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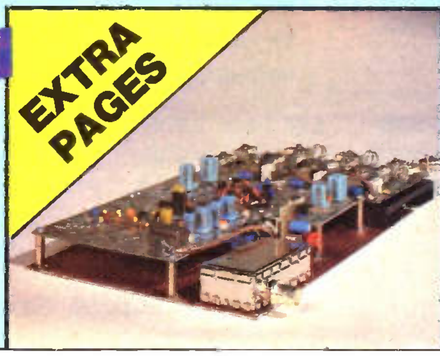

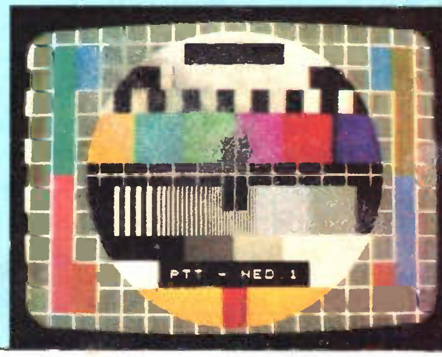

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The communications, electronics & computers magazine

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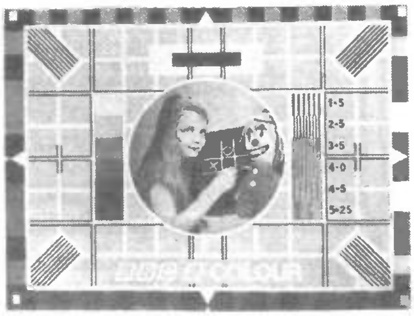
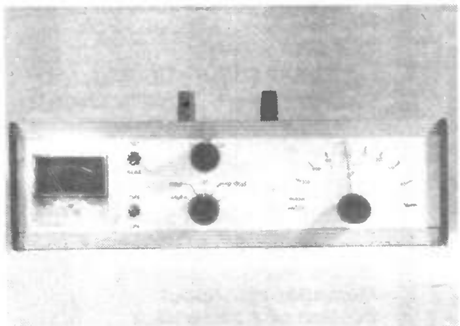
MERRY CHRISTMAS AND A HAPPY NEW YEAR TO ALL OUR READERS





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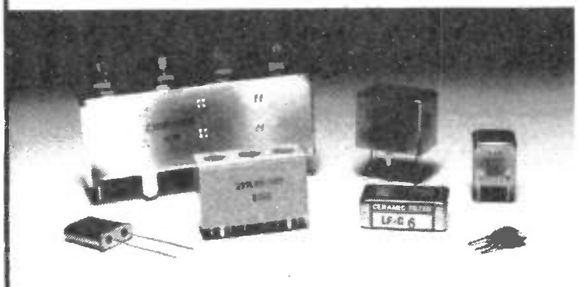

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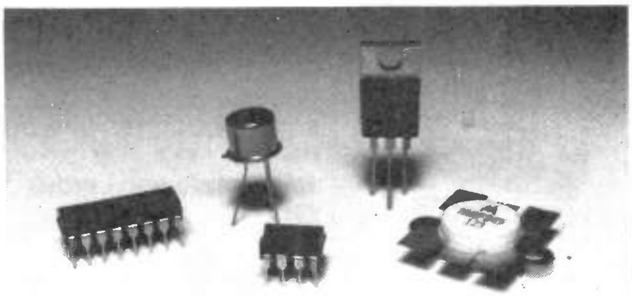

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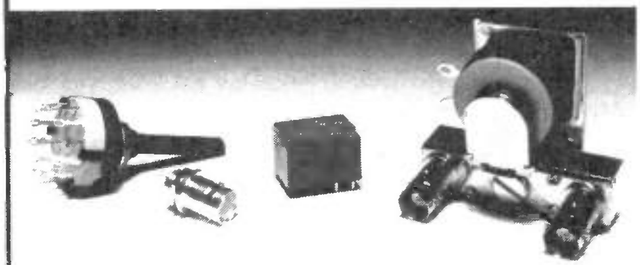

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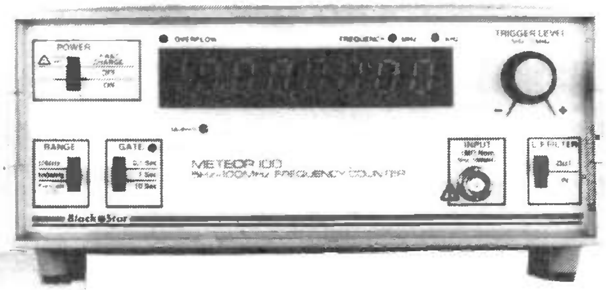

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NEWS

Going up

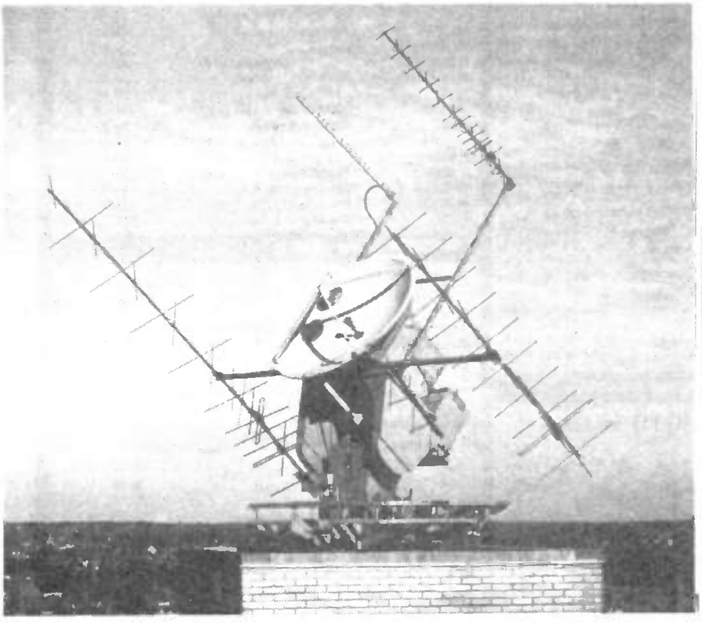
It has recently been announced that Dr Martin Sweeting's satellite team at the University of Surrey is to build another satellite. This will be very similar to the original UOSAT – indeed it's going to be called UOSAT-B prior to launch and UOSAT-2 after launch.

The first UOSAT was launched by NASA two years ago on 6th October 1981 but it continues to provide much scientific and space engineering information, and its signals are received by thousands of amateur and professional ground stations throughout the world (some of whom use the *R&EW* UOSAT receiver, published in May '82!) It attracted particular attention because it was the first spacecraft to transmit information by means of a speech synthesiser as well as by morse and high-speed telemetry; it was thus of special value to school groups and amateurs lacking sufficient practice in morse.

The plan is to launch UOSAT-B in February as a secondary payload to a new LANDSAT spacecraft, whose launch has been brought forward as a result of the premature demise of LANDSAT 4. However, building such a sophisticated craft as UOSAT in only five months represents a considerable challenge, particularly as the design of nearly all the on-board electronics will either be new or greatly reworked. Let's hope it all goes without any major hitch.

More details of this project can be expected in next month's 'Amateur Radio World' feature.

The antennae used for controlling satellites located on the roof of the Electronics Department at the University of Surrey



Alive and well

We have been asked to bring to your attention that, contrary to the impression inadvertently given in these columns, valves are by no means a thing only of the past. For instance, the M-O Valve Company continues to make and market three beam tetrodes; the KT66, the KT77 and the KT88. The company also provides valve enthusiasts with information on these valves and on circuits using them.

Another service offered by M-O Valve is help with tracking down high voltage capacitors, valve sockets, HT-transformers etc for use in valve circuits. Mr N Covington suggests that anyone seeking such assistance should write to him enclosing an SAE, at *The M-O Valve Company, Brook Green Works, London W6 7PE.*

A 'Mean' Model

This multi-levelled model, which has been nicknamed 'The Mekon', is being used at British Telecom's Research laboratories at Martlesham Heath in tests designed to improve telephone performance. These tests are being carried out in an anechoic chamber and The Mekon is supposed to represent 'a "mean" person of average dimensions' – technically known as a 'head and torso simulator' or HATS.

The model has been made to very precise specifications as the idea is to evaluate how sound waves projected at the model bend round it. The outcome of this work should help in setting up some new international standards for the design of telephone equipment.

More provision for TV reception

When Channel 4 and S4C were launched just over a year ago, these programmes were radiated from 31 'main' transmitting sites and 127 local relay stations: they were thus within reach of 87% of the UK population. Over the past year, a further nine 'main' and 75 local sites have been added to the network, bringing the total number of people able to receive these stations up by about four million to almost 95% of the population.

And in among the celebrations of the first birthdays, the IBA confirmed that 'the £50-million engineering of the Channel 4 and S4C transmission networks . . . will be continued with equal energy'. The provision of these transmission facilities – 'the fastest build-up of a major network ever attempted in the UK' – is described as being 'a continuing good news story for British engineering'. Apparently it is still fully on target.

Another recent news story from the IBA concerned 'a technical breakthrough by IBA engineers' whereby Central Independent Television's new East Midlands service has achieved even wider coverage in West Derbyshire. However details of this development were not given: it is only known that the new technique is more immune to interference. (The main transmitter for this station is, by the way, at Waltham near Melton Mowbray.)

A warning

Late in October, Mr Alex Fletcher (Minister for Corporate and Consumer Affairs in the Department of Trade and Industry) issued a warning following reports in the press about the use of high-power amplifiers – commonly known as 'burners' – to disrupt the operation of

NEWS

petrol pumps at filling stations. Mr Fletcher pointed out that, not only the use of such a high-power amplifier coupled to a CB set potentially hazardous through increasing the risk of an electric spark close to the filling nozzle, but that *The Code of Practice for Citizens' Band Radio* (available FOC at Post Offices) specifically draws attention to this.

Moreover, the use of a CB set with a burner is illegal because of the interference it would cause to domestic radio and TV reception and to the emergency services: offenders may be imprisoned for up to three months and fined up to £1000.

Competition winners

As promised last month, here are the results of the two competitions we held earlier in the year.

In August, we asked you to put a caption to the picture shown here. We received a number of suggestions such as 'Bussing Incorporated' and 'Working on baud', but the one we liked most was:

PEEK (thro' the window),
POKE (the keyboard),
Yes! It definitely
computes . . .
I'm on the wrong coach!

and so Mr B G Cooper of Sheffield is the recipient of the Akigawa AD901 multimeter.

In September, we offered you the chance to show how well you had learnt the basics of Z8000 programming – and to win a complete Z8000 development system. Again, this competition attracted a number of entries but we had an outright winner in Mr D Wells of Newport Pagnell, whose suggested project – which was to develop a high-speed sample and store procedure for video signals prior to signal processing – we also rated quite highly. Presentation of the Z8000 development system kindly donated by Arcom Control Systems has still to be arranged at the time of going to press, but we hope to bring you more details later.

Amstrad Ahoy!

Our spies advise us that there is a new personal computer due from Amstrad in 1984. Details are not presently available as Amstrad apparently isn't indulging in the usual practice of pre-announcing a product by six months (and still not managing to deliver!). However, our information is that it is a machine worth waiting for.

Value for money is likely to be the prime marketing weapon when it does appear, although we understand that the design has been undertaken by some of the most acute minds in the business. So watch out, all those at the waterworks!

Company News

ICI is acquiring the business of **Arbco Electronics** of Van Nuys, California – a specialist producer of high technology printed circuit boards for the computer, aerospace and defence industries. The idea is said to be to give added impetus to **ICI's Electronics Group,** established at Runcorn in May 1983 to identify, develop and pursue worldwide business opportunities in the electronics industry. Other acquisitions along the same lines have included that of **Photomasking Services** of Warwick. The latter is now known as **IC Masks** and recently ICI was joined in this new company by **TRE Corporation** of California, with the result that this company will supply advanced mask-making and mask-processing equipment which should help establish IC Masks as a high-quality supplier of masks.

SGS-ATES and **National Semiconductor** have signed an agreement whereby the former will be able to produce National's LM2935 dual-output voltage regulator and the LM1837/97 low noise stereo pre-amps from National's tapes, while the latter gets similar facilities in respect of the L272 and L272M dual power op-amps and the LS404 high-performance quad op-amp. Both companies see this second sourcing and exchange of technology as promoting the development of innovative linear IC's.

Mostek Ireland has been awarded the Quality Mark of the **Irish Quality Control Association** in recognition of 'the overall quality excellence of semiconductor operations' at the firms Blanchardstown facilities. The specific areas audited include quality planning, manufacturing control, environmental control, customer service and product quality management.

The **British Technology Group** (the body that now incorporates the **NRDC** and the **NEB**) is providing £50,000 to **Linear Graphics** of Rayleigh, Essex, as backing for the development and manufacture of low-cost graphics plotters based on a new type of linear motor. The use of such a motor obviates the need for a cable and pulley system to move the pen over the paper with its attendant problems of cable stretching and backlash.

Hewlett-Packard is to set up its first R&D laboratory outside California's Silicon Valley in Britain – or, more precisely, near Bristol. The decision to site this new facility in Britain – and thus to invest several million pounds and employ an estimated 200 'home-grown' research professionals, plus support staff – was taken in view of 'the UK reputation for applied research and the quality of our university and technical college graduates.' The projects to be worked on are not yet defined but will be of a computer science nature. This laboratory represents yet another element in the UK's own Silicon Valley – the area surrounding the M4.

A H Lewis & Betts, a firm of Chartered Surveyors based in Iver, has announced that it is operating a new service specifically for **Radio Amateurs** on the move at no extra charge. This service will comprise keeping tracks of which vendors and which buyers have or will want aerials, a radio shack etc – all of which can take a long time to set up (including getting planning permission). The principal of the firm is himself a radio amateur, as is his wife and the husband of his sales manageress.

Plessey Office Systems has been granted exclusive rights to distribute the video conferencing systems of **Compression Labs Inc.** in the UK and other countries. Their supply will be undertaken in association with **Oceonics Communications.**

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These articles are scheduled for the February issue, but they are all subject to confirmation

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● Interesting vintage GPO telephones: wall and table (candlestick) models, beautifully made in teak. Also pretty 1910 intercom instruments. All reasonably priced; very collectable. Also Victorian plate cameras (mahogany and brass); ideal gifts.Sae for details to: The Advertiser (R.E.W.) 8 Grafton Road, Cheltenham, Glos. GL50 2ES. (Would also like to hear from readers interested in above items and pre-war radio receivers).

● Electronic kits built and tested to order to a high technical standard. Competitive charges, estimates free. Bargain offer. Maplin Talkback (VIC20) Kit No LK00A. New, built and tested £26 post free. A. Harvey, 38 St. Michaels Grove, Fareham, Hants.

● Free! To collector. Brand new and boxed AW47/91 19" mono cathode ray tubes. Mr A. Bray, 12 Westward Way, Kenton, Harrow, Middx. Tel: 907 2920.

● Ex VDU's: Monitors £20: ASCII Keyboards £15; PSU's (big!) £10; ITT VDU's: as is £35; working £50; ZX81 NO PSU 2K RAM Monitor output £15: Practica LLC (meter needs attention) £30: 28mm f2.8 £15; 200mm f3.5 (electric coupling needs adjustment) £10; all prices negotiable! John Stumbles. Tel: 01-589 5111 ext 1190/1174 or 01-693 7718.

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● Low voltage high power mains transformers suitable for transistor amplifiers etc. £5 ono. Woodward. Tel: Worcester 641759.

● Unused DG7-5 CRT (Mullard) Offers. Woodward. Tel: Worcester 641759.

● New BC221 Frequency meter. Checked but never used. C/W Handbook. Calibration book. H/phones and spare tubes. Best offer. J.B. Sewell, 16 Stirling Drive, Burnside, Glasgow G73 4JH. Tel: 041 634 4464.

● Eddystone 5 band midget communications receiver type S870A. 150kHz to 24MHz mains operation. Perfect £36. Heathkit 'Mohican' communications receiver 600kHz to 30MHz. 12V DC or 240V AC operation. Fitted with commercial FM demodulator strip and switching to provide all-mode operation £35. Hansen SWR meter and Eagle phones both as new. £14 the pair. K.W. Clark (G3WIF), 16 Goldney Rd, Clifton, Bristol BS8 4RB. Tel: 0272 293738.

● Transformer Ex-B40 type AP67763A offering 276V out at 80mA also 6.4V at 4A and at 1.2A input 115/230V 40-60HF well used, but working. Any offers? Also 12-322pF 4 stage variable capacitor from B40, appears PWO. Offers? Matthew Probert. 3 Pine View Close, Haslemere, Surrey GU27 IRU. Tel: 0428 3200. (Ask for Matthew).

● Muirhead 'Mufax' facsimile printer plus electronics unit, manuals £45. Marconi mobile data equipment: miniature printer £30. LED display 'soft copy unit' £30. Redifon UHF (200-400MHz) FM transceiver tunable, aerial, nicad etc. £35. Also various aerials, TV cameras, monitors, PA's etc. Write for lists; Bob Sayers, 40 Royal Oak Drive, Leegomery. Telford. Shropshire TF1 4SS. Tel: Newport 811280 ext. 253 (work).

● Army radio sets 19, 18, 38, 38AFV, 31, 31AFV, Canadian CFS adaptor, all complete stations including remote control headgear etc. No non military mods, real collectors items. In good order. Must dispose due to impending space problem. Sensible offers please. Mike Buckley. 12 Ranmore Ave, Croydon, Surrey CR0 5QA. Tel: 01-654 2582.

● Scope CD1400 Solartron dual beam with manual and leads, excellent condition, calibrated. Absolute bargain at £89 for quick sale. Alex Stobbe, 8 Illston Place, Peterborough PE1 4UY. Tel: 0733 40301.

● HRO spares, one brand new unused four gang tuner, three new IF's, one main tuning dial, 19 valves, six coils gen. coverage, two coils band spread twenty and eighty. Bits and pieces £20 the lot. Buyer to collect please. Newly licenced amateur, old age pensioner. Call sign G6ZSP. Age 64, made redundant Oct 1980. Widower, live by myself. Have Racal HF RX and 290R 2 metre rig. R. Pattinson, 135 Meriden Court, Birmingham New Rd, Wolverhampton, Staffs WV4 6BP.

● Cable grip grommets for 1/8" dia. cable 2p each plus SAE. PVC grommets 3/8" bore 3p each plus SAE. Steel boxes 6" x 6" x 2" with lid and 4 screws with metric knockouts all round £1.10 each. Also clearing out LEDS and IC sockets. D. Martin, 6 Downland Gardens, Tattenham Corner, Epsom, Surrey.

● Marconi sig. gen. TF2006 10-500 megs £350. Spare one £90. Marconi sig. gen. TF1064 £50. Marconi watt meter CT44 £6. Marconi sig. gen. TF1066 fixed output £75. Advance sig. gen. SG62B £20. Scope ex-min. CT436 £60. Spare £20. KT88s GEC £5. T/former 1K0, 1KV 235mA £10. Scope advance OS15A £30. Scope servicescope S51A £40. AR88D Tuning gang and switch £6. Sanyo receiver RP8880G 9 bands, crystal marker, double conversion £85. OSC tubes, Hewlett Packard 6" 5083-0353 £15. GEC 1074H two gun £5. ACR10 with screen and base £4. Mullard DG7/6 screen and base £6. Marconi valve V/meter TF2604 £75. Mr P. Baylis, 42 King Edward Ave, Dartford. Kent DA1 2HY. Tel: Dartford 72913.

● Philips/Pye TX portable mono TV chassis complete £10. Philips G6 hybrid CTV LOPTX etc £10, or exchange ultra sonic transducers or data on ultra sonic propagation etc or what have you? Mr A. Bouskill. 129 Lyminster Rd, Sheffield, South Yorks S6 1HY. Tel: 0742 311191.

● Tektronix scope 535A delay timebase 15MHz B/W. 1A2 dual trace plugin with manuals £130. Voltage standard and differential V/meter COHU 302 £45. 22 Birch Dale, Hythe, Southampton.

● TEAC X3R stereo tape recorder, auto reverse, cost £400 will accept £300. Used one hour only. Will accept good SX28 receiver in part exchange. Mr R.M. Dotchin, 2 The Crescent. Shortstown, Bedford MK42 0UJ. Tel: Hitchin 815016 ext 2453 working hours 8-4.30.

● Larsholt 7254 FM stereo tunerset, as new from Ambit International £18. 3 Elm Ave, Newark, Notts NG24 1SE.

● Marconi 'Atlanta' comm. receiver complete with handbook and headphones, covers 15KC to 28MHz, full working condition, ex weather ship receiver. Also Cobra 148 GTL-DX AM FM SSB-CW, 26.515-27.855MHz. digital frequency counter with built-in SWR, power field strength meter. R.F preamp and 25W linear amp £300 ono. May sell separately. Brian Devlin. 30 Dixon Rd, Crosshill, Glasgow G42. Tel: 041-424 1687.

● Nato 2000 AM FM SSB etc £1.50. Starker 9 AM FM SSB LSC Hi Lo £70. Tel: Burton-on-Trent 221870.

● FT101E ex. condition with spare PA valves £390. FRG7000 ex. condition, general cov. RX £200. R.D. Marshall, G4GIQ, 87 Carlton Rd, Witton Park, Northwich, Cheshire CW9 5PW. Tel: Northwich 45584.

● Hitachi TRK 8080E stereo radio cassette recorder, four wave band radio, 16W power, two-way four speaker system. Immaculate condition £100. Only one year old. Also 20 TDK SA audio tapes for £34. Mr A.S. Lota, 53 Campion Rd, Leamington Spa CV32 5XF. Tel: 0926 20488.

● AVO Multiminder in carrying case with instructions and test leads £30. Immaculate condition. R J Nokes, 28 Orchard Way, Bognor Regis, Sussex PO22 9HL.

● Atari games cartridges. Several surplus, will sell or swap. Tunbridge, 76 Church St, Larkhall, Lanarkshire ML9 1HE. Tel: 0698 883334.

● Most common electronic components, such as IC's (digital and analogue), TTL CMOS etc. and transistors for sale. Please write a list of what you need and how much you can pay, and I will see if I can help you. All letters answered. Write to: The Advertiser, 25 Napier Rd, Wembley, Middlesex.

● Clearing out den. JVC portable tele-radio, good order £60. Global patrol SW valve set £5. Canadian No 19 Set £25. Grundig valve set, working, 4 speakers £20. Cossor pre-war 3 valve set. needs power leads rewire £10. Philips valve radio, needs det valve £10. Buyer collects on these please. A.H. Billington, 50 Chipsey Ave, Bugbrooke, Northants NW7 3QW. Tel: Northampton 830492.

● Saba 26inch colour TV with sonic remote control, suitable spares or repair £30. Colour fault. Tel: Plymouth 880674.

● Two H+H 100W audio amps, in as new condition, complete with mains leads and PVC covers. Phone: Kings Lynn 71389 code 0553, call for price etc. Also two projectors, suit disco use. W N Rodger, G4RQN, Flat 1, 23 Valingers Rd, King's Lynn, Norfolk PE30 5HD. Tel: 0553 71389.

● Worth £100 each. Eddystone 770U RX 146 to 500 MHz, also Tandy scanner RX PRO2001 60MHz, 144MHz. 500MHz bands, offers. Robin Andrew, 54 Castle Drive, Coleshill, Birmingham B46 3LY. Tel: 0675 63403.

● Storno hand portable, recently realigned. Crystalled S20, S21, S22, complete with leather case, helical aerial, three nicad battery packs and mains charger. All in good condition £50. Phone: Botley 5628 after 8p.m.

● Marconi TF1066B, 10-470MHz, AM FM sig. gen, fully working £275. Data precision eight digit freq. counter, 250MHz battery pack, charger £55. Icom 720A, AM, CW filters, unused, boxed £790. Pye low band bantams, pair, working, battery pack £15. Tellabs touchtone decoder and encoder chips, info £10. G8NTH QTHR. Guildford 34954.

● Microtan 65 CPU card with Tanbug V2.3, monitor and chunky graphics option. Also Tangerine Hex keypad and power supply MPS1. All as new with original documentation. Cost £136 accept £60. Contact Dave Wells, daytime 0234 750993, after 6p.m. 0908 613628.

● Trio R-1000 General coverage receiver plus matching external speaker – hardly used. £195 ovno. R. Hillum, G6 PAE. 143 Spurriers, Laindon, Basildon, Essex, SS15 5NE. Tel: Basildon 414574.

● 29.5 MHz pre-amplifier £5.00. G3WPO 2 metre pre-amplifier £5.00. Palomar Engineers VLF converter £45.00 ono. Icom ICB 1050 10 metre TX/RX converted for amateur band FM £25.00. Packer 90-200 MHz absorption wavemeter £20.00 ono. Dr Arthur C Gee, G2UK, 'East Keal', 21 Romany Rd, Oulton Broad, Lowestoft, Suffolk, NR32 3PJ. Tel: (0502) 65726.

● Have for sale or part ex Cobra 148 GTL DX transceiver, 2 mics, p/pack mag mount antenna L/amp slide mount and matcher £160 ono. Tel: Runcorn 711393.

● Surplus resistors, components etc. Bags of 100 items £1.00. No callers. Mr C. Cooper, 256 Highbury Grove, Cosham, Portsmouth, Hants, PO6 2RX.

● SX200-N plus Ambit SSB conversion kit – new £150. V. May, Upper Durford. Durford Wood, Nr Petersfield, Hants GU31 5AN. Tel: Liss 2143.

● Futaba radio control 6 channel with 6 servos boats planes cars loads of engines (glow plug) many spare parts cost approx £560 will accept £150. Telephone answering machine with some spare parts GPO approved. Req slight attention a real snip at £25 cost £200. Peter Young, 3 Fawcett Vale, Lower Wortley, Leeds LS12 4TW. Tel: 790272.

● I am clearing my workshop of some excess components (by order of my wife). Quantity of boards with ICs etc from TVs etc 10 for a pound + post. Mixed resistors 1000 mixed for £8 (1 lot only) + post. Peter Young. 3 Fawcett Vale, Lower Wortley, Leeds LS12 4TW. Tel: 790272.

● Neal 4 Channel resolvers £10. 2 multivolt transformers 5V 2 x 12V ASCII keyboard needs a 7.5 2376 IC. £10. Taylor 132 meter £20. Capacitors 6500 35V £1. Want old computer bits, add ons etc. Mel Saunders, 7 Drumcliff Rd, Thurnby Lodge, Leicester LE5 2LH.

● Free diodes. 100's to clear just send SAE. Also 22k lin pots 10p each. Capacitors/resistors/transistors packs of 500 items mixed £7.50 (1½p each). Transformer 240V, 12V 5A output £6 each. Also clearing out lots more. Send SAE D. Martin, 29 St. Johns Close, Leatherhead, Surrey.

● Radio TV Servicing, Molloy, Vols. one to five. – circuits for 1945 to 1955 radio and TV – all lot for £10. Mr. A.C. Holdway, No20 Studland Close, Millbrook, Southampton, Hants.

● Quad Esl. speaker little used in good order. Also rare valves KT66, GF33, GZ33, GZ36. All in mint condition. H.T. Aston, 103 Westfield Rd, Ealing London W13 9JD.

● AVO multi-range test meter £40 plus £3 carriage/packing. Mr. R. Hayward, 'Sunnyfields', Lighthouse Road, St Margarets Bay, Nr Dover, Kent CT15 6EJ.

FREE READER SMALL ADS

● Sentinel 2 metre converter from M.W. £10. Lowe 2 metre receiver with PA3 preamp, fitted 6 xtalled channels £20. Tel: Plymouth 880674.

● DX 300 Gen coverage receiver AC/DC digital 10 kHz – 30 MHz about £180 ring 0734 581481.

● Heathkit SB620 Scanalyzer in good condition with manual. J.P. Barnes, 2 Mappins Road, Catcliffe, Rotherham, South Yorkshire, S60 5TH. Tel:0709 61159.

● Calling all Dxer's, be it short wave, medium wave, or TV, have you ever thought of joining a club? For more information write to the DXAGB, Five Acres, Whiteditch Lane, Newport, Saffron Walden, Essex, CB11 3UD, 'Can you afford to miss it' for the price of a large SAE?' 'The DX Association of Great Britain.' Mr. M.B. Evans (Logging Editor DXAGB) 41, Great Arthur House, Goldern Lane Estate, London EC1. Tel: (01) 251 4950.

● Amplifier for bass guitar 'H.H.' 100 watt Combo, nearly new, used little, immac. cond. cost £250, accept £150. Would deliver 100 miles radius of Sheffield. Bass guitar 'Hondo II' fender copy De Marzio pickups, good cond. £45. Tel: 0709 70021. Taylor.

● Acorn Atom fully expanded including floating point ROM and tool box ROM. Some software £100. Datong FL2 filter £65. PRO 2002 scanning receiver 68-512 MHz all post paid. Tel: (0436) 2539.

● For sale Avo model 7 mark II multimeter in very good condition £45, 28 Orchard Way, Bognor Regis, Sussex PO22 9HL.

● Marconi CR100. Good condition. Also Rhode and Schwarz signal generator 29.2 MHz to 305 MHz; 19 set converted to mains. 2 MHz to 8 MHz transceiver £55. Tel.0872 862575.

● Trio model JR500S double conversion communications receiver 3.5 to 29.7 MHz WWV SSB AM ANL RF gain control stand-by switch ext VFO output 8.445 to 9.045 MHz ext remote control socket, needs re-aligning. Service manual included. New valves bargain £30.00 or near offer. Mr. E. Vaughan, 108 Micklefield Rd, High Wycombe, Bucks HP13 7EY.

● Trio R1000 with FM module fitted excellent condition cost £297 accept £250. 35 Greenlaw, West Denton, Newcastle-on-Tyne. Phone Lemington (0632) 673507.

● Sale or exchn two Avtec dot matrix printers centronic interface £20 each. Would exchange for 2M converter for YAESU 10120 or W.H.Y. D.G. Clifford, 160 Goldsworthy Way, Burnham, Berks, SL1 6AY. Tel: Burnham 64567.

● Heathkit HW101 SSB transceiver 10-80m bands complete with power pack PS23. Factory tuned and in unused mint condition. Cost £600 best offer secures. Robt. McGloin, 72 Maree Drive, Cumbernauld, Glasgow G67 4LP. Tel: 023 67 33770.

● RA1 amateur bands receiver, recently overhauled, in first class condition with QPM16 'Q' multiplier and matching speaker. Buyer collect £40. William J Bryan G3RKC, 20 Thirlmere Court, Felixstowe, Suffolk IP11 9SN. Tel: Fel. 277208.

● Union Jack QSL cards 100 £2.50 H. Hope, 89 Derwent St, Blackhill, Consett Co. Durham DH8 8LT.

● Morse code trainer program for ZX Spectrum 16/48K. £4.50 inc. post. W.H. Cartwright 51 Oak Road, Oldbury, Warley, West Midlands B68 0BH.

● Datong 070 morse tutor £35.00 ono. Daiwa auto ATU CNA1001 £100.00 ono. Trio R600 communications receiver £200 ono. Microdot RTTY unit £350.00 ono. Wanted Yaesu FL2100Z linear, heavy duty rotator and Daiwa CN620A SWR meter or Daiwa CNA 2002. 94 VCU. Tel: 020 888 738 anytime.

● Rockwell AIM65 cased with BASIC FORTH, PL and PROM programmer with TV interface complete with all documents and books. Ideal for complete learning about micros both hardware and software. Cost over £500. Offers to J. Barton Tel. Witney 75220.

● Trio JR 500S £66, also many valves, old radios. 11 Hamberland HQ 170 £230 ono. Hardy, 12 Fyfield Rd, Walthamstow, London E17 3RG.

● Oscilloscope EM102 dual beam 15 MHz battery or mains. Needs attention £100 ono. Tel: 01 550 4527.

● Lowe Electronics SRX30D general coverage receiver. 500 kHz – 30 MHz. Only six months use. LED digital frequency readout. USB, LSB, AM, preselector, RF gain. £160 ono. S. Cowell Tel: (098 064) 675 evenings.

● Casio wristwatch/stopwatch excellent condition now surplus to needs. £6.00. Tel: Smallwood, Treffgarne 644 after six.

● Alpha key. A single paddle key for the connoisseur. P. Sergent, 6 Gurney Close, Costessey, Norwich 0603 747782.

● Cavity wavemeter to cover 2m, 70cm, 23cm. P. Sergent, 6 Gurney Close, Costessey, Norwich 0603 747782.

● Swan Transceiver 100MX 80m – 10m 180 p.e.p. Good condition transistorised £200. MBA/RO Morse Rtty reader fluorescent display £130 ono. As new Q.R.P. Components Japanese V.F.O. 7MHz £5. P.A. Ferries FB-43-240 30 for £3.00. Telephone Mildenhall 717 106 or 41 Donegal Park, Rookery Drove, Beck Row, Bury St Edmunds, Suffolk.

● Vernier slow motion drive type D ref. 10A/8510 brand new neon power indicator. Complete set radio communication mags 1982. Variable condenser, 1. toggle switch, DX foreign listings callbook, lengths of guy wires, brand new Japanese B-M-3 desk mic. £30 lot absolute bargain pack. Will sell mic. separate at £15. Phone G3XWV evenings 0564 82 2280.

● For sale TS 520. VGC £350 ovno. Mr. G. Hayes, 3 Manor Ave, Higher Marston, Nr Northwich, Cheshire CW9 6DS.

● New Zealand wireless set. ZC1 MKz not working £40 plus carriage. Yaesu FR50B RX perfect £60 plus carriage. David Christie, 8 Ballytober Rd, Bushmills, Co. Antrim BT5 78UX. Tel: Bushmills 31086.

● Europa C Transvertor 100W O/P spare valves £12. Several years back copies of Radcom S.W.M. etc FREE to any scout group B.B. or cadet corps with two members who can read 12wpm morse or have passed part of R.A.E. Collect only. Phone G3AKG, Reading (0734) 476718.

● Tektronix 545B oscilloscope two plug in amps 30 MHz dual beam delay manuals probes £125. Phone Blackburn 48131 evening.

● FTT Yaesu 80-10m Tx/Rx v.g.c. + matching power S.W.R. meter £240 o.n.o. P.J. Bradley (G4 BZE), Woodlands, Longdown, Nr Exeter, Devon EX6 7SR. Tel: 0392 81 425.

● 150W 12A power Darlingtons, equivalent 2501/3001 matched pairs £2.00. 60W transformer 120/240V-16V 2A plus 15-0-15,1A £5.50. 12V indicators, panel mounting, 4 for £1.00. 250k log. pot. with DPST switch: 40p. Reed switches, 5 for £1.00. Bargain pack: 100 P.C. electrolytic capacitors plus 100 resistors, £2.00. Tom Merrill, 97 Goodwood Road, Leicester.

● Magazines asst. 1981-1983 ETI WW elektor R&EW approx 50 issues £20. Spectrum 48k + printer, no colour £70 Tel: 0829 270481.

● Nascom 1 with smart case and built in PSU £80. Warrington area Tel. Padgate 812290. HF-5 five band trap vertical antenna and radial kit purchased July £65 ono. Warrington area. Tel: Padgate 812290.

● Storno 'Viscount' 2mtrs. FM mobile transceiver, six channels, all cables: £35. Pye 'Cambridge' 4 mtrs. AM mobile transceiver, three channels: £25. Five element, 2 mtrs. Yagi: £8. 2 mtrs. ground plane: £4. ⅝wavelength 2 mtrs. ring plane mobile antenna, plus boss and coax cable: £18. 7MHz. Traps, pair: £7. Class 'D' wavemeters, two: £7, £5. 'Type 10' crystal marker: £7. Heathkit S.W.R. meter: £9. Canadian '58 set' 6 to 9 MHz AM transceiver: £26. Ex-W.D. '88 set' VHF transceiver: £12. Buyers collect. S.A.E. details: McNeill, 40 Turnpike Road, Newbury, Berks, RG13 3AS.

● Tektronix dual beam storage 'scope type 564 with four plug-in units and instruction manuals. Good condition. Offers. Mr D.H. Edwards, 178 Main Street, Invergowrie, Dundee, DD2 5BD. Tel: 082 67 423.

● Klystrons complete for 3cm. and 10cm's suitable cheap A.T.V. Offers to G8BXO, John Stacey, 3 Westpark, South Molton, Devon EX36 4HJ. Tel: 07695 3382.

● Volumes one and two Radio and Electronic World for sale. Buyer collects. Tel: (0952) 44843.

● FT-290 with Nicads Helical £200. MM 30 watt linear £55. BBC programs morse tutor/keyboard transmit and receive £4. RTTY adjustable speed, auto CR/LF, memories £4. Oric, Electron morse tutor £4. QTH locator, bearing, distance £4. Brookes MBR6 RTTY TU £40. T. Tugwell, 11 The Dell, Stevenage, Herts SG1 1PH. Tel: 0438 354689.

● Amateur bands transceiver. 'Kenwood' TS520SE. 160-10m fan. New MC35S mic. Instruction manual. Box. New March 1981. Little used. Mint condition. £295. 'Advance' constant voltage transformers. CV100A. 244V with 150W lamp. Plus extra tap out 320V no load. £5 each. Trio KA2000A instruction service manual. G3MBL: Tel 01-445 4321. 244 Ballards Lane, Finchley, London, N12 0EP.

● Two secondhand but working 4CX250B valves £8. One new 4CX250B £8. One new 4CX350B £12. 25W car stereo booster £5. Microwave modules MML432/100 linear amp with fault, offers? ITT 'Powerdol' switched mode PSU – SV 20A +12V 2A – 12V 2A as new £35. Best Products solid state EHT unit, requires ±12V approx 1A, 15V output, as new £15. Home built PSU for 4CX350B linear amp or similar – 1.4kV 400mA, variable, stabilised screen volts and grid volts, also 6.3V SA fully metered etc. £45. Datong D70 morse tutor £35. Sodeco printing impulse counter with manual, spare paper £10. Brand new Heathkit external LMO (linear master oscillator), boxed with manual £20. Box of parts for making 4CX350B amp, coils, striplines (for 2m & 70cms) valve bases etc £10. All above items ono. Please phone Martin, G4VKR on Flitwick 712743 after 5 pm.

● T.I. 55-II calculator £20. Lobgear Teletext add-on unit £100. Tel: 0325 466783 (mornings). Geo. W. Cummings, 31 Stockton Road, Haughton, Darlington.

● Trio TR9000 2M multimode TCVR comp with B09 base station plinth, £250. Datong RFC/M RF speech processor module, unused £12. SMC 13.8V 8 amp cont. PSU £20. All items offered in as new condx. Roy Storey G3LBT, 145 The Knares, Basildon, Essex, SS16 5SJ. Tel: (0268) 412177

● IC701 H.F. transceiver, A1 condition for sale. Offers to Jim Watt, 61 Sutton Park, Blunsdon, Swindon, Wilts. Tel: 0793 721046.

● Tektronix Type 551 double beam oscilloscope with power supply, including differential preamplifier (calibrated) Type G, for sale £120. Would exchange above for either Eddystone 770R, or 770U communication receiver. A. Thomson, MSERT, GM3VOX, 108 Tannahill Drive, Calderwood 12, East Kilbride, Glasgow, Lanarkshire, G74 3HT. Tel: East Kilbride 41329.

● New ham selling SWL equipment. R600 rcvr £190. Bearcat scanner plus discone £100. Also V2000 video tapes £1 per hour. Tel: 0842 861495.

● Tono 9000E RTTY ASCII morse sender/decoder £490. GEC VHF mobile TX/RX £20. Brookes MBR6 RTTY terminal unit £40. 13V 2amp PSU £8. Contact G8KMV QTHR 0438 354689 evenings.

● DX TV Bush 125 TV's and other goodies some modified. Lots more electronic bits and pieces. Also VHF and UHF aerials and rotor. All items must be sold due to moving. First come first served. Telephone 0202 738232 for more information.

● Solatron Solarscope CD1212 CT484 single beam scope with 40Mc/s wide band unit. CX1251 and trolley: manual also. £30. Buyer collects. Large and heavy! Mr. D. Dane, 3 Bowmonts Rd, Tadley, Nr Basingstoke, Hants. RG26 6SD. Tel: Tadley 4959.

● FM aerial Smiths Arrow Seven. Complete with rotator, control, 10ft mast and chimney lashings. Never used. £50 complete. Tel: 021 705 0223.

● FT290R with Nicads charger, SWR meter and wavemeter. Also Channel-Master 9502B rotator and Jaybeam 4 element quad with feeder. All mint. £300 ono. Phone Les, St. Albans 73620.

● OEL Viewdata adaptor – with addition of only six cheap ICs. You will have a comprehensive system for Viewdata work. The unit has TV/monitor, printer, recorder connections. Full documentation supplied. Unit totally British Telecom approved – only £108. Also various interesting components – much too numerous to include – just SAE for info. Peter D. Lee, 10 Millfield, High Halden, Nr. Ashford, Kent, TN26 3LX.

● TS700 2metre multimode base station rig mint condition unused since 2nd hand purchase with warranty £195 ono. Jaybeam 2metre 10XY antenna

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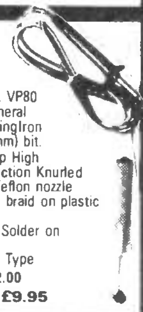

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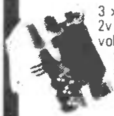

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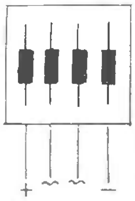

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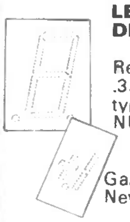

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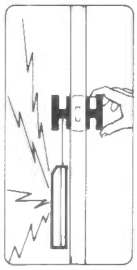

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FREE READER SMALL ADS

unused still boxed offers. Yaesu FT101 Mk1 with new valves £175 ono. John William Horsley, 17 Caerleon Avenue, Bitterne, Southampton, Hants, SO2 5JX. Tel:0703 449837

● President McKinley 120 channel mobile CB radio with power mic, leads etc. Full working order, excellent condition £120 ono. Phone 021-705-5724 after 6pm.

● Car radio medium long wave £5. Audioline push button medium long wave car radio unused £15. 40CH AM CB rig £15. 40CH AM SSB CB rig £25. Car stereo cassette player £7 slide mount £2. Wanted Tandy TRS80 model 100 portable computer. Ring Milton Keynes 316052 ask for Mick.

● Ferrograph professional audio recorder test set RTS2. Measures frequency response, distortion, wow and flutter, signal-to-noise, gain etc. £350. Sabtronics 8110A frequency counter, 20Hz – 100MHz, (originally built from kit) £55. Also, quantity (270) motors, 2-pole, 2,500 rpm., AC mains (115V – 230V), brushless type, ½ins stack, unused. £175 the lot ono. May split, offers? Prefer buyer to collect but would consider delivery – dependent on distance. Tel: Alan (0773) 874197.

● Process lens by Wray Optical (Lustrar 16ins f.10 with stops to f.90). Will sell/exchange for amateur radio gear, comm. RX, TX or what have you. Anything radio or photographic considered. Frank Glynn, 41 Crossways Avenue, East Grinstead, Sussex RH19 1JD.

● Receiver Garex SX200-N scanner. Four months old. In guarantee. Absolutely mint and complete £240 no haggling. Phone Bournemouth 25554 evenings.

● VDU and keyboard – ICL 7181 working order. £20. Buyer collects or carriage extra. Braintree 42391.

● CASIO VL-1 with wallet, excellent condition hardly ever used £25.00. Steven Chambers, 153 Laleham Rd, Catford, London SE6 2AE. Tel:01 697-6356.

● ATV program for the 48K Spectrum as reviewed in Nov 83 R&EW now with 36 features including testcards, maps, large printing, QRA calculator and much much more. The price which includes a 16K version and full instructions is only £5.50 inc P&P from R. Stephens, Toftwood, Mill Lane, High Salvington, Worthing, Sussex. For list of other programs send sae.

● 21LO2 1K low power static RAMs new and unused. 24 for sale 0.75p each ono. Phone Leamington (0926) 641347 after 6.

● PC1211 Sharp PC computer and tape interface (in need of repair) applications book and new set of batteries. Yamaha CS01 keyboard and five music books. TMS9900 family micro data book. Will sell or swap for a good micro or RX or a second hand score. Will reply to all offers. Sean F. Rima, Kylemore, Connemara, Co. Galway, Ireland. Tel: Kylemore 10.

● Marconi Sig. Gen. TF885 DC to 5MHz at 30V (max) o/p £7. Elect. mags £10. Mains transformers 6.3-0-6.3 at 2A £2. Also 400-0-400 plus 4x 6.3V £5. Also Ferranti RD6059 10H inducter £5. Buyer collects. P. Vacquier, 56 Leamington Road, Southend-on-Sea, Tel: 616579 (evenings)

● 2 amp variac input 240 volts mains output 0 to 240 volts AC cost £35 new only £15 as new. Also 12 volt DC relays for 50 pence each. Phone Slough 46684 and ask for Steve.

● Solartron CD1014/2 D.B. scope inst. circ. £50. Anita 1000 comptometer 10 gas discharge readout tubes mains operated £30. Cybernet 2000 C.B. new very compact with centre loaded aerial £30. Harvard two channel xtal C.B. hand held new £12. Hythe (Kent) 68854.

● XTL filters – 10.695 £3.00 each 8kHz b/width or 10.7 at £1.50 each. Only few available as are surplus from ex local CB shop – 6 Lynton Court, Horn Lane, Acton W3 6PN.

● 16K ZX81 DK Tronics keyboard Qsave inverse video cass: control £70. S.ware books and spares. SAE with enquiries to M. Bolt, 112 Leeds Road, Mirfield, West Yorks.

● Have Samwell Hutton Wobulator with spares plus 1.3 to 4.2 GigaHz microwave signal generator Will exchange with any good comm. receiver. Details from J. Bulubi 10 Adair Tower, Appleford Road, London W10.

● Kenwood (Trio) speakers. Woofer 11ins cone type. Tweeter horn type. Super tweeter horn type. Base reflex enclosure F/r 40Hz to 30,000Hz. 75 watt. As new. £85. Unusual item purchased abroad. (Japan). Mr. Paul Sherlock, 74 Dungannon Chase, Thorpe Bay, Southend-on-Sea, Essex SS1 3NJ. Tel: Southend 582460.

● BELCOM LS-102L 26-30 MHz radio £225 ovno. PROTEL Base Mike AM-6000 with equaliser plus power supply £55 ovno. CP-163X Base/Mobile Linear variable input output no plating or loading built in pre-amp 26-30 megs £75 ovno or £325 ovno the lot. Dave P.O. Box 3, Egham, Surrey, TW20 0SW.

● TR2500 handheld with spare Nicad and leather case immac cond. £185. Microwave Modules preamp 2M MMA144V £25. Two seven element German Yagis, low wind loading, little used, plus stacking combiner and coax £45. Tel: Hastings 437513 evenings. G8TQO.

● CASIO 602P programmes including resistor calculator; Hex⟷decimal⟷Binary converter with true alpha input/output; several games – Reverse, Micromind etc. Plus 'Quirks' – displays full character set and uses normally unavailable commands. Send SAE to D. Ingram, 6 Greyfriars Walk, Inverkeithing, Fife, KY11 1DE.

● Icom communications receiver ICR70 as new with Icom FM board fitted. Excellent rig £420. A.E. Chivers G3YFQ. 1, Sycamore Close, Bushey, Herts, WD2 2DT. Tel: 0923-41461

● 1000MHz scope. Hewlett Packard HP185B with HP187B plug-in complete with all adaptors, HP1400A delay line and manuals £150. Computex Automation dual digital cassette drive system with interface for naked mini. Ideal for most home computers. £45. Wanted Tektronix plug-in Type M, also manuals for purchase or hire for Type 82 and 'M', G4DWC 0532 828994.

● Collectors item. 1948 Bush Console radio G.W.O. offers. Or exchange organ, or synth parts. Lots of electronic mags R&EW, E.T.I., H.E., P.E., E.E., W.W., R&EC Jan 1979 to date. S.A.E. with enquiries to 47 Linden Close, Eastbourne BN22 0TT. Tel: 0323 51624/51264.

● 24 GHz S.W.R. meter cost new £700, accept £190 G4FFO Tel: 0223 860150.

● Contents of well stocked junk box for sale ie TX, valves, variable capacitors, HV power supplies etc. s.a.e. or phone for further details. Also have Cavendish model 2000 electronic organ first class condition. Will accept first reasonable offer. J. Peerless, 157 Fairmead Crescent, Edgware, Middlesex.Tel: 01-958-6887.

WANTED

● All sizes of tuning capacitors, roller coasters, feed-through insulators, switches and items suitable for HF ATU. Complete TU5B tuning units considered. Mr. M.R. Davies. GW311D. Hafan, Lady Road, Blaenporth, Cardigan, W. Wales SA43 2BE. Tel:0239-811 022.

● To copy Heath Model ID-1590E June 1979 wind speed/direction indicator instruction and assembly manual. R.F.G. Thurlow. G3WW. 2 Church Street, Wimblington, March, Cambs. PE15 0QS. Tel: 0354-740255.

● Swop Atari TV game + games for 2 PYE 70 pocket phones with rubber aerial etc or swop for IC2E AR22 TR 2500 or AR 240FT 208R. Swop PYE Bantam for 2M 144MHz car aerial. O.M.A. Graham, 27 Crichton Rd., Pathhead, Midlothian, Scotland. EH37 5RA. Tel:0875-320 642.

● 7808, 748, 4011, 741 ICS wanted. Got all sorts of items to exchange i.e. AVO 7 (value £25) cash either way to adjust. Also require light screened microphone cable. Mr. A. Bouskill, 129 Lyminster Road, Sheffield, South Yorks. S6 1NY. Tel: 0742-311191.

● Microwave modules MMT/28/144 MHz Linear transverter new never used boxed from SMC Value £109 and FT224 2MTR Mobile Tramsg. used only base station crystals S.19, 20, 21, 22. R0, R1, R6 requires tone burst. Exchange 2 MTR hand held prefer check. Collect my QTH No car. Could meet Salisbury, Southampton, Bournemouth by public transport. Charles Hooper (G8YKC) 63 Sandy Lane, St. Ives, Ringwood, Hants. BH24 2LE. Tel:Ringwood 5717.

● Transmitter variable capacitor 120 to 160 pF. Preferably surplus component from TU9B or similar. HM Humphreys Gibevu, 10 Mount Eden Park, Malone Road, Belfast. BT9 6RA. Tel:0-232 668979.

● Good Colour T.V. working to use with computer. Craig Tunbridge, 76 Church St. Larkhall, Lanarkshire. ML9 1HE. Tel:0698 883334.

● All non working used home computers wanted for educational purposes. Must be very very cheap. Also electronics magazines required for non profit making training workshop for students. They must also be very cheap. Please write to Bimal, 25 Napier Road, Wembley. Middx. Each letter will be answered.

● Communicator receiver WHH BFO cheap Wavemeter for 934MHz ATU for 27 MHz. A.H. Billington, 50 Chipsey Avenue, Bugbrooke, Northants. NN7 3QW. Tel:Northampton 830492.

● Early (ie 1920s, 1930s) valves and other components wanted particularly 2V. Filament screen grids and triodes, L.F. transformers plug-in coils, formers and bases, etc. Also morse keys and amateur QSL cards. Cash waiting (private collector, not dealer!) Norman Field, G4LQF. 14 Regent Rd., Harborne, Birmingham 17. Tel: 021-426 3663.

● 23CM varactor tripler wanted for ATV work. Please write. Dave Crump, G8GKQ. Officers Mess, RAF Bruggen, BFPO 25.

● Has anyone connected a non RS232 (9 way block connector type) ASR33 printer to a BBC computer? Hardware and software help appreciated. Contact Dave Kelly, 4 Elmdale Road, Claines, Worcester WR3 7PA. Tel: Worc 53842.

● Swop Atari TV game for PYE Bantam and swop for 30 40 PO tower or swop for any 2M HF receiver transceiver. Swop PYE Bantam for yellow flashing light or swop for two Pye two way radios with aerial. H. Graham, 27 Crichton Rd., Pathhead, Midlothian, Scotland. EH37 5RA. Tel: 0875 320 642.

● Need Audio distortion analyser and scope, AVO & accurate signal generator for design of audio systems. Would appreciate PSU and other audio lab gear. Will collect. Peter Kunzler, 166 Ewell Rd., Surbiton, Surrey. KT6 6HG. Tel: 01-399 3990.

● Grundig satellite 3400 or SX 200N scanner wanted must be in good condition. Fair price paid. Tel Runcorn 711393.

● Radio amateur's examination tutor requests help for his students – can anyone please loan past R.A.E. multiple choice question exam papers? 7 day return promised with expenses refunded. (G8PWO QTHR). John Thwaites, 15 Springhead Rd., Kemsing., Sevenoaks, Kent. TN15 6QL Tel: (evenings) Sevenoaks 62481.

● Mitsubishi CRT 470CNB22. May accept used tube. W. Milne, 20 Graham Road., Wimbledon. London SW19 3SR. Tel: 01-684 9621.

● Handbook for Yaesu FRG 7000. Also FM module. Mr. N.J. Smythe, 25 Cefny-y-Lon. Pienyrheol, Caerphilly. CF8 2JS. Tel: 0222 868112.

● Collins, KOKJSAI, Toko, or similar 455KHz mechanical SSB filter. T. Simpson, 58 Cemetery Road, Houghton Regis, Dunstable, Bedfordshire. LU5 5DA. Tel: 0582 62621.

● Sphinx transmitter in good condition if possible. SSB 160m 80m 20m or similar. Tel:0872 862575.

● Manual or circuit diagram for Rochar counter timer A1149, scope tube SE3A1 or similar and TV tube 230DB4. J. Glover, 22 Bennett Road, Bournemouth, Dorset. BH8 8QG.

● Old radio books, catalogues, magazines, service-sheets, QSL cards, Gamages catalogue, A/Ps, valves, components, morse-keys, etc. for the National Wireless Museum. Details pse to hon. curator-Douglas Byrne G3KPO, 34 Pellhurst Rd., Ryde, IOW. Tel: 0983 62513.

● Any 77-68 computer system PCBs (not) working (partly)(fully) built also any details of a BASIC language for this computer, also a 6830 PROM for Swatbuc with manual plus any info on faults that have been found while testing. Please state prices. Norman Henry Pierce. 92, Railway Road, Rock Ferry, Birkenhead, Merseyside. L42 2BQ.

● Cosmac ELF two. Wanted add on units i.e. keyboard RAMs tapes circuits user manuals etc. M.G. Bancroft. 71 Leysholme Cres. Leeds LS12 4HH. Tel:Leeds 630953.

● Clock radio wanted not necessarily in working

FREE READER SMALL ADS

condition. Phone Carlisle (0228) 21981 after 6pm.

- Old QST back numbers 1950 to 1979. Phone Wokingham 782236.
- Mostek digital clock chip MK 50253 N used in digital alarm clock kit from Sintel – GM4JNB QTHR or PO Box 6, Fort William, Inverness-shire PH33 6DB.
- Close tolerance resistors. Source of minute quantities of odd valves wanted. C.J. Collins, Two Ways Cottage, Eghams Wood Rd., Beaconsfield, Bucks. Tel: Beaconsfield 4127.
- Need GJH8 valves for project. All replies answered. Horton GM3XFC, 26 Jamieson Street, Arbroath, Angus. Tel: Arbroath 78383.
- Swap for MF or HF equipment – Single screen oscilloscope, multi-metre, or VHF radio telephone. Petty Officer M. Brownlee, 1c. Croft Terrace, Botcherby, Carlisle, Cumbria. Tel:Carlisle 45552.
- Yeasu FC902 ATU complete with instruction book. Also FT7 must be cheap. Also AR88 receiver must be in good nick. David Christie, 8 Ballytober Road, Bushmills, Co. Antrim. N. Ireland. BT57 8UX. Tel: Bushmills 31086.
- Tunnel Diodes about three same size shape as OA81/0A73. Write 34 York Crescent, Blackburn, Lancs. Mr. Heath. Also Motor type B8k 5U/4661 24V DC blower small square. Tel: Blackburn 48131 (evenings).
- Loan of Heath Assembly Manual for Wind Direction/Speed model ID.1590E-07846. Speed indicator housing jammed on. R F G Thurlow, G3WW, 2 Church Street, Wimblington, March, Cambs, PE15 0OS.
- Wanted medium duty rotator with control box. Also any 10m-2m converters, and any 8 digit frequency counters. Mr Philip Sparrow, 132 Ash Lodge Drive, Ash, Aldershot, Hants GU12 6NR
- IC wanted for Bontempi Organ Type SNB746F. F E Godward, 40 Beaufort Street, Southend-on-Sea, Essex SS2 4NH Tel: 68254 (G3ASL)
- Philips N1512 VCR or just CVBS panel (working or not). Phone:0993 882238 evening or weekend.
- 'The Cathode Ray Revolution' by Philip Kogan £5 offered. Dr Cowan, 51 Wellington Street, Oxford, OX2 6BB
- QRP SSB TX/RX Hustler or similar mobile whip antenna 20m 80m. D Dhuglas, 3 Kirkfield Place, Arrochar, Strathclyde, G83 7AE
- Wanted to purchase or photo copy manual and circuit diagram for Solartron CD523S oscilloscope. Andrew Dexter, 1 Hope Villas, Hope Road, Leighton, Welshpool, Powys. SY21 8HF. Tel: Welshpool 4026
- Old books on microwaves and radar especially McGraw-Hill Radiation Laboratory series. Also looking for monoscope tubes. Andrew Emmerson, 71 Falcutt Way, Northampton, NN2 8PH.
- Sony ICF 2001 portable radio RX new or nearly new condition. C/W documentation – M J Townsend 19 Greenhill Lane, Riddings, Derbyshire Tel: Leabrooks 605219.
- Two disco deck turntables. Mr Victor Linton, 44 St Mary's Court, Gomer Street, Willenhall, West Midlands, WV13 2NW
- Collector seeks very old germanium transistors and diodes. Good prices paid for early point contact and junction types. Data sheets also required for old semics. Information wanted about early transistor computers especially point contact ones. Write for more details or offer. Mr Andrew Wylie, 18 Rue de Lausanne, 1201 Geneva, Switzerland.
- Ex-RAF type 'D' Morse Key wanted by former RAF wireless operator. Also Class D Wavemeter (pref. AC mains) Frank Glynn, 41 Crossways Avenue, East Grinstead, Sussex RH19 1JD. Tel: East Grinstead 22967.
- Wanted B.B. Babani radio books No 107 and 108 four and five valve circuits. No 134 FM tuner construction. No 135 battery portable construction. Nos 100, 121,143, 157 and 178 radio valve guides 1-5. Mullard circuits books. Hartley on Hi-Fi. Also Jacksons tuning scales with S/M drive, types S.L.8 and S.L.5. Coil packs, AC/PEN (5-pin) DR96, PP5/400, AC/HL, UL41, UY41, EL41, B5 sockets. RD junior variable superhet tuners (AM). FM tuners and amplifiers. To N Covington 25, Ridge Road, Letchworth, Herts, SG6 1PW. Tel: 79681.
- YAESU FRG7 operating handbook or copy. Mr D Sibley, 50 Faraday Road, West Molesey, Surrey, KT8 0TQ. Tel: 01 979 2245
- FM board for Yaesu FT1012D. Also narrow CW filter. Cash waiting. Ring Nick G4UKO Tel: Maidstone 859129
- CB hand held TX/RX pref Tandy. Also scanning RX for 120MHz 170MHz Phone: Ashford, Middlesex 44361

FREE SMALL ADS

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

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

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We will endeavour to include all ads received by 15 December 1983 in the February issue. Ads received after this date will be included in the next available issue.

