ea 10/90p**
0.1W Type 100R-1M V&H **7p each 10/65p**

CMOS

4000	0.19
4001	0.24
4002	0.24
4005	0.68
4007	0.24
4008	0.59
4009	0.44
4010	0.39
4011	0.23
4012	0.24
4013	0.35
4014	0.58
4015	0.58
4016	0.38
4017	0.54
4018	0.59
4019	0.59
4020	0.78
4021	0.58
4022	0.68
4023	0.30
4024	0.49
4025	0.24
4026	0.89
4027	0.44
4028	0.44
4029	0.73
4030	0.33
4031	1.28
4033	1.25
4034	1.40
4035	0.68
4036	2.48
4038	0.73
4039A	2.70
4040	0.58
4042	0.48
4043	0.42
4044	0.48
4046	0.58
4049	0.38
4050	0.34
4051	0.68
4051	0.68
4052	0.58
4053	0.58
4066	0.44
4068	0.24
4069	0.24
4070	0.24
4071	0.24
4072	0.24
4073	0.24
4075	0.24
4076	0.68
4077	0.24
4078	0.24
4081	0.24
4082	0.24
4085	0.58
4086	0.58
4089	1.22
4093	0.37
4094	0.70
4095	0.93
4096	0.98
4097	2.65
4098	0.78
4099	0.75
4161	0.96
4162	0.96
4163	0.96
4174	0.96
4175	1.00
4195	0.99
4501	0.38
4502	0.58
4503	0.38
4507	0.45
4508	1.28
4510	0.54
4511	0.54
4512	0.54
4514	1.10
4515	1.20
4516	0.60
4517	2.70
4518	0.48
4020	0.50
4521	1.10
4522	1.20
4526	0.58
4527	0.64
4528	0.68
4531	1.20
4532	0.64
4536	2.50
4538	0.78
4539	0.80
4541	0.94
4543	0.70
4549	3.98
4553	2.40
4554	1.80
4555	0.34
4556	0.54
4557	2.40
4558	1.10
4559	3.90
4560	1.50
4562	3.48
4566	1.60
4569	1.75
4583	1.00
4584	0.54
4585	0.55
40100	2.10
40101	1.20
40102	1.30
40103	3.95
40104	1.15
40105	2.10

INTEGRATED CIRCUITS (£) EACH

709	0.35
741	0.25
747	0.70
AN214Q	3.80
AN240P	3.42
BTT6218	1.98
CA301AT	2.88
CA58E	0.66
CA810CM	1.20
CA3020	2.10
CA3065	1.60
CA3080E	0.68
CA3130E	0.90
CA3140	0.45
HA1366W	1.59
LA4422	3.20
LC7131	4.90
LC7137	5.40
LM324N	0.45
LM380N8-P	1.15
LM380N14-P	1.80
LM1011N	3.20
LM1458N	0.98
LM3900N	0.85
M51513L	2.30
M51515L	3.18
MC1307P	1.99
MC1327P	1.50
MC1330P	1.60
ML23213	2.10
ML23713	2.30
NE555	0.25
SAA1025	4.00
SAS560	2.50
SAS570	1.85
SAS580	2.85
SN76033N	2.50
SN76131N	1.99
SN76226DN	1.70
SN76227N	1.10
SN7666ON	0.75
SN76666NO	1.40
STK015	6.20
TA7146P	4.60
TA7203P	2.76
TA7204P	1.50
TA7205AP	1.30
TA7222P	2.32
TAA550	0.50
TAA611A12	3.50
TAD100	2.90
TDA120A	0.80
AS/S/SB/T/U	0.80
TDA120B	1.30
SA/SQ/UQ	1.30
TBA520	1.50
TBA530	1.20
TBA540	1.64
TDA560C	1.50
TDA800	0.80
TBA810S	1.20
TBA950/2A	3.05
TCA270SA	4.02
TDA1003A	5.50
TDA1006A	2.45
TDA1035S	2.20
TDA1170S	1.99
TDA1352A	1.80
TDA2002	1.80
TDA2020	4.00
TDA2030	1.90
TDA2140	2.90
TDA2160	2.50
TDA2522	2.75
TDA2530	2.20
TDA2532	2.80
TDA2543	3.20
TDA2581	4.60
UPC57512	1.45
UPC741G	0.95
UPC1156H	2.75
UPC1180	2.75
UPC1218H	1.80
UPC1370C2	2.50
UPC2002H	2.75
UPC2002U	2.75

