

electronics today

INTERNATIONAL

JAN 1988 £1.40

SATELLITE TV
A DOWN TO EARTH GUIDE

16 EXTRA PAGES

MUSIC CIRCUITS

CHOOSING MICROPROCESSORS

INTELLIGENT RS232 SPEECH SYNTHESISER

INFRA-RED ALARM

3-COLOUR LIGHT DISPLAY



**£150 FREE-TO-ENTER
COMPETITION**

OMP POWER AMPLIFIER MODULES

OMP POWER AMPLIFIER MODULES Now enjoy a world-wide reputation for quality, reliability and performance at a realistic price. Four models available to suit the needs of the professional and hobby market i.e. Industry, Leisure, Instrumental and Hi-Fi etc. When comparing prices, NOTE all models include Toroidal power supply, Integral heat sink, Glass fibre P.C.B., and Drive circuits to power compatible Vu meter. Open and short circuit proof.

Supplied ready built and tested.

OMP/100 Mk II Bi-Polar Output power 110 watts R.M.S. into 4 ohms. Frequency Response 15Hz - 30KHz -3dB, T.H.D 0.01%, S.N.R -118dB, Sens for Max. output 500mV at 10K, Size 355 x 115 x 65mm. PRICE £33.99 + £3.00 P&P.

OMP/MF100 Mos-Fet Output power 110 watts R.M.S. into 4 ohms. Frequency Response 1Hz - 100KHz -3dB, Damping Factor 80, Slew Rate 45V/uS, T.H.D Typical 0.002%, Input Sensitivity 500mV, S.N.R. -125dB, Size 300 x 123 x 60mm. PRICE £39.99 + £3.00 P&P.

OMP/MF200 Mos-Fet Output power 200 watts R.M.S. into 4 ohms. Frequency Response 1Hz - 100KHz -3dB, Damping Factor 250, Slew Rate 50V/uS, T.H.D. Typical 0.001%, Input Sensitivity 500mV, S.N.R. -130dB, Size 300 x 150 x 100mm. PRICE £62.99 + £3.50 P&P.

OMP/MF300 Mos-Fet Output power 300 watts R.M.S. into 4 ohms. Frequency Response 1Hz - 100KHz -3dB, Damping Factor 350, Slew Rate 60V/uS, T.H.D Typical 0.0008%, Input Sensitivity 500mV, S.N.R. -130dB, Size 330 x 147 x 102mm. PRICE £79.99 + £4.50 P&P.

NOTE: Mos Fets are supplied as standard (100KHz bandwidth & Input Sensitivity 500mV) If required, P.A. version (50KHz bandwidth & Input Sensitivity 775mV) Order - Standard or P.A.

Vu METER Compatible with our four amplifiers detailed above. A very accurate visual display employing 11 L.F.D diodes (7 green, 4 red) plus an additional on/off indicator. Sophisticated logic control circuits for very fast rise and decay times. Tough moulded plastic case, with tinted acrylic front. Size 84 x 27 x 45mm. PRICE £8.50 + 50p P&P.

* PRICES INCLUDE V.A.T. * PROMPT DELIVERIES * FRIENDLY SERVICE * LARGE S.A.E. 28p STAMP FOR CURRENT LIST

BURGLAR ALARM

Better to be 'Alarmed' than 'Informed'. Thandar's famous 'Minder' Burglar Alarm System. Superior microwave principle. Supplied as three parts, complete with interconnection cables. FULLY GUARANTEED.

Control Unit - Houses microwave radar unit, range up to 15 metres adjustable by sensitivity control. Three position, key operated fascia switch - off - test - armed. 30 second exit and entry delay.

Indoor alarm - Electronic swept freq siren 104dB output.

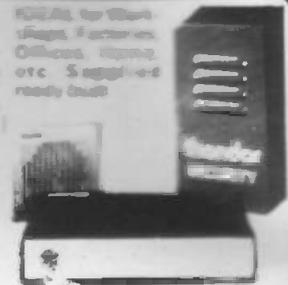
Outdoor Alarm - Electronic swept freq siren 98dB output. Housed in a tamper proof heavy duty metal case.

Both the control unit and outdoor alarm contain rechargeable batteries which provide full protection during mains failure. Power requirement 200/250 Volt AC 50/60Hz. Expandable with door sensors, panic buttons etc. Complete with instructions.

SAVE £138.00 Usual Price £228.85

BKE's PRICE £89.99 + £4.00 P&P

? Why buy a collection of self-assembly boards!



OMP LINNET LOUDSPEAKERS

The very best in quality and value. Made specially to suit today's need for compactness with high sound output levels. Finished in hard wearing black vinyl with protective corners, grille and carrying handle. All models 8 ohms Full range 45Hz - 20KHz Size 20" 15" - 12" Watts R.M.S. per cabinet. Sensitivity 100 Test 20"

OMP 12-100 Watts 100dB. Price £149.99 per pair.

OMP 12-200 Watts 102dB. Price £199.99 per pair. Delivery Secured £8.00 per pair



OMP 19" STEREO RACK AMPS



Professional 19" cased Mos-Fet stereo amps: Used the World over in clubs, pubs, discos etc. With twin Vu meters, twin toroidal power supplies, XLR connections, MF600 Fan cooled. Three models (Ratings R.M.S. into 4 ohms). Input Sensitivity 775mV

MF200 (100 + 100)W. £169.00 Securicor

MF400 (200 + 200)W. £228.85 Delivery

MF600 (300 + 300)W. £322.00 £10.00

1 K WATT SLIDE DIMMER

- Control loads up to 1kW
- Compact Size 1" x 2"
- Easy snap in fixing through panel
- Control cut out
- Insulated plastic case
- Full wave control using 8 amp diode
- Conforms to BS548
- Suitable for both resistive and inductive loads in domestic applications in industry, at home and in shops, theatres etc.

PRICE £13.99 + 75p P&P

BSR P295 ELECTRONIC TURNTABLE

- Electronic speed control 45 & 33 1/3 rpm
- Plus Minus variable pitch control
- Belt driven
- Alum minimum platter with strobed rim
- Cue lever
- Anti-skate (bias device)
- Adjustable counter balance
- Manual arm
- Standard 1" cartridge lugs
- Supplied complete with cut out template
- D.C. Operation 9-14V D.C. 65mA

Price £36.99 + £3.00 P&P



ADC Q4 mag. cartridge for above Price £4.99 ea. P&P 50p

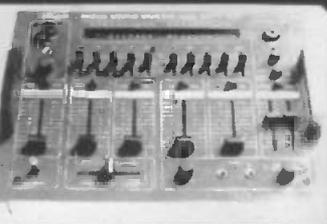
PIEZO ELECTRIC TWEETERS - MOTOROLA

Join the Piezo revolution! The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover is not required these units can be added to existing speaker systems of up to 100 watts (more if 2 put in series) FREE EXPLANATORY LEAFLETS SUPPLIED WITH EACH TWEETER.

- TYPE 'A' (KSN2036A)** 3" round with protective wire mesh. Ideal for bookshelf and medium sized Hi-Fi speakers. Price £4.90 each + 40p P&P
 - TYPE 'B' (KSN1005A)** 3 1/2" super horn. For general purpose speakers, disco and P.A. systems etc. Price £5.99 each + 40p P&P
 - TYPE 'C' (KSN6016A)** 2" x 5" wide dispersion horn. For quality Hi-Fi systems and quality discos etc. Price £6.99 each + 40p P&P
 - TYPE 'D' (KSN1025A)** 2" x 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2KHz). Suitable for high quality Hi-Fi systems and quality discos. Price £9.99 each + 40p P&P
 - TYPE 'E' (KSN1038A)** 3 3/4" horn tweeter with attractive silver finish trim. Suitable for Hi-Fi monitor systems etc. Price £5.99 each + 40p P&P
- LEVEL CONTROL** Combines on a recessed mounting plate, level control and cabinet input jack socket 85 x 85 mm. Price £3.99 + 40p P&P

STEREO DISCO MIXER

STEREO DISCO MIXER with 2 x 5 band L & R graphic equalisers and twin 10 segment LED Vu Meters. Many outstanding features. 5 Inputs with individual faders providing a useful combination of the following - 3 Turntables (Mag), 3 Mics, 4 Line plus Mic with talk over switch, Headphone Monitor, Pan Pot, L & R Master Output controls. Output 775mV. Size 360 x 280 x 90mm. Price £134.99 + £3.00 P&P



B. K. ELECTRONICS DEPT ETI

UNIT 5, COMET WAY, SOUTHEND-ON-SEA, ESSEX, SS2 6TR TEL: 0702-527572

LOUDSPEAKERS 8" to 15" up to 400 WATTS R.M.S. Cabinet Fixing in stock. Huge selection of McKenzie Loudspeakers available including Cabinet Plans. Large S.A.E. (28p) for free details.

- POWER RANGE**
- 8" 50 WATT R.M.S. Hi-Fi/Disco. 20 ohm magnet 1" ally voice coil. Ground ally fixing escutcheon. Res. Freq. 40Hz. Freq. Resp. to 6KHz. Sens. 92dB. PRICE £11.99 P&P £1.50 ea.
 - 12" 100 WATT R.M.S. Hi-Fi/Disco. 50 ohm magnet 2" ally voice coil. Ground ally fixing escutcheon. Die cast chassis. White cone. Res. Freq. 25Hz. Freq. Resp. to 4KHz. Sens. 95dB. PRICE £28.60 + £3.00 P&P ea.

- McKENZIE**
- 12" 85 WATT R.M.S. C1285GP Lead guitar/keyboard/Disco. 2" ally voice coil. Ally centre dome. Res. Freq. 45Hz. Freq. Resp. to 6KHz. Sens. 98dB. PRICE £29.99 + £3.00 P&P ea.
 - 12" 85 WATT R.M.S. C1285TC P.A./Disco 2" ally voice coil. Twin cone. Res. Freq. 45Hz. Freq. Resp. to 14KHz. PRICE £31.49 + £3.00 P&P ea.
 - 15" 150 WATT R.M.S. C15 Bass Guitar/Disco. 3" ally voice coil. Die-cast chassis. Res. Freq. 40Hz. Freq. Resp. to 4KHz. PRICE £57.87 + £4.00 P&P ea.
 - 10" 60 WATT R.M.S. 1060GP Gen. Purpose/Lead Guitar/Keyboard/Mid. P.A. 2" ally voice coil. Res. Freq. 75Hz. Freq. Resp. to 7.5KHz. Sens. 99dB. PRICE £19.99 + £2.00 P&P
 - 10" 200 WATT R.M.S. C10200GP Guitar, Keyboard, Disco. 2" ally voice coil. Res. Freq. 45Hz. Freq. Resp. to 7KHz. Sens. 101dB. PRICE £44.76 + £3.00 P&P
 - 15" 200 WATT R.M.S. C15200 High Power Bass. Res. Freq. 40Hz. Freq. Resp. to 5KHz. Sens. 101dB. PRICE £62.41 + £4.00 P&P
 - 15" 400 WATT R.M.S. C15400 High Power Bass. Res. Freq. 40Hz. Freq. Resp. to 4KHz. Sens. 102dB. PRICE £89.52 + £4.00 P&P.

- WEM**
- 5" 70 WATT R.M.S. Multiple Array Disco etc. 1" voice coil. Res. Freq. 52Hz. Freq. Resp. to 5KHz. Sens. 89dB. PRICE £22.00 + £1.50 P&P ea.
 - 8" 150 WATT R.M.S. Multiple Array Disco etc. 1" voice coil. Res. Freq. 48Hz. Freq. Resp. to 5KHz. Sens. 92dB. PRICE £32.00 + £1.50 P&P ea.
 - 10" 300 WATT R.M.S. Disco/Sound re-enforcement etc. 1" voice coil. Res. Freq. 35Hz. Freq. Resp. to 4KHz. Sens. 92dB. PRICE £36.00 + £2.00 P&P ea.
 - 12" 300 WATT R.M.S. Disco/Sound re-enforcement etc. 1 1/2" voice coil. Res. Freq. 35Hz. Freq. Resp. to 4KHz. Sens. 94dB. PRICE £47.00 + £3.00 P&P ea.
- SOUNDLAB (Full Range Twin Cone)**
- 5" 60 WATT R.M.S. Hi-Fi/Multiple Array Disco etc. 1" voice coil. Res. Freq. 63Hz. Freq. Resp. to 20KHz. Sens. 86dB. PRICE £9.99 + £1.00 P&P ea.
 - 6 1/2" 60 WATT R.M.S. Hi-Fi/Multiple Array Disco etc. 1" voice coil. Res. Freq. 56Hz. Freq. Resp. to 20KHz. Sens. 89dB. PRICE £10.99 + £1.50 P&P ea.
 - 8" 60 WATT R.M.S. Hi-Fi/Multiple Array Disco etc. 1 1/2" voice coil. Res. Freq. 38Hz. Freq. Resp. to 20KHz. Sens. 89dB. PRICE £12.99 + £1.50 P&P ea.
 - 10" 60 WATT R.M.S. Hi-Fi/Disco etc. 1 1/2" voice coil. Res. Freq. 35Hz. Freq. Resp. to 15KHz. Sens. 89dB. PRICE £16.49 + £2.00 P&P

PANTIC 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: £8.62 + 75p P&P.
- 3 WATT FM TRANSMITTER** 3 WATT 85/115MHz varicap controlled professional performance. Range up to 3 miles. 35 x 84 x 12mm (12 volt) Price: £14.49 + 75p P&P.
- 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 22mm (9/12 volt). Price: £17.82 Transmitter 80 x 50 x 15mm (9/12 volt). Price: £11.29 P&P + 75p each. S.A.E. for complete list.



3 watt FM Transmitter

POSTAL CHARGES PER ORDER £1.00 minimum. OFFICIAL ORDERS WELCOME, SCHOOLS, COLLEGES, GOVERNMENT BODIES, ETC. PRICES INCLUSIVE OF V.A.T. SALES COUNTER VISA/ACCESS/C.O.D. ACCEPTED



electronics today

INTERNATIONAL

JAN 1988 VOL 17 No. 1



Cover photograph courtesy Telegraph Colour Library/A. Woolfitt

Editor: Geoff Bains
Assistant Editor: Jez Ford
Projects Editor: Paul Chappell
Ad Manager: Christopher Harris
Classified Sales: Julie Capstick
Copy Control: Andrew Selwood
Group Editor: Dave Bradshaw

- Published by Argus Specialist Publications Ltd., 1 Golden Square, London W1R 3AB. Tel: 01-437 0626.
- UK newstrade distribution by SM Distribution Ltd., 16-18 Trinity Gardens, London SW9 8DX. Tel: 01-274 8611.
- Overseas and non-newstrade sales by Magazine Sales Department, 1 Golden Square, London W1R 3AB. Tel: 01-437 0626.
- Subscriptions by Infonet Ltd., 5 River Park Estate, Berkhamsted, Herts HP4 1HL. Tel: (04427) 76661.
- Typesetting and origination by Multiform.
- Printed by Adlard & Son, The Garden City Press.
- Covers printed by Loxley Brothers Ltd.

ISSN
0142-7229



Member of the
Audit Bureau
of Circulation

Electronics Today is normally published on the first Friday in the month preceding cover date. The contents of this publication including all articles, designs, plans, drawings, and programs and all copyright and other intellectual property rights therein belong to Argus Specialist Publications Limited. All rights conferred by the Law of Copyright and other intellectual property rights and by virtue of international copyright conventions are specifically reserved to Argus Specialist Publications Limited and any reproduction requires the prior written consent of the Company. © 1987 Argus Specialist Publications Ltd. All reasonable care is taken in the preparation of the magazine contents, but the publishers cannot be held legally responsible for errors. Where mistakes do occur, a correction will normally be published as soon as possible afterwards. All prices and data contained in advertisements are accepted by us in good faith as correct at time of going to press. Neither the advertisers nor the publishers can be held responsible, however, for any variations affecting price or availability which may occur after the publication has closed for press.

● Subscription rates: UK £16.80 Europe: £21.00 Middle East: £21.20 Far East: £22.80 Rest: £21.50 or US\$32.00.

1 Golden Square
London W1R 3AB
Tel: 01-437 0626
Telex: 01-881 1896

**ARGUS
PRESS
GROUP**

FEATURES

THE SKY'S THE LIMIT 13
Keith Brindley casts his eyes spaceward for this in-depth look at satellite television - the theory and the practice.

**MUSIC CIRCUIT
POTPOURRI 20**
Music correspondent Bruno Hewitt has been burning the midnight sonatas to produce this bumper bundle of circuits for music makers.

ARTFUL ARITHMETIC 28
Mike Barwise launches the new Chip In series with a look at hardware implementations of arithmetic unit.

IMAGINARY TIMES 32
Paul Chappell continues his investigation of Circuit Theory with a look at complex numbers.

MICRO MEDITATIONS 34
Mike Barwise gives some advice on choosing micro processors and finds there's life in the old 8-bit chips yet.

**DCP INTERFACE
MODULES 36**
Malcolm Brown has been trying out the latest general purpose interfaces for home micro owners and now gives his judgement.

PROJECTS

SMART TALKER 39
Russel Vowles has produced an RS232 speech synthesiser that can easily be linked to most micros and knows what it's talking about too.

**PASSIVE INFRA-RED
ALARM 46**
Robert Penfold gives up the active life for this small box of tricks to protect your home.

CLEAN UP CAMPAIGN 52
Paul Chappell banishes noisy fridge lights, electric drills and other mains spikes for ever with this new, improved mains conditioner.

RGB AUTO-DISSOLVE 58
Impress your friends and blind the cat with this novel lighting effect from M. P. Horsey.

ELECTRONIC VIOLET 63
Ronald Alpiar continues his description of the next classic instrument with a look at the stand-alone version.

TECH TIPS 68
CB Television Interference
Guitar Pick-up Switching
CB Homebase Power Supply
Acoustic Radar
Electronic Blockbusters

REGULARS

NEWS	4	BOOK LOOK	72
NEXT MONTH	6	KEYNOTES	73
DIARY	7	PCB SERVICE	74
READ/WRITE	9	OOPSI!	75
SUBSCRIPTIONS	11	PCB FOILS	76
OPEN CHANNEL	71	CLASSIFIED ADS	79
PLAYBACK	71	AD INDEX	82

Less Women In Engineering

There are 40% less women employed in the engineering industries now than ten years ago claims a recent report from the Engineering Industry Training board.

However, the proportion of women to men has risen in the same period. Women still outnumber men in the offices of engineering companies by about three to one.

Engineering management is still very much a male bastion. Although the proportion of female managers has risen over the last ten years, it is still at an atypical 3.8%.

In electrical and electronic engineering the percentage of women workers is currently at a reasonably healthy 32% - well above the overall engineering average of 20%.

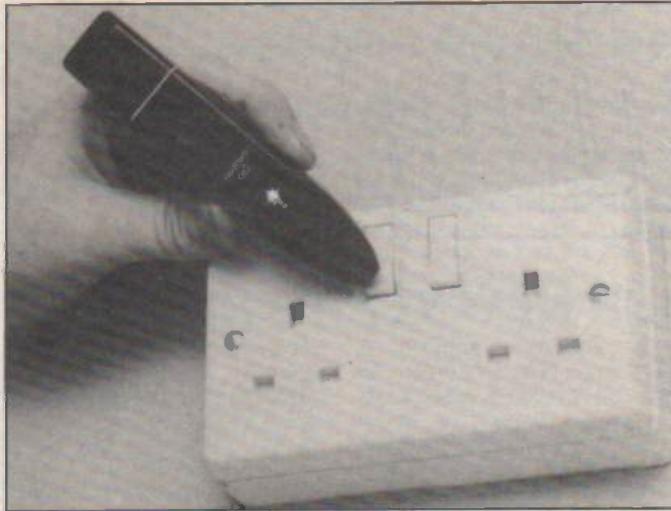
However, the numbers of workers of both sexes in electrical and electronic engineering has fallen since 1978 with a considerably greater drop of women workers.

The prospects for equality in the future look promising. The number of female electrical engineering graduates has more than doubled in the last ten years although the total number of graduations has risen by only a quarter.

The Engineering Industry Training Board report is called 'Women in engineering - trends in employment and training' and costs £10 from EITB Publications, PO Box 75, Stockport, Cheshire SK4 1PH.

Chips To Suit Every Palette

Hitachi has reduced the whole of the video back end of a micro onto a single chip. The HD153108 provides a complete colour palette with three 4-bit DACs, a microprocessor interface, and a 260-word 12-bit dual port RAM. Up to 256 colours can be displayed at once from a palette of 4096 at video dot rates of up to 50MHz. 75ohm drivers for the red, green and blue signals are also provided. Prices for the new chip have not yet been finalised but Hitachi expects the HD153108 to cost in the region of £40. Further details from Hitachi, 21 Upton Road, Watford, Herts WD1 7TB. Tel: (0923) 246488.



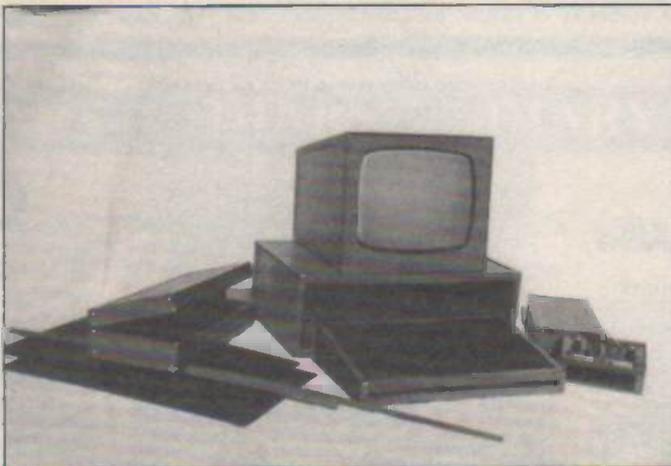
Detection Without Connection

The pocket voltage detector from Subtronic is a mains tester that doesn't need to be touched to the test cable. The pocket unit needs only to be placed near suspected area to register the presence of mains voltage.

The detector is battery powered and indicates mains voltage in the vicinity with an

LED. It is voltage which is detected and not current, so the unit is ideal for plumbers, electricians and other workers dealing with mains wiring.

The pocket voltage detector costs £19.50 + VAT and it is available from Subtronic Ltd, High Street, Hillmorton, Rugby, Warwickshire CV2 4HD. Tel: (0788) 70241.



A Case Of Good Design

Encore Enclosures' DIY case system allows any size and shape of case to be custom made for difficult projects.

The system is based around plastic sheeting and a range of plastic extrusions form the edges of the case and join side panels cut from the sheeting. All panel edges are concealed by the edge extrusions and so considerable neatness and margin for error is achieved even with unprofessional assembly.

A range of corner fittings and front panel edge trims are also available.

Encore claims the DIY system provides cheaper cases

than the ready-made variety as a project can be cased in the bare minimum sized box required for the job rather than in the next largest standard size.

Typical costs are £11 to make up a 19in racking case and £8 for a slope front computer keypad.

The Encore DIY system was originally developed after complaints from Bath University that students were having difficulty finding suitable enclosures for their course projects.

Further details and prices from Encore Enclosures, Unit 3, Willand Industrial Estate, Cullompton, Devon EX15 2QW. Tel: (0884) 820955.

City and Guilds is promoting itself with a 12-minute video. Available free to employers, training agencies and educational establishments, the video highlights the various aspects of the City & Guilds' work in engineering, computing, catering, tourism and chemical engineering. For a free copy write to The Publicity Officer, City & Guilds, 46 Britannia Street, London WC1X 9RG.

Low power PAL devices are now available from Monolithic Memories. The PAL C20R8Z-35/45 ZPAL devices are manufactured in CMOS and consume less than 10uA in standby mode and 3mA/MHz in operating mode. The low power PALs are offered in 24 pin 'Skinny-dip' packages or 28 pin PLCC. Further details from MMI, Monolithic House, Queens Road, Farnborough GU14 6 DJ. Tel: (0252) 517431.

Greenweld's 1988 component catalogue is now available at a price of £1. The 88-page catalogue contains details of all Greenweld's range from single resistors to music keyboards. A free continuity tester is offered to the first 1000 customers. Greenweld, 443a Millbrook Road, Southampton SO1 0HX. Tel: (0703) 772501.

A directory of 'ex-government' software is available from Microinfo. Over 1,700 programs developed for US Federal Agencies are listed in 21 subject areas in the Directory of Computer Software and most are available from Microinfo for purchase but without installation or support. Further details from Microinfo, PO Box 3, Omega Park, Alton, GU34 2PG. Tel: (0420) 86848.

Peculiar custom keypads are easily made up using Highland Electronics' DNC DT series of DIY keypad kits. The kits are available in 4, 12, 16, 40, 80 and 102 key configurations and include the basic switch unit, graphic overlay, colour pad, connector, bezel, and face plate. Dry transfer lettering is also available in a number of styles for labelling the keys. The switches have a steel dome to provide tactile feedback and can be cut up from the seven standard layouts for custom designs. Further information is available from Highland Electronics, Albert Drive, Burgess Hill, West Sussex RH15 9TN.

NEXT MONTH

electronics today

INTERNATIONAL

YOUR NEW YEAR'S RESOLUTION

MORE SATELLITE TV

Keith Brindley knows when he's onto a good thing and next month he looks at 55 satellite TV reception systems (that's TVROs to you if you've read this month's article). Don't miss the February ETI to find which is dish of the day.

TRANSISTOR TESTER

It's been a while since we published one of these. This high tech version tests transistors and diodes in or out of circuit and displays the results on an LCD. Definitely a flashy addition to your workshop.

SPECTRUM CO-PROCESSOR

If you thought 128K Spectrum Plus 17 was the last word in updating the Spectrum architecture then think again. This wondrous add-a-micro unit provides 256K and a second Z80 processor for your Spectrum for truly complex home computing or system development.

NOT FORGETTING ...

... all the rest that go to make ETI the best electronics magazine on the shelves of your local newsagent. There's news, reviews, projects, features and much, much more in next month's ETI.

February ETI - Out 1st January 1988

All these articles are in preparation but circumstances may prevent publication.



HART ELECTRONICS are specialist producers of kits for designs by JOHN LINSLEY-HOOD. All kits are APPROVED by the designer.

LINSLEY-HOOD CASSETTE RECORDER CIRCUITS



Complete record and replay circuits for very high quality low noise stereo cassette recorder. Circuits are optimised for our HS16 Super Quality Sendust Alloy Head. Switched bias and equalisation to cater for chrome and ferric tapes. Very easy to assemble on plug-in PCBs. Complete with full instructions.

Complete Stereo Record/Play Kit £33.70
 VU Meters to suit £2.30 each
 Reprints of original Articles 75p no VAT
 860X Stereo Mic Amplifier £8.70

LINSLEY HOOD 300 SERIES AMPLIFIER KITS
 Superb integrated amplifier kits derived from John Linsley-Hood's articles in 'HIFI News'.
 Ultra easy assembly and set-up with sound quality to please the most discerning listener. Ideal basis for any domestic sound system if quality matters to you. Buy the kit complete and save pounds off the individual component price.

K300-35 35 Watt Discount price for Complete Kit . £98.79
 K300-45 45 Watt Discount price for Complete Kit £102.36
 RLH485. Reprints of Original Articles from 'HIFI News' £1.05 no VAT

LINSLEY-HOOD SUPER HIGH QUALITY AM/FM TUNER SYSTEM.



Our very latest kit for the discerning enthusiast of quality sound and an exotic feast for lovers of designs by John Linsley-Hood. A combination of his ultra high quality FM tuner and stereo decoder described in "ELECTRONICS TODAY INTERNATIONAL" and the Synchrodyne AM receiver described in "Wireless World". The complete unit is cased to match our 300 Series amplifiers. Novel circuit features in the FM section to include ready built pre-aligned front-end, phase locked loop demodulator with a response down to DC and advanced sample and hold stereo decoder together make a tuner which sounds better than the best of the high-priced exotica but, thanks to HART engineering, remains easy to build. The Synchrodyne section with its selectable bandwidth provides the best possible results from Long and Medium wave channels, so necessary in these days of split programming. If you want the very best in real HIFI listening then this is the tuner for you. Since all components are selected by the designer to give the very best sound this tuner is not cheap, but in terms of its sound it is incredible value for money. To cater for all needs four versions are available with variations up to the top of the range full AM/FM model, with any unit being upgradeable at any time. Send for our fully illustrated details.

STUART TAPE RECORDER CIRCUITS

Complete stereo record, replay and bias system for reel-to-reel recorders. These circuits will give studio quality with a good tape deck. Separate sections for record and replay give optimum performance and allow a third head monitoring system to be used where the deck has this fitted. Standard 250mV input and output levels. These circuits are ideal for bringing that old valve tape recorder back to life.
 K900W Stereo Kit with Wound Coils and Twin Meter Drive. £85.67
 RJS1 Reprints of Original Articles £1.30 no VAT

HIGH QUALITY REPLACEMENT CASSETTE HEADS



Do your tapes lack treble? A worn head could be the problem. Fitting one of our replacement heads could restore performance to better than new! Standard mountings make fitting easy and our TC1 Test Cassette helps you set the azimuth spot-on. We are the actual importers which means you get the benefit of lower prices for prime parts. Compare us with other suppliers and see! The following is a list of our most popular heads, all are suitable for use on Dolby machines and are ex-stock.

HC20 Permalloy Stereo Head. This is the standard head fitted as original equipment on most decks £7.55
 HS16 Sendust Alloy Super Head. The best head we can find. Longer life than Permalloy, higher output than Ferris, fantastic frequency response £14.85
 HQ551 4-Track Head for auto-reverse or quadrophonic use. Full specification record and playback head £14.60
 HX100 Stereo Permalloy R/P Head. Special Offer £2.49
 MA481 2/2 Language Lab R/P head £13.35
 SM156 2/2 Erase Head. Standard mounting, AC type £8.85
 SM150 2/2 Erase Head. DC Type £3.60
 HQ751E 4/4 Erase Head for Portastudio etc. £46.80
 Full specifications of these and other special purpose heads in our lists.

HART TRIPLE-PURPOSE TEST CASSETTE TC1

One inexpensive test cassette enables you to set up VU level, head azimuth and tape speed. Invaluable when fitting new heads. Only £4.86 plus VAT and 50p postage.

Tape Head De-magnetiser. Handy size mains operated unit prevents build up of residual head magnetisation causing noise on playback £4.54
 Curved Pole Type for inaccessible heads £4.85

Send for your free copy of our LISTS. Overseas please send 2 IRCs to cover surface Post or 5 IRCs for Airmail.

Please add part cost of post, packing and insurance as follows:

INLAND
 Orders up to £10 - 50p
 Orders £10 to £49 - £1
 Orders over £50 - £1.50

OVERSEAS
 Please send sufficient to cover Surface or Air Post as required.

Personal callers are always very welcome but please note that we are closed all day Saturday

24hr SALES LINE
 (0691) 652894

ALL PRICES EXCLUDE VAT UNLESS STATED



One Good Turn Deserves Another



An ingenious hand held tachometer is available from Electronic Temperature Instruments (a company with a strangely familiar abbreviated name). The PFM120 digital tachometer uses a modulated beam of infra-red light reflected once every revolution from a piece of reflective tape onto the rotating object to determine the rotational speed without contact.

An optional 'contact adapter' is also supplied. This plugs into

the end of the tachometer and the conical head is touched to the end of a rotating shaft to measure rotational speed or a rubber covered disc is placed in contact with conveyor belts, roller surfaces and the like for measuring linear speeds.

The tachometer can measure rotational speeds from 1-100000rpm with four digit accuracy. The PFM costs £125 +VAT from ETI, PO Box 81, Worthing, West Sussex BN13 3PW. Tel: (0903) 202151.

CD ROMs Are Here

The first CD ROM package for personal computers is about to hit the electronic streets. Bookshelf from Microsoft provides ten reference works for writers using an IBM PC compatible micro.

On the read-only optical disc is stored information amounting to 1500 floppy disks, claims Microsoft. Amongst the reference works stored at a comprehensive dictionary, a thesaurus, a business information listing and literary style manual.

The CD ROM runs on a Hitachi drive connected to an IBM PC compatible and can be accessed while using other programs, such as a word processor.

Microsoft hopes to release further CD ROM packages of other reference information soon and claims that optical storage will soon be commonplace amongst office micros.

Bookshelf costs £195 +VAT and includes the CD ROM MS-DOS extensions. A separate CD ROM drive is required. Further details from Microsoft, Excel House, 49 De Montfort Road, Reading RG1 8LP. Tel: (0734) 500741.

European Rocket Finally Leaves The Ground

Ariane has finally managed a successful launch. On 16th September, after a delay caused by fuelling telemetry problems on the third stage, the joint European rocket left the launch pad just after midnight to deposit two communications satellites in geostationary orbit.

The previous Ariane was blown up early in its flight in

1986 because of fuel problems preventing the third stage from igniting.

Now that Ariane is back on stream we can expect a launch every month or so. The next cargo scheduled is the West German RT SAT A3. This heavy 200W satellite will provide Germany with its full DBS service receivable on dishes of

less than 60cm.

The US Space Shuttle has also been having some luck. The recent tests of the solid fuel rocket boosters have shown no leakage of gas through the redesigned o-ring seals (the cause of 1986's shuttle disaster). Many more tests are still to be performed but if these all go well, the shuttle is expected to resume launches in June 1988.

DIARY... DIARY... DIARY... DIARY... DIARY...

The UK Space Programme - December 7th

The IEE, London. Lecture by R. Gibson of the British National Space Centre. Contact IEE on 01-240 1871.

Mathematical Modelling of Semiconductor Devices - January 7-8th

University of Technology, Loughborough. Contact IEE on 01-240 1871 or The Institute of Mathematics and its Applications on (0702) 612177

Early Days Of Electric Lighting - January 11th

IEE, London. Lecture by C. N. Brown of the Science Museum. Contact IEE on 01-240 1871

Corporate Computer Security '88 - January 12-14th

Metropole Exhibition Centre, Brighton. Contact PLF Communications on (0733) 60535

Gallium Arsenide: A New Generation Of Devices - January 14th

IEE, London. Lecture by Prof. D. V. Morgan (UWIST). Contact IEE on 01-240 1871

The Illusion Of Colour - January 14th

Lecture by M. B. Halstead (Thort EMI) at the Gonville Hotel, Gonville Place, Cambridge. Contact Eastern Region IEEIE on (0603) 628321

British Engineering Supplies & Technology - January 18-21st

Olympia, London. Contact Mack-Brooks Exhibitions on (07072) 75641

The Which? Computer Show - January 19-22nd

NEC, Birmingham. Contact Cahners Exhibitions on 01-891 5051

Role Of Highly Elliptical Orbits In Satellite Communications - January 28th

IEE, London. Lecture by G. Beretta of the European Space Agency. Contact IEE on 01-240 1871

Electromagnetic Compatibility And Microprocessor Based Systems - February 2nd

Heathrow Penta Hotel, London. Contact ERA Seminars and Exhibitions on (0372) 374151

European Seminar On Neural Computing - February 8-9th

Royal Garden Hotel, London. Contact IBC Technical Services on 01-236 4080

Energy '88 - February 10-12th

Garrogate Exhibition Centre. Contact Emap Maclaren Exhibitions on 01-686 9200

Cable And Satellite '88 - February 25-28th

Wembley Exhibition and Conference

Centre, London. Contact Montbuild Exhibitions on 01-485 1951

Offshore Computer Show - March 22-24th

Aberdeen Exhibition and Conference Centre. Contact Offshore Conferences and Exhibitions on 01-549 5831

Electro-Optics & Laser UK - March 22-24th

NEC, Birmingham. Exhibition running alongside the Optics-Ecoosa '88 conference at the Birmingham Metropole Hotel. Contact Cahners Exhibitions on 01-891 5051

Computing In The Next Generation - March 25-27th

Annual conference of the British Computer Society's Young Professionals Group. Contact Julia Allen on 01-637 0471 for the venue.

Computers In Retail & Retail Technology Exhibition - March 29-31st

Metropole Exhibition Centre, Brighton. Contact Focus Events on 01-834 1717

HF Radio Systems And Techniques - April 11-13th

The IEE, London. Conference organised by the IEE and The Institute of Mathematics and its Applications. Contact IEE on 01-240 1871

COMPETITION

Win one of two prizes worth £150 in our free-to-enter competition

ETI has two £75 vouchers redeemable against ETI project kits from Specialist Semiconductors just waiting to be given away to two lucky readers. You can use the vouchers in part or total payment against any ETI project kit available from Specialist Semiconductors. See the ad in this issue for a taster of the range available.

What do you have to do to win these precious prizes? Well it couldn't be simpler and we're not asking for you to be superhumanly intelligent in electronics either.

Below you will see two panels. One contains a wordsearch square and the other a simple resistor network. The wordsearch is the really easy one so let's look at that first.

Hidden in that 400-letter mass are more than 30 words (between three and ten letters long) you are likely to find in the pages of ETI. All you have to do is find them. The words are written horizontally, vertically and diagonally and they're not necessarily the right way around. As that's so easy, we're not going to tell you how many there are there - it's more than 30

and a lot less than 452! Ring the letters of each word as you find it, as shown with the word 'KEYPAD'.

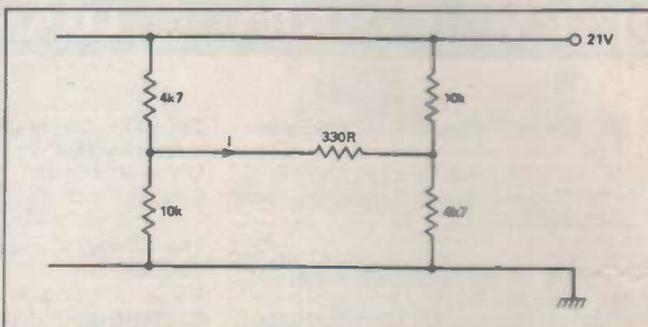
The resistor network is even simpler. Here's your chance to put that *Circuit Theory* to the test. All you have to do is to work out the current (I) flowing through the central resistor, to the nearest milliamp. Couldn't be simpler!

When you've found all the words you're going to, list them out in the space provided (now that gives you some idea how many there are . . .) and write the total where indicated. Write the current you've calculated to be flowing through the central resistor in the space provided for that and send the whole coupon (or a photocopy) to:

**ETI SS Competition
1 Golden Square
London W1R 3AB.**

All entries must be clearly marked for the SS Competition and must arrive at the ETI offices by 12 midnight on 31st December, 1987. The results will be announced in a future issue. Needless to say, the judges decision will be the last word.

D	H	T	O	O	T	W	A	S	V	V	U	R	E	D	I	L	S	X	E
S	O	L	D	E	R	H	E	A	D	Q	Y	N	H	C	F	H	N	O	M
J	V	M	F	D	G	O	E	D	O	I	D	J	M	R	P	Y	C	I	F
S	Q	A	E	R	I	Z	Q	W	W	O	X	S	O	Y	C	I	Y	H	T
A	P	O	N	A	T	I	M	T	U	I	E	M	K	S	Y	E	H	Y	U
F	C	E	O	O	T	D	P	T	Y	J	I	O	O	T	D	Y	O	C	X
I	I	D	H	B	Y	U	P	T	J	R	T	O	Q	A	I	G	E	Z	Q
L	N	I	P	D	C	U	A	R	R	Q	V	T	C	L	A	O	R	O	U
N	O	V	O	A	T	Z	G	O	I	I	Z	H	A	T	F	W	E	B	T
P	I	S	R	E	O	A	E	T	Z	J	A	I	E	X	E	G	T	H	M
A	M	G	C	R	J	D	X	A	K	M	R	C	V	I	E	R	S	G	T
R	R	L	I	B	O	L	E	L	F	E	T	T	U	J	D	O	V	V	I
O	E	C	M	H	E	N	C	L	A	M	Y	B	V	A	B	T	T	Y	U
T	H	G	T	M	T	S	M	I	O	O	H	P	P	S	A	S	N	O	C
I	T	A	E	I	Y	D	B	C	S	R	O	P	A	R	C	I	E	V	R
C	C	Z	D	O	B	W	F	S	R	Y	S	V	E	D	K	S	R	R	I
A	Q	L	M	N	X	Q	X	O	I	J	L	N	T	X	B	N	R	E	C
P	C	D	T	R	E	F	F	U	B	X	E	H	K	A	U	A	U	S	A
A	U	J	B	I	P	O	L	A	R	Z	M	I	T	X	H	R	C	M	K
C	T	J	M	U	T	S	L	J	C	O	A	X	I	A	L	T	D	X	I



The current, I, is:

Total number of words found:

The words I have found are:

Name

Address

.....

.....

.....

READ/WRITE

Dead Clever



Here I was, on my (late) summer hols (better late than never) when I received my September issue of ETI (late, on account of my being (a) overseas and (b) on holiday previously as well).

The little paragraph at the end of Read/Write inspired me to write to you. As a matter of fact I was in Torremolinos but I had to catch a bus and so I couldn't fulfil your request to the letter. However, I'm sending you a postcard from Puerto Banus which is much more distinguished anyway.

Now to electronics: I think the ETI EEG Monitor is a brilliant idea! I shall relate to you an experience I have with a similar device.

I used two well-screened, balanced differential amps feeding a third (as in your Bio-amp) then a buffer, a further amp and the whole thing was connected to a scope.

I used three proper electrodes in saline gel and, having created the proper atmosphere (cauldron, candles, etc) connected it up to a human skull my father has at home.

Lo and behold — alpha-waves! We couldn't believe our eyes (my father is a psychiatrist) so to see if it was just noise we disconnected the skull — nothing. We tried the electrodes on ourselves — alpha!

At this point we ripped the whole thing to bits and tried to forget all about it!

So, a warning to all who build the EEG Monitor: Watch out, watch out, there are alpha waves about!

Ilya Eigenbrot

A train somewhere in Portugal (usually Heidelberg, West Germany)

PS By the way, what's happened to Tech Tips?

What can we say. A postcard — how touching. So there are readers who care!

It's well known that EEG really stands for Eerie Electric Ghost so what did you expect!

Seriously though, folks, as was explained in the last part of the EEG Monitor project (November 1987) it is not a good idea to directly connect up such a device to any mains powered equipment (such as a scope). That is why the opto-isolated output was provided on the ETI device.

As to Tech Tips: Although generalised Tech Tips have been a bit short on the ground recently, there has been an abundance of circuit ideas on specific areas (CB, music, cars and so on) over the last year or so. We will try to fit more of both into the mag in future.

At Last!

I've always wondered what I was supposed to do with ECL logic chips. The *Hardware Design Concepts* in the November ETI has now told me.

Can we have more such articles please.

Neil Sinclair

Gunnerside, North Yorkshire

Mike Barwise's excellent *Hardware Design Concepts* series has now run its course. However, Mike is starting a new series to look at specific ICs and families in this very issue. We hope you find this useful in the coming months.

Who Needs Software?

Thanks for Robert Stevenson's *Concept* controller project. As you said, many controllers have been published before but this has to be the ultimate. I'm now well on the way to finishing mine.

I am a little puzzled, however, by the whole page of EPROM hex dump that you published in the November issue. Given that Robert is selling pre-programmed EPROMs, why take up so much space (which you are always bemoaning as short) in the

magazine with a listing which few, if any, readers would attempt to type into a programmer?

Hugh Young

Congleton, Cheshire

Many ETI projects these days are microcomputers in one guise or another and so a great deal of magazine room is taken up by publishing the software. However, we feel this is essential for those readers who do not wish to pay out for intangibles and for those reading the mag in years to come, after the project's author has moved on.

Next On BBC1...

It is a well known fact that only very weird people ever write in to *Points of View* at the Beeb. You know the kind of thing: "I was disgusted to hear the word 'elbow' mentioned on BBC2 last night before nine o'clock" or "I would gladly give my right arm and several toes for the chance to see the closing credits of last night's six o'clock news again".

Anyway, I am not (very) weird and so I am not going to write to *Points of View*. Instead, I am writing to you to say how glad I am that *Doctor Who* is back on the box (pity about Bonnie Langford, though).

Ever thought of changing your postcode to W12 8QT?

Roger Thomson

Crewkerne, Somerset

It's nice to know that ETI is held in higher esteem than *Points of View*. Quite agree about *Doctor Who* (and about Bonnie Langford).

It's a bit of a silly selection in this month's postbag but who are we to complain. Even a crazy letter is much better than no letter at all. So, with that as your motto, scribble us off a note while this month's controversy is still fresh in your mind.

Write to: *Electronics Today International*
1 Golden Square
London W1R 3AB

ETI

For KITS & COMPONENTS - Choose the easy way - with

Send 50p* & SAE for CATALOGUE (AUTUMN 1987)

*refundable with first order



ORDERS: RING (01) 567 8910 - 24 HRS.

NEW ELECTRONIC GUARD DOG KIT



One of the best deterrents to a burglar is a guard dog and the new kit provides the barking without the bite! The kit when assembled can be connected to a doorbell, pressure mat or any other intruder detector and will produce a random series of threatening barks making the would be intruder think again and try his luck elsewhere. The kit is supplied complete with high quality PCB, transformer, all components and instructions. All you need is a mains supply, intruder detector and a little time. The kit even includes a horn speaker which is essential to produce the loud sound required. The "dog" can be adjusted to produce barks ranging from a Terrier to an Alsatian and contains circuitry to produce a random series of barks giving a more realistic effect.

XK125 Complete kit of parts £21.95

DISCO LIGHTING KITS

DL1000K - This value-for-money 4-way chaser features bi-directional sequence and dimming. 1kW per channel. £17.50
DL21000K - A lower cost uni-directional version of the above. Zero switching to reduce interference. £9.88
DLA/1 (for DL & DL21000K) Optional opto input allowing audio 'beat' /light response. £7.0p
DL3000K - 3-channel sound to light kit features zero voltage switching, automatic level control and built-in microphones. 1kW per channel. £14.25

The **DL8000K** is an 8-way sequencer kit with built in opto-isolated sound to light input which comes complete with a pre-programmed EPROM containing EIGHTY - YES 80! different sequences including standard flashing and chase routines. The KIT includes full instructions and all components (even the PCB connectors) and requires only a box and a control knob to complete. Other features include manual sequence speed adjustment, zero voltage switching, LED mimic lamp and sound to light LED and a 300 W output per channel.

And the best thing about it is the price.

ONLY £28.50



TEN EXCITING PROJECTS FOR BEGINNERS

This kit has been specially designed for the beginner and contains a **SOLDERLESS BREADBOARD, COMPONENTS, and a BOOKLET** with instructions to enable the absolute novice to build TEN fascinating projects including a light operated switch, intruder, burglar alarm, and electronic lock. Each project includes a circuit diagram, description of operation and an easy to follow layout diagram. A section on component identification and function is included, enabling the beginner to build the circuits with confidence.

ORDER NO **XK118** £13.75

MICROPROCESSOR TIMER KIT

Designed to control 4 outputs independently switching on and off at present times over a 7-day cycle. LED display of time and day. Easy programmed via 20 way keyboard. Ideal for central heating control including different switching time for weekends. Battery back-up circuit. Includes box, 18 time settings. **CT6000K** £42.90
XK114 Relay kit for CT6000, includes PCB, connectors and one relay. Will accept up to 4 relays. 3A/240V c/o contacts. £4.30
701 115 Additional relays £1.80



VERSATILE REMOTE CONTROL KIT

This kit includes all components (+ transformer) to make a sensitive IR receiver with 16 logic outputs (0-15V) which with suitable interface circuitry (relays, triacs, etc - details supplied) can be used to switch up to 16 items of equipment on or off remotely. The outputs may be latched (to the last received code) or momentary (on during transmission) by specifying the decoder IC and a 15V stabilised supply is available to power external circuits. Supply: 240V AC or 15-24V DC at 10mA. Size (excluding transformer) 9 x 4 x 2 cms. The companion transmitter is the **MK18** which operates from a 9V PP3 battery and gives a range of up to 60ft. Two keyboards are available—**MK9** (4-way) and **MK10** (16-way), depending on the number of outputs to be used.

MK12 IR Receiver (incl. transformer) £14.85
MK18 Transmitter £7.50
MK9 4-Way Keyboard £2.00
MK10 16-Way Keyboard £5.98
601 133 Box for Transmitter £2.80

HOME LIGHTING KITS

These kits contain all necessary components and full instructions and are designed to replace a standard wall switch and control up to 300W of lighting.

TDR300K Remote Control Dimmer £16.45
MK6 Transmitter for above £4.98
TD300K Touchdimmer £8.50
TS300K Touchswitch £8.50
TDE/K Extension kit for 2-way switching for TD300K £2.70
LD 300K Light Dimmer £4.35

NEW POWER STROBE KIT

Designed to produce a high intensity light pulse at a variable frequency of 1 to 15Hz this kit also includes circuitry to trigger the light from an external voltage source (eg. a loudspeaker) via an opto isolator. Instructions are also supplied on modifying the unit for manual triggering, as a slave flash in photographic applications or as a warning beacon in security applications. The kit includes a high quality pcb, components, connectors, 5W strobe tube and full assembly instructions. Supply: 240V ac. Size: 80 x 50 x 45.

XK124 STROBOSCOPE KIT £12.50

NEW HIGH SECURITY LOCK KIT

Designed for use with our lock mechanism (701 150) this kit will operate from a 9V to 15V supply drawing a standby current of only 50µA. There are over 5000 possible 4-digit combinations and the sequence can be easily changed. To make things even more difficult for an unauthorised user an alarm can be sounded after 3 to 9 incorrect entries—selectable by means of a dial. The alarm can sound for a few seconds to over 3 minutes during which time the keyboard is disabled preventing further entries. A latched or momentary output is available making the unit ideal for door locks, burglar alarms, car immobilisers, etc. A membrane keyboard or pushbutton switches may be used and a beep sounds when a key is depressed. Kit includes high quality PCB, all components, connectors, high power piezo buzzer and full assembly and user instructions.

XK121 LOCK KIT £18.95
350 118 Set of Keyboard Switches £4.00
701 150 Electric Lock Mechanism 12 volt £16.50

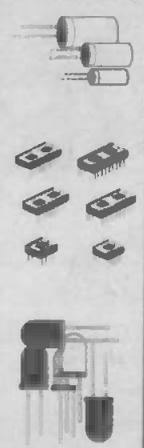
PROPORTIONAL TEMPERATURE CONTROLLER KIT

Uses "burst fire" technique to maintain temperature to within 0.5°C. Ideal for photography, incubators, wine-making, etc. Max. load 31w (240V ac) Temp. range up to 90°C. Size: 7x4x2.5cms. **MK4** £7.10

BARGAIN COMPONENT PACKS

Refill those empty component drawers at a fraction of the normal prices and don't be caught without that odd resistor or capacitor to complete your project. All components supplied are to full spec. and are not seconds or surplus stock.

- Pack A: 650 x .25 watt resistor 47r-10m £4.25
 - Pack B: 60 x Radial electrolytics 1uf - 1000uf £3.25
 - Pack C: 30 x Polyester capacitors a or uf - 1uf £4.50
 - Pack D: 35 x horizontal presets 1k-1m £3.00
 - Pack E: 30 x IC sockets 8, 14, 15 pin £2.00
 - Pack F: 25 x Red 5mm LEDs £1.75
 - Pack G: 25 x Green 5mm LEDs £2.00
 - Pack H: 30 x 5mm LEDs 10 Red, 10 Green, 10 Yellow £2.50
 - Pack J: 50 x 50n 4148 silicone diodes £1.00
 - Pack K: 40 x npn/pnp transistors DC/182/212 General Purpose £2.25
- Free Solderless Breadboard (verdock type). When you buy all ten packs. Prices excluding VAT (15%).



TOOLS ★ TOOLS ★ TOOLS



Good quality tools selected to offer outstanding value for money.

- 650 004 6in mini. Snipe Nose Pliers. Serrated jaws and return spring. £2.10
 - 650 006 6in lat jointed side cutters. Insulated handles and return spring. £2.10
 - 650 006 Light duty cutters. Cutting capacity 0.22-1.2mm copper wire. £1.80
- TOOL KIT** - Contains: side cutters, snipe nose pliers, wire strippers, flat blade screwdriver, Phillips screwdriver in black textured, reinforced and padded case which when opened out measures 240x205mm. £6.80



- 650 007 Self-adjustable automatic wire stripper with built-in cable cutter. £3.95
 - 650 012 Watchmakers Screwdriver Set. 1.0/1.4/2.0/2.4/3.0/3.6mm £1.75
 - 650 019 Set of 4 Stainless Steel Tweezers. Straight nosed, straight nosed-reverse action, bent nosed, flat nosed. 110mm long. £3.68
 - 650 802 Reamit 9-12V dc Drill. £6.80
 - 650 500 Titan 12V dc Drill. £10.25
 - 650 870 Saturn Mains Drill. £16.50
- WE ALSO STOCK ANTEX IRONS AND ACCESSORIES

NOT JUST A MULTIMETER

A professional quality 3 1/2 digit multimeter with 34 ranges. As well as the usual current, voltage & resistance this meter features transistor and diode test, continuity AND CAPACITANCE and TEMPERATURE ranges. Basic accuracy is 0.25%. Size: 170x87x42mm. Includes test leads, thermocouple and full instruction & recalibration manual.

AC Volts	.....200m-2-20-200-750
DC Volts	.....200m-2-20-200-1KV
AC Current	.....200u-2m-20m-200m-2A-10A
DC Current	.....200u-2m-20m-200m-2A-10A
Resistance	.....200-2K-20K-200K-2M-20M
Capacitance	.....200p-2uF-20uF
Temperature	.....-10° to 150° C
Conductance	.....200S
hFE	.....0-1000 (NPN & PNP)
Continuity Buzzer	.....less than 200 ohms (405208)

£55.00



LOGIC PROBE

A MUST for working with TTL & CMOS devices. Displays logic levels and pulses down to 25nS with LEDES and sound. Comprehensive instruction booklet supplied.

Working voltage 4-16V dc
 Input Impedance 1M
 Max. I/p frequency 20MHz

ONLY £8.50

SECURITY PRODUCTS

Install your own burglar alarm and save pounds. All parts available separately.

- 950 120 Stair Pressure Mat 1.70
 - 950 125 Floor Mat 29x16 ins. 2.50
 - 950 130 External bell box - an ideal deterrent on its own! 10.00
 - 950 130 Xenon Beacon (12v) 10.50
 - 950 140 Flush door/window contacts 1.22
 - 950 143 Surface mounting contacts 1.05
 - 960 160 Alarm Control Unit
 - 950 162 Alarm Control Unit
- This unit incorporates all the features required to form the basis of a complete security system for the home or business. Operating off a 240v AC supply with facility to charge a 12v lead acid standby battery. The unit is housed in a white steel box 225x225x80mm. Full instructions supplied to connect normally open and closed sensors, bells, personal alarms etc. Separate entry and exit alarm delays. 2 zone operation complies with BS 4737 price £39.95
- 950170 DOOR PHONE**
 An attractively styled 2 station mains powered handset type door phone. Allowing conversation with visitors without opening the door. Free standing or wall mounted, connections to a 9 volt battery for standby. Electric doorlock release button which may be used with our 701150 lock release mechanism. Ivory and Fawn body 210x100x70mm. £27.95

RECHARGEABLE SOLDERING IRON

Powerful cordless iron complete with table-top/wall-mounting charging bracket. Reaches soldering temperature in 10 seconds. Includes lamp which lights when soldering. Comes with mains charging unit and 12V car battery adaptor. £17.95

ELECTRONIC WEIGHING SCALES

This kit contains a Single Chip Microprocessor, PCB, displays and all electronics to produce a digital readout of weight in Kgs, or Sts, and Lbs. In normal use a toothed wheel (pattern provided) is made to rotate when a weight is placed onto the scales, interrupting two infra-red beams. The processor counts the number of teeth passing the sensor (up or down, depending on which beam is broken first) and shows the reading on the LED display in Sts & Lbs., Lbs. or Kgms. A PCB link selects the scale for bathroom or two types of Kitchen Scales. A linear version of the toothed wheel could also be used. Other uses include up/down counters. A low cost digital ruler could be made by using a wheel with the correct tooth to diameter ratio. **ES1** £5.50



TR ELECTRONICS
 13 BOSTON RD
 LONDON W7 3SJ
 Tel: 01-567 8910

SEND 9"x8" S.A.E. & 50p FOR CATALOGUE OR CALL AT SHOP MON-FRI 9-5pm SATURDAY 10-4pm

ORDERING INFORMATION: ALL PRICES EXCLUDE VAT

FREE P&P on orders over £20 (UK only), otherwise add 75p + VAT. Overseas P&P: Europe £2.75. Elsewhere £6.50. Send cheque/PO/Barclaycard/Accs No. with order. Giro No. 529314002.

LOCAL AUTHORITY AND EXPORT ORDERS WELCOME GOODS BY RETURN SUBJECT TO AVAILABILITY

SUBSCRIPTIONS SENSATIONS!

AT COVER PRICE ONLY!

Any of the magazines from the list below can be delivered to your door
with : NO handling charge NO postage costs

A&B Computing	£18.00
Aeromodeller	£22.20
Citizens Band	£16.20
Clocks	£27.00
Commodore Disk User	£15.00
Disk User	£13.72
Electronics Digest	£11.00
Electronics Today International	£16.80
Ham Radio Today	£15.60
Military Modelling	£15.60
Model Boats	£15.60
Model Engineer	£26.40
Photography	£15.00
Photoplay	£16.80
Popular Crafts	£16.20
Radio Control Model Cars	£16.20
Radio Control Boat Modeller	£7.50
RCM&E	£14.40
Radio Control Scale Aircraft Quarterly	£9.00
Radio Modeller	£14.40
Sea Classic International	£11.70
Scale Models International	£15.00
Video Today	£15.00
Which Video?	£15.00
Woodworker	£15.60
Your Commodore	£14.40
Model Railways	£13.20
Practical Wargamer	£7.80

The Above Prices Refer to U.K. Subscriptions Only

This offer is also open to existing U.K. subscribers who
may wish to extend their current subscriptions.

Please commence my subscription(s) To.....with the..... Issue
I enclose my cheque/postal order for £.....made payable to Argus Specialist Publications Ltd.
or debit £.....from my Access/Barclaycard No.

valid from.....to.....Signature.....
Name.....
Address.....



Send this form with your remittance to:
INFONET LTD. (N.R.S. 88) 5 River Park Estate,
Berkhamsted, Herts. HP4 1HL.



2 issues FREE

When you take out a subscription to any of these magazines

	EUROPE	MIDDLE EAST	FAR EAST	REST OF THE WORLD
A&B Computing	£27.30	£27.60	£31.10	£28.30
Aeromodeller	£27.00	£27.20	£29.00	£27.50
Citizens Band	£20.10	£20.30	£21.80	£20.50
Clocks	£32.40	£32.60	£34.70	£33.00
Commodore Disk User	£18.00	£18.20	£19.30	£18.40
Disk User	£21.60	£21.70	£23.20	£22.00
Electronics Digest	£12.90	£13.00	£13.70	£13.10
Electronics Today International	£21.00	£21.20	£22.80	£21.50
Ham Radio Today	£20.10	£20.30	£22.00	£20.60
Military Modelling	£22.40	£22.60	£25.20	£23.10
Model Boats	£20.00	£20.10	£21.80	£20.40
Model Engineer	£35.40	£35.70	£39.00	£36.30
Photography	£22.00	£22.30	£25.00	£22.80
Photoplay	£21.50	£21.70	£23.50	£22.00
Popular Crafts	£21.40	£21.60	£23.60	£22.00
Radio Control Model Cars	£21.10	£21.30	£23.10	£21.60
Radio Control Boat Modeller	£10.00	£10.20	£11.10	£10.30
RCM&E	£20.40	£20.60	£22.90	£21.00
Radio Control Scale Aircraft Quarterly	£11.10	£11.20	£12.00	£11.30
Radio Modeller	£20.00	£20.20	£22.40	£20.60
Sea Classic International	£10.70	£10.80	£12.00	£11.00
Scale Models International	£19.60	£19.80	£21.50	£20.10
Video Today	£20.20	£20.40	£22.30	£20.70
Which Video?	£19.40	£19.50	£21.20	£19.80
Woodworker	£22.80	£23.00	£25.70	£23.50
Your Commodore	£22.00	£22.30	£25.20	£22.80
Model Railways	£19.10	£19.30	£21.50	£19.70
Practical Wargamer	£7.10	£7.20	£8.00	£7.40

The Above Offer Applies to Overseas Subscriptions Only

This offer is also open to existing subscribers who may wish to extend their current subscriptions.

Please commence my subscription(s) To..... with the..... Issue
 I enclose my cheque/postal order for £..... made payable to Argus Specialist Publications Ltd.
 or debit £..... from my Access/Barclaycard No.
 valid from..... to..... Signature.....
 Name.....
 Address.....