CONDITIONS

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

FREE READER SMALL AD ORDER FORM

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

Classification:

For Sale .... ☐ Wanted .... ☐

USE BLOCK CAPITALS (One word per box)
To avoid mistakes please write clearly and punctuate your ad

USE SEPARATE SHEET FOR MORE WORDS

Name .... Address ....

....

Postcode .... Telephone ....

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The communications, electronics & computers magazine

HANTS

SUSSEX

LINCS

NEXT ISSUE ON SALE 13 JANUARY

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The communications, electronics & computers magazine

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COPY enclosed........☐ to follow........☐

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

CHARGE TO MY ACCOUNT........☐

COMPANY ....

ADDRESS ....

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

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	C	P	I									

SOMERSET

THE NEXT ISSUE OF

Radio & Electronics World

IS ON SALE 13 JANUARY 1984

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

ADVERTISING RATES & INFORMATION

DISPLAY AD RATES

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

COLOUR AD RATES

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

SPECIAL POSITIONS

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

DEADLINES

*Dates affected by public holidays

issue	colour & mono display ad	small ad	mono artwork	on sale
Feb 84	8 Dec 83*	14 Dec 83*	16 Dec 83*	13 Jan 84
Mar 84	12 Jan 84	18 Jan 84	20 Jan 84	10 Feb 84
Apr 84	9 Feb 84	15 Feb 84	17 Feb 84	9 Mar 84
May 84	15 Mar 84	21 Mar 84	23 Mar 84	13 Apr 84

CONDITIONS & INFORMATION

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

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

Printed — web-offset.

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

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

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

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

CRICKLEWOOD ELECTRONICS LTD.

40 Cricklewood Broadway London NW2 3ET Tel 01 452 0161 01 450 0995 Tx 914977

All products first grade franchised source. All items available through (1) MAIL ORDER (2) CALLERS (3) TELEPHONE/CREDIT CARD i.e. Visa, Access, Barclaycard, American Express. (4) OFFICIAL ORDERS from Schools, Govt Depts, Local Authorities etc. All in stock items despatched same day. U.K. please add VAT at 15%. No VAT for overseas orders but min £2.00 p & p. *Stocking parts other stores cannot reach!*

RESISTORS

CARBON FILM 5% HI-STAB LOW NOISE 10Ω to 10MΩ
¼W E24 2p
½W E24 2½p
1W E24 6p
2W E24 12p

METAL FILM ULTRA STABLE 0.4W EXTRA LOW NOISE 10Ω to 1MΩ
2% E24 5p
1% E24 8p

LOW OHMIC GLAZE ⅓W 0.22Ω to 8.2Ω E24 11p

WIREWOUND ON CERAMIC E12 SERIES
2 to 3W 0.22Ω to 330Ω 28p
4 to 7W 0.47Ω to 6K8 33p
10 to 11W 1Ω to 33K 37p

POTS & PRESETS

ROTARY POTS LOW NOISE ¼" SPINDLES E3 SERIES
4K7 to 2M LIN 38p
4K7 to 2M LOG 38p
As above with DP Mains Switch 88p
As above stereo (no switch) 90p

PRE-SETS PIHER (DUSTPROOF) E3 100Ω to 10MΩ
Mini Vertical 15p
Mini Horizontal 15p
Standard Vert. 18p
Standard Horiz. 18p

CERMET 20 TURN PRECISION PRE-SETS ¾" E3 SERIES 50Ω to 500K 89p

CAPS

CERAMIC 100V DISC (PLATE) E12 MICRO-MINI TYPICALLY +5%
1pF to 10nF 7p

POLYCARB 5% SIEMENS 7.5mm MINI BLOC E12
1nF to 6nF 7p
8nF to 47nF 8p
56nF to 150nF 10p

100V
100nF to 150nF 11p
180nF to 270nF 14p
330nF to 390nF 20p
470nF to 560nF 26p
680nF 30p
1µF (10mm) 35p

POLYESTER 250V RADIAL (C280)
10nF, 15nF, 22nF, 33nF, 47nF, 68nF, 100nF 7p
150nF, 200nF 10p
330nF, 470nF 13p
680nF 18p
1µF 22p
1.5µF 39p
2.2µF 39p

FEEDTHROUGH 1nF 500V 7p

HIGH VOLTAGE Capacitors please enquire many types in stock

TANT BEADS
.1/35V 14p
.22/35V 14p
.33/35V 14p
.47/35V 14p
.68/35V 14p
1.0/35V 14p
2.2/35V 14p
3.3/35V 18p
4.7/16V 18p
4.7/35V 20p
6.8/25V 20p
6.8/35V 21p
10/16V 18p
10/35V 27p
15/10V 22p
15/16V 30p
15/25V 32p
22/6.3V 26p
22/16V 29p
33/10V 30p
47/3V 14p
47/6.3V 34p
47/16V 39p
100/3V 32p
100/10V 55p

ELECTROLYTICS Mainly Matsushita (Panasonic) & Siemens
AXIALS (Wires each end)

µFd	V	
.47	63	8p
.47	100	9p
.47	350	30p
1	63	8p
1	100	9p
1	500	40p
2.2	25	8p
2.2	63	9p
2.2	100	11p
2.2	350	30p
3.3	25	10p
3.3	40	11p
3.3	63	12p
4.7	16	8p
4.7	25	9p
4.7	40	11p
4.7	63	12p
4.7	100	14p
10	25	8p
10	40	12p
10	63	14p
10	100	16p
10	350	55p
22	25	11p
22	40	14p
22	63	16p
22	100	21p
47	25	14p
47	40	17p
47	63	26p
47	100	28p
100	16	14p
100	25	16p
100	40	22p
100	63	25p
100	100	30p
220	10	16p
220	16	17p
220	25	22p
220	40	25p
220	63	30p
220	100	40p
470	16	22p
470	25	28p
470	40	33p
470	63	43p
470	100	60p
1000	16	30p
1000	25	38p
1000	40	46p
1000	63	65p
2000	16	40p
2200	25	63p
2200	40	70p
2200	63	134p
4700	16	75p
4700	25	89p

RADIALS (PCB wires one end) Matsushita only

uFd	V	
10	16	6p
22	10	6p
22	16	7p
47	10	7p
47	16	8p
100	10	9p
100	16	10p
220	10	11p
220	16	12p
470	10	17p
470	16	18p
1000	10	20p
1000	16	24p
2200	10	34p
2200	16	44p
3300	10	50p
3300	16	65p
4700	10	65p
4700	16	95p

TRANSFORMERS

All 240V Primary
6.0 6V, 9.0 9V, 12.0 12V, 15.0 15V 100mA 95p
1A 2.65
20.0 20V 1.25A 2.65
12.0 12V 50VA 5.25
12.0 12V 100VA 9.50
0+6+6+9+9 1.25A 4.25
These goods are heavy send extra p & p. We will credit any difference

VERO

0.1" COPPER TRACKS
2.5 × 3.7 83p
2.5 × 5 99p
3.75 × 3.75 99p
3.75 × 5 1.14
2.5 × 17 2.99
3.75 × 17 3.85
4.79 × 17 4.93
VQ Board 1.92
Dip Board 3.90
Track Cutter 1.48
Pin Insertor 1.79
100Pins 55p
Verobloc 3.99
Vero Wiring Pen + Spool 3.35
Spare Spool 75p
Combs 6p

PCB MATS

FERRIC CHLORIDE Quick dissolving Enough to make over 1 litre 1.69

ETCH RESIST TRANSFERS
1. Thin lines
2. Thick lines
3. Thin bends
4. Thick bends
5. DIL pads
6. Transistor pads
7. Dots + holes
8. 0.1" edge connectors
9. Mixture

Any sheet of above 35p

SHADE ONE GLASS PCB SINGLE-SIDED
178 × 240mm 150p
420 × 195mm 1.95
420 × 245mm 2.95

DALO ETCH RESIST PEN + spare nib 1.20

PHOTO SENSITIVE PCB 1st Class Epoxy Glass. For better results than spraying. Expose to UV

Single sided
100 × 160 2.10
100 × 220 2.50
203 × 114 2.40
233 × 220 5.20

Double Sided
100 × 160 2.20
100 × 200 2.80
203 × 114 2.90
233 × 220 5.90

Developer for above (do not use Sodium Hydroxide) 500 ml 2.95

WIRE

PRICES PER METRE
Solid connecting wire

MAINS/SPEAKER
Twin 1 Amp 14p
Twin 2½ Amp 16p
3 Core 2½ Amp 18p
3 Core 6 Amp 31p
3 Core 13 Amp 56p

SCREENED
Single 14p
Stereo 27p
Mini Single 12p
Mini Stereo 15p
4 Core 4 Screens 44p
4 Core Single Screen 54p
8 Core 61p
12 Core 80p
Heavy Duty Mike Guitar Lead 25p

AERIAL
50Ω RG58A 25p
75Ω UHF 29p
75Ω VHF 28p
300Ω Flat 14p

RAINBOW RIBBON Prices per foot
8 way 25p
10 way 25p
16 way 39p
20 way 48p
24 way 62p
30 way 75p
32 way 82p
40 way 88p
64 way 1.49

RECHARGE BATTERIES

Top quality Don't throw these batteries away — they charge up to 1000 times!
HP2(1.2AH) 2.39
HP2(4AH) 4.75
HP7(½AH) 99p
HP11(1.2AH) 2.29
PP3(110mAH) 4.95

Chargers
TYPE H Adjusted to 6 of any HP type Above £15.59
TYPE M: As above but faster charge for 4AH £25.95
TYPE P PP3 £5.50
TYPE A: HP7 (Up to 4 at a time) £5.85

SOLDER

ANTEX SOLDERING IRONS
C240 (15W) 4.95
XS240 (25W) 5.25
Iron Stand 1.75
Elements (State iron) 2.05
C240 Bits
No. 2 (Small) 85p
No. 3 (Med.) 85p
No. 6 (Micro) 85p
XS240/X25 Bits
No. 50 (Small) 85p
No. 51 (Med.) 85p
No. 52 (Lge.) 85p
SOLDER 125gms 18swg 2.95
22swg 3.10

PLUGS & SOCKETS

'D' Connectors 25 Way Solder
Male 1.60
Female 2.09
PCB Wire-Wrap
Male 1.60
Female 2.09
Covers 1.00
Phono Plugs Blk, Red, Grn, Wt or Yell 15p
Line Skts 12p
Chas Skt × 1 20p
Dual 30p
Quad 40p

TRANSISTORS

2N930 20p
2N930A 30p
2N1893 49p
2N2102 39p
2N2217 39p
2N2218 33p
2N2218A 25p
2N2219 27p
2N2219A 28p
2N2220 22p
2N2221 22p
2N2221A 23p
2N2222 24p
2N2222A 25p
2N2223 2.80
2N2223A 4.15
2N2368 25p
2N2369 19p
2N2369A 20p
2N2904A 27p
2N2905 28p
2N2905A 29p
2N2906 25p
2N2906A 30p
2N2907 25p
2N2907A 26p
2N2920 9.25
2N2923 25p
2N2924 15p
2N2925 15p
2N2926 10p
2N3053 27p
2N3054 56p
2N3055 60p
2N3055H 1.20
2N3250 36p
2N3251 36p
2N3439 98p
2N3440 80p
2N3441 1.25
2N3442 1.35
2N3445 4.80
2N3446 6.09
2N3447 5.72
2N3448 6.56
2N3468 1.00
2N3512 1.06
2N3553 2.65
2N3638 55p
2N3638A 70p
2N3702 10p
2N3703 10p
2N3704 10p
2N3705 10p
2N3706 10p
2N3707 10p
2N3708 10p
2N3709 10p
2N3710 10p
2N3711 10p
2N3712 2.00
2N3713 1.38
2N3714 2.98
2N3715 3.31
2N3716 3.60
2N3773 1.99
2N3819 36p
2N3820 38p
2N3821 1.84
2N3822 90p
2N3823 45p
2N3824 1.70
2N3866 90p
2N3903 13p
2N3904 13p
2N3905 13p
2N3906 13p
2N4030 75p
2N4031 65p
2N4032 69p
2N4036 63p
2N4037 49p
2N4240 3.00
2N4400 15p
2N4401 27p
2N4402 30p
2N4403 30p
2N4409 36p
2N4410 42p
2N4416 1.50
2N4427 1.30
2N4870 80p
2N4871 55p
2N4888 99p
2N4901 1.69
2N4902 1.85
2N4903 1.88
2N4904 2.15
2N4905 2.75
2N4906 2.99
2N4907 3.20
2N4908 3.15
2N4909 2.90
2N4918 65p
2N4919 75p
2N4920 85p
2N4921 55p
2N4922 69p
2N4923 99p
2N5086 36p
2N5087 37p
2N5088 37p
2N5089 37p
2N5190 68p
2N5191 70p
2N5193 90p
2N5194 79p
2N5245 37p
2N5246 40p
2N5247 45p
2N5248 46p
2N5249 2.88
2N5266 98p
2N5293 98p
2N5294 1.28
2N5295 1.37
2N5401 35p
2N5415 1.10
2N5416 1.54
2N5447 16p
2N5448 19p
2N5449 21p
2N5450 23p
2N5451 25p
2N5457 29p
2N5458 29p
2N5459 29p
2N5460 72p
2N5551 37p
2N5884 5.95
2N5886 5.95
2N6083 17.95
2N6121 57p
2N6122 59p
2N6123 65p
2N6124 59p
2N6125 65p
2N6126 75p
2N6129 79p
2N6130 93p
2N6131 98p
2N6132 83p
2N6133 1.14
2N6134 1.38
2N6253 1.45
2N6254 1.55
2SC1306 95p
2SC2078 1.70
2SJ49 3.99
2SJ50 4.50
2SJ82 4.75
2SK134 3.99
3SK135 4.50
2SK226 4.75
3N128 1.12
3N140 1.07
3N200 6.93
3N201 2.98
40360 60p
40361 67p
40362 67p
40363 2.95
40406 1.39
40407 75p
40408 1.58
40410 1.80
40411 3.95
40412 90p
40673 70p
40822 1.80
40871 1.00
40872 1.00
AC125 49p
AC126 32p
AC127 32p
AC128 35p
AC132 68p
AC141K 28p
AC142K 28p
AC151 51p
AC152 45p
AC153 55p
AC153K 64p
AC176 27p
AC176K 37p
AC187 25p
AC187K 28p
AC188 25p
AC188K 40p
AF239 55p
AF240 1.00
BC107 10p
BC107A 12p
BC107B 12p
BC108 10p
BC108A 12p
BC108B 12p
BC108C 14p
BC109 10p
BC109B 12p
BC109C 12p
BC140 29p
BC141 37p
BC142 29p
BC143 30p
BC147 10p
BC147A 10p
BC147B 10p
BC147C 20p
BC148 10p
BC148A 12p
BC148B 12p
BC148C 12p
BC149 10p
BC149B 12p
BC149C 13p
BC152 35p
BC153 23p
BC154 27p
BC157 12p
BC157A 12p
BC157B 12p
BC158 10p
BC158A 12p
BC158B 13p
BC159 10p
BC159A 12p
BC159B 13p
BC159C 14p
BC160 42p
BC161 48p
BC167 10p
BC167A 10p
BC167B 13p
BC168 10p
BC168B 10p
BC168C 10p
BC169 10p
BC169B 10p
BC169C 10p
BC177 16p
BC177A 25p
BC177B 26p
BC178 16p
BC178B 24p
BC179 20p
BC179A 25p
BC179B 25p
BC179C 27p
BC182 10p
BC182A 12p
BC182B 12p
BC182L 10p
BC182LA 12p
BC182LB 14p
BC183 10p
BC183A 11p
BC183B 12p
BC183C 12p
BC183L 10p
BC183LA 13p
BC183LB 13p
BC183LC 14p
BC184 10p
BC184B 12p
BC184C 12p
BC184L 10p
BC184LB 13p
BC184LC 14p
BC186 24p
BC187 24p
BC212 10p
BC212A 12p
BC212B 12p
BC212L 10p
BC212LA 12p
BC212LB 13p
BC213 10p
BC213A 11p
BC213B 12p
BC213C 12p
BC213L 10p
BC213LA 13p
BC213LB 13p
BC213LC 14p
BC214 10p
BC214C 12p
BC214L 10p
BC214LB 13p
BC214LC 14p
BC237 16p
BC237A 16p
BC237B 16p
BC237C 18p
BC238 16p
BC238A 16p
BC238B 17p
BC238C 17p
BC239 18p
BC239A 16p
BC239B 17p
BC239C 18p
BC300 45p
BC301 44p
BC302 43p
BC303 47p
BC327 14p
BC328 13p
BC337 15p
BC338 15p
BC440 32p
BC441 33p
BC460 38p
BC461 33p
BC516 40p
BC517 40p
BC546B 15p
BC547 13p
BC556B 15p
BC547A 14p
BC547B 14p
BC548 12p
BC548A 13p
BC548B 14p
BC548C 15p
BC549 13p
BC549B 14p
BC549C 15p
BC550 15p
BC550C 25p
BC557 15p
BC557A 16p
BC557B 16p
BC558 14p
BC558A 15p
BC558B 16p
BC558C 17p
BC559 15p
BC559B 16p
BC559C 17p
BC560 25p
BC560C 25p
BC650 45p
BC651 46p
BCY70 16p
BCY71 16p
BCY72 19p
BD131 44p
BD132 44p
BD135 35p
BD136 35p
BD137 37p
BD138 37p
BD139 38p
BD140 38p
BD237 98p
BD238 98p
BD239A 57p
BD239C 64p
BD240A 59p
BD240C 73p
BD241A 61p
BD241C 67p
BD242A 65p
BD242C 70p
BD243A 72p
BD243C 85p
BD244A 82p
BD244C 1.00
BD245A 1.14
BD245C 1.30
BD246A 1.20
BD246C 1.50
BD249A 2.00
BD249C 2.31
BD250A 2.11
BD250C 2.46
BD419 1.29
BD420 1.37
BD437 88p
BD438 88p
BD439 90p
BD440 91p
BD441 91p
BD442 93p
BD529 1.20
BD530 1.30
BD535 75p
BD536 75p
BD537 80p
BD538 80p
BD539 80p
BD539C 1.10
BD540 85p
BD540C 1.20
BD675 72p
BD676 77p
BD677 78p
BD678 83p
BD711 1.32
BD712 1.32
BDX32 3.47
BDX66B 5.95
BDX67B 5.95
BDY54 1.70
BDY55 1.75
BDY56 1.80
BDY57 5.25
BDY58 6.15
BF194 12p
BF195 12p
BF196 12p
BF197 12p
BF198 15p
BF199 15p
BF200 75p
BF224J 32p
BF225J 35p
BF244A 55p
BF244B 55p
BF245A 55p
BF245B 65p
BF246 70p
BF246B 70p
BF247A 70p
BF247B 75p
BF254 75p
BF255 39p
BF256A 42p
BF256B 58p
BF256C 58p
BF257 65p
BF258 30p
BF259 32p
BF457 35p
BF458 46p
BF459 56p
BF469 62p
BF470 86p
BFR39 86p
BFR40 25p
BFR41 25p
BFR79 25p
BFR80 25p
BFR81 25p
BFR90 2.11
BFS28 2.95
BFS21 1.00
BFS98 1.10
BFX29 26p
BFX30 27p
BFY50 23p
BFY51 23p
BFY52 23p
BFY53 31p
BSX19 24p
BSX20 24p
BSX21 40p
BU104 2.22
BU105 1.70
BU108 3.95
BU109 3.29
BU126 1.47
BU204 2.25
BU205 1.75
BU206 1.89
BU208 1.98
BU226 3.95
BU326S 2.35
BU406 1.45
BU407 1.45
BU408 1.35
BU500 2.95
BUY18S 3.95
E430 5.95
J300 70p
J310 70p
MJ802 3.99
MJ900 2.90
MJ901 3.10
MJ1000 2.50
MJ1001 3.00
MJ1800 3.60
MJ2500 2.19
MJ2501 2.25
MJ2955 1.00
MJ3000 2.19
MJ3001 2.25
MJ4502 3.99
MJ15003 4.85
MJ14004 5.55
MJ15015 2.45
MJ15016 3.34
MJE340 53p
MJE350 1.50
MJE2955 99p
MJE3055 69p
MPSA05 23p
MPSA06 25p
MPSA10 28p
MPSA12 29p
MPSA13 48p
MPSA14 46p
MPSA16 30p
MPSA18 65p
MPSA20 48p
MPSA42 49p
MPSA43 49p
MPSA55 28p
MPSA56 30p
MPSA65 40p
MPSA66 47p
MPSA70 45p
MPSA92 39p
MPSA93 39p
MPSL01 46p
MPSL51 49p
MPSU01 84p
MPSU04 1.32
MPSU05 55p
MPSU06 56p
MPSU07 75p
MPSU51 88p
MPSU55 58p
MPSU56 59p
MPSU57 1.20

JUST RELEASED NEW ILLUSTRATED CATALOGUE £1.00 inc. p&p

TIP29A 29p
TIP29C 38p
TIP30A 35p
TIP30C 36p
TIP31A 33p
TIP31C 34p
TIP32A 38p
TIP32C 42p
TIP33A 65p
TIP33C 78p
TIP34A 74p
TIP34C 88p
TIP35A 1.09
TIP35C 1.28
TIP36A 1.29
TIP36C 1.39
TIP41A 49p
TIP41C 55p
TIP42A 55p
TIP42C 59p
TIP49 1.20
TIP50 1.40
TIP53 1.57
TIP54 1.59
TIP110 74p
TIP112 90p
TIP115 81p
TIP117 96p
TIP120 69p
TIP122 73p
TIP125 84p
TIP127 84p
TIP130 93p
TIP132 93p
TIP135 99p
TIP137 99p
TIP140 1.04
TIP142 1.04
TIP145 1.15
TIP147 1.15
TIP162 4.95
TIP2955 77p
TIP3055 70p
TIS43 50p
TIS88A 80p
VN10KM 60p
VN46AF 95p
VN66AF 99p
ZTX107 10p
ZTX108 10p
ZTX109 12p
ZTX300 13p
ZTX301 15p
ZTX302 15p
ZTX303 23p
ZTX304 15p
ZTX310 35p
ZTX311 32p
ZTX312 35p
ZTX313 36p
ZTX314 24p
ZTX320 35p
ZTX330 35p
ZTX341 28p
ZTX450 39p
ZTX500 14p
ZTX501 14p
ZTX502 14p
ZTX503 17p
ZTX504 24p
ZTX510 24p
ZTX530 24p
ZTX531 25p
ZTX650 45p

DIODES

1N34A 30p
1N821 70p
1N823 92p
1N914 4p
1N916 6p
1N4001 4p
1N4002 4½p
1N4003 5p
1N4004 5½p
1N4005 6p
1N4006 6½p
1N4007 7p
1N4009 20p
1N4148 3p
1N4150 18p
1N4448 22p
1N5400 12p
1N5401 13p
1N5402 14p
1N5404 16p
1N5406 18p
1N5407 19p
1N5408 20p
1N5024 52p
1S44 10p
BA102 25p
BA115 25p
BA133 40p
BA138 30p
BA142 20p
BA155 15p
BA156 38p
BA157 25p
BA158 30p
BA150 32p
BA182 40p
BA201 18p
BA202 26p
BA316 25p
BA317 25p
BA318 30p
BAV10 16p
BAV19 15p
BAV20 15p
BAX13 10p
BB109G 65p
BY126 11p
BY127 12p
BY134 52p

SCR's TRIACS DIACS

THYRISTORS 4, 8 & 12 Amps Texas TO220
Suffix A 100V
B – 200V
C – 300V
D – 400V
M – 600V
TIC106A 46p
TIC106B 47p
TIC106C 48p

4A
TIC106D 49p
TIC106M 68p
TIC116A 66p
TIC116B 68p

8A
TIC116C 71p
TIC116D 73p
TIC116M 80p
TIC126A 72p
TIC126B 72p

12A
TIC126C 73p
TIC126D 77p
TIC126M 96p

TRIACS Texas 400V TO220 Case
TIC206D(4A) 66p
TIC225D(6A) 74p
TIC226D(8A) 88p
TIC236D(12A) 1.16
TIC246D(16A) 1.22
TIC253D(20A) 1.90
TIC263D(25A) 2.11

DIACS
BR100 29p
ST2 29p

ZENER'S

400-500mW E24 Series 2.4-47V 7p
1.3 Watt E24 Series 3.3-82V 14p

BRIDGE

(PIV shown in brackets)
1½ amp type
W01 (100) 28p
W02 (200) 34p
W04 (200) 38p
W08 (800) 50p

2 amp type Square with hole
S01 (100) 46p
S02 (200) 50p
S04 (400) 55p
S08 (800) 66p

6 amp type Square with hole
PW01 (100) 95p
PW02 (200) 99p
PW04 (400) 1.30
PW06 (600) 1.39

25 amp type Metal clad with hole
K01 (100) 2.62
K02 (200) 2.75
K04 (400) 3.25
K06 (600) 4.10
BYW64 35A 400V 4.50

OPTO

LED LAMPS
R Red
G Green
Y Yellow

Large Diffused 1 - 50 +
R5D 9p 7p
G5D 15p 12p
Y5D 15p 12p

Small diffused
R2D 8p 6p
G2D 12p 10p
Y2D 12p 10p

Micro 0.1
R1D 25p 22p
G1D 27p 25p
Y1D 27p 25p

Large clear
R5C 12p 10p
G5C 17p 13p
Y5C 17p 13p

Super bright high efficiency Large (100 times brighter)
R5U 38p 29p
G5U 42p 34p
Y5U 42p 34p

Rectangular Stackables LEDs
R6L 17p
G6L 18p
Y6L 19p

LIN ICS

AY1 5050 95p
AY3 8910 3.99
AY3 8912 4.95
CA3048 2.15
CA3059 2.80
CA3090AO 3.70
CA3130E 87p
CA3130T 2.35
CA3140E 39p
CA3140T 1.40
HA1366W 2.40
HA388 2.54
ICL7106 7.50
ICL7107 9.50
ICL7611 97p
ICL8038 2.99
ICL7555 80p
ICL7556 1.50
LC7120 3.20
LC7130 3.40
LC7137 3.95
LF347 1.50
LF351 47p
LF353 92p
LF355 83p
LF356 92p
LF357 1.30
LF398 4.62
LM335Z 1.60
LM348N 62p
LM349N 1.09
LM350K 4.60
LM379S 5.50
LM380N14 75p
LM380N8 1.50
LM381AN 2.26
LM381N 1.40
LM382N 1.12
LM383T 3.40
LM384N 1.40
LM386 88p
LM388N 2.43
LM391N60 2.10
LM391N80 2.40
LM723CH 95p
LM723CN 35p
LM725CH 3.40
LM725CN 3.19
LM741CH 96p
LM741CN 18p
LM741CN14 80p
LM747CN 69p
LM748CH 1.00
LM748CN 35p
LM1871 3.25
LM1872 4.39
LM1877 5.95
LM1886 7.44
LM1889 3.77
LM2907N 2.75
LM2907N8 2.60
LM2917N 2.40
LM2917N8 2.40
LM3900 48p
LM3911 1.20
LM3914 3.25
LM3915 3.25
LM13600 1.15
MF10 3.50
NE531N 1.36
NE543N 2.50
NE544N 1.95
NE555 18p
NE556 65p
NE558 1.89
NE560 3.25
NE565 1.18
NE566 1.49
NE567 1.37
NE570 4.07
NE571 3.99
NE5534A 1.45
TBA500 2.97
TBA500Q 3.11
TBA510 2.95
TBA510Q 3.05
TBA520 2.57
TBA520Q 2.75
TBA530 2.55
TBA530Q 2.76
TBA540 2.72
TBA540Q 2.74
TBA550 3.25
TBA550Q 3.27
TBA560C 2.87
TBA570 2.37
TBA570Q 2.48
TDA1002 3.39
TDA1003 3.94
TDA1004 3.94
TDA1005 3.94
TDA1010A 2.25
TDA1022 4.95
TDA2611A 2.50
TDA7000 3.45
TL061 40p
TL062 60p
TL064 95p
TL071 34p
TL072 45p
TL074 99p
TL081 29p
TL082 45p
TL084 89p
UAA170 2.49
UAA180 2.49
ULN2003 75p
UPC575C2 2.00
UPC1156H 2.75
XR2206 3.95
ZN409 2.25
ZN414 1.00
ZN1034 1.99

74TTL

7400 19p
7401 19p
7402 19p
7403 19p
7404 19p
7405 19p
7408 19p
7409 19p
7410 19p
7411 19p
7412 19p
7413 25p
7414 50p
7416 40p
7417 40p
7420 19p
7421 19p
7422 19p
7423 19p
7425 19p
7426 19p
7427 19p
7428 26p
7430 19p
7432 24p
7433 24p
7437 25p
7438 36p
7440 22p
7441 55p
7442 32p
7443 89p
7444 89p
7445 69p
7446 59p
7447 70p
7448 70p
7450 15p
7451 15p
7453 15p
7454 14p
7460 29p
7470 34p
7472 29p
7473 55p
7474 55p
7475 55p
7476 55p
7480 49p
7481 1.19
7482 90p
7483 38p
7484 90p
7485 90p
7486 30p
7489 1.68
7490 19p
7491 44p
7492 44p
7493 44p
7494 72p
7495 36p
7496 48p
7497 1.19
74100 1.25
74104 49p
74105 55p
74107 26p
74109 30p
74110 35p
74116 90p
74118 90p
74119 75p
74120 99p
74121 30p
74122 40p
74123 40p
74125 35p
74126 34p
74128 35p
74132 39p
74136 39p
74141 55p
74142 1.95
74143 2.08
74144 2.08
74145 70p
74147 88p
74148 75p
74150 1.20
74151 39p
74153 39p
74154 1.20
74155 45p
74156 45p
74157 45p
74159 1.50
74160 59p
74161 59p
74162 49p
74163 49p
74164 56p
74165 76p
74166 99p
74170 1.25
74172 2.49
74173 59p
74174 54p
74175 49p
74176 39p
74177 45p
74178 79p
74180 40p
74181 1.40
74182 80p
74184 89p
74185 69p
74186 4.69
74188 2.48
74190 60p
74191 60p
74192 60p
74193 60p
74194 60p
74195 60p
74196 45p
74197 45p
74198 1.50
74199 1.50
74221 73p

74LS TTL

74LS00 19p
74LS01 19p
74LS02 19p
74LS03 19p
74LS04 19p
74LS05 19p
74LS08 19p
74LS10 19p
74LS11 19p
74LS12 19p
74LS13 39p
74LS14 39p
74LS15 15p
74LS20 19p
74LS21 19p
74LS22 19p
74LS27 19p
74LS28 19p
74LS30 19p
74LS32 19p
74LS33 19p
74LS37 19p
74LS38 19p
74LS40 19p
74LS42 35p
74LS47 60p
74LS51 19p
74LS54 19p
74LS55 19p
74LS73 28p
74LS74 28p
74LS75 28p
74LS76 28p
74LS78 35p
74LS83 40p
74LS85 60p
74LS86 22p
74LS90 32p
74LS92 45p
74LS93 24p
74LS95 39p
74LS96 93p
74LS107 35p
74LS109 35p
74LS112 35p
74LS113 35p
74LS114 35p
74LS122 35p
74LS123 60p
74LS124 1.50
74LS125 24p
74LS126 25p
74LS132 40p
74LS136 29p
74LS138 39p
74LS139 39p
74LS145 99p
74LS147 99p
74LS148 1.19
74LS151 47p
74LS153 49p
74LS154 1.50
74LS155 39p
74LS156 46p
74LS157 40p
74LS158 35p
74LS160 50p
74LS161 50p
74LS162 50p
74LS163 50p
74LS164 50p
74LS165 60p
74LS168 1.40
74LS169 1.09
74LS170 1.19p
74LS173 90p
74LS174 40p
74LS175 40p
74LS181 1.20
74LS183 1.20
74LS190 60p
74LS191 60p
74LS192 60p
74LS193 60p
74LS194 50p
74LS195 50p
74LS196 59p
74LS197 59p
74LS221 95p
74LS240 1.40
74LS241 1.40
74LS242 1.40
74LS243 1.40
74LS244 1.40
74LS245 1.40
74LS247 1.40
74LS248 1.40
74LS249 1.40
74LS251 45p
74LS253 45p
74LS257 45p
74LS258 45p
74LS259 80p
74LS261 99p
74LS266 25p
74LS273 75p
74LS275 1.25
74LS279 33p
74LS280 1.80
74LS283 49p
74LS289 4.70
74LS290 55p
74LS293 49p
74LS295 74p
74LS298 79p
74LS299 1.95
74LS323 1.95
74LS324 1.95
74LS325 3.50
74LS326 3.50
74LS327 3.50
74LS347 1.35
74LS348 1.40
74LS352 71p
74LS353 71p
74LS362 7.25
74LS365 40p
74LS366 40p
74LS367 40p
74LS368 40p
74LS373 99p
74LS378 99p
74LS386 1.14
74LS390 46p
74LS393 99p
74LS395 89p
74LS396 1.90
74LS398 2.70
74LS399 1.59
74LS445 1.40
74LS490 1.40
74LS540 89p
74LS541 79p
74LS640 2.00
74LS641 2.00

CMOS

4000 16p
4001 16p
4002 16p
4006 49p
4007 19p
4008 32p
4009 24p
4010 24p
4011 16p
4012 19p
4013 19p
4014 46p
4015 39p
4016 19p
4017 32p
4018 45p
4019 24p
4020 42p
4021 39p
4022 39p
4023 19p
4024 32p
4025 19p
4026 79p
4027 28p
4028 39p
4029 43p
4030 19p
4031 1.19
4032 79p
4033 1.19
4034 1.29
4035 44p
4036 2.49
4037 1.13
4038 99p
4039 2.45
4040 39p
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4043 39p
4044 39p
4045 99p
4046 44p
4047 69p
4048 39p
4049 22p
4050 23p
4051 44p
4052 58p
4053 49p
4054 79p
4055 83p
4056 83p
4059 4.35
4060 42p
4063 79p
4066 22p
4067 2.39
4068 19p
4069 19p
4070 19p
4071 19p
4072 19p
4073 19p
4075 19p
4076 45p
4077 19p
4078 19p
4081 19p
4082 19p
4085 49p
4086 60p
4089 1.23
4093 19p
4094 69p
4095 71p
4096 69p
4097 2.88
4098 74p
4099 89p
4502 55p
4503 39p
4507 33p
4508 1.26
4510 44p
4511 44p
4512 48p
4514 1.13
4515 1.13
4516 55p
4518 39p
4519 29p
4520 48p
4521 88p
4526 68p
4527 62p
4528 74p
4532 69p
4534 3.96
4536 2.59
4538 78p
4539 89p
4543 68p
4553 2.25
4555 35p
4556 35p
4560 1.49
4566 1.49
4569 1.65
4584 39p
4585 59p

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Z80B 8.60

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SAA5040 15.00
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SAA5052 8.50
SAA5070 16.95
TMS6011 3.65
8T26 95p
8T28 1.20
8T95 85p
8T97 85p
81LS95 80p
81LS96 85p
81LS97 90p
81LS98 85p
6522 3.19
6532 5.70
8154 9.00
8155 3.50
8212 1.70
8216 99p
8224 1.95
8226 2.50
Z80ACTC 2.60
Z80ADART 5.50
Z80ADMA 6.70
Z80APIO 2.70
ZN425E8 3.39

V REGS

– Positive – 100mA
78L05A 29p
78L12A 29p
78L15A 29p
78L24A 29p

1 Amp TO220
7805T 45p
7812T 45p
7815T 45p
7824T 45p

– Negative – 100 mA TO92
79L05 49p
79L12 49p
79L15 49p

1 Amp. TO220
7905T 57p
7912T 57p
7915T 57p
7924T 57p

ZIF SOCKET

24 Pin 4.35

SWITCHES

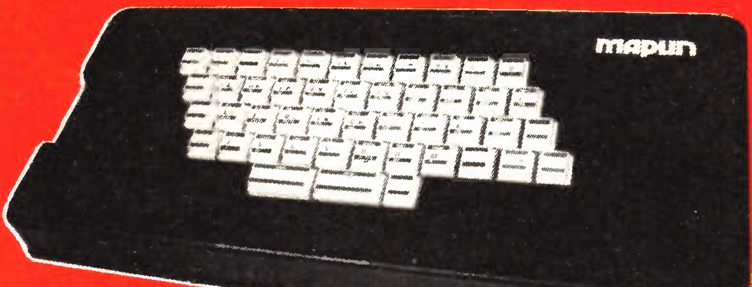
TOGGLE (MINI)
SPST 49p
SPDT 59p
DPDT 69p
DPDT C OFF 79p
4PDT 2.75

Full-travel, full size

KEYBOARD

Simply plugs into expansion port on your

SPECTRUM



KIT ONLY £39.95
READY-BUILT £44.95
Case included in both prices

- ★ *Single-key selection of all major multi-key functions.*
- ★ *Plugs directly into Spectrum expansion port and extends port for other peripherals.*
- ★ *Can accept Atari-type joysticks (optional extra).*
- ★ *Absolutely no soldering or dismantling of Spectrum.*
- ★ *Available in kit-form or ready-built.*

The kit is sold in three parts — the Keyboard Main Kit which allows you to make your own arrangements for connection to the Spectrum — the Adaptor Kit which contains the extension board and socket for the expansion port and the cable between the extension board and the keyboard — and the Case Kit which includes all the necessary mounting hardware.

Order As	**LK29G (Keyboard Main Kit)**	**Price £28.50**
	LK30H (Adaptor Kit)	**Price £6.50**
	XG35Q (Case)	**Price £4.95**

Full construction details in Projects Book 9.

Also available ready-built for direct connection and including case.
Order As XG36P (Spectrum Keyboard) Price £44.95

HEATHKIT SUPERB QUALITY KITS BRING THE EXCITEMENT BACK INTO AMATEUR RADIO

Experience the ultimate satisfaction of talking to someone on the other side of the world with a transceiver you actually built yourself. Just look at the wealth of state-of-the-art features on this quality HF SSB/CW Transceiver Kit. (HW-5400)

- ★ **PLL synthesised stability gives high accuracy**
- ★ **Covers all amateur bands 80m to 10m**
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- ★ **Frequency display with resolution to 50Hz.**
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- ★ **Excellent image & I.F. rejection and I.F. shift tuning ±600Hz.**
- ★ **VOX facility eases sideband operation.**
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Plus a whole host of other excellent features.

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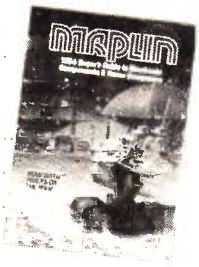

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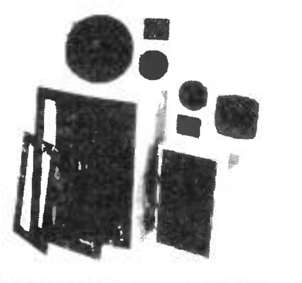

Purposefully designed 40 watt R.M.S. and 30 watt R.M.S. 8 ohm speaker systems recently developed by MULLARD'S specialist team in Belgium. Kits comprise **Mullard** woofer (8" or 5") with foam surround and aluminium voice coil. **Mullard** 3" high power domed tweeter. **B.K.E.** built and tested crossover based on Mullard circuit, combining low loss components, glass fibre board and recessed loudspeaker terminals. SUPERB SOUNDS AT LOW COST. Kits supplied in polystyrene packs complete with instructions.

8" 40W system — recommended cabinet size 240 x 216 x 445mm
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Designer approved flat pack cabinet kits, including grill fabric. Can be finished with iron on veneer or self adhesive vinyl etc.
8" system cabinet kit **£8.00 each + £2.50 P & P.**
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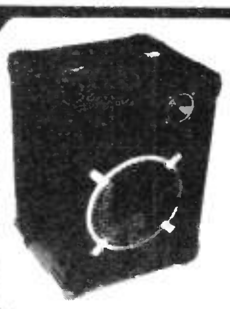
OMP 80 LOUDSPEAKER



The very best in quality and value.

Ported tuned cabinet in hard-wearing black vynide with protective corners and carry handle. Built and tested, employing 10in British driver and Piezo tweeter. Spec: 80 watts RMS; 8 ohms, 45Hz-20KHz. Size: 20in x 15in x 12in. Weight 30 pounds.

Price **£49.00 each**
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Carriage **£5 each £7 per pair**

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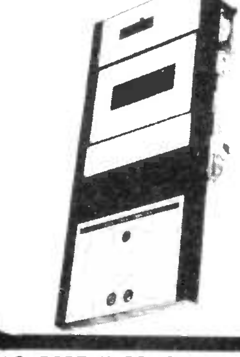
STEREO CASSETTE TAPE DECK MODULE



Comprising of a top panel and tape mechanism coupled to a record/play back printed board assembly. Supplied as one complete unit for horizontal installation into cabinet or console of own choice. These units are brand new, ready built and tested.

Features: Three digit tape counter. Autostop. Six piano type keys, record, rewind, fast forward, play, stop and eject. Automatic record level control. Main inputs plus secondary inputs for stereo microphones. **Input Sensitivity:** 100mV to 2V. **Input Impedance:** 68K. **Output level:** 400mV to both left and right hand channels. **Output Impedance:** 10K. **Signal to noise ratio:** 45dB. **Wow and flutter:** 0.1%. **Power Supply requirements:** 18V DC at 300mA. **Connections:** The left and right hand stereo inputs and outputs are via individual screened leads, all terminated with phono plugs (phono sockets provided). **Dimensions:** Top panel 5½in x 11¼in. Clearance required under top panel 2¼in. Supplied complete with circuit diagram and connecting diagram. Attractive black and silver finish.
Price £26.70 + £2.50 postage and packing.
Supplementary parts for 18V D.C. power supply (transformer, bridge rectifier and smoothing capacitor) **£3.50.**

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HOBBY KITS. Proven designs including glass fibre printed circuit board and high quality components complete with instructions.

FM MICROTRANSMITTER (BUG) 90/105MHz with **very** sensitive microphone. Range 100/300 metres. 57 x 46 x 14mm (9 volt) **Price: £7.99p**

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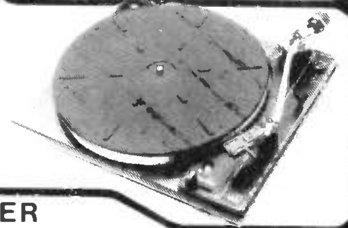
3 WATT FM TRANSMITTER 3 WATT 85/115MHz varicap controlled, professional performance. Range up to 3 miles 35 x 84 x 12 mm (12 volt) **Price: £12.49p**

SINGLE CHANNEL RADIO CONTROLLED TRANSMITTER/RECEIVER 27MHZ Range up to 500 metres. Double coded modulation. Receiver output operates relay with 2amp/240 volt contacts. Ideal for many applications. Receiver 90 x 70 x 22 mm 9/12 volt) **Price: £16.49** Transmitter 80 x 50 x 15 mm (9/12 volt) **Price £10.29** P&P All Kits +50p. S.A.E. for complete list.

3 watt FM Transmitter

BSR P256 TURNTABLE



P256 turntable chassis ● S shaped tone arm ● Belt driven ● Aluminium platter ● Precision calibrated counter balance ● Anti skate (bias device) ● Damped cueing lever ● 240 volt AC operation (Hz) ● Cut out template supplied ● Completely manual arm. This deck has a completely manual arm and is designed primarily for disco and studio use where all the advantages of a manual arm are required.
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THREE QUALITY POWER LOUDSPEAKERS (15", 12" and 8" See Photo) **Ideal for both Hi-Fi and Disco applications.** All units have attractive cast aluminium (ground finish) fixing escutcheons.

Specification and Prices.

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12" 85 watt R.M.S. McKENZIE C1285GP (LEAD GUITAR, KEYBOARD, DISCO) 2" aluminium voice coil, aluminium centre dome, 8 ohm imp., Res. Freq. 45Hz., Freq. Resp. to 6.5KHz. Sens. 98dB **Price: £23.00** + £3 carriage

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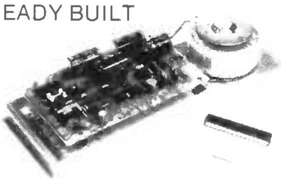
15" 150 watt R.M.S. McKENZIE C15 (BASS GUITAR, P.A.) 3" aluminium voice coil. Die cast chassis. 8 ohm imp., Res. Freq. 40Hz., Freq. Resp. to 4KHz. **Price: £47** + £4 carriage.

OMP POWER AMPLIFIER MODULE

READY BUILT



New model.
Improved specification

NEW OMP100 Mk.II POWER AMPLIFIER MODULE Power Amplifier Module **complete** with integral heat sink, toroidal transformer power supply and glass fibre p.c.b. assembly. Incorporates drive circuit to power a compatible LED Vu meter. New **improved** *specification makes this amplifier ideal for P.A., Instrumental and Hi-Fi applications.*

SPECIFICATION
Output Power:— 110 watts R.M.S.
Loads:— Open and short circuit proof 4/16 ohms.
Frequency Response:— 15Hz - 30KHz -3dB.
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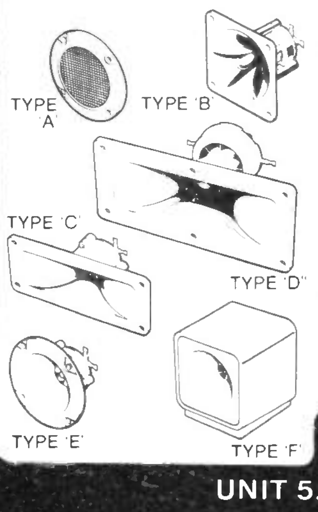

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PRODUCT NEWS

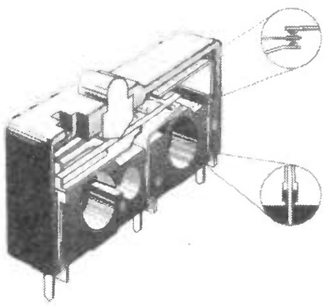
Featured on these pages are details of the latest products in communications, electronics and computers. Manufacturers, distributors and dealers are invited to supply information on new products for inclusion in Product News

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

NOVEL SUB-MINIATURE MICRO SWITCH

The new SS-01 series of sub-miniature micro switches are based on a novel contact material — an alloy of platinum, gold and silver known as PGS. It is claimed that the use of this material, together with the 'advanced' cross bar design of the contacts, ensures 'ultra reliable switching of voice and data to a degree never before thought possible in micro switches'.

The SS-01 is available from IMO Omron in a variety of



styles and with a range of actuators covering (among others) the standard operating force of ~90—150gm; the low operating force of ~30—50gm; and super low operating force of ~10—25gm. Connection is via PCB solder terminals or 110 push-on tabs and the operational life is quoted as being in excess of 10^7 operations.

IMO Precision Controls Ltd, 1000 North Circular Road, London. NW2 7JP

SOUND BROADCAST EQUIPMENT

Series 8000, the new range of sound broadcast equipment from Whiteley Electronics, comprises high technology amplifiers and a range of ancillary equipment for broadcasting speech, music, time signals and alarms. The series incorporates a range of amplifiers offering audio power at up to 20, 60, 120 or 250W, along with slave amplifiers of 60, 120, 250 and 500W which could boost the output to 1kW or more. All these amplifiers can fit into standard 19-inch racks. In addition, there is a 'comprehensive' range of pre-amplifier modules available.

The range is expected to be of particular value in such commercial, industrial or institutional premises as offices, factories, shops, supermarkets and hospitals.

Whiteley Electronics Ltd, Victoria Street, Mansfield, Notts NG18 5RW (Tel: Mansfield 24762).

NEW MICROPHONES

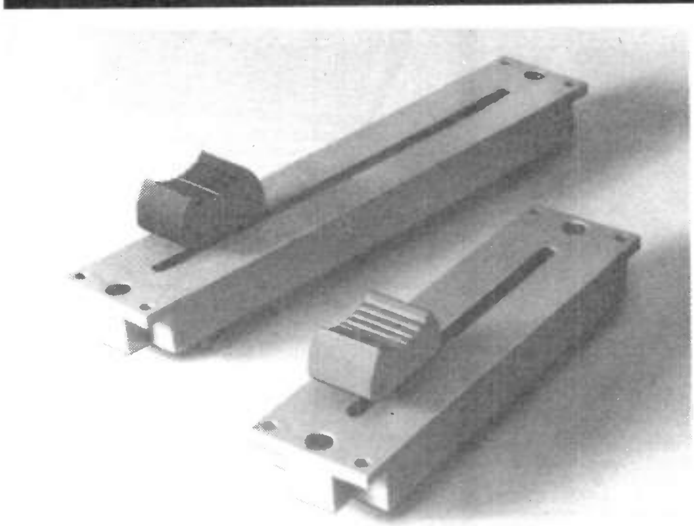
Comtech has announced the introduction of a new series of desk microphones designed for use as part of communications systems and pagers. It thus comes with a wide range of inserts, themselves having a variety of impedances. The values have been chosen to 'tailor' their audio response to the requirements of AM, FM and SSB radio telephones, line communications, public address systems and paging equipment.

The microphones of this DB-1 range should thus be ideally suited to the requirements of large-scale users of radio of line communication systems. 'Push-to-talk' or 'on–off' switching is standard, as is provision to key external circuits. Options include integral pre-amplifiers or line amplifiers, 'busy' signal lights and 'time-out' timers, among others.

Communication Technology Ltd, 279 Addiscombe Road, Croydon CR0 7HY (Tel: 01-656 3631).

'WHISPER GLIDE' FADERS

Variohm Components is the UK agent for the new 'Whisper Glide' audio fader from Waters Manufacturing Inc. pictured here. This uses a stable, glass hard resistance element together with a precious metal wiper to promote long service life without any contact noise. At the same time, Waters 'exclusive curve-shaping correction technique' has



been built-in, this being a way both of reducing variations between units and of ensuring proper tracking in all stereo and multi-channel mono applications. In addition, the 'Whisper Glide' uses conductive plastic elements that permit a smoother action, a feature that should be welcome among today's recording and broadcasting industries.

Another advantage is that the glide can readily be cleaned (i.e. special tools and procedures are not required) while the plastic (MystR) is anyway impervious to all common contaminants. Moreover, the fader is equipped with industry standard gold-plated multi-pin connectors for quick installation or replacement.

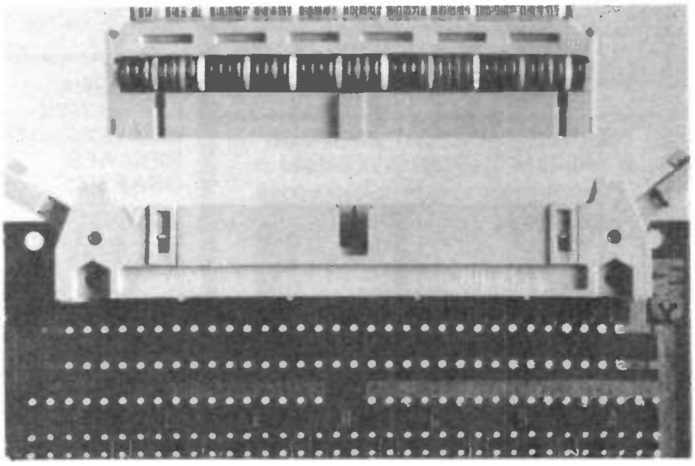
Variohm Components, The Cattle Market, Watling Street, Towcester, Northants NN12 7HN (Tel: Towcester 51004).

SCOTCHFLEX SOCKETS

3M now has Scotchflex sockets with centre bump polarisation available across the full range of 10-way to 60-way. These versions are said to offer 'all the benefits of 'Click' style polarisation with the extra facility of the centre bump for applications requiring centre slot polarising'. They will mate with Scotchflex 'Click' headers, low profile headers and plug connectors. The proven 3M beryllium copper 'U' element ensures gas tight corrosion-free contact.

The new sockets are supplied with either open-end or closed-end covers which are secured to the body with durable locking metal J-clips.

Electronic Products Group, 3M United Kingdom Plc, 3M House, PO Box 1, Bracknell, Berks RG12 1JU (Tel: Bracknell 58743).

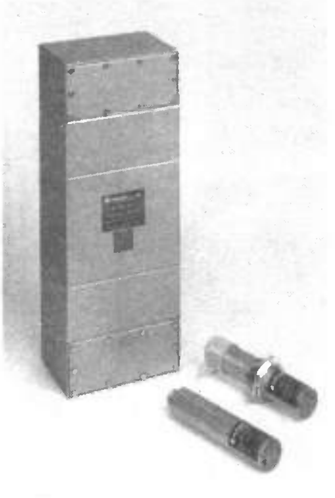


PRODUCT NEWS

HIGH-SYMMETRY TELEPHONE FILTERS

Belling Lee Intec, the RFI/EMC specialist within the Cambridge Electronic Industries group, has announced a new range of high-symmetry telephone line filters which have already been accepted for use in approved modem circuits by British Telecom and its Dutch counterpart, Nederlands PTT. These filters were developed in the light of the data error rates that have been experienced when conventional audio-frequency filters are included with modems in circuits for passing data over telephone lines. Studies by Belling Lee Intec and the Dutch Post Office suggested that the problem lay in imperfect symmetry between the lines: hence the development of high-symmetry devices.

At present the range comprises two 2-line filters and two 32-line filters, one fitted with transient suppressors. They are believed to be the only such filters available for this kind of data transmission. Moreover they can be used in EMC and Tempest applications, while those fitted with transient suppressors on each line are suitable for use in EMP protection systems.

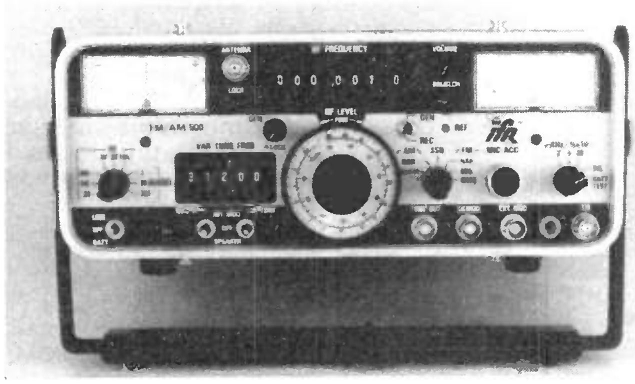


Belling Lee Intec Ltd, Intec House, 540 Great Cambridge Road, Enfield. EN1 3QW

COMMUNICATION SERVICE MONITOR

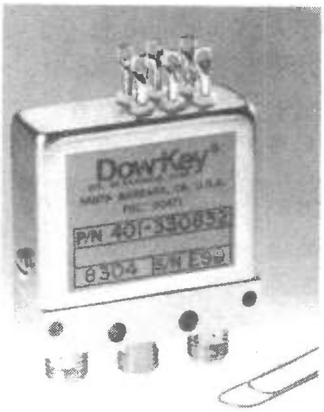
The FM/AM 500 'Micro Monitor' pictured here is a member of the latest generation of IFR communication service monitors. It offers the following features as standard: FM signal generator; AM signal generator; sensitive 2 μV receiver for AM, FM and SSB; dual audio generator; frequency error meter; auto-protected generator output of up to 150W; 0.5ppm TCXO; microphone input; and audio output. But perhaps its strongest selling point is that the Micro-Monitor is lightweight—weighing just 19lbs with the internal battery fitted—and that this has been achieved without any loss of performance, dependability or features. Moreover, the unit is readily portable and rugged.

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



MICROWAVE SWITCHES

Walmore Electronics' Microwave Components Division is marketing a range of Dow-Key microwave switches designed for operation between DC and 18GHz. These are available as either single-pole double-throw (SPDT) or transfer switches. In the former category are the 401 – designed to carry out broadband and high frequency, high isolation switching (break before make) – and the 402, which is designed to give high performance in microwave systems up to 12.4GHz. The latter is particularly well suited to earth station polarisation switching or any application where high isolation and low VSWR are required.



The transfer switches are four-port, providing a pair of independent coaxial paths in each position. Again, there are two versions – the 411, a failsafe switch for use over the complete range of DC to 18GHz, and the 412 failsafe or latching transfer switch, designed for high power applications from DC to 12.4GHz.

Walmore Electronics Ltd, 11–15 Betterton Street, London WC2H 9BS (Tel: 01-836 1228).