74LS

74LS00	0.24
74LS01	0.24
74LS02	0.24
74LS03	0.24
74LS04	0.24
74LS05	0.24
74LS08	0.24
74LS09	0.24
74LS10	0.24
74LS11	0.24
74LS12	0.24
74LS13	0.33
74LS14	0.48
74LS15	0.24
74LS19	0.44
74LS20	0.24
74LS21	0.24
74LS22	0.24
74LS24	0.28
74LS26	0.24
74LS27	0.24
74LS28	0.24
74LS30	0.24
74LS32	0.24
74LS33	0.24
74LS37	0.24
74LS38	0.24
74LS40	0.24
74LS42	0.50
74LS47	0.79
74LS48	0.85
74LS51	0.24
74LS55	0.24
74LS73	0.30
74LS74	0.33
74LS75	0.44
74LS76	0.38
74LS78	0.38
74LS83	0.68
74LS85	0.82
74LS86	0.35
74LS90	0.48
74LS91	0.90
74LS92	0.54
74LS93	0.54
74LS95	0.60
74LS96	1.20
74LS107	0.40
74LS109	0.44
74LS112	0.44
74LS113	0.40
74LS114	0.39
74LS122	0.68
74LS123	1.00
74LS124	1.25
74LS125	0.52
74LS126	0.50
74LS132	0.60
74LS135	0.26
74LS136	0.42
74LS138	0.44
74LS139	0.58
74LS145	0.93
74LS147	1.64
74LS148	1.28
74LS151	0.70
74LS153	0.70
74LS155	0.55
74LS157	0.45
74LS158	0.58
74LS160	0.62
74LS161	0.68
74LS162	0.70
74LS163	0.68
74LS164	0.74
74LS165	1.10
74LS166	1.50
74LS168	1.48
74LS170	1.40
74LS173	0.98
74LS174	0.75
74LS175	0.70
74LS190	0.82
74LS192	0.98
74LS193	0.98
74LS194	0.75
74LS195	0.74
74LS196	0.84
74LS197	0.96
74LS221	0.85
74LS240	0.60
74LS241	0.80
74LS242	0.94
74LS243	0.94
74LS244	0.80
74LS245	1.20
74LS247	1.00
74LS251	0.75
74LS257	0.73
74LS258	0.75
74LS259	1.20
74LS266	0.55
74LS273	1.20
74LS279	0.70
74LS283	0.80
74LS353	1.10
74LS365	0.50
74LS366	0.50
74LS367	0.50
74LS368	0.50
74LS373	1.00
74LS374	1.00
74LS375	0.70
74LS377	1.25
74LS378	0.95
74LS390	0.60