Send this form with your remittance to:

INFONET LTD. (S.O. 88) 5 River Park Estate,
 Berkhamsted, Herts. HP4 1HL.



THE SKY'S THE LIMIT

Keith Brindley has scanned the heavens for this low-down on Satellite TV equipment

There's a lot of trash talked about satellite television, not the least by some specialist journalists so the first thing we need to do here is get back down to earth and define a few terms.

The term *satellite television* covers any system where television pictures are transmitted from an *earth station* to a satellite in orbit around the earth. Generally, though not specifically, the transmitted pictures on the *uplink* (from the earth station to the satellite) are retransmitted from the satellite back to another earth station on a *down-link* at a different frequency.

On the satellite, the devices which receive and retransmit satellite communications are known as *transponders*. At the earth station, an antenna (if satellite communications had been pioneered in Britain we'd have called this an aerial!) does the transmission and reception.

Satellite transmissions are typically in microwave frequencies - more specifically in Band VI in the super-high frequency range (between about 11GHz and 13GHz). The antennae are parabolic reflecting dishes which concentrate the signal onto a receiving

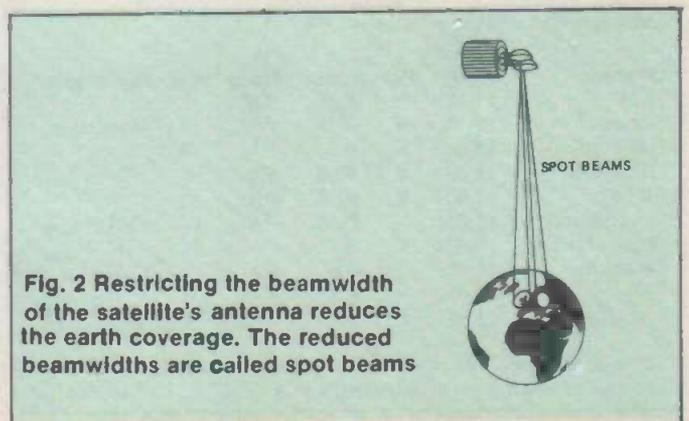
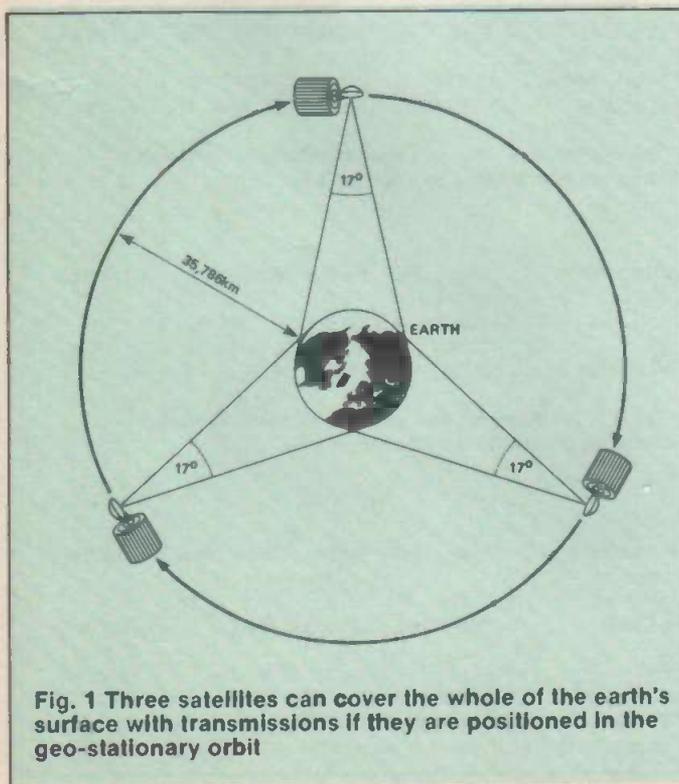


device at the focal point, much like a concave mirror. The parabolic dish must be accurately pointed at the satellite within only a fraction of a degree, to satisfactorily focus the microwave signals onto the receiving device.

All the satellites of interest to us are in a geo-stationary orbit (GSO) around the earth, sometimes known as the *Clarke belt* after the science fiction writer Arthur C Clarke who, in an article in the October 1945 issue of 'Wireless World' showed how a satellite positioned 35,786km (give or take a centimetre) above the earth's equator would rotate with exactly the same period of revolution (24 hours) as the earth itself.

The GSO is quite a long way out from the earth - about five times the earth's radius from its surface or one tenth of the way to the moon - and at this distance any one satellite can have an extremely wide coverage (known as a *footprint*) of the earth's surface. As few as three satellites (Fig. 1) can cover the whole of the earth.

To do this, the *beamwidth* of the transponder's transmission only needs to be about 17° . Generally, though, satellites with restricted footprints are used (Fig. 2) where the beamwidth is reduced. These *spot beams*, are then used to transmit only to selected areas.



Beamwidth in degrees	Diameter of spot beam on earth (in miles)
10	3900
5.7	2200
2.8	1100
1	390
0.57	220

Table 1. Relationships of spot beam coverage to satellite transponder beamwidth.



Fig. 3 Multiple spot beams, used to exactly cover a specific area of the earth

Naturally enough, the beamwidth defines the area selected and approximate area sizes are as listed in Table 1. Sometimes, a number of beams are used close together, as *multiple spot beams*, to cover an area (Fig. 3).

The GSO does not, of course, form the only orbit of consequence, many others exist but none are useful for television picture reception in the same way as the GSO because of one vital fact. From a stationary viewpoint on the earth, any chosen satellite in the Clarke belt appears stationary – a factor which greatly eases the requirements of pointing an antenna directly at it. In terms of reception here in Britain, it also means that the satellite must also be within just a few degrees or so either side of south (otherwise it will be over the horizon and invisible in terms of microwave transmissions!) and the antenna must have a clear

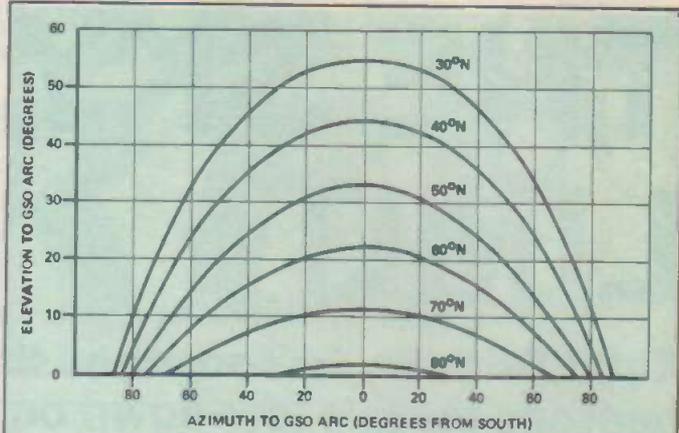


Fig. 4 Showing how the GSO is viewed at different latitudes of north

unobstructed view of the southern aspect, on an arc to 30° or so east and west of due south.

On the equator, the GSO is directly overhead, swinging from directly east to directly west. At more northerly latitudes like Britain, the GSO forms more of an arc, peaking over the south and dropping away towards east and west. How high the actual peak is depends purely on the observer's latitude. The further north the observer, the lower the peak.

Figure 4 shows a view of the GSO arc from a number of latitudes. In Britain the arc varies from about 29° at latitude 50° north (Land's End) to 21° at 59° north (John O'Groats). The exact arc seen by the observer at any particular latitude is of direct relevance when installing an antenna.

Sometimes, the earth station both transmits and receives transmissions but in the case of satellite television systems, the earth station is more likely just to receive. For this reason, such systems (the sort you may have in your home) are called *television receive-only* (TVRO) systems. Sometimes, the reception of television pictures is not meant for an individual home but for, say, a cable network to a

Channel	Freq.	Pol	Audio	Video	Hrs.	Scramble
Anglovision	11.515	V	6.6	PAL	6	-
Arts Channel	11.135	H	6.6	PAL	3	-
BBC1/2	11.175	H	6.65	PAL	8	Sat-Tel SAVE
Children's Channel	11.015	H	6.6	PAL	10	-
CNN	11.155	V	6.65	PAL	24	-
Lifestyle	11.135	H	6.6	PAL	4	-
MTV	10.975	H	6.65	PAL	24	-
Premiere	11.015	H	6.6	PAL	9	-
Satellite Information	11.575	H	Digital	B-MAC	4	SAB-MAC
Screensport	11.135	H	6.6	PAL	6	-

Table 2. Frequencies and specifications of television channels transmitted by Intelsat VA F11.

Channel	Freq.	Pol	Audio	Video	Hrs.	Scramble
3Sat	11.175	H	6.65	PAL	8	-
Filmnet	11.140	V	6.6	PAL	24	Matsushita
RAI Uno	11.007	H	6.6	PAL	18	-
RTL-Plus	11.091	V	6.65	PAL	5	-
SAT1	11.507	V	6.65	PAL	10	-
Skychannel	11.650	H	6.65	PAL	19	OakOrion
Superchannel	10.674	V	6.65	PAL	24	-
Teleclub	11.987	V	6.5	PAL	8	-
TV5	11.472	H	6.65	PAL	8	-
Worldnet	11.512	H	6.65	PAL	4	-

Table 3. Frequencies and specifications of television channels transmitted by Eutelsat 1 F1.

Channel	Freq.	Pol	Audio	Video	Hrs.	Scramble
Norsk						
Rikskringkasti	11.644	H	Digital	C-MAC	9	-
Worldnet	11.591	H	6.6	SECAM	4	-

Table 4. Frequencies and specifications of television channels transmitted by Eutelsat 1 F2.

Channel	Freq.	Pol	Audio	Video	Hrs.	Scramble
CanalJ	12.564	V	5.8	PAL	10	-
La Cinq	12.606	V	5.8	SECAM	17	-
M6	12.648	V	5.8	SECAM	10	-
Worldnet	12.732	V	5.8	NTSC	4	-

Table 5. Frequencies and specifications of television channels transmitted by Telecom 1 F2.

Channel	Freq.	Pol	Audio	Video	Hrs.	Scramble
Infofilm & Video	11.015	H	6.6	PAL	3	-
SVT-2	11.178	H	Digital	C-MAC	7	Tanberg C-MAC
SVT-1	11.133	H	Digital	C-MAC	7	Tanberg C-MAC

Table 6. Frequencies and specifications of television channels transmitted by Intelsat F2.

group of homes. Such systems are called *satellite master antenna television* (SMATV) systems and don't concern us here.

The most well-publicised TVRO satellite system is the proposed *direct broadcast by satellite* (DBS) service due to start within the next year or so, with five or less channels. DBS will use quite high powered satellite transponders and so receiving antennae will be around 0.9m in diameter or less, so being little more obtrusive than some existing terrestrial television system aerials.

Waiting for Godot

Waiting for DBS to appear has become a bit of a joke in Britain and although plans seem to have been finalised, it's still a long way off and it will only provide a maximum of five channels (that's all we've been allocated). On the other hand, existing communications satellites (with lower-powered transponders) are already in use by British programme providers to transmit television signals to SMATV systems.

A growing number of suppliers now market antennae and equipment capable of receiving the signals and displaying them on an ordinary television set, in such a way that the systems have been coined as *quasi-DBS* satellite receivers by some observers.

These systems are at a price which may tempt the individual, particularly when it's considered that around ten channels of English-spoken television programmes are currently broadcast from two satellites (Intelsat BA F11, and Eutelsat 1 F1). Other satellites transmit foreign programmes. Around sixteen more could be transmitted from another satellite (Astra) due to come on stream this year. Compare that lot with the five channels of DBS!

Tables 2 to 6 list channels, various technical specifications and number of hours (approximately) broadcast per day, transmitted from the satellites Intelsat VA F11, Eutelsat 1 F1, Eutelsat 1 F2, Telecom 1 F2 and Intelsat V F2. Still other satellites exist and transmit television signals which may be received in Britain - for example Russian Gorizont satellites.

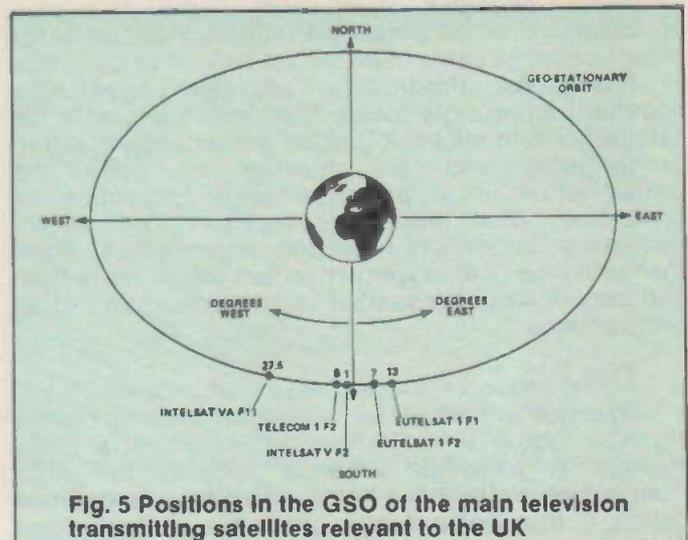


Fig. 5 Positions in the GSO of the main television transmitting satellites relevant to the UK

Some other satellites are so far away from true south they would be impossible to locate with an antenna unless it's on a steeply-sloping south-easterly or south-westerly facing high hilltop. Best of luck if that's what you want!

Figure 5 shows positions of the main satellites in the GSO as far as Britain is concerned. Figure 6 shows a similar view of the world-wide proposed DBS satellites listed with the various countries satellite positions. Also shown is the Astra satellite due to start operations shortly - although not actually a DBS satellite by strict classification, it's going to provide a similar (if not better) function.

Antennae for low-powered communications satellites need to be a lot bigger than DBS antennae (generally, between about 1.2 metre and 1.8 metre) depending on situation and Astra is a higher-powered satellite and so will allow antennae of around the DBS size to be used.

Up to now, most signals can be received and displayed on ordinary television receivers without problem using satellite reception equipment. The reason for this is mainly because most programme

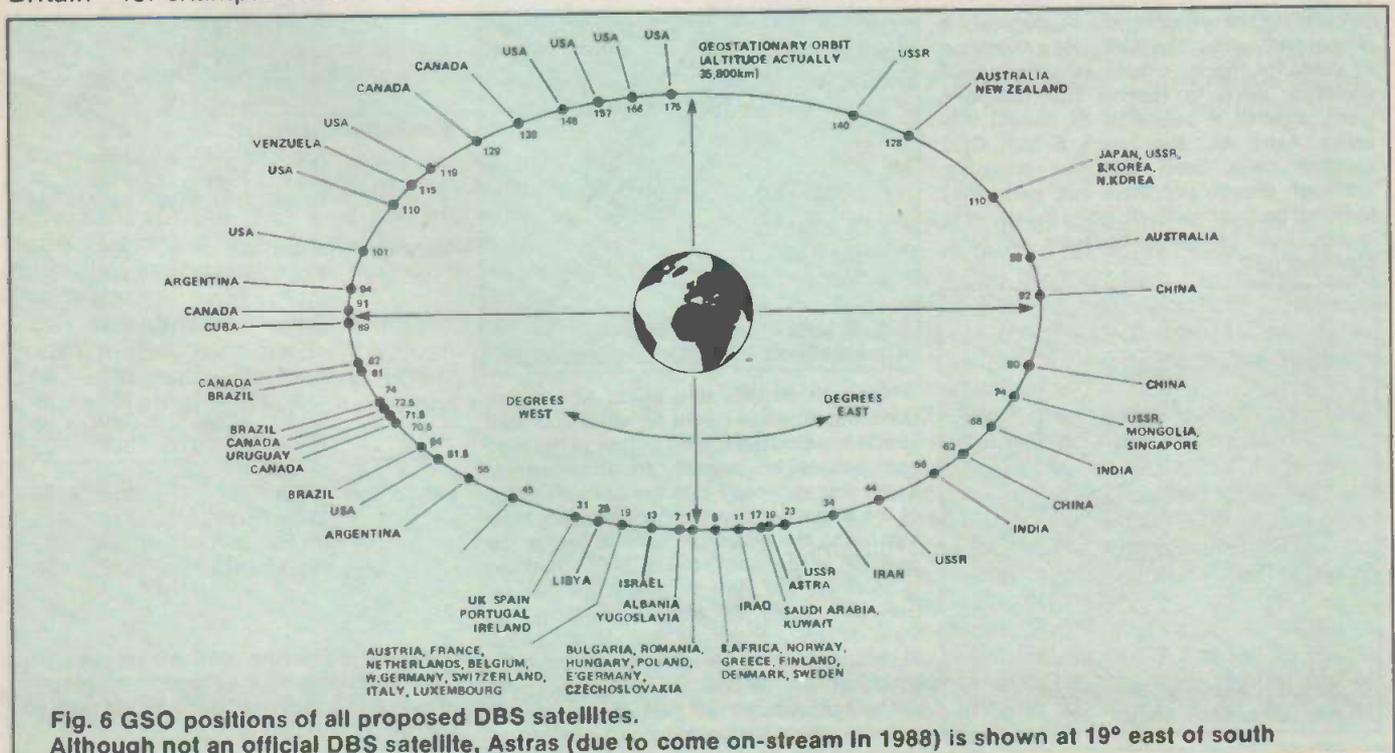


Fig. 6 GSO positions of all proposed DBS satellites.

Although not an official DBS satellite, Astras (due to come on-stream in 1988) is shown at 19° east of south

providers consider themselves cable television companies, providing television signals via satellite for reception at the cable head-end to be split to a number of televisions. Programme providers have now become increasingly aware that Joe Public with his satellite dish in his back garden is effectively stealing programmes and are moving to code the transmissions in a process called *encryption* or *scrambling*. When this is the case, viewers will require necessary decoders to view programmes and as more than one type of encryption process exists, more than one decoder will be needed to allow reception of all programmes.

The Biz

So, what's needed to receive satellite television signals? Figure 7 shows the main parts of a basic system. A parabolic antenna focuses the high frequency signals, a *low noise converter* - sometimes called a *low noise block converter* or *low noise blockdown converter* (LNC or LNB) - receives the high frequency signals transmitted from a satellite and

reflected from the antenna, amplifying and converting them to a lower frequency between 950MHz and 700MHz, coaxial cable carries the signals indoors and a receiver provides an output suitable for an ordinary television set.

In essence, that's it. A system like this would

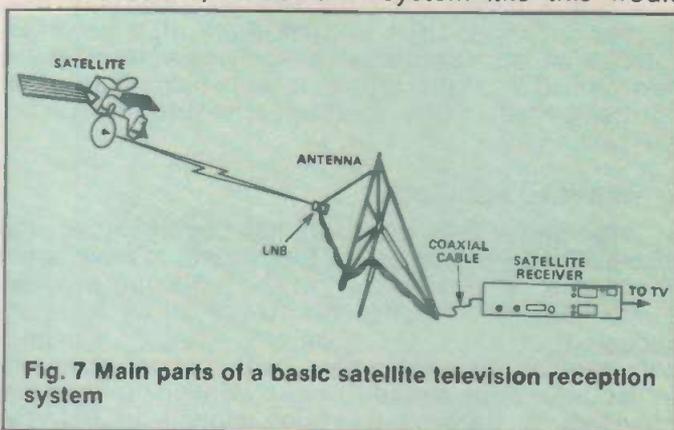


Fig. 7 Main parts of a basic satellite television reception system

Site Survey

Surveying the system site is a matter of locating a suitable position for the antenna to stand. If you're going to buy a system from a dealer, he'll probably do a brief site survey, checking that all desired satellites can be 'seen' by the antenna. This involves nothing short of trudging around the area armed with a good compass. You can do it yourself if you want to do a preliminary check and yours will probably be every bit as accurate as the dealer's.

So, you need a compass. Helpful, too, is a sheet of thick card, marked in angles up to about 45° and folded to provide a platform to stand the compass on, as shown in Fig. A. You should now mark the card with the various elevation and azimuth angles of every satellite you wish to receive transmissions from.

Satellite elevations and azimuths depend on whereabouts the antenna is to be located. There are accurate methods of calculating these but for the purposes of a simple site survey, the table lists a selection of them for the four main satellites you'll probably want to receive transmissions from, against a selection of salient site areas. Astra and the future British DBS satellite have been included because, although they're not there yet, eventually they will be and there's no point in having to re-site your antenna because of poor planning now.

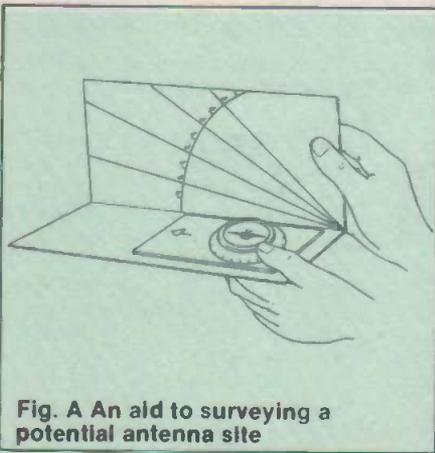


Fig. A An aid to surveying a potential antenna site

You need to bear in mind that all azimuths are with respect to true south but your compass will only give you a reading for magnetic south. Again, there are methods for accurately calculating the angle between magnetic north and true north but an Ordnance Survey map of the area will give more than enough detail for the survey. Say the approximate difference between magnetic north and true north is 5°, accurate enough for most purposes then simply subtract 5° from all east of southerly satellite azimuths and add 5° to all west of southerly satellite azimuths. Mark both elevations and adjusted azimuths down on the card, so you don't have to keep referring back to the list.

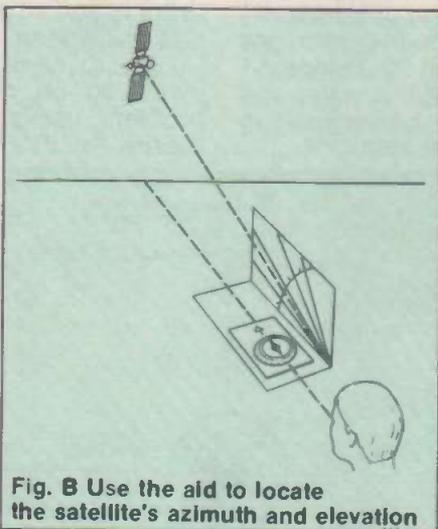


Fig. B Use the aid to locate the satellite's azimuth and elevation

Now, go outside and stand where you think the antenna might be sited and face south. Holding the folded bottom of the card and compass horizontally and the elevation angle side vertically, aim the azimuth angle of the first satellite with the compass. Now aim along the elevation lines to locate the position of the satellite (Fig. B). If anything is blocking the view to a satellite (house, tree, wall, fence, the missus) you'll have to try a different location. Step through the azimuths and elevations of all chosen satellites until a position is found where nothing obstructs your view of any satellite - that is where the antenna can be sited.

Area	Satellite	Az	EI
John O'Groats	Astra 19E	25E	21
	Eut 1 F1 13E	19E	22
	Int F11 28W	28W	20
	British DBS 31W	32W	19
Aberdeen	Astra 19E	25E	23
	Eut 1 F1 13E	18E	24
	Int F11 28W	30W	21
	British DBS 31W	34W	20
Newcastle	Astra 19E	25E	25
	Eut 1 F1 13E	18E	26
	Int F11 28W	31W	23
	British DBS 31W	35W	22
Liverpool	Astra 19E	27E	26
	Eut 1 F1 13E	20E	27
	Int F11 28W	30W	25
	British DBS 31W	34W	24
Dublin	Astra 19E	30E	25
	Eut 1 F1 13E	24E	27
	Int F11 28W	26W	26
	British DBS 31W	29W	25
Birmingham	Astra 19E	26E	27
	Eut 1 F1 13E	19E	29
	Int F11 28W	31W	26
	British DBS 31W	35W	24
Norwich	Astra 19E	22E	28
	Eut 1 F1 13E	14E	29
	Int F11 28W	35W	24
	British DBS 31W	39W	23
London	Astra 19E	24E	29
	Eut 1 F13E	16E	30
	Int F11 28W	34W	26
	British DBS 31W	38W	25
Land's End	Astra 19E	31E	28
	Eut 1 F1 13E	24E	30
	Int F11 28W	28W	29
	British DBS 31W	32W	28

Satellite azimuths and elevations for four satellites at a selection of places around the British Isles. All angles to the nearest degree.

receive *some* signals from a *single* satellite and allow viewing. But there are problems. First, satellite signals are polarised, either horizontally or vertically and the basic system of Fig. 7 can only receive signals of one polarisation. To receive signals of the other polarisation, either the LNB needs to be turned through 90° or a second LNB mounted at right angles needs to be fitted.

The viewer may wish to receive signals from a second, or subsequent satellite. So, two or more antennae are needed (expensive and unsightly) or the antenna needs to be turned to point at whichever satellite is required.

More complex satellite reception systems control these functions with motor-driven polarising and positioning equipment which, in turn, have to be controlled by internal equipment – either as part of the receiver itself or as a separate piece of equipment. Usually the motor-controlled polarising equipment is known as a *polarator* or *polariser*, while dish-positioning equipment is called an *actuator* or simply *dish positioning equipment*.

A Dish Fit For A King

The dish itself is generally of one of three types – prime focus, offset feed or Cassegrain feed type (Fig. 8). Parabolic dishes are used because the parallel (well, as near as damnit!) transmissions from the satellite are focused onto a single point where the LNB is situated. They are also decidedly unidirectional so transmissions focused on the focal point will only be from one direction – the satellite.

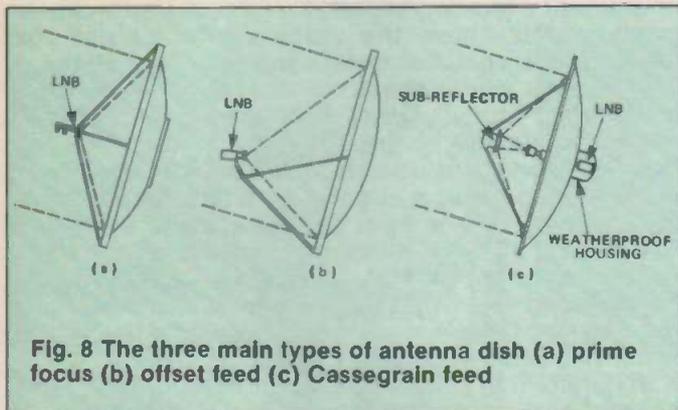


Fig. 8 The three main types of antenna dish (a) prime focus (b) offset feed (c) Cassegrain feed

There are three main types of antenna mounts, shown in Fig. 9. A fixed mount allows no freedom of movement for the dish and repositioning to receive signals from a different satellite means, quite simply, unbolting everything, pointing in the new direction and re-fixing.

The *el/az* (elevation/azimuth also known as *az/el*) mount allows independent adjustments along two axes – left and right, up and down. So by adjusting both azimuth and elevation settings the antenna can be moved from one satellite to another.

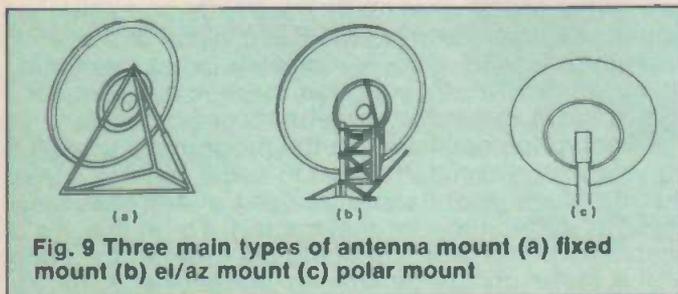


Fig. 9 Three main types of antenna mount (a) fixed mount (b) el/az mount (c) polar mount

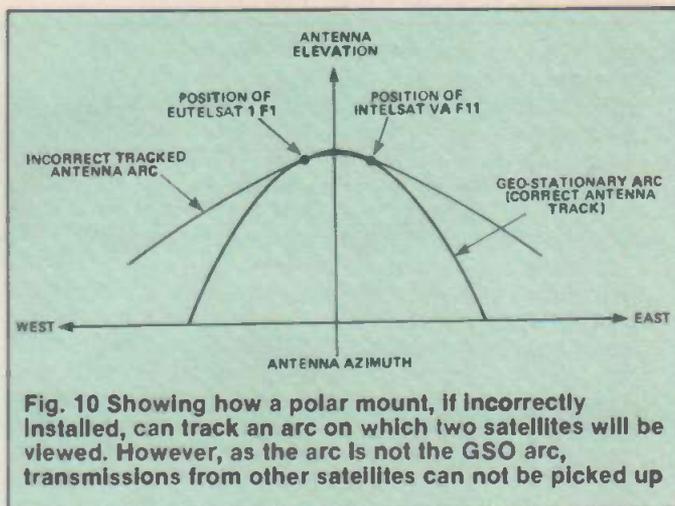


Fig. 10 Showing how a polar mount, if incorrectly installed, can track an arc on which two satellites will be viewed. However, as the arc is not the GSO arc, transmissions from other satellites can not be picked up

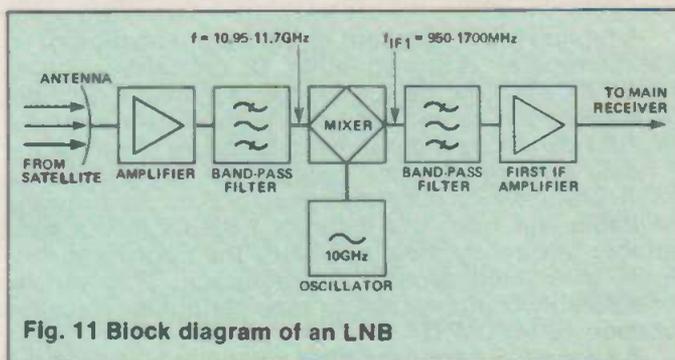


Fig. 11 Block diagram of an LNB

For easiest manoeuvring between satellites, a polar mount is best as it has only one axis to follow and so can be made to track continuously along the GSO arc. Setting up the polar mounted antenna is an involved job, mind you, because the arc has to be followed precisely. The polar mount will always track an arc – any old arc – purely because of its nature. On this arc you might just find two satellites (Fig. 10) but unless the tracked arc truly is the GSO, no further satellites will be found.

The enormous advantage of the polar mount (however difficult it may be to set up) is that it may be easily motorised. A single actuator only needs to push or pull it in its single axis to track all satellites in the visible GSO arc.

LNBs

Figure 11 shows a block diagram of a typical LNB and it can be seen it's quite a complex beast. The signal from the antenna is fed directly to a low-noise GaAs amplifier followed by an image rejection bandpass filter. The noise figure for the LNA must be as low as possible because this defines the basic signal-to-noise ratio for the whole system.

A mixer and fixed frequency local oscillator (10GHz) convert the received satellite transmissions to an IF frequency band of 950-1700MHz (block down conversion) which is then bandpass filtered and amplified by a first IF amplifier. From there, co-axial cable connects the LNB to the receiver indoors.

Yes, the IF frequency band is 950-1700MHz which means the LNB is effectively 'looking' at a 10.95-11.7GHz transmission band from a satellite. Transmissions from the Telecom 1 F2 satellite (listed in Table 5) cannot be received as their transmission frequencies are all around 12.5GHz. A different LNB will be required to do that.

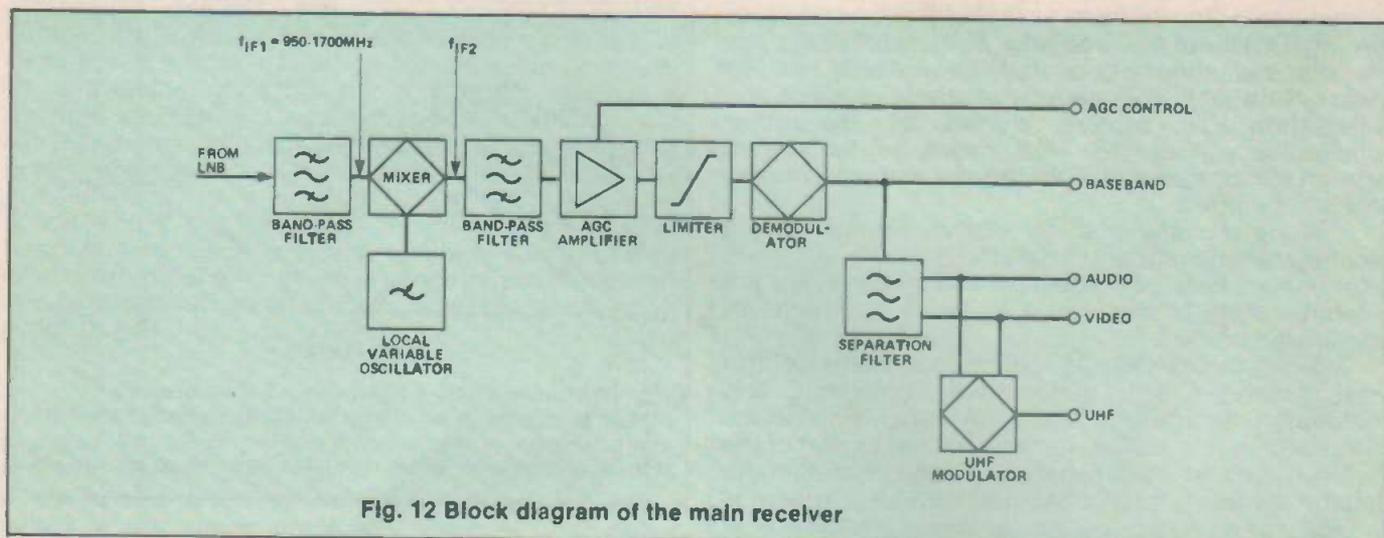


Fig. 12 Block diagram of the main receiver

A typical block diagram of the tuning section of a satellite receiver is shown in Fig. 12. Effectively, there is little more to the device than a reasonable-quality FM tuner, such as you may use in your hi-fi system. The first bandpass filter allows a measure of rejection of noise and interference outside the 950-1700MHz first IF band, which may have been picked up through the cable run from the external LNB. A mixer and variable frequency local oscillator then converts the signal to a fixed second IF frequency. This varies considerably from receiver to receiver but is typically between 100-600MHz.

A second IF bandpass filter - usually a SAW (surface acoustic wave) filter - limits the second IF bandwidth to about 27MHz whereupon the signal is amplified by an AGC amplifier and limited. Often a DC control output is taken from the AGC voltage for signal strength display.

From there the signal is demodulated down to a composite *baseband* television signal. In cheaper receivers this is done by a single demodulator but for optimum sound and vision, two demodulators are used. However separation is performed, audio demodulation must allow for different audio sub-carrier frequencies (which we'll come to in a minute).

Separate audio and video signals, although usable by, say, a video cassette recorder or some monitors (composite input monitors with audio, not your Beeb RGB monitor) aren't really suitable for use by a bog-standard telly. So an integral part of the satellite receiver is a modulator which converts the signal up to a UHF channel (typically channel 39) for display via the television receiver's conventional aerial socket.

Often, just before this stage, a receiver might have a loop-through facility to allow an encryption decoder, nicknamed a *descrambler*, to be added to the system to allow display of the signal, in the same way that, say, a graphic equaliser can be added to a hi-fi system via the tape monitor outputs and inputs of an amplifier.

Generally, the complete satellite receiver is more than just a tuner and other parts (notably a polarising circuit and an actuator drive circuit) will be included. More often than not, the actuator drive circuit will be housed separately from the receiver as there are some high currents associated with driving the actuators, which may cause interference to the tuner. In most current systems the actuator drive - as well as being housed separately - is a remote device, in the sense that to watch channels on different satellites the user has to first change antenna position via the actuator drive circuit, then change the tuned frequency/polarity/audio sub-carrier via the tuner.

However, some of the latest satellite receivers have reduced this to a single change. The tuner automatically controls the actuator driving circuit at the same time as changing frequency and so forth.

Scrambled Egg

To understand encryption we've first got to look at the baseband signal, which in most cases is similar to the standard British 625-line terrestrial broadcast television signal - a PAL encoded composite video/audio signal, a spectrum of which is shown in Fig. 13. A vision carrier carries luminance (black and white) and chrominance (colour) signals and a sound sub-carrier spaced 6MHz above the vision carrier carries the sound signal. Total bandwidth is just under 8MHz.

The PAL signal spectrum in Fig. 13 is that of a British PAL signal. Other European countries use variants, which differ usually only in terms of the spacing between vision and sound carriers. However, North America uses a slightly different signal format (NTSC) and the original French colour television system used SECAM. Although France itself has since started to adopt a PAL derivative, much of the remainder of the world's television systems still use SECAM. So there's a range of available television signal standards in use.

The fact that different satellite transmissions use different audio sub-carrier frequencies is the reason why a receiver must have the capability of adjusting the audio sub-carrier frequency when demodulating the signal. Also, there is the possibility that the transmission may have more than one sub-carrier - different languages could be broadcast on each.

Where the total 8MHz channel is modulated onto a carrier in the region of about 450-900MHz for terrestrial television, satellite television signals are modulated onto a carrier in the region of 11-12GHz. so, the basis of a satellite television receiver is a tuner, capable of demodulating the microwave signal back down to the original 8MHz channel. In fact, as we've seen, what the tuner actually does is demodulate the signal right back down to the basic vision and sound baseband signals and for display on a standard television receiver they are put through a modulator. This is much as a video cassette recorder.

Encryption occurs when the programme provider adjusts the transmitted signal in some way such that the received signal cannot be used by the television receiver (or monitor, for that matter). To do this, it's a simple matter of, say, swapping the order of the lines which make up the picture on the television tube's screen or even cutting lines in two and reversing their

FEATURE: Satellite TV

order. Other encryption methods break up the sound into parts and scramble them. As far as the satellite tuner and the television receiver are concerned, they've done their job but to the viewer the picture is broken up and totally unwatchable or the sound is garbled.

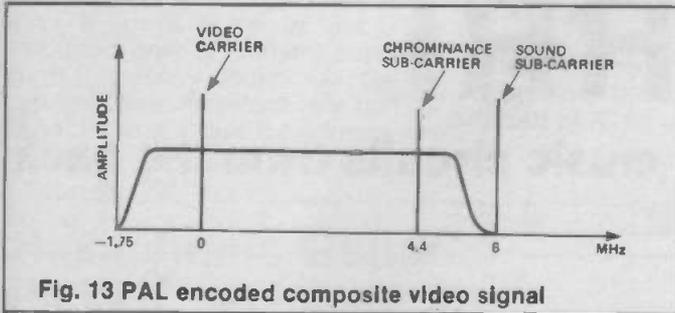


Fig. 13 PAL encoded composite video signal

The complexity of the encryption process depends totally on the enthusiasm of the programme provider to prevent unauthorised people from watching the programmes. In many instances signals aren't encrypted severely and so decoders are simple - the likes of ETI readers would be able to build a descrambler as easily as falling off a log.

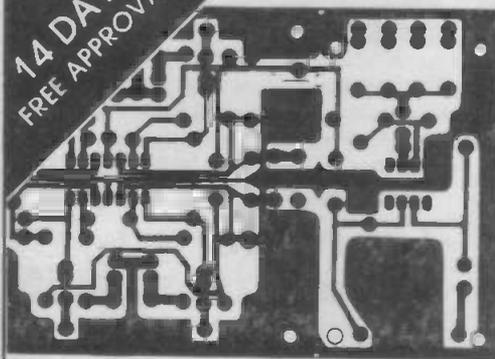
However, if the programme provider wants almost total prevention of unauthorised viewing, the scrambling will be severe, generated by random binary sequence techniques in extremely complex ways. Descrambling is equally complex, perhaps requiring the user's personal identification number and/or authorisation codes which may change regularly. Whatever the complexity, encryption can never be totally secure. There may always be a bright spark who comes along and builds a descrambler. In the case of complex encryption, this is just less likely - particularly if LSI devices are used to build the circuits.

Most programme providers, aware that they either have to go to the expense of developing and running a complex system or stick to simple methods, choose the latter option. Then they provide cheap decoders to authorised users, usually as part of the subscription process. Although the risk is taken that unauthorised users may go to the lengths of building or buying a descrambler, the risk is pretty small.

Next month, we'll be looking at a selection of available satellite television reception systems, comparing features and prices like for like.

ETI

14 DAYS
FREE APPROVAL



THE TIME - PRECISELY

THE SOLEX MICROCIRCUIT LABORATORY TIMER

ONLY £14.95
inc. P & P

Special Offer!

Free five function stopwatch worth £10
(inc. VAT) with every timer ordered
before 31st January 1988

Send no money - we will send
your Solex timer and your free
stopwatch on 14 day approval.
If not completely satisfied
you can return them.

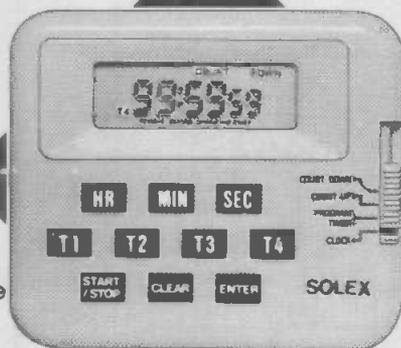
SOLEX INTERNATIONAL
44 Main Street,
Broughton Astley,
Leicestershire
LE9 6RD

PHONE 0455 283486 NOW OR COMPLETE THE COUPON BELOW
Please send me the Solex S540 timer (tick) on approval (tick) payment enclosed (tick) to cover total
I enclose a cheque/P.O. for the value of
cost (£14.95 each)

NAME _____ ADDRESS _____ TEL No _____
FOR GOODS TO BE DELIVERED ON
APPROVAL, YOUR NAME AND FULL
NAME AND ADDRESS MUST
BE SUPPLIED

ETI 1/88

- ▼ Fully programmable with liquid crystal display
- ▼ Count-down, count-up facility with electronic alarm
- ▼ Roll-over facility - indicates time over-run
- ▼ 4 separate count-down time intervals can be stored at anyone time
- ▼ Pocket clip adapts to bench stand with magnet for attaching to steel cased equipment
- ▼ Battery supplied.



MODEL S540

SOLEX

tial) control input of the first VCA, thus completing a negative feedback loop which acts in such a way as to decrease the VCA gain when input signal level is high. The difference lies in the value of C1, which is about 10,000 times lower than it ought to be. In fact C1 is included only to prevent spurious high frequency oscillation. So the compression is effectively instantaneous and input waveforms are flattened out progressively and

smoothly, to a degree of sharpness determined by the external control input to IC1b.

Controlling the gain of the feedback path in this way results in a 15dB drop in output at maximum distortion setting (+10V control input). This can be corrected or even reversed by adding a proportion of the control voltage to the input of IC1b via R1.

The value of 470K actually

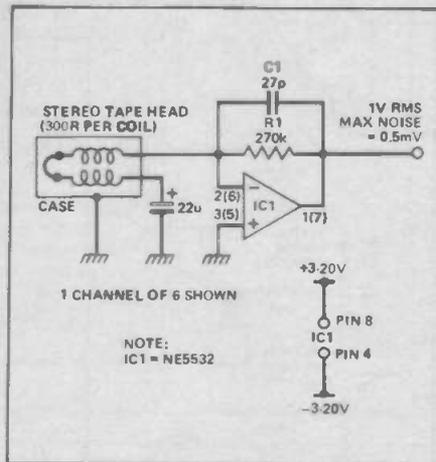
corresponds to a drop of around 6db, which gives a subjective impression of equal loudness due to the interactive perception of sound intensity and spectral content that goes on in the brain. Of course, this effect depends to some extent on the brightness and shape of the input waveform, so experimentation is necessary. Decreasing the value of R1 increases the signal output at high distortion settings.

Hexaphonic Guitar Pickup

Polyphonic guitar synths require that signals corresponding to the vibrations of individual strings be kept separate. In practice this is not easily achieved and initial attempts at making a hexaphonic pickup with low noise and good string-to-string separation are likely to be disappointing.

Cassette tape heads are well suited for use as string pickups because of their small size and their highly localised sensitivity, meaning that signal output is negligible for a string-to-pickup spacing of only 2.55mm. Thus, if six heads are mounted near the bridge saddles with a clearance of 0.5 - 1mm, then 50 - 55db of separation between adjacent strings can be achieved.

Stereo tape heads can be used with their coils connected back to back in the standard 'humbucking'



configuration, which significantly improves signal-to-noise ratio due to cancellation of the effects of non-local ambient magnetic fields, such as those caused by mains transformers and wiring.

Tape heads do not contain magnets (fortunately for tape users) and an external magnetic field must be provided by a strong magnet in close proximity to both

the strings and heads. The stronger the magnet, the better the signal-to-noise ratio and with a good magnet you can expect 70dB.

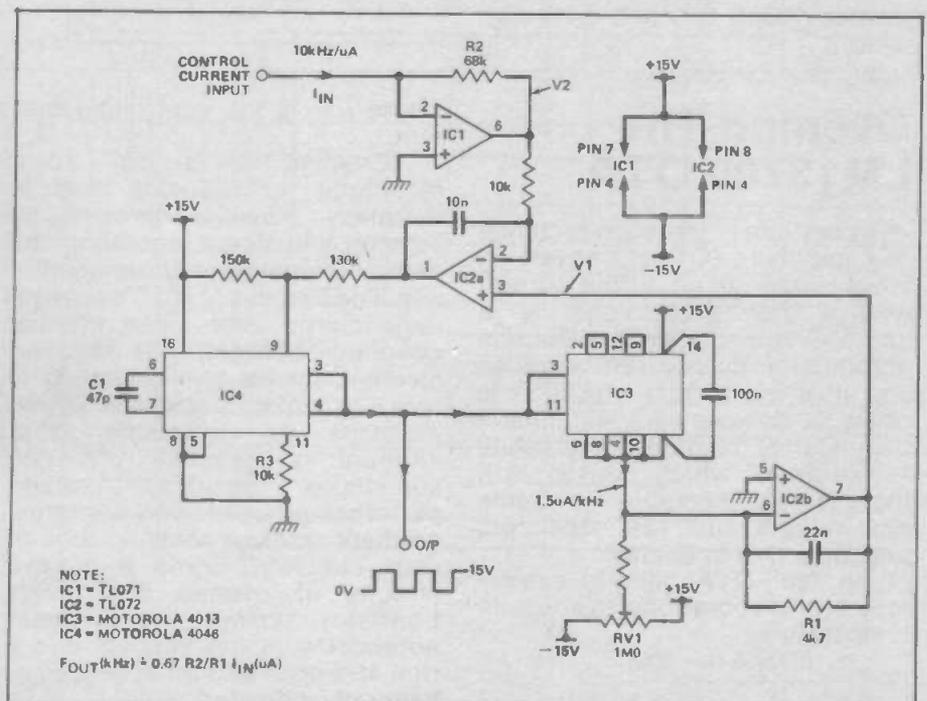
Output from the heads is very low, normally in the region of several millivolts peak. The circuit shows a suitable low noise amplifier, which had a gain of 450 with the heads used. Gain is given approximately by the ratio of R1 to the head resistance and should be adjusted according to measured output. C1 limits bandwidth to 22kHz and helps to reduce spurious pick-up of radio signals but the strings and head cases should be earthed to solve this problem entirely.

A very useful feature of the NE5532 op-amp is its ability to drive loads of as little as 470R which can be placed at the receiving end of long multicore guitar leads in order to minimize hum pick-up and crosstalk between channels caused by capacitive coupling.

High Frequency Current-Controlled Oscillator

This ICO achieves linearity of 0.1% over the frequency range 0.7kHz-1.5MHz (a span of 10 octaves). VCOs and ICOs usually rely on some form of current-switching arrangement around a capacitor with the charge/discharge cycle sensed and controlled by a Schmitt trigger. A switching delay of only 10ns causes an error of 1% at 1MHz in the case of a sawtooth oscillator, 2% in the triangle case since two transitions are required per cycle.

This effect can in principle be compensated by the judicious use of a resistor in series with that timing capacitor but the snag is that switching delay is generally not constant, tending to increase



at the higher current levels that correspond to higher frequencies.

The ICO shown here cheats its way round the problem by employing a highly linear frequency to voltage converter (IC3, IC2b) and a feedback loop (IC2a) controlling a cheap and fairly dodgy VCO (IC4).

The FV converter exploits the dependence of CMOS supply current on clock frequency which

for the 4013 dual flip flop (connected as shown) is a consistent 1.5uA/kHz up to at least 1.5MHz. RV1 corrects for the op-amp offsets and 4013 quiescent current (nominally 1uA maximum but nearer to 10nA in practice).

Scaling is controlled by the ratio of R2 to R1, provided that V1 and V2 do not exceed -12V. If the frequency range is to be extended up or down, C1 and/or R3 should

be changed accordingly. Regarding the output of the 4046, the mark/space ratio varies with frequency so if a true squarewave is required then a divide-by-two flip flop or counter stage should be added to the output.

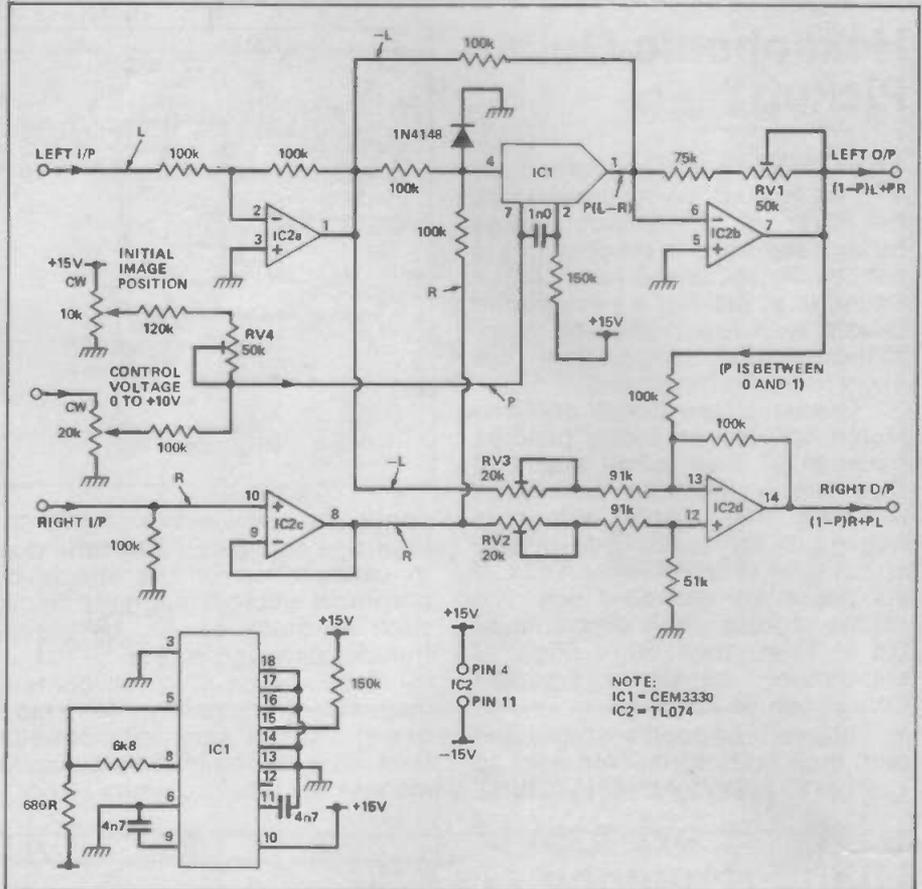
High frequency ICO/VCOs are useful for controlling the clock rate in samplers, switched capacity filters and waveform generators based on EPROM look-up tables.

Voltage Controlled Stereo Cross-Pan

It can all be done with just one VCA! Follow the L and R signals through the top half of the circuit and you will arrive at a left output expression $L+P(R-L)$, which simplified to $(1-P)L+PR$, as shown. The three signals R, L and $-(L+P(R-L))$ are summed (with equal weight) in the differential amplifier IC2, giving $R+L-L-PR+PL$. The two L's cancel out and rearrangement gives $(1-P)R+PL$, the right output.

Calibration procedure is as follows. Connect a signal to the right input, turn the image position pot fully clockwise and adjust RV4 so that there is no output from the right output. Adjust RV1 for unity gain from the right input to the left output. Set the image position pot down to zero and adjust RV2 such that there is now no signal at the left output. Finally, swap the signal to the left input and adjust RV3 for no signal at the right output.

The VCA used is one half of a dual CEM3330 device, which has a claimed 100dB S/N and 0.1% distortion.



Ovening The LM13700 OTA

Operational transconductance amplifiers (OTAs) convert an input voltage to an output current with a gain proportional to a controlling current. Circuits abound for these useful devices and it is a pity that precision is often let down by the significant dependence of gain on absolute temperature, which causes drift that is unacceptable in some applications such as oscillators and Q control in filters.

In fact OTA gain is exactly inversely proportional to absolute temperature:

$$I_o = \frac{5802.4 I_{ABC} V_{IN}}{T}$$

where I_{ABC} is the controlling current.

'Ovening' is a well-known technique for reducing drift in thermally sensitive circuits by sensing and finely regulating the device temperature thermostatically. The success of such a scheme depends on very close thermal coupling between the heating element, device and sensor. It is best to integrate these three elements on a single chip, although in practice this can sometimes actually worsen performance by placing a thermal gradient across a sensitive area of chip circuitry. Some published circuits of ovened 3046 NPN transistor arrays have been noteworthy in this respect and a trial and error design approach is generally indicated.

The LM13700 dual OTA seems to lend itself well to ovening, achieving a measured temperature regulation of $\pm 0.0018\%$. Warm-up time at switch-on is less than one second. One of the two OTAs in the device is used as a thermal sensor, generating a voltage of around 5.6V at 25°C, which drops by 10% to 5.04V at 58°C.

The difference between this voltage and the reference voltage at the inverting input of op-amp IC2b is amplified by a factor of 560 and used to control the heating current flowing through both of the uncommitted darlington transistors on the chip. The LED is used primarily to generate a 2.2V voltage drop which keeps the output of IC2b 3-4V away from the negative rail but additionally serves as a visual indication of correct operation and

FEATURE: Music Potpourri

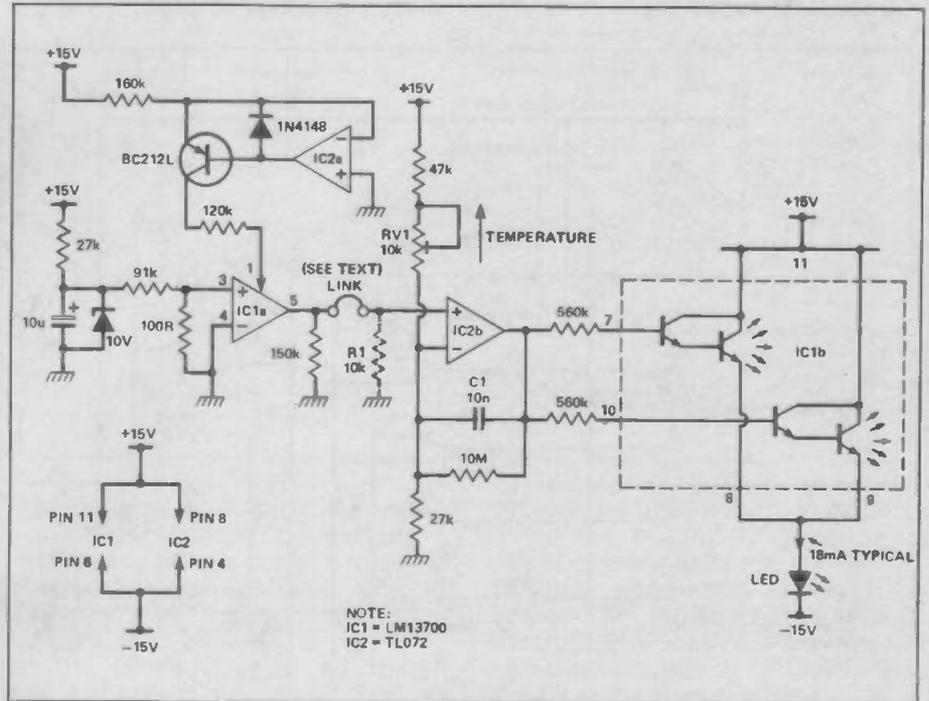
even acts as a fuse if all goes wrong.

C1 in the feedback path of the error amplifier imparts a 70ms time constant which matches the thermal time constant of the system and optimizes stability. Temperature regulation is independent of positive supply fluctuations since both sensor and reference voltages track this supply. A 45mV increase of the -15V rail (to -13.959V) will cause the reference voltage to increase very slightly, resulting in a 0.0006°C drop but provided that a regulated negative supply is used this problem is not likely to be significant.

Calibration procedure is as follows. First (before power-up) disconnect the link shown joining IC1 to IC2b and ensure that R1 is connected. Now power up the circuit and measure V_T . Adjust RV1 so that V_{REF} is 10% lower than V_T . Remove the power, remove R1 and reconnect the IC1/IC2b link. Following this procedure will avoid overcooking the circuit.

Note that the LM13600 has an internal connection between its current control inputs and

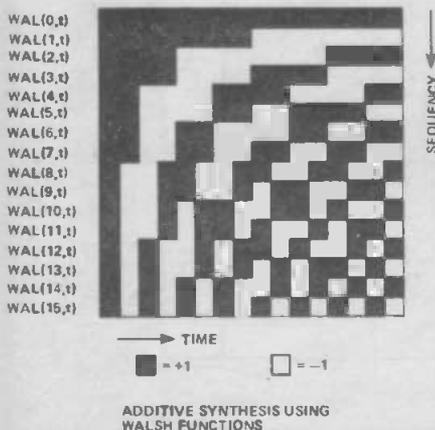
darlington, which renders it unsuitable for use in lieu of the LM13700 in this application.



Additive Synthesis Using Walsh Functions

Sine waves are not the only set of functions possessing the magical property of orthogonality which allows any signal to be expressed in terms of a spectrum of components. Square waves are just as orthogonal but do not on their own constitute a complete set of building blocks and therefore cannot be used to represent any arbitrary signal.

This problem can be overcome by including in the set some

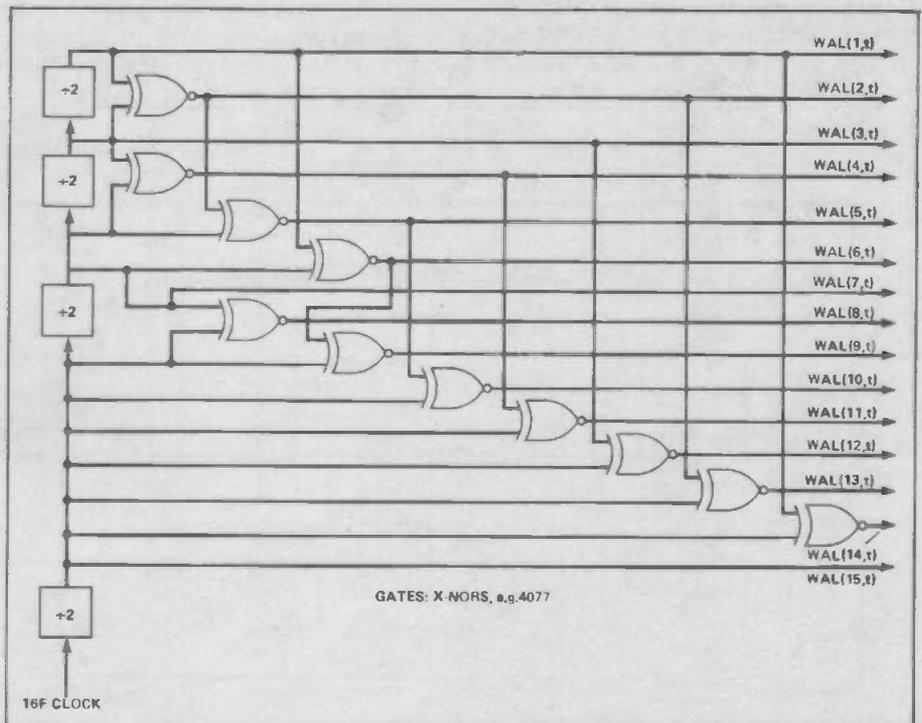


additional pulse waveforms which are systematically derived from square waves (by a recursive process of modulo-2 additions) thus generating a complete set known as the Walsh functions.

Then were invented by mathematician J. L. Walsh in 1923 and have not hitherto received the attention they deserve. Sine waves always seem to steal the limelight, perhaps in much the same way that

analogue technology dominated before the arrival of digital.