TO PROGRAM PROMS

The BP5 is a new module designed specifically to program Signetics bipolar PROMs which has been launched by GP Industrial Electronics. This low cost unit is for use with GP's range of EPROM programmer/emulator units but, even with the most expensive of these, the overall cost is still less than half that of any comparable unit on the market.

In addition to programming, the BP5 is able to perform a variety of other functions such as checking that the device's fuses are intact, comparing the stored RAM data with the PROM data, copying a selected device into RAM and making copies from a master bipolar PROM. The unit has five panel-mounted sockets to accommodate the different sizes of PROM in existence.

GP Industrial Electronics, Unit E, Huxley Close, Newnham Industrial Estate, Plymouth, Devon PL7 4JN (Tel: Plymouth 332961).

ANTI-STATIC 'ZAP MAT'

The major generator of the static charges that can play havoc with the operation of one's personal computer is the human body, walking on carpets or wearing synthetic clothing. There are several anti-static floor rugs and sprays available but these are ineffective when rubber-soled or synthetic shoes are worn. However, Inmac's new 'Zap Mat' is designed to cope with this problem by removing the static from the operator before he or she touches the sensitive piece of electronic equipment resting on the mat.

The removal of static is achieved with the aid of 3m of grounding cord attached to a convenient metal object such as a radiator, and it should take less than one second. However Inmac recommends that any operator touches the mat for five seconds to make absolutely certain.

Inmac (UK) Ltd, Dary Road, Astmoor, Runcorn, Cheshire WA7 1PZ (Tel: Runcorn 67551).

AUTORANGING DMM

The new Anders SK 6330 compact multimeter is said to 'combine a high performance specification with ease of use and a high degree of protection'. Not only does it have 'a fully captioned digital readout' but AC/DC voltage/current/resistance measurements are essentially available at the press of a button. The built-in custom LSI circuit automatically selects the optimum range for any voltage or resistance reading, (a feature that can be manually overriden if so desired) whereupon that reading is displayed together with the captions relating to selected function and range. Additional captions can be used to indicate auto/manual mode, DC input polarity or low battery power.

The ranges of measurement available are 200mVDC–1000VDC, 2-600VAC, and 200Ω–2MΩ, together with 20mA, 200mA and 10A manually selected AC/DC current ranges. The input impedance is 10MΩ and the basic instrument accuracy is quoted as being 0.5% of the reading. Other features include a 'zero adjust' function (that can be used to give difference readings or to null out test lead resistance, for example), an in-built buzzer (used to warn of input overrange and to perform audible continuity checks) and shrouded test lead connectors. The instrument itself is protected up to 750VRMS/1000VDC, while dual fuse protection is provided on the resistance and mA ranges.

Anders Electronics Ltd, 48-56 Bayham Place, London NW1 0EV (Tel: 01-387 9092)

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U193 0.65
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UAF42 1.00
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UCC85 0.60
UCF80 1.00
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UCH41 1.20
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6BN7 4.50
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6BQ7A 0.72
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6BL8 0.65
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6BR7 4.15
6BR8 2.15
6BR8A 2.15
6BS7 4.50
6BS8 2.50
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6BW6 5.35
6BW7 1.50

6BW8 4.00
6BX6 0.48
6BX7GT 3.50
6BZ6 2.00
6BZ7 2.95
6BZ8 0.95
6C4 1.10
6C5 1.95
6C6 0.50
6C8G 1.50
6C11 2.50
6C15 2.50
6C18 2.50
6CA4 0.60
6CA7 4.50
6CB6 1.50
6CD6GA 4.50
6CF6 1.50
6CH6 10.35
6CL6 3.50
6CL8A 2.00
6CM5 1.60
6CS6 0.75
6CW4 7.25
6CY5 1.00
6DC6 2.95
6DK6 1.15
6DQ5 3.35
6DQ6B 2.50
6EA8 2.50
6EB8 1.75
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6EW6 1.50
6F1 2.00
6F6G 2.00
6F12 1.50
6F13 3.00
6F14 1.00
6F17 2.75
6F18 1.50
6F19 0.48
6F21 2.50
6F22 0.70
6F23 0.60
6F24 1.25
6F25 1.25
6F28 1.25
6F33 17.00
6FG5 1.95
6GH8A 0.80
6GK5 1.50
6GK6 2.00
6GV7 2.50
6GW6 2.50
6H3N 1.10
6H6 1.95
6H6GT 1.20
6J4 1.10
6J4WA 3.15
6J5 1.95
6J5GT 1.50
6J6 0.65
6JB6A 3.95
6JE6C 3.95
6JS6C 3.50
6K7G 0.70
6K8Y 0.60
6KD6 5.50
6L1 2.50
6L19 3.95
6L6GC 2.75
6L6GT 1.15
6L7G 0.75
6LD20 0.60
6LF6 4.50
6LQ6 4.50
6N7 2.50
6N7GT 1.50
6P15 1.50
6P25 4.00
6P28 2.00
6Q7 1.20
6Q7GT 1.20
6S4A 1.50
6S7 1.10
6SA7GT 1.00
6SC7 1.50
6SG7 1.20
6SH7 1.20
6SJ7GT 1.20
6SK7 0.80
6SK7GT 1.20
6SL7GT 0.65
6SN7GT 0.69
6SQ7 0.80
6SS7 1.95
6U4GT 1.75
6U5G 1.50
6U8 0.65
6U8A 1.50
5V6GT 0.80
6X2N 1.00
6X4 0.96
6X5GT 0.80
6X5GTY 1.00
6X8A 2.25
7A7 2.00
7AD7 1.75
7B7 2.50
7C5 3.00
7C6 2.80
7H7 2.00
7Q7 2.00
7S7 3.00
7Y4 1.95
8B8 2.50

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10C1 5.50
10C2 0.70
10D2 1.25
10F1 0.75
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20D4 1.75
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20P3 0.60
20P4 1.05
20P5 1.15
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25L6GT 1.75
25BQ6 1.75
29C1 19.50
30 2.85
30C1 0.70
30C15 0.40
30C17 0.40
30C18 1.48
30F5 0.95
30FL1 1.00
30FL2 1.35
30FL12 0.95
30FL13 1.10
30FL14 1.25
30L1 0.45
30L15 0.60
30L17 0.60
30P4MR 1.00
30P12 1.00
30P18 0.60
30P19 1.00
30PL1 2.50
30PL13 0.60
30PL14 1.75
31JS6A 4.15
35A5 4.50
35L6GT 2.00
35W4 0.70
35Z3 1.85
38HE7 4.50
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47 6.00
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50C5 0.95
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958A 0.90
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4313C 4.00
5642 8.50
5651 3.20
5654 1.95
5663 1.95
5670 3.25
5672 4.50
5675 23.50
5687 4.50
5692 3.50
5696 3.50
5704 3.50
5718 6.50
5725 2.50
5726 2.50
5727 2.50
5749 2.50
5750 2.00
5751 3.50
5763 4.95
5814A 3.25
5840 3.50
5842 6.50
5879 3.90
5881A 4.60
5894 39.60
5899 4.50
5963 2.00
5965 2.25
5993 8.00
6005 1.95
6012 18.00
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6060 2.95
6062 4.50
6063 2.00
6064 3.25
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6360 5.50
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7558 11.50
7581A 3.00
7586 11.50
7591A 3.95
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7868 3.95
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9006 0.90
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	2K2-6K8	0.18
	10K	0.24
7 Watt	R47-4K7	0.18
	5K6-12K	0.19
	15K-22K	0.20
11 Watt	1R-10K	0.20
	15K-22K	0.24
17 Watt	1R-10K	0.26
	15K-22K	0.28

WW-2

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B7G 0.16
B7G Skirted 0.30
B8G 0.70
B9A 0.20
B9A Skirted 0.30
B10B 0.16
B13B 0.50
8 Pin DIL 0.14
14 Pin DIL 0.15
14 Pin DIL/Q 0.30
16 Pin DIL 0.17
DCTAL 0.35
CANS 0.27
B9A PCB 0.16
B5 0.75
B9G 0.38

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 6V2 9V1 10V 11V 12V 13V 15V 18V 20V 24V 27V 30V

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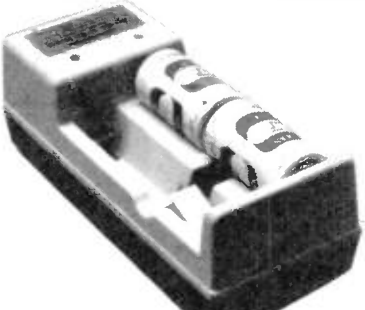

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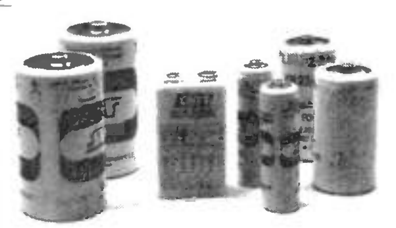
Format	Capacity (AH)	Height (mm)	Diameter (mm)	Prices 1-9	10-24	25-99
AAA	0.18	45.0	10.5	1.34	1.27	1.22
⅓AA*	0.10	18.0	14.3	1.58	1.50	1.44
½AA*	0.24	28.1	14.3	1.45	1.37	1.32
AA	0.50	50.2	14.3	0.90	0.85	0.82
AA*	0.50	50.2	14.3	0.96	0.91	0.88
½A*	0.45	28.1	17.3	1.53	1.45	1.38
RR*	1.20	42.1	22.6	1.70	1.61	1.52
C	2.20	49.7	25.9	2.40	2.30	2.20
D (sub)	1.20	60.5	32.9	2.40	2.30	2.20
D	4.00	60.5	32.9	3.50	3.32	3.15
D*	4.00	60.5	32.9	3.59	3.41	3.24
F*	7.00	91.3	32.9	6.85	6.50	6.20
SF*	10.00	91.3	41.7	10.50	9.50	8.90
PP3	0.11	49 × 26.5 × 17.5		4.35	4.10	3.85

* Denotes cell fitted with solder tags



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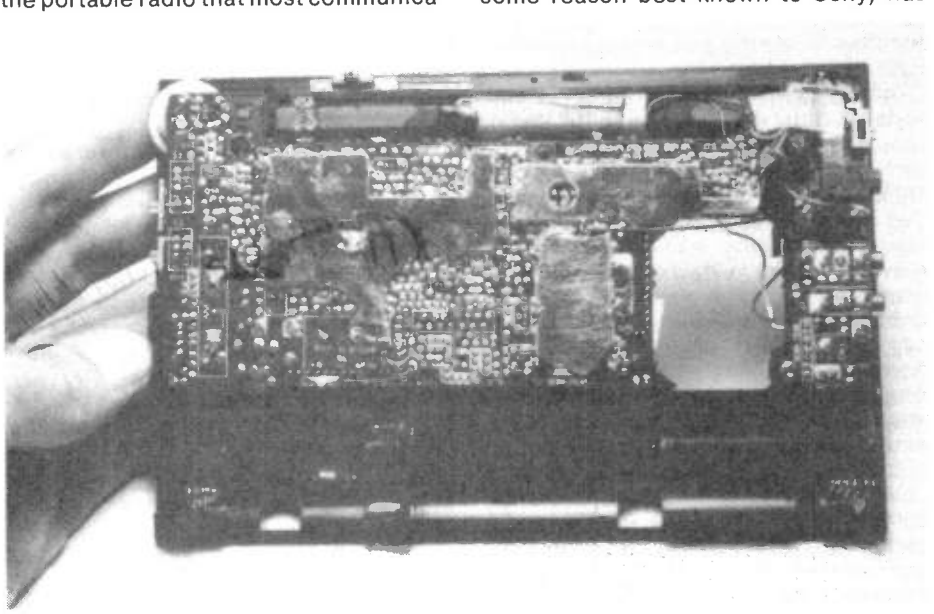
SONY DO IT AGAIN!

Just when you thought it was safe to go back to designing portable radios . . .

Sony have delivered a crushing blow to the morale of all of us who felt we might just be getting to grips with the latest technologies on the portable radio scene. But first, before letting you know just what they've done, a bit of scene setting.

The Sony ICF2001 was launched around three years ago and, despite taking about a year to find its way onto the UK market, it has established itself as the portable radio that most communications enthusiasts would like to own. However, to tell the truth, the technology wasn't quite the last word in communications engineering – being a first-generation transition from bandswitched to continuous tuning philosophy – and the battery consumption brought a tear to the eye of even the most hardened radio enthusiast without shares in Berec.

The recently introduced ICF2002 (also known as the ICD7600D in the UK, for some reason best known to Sony) has shrunk the features and facilities of the ICF2001 into a package that fits in a jacket pocket – and added a few new ones for good measure.

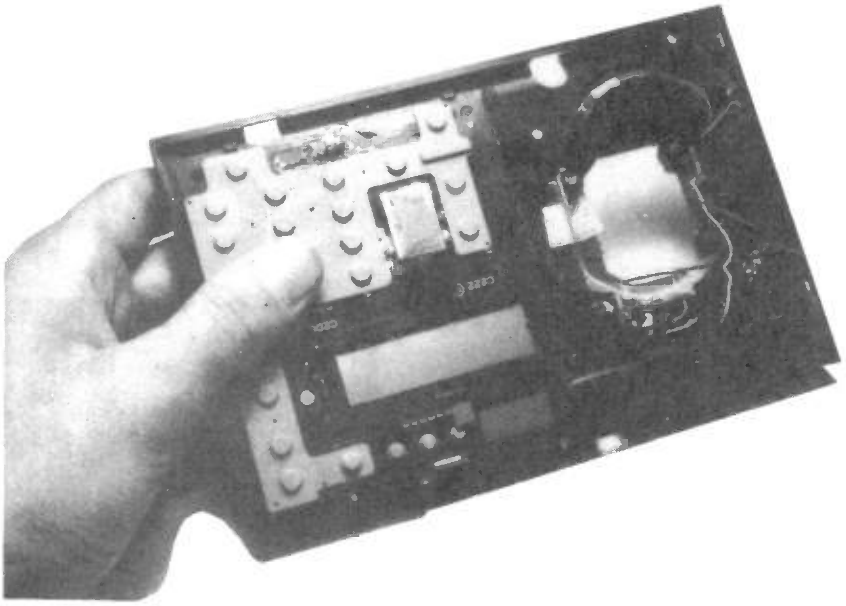


Technologically speaking, the ICF2002 is still a bit of a mystery. To unravel its secrets, we need to get our hands on the Sony service manual – and if that's as good as the one they produced for the ICF2001, then it will provide a great deal of interest on which the circuit designer may care to ponder. The implication, given the similarity of the frequency coverage, is that it is a scaled down version of the big brother – a dual conversion system, with one of the IFs at 450kHz, as the instruction booklet supplied advises users not to worry too much about strange happenings on 450kHz, 25385kHz, 27025kHz and 27475kHz.

Stepping through the airwaves

The ICF2002 covers 153kHz to 29,995kHz continuously in a LW/MW/SW band, and 76–108MHz also continuously on FM. The coverage is, nonetheless, decompartmentalised into 'channels' so that LW is covered in 3kHz steps while MW is covered in switch selectable 9kHz or 10kHz increments. Thus the forthcoming relocation of the 200kHz transmission from Droitwich to 198kHz has been pre-empted, but otherwise hasn't generated any problems.

A fine-tune/interpolation control is supplied in the form of a thumbwheel pot



on the top right-hand side of the set, and operation of this fills in any blanks in the synthesised stepwise coverage. Its operation is optional: indeed, a three-way switch permits selection of strictly stepped coverage if required.

Internal ferrite rod antennae provide excellent basic sensitivity on LW and MW without the sensitivity to atmospherics that characterises active rod antennae at these frequencies.

Short wave coverage (above 1.610MHz) shifts to 5kHz increments. However, the IF bandwidth seems somewhat more than 5kHz and it is possible to tune strong signals simultaneously on the upper and lower adjacent channels. An excellent BFO and product detector is also supplied, which tunes in conjunction with the fine tuning control mentioned above. Although a trained communications ear can provide adequate filtering to resolve stations in bands such as 40m, it would be nice if the 'speech/music' selector switch actually switched IF filters rather than (apparently) a capacitor across the audio.

As you can see from the internal pictures *(Photos 1, 2)*, it's going to take a brave owner to try to perform any such modifications on the insides of the receiver: for a start; it makes extensive use of LSI and the smallest coils known to man. Notwithstanding the small size, the ICF2001 doesn't use very many more parts than many far more conventional receivers – prompting speculation that if they really wanted to, Sony might be able to sell the thing for about half the £169 presently being asked.

The FM coverage, by the way, is stepped in 100kHz increments and is not subject to interpolation.

Tuning in

To tune a station, simply enter 'AM' or 'FM', then the frequency, and finally press 'EXECUTE'. If the combination is allowable, the receiver tunes in without further ado in less than a second.

Up to ten stations so tuned can be entered as presets by first tuning in as above – or by using the rocking up/down tuning switch until you have found the station you want. Install a preset by pressing 'ENTER', followed by the key number to store it under.

The scanning switch is a little disappointing since it only tunes up from the starting frequency, and pauses for about 1–2 seconds to sample the stations it finds. The ICF2001 allowed for presettable upper and lower limits so that the set would 'revolve' around the band thus selected, looking for signals of interest.

On the other hand, scanning is all but meaningless in view of the crowded state of HF (and it's getting that way in VHF FM, too). It took the set over 15 minutes to nose its way from 153kHz to 30MHz!

Sensitivity

The Owner's Handbook doesn't mention sensitivity. However, it would not be too presumptious of Sony to describe this as 'adequate' (in the manner of a well-known motor car manufacturer who declines to rate the power output of their cars).

This is easily the most sensitive FM portable of its size ever seen by *R&EW* people, and the AM and shortwave performance is equivalent to that of an R1000 – although you shouldn't expect to plug in an enormous antenna and not get some overloading and strong signal intermodulation effects. An antenna attenuator switch is provided for such circumstances, and theory says that it may perform a useful purpose in restraining strong signals without relegating the weaker ones below the noise threshold. Non-exhaustive trials around 40m after dark suggested this to be the case.

Like the ICF2001, sensitivity tails off – failing dramatically when the batteries start to conk out. However, the quiescent consumption of power is a fraction more restrained than in the ICF2001 – only 40mA in AM mode and 55mA in FM, as opposed to 200mA or so for the ICF2001 – but... Four AA-size alkaline batteries should last around 20 hours (assuming about 1200mAh of useful life to an unacceptable end-point voltage). On the other hand, the ICF2001 uses D cells which ought to last about eight times as long as AA's. Do the sums and you'll find you will be changing the ICF2002's batteries more frequently!

NiCads (typically holding 500mAh) will provide around 8–10 hours of operation on a single charge – and in view of this relatively fierce thirst, Sony are at pains to supply not only a mains PSU (6VDC), but also a 12V converter and a useful battery pack that stacks four C cells and has a DC power plug on the end.

The ICF2002 should be an ideal traveller's radio (probably, now, the *definitive* traveller's radio), and a charged up set of C's should provide a good week's bedside listening between charges.

Timer options

A function – indeed, the single function – that obviously caught the microprocessor software designers short of their last few bytes of ROM was the 'Sleep timer'. It's 65 minutes, take it or leave it – not usefully decremented in 10-minute segments as in the 2001. Sixty-five minutes to get to sleep is pretty insomniacal stuff, and likely to waste a lot of battery power unnecessarily.

The on-timer (a function not present on the 2001) is very useful, and works in conjunction with the very useful LCD time display (switchable between 12 and 24-hour modes). The last station tuned is switched on at a pre-allotted time after the 'STANDBY' button has been pressed (whereupon 'STANDBY' appears on the LCD).

Conclusions

The ICF2002 (ICF7600D) appears to have no competitor. The frequency stability, sensitivity and versatility of this diminutive portable would have been considered utterly impossible a mere five years ago – and it would have given many 'communications' receivers a good run for their money just three years ago. It's interesting that it should be released about the same time that Tandy and Uniden appear to be marketing a competitor to the ICF2001.

It's a shame, however, that there isn't an option for some more IF selectivity, since that appears to be all that stands between the ICF2002 and its application as a significant 'standby' receiver in a variety of marine and similar roles. Not surprisingly, there are said to be severe supply problems breaking out across the country where this receiver is concerned.

It would be terribly sporting of the awfully nice people at Sony to send us a complete workshop manual on the receiver so that we can give you a thorough inside low-down. Watch this space.

How can they follow this? A solar powered/recharged version with adjustable IF bandwidth, perhaps...

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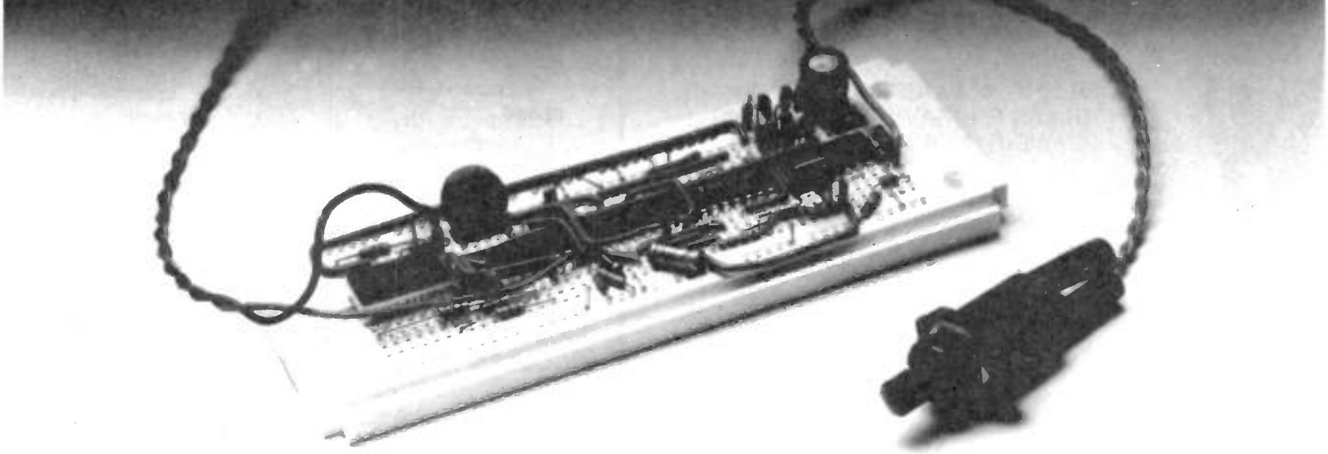

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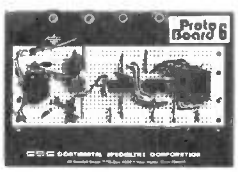

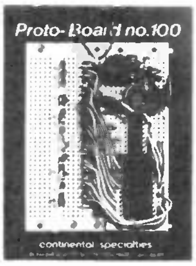

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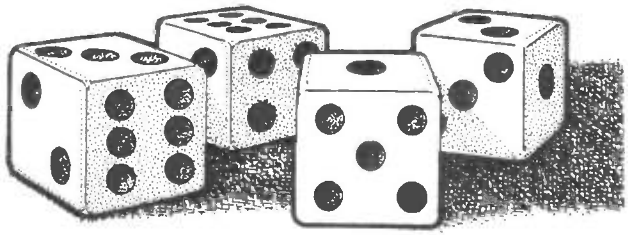

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ACTIVE ANTENNAE

Many radio users express a healthy degree of scepticism over statements that one foot of antenna rod and an active stage can equate in performance to a long piece of wire and a continuously variable matching unit. The designs for active antennae presented a couple of issues ago are discussed further here, outlining their performance and giving PCB and constructional details

The electrical model of the simplest type of active antenna is presented in *Figure 1*. The basis of the system is its electrostatic operation, whereby an electrically short antenna element exhibits an effective capacitance of C_a which is about 25pF per metre. The FET element of the active antenna exhibits an input capacitance of C_t, and so together they form a capacitive divider.

The voltage generated on the antenna (V_a) is the product of the electric field strength E (in volts per metre) and the effective height of the antenna H_e (in metres). Thus the voltage delivered to the input of the transistor matching/amplifying stage is given by:

$$V_t = \frac{E.H_e}{1 + (C_t/C_a)}$$

For electrically short antennae, the bandwidth is broad. This means that the performance of an HF antenna over the range 100kHz–30MHz will be essentially constant. Indeed, the frequency response of its FET will not deteriorate performance until well into VHF or possibly UHF.

Signal-to-noise is determined at the active antenna stage, and provided the noise gathered by the antenna from the atmosphere exceeds the noise generated within the transistor, the active antenna will produce the same signal-to-noise ratio as a properly matched passive antenna for the same specific frequency.

A full wave dipole for 30m produces 30 times the EMF of a 1m rod, but the atmospheric noise contained in the output will be correspondingly higher as well. For all practical purposes, the signal-to-noise ratios are the same in both cases. *Figure 2* shows how typical ionospheric noise levels vary as a function of frequency.

Average atmospheric noise levels are no better than 10dB worse than those of decent RF FETs: so given the fact that the active antenna does not impair S/N, the difference in signal amplitude between the long wire and the short rod can be

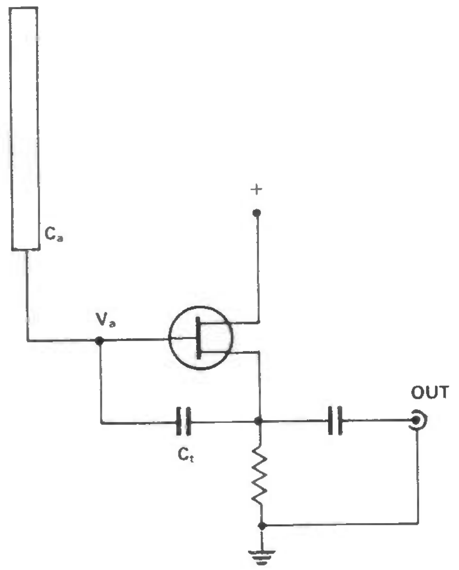

Fig 1 *Electrical model of an 'active' antenna*

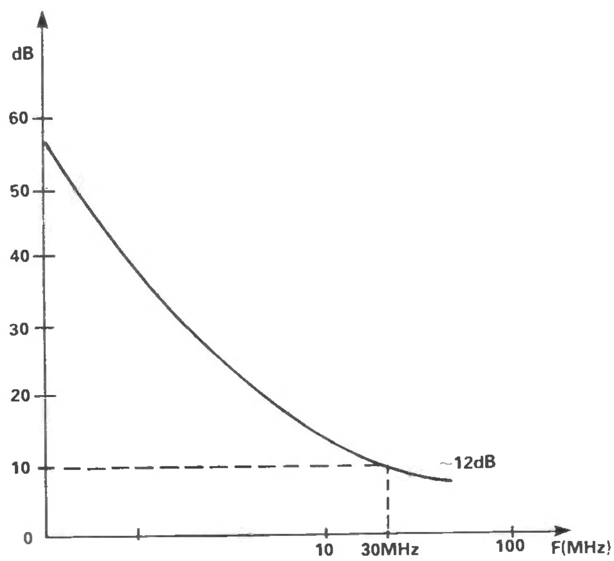

Fig 2 *Atmospheric noise related to frequency*

made up by amplification, where there is a substantial margin of noise figure left to the squander before any degradation is apparent.

In-car applications

Of particular note here are the noise levels around 1MHz (i.e. on MW). It seems surprising that so few car radio manufacturers have taken advantage of nature's own limitations to produce active car antennae: as far as we are aware, only SEI have been bright enough to use the elements of the heated rear window as the basis of an active car antenna, but there are doubtless some readers who are going to have a go now we mentioned it!

The incorporation of such a modification may require some revision of the car radio's own input stage, most of all because the capacitance of the antenna cable and the rod is an integral part of the tuning circuitry. And don't forget that the alternator whine delivered via the power to the heating element will require very substantial filtering. *R&EW* would be pleased to hear of any practical experiences.

Going deeper

The purely voltage-following type of active antenna has the advantage of keeping the signal levels low at the first mixer input. A simple voltage-follower circuit, such as that illustrated in *Figure 1* is prone to second-order intermodulation distortion as a result of the antenna's square law characteristics.

The broadband active antenna of *Figure 3* was first discussed in the November issue: this time we present a suitable layout for this circuit and its performance details in the shape of a series of traces from the spectrum analyser. If a 455kHz IFT is used in the trap position, the LF roll-off is substantial – which will help correct the characteristically much higher signal levels present at low frequencies (particularly) at night.

The 'off-air' results shown in *Photos 1–6* were taken at approx. 9.30am during daylight. The peaks are the result of imperfect matching into the filter section: however, by selecting components carefully, it is possible to place the peaks and troughs where they can do most good by compensating the areas of signal crowding in the HF bands.

One further rather useful (if unplanned) result of the active antenna is the fact that it performs the task of remote attenuator rather well – simply by winding down the supply voltage from the nominal 12V.

The active antenna of *Figure 4* is a further development of the second antenna described in the November issue. The complete bandpass shaping network ahead of the active impedance transformation stage has been 'borrowed' from the technology incorporated into most modern HF receivers. By selecting values of chokes and capacitors from *Table 1*, the results can be very accurately tailored. If you have specific bands of interest – or if you have a particular local overload problem – this approach can produce the best results.

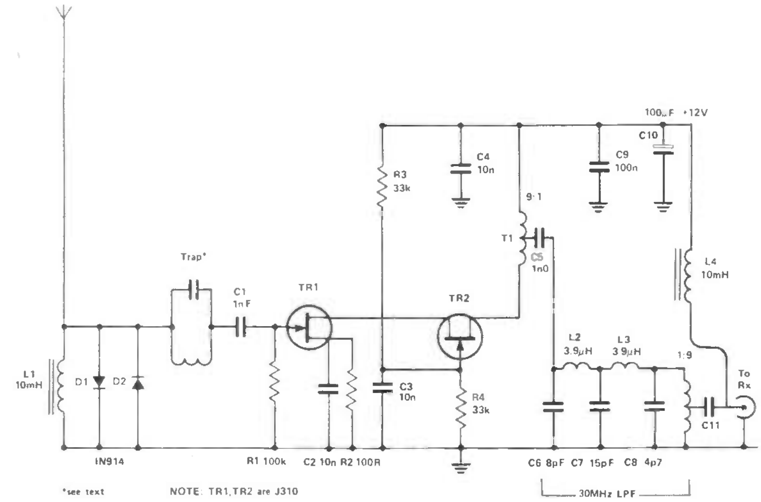

Fig 3: *Active antenna head amplifier with low-pass filtering first considered in the November '83 issue*

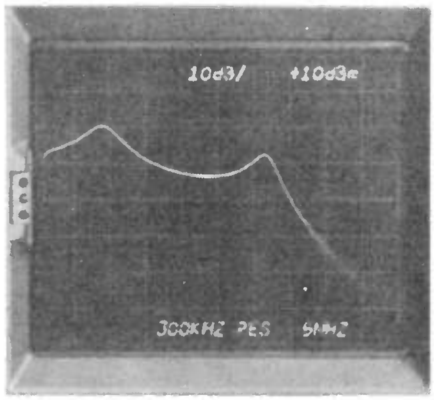

Photo 1: *Attenuator effect*

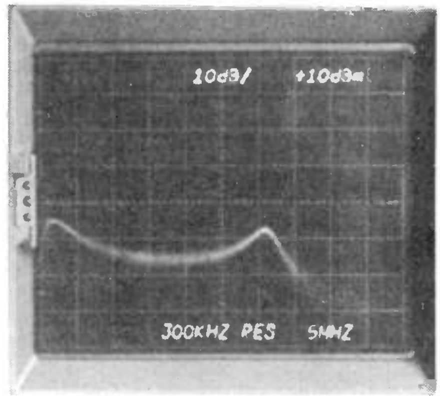

Photo 2: *Increased attenuator effect*

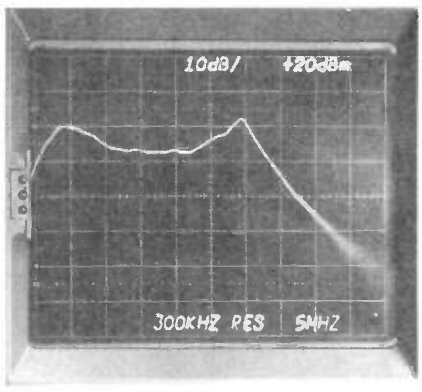

Photo 3: *Antenna gain characteristics. Centre line = 0dB*

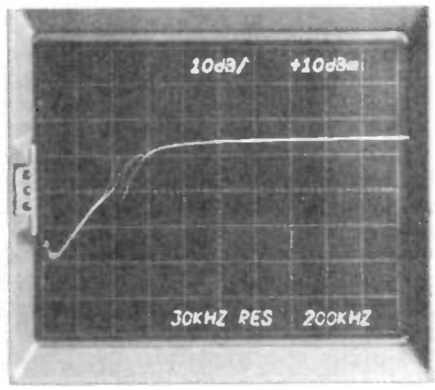

Photo 4: *LF roll-off and 455kHz trap effect*

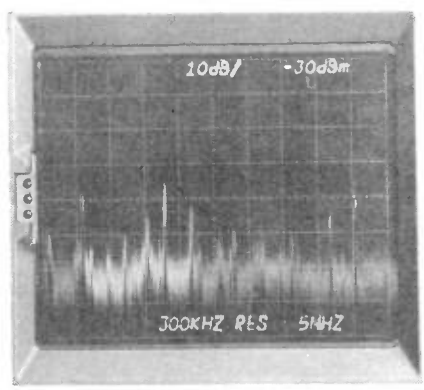

Photo 5: *Typical HF spectrum on a wire antenna*

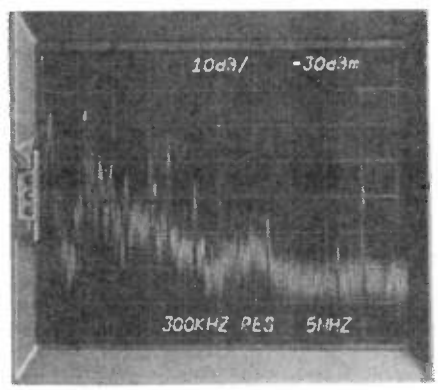

Photo 6: *Same HF spectrum but using the active antenna*

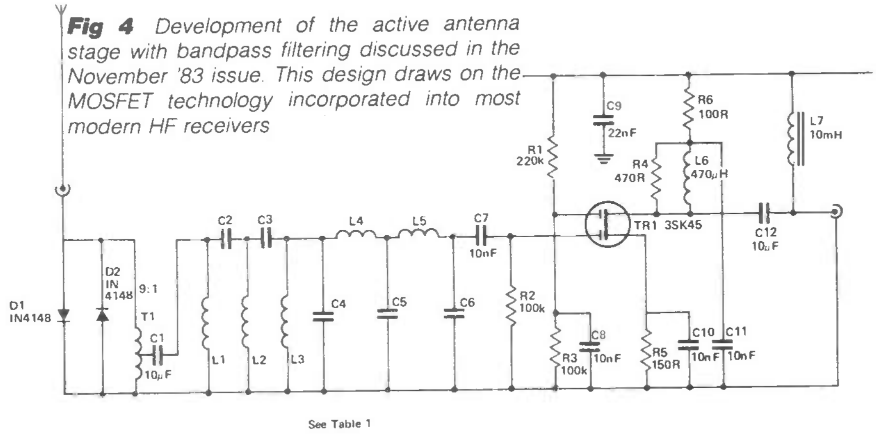

Fig 4 Development of the active antenna stage with bandpass filtering discussed in the November '83 issue. This design draws on the MOSFET technology incorporated into most modern HF receivers

Table 1 Values of coils and capacitors for the filter section of Figure 4.

MHz	C2	C3	C4	C5	C6	L1	L2	L3	L4	L5
0.2–1	1.2n	1.2n	270p	560p	270p	470µ	220µ	470µ	120µ	120µ
1–2	220p	220p	150p	270p	150p	100µ	47µ	100µ	68µ	68µ
2–4	100p	100p	68p	120p	68p	47µ	22µ	47µ	33µ	33µ
4–8	47p	47p	27p	56p	27p	22µ	12µ	22µ	15µ	15µ
8–16	27p	27p	15p	27p	15p	12µ	5.6µ	12µ	8.2µ	8.2µ
16–30	15p	12p	8.2p	10p	5.6p	5.6µ	2.7µ	5.6µ	3.9µ	3.9µ

Construction

PCB designs for the two antennae described above are shown in *Figures 5–8*. There is little to watch out for when constructing these simple units – just remember that the power supply is conducted along the inner core of the feeder cable, and that it should be properly decoupled at the receiver end.

Either antenna when finished can be housed in its entirety in a piece of plastic waterpipe and be completely weatherproofed. As with any antenna, mount it as far away from any source of interference as possible.

Rigorous analysis

One of the leading receiver design 'thinkers', Dr Ulrich Rhode, has proposed (in Reference 1) the active antenna circuit shown in *Figure 9*. The push–pull arrangement is designed to assist in avoiding intermodulation products, particularly in applications where a local transmission may be present that would otherwise block a simpler design. The system noise figure (F_s) is given by

$$F_s = F_a + \frac{(F_r - 1) \cdot a}{G_v}$$

where F_a, F_r are the noise figures of the antenna and the receiver, respectively; *a*

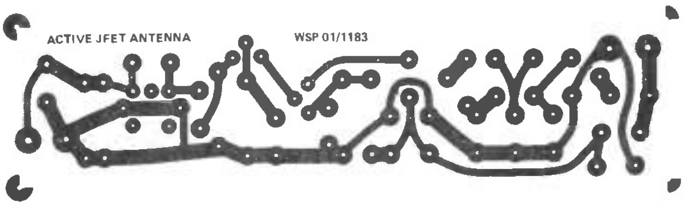

Fig 5 PCB design for the active JFET antenna outlined in Figure 3

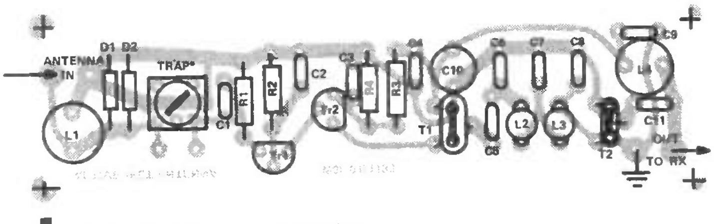

Fig 6 Component overlay

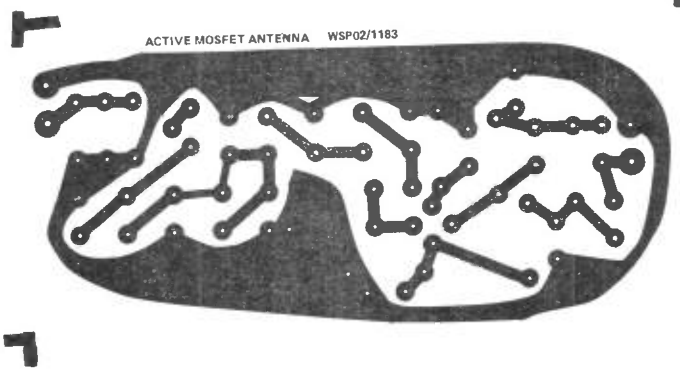

Fig 7 PCB design for the active MOSFET antenna outlined in Figure 4

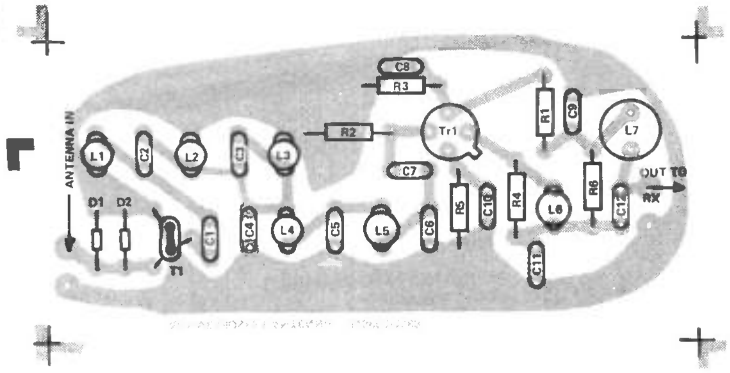

Fig 8 Component overlay

is the signal amplification; and G_v, the electrical gain of the antenna, is given by:

$$G_v = 4 \left(\frac{V_a}{V_o}\right)^2 \cdot \frac{R_a}{Z_l}$$

where Z_l is the impedance of the load.

Assuming that the output voltage (V_o) is twice the antenna voltage (V_a), and solving for F_a, gives:

$$F_a = F_{min}\left(1 + C\frac{(Z_a - Z_{opt})^2}{R_a \cdot R_{opt}}\right) = F_{min}(1 + A)$$

where Z_a is the antenna impedance; and Z_{opt} is the optimum noise matching impedance ($Z = R + jX$). The largest possible bandwidth corresponds to the condition when X_{opt} is 0: in this case, the antenna noise figure is given by:

$$F_a = C\left(\frac{R_a}{R_{opt}} + \frac{R_{opt}}{R_a} + \frac{X_a^2}{R_a \cdot R_{opt}} - 2\right)$$

The high input impedance requires that

$$\frac{R_a}{R_{opt}} < \frac{R_{opt}}{R_a};$$

$$\frac{R_a}{R_{opt}} + \frac{R_{opt}}{R_a} + \frac{X_a^2}{R_a \cdot R_{opt}} > 2$$

yielding F_a as:

$$F_a = F_{min}\left[1 + \frac{C}{R_a}\left(R_{opt} + \frac{X_a^2}{R_{opt}}\right)\right]$$

The rod antenna impedance Z_a has the approximate form:

$$Z_a = KR\omega^2 + j\frac{kX}{\omega}$$

where K, k are constants. Thus as the frequency increases, the impedance decreases faster than the noise figure and so the optimum matching resistance should be specified at the lowest operating frequency.

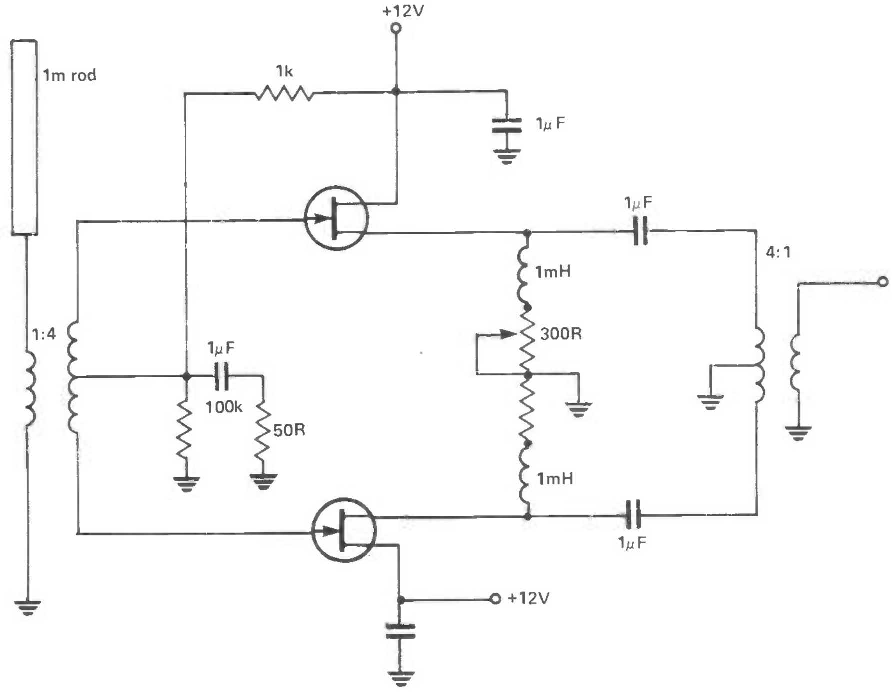

Fig 9 *The strong signal active antenna suggested by Ulrich Rhode. The FETs quoted are CP640's, but J310's should substitute adequately for amateur purposes*

Active antennae at VHF and UHF

A final thought on the behaviour of these antennae at short wavelengths. As the rod length becomes a significant part of the wavelength, the broadband characteristics tail off as the impedance drops – really quite dramatically – as the element length approaches a quarter-wave. Active antennae can still be used up to 150MHz, but the reduced atmospheric noise makes the implementation less satisfactory than a properly matched passive antenna.

References

1. Ulrich Rhode 'Active Antennas' *RF Design* (Cardiff Publishing) May/June 1981.

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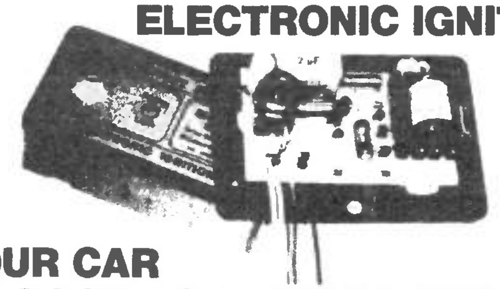

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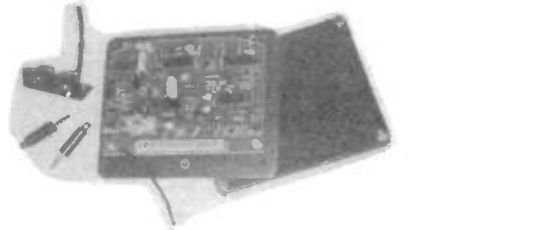

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Name ....
Address ....
....
....
....Code...................

A FAX RECEIVER

As FAX receiving equipment is generally quite expensive, Lionel Sear decided to develop a means of receiving these pictures with the aid of computer graphics.

A large proportion of the HF radio spectrum is taken up with the dissemination of weather information. National agencies such as our own Meteorological Office collect and exchange basic weather information using teleprinter links, and from these and other sources put together weather charts for the various users such as maritime and aviation authorities. Such information is usually transmitted as facsimile or 'FAX' signals.

Much of the information is rather esoteric – for example, the weather at various heights in the atmosphere. However, information of direct relevance to amateur aviators, sailors, VHF radio enthusiasts and many others is output – updated on a regular basis, typically four times every 24 hours.

If you are unfamiliar with FAX signals, try tuning a communication receiver (with the BFO switched on) to 4783kHz. A picture transmission may be in progress at the time, in which case the characteristic cyclic grating sound of the 800Hz FSK format will be apparent. Eventually this picture ends with a tone several

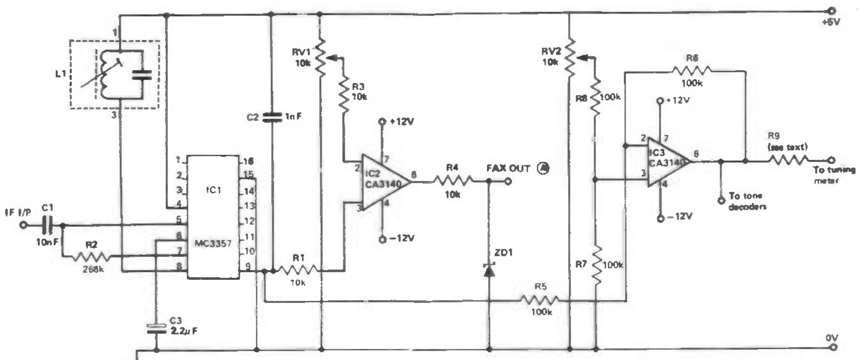


Fig 1 Circuit for FAX demodulator (Board 1)

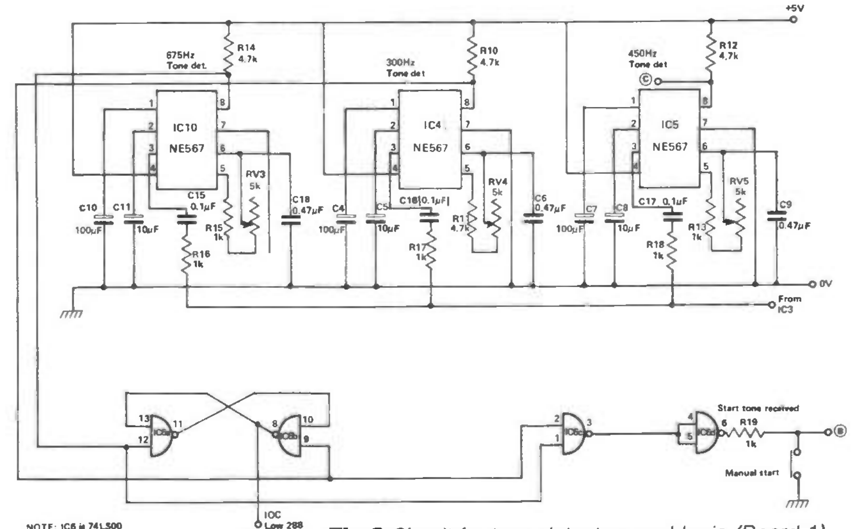


Fig 2 Circuit for tone detectors and logic (Board 1)

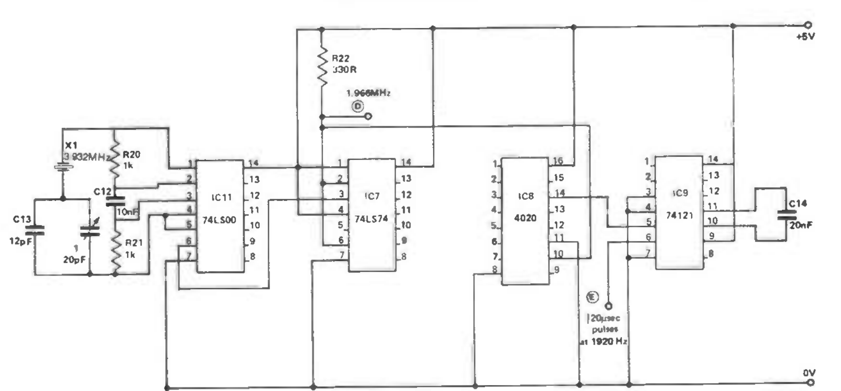


Fig 3 Circuit for timing chain (Board 1)

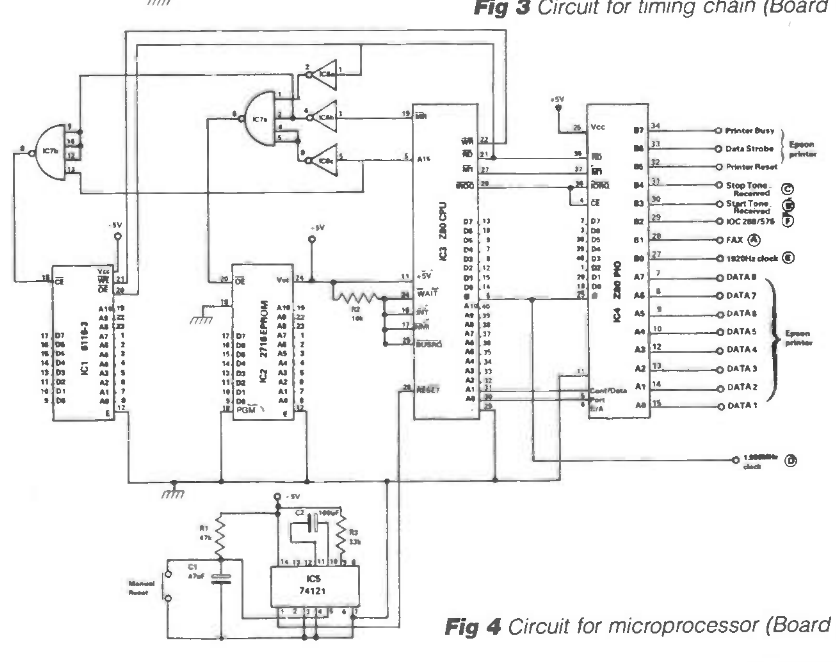


Fig 4 Circuit for microprocessor (Board 2)

seconds in length. A fresh picture starts with a similarly lengthy tone, followed by a series of single pulses at about 0.5sec intervals: these last for 30 seconds, before giving way to the picture information which itself may last for up to 15 minutes or so.

What is going on?

At the transmitting end, the picture to be sent is wrapped around a drum which rotates at an accurately maintained 2 cycles/second. An optical sensor mounted on a screw feed picks up the black-and-white information from the picture as it rotates. It moves along the drum at a speed determined by the pitch of the screw, thus covering the whole of the picture. The black-and-white information is translated into a frequency shift on the transmitted signal.

At the receiving end, another drum apparatus carries out the reverse process, with a scribe on a screw feed impinging on electrically sensitive paper wrapped around the drum. The demodulated signal is applied to the scribe and the electrically sensitive paper blackened in sympathy with the picture on the sending apparatus.

We can now relate all this back to the various facets of the signal as heard on our receiver. The tone at the beginning of the transmission sets off the chain of events at the receiving end: in addition, the tone itself will be either 300Hz or 675Hz for an index of cooperation (IOC) of 576 or 288, respectively. This IOC is a measure of the speed at which the screw-fed sensor or 'scribe' moves along the drum. With an IOC of 576, pictures are of higher definition and take longer to send.

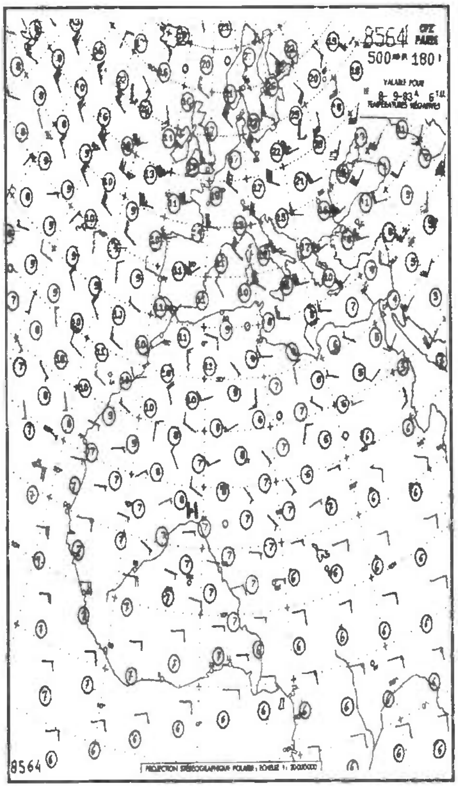
The single pulses that follow allow the receiving apparatus to inch its way around so that the start of the subsequent picture is at the top left hand side of the paper. After the actual picture information has all been sent, a stop tone of 450Hz brings the process to an end.

Equipment considerations

Needless to say, the speed tolerances for the receiving apparatus are extremely high and demand high standards of mechanical construction and hence do not come cheaply. Indeed new FAX receiving equipment is probably beyond the pocket of most amateurs. Surplus machines do appear from time to

Table 1. *2716 EPROM HEX program.*

0000	3E	CF	D3	07	3E	9F	D3	07
0008	3E	CF	D3	06	3E	00	D3	06
0010	3E	60	D3	05	31	FF	87	3E
0018	40	D3	05	06	50	10	FE	3E
0020	60	D3	05	CD	00	03	1B	41
0028	08	0A	1B	4C	C0	03	00	CD
0030	1F	03	0A	1B	4C	C0	03	00
0038	DB	05	CB	5F	20	FA	CB	57
0040	20	04	3E	08	18	02	3E	10
0048	32	D0	83	CD	44	03	D9	21
0050	00	84	01	00	00	D9	21	00
0058	80	01	00	00	DB	05	CB	4F
0060	28	FA	CD	33	03	DB	05	CB
0068	4F	28	F1	DB	05	CB	4F	20
0070	FA	CD	33	03	DB	05	CB	4F
0078	20	F1	3A	D0	83	47	CB	81
0080	DB	05	CB	47	28	FA	3A	D0
0088	83	FE	10	28	4D	DB	05	1F
0090	1F	CB	16	23	CB	49	28	18
0098	DB	05	17	38	13	1A	D3	04
00A0	CD	14	03	13	7B	FE	C5	20
00A8	07	7A	FE	87	20	02	CB	89
00B0	7D	FE	C0	20	CB	7C	FE	83
00B8	20	C6	21	00	80	3A	D0	83
00C0	FE	10	20	05	CB	19	3F	CB
00C8	11	10	B5	D9	CB	C9	11	00
00D0	80	DB	05	CB	67	CA	00	00
00D8	18	0D	CB	41	20	AF	DB	05
00E0	1F	E6	01	B6	77	18	AC	3A
00E8	D0	83	47	CB	81	DB	05	CB
00F0	47	28	FA	3A	D0	83	FE	10
00F8	28	4E	DB	05	1F	1F	CB	16
0100	23	CB	49	28	18	DB	05	17
0108	38	13	1A	D3	04	CD	14	07
0110	13	7B	FE	C5	20	07	7A	FE
0118	83	20	02	CB	89	7D	FE	C0
0120	20	CB	7C	FE	87	20	C6	21
0128	00	84	3A	D0	83	FE	10	20
0130	05	CB	19	3F	CB	11	10	B5
0138	D9	CB	C9	11	00	84	DB	05
0140	CB	67	28	11	00	C3	7A	00
0148	CB	41	20	AE	DB	05	1F	E6
0150	01	B6	77	18	AB	C3	00	00
0300	E3	DB	05	17	38	FB	7E	23
0308	A7	28	07	D3	04	CD	14	03
0310	18	EF	E3	C9	DB	05	CB	B7
0318	D3	05	CB	F7	D3	05	C9	E3
0320	01	C0	83	11	C0	87	7E	23
0328	A7	28	06	02	12	03	13	18
0330	F5	E3	C9	C5	06	97	10	FE
0338	C1	C9	C5	06	64	CD	33	03
0340	10	FB	C1	C9	C5	06	C8	CD
0348	3A	03	10	FB	C1	C9		



Connections to Epson MX80 printer
Amphenol 36-way plug Centronics parallel

Pin No.	Signal
1	$\overline{\text{STROBE}}$
2	DATA 1
3	DATA 2
4	DATA 3
5	DATA 4
6	DATA 5
7	DATA 6
8	DATA 7
9	DATA 8
11	BUSY
31	$\overline{\text{PRINTER RESET}}$

Pins 19–30 may be used with the above as twisted pair ground returns.