TRANSISTORS + DIODES

Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)
AC127	0.28	BC125	0.14	BC440	0.36	BF158	0.30	BRY56	0.42	BYX10	0.20	TIS43	0.88
AC128	0.30	BC140	0.27	BC441	0.40	BFR160	0.23	BSX19	0.32	BYX36/150	0.40	TIS88	0.50
AC128K	0.34	BC141	0.26	BC461	0.58	BF167	0.32	BSX20	0.30	BYX36/600	0.48	TIS90	0.27
AC141	0.58	BC142	0.24	BC478	0.24	BF177	0.42	BSX59	0.78	BYX48/300	0.70	TIS20	2.45
AC141K	0.38	BC143	0.26	BC516	0.48	BF178	0.26	BSX76	0.65	BYX55/600	0.30	Y728	0.14
AC142	0.56	BC147	0.18	BC547	0.12	BF180	0.27	BSY52	0.35	BYX71/600	1.18	Y969	2.80
AC142K	0.38	BC147B	0.14	A or B	0.10	BF181	0.27	BSY95A	0.25	BYZ212	0.78	ZE75	0.60
AC151	0.45	BC148	0.10	BC548	0.12	BF182	0.32	BT100A/02	0.90	C106D (400V)	0.48	ZTX107	0.14
AC152	0.45	BC148B	12	A B or C	0.10	BF183	0.32	BT101/300	2.75	C106F (50V)	0.36	ZTX502	0.22
AC153	0.57	BC149	0.10	BC549	0.10	BF184	0.30	BT101/500	3.25	D40C1	1.08	IN4001	0.04
AC153K	0.46	BC149C	0.14	A or B	0.10	BF185	0.28	BT102/300	3.60	D40N1	1.12	IN4003	0.05
AC176	0.30	BC157	0.10	BC550	0.10	BF194A	0.15	BT106	1.15	E1222	0.30	IN4004	0.05
AC176K	0.38	BC158	0.12	A or B	0.10	BF195	0.12	BT108	1.25	E5024	0.30	IN4006	0.07
AC187	0.28	BC159	0.12	BC557	0.10	BF200	0.30	BT109	1.15	GET872	0.60	IN4007	0.07
AC187K	0.38	B/C	0.14	BC558A	0.10	BF222	0.38	BT116	1.20	GET881	1.70	IN4148	0.04
AC188	0.28	BC160	0.30	BCY70	0.16	BF224	0.16	BT119	3.30	GET882	1.90	IN5400	0.12
AC188K	0.38	BC161	0.30	BCZ10	£3.21	BF224J	0.20	BT120	3.50	ITT2001	0.18	IN5402	0.13
ACY22	1.50	BC168B	0.20	BCZ11	£2.60	BF240	0.30	BT121	2.99	ITT2003	0.34	IN5405	.16
AD142	0.88	BC169C	0.12	BD124P	0.70	BF241	0.30	BT138/600	1.30	MCR106/5	1.20	IN5406	0.17
AD143	0.88	BC170	0.16	BD129	0.90	BF244	0.34	BT151/560R	0.90	ME0413	0.70	IN5408	0.19
AD149	0.72	A B or C	0.16	BD130Y	0.68	BF244A	0.30	BTY79/400R	2.80	ME6002	0.26	IS44	0.06
AD161/162	1.20	BC171	0.10	BD131	0.36	BF257	0.22	BU100A	2.30	MEU21	0.62	IS920	0.07
AD162	0.52	A or B	0.10	BD132	0.36	BF258	0.26	BU104	1.80	MJ400	0.45	2N1306	1.42
AF114	1.20	BC172	0.12	BD135	0.26	BF259	0.30	BU105	1.20	MJ2955	1.00	2N2122A	0.34
AF115	2.10	B or C	0.12	BD136	0.26	BF262	0.34	BU105/02	1.55	MJ3000	1.80	2N2222	0.30
AF116	2.10	BC177	0.24	BD137	0.28	BF263	0.38	BU108	1.75	MJE340	0.46	2N2904A	0.48
AF121	0.56	A B or C	0.24	BD138	0.30	BF270	0.30	BU124AE	0.98	MJE520	0.44	2N2926G	0.14
AF124	0.42	BC182	0.10	BD139	0.30	BF271	0.28	BU126	1.40	MJE2955	1.60	2N3053	0.30
AF125	0.58	A B or C	0.10	BD140	0.28	BF273	0.22	BU133	1.90	MJE3055	1.40	2N3054	0.80
AF126	0.58	BC182L	0.12	BD142	1.26	BF274	0.34	BU204	1.30	MPSA05	0.30	2N3055	0.65
AF127	0.38	LALDLC	0.12	BD145	1.82	BF294	0.46	BU205	1.30	MPSA12	0.30	2N3703	0.10
AF139	0.40	BC183	0.10	BD150B	0.72	BF336	0.32	BU206	1.50	MPSL01	0.34	2N3773	2.80