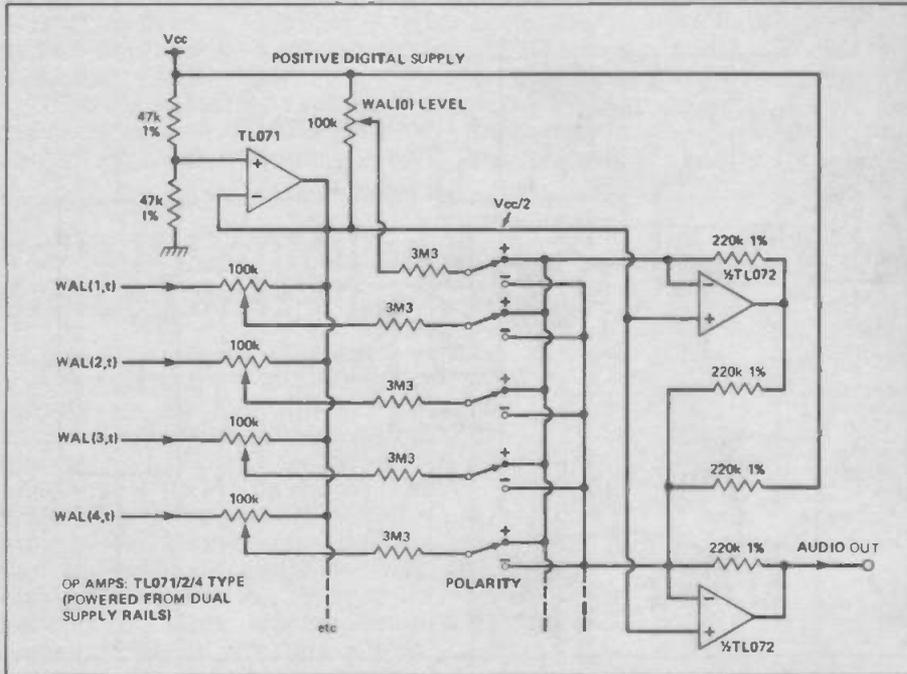
The figure shows one cycle of the first 16 Walsh functions, using an unconventional format which helps to make their pattern and symmetry clearer than is possible with an ordinary timing diagram. Note that Walsh functions are AC, alternating between +1 and -1 like sines. Note also that, unlike sines, phase is built into the series. For



example, $WAL(2,t)$ is simply $WAL(1,t)$ time-shifted. The notion of frequency also goes out the window and is replaced by the concept of 'sequency.'

The circuit shows a Walsh function synthesiser which can easily be expanded if desired. The digital supply rails should be earth and a positive voltage - +15V if

4000 series CMOS is used. Exclusive-NOR gates are shown in order to match up the outputs with the timing diagram in the figure which has in fact been time-shifted by half a cycle for clarity. Exclusive-OR gates (modulo2 adders) can be used instead with no circuit modifications. Logical 1 is interpreted as +1, logical 0 as -1. The pulses are mixed and centred about earth by the op-amp circuitry.



The Walsh coefficients for a sine wave start off as follows:

- 0.663 $WAL(1,t)$
- 0.063 $WAL(92,t)$
- 0.263 $WAL(95,t)$
- 0.025 $WAL(6,t)$
- 0.052 $WAL(0,t)$
- 0.006 $WAL(10,t)$
- 0.126 $WAL(13,6)$
- 0.013 $WAL(14,t)$

Anyone seriously interested in the subject is urged to get hold of *Applications of Walsh and Related Functions* by K. G. Beauchamp (Academic Press, 1984). Price is around £30.

Improved Frequency Doubler

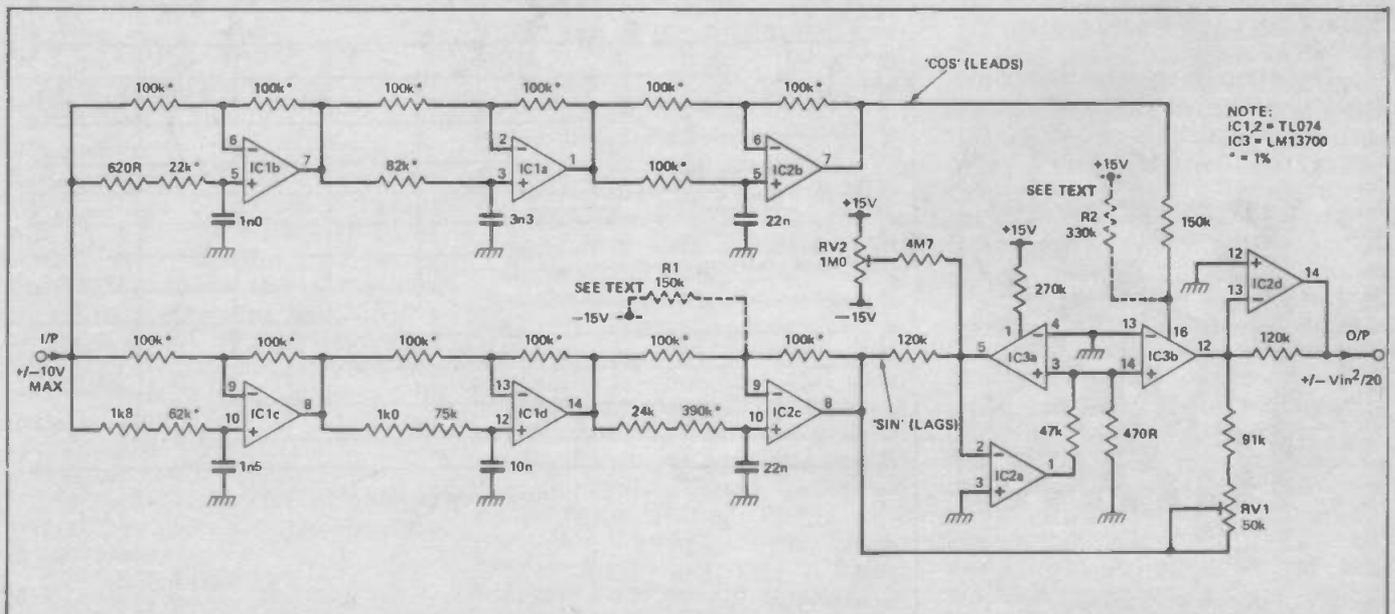
When two sine waves are multiplied together the result is two new sine waves with frequencies given by the difference between and sum of the original two frequencies. The figure shows the exact relations. This phenomenon has been used in the past as a guitar effect, in

which the signal is multiplied by itself with a ring modulator (four-quadrant VCA) to produce a frequency-doubled output (and also an annoying DC click or thump).

However, observation of the third equation reveals that if one of the multiplier inputs is shifted by 90° in relation to the other, then the difference component, which has zero frequency, is a sine rather than cosine wave. The sine of zero is zero and so the difference component conveniently loses

itself.

The hardest part is to achieve a consistent 90° phase difference over a wide frequency range. In practice this condition can only be approximated by means of two cascades of phase shifters (all-pass filters) with judiciously staggered time constants. The calculation of time constant values is actually rather tricky, so it is best to stick to the component values shown. Six phase shift stages are used to get a 90° complementary output with a phase error of less

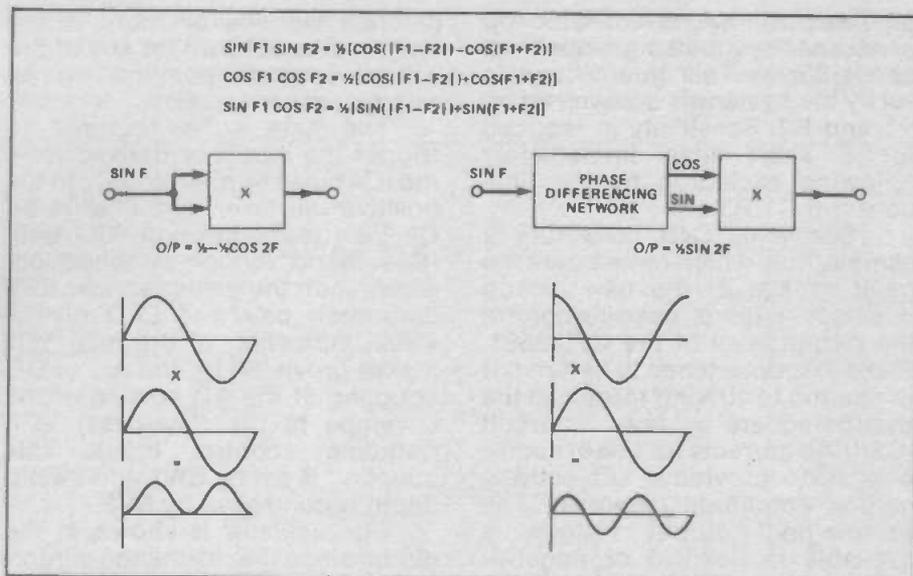


FEATURE: Music Potpourri

than a few degrees over a frequency range of 35Hz to 4kHz. Multiplication is performed by IC2a/IC2d/IC3. RV1 and RV2 can be used to trim the feedthrough of 'sin' and 'cos' multiplier inputs respectively, if required.

Note that, because the input is being multiplied with itself, albeit with a phase difference, the output amplitude is the square of the input amplitude, which is equivalent to a 2:1 expansion on the decibel scale. It is therefore desirable to precede the input with a compressor or sustain unit.

Note also that intermodulation occurs when the input is a composite of sine waves - the device is not a harmoniser but is well-suited to guitar sounds



Electronic Percussion Synth

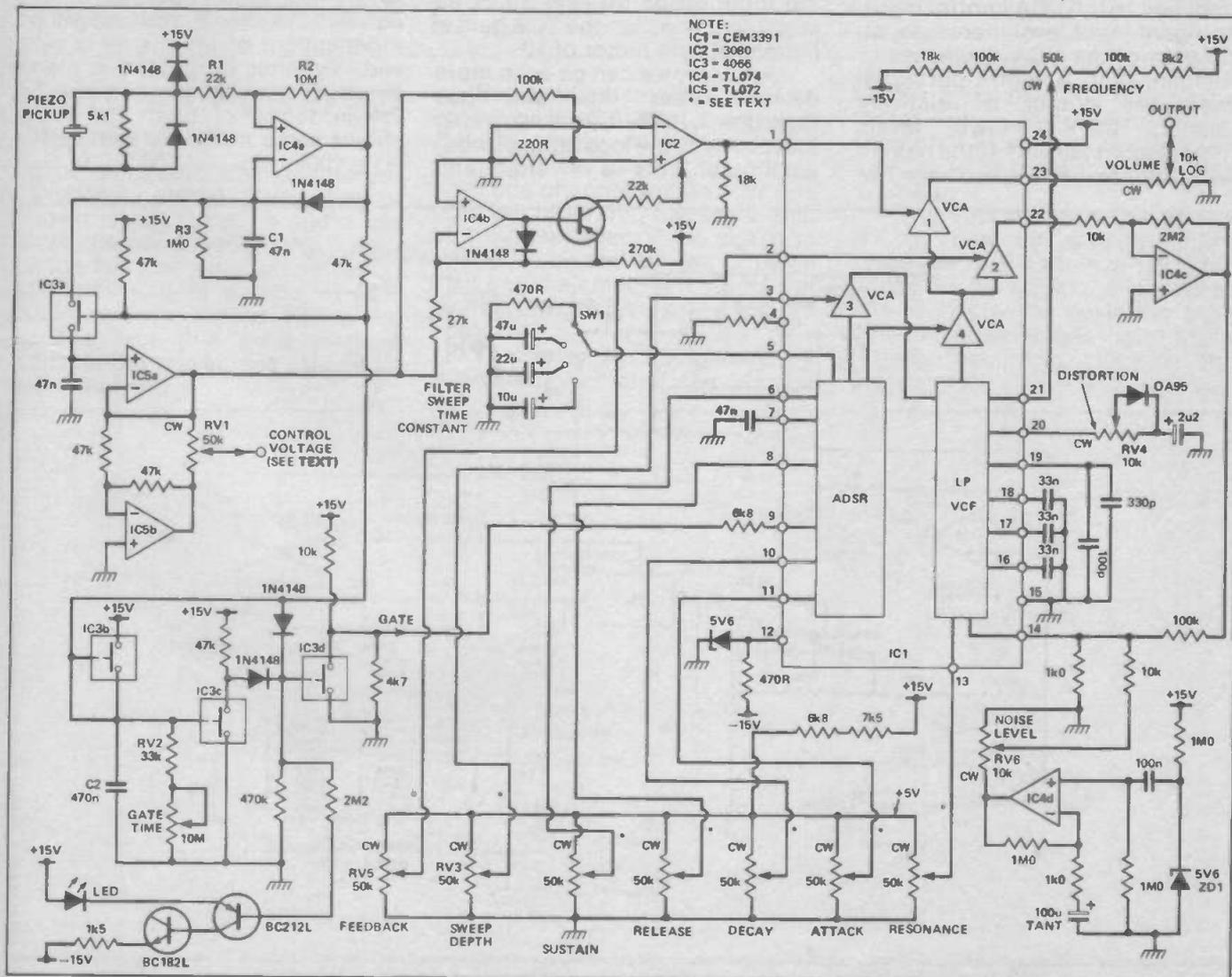
This percussion/effects unit is based on an all-singing, all-dancing synthesiser chip, providing fourteen controllable

parameters with only five ICs. Sound is initiated by striking a wooden or plastic surface to which the piezoelectric pickup (Maplin QY13P) is glued on the underside.

It is advisable to damp resonances of the striking surface with rubber sheet, preferably both

on top and underneath, in order to avoid the possibility of spurious multiple retriggering. The 5k1 resistor connected across the pickup is adjusted to give a maximum output of 10V from the sample/hold IC5 when the unit is struck as hard as possible.

Op-amp IC4a produces a brief



positive pulse whenever the pickup produces an impulse greater than about 30mV. This guard-band is set by the hysteresis determined by R1 and R2. Sensitivity is reduced for a short time immediately following excitation by the time constant C1/R3.

IC3a and IC4b constitute a sample/hold which remembers the peak voltage of the new pickup impulse, which is used to control the output level of the CEM3391. Piezo response tends to flatten out in relation to striking force and the pseudo-square law circuit IC2/IC4b corrects for this in such a way as to provide a subjectively natural amplitude response. The sample/hold output voltage is available in positive or negative polarity from RV1 and can be

patched via one or more rotary switches (not shown) to any of the voltage-control points marked with asterisks.

The gate pulse required to trigger the ADSR is derived from the IC4 pulse by charging C2 to the positive rail level. The charge on C2 then leaks through RV2 until IC3c is no longer switched on, whereupon the gate goes low. The darlington pair and LED give a visual indication of the gate. IC1 makes provision for the AC or DC coupling of the envelope to the (low-pass) VCF frequency control input. This coupling is set by SW1 and sweep depth is controlled by RV3.

No oscillator is shown in the circuit since the resonance control is capable of setting the filter into

oscillation. This oscillation is a sine wave with a distortion of only a few per cent, which can be made considerably raunchier by means of the germanium diode and RV4.

There is a second resonance control called 'feedback' (RV5) which uses the second VCA output (pin 22) of IC1. The resonance caused by feedback is dependent on the ADSR envelope. With short envelopes the filter impulse response that results from heavy use of this feedback becomes very rich and interesting, indeed almost acoustic.

Noise Input to the filter is provided by zener diode D1 and IC4d under the control of RV6, allowing good snare, whip-lash, gun shot and explosion sounds to be produced.

Feed-Forward AGC

Automatic gain control circuits are usually configured as a VCA with a feedback loop, via an envelope follower and inverting amplifier, to the VCA control input. As signal input level increases, so the gain of the VCA decreases in compensation. At high input signal levels the output is relatively constant but at lower levels compression falls off. If the gain in the feedback path is increased to

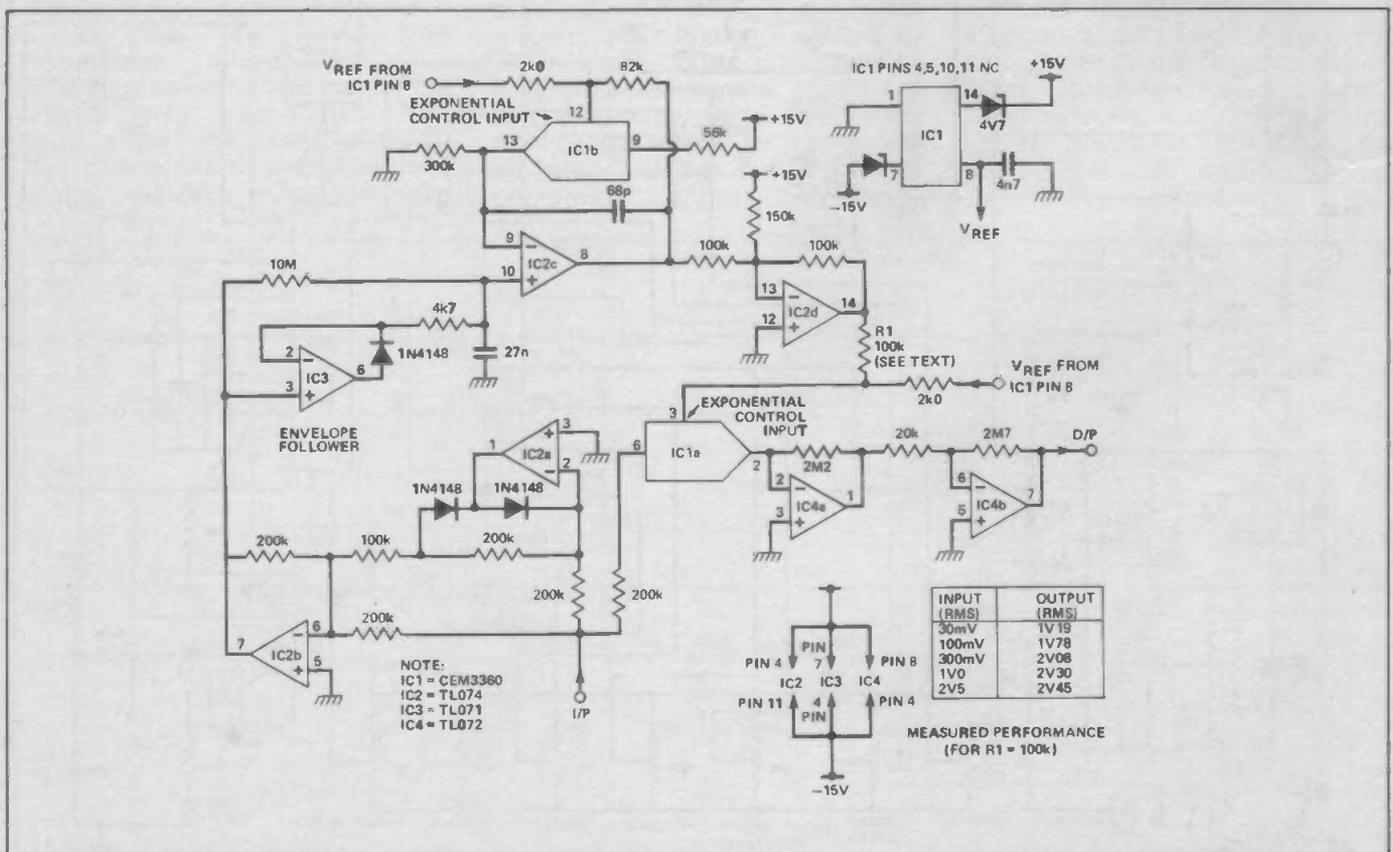
counteract this effect, instability usually arises.

The answer is to avoid feedback by controlling VCA gain from the signal input rather than output. To do this we can use a reciprocal (1/x) function, so that if the input drops to, say, 0.1 of its previous value then the VCA gain is increased by a factor of 10.

Actually, we can be even more devious than this and use logarithms. IC1b/IC2c is a log amp that provides the logarithm of input amplitude. This is inverted and

added to a constant by IC2d then fed via R1 to the exponential control input of the VCA IC1a.

The value of R1 then determines the compression slope on the decibel scale. If it is less than 82k then larger inputs will result in *smaller* outputs. If it is equal to 82k then the output will be independent of input over a very wide dynamic range. If it is made twice 82k then compression will be 2:1 in terms of dBs. The table shows some measured results for R1 = 100k.



Self Modulation

Signals can be persuaded to frequency modulate themselves by using them to control their own rate of propagation through a delay line, in this case a TDA1022 BBD (which has certain advantages over the more popular MN3000 types).

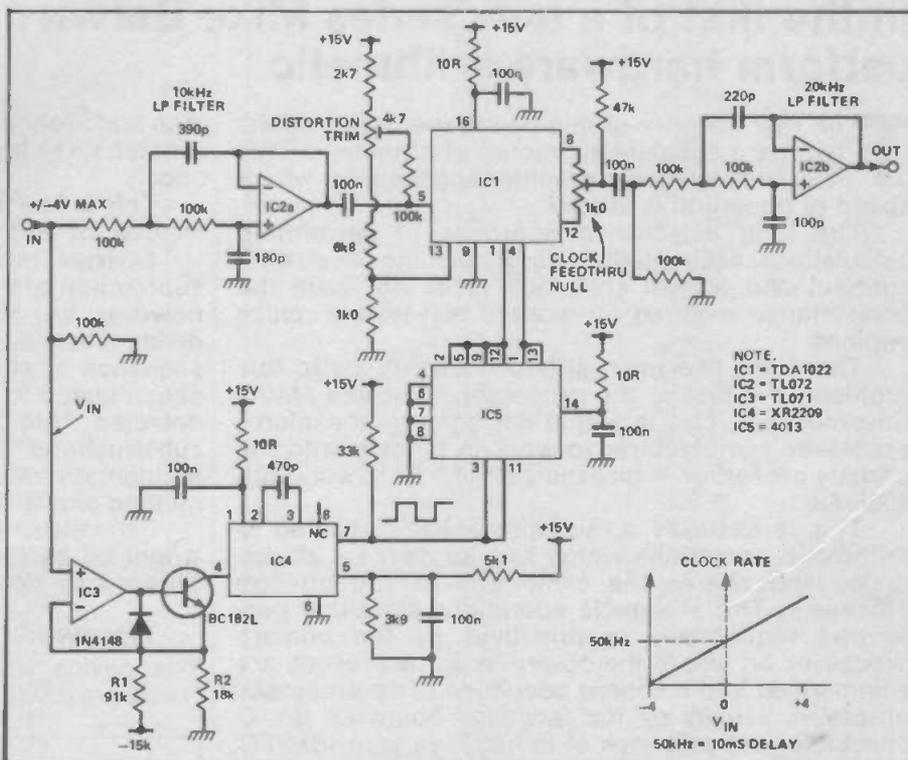
When the input is zero, clock rate at the output of the linear VCO comprising IC3 and IC4 is about 50kHz, which corresponds to a delay time of 10ms. Clock rate drops to zero for an input of -4V and increases to 100kHz at +4V. R1 sets the quiescent clock rate and R2 sets the sensitivity to input voltage.

Note that the peak input to the TDA1022, pin 5, should not exceed $\pm 4V$ if distortion is to be avoided. IC5 generates a clean antiphase squarewave pair for the delay line. IC2 is a second order unity gain Butterworth low pass filter which helps to keep aliasing effects down, while IC2b is a similar filter, which helps to keep Britain tidy!

Strong harmonics and sum/difference frequency components can be generated in practice but

not to the same degree as in a digital FM synth, since a delay line is incapable of providing a negative delay, necessary to

'modulate through zero'. However, by the same token an FM synth is incapable of modulating an existing audio signal.



Constant Power Pan Pot

The apparently common sense, simple stereo pan control shown is not suited to audio use since the combined power output of the left and right amplification channels suffers a drop of 3dB when the pot is central. This is due to the fact that here we are considering power, not voltage as we usually do.

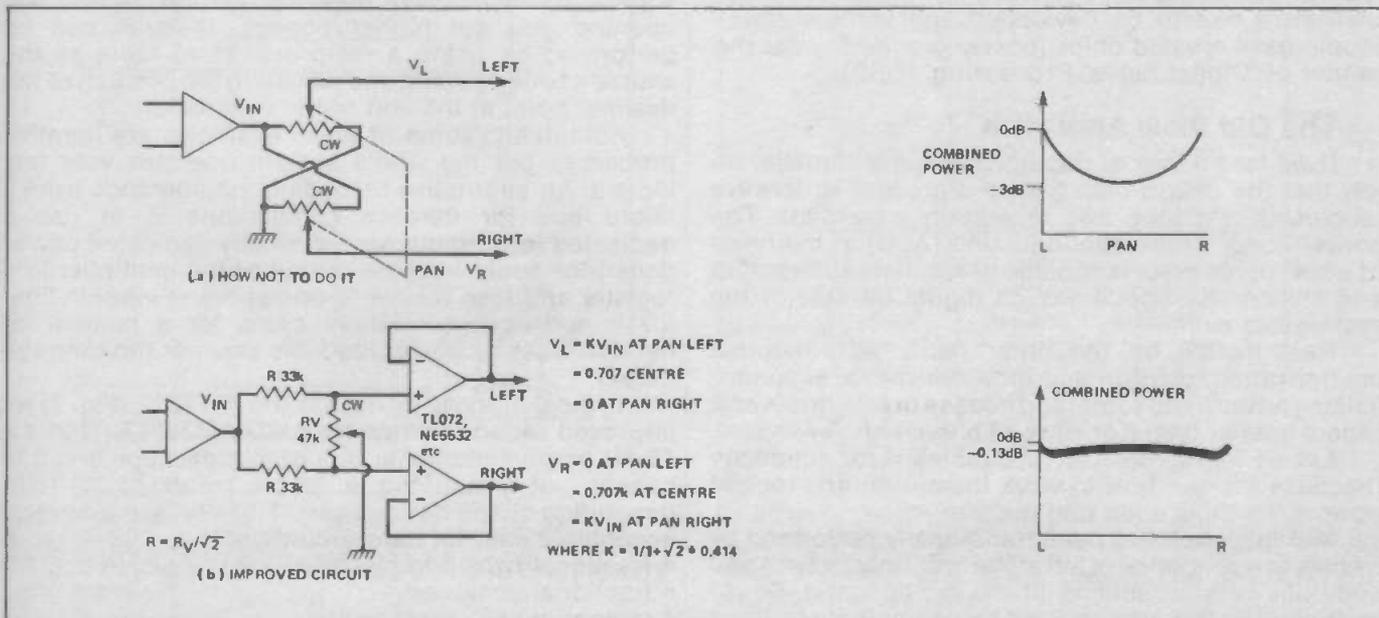
Say a stereo amplifier gives an output power of 10W for an input voltage of 1V. At the end-stop settings of the pan pot the output from one channel will be 10W and from the other 0W, making a total of 10W. However, if the pot is at midpoint, V_L and V_R will both be 0.5V and the amplifier outputs will be delivering 2.5W each, a total of only 5W.

This is easily understood by remembering that if the voltage

across a speaker coil drops by a factor of two, the current flowing through it will consequently halve also, causing a net four-fold drop in power.

The improved scheme shown is not new (it was originally proposed by R. Orban in 1971) but handy to be reminded of. When $R = R_v/1.414$ the deviation from constant power is less than 1.6% or 0.14dB (occurring close to the scale ends).

ETI



ARTFUL ARITHMETIC

In the first of a new series Mike Barwise looks at devices to perform hardware arithmetic

The vast majority of microcomputer applications require a substantial amount of arithmetic. This is especially true in graphics applications, where speed of operation is crucial.

The long established approach of performing calculations sequentially using machine level add, subtract and logical shifts just does not yield the performance required by modern real-time graphics engines.

There are two main alternative solutions to this problem: the first is the processor-dedicated *Maths Co-processor*. This is a chip designed by the microprocessor manufacturer to work in tandem with the primary processor — for example the 8087 to work with 8086/88.

This is basically a microprocessor dedicated to arithmetic operations which has its own set of op-codes and shares the same bus as the primary processor. The arithmetic operations are either performed sequentially in primitives by the primary processor or, where the co-processor is present, are summarised into a shorter sequence of co-processor op-codes, usually by the language compiler. So, C checks for the presence of the 8087 in your IBM/PC and compiles your code accordingly.

The co-processor solution is flexible. You can perform almost any calculation using the same hardware and the hardware is a totally standard package but it does not represent the maximum in attainable performance.

The very fastest arithmetic is performed by *Function Dedicated Arithmetic Circuits*.

These are one-job black boxes which are hard-wired implementations of specific mathematical algorithms (formulae, functions). The speed of operation attainable by this approach is phenomenal but until recently the circuits have been difficult to design and required a circuit board the size of a football field strapped to Battersea power station to operate.

With the demise of Battersea power station, some alternative had to be developed and various clever people have created chips loosely grouped under the banner of 'Digital Signal Processing' (DSP).

The Old Slow Approach

If we take a look at microprocessor arithmetic, we see that the delays occur when a process is iterative (enclosed in a loop and repeatedly executed). The conventional Arithmetic/logic unit (ALU) at the heart of a microprocessor is capable of addition, subtraction and shift/rotate operations on digital bit sets of the system bus width.

Real maths, on the other hand, also requires multiplication, division and their derivative, exponentiation (powers and roots) and needs a precision several orders greater than 8 or 16 or 32 bits.

Let us leave roots for the moment for simplicity (because I forget how to work them out!) and look at powers, multiplication and division.

Multiplication has been traditionally performed by micros as a sequence of left shifts (multiply by two) and additions or subtractions of the multiplicand. So, to multiply X by five, you shift left twice (multiply by four)

then add X once to finish off. To multiply by seven you shift left three times (multiply by eight) then subtract X once.

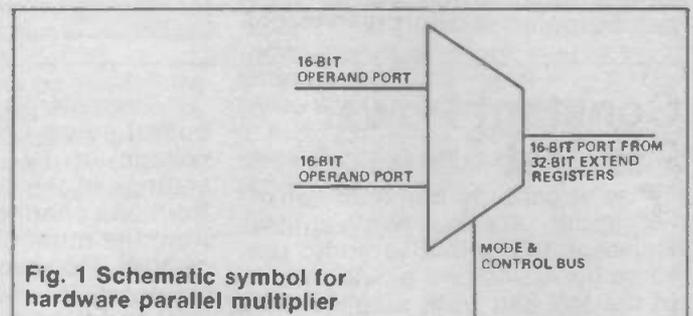
This is fine for small numbers but it gets quite long winded for fiddly values such as 129×51 .

Division is performed most simply by repetitive subtraction of the divisor from the dividend. There is, however an alternative method. The divisor and dividend are aligned and the operation consists of a sequence of shifts and bitwise comparisons. One is accumulated to the quotient every time a carry flag is detected. This is actually a little faster than repetitive subtractions of the divisor from the dividend. Incidentally, multiplication can also be performed by a method similar to this.

To calculate a power, multiple multiplications would be performed, resulting in two levels of loop. This is very slow.

Hardware Multipliers

The device which will save all this hassle is the *Hardware parallel multiplier* (Fig. 1). This has two input



ports of operand width and an output port of double width. The operands are loaded and a start signal is given. The output appears in typically less than 100n. By applying the same operand to both inputs you get a square. By feeding the previous result back into one operand you get higher powers. Division can be performed by using a reciprocal (1/n) table as the source of one operand and adjusting the position of the decimal point at the end of the calculation.

Admittedly, some of these examples are iterative processes but the whole system operates very fast indeed. An alternative to loading the operands from a micro bus for iterative calculations is to use a dedicated logic sequencer. A totally dedicated power generator could trap the output of the multiplier in a register and feed it back to one operand input in time for a subsequent multiply cycle for a number of iterations set by a user loadable counter (holding the Index).

Typical of these devices is the IDT7217 (Fig. 2) an improved second source for AMD AM29517. This is a 16-bit parallel multiplier in a 64-pin package and it is capable of producing a 32-bit result in 70-185n depending on the device suffix. This device has several acceptable data formats, including:

- fractional twos-complement
- fractional unsigned
- integer twos-complement

C

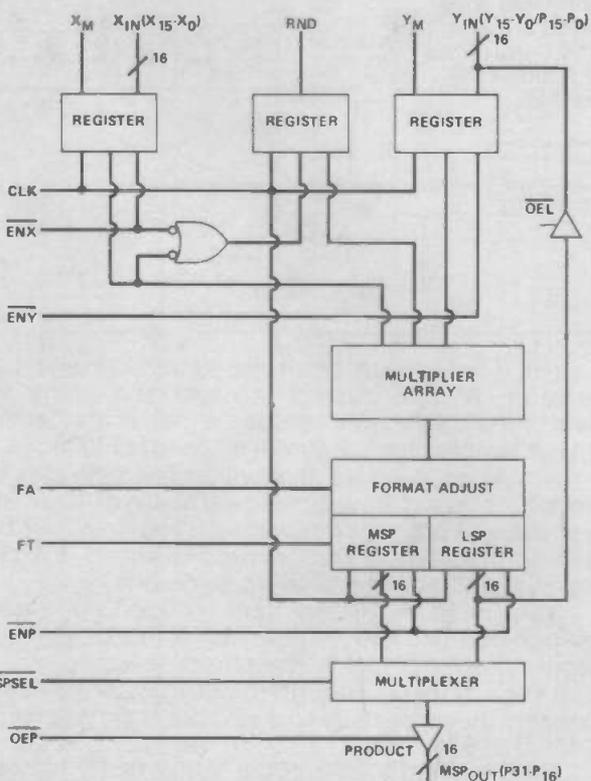
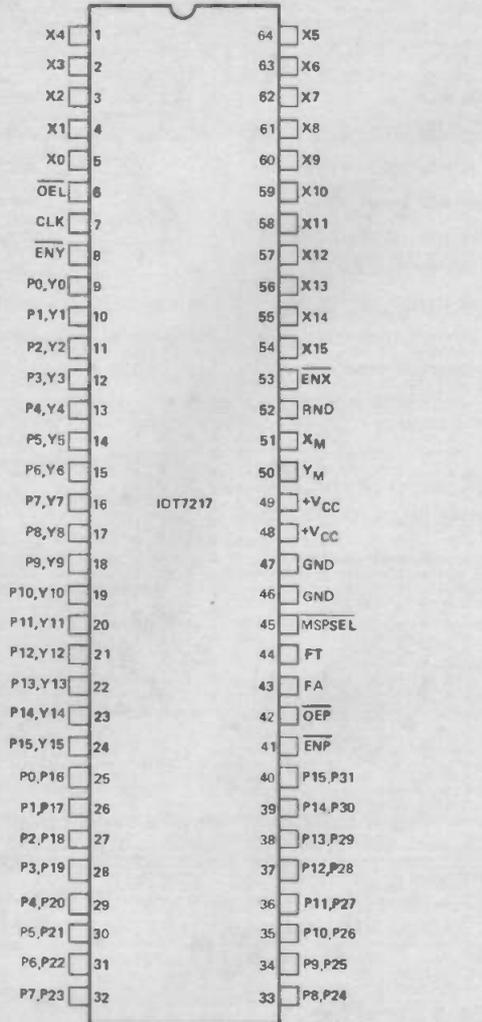


Fig. 2 Pinout and block diagram of the IDT7217 CMOS multiplier

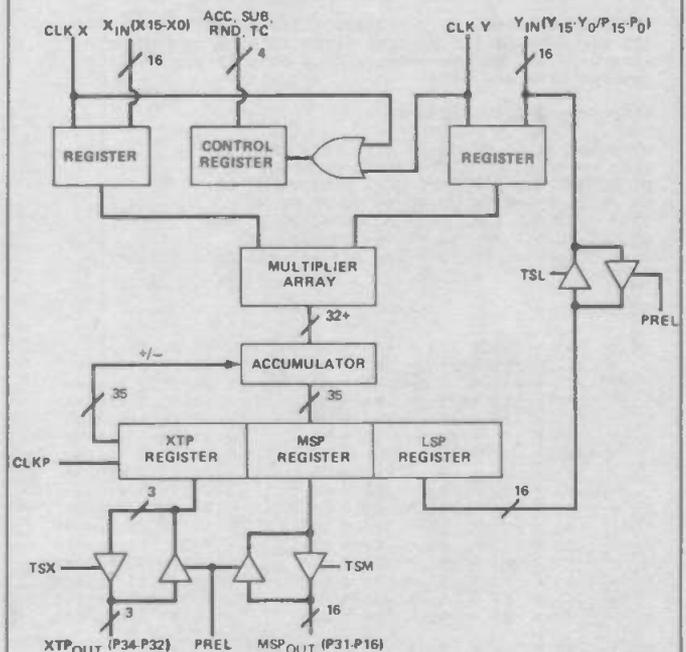
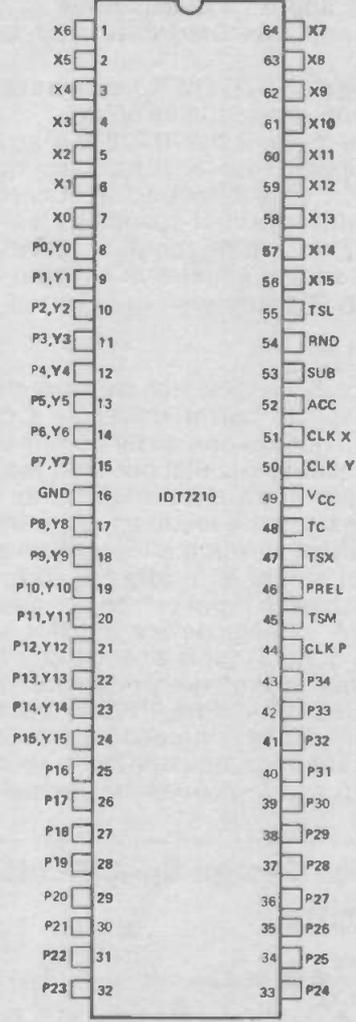


Fig. 3 Pinout and block diagram for the IDT7210 multiplier-accumulator

CHIP IN: Hardware Arithmetic

- integer unsigned
- a fractional and an integer mode in which twos-complement and unsigned data may be multiplied together.

A 12-bit version (IDT7213L) is also available, with a conversion time of as little as 55ns.

Even more clever is the IDT7210 (Fig. 3) — a 16-bit parallel multiplier with a result accumulator. This allows addition or subtraction of successive results into the output register at speeds as fast as 65ns per conversion. This single chip is capable of such operations as sum of squares of all input operands by simple routing of operands.

Flexibility

An additional device which can improve the system performance is the barrel shifter — a device which multiplies or divides in one go by powers of two. This is a kind of parallel-in/parallel out shift register, except that the direction and number of shifts are set by a bank of control lines and the result appears after one clock instead of shifting through all intermediate states.

The barrel shifter is in effect a compound multiplexer, in which each input can be connected to any of the outputs. A sample device in MMI Mega-PAL is shown in Fig. 4. Add to this a twos-complementer and you have the makings of a very powerful ALU. A sample design (this time in MMI PRE/PROM) is shown in Fig. 5.

OK I hear you say, supposing I need to perform several different calculations. Do I need a separate multiplier chip and logic network for each?

PAL Device Design Specification

Title Barrel_Shifter
 Pattern Barrel.pds
 Revision A
 Author Mahrnaz Hada
 Company Monolithic Memories Inc. Santa Clara, CA
 Date 1/15/85

The 16-bit barrel shifter will shift 16 bits of data (D15-D0) a number of locations into the output pins, as specified by the binary encoded input. A compacted equation can be used to specify this design. It can be specified as following:

$$Q[J=0..15] := OR[K=0..15] [D[(J+K) - ((J+K)/16)*16] * BIN(K, I=3..0) S(I)]$$

Inputs are shown by D. S1 are shift amount inputs and QJ are outputs. 16 product terms in each output pair are directed to one output; thus only 16 out of 32 output pins are used.

CHIP BarrelShift PAL64R32

D7 D6 D5 D4 D3 D2 D1 D0 /PL1 /PS1 GND CLK1 /OC1 Q0 NC Q1 NC Q2 NC Q3 NC Q4 NC Q5 NC Q6 NC Q7 NC /OC2 CLR2 VCC /PS2 /PL2 NC NC NC NC NC S0 S1 S2 S3 NC NC NC NC NC NC NC /PL3 /PS3 GND CLR3 /OC3 NC Q8 NC Q9 NC Q10 NC Q11 NC Q12 NC Q13 NC Q14 NC Q15 /OC4 CLK4 VCC /PS4 /PL4 D15 D14 D13 D12 D11 D10 D9 D8

EQUATIONS

Q0 := /S3 * /S2 * /S1 * /S0 * D0	; No shift
+ /S3 * /S2 * /S1 * S0 * D1	; Shift 1 space
+ /S3 * /S2 * S1 * /S0 * D2	; Shift 2 spaces
+ /S3 * /S2 * S1 * S0 * D3	; Shift 3 spaces
+ /S3 * S2 * /S1 * /S0 * D4	; Shift 4 spaces
+ /S3 * S2 * /S1 * S0 * D5	; Shift 5 spaces
+ /S3 * S2 * S1 * /S0 * D6	; Shift 6 spaces
+ /S3 * S2 * S1 * S0 * D7	; Shift 7 spaces
+ S1 * /S2 * /S1 * /S0 * D8	; Shift 8 spaces
+ S1 * /S2 * /S1 * S0 * D9	; Shift 9 spaces
+ S1 * /S2 * S1 * /S0 * D10	; Shift 10 spaces
+ S1 * /S2 * S1 * S0 * D11	; Shift 11 spaces
+ S1 * S2 * /S1 * /S0 * D12	; Shift 12 spaces
+ S1 * S2 * /S1 * S0 * D13	; Shift 13 spaces
+ S1 * S2 * S1 * /S0 * D14	; Shift 14 spaces
+ S1 * S2 * S1 * S0 * D15	; Shift 15 spaces

Q1 := /S3 * /S2 * /S1 * /S0 * D1	; No shift
+ /S3 * /S2 * /S1 * S0 * D2	; Shift 1 space
+ /S3 * /S2 * S1 * /S0 * D3	; Shift 2 spaces
+ /S3 * /S2 * S1 * S0 * D4	; Shift 3 spaces

Fig. 4 PAL specification of a Barrel shifter

PLE808 PLE CIRCUIT DESIGN SPECIFICATION
 P5015 MIKE VOGEL 11/28/83
 8-BIT TWO'S COMPLEMENT CONVERSION
 MMI BRZA, CALIFORNIA
 .ADD D0 D1 D2 D3 D4 D5 D6 D7
 .DAT Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7

Y0 = D0 ; CONVERT 1ST BIT (LSB)
 Y1 = D1 +: D0 ; CONVERT 2ND BIT
 Y2 = D2 +: D0 + D1 ; CONVERT 3RD BIT
 Y3 = D3 +: D0 + D1 +: D2 ; CONVERT 4TH BIT
 Y4 = D4 +: D0 + D1 + D2 + D3 ; CONVERT 5TH BIT
 Y5 = D5 +: D0 + D1 + D2 + D3 + D4 ; CONVERT 6TH BIT
 Y6 = D6 +: D0 + D1 + D2 + D3 + D4 + D5 ; CONVERT 7TH BIT
 Y7 = D7 +: D0 + D1 + D2 + D3 + D4 + D5 + D6 ; CONVERT 8TH BIT (MSB)

FUNCTION TABLE

D7	D6	D5	D4	D3	D2	D1	D0	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	DECIMAL
L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	0
L	L	L	L	L	L	L	R	R	R	R	R	R	R	R	R	1
L	L	L	L	L	L	R	R	R	R	R	R	R	R	R	R	3
L	L	L	L	L	R	R	R	R	R	R	R	R	R	R	R	7
L	L	L	L	R	R	R	R	R	R	R	R	R	R	R	R	15
L	L	L	R	R	R	R	R	R	R	R	R	R	R	R	R	31
L	L	R	R	R	R	R	R	R	R	R	R	R	R	R	R	63
L	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	127
R	R	R	R	R	R	R	R	L	L	L	L	L	L	L	L	255
R	R	R	R	R	R	R	R	L	L	L	L	L	L	L	L	254
R	R	R	R	R	R	R	L	L	L	L	L	L	L	L	L	252
R	R	R	R	R	R	L	L	L	L	L	L	L	L	L	L	248
R	R	R	R	R	L	L	L	L	L	L	L	L	L	L	L	240
R	R	R	R	L	L	L	L	L	L	L	L	L	L	L	L	224
R	R	R	L	L	L	L	L	L	L	L	L	L	L	L	L	192
R	R	L	L	L	L	L	L	L	L	L	L	L	L	L	L	128

8-BIT BINARY NUMBER (D7-D0) → TWO'S COMPLEMENT CONVERSION → TWO'S COMPLEMENT REPRESENTATION (Y7-Y0)

Fig. 5 Specifications of a twos-complementer

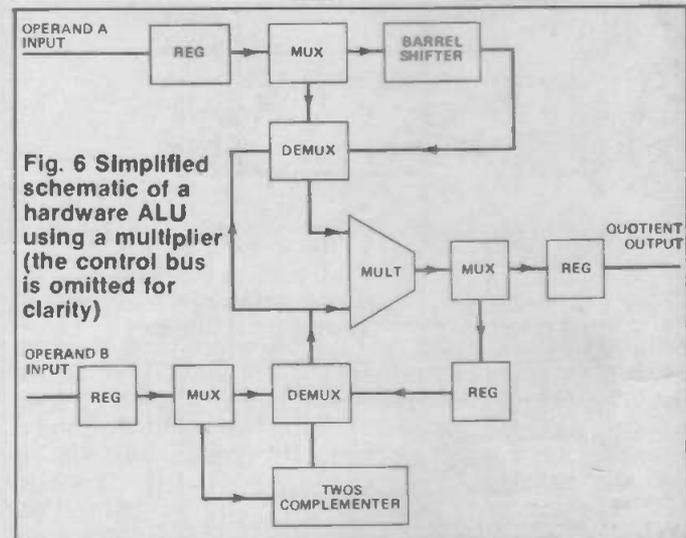


Fig. 6 Simplified schematic of a hardware ALU using a multiplier (the control bus is omitted for clarity)

No! That would get quite expensive and is very wasteful. A little careful thought and some multiplexers yield a flexible solution which is in effect a fast ALU. A simple block diagram is given in Fig. 6.

A system such as this will allow complex arithmetic to be performed independently of your microprocessor. The only intervention required will be the loading of function and operand registers, the checking of status and the reading of results.

You need not stop here, though. If there are enough pennies in your piggy bank this can be just the beginning of parallel arithmetic processing.

I reckon this is enough to get you started. Detailed data on these devices is available from Microlog on (04862) 29551.

I am currently examining some really interesting new departures in video and electro-optics among other things, so next month I will probably have some surprises for you.

ETI



Electro Mech Industries Limited

More Transistors, Thyristors, Triacs, Diodes,
744, Switch Mode PSUs etc. All at
competitive prices. Details on request.
ACCESS or VISA welcome. Just phone your
order through, we do the rest. 24hr answerphone.
Telex: 83147 Atm. ELMFC
Fax: 0855-726753 (GRP 2-3)

Unit 2, Wessex Industrial Estate, Station Lane, Witney, Oxfordshire. Telephone (0993) 75827 or 76605

IBM COMPATIBLES

Superb quality at sensational prices by Betron Computer Systems Inc.
EX VAT P&P
XT COMPATIBLE 790.00 86.00
AT COMPATIBLE 1245.00 10.00
TURBO/AT EGA SYSTEM 1640.00 10.00
Full technical specs available. Range of options/peripherals available at incredibly low prices.
Demonstrations can be arranged by appointment. Write/phone for brochure & price list.

MEMOTECH

MTX512 200K RAM 80.00 5.00
MTX512 Series 2 256K RAM 87.00 8.00
MDL 3.5" CP/M Disc Drive Upgrade 225.00 5.00
SPECIAL OFFERS
3.5" CP/M Disc Drive Upgrade, MTX512 Series 2 Computer, 12" Hi-Res Monitor, Comprehensive Software Package, Detailed Manuals, 10 x 3.5" Disquettes
All this for £399 inc. VAT. Delivery at £10.00 extra. Various Expansions Available.

BBC

Master 128 385.00 7.00
Compact Entry System 360.00 7.00
Compact Computer System 549.00 7.00
Archimedes Basic 305 System 795.00 7.00
Archimedes Basic 310 System 875.00 7.00
Full range of accessories - Send for price list.

EMI DISC DRIVE RANGE

BBC DISC DRIVES
All supplied with Leads, Manual & Utilities Disc
Price (Ex VAT)
5.25" DRIVES, WITHOUT POWER SUPPLY
Single 200K drive, 40 Track D/S £95.00
Single 400K drive, 40/80 Switchable £112.00
Dual 400K drive, 40 Track D/S £168.00
Dual 400K drive, 40/80 Switchable £214.00

5.25" DRIVES, WITH POWER SUPPLY
Single 200K drive, 40 Track D/S £108.00
Single 400K drive, 40/80 Switchable £125.00
Dual 400K drive, 40 Track D/S £198.00
Dual 400K drive, 40/80 Switchable £235.00
horizontally mounted in monitor stand (Master Version) £265.00

3.50" DRIVES, WITHOUT POWER SUPPLY
Single 400K drive, supplied in dual case, with blanking plate, to allow easy upgrade to dual drive. £95.00
Dual 400K drive. £165.00

3.50" DRIVES, WITH POWER SUPPLY
Single 400K drive, as above £110.00
Dual 400K drive, as above £180.00
NB: Please add £3.00 P and P per Single Drive, and £5.00 P and P per Dual Drive. Please add £7.00 delivery on Monitors, £3.00 on Modems.

CASED/UNCASED FLOPPY DISC DRIVES

5.25" FLOPPY DISC DRIVES Price (Ex VAT) P and P
500K 48 TPI D/S 40T £75.00 £2.00
1MB 96 TPI D/S 80T £80.00 £2.00
• 500K 40 T 48 TPI Cased with PSU & Leads £105.00 £3.00
• 1MB 80 T 96 TPI Cased with PSU & Leads £110.00 £3.00
3.50" FLOPPY DISC DRIVES
1MB 135 TPI D/S Slimline £75.00 £1.50
• 1MB 80 T 135 TPI Cased with PSU & Leads £95.00 £3.00
• Twin 1MB 80 T 135 TPI Cased with PSU & Leads £165.00 £5.00

DISC DRIVE ACCESSORIES

DISKETTES
5.25" Double Sided/Double Density £0.90
3.50" Double Sided/Double Density £2.00
3" CP2 £3.99
3" CP2DD £5.00
Regulated PSU (state 5.25" or 3.50") £8.50 £1.50
5.25" Drive Case Takes 1 5.25" H/Height Drive £9.00 £2.00
3.50" Drive Case Takes 2 3.50" Drives £15.00 £2.00
Drive Interface Cable - Single £5.00 £0.50
Drive Interface Cable - Double £7.00 £0.50
5.25" Drive Case and PSU assembled - Takes 1 H/H Drive £20.00 £3.00
3.50" Drive Case and PSU assembled - Takes 2 Drives £24.00 £3.00
• Available in 110 & 220V Versions

MONO/COLOUR MONITORS

PHILIPS
High-res. Green screen monitor, Model No BM7502 £72.50
High-res. Amber screen monitor, Model No BM7522 £77.50
IBM compatible (Green) with Leads Model No BM7513 £95.00
Dark glass, White screen monitor, Model No BM7542 £77.50
MITSUBISHI - Colour
Med. Res. BBC Compatible Model 1404 £232.00
Med. Res. IBM Compatible Model 1404E £284.00
Med. Res. IBM Compatible - Colour Card Model 1404EC £391.00
HANTAREX
SPECIAL OFFER HK12 HI-RES MONO GREEN £65.00
CT9000 MED RES 14" COLOUR RGB, HGB1 £179.95

MODEMS
Nightingale plus Comstar software £120.00
Answer call mini modem MD101, V21 £73.00
Miracle Technology WS2000 V21, V21 £95.00
Miracle Technology WS3000 V21, V23 AA AD £271.00
Miracle Technology WS3000 V22, V21, V22 AA AD £475.00
Miracle Technology WS3000 V22B, V21, V23 AA AD £595.00

LINEAR ICs COMPUTER ICs

AY-3-1014A	2.75	1N5401	0.10	79L05	0.33
AY-3-1015D	2.75	1N5402	0.10	79L08	0.40
AY-3-1470	2.00	1N5404	0.12	79L12	0.33
AY-3-1475	2.00	1N5406	0.14	79L15	0.40
AY-3-1710	3.15	1N5408	0.17	79L24	0.80
AY-3-1725	4.00	DA17	0.14	79L18	0.40
CA3011	1.10	DA30	0.14	79L24	0.40
CA3018	0.75	DA31	0.07		
CA3028A	1.00	156A1			
CA304	0.80	6622A	4.00		
CA3052	1.80	6800	2.00		
CA3054	1.00	6802	2.60		
CA3085	2.00	6803	8.25		
CA3088A	2.00	6805	5.00		
CA3090AD	0.55	6806E	1.00		
CA3085	1.00	6810	1.50		
CA3088	0.50	6818	1.50		
CA3088E	2.00	6820	1.50		
CA3089B	2.00	6821	1.50		
CA3090AD	2.30	6840	2.30		
CA3100S	2.00	6845	5.25		
CA3130E	0.75	6847	6.50		
CA3140T	0.70	6850	1.40		
CA3181E	1.10	6952	2.10		
CA3185A	2.00	6954	4.50		
CA3189E	2.25	69000	14.00		
CA3193E	1.50	70489	2.50		
CA3240E	0.80	8035	3.15		
CA3260E	2.50	8080A	4.15		
CA3280E	1.10	8085A	2.75		
HA1366W	1.70	8089	9.75		
LA300	1.90	8131	3.90		
LA4032P	2.45	8155	3.50		
LA4400	3.00	8156	3.50		
LA4420	2.75	8212	4.50		
LM442	3.20	8214	4.75		
LM4451	3.50	8216	4.50		
LC7120	3.00	8224	2.80		
LC7130	3.00	8226	2.90		
LC7131	5.00	8228	3.00		
LM1889A	2.50	8243	3.00		
MS1511A	2.00	8251A	3.25		
MS1615A	1.00	8253	3.25		
MB3712	1.80	8255	3.50		
MC1315P	2.20	8256A	11.00		
MC1330P	1.90	8257S	5.50		
MC1349P	1.50	8259	3.80		
MC1408G	2.90	8271	32.00		
MC1463A	4.80	8272	12.00		
MC1468P	3.80	8277A	14.25		
MC1604D	0.90	8283	4.40		
ML237B	2.50	8284	5.00		
ML238B	4.80	8288	10.00		
MS35T	1.10	8726A	0.90		
NE530T	0.80	8727	1.45		
NE533AM	1.00	8728	1.50		
SAB320	3.75	8731	3.45		
SN76008N	2.25	8795	0.85		
SN76110N	1.20	8797	0.85		
SN76115AN	1.90	8798	1.40		
SN76131N	1.25	8748	1.20		
SN76396N	1.65	9218	1.90		
SN76600P	1.30	MC1488	0.65		
SN76800N	0.80	MC1489	0.65		
SN76707N	2.10	MC3242	6.50		
TA7640	3.00	MC3446	3.00		
TA7204P	1.30	MC3447	3.00		
TA7205AP	0.90	MC3486	2.15		
TA7208P	1.30	MC3487	2.15		
TA7222P	1.30	Z80ACPU	2.00		
TA7310P	7.50	Z80BCPU1	2.00		
CA3020	2.00	Z80GCTC	2.00		
HA1387	2.50	Z80ADART	7.00		
LM1357P	1.95	Z80ADMA	8.25		
LM301AM	0.30	Z80APU	2.75		
LM309N	2.10	Z80ASIO	0.70		
LM311	0.45	Z80ASIO-1	3.00		
LM319	1.50	Z80ASIO-2	8.00		
LM324M	0.35	UJN202	0.70		
LM338N	0.35	UJN203	0.70		
LM358N	0.45	UJN204	0.70		
LM358N-14	0.60	TMS3901	4.45		
LM381	1.50	TMS3902	5.45		
LM3900	0.45	TMS3903	6.45		
LM358	1.00	TMS3904	7.45		
LM710CN	0.90	TMS3905	8.45		
LM711CN	0.90				
LM741	0.80				
LM7420	0.80				
MB3756	4.00				
NE555	0.20				
NE556	0.55				
NE560	1.30				
TB1205	0.60				
TA74620	1.75				
TA1011N	1.50				
TA1022	4.00				
TA2020	3.10				
TA2120	2.40				
TA2191	2.80				
TA2620	1.50				
TL071CP	1.90				
TL072CP	0.30				
TL074CN	1.00				
TL081CP	0.30				
TL082CP	0.50				
TL084CN	0.90				
TR19A00	2.75				
TC9100	1.50				
TC9109P	7.50				
TC1070S8	3.00				
TC1600	3.50				
TC1605	2.40				
TC1800	1.80				
TC1910	1.90				
TC1910A	1.90				
TC1910B	1.90				
TC1910C	1.90				
TC1910D	1.90				
TC1910E	1.90				
TC1910F	1.90				
TC1910G	1.90				
TC1910H	1.90				
TC1910I	1.90				
TC1910J	1.90				
TC1910K	1.90				
TC1910L	1.90				
TC1910M	1.90				
TC1910N	1.90				
TC1910O	1.90				
TC1910P	1.90				
TC1910Q	1.90				
TC1910R	1.90				
TC1910S	1.90				
TC1910T	1.90				
TC1910U	1.90				
TC1910V	1.90				
TC1910W	1.90				
TC1910X	1.90				
TC1910Y	1.90				
TC1910Z	1.90				

74HC & 74HCT

74HC00	0.28	4000	0.18
74HC02	0.28	4007	0.18
74HC03	0.28	4008	0.18
74HC04	0.28	4009	0.18
74HC05	0.28	4010	0.18
74HC06	0.28	4011	0.18
74HC07	0.28	4012	0.18
74HC08	0.28	4013	0.18
74HC09	0.28	4014	0.18
74HC10	0.28	4015	0.18
74HC11	0.28	4016	0.18
74HC12	0.28	4017	0.18
74HC13	0.28	4018	0.18
74HC14	0.28	4019	0.18
74HC15	0.28	4020	0.18
74HC16	0.28	4021	0.18
74HC17	0.28	4022	0.18
74HC18	0.28	4023	0.18
74HC19	0.28	4024	0.18
74HC20	0.28	4025	0.18
74HC21	0.28	4026	0.18
74HC22	0.28	4027	0.18
74HC23	0.28	4028	0.18
74HC24	0.28	4029	0.18
74HC25	0.28	4030	0.18
74HC26	0.28	4031	0.18
74HC27	0.28	4032	0.18
74HC28	0.28	4033	0.18
74HC29	0.28	4034	0.18
74HC30	0.28	4035	0.18
74HC31	0.28	4036	0.18
74HC32	0.28	4037	0.18
74HC33	0.28	4038	0.18

IMAGINARY TIMES

Paul Chappell takes his life in his hands with an explanation of complex numbers.

For many people the thought of complex numbers seems to induce reactions of panic and mental numbness out of all proportion to the difficulty of actually doing the calculations.

I have a suspicion this is partly a balking at interference with anything so familiar and 'obvious' as the ordinary number system. After all, we've been using numbers since primary school days for counting and measuring. They are safe, predictable, easy to understand.

Then along come these new numbers which do odd things, are not easy to interpret and are utterly useless for counting and measuring!

If you have doubts about the meaning and value of complex numbers, you're in good company. At the beginning of the last century they were generally held to be meaningless and 'imaginary' and their study a waste of time. The main reason for this was that they had no obvious interpretation. Allowing them into algebraic equations gave solutions of a sort, but what could be understood by an answer such as $7+j9$, where j is to be interpreted as $\sqrt{-1}$?

It may as well have been 'hickory dickory dock' for all the sense it made.

Why Complex Numbers?

The study of complex numbers arose from dissatisfaction that perfectly reasonable looking equations and expressions have no solution within the ordinary number system. The quadratic equation $x^2+5x+6=0$ has roots (values of x which make it 'true') of -2 and -3 . If you substitute either of these values for x in the equation, the left hand side does indeed add up to zero. Yet, try as you might, you won't find a value of x to make $x^2+5x+7=0$ come out 'true'.

At an even simpler level, there seems to be no candidate within the ordinary number system for the value of, say, $\sqrt{-4}$. It can't be negative (since any negative number multiplied by itself will give a positive result) and it can't be positive for the same reason. It's certainly not zero, which is the only remaining possibility.

If we return to the awkward quadratic equation and try to use the well worn formula:

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

to find the roots, we hit a similar problem. All goes well until we try to evaluate $\sqrt{b^2-4ac}$, which in this case will be $\sqrt{-3}$. The square root of a negative number again!

What if we allow negative numbers to have square roots — what then?

One thing we won't be able to do, as we've already seen, is to find a place for these new numbers within the realm of the ordinary counting and measuring

numbers. Whatever solution is found will have to be given a new meaning. Let's just put this into perspective.

Cracked It!

The process for solving quadratic equations by completing the square (the basis of the formula given above) was known to the Babylonians. Yet the range of things they would accept as proper answers was even more restricted than those accepted by 19th century mathematicians. They only liked positive solutions.