Connections to Amphenol Plug to Epson HX80
Ribbon cable from purple/brown pair in

Signal Pin	Return Pin	Colour	Signal
1	19	purple	$\overline{\text{STROBE}}$
2	20	blue	DATA 1
3	21	green	DATA 2
4	22	yellow	DATA 3
5	23	orange	DATA 4
6	24	red	DATA 5
7	25	brown	DATA 6
8	26	black	DATA 7
9	27	white	DATA 8
11	29	grey	BUSY
31	30	purple	$\overline{\text{INIT}}$

time but non-standard speeds may be a problem: the author has even heard of mechanically adept enthusiasts making their own apparatus, but this is unfortunately outside the scope of the majority of people.

The author was thus prompted to try to develop a means of receiving these pictures with the aid of computer graphics, and since an Apple II was available, initial experiments were carried out on this. It soon became apparent that the 280 x 180 dot resolution of the Apple graphics was hopelessly inadequate for meaningful results, even when only part of a picture was being displayed. But it did show that the idea worked and that a printer with suitable graphics capability could safely be purchased to allow the project to develop further.

The printer purchased was the Epson MX80 which, in so-called 'double density' mode, has a horizontal dot capacity of 960, adequate for the production of pictures suitable for all but the most demanding of applications.

A decoder was built to convert the FSK signal to TTL levels (at the time, this was done on the AF output of the receiver), along with a crystal oscillator/divider chain to give TTL pulses at 1920Hz, i.e. 960 per half second. A machine code program was written by which the Apple polled the 1920Hz pulse generator and, on receiving a pulse, looked at the demodulator and set or reset a bit in memory according to whether it were black or white. Two inputs on the games socket were used for this. When the data from eight lines had been collected, this was output to the printer through a parallel interface.

This was all very well, but not everyone has Apples, and it was felt that the project would have wider appeal if it were developed as a dedicated minimum chip system for one of the commonly available micros and, since the author felt happiest with Z80 code, this was chosen. The program was converted to Z80 code with the aid of a Nascom I with 3K of extra RAM, and then transferred to 2716 EPROM for use in the system.

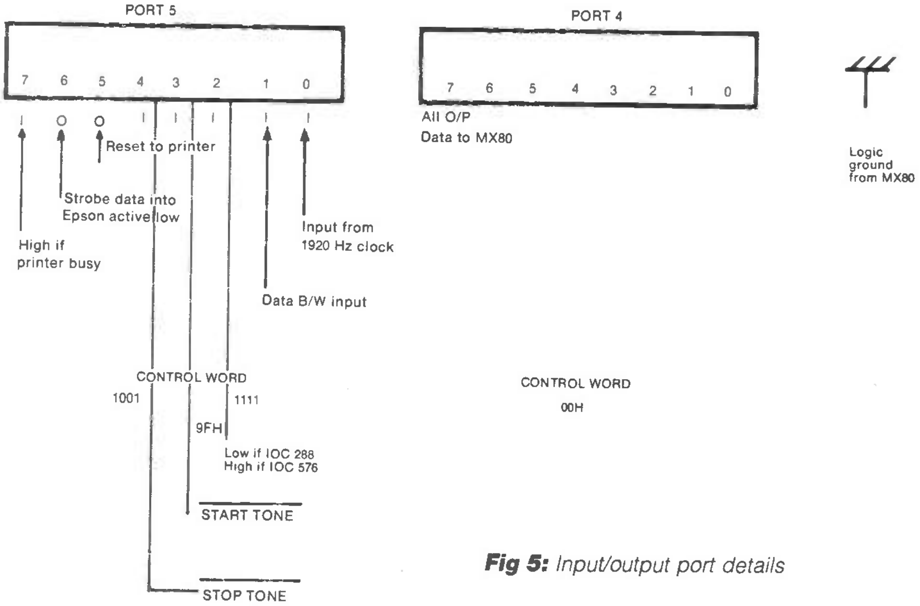


Fig 5: Input/output port details

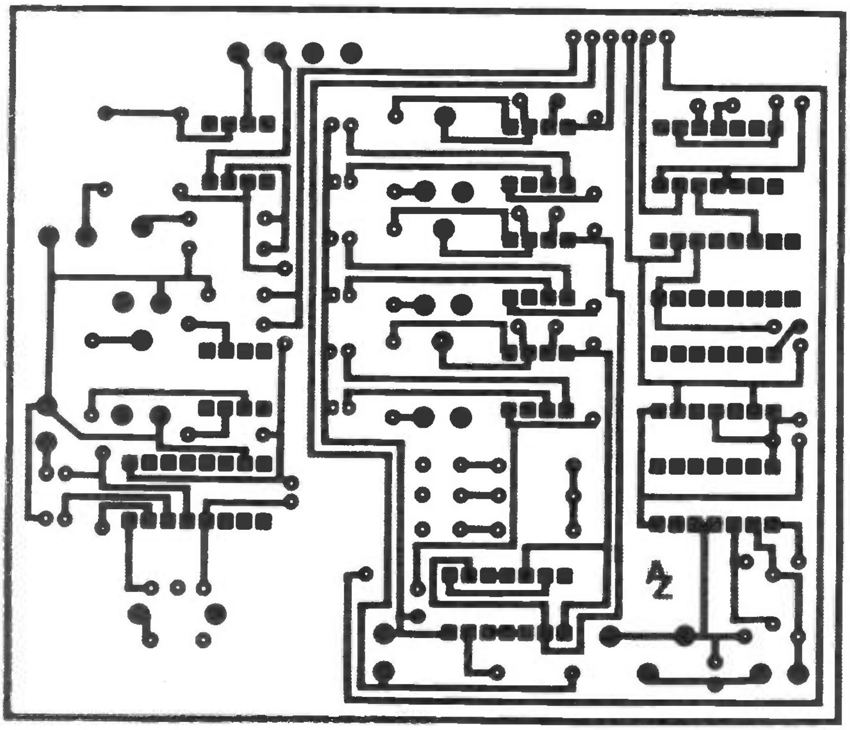
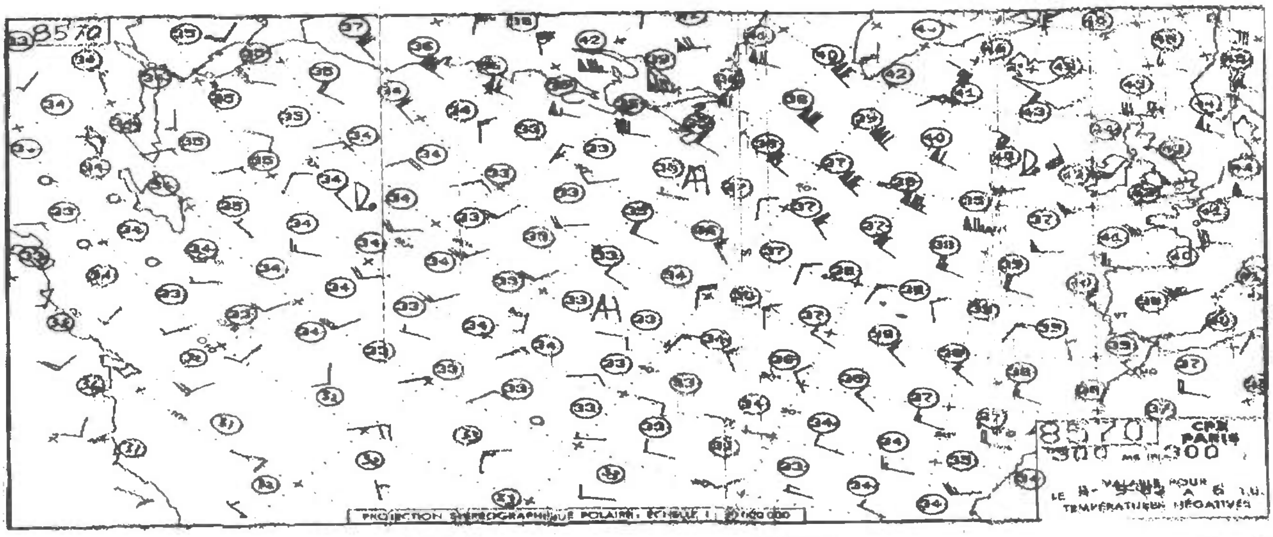


Fig 6: Receiver bottom plane



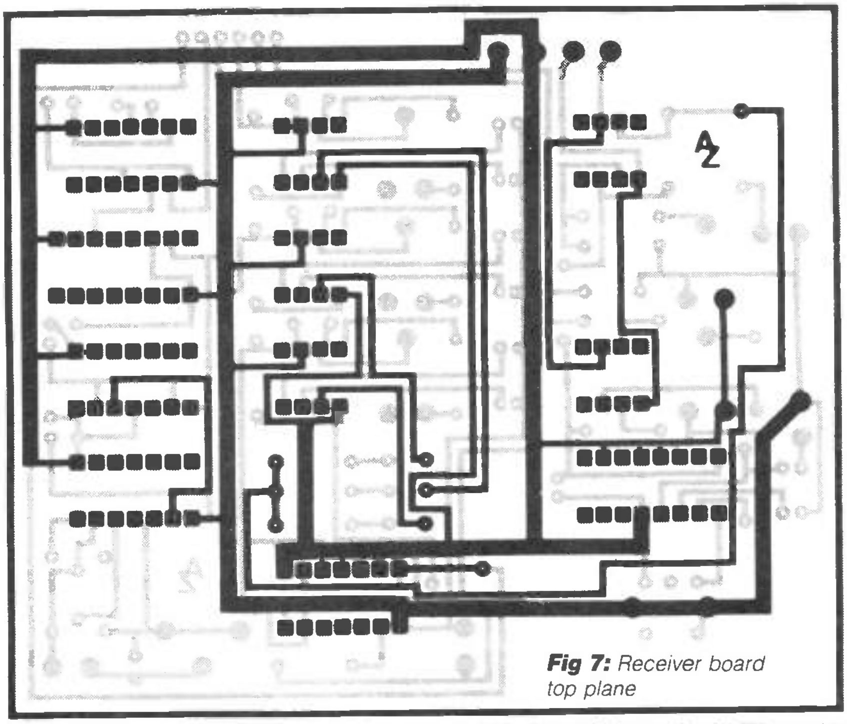


Fig 7: Receiver board top plane

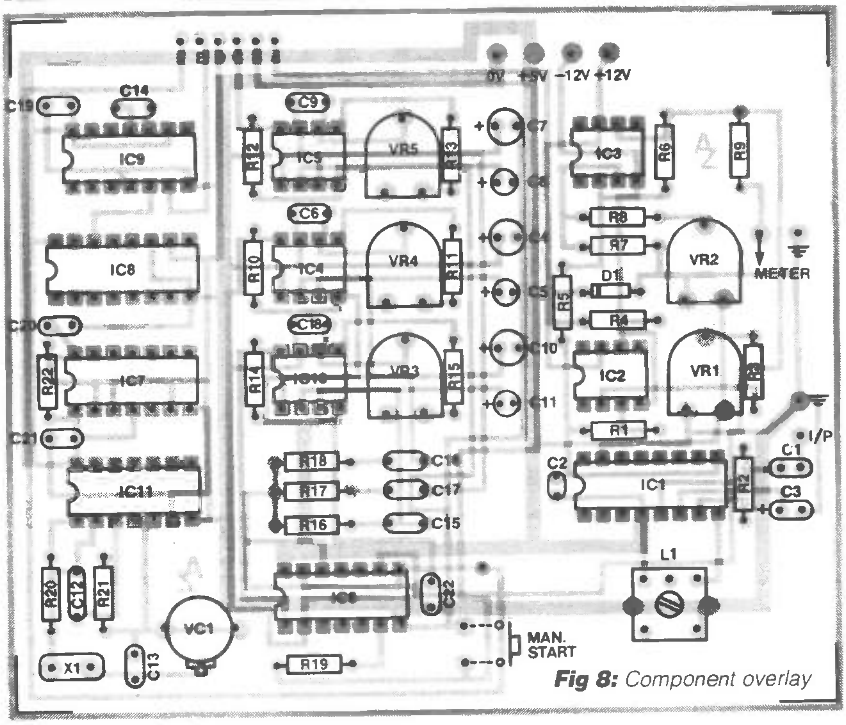


Fig 8: Component overlay

CIRCUIT DESCRIPTION

Demodulator/Tone decoders/Timing chain

This section of the receiver is constructed on Board 1, and the appropriate circuit diagrams are shown in *Figures 1, 2 and 3.*

Demodulation at IF using an MC3357 in the role of IC1 was chosen after various experiments at AF. Indeed, at 465kHz and using a standard transistor IF coil as the quadrature inductance, an 800Hz FSK signal was found to give a healthy 0.75V DC shift on the output which is fed to the slicer (IC2): the latter converts the signal to a black-and-white output at TTL levels. The output from IC1 is also fed to IC3 which acts as a unity gain buffer in the line to the tuning meter and the tone decoders.

Three of the ubiquitous NE567 tone decoders are used to sort out the start and stop tones. The start tones of 675Hz or 300Hz are detected by IC10 or IC4, respectively, and the output from these sets or resets the flip-flop formed by IC6a,b, thus giving an output which is high for an IOC of 576 or low for one of 288. Moreover, if either of the IC10 or IC4 outputs goes low, the output of IC6d also goes low, giving the indication for 'start tone received'. IC5 detects the 450Hz stop tone and its output is used direct.

The timing chain *(see Figure 3)* is straightforward and derived from a crystal oscillator (IC11) working at 3932kHz. This is divided by two in IC7, with R22 as an external load – thus providing a convenient clock for the microprocessor board. Division by a further 2^n in IC8 yields 1920Hz which is fed to IC9 to yield 20μsec pulses at this frequency.

Microprocessor board

The circuit diagram for this part of the receiver is shown in *Figure 4.* IC3 is a Z80, serviced by 2K of RAM in IC1 and 2K of ROM in IC2. IC6 and IC7 decode the memory addressing in such a way that READ/WRITE requests with A_{15} high cause the RAM of IC1 to be selected, while READ requests with A_{15} low cause the ROM of IC2 to be selected.

IC5 delivers one shot for power on and manual reset, the pulse deliberately being several seconds long to allow the tone decoders on the demodulator board to sort themselves out before the program starts. IC4 is a Z80 PIO with both ports used in the control mode. Interrupts are not used.

THE PROGRAM

A HEX listing of the program is shown in *Table 1*. It is, in fact, quite simple and Nascom buffs will have no trouble in disassembling and relocating it to run on their machines. In operation, the program resets and initialises the printer, and then waits for a start tone to be detected. When one is received, a delay of 20sec ensues to allow most of the starting pulses to be got out of the way.(We only need one!) On completion of the delay, the FAX input is checked until a starting pulse is received, and this is used to ensure that the picture starts at the top left of the paper.

The timer is now polled and, with each detected timing pulse, the FAX input is sampled, with the result that a bit in the appropriate byte in one of two 960-byte buffers is either set or reset according to whether it represents black or white. This continues until one bit in all 960 bytes have been set in this way and a single line of the picture is received.

The process is then repeated until eight such lines have been received and then all eight bits in each byte of the 960-byte buffer have been set in response to the received signal.

The other 960-byte buffer is selected for storage and at the same time as this is being filled, the first buffer is being output to the printer as and when time allows. The program carries on filling one buffer whilst outputting the other until the picture is complete.

At the end of each line, the part of the decoder dedicated to the stop tone is checked and if TRUE (i.e. stop tone received) the program resets and waits for the next picture.

To be precise, the above is the way an IOC 288 picture is received; under this scheme, an IOC 576 picture would be twice as long as it should. In fact, in this case, each successive two lines received are averaged and the aspect ratio restored.

CONSTRUCTION

The author has neither the expertise nor the facilities needed to produce the double sided PC boards that would be needed for this project and thus used Eurocard veroboards. However, designs for such boards are shown in *Figures 6–11*, for those interested in building the receiver on PCBs.

One board was used for the microprocessor and the other for the remaining circuitry. Power supply requirements are modest, consisting of +12V 10mA, +5V 500mA and −12V 10mA.

Alignment

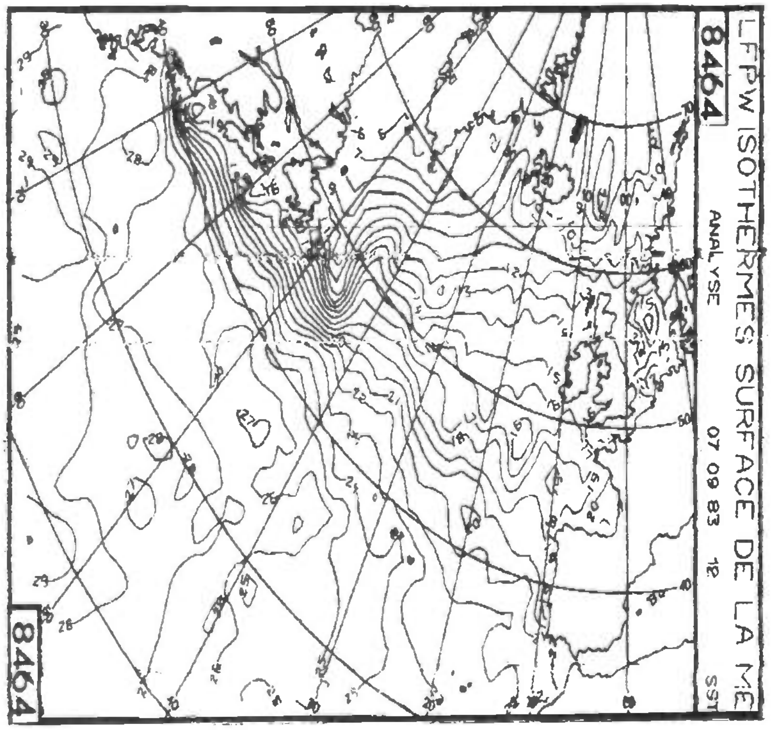
An IF signal is applied to the limiting amplifier via C1 and L1 is adjusted so that the DC level on pin 9 of IC1 is at the mid-point of the characteristic 'S' curve when the IF signal is in the middle of the IF passband.

If you are unsure how to get at the IF of your receiver, and an output socket is not provided, consult your dealer. The author has a Yaesu FRG7000 and took an IF signal from the feed to the AM detector circuitry with the receiver switched to the SSB position but with the BFO off.

RV1 is then adjusted so that the slicer (IC2) switches at the mid-point of the IF passband. A tuning meter is essential and R9 is chosen to give a suitable deflection when tuning across the signal; the author found 10kΩ with a 100μA meter just right.

RV2 is adjusted for a 50% reading on the meter at the centre of the IF passband. IC's 10, 4 and 5 are set to run at 675, 300 and 450Hz respectively, with the aid of a frequency counter or an accurate oscilloscope.

Both boards and the Epson printer may now be fully interconnected and power applied. Both 'power-on' and 'manual reset' should cause an obvious printer reset after the deliberately long delay of several seconds. If this does not occur, then the program is not running and errors should be sought.



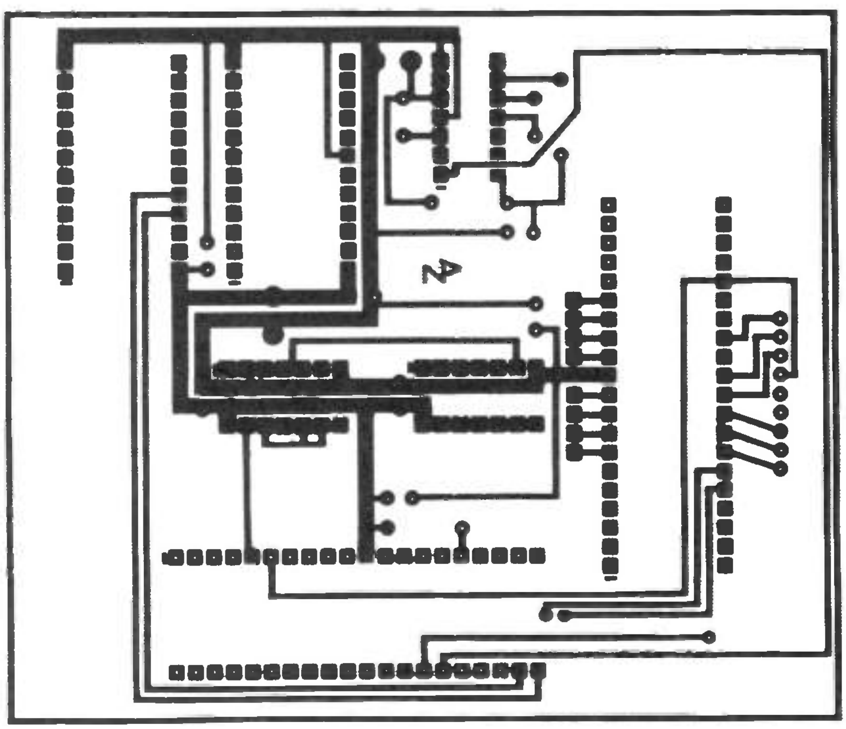


Fig 9: *Micro board bottom plane*

Assuming all is well, the unit should receive pictures and may be started in the middle of one that is already being sent. Output should be apparent after a 20-second delay; if this is white on black instead of black on white, then the inputs to IC2 should be swopped over. When properly adjusted and connected to a receiver of adequate stability, the unit will start and stop automatically, coping automatically with IOC's of 288 and 576. Examples received from Paris-National on 8185kHz are displayed on these pages.

Postscript

Old hands at HF reception will be aware of the problems of fading, interference and multi-pathing especially at night. In this respect, VLF stations are better and Keith Mitchell's approach (see *R&EW* September '83 p49) is recommended here. The unused sections of the MC3357 are available for this.

The author is grateful for the help and support of other radio amateurs, especially Bob Currell G4EIK, Clive Bowden G3OCB and Arnie Lambe G4BRU.

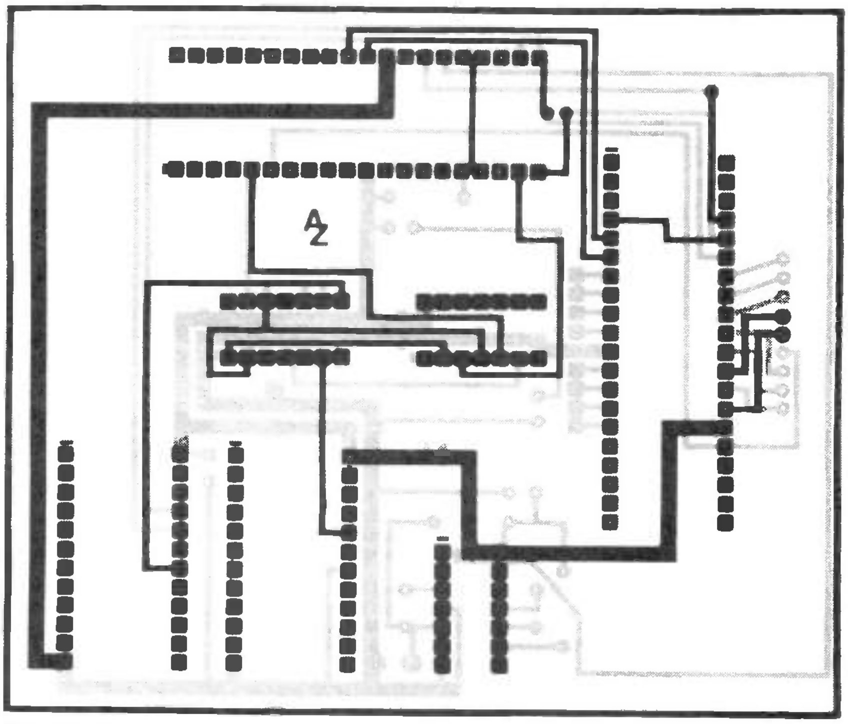
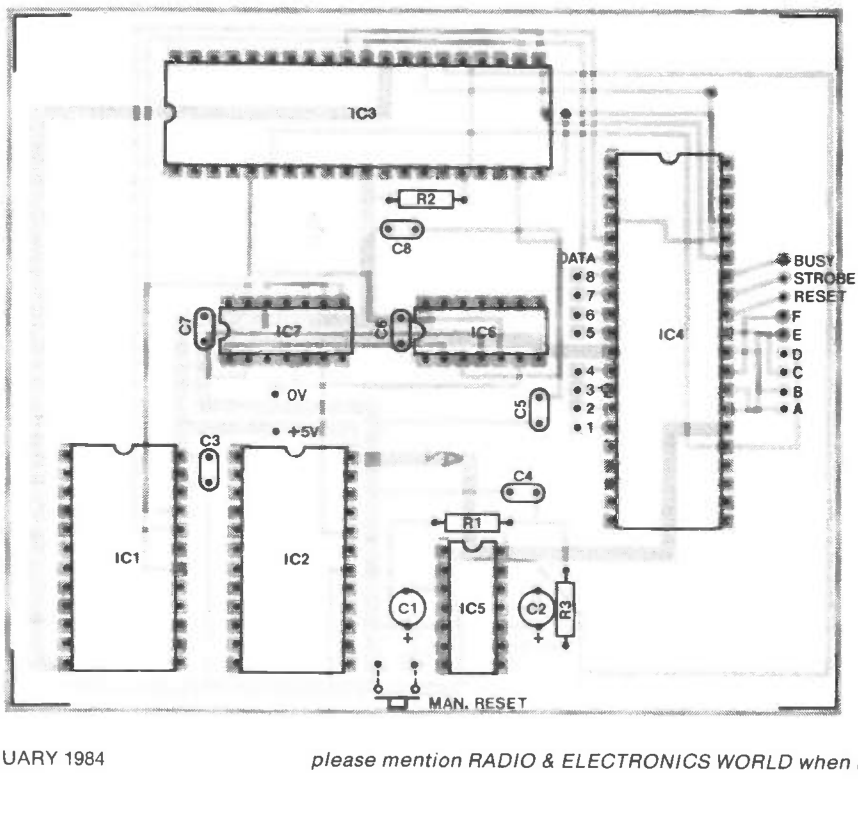


Fig 10: *Micro board top plane*

Fig 11: *Component overlay*



PARTS LIST

Demodulator, tune decoder and timing chain board

Resistors

R1, R3	10kΩ 0.25W
R2	68kΩ 0.25W
R5, R6, R7, R8	100kΩ 0.25W
R9	choose to give suitable deflection on tuning meter used
R10, R11, R12, R14	4.7kΩ 0.25W
R4, R13, R15, R16, R17, R18, R19, R20, R21	1.0kΩ 0.25W
R22	330Ω 0.5W

Capacitors

C1, C12	10nF mono
C2	1nF mono
C3	2.2μF 35V tant.
C4, C7, C10	100μF 6.3V tant.
C5, C8, C11	10μF 16V tant.
C6, C9, C18	0.47μF polyester
C13	12pF ceramic
C14	22nF polyester
C15, C16, C17	100nF mono
CV1	2–22pF foil trimmer

Presets

RV1, RV2	10kΩ preset
RV3, RV4, RV5	5kΩ preset

Semiconductors

IC1	MC3357
IC2, IC3	CA3140
IC4, IC5, IC10	NE567
IC6	74LS04
IC7	74LS74
IC8	4020
IC9	74121
ZD1	5V1 Zener

Miscellaneous

X1	3.932MHz
L1	TOKO YRCS11098AC

Microprocessor board

Resistors

R1	47kΩ 0.25W
R2	10kΩ 0.25W
R3	33kΩ 0.25W

Capacitors

C1	47μF 6.3V tant.
C2	100μF 6.3V tant.

Semiconductors

IC1	6116-3
IC2	2716 EPROM
IC3	Z80 CPU
IC4	Z80 PIO
IC5	74121
IC6	74LS04
IC7	74LS20

Double-sided PCBs for this project are available from Edwardschild Ltd, 453a Becontree Ave, Dagenham, Essex RM6 6RR.
The prices are
Receiver board: £4.65 ea inclusive
Micro board: £4.35 ea inclusive

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UHF ALL-MODE TRANSCEIVER TR 9500 TRIO

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The transceiver is designed for FM, SSB, and CW modes, utilizing a microcomputer which permits frequency selection in 100Hz, 1kHz, and 5kHz, 25kHz steps by means of two digital VFOs. The microcomputer also permits memory, scanning, searching, and other features.

SP 120 TR-9500 BO-9 PS-20

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

- 25 watts output on FM, SSB and CW.
- FM/USB/LSB/CW all mode operation.
- For added convenience in all modes of operation, the mode switch, in combination with the digital step (DS) switch, determines the size of the tuning step, and the number of digits displayed.

TR 9130 TRIO

- Six memories. On FM, memories 1 through 5 for simplex or +600kHz offset, with the OFFSET switch. Memory 6 for non-standard offset. All six memories may be operated simplex, any mode.
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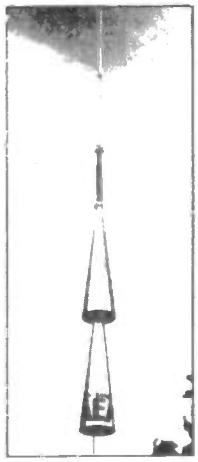
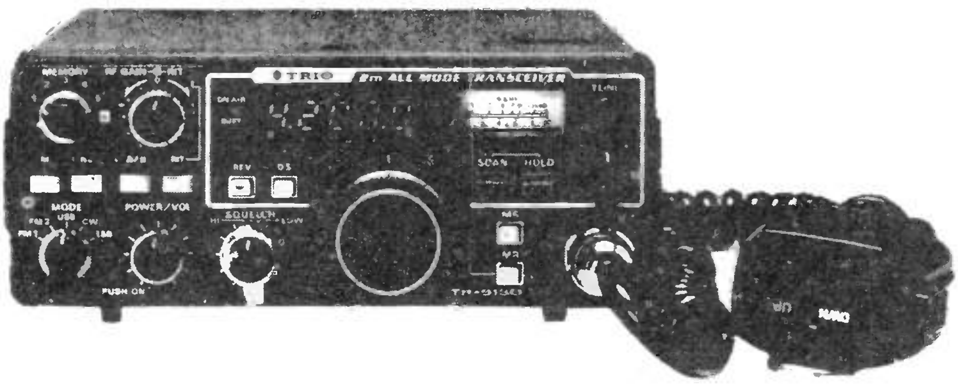
- Automatic band scan. Scans within whole 1MHz segments (ie 144.0-144.999MHz), for improved scanning efficiency.
- Dual digital VFOs. Incorporates two built-in digital VFOs, selected through use of the A/B switch and individually tuned.
- Squelch circuit on all modes (FM/SSB/CW).
- Repeater reverse switch. For checking signals on the repeater input, on FM.
- CW semi break-in circuit with sidetone. Built-in, for convenience in CW operations.
- Digital display with green LEDs.
- Transmit offset switch for repeater shift
- High performance noise blanker.
- RIT (Receiver Incremental Tuning) circuit. Useful during SSB/CW operations.
- HI/LOW power switch. Select 25 or5 watts RF output on FM or CW.
- A four-pin accessory terminal is provided for use with a linear amplifier or other accessory
- Includes quick release mobile mounting bracket and up/down microphone.





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CAPACITORS FOR COUPLING, DE-COUPLING AND FILTERING

A brief résumé of their application by Dr CJD Catto starting with AC coupling

A glance at an audio circuit will reveal how much space is taken up by capacitors, the majority of which are for interstage coupling, i.e. for transferring the AC signal whilst blocking the DC component. In particular, those capacitors for operation at low frequencies can be really quite large, and in the awkward case where the polarising voltage may reverse, it is necessary to use a 'reversible' electrolytic. This is, in effect, two capacitors back-to-back, as illustrated in *Figure 1* – a somewhat clumsy component. The alternative in general is to keep the impedances higher (e.g. by using FETs), thereby permitting smaller values of C. However, in the case of a power amplifier, having a large coupling capacitor to the loudspeaker can be avoided if a double (bridge-connected) output stage is employed.

Another answer is to apply some 'lateral thinking' and find ways of reducing the number of stages. One of the many advantages of transistors over valves is that complementary devices are available, thus avoiding the need for so much level shifting. In addition, it is often possible to apply DC feedback over several stages and so reduce the number of capacitors.

Rail de-coupling

Most power supplies are situated some distance from the load and, assuming the latter to be an array of ICs or other active devices taking varying currents, it is necessary to 'de-couple the rails'. The object of this is to reduce the local voltage variation $\triangle V$ to a minimum (e.g. 100mV peak-to-peak on a 5V rail), but paradoxically this is rarely achieved by employing the largest available capacitor. A satisfactory arrangement is shown in *Figure 2a*, where a 33nF ceramic capacitor is employed in a configuration that has minimal track length. In contrast, the layout shown in *Figure 2b* is ineffective at high frequencies.

An even better component to use than the conventional ceramic capacitor is the flat device recently introduced by Rogers Corporation (see Reference 1), which can sit directly under the IC *(see Figure 3)*. The series inductance is considerably reduced this way. There is, of course, much claim and counter-claim by manufacturers of ceramic and plastic film capacitors. The metallised-film variety is inherently self-healing, as the film at a pin-hole short should melt back and clear the fault. However, it has been claimed that this manifests itself as bursts of current, a type of noise of which its ceramic rival is believed to be innocent (see Reference 2).

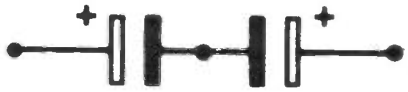


Fig 1 *Back-to-back arrangement of capacitors that could be required for interstage coupling where the polarising voltage may reverse.*

Rectifier filtering

When valves, with their relatively high voltages and low currents, were in general use, the two-section capacitor was frequently employed in rectifier-filter circuits such as that shown in *Figure 4*. Then came transistors and low-voltage, high-current power supplies with high-capacitance electrolytics, sometimes together with big iron-cored inductors. The latter were soon abandoned when series-pass transistor regulators became popular.

There are many advantages to the more recent switched-mode regulators, and their popularity has brought high-voltage electrolytics back into favour, particularly as these allow the mains to be rectified direct. There is, in any case, some advantage to be gained in storing energy at a higher voltage: for a given physical size of capacitor, CV is fixed but the energy stored is proportional to CV^2.

However, the high frequency performance is now an important consideration. In particular, the equivalent series impedance should be kept low, e.g. by multiple-tab construction which can take the point of Z_{min} *(see Figure 5)* beyond 10kHz. Reducing the equivalent series impedance is anyway an important goal, and it can be achieved by using such devices as the Mullard type 106, for which Z_{min} is below 10 milliohms (at 10,000μF, 25V).

Among the smaller capacitors, aluminium electrolytics with 'solid electrolyte' are effective: they may be somewhat larger than 'solid tantalum', but the ripple rating is much higher. For example, at 150μF and 6V, the volume ratio is 3:1 but the ripple ratio is about 10:1.

Case histories

To conclude – some practical examples that demonstrate the advantage to be gained through taking care over which capacitor to use.

• A valve oscillator began to produce a smell like a dead rat. This was traced to an oil-impregnated paper and foil capacitor, which had become lossy and was overheating. It was replaced by a 'mixed dielectric' (impregnated paper and

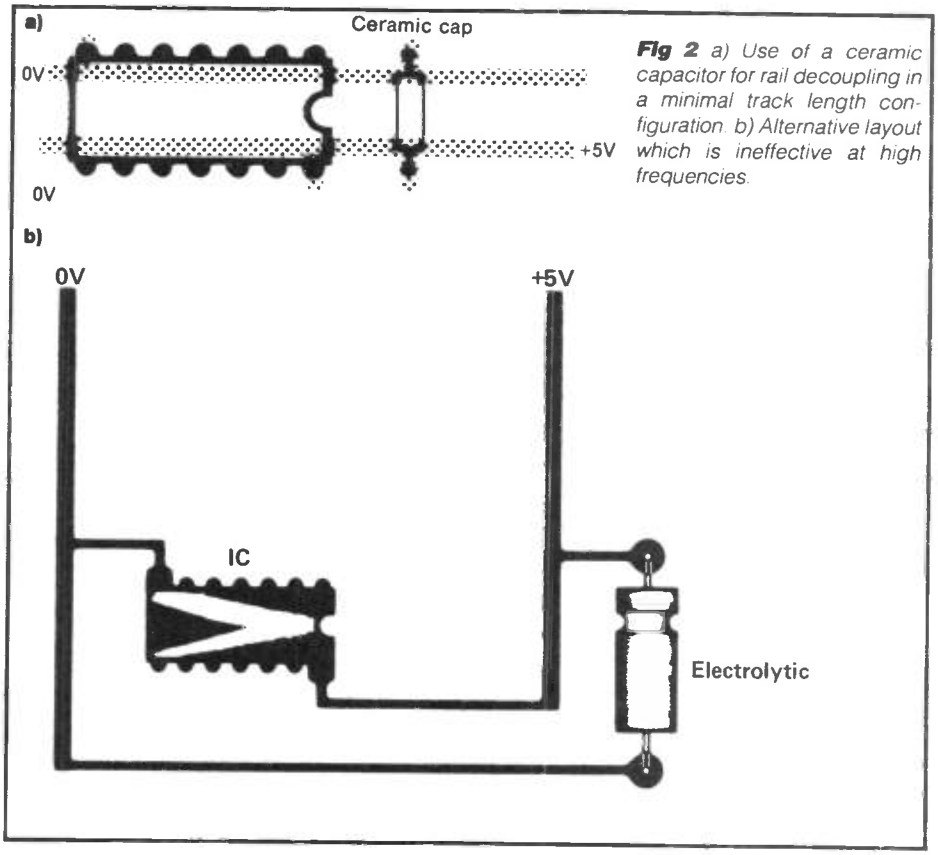


Fig 2 *a) Use of a ceramic capacitor for rail decoupling in a minimal track length configuration. b) Alternative layout which is ineffective at high frequencies.*

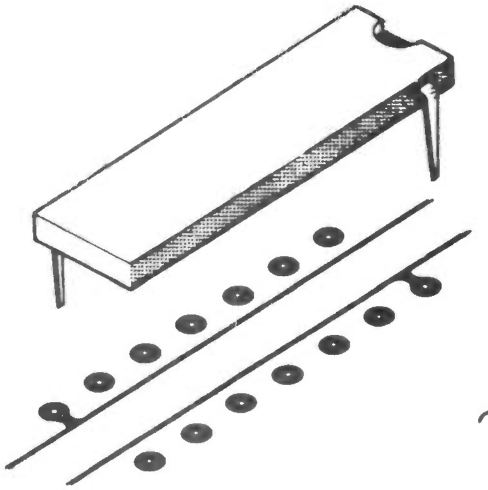
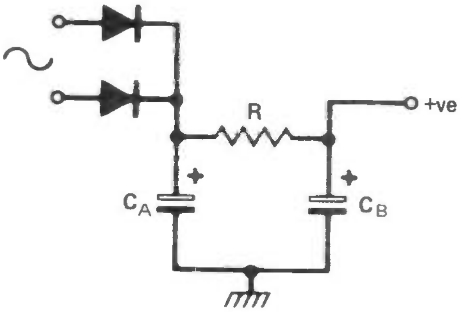


Fig 3 A flat capacitor used for rail decoupling that can be mounted directly below the IC

Fig 4 A typical rectifier-filter circuit



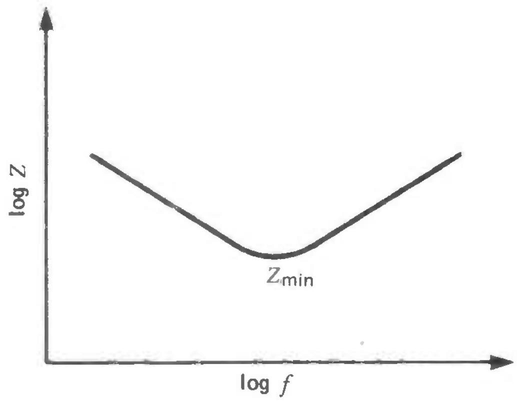


Fig 5 Typical dependence of impedance on frequency for a high-voltage electrolytic.

polyester) type – at a fraction of the size and cost – and the circuit then continued to work happily.

A word of caution in respect of this example, though: in applications where the pulse rating is more severe (e.g. around 1kV/μsec) it is preferable to use the more modern polypropylene type, and even these must be de-rated above 10kHz.

• In another case, a pair of 47μF tantalum capacitors acting as the filter of a high frequency rectifier continually failed catastrophically after less than 100 hours. It became evident that they could not handle the ripple current: although ΔV was only a few hundred millivolts, the product $C\Delta V/\Delta t$ worked out at one amp per capacitor. A more practical expedient was to replace them with a 100μH choke followed by a group of five 4μ7 film/foil capacitors. Although physically larger, this arrangement has proved its worth by surviving thousands of hours of operation.

All this, to my mind, goes to show that, despite the invasion of digital circuits and complex ICs, capacitors are still an important sector of electronics, especially when it comes to reducing ΔV.

References

1. *MICRO/Q* (Mektron Circuit Systems Ltd, Leatherhead)
2. A G Martin and B S Rawal (AVX Ceramics) *MLCS Outperform Metallised-Film Capacitors under Actual Operating Conditions*

IC-751, £969. HF Transceiver

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One of the most popular amateur bands transceivers, make a few improvements such as adding 36 memory channels, doing away with mechanical bandswitching and then add full HF receive capabillity (0.1-30 MHz) which is even an improvement on the famous R70 and you get a pretty good idea of what the IC-751 is like. It is fully compatible with Icom Auto units such as the AT-500 and IC-2KL and a further option for computer control can be added. There is also a digital speech synthesizer option which will be ideal for blind operators For power supplies you have the option of the IC-PS740 (which fits inside) or the PS-15/PS20 range for external use.

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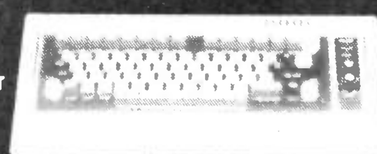

CWR-610E, Decoder £189.

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IC-290D, VHF. £433. Multimode Mobile

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

IC-2E, VHF/FM, £179. IC-4E UHF, £199.

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

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

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

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RGB INTERFACE FOR THE FERGUSON TX-90

ALAN WARNE, T.ENG. (CEI) FSERT-G4EZO

Although standard resolution RGB monitors are becoming less expensive these days they still cost considerably more than the average domestic television receiver although they contain far fewer components. Thus to combine both TV and RGB monitors could be an advantage, particularly in view of the large number of home computers now being used in this country, the majority of which have the capability for displaying colour graphics. This normally means that they generate either video information superimposed on a radio frequency carrier which is transmitted to the television via its aerial socket or an RGB higher definition signal which is designed for display on a special high definition RGB monitor. In fact, the direct RGB method of interface gives far better quality pictures over the RF method which can suffer from spurious patterning, poor definition and drifting off tune.

A receiver worth considering for conversion is the new Ferguson 37140 colour television which uses the TX-90 chassis. The set has a 14" tube with a fully isolated chassis and has already proved popular with computer users. Its design is different from other current models manufactured by Thorn – in particular, by using far fewer components which in turn leads to a large reduction in manufacturing costs which is reflected in its budget price.

The author considered it worthwhile producing an RGB interface for this chassis which will give higher quality pictures from a computer than normal RF injected signals and still represent a cost effective dual purpose display device.

Specification

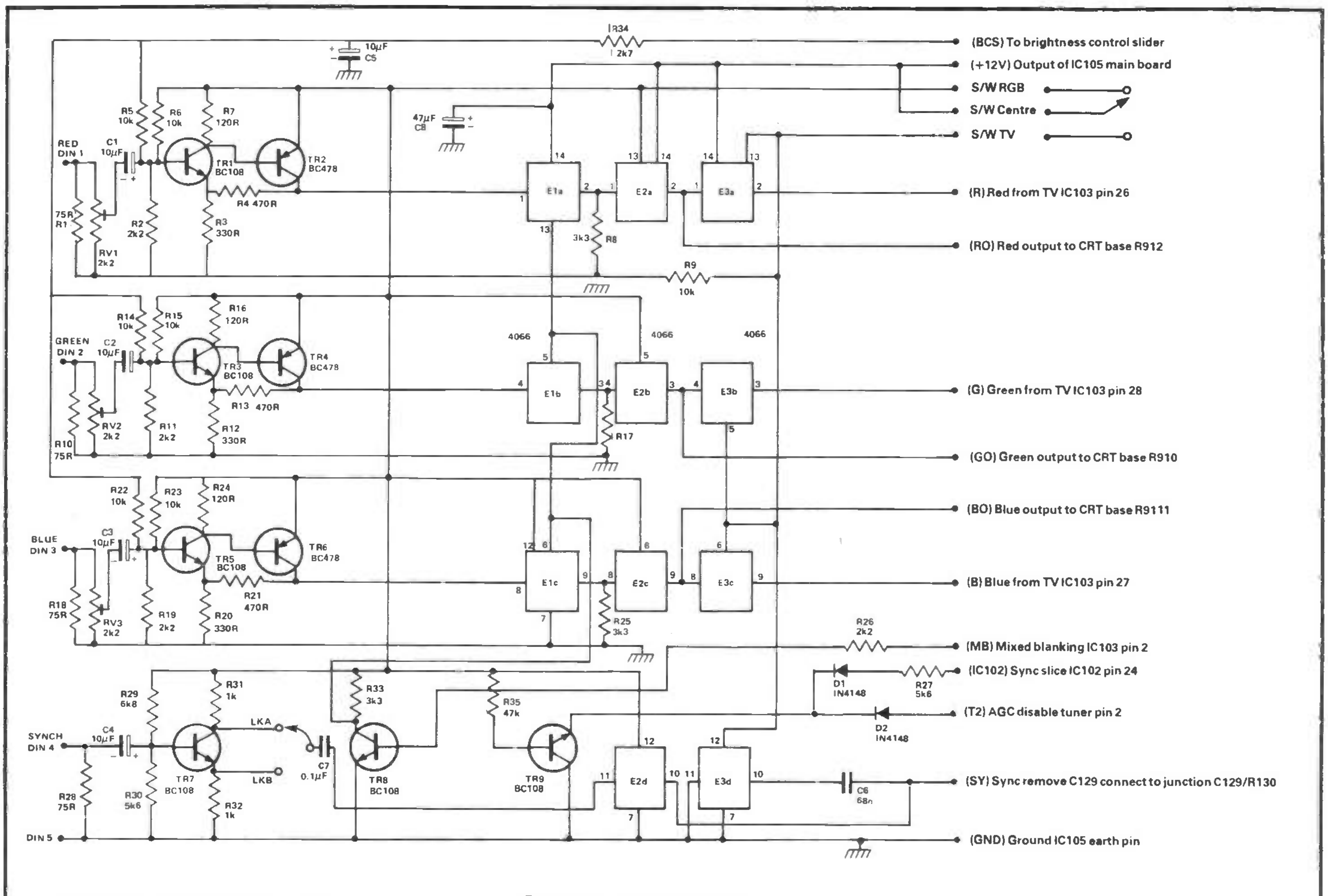
- When switched to RGB monitor mode, the interface should accept red, green and blue video signals of 1V peak-to-peak positive going, with a separate mixed synchronising signal of 2V peak-to-peak negative going, all input signals being terminated in 75Ω.
- The monitor/television should be fully isolated with respect to the mains supply.
- Switching between off-air programmes and external RGB inputs should be simple to operate.
- Linear circuitry within the interface should satisfy linear or TTL inputs.

Design

The TX-90 was initially selected for its low price and its ideal screen size for computing, but it of course has other advantages such as availability in the high street shop, together with spares and service information being readily available.

This chassis uses two main signal processing IC's. IC102 is a TDA 4500 which accepts an IF input from the television tuner: after vision detection and amplification, the integrated circuit generates line and field drive signals which are already synchronised and can be fed directly to the line and field output stages. IC103 is a luma/chroma processor type UPC 1365 which decodes the composite PAL encoded signals into RGB video drives.

The interface board must therefore disconnect signals from off-air programmes and substitute external red, green and blue video, together with mixed sync signals. Existing RGB signals leaving IC103 and connected to three different class A amplifiers also have mixed blanking signals applied, and care must be taken to reconstitute blanking when connecting the external video signals. Externally mixed synchronising signals are connected to IC102: internal syncs and the AGC line are then disabled to prevent interaction from off-air information. *Figure 1* shows a block diagram of the principle adopted.



NOTE: DIN refers to input socket pin numbers

Complete circuit diagram

NOTE: Letters in brackets denote pickup points on PCB

Circuit description

Three separate channels – which are identical in operation – amplify, blank and switch each video channel, so we will confine our attention to just the red channel here.

Incoming signals are first terminated by R1 into 75Ω. RV1 then sets the signal amplitude level (or contrast). After AC coupling via C1, the signal passes through TR1 and TR2 which form a non-inverting amplifier.

E1a is a CMOS switch, its enable pin driven from TR8 which is operating as a switch. The base of TR8 is fed with blanking pulses from the TX-90 which causes TR8 to switch, turning E1a off at flyback. By feeding the video signal through E1a, simple blanking will take place. E2a is enabled in RGB monitor mode with the result that it completes the path of the video signal to the class A red amplifier, which drives the CRT.

Signals from the base of TR1 through to the tube are DC coupled (by varying the DC conditions at a convenient point) to give brightness control. R34 and R5 are connected to the slider of the existing brightness control and cause a change in the base voltage at TR1 as the control is adjusted. R6 and R2 provide conventional biasing to maintain a standing level when the brightness control is set to either of its extremes. When in normal TV mode, E2a is disabled and E3a enabled, the latter passing the TV signal through to the CRT.

Mixed synchronising pulses are inverted by TR7 and are switched through E2d into IC102. On switching into normal television mode, E2d is disabled while E3d grounds C6. The combination of D1 and R27 sets up the top sync detector and, together with D2 (AGC disable), it is grounded by switching transistor TR9.

Construction

All components are mounted on a single sided PCB (the design for which is given in *Figures 2 and 3*), taking care to fit polarised components correctly. CMOS IC's should be mounted in IC holders and great care should be exercised in handling them.

A right-angled aluminium bracket is mounted on the front edge of the PCB for mounting the DIN socket and changeover switch. An alternative mounting for the switch may be constructed on the front of the set but this would necessitate drilling the front escutcheon.

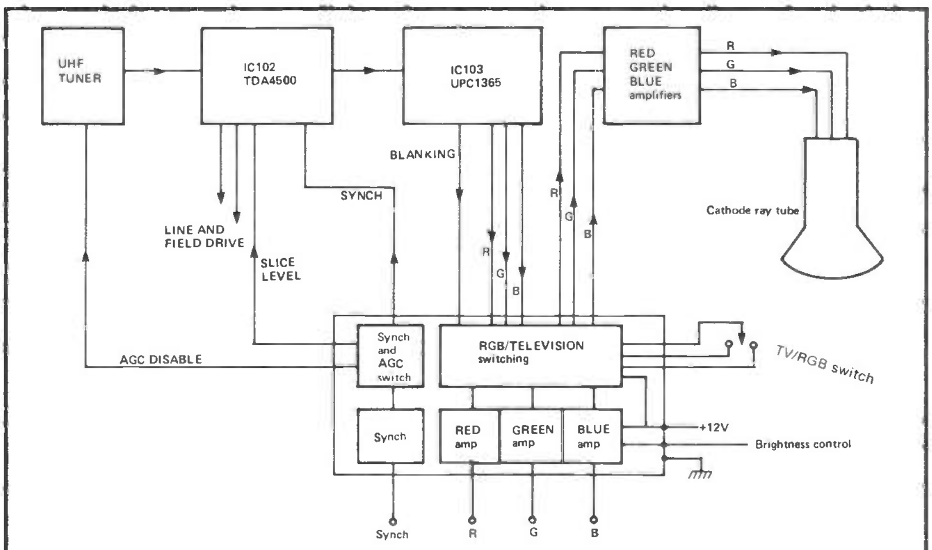


Fig 1: *Block diagram showing operation of interface*

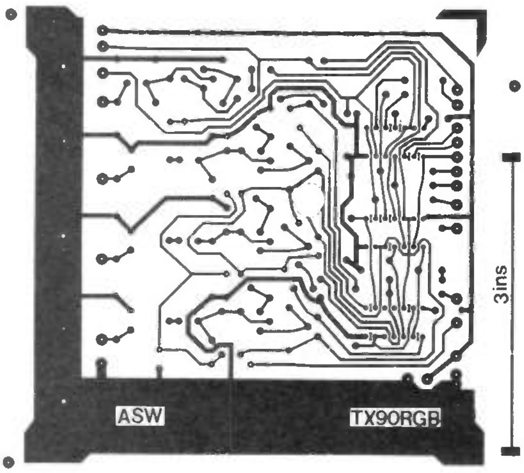


Fig 2: PCB foil pattern

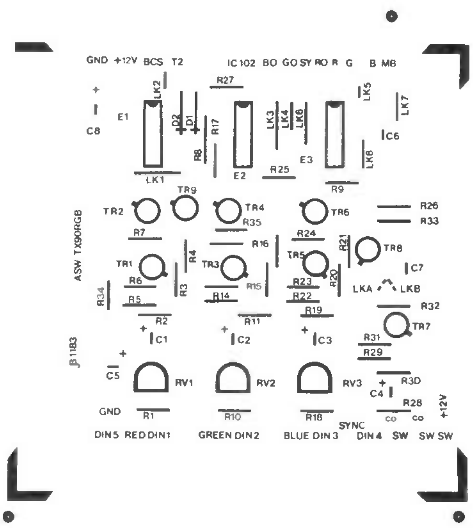


Fig 3: Component overlay

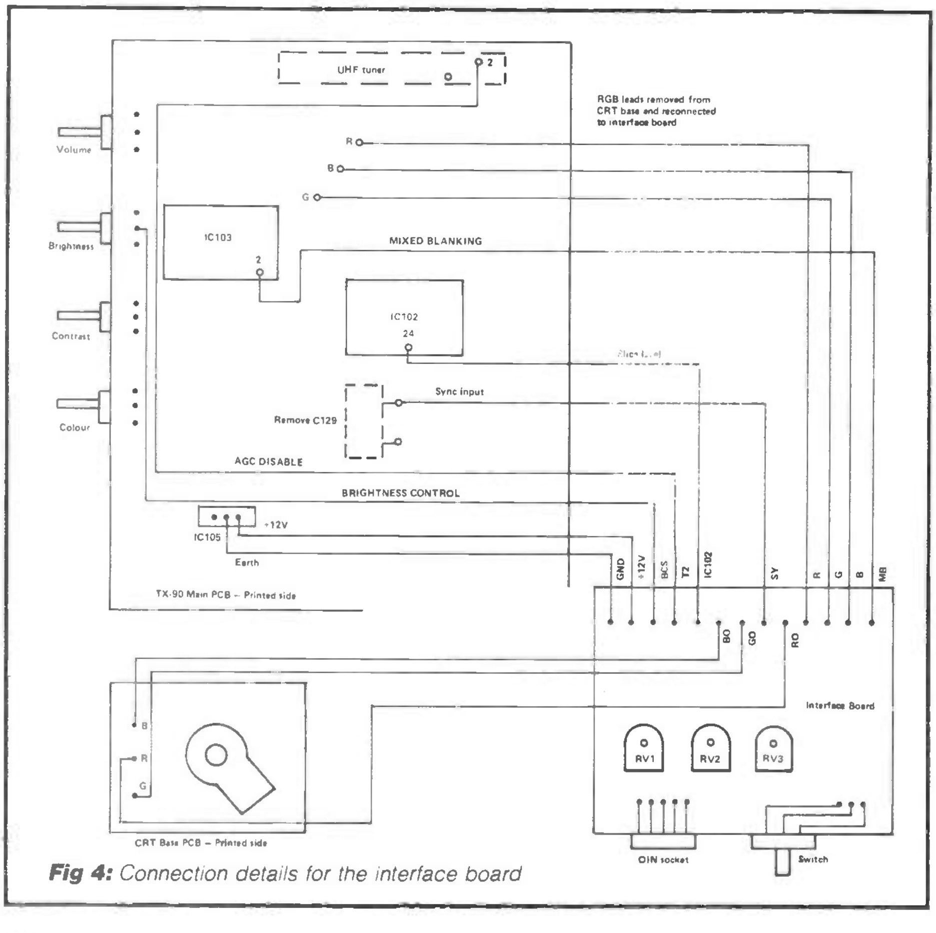


Fig 4: Connection details for the interface board

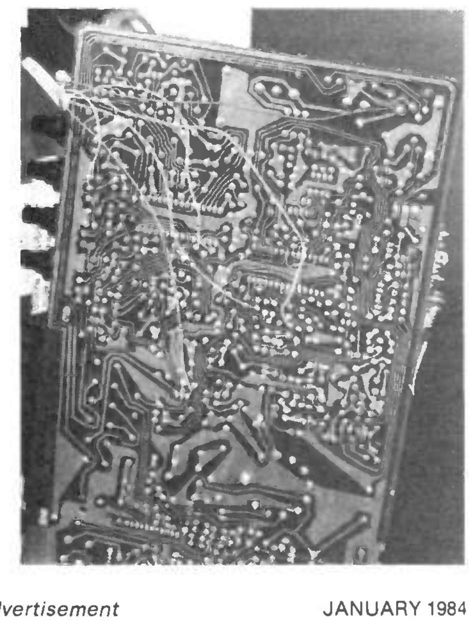
Ensure that wire links are fitted to the interface PCB where indicated: there are nine in all. Links LK1–LK8 are fixed, while the other link is marked LKA or LKB. To meet the specification, LKA should be fitted because this enables use of a negative going sync pulse. However, some computers use positive going syncs and, by using LKB instead, the interface will accept positive going sync inputs.

Interconnecting cables leave the rear of the interface PCB and are connected to the main TX-90 board and to the CRT base board using multistranded PVC covered cable (16/0.2mm or similar): I would suggest using different colours for easy identification.