AF178	2.28	A B or C	0.10	BD160	1.58	BF337	0.28	BU208	1.40	MPSU05	1.05	2N3904	0.20
AF239	0.50	BC183L	0.10	BD165	0.45	BF338	0.28	BU208A	1.40	MPSU06	1.18	2N3906	0.20
AF279S	1.40	LALBLC	0.10	BD183	0.70	BF355	0.37	BU208/02	2.05	MR502	0.40	2N5294	0.80
AL100	5.40	BC184	0.10	BD201	0.52	BF363	0.35	BU326S	1.75	MR854	0.86	2N6107	0.80
AL102	4.40	ABCLLCLB	0.10	BD202	0.57	BF367	0.24	BU407	1.10	NKT SER18	1.68	2SB337	1.80
ASY80	5.20	BC207	0.15	BD204	0.50	BF371	0.27	BUX80	3.70	OA91	0.07	2SC1098	0.84
ASZ17	2.00	BC212	0.10	BD222	0.80	BF422	0.20	BUY20	2.75	OA210	0.66	2SC1172Y	1.70
AU110	2.80	A B or C	0.10	BD225	0.40	BF450	0.38	BUY69A	2.60	OC26	2.65	2SC1173Y	0.88
AY102	4.32	BC212L	0.09	BD232	0.45	BF457	0.36	BUY69B	1.98	OC35	4.75	2SC1279	0.50
B40C2200	1.03	LALB	0.10	BD234	0.30	BF458	0.37	BY100	0.80	OC36	1.75	2SC1306	0.92
BA110	0.68	BC213	0.10	BD235	0.30	BF459	0.35	BY103	0.50	OC44	0.72	2SC1307	1.50
BA115	0.14	A B or C	0.10	BD236	0.38	BFR51	0.36	BY122	0.60	OC72	0.70	2SC1413A	2.70
BA121	0.40	BC213L	0.10	BD237	0.38	BFR61	0.32	BY126	0.10	OC81	0.68	2SC1449	0.60
BA129	0.38	LALBLC	0.10	BD410	0.76	BFR90	0.86	BY127	0.08	ORP12	0.85	2SC1507	0.60
BA148	0.16	BC237	0.11	BD434	0.58	BFT41	0.68	BY133	0.08	R2008B	1.20	2SC1678	1.00
BA155	0.12	BC238	0.12	BD438	0.58	BFT43	0.86	BY135	0.35	R2010B	1.20	2SC1758	0.68
BA157	0.28	BC251	0.14	BD439	0.85	BFW11	0.84	BY164	0.45	R2010B	1.20	2SC1909	1.20
BB105B	0.30	AB	0.14	BD441	1.00	BFW44	0.88	BY179	0.56	R2540	2.71	2SC1923	0.30
BB105G	0.48	BC262	0.26	BD507	1.05	BFX29	0.28	BY182	0.80	TIC45	0.45	2SC1945	2.88
BB110B	0.42	AB	0.28	BD520	1.20	BFX48	0.78	BY184	0.38	TIC47	0.70	2SC21953	0.70
BC107	0.10	BC301	0.30	BD687	0.88	BFX80	6.46	BY187	0.65	TIC29	0.30	2SC1957	0.70
A or B	0.12	BC302	0.30	BD707	0.88	BFZ85	0.35	BY189	6.75	TIP30A	0.32	2SC1969	2.80
BC108	0.10	BC303	0.30	BDX18	1.00	BFY50	0.22	BY198	0.64	TIP31C	0.39	2SC2028	0.73
A B or C	0.13	BC307A	0.18	BDX32	1.48	BFY51	0.22	BY199	0.72	TIP32	0.35	2SC2029	2.70
BC109	0.10	BC317A	0.12	BF115	0.32	BFY52	0.22	BY206	0.14	TIP33A	0.55	2SC2078	1.05
A B or C	0.14	BC323	0.90	EF117	0.50	BFY90	0.80	BY207	0.16	TIP34A	0.70	2SC2091	0.70
BC113	0.42	BC327	0.16	BF119	0.82	BFY90S	1.34	BY210/400	0.21	TIP41C	0.42	2SC2098	2.90
BC115	0.12	BC328	0.16	BF120	0.38	BR100	0.25	BY210/600	0.24	TIP42	0.44	2SC122A	3.20
BC116	0.12	BC337	0.12	BF125	0.42	BR101	0.40	BY210/800	0.28	TIP47	0.42	2SC2314	0.80
BC117	0.22	BC338	0.12	BF127	0.41	BR103	0.50	BY227	0.22	TIP121	0.63	2SC2335	1.50
BC118	0.16	BC350A	0.24	BF154	0.14	BR303	2.75	BY228	0.46	TIP2955	0.70	2SK135	3.80
BC119	0.28	BC351	0.16	BF157	0.46	SRY39	0.50	BY238	0.65	TIP3055	0.58	3N211	3.52

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