When it came to subtracting one number from a smaller one, they had no way to cope with it. To their practical, commonsense minds you either had something or you had nothing. To talk about having less than nothing was just plain nonsense. They had a point — didn't they?

From the viewpoint of our familiarity with the arithmetic of negative numbers, we can find all kinds of interpretations which would have seemed the epitome of abstract philosophical twaddle to the Babylonians.

Instead of thinking of an overdraft as owing a positive amount of money, we can think of it as *owning* a negative amount. If a current goes one way in a circuit, we might call it positive. If it goes the other way it's negative, although there's no real difference between the two. We might consider a hole in the ground as having negative height, sadness as negative happiness — once we've caught on to a pattern, there's no end to the ways we can apply it.

To get a firm grasp of complex numbers, we'll see what kind of pattern they make when we put them through their paces and then try to match it up with something familiar. This being ETI, there are no prizes for guessing what that familiar subject will be!

The Basic Properties

I don't intend to go too deeply into the mechanics of manipulating complex numbers this month but there are two things to consider before we go any further. First, since $-n$ can be written as $-1 \times n$ for any number n , it is reasonable to write $\sqrt{-n}$ as $\sqrt{n} \times \sqrt{-1}$. This means that the square root of any negative number can be looked on as a multiple of $\sqrt{-1}$.

If we use the symbol j to represent $\sqrt{-1}$, we have a neat way to write down these new numbers: $\sqrt{-16}$ will be $j4$, for instance.

Second, all text books I've ever come across begin with the assumption that complex numbers are of the form $a+jb$. I've no objection to this (I'll be doing the same myself) but I think it's worth considering for a moment why this assumption can be made.

If you give j the status of a number and allow it to run amok through your equations, there's no knowing

what might come out. One thing to notice about j is that it has certain 'self-simplifying' properties. For instance, j^2 is (obviously) -1 , j^3 is $-j$, j^4 is 1 , and higher powers of j just trudge eternally around the loop $j, -1, -j, 1$, so at j^5 we're back to j again, j^9 will be $-j$, and so on.

Similarly, something of the form $(c+jd)^n$ will also reduce to $a+jb$. Tug it! Expand it out, replace all the powers of j by $j, -1, +j$ or 1 , then gather together all the ordinary numbers and all the multiples of j and you're there!

To follow this bottom-up approach to the bitter end would mean anticipating every single combination that could emerge from an equation and showing that they all reduce to the form $a+jb$. There would always be the possibility that one had been overlooked.

The alternative is to take a top-down view. Assume that all complex numbers are of the form $a+jb$, then show that numbers of this form can provide solutions to all possible equations. This is also a tall order if you include every conceivable equation, but a simple proof is possible for the case of algebraic equations. Other equations can be considered on their own merits and we'll be looking at one example in particular next month.

Two-Dimensional Numbers

The first step towards providing an interpretation for the square roots of negative numbers was taken by Jean Robert Argand in 1806. He developed a geometric representation which placed them along a line at right angles to the ordinary number line (Fig. 1). This construction would probably have had a much greater impact for generations brought up on Euclid's 'Elements' than it does for us but at least it gives a way of visualising the situation.

Gauss later extended Argand's idea to incorporate numbers of the form $a+jb$ as points on the plane. $2+j3$, for instance, would be represented by a point two units to the right of zero and three units upwards — rather like a map reference showing where the number can be found.

That's as far as I intend to go for this month, but before I leave, does anyone have any questions?

I've seen all this before — Argand diagrams and all that kind of stuff. But I still don't see what complex numbers are. For example, if an answer comes out to $4+j6$, is that more than 4? Or the same (if so, why the $j6$?), or less?

You're looking down the wrong end of the telescope! You can't take complex numbers and try to crush them into the structure of ordinary numbers. The best way of looking at the situation I can give at the moment is this:

Suppose you were a master chef with a fine appreciation of the subtle variations in flavour you can obtain by adding different kinds of salt to your dishes — sea salt, table salt, and so on.

One day a chemist comes to eat at your restaurant. You fall to talking about salt and he tells you that from his point of view the word covers a whole class of chemical compounds. As a chef, you might be excited at the prospect of the culinary masterpieces you will be able to prepare when you come to terms with all these new types of salt. Chicken à la ferric chloride, perhaps. The chemist explains that salts in general are not really much good for flavouring food and to think that all salts must have the properties of the familiar one is a mistake.

With complex numbers, you've got to take the chemist's-eye view — that numbers are really of the form $a+jb$ and they don't necessarily have the properties of the familiar type. The only ones which are

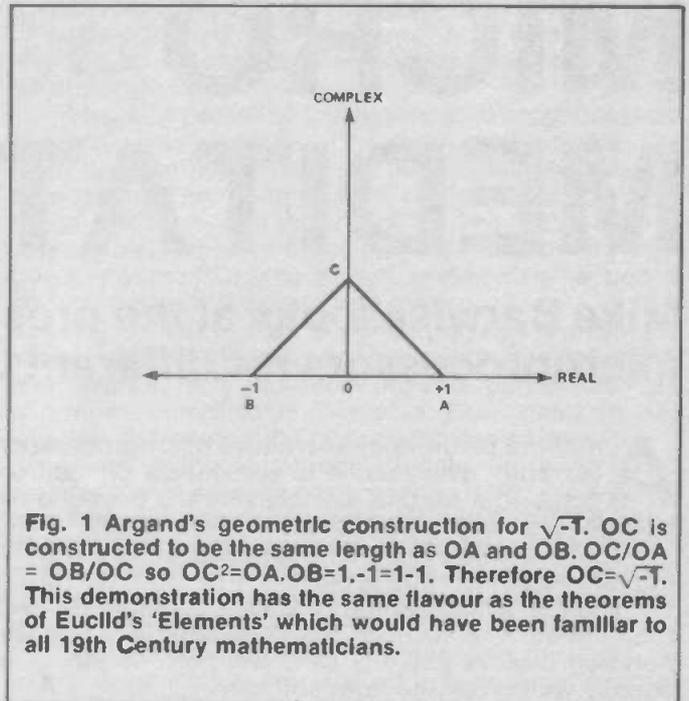


Fig. 1 Argand's geometric construction for $\sqrt{-1}$. OC is constructed to be the same length as OA and OB. $OC/OA = OB/OC$ so $OC^2 = OA \cdot OB = 1 \cdot -1 = -1$. Therefore $OC = \sqrt{-1}$. This demonstration has the same flavour as the theorems of Euclid's 'Elements' which would have been familiar to all 19th Century mathematicians.

any good for counting and measuring are those in which $b=0$. The others have different uses, which become evident when you start experimenting with them.

Ordinary numbers can only be compared with each other because they 'lie in a straight line'. We then adopt the convention that any number on the line is greater than all numbers to its left and less than any number of its right. This isn't so easy to do when the numbers are spread out over a plane (although there is a more restricted sense in which their 'sizes' can be compared).

You promised these numbers would have some kind of a pattern which would make it clear how to interpret them. I haven't seen much of a pattern yet!

I agree. I promised to make you a number naturalist and so far I've only shown you a stuffed otter in a glass case. The pattern of complex numbers only becomes apparent when you study the habits of live ones.

The particular pattern we will be interested in is how closely the behaviour of complex numbers matches that of electronic components and circuits. That must wait until next month.

OK, so we've got a way of showing the square roots of negative numbers. That's no big deal. What about all the other things that have no answer, like the logs of negative numbers? Are we going to have negative-log numbers next? And how about things like e^j or $\sqrt{-j}$, or even j^j ? Are we going to need hyper-complex numbers to give answers to this kind of thing? Where will it all end?

The interesting thing about complex numbers is that the expansion of the number system has ended already. All the problems you pose (and more!) can be given solutions of the form $a+jb$. For algebraic equations, this is known as the fundamental theorem of algebra. Functions like e^j (which we will be looking at next month — it's important for electronics calculations) also have a place within the realm of complex numbers.

The value of j^j , by the way, is $0.2078795 \dots$ which is just the kind of thing you need to know if you're a mathematical 'Trivial Pursuits' player!

ETI

MICRO MEDITATIONS

Mike Barwise looks at the pros and cons of different microprocessors for different uses

Amid the plethora of alternative microprocessors currently available, it is sometimes difficult to come to a rational decision on the best choice of processor for a given task.

There are two mutually opposed common misapprehensions on this subject:

The first is that certain CPUs are generally 'better' than others. The second, that there is little to choose between devices and any CPU will perform any task equally well given the right software.

The truth lies somewhere between these two poles. The choice of processor for a given task depends primarily on the application designer's criteria in a given design situation.

Alternative factors which could guide or dictate choice are:

- system chip count in a low cost commercial application
- system throughput as an absolute parameter
- system efficiency as an absolute parameter
- system cost effectively represented as throughput per pound or dollar cost
- system adaptability for non-standard implementations
- system reliability or the capacity of the system for self-maintenance
- designer familiarity with the system.

The list could go on indefinitely but this sample shows just how diverse are the factors which seem significant in varying design situations.

What I would like to do in this resumé is to give my personal overview of the current mainstream CPUs and support devices and to outline some of the criteria I consider most important in different areas of application.

Bus Width, Speed And Map Size

Sadly, these three parameters are inextricably intertwined. Early 8-bit CPUs with low clock rates and 64K maps have given way to apparently much faster 16 and 32-bit CPUs with maps in excess of 1Mb, without any transitional devices.

This is probably a major influence on the 'generally better' theory. Faster is better, faster is 16 or 32-bit, 16 or 32-bit has a larger map and so on.

In practice, the three parameters should ideally be considered quite separately. It may not hurt to have a 16-bit bus width when you need a large map or it may be no problem to have a large map when you need a high throughput, but in either case it may be no advantage either.

To take a typical example: if you are building a microprocessor driven printer buffer you may need a data buffer expandable to about 512K bytes (quite a few word processor files on my IBM compatible are in this order of size). You will not, however, need a bus wider than 8-bit, as all your data objects are single bytes, as are the system ports.

Neither will you need exceptionally high speed, as the fastest parallel printer port is limited to about 64K per second by the duration of its strobe/acknowledge sequence. However, to directly map the data buffer into the CPU, you are stuck with a 16-bit processor for this application.

Alternatively, you may need very high speed and a 16-bit bus for a specialised high resolution transient capture unit but you are very unlikely to need 1Mb or more of memory for it.

A Fistful Of CPUs

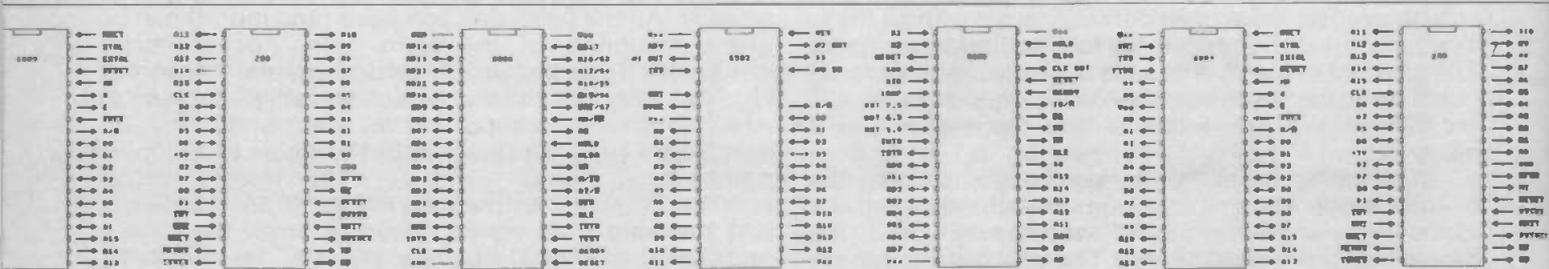
The most common devices and the ones I am mainly considering here are:

- 8-bit: 6500, 6800, Z80 and their derivatives;
- 16 and 32-bit: 8068, 68000 and their derivatives;
- pseudo 16-bit: 8088

Let's take the 8-bit devices first. Most of us are familiar with the 6502 which is the simple entry point of the 6500 system. It has been around since about 1978 and is very well documented.

It has its problems. The original NMOS device has only ever been available at 1MHz and 2MHz which makes the throughput rather low in real terms and some unused op-codes can lock it solid or perform rather random operations.

However, even the NMOS chip is about the cheapest processor available in pounds per throughput. It is probably the easiest processor to use to build hardware as you can (but are not obliged to) use the standard support chips such as peripheral interfaces and so on. Specifically for control jobs, it is



probably one of the simplest processors to write for (a close runner-up being 6809).

The real beauty of the 6502 is, however, in the upgrades which have materialised with the conversion to CMOS technology. Rockwell, one of the largest suppliers of 6500 parts, has produced a set of three R65C00 processors which, apart from the power consumption improvements inherent in CMOS, also have the following enhancements:

- no action taken on any invalid op-code
- clock speeds to 4 (yes! FOUR) MHz
- price in the under £10 bracket.

This is characteristic of the upgrade trend in 8-bit processors.

A Few CPUs More

Among the 8-bit devices, the Z80 is probably the most fiddly to work with. Many experienced users swear by it whereas most newcomers swear at it. The Z80 has, however, the distinction of being one of the very earliest 8-bit CPUs readily available and was given an enormous boost by the creation of CP/M.

It is still the preferred engine for 8-bit office tasks but I feel that this is more probably tradition than anything else.

Overall, I think there is little to distinguish the various mainstream 8-bit processors except for personal preference, as long as your selection criteria are correct.

It is no good, for example, just looking at clock rate to gain an idea of relative throughput. You have to examine the instruction execution cycle in detail. For example, a Z80 with a standard clock speed of 4MHz sounds a lot faster than a standard 6502 with a 1MHz clock. However, when you look at real instruction execution rate you find the Z80 averages about 15 clock cycles per instruction, while the 6502 averages about 3½. When you work the result through, you find that both processors have (surprise, surprise!) about the same throughput.

The other set of processors under discussion is the generation of 16-bit and beyond.

Around the time we were all coming to grips with 8-bit microprocessors, the silicon industry was taking a radical new direction in CPU architecture.

This was not just the expansion of bus width and memory map (which results from the greater number of address lines available as a wider bus) or in the enhancement of the silicon geometry to increase system speed. The underlying principle was *uniformity*.

The idea was to create a totally application-independent hardware solution with the application defined solely by software. The incentive was, of course, essentially commercial. Software redesign is cheaper than hardware redesign when you find you have goofed. Nevertheless, this idea has persisted to the present day and probably is with us for the foreseeable future.

You must remember that the majority of profitable microsystems manufacturers rely essentially on the office data processing market. In this field, the tasks

are simple and relatively undemanding of everything except data capacity. Practically all throughput is ultimately limited by human interfaces of one sort or another, so absolute processor speed does not have to be phenomenal.

Where speed is of the essence, microprocessors are not used anyway. The junk mail houses use massive mainframes, as do all the financial processing companies. The market we are really discussing is the office personal computer boom. The ideal here is *compatibility*, the option of slotting the same program into any of the PCs where it will accept disk, keyboard, comms and printer input and output.

The ultimate result is something like the IBM PC series, which is basically an Intel recommended implementation of Intel standard chip sets, pared down to a minimum complexity. There is little need to ask whether the compatibility concept has come off!

Given this commercial climate, it is no great wonder that the newer generations of CPU are less and less flexible in their implementation. The 8086 has a dedicated bus controller (8288), DMA controller (8257) and interrupt prioritiser (8259) and you can't for practical purposes implement these functions except by use of these chips.

The interrupt prioritiser, for example, and the CPU interchange data during the priority decision process via a dedicated set of control lines and the data bus. Any alternative implementation has to obey the same protocol, as no explicitly coded READ operation takes place.

Conversely, the software set of the 8086 and its family is extremely flexible. Flexible to the extent of being thoroughly confusing. The indirection of addresses via the contents of updatable registers, combined with a segmented address map (yielding 64K alternative address notations for each physical byte) make the visual analysis of disassembled code almost impossible.

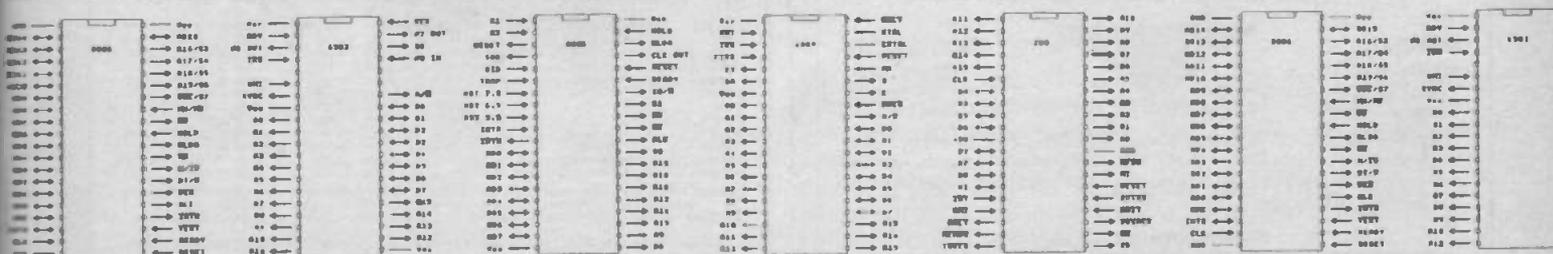
The Good

We now come to the 68000. This Motorola invention (the same people who invented the 6809) bridges the gap between the inherently simple 8-bit devices and the complex future.

The 68000 is a 16-bit processor with internal 32-bit registers and an instruction set surprisingly reminiscent of the 6809. The 32-bit program counter directly addresses 16Mb which is preferable to the segmented format of the 808n series and the system appears to have been well minimised.

The 68000 will accept its own peripheral chips from the 6809/6502 families and is sufficiently open in architecture to also accept custom interfaces. This processor is really my favourite among the 16-bit devices and I would recommend further investigation. It is, by the way, the processor used in the Apple Mac — the only non-Intel office system to prove itself viable.

Finally, under the heading of standard devices in current use we have the pseudo 16-bit processors (such as 8088). The same comments apply to each as to its parent device except that generally they have



comparatively poor performance.

Inevitably, to load 16-bit registers from an 8-bit bus, a bandwidth at least double that of the 16-bit bus will be needed to maintain system speed. Where you don't have that bandwidth (as in the IBM PC and PC/XT), the system performs badly in comparison with a true 16-bit configuration.

A final comment on the 8-bit processors: they still represent the most cost-effective solutions for general control jobs. Various derivative devices incorporating mask ROM, RAM and alternative peripheral ports in single packages form the basis of the controllers in our washing machines, central heating systems and, increasingly, in our cars.

The dedication of most standard 16-bit processors to their own support devices has recently prompted some manufacturers to hybridise. You can now get a complete IBM PC/AT equivalent on two pin grid arrays with a total board space requirement of about eight square inches!

The Bad And The Ugly

Apart from the mainstream processors, there are now many more esoteric chips around, ranging from fairly conventional devices with small user bases, such as the Zilog Z8000, through to RISC and parallel processor networks.

The really interesting departure is probably the parallel processing option. RISC, after all has been around from some time (the 6502 could be considered a RISC processor, as I think Acorn realised when they developed their own RISC along similar lines).

For the uninitiated, RISC (Reduced Instruction Set Computer) architecture consists of minimisation of the

complexity of CPU operations, so that you end up with a small set of primitives running on a greatly simplified (and so extremely fast) Arithmetic Logic Unit.

However, back to parallel processing. The idea behind this is that any complex problem can be broken down into sub-problems which only inter-connect at certain critical points. A conventional sequential processor would solve sub-problem (sp) A, store a result, then solve spB using that result and so on.

However, if spB only needs spA's result three quarters of the way through its own operation, you could save time if spA and spB could be running simultaneously.

The parallel processor has in effect a CPU per sub-problem. All of them start executing at the same time and any sp which needs data from another is constrained to wait *only from the moment it needs data to the moment the data is available*. This concept results in a very fast overall execution rate.

There is, however, a point that I find rather funny. The total problem solution in a parallel network is an intensely *problem dedicated* hardware implementation for most problems which merit the technique.

This means we are back to one-job machines which we always knew were potentially faster anyway! It is quite possible that in striving for across-the-board compatibility over the last 8-10 years, the micro industry has significantly retarded the progress of computer solutions.

I leave you with the thought that this situation is unlikely to change unless the end users of micro-systems become much more critical and discerning in their quest for results on time and at the right price.

ETI

Practical Digital Electronics Handbook

Mike Tooley BA

208 pages · 216 x 138mm · illustrated · ISBN 1-870775-00-7
£6.95 (plus 50p post & packing)

New book!

A practically based introduction to digital electronics for the enthusiast, technician and student.

- Covers circuits, logic gates, bistables, timers, microprocessors, memory devices, I/O, RS232C interface, IEEE488 and IEEE1000 buses, the oscilloscope.

- 50 pages give full constructional details for nine test gear

projects including power supply, versatile pulse generator, digital IC tester, current tracer, audio logic tracer, versatile digital counter/frequency meter, logic pulser, logic probe, RS232C breakout box.

- Data section with TTL and CMOS pinouts, binary, hex, ASCII conversion tables, suppliers' addresses, further reading, study courses.

Send your cheque/postal order for £7.45 payable to
PC Publishing to:

PC Publishing, 22 Clifton Road, London N3 2AR

Introducing
Digital Audio -
CD, DAT and Sampling
by Ian R Sinclair

All you ever wanted to know
about the new digital
technology in clear non
mathematical language!

Coming soon!

Practical MIDI
Handbook
by RA Penfold

A practical guide to using MIDI
based instruments for the
technician or performer.

Send for brochure to address above

SMJ ELECTRONICS

Specialists in Semiconductors

Transistors

2N3055	£0.47	2SC045	£0.08	2SC2028	£1.30	2SK30	£0.37	BD235	£0.30
2N3773	£1.85	2SC1060	£0.59	2SC2029	£1.15	2SK33	£0.40	BD241	£0.34
2N3886	£1.10	2SC1061	£0.49	2SC2078	£0.74	2N201	£0.11	BD243	£0.30
2SA473	£0.42	2SC1096	£0.71	2SC2096	£0.43	3SK40	£1.27	BD246	£0.33
2SA564	£0.10	2SC1213	£0.12	2SC2092	£1.41	3SK48	£2.28	BD245	£0.04
2SA608	£0.11	2SC1306	£0.74	2SC2097	£2.09	3SK86	£0.59	BD246	£0.75
2SA873	£0.13	2SC1312	£0.09	2SC2099	£1.25	3SK97	£3.08	BD262	£0.01
2SA678	£0.30	2SC1318	£0.32	2SC2166	£0.95	40E75	£1.50	BF244	£0.39
2SA683	£0.20	2SC1359	£0.13	2SC2228	£0.22	BC107	£0.13	BF245	£0.29
2SA684	£0.31	2SC1384	£0.27	2SC2291	£24.55	BC108	£0.07	BF500	£0.05
2SA699	£0.20	2SC1398	£0.60	2SC2312	£3.15	BC109	£0.14	BFV51	£0.25
2SA733	£0.13	2SC1674	£0.16	2SC2314	£0.30	BC141	£0.05	MRF237	£3.39
2SA966	£0.26	2SC1676	£0.14	2SC2320	£0.10	BC142	£0.19	MRF238	£13.64
2SA990	£0.10	2SC1678	£0.80	2SC2395	£16.20	BC182	£0.08	MRF450	£13.50
2SA1012	£0.09	2SC1815	£0.10	2SC2539	£10.82	BC184	£0.10	MRF450A	£13.80
2SA1015	£0.11	2SC1909	£0.08	2SC3030	£12.90	BC212	£0.08	MRF454	£22.84
2SB525	£0.25	2SC1945	£2.61	2SD274	£0.48	BC214	£0.08	MRF455	£23.05
2SC280	£0.09	2SC1946	£12.37	2SD235	£0.41	BC238	£0.05	TIP29C	£0.28
2SC495	£0.35	2SC1947	£4.29	2SD313	£0.56	BC639	£0.12	TIP30C	£0.29
2BC336	£0.10	2SC1957	£0.06	2SD325	£0.43	BC649	£0.13	TIP31C	£0.27
2SC710	£0.11	2SC1969	£1.58	2SD330	£0.48	BD131	£0.42	TIP32C	£0.33
2SC711	£0.09	2SC1970	£1.52	2SD360	£4.28	BD132	£0.32	TIP41C	£0.35
2SC730	£3.83	2SC1971	£2.95	2SD471	£0.29	BD135	£0.09	TIP42C	£0.38
2SC828	£0.09	2SC1972	£1.25	2SD837	£0.71	BD139	£0.08	TIP120	£0.38
2SC900	£0.27	2SC1973	£0.51	2SD860	£0.41	BD140	£0.25		
2BC830	£0.17	2SC2002	£0.25	2SK192	£0.23	BD201	£0.33		

BOOKS

Screwdrivers Guide to CB	£5.00	Active Filter Boards	
PLL Data Book	£5.00	A 10 695MHz active filter specifically designed for the HAM	
Cybernet Service Manual	£3.00	International and NATO 2000 type CBs. This board	
Uniden Service Manual	£3.00	significantly reduces image reception and cross modulation	
		without affecting sensitivity.	Price £8.90

Crystal Filter

This is a 10 695MHz 1.1kHz 10kHz bandwidth crystal filter suitable for most FM CBs. The filter greatly reduces cross modulation (bleedover) and is extremely easy to fit. Price £2.39

Integrated Circuits

7805	£0.40	HA1377	£1.90	LC7120	£2.75	RC6568	£0.55	TDA1010	£1.15
7808	£0.38	HA1368	£2.01	LC7130	£3.28	S042	£2.80	TDA1011	£1.37
7812	£0.39	HA1392	£2.54	LC7131	£3.21	TA7061	£0.76	TDA1020	£2.28
7815	£0.37	HA1394	£2.72	LC7132	£2.89	TA7120	£0.48	TDA1510	£3.99
7818	£0.09	HA1397	£2.55	LC7137	£2.77	TA7130	£0.53	TDA1812	£3.12
AN240	£1.28	HA1398	£2.00	LM324	£0.45	TA7204	£0.99	TDA2002	£0.74
AN6551	£0.73	LA1230	£1.19	LM396	£1.18	TA7205	£0.91	TDA2004	£1.81
AN7131	£1.37	LA4102	£0.84	MS1102	£1.85	TA7217	£1.22	TDA2005	£1.65
AN7140	£1.05	LA4112	£0.94	MS1513	£1.86	TA7222	£1.22	TDA2020	£1.81
AN7178	£2.95	LA4140	£0.89	MS1515	£1.94	TA7227	£2.08	TDA2030	£1.30
BA402	£0.59	LA4201	£1.81	MS1517	£1.84	TA7240	£2.08	TDA2611	£0.79
BA521	£1.55	LA4420	£1.41	MS3712	£0.09	TA7241	£1.96	UPC1028	£0.95
BA656	£1.19	LA4250	£2.23	MB3730	£2.08	TA7270	£1.93	UPC1032	£0.73
CD4001	£0.28	LA4400	£2.58	MB3756	£1.94	TA7271	£1.93	UPC1156	£2.05
CD4008	£0.89	LA4420	£1.32	MB8719	£0.42	TA7274	£1.98	UPC1181	£0.91
CD4011	£0.11	LA4422	£1.13	MC1723	£0.46	TA7310	£0.66	UPC1182	£1.04
CD4048	£0.09	LA4440	£1.89	MC3357	£2.11	TA7502	£0.99	UPC1185	£1.81
CD4068	£0.34	LA4445	£1.90	MC3359	£2.29	TA8201	£1.36	UPC1186	£0.71
CD4069	£0.18	LA4460	£1.71	MM55108N	£3.00	TB8410T	£0.49	UPC1230	£1.80
HA13001	£2.16	LA4461	£1.71	MS567	£0.52	TC9108	£8.60	UPD0856	£1.65
HA1366W	£1.33	LB1405	£0.97	PLL02	£7.98	TC9109	£4.38	UPD2816	£3.34

We have listed only a small proportion of our stock. Please feel free to contact us with your requirements. All prices are quoted at the one off prices. Discounts being available for quantities of ten or more of any one device. Same day despatch on all items in stock. Cheque/Postal order with order. Please add 75p postage and packaging on all orders under £10.00. All prices are exclusive of VAT.

All mail order to: 55 Stratford Road, EDINBURGH, EH11 1PB. Cashiers Welcome. TEL: 031 337 8950/031 337 2446.

DCP INTERFACING MODULES

Martin Tame has been putting his micros to work with the new interfacing modules from DCP

Regular readers of ETI will have noticed the frequent appearance in the magazine over the last year or so of an advertisement for the special offer of interfacing modules from DCP Microdevelopments for the BBC micro and Spectrum — the Interbeeb and Interspec.

Now DCP has released a complete new series of 'Interpack' modules which can be used with a whole range of micros. The new modules use a clever system of standard interface units with 'InterCard' personality modules to link them to specific micros. At present the InterCard range covers six popular micro ranges:

- Spectrum and ZX81
- BBC micro/Master
- Commodore 64/128
- Apple II/IIe/IIIGS
- Amstrad CPC464/664/6128
- IBM PC/XT

There is also an InterCard for the Scorpion micro-controller and one to adapt one Interpack unit to be added to another.

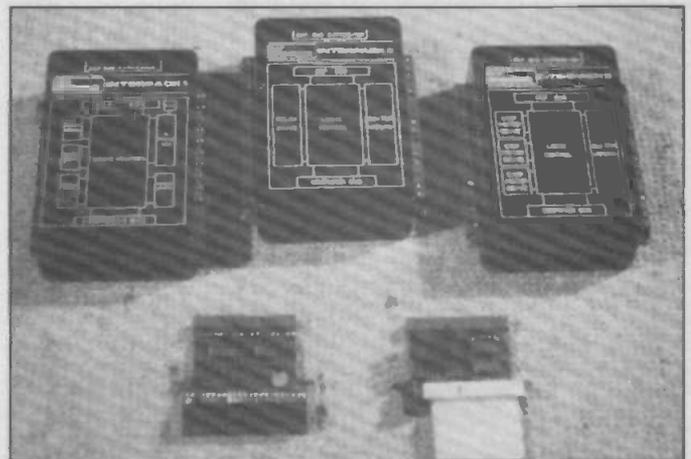
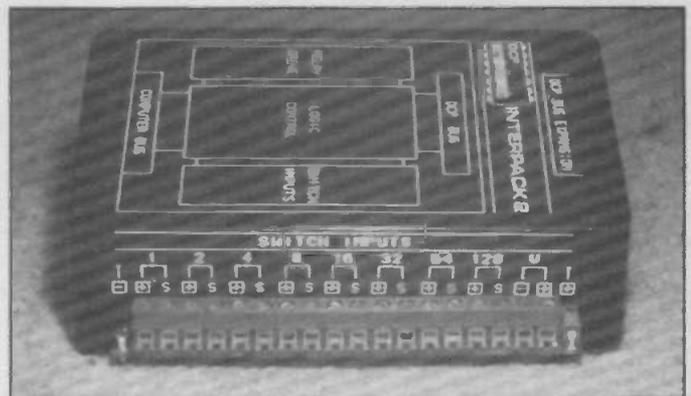
For most ETI readers the two most important and popular InterCards are those for the Spectrum and BBC micro. A Spectrum system derives all its power from the Spectrum's power supply and simply plugs onto the Spectrum's rear edge connector. The BBC micro InterCard includes a mains adaptor to provide the 9V supply and connects to the 1MHz bus.

For long strings of modules or systems which will consume a lot of power, a 'Powerbus' card is available to connect into the DCP bus line with its own mains adaptor and regulator to provide extra boost for the +5V and +9V bus lines.

The necessary InterCard board fits inside the chosen Interpack unit to form a solid single unit to plug into your micro as though it was built specifically for your machine. The new modules also have the same 'DCP Bus' to connect further units — either fast ADC or DAC modules available for the old modules, or units of your own make.

The DCP bus system is organised so that the main Interpack has three locations allocated to it, either memory mapped or I/O port locations depending on the host micro. This allows the interpack units to have up to 24 output bits and 24 input bits.

Full information is provided in the Interpack and InterCard manuals as to how to write simple programs to read and write data to these locations. It really couldn't be simpler. A further two locations are provided on the DCP bus for add-on units. Two address lines, a read and write line are available on the bus along with the micro's



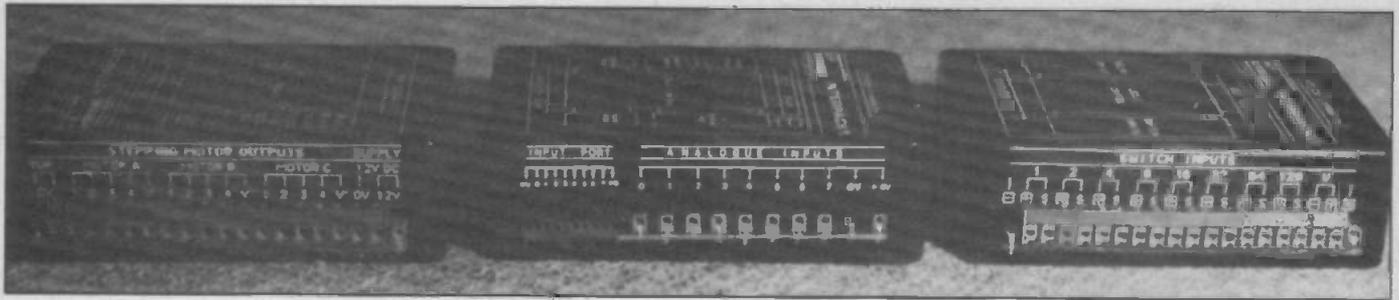
data lines and the +9V and +5V powers supply lines to allow two input and two output ports.

To make full use of these — to allow more than one unit to be connected — an 'Invertabus' unit is available with sockets for two ADC and two DAC units or your home-made equivalents.

Interpack 1

The three new modules on which the whole DCP interface range is now based are called Interpack 1, 2 and 3. Interpack 1 provides basic digital and analogue inputs and outputs. One 8-bit input port and one 8-bit output port are provided for TTL signal interfacing. These are simple buffers to the data bus with Molex connectors for connection of external circuitry.

A further 4-bit input port is configured for use with



any kind of switch, light dependent resistors or the like. The switch inputs consist of a quad buffer chip with pull-down resistors and a common positive line for switching individual inputs. The Interpack 1 also has four relay-isolated outputs. The relay contacts are rated at 24V at 1A. A little unfortunately, one contact of each relay's single pole switch is connected to a single common terminal for all four relay outputs. This restricts their flexibility somewhat.

As if that wasn't enough there is also an analogue to digital converter crammed into this 4.5x3x1in box. Eight analogue input channels are provided, each capable of 8-bit resolution of a 2.45V input with a 10ms conversion time. As such, the Interpack 1 has the same facilities as the old Interspec and Interbeeb, but without the relevant micro interfacing and decoding, of course.

Interpack 2

The Interpack 2 unit is less sophisticated than Interpack 1. This module contains just switch inputs and relay outputs.

The eight switch inputs are pulled low with resistors and must be taken high via switches to register.

The six relay outputs this time have all three terminals of each relay's single pole, double throw switch accessible. The power supply lines are also provided. The contacts to both switch inputs and relay outputs are small screw terminals so connecting up all manner of motors, lamps, switches and so forth is extremely simple.

Interpack 3

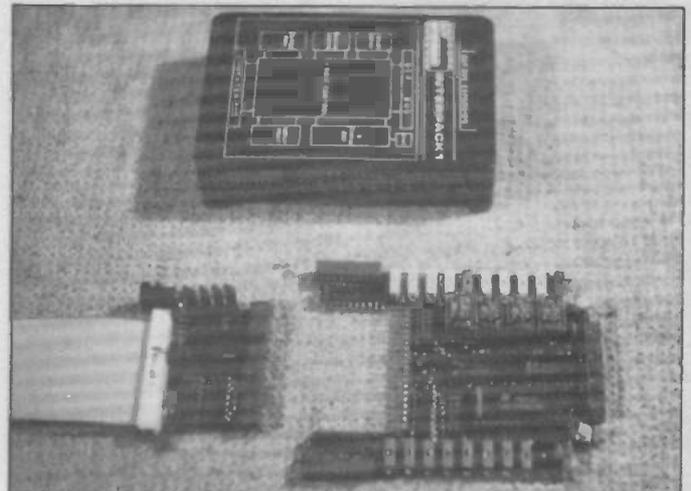
The Interpack 3 module is a new departure for DCP. This is a stepper motor driver. Three 12V stepper motors (of the ID35 type) can be controlled at a time. However, a regulated DC supply suitable for the motors must also be added to the interface and connected to it. The three stepper motor driver chips (SAA1027) inside the Interpack 3 are configured so that each time the relevant register is addressed, the corresponding motor turns through one step in the direction specified by the data written to the register.

This is a simple system to use and works well. Quite complex and effective motor control programs can be easily written in Basic. For real control of floor robots or robot arms, some kind of feedback is necessary. The Interpack 3 modules provides this with eight switch inputs similar to those in Interpack 2.

It really is quite easy to produce your own robot using this unit and have only some simple wiring to do. The old Interspec and Interbeeb modules provided easy interfacing for anyone wanting to dabble with electronics with the BBC micro or Spectrum. The new range has continued the flexibility and ease of use of the old modules while vastly increasing the range of micros which can be used and adding to the flexibility of the system.

For the occasional excursion into the world of micro-computer interfacing and control or for development work, these units are tremendously useful and cannot really be faulted.

ETI



Prices

Interpack 1	.....	£54.95
Interpack 2	.....	£44.95
Interpack 3	.....	£54.95

ZX Interpack	.....	£14.95
BBC micro Interpack	.....	£24.95
Commodore 64 Interpack	.....	£19.95
Apple II Interpack	.....	£29.95
Amstrad CPC Interpack	.....	£19.95
IBM PC Interpack	.....	£29.95
Scorpion Interpack	.....	£29.95

DCP Bus Interpack	.....	£14.95
Powerbus Card	.....	£19.95
Invertabus Card	.....	£4.95

DCP Microdevelopments, 2 Station Close,
Lingwood, Norwich NR13 4AX. Tel: (0603) 712482.

SMART TALKER

Russel Vowles has produced a speech synthesiser that will work with almost any micro and is intelligent into the bargain.

Most speech synthesisers use allophone coding of the words to be spoken. This requires the user to convert the words into their phonetic equivalent and then match up each sound of the word with a sound that can be 'spoken' by the synthesiser.

This is obviously a tedious process which, of course, like most tedious processes, is ideally done by a computer. Some speech synthesisers are manufactured to use a text-to-allophone program which requires a large amount of software resident on the host computer. This software of course differs from one computer to another due to incompatibility of programming languages.

In addition, most of the speech synthesiser designs already published connect to the host computer's data and address buses via an interface circuit which also has to vary due to major differences in the allocation of memory space and types of microprocessor found in different computers.

This design has few incompatibility problems compared to earlier designs and yet has a built-in text-to-speech algorithm allowing English words to be spoken directly (Fig. 1).

The speech synthesiser can be used with virtually all computers that incorporate a serial (RS232 or RS423) output. This includes the majority of computers now available.

Here I have concentrated on using the synthesiser with the Amstrad PC1512 (IBM PC compatible) and BBC micro but this should not deter you from connecting the synthesiser to other computers.

All this has been made possible by the introduction of a new IC from General Instruments called the CTS256-AL2. This is a masked programmed version of the PIC7041 microcomputer programmed with the text-to-speech algorithm and designed to interface directly with an SPO256-AL2. This is the speech synthesis IC used in most speech

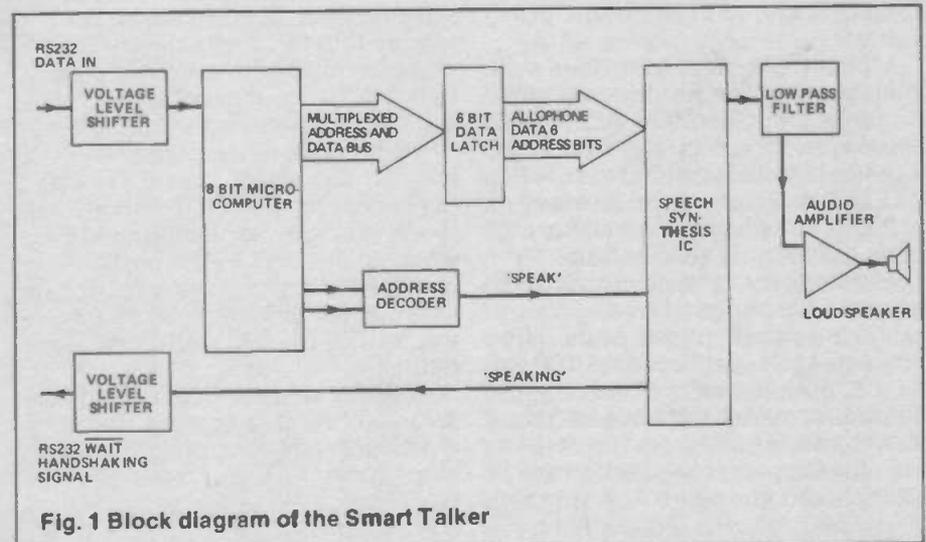
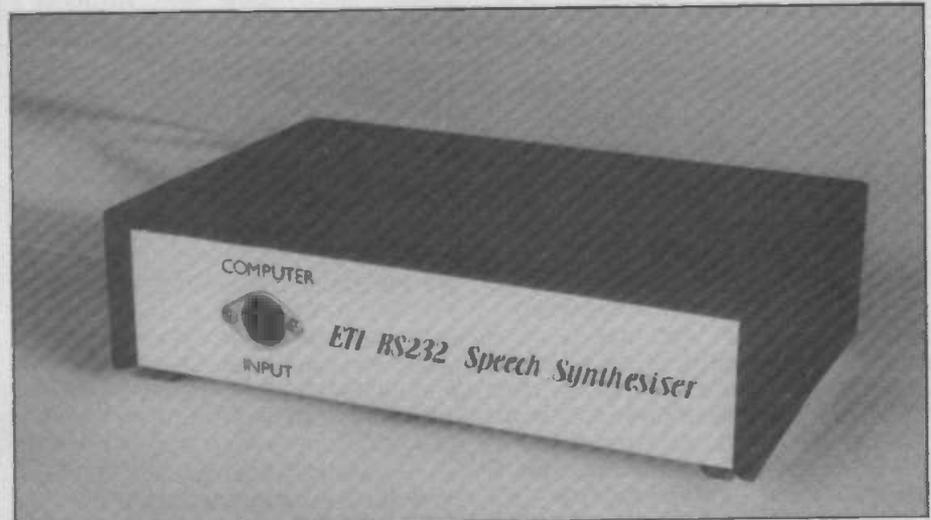


Fig. 1 Block diagram of the Smart Talker

synthesiser designs based on the allophone (phonetic) method of speech generation.

As the CTS256-AL2 is a relatively new device and probably not familiar to most readers, a more complete technical description of the device is in order.

CTS256-AL2

The CTS256-AL2 (Fig. 2) is capable of receiving characters which make up the word to be spoken from a serial RS232 interface or from a parallel 8-bit interface. The characters are simply sent to the CTS256-AL2 in ASCII format followed by a space or carriage return character to

signify the end of the word and to tell the CTS256-AL2 to send allophone data to the SPO256-AL2 speech synthesis IC to be spoken.

The text-to-speech algorithm built into the CTS256-AL2 was developed by General Instruments following research by the United States Navy. So, the complete circuit talks with an American accent and not with precision of the Queen's English! However, this can be overcome by spelling a few words wrong but phonetically correct.

Text is converted to allophones using the algorithm to look at each letter of the word to be spoken and then letters to the left and right. The combination of

these three characters is analysed using a letter context-to-sound table and the appropriate allophone code is then stored ready to be sent to the SPO256-AL2.

This process is repeated for every letter in the word producing a string of codes. However, certain combinations of characters are treated differently to account for some of the words which are the exception to the normal rules of English.

The algorithm also interprets a few characters as being whole words. These characters are %, #, \$ and they represent the words, *percent, number, dollars*. The numbers 0 to 9 are also correctly spoken by sending a single digit to the CTS256-AL2.

As each character of the word is received, it is stored in an internal input buffer. Then, when a delimiter such as a space, punctuation mark or carriage return is received, the contents of the input buffer is processed by the IC using the text to speech algorithm. The resulting allophone codes are stored in an output buffer.

If the INT1 input (pin 13) is low, then the first allophone code is output to the SPO256-AL2. The allophone code is output from the IC as part of a 15-bit address. The CTS256-AL2 outputs an address of 2000 (hexadecimal) plus the code number of the allophone. This means that a code is output when A13 is high and A0 to A5 represent the allophone code. The first eight bits of this address A0 to A7 are multiplexed with the microcontroller's data bus and so must be separated from the data bus. An address is present on the multiplexed bus when ALA (pin 38) is low.

Shortly after ALA has gone low the ENABLE signal (pin 39) also goes low to indicate that there is a valid address on the address bus. This process for outputting an allophone code is repeated each time INT1 goes low or until the output buffer is empty.

If either the input buffer or the output buffer become full, data could be lost or, worse still, the program which is running within the CTS256-AL2 can crash. If the input or output buffer does become almost full, the BUSY output changes from low to high, warning that the buffers should be emptied.

The CTS256-AL2 can be initialised by taking the RESET signal (pin 14 IC3) low. This

PIN	MODE	BAUD RATE
6 7 8		
0 0 0	parallel input	—
0 0 1	serial	50
0 1 0	serial	110
0 1 1	serial	300
1 0 0	serial	1200
1 0 1	serial	2400
1 1 0	serial	4800
1 1 1	serial	9600

Table 1 Selecting the data input mode of the CTS256-AL1

causes all buffers and registers to be cleared followed by execution of the internal program. The program starts by outputting the allophones to speak 'OK'. This is to show the user that the program is ready to accept characters for processing.

Selection of parallel/serial data input mode is performed using pins 6, 7 and 8. These also select the serial input baud rate that will be used by the IC's internal UART according to Table 1.

If parallel data input mode is selected, an external data latch must be provided at address 200 hexadecimal. The data must be loaded into this latch and then a negative going strobe pulse given to the INT3 input (pin 12) to transfer data into the input buffer.

When one of the serial input modes is selected, the serial data at the correct baud rate and at TTL levels is simply applied to pin 16 which is the DATA IN input.

Pin 9 allows for the selection of default or program-selected UART values. For most applications the default UART values should be used. This sets the UART to adopt an asynchronous communication mode with eight data bits and one stop bit and no parity. Default UART values are selected by connecting pin 9 to 0V.

By connecting pin 9 to 5V, various UART modes are possible using programmed values but these must be stored in an external EPROM.

Pin 10 is used to select buffers for input and output that are external to the CTS256-AL2. External buffers can be up to 2K in size, allowing whole pages of text to be sent to the CTS256-AL2 at once. However, an extra RAM IC and address decoding circuitry must be added.

The internal buffers are much smaller (20 bytes for input and 26 bytes for output) but this allows for most English words. However, the host computer must wait while the word is spoken before sending more data or the buffer will

overflow causing the BUSY output to go low.

If pin 11 is tied to OV, a carriage return is the only delimiter used to initiate speaking. For this mode the Input buffer must be capable of storing a whole line of text input. Since the internal input buffer can only hold 20 characters, this mode is only practical when external buffers are used. So pin 11 is connected to +5V allowing punctuation marks, spaces and carriage returns to initiate speaking.

Other advanced features of the CTS256-AL2 are its ability to run user programs written in TMS7001 assembly language and to allow users to modify the pronunciation of certain words which are not spoken very well, using the text-to-speech algorithm. Both these features, however, require extra circuitry and quite a large amount of software on EPROM.

For more information on the CTS256-AL2 refer to the General Instruments data sheet on the device. Alternatively, some information is given in the 1987 edition of the *Semiconductor Reference Guide* available from Tandy shops.

Construction

The synthesiser can be built with or without its own power supply. The power requirements of the synthesiser are +5V to +15V at 20mA, -5 to -15V at 20mA and a 0V connection. If your computer cannot supply the synthesiser with these voltages and currents then

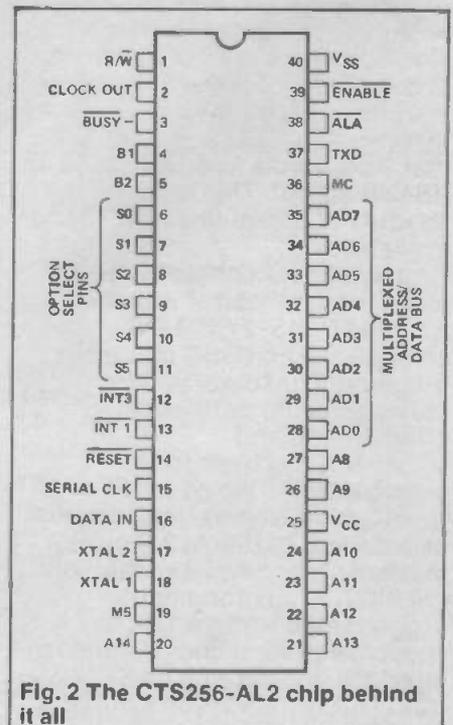


Fig. 2 The CTS256-AL2 chip behind it all

the optional power supply components will have to be added to the unit.

If the computer's power supply is to be used then the +5V and 0V connections should be made with wires capable of carrying a current of a few amps (such as 3A 16/0.2mm wire) and should not be too long, to prevent large voltage drops in the 5V supply which could lead to intermittent operation of the circuitry.

The low current positive and negative supplies do not require any special precautions when connecting them but you must ensure that both supplies are well smoothed.

The synthesiser can be connected to the BBC micro using the auxiliary power output on the underside of the micro as shown in Fig. 4.

With other machines (such as IBM PC compatibles) the power supply components will probably be needed as there is no convenient way of obtaining

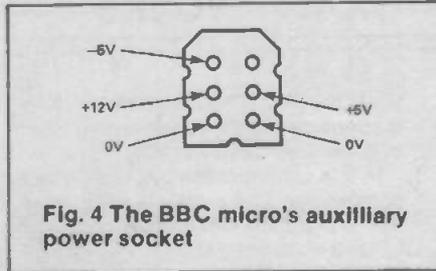


Fig. 4 The BBC micro's auxiliary power socket

power from the micro.

Construction should be started by soldering components onto the PCB according to the component overlay diagram Fig. 5 in the order: wire links, IC sockets, resistors, capacitors, followed by all the semiconductors and XTAL1.

Take special note of the orientation of the electrolytic capacitors, IC1, BR1 and the zener diodes. Care should also be taken when fitting XTAL1 onto the board. The leads to this device should not be cut too short or bent close to the case and the minimum of heat should be used when

soldering the crystal to the PCB. Excessive heat can easily cause damage to the crystal.

If the power supply components are used, IC1 will require a small heatsink which can be made from a rectangular piece of aluminium 30 x 20mm. This is then bolted to the PCB and IC1 as shown in the overlay diagram.

The RS232 interface and loudspeaker connections are made with any thin stranded wire that is to hand. The RS232 connections were taken to a chassis mounted 3-pin DIN sockets on the case of the prototype. However, constructors may prefer to terminate the RS232 connectors using another connector to suit the host computer.

If the power supply components are not used, power to the board must come from the host computer and is connected to the points marked A, B, C and D on the overlay as follows:
A -10V (between -5V and -15V)
B +10V (between +5V and +15V)
C 0V
D +5V

After all components and wires have been soldered onto the board it should be cleaned to remove all flux residue, especially around the connections to XTAL1. Do not use solvents that will leave a residue and take care not to contaminate CV1 or RV1.

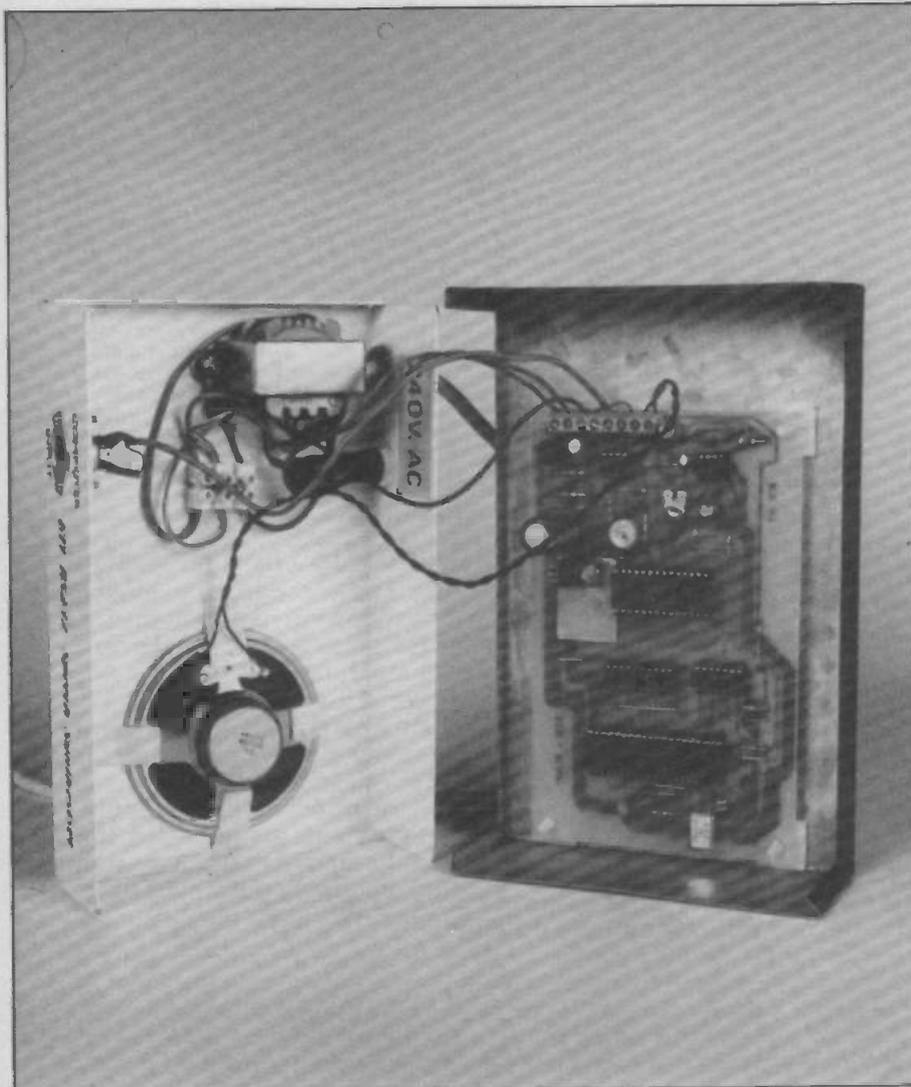
The board should now be carefully checked for solder blobs bridging tracks, incorrect component orientation and dry joints. If all is well, the ICs can be plugged into their sockets. IC3 and IC5 are MOS devices and should not be handled too much as static electricity can damage them.

After double checking that all components, links and wires have been inserted correctly the board should be ready for testing.

Testing

The initial stages of testing can be carried out without connecting the synthesiser to the host computer's serial interface. Set RV1 to mid position and switch on. It should immediately say 'OK'. If this happens the unit should be turned off and the RS232 connections to the computer can be made. The synthesiser operation can then be tested further by sending a few characters to the board and verifying that they are spoken correctly (see below).

If you have been unlucky and



HOW IT WORKS

The complete circuit is split into two main sections — the optional power supply and the speech synthesis section.

The circuit diagram for the power supply is shown in Fig. 3(a). The mains voltage is stepped down by the transformer T1 to give 24V AC centre tapped. This is full wave rectified by BR1 to give outputs from BR1 of approximately +15.7V and -15.7V with respect to 0V. The positive supply from BR1 is smoothed by C2 and then passed to two voltage regulators.

The first regulator provides the +10V supply needed for the RS232 circuitry and is comprised of R1 and the zener diode ZD2. The second regulator (IC1) is used to provide a stable +5V supply to the synthesiser section of the circuit.

The unregulated negative supply from BR1 is smoothed by capacitor C1 and regulated using R2 and zener ZD1 to provide the -10V supply needed by the RS232 interface.

The circuit diagram of the speech synthesis section is shown in Fig. 3(b).

R3, ZD3 and IC2a provide the necessary attenuation and inversion of the RS232 data input signal. The input at R3 could be any voltage from +30V to -30V and this needs to be converted to the +5V to 0V TTL levels. R3 limits the current flowing through ZD3, which ensures that the voltage input to IC2a is never greater than 4.7V or less than 0V.

The output from IC2a is RS232 data at TTL levels and is fed to the data input of IC3. Although this RS232 interface circuitry is a little unconventional (an MC1489 RS232 receiver IC is usually used) and does not provide a great amount of noise immunity, it has proved reliable in operation with lengths of cable over one metre.

The RS232 compatible WAIT signal from the circuit is generated by the SBY output of IC5. The SBY output is normally high (+5V) but goes low (0V)

when the SPO256-AL2 is 'talking'. SBY is connected to the non-inverting input of operational amplifier IC6.

In this configuration IC6 is used as a comparator. The output is +10V when SBY is high (this tells the host computer to send more data) and -10V when SBY is low, telling the host computer to stop sending data as the SPO256-AL2 is talking.

The output of IC6 does incorporate short circuit protection to 0V but can still be damaged if its output is accidentally connected to a voltage other than ground which could easily occur when experimenting with connections to the host computer's RS232 port. The inclusion of R10 limits any current flowing in or out of this output and prevents damage to IC6.

The clock for the CTS256-AL2 microcomputer (IC3) is generated using XTAL1 with C4 and C5 providing the capacitive loading required by the crystal. It may be tempting to replace the 10MHz crystal with one of lower cost (6.144MHz). IC3 would then still operate correctly (albeit at lower speed) but the baud rate for RS232 communication would be wrong and so a 10MHz crystal must be used.

Power-on reset for IC3 and IC5 is provided by C7 and R5. A reset condition is also caused if the BUSY output (pin 3, IC3) should go low, indicating that the input buffer is full. This is to prevent the program within IC3 from crashing if the host computer sends too many characters to IC3 before speech has started. R4 limits the current from BUSY into C7.

Decoding of A13 and the ENABLE signals from IC3 are provided by IC2b and IC2c. This circuitry ensure an allophone code is only loaded into IC5 when A13 is high (when an address of &2000 + the allophone code is being output) and the ENABLE output is low, implying that the address is a valid one. When both these conditions are met, the output from IC2c goes low. This negative pulse on the address load (ALD) pin of IC5 causes an allophone

code to be loaded and speech to start.

Allophone codes are transferred from IC3 to IC5 via the address latch. This 74LS373 latch separates the first six address lines (A0-A5) from the multiplexed address/data bus (ADO-AD5). A new address is latched onto the outputs of IC4 each time pin 38 of IC3 (ALA) goes low.

The clock generation circuitry used for the SPO256-AL2 (IC5) is a little unusual. A 3.12MHz crystal with loading capacitors is usually used, being connected between pins 27 and 28. However, use of a 3.12MHz crystal does not allow the user to vary the pitch of the speech and can be expensive as 3.12MHz crystals are not common.

The design shown allows the user to vary the pitch of speech by altering the value of CV1 which is part of the resonating circuit formed by L1, C9 and CV1. The resonant frequency of this arrangement is given by the equation:

$$f = \frac{1}{2\pi L1 \left(\frac{CV1 + C9}{CV1 \times C9} \right)}$$

This arrangement can often be used when a low cost variable alternative to a quartz crystal is needed.

The speech output from IC5 is in digital pulse width modulated form which is low pass filtered by R8, C10, R9 and C11 to give an analogue voltage across RV1 (used as a volume control). The voltage on the wiper of RV1 is passed via DC blocking capacitor C12 to the input of IC7.

IC7 is an LM386 audio amplifier. Capacitor C18 is used to prevent DC current from flowing through LS1. C15 sets the gain of IC7 to around 46dB. C14, C16 and R11 ensure stability of the amplifier circuit. Capacitor C13 was added to improve the sound quality from a low cost miniature loudspeaker and may not be necessary if a good quality speaker is used.

Power supply decoupling is provided by C6, C8 and C17.

the unit does not reassure you by saying 'OK' then immediately switch off the unit. A good mug of tea or stronger brew is recommended at this point to calm the nerves!

The ICs should be removed from their sockets and the operation of the power supply checked (if used) using a volt meter to check the voltages across C6, ZD2 and ZD3 which should be +5V, +10V and -10V respectively. If these are incorrect, check that all the power supply components have been mounted on the board correctly and make any changes necessary.

Once the power supply is in order check that all the IC sockets have power on the correct pins

and then re-check all connections. With the power off, plug the ICs back into their sockets and start testing the unit again. If the unit still does not work then a damaged IC should be suspected, especially if the power supply was faulty.