Method of fitting

Disconnect the three leads from CRT base board coloured red, green and blue – and remember in which order they were removed. Re-route these three leads to the rear of the interface board and connect as shown in *Figure 4*. Fit three new red, green and blue leads to the interface board and connect them to the previously used connections on the tube base board, keeping the lead length as short as possible to avoid pick-up. Fit different coloured wires to the remaining seven spare connections at the rear of the interface board. These should be about 24 inches long and tied neatly in a loom. The new board may now be inserted into the runners in the centre of the cabinet base, these runners normally being used for remote control models.

Next slide out the main board of the receiver and bring the new seven-cable wiring loom round the front of this board, hanging it over the top of the volume control spindle. Then bring each wire to the appropriate solder point on the solder side of the board, cutting to length as necessary. Remove capacitor C129, which is a 68nF device located below pin 26 of IC102, and connect the appropriate lead of the loom to the empty hole nearest the IC. The six remaining leads are connected as shown in *Figure 4*. Refit the board into the cabinet making sure that the wiring loom sits neatly above the volume control.



Testing

Switch on the receiver and connect a computer input to the 6-pin DIN socket. Display a page of text or a test card which is in black and white. Adjust RV1, RV2, RV3 for good contrast, ensuring that the white areas of the screen are white and not overcast with a predominant R, G or B. Switch over to normal TV mode and compare contrast levels: re-adjust RV1, RV2, RV3 if necessary to obtain equal levels on either system.

Line up the DIN socket switch panel (*see Figure 5*) with the rear edge of the receiver base and drill through two locating holes at the rear of the interface PCB into the cabinet base. Fit two 3m nuts and bolts to prevent the PCB from sliding forward when the DIN plug is inserted. Cut out a small hole in the rear of the cabinet for the DIN socket and switch access and fit back in (*see Figure 6*).

Conclusion

The interface uses readily available components which are inexpensive. A mains isolating transformer is not required, cutting costs even further. The prototype has run for over two months every day and has been reliable and given good results using a BBC computer.

PARTS LIST

Resistors

R1, R10, R18, R28	75Ω ⅛W carbon
R7, R16, R24	120Ω ⅛W carbon
R3, R12, R20	330Ω ⅛W carbon
R4, R13, R21	470Ω ⅛W carbon
R31, R32	1kΩ ⅛W carbon
R2, R11, R19, R26	2.2kΩ ⅛W carbon
R34	2.7kΩ ⅛W carbon
R8, R17, R25, R33	3.3kΩ ⅛W carbon
R27, R30	5.6kΩ ⅛W carbon
R29	6.8kΩ ⅛W carbon
R5, R6, R9, R14, R15, R22, R23	10kΩ ⅛W carbon
R35	47kΩ ⅛W carbon
RV1, RV2, RV3	2.2kΩ skeleton presets

Capacitors

C1, C2, C3, C4, C5	10μF 16Vw tantalum
C6	68nF 63Vw polyester
C7	0.1μF 50V polyester
C8	47μF 16Vw tantalum

Semiconductors

TR1, TR3, TR5, TR7, TR8, TR9	BC108
TR2, TR4, TR6	BC478
D1, D2	IN4148
E1, E2, E3	MC14066 or 4066 CMOS switch

Miscellaneous

1 printed circuit board; 1 changeover switch, toggle SPDT; 1 DIN socket 6-pin, 240°; 3 14-pin DIL IC holders; 1 aluminium bracket for DIN socket and switch.

Both a printed circuit board with silkscreen (£5 including postage and packing) and a complete kit of parts (£25 including postage and packing) are available from the author at *113 Queens Road, Vicars Cross, Chester, CH3 5HF*. Cheques should be made payable to A V Warne.

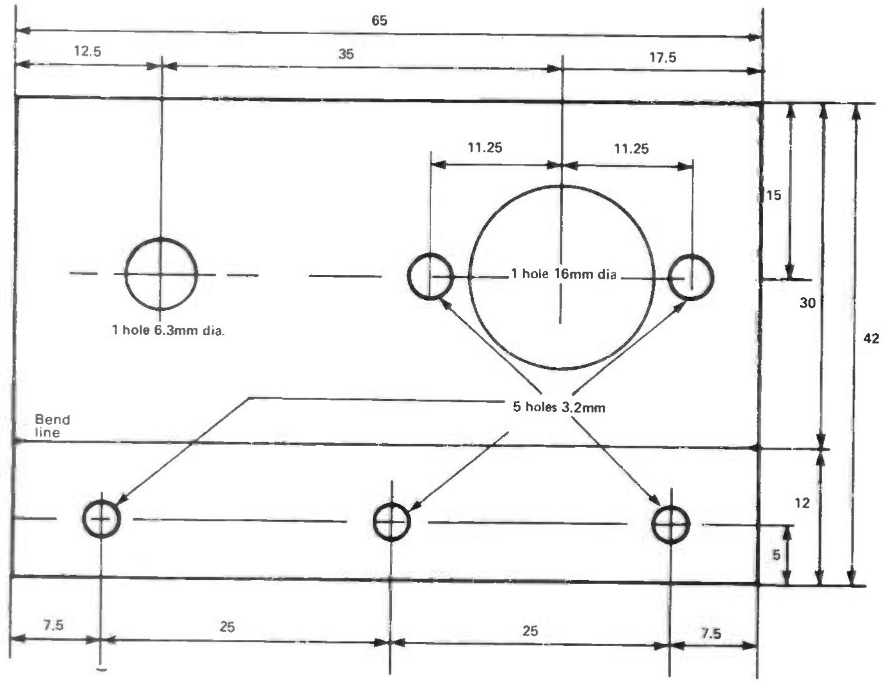


Fig 5: *Design for the metal bracket. All dimensions are in millimetres*

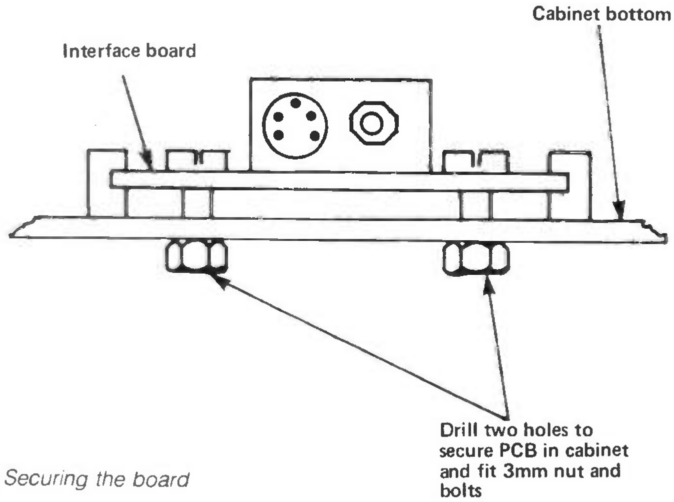
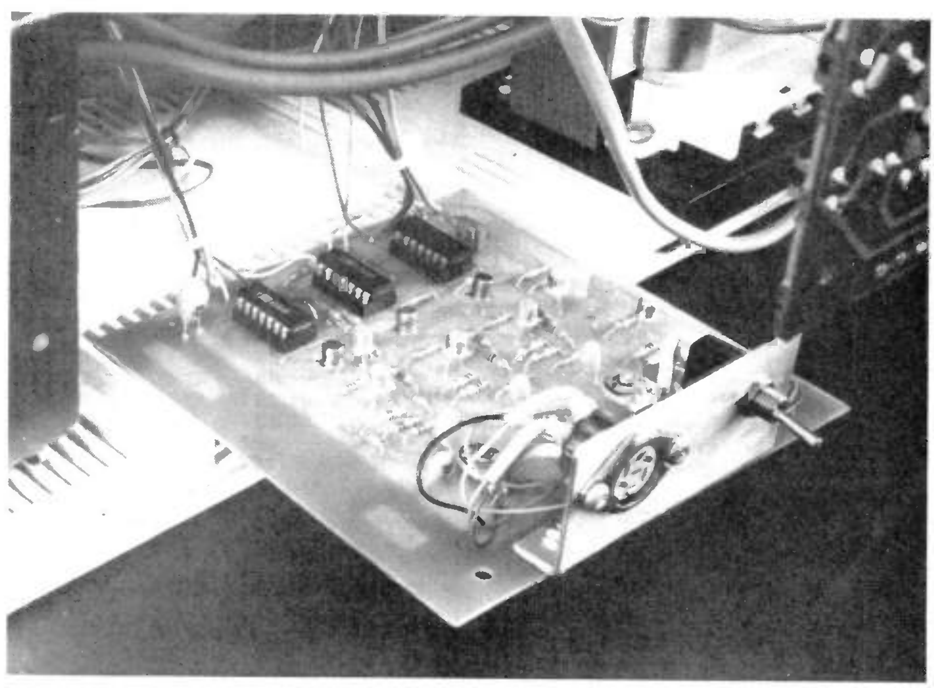


Fig 6: *Securing the board*



One Night's Work

A couple of quick designs for a voltage level detector put together by Stephen Ibbs

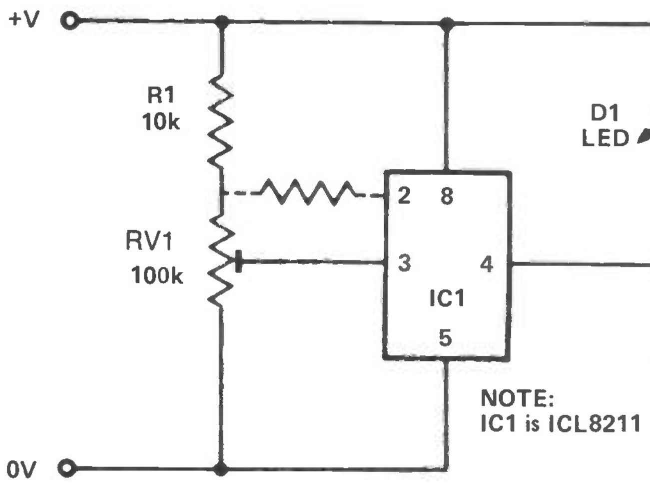


Fig 1 *Circuit diagram for a voltage level detector based on a 8211*

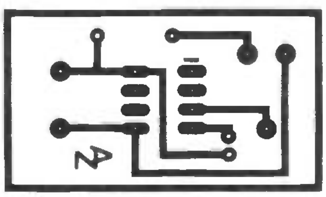


Fig 2 *PCB foil pattern corresponding to Figure 1*

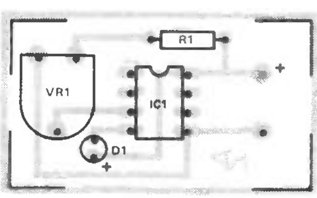


Fig 3 *Component overlay*

This little project concerns the detection of voltage levels, and how a warning can be given whenever the level rises or falls significantly. Intersil produces two ICs which can be used in this role – the ICL8211 and the ICL7665. We will consider them separately.

Using an ICL8211

The 8211 is an 8-pin device that typically operates between 1.8V and 30V, and it provides a constant 7mA sink output when triggered. This means that if the threshold input voltage drops, the output pin can be used to light an LED and thus tell an operator that the supply voltage has fallen below the preset level. Such a facility can be invaluable in battery-powered equipment, through giving a warning of impending battery failure. Readers who saw the PF70 conversion article (*R&EW* September '83) may be interested to know that I incorporated an 8211, set to trigger at 12.5V (the nominal battery voltage being 15V), so that I would know when the rig was about to pack up and die.

Pin 2 of the IC is the hysteresis pin, and its performance can be adjusted via a resistor in the position indicated by dotted lines in the circuit diagram (*Figure 1*). The effect is to make the LED switch on and off at slightly different voltages, and so prevent flickering in an electrically noisy environment, but this has not been included on the circuit board present here.

The role of R1 is to reduce the voltage swing across the preset: it can be replaced by a wire link, or altered in value in order to change the operating range of the circuit, if so desired.

As usual, either veroboard or a PCB can be used for this circuit's construction: a PCB design is given in *Figures 2 and 3*. Note that no current-limiting resistor is needed because the output current is already limited to 7mA. Mount the components, switch on the supply and set to the required trip voltage. Adjust RV1 until the LED just lights...end of project!

However, what if you want a device that will register both high and low voltage levels? *(contd.)*

Using an ICL7665

The 7665 does just this: in many ways, it is like two 8211s in one 8-pin package, with the hysteresis pins being pins 2 and 5. The main differences are (*a*) the operating voltage range is 0.3V to 18V, and (*b*) the outputs are not current limited to 7mA. Instead, either output can sink up to 25mA, and what this means for us is that a current-limiting resistor for the LED must be included to prevent it blowing up.

Another inclusion is a disc ceramic capacitor of 0.04μF (see the circuit diagram of *Figure 4*). Its role is to lengthen the rise time of the supply voltage in battery applications.

Once again, veroboard or a PCB can be used for the construction and a suitable design is given in *Figures 5 and 6*. Mount the components and adjust the presets to light the LEDs, (LED2 for low, LED1 for high). Make sure that only about 10mA is flowing through the LEDs – if necessary, by adjusting R1 and R2 accordingly.

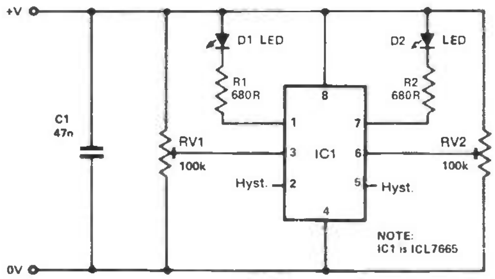


Fig 4: *Circuit diagram for detector based on a 7665*

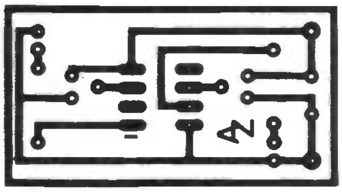


Fig 5: *PCB foil pattern corresponding to Fig 4*

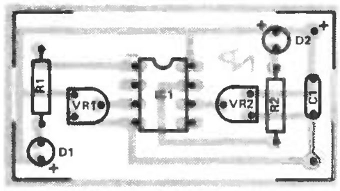
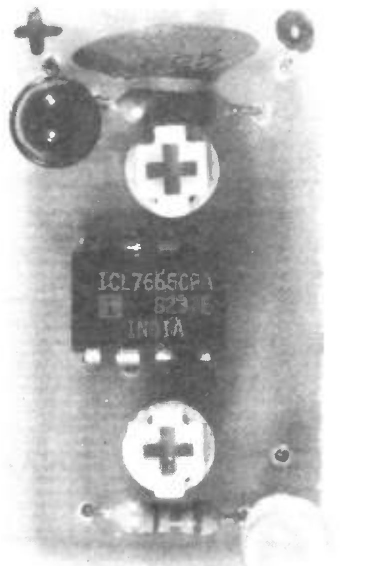
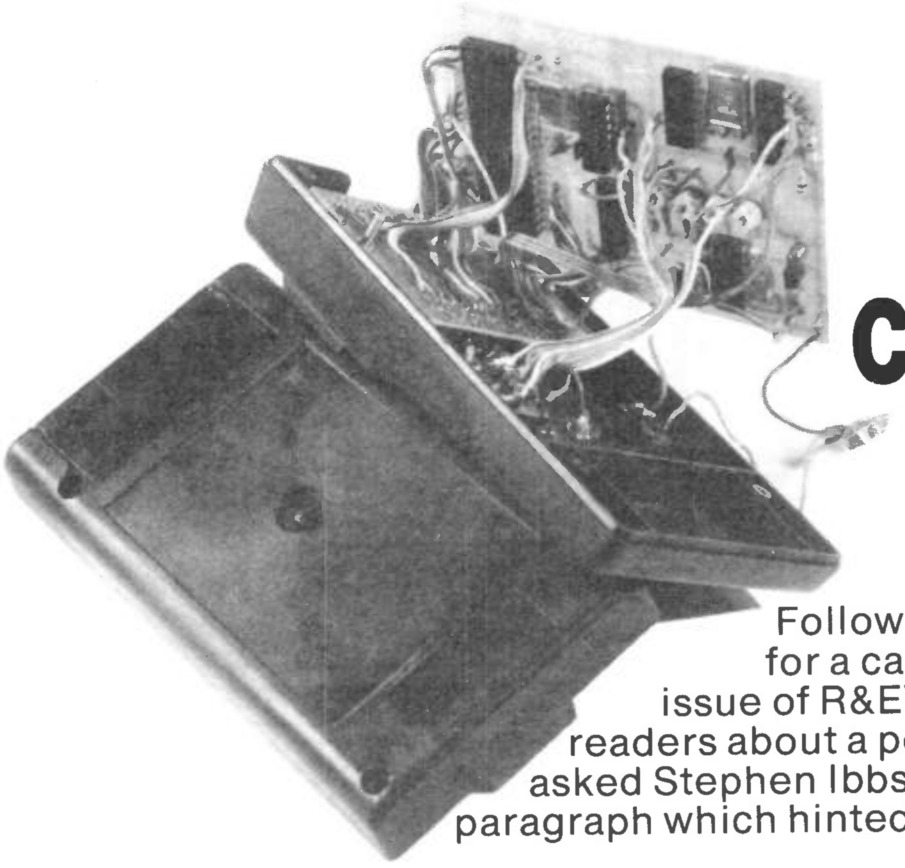


Fig 6: *Component overlay*



PCBs for both these detectors are available from Edwardschild Ltd, 453a Becontree Ave, Dagenham, Essex RM8 3UL at £0.99 ea inclusive.



PORTABLE LCD CAPACITANCE METER

Following the publication of a design for a capacitance meter in the July '83 issue of R&EW, we received enquiries from readers about a portable LCD version and so we asked Stephen Ibbs to expand more upon his final paragraph which hinted at other thoroughbreds in the Intersil stable of counters

Intersil produces a series of 4½-digit counters, the most interesting one in terms of this particular application being the ICM 7224 LCD counter. However, unlike the frequency meter ICs from the same stable, this device does not generate its own gate, store and reset pulses, which consequently have to be produced externally. The earlier version of the capacitance meter did this with a 7556, a 40106 and a 4011, which was all very well. However, for handheld use, three ICs occupy too much room, particularly when a 40-pin IC (the 7224) is being used instead of the 28-pin 7217A.

The present LCD meter thus obtains its gate, store and reset pulses by taking advantage of a single IC designed specifically for the purpose, the ICM7207A, with its attendant 5.24288MHz crystal. The other major change in the overall design is in respect of the oscillator frequency, explained in more detail below.

How it works

The principles involved in the circuit's operation are best understood from the block diagram of *Figure 2*. Imagine that monostables 'A' and 'B' operate gates or barriers which, when closed, prevent anything travelling past them along the line from the oscillator to the counter. The 7207A will open gate 'B' for either 0.1 or 1sec (depending on whether pin 11 is high or low). So if gate 'A' were also open, the counter would receive 20,000 pulses (its maximum reading) every 100msec – assuming that a 200kHz oscillator is used. At the end of each group, it has to store the result, by transferring it to data latches, and then reset. The timing

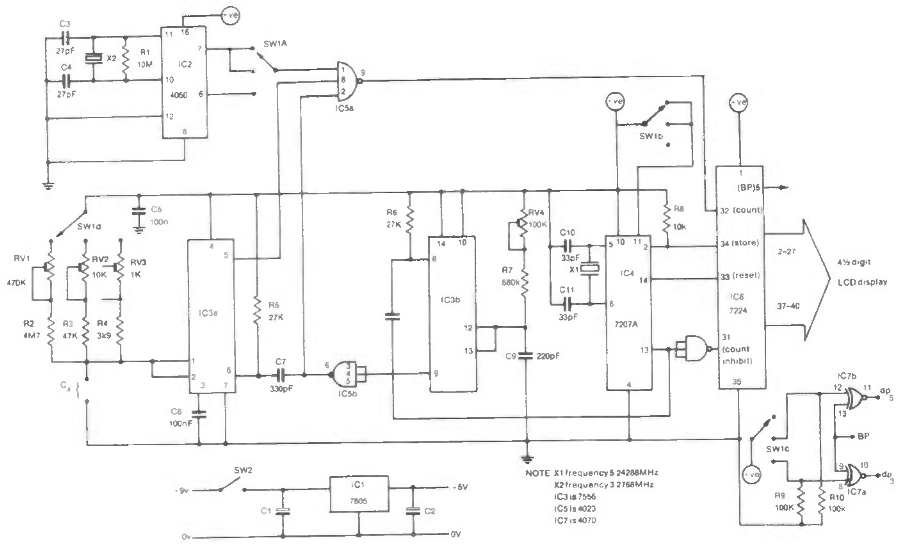
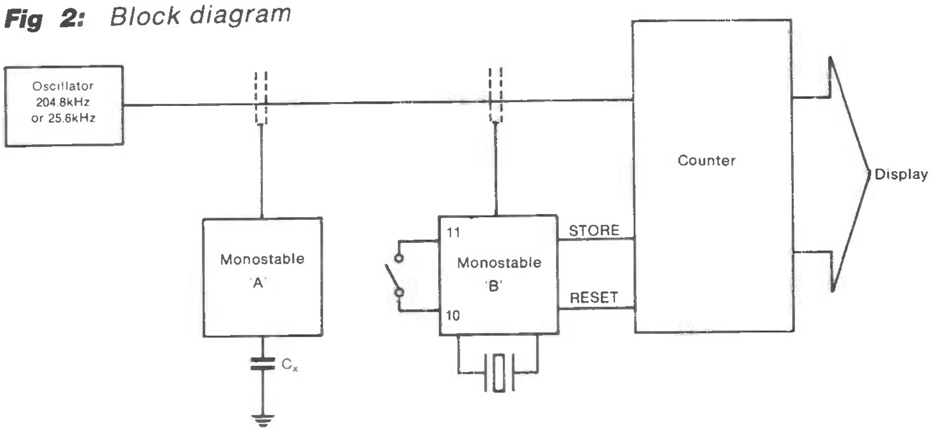


Fig 1: Circuit diagram for LCD capacitance meter

Fig 2: Block diagram



monostable controls gate 'A' in such a way that it turns out that the smaller the capacitor, the fewer pulses get through gate 'A' in the time that gate 'B' is also open. Logic needs to be included to ensure that the two gates are synchronised.

The meter itself is best considered in sections starting with the 7556 dual-timer IC (IC3 on the circuit diagram of *Figure 1*). The first half takes the negative-going gate pulse from the 7207A and uses this to provide a brief trigger pulse to the second half which is the main monostable. The output from the first half is also used as an extra control on gate 'A', in effect keeping it shut for a small fraction of a second to null out any stray capacitance in the circuit. In this it acts as a zero-adjust via RV4.

The period of the main monostable is determined by the unknown capacitor C_x and one of the resistor combinations accessed via switch SW1d. The 7556 data sheet suggests that it is relatively easy to obtain a period of around 100msec by using suitable resistors where this corresponds to either 20,000pF (20nF) or 2μF FSD. This in turn means that the 0.1sec gate on the 7207A can be used to give a fast response time. For 20,000pF FSD and a 100msec period we thus need at least a 200kHz oscillator. This is most easily provided by a 3.2768MHz crystal divided by 2^4 by the 4060 ripple-binary counter to give 204.8kHz at pin 7, which allows us a small overhead margin for calibration purposes.

A problem arises on range 3 of the meter (200μF – each range is a factor of 100 up on the previous range) because it is very difficult to obtain a 100msec period in this case. However, a period of approximately 1sec is feasible; SW1b is used to disconnect pin 11 of the 7207A from the +ve supply, thus altering the gate 'B' period to 1sec. The resistor-capacitor combination will open gate 'A' for approximately 1sec (adjustable via RV3), but this is obviously too long with a 200kHz oscillator as the 7224 would simply overflow after 100msec. Consequently pin 6 of the 4060 is simultaneously selected by SW1a, as this gives a divided-by-2^7 output, i.e. 25.6kHz. By calibration, the counter will display 20000 in response to a 200μF capacitor.

The 4070 (IC7) can be considered a bit of a luxury extra. It would be nice to have full scale deflection displayed as 19999 on range 1, 1.9999 on range 2, and 199.99 on range 3. The best way to activate the desired decimal point is to drive it with an inverted backplane signal (achieved by connecting the EX-OR gates as inverters) with SW1c deciding which point will be activated by connecting the second pin of the relevant gate to +ve. Readers who do not want this refinement can simply omit the 4070.

Construction

NB: Switch off after each check, prior to inserting any ICs!

The main PCB has been designed to fit a specific case (RS 507-983): the foil pattern and component overlay are given in *Figures 3 and 4*. Insert the two wire links first, followed by all the other

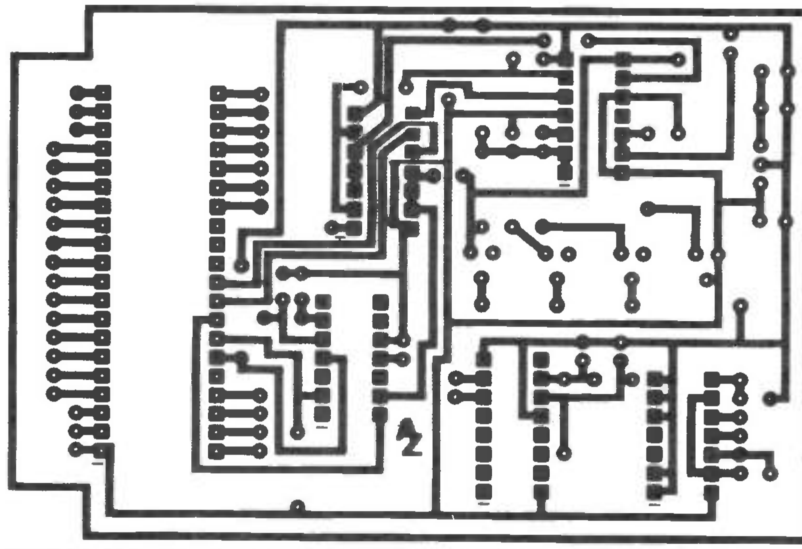


Fig 3 *PCB foil pattern for meter board*

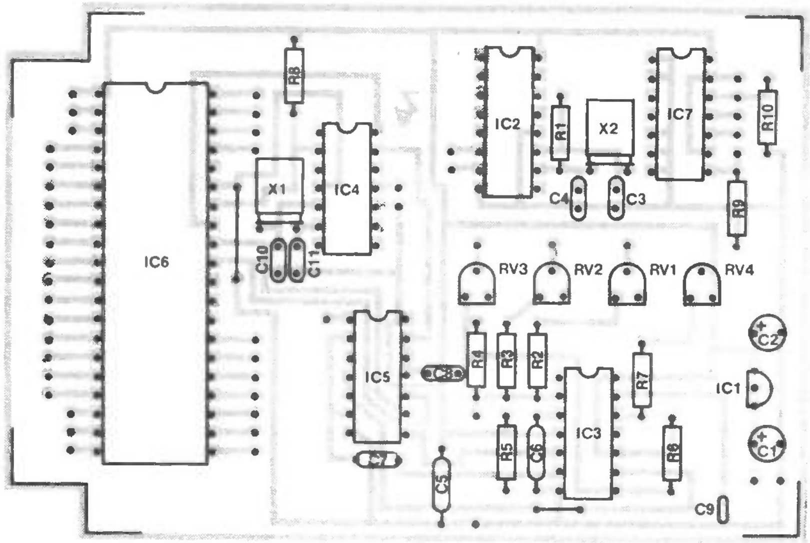


Fig 4 *Component overlay*

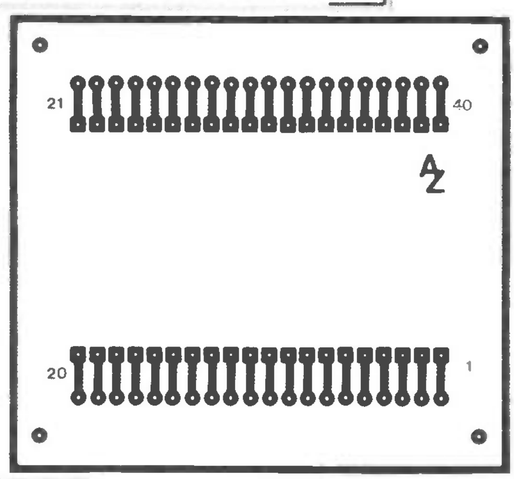


Fig 5 *PCB foil pattern for display*

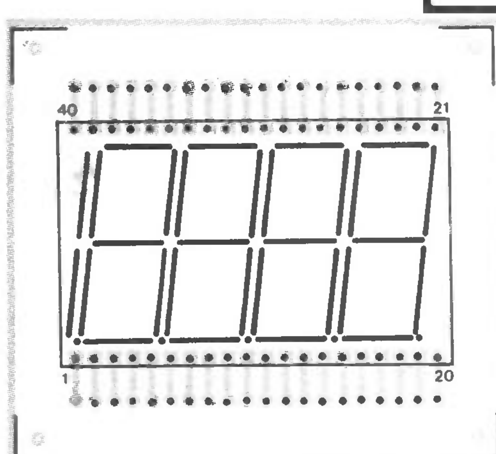


Fig 6 *Component overlay*

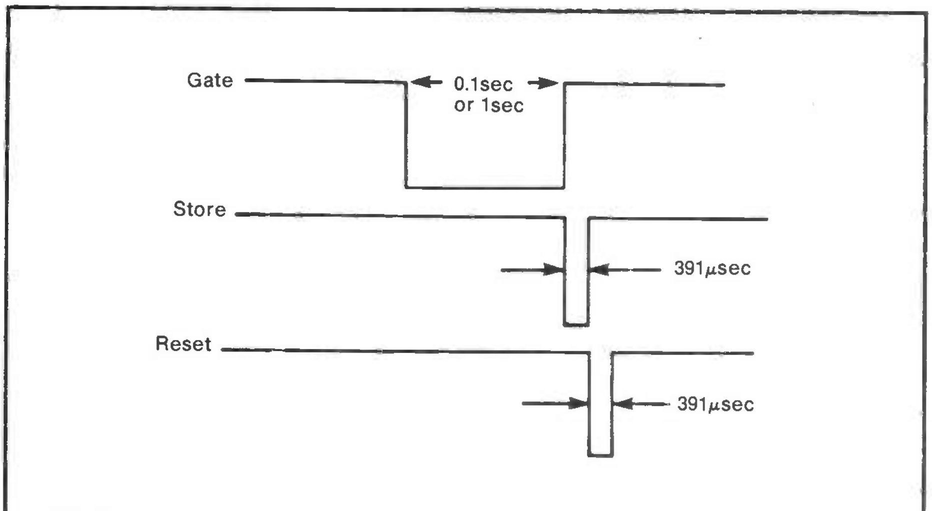


Fig 7: *7207A output pulses*

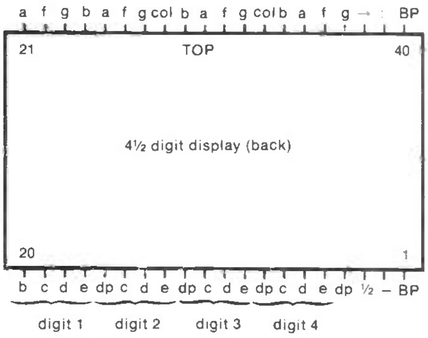
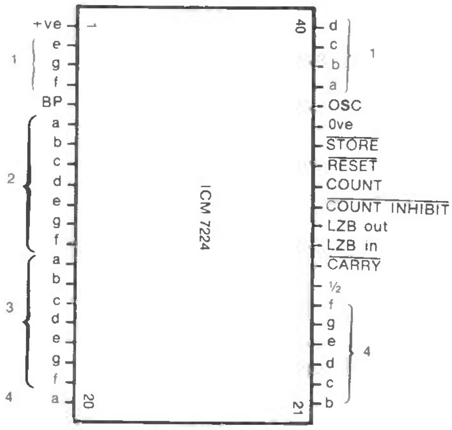


Fig 8: *Pin out for 7224*



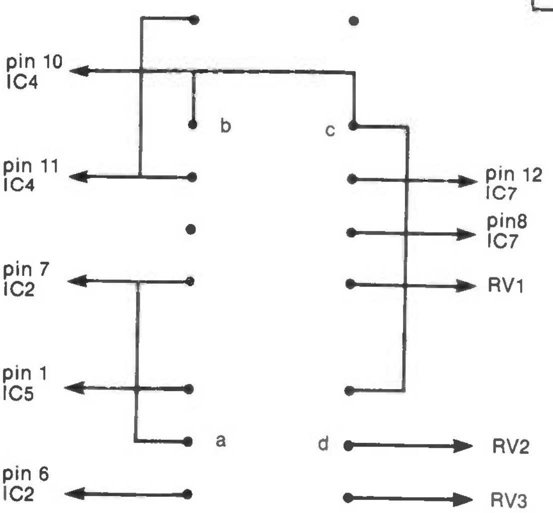


Fig 9: *Back of SW1 which is a 4-pole 3-way slide switch*

PARTS LIST

Resistors

R1	10MΩ
R2	4.7MΩ
R3	47kΩ
R4	3.9kΩ
R5, R6	27kΩ
R7	680kΩ
R8	10kΩ
R9, R10	100kΩ

Presets (all min 6mm cermet type HO651A)

RV1	470Ω
RV2	10kΩ
RV3	1kΩ
RV4	100kΩ

Capacitors

C1	0.22μF tantalum
C2	2.2μF tantalum
C3, C4	27pF
C5, C6	0.1μF
C7, C8	330pF
C9	220pF
C10, C11	33pF

Semiconductors

IC1	78L05
IC2	4060
IC3	7556
IC4	ICM 7207A
IC5	4023
IC6	ICM 7224
IC7	4070

Others

RS handheld case (507-983)
RS 4½-digit LCD bezel
4½-digit LCD display (LUCID 103F111)
4-pole 3-way slide switch (Maplin)
1-pole 2-way slide switch
3.2768MHz crystal
5.24288MHz crystal

Presets available from Ambit; Crystals available from Watford Electronics; ICM 7207A, ICM 7224 available from Watford Electronics or Quorn don Electronics (Derby)

PCBs for this LCD capacitance meter are available form Edwardschild Ltd, 453a Becontree Ave, Dagenham, Essex RM8 3UL at £3.85 ea for the control board and £1.40 ea for the display board, both inclusive

components except the ICs. **Note:** Sockets should be used for all the ICs, with the possible exception of the 7224 because space is at a premium at that end of the board.

The cut out on the front panel needs to be slightly widened for the specified bezel, which comes complete with a display PCB (the design for this is anyway given in *Figures 5 and 6*). In addition, two holes have to be drilled and filed for SW1 and SW2, which need to be sited carefully to avoid fouling the PCB. These are held in place either by small nuts and bolts or (as in the prototype) by epoxy resin. Two holes also need to be drilled for the capacitor terminals which can be either spring-loaded terminals or 1mm sockets.

Do not wire the display up yet.

After visual inspection, insert IC1 (the 78L05) and check that +5V appears at its output. Insert the 4060 (IC2) and measure the output to confirm that the oscillator is working. Next insert the 7207A and verify that the output pulses are appearing as in *Figure 7* (which is *not* to scale). The store and reset lines are very thin negative-going pulses. Insert the 7556 and 4023 (IC's 3 and 5) and measure the output at pin 9 of the former, which should show a brief positive-going pulse. With a capacitor in the C_x position, pin 5 should reveal a positive-going pulse, with a period adjustable via the appropriate resistor RV1, 2, 3. Monitor pin 9 of the 4023 to see that a repeating 'block of pulses' appears lasting either 0.1 or 1sec depending on the range.

Finally insert the 7224, *the correct way round,* and wire up the display according to *Figure 8.* Switch on and adjust RV4 so that it just gives a blank display (altering R7 if necessary). Adjust RV1, 2, 3, with close tolerance capacitors in the C_x position.

If all is well, the case can finally be screwed together.

DATA FILE

Ray Marston continues his survey of op-amp principles and applications by looking at practical amplifier and active filter circuits.

In last month's edition of 'Data File' we took an in-depth look at the basic operating principles of conventional voltage-differencing operational amplifiers, and showed some of the basic circuit configurations in which an op-amp can be used. In this month's article, we shall concentrate on practical methods of using op-amps as linear amplifiers and active filters.

When reading the present article, it should be remembered that all circuits are shown designed around a standard 741 op-amp and operated from dual 9V supplies. But, in practice, these circuits will work – without modification – with virtually any voltage-differencing op-amp, and from any supply voltages within the operating range of the op-amp. If alternative op-amps are used, however, attention should (where applicable) be paid to possible differences in offset biasing networks. With these points in mind, let's move on and look at practical linear amplifier circuits.

Inverting amplifier circuits

Figure 1 shows the practical circuit of an inverting DC amplifier, which has an overall voltage gain (*A*) of x10 and an offset nulling facility that enables the output to be set to precisely zero with zero applied input. The voltage gain and input impedance of the circuit are determined by the values of R1 and R2, and can be altered to suit the needs of the individual user. The gain can be made variable (if so desired) by using a series combination of a fixed and a variable resistor in place of R2. For optimum biasing stability, R3 should have a value equal to a parallel combination of R1 and R2.

One point to note about the *Figure 1* circuit is that it will continue to function if the RV1 offset-nulling network is removed, but in this case the output may be offset by an amount equal to the op-amp's input offset voltage (typically 1mV in a 741) multiplied by the closed-loop voltage gain (*A*) of the circuit. For example, if the circuit has a gain of x100, the output may be offset by 100mV with zero input applied. Also note that the bandwidth of the circuit is equal to the f_T value (1MHz in a 741) divided by the *A* value: thus the *Figure 1* circuit gives a bandwidth of 100kHz with a gain of x10, or 10kHz with a gain of x100.

The circuit can, incidentally, be adapted for use as an AC amplifier, simply by wiring a blocking capacitor in series with its input terminal, as shown in *Figure 2*. In this case, however, no offset nulling facility is needed and the value of R3 corresponding to optimum biasing is equal to the value of R2.

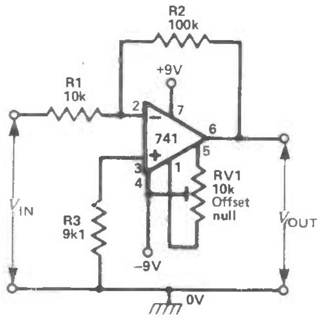


Fig 1 *Inverting DC amplifier with a x10 voltage gain and incorporating an offset-nulling facility.* $A = R_2/R_1$; $V_{OUT} = -A \times V_{IN}$; $Z_{IN} = R1$; Bandwidth $= f_T/A$; $R3 = R1//R2$

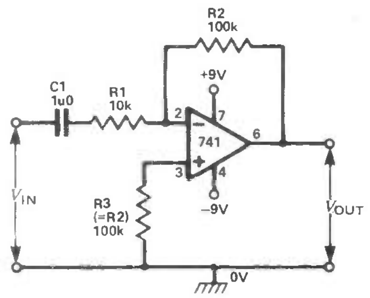


Fig 2 *Inverting AC amplifier with x10 gain*

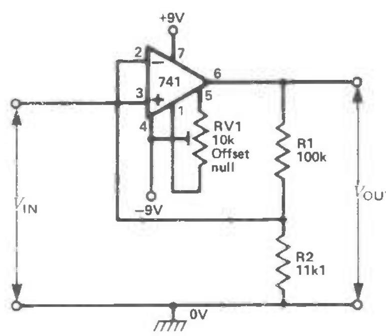


Fig 3 *Non-inverting DC amplifier with offset nulling facility and x10 gain.* $A = (R_1+R_2)/R_2$. $R_{source} = R1//R2$

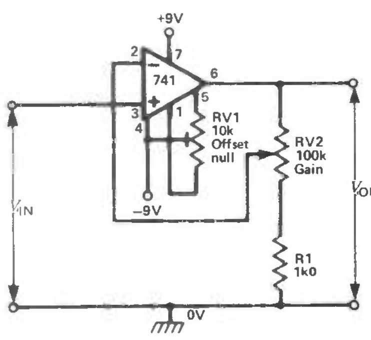


Fig 4 *Non-inverting variable-gain (x1 to x101) DC amplifier*

Non-inverting amplifier circuits

An op-amp can be used as a non-inverting DC amplifier with offset compensation by using the connections shown in *Figure 3*. The voltage gain in such a circuit is determined by the ratios of R1 and R2, so that shown here is for a x10 amplifier. If R1 has a value of zero the gain falls to unity, but if R2 has this value the gain rises to a value equal to the open-loop gain of the op-amp. The gain can thus be made variable by replacing R2 with a pot and connecting its slider to the inverting terminal of the op-amp. This is illustrated in the circuit shown in *Figure 4*, in which the gain can be varied over the range x1 to x101 via RV1.

It is important to note that, for correct operation, the input (non-inverting) terminal of each of these circuits must be provided with a DC path to the common or zero-volt rail; this path is provided in the circuits shown via the DC input signal. Another point to note about *Figure 3* is that the parallel value of R1 and R2 should ideally be equal to the source resistance of the input signal, as this gives optimum biasing.

A major feature of this non-inverting op-amp circuit is that it gives a very high input impedance. In theory, this impedance is equal to the open-loop input resistance (1MΩ in a 741) multiplied by A_o/A. In practice, DC circuits such as those of *Figures 3 and 4*, can easily have input impedance values of hundreds of megohms.

Figure 5 shows how the *Figure 3* circuit could be modified for use as a x10 non-inverting AC amplifier by removing the

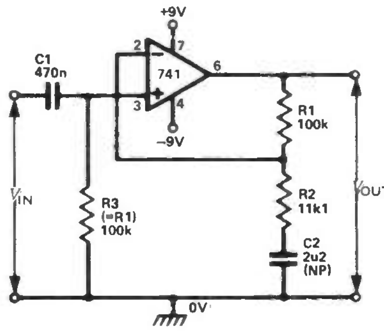


Fig 5 *Non-inverting x10 AC amplifier with 100k input impedance*

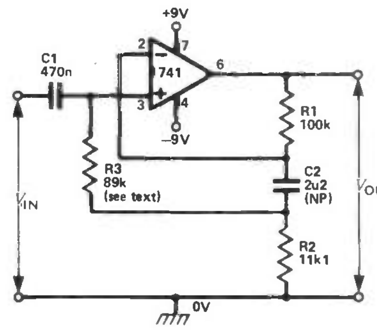


Fig 6 *Non-inverting x10 AC amplifier with 50M input impedance*

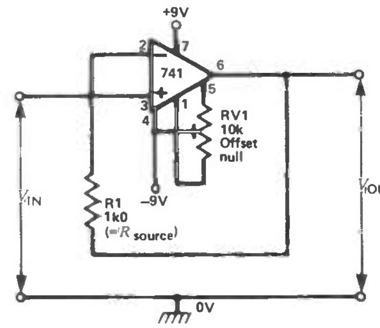


Fig 7 *Precision DC voltage follower with offset nulling facility*

NOTE: NP = non polarised

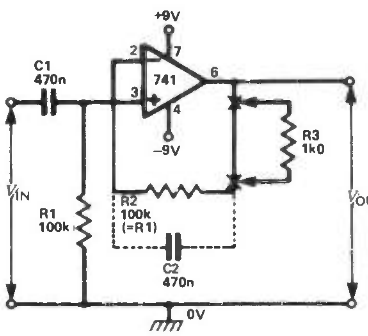


Fig 8 *AC voltage follower with 100k input impedance*

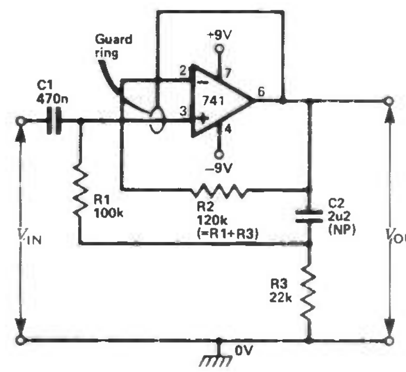


Fig 9 *AC voltage follower with 50M input impedance without the guard ring, or 500M with the guard ring*

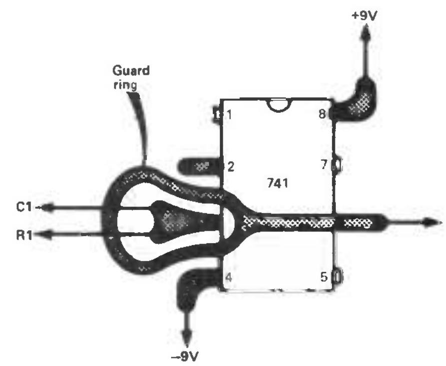


Fig 10 *Guard ring etched on a PCB and viewed through the top of the board*

offset biasing network, connecting the non-inverting terminal of the op-amp to ground via the biasing resistor R3, and connecting the input signal via a blocking capacitor. The point to note here is that the gain-control resistors R1 and R2 are isolated from ground via the blocking capacitor C2. At practical operating frequencies, C2 has negligible impedance and so the voltage gain is still determined by the ratios of R1 and R2. But the inverting terminal of the op-amp is subject to virtually 100% DC negative feedback, and the circuit consequently has excellent DC stability. For optimum biasing, R3 should have a value equal to that of R1.

Clearly, the input impedance of the circuit shown in *Figure 5* equals the value of R3 and it is limited to a maximum value of only a few megohms by practical considerations. *Figure 6* shows how the above circuit can be further modified so that it has a very high input impedance (typically 50MΩ). Here, the position of C2 is moved relative to *Figure 5,* but this modification does not influence either the gain or the DC negative feedback characteristics of the circuit.

In the *Figure 6* circuit, however, the low end of R3 is taken to ground via R2, and the AC feedback signal appearing at the R2–R3 junction is virtually identical to that appearing on the non-inverting input terminal of the op-amp. Consequently, near-identical signal voltages appear at both ends of R3, which thus passes negligible signal current, and the apparent impedance of this resistor is thus increased to near-infinity by this 'bootstrap' action. In practice the input impedance of this circuit is typically limited to about 50MΩ by leakage impedances within the actual op-amp socket and the PCB to which it is wired.

For optimum biasing, the sum of the R2 and R3 values should equal R1: in practice, the R3 value can differ from this ideal by up to 30%. Thus a resistor with a value of 100k can be used in the *Figure 6* circuit.

Voltage follower circuits

A voltage follower circuit produces an output voltage that is identical to that of the input signal, but has a very high input impedance and a very low output impedance. The circuit actually functions as a unity-gain non-inverting amplifier, with 100% negative feedback, and *Figure 7* shows the 'idealised' design for a precision voltage follower with offset biasing. In this case, the feedback resistor R1 should have a value equal to the source resistance of the input signal, in order to bias the circuit optimally.

In practice, this circuit can often be greatly simplified. Eliminating the offset biasing network, for example, adds an error of only a few millivolts to the output of the op-amp. Again, the value of the feedback resistor R1 can be varied over a wide range (from zero to 100k) without greatly influencing the output accuracy of the circuit. If an op-amp with a low f_T value (such as the 741) is used, the R1 value can usually be reduced to zero. However, many 'high-f_T' op-amps tend towards instability when used in the unity-gain mode, and in such cases R1 should be given a value of 1kΩ or greater in order to reduce the circuit bandwidth substantially and thus enhance circuit stability.

Figure 8 shows an AC version of the voltage follower. In this case, the input signal is DC blocked via C1, and the non-inverting terminal of the op-amp is tied to ground via R1, which determines the input impedance of the circuit. Ideally, the feedback resistor R2 should have the same value as R1. If R2 has a high value, it may significantly reduce the bandwidth of the circuit; however, this problem may readily be overcome by shunting R2 with C2 (shown dotted in the diagram). If the latter technique is used with a 'high-f_T' op-amp, resistor R3 should be connected as shown to ensure circuit stability.

If a very high input impedance is required from an AC voltage follower, it can be obtained by using the basic configuration shown in *Figure 9,* in which R1 is 'bootstrapped' from the op-amp output via C2, so that the R1 impedance is increased to near-infinity. In practice, this circuit will easily give an input impedance of 50MΩ from a 741 op-amp, this limit being set by the leakage impedances of the op-amp's IC socket and the PCB.

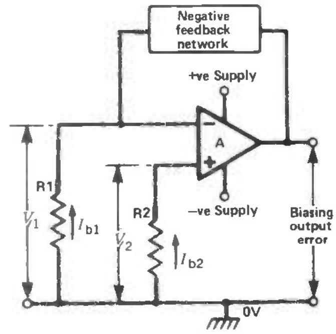


Fig 11 Input biasing of an op-amp. $I_{b1} = I_{b2} = I_b$; Biasing output error$= I_b(R_2 - R_1) \times A = A(V_2 - V_1)$

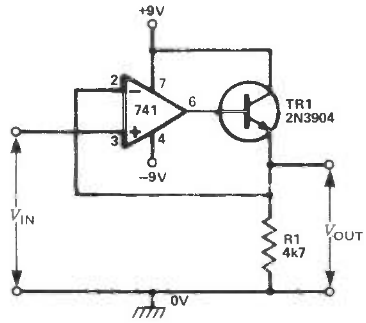


Fig 12 Unilateral DC voltage follower with boosted output-current drive

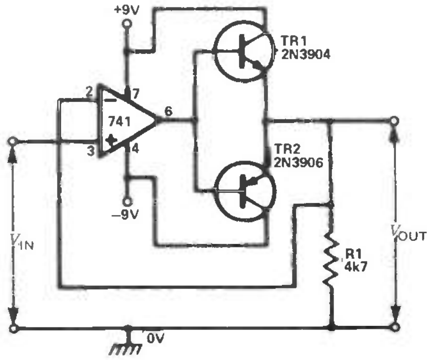


Fig 13 Bidirectional DC voltage follower with boosted output-current drive

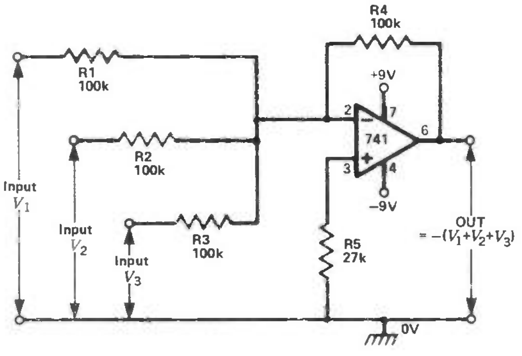


Fig 14 Unity-gain inverting DC adder

If even greater input impedances are required the area of PCB surrounding the op-amp input pin should be provided with a printed 'guard ring' that is driven from the op-amp output, so that the leakage impedances of the PCB, etc are themselves bootstrapped and raised to near-infinite values. In this case the *Figure 9* circuit gives an input impedance of about 500MΩ when a 741 op-amp is used – or even greater if a FET-input op-amp is used. *Figure 10* illustrates an example where the guard ring has been etched on the PCB.

Biasing accuracy

In the above descriptions of the circuits shown in *Figures 1–9*, great emphasis has been placed on the selection of particular component values in order to achieve 'optimum biasing'. In practice, however, op-amps are very versatile devices and can accept considerable errors in the values of these components. *Figure 11* should help put the subject of 'biasing' into perspective.

This figure shows the equivalent circuit of an 'idealised' amplifier, in which the actual op-amp has zero intrinsic input offset voltage error, and the voltage gain *A* of the complete circuit is controlled by a negative feedback network. The op-amp is biased by wiring its input terminals to the ground or to a 'common' line via resistors R1 and R2. The op-amp draws input bias currents $I_{b1,2}$ via these resistors, and thus generates a voltage drop across each bias resistor.

For all practical purposes, the two bias currents of any op-amp have the same value. Consequently, if R1 and R2 have equal values, the voltage drop across each resistor will be identical. The result of this is zero differential input voltage and thus a zero biasing error at the output of the circuit; this is the 'ideal' biasing arrangement. If, on the other hand, R1 and R2 do not have equal values, their voltage drops will differ – resulting in an input differential error of $I_b(R_2 - R_1)$ and an output error that is '*A*' times greater than this value. But how significant is this error?

In practice, a bipolar op-amp such as the 741 has a typical I_b value of about 200nA (=0.2μA), corresponding to a drop of 0.2mV across a 1kΩ resistor. FET-input op-amps, on the other hand, have typical I_b values of about 0.02nA, corresponding to a drop of a mere 0.02μV across a 1kΩ resistor. Thus, in *Figure 11*, if the R1 and R2 values differ by as much as 10kΩ, the biasing output error from a 741 op-amp will still only be 2mV in a unity-gain voltage follower circuit, or 20mV in a x10 amplifier circuit. If a FET-input op-amp were used in place of the 741, the biasing output error of the voltage follower would be a mere 0.2μV, and that of the x10 amplifier just 2μV.

From this, it can be seen that all of the circuits of *Figures 1–9* can accept considerable latitude in their biasing component values. With this point in mind, let's look at some more amplifier circuits.

Current-boosted follower circuits

Most op-amps provide a maximum output current of only a few milliamps; this is therefore the current-driving limit of the voltage follower circuits of *Figures 7–9*. However, the current-driving capacity of a voltage follower can easily be increased by wiring a simple or a complementary emitter-follower current booster stage between the op-amp output and the final output terminal of the circuit, as shown in the basic designs of *Figures 12 and 13*. Note that the base–emitter junctions of the transistors are wired into the negative feedback loop of the op-amp, because this will virtually eliminate the effects of junction non-linearity.

The circuit shown in *Figure 12* is able to source large currents (via TR1), but can sink only relatively small ones (via R1). This circuit can thus be regarded as a unidirectional, positive-only, DC voltage follower. We'll illustrate several practical applications of this type of circuit in Part 4 of this 'Op-Amp' series.

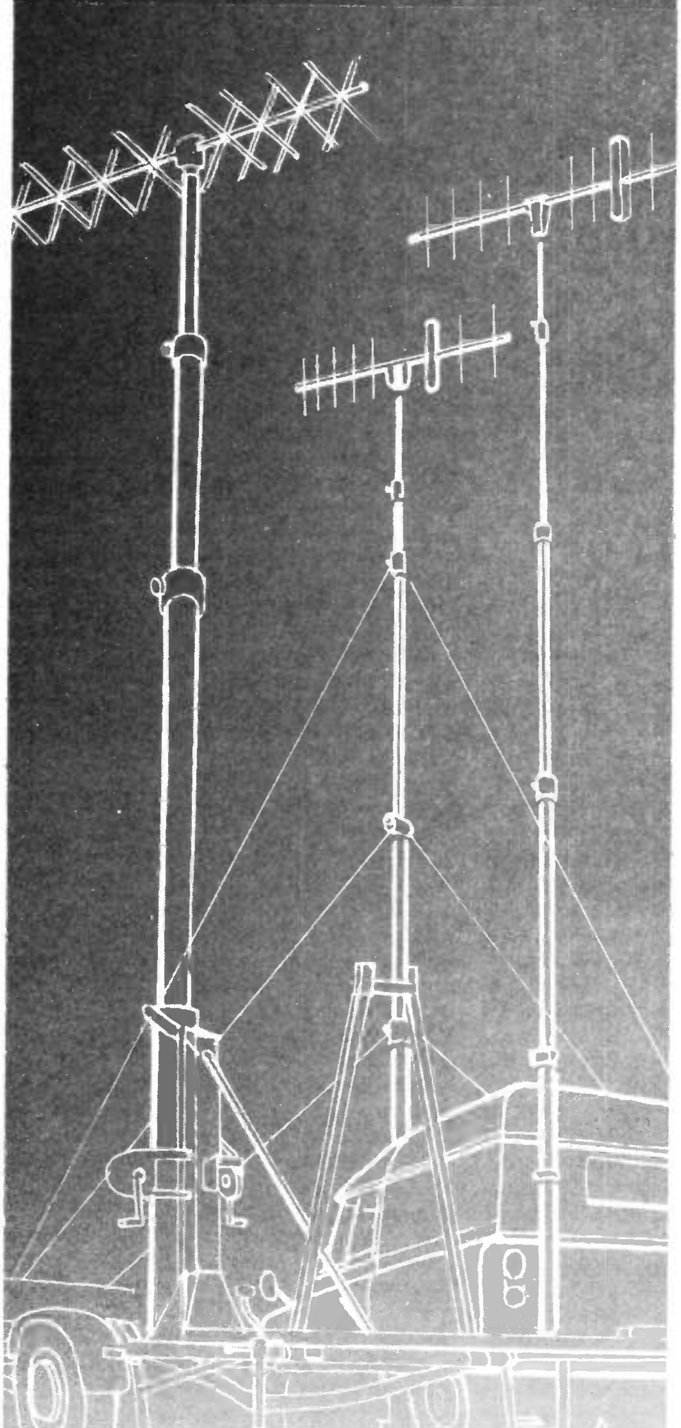
The *Figure 13* circuit can both source (via TR1) and sink (via TR2) large output currents, and so can be regarded as a bidirectional (positive and negative) voltage follower. In the simple form shown in the diagram, the circuit produces significant cross-over distortion as the output moves around the zero volts value. This distortion can be eliminated by suitably biasing TR1 and TR2, in which case the circuit could be the basis of a good hi-fi amplifier.

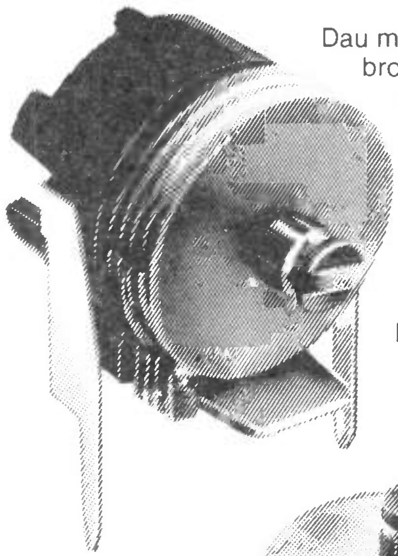
In practice, the two circuits have maximum current-drive capacities of about 50mA, this figure being dictated by the low power ratings of the specified transistors. Greater drive capacity can be obtained by using other transistors.