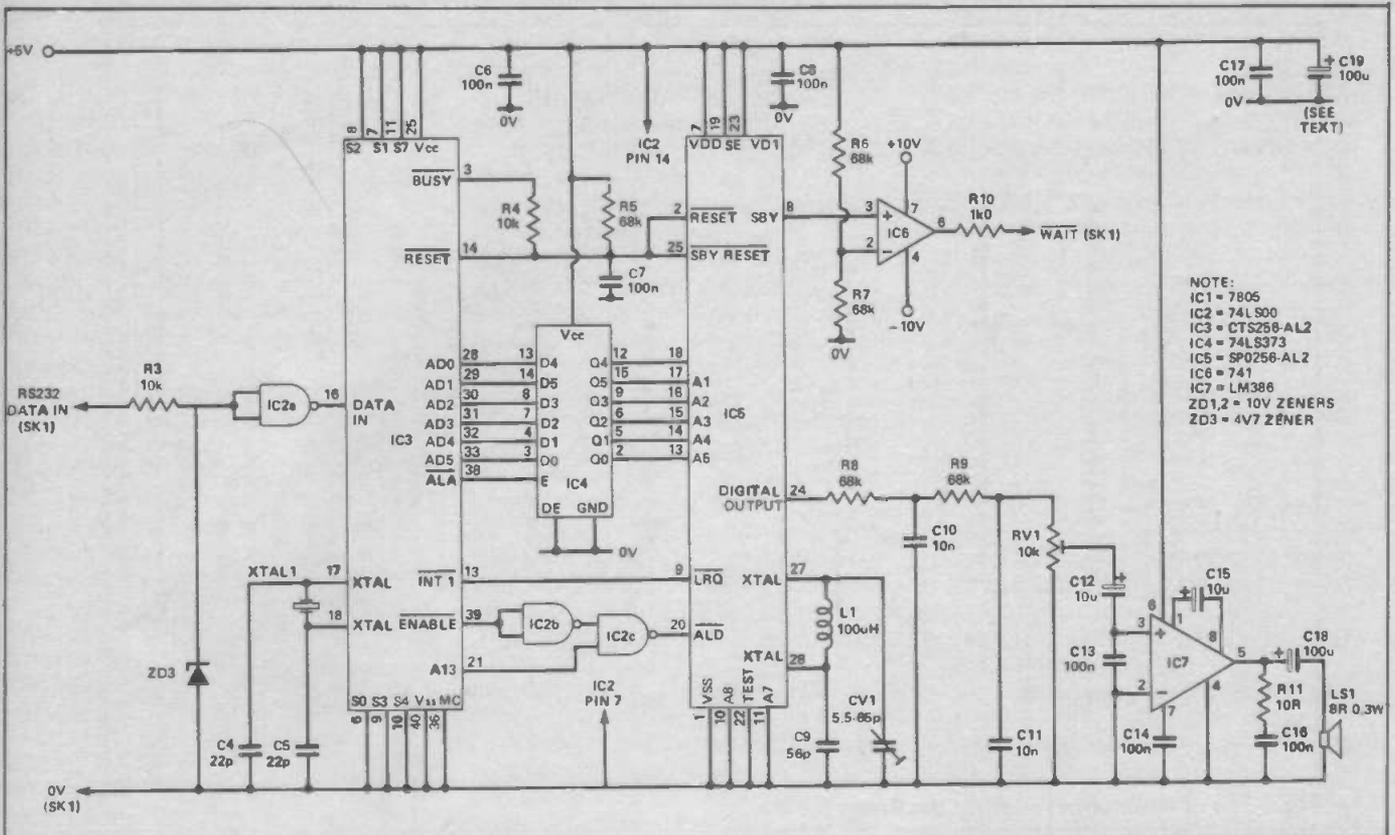
After testing has been completed the pitch of speech and the volume can be set with CV1 and RV1. The board can then be fixed into the box using the four mounting holes on the board. The prototype board was fitted to the lid of the box with self adhesive board mounts with the speaker mounted on the base which was drilled with a series of holes for the speaker. The base of the box was then fitted with adhesive rubber feet.

Using The Synthesiser

The host computer must meet the following requirements:

- RS232 or RS423 serial port
- baud rate set to 300
- serial port configured for eight data bits, one stop bit, no parity
- ability to send text characters to the serial port
- if the optional power supply components are not fitted, the computer must be able to supply the necessary power lines.

The connections to the computer's RS232 port are straightforward but some experimentation may be required to determine whether the WAIT line from the speech synthesiser



NOTE:
 IC1 = 7805
 IC2 = 74LS00
 IC3 = CTS256-AL2
 IC4 = 74LS373
 IC5 = SP0256-AL2
 IC6 = 741
 IC7 = LM388
 ZD1,2 = 10V ZENERS
 ZD3 = 4V7 ZENER

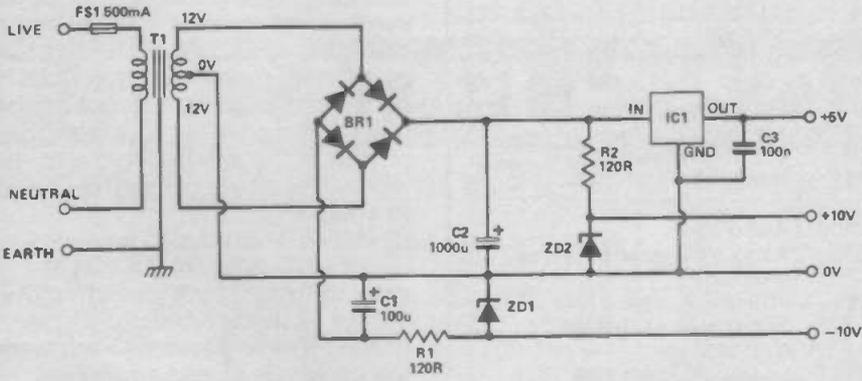


Fig. 3 The circuit diagram of the Smart Talker

should be connected to CTS or DCD and DSR on the host computer.

Details for connection of the synthesiser to the BBC micro's RS423 port are shown in Fig. 6a. Connection is made via a 5-pin 'domino' DIN plug which can unfortunately be inserted either way up. This connector should be inserted with care as plugging it in the wrong way round will prevent the synthesiser from working.

Connection to the Amstrad PC1512 or other PC compatible is made via a 25-pin 'D' socket, details of which are shown in Fig. 6b.

Software

Most computers will require very little software to use the synthesiser. The basic functions of the software are to:

- initialise the computer's serial port to transmit at 300 baud with eight data bits, one stop bit and with no parity.
- set the serial port as the output device rather than the screen or parallel printer. This can often be achieved by setting the computer to use a serial printer and then treating the speech synthesiser as a pseudo printer.
- ensure the synthesiser is not overrun with data.

Even with the hand shaking provided, it is still possible to fill the input buffer by sending more

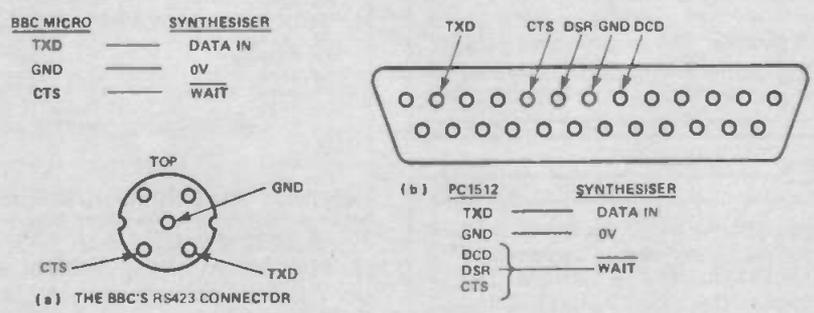


Fig. 6 Connecting the speech synthesiser to (a) the BBC micro and (b) the Amstrad PC1512

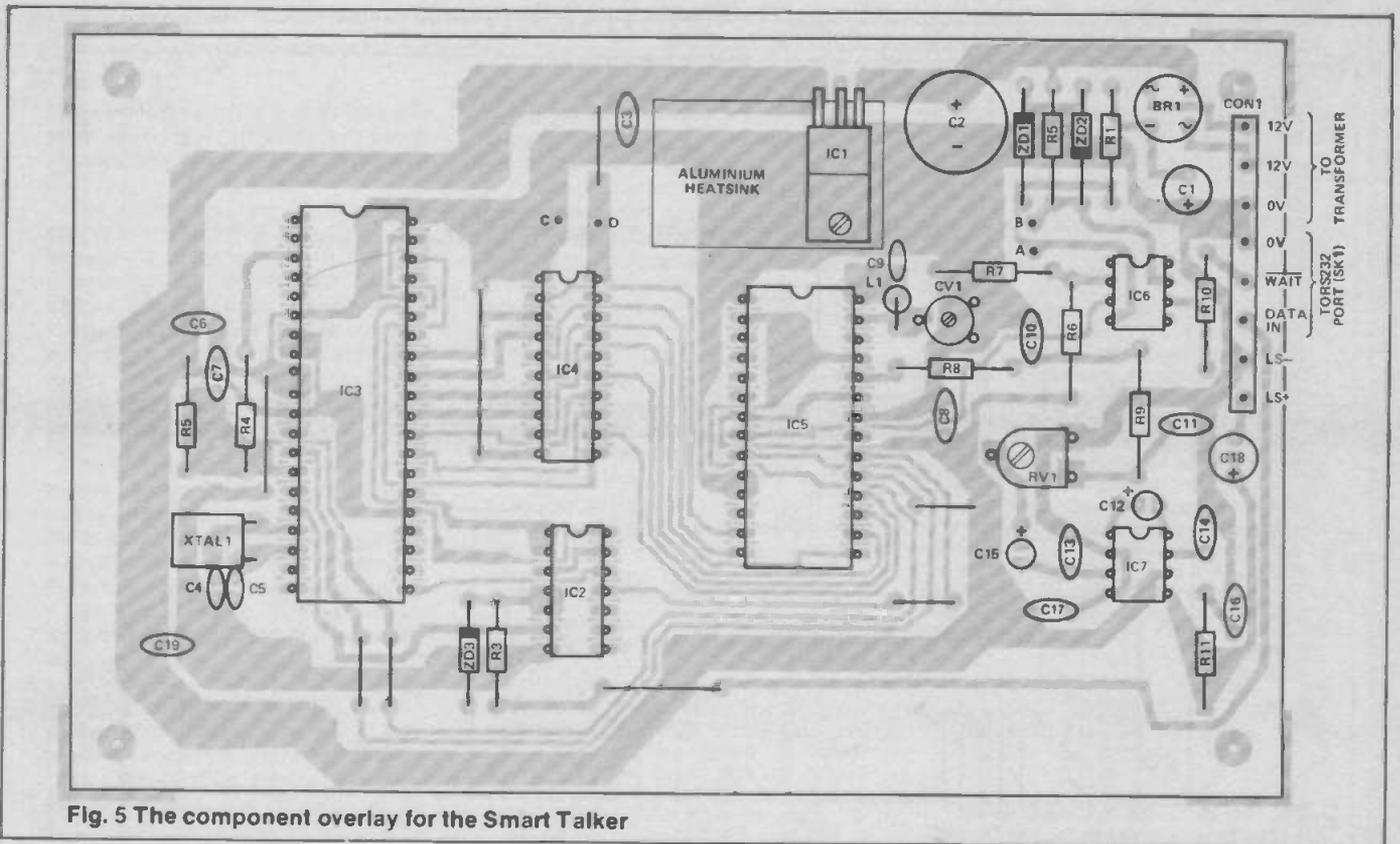


Fig. 5 The component overlay for the Smart Talker

PARTS LIST

RESISTORS (all 1/4W 5% unless otherwise stated)

- *R1, 2 120R
- R3, 4 10k
- R5-9 68k
- R10 1k
- R11 10R
- RV1 10k horizontal preset

CAPACITORS

- C1*, 18, 100µ 16V radial electrolytic
- 19
- C2* 1000µ 16V radial electrolytic
- C9 56p ceramic
- C3*, C6, 100n ceramic
- 8, 13, 14, 16, 17
- C4, 5 22p ceramic
- C10, 11 10n ceramic
- C12, 15 10µ 16V radial electrolytic
- CV1 55-65p trimmer

SEMICONDUCTORS

- IC1* 7805
- IC2 74LS00

- IC3 CTS256-AL2
- IC4 74LS373
- IC5 SP0256-AL2
- IC6 741
- IC7 LM386
- ZD1*, 2 10V 400mW zener
- ZD3 4V7 400mW zener
- BR1* W004

MISCELLANEOUS

- CON1 8 way PCB mounted screw terminal
- FS1* 500mA quick blow fuse
- L1 100µH choke (Siemens B78108S)
- LS1 Loudspeaker 8R 0.3W
- SK1 3 pin DIN socket
- T1* 12-0-12 250mA mains transformer
- XTAL1 10MHz crystal

PCB; case; connection wire; RS232 cable; nuts and bolts.

Items marked * are only required if the optional power supply circuitry is to be built.

BUYLINES

The box is available from Maplin (stock number LH38R) as is the transformer (stock number YN16S). The CTS256-AL2 (IC3) should be available from Tandy Stores. However, the author can supply the CTS256-AL2 for £17.00 and the PCB for £8.00.

A complete kit of parts excluding case but including the power supply components and PCB can also be

supplied by the author for £40.00. A kit excluding power supply components costs £37.50. Please include 75p postage and packing. Orders should be sent to Russel Vowles, 3 Orchard Way, Uxbridge, Middlesex, UB8 2BN.

The author will also endeavour to repair any board made to the layout shown for £6.00 plus parts.

than 19 characters without a delimiter. Doing this will cause the synthesiser to reset itself and say 'OK'. If for example, a word of 13 characters is sent and this word is converted to 26 allophones by the text to speech algorithm, the output buffer will be filled and, at worst, this could cause the system to crash.

Users should also be aware that if large amounts of text are sent, there will be times when the output buffer is nearly full. The easiest way to prevent overrun of the buffers is to add small time delays before sending each word to the synthesiser.

```

10 REM BBC MICRO SPEECH
20 ON ERROR GOTO 100
30 *FX8,3
40 REPEAT
50 INPUT "ENTER A WORD*"; A$
60 *FX3,7
70 PRINT A$
80 *FX3,4
90 UNTIL FALSE
100 *FX3,4
110 IF ERR<>17 REPORT:PRINT " at line
";ERL
120 END

```

Listing 1 The BBC micro program

A simple program to demonstrate the synthesiser with the BBC micro is shown in Listing 1. The transmit baud rate for the RS423 port is set to 300 baud using the command *FX8,3. The command *FX3,7 tells the computer to send any output from PRINT commands to the RS423 port rather than the screen. Output

can be returned to the screen using the command *FX3,4.

When using the synthesiser with the PC1512 it should be noted that different software packages use different hand shaking protocols. For example, MS-DOS has a time-out condition which prevents the use of the synthesiser because it receives its data too slowly. However, DOS Plus is also supplied with the PC1512 and uses the serial port without any time-out condition.

Use of the synthesiser under DOS Plus V1.2 is simplicity itself using the copying command PIP. To use this command, the file PIP-CMD must first be copied from DISK 4 (which was supplied with the computer) onto a bootable formatted DOS Plus work disk.

Execute the NVR program supplied on DISK 3 with the Amstrad and select the **STANDARD RS232 PARAMETERS** option. Set the BAUD RATE to 300, PARITY to NONE, DATA BITS to 8 and STOP BITS to 1. Press escape twice to bring up the EXIT MENU, then press the carriage return key twice to **SAVE THESE ALTERATIONS**

TO NVR and EXIT TO DOS. The computer must now be re-booted by pressing CTRL, ALT and DEL to ensure that the new RS232 settings are used.

The computer can now send text to the synthesiser using the PIP command on the work disk. Entering the command PIP AUX:=CON: will allow anything typed at the keyboard (console) to be spoken. Small text files can also be spoken using the command PIP AUX: file name. The COPY command can also be used to carry out the above operations but text is sent a line at a time and so the synthesiser more likely to be overrun with data.

The synthesiser can be made more versatile if it is used with the programming language Basic2. When using Basic2 the synthesiser must be used as a pseudo printer. This is achieved by closing the current printer stream and then opening a printer stream as COM1 (the serial port). Any words that would normally be sent to the printer will now be sent to the speech synthesiser instead. The relevant commands are: CLOSE #0 — closes the current

printer stream which is by default stream #0, linked to the parallel printer port. OPEN #0 PRINT 4 — re-opens #0 as a printer stream. The number 4 tells the computer to link the printer stream to COM1. LPRINT "any text" — used in the usual way but text will be spoken instead of printed.

```
rem AMSTRAD PC1512 SPEECH
close #0
open #0 print 4
label again
input "ENTER WORD TO BE SPOKEN " :as
if a$="STOP" or a$="stop" then end
lprint a$
goto again
```

Listing 2 The Basic 2 program

The RS232 parameters must have been set up first with the NVR program as described above. An example Basic2 program is given in Listing 2.

The Speech Synthesiser can also be used with many other languages, operating systems and communications packages. Indeed it can be used with most modern microcomputers and readers are recommended to give it a go.

ETI

PINEAPPLE SOFTWARE

Programs for the BBC model 'B', B+, Master and Master Compact with disc drive

DIAGRAM II

Diagram II is a completely new version of Pineapple's popular 'Diagram' drawing software. The new version has a whole host of additional features which make it into the most powerful and yet quick to use drawing program available for the BBC micro. The new features mean that 'Diagram II' can now be used for all types of drawings, not just circuit diagrams. Scale drawings are possible and the facilities for producing circles and rubber banded lines together with the pixel drawing routines make any type of drawing possible. This advert has been produced completely using Diagram II.

Summary of Diagram II features:-

1. Works on all model BBC computers and makes use of Shadow memory if poss.
2. Rapid line drawing routines with automatic joins for circuit diagrams.
3. Rubber band line and circle drawing modes.
4. Makes use of the Acorn GXR rom to produce ellipses, arcs, chords and flood filling.
5. Pixel drawing mode allows very fine detail to be added.
6. Defined areas of screen may be moved, copied, deleted or saved to disc.
7. On-screen cursor position indication allows scale drawings to be made.
8. Keyboard keys may be defined to print User Defined Characters allowing new character sets to be used.
9. Wordprocessor files may be loaded and formatted into defined areas.
10. Up to 880 UDC's if shadow memory available, 381 without shadow.
11. Compatible with Marconi Trackerball and most makes of 'mouse'.
12. All 'Diagram Utilities' are included.
13. Completely 'scalable' print routines allow any area of the diagram to be printed either horizontally or through 90deg. in scales that may be varied in 1% steps allowing up to 18 mode 0 screens to be printed on an A4 sheet (still with readable text).
14. Smooth scrolling over the whole area of the diagram.

Diagram II consists of a set of disc files and a 16k Epron. The disc is formatted 40T side0 and 80T side2. Please state if this is unsuitable for your system, or if you require a 3.5" Compact disc

DIAGRAM II - £55 + vat P & P free

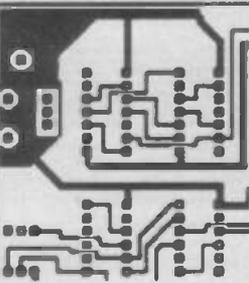
MARCONI TRACKERBALL

For Model 'B' and B+ (with Icon Armaster)	£ 60.00	+ vat
For Master 128 (with Pointer Rom)	£ 60.00	+ vat
Bare Trackerball (no software)	£ 49.00	+ vat
Pointer Rom (available separately)	£ 12.50	+ vat
Trackerball to mouse adapters	£ 8.00	+ vat
Postage and Packing on Trackerballs	£ 1.75	

All orders sent by return

PCB

Pineapple's now famous PCB drafting aid produces complex double sided PCB's very rapidly using any model BBC micro and any FX compatible dot-matrix printer. The program is supplied on Epron and uses a mode 1 screen to display the two sides of the board in red and blue either separately or superimposed. Component layout screens are also produced for a silk screen mask. The print routines allow a separate printout of each side of the board in an expanded definition high contrast 1:1 or 2:1 scale. The print time is typically about 5 mins. for a 1:1 print of a 7" x 5" board. This program has too many superb features to adequately describe here, so please write or phone for more details and sample printouts.



Price £85.00 + vat

PCB Plotter Driver

A new addition to the PCB software is the PCB plotter driver program. This enables files produced by PCB to be used in conjunction with most types of plotter to produce plotted output rather than the normal dot-matrix printer output. The program is suitable for use with most makes of plotter including Hewlett Packard, Hitachi and Plotmate M. The program can also be configured to work with other plotters by entering suitable plotter instructions. All the features of the printer driver are included, such as the automatic thinning down of tracks between rounds. Mirror image plots are also available.

PRICE £ 35.00 + vat

ADFS Utilities Rom

ADU is an invaluable utility for all ADFS users. It adds over 20 new commands to the ADFS filing system as well as providing an extensive Menu facility with over 35 sub commands covering areas such as repeated disc compaction, saving and loading Rom images, auto booting of files and many more.

Copying of DFS discs onto ADFS discs can be made in one pass with automatic creation of the required directories on the ADFS disc. All functions are fully compatible with Winchester drives including BACKUP which allows backing up of Winchester's onto multiple floppies. New commands are as follows:- *ADU, *BACKUP, *CATAL, *CHANGE, *DFSADFS, *DIRALL, *DIRCOPY, *DIRDESTROY, *DIRRENME, *DISCEDIT, *DRIVE, *FILEFIND, *FORMAT, *KILLADU, *LOCK, *MENU, *PURGE, *PURBK, *UNLOCK, *VERIFY, *VFORMAT

PRICE £ 29.00 + vat

MITEYSPICE — Powerful A.C. & D.C. circuit analyser package - £119.00 +vat with Graphics output. Send for more details

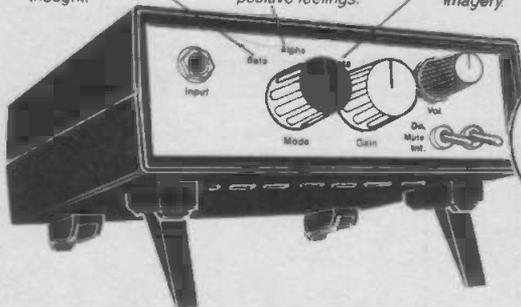
VISA

39 Brownlea Gardens, Seven Kings, Ilford, Essex IG3 9NL Tel 01-599 1476

Access

Brainwave monitor

- 1 BETA - Concentration, problem solving, active thought.
- 2 ALPHA - Relaxation, pleasure, tranquility, positive feelings.
- 3 THETA - Imagination, creativity, hypnagogic imagery.



BRAINWAVE MONITOR PARTS SET ONLY
£36.90
+ VAT

This unique project will allow you to hear your own brainwaves! Through a simple training program you can learn to control them and achieve peak performance in all situations. It will revolutionise your life!

The approved parts set contains: two PCBs; all components, including three PMI precision amplifiers; shielded box for screening the bio-amplifier, attractive instrument case with tilting feet; controls, switches, knobs, plugs, sockets; leads and brass electrodes, full instructions for assembly and use.

Parts are available separately. We also have a range of accessories, professional electrodes, books, etc. Please send a stamped, self-addressed envelope if you just want the lists. Otherwise, an SAE + £2 will bring you lists, construction details and further information.



THE ALPHA PLAN

Can you really train your mind to think more effectively? Can you really excel at things you're 'no good at'? The Alpha Plan has all the answers!
£2.50 (no VAT)



SILVER SOLUTION

Just wipe on with a cloth to plate PCB tracks, connectors, wire, component leads, coins or household ornaments with a layer of pure silver. It must be magic!
LARGE BOTTLE (150ml) **£11.20 + VAT!**

POWER CONDITIONER

As featured in ETI, January 1988. The approved parts set contains PCB, case, toroidal cores, class X and Y capacitors, VDRs, ICs, transistors, LEDs, all components, and full instructions.

Parts are available separately. Please send a stamped, self-addressed envelope if you want the lists. Otherwise, an SAE + £1 will bring you lists, construction details and further information.



POWER CONDITIONER PARTS SET ONLY
£28.50
+ VAT

- For those who will only be satisfied with the best
- Use with Hi-Fi, computers, radios, TV sets to eliminate mains-borne interference
- 10 LED logarithmic display shows the amount of interference removed
- Massive filter section with thirteen capacitors and two current-balanced inductors
- Bank of six VDRs to remove transients and spikes
- Suppresses common mode and differential mode interference

Complete Parts Sets for ETI Projects

MAINS CONTROLLER

FEATURED IN ETI, JANUARY 1987

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

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

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

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

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



KNIGHT RAIDER

FEATURED IN ETI, JULY 1987

The ultimate in lighting effects for your Lamborghinis, Massaris, Buays for any other car, for that matter! Picture five eight powerful lights in line along the front and eight along the rear. You flick a switch on the dashboard control box and a point of light moves easily from left to right leaving a comet's tail behind it. Flip the switch again and the point of light becomes a bar, bouncing backwards and forwards along the row. Press again and try one of the other six patterns. An LED display on the control box lets you see what the main lights are doing.

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

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

KNIGHT RAIDER CONTROL BOX ONLY **£6.90 + VAT!**
KNIGHT RAIDER SEQUENCE BOARD ONLY **£13.90 + VAT!**

MATCHBOX AMPLIFIER

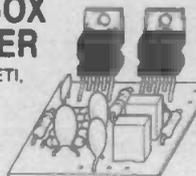
FEATURED IN ETI, APRIL 1986

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

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

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

SINGLE IC MATCHBOX AMPLIFIER SET (20W into 4 Ohms) **£6.50 + VAT**
BRIDGE AMPLIFIER SET (50W into 8 Ohms) **£8.90 + VAT**
L165V IC, with data **£3.90 + VAT**



POWERFUL AIR IONISER

FEATURED IN ETI, JULY 1986

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

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

We can supply a matched set of parts, fully approved by the designer, to build this unique project. The set includes a roller lined printed circuit board, 56 components, case, mains lead, and even the parts for the tester. According to one customer, the set costs 'about a third of the price of the individual components'. What more can we say?

DIRECT ION PARTS SET WITH BLACK CASE **£11.50 + VAT**
WITH WHITE CASE **£11.80 + VAT**

Instructions are included



SPECIAL OFFERS

AD7541 Precision 12-bit multiplying DAC	£1.20 + VAT
LM3524 Switch mode regulator IC	£0.80 + VAT
CF585 Calculator IC	£1.00 + VAT
LM339 Quad comparator IC	3 for £1.00 + VAT
MC1458 Dual op-amp	3 for £1.00 + VAT

All ICs supplied with FREE DATA. Prices apply only while stocks last.

LM2917 EXPERIMENTER SET

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

LM2917 Experimenter Set **£5.80 + VAT**

RUGGED PLASTIC CASE

suitable for mains conditioner and mains controller.

ONLY **£1.65 + VAT**



LEDs

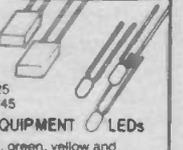
Green rectangular LEDs for bar-graph displays.

50 for **£3.50** 500 for **£25**

100 for **£6** 1000 for **£45**

DIGITAL AND AUDIO EQUIPMENT LEDs

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



Prices shown are exclusive of VAT, so please add 15% to the order total. UK postage is 70p on any order. Carriage and insurance for overseas orders £4.50. Please allow up to 14 days for delivery.

Specialist

MICRODUCTORS LIMITED

SALES DEPT
ROOM 107
FOUNDERS HOUSE
REDBROOK
MIDNORTH
GWENT

PASSIVE INFRARED ALARM

Protect your home and valuables with this simple but effective alarm from Robert Penfold

Burglar alarms which rely on an infra-red beam being broken by any intruder are not new and devices of this type must have been in existence for at least 20 years. The same principle has been applied to automatic doors and similar applications and it is now a standard form of 'presence' detection.

Although this unit could be described as an infra-red broken beam detector, it is not of the normal active variety. Those generally have a transmitter which sends a narrow beam of infra-red pulses to a receiver unit. Anyone passing between the two units momentarily cuts the signal to the receiver and triggers the system.

The system described here is a single-ended type which is based on passive infra-red detection techniques. In other words, it detects the body heat of anyone passing through the 'beam' of high sensitivity.

Most passive infra-red detection systems are designed to cover a wide area, generally with the aid of a fresnel lens which gives zones of high and low sensitivity. A different approach has been taken with this design which has an ordinary convex lens ahead of the pyro sensor. It therefore has a very narrow corridor of high sensitivity and in use it is more directly comparable to a broken beam type alarm than a normal passive infra-red detector.

There are both advantages and disadvantages to this type of detector. It offers what is generally a much better range than a wide angle passive detection system but has substantially lower performance in this respect when compared to an active beam system. However, with a maximum range of around 30m it is perfectly adequate for most likely applications and does not require the difficult alignment procedures associated with active systems. A

passive beam system is also less prone to problems with spurious triggering as there are no problems with the system slipping slightly out of alignment or moths flying through and breaking the beam!

Compared with an active system there is also the advantage that only a single unit is required. This can greatly ease installation.

As described here the unit is a burglar alarm, complete with switch-on and activation delays, automatic alarm switch-off, and a built-in modulated alarm generator. However, the detector section of the unit can easily be extracted from the design and used as the basis of automatic doors, or whatever.

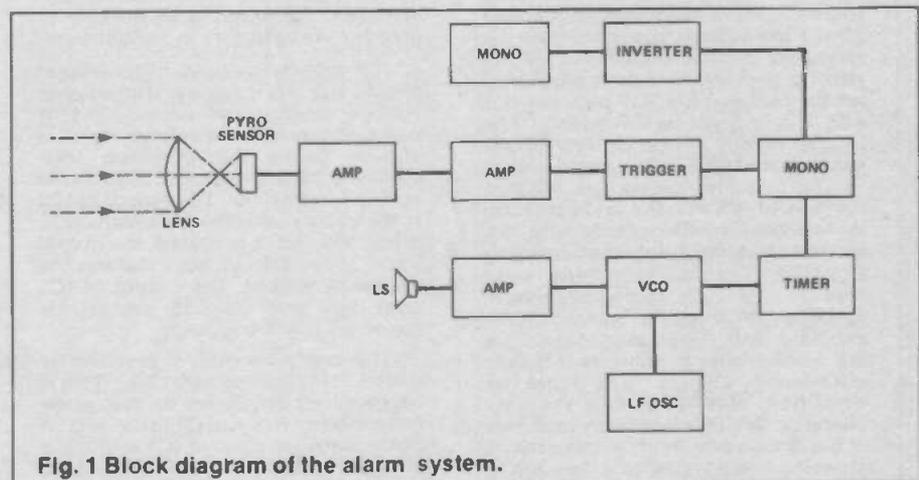
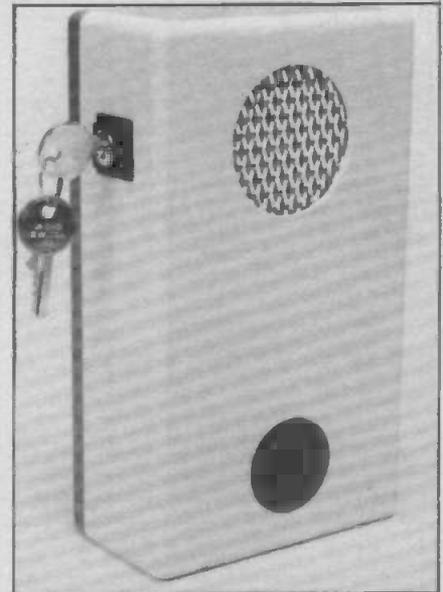


Fig. 1 Block diagram of the alarm system.

The System

The block diagram of Fig. 1 helps to explain the way in which the unit functions. Obviously some means of detecting the infra-red energy radiated by someone passing through the beam is required. Ordinary photo-transistors and the like are completely useless in this application.

Although many semiconductor photo-sensitive devices have peak performance in the infra-red part of the spectrum,

this is normally at wavelengths quite close to the visible red part of the spectrum. The actual wavelengths involved are in the region of 0.7 to 1 micron. For effective detection of body heat it is at much longer wavelengths (around 7 to 15 microns) that good sensitivity is required.

This requires the use of special sensors based on ceramic crystal materials that produce a small charge when a change in the infra-red level is detected. An important point to realise when dealing with these devices is that it is a *change*

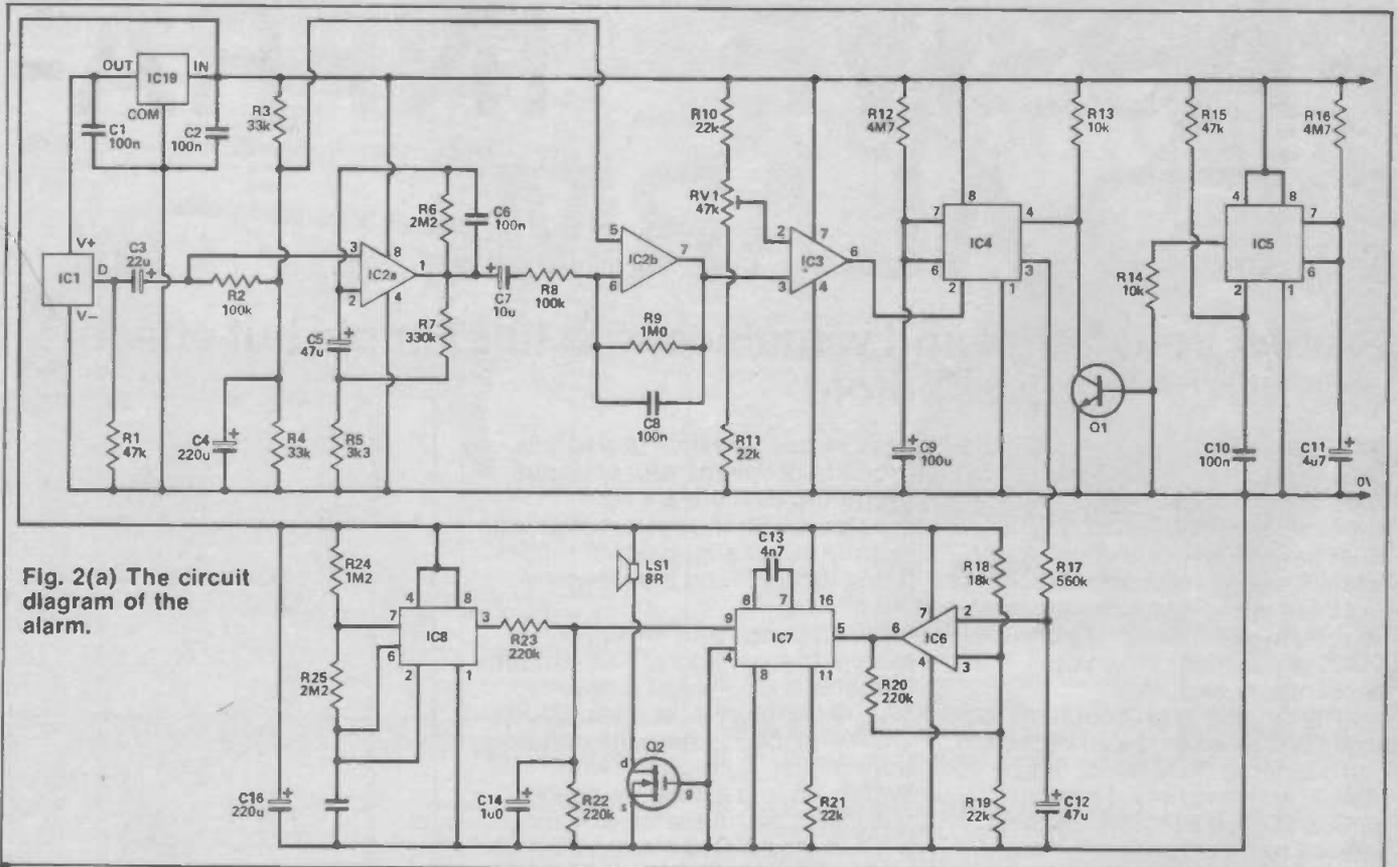


Fig. 2(a) The circuit diagram of the alarm.

HOW IT WORKS

IC1 is the pyro sensor and this is a single element type. In common with other pyro sensors it has a built-in source follower buffer amplifier which gives a low output impedance from the very high source impedance of the sensing element. R1 is the load resistor for the buffer stage. IC9 provides IC1 with a highly stable 5V supply. The supply voltage range for the SSC10 pyro sensor is 2.2 to 10V, incidentally.

The amplifier stages use the two sections of IC2 with the first operating in the non-inverting mode and the second one functioning as an inverting amplifier. The configurations used here are very similar to standard operational amplifier audio types but the coupling and decoupling capacitors are much higher in value as it is only infra-audio signals that must be amplified. C6 and C8 severely attenuate the high frequency response of the circuit, with 'high' in this context meaning frequencies of a few Hz or more!

With passive infra-red detectors the limiting factor on the degree of sen-

sitivity that can be obtained is the noise level of the pyro sensor itself. The gain of the amplifier could easily be increased but it would be unlikely to give any improvement in performance.

IC3 acts as the basis of the trigger circuit, and this is really just an op-amp voltage comparator circuit. RV1 is adjusted to provide a voltage which is slightly below the minimum level achieved by the output of IC2b under standby conditions. The output of IC3 is therefore normally at the high state. When the unit is activated, the output from IC2b briefly goes below the reference voltage, the output of IC3 goes low and the 555 monostable based on IC4 is triggered.

The switch-on delay is provided by a second 555 monostable (IC5). This is triggered at switch-on by the pulse generated by R15 and C10 and via Q1 it holds the reset input of IC4 in the low state. When the pulse from IC5 ceases, the reset input of IC4 goes to the high state and IC4 will then respond to any subsequent triggering.

IC6 provides the alarm activation delay and this is a Schmitt trigger preceded by a basic C-R timing circuit. About 25 seconds from the start of the pulse from IC4 the charge on C12 reaches the trigger voltage and the output of IC6 switches to the low state.

This gates on the VCO which is part of the 4046BE (IC7). The 4046BE is actually a CMOS micro-power phase locked loop but in this circuit only the oscillator section is utilised and the other stages of this component are just ignored.

The modulation is provided by IC8 — a standard 555 astable circuit having an operating frequency of just under 2Hz. Its almost squarewave output is attenuated slightly by R22 and R23 and filtered by C14. This gives an almost triangular modulation signal of a few volts peak to peak, which sweeps the audio tone from the VCO over a wide frequency range. This gives a very effective alarm signal. Q2 is a VMO power FET which is used to drive the loudspeaker and provides an output power of a few watts.

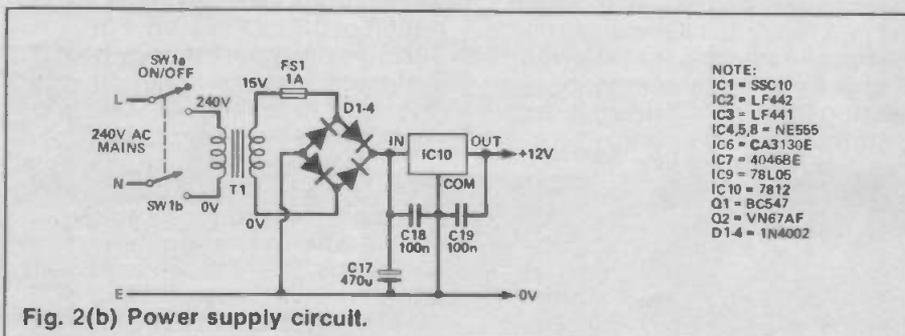


Fig. 2(b) Power supply circuit.

NOTE:
 IC1 = SSC10
 IC2 = LF442
 IC3 = LF441
 IC4,5,8 = NE555
 IC6 = CA3130E
 IC7 = 4046BE
 IC9 = 78L05
 IC10 = 7812
 Q1 = BC547
 Q2 = VN67AF
 D1-4 = 1N4002

in the infra-red level that is detected and not the absolute level.

An increase in the strength of the received signal produces a larger output voltage but this voltage soon starts to subside, even if the intensity of the signal is maintained. The bandwidth of pyro sensors is usually very restricted, with 0.3-3Hz being typical. However, this is adequate for intruder alarms and similar

PROJECT: Infra-Red Alarm

applications.

To achieve a really good maximum operating range a convex lens must be added ahead of the sensor. This gathers up infra-red radiation over a relatively large area and concentrates it onto the sensing element. This gives an effective boost in gain but makes the system highly directional. This is analogous to a high gain radio aerial, where increased signal strength but also greater directivity are obtained.

The output from the sensor is still quite low — often under one millivolt peak to peak. A great deal of amplification is therefore needed in order to bring the signal up to a usable level and in this case a two stage amplifier is used. This is followed by a trigger circuit which is activated when the output voltage from the second amplifier stage goes below its quiescent level by more than a preset amount.

Anyone passing through the 'beam' of high sensitivity will produce a signal from the sensor that results in the output of the second amplifier varying widely either side of its quiescent level, activating the trigger circuit.

The negative output pulse from the trigger stage is used to activate a monostable multivibrator. This has a long output pulse duration of about ten minutes. It activates the alarm generator via a delay circuit.

The point of driving the alarm

generator via a monostable rather than a latch is that an automatic switch-off is obtained after about ten minutes. This ensures that once the alarm has served its purpose it does not cause unnecessary annoyance to your neighbours.

The delay circuit prevents the alarm from being sounded as soon as the unit is activated but only about 25 seconds elapses before the alarm is switched on. This gives someone legitimately entering the premises an opportunity to switch off the unit before the alarm generator is activated.

Although the alarm generator is a fairly simple type, it is nevertheless quite effective. It is based on a VCO (voltage controlled oscillator) that is frequency modulated over a wide range by a low frequency oscillator. A power amplifier stage provides the unit with an output of several watts, which gives a very loud alarm sound when used with any reasonably efficient loudspeaker.

A second monostable controls the first one via an inverter stage. This second monostable is automatically triggered at switch-on and it has an output pulse duration of about 25 seconds. Its purpose is to prevent the unit from being triggered until the person who switches on the alarm has had time to move out of the monitored zone.

Construction

Most of the components fit onto a single printed circuit board, including the power supply components apart from SW1 and T1. The component overlay is shown in Fig. 3.

Parts List

RESISTORS (all 1/4 watt 5% carbon)

R1, 15	47k
R2	100k
R3, 4	33k
R5	3k3
R6, 25	2M2
R7	330k
R8	180k
R9	1M0
R10, 11, 19, 21	22k
R12, 16	4M7
R13, 14	10k
R17	560k
R18	18k
R20, 22, 23	220k
R24	1M2
RV1	47k sub-mIn horiz preset

CAPACITORS

C1, 2, 18, 19	100n ceramic
C3	22µ 16V radial electrolytic
C4, C16	220µ 16V radial electrolytic
C5, 12	47µ 16V radial electrolytic
C6, 8, 10, 15	100n polyester
C7	10µ 25V radial electrolyte
C9	100µ 16V radial electrolytic
C11	4µ7 63V radial electrolytic
C13	4n7 mylar or ceramic
C14	1µ 63V radial electrolytic
C17	470µ 25V radial electrolytic

SEMICONDUCTORS

IC1	SSC10 pyro sensor
IC2	LF442
IC3	LF441
IC4, 5, 8	NE555P
IC6	CA3130E
IC7	4046BE
IC9	78L05
IC10	7812
Q1	BC549
Q2	VN67AF or similar
D1, 2, 3, 4	1N4002

MISCELLANEOUS

LS1	8R, 8W loudspeaker
FS1	20mm 1A anti-surge fuse
SW1	Mains switch
T1	15 volt, 1A mains transformer

PCB; Case; CE01 lens; small finned heatsink; six 8 pin DIL IC holders; 16 pin DIL IC holder; pair of 20mm fuse-clips; pins; wire; nuts and bolts.

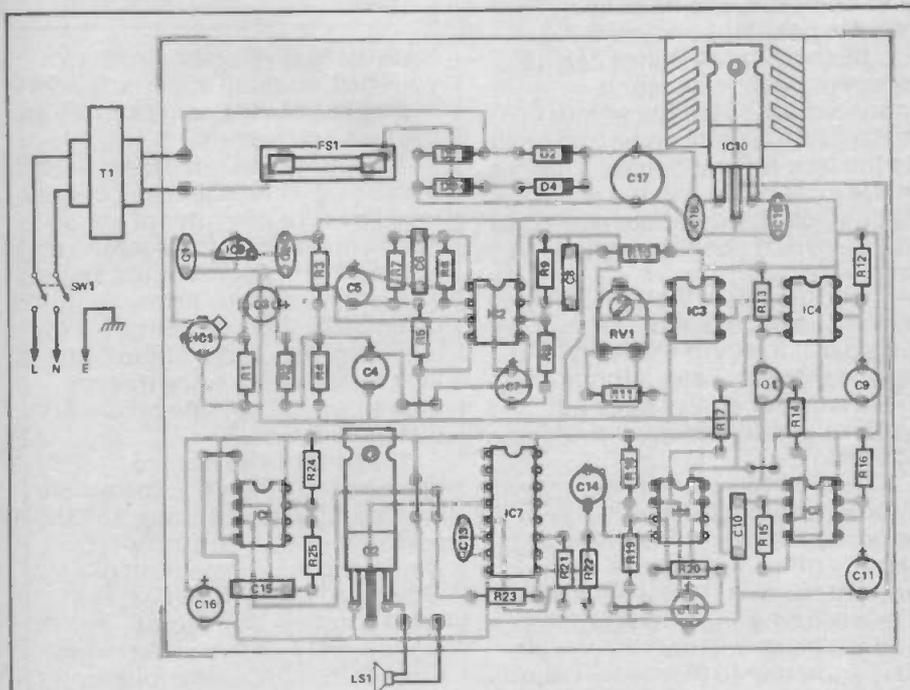


Fig. 3 The component overlay for the alarm PCB.

IC6 and IC7 are MOS devices and the usual anti-static handling precautions should be taken when dealing with these components. Q2 is a MOS device but it has an integral zener protection diode that makes special handling precautions unnecessary.

I used a VN67AF for Q2, but similar devices such as the VN46AF and VN66AF are equally suitable.

As Q2 is operated as a switch in this circuit it does not have to dissipate much power but it is advisable to fit it with a small heatsink to ensure safe operation. A small fin made from an odd scrap of aluminium is all that is needed here.

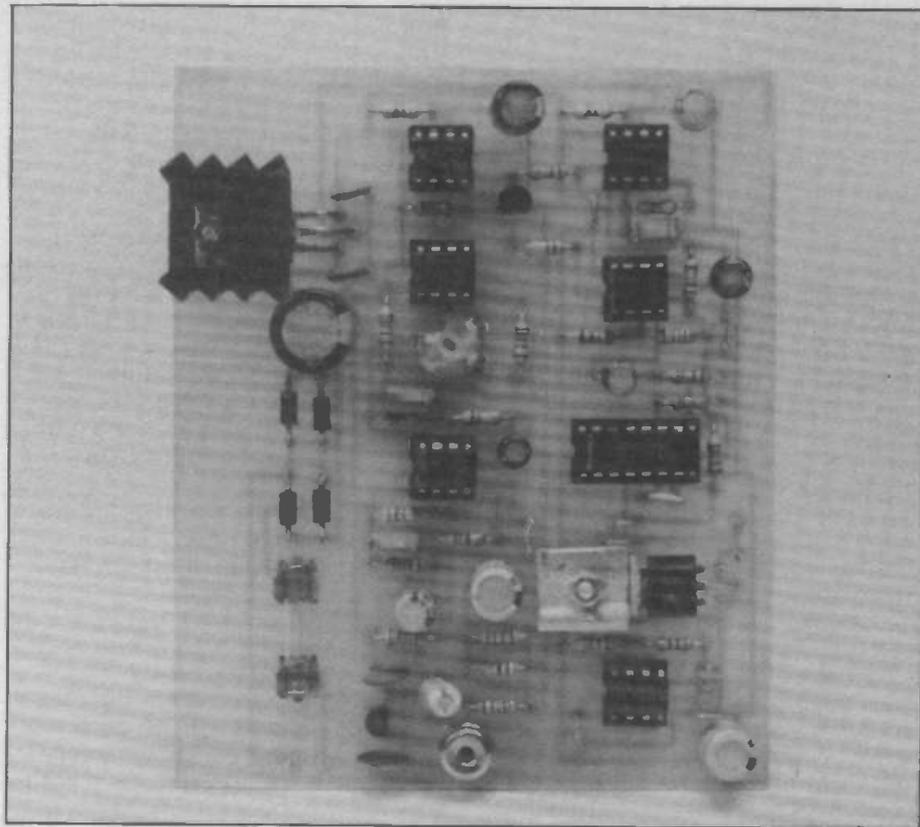
In the power supply circuit IC10 has to dissipate a few watts of power when the unit is activated and it should also be fitted with a small heatsink. It has to dissipate somewhat more power than Q2 and the use of a ready-made finned heatsink is recommended.

It is advisable to use an anti-surge fuse for FS1, as a quick-blow type might be blown by the initial surge of current at switch on as C17 charges up.

If the three timer circuits in the unit are to function properly it is essential that the timing capacitors are good quality types. Superior grade electrolytics are usually satisfactory but tantalum types probably offer the best reliability. Even using good quality components it is not possible to set the various times particularly accurately and they will generally be somewhat longer than the calculated times. This does not really matter here as timing accuracy is obviously of little importance.

The ideal delay times will depend on the exact circumstances under which the unit is used but they can be altered by changing the value of the relevant timing resistor and/or capacitor. The delay times are proportional to the values of both components.

Mechanical construction must be varied to suit the conditions under which the unit will operate. As the unit is mains powered it is essential that the normal safety precautions are observed. The unit must be fitted in a case that has a screw fixing lid or cover, so that there is no easy means of gaining access to the dangerous mains wiring. It is a good idea to insulate any exposed mains wiring anyway and any exposed metalwork must be earthed to the mains earth lead.



For security reasons the unit could be fitted in a really tough case and the on/off switch SW1 should be a key type. The alternative which is preferred by many is to disguise the unit so that the alarm goes off before the unit is discovered.

The only slightly awkward aspect of construction is mounting of the lens. Assuming that the recommended lens is used, the photocell and lens must be in the relative positions shown in Fig. 4.

In some cases things can be easier if the pyro sensor is mounted off-board but in most instances the unit can be arranged so the lens is fixed behind a cutout in the front panel and the printed circuit board is mounted with IC1 in the correct position behind the lens.

It is important that the 30mm distance from the lens to the window in the pyro sensor is reasonably accurate, although a millimetre either way does not seem to greatly reduce the range of the unit.

Getting the window well centred behind the lens is also important. If the pyro sensor is slightly off centre this will not prevent the unit from working but there will be a slight loss of range and the beam will not run perpendicular to the lens. This will make it difficult to aim the finished unit correctly.

If you require some window

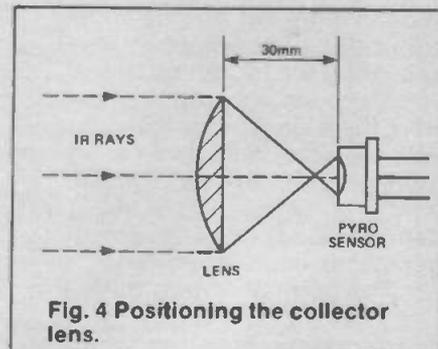


Fig. 4 Positioning the collector lens.

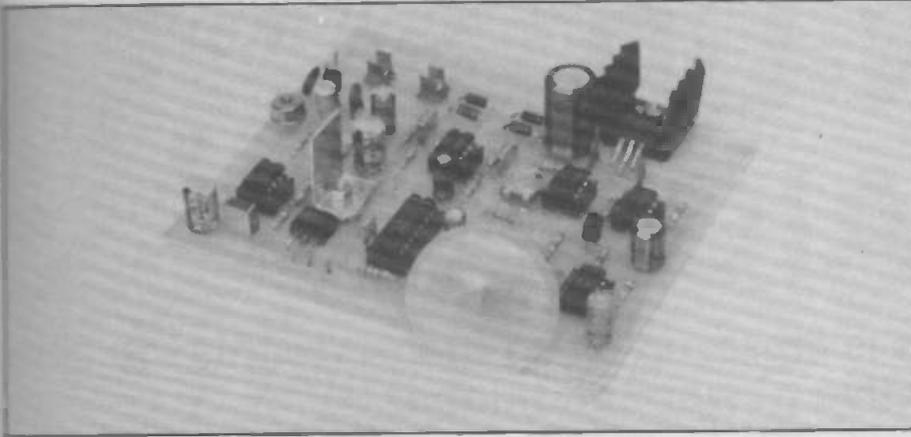
material to give a neat finish to your cell, suitable material is available from the same source as the lens and sensor.

In theory it is not essential to use the CE01 lens and any convex lens having a diameter of about 30mm or so and a focal length of around 25 to 30mm should suffice. The lens to sensor distance should be equal to the focal length of the lens. In practice use of the CE01 lens is advisable, since this is guaranteed to operate properly in this application.

Most other lenses are designed to operate in the visible light part of the spectrum and their performance at long infra-red wavelengths is something of an unknown quantity. At best the focal length is likely to be significantly shifted and at worst there will be little transmission of long infra-red radiation.

I tried a few other lenses in the unit but they all failed to work

PROJECT: Infra-Red Alarm



properly and did in fact seem to be opaque at the wavelengths involved in this application!

Adjustment

The only adjustment needed before the unit is ready for use is to give RV1 the optimum setting. With this set fully anti-clockwise the unit will probably function reasonably well but with a relatively low maximum range. Advancing RV1 should improve sensitivity but adjusting it too far in a clockwise direction will result in frequent spurious triggering of the unit.

Finding the best setting is really a matter of experimenting a little with various settings. When making these adjustments it is probably best to disconnect the loudspeaker and to use a voltmeter to monitor the output of IC3. This saves your ears from the alarm generator and it also circumvents the delays which would otherwise make adjustment of RV1 a very slow and difficult business.

Remember that the output voltage from IC3 is normally high and goes low momentarily when the unit is activated.

Alarms of this type have reasonable immunity from false alarms but be careful not to position the unit where there are any obvious sources of infra-red that could trigger it. In particular, when used out of doors avoid aiming the unit in the direction of passing cars. These can trigger the unit at more than its 30 metre 'human' range.

Bear in mind that the unit responds most readily to someone passing through the 'beam' at a right angle to it and that the sensitivity is relatively low for someone moving along the beam.

BUYLINES

The majority of the components used in this project are easily available from the usual sources. The Pyro detector and the Infra-red lens are available from Chartland Electronics, PO Box 83, Chobham, Surrey, KT11 2QB.

The power supply is a basic stabilised type having a fullwave (bridge) rectifier and stabilisation provided by monolithic voltage regulator IC10. Under standby conditions the current consumption of the circuit is around 35mA but when the alarm generator is activated, the current drain rises to well over 600mA.

Xen-Electronics

(0983 - 292847)



IC's	Fixed Voltage Regulators	24 Way	20	220 µ F 10V	06
4001UB	+5 1A	30	28 Way	330 µ F 16V	.19
4011UB	+12 1.5A	30	40 Way	470 µ F 16V	.25
4011	+1.5A	68	Turned Pin	470 µ F 50V	.40
4017	+12 1.5A	30	6 Way	470 µ F 63V	.53
4028	+15 1A	30	8 Way	1000 µ F 10V	.27
4040	+24 1A	68	14 Way	1000 µ F 16V	.27
4053	-5 1A	.39	16 Way	2200 µ F 16V	.45
4066	-12 1A	2.10	18 Way	Axial Lead	
4031	-12 1A	.39	20 Way	4.7 µ F 63V	.06
Z80ACPU	+24 1A	39	22 Way	10 µ F 35V	.11
Z80APIO	+5 0.1A	28	24 Way	47 µ F 25V	.18
7217IPI	+8 0.1A	28	28 Way	470 µ F 10V	.22
6402IPL	+12 0.1A	28	40 Way	1000 µ F 10V	.31
555	+15 0.1A	.36	40 Way	Metallised Polyester	
558	-5 0.1A	.30	Connectors D Type	5/7 5mm Pitch	
741	-12 0.1A	.30	9 W Skt	3 nF 400V	.08
LM380N	-15 0.1A	.30	9 W Plug	0.01 µ F 100V	.08
TDA3810	Transistors		9 W Cover	0.022 µ F 63V	.08
TL074CP	BC107	.16	15 W Skt	0.047 µ F 100V	.08
SG3526N	BC108	.21	15 W Plug	1 µ F 63V	.08
SG3526J	BC109C	.19	15W Cover	0.15 µ F 63V	.17
SL486DP	BC182	.05	25 W Skt	0.33 µ F 63V	.33
SL490DP	BC212	.05	25 W Plug	9.47 µ F 63V	.17
ML926DP	BC546B	.04	25W Cover	Resistors Carbon Film	
Diodes	BC556A	.04	PCB Mount	0.25 Watt 5%	
1N4001	BD233	.42	15 W Skt	1 w to 10M Ω	EACH 0.2
1N4003	BFY51	.54	15 W Plug	0.5 Watt 5%	
1N4005	BF259	.58	25 W Plug	10 Ω to 10M Ω	EACH 0.4
1N4007	BSR50	.49	Capacitors Radial	Terminator Bead (NTC)	
1N5401	IRF520	1.61	Lead	GM472W (4.7k Ω)	1.95
Zener Diodes	IRF840	4.60	22 µ F 50V	Potentiometers PCB Mount	
2V7 4V	J112	.57	2.2 µ F 63V	Cermet Top Adj.	
5V1 4W	MT18N10	1.44	4.7 µ F 63V	100 Ω	
7V5 4W	TIP121	.34	33 µ F 16V	1k Ω	.30
9V1 4W	TIP126	.34	47 µ F 10V	5k Ω	.30
10V 4W	TIP31C	.30	47 µ F 25V	10k Ω	.50
11V 4W	TIP32C	.30	47 µ F 35V	20k Ω	.50
LED's	2N2646	1.18	47 µ F 63V	100k Ω	.50
5mm Dia	2N3055	.47	47 µ F 100V	200k Ω	.50
Red	1C Sockets		10 µ F 35V	Project Kits RS232 to Centronics Converter	
Green	Coil		10 µ F 63V	Kit only	£18.40
Orange	6 Way	.05	22 µ F 100V	Z80 Based Controller Board, 4NHz	
Yellow	8 Way	.07	100 µ F 10V	Kit Only	£20.45
3mm Dia	14 Way	.11	100 µ F 16V	Ultrasonic Tapemeasure (Display Module Extra)	
Red	16 Way	.13	100 µ F 25V	Kit Only	£23.52
Green	18 Way	.15	100 µ F 35V	Four Digit LCD Module for above Kit Only	£14.30
Orange	20 Way	.16	100 µ F 50V		
Yellow	22 Way	.18	100 µ F 63V		

Who says we never give anything away? An offer which can only last until stocks are exhausted. The Electronic Industry Telephone Code Book and Diary 1988. Yours absolutely FREE when you next place an order worth £25 or more. Alternatively you can order the diary on its own at a price of £7.25, zero retail. ORDER NOW AND DON'T BE CAUGHT WITHOUT IT! MAIL OR TELEPHONE ORDERS ONLY PLEASE TO: Samuel Whites Estate, Bridge Road, Cowes, Isle of Wight, PO31 7LP Please add £1 for 1st class post and packaging and 15% VAT to total. Stock listing available soon, please send SAE to be put on the mail list.

OSCILLOSCOPES	SPECIAL OFFERS
TELEQUIPMENT D83 Dual Trace 50MHz Delay Sweep. Large Tube. £350	COSSOR OSCILLOSCOPE CDU150 Dual Trace 35MHz Delay Sweep. Solid State Portable 8x10cm Display With Manual. NOW ONLY £180
S.E. LABS SM111 Dual Trace 18MHz Solid State. Portable AC or External DC operation 8x10cm display with Manual. £150	Optional Front Protection Cover Containing 2 Probes & Viewing Hood. £10
TELEQUIPMENT D81 Dual Trace 10MHz With Manual £100	SOLARTRON OSCILLOSCOPE CD1400 Dual Beam 15MHz With Manual. ONLY £85
TELEQUIPMENT D43 Dual Trace 15MHz With Manual £100	AVO VALVE TESTER CT160 Suitcase style. 2 ONLY £25
TELEQUIPMENT 254A Single Trace 10MHz. Solid State With Manual. £90	GOULD/ADVANCE OS255 Dual Trace 15MHz. £225
GOULD/ADVANCE OS255 Dual Trace 15MHz. £225	With Manual
ADVANCE OS250TV. Dual Trace 10MHz. £150	With Manual
HAMEG 207 Single Trace 6MHz. With Manual. £50	
MULTIMETERS	OTHER SWITCHED MODE PSU available. Please enquire.
AVO 8 Complete with Batteries & Leads from. £45	DATRON 3000 PROM COPIER (copies up to 10) £150
AVO 8 MkV Complete with batteries Leads & Case. £90	SWITCHED MODE PSU +/- 12V 0.25A. 5V 15A etc £12
AVO TEST SET No 1 (Military version of AVO 8) Complete with Batteries Leads & case. £65	(p&p £3)
TEST LEADS suitable for AVO METERS Red & Black with 2 croc-clips & 2 prods (p&p £2). £5	QWERTY KEYBOARD (as in LYNX MICRO) push to make Case. £5
AVO Model 7x Complete with Batteries. Leads & carrying case. £40	QWERTY MODE PSU +/- 12V 0.25A. 5V 15A etc £12
AVO Model 73. Pocket Multimeter (Analogue) 30 ranges. Complete with batteries & leads. £18	(p&p £3)
AVO - 72 Similar to above but no AC current range. With batteries & leads. £10	B + K Precision CRT Restorer/Analyser Model 467. Supplied with 2 bases and Manual (P&P £7) ONLY £125 each
ANALOGUE POCKET MULTIMETERS Philips/Taylor etc. With Batteries & Leads. from £10	LARGEAR Colour Bar Generator KG1. 8 Test Patterns (P&P £4). ONLY £40 each
COMMUNICATION RECEIVERS	MARCONI AM/FM Sig Gen TF1066B 10-470MHz. £250
RACAL RA17 500KHz-30MHz with Manual. only £150	MARCONI AM/FM Sig Gen TF995 range from. £150
Eddystone 730/4 480KHz-30MHz only £110 each with manual.	FARNELL SINE/SQUARE type LFM2 1Hz-1MHz Compact. £80
AVO TRANSISTOR TESTER TT169	ADVANCE SG62B AM 150KHz-220MHz. £80
Handheld GO/NOGO for In-situ Testing. Complete with Batteries Leads & instructions (P&P £3) unused £12	NEW EQUIPMENT
ISOLATING TRANSFORMERS 240V INPUT	HAMEG OSCILLOSCOPE 605 Dual Trace 60MHz Delay Sweep. Component Tester. £583
240V Out 500VA £15 (p&p £5) 100VA £8 (p&p £2)	HAMEG OSCILLOSCOPE 203.6. Dual Trace 20MHz Component Tester & 2 Probes. £314
24V Out 500VA £8 (p&p £5) 200VA £4 (p&p £4)	All Other Models Available
STEPPING MOTORS	BLACK STAR FREQUENCY COUNTERS P&P £4
Type 1 200 Steps per rev. 4 Phase (5 wire) 12 24V Torque 25oz inch will run on 5V with reduced torque. £15	Meteor 100-100MHz. £99
Type 2 6/12 Steps per rev. 3 Phase 12/24V (will work on 5V) £2 as 6 oh. £7.50	Meteor 600-600MHz. £126
Type 3 NORTH AMERICAN PHILIPS 24 Steps per rev. 4 wire 5V 3.3Amps 0.250rps. £8	Meteor 1000-1GHz. £175
Type 4 200 Steps per rev. 120V (3 wire) Torque 25 oz inch. £4	BLACK STAR JUPITOR 500 FUNCTION GENERATOR. Sine/Square/Triangle 0.1Hz-500KHz. P&P £4. £110
Type 7 WARNER 24 Steps per rev. 3 Phase (6 wire) 28V Holding Torque 45 oz. inch. £5	BLACK STAR ORION PAL TV/VIDEO COLOUR PATTERN GENERATOR. £199
	HUNG CHANG DMM 7030 3 1/2 digit. Hand held 28 ranges including 10 Amp AC/DC 0.1%. Complete with batteries & leads P&P £4. £39.50
	As above DMM 6010 0.25%. £33.50
	OSCILLOSCOPES PROBES Switched x1: x10 P&P £2. £11
	Used equipment - with 30 days guarantee. Manuals supplied if possible. This is a VERY SMALL SAMPLE OF STOCK. SAE or Telephone for Lists. Please check availability before ordering. CARRIAGE all units £16. VAT to be added to Total of Goods & Carriage.
	STEWART OF READING
	110 WYKEHAM ROAD, READING, BERKS RG6 1PL
	Telephone: 0734 68041 Callers welcome 9 am - 5.30 pm Mon.-Fri. (until 8 pm Thurs.)

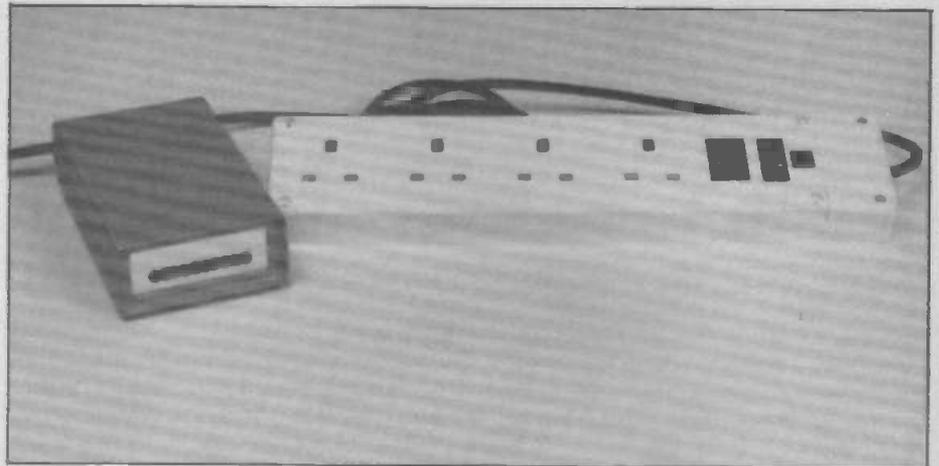
CLEAN UP CAMPAIGN

Paul Chappell's mains is close-up clean thanks to this top spec and remarkably attractive power conditioner.

Year by year the pollution of the mains supply grows steadily worse. In addition to the usual industrial effluents from rotating machinery, waste products from switch mode power supplies, sewage from drills, washing machines, vacuum cleaners and oven thermostats, there are now plans afoot to pollute the mains deliberately.

I hardly need to mention the consequences — streaky TV pictures, popping and crackling radios, mushy hi-fi sound. Greenpeace — where are you when we need you?

Mains borne interference is not a thing to be taken lightly. Spikes of 1kV and above are a common (in some areas frequent) occurrence and this can and does damage unprotected equipment. A simple voltage dependent resistor (VDR) connected between live and neutral of the mains plug will usually forestall damage to the equipment but it doesn't prevent



the annoying interference effects. Apart from spikes and impulsive interference, there is a constant background of more regular interference which gets steadily worse as time goes on. RF interference has become more of an annoyance since the CB boom and the increasing use of switch mode power supplies adds its own

contribution. The latter are supposed to be suppressed at source but this only serves to reduce the interference and doesn't eliminate it.

Another development has been the increasing use of the mains for signalling purposes. At its lowest level this can be equipment such as cordless

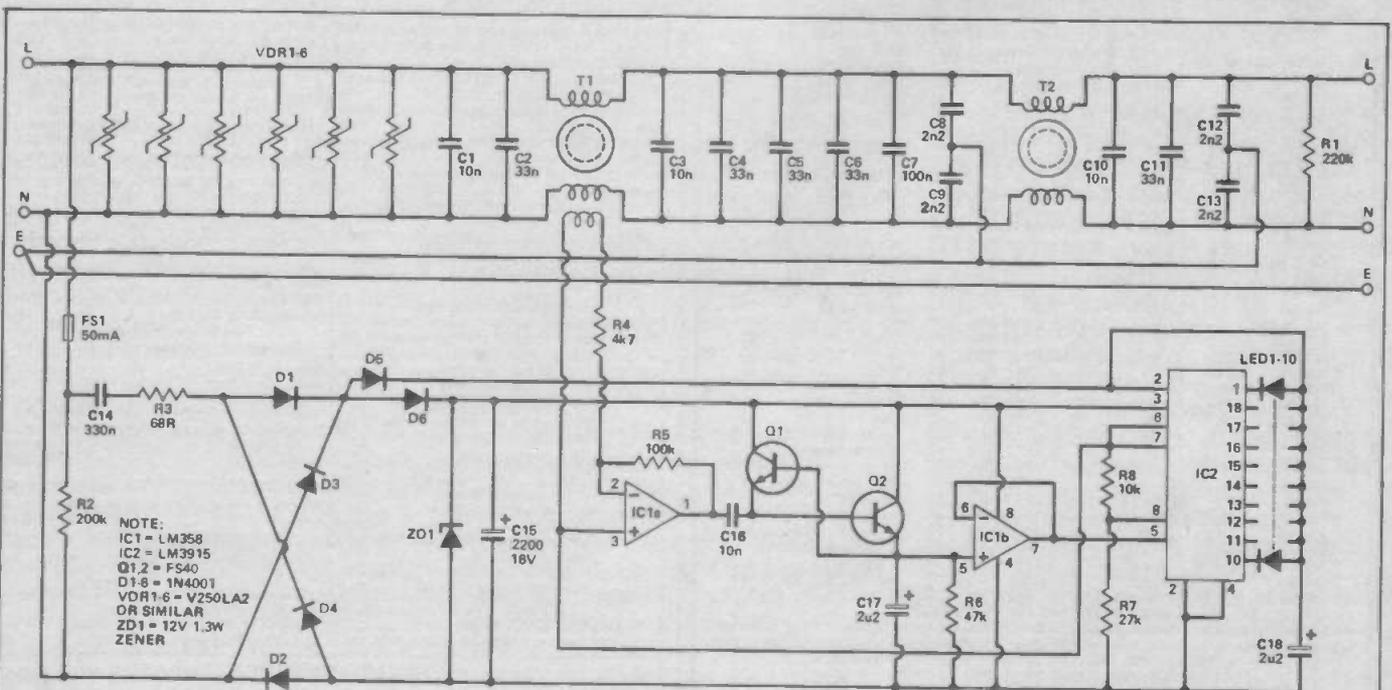


Fig. 1 The circuit diagram of the Power Conditioner.

intercoms but the problems associated with sending digital signals through the mains are rapidly being overcome.

Some years ago National Semiconductors introduced the Bi-Line system, the front end of which was an IC (the LM1893) which puts data through the mains by means of an FSK modulation system. It was, by its nature, for localised use but this and similar systems — even the home computer add-ons for through the mains control — are all adding to mains borne interference.

A system to eliminate gas and electricity meter readers has now reached the stage of field trials. The idea is that meter readings are sent via the mains as far as the nearest sub-station, from where they will be transferred to the telephone lines by means of a modem.

This long distance use of mains signalling obviously can't be suppressed, so a band has already been set aside for it. One can envisage a time when the 'mains waves' will be just as strictly regulated (and just as crowded) as the air waves. The effects on hi-fi and audio equipment have yet to be seen.

In addition to all this man-made interference, there is another source which will always be beyond any kind of legal regulation and control — the weather. Electric storms and even lightning strikes make their presence felt through the mains.

The only way to be sure of an unpolluted power supply for your audio equipment, TV or computer is to clean it up yourself. The ETI power conditioner is the tool you need for the job.

Inside the conditioner the mains supply is purified, transients are cleared and RF interference is blocked. The clean supply is then fed to a socket or multi-way outlet which can supply power to all your sensitive equipment.

If you find it hard to believe that the mains is really as polluted as I say, this project will certainly convince you. A unique feature is its bar graph display which actually lets you see how much interference it is removing.

As you watch the LEDs move and occasionally flick way up towards the top of the scale, you'll be in no doubt that the power conditioner is working for its living.

The Dorchester Doorman

The correct way to avoid any problems with mains connections the gospel goes is to plate all your plugs with gold. The reasoning behind this was explained to me by the proprietor of Hi-Price Audio to be something like this:

The gold plating on the plug acts very much like the uniform of the doorman at the Dorchester Hotel. Nice, well-bred sine waves know that they will be welcome inside, whereas interference is overawed by the golden splendour of the doorman's uniform and embarrassed by its own scruffy appearance. It knows that it will feel out of place in such magnificent equipment and wanders on in search of the electronic equivalent of a Yummy Eater fast food bar.

"Besides," he said, "if punters fink they can hear a difference, am I going to argue?" I was impressed by his logic and bought a dozen.

HOW IT WORKS

The filter section begins with six VDRs, which are intended to remove the damaging effects of high energy transients on the mains. To some extent they will reduce impulsive interference effects too but will not eliminate them.

The filter section will remove RF interference from the power lines. The current balanced inductors in combination with the Y-capacitors (C8, 9, 12, 13) serve to clean up common mode interference, while the X-caps (C1-6, 10, 11) do the same for differential mode noise.

The current balancing in the toroids prevents the cores from saturating under the effects of the current drawn by the load.

The pick off coil from the first toroid detects any imbalance caused by interference currents flowing to ground via the Y-capacitors. The signal is amplified by IC1a and passed to the

detector circuit consisting of Q1 and 2 and associated components.

This detector responds to the peak value and to the duration of the signal, so a short, high voltage pulse will give the same reading as a sustained, low amplitude burst.

IC1b feeds the detected voltage to IC2, which is a common or garden bar-graph drive IC.

The LEDs are fed with current pulses from D5 to reduce the overall current consumption of the circuit and dissipation in IC2. The IC is switched to dot mode twice each cycle of the mains (via pin 9) to reduce the current requirements still further.

If you look closely at the display, you might just discern a difference in brightness between the highest dot and the rest of the bar but the overall effect is of a continuous bar display.

Of course, back in the real world we have a mains filter which works to consider.

The circuit is shown in Fig. 1. The filter begins with six VDRs. This is partly a concession to the fringe hi-fi community who believe that if one is good, six must be six times as good. For a given spike, the clamping voltage will be reduced by an infinitesimal amount by having a number of VDRs in parallel, due to the highly non-linear voltage to current relationship of these devices.

It's rather like hoping to reduce the forward voltage drop of a diode by wiring half a dozen in parallel. It will be reduced very slightly but not so's you'd notice the difference.

For more rational beings, there is another reason for having half a dozen VDRs.

A VDR will only absorb a certain amount of energy from a spike before becoming stressed beyond its limits. If these limits are exceeded, it can result in the VDR breaking open and scattering zinc oxide far and wide. After that, your equipment is no longer protected.

One of the essential figures on a VDR data sheet is the maximum energy it can absorb in a short period of time. Figures of 5 to 20 Joules in 10µs are common for small components. To increase the energy you have the choice of buying a larger VDR or using several in parallel.

Parallels

The parallel option has the advantage that you can choose how much protection you want to give (an upgradable mains filter!) and that the average absorption over a longer period of time will be

The power for the low voltage circuit is derived from the mains via C14. R3 prevents damaging inrush currents if the mains happens to be close to its peak value at the time the circuit is switched on.

R2 provides a discharge path for C14 when the conditioner is disconnected from the mains or if the fuse should blow.

This kind of power supply does not isolate the low voltage circuit from the mains and is only suitable for use in completely self-contained pieces of equipment like the conditioner. The supply capacitor will be large but nowhere near as bulky or heavy as a mains transformer for circuits requiring small currents (up to 100mA or so).

A capacitor used in this way should be X-rated since it is effectively connected across the mains.

greater than for a single large VDR.

It could be that because of an electric storm you get just the conditions to pop a large VDR (and your equipment) but which would allow the parallel combination to continue giving protection. Speaking as one whose new TV set has just been zapped by a thunderstorm which exploded the plug VDR too, the more protection you can give, the better.

For those of you who are not familiar with the characteristics of VDRs, they are rather like AC versions of the zener diode, although the voltage clamping is not so sharp.

Below their rated voltage they are virtually an open circuit. A little above this they begin to conduct until at about twice the rated voltage they have virtually no resistance at all. It may seem that a sharper cut-off would be an advantage but too quick a conduction would lead to blown VDRs every time there was a long term surge in the mains voltage. They are, in fact, very well suited to their job.

The clamping voltage is usually measured at 100A and will be somewhere between 600V and 800V for a device rated for 240V mains operation (which will begin to conduct at about 350V — just above the mains peak). The peak current for even a small VDR will be many hundreds of Amps but this can only be sustained for a few microseconds.

High peak currents for a very short time is exactly what impulsive interference will give.

Capacitor, heal thyself

The main section of the filter consists of a pair of current balanced inductors and banks of capacitors to remove RF interference. A number of capacitors in parallel are used in preference to a single large capacitor to take advantage of the much higher self resonant frequency of the smaller caps and also because they are generally able to withstand short term thermal and voltage overload better than their larger brothers.

The value of the capacitors to earth is limited by the need to comply with earth leakage regulations — they are the maximum allowable values, taking into account their tolerance and should not be increased under any circumstances.

Connecting capacitors across the mains puts them under

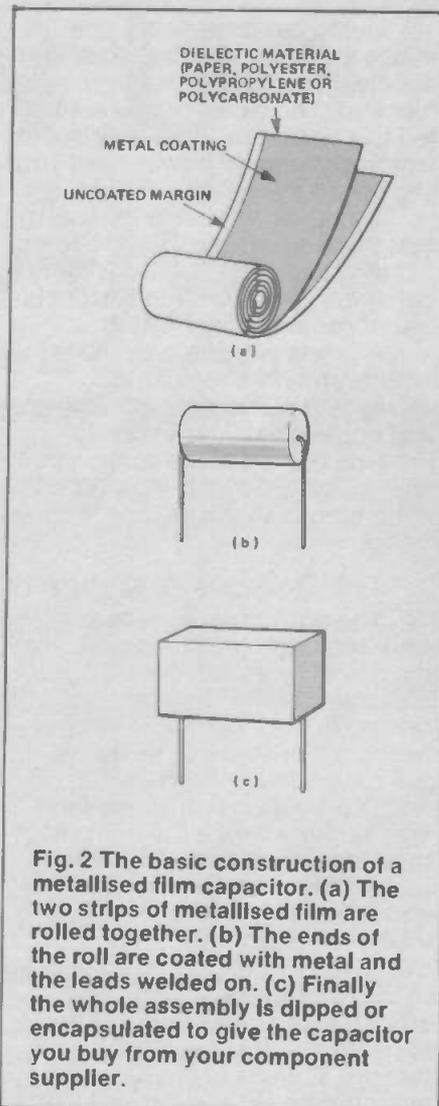


Fig. 2 The basic construction of a metallised film capacitor. (a) The two strips of metallised film are rolled together. (b) The ends of the roll are coated with metal and the leads welded on. (c) Finally the whole assembly is dipped or encapsulated to give the capacitor you buy from your component supplier.

enormous stress and components not designed for the job can easily catch fire, short circuit, or at best just quietly fail — even if the voltage rating is high enough.

Capacitors which have been designed to withstand the stresses and to comply with the appropriate standards are divided into three main categories: Class X1 These are for connection between live and neutral in situations where pulses of over 1.2kV can be expected. Class X2 These are for connection between live and neutral where transients will not exceed 1.2kV. Class Y These are made to the highest standard of all and are used for connection between a power line and earth or any other situation where failure might expose someone to a lethal shock.

Most capacitors for mains use have the rather magical sounding property of self-healing. This is a consequence of the metallised film construction, the essentials of which are shown in Fig. 2.

The dielectric material is coated with a very thin layer of aluminium — around 300

Angstroms (3×10^{-8} metres) thick. Two dielectric strips will be coated — one with a margin on the left hand side and one with a margin on the right. The two will then be wound together so that the metal film of one 'plate' extends to one side of the roll and the other to the opposite side.

To make the connections, the two sides of the roll are sprayed with metal from a flame or arc gun and the leads attached.

You can see this kind of construction in the 'naked' metallised polyester capacitors — the block shaped ones with metal at either end and leads that fall off at the slightest provocation. These caps are layered in long strips and then sawn up into individual capacitors rather than being individually wound, but the principle is the same.

The difference between class X and Y capacitors and the cheap 'n' cheerful metallised types is mainly in the standard of construction. The mains capacitors may be interleaved with paper (sounds an odd material but it has some excellent properties), be vacuum impregnated with epoxy to remove air pockets where ionisation may take place, be series wound to reduce electrical stresses, have several layers of bonding metal, be encapsulated in fire retardant material and so on. Construction varies from manufacturer to manufacturer.

If the dielectric is punctured by a high voltage spike, instead of short circuiting through the carbonised mess left behind when the dielectric burns, the very thin metallisation is vapourised away from the area and the capacitor carries on as if nothing had happened!

Strictly speaking, the metallisation is oxidised, the oxygen being supplied by the decomposition of the dielectric. The oxide doesn't conduct, so the damaged area is sealed off. It's not quite self-healing but almost as good!

Construction

The component overlay for the project is shown in Fig. 3. Some of the components are mounted vertically to save space — the leads should be bent carefully and not too close to the body of the component to avoid stressing the bonding.

The best way is to hold the lead just above the component body in a pair of pliers, then to bend the lead in a smooth curve with finger and thumb.

PROJECT: Power Conditioner

The VDR positions have two holes for the 'live' connections, allowing components with either a 0.2in or 0.3in lead pitch to be mounted. Similarly, the capacitor which supplies the low voltage circuit has two pads for one of its connections to allow two popular sizes of capacitor to be mounted. The remaining hole is left unused.

Each coil on the two toroids has 15 turns of 1mm diameter enamelled or the circuit will not work properly. In addition to the power windings, T1 has a further pick-off coil of 15 turns of 0.25mm diameter wire over the centre of the coil in the neutral line. This connects to points A and B on the circuit board. The direction of this winding is not important.

The 1mm diameter wire is firm enough to support the toroids on its own (in fact, you'll need quite strong fingers to wind it into a neat coil) but holes have been provided on the PCB for strapping them down with cable ties, just to be sure.

Figure 4 shows details of the inlet and outlet cables and connections. A 2BA bolt and solder tag is used to earth the metal chassis of the case and to provide a connection point for all the earth wires. Strain relief grommets must be used on the panel cable holes to clamp the leads firmly in place.

The front panel is drilled with a line of holes at 0.2in intervals for the LEDs. I used 3mm round red LEDs in the prototype but there is no reason why you should not use other shapes or colours if you wish. The usual black mounting

clips can be used but they will have to be pared slightly with a sharp knife to fit the 0.2in spacing of the holes. Otherwise, you may prefer the appearance of the LEDs without clips.

Whether or not the clips are used, the LEDs should be stuck in place with epoxy resin so there is no possibility of the leads touching the panel or slipping through and becoming exposed.

The low voltage section of the circuit is not isolated from the mains, so for safety purposes must be thought of as being live.

When the LEDs and the inlet and outlet cables have been attached to their respective panels, you can solder the power connections to the PCB. The LEDs are best left unconnected until the case has been assembled, otherwise you won't know how short to trim the leads. Screw the chassis together, with the PCB resting on the bottom flanges of the side pieces. Turn the whole assembly over and check that there is enough clearance between the metal flanges and the pads and tracks of the PCB. Check also for solder blobs, untrimmed leads or any swarf on the flanges that might cause a short between the metal and the PCB tracks.

When you are sure that all is well, fit the chassis into the bottom section of the case and screw the PCB to the support pillars. The LED leads can now be trimmed to size and soldered to the header pins on the PCB.

All that remains is to put in the fuse, screw down the lid of the case, press in the rubber feet and

PARTS LIST

RESISTORS

R1, 2	220k 1/2W
R3	68 1W
R4	4k7
R5	100k
R6	47k
R7	10k
R8	27k

CAPACITORS

C1, 3, 10	10n class X2
C2, 4-6, 11	33n class X2
C7	100n class X2
C8, 9, 12 13	2n2 class Y
C14	330n class X2
C15	2,200µ 16V radial electrolytic
C16	10n ceramic
C17	2µ2 16V electrolytic
C18	2µ2 tant or 10µ electrolytic, 16V

SEMICONDUCTORS

IC1	LM358
IC2	LM3915
Q1, 2	FS40
D1-6	1N4001
VDR1-6	V250LA2, Mullard 593/4 series, or equivalent
LED1-10	3mm red LED
ZD1	12V 1.3W zener

MISCELLANEOUS

T1, 2	FX4054 coated toroid cores wound with 1mm and 0.25mm enamelled wire as per the text
FS1	PCB mounting fuse clips and 50mA fuse
PCB; case; 20-way right angle PCB header; mains plug; mains socket or multi-way connector; 0.75mm ² mains cable; strain relief grommets; LED clips; nuts and bolts.	

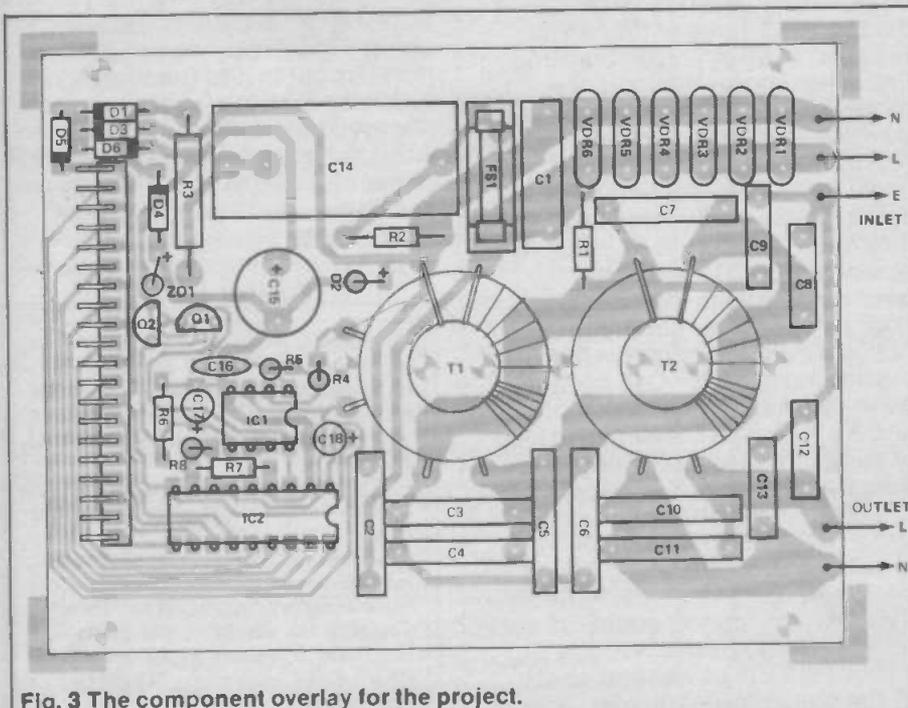


Fig. 3 The component overlay for the project.

your Power Conditioner is complete!

Testing

There is very little that could be wrong with the filter section of the circuit except for open or short circuits (you did check the PCB carefully, didn't you?)

Before plugging in, it's best to do a quick resistance check. Set your multimeter to a high resistance range and check the resistance between ground and live on the inlet lead, then between ground and neutral. Both should appear as an open circuit.

If there is any movement of the meter whatsoever, *don't attempt to use the conditioner*. Check the PCB again, check your input lead connections and if both of these seem OK, take out each Y-capacitor in turn and check its resistance. The fault can only be in one or other of these places, so you won't have far to look.

A resistance measurement between live and neutral on the inlet or outlet lead should show up a resistance of about 220k — the discharge resistor. If it is much below this (say, below about 180k, which could just be the result of resistor tolerance and meter inaccuracies) take out the fuse to the low voltage circuit and see if this makes any difference.

If not, check the PCB carefully and as a last resort check the resistance of each of the X-capacitors. A final possibility — if you've damaged the coating of the copper wire on the toroid coils and allowed the two coils to touch (I hope not!) this will also cause problems (to say the least!)

If all is well so far, check the continuity of the live, neutral and particularly the earth connections. (Check the resistance between the input earth and output earth and make sure it's zero and so on).

After making sure that there is a suitable fuse in the plug, apply power to the conditioner but don't plug anything into the output socket yet. You should see the LED display flick upwards as you turn on the power, then the LEDs will go out one by one until they are all extinguished. If you keep watching the display for a while, you'll probably see it flick upwards every now and again as the conditioner catches some interference. Even with nothing connected to the output, it still removes pollution and gives an indication of how much there is around.

If all the LEDs light up and remain lit, don't instantly conclude that there's something wrong. Take a look around and see if you can find anything that might be causing a lot of interference.

When I first tested the prototype in the ETI lab, all the LEDs lit up and I spent several minutes puzzling what could be wrong — everything seemed OK. Then the photocopier in the next room stopped printing...

Now is the time to find out how good a job you've made of winding the coils. Plug your hi-fi, TV set or whatever into the outlet socket and take another look at the LED display. The sensing circuit will always pick up a certain amount of 50Hz signal from slight imbalances in the inductor and from slight differences in the Y-capacitor values, but it should not be enough to swamp the display.

If most or all of the LEDs remain lit ten seconds or so after plugging something into the output socket, there is a good chance that you have one turn too

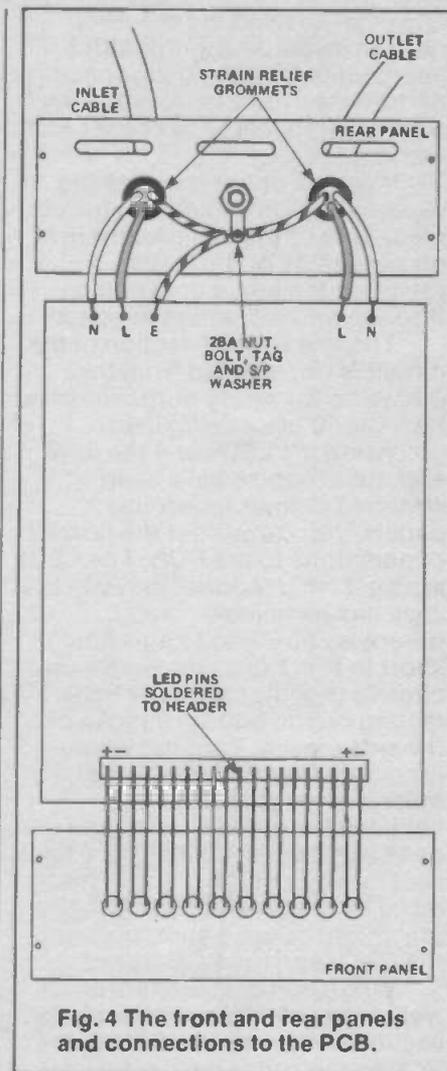


Fig. 4 The front and rear panels and connections to the PCB.

many or too few on one of the coils.

If one or two LEDs remain constantly lit, you can improve matters by adjusting the coils (or re-winding them if they're untidy!) or as an absolute desperation measure the value of R5 can be reduced to bring the display into line. The heavier the load, the more apparent any imbalances will be — an electric fire makes a good test load.

If the display section does not seem to be working properly, don't attempt to test it with its capacitor power supply. Remove all connections from the mains, set your bench power supply to about 16V, connect the negative lead to the negative lead of C15 and the positive lead to the junction of C14 and R3. Connect the negative lead of the multimeter to the negative terminal of your power supply.

Check the voltages on pins 9 and 3 of IC2. Both should be 12V (or within 1V either way). If both are higher, ZD1 is probably faulty. If only one is higher, check D5 or D6. If either or both are low, disconnect the power and check all the diodes (in particular, check they are the right way around).

Also check C15 and C18 and the PCB for shorts.

If the readings are OK so far, check the voltage at pins 6 and 7 of IC2 and pins 1, 2 and 3 of IC1. They should all be the same at about 6V. Touching a finger to pin 2 of IC1a should cause all the LEDs to light. Remove the finger and they should turn off one by one.

If this works but the display doesn't seem to pick up anything from the mains, check R4 and the connections to the pick-off coil.

If nothing happens at all, measure the voltage at the positive plate of C17 and see if it rises when you touch the IC pin. If not, check for a short in C17 (or a solder blob across its pads!) and the connections of Q1, Q2 and C16.

If the voltage across C17 rises, but the LEDs don't light, check the voltage at pin 5 of IC2. This should also rise. If not, IC1 is faulty. If it does rise but the LEDs don't light, check all the connections around IC2 and replace it if necessary. If the voltage across C17 remains high at all times (without the finger), suspect Q1, Q2 or C16.

Using The Conditioner

In the form presented so far, the Power Conditioner can be used with loads of up to 1.5kW. It will, in fact, cope with loads of 2kW intermittently — I tested the prototype by running it for an hour with a 2kW electric fire as a load. It didn't come to any harm but it did get rather hot!

Most domestic equipment will have a label or tag on it somewhere to say how much power it consumes. If you are using a multi-way output socket, don't forget to add the loading of all the equipment you have plugged into it.

As a very rough guide, a TV set consumes 100 to 150W, a 100W per channel hi-fi will consume about 300W with the volume

BUYLINES

The case is available from West Hyde Developments, toroids and X- and Y-rated capacitors from Farnell. The PCB can be obtained from our PCB service and other components from your usual supplier.

The plug, socket and mains cable is available from Woolies or from your local electrical shop.

A complete parts set for this project, including case, PCB, components, (but not the mains plug, socket and cable) is available for £28.50 + 60p postage + VAT from Specialist Semiconductors, Founders House, Redbrook, Monmouth, Gwent.

PROJECT: Power Conditioner

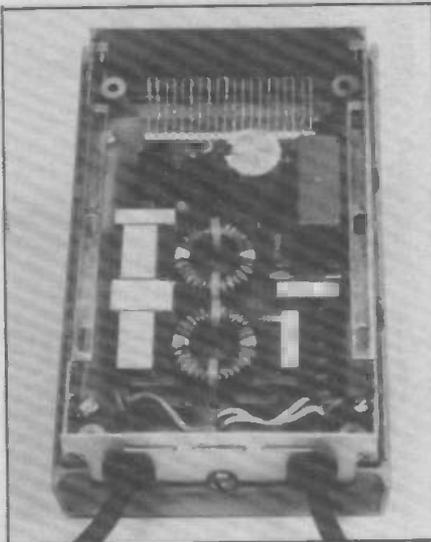
turned up to full blast, a home computer may be anywhere between 10W and 250W depending on whether it has its own screen, disc drives, or whatever.

It is also important to use mains cable that is suited to the load. To be on the safe side, you could wire the conditioner up immediately with 13A cable but it's wasted if you're only running small, sensitive devices.

The normal 0.5mm² mains flex will cope with loads of up to 750W total. The thicker 0.75mm² cable will be OK up to 1.5kW, so this is probably the best compromise.

Unless you intend to load it to the limit, a 5A fuse in the inlet plug is advisable. If you are in doubt about any of this, your local electrician who can advise you.

The conditioner will cope with all likely loads as it is (you don't really want to decontaminate the power to your electric fire, do you?) However, there are always one or two big-number enthusiasts who want to upgrade to the limit.



The way to do it is simply to use thicker wire to wind the toroids. You'll be faced with the option of using fewer turns (which is OK as long as all the coils have the same number, although lower frequency performance will be impaired) or of overlapping the turns slightly. I wish you luck!

If you do have an application for the higher current version, it

would be advisable to solder some thick copper wire along the main current carrying tracks (the wide ones) on the PCB.

Unless you can find a way of winding the coils evenly, or are willing to accept fewer turns, you will probably find the bar graph registering 50Hz pick up.

Reducing the value of R5 will prevent it from swamping the display, which will then be less sensitive but should still give a good indication of the suppression.

There is no lower limit to the value of R5 — it's up to you to choose a suitable compromise between rejection of unwanted pick up and display sensitivity.

In areas of high RF interference, it is a good idea to keep all leads after the conditioner as short as possible. Use the inlet lead to give you the reach you need, then keep the outlet leads trimmed short. Most of the time this will not be critical but it's worth bearing in mind if you live next door to a CB enthusiast.

Twelve-ten till we do it again, good buddies.

ETI

KEF CONSTRUCTOR SERIES SPEAKER KITS

Based on the famous Kef Reference Series, these three DIY designs give the home constructor the opportunity to own an upmarket pair of loudspeakers at a very down-to-earth price!

With a Wilmslow Audio Total Kit it's easy — no electronic

or woodworking skill is necessary. Each kit contains all the cabinet components (accurately machined from smooth MDF for easy assembly), speaker drive units, crossover networks, wadding, grille fabric, terminals, nuts, bolts etc.

Model CS1 is based on the Reference 101, CS3 is equivalent to the Ref. 103.2 and CS9 is based on the Reference 105.2 (but in a conventionally styled encl.).

CS1 £117 pair inc. VAT plus carr/ins £6
CS3 £143 pair inc. VAT plus carr/ins £12
CS9 £393 pair inc. VAT plus carr/ins £18

We also offer a kit (less cabinet) for Elector PL301

Lightning service on telephoned credit card orders!

WILMSLOW AUDIO LTD.

35/39 Church Street, Wilmslow, Cheshire
SK9 1AS Tel: 0625 529599

Call and see us for a great deal on HiFi.
(Closed all day Mondays)

DIY Speaker catalogue £1.50 post free (export \$6)

Zenith Electronics.®

Kits — Modules — Hardware

CHRISTMAS SPECIAL

10-Channel variable speed running light kit, drives LED's or Mains lamps - plus 2-FREE LED display boards and LED lamps. An ideal festive project.



The following are examples of our proven product designs

- ★ High quality touch dimmer 500W R/Built £12.99
 - ★ Selectable tone generator 9-12v operation £8.50
 - ★ 3 Note Electronic Door Chime unit; 9 volt operation, 3 melodious tones; variable frequency. Kit £9.83
 - ★ Miniature FM Transmitter; 60-145MHz. Kit £6.95
 - ★ R/Built £8.95
 - ★ 3 Watt FM Transmitter, 80-108MHz. Kit £13.99
 - ★ R/Built £18.99
 - ★ 300 Watt Light Dimmer unit for 240 volt mains lights. Kit £6.95
 - ★ 4 Code Digital Code unit plus Key Pad - select own code; 9 volt. Kit £15.95
 - ★ 5-100 Watt Electronic Loudspeaker Overload Protector, adjustable. Kit £11.11
 - ★ VU Meter 10 LED indicator; -5 to +12dB range. Kit £12.59
 - ★ Automatic light controller; automatically turns on and off lights at pre-set times and triggered by darkness. Kit £25.08
 - ★ Mains Wiring and Metal Detector. R/Built £11.00
 - ★ Zenith Speech Processor P-202 R/Built £25.00
 - ★ 18-Watt Car/Home Power Amp. 12-V. Kit £13.23
 - ★ Amplifier Power Meter; 10 LED indicator from 0.25-100 Watt Input - 9 volt operation. Kit £9.52
 - ★ Light sensitive relay unit; variable sensitivity trigger control; senses light or dark - selectable. Kit £8.45
- ALL KITS CONTAIN FULL INSTRUCTIONS; P.C.B.s AND COMPONENTS.
ALL PRICES INCLUDE VAT AND POSTAGE & PACKING.
OVERSEAS ORDERS—ADD 10% TO ABOVE PRICES.
PLEASE SEND CHEQUE OR POSTAL ORDERS WITH ORDER.

SAE For
-FREE-
Data Pack

Zenith Electronics, 14 Cortlandt Business Centre,
Hailsham, E. Sussex, U.K. BN27 1AE.
Tel: 0323 847973 Telex: 878334

RGB AUTO-DISSOLVE

Brighten your home with a kaleidoscope of colours from this novel lighting display from M P Horsey

The Auto Dissolve enables three coloured lights (or three sets of lights) to fade up and down in sequence, creating a wide variety of effects. When directed towards a white surface, the three colours — normally red, blue and green — mix to produce varying shades from green to cyan, blue, magenta, red, orange, yellow and back to green.

Four potentiometers and three presets are provided to set up the desired sequence and Fig. 1 shows the particularly pleasing effect achieved by placing a red light in channel 1, blue in channel 2 and green in channel 3 and by setting the controls as described later.

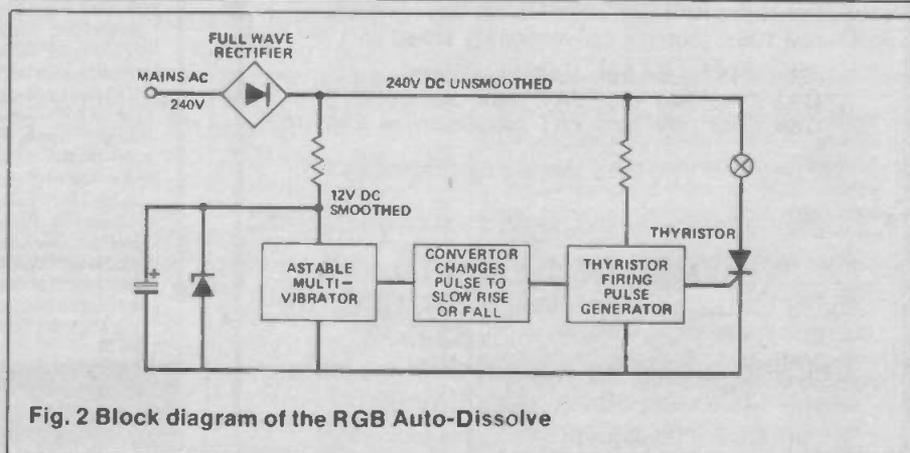
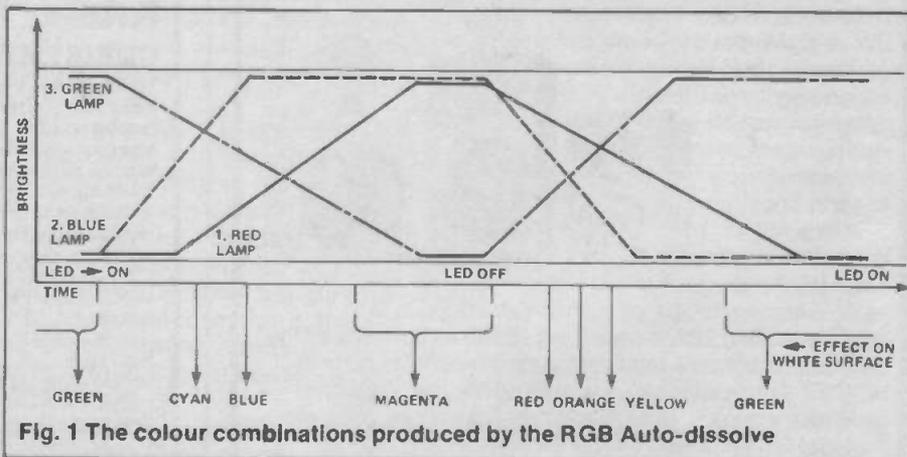
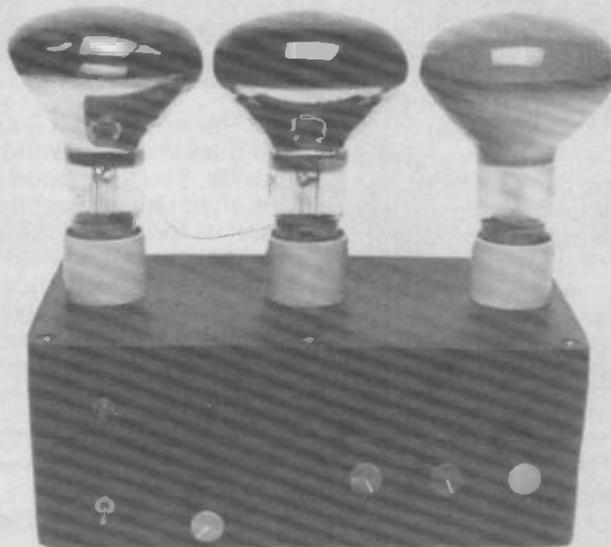
The unit is ideally suited to projecting on to a white ceiling and could be placed behind a piece of furniture with the light spilling up the wall. Alternatively it could be used with the spotlamps pointing towards the room, in which case an alternative choice of colours and settings could be tried.

Each channel is more than capable of handling the current required by a single spotlamp and the project will drive three sets of spotlamps if required.

The values in the circuit are calculated to produce quite a slow transition from one colour to another and the unit is at its most effective at slow settings.

The RGB Auto Dissolve relies on a thyristor dimmer controlling the light output of each of the three channels. The lamps are run on rectified mains at 240V DC to simplify the design and to use just one thyristor for each channel. These are controlled by separate triangular waveforms produced from and synchronised by a free-running oscillator (see Fig. 2).

The ramps for the red and blue channels are largely in phase but produce different rates of increase and decrease in brightness. The green channel is out of phase with



HOW IT WORKS

The circuit operates at two DC voltage levels — 240V for the mains coloured spot lamps and 12V for IC1 and the thyristor firing pulse circuits.

The AC mains enters via SW1, and fuse FS1, to full wave rectifying diodes D1 to D4.

The 12V power supply is derived via resistor R7 and zener diode ZD1. This diode maintains exactly 12V across smoothing capacitor C1 providing a smooth supply for IC1 and associated components.

The triggering circuit from RV5 onwards is best considered separately. It acts like a high quality manual dimmer circuit, with preset RV5 controlling the brightness of channel 1, RV6 for channel 2 and RV7 for channel 3.

This part of the circuit must be synchronised with the unsmoothed DC supply and this is achieved with transistors Q1 and Q3.

Resistors R2 and R1 form a potential divider so the voltage at the base of Q1 causes it to switch on at all times except when the 240V DC supply is at 0V.

So, the base of Q3 falls to zero whenever the 240V DC supply is not at zero, with the result that the presets and resistors R14, 16 18 are all connected to the 12V supply for a mains half cycle (See Fig. 4).

During this half cycle, current flows via preset RV5 and will charge capacitor C6. At a certain voltage the unijunction transistor Q4 will deliver a pulse from C6, via R20 to the gate of thyristor SCR1.

The point in each mains half cycle where this pulse will occur is determined

by the rate at which C6 charges and so by the setting of RV5. RV5 acts like a manual dimmer control, able to control the brightness of lamp LP1 from zero to virtually full power. Channels 2 and 3 work in a similar way.

In this circuit, RV5-7, are set to provide a low brightness level. Additional current flowing via diodes D7, 8 and 9 is used to charge capacitors C6-8 providing automatic control.

IC1 is the CMOS version of the NE555 timer IC and is wired as an oscillator. Output pin 3 changes state at an interval set by the values of resistor R3, variable resistor RV1 and capacitor C2.

The values chosen enable RV1 to select a time from a few seconds to several minutes. The IC is wired to produce an equal mark/space ratio. To achieve this, discharge pin 7 is ignored, and the resistor chain R3 and RV1 is connected to pin 3.

An LED is provided to monitor the output. This is useful when setting up and testing. As the supply current via R7 is limited, the value of R4 is calculated to pass a current of about 3mA. A standard red LED will operate on this rather low current but for best results a low current LED should be used.

So, the voltage at pin 3 of IC1 is switching between nearly zero and nearly 12V, at a rate determined by the setting of RV1. With output pin 3 at nearly zero volts, capacitors C3 and C4 will be fully discharged and no current will flow via diodes D7 or D8 so the lamps LP2 and LP3 will be at a low level determined by RV5 and RV6.

When output pin 3 goes high, current will flow via R5 and RV2, charging C3. As C3 charges, current will flow via R10 and D7 causing C6 to charge earlier in each mains half cycle and lamp LP2 to increase in brightness. The rate at which C3 charges is determined by the setting of variable resistor RV2. Channel 2 works in the same way, except that the value of C4 is half that of C3 and it will tend to charge more quickly. When output pin 3 goes low again, C3 and C4 will slowly discharge, causing the lamps LP2 and LP3 to fade.

When pin 3 goes high, channel 2 fades up first, followed by channel 1. When pin 3 goes low, channel 2 fades down first, again followed by channel 1.

Channel 3 works in reverse with transistor Q2 inverting the output at pin 3. With pin 3 low, Q2 will be switched off, and current will flow via resistor R8, RV4 and D6, to charge capacitor C5. As C5 charges, the current flowing via D9 will charge C8 more quickly and Q6 will fire SCR3 earlier in each half cycle.

When output pin 3 goes high, transistor Q2 turns on and the voltage at its collector falls to nearly zero. Capacitor C5 therefore discharges slowly, and lamp LP3 falls in brightness.

D5 is wired in parallel with R9 to allow C5 to charge more quickly than it discharges. This produces a more pleasing colour mixing effect. The value of R9 is chosen to match a slower range of settings of the circuit. If a higher speed is required R9 should be reduced in value, otherwise lamp LP3 will not have time to fade down properly.

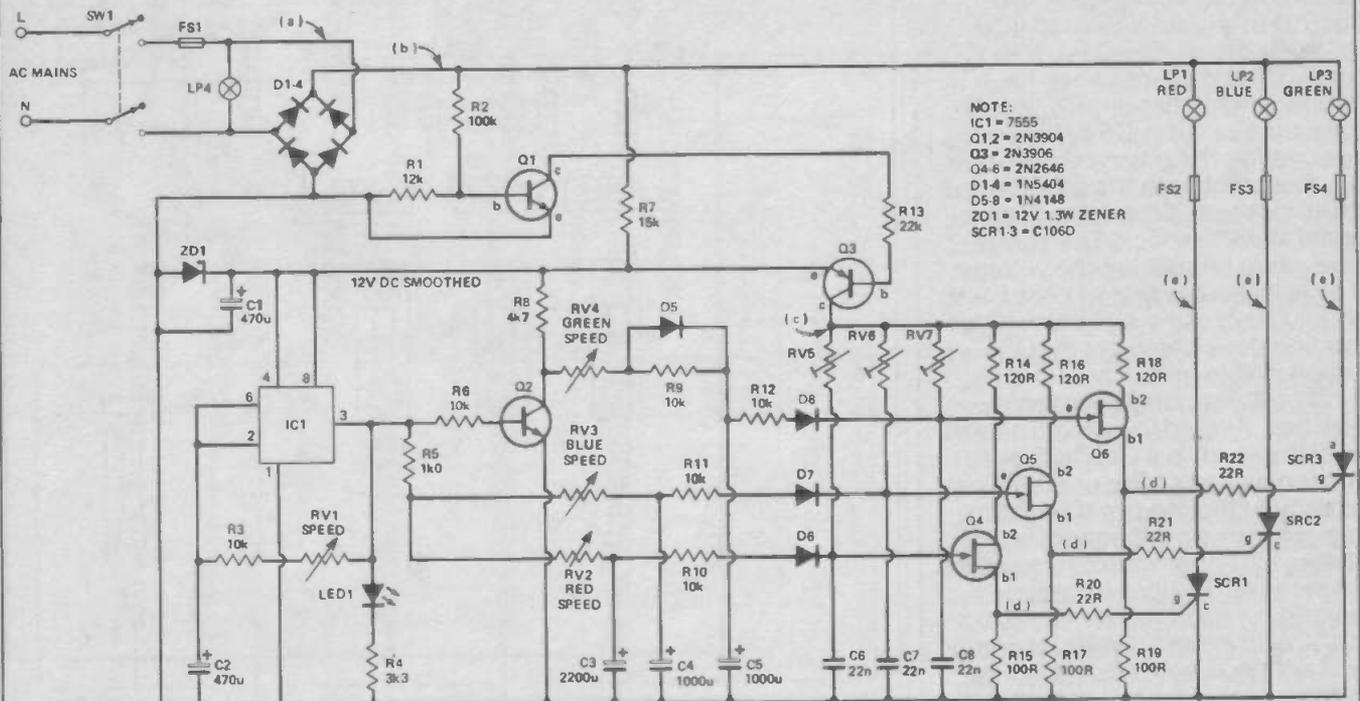


Fig. 3 The circuit diagram

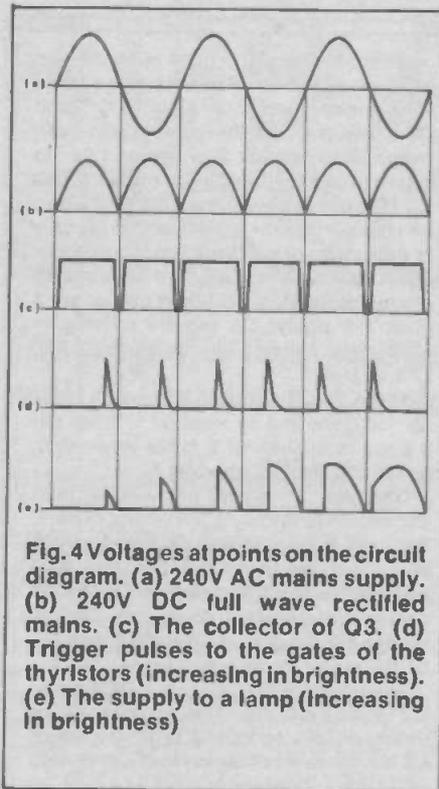
the other two.

The power supply for the whole unit is derived directly from the rectified mains and requires no transformer.

Construction

The circuit is constructed with the majority of components on one printed circuit board and the overlay is shown in Fig. 5. Note

that resistor R7 is rated at about 10W. If this type proves difficult to obtain, lower wattage types may be connected in series to make up the total required value. For



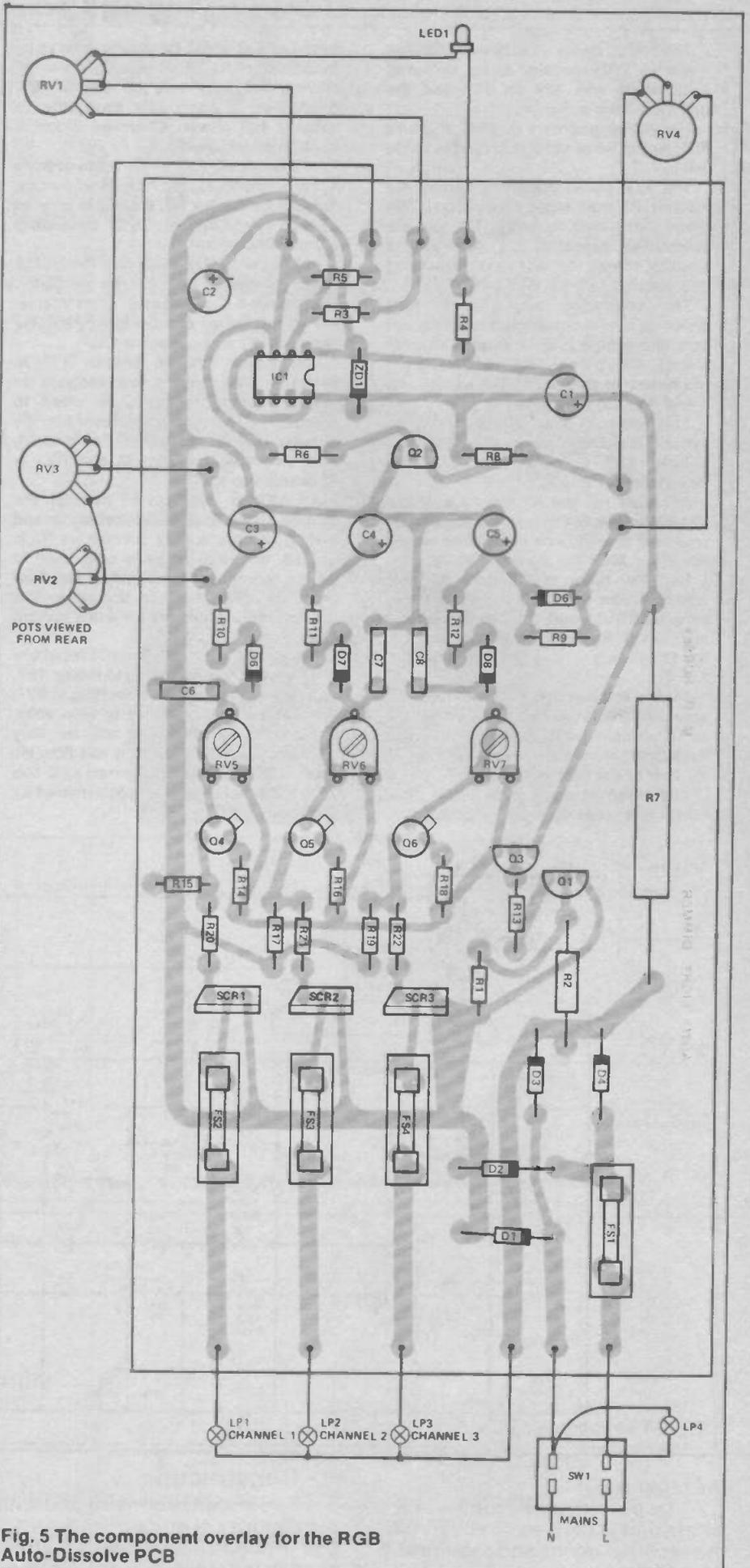
example, three 3W 4k7 resistors wired in series will achieve the same effect as the resistor specified. Resistor R2 should be a 1W type.

Failure to connect zener diode D5 properly will cause the low voltage supply rail to rise to a dangerous level. A precaution against this type of mishap is to solder in the diodes D1-4, the fuses, R7 and D5 and then to connect the mains supply to test the voltage across D5 before connecting the other components.

Note that both the positive and 'zero' sides of D5 can provide a lethal electric shock. Take great care when measuring the voltage. If all is well a reading of about 12V should be obtained. However, this reading does not imply that the circuit is safe to touch.

The other components may now be soldered in, using a socket for IC1 (which is a CMOS type to conserve power). Ensure that the polarity of the diodes, transistors and electrolytic capacitors is observed. The thyristors should be mounted vertically. No heat sinking is necessary for lamps up to 100W. If more powerful lighting sets are used, some heat sinking may be necessary but note that the metal tabs on the thyristors are live.

Complete the external connections to the potentiometers, switch and so forth and plug IC1 into its socket the correct way round.



PARTS LIST

RESISTORS (all 1/2 watt 5% unless stated)

R1	12k
R2	100k 1 watt
R3, 6, 9-12	10k
R4	3k3
R5	1k0
R7	15k 10 watt
R8	4k7
R13	22k
R14, 16, 18	120R
R15, 17, 19	100R
R20, 21, 22	22R
RV1	1M0 1in pot
RV2, 3, 4	100k 1in pot
RV5, 6, 7	470k horiz preset

CAPACITORS

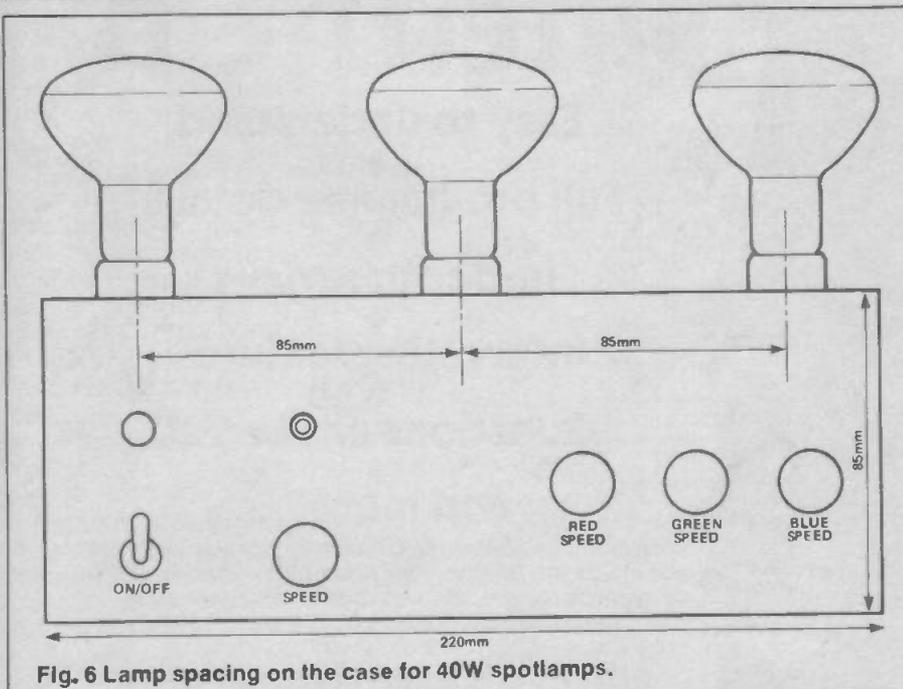
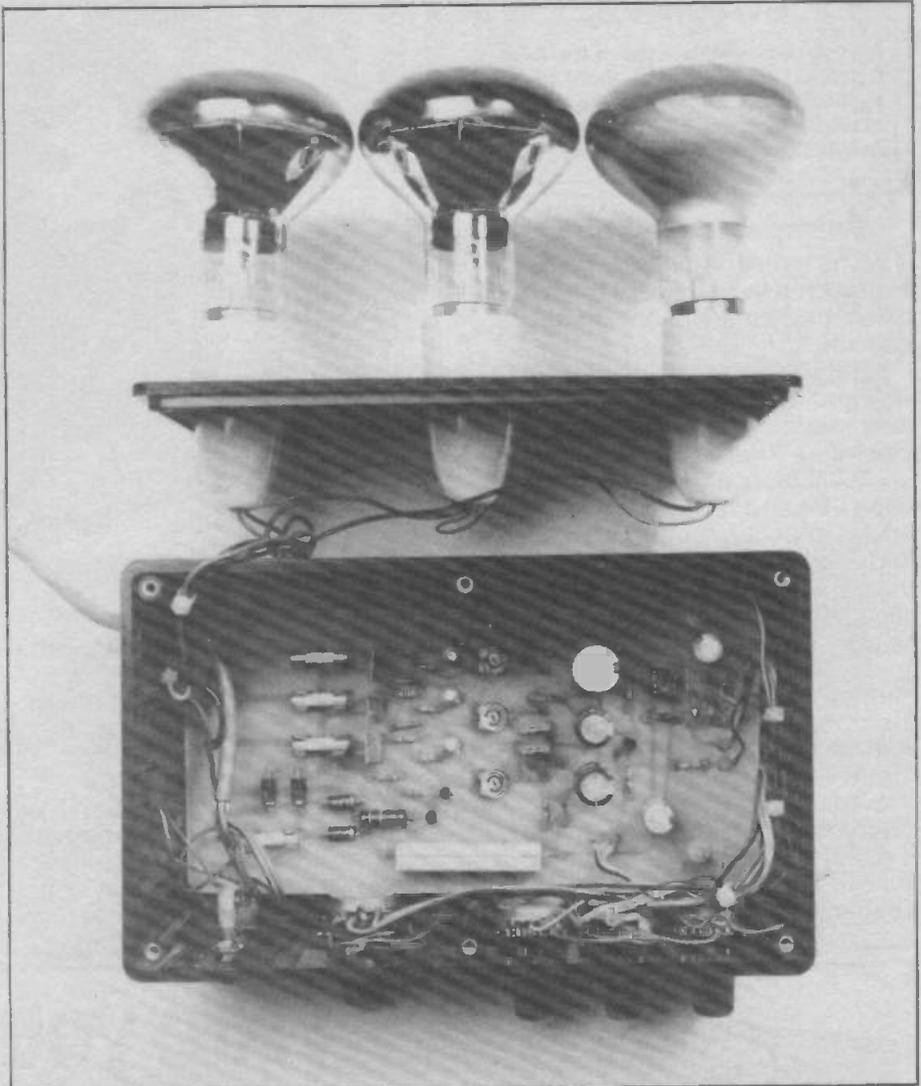
C1, 2	470µ 16V electrolytic
C3	2200µ 16V electrolytic
C4, 5	1000µ 16V electrolytic
C6, 7, 8	22n polyester

SEMICONDUCTORS

IC1	ICM7555 (CMOS 555)
SCR1-3	C106D
Q1, 2	2N3904
Q3	2N3906
Q4-6	2N2646
ZD1	12V 1.3W zener
D1-4	1N5404 (3A 400V)
D5-8	1N4148
LED1	red LED (low current type)

MISCELLANEOUS

FS1	3A fuse and fuseholder
FS2-4	1A fuse and fuseholder
LP1-3	coloured spotlamps (40W or 75W — see text)
SW1	DPST mains switch
PCB; case; IC socket; lamp sockets; knobs; wire; nuts and bolts.	