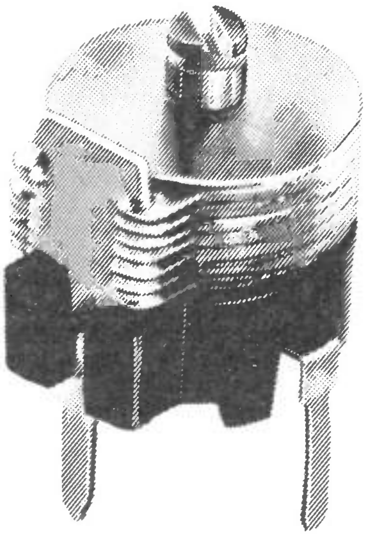
Adders and subtractors

Figure 14 shows the circuit of a unity-gain analogue DC voltage adder, which gives an inverted output voltage equal to the sum of the three input voltages. The input resistors R1–R3 and the feedback resistor R4 have identical values, and so the circuit acts as a unity-gain inverting DC amplifier between each input terminal and the output. The current flowing in R4 is equal to the sum of those flowing through R1–R3, and the inverted output voltage is thus equal to the sum of the input voltages. For high-precision applications, the circuit can be modified to have an offset nulling facility.

Figure 14 shows only three input connections, but the circuit can in fact







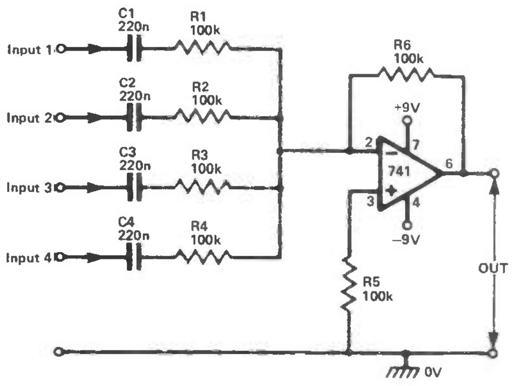


Fig 15 *Four-input audio mixer*

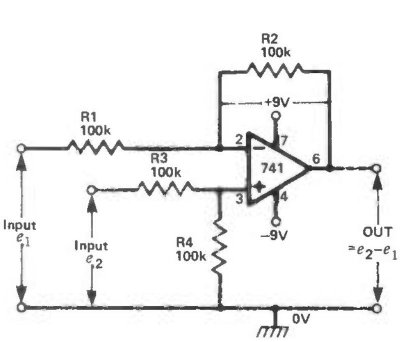


Fig 16 *Unity-gain DC differential amplifier, otherwise known as a subtractor.* $R_1/R_2=R_3/R_4$; $A=R_2/R_1$

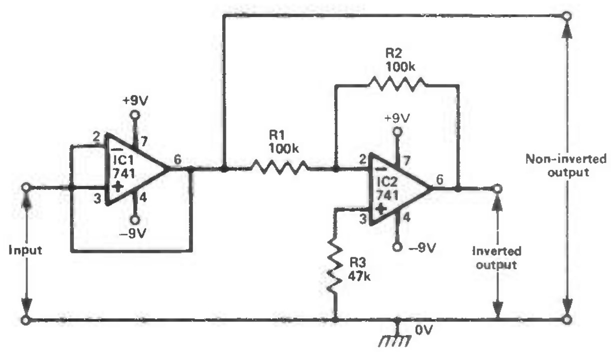


Fig 17 *Unity-gain balanced DC phase-splitter*

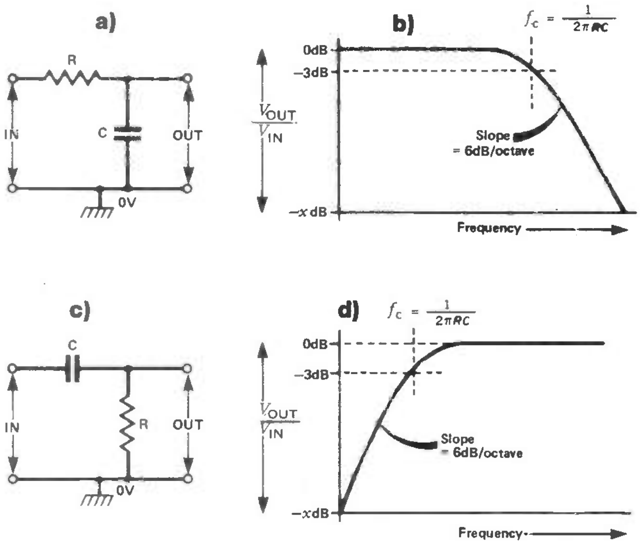


Fig 18 *Circuits and response curves of simple first-order R–C filters.* ***Parts a,b*** *refer to low-pass filters;* ***parts c,d*** *to high-pass filters*

incorporate any number of inputs (each via a resistance equal in value to R1), but in this case optimum biasing requires the R5 value to be altered to the parallel value of all the other resistors. Furthermore, the circuit can – if so desired – be made to give a voltage gain greater than unity, simply by increasing the value of the feedback resistor R4.

Another point to note is that the circuit can be used as a multi-input 'audio mixer' by AC-coupling the input signals and giving R5 the same value as the feedback resistor, as shown in the four-input circuit of *Figure 15*.

Figure 16 shows the circuit of a unity-gain DC differential amplifier – otherwise known as an analogue subtractor – in which the output equals the difference between the two input signal voltages(i.e. e_2-e_1). In this type of circuit the component values are chosen such that $R_1/R_2=R_3/R_4$, in which case the voltage gain A equals R_2/R_1. When, as in *Figure 16*, R1 and R2 have equal values, the circuit gives unity overall gain and thus acts as an analogue subtractor.

Balanced phase-splitter

The next configuration to be considered – a phase-splitter – incorporates a pair of output terminals, which deliver outputs that are identical in amplitude and form, but one output is phase-shifted by 180°(i.e. inverted) relative to the other.

Figure 17 illustrates an easy way of making a unity-gain balanced DC phase-splitter, essentially by using just a pair of 741 op-amps. Here, IC1 acts as a unity-gain non-inverting amplifier (or voltage follower) and provides a buffered output signal that is identical to that of the input. This output also provides the input drive to IC2, which acts as a unity-gain inverting amplifier and provides the second output, which is inverted but is otherwise identical to the original input signal.

ACTIVE FILTERS

Filter circuits are used to reject unwanted frequencies and pass only those wanted by the designer. A simple R–C low-pass filter (*Figure 18a*) passes low-frequency signals, but rejects high-frequency ones. The output is down by 3dB at its 'break' or 'cross-over' frequency f_c of $1/(2\pi RC)$, and then falls at a rate of 6dB/octave (=20dB/decade) as the frequency is increased *(see Figure 18b)*. Thus, a 1kHz version of this filter will give roughly 12dB of rejection to a 4kHz signal, and 20dB to a 10kHz one.

A simple R–C high-pass filter *Figure 18c* passes high frequency signals but rejects low-frequency ones. The output will be 3dB down at the break frequency of $1/(2\pi RC)$, and fall at a rate of 6dB/octave for frequencies below this value *(see Figure 18d)*. Thus, a 1kHz filter of this type will give 12dB of rejection to a 250Hz signal, and 20dB to a 100Hz signal.

Each of the above filter circuits uses a single R–C stage, and is known as a 'first order' filter. If we could simply cascade a number (n) of these filter stages, the filter would be known as an 'nth order' filter and would have an output slope beyond f_c of 6ndB/octave. Thus, a 4th order 1kHz low-pass filter would have a slope of 24dB/octave, and thus would give 48dB of rejection to a 4kHz signal, and 80dB to a 10kHz signal.

Unfortunately, simple R–C filters cannot be simply cascaded; if they were, they would interact and give very poor results. Filters can, however, be *effectively* cascaded by incorporating them into the feedback networks of suitable op-amp circuits. Such filters are known as 'active'filters. Let's look at some practical designs.

Active filter circuits

Figure 19 shows the circuit for a maximally-flat (Butterworth) 2nd-order low-pass filter with a break frequency of 10kHz. This design gives unity overall gain within its passband. To change the break frequency, simply change the value of either R or C according to the formulae $R_{new}(k\Omega)=24 \times (10kHz/f_{new})$ and $C_{new}(pF) = 470 \times (10kHz/f_{new})$, respectively. In other words the component values should be reduced in the ratio

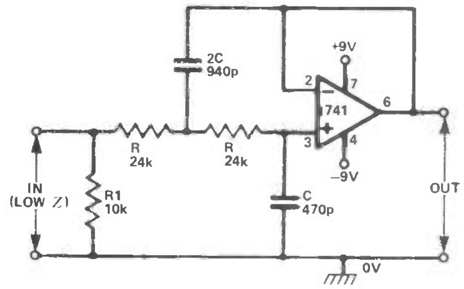


Fig 19 *Unity-gain 2nd-order 10kHz low-pass active filter: $f_c = 1/2.83\pi RC$*

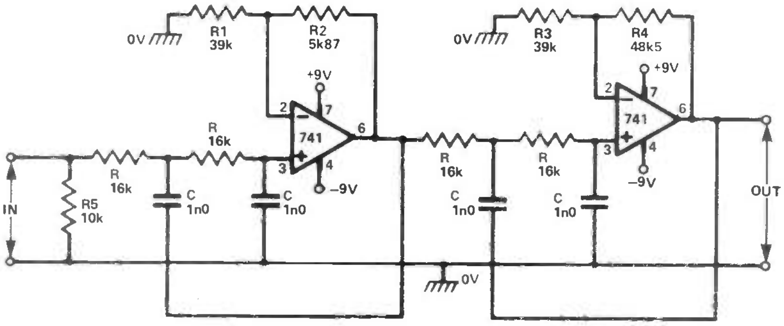


Fig 21 *4th-order 10kHZ low-pass filter: $f_c = 1/2\pi RC$*

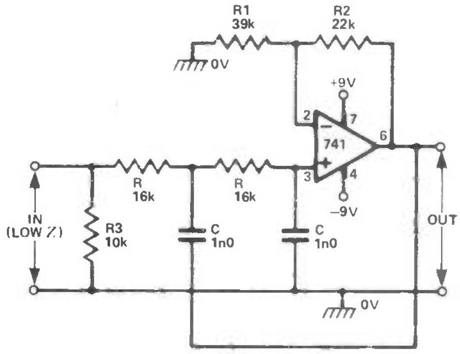


Fig 20 *'Equal components' version of a 2nd-order 10kHz low-pass active filter: $f_c = 1/2\pi RC$*

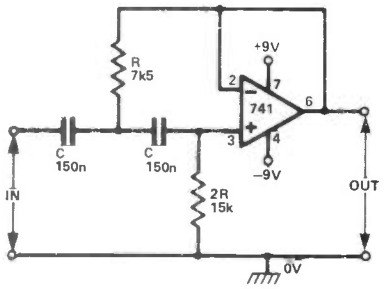


Fig 22 *Unity-gain 2nd-order 100Hz high-pass filter: $f_c = 1/2.83\pi RC$*

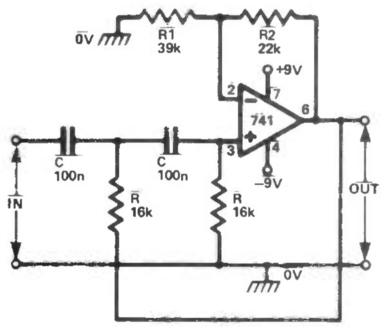


Fig 23 *'Equal components' version of a 2nd-order 100Hz high-pass filter: $f_c = 1/2\pi RC$*

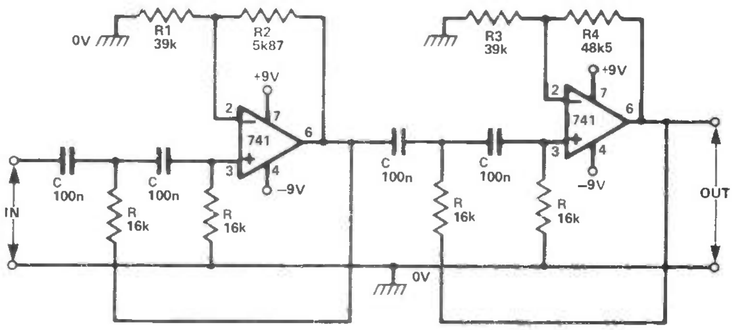


Fig 24 *4th-order 100Hz high-pass filter: $f_c = 1/2\pi RC$*

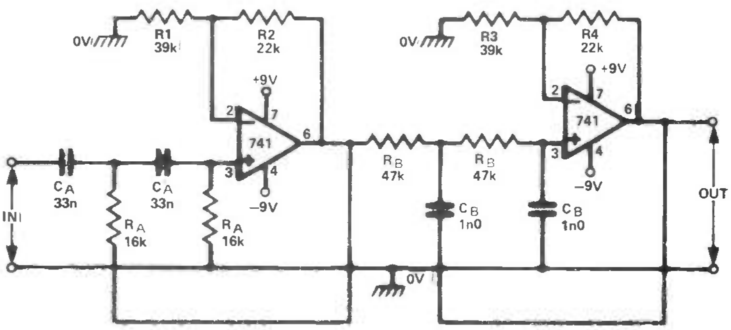


Fig 25 *300Hz–3.4kHz speech filter with 2nd-order response*

10kHz:f_{new} to increase the frequency, or increased in the same ratio to reduce the frequency. Thus, for 4kHz operation, the R values (say) should be increased by a factor of 10kHz/4kHz, or 2.5 times.

A major disadvantage of the circuit shown in *Figure 19* is that one of its 'C' values has to be precisely twice the value of the other for correct operation, and in practice this can result in some rather odd component values. *Figure 20* shows an alternative 2nd-order 10kHz low-pass filter circuit which overcomes this snag and uses equal component values. Here, the op-amp has a voltage gain determined R1 and R2 – 4.1dB in this case: it is therefore vital that R1 and R2 have the values shown.

Figure 21 shows how two of these 'equal component' filters can be cascaded to make a 4th-order low-pass filter, with a slope of 24dB/octave. Note in this case that gain-determining resistors R1 and R2 are in the ratio 6.644:1 while R3 and R4 are in the ratio 0.805:1, giving an overall voltage gain of 8.3dB. The odd values of R2 and R4 can be made up by connecting 5% resistors in series.

Figures 22 and 23 show unity-gain and 'equal component' versions respectively of 2nd-order 100Hz high-pass filters, while *Figure 24* shows a 4th-order 100Hz high-pass filter. The operating frequencies of these circuits, and those of *Figures 20 and 21,* can be altered in exactly the same way as for the circuit shown in *Figure 19,* i.e. increase either the R or C value to reduce the break frequency, or *vice versa.*

The final circuit to consider in this edition of 'Data File' is that shown in *Figure 25* which illustrates how the *Figure 23* high-pass and the *Figure 20* low-pass filters can be wired in series to make (with suitable component value changes) a 300Hz–3.4kHz speech filter that gives 12dB/octave rejection to all signals outside of this range. The 'C' values of *Figure 23* (the high-pass filter) are reduced by a factor of three to raise the break frequency from 100Hz to 300Hz, while the 'R' values of *Figure 20* (the low-pass filter) are increased by a factor of 2.94 to reduce the break frequency from 10kHz to 3.4kHz.

Farewell to Test Card 'F'

Keith Hamer and Garry Smith

If you were asked what the link is between Australia, Norway, New Zealand, Sweden, the United Kingdom and Bahrain, you may have a little difficulty in coaxing the old grey matter to come up with an intelligent answer. The reply which we have in mind is *Test Card 'F'*. All these countries, plus others no doubt, have at one time or another used this test card for television test transmissions. The girl on the test card must surely be the most observed person on television though few actually know her name. Just for the record, she is Carol Hersee, daughter of one of the BBC designers involved with the production of Test Card 'F'.

Recent developments

Unfortunately Carol has been banished from British screens in favour of sample pages from the BBC's teletext information service *Ceefax* as Trade Test Transmissions were discontinued last May. Incidentally, the test card disappeared from IBA channels many years ago in an effort to fill almost every available minute with programmes and revenue-earning commercials.

An electronic test pattern is radiated by the IBA (called the ETP-1 and featured in the August 1982 edition of *R&EW*) but there are serious omissions in its design if it is to be used satisfactorily for the setting up of television receivers. For instance, there isn't a centre circle for checking linearity and, as it is an electronic type, no flesh tones are incorporated.

A brief history

Following the introduction of the world's first public high-definition television service from Alexandra Palace on 2nd November 1936, it soon became apparent to BBC engineers that a simple method of checking studio equipment was required. An optical test card was devised for placing directly in front of studio cameras to check alignment. It was called Test Card 'A' *(Photo 1)* and was soon followed by an improved version designated by the letter 'B'. Both test cards were never transmitted but were used only internally.

When the television service resumed following World War II, it was decided that a new test card should be designed and radiated for the benefit of service engineers. Test Card 'C' first appeared in the late 40s and continued, with minor modifications, until the early 1970s.

The designers of this test card *(Photo 2)* could be justly proud of their endeavours as it could check a whole host of parameters – too many to list here. The basic features of Test Card 'C' were incorporated in all those which followed in the UK.

As more and more television services started throughout the world, a variety of test cards emerged but most were based on the BBC design. As the test card was to be used not only by the BBC and service engineers but also by television retailers and the public, a decision was made to broadcast a musical accompaniment. Initially 78rpm records were used but in later years the music was carefully

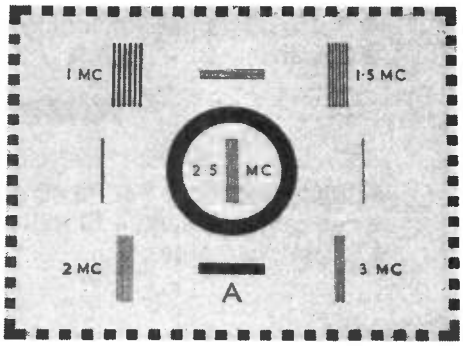


Photo 1 *Test Card 'A' – the first to be designed by the BBC*

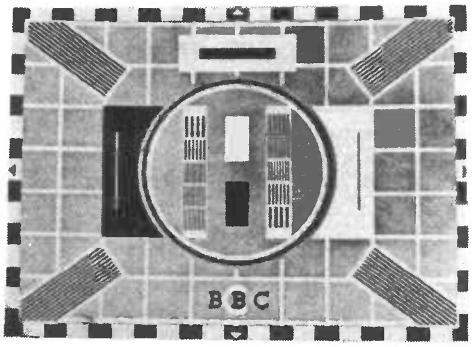


Photo 2 *The BBC Test Card 'C' used in various forms throughout the world*

Photo 3 *First colour test card used by the BBC way back in 1955 during experimental colour TV transmissions outside normal programme hours*

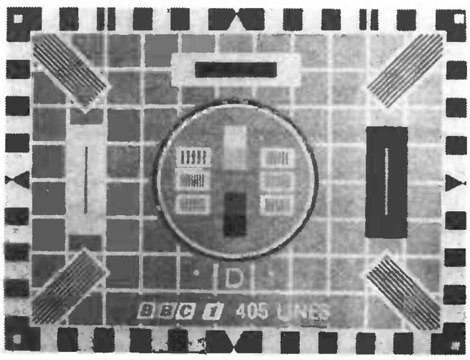


Photo 4 *April 1964 saw the introduction of Test Card 'D' on VHF 405 lines*

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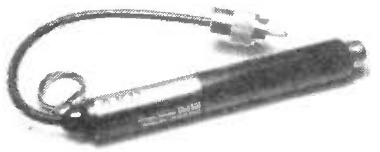

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selected and compiled by the BBC Foreign Recordings Unit in Broadcasting House.

When BBC-2 officially opened on 20th April 1964 (actually the opening was delayed until the following day due to a major power failure at Battersea, but that's another story...) a new test card was introduced on BBC-1 405 lines (*Photo 4*). This was designated by the letter 'D'. A modified Test Card 'C' was radiated on BBC-2 for a time (*Photo 5*) but was soon replaced by Test Card 'E' which was virtually identical to Test Card 'D'.

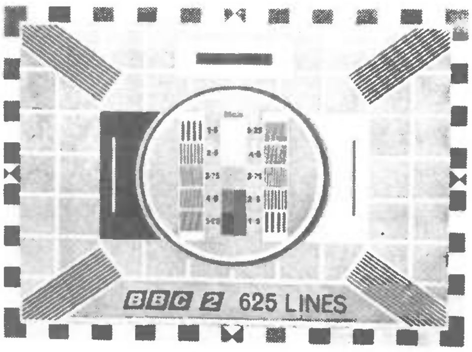


Photo 5 *A modified version of Test Card 'C' radiated by BBC-2 on UHF*

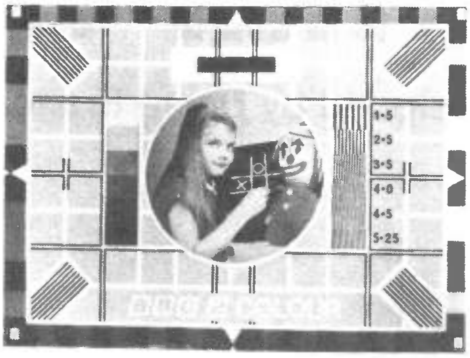


Photo 6 *The world-famous BBC Test Card 'F' radiated from December 1967 until May 1983*

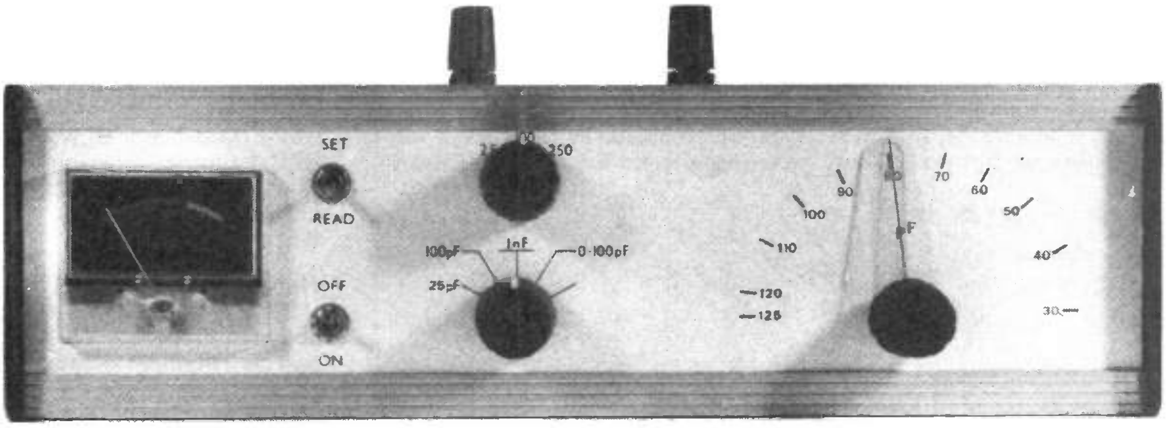
When the first colour television service in Europe commenced on BBC-2, a new test card (Colour Test Card 'F', shown in *Photo 6*, was introduced. This happened on 2nd December 1967; meanwhile, Test Card 'D' was continued on BBC-1. From 15th November 1969, BBC-1 was duplicated on 625 lines UHF in colour and so Test Card 'D' was replaced by Test Card 'F'.

Electronic Test Card 'F'

BBC engineers have recently been active in preparing a new version of the test card in which all the area outside the centre circle would be generated electronically. The area within the circle (showing Carol and friend) was to be generated from an electronic store. These plans have now been abandoned.

Colour Test Card 'G' which is a modified version of the PM5544 electronic test card, will still be used occasionally by certain BBC regions for short periods, mainly on BBC-2. This is necessary as it enables expensive landline circuits to be released for sending programme material between studio centres. Test Card 'F' will still be generated internally at Television Centre in London and may be transmitted on very rare occasions, notably if and when the *Ceefax* equipment develops a fault.

So, regrettably, after 36 years of BBC-TV radiating a test card on an almost daily basis, the end of a broadcasting era has arrived. It's time to bid BBC test cards a final farewell.



The Cymar Q Meter

Designed by David Francis

Anyone involved with the development of RF circuits will have occasion to wind coils of a given inductance. The professional will have access to an inductance bridge, an expensive piece of equipment not usually found in the amateur workshop. Construction of such an instrument will involve costly close-tolerance inductors, when they can be found!

An alternative solution is the construction of a *Q*-meter which does not involve any expensive components. Although this type of instrument is primarily intended for the sole function of measuring the *Q* of an inductor, spin-off data (e.g. frequency and calibration capacitance) enable the rest of the coil's constants to be calculated. Moreover the readings can be taken at or near the frequency of operation of the coil (very important as you approach VHF), a facility not found in most bridges which operate with fixed oscillators at low frequencies.

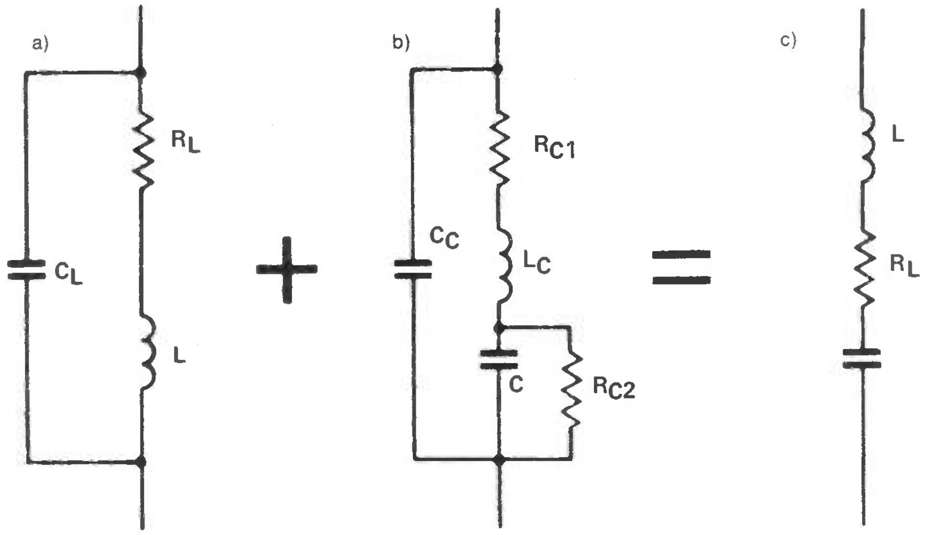


Fig 1: *a) Equivalent circuit of an inductor; b)Equivalent circuit of a capacitor; and c) Simplified series tuned circuit*

The theory

At the risk of teaching one's grandmother how to suck eggs, the basic theory of the *Q*-meter is as follows:

A tuned circuit resonates at a frequency determined by the formula:

$$f = \frac{1}{2\pi\sqrt{LC}}$$

where *f* represents frequency of the resonance in Hz; *L*, inductance in henrys; and *C*, capacitance in farads. The other important relationship is that between the current passed by the tuned circuit and the impressed voltage signal. Now in a series tuned circuit, the impedance is equal to the distributed resistance contained in the circuit *(see Figure 1);* but since most of this resistance is contained in the inductor, the impedance can be said to equal the DC resistance of the coil. So if we apply a signal at the resonant frequency, the current that will flow will obey the following:

$$I = V/R_L \qquad (1)$$

where *I* is the current passed by the tuned circuit; *V* is the amplitude of the voltage; and R_L is the DC resistance of the inductor.

The capacitor and inductor in the circuit will develop voltages that are equal in amplitude but of opposite phase, thus cancelling out. The amplitude of this voltage will, however, be:

$$V_L = I.X_L$$

where V_L is the voltage across inductor and X_L is the reactance of the inductor. By rearranging we get

$$I = V_L/X_L$$

and by substituting in equation 1, we get

$$V/R_L = V_L/X_L$$
$$\therefore V_L = V.X_L/R_L \qquad (2)$$

However the textbooks tell us that X_L/R_L is equal to the *Q* of the coil, so

$$V_L = Q.V \qquad (3)$$

and since the voltage across the capacitor V_C is equal to that developed across the inductor it follows that:

$$V_C = Q.V \qquad (4)$$

The point of the present exercise is to produce a *Q*-meter and from the above we see that it is possible to measure the *Q* of our inductor by placing it in a series tuned circuit and measuring both the applied voltage and the voltage across either the inductor or the capacitor. The ratio of the applied voltage to either V_C

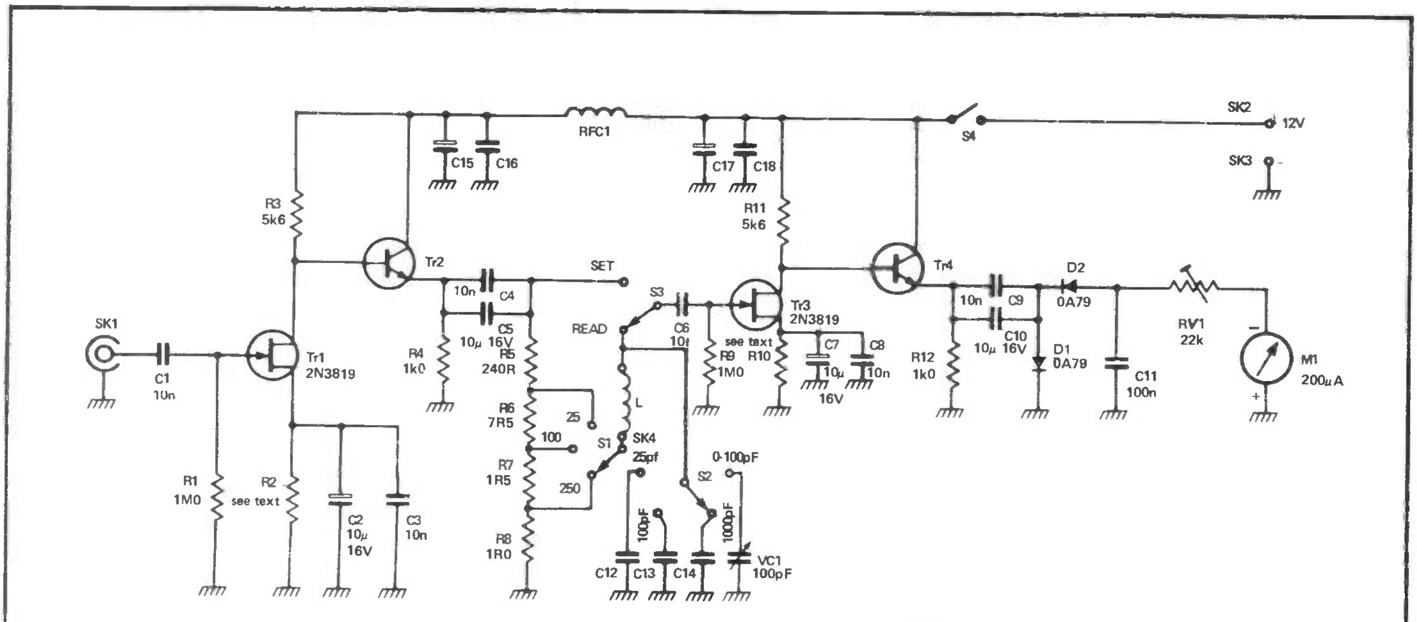


Fig 2: *Circuit diagram for the Q-meter*

or V_L will represent the Q of the inductance.

Applying the theory

The first requirement for the Q-meter is a variable frequency oscillator (VFO) that will cover the desired frequency range. Since most workshops will have a signal generator available, it was decided to use this as the VFO.

In addition, the tuned circuit requires a low impedance feed and since the signal generator output impedance is not always defined, it is imperative to arrange for high to low impedance conversion between the two parts of the circuit. Similarly, in order not to influence the tuned circuit, the output voltmeter requires a high-impedance low-capacitance input with a low impedance output for feeding the diode detector. In the interest of simplicity, it was decided to use the same circuit for both the applications. The circuit is shown in *Figure 2.*

The input circuit comprises an FET used in common source mode and biased to have a drain current of 1mA. This is accomplished by an appropriate selection of the source resistor R2. A good value to start with is 2k7 and then either increasing its value (decreasing drain current) or decreasing its value (increasing drain current). Alternatively the resistor could be replaced by a preset potentiometer. The output of the circuit — an emitter—follower — provides the necessary low output impedance.

The detector incorporates a voltage-doubler circuit to improve the sensitivity of the instrument and it can in fact feed meters ranging from 50µA to 1mA.

It will be noticed that 10µF and 0.01µF capacitors are placed in parallel at various points in the circuit. It is important that these are bead tantalum and ceramic respectively. Should the wrong types be used, 'holes' will result in the Q-meter's frequency response.

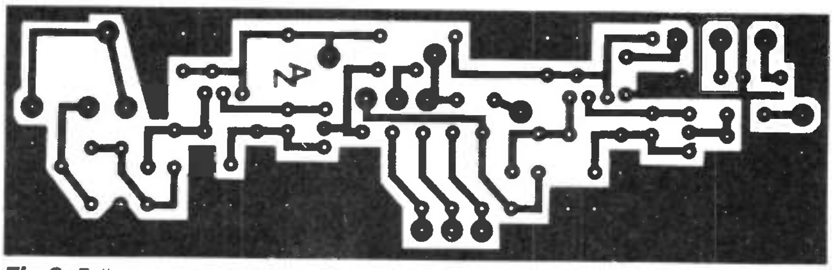


Fig 3: *Foil pattern for Q-meter*

Construction

The two amplifiers are constructed on a printed circuit board (the foil pattern for which is shown in *Figure 3*) bar the two FET source resistors. When the board has been completed, these 2k7 resistors can be tacked into position on the copper side of the board. The 12V supply is then connected and the voltage on the emitter of the output transistor checked. The value of the source resistor should be adjusted until this is approximately *6V*.

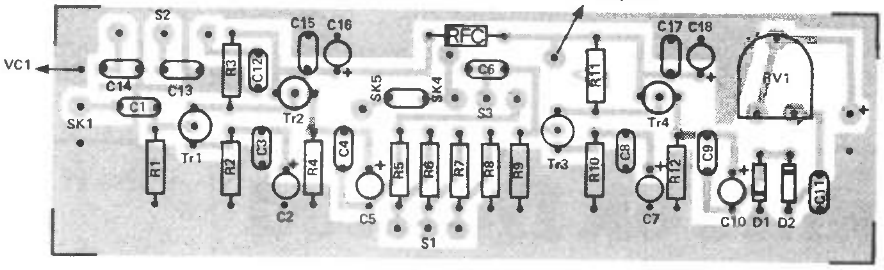
Once this has been completed, a resistor of the required value may be placed permanently in position on the component side of the board and the PCB in its position in the cabinet. The layout used is shown in the component overlay *(Figure 4)*, and this should be adhered to if repeatable results are to be obtained.

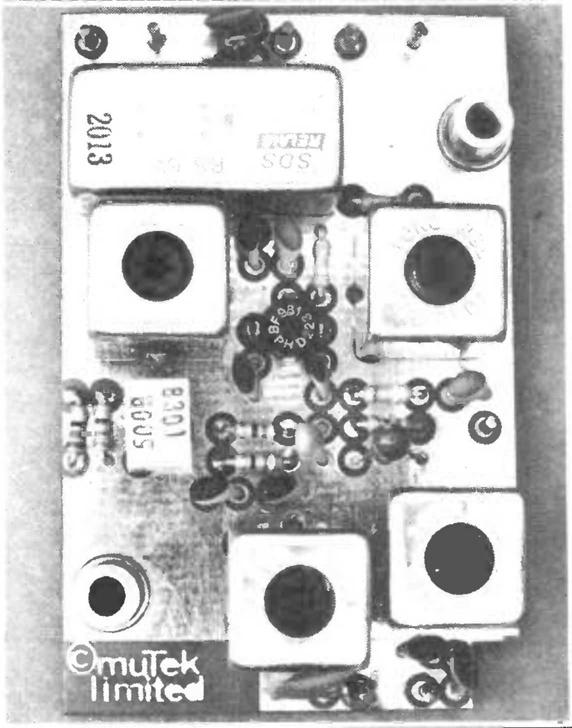
Most of the components are mounted on the printed circuit board; however there are a few additional points to bear in mind.

Since the wiring associated with the tuned circuit must be of low capacitance in order not to affect the calibration, all wiring must be as short as possible and kept well clear of the chassis. Screened wire must not be used except on the input from the signal generator.

The capacitors on switch S2 must be

Fig 4: *Component overlay*





Bigger Ears Than Dumbo!

— the SLNA 145sb preamplifier
for the FT290.

£27.40 + 1.20 p&p inc. vat

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

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

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

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

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

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

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

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

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

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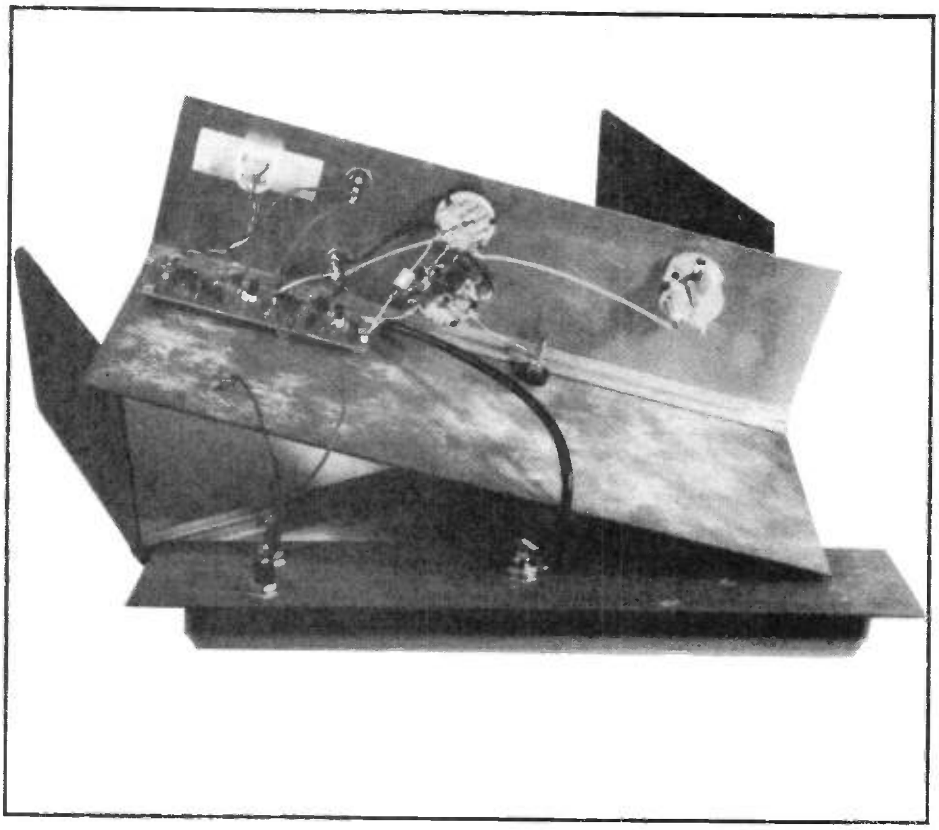


PARTS LIST

Resistors

R1, R9	1MΩ
R2, R10	see text
R3, R11	5.6Ω
R4, R12	1kΩ
R5	240Ω
R6	7.5Ω
R7	1.5Ω
R8	1Ω
VR1	22kΩ preset

Capacitors

C1, C3, C4, C6, C8, C9	10nF mono cap
C2, C5, C7, C10	10μF 16V tantalum
C11	100nF disc cap
C12–14	see text
VC1	100pF variable

Others

TR1, TR3	2N3819
TR2, TR4	BF254
D1, D2	OA79 or similar germanium diode
S1	1P3W switch
S2	1P4W switch
S3, S4	SPST toggle
SK1	BNC socket
SK2, SK3	Banana socket
SK4, SK5	Screw terminals
M1	200μA meter

Case, knobs, 1mH RFC

close-tolerance temperature-stable types and it is recommended that mica or COG-type ceramics be used.

It should be noted that the circuit board is mounted on the inside of the top of the cabinet. This was found to keep stray capacitance down to an acceptable level and so assure the accuracy of the instrument.

Calibration

To calibrate the finished instrument (minus its calibration capacitors), an inductor of known value is required: its actual value is irrelevant (within reason). This is connected in the position of the unknown inductor and the power supply and signal generator are also connected. Switch S2 is set to its open circuit position. Using the value of the chosen inductor and a capacitance of 28pF, calculate the resonant frequency. With the range switch set to 25 and also to READ, sweep your signal generator across the frequency you've calculated. Whilst doing so observe the meter and tune the generator to the peak. Note the frequency of the generator.

Substitute this frequency and the value of the known inductor into the following formula:

$$C = \frac{1}{(2\pi f)^2 . L}$$

The resultant value is the stray capacitance of the instrument and should be deducted from the values of the calibration capacitors. In the prototype this was found to be 23.54pF and, provided the original layout is copied, this value could be used if a known inductor is not available.

The variable capacitor is calibrated by using an inductor of known value (even if you don't have one in the first place, you can use any inductor and measure its value using the procedure described later) and calculating the resonant frequency for capacitance values from 30pF to 130pF. With the switches set as previously described, except for the capacitance calibration switch S2 which is now to be set to the 0–100pF position, set the signal generator to each of the calculated frequencies and peak the meter by adjusting the variable capacitor, marking each point on the scale. The one in the prototype was found to cover 30pF to 125pF.

Using the Q-meter

The procedure for using the instrument is as follows:

1) Connect the power supply and signal generator to the *Q*-meter.
2) Put the SET/READ switch to the SET position and the *Q*-range switch to the 25 position.
3) Adjust the output level of the signal generator so that the meter indicates FSD (the preset in series with the meter can be used to make up any deficiencies in generator output).
4) Reset the SET/READ switch to the READ position and sweep the signal generator from the high frequency end to the low frequency end until the meter peaks. (This is essential since you do not want to operate on a harmonic.)
5) Revert back to the SET position and re-adjust the generator for FSD (few signal generators give constant output at all frequencies).
6) Return to the READ position and read the *Q* from the meter, if necessary changing the *Q*-range switch.

If at this stage the inductance is not known, the calibrating capacitor value should be noted along with the signal generator frequency. From these it is easy to calculate the inductance from the formula:

$$L = \frac{1}{(2\pi f)^2 . C}$$

where L is the unknown value of inductor; f, the frequency of the signal generator; and C, the calibration capacitance.

Final thoughts

The capacitors used for calibration should be of the close tolerance low drift type. Silver mica is ideal for this application but others could be used, such as ceramic NPO types.

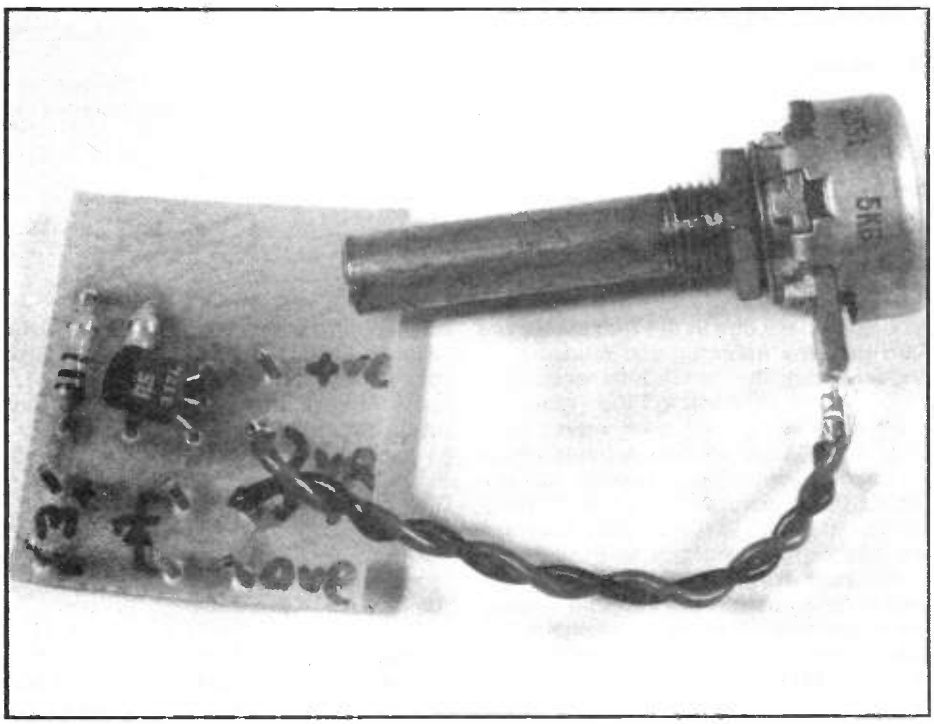
Do not use screened leads on the input to the meter amplifier since it will considerably increase the stray capacitance and limit the minimum calibration capacitance. Their use on the signal generator amplifier input and output is, however, recommended since it will decrease the effects of stray RF coupling due to stray capacitances, which can lead to errors.

Although the *Q*-meter was designed for use with an external power supply there is adequate room inside the case to build an integral power supply. In either case, the 12V line should be regulated since any variation in the line voltage will drastically affect the biasing of the DC coupled amplifiers.

A PCB for this project is available from Edwardschild Ltd, 453 Becontree Ave, Dagenham, Essex RM8 3UL price £2.65 ea. inclusive.

One Night's Work

Stephen Ibbs was inspired to design the couple of circuits presented here by components rescued from old boards



If, like me, you often buy old component boards from rallies with the intention of rescuing the ICs, resistors etc, you will – no doubt – at some time acquire a number of dubious looking Zener diodes with weird notations – and you will have no way of telling whether they are still functional. A simple go/no-go tester is therefore required.

A Zener diode checker

The circuit that I've used for some time is shown in *Figure 1*. This can be constructed either on veroboard or on a PCB, a design for which is given in *Figures 2 and 3*. In the 'prototype', veropins were used for the various connections.

The principle of the circuit is as follows. The input of the voltage regulator IC1 is held at approximately 18V by the batteries. (I use two PP3's connected in series.) The output from this device, which can be varied by altering RV1, is fed via a current-limiting resistor R2 to the Zener diode on test. If the diode is good, then the 0–15V meter mounted in parallel with it should give a relatively stable reading once the avalanche point has been reached. (I used an old meter movement with a series resistor to give me the right range, but a multimeter can be connected into the circuit just as easily.)

In use, RV1 is set for minimum voltage, the diode is connected and the unit turned on. Gradually turn RV1 and watch

Fig 1: *Circuit for the Zener diode checker*

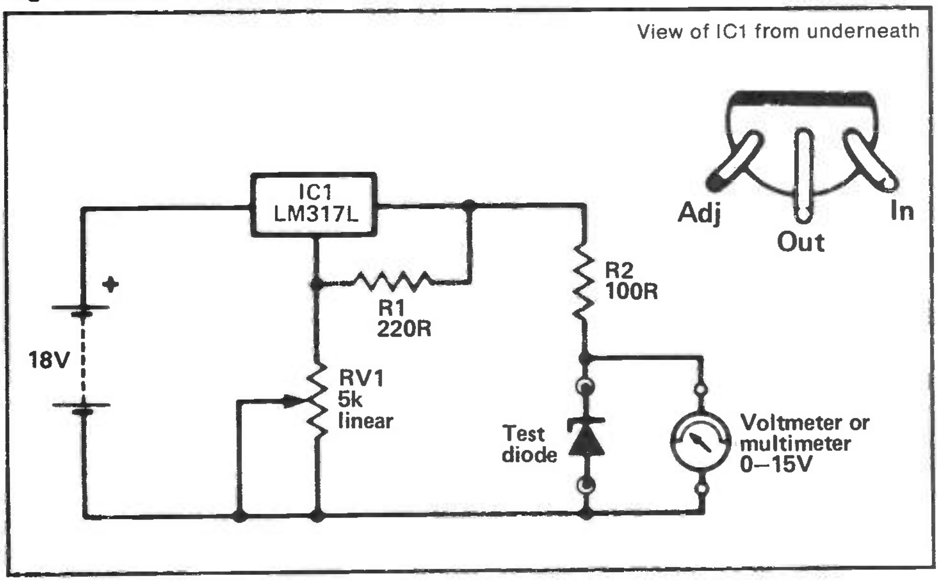
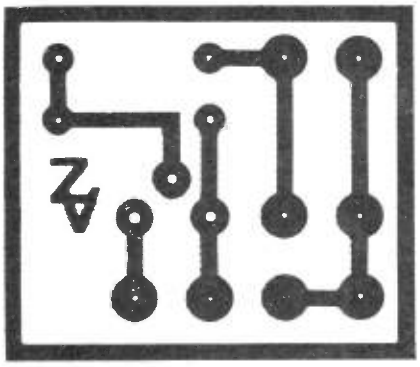


Fig 2: *PCB foil pattern*



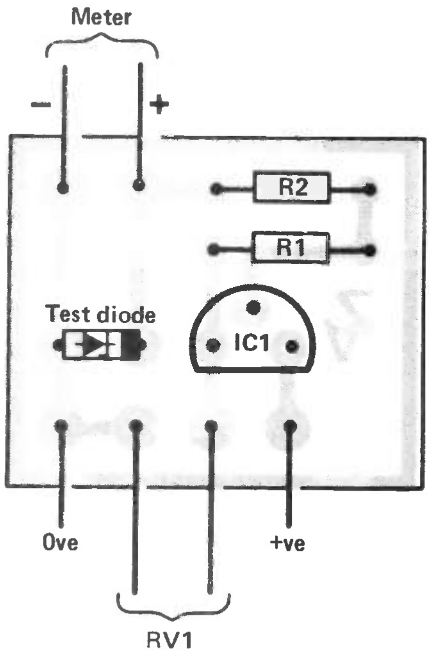


***Fig 3:** Component overlay*

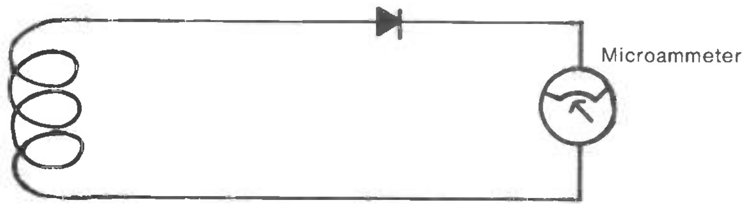


***Fig 4:** Circuit for the RF sniffer*

the meter rise and then stabilise: this voltage is the Zener voltage.

A word of warning at this point. Don't turn the applied voltage up much beyond that at which the meter stabilises or the diode may have to dissipate too much power.

If the meter fails to move, or doesn't stop moving, the diode is extremely suspect – or its characteristic voltage is above 15V and out of the range of this circuit.

An RF sniffer

The use of an old meter movement in the above circuit reminded me of what is probably the most useful piece of elaborate(!) test equipment in the shack – an RF sniffer. This device displays when there is any RF in the vicinity and is invaluable for poking into transmitters when tuning up.

The design shown here *(Figure 4)* costs virtually nothing and consists of the most sensitive meter movement you can find (mine is an old 50μA movement), some 18-20 SWG wire (enamelled to prevent possible shorting) and a diode – preferably a sensitive germanium type. Wind two or three turns of wire, leaving tails about 3" long: then trim a bit off one end and connect the diode. Next, attach the other end of your coil and the spare end of the diode to the meter terminals.

In principle, the deflection should rise as the meter is moved away from any source and, as a result, peaking is extremely easy. Once you have constructed this unit, switch on a nearby transmitter: if the meter needle deflects the wrong way – just turn the diode round.

That's it – and you'll wonder how you ever managed without one!

QRM KILLERS

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is the definitive and long awaited answer to the Russian Woodpecker. Others claim to solve the problem of the distinctive RAT A - TAT TAT of the Russian radar system. **DATONG are the first to succeed with a fully automatic blanker.**

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Price: **£75.00 + VAT** (£86.25 Total)

MODEL ANF

The value for money, stand alone automatic notch filter that doubles as a CW filter. Model ANF is small in size but neat in looks and big in performance. Simply connect model ANF in series with the loudspeaker lead of your receiver and from then on heterodynes, whistles and other steady tones that often make listening on the crowded amateur and short wave bands hard work will vanish automatically, as model ANF notches them out.

A bargraph LED display shows you the frequency of the offending interference. At the push of a button model ANF becomes a good CW filter eliminating all but the signal you want to hear. Manual or automtaic operation in notch and peak modes, plus automatic frequency control, makes model ANF extremely versatile and easy to use.

A power supply of 10 to 16 volts DC @ 100 ma is required. Model ANF is supplied with connecting leads, and is identical in size to model SRB 2

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A Drinker's Delight

David Francis

One of the many accusations levelled at *R&EW* is that it only considers the electronically inclined minority and so does very little for the drinking majority. Since most of the people working for *R&EW* are, nonetheless, contained within the aforesaid majority, we took the comment to heart.

After much fruitless discussion over many pints of the local landlord's beverage, the meeting was adjourned to the demesne of one of our number where the talking continued over the home-brewed beer (lipsmakinthirstquenchin-drunkmakin). But matters came to an abrupt halt when it was discovered that – horror of horror – the elixir of life had run out. No warning of imminent drought had been given since the beer was contained in an opaque plastic barrel.

After emergency supplies had been obtained from the local off-licence, it was decided that a means of giving warning of the impending cessation of our supply should be sought. The following day found several of our number perusing all the manufacturers' data books in the hope of finding something suitable for our needs. Eventually, a bleary eye spotted a fluid detector type ULN2429A which will indicate via a lamp when a liquid reaches or falls below a given level. The manufacturer was contacted and a sample liberated.

The circuit shown in *Figure 1* was constructed and two probes spaced half an inch apart were fixed to the barrel screw cap. One of our number *(a genius)* decided that the best test was to fill the barrel with beer and then to continue drinking its contents until the alarm was set off. Promptly the petty cash was raided (it was in the interest of research, wasn't it?) and all present set to with gusto.

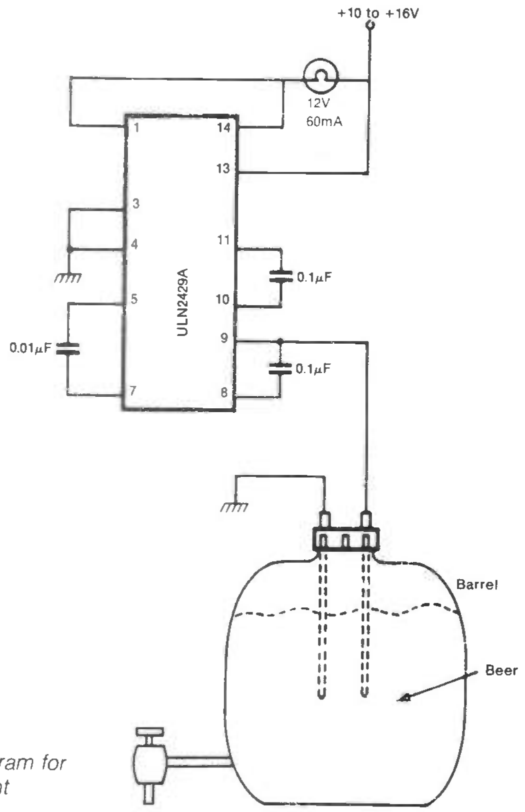


Fig 1: *Circuit diagram for the Drinker's Delight*

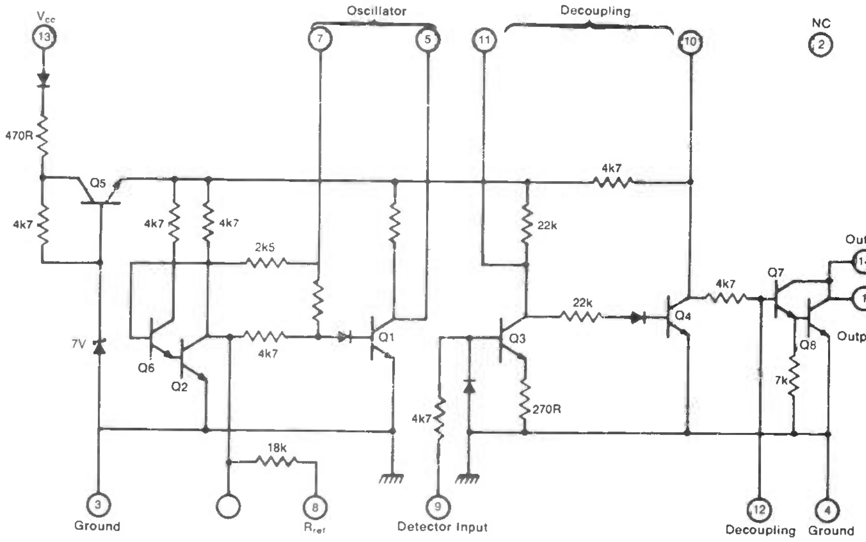


Fig 2: *Internal circuit of a ULN2429A*

How it works

The ULN2429A, although primarily designed for use as a detector of when an automobile's coolant is low, is equally applicable to work on almost any conductive liquid (and non-conductive types with only a little modification).

A 2.4kHz (approx.) oscillator drives the probes via an 18kΩ resistor. Since the liquid between the probes is conductive, only a fraction of the oscillator voltage will be available at the probe. This fractional signal is connected to an amplitude detector which will not operate unless the voltage equals or exceeds the raw oscillator output. When the fluid is removed from between the probes, the resistance approaches infinity and the threshold sensitivity of the detector is exceeded. This, in turn, turns the output transistors on – thus illuminating the lamp.