A plastic case measuring 220 x 130 x 85mm was used to house the prototype. Begin by drilling four holes to mount the PCB and the holes required in the front panel.

Ventilation holes, a side entry hole for the mains cable and possibly a cable for external lights are also required.

If the lamps are to be mounted

in the top, three large holes are required as shown in Fig. 6. If external lights are required as an alternative to, or in addition to the lamps shown, a small hole should be drilled to mount a four way terminal block.

A minor problem occurred in the prototype where the plastic ridges of the case prevented the switch and pots from fitting correctly with their threads right through the plastic. An old 25W soldering iron was used to melt the ridges near the holes and allow the threads to project correctly.

The spacing of the lamp-holders shown in Fig. 6 is suited to most 40W coloured spotlamps available. However, providing the centre lamp is a 40 watt type, the two outer lamps may be the larger 75W variety. Alternatively the lamps could be mounted elsewhere in which case three 75W or 100W lamps could be used.

The 75-40-75 watt arrangement is ideally suited towards red (outside) for channel 1, blue (outside) for channel 2, and green (in the centre) for channel 3.

BUYLINES

All the components used in the RGB Dissolve are available from usual suppliers such as Maplin. The PCB is available from the ETI PCB Service as detailed at the back of this issue.

Set-up And Testing

The entire circuit should be considered live and care must be taken, particularly when testing and adjusting the presets.

Set the presets to about mid-way and the potentiometers to their minimum values (fully clockwise if wired correctly).

Switch on, and ensure the neon LP4 and the LED both light up. If either fail, switch off at once and check for faults. If all is well, the LED should go out after a few seconds, then light up again, and so on.

Switch off SW1 and wait a minute or so for the capacitors to discharge. Now switch on SW1, wait for the LED to go out, then turn RV1 fully anticlockwise. Wait a few seconds for C3 and C4 to discharge, then adjust the presets RV5 and RV6 using an insulated screwdriver. RV6 should be adjusted so that the blue lamp



(channel 2) is just glowing. RV5 should be turned until the red lamp (channel 1) is just off.

Switch off SW1, and check that RV1 is still fully anticlockwise. Switch on SW1, and adjust preset RV7 to make the green light (channel 3) glow dimly.

Now check the operation of RV2, RV3 and RV4 noting that they should each control the speed at which their respective lamps fade up and down. Note however that resistor R9 increases the fade-

down time of channel 3.

The controls may now be set to achieve the correct balance, noting that slower rates provide the greatest colour effects when reflected from a white surface.

If the coloured spotlights are interchanged a different set of combinations is possible and it is well worth experimenting with a variety of settings of the controls.

ETI

FREE EACH MONTH WITH
OUT NOW AT YOUR LOCAL NEWSAGENT

Are you receiving it?

SATELLITE TV

Easy to understand

Full programme details

In-depth reviews

Interesting features

Questions answered

and more...

Each month this magazine contains all you need to know about Satellite TV – the latest news, hardware and programme reviews, answers to often-asked readers' questions, interesting features and a comprehensive programme listing for the next month's viewing.

YOU CAN'T AFFORD TO MISS IT!

video **Which**
TODAY **and Video?**

Argus Specialist Publications Ltd., No 1 Golden Square, London W1R 3AB

ELECTRONIC VIOLET

Ronald Alpair continues his search for the perfect musical instrument with a description of the stand-alone version of last month's Violet.

We met the BBC micro version of the Electronic Violet last month. For those readers who don't own a BBC micro and Music 5000 or who just want to get their teeth into a more complex version less reliant on the electronic efforts of others, this month we look at a stand-alone version providing a totally independent instrument.

The mechanics of the keyboard (or rather the fingerboard) for the instrument is constructed in the same way as described last month. Figure 1 serves as a remainder.

Each string has a potential drop along its length and when touched to the metal plate the voltage at that point is fed to the circuitry providing a pitch signal.

Each plate is mounted on pressure pads which change resistance as they are compressed. The alteration of voltage from these provides touch sensitivity signals.

In the stand-alone version of Electronic Violet, electronics replaces all the operations which were performed by the Ample program running on the BBC micro in last month's version. This version is entirely computer independent. It requires only a hi-fi or backline amplifier to form a complete instrument.

In the author's prototype, a separate circuit board is dedicated to each major function and the whole set of boards (nine altogether) are plugged into a rigid frame by means of plug-and-socket terminal blocks. The plug-and-socket sequence on each type of board is different, making it physically impossible to plug a board into the wrong frame location.

Each board is approx 6 x 4in and is cut from lengths of fibreglass stripboard (or 'Veroboard').

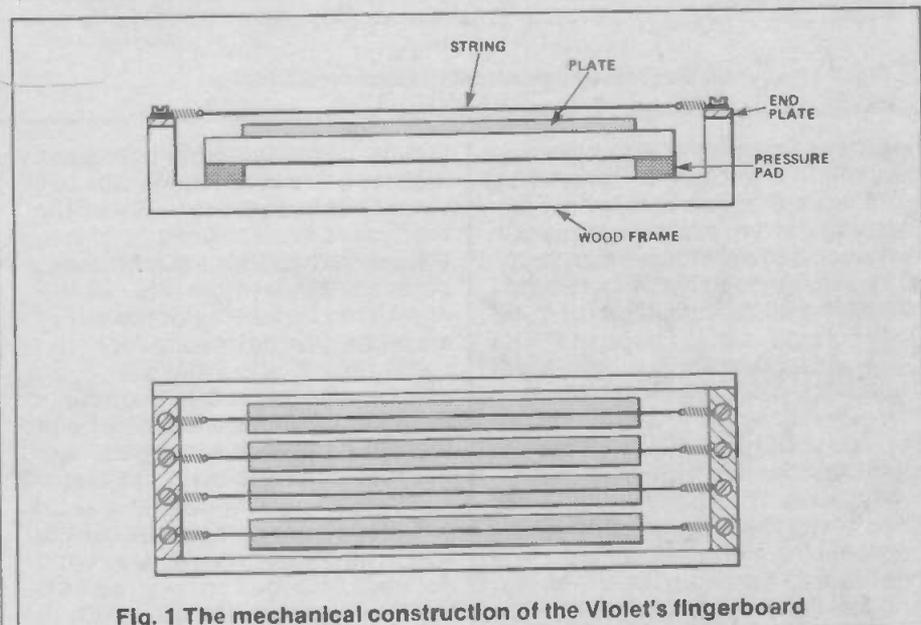
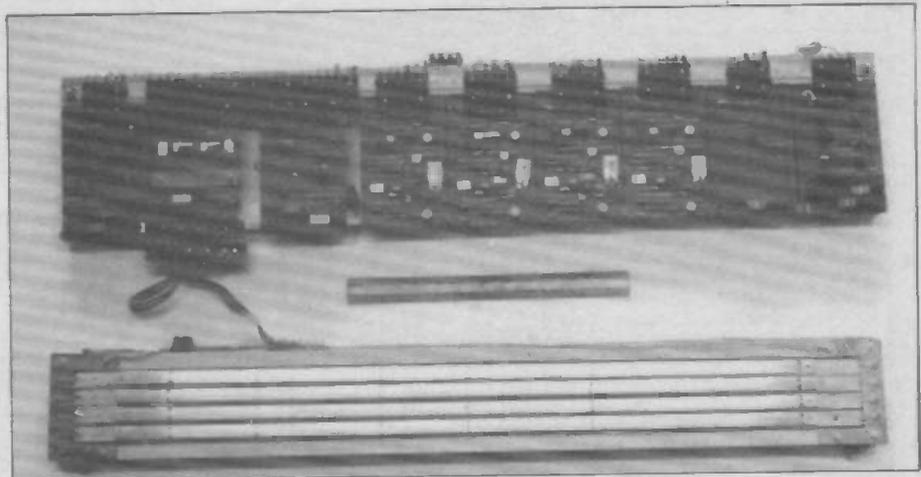


Fig. 1 The mechanical construction of the Violet's fingerboard

The plug-and-socket terminal blocks are screwed firmly along one 4in edge of each board or along both 4in edges in the case of the 'Test' board. This board interfaces with a matching terminal block and, via flat cable, to the fingerboard assembly.

Several boards also have slide pots along the other 4in edge, within easy reach of the player. These enable the instrument to be transposed in pitch, fine tuned,

and allow for setting of its degree of touch sensitivity, overall volume and tone.

Like the BBC micro version of the Electronic Violet, the stand-alone version is presented here in a very open-ended manner.

You can just construct what is given here on a series of stripboards, as did the author, and leave it at that but that is only half the fun! The Electronic Violet is a young invention and both an

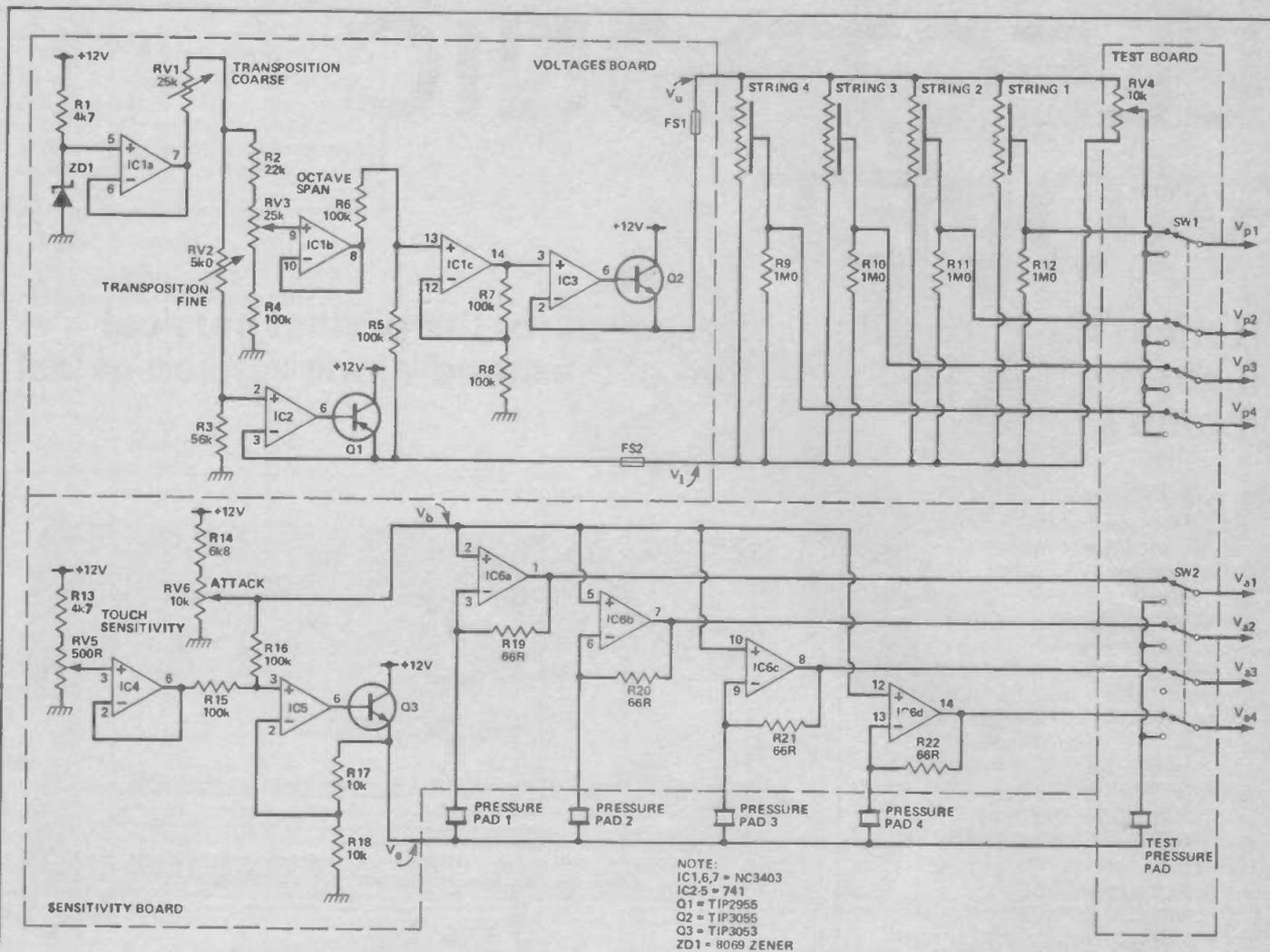


Fig. 2 The circuit diagram of the complete Electronic Violet

improved instrument and a great deal of fun is likely to arise from a bit of experimentation.

An external dual power supply is required to provide a balanced $\pm 12V$ at 2A to feed the fingerboard frame and all the op-amps.

The Voltages Board

The voltages board supplies stabilised but adjustable voltages V_i and V_u to the 'lower' and 'upper' ends of the four parallel strings. It contains three slide pots for coarse and fine adjustment of V_i and for fine adjustment of $(V_u - V_i)$.

The first two pots (RV1 and RV2) determine the transposition of the instrument (from the register of the cello up to that of the violin). The third pot (RV3) allows for adjustment of the span of an octave, normally covering 9in of the 30in string length.

V_i determines the lowest note playable on the strings while $(V_u - V_i)$ fixes the range of the strings and hence the spacing of octaves. To span the cello-violin

family, V_i is adjustable between 0.88 to 1.20V and $(V_u - V_i)$ can be varied between 0.8 to 0.96V so that the octave marks on the fingerboard produce pitches an octave apart.

As the resistance of the string assembly is only around $7R_0$, some 130mA of current is consumed. This is too much for ordinary op-amps which are therefore boosted with power output transistors on heatsinks.

Voltage reference ZD1 produces a very stable 1.2V from which all other voltages are derived. After buffering, one resistance chain (RV1-RV2-R3) generates V_i , which is again buffered and boosted by PNP power transistor Q1. It then proceeds to the fingerboard via a 500mA fuse.

The other resistance chain (R2-RV3-R4) generates $(V_u - V_i)$. This voltage is then added to V_i to give simply V_u . Again this is buffered and boosted, this time by an NPN power transistor Q2, before proceeding via a fuse to the fingerboard.

The Test Board

An optional but extremely convenient extra, this board enables the electronic performance of the circuit board assembly to be tested quite independently of the fingerboard.

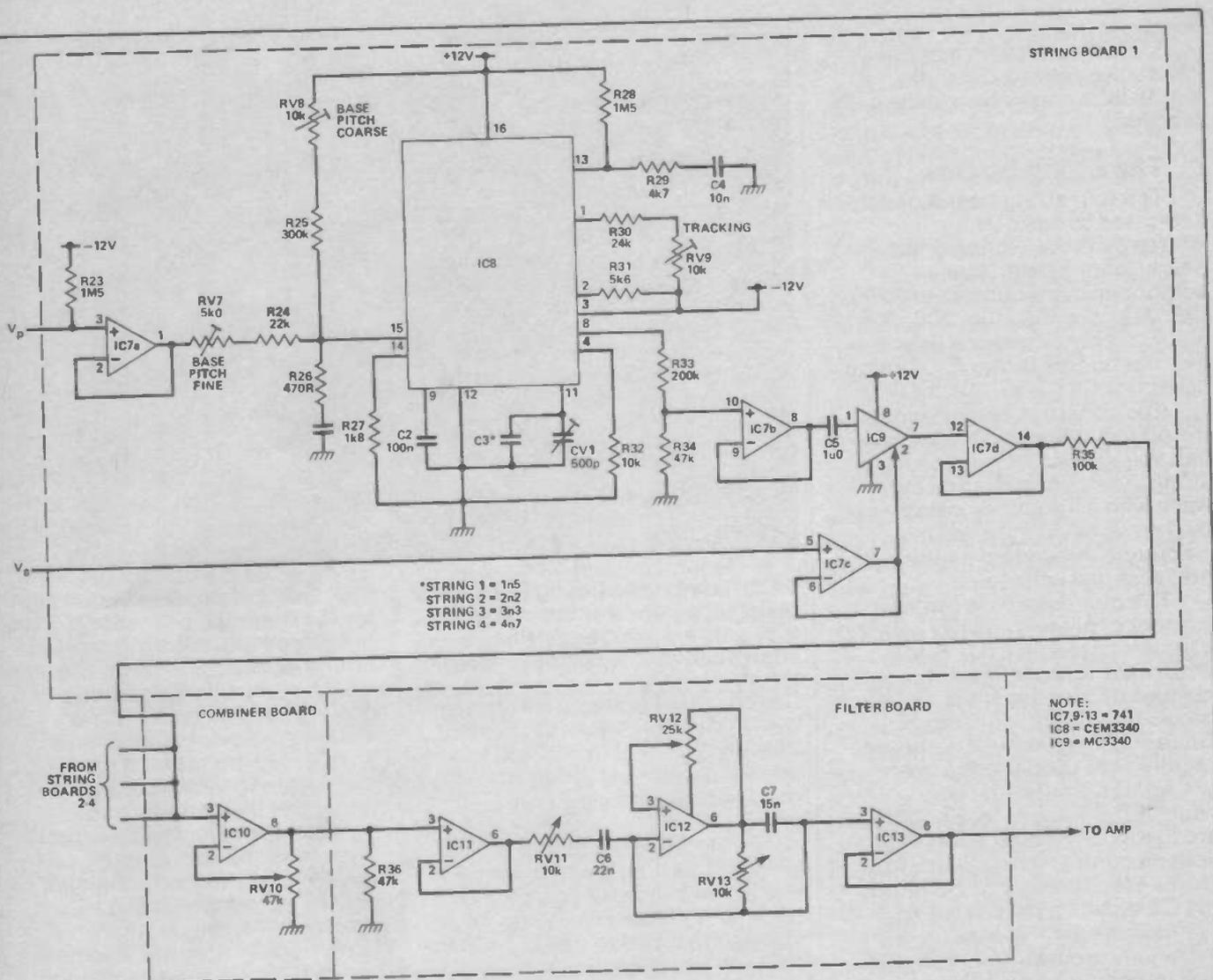
Two banks of four changeover DIL switches determine whether the pitch and amplitude signals for each string come from the fingerboard or from signals generated internally on the test board itself.

The 10k pot (RV4) generates an on-board pitch signal and a mock-up pressure pad unit also on the board produces the amplitude signal.

The Sensitivity Board

This provides stabilised but manually adjustable voltages to the four sets of pressure pads in the fingerboard assembly. The adjustment allows for variable attack and degree of touch sensitivity ranging from zero (touch insensitive) to maximum sensitivity.

PROJECT: Electronic Violet



The resistance of the pressure pad assemblies varies from about 1R0 (string pressed down fully) to infinity (string fully released). These resistance changes must be translated into voltages for the voltage controlled attenuator in the string board.

The attenuator requires a control voltage of about 5V to completely attenuate the input signal. At the other extreme, a control voltage of about 3.5V produces zero attenuation.

So we need a circuit in which a falling resistance produces a falling control voltage. This is accomplished by placing a voltage V_c on the base contact of the pressure pad and comparing (using IC6) the voltage on the upper contact of the pad with a slightly smaller voltage V_b .

The resistance chain R14-RV6 generates the comparison voltage V_b . This is fed to the positive input of op-amp IC6. It also goes to a second op-amp IC5 where it is added to a small difference voltage V_d (generated by the resistance chain R13-RV5). The resulting

voltage ($V_c = V_b + V_d$) feeds the base contact of the pressure pads.

The four op-amps of IC6 operate as comparators. Assuming a feedback resistor of R_f (R19-22) and a pressure pad resistance of R_p , the output voltage V_o of the comparator is given by: $V_o = V_b - V_d(R_f/R_p)$.

The best value for R_f will depend on the characteristics of the pressure pad material. With the prototype, R_p varies between 1R0 and effectively infinity, giving a suitable value of 66R for R_f and voltages $V_b=5V$ and $V_d=22mV$. This gives a range for V_o from 3.55 to 5V.

On the sensitivity board V_b and V_d are individually controlled by slide pots RV6 and RV5 respectively. The value of V_b determines how loud a note sounds with absolutely minimal finger pressure on the string. By means of V_b we can thus move from a smooth to a percussive attack.

If the attack is too smooth, the finger action is 'spongy' and the note does not sound till the string

has been pressed down a small distance.

This makes the performance of rapid passages difficult so at one stage a footswitch was added to the design with the effect of decreasing V_b and firming-up the attack phase of notes. This footswitch is depressed when individual notes require special accentuation, or when fast passages of music occur.

However, a similar effect can also be produced without using a footswitch, purely by finger techniques. The notes are 'rolled' rather than depressed. This causes the pressure pad to be slightly compressed before the resistance string contacts its base plate to produce the required pitch.

By adjusting V_d we can vary from a touch insensitive fingerboard to one with maximum sensitivity. It is inadvisable to make the action too touch sensitive because, although greater expression is offered, it requires careful finger discipline to produce a smooth legato

phrase.

Instead, start with a touch insensitive setting and only gradually increase sensitivity with practice.

The String Boards

The four string boards (each dedicated to one of the instrument's four strings) are nearly identical and the components are numbered R25, 125, 225, 325, C5, 105, 205, 305, etc. The only difference between the four boards is the VCO timing capacitor C3 (C103, C203, C303).

Each board takes two inputs, the pitch voltage (V_p) and pressure pad voltage (V_s) from its own string. The output is a sawtooth wave with a frequency determined by the pitch voltage and an amplitude dependent on the pressure pad voltage.

The boards each include a number of preset pots (RV7-9) and a trimmer capacitor (CV1) to ensure the four strings are accurately tuned to fifths and track precisely over their full range. Once set, these trimmers should require little further adjustment.

Apart from the timing capacitor C3, these four boards are identical. At their heart lies a voltage controlled oscillator from Curtis Electromusic Specialities, the CEM3340.

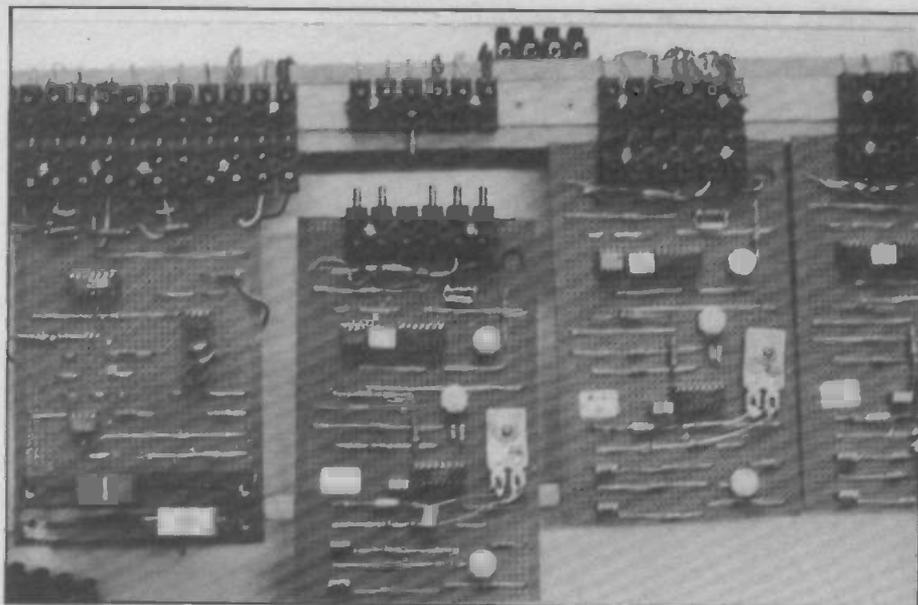
Essentially, this is an extremely precise, wide-ranging and temperature-stabilised converter, which translates linear changes of input voltage into exponential changes of output frequency. This exponential law is exactly what is needed to produce equal pitch ratios from equal displacements along the strings.

In other words, the exponential voltage controlled oscillator (VCO) gives us a linear fingerboard. As was explained last month, this fingerboard linearity is similar to that of conventional keyboards, as opposed to members of the fiddle and guitar family, where the higher notes are squeezed together.

The CEM3340

The VCO is a sophisticated IC and readers requiring a detailed description should study the helpful manufacturer's literature. However, a quick look is in order here. The supply voltages ($\pm 12V$ and $0V$) are supplied to pins 3, 12 and 16.

Pin 15 is the voltage control input to the VCO. It is derived from the buffered frequency signal, V_p , from the strings (via the test



board) and via buffering IC7a and resistance networks including two trim pots for coarse and fine adjustment of the bottom pitch of the string.

The input is also anchored to the $-12V$ supply via a $1M\Omega$ resistor. This ensures that oscillation is inhibited when the string is released, giving us a gateing effect.

Pin 11 provides tuning of the strings. The timing capacitor C3 is fine tuned by means of a parallel trimmer CV1. Since successive strings are tuned to musical fifths, the ratio of capacitors on successive boards should be 3:2. The series of standard values $1n5$,

$2n2$, $3n3$, $4n7$ come close enough for the trimming capacitor to iron out any errors, allowing accurate tuning of fifths.

The resistance chain and preset (RV9) on pins 1 and 2 enable the scale to be adjusted. This is very important if the four strings are to track accurately to fifths over their entire span.

We have selected a sawtooth wave from the four output waveforms (sawtooth, triangle, square, pulse) which this IC provides. Not only is it harmonically rich, it is also not unlike the relaxation oscillation produced by the bowing action on stretched strings.

PARTS LIST

RESISTORS

R1, 29, 129, 229, 329	4k7
R2, 24, 124, 224, 324	22k
R3	56k
R4-8, 15, 16, 35, 135, 235, 335	100k
R9-12	1M0
R13, 34, 134, 234, 334, 36	47k
R17, 18, 32, 132, 232, 332	10k
R19-22	66R
R23, 123, 223, 323, 28, 128, 228, 328	1M5
R25, 125, 225, 325	300K
R26, 126, 226, 326	470R
R27, 127, 227, 327	1k8
R30, 130, 230, 330	24k
R31, 131, 231, 331	5k6
R33, 133, 233, 333	200k
RV1, 3, 12	25k slide pot
RV2	5k0 slide pot
RV4, 6, 11, 13	10k slide pot
RV5	500R slide pot
RV7	5k0 preset
RV8, 9	10k preset
RV10	47k slide pot

CAPACITORS

C1, 101, 201, 301, 4	10n ceramic
C2, 102, 202, 302	100n ceramic
C3	1n5 ceramic
C103	2n2 ceramic
C203	3n3 ceramic
C303	4n7 ceramic
C5, 105, 205, 305	1 μ 0 tantalum
C6	22n ceramic
C7	15n ceramic
CV1	500p trimmer

SEMICONDUCTORS

IC1, 6, 7	MC3403
IC2-5, 7, 9-13	741
IC8	CEM3340
IC9	MC3340
Q1	TIP 2955
Q2	TIP3055
Q3	TIP3053
ZD1	8069

MISCELLANEOUS

FS1, 2	500mA fuse
SW1, 2	4 pole changeover
Circuit boards; wire; plates; resistance wire; pressure pad material; wooden frame; nuts and bolts.	

PROJECT: Electronic Violet

BUYLINES

The majority of components used to construct the Electronic Violet are easily available from usual suppliers (and the local hardware shop!) The CEM3340 VCO chip is the exception and not widely available. These may be obtained from Cicada Engineering, 54 Gibson Square, London N1 0QR.

The wave output is from pin 8 ranging from 0 to about 10V. This is too large for the attenuator (IC9) and is accordingly scaled down to a maximum of 2V by a resistor chain (R33-R34) before being buffered by IC7b and fed to the input IC9.

IC7c buffers the V_s signal from the pressure pads and feeds it to the control voltage at pin 2 of IC9. The output from IC9 is buffered by IC7d and fed to the combiner board.

Physically the string boards are the densest of all. It is well

worth investing some time and effort to design a nice clean layout.

The Combiner Board

This simple board combines the outputs of the four string boards into a single signal. It also includes a slide pot for overall volume setting.

In contrast to the preceding boards, this board is so simple as to hardly justify a board of its own. Indeed there is plenty of room on the next board to accommodate it. However, our modular design which allows alternative boards to be plugged in for experimental purposes dictates that logically different operations be physically separate.

Moreover, this 'additional' board produces a total frame width for the nine boards (36.25in) close to the width of the fingerboard assembly (36in), a

serendipitous source of aesthetic satisfaction!

The op-amp IC10 simply sums the outputs from the four string boards and for good measure a 50k pot (RV10) in its feedback loop provides a convenient overall volume control.

Bandpass Filter Board

The bandpass filter allows for great variations in the timbre of the instrument. Three slide pots control the position and depth (Q) of the passband.

In the prototype the critical capacitors (C6, 7) simply plug into IC sockets, enabling the values to be changed easily for experiment.

The signal is buffered before and after filtering by IC11 and IC13. A series RC filter (RV11-C6) operates on the negative input to filter op-amp IC12 with a parallel RC filter (RV13-C7) in the feedback loop.

For any input frequency, there are an infinite number of settings of the pots RV11, 12, 13 which will result in resonance instability.

No attempt has been made to modify the circuit so as to block such instabilities, as this would inevitably also delimit the very wide variety of effects of which this filter is capable.

The Last Word?

The Electronic Violet is merely the latest of a long line of predecessors, too numerous to count, which have been constructed over a decade or more.

Every year or so, the current model is dismembered, cannibalised, or left to haunt some dark cupboard or attic, awaiting the next domestic clearout and consignment to an overflowing rubbish skip.

A new model, often dramatically dissimilar from its parent takes its place for a few proud months in the living room. So it will go on.

Were I to reconstruct a new Violet today, I doubt it would resemble the instrument described here. The general principles may indeed survive, while successive reincarnations evolve in unexpected directions.

So, while recommending the underlying philosophy to readers, I am loathed to present the current design as a model to be slavishly copied. On the contrary, the author is eager to hear from any readers who develop the Violet in any direction.



ETI

TECH TIPS

CB Television Interference

A. Armstrong
Leighton Buzzard

Legal CB uses frequency modulation and is less likely than the old illegal variety to interfere with television reception. Problems can still occur but they will be different in character from those caused by any form of amplitude modulation, including SSB. In particular, the effect on TV picture or sound is unlikely to depend on the modulation.

Typically, the picture may change from colour to black and white, and/or may show diagonal lines. The sound is less likely to be affected, but it may be reduced in volume or suffer from a humming noise when the CB rig is transmitting. If a case of interference is identified, the first thing to do is to try to find out which route it is taking into the signal path of the television set.

The obvious first experiment is to disconnect the television aerial and find out if the CB transmitter is still

able to influence the television. You can't tell for certain that it is not because it may be necessary to have a picture to detect the problem. If, on the other hand, the transmitter is still affecting the television, then interference is probably getting in via the mains cable. In this case, a mains filter will probably cure the problem. In some cases, simply looping the mains cable a few times through a toroidal core can remove the interference.

If a mains filter does not cure the interference, even with the television aerial unplugged, the interfering signal is probably being picked up in the IF amplifier. This is unusual and can be virtually incurable. The first thing to try is repositioning the transmitting aerial. If that doesn't work you could always accidentally hit the TV with a 14 pound sledgehammer!

If the interference is found to be entering the set via the aerial lead, the next step is to find out precisely why. It might be that the connection to the aerial, the aerial plug or any intermediate connector, is corroded and is acting as a rectifier, which will work as a crude modulator and impress the CB signal on to the received television signal. A few minutes with a soldering iron will cure this.

It is more likely that the tuner itself is acting as a frequency multiplier to multiply the 27MHz signal up onto the UHF TV band. This is not surprising because the tuning is controlled by means of varicap diodes, which are specifically used as high efficiency frequency multipliers in another guise. If this is happening, the answer is to use an inline filter tuned to reject CB frequencies while providing minimal attenuation at UHF. Such filters are not costly to purchase but if you wish to make your own, fit a parallel tuned circuit tuned to citizens band in series with the inner conductor of the aerial lead. The circuit should be tunable by means of a preset capacitor. Adjust this to eliminate interference while the CB transmitter is running.

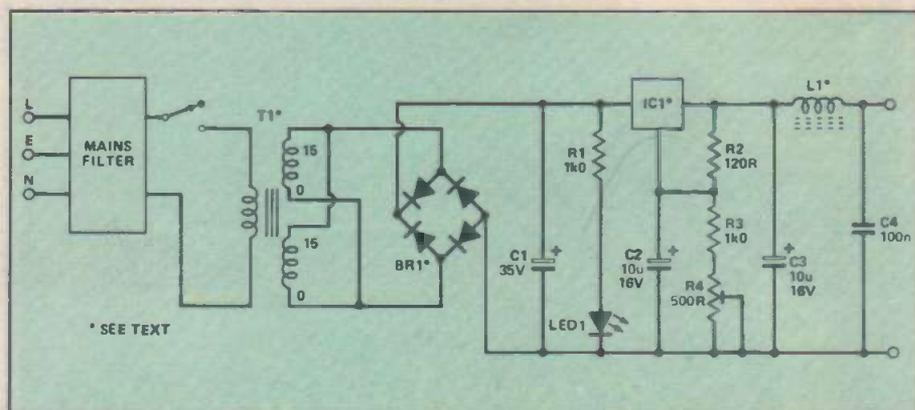
There is one situation in which this may not work as expected. If a masthead aerial pre-amplifier is in use, the CB signal may be overloading that and causing it to generate spurious frequencies. In this case, the CB filter should be inserted between the aerial and the preamp. If this is outside then the filter must be waterproofed very carefully because a box full of water will eliminate the interference and the TV signal impartially!

CB Homebase Power Supply

A. Armstrong
Leighton Buzzard

Here is a simple power supply design which can be adapted for different load currents. All the components marked with an asterisk should be chosen for the load current required. The available current ranges are set by conveniently available types of voltage regulator IC. This circuit is designed to use an LM317T for up to 1.5A, and an LM338K for 1.5A to 5A.

When a transformer is used on a rectifier and capacitor load, it should not be expected to provide as much current as its VA rating might suggest. In most applications a reasonable limit is to draw a direct current of $\frac{2}{3}$ the AC rating if a bridge



rectifier configuration is used and under half the AC rating if a dual half wave rectifier configuration is used.

In this design, a load current of 1.5A would seem to require a transformer rated at 33.75VA but it would be reasonable to use a 30VA toroidal transformer. Toroidal transformers do not exhibit as much sag as conventional types and the maximum current is only drawn when

transmitting so the heating of the transformer will not be excessive. However, the bridge rectifier should be rated at the full 1.5A.

The choice of the value of C1 is a compromise between a monster sized component and excessive ripple. A reasonable value would be 4700 μ , which will give a ripple of just under 3V at maximum load. This is cutting things a little fine to avoid

Guitar Pick-up Switching

M. Mullen
Glasgow

This circuit gives a unique type of switching arrangement to any electric guitar employing three electromagnetic pickups. Eleven different arrangements of individual or combined pickups are made available using this system. The switching facilities are as follows:

- any one pickup from three can be individually selected.
- any combination of two pickups from three, either in series or in parallel can be selected.
- all three pickups, either in series or in parallel can be selected.

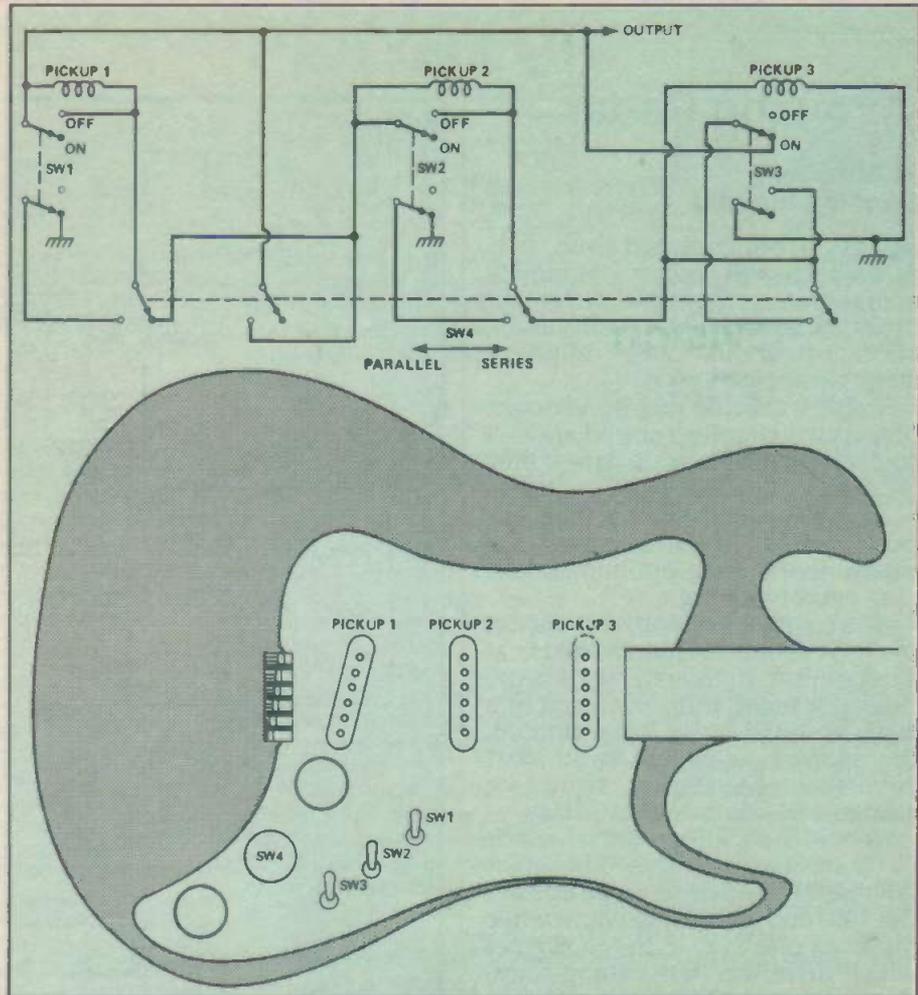
These switching arrangements provide a wide range of tonal variation, ranging from a sharp hard treble to a very rich mellow sound.

An additional advantage is that the system employs no active electronics, the switching components consisting of just three double-pole changeover toggle switches and one four-pole, two-way rotary switch.

The three toggle switches SW1,2,3 function as on-off switches for pickups 1, 2 and 3, respectively.

This arrangement allows any one, two or all three of the pickups to be selected depending on which of the three switches are down in the on position.

Switch SW4 has two positions.



One position connects the pickups in a parallel configuration and the other position connects them in a series configuration. This arrangement applies no matter which combination of two or three pickups are selected by the toggle switches.

In addition, any single pickup can

be individually selected regardless of whether the switch, SW4 is in the parallel or the series position.

The output from the pickups and switching circuit is connected, in the conventional manner, to the guitar's own volume and tone control circuitry.

regulator dropout and a minority of units may exhibit this problem at maximum load. If this does occur, use a second 4700 μ capacitor in parallel with C1 to remove the problem.

If a 5A current rating is required then a higher transformer voltage must be used because it will be necessary to allow a higher ripple voltage on C1 to keep the required value within bounds. A transformer with two 9V secondaries connected in series would be suitable or, of course, two 18V secondaries in parallel. A rating of 135VA would seem to be required but once again it is probably reasonable to use a standard 120VA transformer so long as full load is applied only intermittently. Once again, the bridge rectifier must be rated for the full 5A and it should be mounted on the metal case to dissipate the heat.

If a 15000 μ capacitor is used for C1, the ripple will be just over 3V at full load, which should pose no

problems.

The voltage regulator, ICI, should be mounted on a heatsink. A fairly small heatsink will do for the 1.5A option but a much larger one will be needed for 5A because of the higher voltage on C1. For the LM317T running at 1.5A max, Electromail type 402-995 rated at 6.8 $^{\circ}$ C/W should be adequate, particularly if it is mounted on a metal box which will provide a little extra heatsink capacity. For the LM338K running at 5A, a heatsink of 1.5 $^{\circ}$ C/W or better should be used. Electromail type 403-083 would be suitable but type 401-807 would be better and more compact.

Inductive filtering is shown on the output of the power supply. This has two purposes. One is to remove any switching noise which may be generated by the rectifier, to avoid interference to the rig. L1 and C4 also prevent RF being picked up on the output lead and interfering with the operation of the voltage regulator. L1

should be about 20 turns of 1mm wire wound on a length of ferrite rod. Ideally, C4 should be connected directly across the output terminals.

A mains filter is also shown. Either a filtered IEC input connector may be used or the ETI mains filter would be suitable. For the reasons mentioned above, it is necessary to prevent radio frequency interference from entering or leaving the power supply box.

The unit must be constructed in a metal case to provide both screening and heatsinking. The LED should be mounted on the front panel to indicate power on. A neon is not used, to avoid the radio interference which they usually generate.

When the supply has been built, it should be adjusted to provide an output of 13V5. Most rigs are rated to give maximum output at 13V8, but reducing the voltage by 0V3 will allow a small margin for error or drift, while not affecting the output significantly.

Acoustic Radar

A. Armstrong
Leighton Buzzard

Not to be confused with bats (which the author is rapidly going) this is a simple system to provide a quantised range discrimination of acoustically reflective targets.

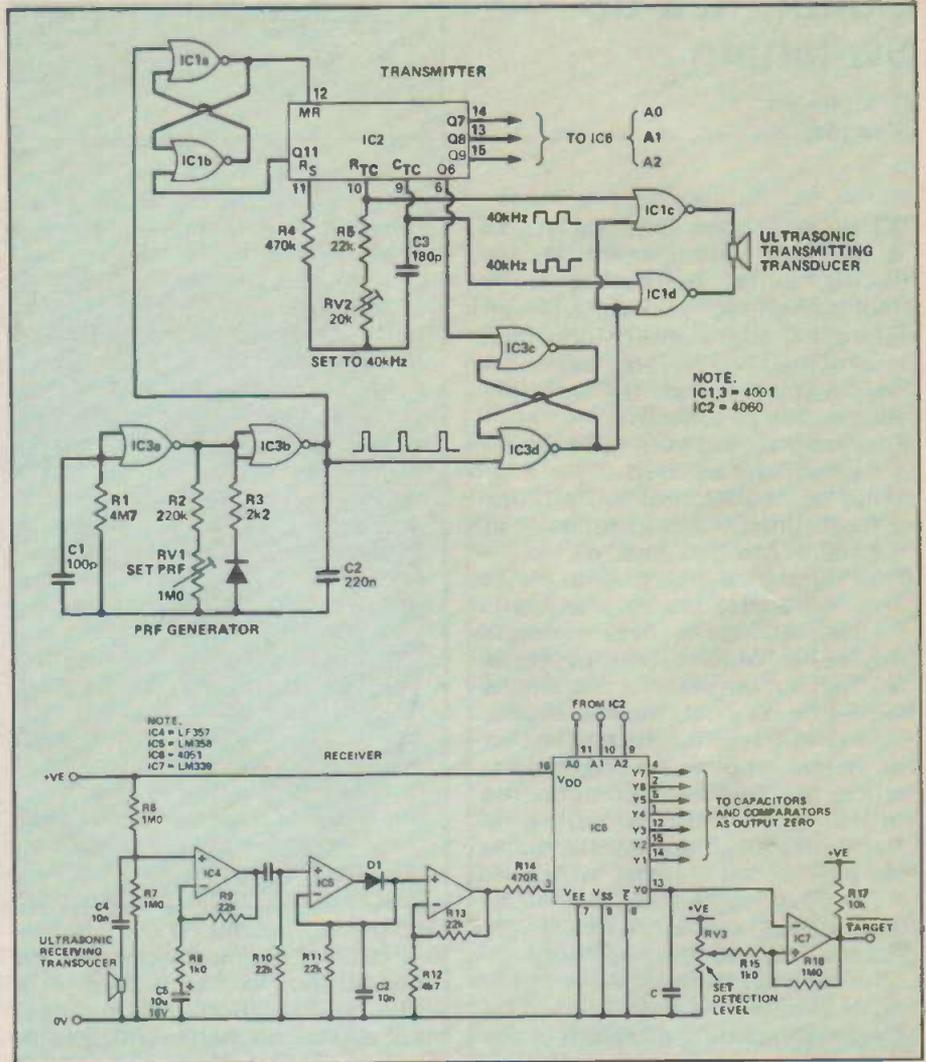
To put it another way, it will detect objects which reflect sound and tell you which ranges of distance they fall into.

Not every part of the idea has been tested. It is intended for experiment and component values may need tweaking.

The transmitter sends out a short burst of sound frequency 40kHz at a repetition frequency set by the oscillator made from two parts of a 4001. After the pulse is transmitted, the address signal fed to the 4051 counts round so received signals are graded according to their delay.

When the PRF generator sends out a short pulse, the two bistables are reset. The upper bistable enables the 4060 and allows it to count while the lower one enables the NOR gates which drive the transmitting transducer. The lower bistable is set when the Q_6 output of the 4060 switches to logic one for the first time. This sets the pulse length for a given range by moving this connection. Outputs Q_7 , Q_8 and Q_9 switch the address lines of the 4051 data selector to route signals with different delays to different comparators for detection.

When the Q_{11} output of the 4060 switches to logic one, the upper bistable is set and the 4060 is held reset. Unfortunately, because there is not a Q_{10} output, the address of the 4051 is cycled round twice, but this is not likely to matter as later



reflections are likely to be very weak. If it is a problem, a three input AND gate could be used to decode address 111 and set the bistable. This, however, will gate off the last channel as soon as it is switched on, so the longest range detector will do nothing. More complex solutions are unlikely to be worthwhile.

The receiver itself consists of a fast

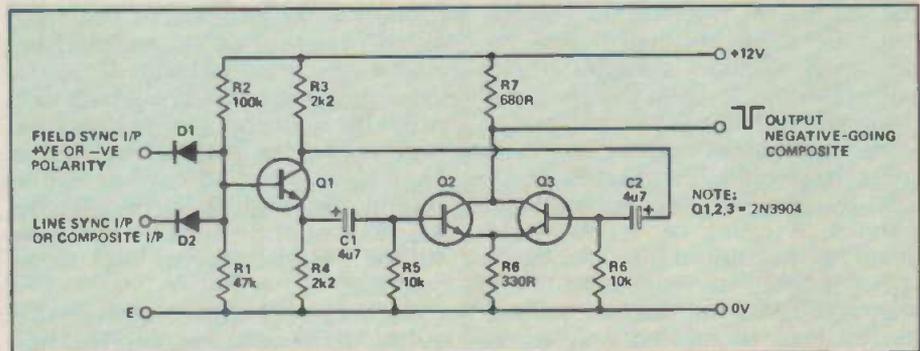
op-amp used to provide gain at 40kHz, followed by a half wave precision rectifier and a buffer with gain. The gain of this should be altered by changing the feed-back resistors to suit the signal levels found in practice. The capacitors on the output of the 4051 average the target over several scans and their value can be chosen by experiment.

VDU Sync Sorter

L. Sage
Bingley

The circuit will accept either positive or negative sync pulses, and either composite or separate line and field sync, at TTL or CMOS levels. It produces a negative-going composite sync output. This greatly enhances the versatility of a monitor allowing it to be connected to a wide variety of different signal sources without the need to fiddle with sync switching.

This is particularly useful for schools and colleges where the person setting up or operating the video equipment may not be tech-



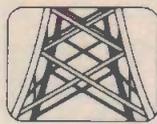
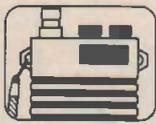
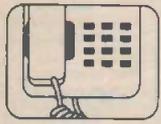
nical and just expects the various pieces of equipment to work without adjustment when connected up.

Separate line and field sync pulses are fed to Q1 via the two diodes. These isolate the pulse sources ensuring they cannot interact with

each other. Q1 is connected as a phase splitter and together with the bias at the base D1,2 set the sync slicing level at around 2.7V. Opposite polarity sync pulses appear at the collector and emitter of Q1. Q2,3 are biased off.

ETI

OPEN CHANNEL



A funny thing happened to me on the way to the office. A little bird told me a story that I couldn't ignore. I'd been doing a lot of research for the article on satellite television and the little bird was a senior manager of a large satellite supply concern.

As far as he was concerned he had no axe to grind and so I could do nothing but take the matter as fact. He told me that the arrangements for obtaining and paying for a licence to receive satellite broadcast television pictures was set to change - dramatically!

The present system involves the user applying for a TVRO (television receiver only) licence direct from the Radio-communications Division of the DTI.

A single payment of £10 secures the licence and it is valid indefinitely.

The changes which my little bird had heard were that the licence would be only valid for one year and would cost a 'minimum of £70'. In other words, the licence is to be similar to the yearly licence required for terrestrial television services.

If this change is to take place, it means two main things. First, and most important as far as the user is concerned, it's an added expense to an already quite expensive system. As it would be paid every year, the expense is with the user for life - even before the user switches the system on, the standard television licence and the TVRP licence must be paid (a total of about £140) each year.

Second, and quite sinister, the money paid by users either goes to the Government's coffers or (more probably) to fund a specific broadcasting organisation (or organisations) much as the terrestrial licence funds the BBC.

I started some investigations with the Department of Trade and Industry, to see if this rumour could be confirmed or denied. Here, my source said he had no knowledge of the present arrangement being changed. In his own words, there is a possibility the rumour started after someone had overheard two ministers chatting in the toilets about the necessity of a yearly licence. In which case, I can only take this to mean that the rumour may well be true.

If it is true then who is to be funded by the licence fee?

Surely not Aunty Beeb, because they are already funded by the terrestrial licence. Then who? British Satellite Broadcasting, who is running the British DBS system?

I have an open mind at present about the possible change. On the one hand I can't personally see why the status quo needs to be changed. It doesn't follow the rules of common sense. On the other hand, when has common sense ever prevailed where Governments and revenue are concerned?

Look, No Wires

Cordless phones have become quite commonplace over the last couple of years, with consequent price drops and raging competition by the leading manufacturers.

Such a healthy market would lead one to assume that all is well with these devices and that most manufacturers would not tamper with the successful formula. Even so, the 'second generation' (nicknamed CT2) of cordless phones is likely to be with us in a fairly short time.

Some readers may have heard the name of Sir Clive Sinclair before! One of the companies under the Sinclair Research umbrella, Shaye Communications, is heavily into CT2 and hopes to launch a model later this year.

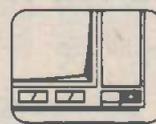
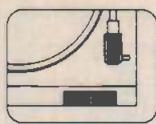
CT2 phones are digital and will operate in the same frequency range as current cellular radio phones (around 900MHz) so high quality reproduction will be possible, given the limits of the telephone network they will be connected to. The Shaye version of CT2 phones will also feature a Mercury button, to connect the phone onto Mercury's digital network.

Although the first CT2 phone to hit the marketplace will be a single-line device - they connect one user with one exchange line - the future for cordless phones will be more as PABX (private automatic branch exchange) replacing current switchboards in small offices.

Each employee who would normally have a desk-based telephone, will have a pocket-sized cordless CT2 phone and will be able to take incoming calls and make outgoing calls on it.

Keith Brindley

PLAYBACK



This month I shall take a look at cassette recorders. Not the fancy new digital jobs but the pedestrian old analogue variety, which I believe has life in it yet.

The cassette is really an example of advancing technology (and public demand) turning a simple idea upside down. Originally, Phillips designed a recording system for speech - for dictaphone use and the like. People soon started to use it for recording music because it was small and convenient.

Demand soon persuaded manufacturers to make slightly better quality recorders (still in mono) which in turn stimulated more demand.

Phillips' decision to allow other manufacturers to produce cassettes and machines conforming to the standard, was no doubt a great help in establishing it.

Initially, the frequency response was very limited, tape hiss was at a high level and the maximum recording level wasn't. There was, however, a small range of recording levels in the middle where the music was louder than the hiss but not quite loud enough to overload and distort.

Modern cassette recorders give vastly better performance and the best of them are so good that a Dolby C recording of a compact disc is, for many people, indistinguishable from the original.

Many special qualities and features are claimed for one machine or another, so how can one decide what is important and what is frippery? This matter is further complicated by the tendency for features which add quality in well engineered machines to detract from the performance of poorer ones.

Dolby

Not a lot of people know this, but Dolby B can make worse the sound from a poor quality or badly adjusted machine and Dolby C can totally ruin it!

Dolby is a compression/expansion system which boosts weak treble during recording and cuts it (and the hiss) down again on replay.

To reverse the process accurately on replay, the recorded level and frequency response must match that for which the Dolby was calibrated.

Errors in frequency response or in overall signal level on the tape cause bigger inaccuracies in the decoding process. A slight deficiency in treble without Dolby can be multiplied by the Dolby to give very little treble at all.

Dolby C does much the same as Dolby B but more so. Not only does it compress a treble band but also a middle range of frequencies.

This pretty well guarantees that when the signal in a particular frequency range is not loud enough to mask the normal level of tape noise, the noise had been cut down to inaudible levels. Inevitably, errors in the recording process are accentuated more by Dolby C than by Dolby B.

To make good use of Dolby (especially Dolby C) a recorder must be able to record onto the tape the right signal levels, at all frequencies, for the system to function properly.

Calibration

If a machine is calibrated to do this with one brand of tape, the chances are that it will not accurately match another brand unless it can be readjusted. Both the post Dolby record level (nothing to do with the record level control on the front panel) and the bias may need to be readjusted to suit different tapes.

Some machines have a manual bias adjustment on the front panel and some feature automatic adjustment under microprocessor control. Rarely is the post Dolby record level adjustable by the user but it is often included in the adjustments carried out by a microprocessor adjustment system.

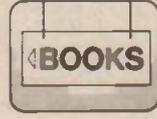
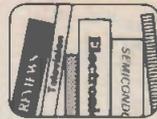
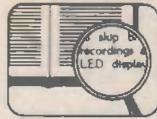
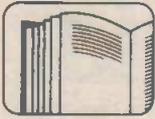
Unless the machine is only to be used with one type of tape (and so long as the manufacturers don't change the formula!) I would consider some form of calibration adjustment almost essential to get the best from Dolby.

Incidentally, for those machines requiring manual bias adjustment, the interstation hiss from an FM tuner is a good test signal to check that the replay sounds like the original. Small inaccuracies are easily audible with this type of noise.

Some machines provide a built in test tone generator for this purpose.

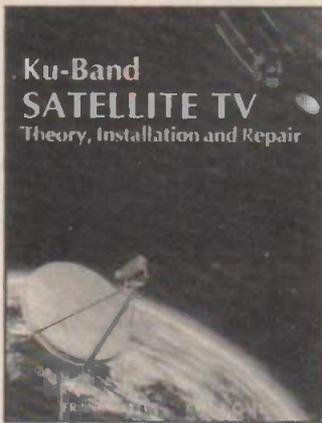
Andrew Armstrong

BOOK LOOK



With the article on satellite television elsewhere in this issue, you might be forgiven for thinking there is little more you need to know about the subject. However, these two books available from the publishers of *Satellite TV Europe* - the TV Times of the satellite world - show just how much there is to know if you want to.

Ku-band Satellite TV - Theory, Installation and Repair by Frank Baylin and Brent Gale (Baylin Gale Productions) £29.95.



A mammoth work, this, with a mammoth price too. However, I've yet to see another single book which contains so much information over such a range as this.

Now, I know most of the superficial theory of satellite TV broadcast and reception. I know much of the jargon and I'm saving busily for the price of a decent system! Nevertheless, despite my vast experience(!) this book held me relatively spellbound.

I say only 'relatively' because this is not really a book for bedtime reading. It is not a book to read from cover to cover - not only because the covers are separated by a phenomenal amount of information but also because this is a reference work.

Despite the title, this book is not divided into three simple sections. In fact there are nine sections and a useful set of appendices crammed into the 350-odd pages.

The book starts with the basic theory of satellite TV broadcast and reception. Everything from microwaves to footprints are covered here.

In the second section it's the turn of the individual com-

ponents of a TVRO system - not only the antenna, LNB and receiver but the mount, actuator, feedhorn, power supply, even the co-ax cable is fully described, evaluated and the maths of its operation given.

The operation of every item in the chain from the dish surface to the TV picture and sound is investigated here.

The next section looks at the ku-band itself. If you want to get lost in rain attenuation, path loss and ground noise contributions then this is the place to look. However, you'll have to be ready for all the theory and maths of it all.

Section four looks at selecting TVRO equipment. Unfortunately, this book's American origin makes this section less useful for UK readers. The basic ideas and philosophies are sound enough but the specific equipment mentioned has little relevance here.

The next section on installing the system has as much relevance in the UK as anywhere. Most users will probably get a dealer to install their system but there's no reason, really, why you shouldn't do it yourself. Most of the information you need is given (even for the UK) and directions are given for where to go for anything else.

There's a section on retrofitting ku-band to C-band systems next. This won't have much relevance to most people and nor will the following section on multiple receiver systems (unless you run a hotel or the like).

The next section is a world-wide perspective of ku-band satellite television. By its very nature this is limited in its extent. Although it makes interesting reading, if you're really interested in the details around the world you'd be better off looking at the second book reviewed here.

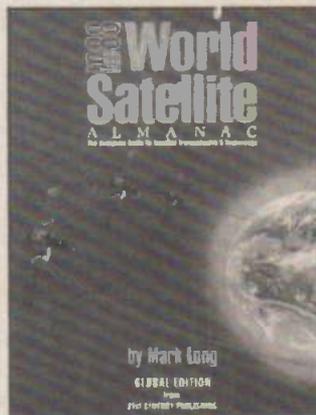
The book's final section deals with repair and troubleshooting. There is not a great deal a book aiming to cover every conceivable system can say about this subject but it seems to me that this section says it. The basic ideas of checking, especially for mechanical failure (such as water ingress) is a good

reminder to ETI readers who tend to become obsessed with electronics isolated from all else!

The book also has several appendices covering footprints of the major satellites around (no pun intended!) the world, lists of manufacturers, a glossary of terms and even a Basic program for calculating azimuth and elevation from published satellite data.