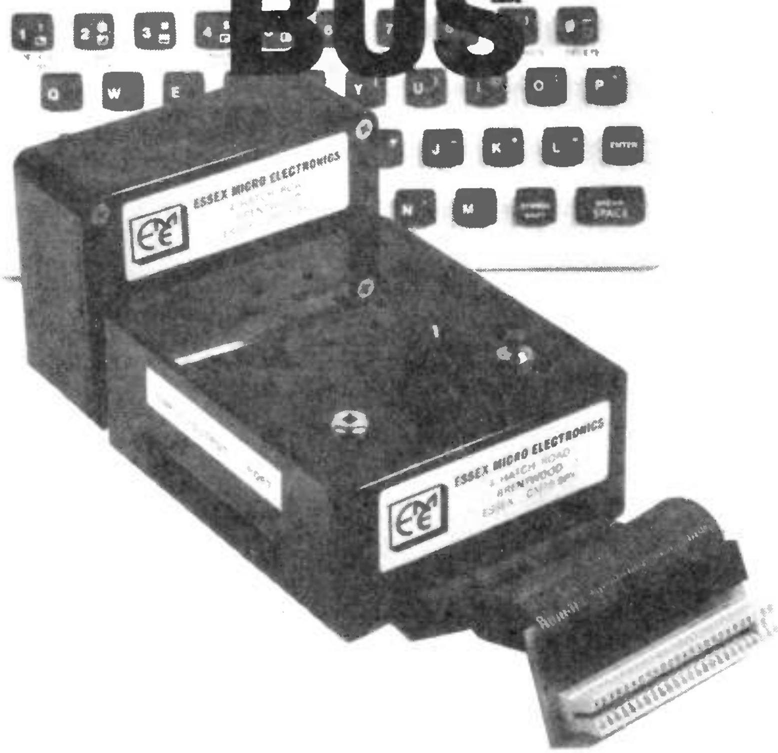
Typical conductive fluids are tap water, sea water, tea, wet soil, beer and coffee. Non-conductive fluids include most petroleum products, distilled water, dry soil and (surprisingly) vodka.

In practice the probes could be replaced with any variable resistance element such as photodiodes, photoconductive cells, rotary or linear resistive position sensors, thermistors etc.

In theory, the circuit can be converted for use with non-conductive fluids by taking the oscillator output from pin 6 to the probes via a low value capacitor. Although the probes will not have a usable resistance, they will have a finite capacitance so that a capacitive voltage divider will be formed. If the fluid level drops, the capacitance will change and thus the output voltage also will change.

It took several barrels-full before we were satisfied that its operation was satisfactory. Strangely, the indicator lamp exhibited a tendency to multiply itself intermittently – a facet of its behaviour noted towards the end of our function tests.

Jupiter ACE EXPANSION BUS



'Ding Ding': next stop on the Expansion Bus is the Jupiter Ace SOUNDBOARD from Essex Micro Electronics. 'Sounds' like a good idea. Roland Perry finds out what we have 'hear'.

Most personal computers have some sort of sound output built in, and many have a small loudspeaker as well. To have more than a puny 'beep' or more than a single voice, however, usually requires some help from a dedicated sound generation chip. Custom designed devices are used in some personal computers, but the easiest route is to use one of the readily available general purpose programmable sound generator chips. In the case in point, Essex Micro Electronics have chosen the same chip to expand the range of sounds available from the Jupiter Ace as is used in, amongst others, the ORIC and COLOUR GENIE. This is no less than the AY-3-8910 from General Instrument.

The AY-3-8910 was originally designed for use with the CP1600 microprocessor which has a multiplexed data and address bus. In practice this origin is not a problem, and interfaces to such well-known 8-bit micros as the Z80 merely require two distinct I/O operations to send each byte of information to the sound generator. A much more comprehensive study of the chip, and how to create 'interesting' noises will be published in *R&EW* next month; for now we need to know just the general principles.

The sound generator is intended to be used on a system, such as a video game, where the processor has many other tasks to perform and the overhead of making music would thus be too great a burden. Once the commands have been latched into the various registers within the AY-3-8910, it will continue to produce the sound without any further intervention from the host microprocessor. Ten registers are required to specify the sound which comes out *(see Figure 1)*: some of these are 8-bit registers while others are 16-bit, giving a total of fourteen 8-bit locations to program. In practice, many are only active on the lower order bits and the higher order bits are ignored.

Principles

First, let's look at the generation of tones and white noise. Three different notes can be specified, obtained by dividing the clock by a 'magic' number to get the frequency of the output. These magic numbers, which are set into the first six registers, are effectively values for the period of each tone: they are 12-bit numbers divided between coarse and fine tune registers. More about the mathematics next month: for now, we offer a program, published below, which shows how to calculate the values (in HEX) for a specific clock frequency. Seven or eight octaves of notes in the standard musical scale can reasonably be expected from typical clock frequencies. The noise period is derived in the same way, but an internal divide by 16 means you effectively start with a lower clock frequency.

Now that the tone and noise are under way, the user has complete control over how the three tones and noise are switched through to the 'volume control' of each channel. This is achieved via the enable register. Note that although there are three different tones, the 'same' noise is sent to all channels which have noise enabled. The three-channel volume control allows either a fixed amplitude specified by a number in the range 0 –15 from each of the three mixed tone and noise sources, or automatic envelope control of each mixture. The envelope control is envoked by setting an amplitude in the range 16 –31 (i.e. the 'M' bit is on) although volume control bits 'L0' to 'L3' are ignored in this configuration.

All channels with envelope control selected obey the same envelope period and shape. The period is, yet again, derived from the clock frequency by division – this time after a x256 prescaler. The longest period normally available will be a few seconds; the shortest, fractions of a millisecond. The envelope shape is defined by a combination of four bits which control such matters as the slope direction and repeat enabling. For now it is sufficient to demonstrate the envelope generator outputs given by particular set-up values *(see Figure 2)*. The most useful of these in practice is the single decaying note at the top of the chart.

Results

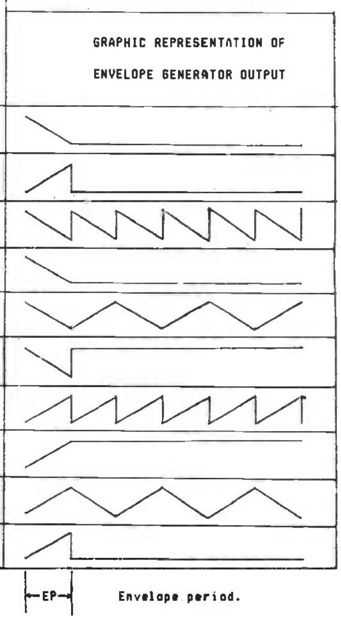
Any single register or combination of registers can be changed to alter the quality of the final output and it is common practice to publish 'recipes' of well-known effects. The Essex Micro Electronics SOUNDBOARD manual has suggested recipies for a wolf-whistle, a trimphone and a train, along with register values for other effects such as a piano. Their wolf-whistle sweeps a little slowly, but the trimphone and train are excellent. The recipies published by General Instrument are couched in terms of clock frequencies, register values and milliseconds: the SOUNDBOARD recipies use various routines in FORTH to do the hard work of calculating

REGISTER	FUNCTION	B I T							
		7	6	5	4	3	2	1	0
R 0	Channel A Tone Period	8-bit fine tune (A)							
R 1		-	-	-	-	4-bit coarse tune (A)			
R 2	Channel B Tone Period	8-bit fine tune (B)							
R 3		-	-	-	-	4-bit coarse tune (B)			
R 4	Channel C Tone Period	8-bit fine tune (C)							
R 5		-	-	-	-	4-bit coarse tune (C)			
R 6	Noise period	-	-	-	5-bit period control				
R 7	Main control register	In / Out		Noise			Tone		
		I/O A	I/O B	C	B	A	C	B	A
R 8	Channel A Volume	-	-	-	Env en	4-bit volume (A)			
R 9	Channel B Volume	-	-	-	Env en	4-bit volume (B)			
R 10	Channel C Volume	-	-	-	Env en	4-bit volume (C)			
R 11	Envelope Period	8-bit fine tune Envelope							
R 12		8-bit coarse tune Envelope							
R 13	Envelope profile	-	-	-	-	4-bit control			
R 14	I/O Port A	8-bit parallel port							
R 15	I/O Port B	8-bit parallel port							

NOTE : $\bar{X}$ Means that X is active low.
- Means bit not used.

Fig 1: *AY-3-8910 Register layout*

REGISTER 13 CONTROL BITS				
BIT 3	BIT 2	BIT 1	BIT 0	
CONTINUE	ATTACK	ALTERNATE	HOLD	GRAPHIC REPRESENTATION OF ENVELOPE GENERATOR OUTPUT
0	0	X	X	
0	1	X	X	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	



X = Don't care. EP Envelope period.

Fig 2: *Envelope profiles*

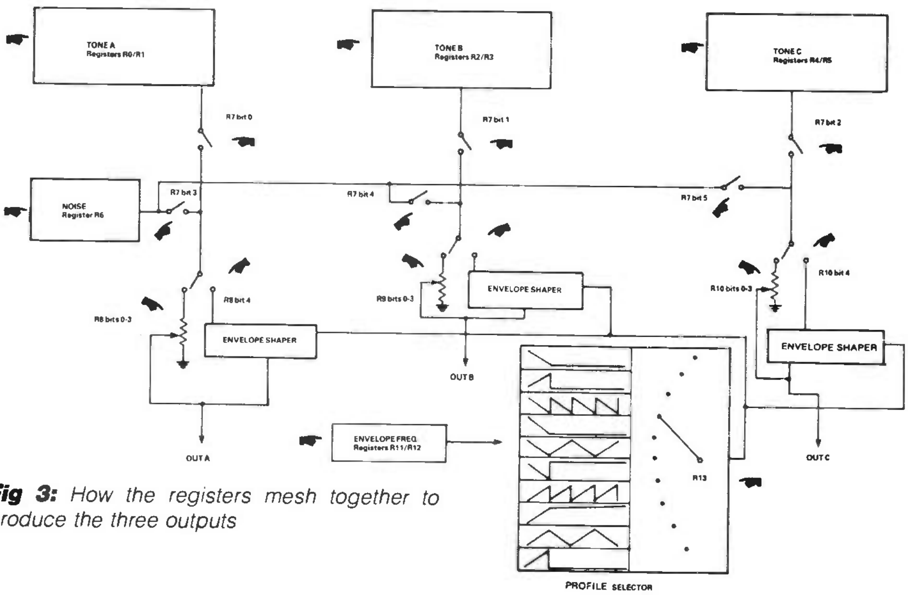


Fig 3: *How the registers mesh together to produce the three outputs*

```
100 REM COMPUTE A TABLE FOR AY-3-8912 NOTES
110 REM 23/10/83
120 REM
130 FCLOCK£=1E+06
140 PRINT "Equal tempered chromatic scale (Fclock=";USING "£££££££";FCLOCK£;
150 PRINT "Hz)":PRINT
160 WIDTH 80
170 PRINT "NOTE     OCTAVE      IDEAL    ACTUAL    DIVIDE"
180 PRINT "----     ------      -----    ------    ------"
190 PRINT
200 NOTE$="C C£D D£E F F£G G£A A£B "
210 FOR OCTAVE=1 TO 8
220  FOR NOTE= 1 TO 12
230  TWOPOWER£=((OCTAVE*12+NOTE-22)/12)
240  FT£=55£*2^TWOPOWER£
250  TP10=INT((FCLOCK£/(16*FT£))+.5)
260  CT10=INT(TP10/256)
270  FT10=TP10-(CT10*256)
280  AF£=FCLOCK£/(16*(256*CT10+FT10))
290  HEXFT10$=HEX$(FT10):IF LEN(HEXFT10$)=1 THEN HEXFT10$="0"+HEXFT10$
300  PRINT MID$(NOTE$,NOTE*2-1,2),OCTAVE,USING "££££.£££";FT£,
310  PRINT "  ";USING "££££.£££";AF£,
320  PRINT " ",HEX$(CT10);HEXFT10$;
330 NEXT NOTE
340 NEXT OCTAVE
```

and setting up the period registers, as well as that of switching the various combinations of tone and white noise.

The SOUNDBOARD plugs directly into the expansion port of the Jupiter Ace using a flexible cable to avoid connector wobble problems. An extension to the expansion bus at the rear of the unit allows the recommended RAM add-on to be fitted as well. It also has a fitted volume control and a loudspeaker giving ample output, plus a jack socket for an alternative external speaker if required. A reset button feeds to the sound generator chip (rather than the processor) permitting instant relief if required.

On the side of the case is an input/output port which uses a facility of the AY-3-8910 not discussed so far. (Indeed, you will have to wait for next month's instalment!) It also has a parallel port. The latter is accessed via the last two of the sixteen sound generator chip registers and the upper two bits in the enable register. Essex Micro Electronics provide some helpful suggestions as to how to make use of this added facility by giving some circuit diagrams and, yet again, routines in FORTH.

Sections in the manual describe how the sound chip is organised, the register descriptions and functions. A library of commands is built up step by step in FORTH to let the operator have a high-level-language interface to the hardware.

Conclusions

Altogether this add-on is highly recommended. The manual is comprehensive and clear and the SOUNDBOARD really does make superb noises. The only flies in the ointment are *(a)* that it is dedicated to the Jupiter Ace and, at the time of writing, Jupiter's future is uncertain – and *(b)* that writing programs in FORTH gives yours truly a headache!

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AND BASIC ACCURACY DC Current: 0.1μA — 10A±0.8% AC Current: 0.1μA — 10A±1.0%
Resistance: 0.1 ohm — 20M ohms±0.8%
OPERATING TEMPERATURE 0° to 50°C
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OVERRANGE INDICATION Highest digit of '1' is displayed
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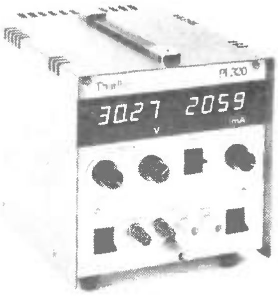

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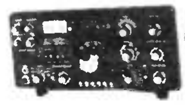

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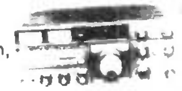

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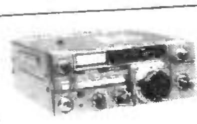

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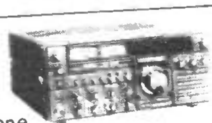

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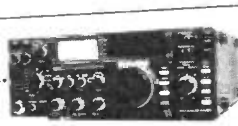

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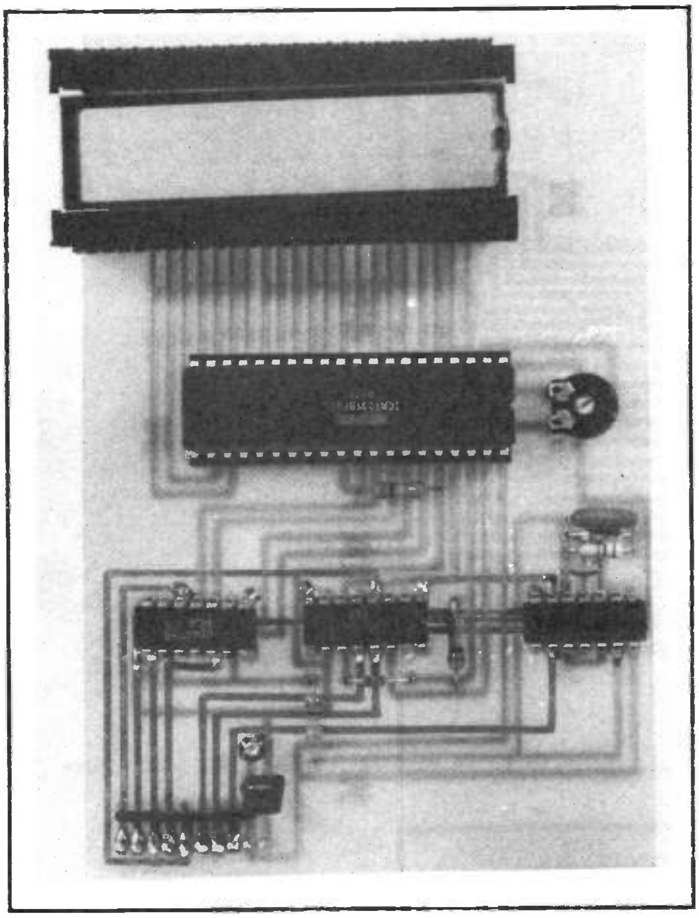

LCD DISPLAY OPTION FOR THE REWBICHRON II

Readers interested in building the Rewbichron II (*R&EW* April, May '83) will almost certainly realise that the outputs from the main board are capable of driving other displays than the 7-segment LED's considered in the original article. The option presented here is for an LCD version and it was designed by Stephen Ibbs in conjunction with John Robinson: a vacuum fluorescent display is also being considered for a future article

The main consideration when designing any alternative display option is that it should be fully compatible with the main board software... i.e. there should be no need for the EPROM to be modified or for any other changes to be made to the main board. This in fact proved to be a bit of a headache in the initial design stages to this project because of the way the display blanks certain digits, as will be explained later. But first, on with the description.

The new display

The main IC used in this design is the Intersil 7231B triplexed LCD driver. The technique of triplexing LCD displays is fairly recent and it enables eight digits to be driven by one 40-pin IC quite easily, overcoming the need for masses of segment connections. It is outside the scope of this article to explain triplexing in detail; suffice it to say that three common lines are used instead of the one backplane, and the display is constructed like a matrix between these and the segment lines. Readers seeking more detailed information are referred to the Intersil data sheets.

As only six digits are required, the outputs are split up to drive digits number 0,1,3,4,6 and 7 – the idea being to give three groups of two, corresponding to hours, minutes and seconds or date, month and year as appropriate.

This IC requires data input in 4-bit binary code, while a 3-bit control code is used to address the various digits. This can be provided by the main board direct, and will work fine – except when the processor blanks certain digits as it does:

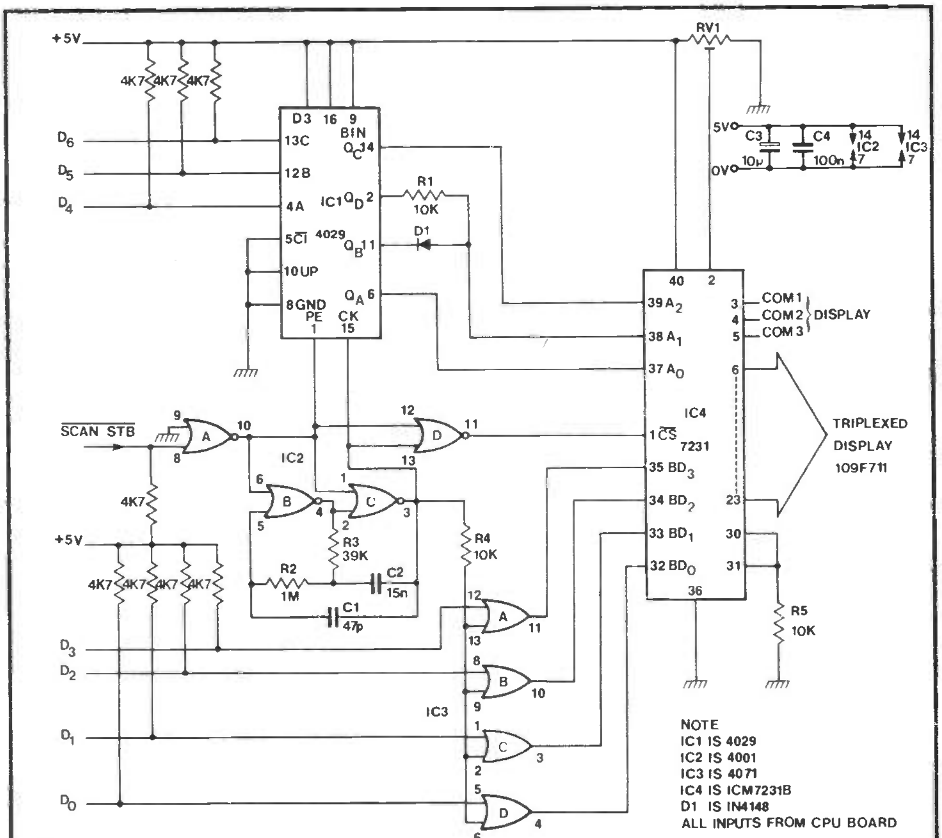

Fig 1: *Circuit diagram*

a) Before and after the date display (all digits)
b) In response to leading zero of day, month and (12-hour mode) hour
c) At 00 seconds when invalid Rugby data has been received

The 7231B has to have data all the time otherwise the display shows meaningless rubbish. Thus some sort of interface was needed and eventually the following solution developed, the circuit for which is shown schematically in *Figure 1.*

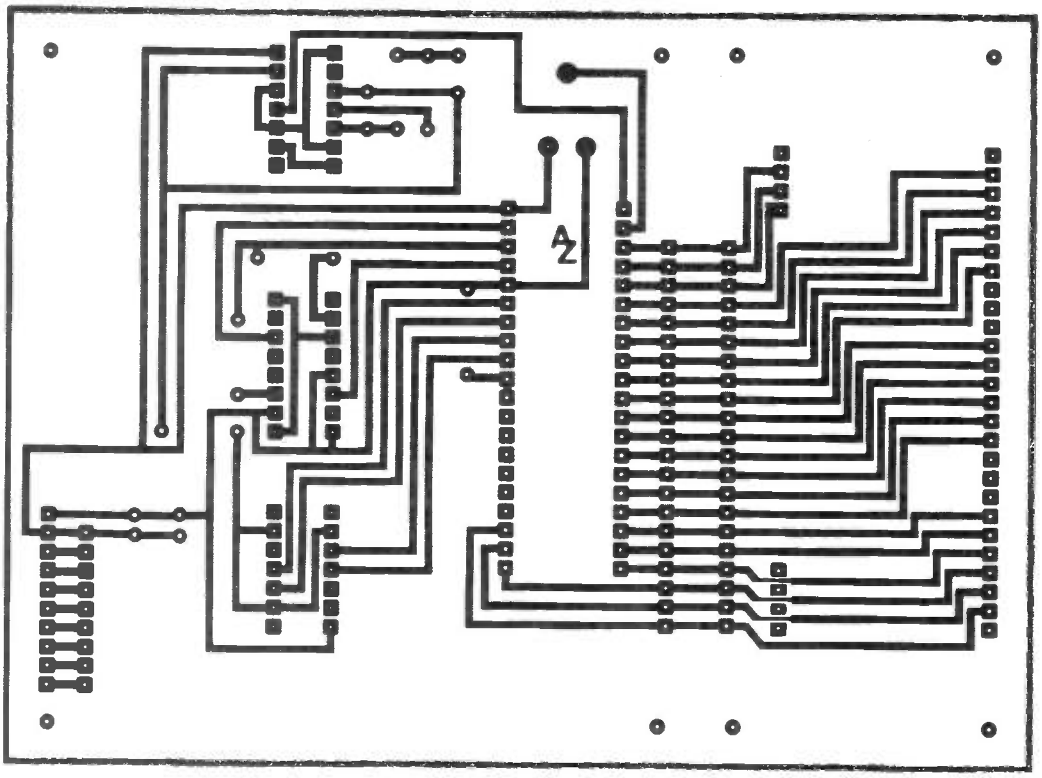

Fig 2 PCB bottom plane

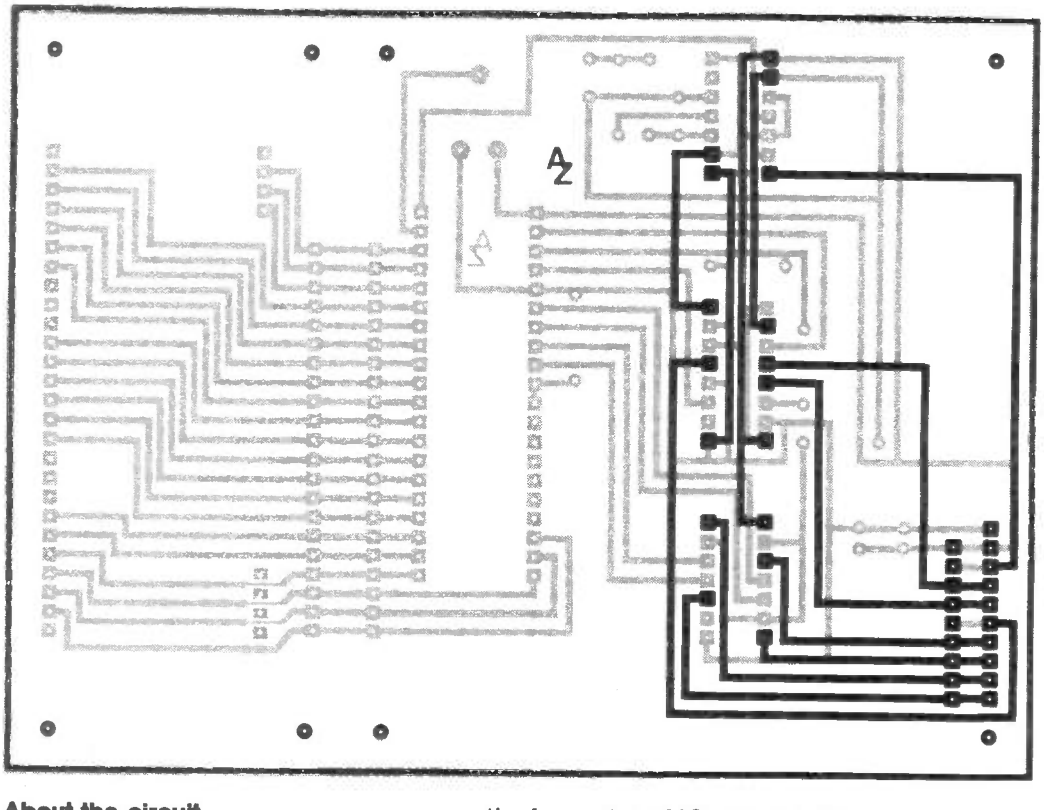

Fig 3 PCB top plane

About the circuit

Under normal circumstances, i.e. when a scan strobe is present, each high level pulse from IC2a makes IC1 'transparent' so that the digit address data is fed unchanged to the LCD driver (IC4). During this pulse, IC2 pin 11 is forced low, feeding 'chip select' ($\overline{CS}$) on the 7231B. (Note, however, that the address and data are not latched until IC2 pin 11 goes high at the end of the strobe pulse.) The oscillator, comprised of IC2b,c, is inhibited during the scan strobe pulse, and moreover will not start during the normal inter-pulse gaps. Also at this time the four gates of IC3 act as buffers only, and the binary data is fed unchanged to pins 32–35 of the 7231B.

If, however, a long gap occurs, for example when a digit is blanked and its scan strobe is omitted, the oscillator will start to generate a square wave at approximately the scan-strobe frequency (set by R3 and C2). Each positive-going edge at IC2 pin 3 clocks IC1 (which up to now has been preset-enabled) with the result that it counts down to the next digit address in the scan sequence. Now if one input of a 4071 OR gate is high, the output will also be high: thus in these circumstances IC3, via R4, forces the digit data to 1111 which is the blanking code for the 7231B, and IC2 pin 11 takes 'chip select' low. But when the oscillator goes low again, 'chip select' goes high, latching the address and data codes into the LCD driver. R4, together with the stray capacitance at the IC3 inputs, delays the removal of the forced 1111 digit data long enough to meet the specified hold time for the 7231B.

R1 and D1 are connected to ensure that digit 5 in terms of the circuit (digit number 7 in terms of the display) can be blanked. (The digits are numbered, you

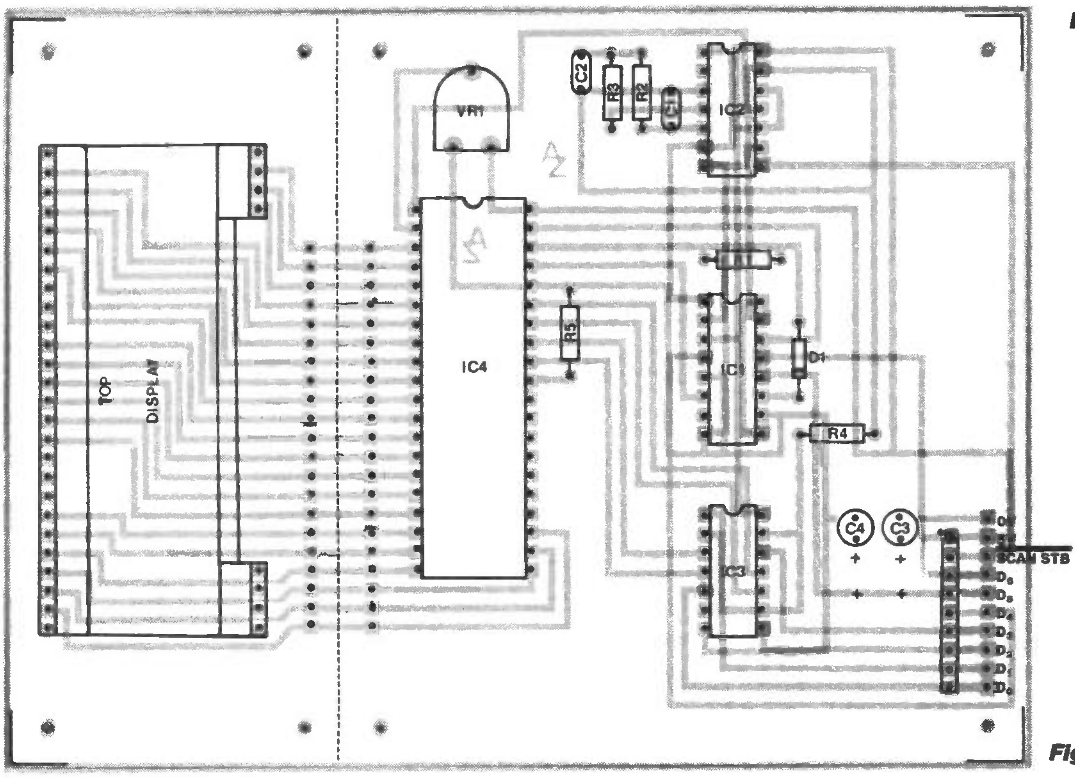

Fig 4 Component overlay

KB Connector fitting method

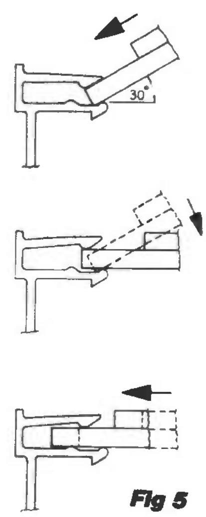

Fig 5

remember, 0 – 7 counting from the right when looking at the front of the display.) If the counter counts down from 0000, it would normally go to 1111 on the next clock, which will not result in the correct digits being blanked. The arrangement is such that an address of 0000 actually comes from a counter state of 1000; the next count below this is 0111 and the 0 from Q_D forces the A_1 output to 0, making the address 0101, which equals 5.

During periods of total blanking, such as the time/date gaps, the counter cycles round all the digit addresses loading the blanking code. A point to note is that, on the first cycle, it addresses the digits in a curious order as a side-effect of R1 and D1, but thereafter it is correct. This however has no effect on the appearance of the display.

There are a few other points to note about this interface. Firstly, the preset feeding pin 2 of the 7231B allows the display contrast to be set to suit the surrounding light and the viewing angle. Secondly, R5 holds the two annunciator pins 30 and 31 low: but if one of these is pulled high, the appropriate decimal point (31) or chevron (30) will light. Finally, because the display board uses CMOS logic while the main board is TTL, pull-up resistors have been provided on all data inputs by the inclusion of an SIL resistor network (not shown in *Figure 1*).

If you have followed this explanation, congratulations! If not, then we ask you merely to accept that the interface circuit shown in *Figure 1* provides the correct signals to blank the display digits for which no scan strobe is provided...in practice, it really does work!

Construction

A double-sided PCB has been designed and the foil patterns and component overlay are given in *Figures 2–4*. Please note the dotted line running between the two rows of pads. If readers so wish the board may be cut here so that the display can be mounted remotely, joined by ribbon cable between the two rows.

Some pins of the ICs need to be soldered on both sides of the board: if readers are unsure about how to mount the device direct, it is recommended that soldercon pins are used, as these can easily be inserted and soldered on both sides prior to mounting the ICs. Be careful not to let solder run up the inside of the pin sockets.

A normal socket is used for the 40-pin IC, and either soldercon pins, or a normal socket (cut up), for the display. Note that several pins on one side remain unconnected.

Be very careful when inserting the display into its strip holders. *Figure 5* shows the correct way. Failure to observe this may bend the pins, and damage the glass seals.

Mount all the components, making sure that the SIL resistor network is inserted the correct way round...the dot goes to +ve as indicated on the component overlay. Veropins should be inserted for the connections to the main Rewbichron board, and eight of these should be soldered on both sides.

After careful checking – particularly to see that all through-board connections have been made – connect to the main board and turn the preset fully anticlockwise. Switch on and once Rugby has been fully received, the display should leap into action. Adjust the preset to give a well contrasted display with no ghosting of segments.

If nothing happens, it is likely that the scan strobe preset on the main board has not been adjusted correctly to ensure that the pulses are as long as possible, consistent with six distinct pulses per 10msec. Adjust the preset and at some point the LCD display should become stable.

NB: The main IC must be the *7231B*. The 'A' version, as supplied by RS Components (for example), is not suitable because the code 1111 will cause the letter F to be displayed. Similarly, a normal 8-digit display will not work as it must be triplexed. The LUCID display type 109F711 (available from Ambit) is suitable and was used in the prototype.

PARTS LIST

Resistors

R1, R4, R5	10kΩ
R3	39kΩ
R2	1MΩ
RV1	see text

Capacitors

C1	47pF
C2	15nF
C3	10μF
C4	0.1μF

Semiconductors

IC1	4029
IC2	4001
IC3	4071
IC4	ICM7231B
D1	IN4148

Miscellaneous

Triplexed display – 109F711; 8 commoned resistor SIL package (4.7kΩ); 8 biasing resistors (see text, *Figure 1*)

A PCB for this project is available from Edwardschild Ltd, 453a Becontree Ave, Dagenham, Essex RM8 3UL at £4.55 ea. inclusive.

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XF82HSN	1.8 KHz Narrow SSB filter	£18.80
XF82HC	600 Hz CW filter	£18.80
XF82HCN	300 Hz CW filter narrow	£18.80
XF455C	500 Hz CW filter	£44.85
XF455CN	270 Hz CW filter narrow	£44.85
FT77	Transceiver 8 band mobile multimode	£459.00
FT77S	Transceiver 8 band mobile 10 watts	£399.00
MRKT77	Calibration marker unit option	£9.60
FMUT77	FM Board option	£25.30
FP700	External power supply/speaker	£110.00
FC700	Antenna tuner	£85.00
XF8.9KC	600 Hz CW filter	£17.25
FT757GX	Amateur bands TX General RX	£625.00
FP757GX	Switch mode PSU	£135.00
FC757AT	Automatic Antenna Tuner	£210.00
FT902DM	Transceiver 9 band, multimode	£765.00
FT902DE	902DM less invertor, memory & FM	£749.00
FT902D	902DM less invertor, memory & keyer	£749.00
FMU901	FM Module	£28.00
KEYT901	Curtis Keyer	£26.85
MEMT901	Memory Unit	£87.90
DCT901	Invertor (from 12VDC)	£46.75
XF89GF	12 KHz crystal filter FM	£26.05
FTV901R	**SOLD OUT**	
50TV	6m transvertor module	£79.75
70TV	4m transvertor module	£84.70
144TV	2m transvertor module	£109.65
430TV	70cms transvertor module	£214.65

XF8.9HC	CW Filter 600Hz	£26.05
XF8.9HCN	CW Filter 300Hz	£26.05
XF8.9GA	AM Filter 6KHz	£26.05
FL2100Z	Linear Amplifier 1200 W + (PIP)	£475.00
FT707	Transceiver 100W 10-80M (8 bands)	£499.00
FT707FM	**SOLD OUT**	
FP707	Mains power supply/speaker	£110.00
FV707DM	Digital VFO	£170.00
FC707	Antenna Tuner	£85.00
FTV707R	Transvertor c/w 2M	£99.00
FRB707	Relay switching box	£15.35

FT-726R

FT726R(2)	Multimode multiband c/w 2M	£675.00
FT726R	Main frame only	£550.00
50/726	6m module	£170.00
21/24/28	HF module for 15m, 12m and 10m	£180.00
144/726	2m module	£135.00
430/726	70cm module	£230.00
SAT726	Full duplex module	£90.00
XF455MC	600Hz CW filter	£39.85
FT230R	Transceiver 2m FM 25W	£239.00
FT730R	Transceiver 70cm FM 10W	£259.00
FT690R	Transceiver 6m 2.5W multimode	£239.00
FT290R	Transceiver 2m 2.5W multimode	£249.00
FT790R	Transceiver 70cm 1W multimode	£299.00
SMC2.2C	Nicad cell, 2.2 A/hr 'C' size	£2.70
SMC8C	Slow charger (220mA)	£8.80
MMB11	Mobile mount	£24.90
CSC1A	Soft carrying case	£3.85
YHA15	Flexible helical antenna	£5.00
FL2010	Linear amplifier 2m 10W	£59.00
FL7010	Linear amplifier 70cm	£91.00
FT680R	Multimode transceiver 6m	£349.00
FT480R	Multimode transceiver 2m	£399.00
FT780R	**SOLD OUT**	
FT780R1.6	**SOLD OUT**	
FP80A	Power supply unit	£55.00
SC1	Station console	£138.00
FL2050	Linear amplifier 50W	£115.00
FT720RV	Transceivers 2m 10W FM	£199.00
FT720RVH	Transceivers 2m 25W FM	£209.00
FT720RU	Transceiver 70cms 10W FM	£229.00
FT720R	Control head	£100.00
720RV	Deck only 2m 10W	£100.00
720RVH	Deck only 2m 25W	£110.00
720RU	Deck only 70cms 10W	£130.00
S72	Switching box	£39.00
E72S	Cable, 2m long	£10.00
E72L	Cable, 4m long	£15.00

Prices include VAT & Carriage

FT-290R

FT208R	Transceiver Handheld 2.5 2m	£199.00
FT708R	Transceiver Handheld 1W 70cms	£209.00
FNB2	Nicad Battery Pack	£19.95
FBA2	Battery pack sleeve (fits FNB2)	£3.05
FBA3	Charging sleeve (for FT207 acc)	£5.35
NC9C	Slow charger	£8.00
NC7C	Base Master	£30.65
NC8C	Quick charge and PSU	£50.60
MMB10	Mobile bracket	£6.90
FRG7700	Receiver 0.15-3.0 MHz AM/CW/SSB/FM	£335.00
FRG7700M	Receiver c/w 12 channel memory	£389.00
DCRG7700	DC modification kit	£1.15
MEMG7700	Memory option	£98.90
FRT7700	Antenna tuner/switch	£42.55
FRA7700	Active antenna	£38.70
FF5	Low pass filter 500 KHz	£9.95
FRV7700A	Convertor 118-130, 130-140, 140-150 MHz	£78.95
FRV7700B	Convertor 118-130, 140-150, 50-59 MHz	£84.70
FRV7700C	Convertor 140-150, 150-160, 160-170 MHz	£74.75
FRV7700D	Convertor 118-130, 140-150, 70-80 MHz	£80.90
FRV7700E	Convertor 140-150, 150-160, 118-130 MHz	£83.95
FRV7700F	Convertor 150-160, 160-170, 118-130 MHz	£83.95
YM21	Hand 600, 4 pin noise cancel	£15.70
YM24A	Hand 2K, 6 pin min. speaker/mic	£18.40
YM35	Hand 600, 8 pin scan	£15.35
YM36	Hand 600, 8 pin, noise cancel	£14.95
YM37	Hand 600, 8 pin	£7.30
YM38	Stand 600/50K, 8 pin scan	£27.20
YM47	Hand 600, 7 pin, scan control	£10.75
YM49	Hand 600, 7 pin, speaker/mic	£16.85
YE7A	Hand 600, 4 pin	£7.65
YD148A	Stand 600/50K, 4 pin	£22.60
YD844A	Stand 600/50K, 4 pin	£26.85
MH-1B8	Hand 600, 8 pin scan	£13.80
MD-1B8	Desk 600, 8 pin scan	£49.85
FSP1	Mobile speaker 8 ohms	£11.15
FSP2	Mobile speaker 4 ohms	£11.15
YH55	Headphones padded low z	£9.95
YH77	Headphones lightweight low z	£9.95
YH1	Lightweight mobile headset/boom mic	£13.80
SB1	PTT switch box for FT208/FT708	£14.95
SB2	PTT switch box for FT290/FT790	£12.65
SB3	PTT switch box for FT202	£13.80
FP4	12V power supply 4 amps	£44.45
QTR24D	World time clock quartz	£31.45
FF501DX	Low pass filter	£25.70
YP150Z	Terminated Wattmeter 5-30-150W FSD	£92.00

YAESU SPECIAL OFFERS

FTV107R TRANSVERTER c/w 2m	£89.00	FV101DM VFO	SOLD OUT
FTV901R TRANSVERTER c/w 2m	£139.00	FV901DM VFO	SOLD OUT
FTV707R TRANSVERTER c/w 2m	£99.00	FT227R	SOLD OUT
DMS 107 DMS UNIT for FT107	£69.00	FP107PSU	SOLD OUT

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R&EW Data Brief MC1377

MC1377
Colour signal encoder

One of the last remaining discrete areas in 'consumer' electronics has succumbed to integration with Motorola's new MC1377 colour signal encoder device that claims to operate to standards that permit quality TV camera applications, as well as the current fad products of colour computers and TV games consoles. There have been such devices available from National for some years past based on 3-bit switched levels – LM1886/LM1889. These devices were essentially somewhat crude, dating back to the introduction of some of the first integrated 'Tele-tennis' devices. The advent of the latter devices now seems like an aeon ago.

The MC1377 *(Figure 1)* is everything any computer, video games or TV manufacturer needs in a low cost colour encoder. It accepts red, green and blue (RGB) signals, and encodes them into a composite video signal in either PAL or NTSC formats. The IC contains an on-board reference Colpitts oscillator (which may optionally be slaved from another 'master' oscillator in the system), a voltage-controlled 90-degree phase shifter, two double sideband modulators and blanking level clamps.

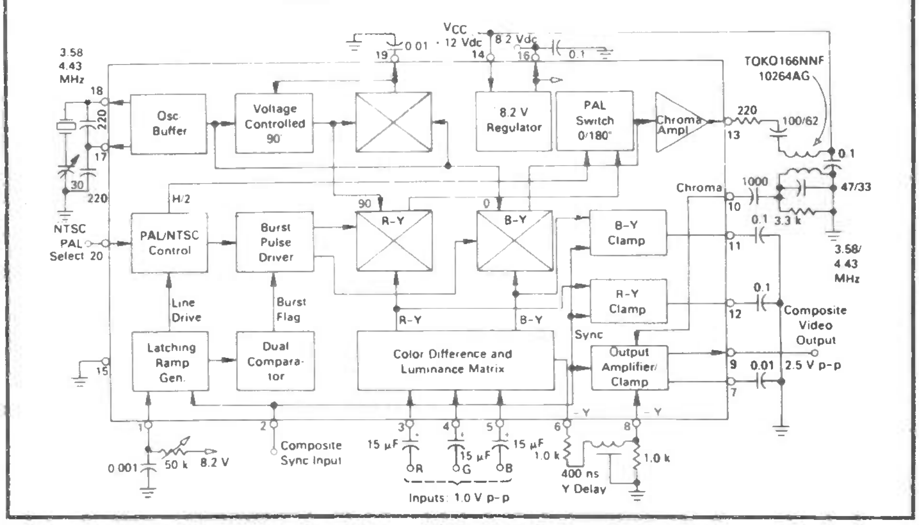
The chroma signals saturate at 1.0V p-p. (R-Y), (B-Y) and (−Y) signals are generated in the input matrices and are DC clamped to the 'black' level by a sync driven clamp. Burst generation is provided by a sync triggered ramp on pin 1, combined with two internal level sensors. Only a small portion of the ramp is used (at the beginning) with the result that sufficient accuracy is achieved with using fixed components on pin 1. Burst amplitude is internally fixed to correspond to sync level, allowing for a 3dB loss in the chroma bandpass filter. *Figure 2* shows some typical waveforms.

Working in conjunction with the MC1374 *(Figure 3)* enables a complete encoder/modulator to be built to operate to standards hitherto only achieved with nearly five times as many parts. US pricing is quoted at \$2.35 for 100–999: however, deliveries are already 10–14 weeks and they will probably get worse as this part is likely to be adopted very quickly by computer and games manufacturers.

The spec is listed in the table alongside.

The chroma bandpass filter (out of

FIGURE 1 — BLOCK DIAGRAM AND APPLICATION CIRCUIT



Rating	Symbol	Value	Unit
Supply Voltage	V_{CC}	15	Vdc
8.2 Vdc Regulator Output Current	I_{REG}	10	mAdc
Operating Temperature	T_{AMB}	0 to +70	°C
Storage Temperature	T_{stg}	−65 to +150	°C
Junction Temperature	$T_{J(max)}$	150	°C
Power Dissipation, package Derate above 25°C	P_D	1.25 10	W mW/°C

RECOMMENDED OPERATING CONDITIONS

Supply Voltage	12 ± 2	Vdc
Sync Tip Level Sync, Blanking Level	−0.5 to +1.0 +1.7 to +8.2	Vdc
Red, Green, Blue Inputs (Saturated)	1.0	V_{p-p}

ELECTRICAL CHARACTERISTICS (V_{CC} = 12 Vdc, T_A = 25°C, Circuit Of Figure 1 Unless Otherwise Noted.)

Characteristic	Pin No.	Min	Typ	Max	Unit
Supply Current	14	—	32	—	mAdc
Oscillator Amplitude	17	—	0.5	—	$V_{(p-p)}$
External Subcarrier Input (Oscillator Components Removed)	18	—	0.25	—	V_{RMS}
Subcarrier Input: Resistance Capacitance	18	— —	5.0 2.0	— —	k Ω pF
Modulation Angle (R–Y) to (B–Y)	—	87	90	93	Degrees
(R–Y) Angle Adjustment	19	—	0.25	—	Deg/µA
R, G, B Input For 100% Color Saturation	3, 4, 5	0.95	1.0	1.05	$V_{(p-p)}$
R, G, B Input: Resistance Capacitance	3, 4, 5	— —	10 2.0	—	kΩ pF
Sync Threshold (See Figure 2e)	2	—	1.7	—	V
Sync Input Resistance (Input > 1.7 V)	2	—	10	—	kΩ
Chroma Output Level At 100% Saturation	13	—	1.0	—	$V_{(p-p)}$
Chroma Output Resistance	13	—	—	80	Ω
Chroma Input Level For 100% Saturation	10	—	0.7	—	$V_{(p-p)}$
Chroma Input: Resistance Capacitance	10	— —	10 2.0	— —	kΩ pF
Composite Output, 100% Saturation (See Figure 2d): Sync Luminance Chroma Burst	9	— — — —	0.6 1.4 1.7 0.6	— — — —	$V_{(p-p)}$
Output Impedance (See Note 1)	9	—	—	100	Ω
Luminance Bandwidth (3 dB), Less Delay Line	9	—	8.0	—	MHz
Subcarrier Leakage In Output	9	—	—	40	$mV_{(p-p)}$

Note 1: Output Impedance can be reduced to less than 10Ω by using a 150Ω output load from Pin 9 to ground. Power supply current will increase to about 60 mA.

FIGURE 3 — COUPLING THE MC1377 TO THE MC1374 RF MODULATOR

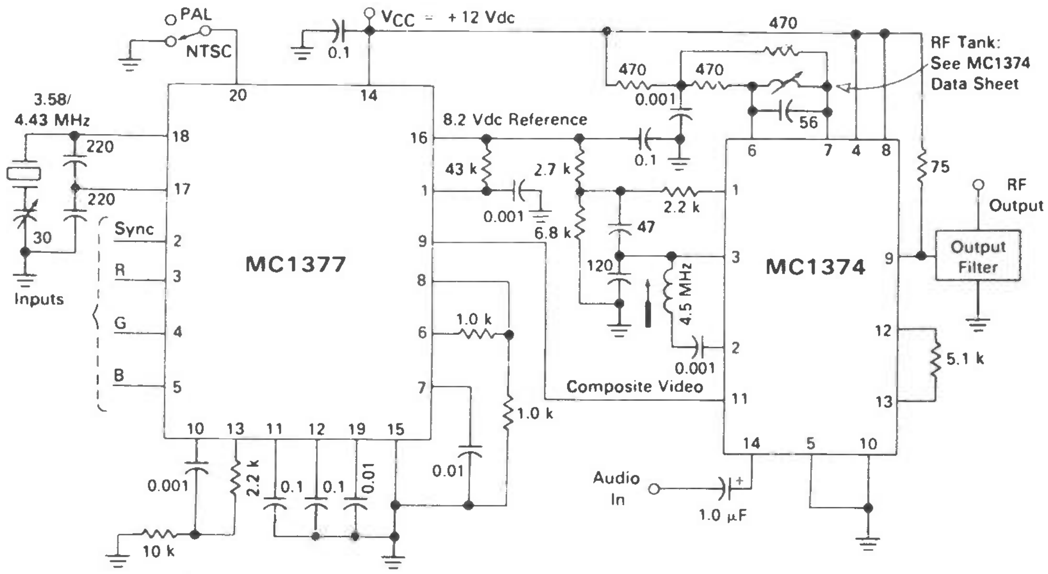
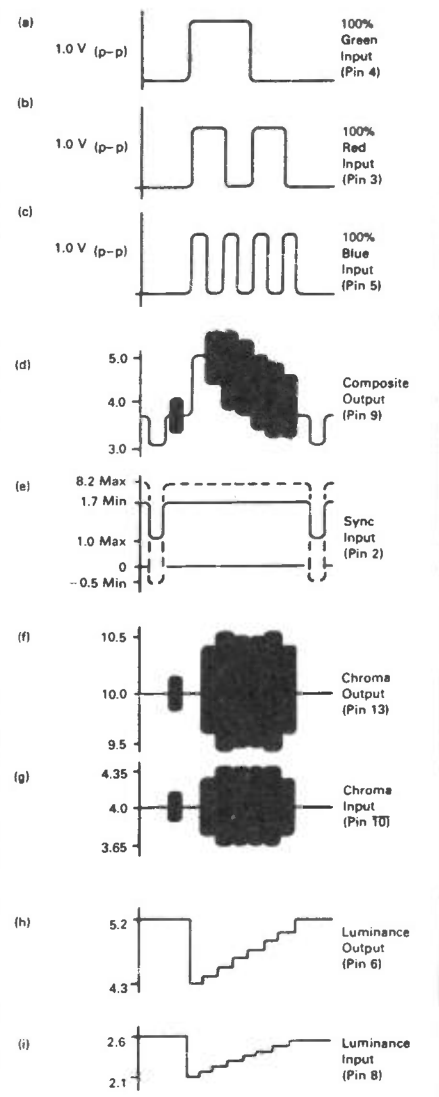


FIGURE 2 — SIGNAL VOLTAGES (CIRCUIT VALUES OF FIGURE 1)



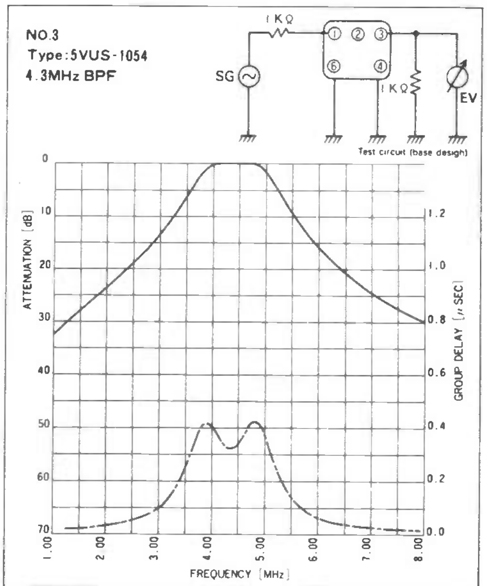


Fig 4: *VUS1054 bandpass and test circuit results*

pin 13, into pin 10) can be accomplished with a standard bandpass coil arrangement. Alternatively, it is quicker and easier to adopt a standard TOKO video block filter, such as the VUS1054, whose bandpass and test circuit results are shown in *Figure 4.* The 400nsec delay line is of the same standard as that found in a colour TV: however it performs the opposite function in the encoder.

For those of you who are not familiar with the operation of NTSC and PAL, the June '82 issue of *R&EW* contained a useful piece on the workings of colour TV systems within a feature entitled *'Video Recorders Explained'.* Back issues still available!

ATV on the Air

Presented by Andy Emmerson, G8PTH

Did you know that ATV has never been more popular than now? The BATC (British Amateur Television Club) has nearly 2000 members, which is a far cry from the handful who started things going back in 1949. However, due to lack of publicity, there are still a lot of people who don't know about the club, many of whom are not radio amateurs but are still keen on TV.

Some of the BATC's most recent members have come from home movie circles, who are now going over to video; others enjoy playing around with closed circuit TV equipment or collect old TV equipment. One guy who joined the club has over 30 old 405-line TV receivers and was looking for a 405-line picture source to keep his collection going once the BBC and ITV transmissions cease. Fortunately he is acquiring an old monoscope camera with Test Card 'C', which should be ideal.

Monoscope cameras, by the way, were the way we got test cards in the days before colour slide scanners or electronic test pattern generators. The monoscope camera had a special type of non-optical camera tube. There was therefore no lens, but instead a printed metal plate which was scanned to produce an image of the test card or picture printed on the metal plate. The whole affair was full of valves and typically stood about 5 feet tall in a 19-inch rack. Monoscope cameras took a fair bit of setting up but ah!, what a picture...takes you back to the 'good old days' of black-and-white television.

BATC activities

You might be surprised at the number of lunatics in the BATC who collect old broadcast or industrial TV equipment: of particular note is a group who are collecting cameras for an eventual museum. Of course, restoring this ancient gear can be a bit of a problem since spares are generally unobtainable – even common types of valves can be mighty expensive if you have to buy them from the few dealers who have stock-piled them. Moreover, old capacitors have a tendency to dry out and go open circuit (or leaky!), while wound components have to be kept dry to guard against damp.

If you know of any old TV equipment which you would like to make sure goes to a good home, please drop me a line and I will make sure your letters are passed on to the appropriate collectors. If you have any monoscope tubes, do please let me know!

However, getting back to the aim of the first half of this article, which was to mention some of the benefits of belonging to the BATC, I should mention first of all the quarterly magazine *CQ-TV*, which is sent free to members. This features circuits, constructional articles, news and details of members' activities. The sales and wants pages are always packed with bargains, and there is an order form for the specialised items the club sells to members. These include those hard-to-find bits and pieces like camera tubes, scan coils, test cards, crystals and printed circuit boards for club projects.

The BATC also organises conventions and demonstrations twice a year, where we 'videots' can get together and natter or spend money on more old rubbish or...well, you know the sort of thing. The BATC also organises operating contests for transmitting members and issues award certificates for operating achievement. Membership costs just £4 a year and you can get a form to sign up by sending a SAE (important!) to *Brian Summers, 13 Church Street, Gainsborough, Lincs.*

Because there is not a lot of information in print on the subject of amateur television, the club publishes four booklets. The shortest explains about the club and the very basics of amateur television; this is sent free when you join. A more complete introductory book is *TV for Amateurs* (£1.50) with 52 pages covering:

- TV principles
- Building a TV station
- Getting the equipment to start
- Sources of vision
- Transmitting
- Operating matters on the air
- Colour TV technique
- Microwave TV (the future!)
- All about the BATC.

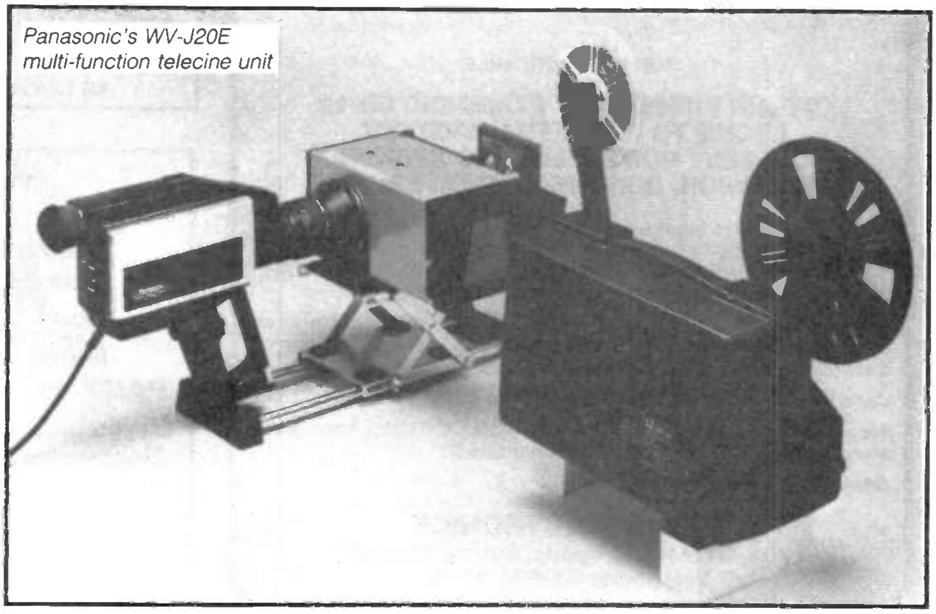
Once you have learned all there is to know at the beginner's level you will wish to read some more 'hard-core' material. You can get this from the BATC as well, in the form of *Handbook One* (£1.50) and *Handbook Two* (£2.00). Both of these contain more advanced construction of projects and are replete with all circuit and component details. Non-members can buy these books as well; add 40 pence per volume for postage and write to *BATC Publications, 14 Lilac Avenue, Leicester, LE5 1FN*. These are, of course, non-commercial productions but they are very professional in content, despite the low price. Further titles are planned, the next to appear being *Getting started on 24 centimetres*.

For a totally different approach you might also like to read a book from across the pond. This is called *Everything you always wanted to know about amateur television – but were afraid to ask*. Now in its third edition, it is published by QCD Publications, who also issue *A5*, the American ATV magazine. For $9.95 you get 112 pages covering ATV, slow-scan TV, computers and a lot more, all from an American viewpoint. Of course, a lot of the material is relevant to operation elsewhere – and it's great fun to read, too. The price is $9.95 plus $2.50 postage from *QCD Publications, PO Box H, Lowden, Iowa 52255 0408, USA*. Yes, their new postal codes are more complex than ours!

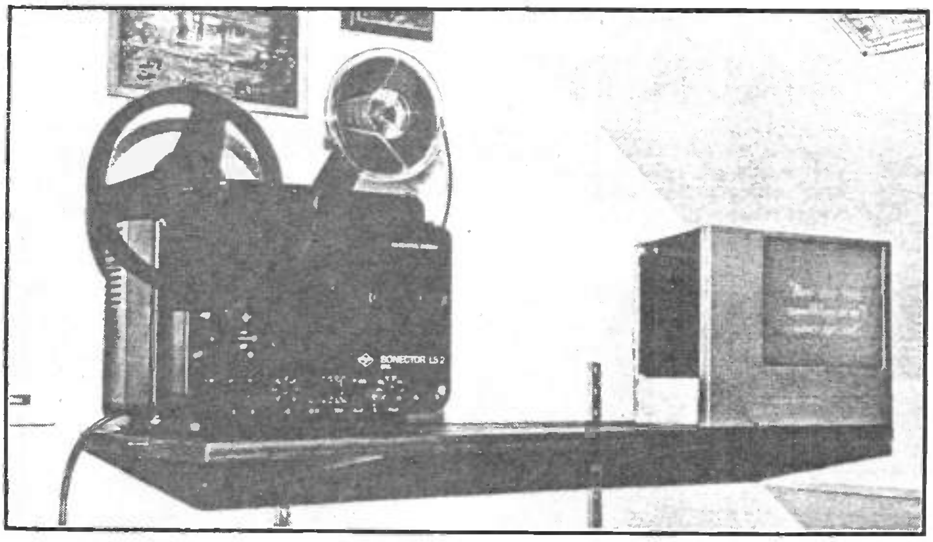
Sending slides

Changing the subject entirely, how do you go about putting slides or 8mm movies onto video or on the air? The answer is a telecine unit, and our pictures show a couple of ways of doing this, amateur style.

If you're only concerned with 35mm slides, you can buy an adaptor which screws onto a video camera lens. Cameras made by Sony, Panasonic, Canon and Olympus have these adaptors (technically known as diascopes) made for them. As well as slides you can also view colour negatives if you have one of those clever colour cameras which have the colour reversal facility. For years I



Panasonic's WV-J20E multi-function telecine unit



Norrie McDonald's solution to the problem of how to convert your cine film for transmission over the amateur TV network

made do with an ancient Philips diascope together with a black-and-white camera, but I think I may upgrade soon.

To show films as well you need a more complex arrangement that incorporates a 45° mirror, a neutral density filter to reduce light level and a ground glass screen. One of the pictures shows Panasonic's WV-J20E multi-function gadget which I rather like. Unlike some other telecine adaptors on the market, this one is fully adjustable so that you can vary the height and distance until it suits your video camera. It is then a matter of propping up the film projector on books or whatever until it shines right into the adaptor. Focusing of camera and projector brings you even closer to perfection. With the Panasonic unit, you can also 'shoot' still pictures or caption cards as well (see illustration).

The other picture shows a good old amateur solution, made by Norrie McDonald GM4BVU. In essence it's a Boots home preview screen, though Norrie changed the mirror to solve a problem of double images. He got a local glass firm to cut him a special front-surfaced silvered mirror for a few pounds, which has made all the difference. Apart from this, he has taped a Hoya +1 dioptre close-up lens onto the Hanimex 1200A slide projector's normal lens. His Agfa Sonnector LS2 film projector (shown here) has a 16.5–30mm zoom lens, and this makes positioning less critical. A +1 close-up lens was also necessary on the video camera.

Norrie says he tends to transfer slides to video tape (and add a voice-over commentary) before transmission. One minor drawback is that the camera AGC circuits are fooled each time the slide changes but they quickly adjust to the new brightness level. When using movie film, a slight flicker is visible since the film is scanned at 24 frames per second (compared to video's 25); Norrie adds that this is not sufficient to cause concern, considering the primitive nature of the set-up. I, too, have noticed this in my experiments, but it is only visible on really bright scenes. If you use a black-and-white vidicon camera, no flicker is visible at all because of the lag effect. (Three cheers for monochrome!)

Showing film sequences adds variety to amateur TV transmissions, but you should avoid sending any copyright material. Slides will also give high quality test cards or captions, of course.

If you have made any experiments with telecine, why not drop me a line care of the Editor? I am always keen to receive news and photos to print. See you next time....

EVENTS: MOBILE RALLIES

13th December	Sale of surplus equipment	Biggin Hill	Ian Mitchell G4NSD
28th December	Obtaining and working with reciprocals	Hornsea, N Humberside	Norman Bedford G4NJP
11th January	Aurora – what causes it?	Lincoln Short Wave Club	Pam Rose G4STO
14th January	RSGB Presidential Installation	Cardiff Castle, Cardiff	RSGB, Potters Bar 59015
19th January	Moulded Case Circuit Breakers	Leeds	IEEIE, 01-836 3357
25th January	Liquid Crystals – Beautiful and Useful	Hull College of Further Education	IEEIE, 01-836 3357
26th January	Operational Use of European Communications Satellite by the European Broadcasting Union	IEE, Savoy Place, London	IEEIE 01-836 3357
5th February	Bury Radio Society Ham Feast	The Mosses Centre, Cecil St, Bury	MHS Bridge G3VC
8th February	Lecture and slides on Astrophotography	Lincoln Short Wave Club	Pam Rose G4STO
21st February	Demonstration of 10GHz operation	Biggin Hill	Ian Mitchell G4NSD
14th March	Lecture – Amateur Radio on a Shoestring	Lincoln Short Wave Club	Pam Rose G4STO
16th March	BCS/Computing Award Winner	Lanchester Polytechnic	BCS, Coventry Branch
18th March	4th Annual Components Fair	Carleton Community Centre, Pontefract	A Mason G4TGU N Whittingham G4ISC
1st April	White Rose ARS Rally	University of Leeds	A N Bramley G4NDU
28–29th April	RSGB National Amateur Radio Exhibition	National Exhibition Centre, Birmingham	RSGB, Potters Bar 59015

Radio & Electronics World

The communications, electronics & computers magazine

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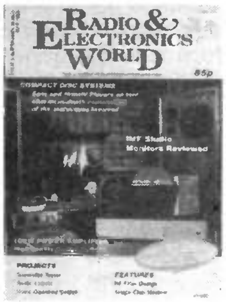
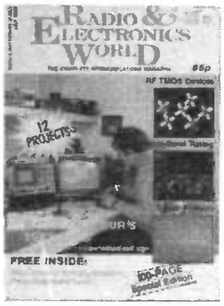
All issues, with the exception of January 1982, are still available. All orders must be pre-paid, the cost of each issue being £1.00 inclusive of postage and packing. To ensure that you don't miss any future issues, we suggest that you place a regular order with your newsagent or complete the subscription order form found in this magazine.

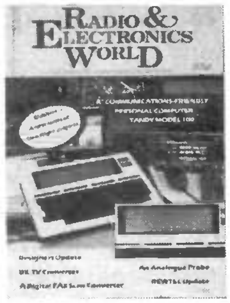


MAY 1983
Projects — Audio Limiter (Overload Prevention); Data Brief 1-Voice Operated Switch; Data Brief 2-State Variable Filter; IR Volume Control; 100W Power Amplifier; Train Controller; Rewbichron II; Transistor Tester. Features — RF Filters; Inside the 7910; Z8 Exec; CD Revealed; Amateur Satellites. Reviews — Sony and Hitachi CD Players; IMF Studio Monitors; Auto Scan 5000

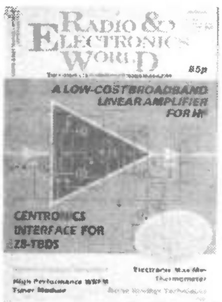
JUNE 1983
Projects — RF/RGB TV Interface (switchable converter); Synthesiser Control System (70cm and 2m bands); Data Brief 1-Universal Counter; Data Brief 2-Preamplifier; Wideband LCD-DFM; 2m Update; FRG7700 Memory Expansion; 100W Power Amlifier II. Features — Optical Astronomy; Zilog Z8000; Weather Satellite Reception. Reviews — AMS1 (Audio Measuring System); GSC 50000 (latest counter/timer); ICR70/R2000 Receivers; Circuit Modeller (CAD for CPM)



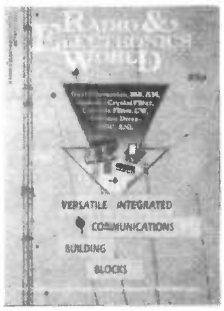
JULY 1983
Projects — Radio Amateur's Test Card; Central Heating Controller; Data Brief 1-DC/DC Converter; Data Brief 2-Up/Down Counter; TX10-RGB (another conversion); Z8 Backplane, Universal Interface; Synthesiser Control System II, Solid State Coupler; SSB Adaptor for the SX200-N; Digital Capacitance Meter; DTMF Signalling System; PF1 Conversion. Features — RF TMOS; Zilog Z8000; HF Receiver Performance; Signal Analysis; RF Filters II; Pass Band Tuning Techniques; ATV on the Air, new series for amateurs. Reviews — Sony TC-D5M (Live Performance Recorder); Datong ANF (Removes Heterodynes); PMS PROM1 (Plug-in Programming)



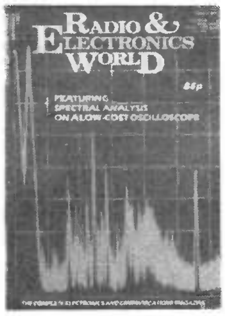
AUGUST 1983
Projects — Analogic Probe; Data Brief 1-Tape Controller; Data Brief 2-RMS-to-DC Converter; Synthesiser Control System III, Crystal Reference: Test Card EPROM Expansion; Continuity Tester; WB RF Amplifiers (Two basic designs); DX Converter. Features — Euro-broadcast TV Services (Station information); Zilog Z8000; Polar Orbiting Satellites; Digital FAX Conversion (More on Meteosat); ATV on the Air; HF Rx II. Reviews — PDF-11M; TV Aerials; Tandy Model 100 (Communications computer?); 2m Synthesiser



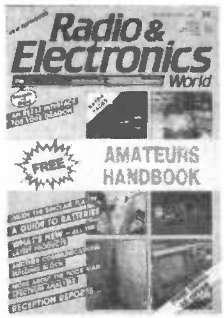
SEPTEMBER 1983
Projects — Max/Min Thermometer; 4 Channel Audio Mixer Morse Key Oscillator; Wideband FM Stereo Tuner Module I; Rotary Encoder Interface (to Control TTL); Centronics Interface for Z8-TBDS (Parallel printer interface); Linear HF Power Amplifier; Features — Weather Fascimile Reception; Zilog Z8000; Data Brief 1-ZN419CE Servo IC



OCTOBER 1983
Designs — Modular Communication Systems Part 1; 4 Channel Audio Mixer Part 2; Tone Bursts; PF70 Conversion. Features — Noise Blanking Techniques; The Lambda Diode; A Guide to HF Coils Part 1; The Chromicro (Colour Processing); Timeplex. Data Brief - The NEC PC1037H Double Balanced Modulator; Amateur Radio World. Reviews — Tandy VSC-1000 (Variable Speech Control); Yaesu FT-77 (Solid State HF Transceiver)



NOVEMBER 1983
Designs — Communications Building Blocks (Front Ends); Poor Man's Spectrum Analyser; Wideband FM Stereo Tuner Module Part 2; 4 Channel Audio Mixer Part 3; Three Digit Timer. Features — Squelch Systems; Expansion Bus (First add-on — A light pen); A Guide to HF Coils Part 2; Data Brief — NE564 PLL Tone Decoder. Reviews — Meteor 100, 600, 1000 (All-British Frequency Counters); Personal Pearl (For text and information manipulation)



DECEMBER 1983
Designs — Poor Man's Spectrum Analyser Part 2; Communications Building Blocks Part 2; A 4001/4011 Tester; Continuity Tester. Features — Inside the Sinclair Flat TV. An in-depth probe; A Circuit Designers Guide to Batteries; Data File on Op-Amps Part 1, Metal Detectors in Warfare; Data Brief 1-LM1821S Video IF PLL Synchronous Detector; Data Brief 2-SL6270 Gain Controlled Audio Amplifier; An RS232C Interface for Your Dragon 32. Reviews — ALDEN Weather Chart Recorder Kit; Digithurst MicroSight 1.

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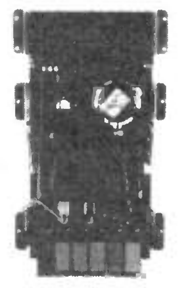

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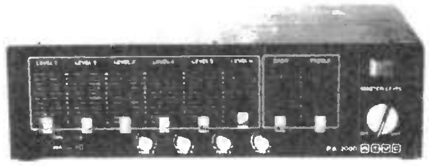

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Frequency response: 5kHz – 22kHz. Size: 60mm square. Impedance: 8 ohms. **£5.50** +60p P&P.

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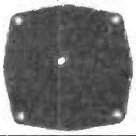

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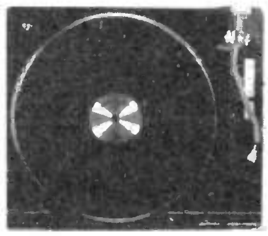
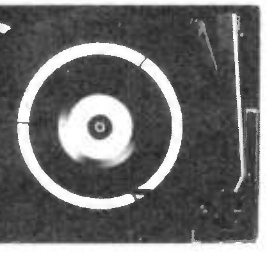


£17.50 plus £1.75 p&p.



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RTVC

DX–TV RECEPTION REPORTS

Compiled by Keith Hamer and Garry Smith

DX-TV occurred on all bands during September, much to the chagrin of the domestic viewer but much to the delight of the long-distance television enthusiast. Sporadic-E activity continued at a low level throughout the month, although several interesting openings were evident on a number of days, albeit minor ones. The period of the 23rd to the 29th produced spectacular tropospheric DX on all bands: in the South of England, Band III signals were arriving from as far away as the Austrian/Hungarian border.

Here in the Midlands, Sporadic-E occurred on the 5th, 12th, 13th, 14th and 15th. The star performer was the elusive Finnish station on E4 (Vuokatti). This appeared using an FuBK test card and it was the first sighting this year. A lunchtime opening from the south on the 15th gave reception of Spanish transmissions on channels E2, E3 and E4, while on E3, both the 'TVE ARAGON' colour bar pattern and 'TVE VALENCIA' caption were present before regional programmes commenced. At 2010 BST on the same day, an unusual signal appeared on E4 via Meteor Shower (MS): this was the Philips PM5544 pattern. We can only conclude that this was RUV-Iceland since they open late. Band III MS was present on the 18th, as evidenced by several 'pings' on channel E5/R6 during the early evening – all on programmes, of course!

Tropospheric DX towards the end of the month was excellent with signals overriding the local Sutton Coldfield channel at times. The Belgian Liège transmitter on E3 was seen here in colour for three nights; usually it is only just above the noise.

Reception reports

The 1983 Sporadic-E season was a fairly good one: at least, that was the verdict of Roger Bunney (Romsey, Hampshire). Televiziunea Romana (TVR-Rumania) was seen many times on channel R2, but there were no Arabic signals other than a suspected Lebanese E2 programme which had a French-speaking news announcer. His best trop signal towards the end of September was Österreichischer Rundfunk (ORF-Austria) on E9 from the Mugel transmitter near Graz, a distance of approximately 830 miles.

Cyril Willis (Little Downham, Cambridgeshire) has forwarded details of suspected African reception which occurred on 27th August at 2015 BST. The channel was E3 and programme content consisted of an African wearing a *fez* and robes. Other dark-skinned people were present and the reception continued for some 15 minutes before a white circular caption appeared. Prior to this there was a smeary signal on E2 which Cyril thought came from either Zimbabwe or Ghana. In view of the difficulties posed in identifying such reception, does anyone have any information regarding test cards, captions or programme schedules from African TV services? Please forward any info via the Editor at *R&EW*.

William Pitte (Northern France) receives the UK most of the time on his Otake Export colour portable. During a tropospheric opening earlier this year he received Radio Telefis Eireann (RTE-Eire) – *see Photo 4*.

From his Welsh DX location at New Radnor, Simon Hamer saw programmes from a number of UK transmitters during the latter half of September. He identified Dover, Hannington, Midhurst, Crystal Palace, Guildford (relay station), Sandy Heath, Sudbury, Tacolneston, Bilsdale and Waltham. Reception on channel 32 is now marred due to Ridge Hill beaming Channel 4. Continental transmitters identified included RTBF-1 (Belgium, a French-speaking service) on E8 (Wavre) with the 'jt' news and sports programme during the evening of the 27th and also BRT-1 (the Belgian Flemish service) on E10 from Wavre with *Nieuws* and *Lotto* at 1930 BST. Later in the evening, France Regions-3 was seen on E53 from the outlet at Vannes, together with NOS-1 (Netherlands) from Lopik.

Featured fortunes

We thought that we would feature Clive Athowe's reception log for September this time to show just what can be received during a normally 'quiet' month. All signals were via Sporadic-E (SpE) propagation apart from those via trops between the 23rd and the 29th.

2/9/83: RAI-1 (Italy) on channels IA and IB with programmes; TVR (Rumania) on R2 with the EBU test pattern showing the 'TVR BUCURESTI' identification; RTS (Albania) on IC with children's programmes; JRT (Yugoslavia) on E3, E4 with programmes.
6/9/83: TSS (Russia) on R1 and R2 with BPEMR news/current affairs programme.
7/9/83: TVE (Spain) on E3 showing colour test pattern with the 'AITANA 3' identification.
8/9/83: ZTV (Zimbabwe) on E2 at 1803 BST from the Gwelo transmitter with programmes via F2/SpE propagation; RAI-1 on IA with programmes.
9/9/83: TSS on R1, R2 with 'UT 0167' colour test card; MTV-1 (Hungary) on R1 and R2 with 'MTV-1 BUDAPEST' PM5544 test card; CST-1 (Czechoslovakia) on R1, R2 radiating their distinctive EZ0 test card with the 'RS-KH' identification.
10/9/83: TSS on R1 with programmes.
11/9/83: TSS on R1, R2 with programmes; TSS EESTI-TV (Estonia) on R1 with programmes; TVP (Poland) on R1 with programmes.
12/9/83: TVE-1 on E2, E3 and E4 with cartoons; JRT on E3 with programmes.
13/9/83: SR-1 (Sweden) on E2 showing schools programmes; YLE-1 (Finland) on E3 using the FuBK test card with the identification 'YLE-TV 1'.
23/9/83: RTL (Luxembourg) on E7 radiating the PM5534 test card (with a digital clock insert); RTL on E21 with programmes; SRG-1 (Switzerland) on E12 from the Niederhorn transmitter with programmes in the German language; TSI-1 (Switzerland) on E30 with programmes in Italian from the Niederhorn; TSI-1 and SRG-1 also on channels E34 and E31 from

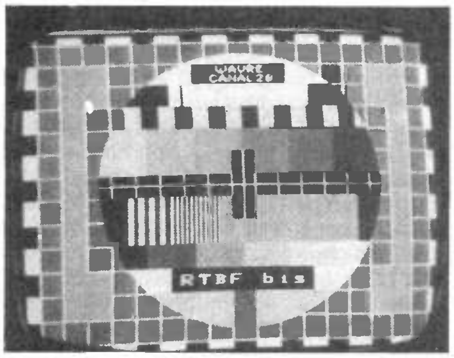

Photo 1 *Belgian PM5544 test card from the Wavre transmitter on channel E28*

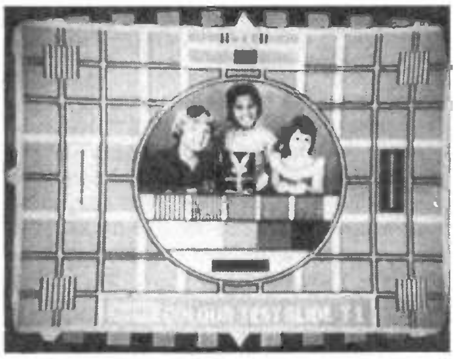

Photo 2 *Unique monoscopic test card radiated in New Zealand. Photograph courtesy of the New Zeland Broadcasting Corporation (NZBC)*

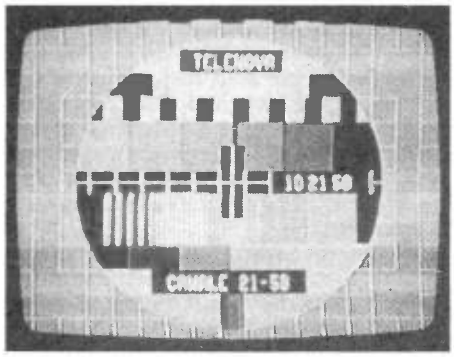

Photo 3 *Test card used by one of the italian private stations — Telenova. The service operates on channels E21 and E59*

La Dôle; DDR:F1 (East Germany) on E5, E6 and E12 (Inselsberg, Brocken and Sonneberg, respectively); DDR:F2 on E31 (Inselsberg), E33 (Sonneberg) and E34 (Brocken); BR-1 (Bayerischer Rundfunk, West Germany) on E2 and E3 showing *Tagesschau* news programme.
25/9/83: RTL on E21 radiating the 'ECOUTEZ RTL' FuBK test card (System L, SECAM colour), as well as the RTL FuBK on channel E27. However, the latter used System B/G PAL (see *R&EW*, August 1983 p20 for details of these transmission systems). Many West German trops were also seen on Band III and UHF. Similar Swiss and East German trops were noted to the 23rd, with the additions of SRG-1 on E6 from the Rigi transmitter, SRG-1 on E7 (from Saentis), SSR-1 on E32 (a French-language network from Rigi) and TSI-1 on E29 (the Italian-language network from Rigi). SSR-1 on E31 and TSI-1 on E34 were also received, both from Saentis. DDR:F2 on E33 was noted from the Sonneberg outlet.
26/9/83 to 28/9/83: Mostly West German trops (ARD and ZDF) at good strength.
29/9/83: SRG-1 on E31, TSI-1 on E34 and SSR-1 on E4 with the FuBK test card and '+PTT' identification, all from the La Dôle transmitter near the French border. The E4 signal is rare via trops. RTE-1 (Eire) channel D (from the Mullaghanish outlet) with the 'RTE 1' PM5544 test card; also on channel F from Mt Leinster and on E40 from Cairn Hill. The second network was seen on channel I from Mt Leinster and on E45 from Cairn Hill.
30/9/83: TSS on R1 with programmes via Sporadic-E.

DX miscellany

Roger Phillips of London points out that the multitude of Italian private/free radio and television services we drew attention to in the October issue are not in fact illegal. Many of the smaller stations have joined forces to form networks throughout the country. These include Euro-TV and Rete Quatro. Roger hasn't the equipment to receive DX-TV but he received Italy and a Scandinavian country via Sporadic-E on the FM radio band last summer.

D Elliott of Sheffield has taken a fancy to the DX-TV converter featured in the August 1983 edition of *R&EW*, but lack of constructional experience has meant that it's a 'no go' situation. It transpires that he owns a Sanyo 9300 VCR which has tuners for Bands I and III fitted. The machine can be used as a wideband DX converter when functioning in the E-to-E mode (using the VCR tuner and viewing at UHF on the receiver). The bandswitch selectors consist of a rotatable plastic collar surrounding each tuning preset. Now all that's required to DX successfully are a few aerials and favourable conditions!

Andrew Webster (Billinge, near Wigan) tells us that the teletext decoder which he has recently fitted to his Grundig colour receiver is a boon to DX-TV. During the lift in tropospheric conditions he found that signals could easily be identified by simply dialling the text. Even though weak signals displayed garbled information, the service identification at the top of the page was always clearly received.

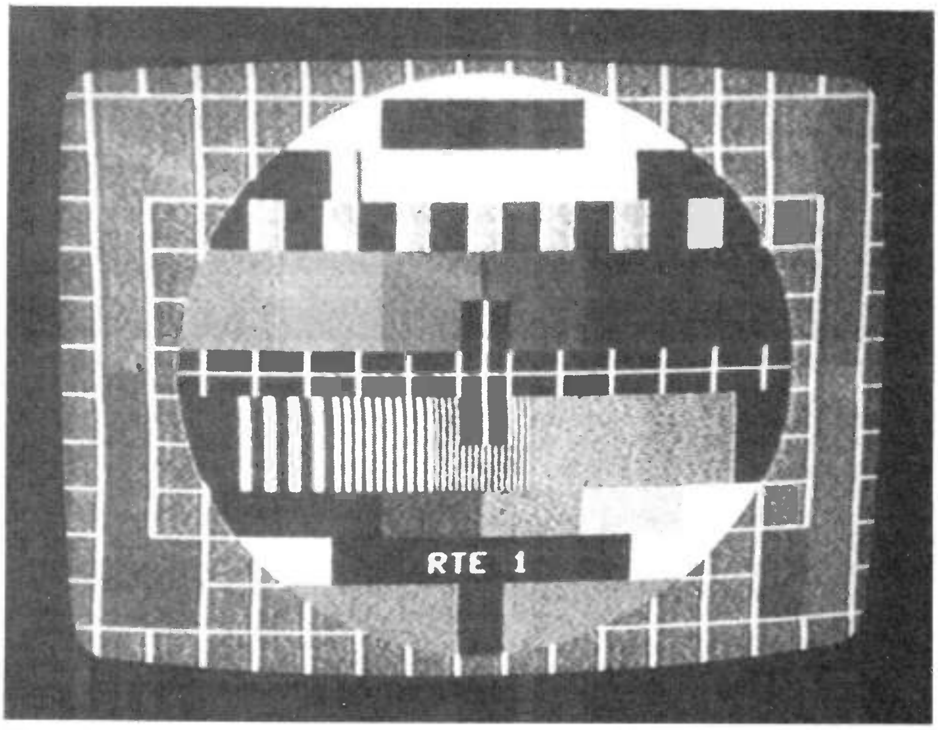

Photo 4 *Reception of Radio Telefis Eireann (RTE-Eire) noted in France by R&EW reader, William Pitte*

Photo 5 *Closedown caption with digital clock used by Westdeutsches Fernsehen (WDR) in West Germany*

Clive Athowe (Blofield, Norfolk) intends to erect a Western Electronics tilt-over tower. This will be 58ft high, plus an extra 10ft for aerials. He plans to use stacked Fuba XC391c arrays for UHF DX. Dutch TV is present all the time in East Anglia and this can be a nuisance when trying to receive a more distant station on the same channel.

Service information

Australia: Multi-cultural television started last October on channel 0 (46.25MHz) and on channel 28 (UHF) from outlets in Sydney and Melbourne. The service will be extended to Canberra, Cooma and Goulburn on UHF-only in the near future. It is proposed to close down several channel 0 (VHF) transmitters by January 1985.
Lebanon: A new organisation has taken over responsibility for television broadcasting in this war-torn country. Télé Liban (TL) operates three services: TL1, TL2 and TL3 with programmes in Arabic for the first two networks while the third is in French. Transmission system B is used for VHF channels E2–E12, while system G is used for UHF. SECAM colour is used for both systems.

There is a 1kW transmitter at Beit Mery on channel E2 (transmitting French-language programmes) and a 60kW outlet on E4 located at Maasser El Chouf radiating programmes in Arabic.
Luxembourg: Radio-Télé-Luxembourg (RTL) are radiating the PM5534 test card (which includes a digital clock insert) from the channel E7 transmitter at Dudelange with the identification 'RTL +'. System B is used with PAL colour here, along with a German-language sound channel. This usually reverts to System C (positive video, AM sound) with PAL colour during normal programme hours.
Rumania: A new electronically generated test card is reported to be in use carrying the identification 'TELEVIZIUNEA ROMANA' at the top. We hope to have further details shortly.
Syria: According to the European Broadcasting Union's 'List of Television Stations,' there is a new 400kW transmitter in service on channel E3 at Aboukamal radiating programmes in SECAM colour from Syrian Broadcasting and Television (SRT). Given favourable Sporadic-E conditions, reception of Syria should be feasible. The same source also mentions that the E3 outlet at Nabi-Saleh has increased its ERP from 180kW to 400kW.
Trinidad: The Trinidad & Tobago Television Company (TTT) radiates standard colour bars with a digital clock insert in the lower right-hand corner rather than a test card during test transmissions.

The above information was kindly supplied by Robert Copeman (Victoria, Australia), Earl Drayton (Trinidad), Kevin Jackson (Leeds), Goesta van der Linden (The Netherlands), Alexander Wiese (West Germany) and the EBU (Belgium).

PREVIOUSLY ADVERTISED STILL AVAILABLE

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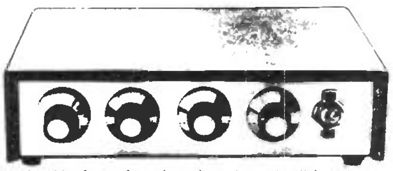
for robots, meccanos, drills, remote control planes, boats, etc. £2.95.



Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special price is £14.95 in kit form or £25.00 assembled and tested.

12 volt MOTOR BY SMITHS

Made for use in cars, etc. these are series wound and they become more powerful as load increases. Size 3½" long by 3" dia. They have a good length of ¼" spindle – **Price £3.45.**
Ditto, but double ended £4.25.
Ditto, but permanent magnet £3.75.

EXTRA POWERFUL 12v MOTOR

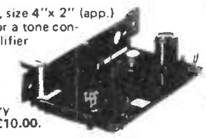
Probably develops up to ¼ h.p. so it could be used to power a go-kart or to drive a compressor, etc. £7.95 + £1.50 post.

THERMOSTAT ASSORTMENT

10 different thermostats. 7 bi-metal types and 3 liquid types. There are the current stats which will open the switch to protect devices against overload, short circuits, etc., or when fitted say in front of the element of a blow heater, the heat would trip the stat if the blower fuses; appliance stats, one for high temperatures, others adjustable over a range of temperatures which could include 0 – 100°C. There is also a thermostatic pod which can be immersed, an oven stat, a calibrated boiler stat, finally an ice stat which, fitted to our waterproof heater element, up in the loft could protect your pipes from freezing. Separately, these thermostats could cost around £15.00 – however, you can have the parcel for £2.50.

MINI MONO AMP

on p.c.b., size 4"x 2" (app.) Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amp. Brand new, perfect condition, offered at the very low price of £1.15 each, or 10 for £10.00.



– BARGAIN OF THE YEAR –

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 as 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 – 270 KHz, medium wave band 525 – 1650KHz, FM band 87 – 108MHz, mono, stereo & AFC switchable, tuning meter to give you spot on stereo tuning, optional LED wave band indicator, 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 £6.00** + £1.50 post + insurance.

THIS MONTH'S SNIP

MAINS FILTER – Don't let mains interference muck up your program or game – up to 13 amp load. Mains filter type FEC. **SNIP PRICE ONLY £3.99.**

REVERSIBLE MOTOR WITH CONTROL GEAR

Made by the famous Framco Company this is a very robust motor, size approximately 7½" long, 3½" dia. 3/8" shaft. Tremendously powerful motor, almost impossible to stop. Ideal for operating stage curtains, sliding doors, ventilators etc., even garage doors if adequately counter-balanced. We offer the motor complete with control gear as follows.

1 Framco motor with gear box
1 manual reversing & on/off switch
1 push to start switch
2 limit stop switches
1 circuit diag. of connections

£19.50 plus postage £2.50

FOR SOMEONE SPECIAL

Why not make your greeting card play a tune? It could play 'Happy Birthday' 'Merry Christmas', 'Wedding March', etc. or 'Home Sweet Home', etc. Wafer thin 3 part assemblies, for making cards musical. Mini microchip speaker and battery with switch that operates as the card is opened. Please state tune when ordering. Complete, ready to work £1.25.

REEL TO REEL TAPE DECKS

Ex-Language Teaching School. Second, but we understand these are in good order; any not so would be exchanged. The deck is a standard BSR with normal record, replay facilities and an additional feature is tape rev counter. Nicely finished in teak type box. We have 30 only of these. Price £8.50 each + £3 carriage.

TELEPHONE ITEMS

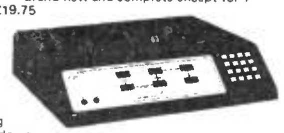
Plug and Wall socket – 4 pin or 5 pin	£3.45
Plugs only 4 pin or 5 pin	£1.15
Modern desk telephone	£7.50
Heavy black old type	£5.50
External bell unit	£6.50
Bell ringing power unit	£4.50
Pick up coil	£1.15

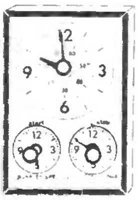
STABILISED POWER SUPPLY (Mains Input)

By LAMDA (USA) – Ideal for computer add-ons, d.c. output. Regulated for line volts and load current. Voltage regulation .1% with input variations up to 20% – load regulation 1% from no load to full load – or full load to no load. Complete in heavy duty case – Models available: 5v - 6A £17.25. 5v - 9A £23. 12v - 1.5A £13.25. 15v - 1.2A £13.25. 24v - 2A £23.

PRESTEL UNIT

– brand new and complete except for 7 plug in IC's – Price: £19.75 + £2.00 p&p.
Note: British Telecom may not connect this equipment as there is no manufacturer to guarantee it, however it is well worth buying for its immense breakdown value – sold originally at over £150.





WATERPROOF HEATING WIRE

100 ohms per yard, this is a heating element wound on a fibre glass coil and then covered with pvc. Dozens of uses – around water pipes, under grow boxes, in gloves and socks. Price: 23p per metre.

TIME SWITCH BARGAIN

Large clear mains frequency controlled clock, which will always show you the correct time + start and stop switches with dials. Complete with knobs **FOR ONLY £2.50.** 10 for £11.50!

ROPE LIGHT

6 metres of translucent plastic tube full of coloured bulbs makes a wonderful display – suitable indoors or out. £25 + £2 post.

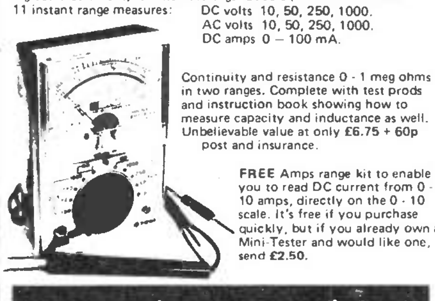
50 THINGS YOU CAN MAKE

Things you can make include Multi range meter, Low ohms tester, A.C. amps meter, Alarm clock, Soldering iron minder, Two way telephone, Memory jogger, Live line tester, Continuity checker, etc. etc., and you will still have hundreds of parts for future projects. Our 10Kg parcel contains not less than 1,000 items - panel meters, timers, thermal trips, relays, switches, motors, drills, taps, and dies, tools, thermostats, coils, condensers, resistors, neons, earphone/microphones, nicad charger, power unit, multi-turn pots and notes on the 50 projects.

YOURS FOR ONLY £11.50 plus £3.00 post.

MINI-MULTI TESTER

Deluxe pocket size precision moving coil instrument, Jewelled bearings - 2000 o.p.v. mirrored scale.
11 instant range measures: DC volts 10, 50, 250, 1000. AC volts 10, 50, 250, 1000. DC amps 0 – 100 mA.



Continuity and resistance 0 - 1 meg ohms in two ranges. Complete with test prods and instruction book showing how to measure capacity and inductance as well. Unbelievable value at only £6.75 + 60p post and insurance.

FREE Amps range kit to enable you to read DC current from 0 - 10 amps, directly on the 0 - 10 scale. It's free if you purchase quickly, but if you already own a Mini-Tester and would like one, send £2.50.

J. BULL (Electrical) Ltd.

(Dept RE), 34 - 36 AMERICA LANE, HAYWARDS HEATH, SUSSEX RH16 3QU. Established 30 YEARS

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £12 add 60p 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.

EXTRACTOR FANS – MAINS OPERATED

Woods extractor.
5" – £5.75, Post £1.25.
6" – £6.95, Post £1.25.
5" Plannair extractor £6.50. Post £1.25.
4"x 4" Muffin 115v. £4.50. Post 75p.
4"x 4" Muffin 230v. £5.75. Post 75p.
All the above ex-computer, those below are unused.
4" x 4" £8.50 Post 75p.
9" American made £11.50 post £2.00.
Tangential Blower 10x3 air outlet, dual speed £4.60. Post £1.50.

TANGENTIAL BLOW HEATER

by British Solartron, as used in best blow heaters. 2Kw approx 9" wide £5.95, 3Kw either 9" or 12" wide (your choice) £6.95 complete with 'cold' 'half' and 'full' heat switch, safety cut out and connection dig. Please add post £1.50 for 1 or £2.30 for two.

2.5 Kw KIT

Still available: £4.95 + £1.50 post.

DISCO PANEL

Make your party or disco more thrilling – add to your record player or amp, a multi-coloured, sound-enhanced lighting display. Made for Amstrad, their ref. No. RP10. Mains operated stereo or mono controlled – has 48 coloured lamps (plus 4 spares) and light level controls. Brand new and unused – offered at a never to be repeated price of £5.75 plus £2.00 post.

BLEEP TONE

These work off 12v and have an unusual and pleasant bleep 69p each.

CONNECTING WIRE PACK

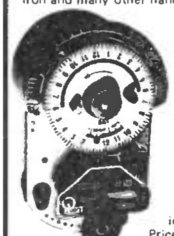
48 lengths of connecting wire, each 1 metre long and differently colour coded, a must for those difficult interconnecting jobs. 85p the lot.

RED LEDS

10 for 69p. 100 for £5.75. 1000 for £52.

IN LINE SIMMERSTAT

Ideal heat controller for soldering iron and many other hand-held appliances. £2.30. 10 for £17.25.



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. These are without case but we can supply a plastic case - £1.75.
Also available is adaptor kit to convert this into a normal 24 hr. time switch but with the added advantage of up to 12 on/offs per 24 hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2.30.

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.

OTHER POPULAR PROJECTS

Short Wave Set – covers all the short wave bands using plug-in coils. Kit complete	£14.50
R C Bridge Kit	£9.95
3 Channel Sound to Light – with fully prepared metal case.	£14.95
Ditto – made up	£25.00
Big Ear, listen through walls	£9.50
Robot controller – receiver/transmitter	£9.50
Ignition kit – helps starting, saves petrol, improves performance	£13.95
Silent sentinel Ultra Sonic Transmitter and receiver	£9.50
Car Light 'left on' alarm	£3.50
Secret switch – fools friends and enemies alike	£1.95
3 – 30v Variable Power Supply	£13.80
2 Short & Medium wave Crystal Radio	£3.99
3v to 16v Mains Power Supply Kit	£1.95
Light Chaser – three modes	£17.50
Mullard Unilex HiFi stereo amplifier with speakers	£16.75
Radio stethoscope – fault finding aid	£4.80
Mug stop – emits piercing squark	£2.50
Morse Trainer – complete with key	£2.99
Drill control kit	£3.95
Drill control kit – made up	£6.95
Interrupted beam kit	£2.50
Transmitter surveillance kit	£2.30
Radio Mike	£6.90
FM receiver kit – for surveillance or normal FM	£3.50
Seat Belt reminder	£3.00
Car Starter Charger Kit	£15.50
Soil heater for plants and seeds	£16.50
Insulation Tester – electronic megger	£7.95
Battery shaver or fluorescent from 12v	£6.90
Matchbox Radio – receives Medium Wave	£2.95
Mixer Pre-amp – disco special with case	£16.00
Aerial Rotator – mains operated	£29.50
Aerial direction indicator	£5.50
40 watt amp – hifi 20hz – 20kHz	£9.50
Microvolt multiplier – measure very low currents with ordinary multitester	£3.95
Pure Sine Wave Generator	£5.75
Linear Power output meter	£11.50
115 Watt Amplifier 5Hz 25kHz	£13.50
Power supply for one or two 115 watt amps	£17.50
Stereo Bass Booster, most items	£8.95

'NOTES FROM THE PAST'

Stereo and the cost of components were two of the topics of concern for Centre Tap twenty-five years ago.

This column's interest in stereophonic sound brings to light an anecdote told by W E Thompson (G3MQT).

At the time of the slump in the early 'thirties he was 'axed' under an economy drive from the technical development section of Standard Telephones and Cables, so he went to help out his mother who had recently acquired a business near Southend. The shop carried a fair stock of gramophone records and a few quite-good-for-their-period cabinet gramophones.

Surrounded by such a galaxy of material, it wasn't long before Bill hit on the idea of playing two discs of the same recording simultaneously in an endeavour to obtain a stereophonic effect. His experiments along these lines were as a matter of personal interest rather than with any idea of exploiting it commercially. Naturally he had fun and games keeping the clockwork motors in step and getting the discs to start off exactly together. Even when he acquired the knack, it required so much attention to operate that little or no time was left for listening to the resultant distribution of sound. Improving on the idea, he swapped the mica-diaphragmed sound-boxes for electric pick-ups. Incidentally, the early pick-ups were often heavier than the sound-boxes they were intended to replace. Generally they were used in conjunction with the old-fashioned tone arm. Combined, they acted on the record surface rather like a miniature drill, penetrating deep in the grooves. The facetious types used to swear they threw their records away because after a few playings they alleged the loud passages from the other side would start breaking through! Nevertheless, record wear had to be sacrificed to the slightly wider frequency range and the possibility of having effective forms of tone and volume control.

Bill, of course, being progressive, soon added pick-ups and separate amplifiers using LS6A triodes plus mains-energised speakers mounted on 3ft square baffles. In the early 'thirties anything less than nine square feet of baffle was distinctly non-U. To simplify synchronisation he mounted two turntables and pick-ups, one mounted above the other; the turntables were coupled by means of a keyway on the spindle to keep them in step, and one of the pick-ups was adjustable through a small arc. It was then only necessary to locate the records so that the run-in grooves came in roughly the same place. Adjustment of the upper pick-up arm forwards or backwards enabled perfect synchronisation or stereophonic reproduction to be obtained at a touch.

Bill used this scheme for a long time and it created a great deal of customer interest. When the discs were timed to be slightly out of step, the variation in the stereophonic effect was most marked: the source of sound could appear to shift from one speaker to the other, or it could be made to sound as if coming from the space between the two. This scheme was, of course, a complete basis for the latest innovation in stereo-gramophone reproduction except that Bill was using two discs instead of a dual recording on one – nearly thirty years before its commercialisation.

Perhaps the ironic part of this little story is that he wrote up a description of it and sent it to one of the radio magazines of the period. They did not even reply, let alone publish it! This was by no means a unique experience with certain periodicals of that era, due possibly to a form of prejudice by 'professionals' disdaining the work of mere amateurs. Or, maybe, the idea of anybody wanting to wear out their records two at a time, even for the sake of stereo, was too much for some unimaginative editorial assistant.

More of yore

This month (September 1958) several letters have touched on an aspect previously overlooked – the early craze for miniature receivers. This, of course, is one of the delights denied the modern enthusiast. What with transistors and miniaturised components, tiny sets are comparatively easy to design nowadays and unless one manages to compress it to the size of a wrist-watch no-one is very greatly impressed. In the old days, to design a working set of really diminutive dimensions demanded considerable ingenuity on the part of the constructor. The first real midget I saw was fitted into a teacup, over which many hours of patient and loving care had been spent. Then came the matchbox receivers. This size somehow grew to be the accepted standard. All real enthusiasts used actual matchboxes. They were not content to simply keep it to matchbox size.

The other predominant subjects this month were (*a*) the more favourable position of Old Timers in regard to component prices, and (*b*) their less favourable position in the same respect. At first this seems flatly contradictory, but I suppose a lot depends on just what period is under review.

Is the newcomer really proportionally better off in this respect or not?

Personally, I should say that in the early days one could do quite a lot for a small expenditure. Then came the 1922–1930 period. One simply had to buy valves, etc and they were mighty dear. This period in my opinion made by far the heaviest demands on the constructor's pocket, yet strangely enough home-construction proceeded on an enormous scale. Practically every household had a set built by one of its members, a friend or a neighbour. Sets were straightforward to make and were supplied in kit form so simplified that anyone who could read and use a pair of pliers became a 'constructor'. They were expensive (judged by comparative modern costs) but the real enthusiast could make most of his own parts cheaply.

In the thirties, mass production of domestic receivers began to get into its stride and vast quantities of manufacturers' 'surplus' found its way on to the market. This was often sold at knock-down prices. It was too much for the handyman type to design his own set and hence, with a diminishing number of buyers for a swelling quantity of manufacturers-type over-produced components, prices fell sharply and enthusiasts bought shrewdly. These were happy days for the amateur with a lean purse.

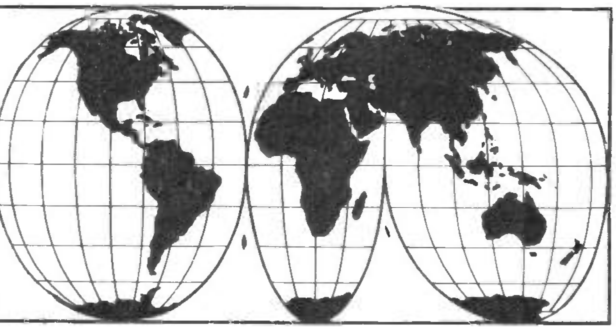
In more recent years prices have hardened again, but there are still plenty of bargains to be had – if you study the advertisement pages carefully. Modern conditions demand a much more complicated type of set and many new components and the later types of valves and transistors are expensive. I should say the latest newcomers aren't having quite such a good time of it as some groups of the older hands did when they built up the basis of their stock.

In radio, as with most other hobbies, if you want the latest and best of everything you can soon run through a three-figure bank balance. But you can still get lots of fun for the outlay of only a few shillings, and generally speaking this was true whatever period you entered the brotherhood of radio hobbyists.

SHORT WAVE NEWS FOR DX LISTENERS

by Frank A Baldwin

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



Indonesia is the target for many DXers at this time of year, the season giving the best chance of reception here in the UK being from around late September until late March because then the signal path via the short route is mostly in darkness. I therefore propose to discuss some of the relatively easy-to-receive stations in Indonesia which operate on the 60-metre band.

To set the scene, Indonesia is a republic in South East Asia that comprises many small islands straddling the Equator – some 3,000 in fact and all in the Malay Archipelago. The capital is Djakarta in North West Java. The population of the whole country is mainly Malayan and Papuan, with the Chinese forming the largest minority group: the main religion is Islam.

Many of the Indonesian transmitters on the 60-metre band open at 2200 and have a final closing time of 1600. It is just prior to these times that one should tune to the channels mentioned in this article. Listen for the openings from around 2155 onward until fade-out (which is often around the 0030 mark) and from 1530 – or earlier if conditions prove satisfactory – until sign-off time. The latter is usually preceded by some quotations from the Holy Koran, announcements in Indonesian and then a most charming melody, entitled 'Love Ambon', rendered on a Hawaiian guitar.

Among the most often reported stations are the following:

• RRI (Radio Republik Indonesia) Ujung Pandang on **4753** which opens at 2130 and closes at 1520 (the full schedule is 2130 to 0030 and from 1150 to 1520), the power being 20kW. Ujung Pandang is situated in Celebes (*Sulawesi* to the locals) – or, more precisely, in *Propinsi Sulawesi Selatan,* literally Province Celebes South.

• RRI Medan on **4764**, which has a 50kW transmitter and opens at 2300, finally closing at 1700. This one is located in Sumatra (*Sumatera*) in *Propinsi Sumatera Utara,* the translation for that being Province Sumatra North. Local time is GMT + 7 hours.

• RRI Ambon, which may be heard on **4845** where it opens at 2000 and finally closes at 1400. Ambon is in the Moluccas (*Maluku*) and the local time is GMT + 9 hours. The difficulty with logging this 10kW transmitter is that the channel is also occupied by another South East Asian station in the form of Radio Malaysia, Kuala Lumpur. The latter station has a 50kW signal and presents programmes for the local Indian community from 2130 to 0130 and from 0545 to 1530 (Saturday from 2200 to 0330). To hear Ambon, therefore, one has to tune to **4845** prior to Kuala Lumpur opening at 2130 – and trust that the 100kW African at Nouakchott in Mauritania is well down in signal strength. Local time is GMT + 9 hours.

• RRI Palembang on **4856**, at which point on the dial it opens at 2200 and finally closes at 1600. Most Indonesian stations have two separate periods of operation, hence the use of the word 'finally'. Palembang, for instance, opens at 2200 and closes at 0115 (Sunday at 0700), only to open again at 0900 and finally close at 1600. With a 10kW transmitter, Palembang is sited in South Sumatra. Local time is GMT + 7 hours.

• RRI Sorong in *Irian Jaya* (Irian West). This has a 10kW signal and is often heard by UK DXers. This one opens at 2100 and finally closes at 1400. Listen on **4875** and you may well be rewarded. Local time is GMT + 9 hours.

• RRI Surakarta in Java (*Jawa*) in *Propinsi Jawa Tengah* (Province Java Central). This uses a 10kW transmitter and operates on **4899** where it can be heard opening at 2230 and finally closing at 1600. The local time is GMT + 7 hours.

• The (often reported) RRI station on **4955** located in Banda Aceh, the capital of *Daerah Istimewa Aceh* (District Special Aceh) in Java. RRI Banda Aceh opens at 2300 and finally closes at 1600. The power is 10kW and the local time is GMT + 7 hours.

• RRI Yogyakarta on **5046**, opening at 2300 and closing at 1700. The power is 20kW and the location is Java. A tune to this channel at 1630 will bring the desired result provided conditions are reasonable for signals from this general area.

A rarely reported Indonesian on the 60-metre band is RRI Fakfak in West Irian from where it operates on **4789** with a 1kW transmitter. It opens at 2030 and finally closes at 1400. This one is classed in my book as super-DX.

Another one that *can* be logged is RRI Bukittinggi in *Propinsi Sumatera Barat* (Province Sumatra West) on **4910**. It opens at 2300 and finally closes at 1600, the power being 1kW. *Can* be logged? Yes, several UK DXers have logged this one, including myself – however, I have yet to succeed with RRI Fakfak on **4789**. Perhaps you may!

AROUND THE DIAL

In which are presented the frequencies, the times and some of the programme content of stations that may interest you.

AFRICA

Malagasey

'Radio Madagasikara' Tananarive on a measured **3286.4** at 1813: OM with some announcements in Malagasey, then YL with a folk song complete with local-style percussion backing. This is the Home Service in Malagasey, scheduled from 0300 to 0500 and from 1500 to 1900. From 1900 to 2100, the language used is French. The power is 100kW.

Mozambique

Maputo on **3265** at 1750: interval signal rendered on a local xylophone-type of instrument – a *Mbira* – and repeated many times until 1755 when the station identification was given in Portuguese, English, French and some vernacular language. News of African affairs followed in the English Foreign Service transmission to South Africa, scheduled on this channel from 1800 to 1830. The power is 25kW.

Rwanda

Kigali relay of *'Deutsche Welle* – the Voice of Germany' in Cologne on **21600** at 2025: OM with news comment in the German programme for Africa and Europe, timed from 2000 to 2200.

Senegal

Dakar on **4895** at 0100: OM with announcements in French, the National Anthem and off at 0103. The schedule is from 0600 to 0900, 1155 to 1600 and from 1715 to 0100.

Togo

Togblekope on **5047** at 1827: OM's with a discussion in the vernacular. This one operates in French and vernaculars, and is scheduled on the air from 0530 to 0800 and from 1700 to 2400. The power is 100kW.

THE AMERICAS

Brazil

Radio Nacional, Cruzeiro do Sul on **4765** at 0353: OM with announcements in Portuguese, YL with a local pop song. Station identification at 0400, the

signal riding over the Havana relay of R Moscow – surprise, surprise! The schedule of R Nacional is from 1000 to 0500 and the power is 10kW.
Radio Brasil Central, Goiania on **4985** at 0146, OM with a *futebol* (football) commentary in Portuguese, this programme also being heard on **5015** from Radio Cultura in Cuiaba, Brazil.

Colombia

Radio Bucaramanga on **4845** at 0052: OM with a love song in Spanish called *'Hacer el amor'* (to make love). Poor fellow, he was suffering! Timed from 1000 to 0400, the power is 1kW.
La Voz del Cinaruco, Arauca on **4865** at 0055: OM with a talk in Spanish all about Colombian affairs and commerce with an item about *marca registrada* (trade names). The schedule is from 0900 to 0400 but sometimes around-the-clock. The power is 1kW.

Ecuador

Emisora Gran Colombia, Quito on **4911** at 0107: OM announcing local pops on records. This one is on the air from 1100 to 0600 but sometimes around-the-clock with a power of 10kW.

Netherlands Antilles

Bonaire on **9715** at 0916: OM with a talk about Dutch football clubs and fixtures during the English transmission directed at Australia and New Zealand from 0830 to 0925.

USA

WYFR Family Radio, Okeechobee, Florida on **21615** at 1332: OM with a news commentary on both world and local affairs, all in English. This one has been logged at various times on this band on other frequencies – **21510, 21525** and **21625.**
'Voice of America' Greenville on **21840** at 1948: OM with a talk in English all about Libyan affairs.

Venezuela

Radio Barquisimeto on **4990** at 0332: OM with a folk ballad in Spanish. 'Radio Barquisimeto Internacional' is scheduled from 1000 to 0400 with a power of 15kW.
Radio Mundial on **4770** at 0047: OM with promos in Spanish and local pops on records. R Mundial in Bolivar is on the air from 1000 to 0400 and the power is 1kW.

ASIA

China

Xinjiang PBS on **5060** at 0006: OM with announcements in the Mongolian programme, OM's with songs and accordion music in the Home Service transmission, scheduled from 2330 to 0555 and from 1200 to 1700 (January to April from 1100 to 1625).
Yunnan PBS on **4760** at 2236: OM with a talk in Chinese. This is Yunnan 1 which can be heard in the time slot from 2150 to 0100.
Xinjiang PBS on **4735** at 0044: OM and YL alternately with announcements during the Uigher programme, timed from 2230 to 0320 and from 1030 to 1730.
Radio Beijing (Peking) on **6665** at 2104: OM with a talk in Chinese in the Domestic 1st Programme, scheduled on this frequency from 2000 to 2300, from 0100 to 0300 and from 1100 to 1730. Also on **6890** at 2108: OM speaking in Chinese in the Domestic 2nd Programme, which is on this channel from 2100 to 0100 and from 1100 to 1558.

Iraq

Baghdad on **21585** at 0730: OM with the station identification in Arabic, the sound effect of two bursts of machine gun fire, then OM with news of the war – all in the Domestic Service which is scheduled on this channel from 0000 to 2305.

Kuwait

Radio Kuwait on **21675** at 1440: OM with quotations from the Holy Koran in a programme of the Domestic/External Service on this channel 1300 to 1630.

Pakistan

PBC Rawalpindi on a measured **5006** at 0111: OM with a Home Service programme in Urdu – all talk. This one varies in frequency between **5005** and **5010.** The schedule is from 0045 (December to March from 0130) to 0400 (Friday until 0500) and from 1500 to 1800.

United Arab Emirates

Dubai on **21700** at 0723: YL with announcements followed by a programme of songs and music in the Arabic transmission intended for Europe and North Africa, scheduled from 0630 to 1015.

EUROPE

Austria

Vienna on **15560** at 1845: YL with the English transmission timed from 1830 to 1900 and intended for Europe, North Africa, the Middle East and South and East Africa. It was all about computers.

Belgium

Brussels on **21460** at 1448, radiating a programme of music and songs in the French language transmission which is on this frequency from 0930 to 1700.
Brussels on **21815** at 1420: YL with announcements, OM with songs in the English presentation to North America and the Far East, scheduled from 1400 to 1445 Monday to Friday inclusive.

West Germany

Cologne on **21600** at 0728: OM with a talk in the German programme for Europe and Australasia, timed from 0600 to 0800. Also logged in parallel on **21560.**

Hungary

Budapest on **17710** at 0935: YL with a newscast during the English transmission for Australia, New Zealand and Japan, being scheduled from 0930 to 1000.

The Netherlands

Radio Netherlands, Hilversum on **21480** at 0738: YL and OM alternately with news of both local and world events in the Dutch programme beamed to Europe, North West Africa, South East Asia and the Middle East and timed from 0730 to 0820.

Switzerland

Berne on **9560** at 0901: YL with news of world affairs in the English session for Australia, the Far East, South and South East Asia, timed from 0900 to 0930. Also on **21570** at 1338: music in the unmistakable Swiss style and OM with announcements in the English programme to Europe, the Far East, South and South East Asia and North and Central America, scheduled from 1315 to 1345.

CLANDESTINE

'Voice of the Sudanese Popular Revolution' (in Arabic, *'Sawt ath-Thawrah ash-Sha'biyah as-Sudaniyah')* on **17940** at 1417: Arabic-style music with announcements in that language. This station is hostile to the present Sudanese Government and operates from 1330 to 1630. Thought to be located in Libya, the programmes are entirely in Arabic.
The clandestine mentioned in the December issue as operating on **5106** when broadcasting a CID programme is, in fact, 'Radio Ignacio Agramonte'. It was logged again recently at 0150.

NOW LOG THIS

For your special attention this month, the signals from 'La Voz de Nicaragua' in Managua. If you tune to **5950** just prior to 0400, you may hear the station identification given by a YL and a time-check (local time) in English at 0400 after the Spanish transmission ends. When logged recently by the writer, what was heard was a newscast followed by a programme announced as 'Nicaragua Today'.
'The Voice of Nicaragua' operates in Spanish from 1100 to 1300 and from 2300 to 0100, there being a repeat of this latter transmission from 0200 to 0400. The English programme is radiated from 0100 to 0200 with a repeat timed from 0400 to 0500. The address is Apartado 4665, Managua.

NOW HEAR THESE

- Radio Inca, Lima, Peru on a measured **4762** at 0327: OM with a talk in Spanish about local affairs. This one is on the air from 1000 to 0500 at 1kW.
- Radio Abaroa, Riberalta, Bolivia on **4720** at 0246: YL with a pop song in Spanish complete with local orchestral backing. Power is 0.5kW, and the schedule from 1000 to 0400.
- Radio Riberalta, Bolivia (same place as above) on a measured **4697** at 0251: OM with a folk song in Spanish with a guitar accompaniment. This is scheduled from 1000 to 0300 at 3kW.

With that lot to cope with, I'll leave you all until next month!