The US origins of the book get a bit tedious at times when the emphasis shifts from where I want it but on the whole a good attempt has been made to aim this book at a worldwide audience. It's simply packed with information and, if you can afford the high price, it makes an excellent introduction to the technical side of satellite TV.

1988 World Satellite Almanac by Mark Long (21st Century Publishing) \$33.25.



This one's even heavier than the last and is packed with even more information. A massive 650 pages and it uses both big pages and small writing. It's a true encyclopaedia of satellite TV if ever there was one.

However, it is even more of a book for reference only than the last. It is solid facts and figures with hardly a scrap of erudite prose to ease the brain between them.

This work is in three main sections. Again, the book starts off with a bit of basic theory and history. Then it's into the hard stuff.

This is truly a world almanac and this first section classifies and describes the whole world picture - TV standards, voice and data transmission techniques, maritime satellites and so on, all over the world. There's even a chapter on the Russian

satellite system and the Inter-sputnik agreement.

The second section of the book looks at the statistics of the satellites up there. Every satellite dotted around the celestial equator is there and for each there is listed the position, the frequencies used, the footprint, a brief history of the satellite and several other often intriguing items.



About 178 satellites in all are detailed here.

The third section of this book is the appendices. It's a bit odd finding a book of tables and lists with a large section of appendices containing more tables. Never mind - why not!

The appendices form a hotch-potch of different collections of data. There are lists of satellites, service providers, a GMT conversion chart, intended launch schedules and several others.

Both these books are expensive. They are just paperbacks and despite their size and length these are steep prices. However, for anyone contemplating setting up a satellite TV business, eager to track down and receive TV from far away foreign parts or just interested in the technical side of satellite TV in general, both these books in their different ways provide a bounteous source of information.

The first book provides the thorough technical background suitable for the technically interested. This last book has all the information you could possibly require for more detailed day-to-day reference of every aspect of satellite TV. I can (subject to the prices) only recommend both.

Martin Tame

TEST INSTRUMENTS

UK's LARGEST IN-STOCK RANGE

DIGITAL MULTIMETERS

(All 3½ Digit LCD, *4½ Digit, **With Case, †Case £2.17)
 (R = Rotary Pb = Push Button S = Slide)
 KT305 (*) 28 range plus Hie test 10A AC/DC 20meg buzz 0.5% (R) £37.00
 KT10 (*) 31 range incl. 5 range CAP 10A AC/DC 20meg buzz 0.5% (R) £36.00
 KT5005 (†) 4½ digit 28 range plus Hie 10A AC/DC 20meg 0.07% (Pb) £83.00
 KD5008 (†) 15 range AC/DC volts 0.2A DC 2 meg (S) £19.96
 KD578 (†) 20 range 10A AC/DC auto range display hold 0.8% (R) £34.50
 GO10 (†) 28 range 10A AC/DC 20 meg 0.25% (Pb) £33.50
 5010EC (†) 34 range incl. CAP Hie temp etc 0.25% (R) £52.13
 M3530 (*) 28 range incl. 5 range CAP plus Hie 10A AC/DC 0.5 (R) £53.00
 M3800 (*) 30 range plus Hie 20A AC/DC 20 meg 0.5% (R) £35.00
 M3650 (*) 30 range incl. Hie CAP freq. count 20A AC/DC 0.3% (R) £57.00

SCOPES (★with probes)

HAMEG - all with component testers
 ★203/6 Dual 20MHz £314.00
 204/2 Dual 20MHz + sweep delay £418.00
 ★205/2 Dual 20MHz + digital store £527.00
 605 Dual 60MHz + sweep delay £583.00
HUNG CHANG (6" FLAT screen 615 3½ CRT)
 ★620 Dual 20MHz + comp test £295.00
 ★635 Dual 35MHz sweep delay £399.00
 ★650 Dual 50MHz sweep delay £579.00
 ★615 Dual 15MHz Batt/mains £399.00

POCKET INSTRUMENTS (★With Case, †Case £2.17)

★KT905 7 Range Digital Cap Meter £40.00
 ★555 20KHz to 150KHz Audio Generator £47.50
 2030ET 27 Range multimeter 10A AC/DC + Hie + Cap £37.90
 5050E 41 Range FET meter 0.1µA 1000 meg etc. £28.85
 102BZ 19 Range Meter 20K/V 10A DC Buzzer £12.81
 07 20 MHz Logic Probe + Logic Pulse 0.5/400Hz £9.52
 625 50 MHz Logic Probe + Logic Pulse 0.5/400Hz £22.95
 X1/X10 Scope/Inst. Probe 250 MHz with access £11.50
 PFM 200A 200MHz LED 8 digit Freq counter £75.00
 KDM6 1.5MHz to 250MHz TR Dipmeter £43.04
 ★ST300 0/300 AMPS AC 5 range 0/800V AC 4 ranges 1KOH Res clamp meter £32.83
 ★501 Electronic insulation tester 500V DC 100 meg £65.00
 ★6060 Digital power meter 2Kw/4Kw true power 10A AC/DC volts LCD £63.04
 TH301 Digital temperature meter with probe LCD £59.50
 ★HC201 19 range analogue meter. 12A AC/DC £14.17

MEASURING INSTRUMENTS SECURITY COMMUNICATIONS PUBLIC ADDRESS TOOLS AUDIO/TV/VIDEO/COMPUTER ACCESSORIES - SEE CATALOGUE

BENCH DIGITAL MULTIMETERS

3½ digit LCD 100µV AC/DC 100mA 100m Ohm con buzzer batt operated 20A AC/DC £89.00
 3225 0.25% basic £119.00
 3210 True RMS Version 0.1% £85.00
 Tm355 3½ digit LED 10A AC/DC 0.25% (Batt operated) £85.00
 Tm351 LCD 0.1% £115.00; Tm356 LCD 0.25% £95.00

COUNTERS & TIMERS

ALL BENCH MODELS
FREQUENCY COUNTERS
 MET100 220/240V AC 8 digit £99.00
 MET600 LED 0.1Hz £126.00
 MET1000 RESOLUTION £175.00
 MET1500 5mv min Sensitivity £199.00
 TF200 8 digit LCD batt 200 MHz £175.00
COUNTER/TIMERS 8 DIGIT LED
 APPOLLO 10 STANDARD MODEL £219.00
 APPOLLO 100 PLUS DISPLAY HOLD RPM STOP WATCH ETC. £285.00

SIGNAL GENERATORS

220/240 VAC operation
TV - VIDEO
 PAL VHF/UHF, AM/FM 55/6/6.5 MHz Sound, RGB and Sync D/P's, colour B/W etc. £199.00
 FUNCTION SINE/SQ/TRIANGLE/TTL o/p £110.00
 Jupiter 500 0.1Hz to 500KHz £110.00
 J6101 0.02Hz to 200KHz £160.00
 J6102 0.2Hz to 2MHz £149.00
 Jupiter 2000 0.2Hz to 2MHz

PLEASE ADD VAT (UK ONLY)
CATALOGUES SEND 12" x 9" SAE WITH £1.00 STAMP UK — TRADE CATALOGUES FREE ON WRITTEN REQUEST. QUOTE CAT/E

ORDER BY POST OR PHONE • OPEN 6 DAYS A WEEK FOR CALLERS
HENRY'S 404 EDGWARE ROAD LONDON W2 1ED 01-724 0323

WIN A 600MHz FREQUENCY COUNTER!

IN THE NEW STYLE WINTER 1987/88

Cirkit CATALOGUE



PACKED WITH NEW LINES

- 2 new HF Receiver kits
- 5 and 50W RF Power Heads
- Oscilloscope Digital Storage Unit
- Component Packs
- 12 new books
- Temperature Controlled Irons
- Easy to Enter Competition
- Special Offers
- Quantity Price Discounts
- 24 hour order line
- PCB Prototyping System
- CB Rigs
- £££s of Discount Vouchers

ONLY £1.20

Available from your local newsagent or direct from Cirkit at the address shown below

Cirkit



Cirkit Distribution Ltd.

Park Lane, Broxbourne, Herts EN10 7NQ
 Telephone (0992) 444111 Telex: 22478

ETI PCB SERVICE

Build your projects in style with a properly designed PCB.

Use the form below (or a photocopy) for your order. Please fill in all parts of the form.

The board reference number tells you when the PCB foil was published. The first two numbers are the year and the next two the month. The number after the dash indicates the particular project in that issue.

The terms are strictly cash with order. Make cheques payable to ASP Ltd. We cannot accept official orders but we can supply a pro-forma invoice if required. Such an order will not be processed until payment is received.

Orders can also be made by telephone on (0442) 41221 for Access and Visa card holders.

Please allow 28 days for delivery.

Price Code	Price (inc VAT) £
C	1.80
D	2.50
E	3.23
F	4.00
G	4.75
H	5.50
J	6.62
K	7.20
L	8.80
M	10.60
N	13.10
O	15.80
P	17.90
Q	21.80
R	23.90
S	25.90
T	29.00
U	32.20
V	35.80
W	37.90
X	40.70

TO: ETI READERS' SERVICES DEPARTMENT
Argus Specialist Publications Ltd,
9 Hall Road, Hemel Hempstead,
Herts HP2 7BH

Please supply:

No. required per type	Board reference number	Price letter	Price each £	Total for board type £
	E	-	£ . p	£ . p
	E	-	£ . p	£ . p
	E	-	£ . p	£ . p
	E	-	£ . p	£ . p

POSTAGE & PACKING £ 0.75p

TOTAL ENCLOSED £ . p

ORDER TO BE SENT TO: (BLOCK CAPS PLEASE)

Name

Address

Postcode

(Make cheques payable to ASP Ltd)

ACCESS and VISA credit card orders can be taken on (0442) 41221 (office hours only).

E8107-1	System A Disc Input bd MC-MM.....	F
E8107-2	System A Preamp Main	K
E8108-1	System A Power Amp	L
E8109-2	System A PSU	F
E8201-2	Infant Guard	C
E8202-5	MM Stage Disc Preamp (Tilsbrook)	G
E8206-5	Logic Lock	F
E8208-1	Playmate Practice Amp 3bds SA1	K
E8212-1	ELCB	F
E8301-2	Analogue to digital conv (ZX81/Spectrum)	E
E8305-3	Dual Audio Power Supply, Linsley Hood	G
E8305-5	Balanced Input Preamp	F
E8307-2	Flash Trigger-sound or FR	F
E8308-1	Graphic Equaliser 1/2 Oct/Chnl	M
E8308-2	Servo Fail-safe	C
E8309-1	NICAD Charger/Regenerator	F
E8310-3	Typewriter Interface - EX42	F
E8311-1	Mini Drum Synth	F
E8311-8	Moving Coil Pre-Preamp	F
E8312-3	Light Chaser EPROM Controlled (2 Boards)	K
E8402-1	Speech Board	M
E8402-2	Modular Pre-amp Disc Input Mono	F
E8402-3	Modular Pre-amp Stereo Output	F
E8402-4	Modular Pre-amp Relay, PSU	F
E8402-5	Modular Pre-amp Tone Main Mono	F
E8402-6	Modular Pre-amp Tone Filter, Stereo	F
E8402-7	Modular Pre-amp Balanced Output	F
E8402-8	Modular Pre-amp Headphone Amp	F
E8404-2	Mains Remote control Receiver	F
E8405-1	Auto Light Switch	F
E8405-2	ZX81 EPROM Programmer	N
E8405-3	Mains Remote Control Transmitter	H
E8405-4	Centronics Interface	F
E8405-6	Drum Synth	F
E8406-1	Oric EPROM Board	O
E8406-2	Spectrum Joystick	E
E8406-3	Audio Design RIAA Stage	G
E8406-4	AD Buffer/Filter/Tone	H
E8406-5	AD Headphone Amp	F
E8406-6	AD Preamp PSU	K
E8406-7	AD Power Amp	H
E8406-8	AD Power Amp PSU	J
E8406-9	AD Stereo Power Meter	F
E8406-10	AD Input Clamp	C
E8407-1	Warlock Alarm	M
E8408-2	EPROM Emulator	N
E8408-3	Infrared Alarm Transmitter	E
E8408-4	Infrared Alarm Receiver	F
E8409-1	EX42 Keyboard Interface	F
E8409-2	Banshee Siren Unit	F
E8410-1	Echo Unit	F

E8410-2 Digital Cassette Deck N
 E8410-3 Disco Party Strobe H
 E8411-5 Video Vandal (3boards) N
 E8411-6 Temperature Controller D
 E8411-7 Mains Failure Alarm D
 E8411-8 Knite Light D
 E8411-9 Stage Lighting Interface F
 E8411-10 Perpetual Pendulum E
 E8412-1 Spectrum Centronics Interface F
 E8412-4 Active - 8 Protection Unit F
 E8412-5 Active - 8 Crossover F
 E8412-6 Active - 8 LF EQ F
 E8412-7 Active - 8 Equaliser F
 E8501-3 Digital Delay (2 boards) T
 E8502-1 Digital Delay Expander N
 E8502-2 Data Logger J
 E8503-1 Combo Preamplifier F
 E8503-2 THD Meter mV & oscillator bds (2 boards) K
 E8503-3 THD Meter Mains PSU F
 E8504-1 Framestore Memory M
 E8504-3 Framestore Control N
 E8504-4 Buzby Meter E
 E8504-5 CCD Delay F
 E8505-5 Stereo Simulator F
 E8506-1 Audio Mixer Main J
 E8506-2 Audio Mixer PSU F
 E8506-3 Audio Mixer RIAA D
 E8506-4 Audio Mixer Tone Control D
 E8506-5 EPROM Prog MKII O
 E8508-1 RCL Bridge N
 E8508-2 EX42/BBC Interface E
 E8508-3 EPROM Emulator L
 E8509-1 Spectrum F
 E8509-2 Direct Injection Box K
 E8510-9 Sunrise Light Brightener E
 E8511-1 MTE Waveform Generator H
 E8511-2 Millifaradometer H
 E8511-3 Cymbal Synth J
 E8511-5 Chorus Effect H
 E8511-7 Enlarger Exposure Meter F
 E8511-8 Switching Regulator E
 E8511-9 Second Line of Defence M
 E8512-1 Spectrum connector F
 E8512-2 MTE Pulse Generator H
 E8511-3 Spectrum L
 E8601-2 Walkmate L
 E8601-3 MTE Counter-timer M
 E8602-1 Digibaro O
 E8603-2 Programmable Logic Evaluation Board H
 E8603-3 Sound Sampler Analogue Board R
 E8604-1 JLLH PA PSU H
 E8604-2 Matchbox Amplifier C
 E8604-3 Matchbox Amp Bridging Version C
 E8604-4 MTE Analogue/Digital Probe M
 E8605-1 Microlight Intercom E
 E8605-2 Baud Rate Converter M
 E8605-3 Baud Rate Converter PSU Board G
 E8605-4 Portable PA H
 E8606-1 Midi-CV Converter Board H
 E8606-2 Midi-CV Converter PSU D
 E8606-3 Troglograph F
 E8606-4 80m Receiver H
 E8606-5 Sound Sampler R
 E8607-1 Direction E
 E8607-2 Upgradeable Amp, MC stage (Stereo) G
 E8607-3 BBC Motor Controller F
 E8608-1 Digital Panel Meter G
 E8608-2 Upgradeable Amp, MM stage (mono) H
 E8609-1 Mains Conditioner E
 E8609-2 Experimental preamp F
 E8609-3 Upgradeable amp, Tone board (mono) H

E8609-4 Upgradeable amp, Output board (mono) F
 E8610-1 Audio Analyser Filter Board L
 E8610-2 Audio Analyser Display Driver K
 E8610-3 Audio Analyser Display H
 E8610-4 Audio Analyser Power Supply F
 E8611-1 Audio Switcher (2 bds) H
 E8611-2 PLL Frequency meter (4 bds) ... Q
 E8611-3 Upgradeable Amp PSU J
 E8611-4 Call meter, main bd. O
 E8611-5 Call meter, interface bd. N
 E8612-1 Bongo Box J
 E8612-2 Biofeedback monitor (Free PCB) E
 E8701-1 RGB Converter F
 E8701-2 Mains Controller D
 E8701-3 Flanger H
 E8701-4 Audio Selector main board M
 E8701-5 Audio Selector PSU H
 E8701-6 Tacho-Dwell F
 E8702-1 Ratemeter main board K
 E8702-2 Ratemeter ranging board F
 E8702-3 Photo Process Controller (3bds) O
 E8702-4 LEDline display board (2 off) K
 E8702-5 LEDline PSU and controller (2 bds) G
 E8703-1 Capacitometer F
 E8703-2 Geiger Counter L
 E8703-3 Credit Card Casino E
 E8704-1 BBC micro MIDI interface L
 E8704-2 ETIFaker patch box H
 E8704-3 24Hr. Sundial E
 E8705-3 MIDI Keyboard keyswitch boards (3 boards) W
 E8705-4 Battlite C
 E8705-5 Budget Power Meter E
 E8706-1 Hi-fi Power Meter N
 E8706-2 MIDI Keyboard CPU U
 E8706-3 MIDI Keyboard Front Panel ... O
 E8706-4 Flame Simulator G
 E8707-1 MIDI Keyboard PSU H
 E8707-2 Telephone Alarm J
 E8707-3 Nuclear Strategy Simulator J
 E8708-1 Remindalite F
 E8708-2 Rear Wiper Alarm G
 E8708-3 Rev Counter F
 E8708-4 Car alarm F
 E8708-5 Knight Raider J
 E8709-1 Boiler Controller G
 E8709-2 Amstrad Sampler (2 bds) P
 E8709-3 Portable PA G
 E8709-4 EEG Monitor (2 bds) L
 E8710-1 Concept CPU board N
 E8710-2 Concept Power board K
 E8710-3 Concept display board G
 E8710-4 Hyper-Fuzz F
 E8710-5 Big Digits digit board N
 E8710-6 Big Digits minute board F
 E8710-7 Big Digits battery board G
 E8711-1 Quiz Controller E
 E8711-2 256K Printer Buffer N
 E8712-1 Heating Management System ... O
 E8712-2 SWR Meter H
 E8712-3 Dream Machine (free PCB) ... D
 E8801-1 Smart Talker L
 E8801-2 Passive IR Alarm H
 E8801-3 Mains Cleaner G
 E8801-4 RGB Dissolve L



Flat Alarm (June 1987)

In the circuit diagram Q2 is shown as an NPN transistor. It should be a PNP device as given in the parts list. IC4 is given in Fig. 2 as a 74LS260 and C5 as 470n. They should be 74LS132 and 4 μ 7 as in the parts list. R13 is incorrectly given as 280R in the parts list instead of 270R.

Nuclear Strategy Simulator (July 1987)

The bridge rectifier (BR1) on the overlay diagram has no polarity markings. It should be positioned with the positive at bottom left, connected to the track which connects to IC8 1N and C4 positive.

Telephone Alarm (July 1987)

In the component overlay (Fig.2) IC1 and IC2 should be swapped. The capacitor to the right of IC1,2 is C1 and the inductor between them is L1. The unmarked resistor to the left of L1 should be a wire link. In the circuit diagram (Fig.1b) IC4a,b should be AND gates. IC5 should be NAND gates. The parts list is correct.

Kappellmeisters (July 1987)

The position of the speaker port in the front panel was omitted from Fig.2. This should be a 7 $\frac{1}{4}$ x4 $\frac{1}{2}$ in ellipse centred across the panel with its top edge 2 $\frac{1}{2}$ in below the panel top.

Knight Raider (August 1987)

In Fig.1(a) pins 4 and 5 of IC1 are swapped. IC2-3 show the correct pin-out.

Car Alarm (August 1987)

In Fig. 1 Q7 is not numbered and its emitter is shown unconnected. This connects to earth. The transistors in the parts list went a little awry. Q2-6 are BC237 and Q7 is a TIP31.

Boiler Controller (September 1987)

In Fig. 2 (a) the primary of T2 is shown connected to Earth. This should be neutral. In Fig. 2(b) one of the bridge rectifier diodes, D6-9, is shown the wrong way around. This is correctly shown in Fig. 5.

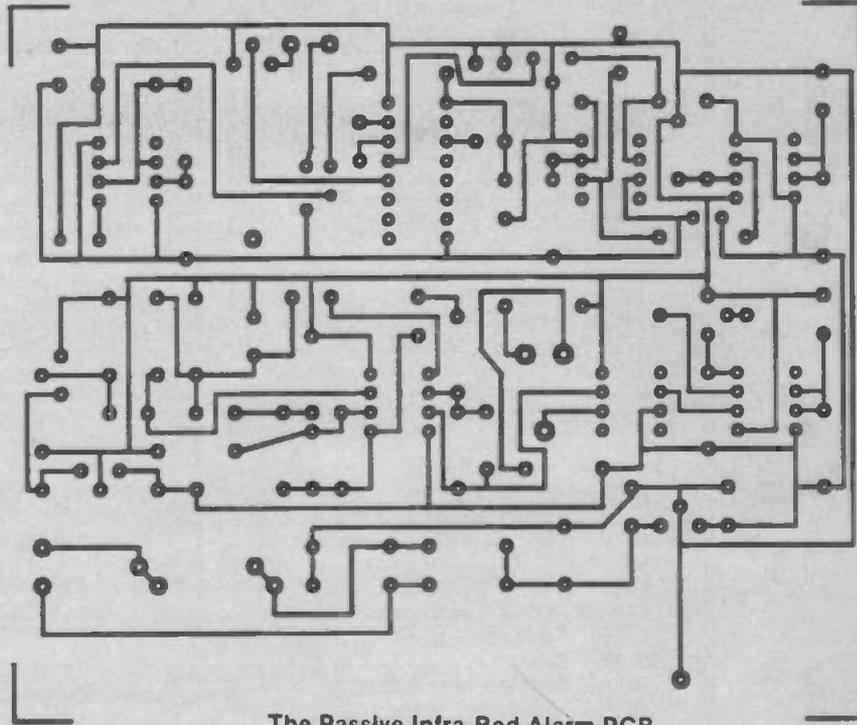
EEG Monitor (September 1987)

In Fig.3a the pins of IC1 connected to the power rails are shown swapped around. In Fig.4a R7 is unlabelled and is between C3 and C6. In Fig.5 C20 should be ϵ 10 and R18 is unlabelled. It lies between R17 and R19.

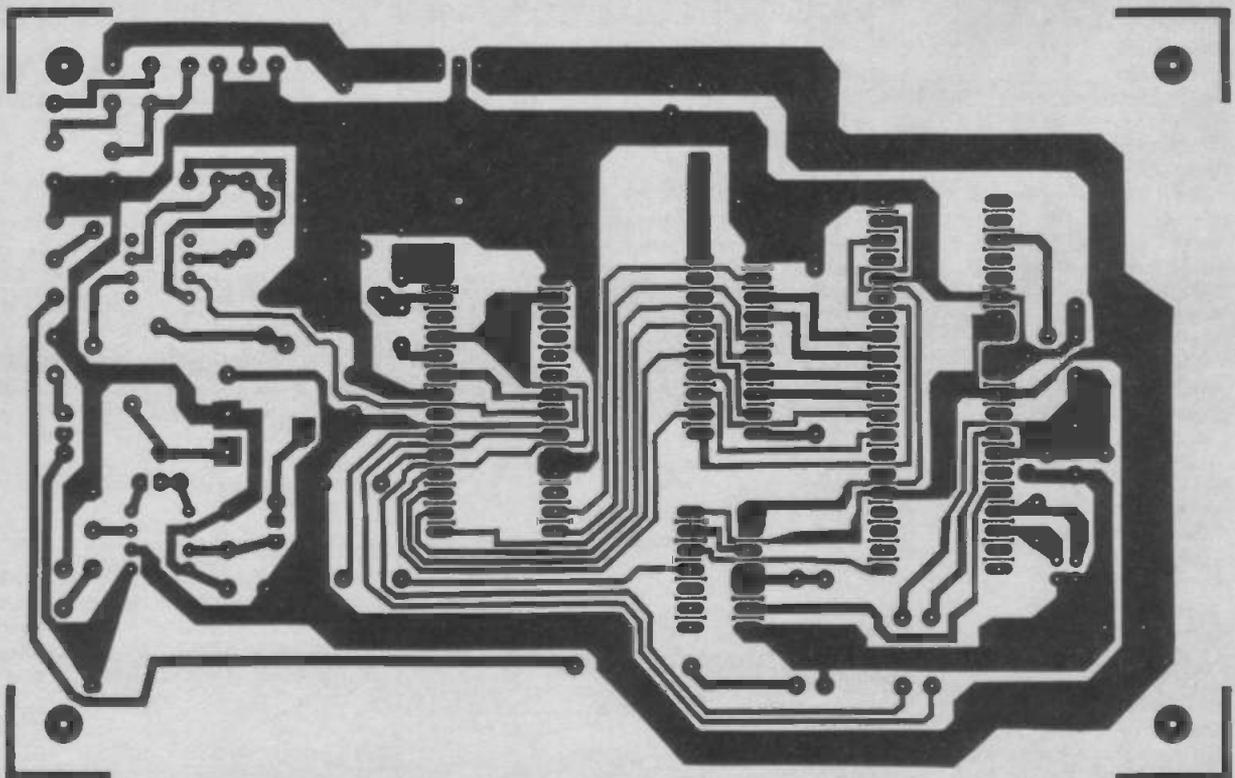
ETI Concept (October 1987)

The Power Board parts list wrongly lists R6 as 270k. This should be 270k. Also, note that the power board's 0V rail must not be connected to Earth or the 0V rail of the CPU board.

PCB FOIL PATTERNS

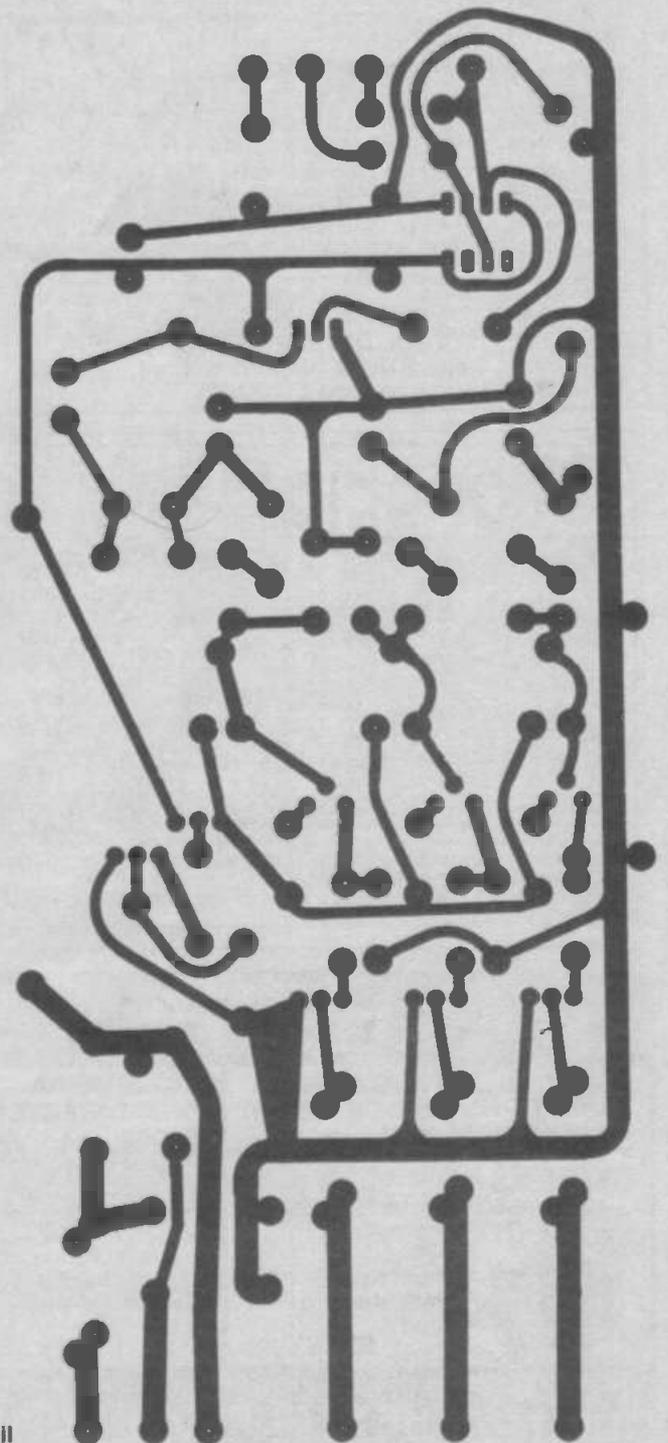
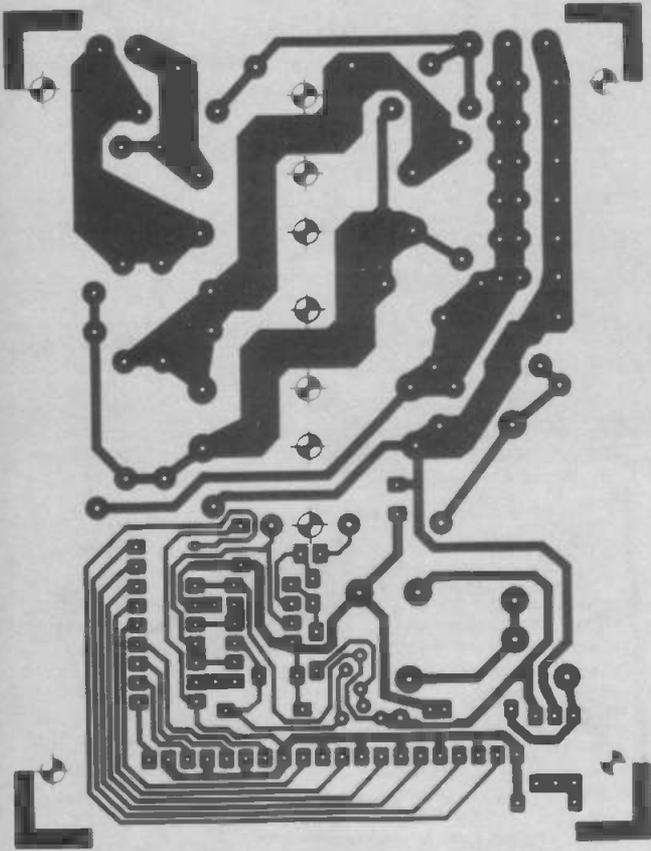


The Passive Infra-Red Alarm PCB



The foil for the Smart Talker

The Mains Conditioner PCB foil

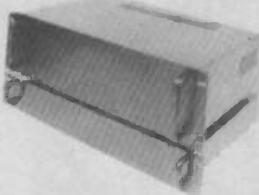


The RGB Auto-dissolve PCB foil

19" RACK CASES

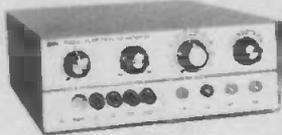
* Suitable for instruments, high quality amplifiers and many other applications that demand strength and professional finish * New improved construction and finish * Black anodised aluminium front panels * Separate front mounting plate, no fixing screws visible on the front and the side of the enclosure * Heavy gauge front panel is of brushed aluminium finish enhanced with two professional handles * With ventilation slits and plastic feet * Rear box manufactured from 1.1mm steel finished in black. Rack mounting or free standing. Comes in quick assembly flat package spare front panels available.

Order Code	Panel Size W H (inch)	Rear Box W H D	Weight	Price £
1U-10	19 x 1.75	17 x 1.5 x 10	2.4kg	23.50
2U-10	19 x 3.5	17 x 3.0 x 10	2.9kg	24.50
3U-10	19 x 5.25	17 x 5.0 x 10	3.5kg	26.50
2U-12	19 x 3.5	17 x 3.0 x 12	3.3kg	25.50
3U-12	19 x 5.25	17 x 5.0 x 12	4.0kg	27.50
4U-12	19 x 7.0	17 x 6.5 x 12	4.6kg	29.95



Please add £3.00 P&P for the first item and £1.50 for each additional item. No VAT to be added to the price.

TEST EQUIPMENTS



C83A Digital Power Supply/Voltmeter (0/35 Volts 1.5 A)	£39.95
C83B Digital Power Supply (0/30 Volts 1 A)	£35.95
C89A Function Generator (2 HE to 200 KHE)	£35.95
C86A 60 MHz Counter/Timer	£45.95
C87A Autoranging Capacitance Meter (0.1 pF to 99.9 mF)	£42.95
MV338 Metal-mains detector	£7.99

A new range of quality test equipment at the lowest possible price. The C89A (£29.95) and C86A (£39.95) are also available in kit form with full construction details. Please add £3.00 p/p per item (£1.00 for MV338). Special introductory offer, C83B (£29.95). A fully protected digital power supply at the price of a digital panel meter. Offer ends 31 December 1987.

To order send cheque/postal order — please allow up to 7 days despatch for cheque clearance. Quantity discount available. Customers who require further information please send S.A.E. Trade and overseas orders welcome. Mail order only.

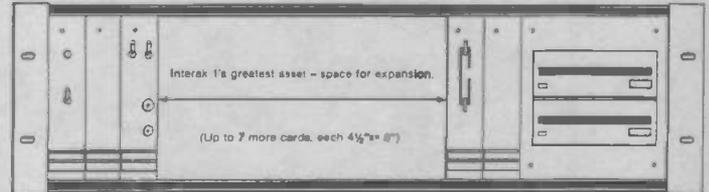
T.J.A. DEVELOPMENTS
Dept. ETI, 53 Hartington Road,
London E17 8AS.

Interak 1

AN EXPANDABLE DISK-BASED Z80A DEVELOPMENT SYSTEM YOU CAN BUILD YOURSELF!

Universities, Colleges, Industry, Enthusiasts:

Unlike home computers, development systems have entirely "open" architectures, use standard TTL etc. chips (ie no ULA's!), and are built in a proper engineering fashion. Usually these superior products carry a correspondingly superior price tag, but you can build Interak yourself board by board and thus afford a system which would normally be out of your reach and/or understanding.



Interak 1's greatest asset - space for expansion.
(Up to 7 more cards, each 4 1/2" x 8")

The initial development system has 64K of RAM, a 4 MHz Z80A CPU, parallel ASCII keyboard interface, VDU interface (TV set or monitor), and a floppy disk drive interface for up to 4 drives. Any size (including 8" double density) can be used, but our 1 Megabyte 3.5" drives are proving very popular because they can fit into the system rack, (and they only cost £94.00 each + VAT). CP/M Plus is available, giving access to thousands of "public domain" programs.

The system can be described as "future proof" because it uses plug in 4.5" x 8" cards in an industrial quality 19" 3U rack. We have been established since 1970, and this system was first made in 1977 so (unlike almost all other computers) it has stood the test of time.

Send two second class stamps, or telephone for a detailed descriptive leaflet, specification, prices, etc.

Greenbank

Greenbank Electronics (Dept T12E), 460 New Chester Road,
Rock Ferry, Birkenhead; Merseyside L42 2AE. Tel: 051-645 3391

Microkit LTD 0536 744664 24 hr 7 days/week

74TL	157 40 55	LM3900 40	TL072 50	MEMORIES
LS MC	156 40 55	OP07CP 65	TL082 45	DRAM 5V NMOS
00 20 25	161 55 55	NE555 18	TL084 45	4184 64k x 1 £0.88
02 20 25	163 55 55	TL074 90	ULN2004 70	41256 256K x 1 £2.39
04 20 25	164 55 55			4416 16K x 1 £3.30
08 20 25	165 60 75			41464 64K x 1 £3.30
10 20 25	166 60 60			
11 20 25	FLOPPY			SRAM 5V NMOS
14 20 29	DISC CON-			2114LP 1K x 4 £1.50
20 20 29	TROLLERS			2128LP 2K x 8 £2.50
21 20 29	WD2797 19.00			SRAM 5V CMOS
27 20 29	WD1797 19.00			6118LP 2K x 8 £1.10
42 49	WD9216 14.25			6284LP 8K x 8 £2.40
51 20 25	7812 30			62256LP 32K x 8 £14.50
74 20 39	78M12 30			EPROM 5V NMOS
85 59	75154 90			2716 2K x 8 £2.70
86 20 49	ADC0808 9.90			2732 4K x 8 £2.65
123 60 55	LM311 40			2754 8K x 8 £2.45
132 49	LM324 40			27128A 16K x 8 £3.70
138 40 49	LM337 1.20			27256 32K x 8 £3.75
139 40 49	LM348 55			27512 512K x 8 £9.70
153 45 59	LM358 45			

SAVE OVER 40% ON OUR EQUIPMENT MEMORIES AND PROMS
1000's of delighted customers
GUARANTEED UV ERASED AND TESTED
16K x 8 £0.75
EPROMS
2716 2K x 8 £1.50
2732 4K x 8 £1.50
2784 8K x 8 £1.20
27128 16K x 8 £2.50
All taken from working boards. Try some. You will SAVE POUNDS ~~££££~~

ADD VAT 15% ORDERS UNDER £25 ADD £1 P&P OVER £25 POSTAGE FREE
ORDERS DISPATCHED SAME DAY BEFORE 3.30PM
DEPT (E7) 18 KOLDERMEADOW A V CORBY NORTHANTS NN18 9AJ

19" RACK MOUNTING EQUIPMENT CASES

This new range of 19" rack equipment cases have been designed with economy and versatility as their objective. These cases are supplied as a flat pack kit with assembly instructions. The equipment cases feature a black powder coat 1/2" (3mm) aluminium frontpanel with the rest of the case constructed from 7mm or 9mm 'Stielvite' PVC coated steel. All kits include front panel handles and rubber feet.

They are available in the following popular sizes with all the units having a standard front panel width of 19" and an enclosure width of 17 1/2" (438mm) by a depth of 10" (254mm).

ORDER CODE	HEIGHT	PRICE
U1	1 3/4" (44mm)	16.00
U2	3 1/4" (88mm)	18.00
U3	5 1/4" (133mm)	20.00
U4	7" (178mm)	22.00
M6U Sloped mixer console		£25.50

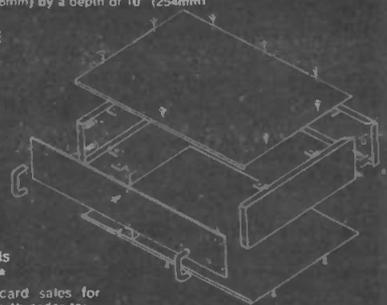
All prices Exclude V A T
Please include £2.50 + VAT Per Item
For Post & Packing.
Flat pack size = 500 x 260 x 32
Maximum weight = 1.5Kgs.

Blanking Panels, Racking Consoles and Rack Cabinets also available.

Please send S.A.E for further details
TRADE ENQUIRIES WELCOME

Tel 0275 823983 for Access/Visa card sales for immediate despatch or send cheque with order to

RACKZ PRODUCTS PO. BOX NO. 1402, MANGOTSFIELD, BRISTOL, ENGLAND, BS17 3RY



SECURITY SECURITY SECURITY SECURITY

COMPLETE SECURITY SYSTEMS START AT

ONLY £39.95 + VAT

PASSIVE INFRA RED DETECTOR RP33

Hi-tech Sensor which operates by detecting body heat. £23.95 + VAT



DIGITAL ULTRA-SONIC DETECTOR US5063



For use in a wide range of movement detection applications £13.95 + VAT

INFRA RED BEAM SYSTEM IR1470



For Security Photography or Lighting applications £25.61 + VAT

ADVANCED CONTROL UNIT WITH AUTO LOOP TEST CA1382

Available in kit form (fully built electronics) £39.95 + VAT
Fully built and tested £44.95 + VAT



SEND OR TEL FOR FULL DETAILS OR CALL AT OUR SHOWROOM & SEE THE UNITS ON DEMONSTRATION. MON.-FRI. 9-5. SAT. 9-1. CLOSED ALL DAY SAT. & SUN. P&P UK orders - 75p Exports add - 10%.

RISCOMP LIMITED

plus magnetic contacts, bell boxes, P.A. switches etc. etc.
THE SECURITY SPECIALISTS

Dept. ETI/1, 51 Poppy Road, Princes Risborough, Bucks, HP17 9DB. Tel: (08444) 6326

FULL TECH. ADVISORY SERVICE

ELECTRONICS TODAY INTERNATIONAL CLASSIFIED

Lineage:

44p (VAT excl) per word (minimum 15 words)

Semi Display: (minimum 2 cms)

£12.20 per single column centimetre + VAT

Ring for information on series bookings/discounts

All advertisements in this section must be prepaid.

Advertisements are accepted subject to the terms and conditions printed on the advertisement rate card (available on request)



01-437 0699 Ext 292

Send your requirements to:
Julle Capstick
ETI Class. Dept.,
ASP Ltd.,
1 Golden Square,
London W1.

FOR SALE

LYTHALL COMMUNICATIONS

49a LINDEN WAY, HADDENHAM, ELY,
 CAMBS, CB6 3UG. TEL (0353) 740664

CORDLESS TELEPHONE

Range 700 feet, re-dial, call, mute etc. 240v AC power (BABT approved). £89.95p inc P&P.

ANSAFONE

240v AC power, complete. (BABT approved) £99.95p inc P&P

MODEMS(all RS232 to micro)

1. V23 (1200/75 baud) such as used by PRESTEL and XMODEM type protocols. Autoanswer/originate. Duplex. Inc COMSTAR II ROM comms software for BBC micro series. £149.99p inc P&P.

2. V21 (300/300 baud) + V23(1200/75 baud). Call progress mon speaker, processor controlled, Autodial (pulse/DTMF) with 32 number store, Autoanswer, Duplex, Hayes Compatible so requires no special software. £199.95p inc P&P.

3. V21 (300/300) + V23(1200/75). Autodial (pulse/DTMF) with 64 number store, Autoanswer (V25 protocols), Duplex, Speed buffering, Hayes command set. Parallel printer port, date and time stamp. BABT approved. £399.00p inc P&P.

COMPUTER SWITCH (patent pending)

Enables your computer to switch external low power circuits (eg Buzzers, Radio's, Alarms, Indicators etc) on and off under software control. Compatible with most computers eg APPLE, ATARI, BBC, EINSTEIN, SINCLAIR. Powered by Internal PP3 battery (supplied). Supplied with detailed instructions and example programmes (including morse-trainer+clock/timer) £34.99p inc P&P. Sample programmes available on 5.25" disk for Apple][, add £4.95p

MODEM ELIMINATOR

Enables you to get programmes over wires to another computer of the same type. Internally powered from PP3 battery (supplied). Not suitable for use with other modem. Supplied with detailed instructions. £26.95p inc P&P.

Morse Trainer for Tatung Einstein on disk, (using Internal speaker) £5.95p inc P&P. Other software for Einstein SAE.

Send SAE for further details of any item, or send Cheque to

LYTHALL COMMUNICATIONS, 49 LINDEN

WAY, HADDENHAM, ELY, CAMBS, CB6 3UG.

Accept ACCESS & BARCLAYCARD

SPECIAL OFFERS

CASSETTE MOTORS large and small 2 for £1.00. Mono and stereo cassette tape heads. 2 for £1.00. Microphone small for cass. tel. etc. 2 for £1.00 Solar Cells at 35p each. Please add 75p p&p, no VAT. Access card accepted. Golden Orange Supplies, Brockhollands Road, Woodside, Bream, Lydney, Glos. Tel: 0594 563009.

FREE MEMBERSHIP to a new NATIONAL ELECTRONICS CLUB.

For details and a free gift of components worth over £10 send only £1.00 p&p to Woodside, Dowsett Lane, Ramsden Heath, Essex CM11 1JL.

WANTED

IDEAS/INVENTIONSwanted. Call I.S.C. 01 434 1272 or write, Dept ASP 99 Regent St, London W1.

Turn your surplus transistors, IC's etc., into cash. Immediate settlement. We also welcome the opportunity to quote for complete factory clearance. Contact:

Coles Harding & Co.
 103 South Brink
 Wisbech, Cambs.

ESTABLISHED OVER 10 YRS
 Tel: 0945 584188

SCOPES

MENDASCOPE LTD.

REPAIR & RECALIBRATE OSCILLOSCOPES.

ALL MAKES ALL MODELS.

NATIONWIDE COLLECTION & DELIVERY

FREE ESTIMATES

Phone 069-172-597

COMET TEST EQUIPMENT

Tektronix Oscilloscopes in fine condition

85MHz dual-trace, delay sweep	£195
50MHz dual-beam, 4 trace, delay sweep	£185
50MHz dual-trace, delay sweep	£135
24MHz dual-trace, delay sweep	£85
19MHz eight-trace	£155
875MHz dual-trace, Sampling	£145
F.E.T. Conversion for 1A1	£25
106 Pulse Generator 1n Sec rise time	£95
Phlips PM6507 transistor curve tracer	£145
HP delay line, model T100A	£25

Wide range of plug-ins, manuals, spares, CRTs, valves, transistors, accessories.

Tel: (01) 868 - 4221

SURVEILLANCE

ESKAN ELECTRONICS

(MANUFACTURERS AND SUPPLIERS OF SURVEILLANCE AND AUDIO EQUIPMENT)

MICRO BUG

SK1 Miniature Transmitter 20mm x 47mm x 20mm, extremely sensitive. Operates from 1.5v battery, elegant metal box included.

Ready built + tested only. £29.50
 Kit Form £24.90

EXTRA MINIATURE TRANSMITTER

EK2 25mm x 30mm x 9mm
 Ready built + tested £49.00
 Kit Form £37.95

HIGH POWER FM RADIO TRANSMITTER

EK65, 65W adjustable frequency Mains operated. £650 + £35 p&p (Operation in the UK illegal without licence).

AUTOMATIC TELEPHONE MONITOR

SK19 ready built + tested £34.50
 Kit Form £29.95

Many other surveillance equipment available. Send large S.A.E. for catalogue.

SOUND TO LIGHT UNIT

SK72 separate sensitivity, bass, treble and mid-range frequency controls, designed and manufactured to highest professional standard.

Ready Built.....£39.95 p&p £3.50
 Kit Form £21.95
 Casing £11.95
 SK70 sound to light control unit
 Kit Form £14.95

Send Cheque or P.O. payable to:

ESKAN ELECTRONICS

172 Caledonian Road,
 London N1 0SG.

Tel: 01 278 1768



Trade and Export Enquiries Welcome

SWITCHES

VOICE/SOUND ACTIVATED SWITCHES easy to follow diagrams and uses only £1.00. Components and P.C.B's available. **Herrington, 63 Home Farm Rd, Hanwell, London W7 1NL.**

COMPONENTS

ANTEX 15 WATT SOLDERING IRON KIT

Everything you need in one quality kit with "How to Solder" £11.50 post free.
 ALTAI SOLDER PUMP £4.50 post free.
 SOLDER Size 10 39.6 metres 0.7mm 22swg.
 Amazing value at £4.83 + 30p P&P
 BAGS OF ASSORTED COMPONENTS £2.10 each
SEND FOR FREE LISTS.
STRACHAN ELECTRONICS (ET)
 9 CROALL PLACE,
 EDINBURGH EH7 4LT.

SATELLITE



SEE IT LIVE AT OUR SHOWROOM
 SMATV & TVRO
 SURVEY • INSTALLATION • SERVICES

LONDON SATELLITE CORPORATION LTD.
 DEPT ET, 17 REGINA ROAD, SOUTHALL,
 MIDDX UB2 5PL TEL: 01-571 9605
 Open: 10 a.m.-7 p.m.

ELECTRONIC COMPONENTS

BRYANT ACOUSTIX

5 BELLE VUE TERRACE, GILESGATE MOOR,
DURHAM DH1 2HR.
TEL: (091) 3864500

8mm RED 41p
8mm YELLOW 42p
8mm GREEN 42p
8mm LED CLIP 27p
Special Offer - pack
of 10 8mm LED's
any colour £3.49
CARRIAGE £1
ALL ORDERS
All prices include VAT.
Quantity prices available.

FREE! OCT - JAN CATALOGUE NOW AVAILABLE

Please enclose a 4"x9" SAE for a copy of our new 1987 catalogue, detailing Accessories, Books, Cable, Caps, Connectors, Semiconductors, Led's etc. Trade list also available.
SPECIAL OFFER LIST SENT OUT WITH ALL CATALOGUES
100's of new items in stock.

8mm LED's SPECIAL OFFER

CENTRAL REGION

Ex-stock Electronic Components, Test Equipment, Computers, Peripherals, Word Processors.

TECH SUPPLIES

19i Winchester Avenue,
Denny, Stirlingshire,
FK6 6QE.

Phone:

(0324) 825627

NO ORDER TOO SMALL

Open: 9am-4pm and
7.30pm-10pm 7 DAYS.

BOOKS

PARAPHYSICS Journal (Russian Translation); Psychotronics; Kirlianography, Heliphon Music, Telekinetics. Computer Software. S.A.E. 4 x 9", Paralab, Downton, Wiltshire.

KITS

AMAZING KITS: BUG-87 matchbox sized surveillance transmitter with super sensitive microphone can be received by any FM/VHS radio, £4.95 inc. **ROBO-VOX** instantly transforms your voice into Dalek/Robot type also amazing feedback/Sound effects possible, £11.95 inc. **ROBOT CIRCULAR** unique radio controlled robot can also be converted to control via computer £16.95 inc. **EDU-SCOPE** Build your own Oscilloscope with flat LED screen complete kit of parts excluding case £39.99 inc. All enquiries send SAE. **IMAGINA-TRONICS**, Aberdeen House, The Street, Charlwood, Surrey RH6 0DS.

MICRO TRANSMITTER KIT, 500m Range, tunable 88-115MHz, sensitive microphone, £3.95. Cheques/PO's to Quantek Ltd., (ETI), 267 Rednal Road, Kings Norton, Birmingham B38 8EB.

LEAP INTO 1988 WITH ETI.
CALL JULIE CAPSTICK ON 01-437 0699
FOR ADVERTISING DETAILS

AUDIO

See review
ETI May 1987

SUPERMOS

See ETI Oct. ad
for more details

Build the very best in British Hi-Fi sound quality and with a technical performance to rival even the best Japanese or American amplifiers

HIGH EFFICIENCY MOSFET CLASS A WITHOUT THE HEAT!

Are you still listening to crossover distortion generated by darlington bipolar transistors operating in class AB? Switch to SAGE active CLASS A MOSFET power amplifiers and we guarantee you'll never switch again.

All conventional Hi-Fi power amps (including so called pure class A) when driving a real loudspeaker generate crossover distortion. The unique SAGE ACTIVE class A amp module will never switch to class B even when driving real speaker loads and can supply up to 50amps p-p in pure class A mode. In addition, harmonic distortion is almost beyond measurement (2ppm at 100W) and slewrate is a super fast 250V/us.

Many audio manufacturers build technically excellent amplifiers whilst turning a deaf ear to 'Component Sound Quality'.

Others use 'Audio Grade Components' whilst totally ignoring BASIC technical performance specifications.

THE SAGE AUDIO DESIGN PHILOSOPHY

THE WORLDS HIGHEST
TECHNICAL PERFORMANCE

A power amplifier module with
**A UNIQUE
COMBINATION**

BUILT WITH AUDIO
GRADE COMPONENTS

Ultra linear active class A MOSFET
THD 0.0002% (2ppm) @ 100W
Slewrate >250V/us
Output current 50amps p-p
Signal to noise ratio >120dB
Real reactive speaker drive capability.

+

Close tolerance, polypropylene and extended foil capacitors. HOLCO resistors and for real precision we use Lazer trimmed SMD resistors, superior to BULK FOLDS. Custom built fast MOSFETs and matched selected transistors.

For full details of these superb amplifier modules send a 9"x4" SAE or 4 IRC's. New style user manual giving full PSU/wiring details, components etc. £2.50 (12 IRC's), refunded on purchase. **SUPERMOS MODULES £65 TOTAL INC. P&P.** We now stock a full range of GRADE 1 audio components, PSU caps, 36amp bridges low noise toroids LS terminals.

**SAGE
AUDIO**

Construction House, Whitley Street, Bingley, Yorks. BD16 4JH.
Export Facilities Worldwide. Tel: 0274 568647, Telex 517783, Fax 5510065

COURSES

Start training now for the following courses. Send for our brochure — without obligation or Telephone us on
-06267 79398

REF: ETI/6

NAME _____

- City & Guilds Exam 271
- Radio Amateur Licence
- Micro-processor
- Introduction to Television

Radio & Telecommunications Correspondence School,
12, Moor View Drive, Teignmouth, Devon. TQ14 9UN.

ENGINEERING

PCB'S

Artwork, proofing and development by CAD, RF and microwave placement. Fixed rates, incs drafting-DS/SS, overlays, silk screen, drill templates, solder mask. Update facility. Free estimates. Send circuit diagrams to:

DTL
5-9 Portland Street, Luton, Beds.
Tel: UK 0582 458375
Truppacherstrasse 42, 6662 Contwig 1
W. Germany. Tel: 06332 5242
Telex: 265871 Quote MAG 95167
Fax: W. Germany 06842 51736 after hours
or by ARR.

RING 01-437 0699
FOR ADVERTISING
DETAILS

ELECTRONICS TECHNICIANS

Updating Courses
London Electronics College,
(Dept ETI), 20 Penwynn Road,
London SW5 9SU. 01-373 8721.

KITS AND READY BUILT

ELECTRONIC KITS—For those Winter evenings. SAE for details: COVE ELECTRONICS, 7 St. Anne's Avenue, Southbourne, Bournemouth, Dorset BH6 3JR.

PLANS & DESIGNS



Design and build your own electronic dashboard
Plans, instructions, circuits, parts lists
£4.95 inc p&p

BURLINGTON MOTOR CO. LTD.
(G7) ARCH 39M, BATH PLACE,
LEAMINGTON SPA, CY3 3AQ.

ELECTRONIC PLANS, laser designs, solar and wind generators, high voltage teslas, surveillance devices, pyrotechnics and computer graphics tablet. 150 projects. For catalogue, SAE to Plancentre Publications, String Works, Bye St., Ledbury HR8 2AA.

PCB'S

PRINTED CIRCUIT BOARDS
Need 100 off...or just one? You can send the Artwork (1:1 single sided) for your boards or let me work, at little extra cost, from your own drawings. Enquiries: Watling Wires PCB Production, 52 Watling Street, Nuneaton, Warwickshire, CV11 6JL or telephone (0203) 382296.

PAYNE ELECTROPRINT LTD

Marcus Road, Denkeswell,
Honiton, Devon EX14 0RA.
Metal cases manufactured to your design. Your ETI projects professionally silk screen printed. Manufacturers of Printed Circuit Boards.

Sonolux

PCBs from your own artwork from as little as £4.00 + p&p (excluding VAT)
Send SAE or telephone for details:

SONOLUX LTD
29-31, Corporation Street,
Lincoln, LN2 1HL
Telephone: (0522) 510013

BOOKS AND PUBLICATIONS

CIRCUIT DIAGRAMS

Any make, Model, Type, Audio, Music Systems, Television, Video Recorders, Amateur Radio, Test Equipment, Vintage Wireless etc.
£3.00 plus LS&E. State Make/Model/Type with order. Full Workshop Manual prices on request with LS&E.
MAURITRON (ETI), 8 Cherry Tree Road, Chinnor, Oxon. OX9 4QY

ALARMS

ALARMS



FREE BOOKLET

on
BURGLAR ALARMS

with

LOWEST U.K. DIY PUBLISHED PRICES

PHONE OR WRITE FOR YOUR COPY

051-523 8440

AD ELECTRONICS

217 WARBRECK MOOR
AINTREE, LIVERPOOL L9 0HU



RETAIL OUTLETS

LIVERPOOL

PROGRESSIVE RADIO

87/93 Dale Street Tel: 051 236 0154

47 Whitechapel, Tel: 051 236 5489

Liverpool 2

'THE ELECTRONICS SPECIALISTS'

Open: Tues-Sat 9.30-5.30

LONDON

CRICKLEWOOD

FOR COMPONENTS
LOTS OF NEW DEVICES
LOTS OF LOWER PRICES
Phone for our catalogue:
01 452 0161/450 0995 Telex: 814 977
40 Cricklewood Broadway,
London NW2 3ET.

TYNE AND WEAR

ELECTRONIC COMPONENTS AND KITS



STATION ROAD, CULLERCOATS.
NORTH SHEILDS, TYNE & WEAR NE30 4PQ
081 251 4363

New 1988 Catalogue now available £1.85 incl p&p. MON-SAT 9.30 to 5.30
CLOSED THURS.

ELECTROMART

ELECTROMART

COMPONENTS

T-systems Ltd

COMPUTER SYSTEMS AND COMPONENTS

3" CF2 Maxell disks	£1.90
3.5" unbranded DS disks	£0.90
5.25" unbranded disks, DS96, TPI	£0.35
Bulk storage, 5.25"/50	£6.90
Bulk storage, 3.5"/80	£8.00
Epson MX/FX80 ribbon	£2.75
Epson MX/FX100 ribbon	£3.10
Epson LX80/86 ribbon	£2.50
M/Tally MT80 ribbon	£2.90
Printer cable, PC1512/IBM	£7.95

All prices inc. P&P, please add VAT at 15%.

T-SYSTEMS LTD.

The Signal Cabin, 61 High Street, Orpington, Kent BR6 0JF.
Access card accepted. Tel: 0689 22196

PROMs - EPROMs - PALs ANY PROGRAMMABLE IC SUPPLIED OR BLOWN

Typical prices (excluding VAT)
(Data Entry P&P extra)

2716 £4.20 2732 £3.85

2764 £2.85 27128 £4.40

BIPOLAR PROMs from £1.35

e.g. 82S123, 18S030, 74S288

PALs, PLDs etc. from £3.26

e.g. 82S153, 16L8, EP310

Full design and prototyping service.

Any quantity programmed - SAE or

phone for details.

P.L.S., 80 Central Road,

Worcester Park, Surrey, KT4 8HU

Phone: 01-330 6540

TERMS

CLASSIFIED ADVERTISING TERMS & CONDITIONS

Our terms for new advertisers (semi-display and Inpage) are strictly pre-forma payments until satisfactory reference can be taken up (excluding recognised advertising agencies). Cheques and P.O.'s should be crossed and made payable to ARGUS SPECIALIST PUBLICATIONS LTD. and sent together with the advertisement to:

"The Classified Dept.,
No. 1 Golden Square,
London W1R 3AB.

There are no reimbursements for cancellations. Advertisements arriving too late for a particular issue will be inserted in the following issue unless accompanied by instructions to the contrary. It is the responsibility of the advertiser to ensure that the first insertion of every series is published correctly, and corrections must be notified in time for the second insertion, otherwise the publishers will not accept any liability or offer any reduction in charges.

All advertising sales are subject to Government Regulations concerning VAT. Advertisers are responsible for complying with the various legal requirements in force eg: The Trade Description Act, sex discrimination act & the business advertisements (disclosure) order 1977.

Full Terms & Conditions of Advertising available on request.

Carbon Film Resistors 1/4W E24 series 0.51R to 10M0 -1p 100 off per value-75p 1000 off in even hundreds per value-£7 Metal Film 1/4W 10R0 to 1M0 5% E12 series-2p 1% E24 series-3p 1/2Watt metal/carbon film E24 series 1R0 to 10M0-11p 1 Watt metal/carbon film E12 series 4R7 to 10M0-5p 8C107/8/9-12p 8C547/8/9-8p 8C182L 184L-10p 8FY50V/51/52-20p 2N3055-50p TIP31A,32A-25p TIP.41,42-40p

Tantalum bead subminiature electrolytics (Mkds/Volts) 0.1/35, 0.2/35, 0.4/7/35, 3.3/16-14p 4.7/35-15p 2.2/35, 4.7/25, 10/15-15p 4.7/35, 6/8/16-10p 10/16,22/16-20p 22/16-30p 33/10-30p 47/10-35p 100/16-40p

Aluminium Electrolytics (Mkds/Volts) 1/50, 2.2/50, 4.7/25, 4.7/50, 10/16, 10/25, 10/50-5p 22/16, 22/25-8p 22/50, 47/16, 47/25, 47/50-8p 100/16, 100/25-7p 100/50-12p 100/100-14p 220/16-10p 220/25, 220/50-10p 470/16, 470/25-11p 1000/25-18p 1000/35, 220/25-22p 4700/25-70p

Miniature Polyester Capacitors 250V Wkg. Vertical Mounting. 01, 015, 022, 033, 047, 068-4p 0.15p 0.15, 22-8p 0.47-8p

Mylar Capacitors 100V Wkg. Vertical Mounting E12 Series. 1000p to 8200p-3p .01 to 068-4p 0.15p 0.15, 0.22-8p

Subminiature Ceramic Plate 100V Wkg. E12 Series Vertical Mounting. 2% 1P8 to 47P-3p 56P to 330P-4p 10% 390P to 4700P-4p Ceramic plate/disc E6 Series 50V 22P to 047-2p

Polystyrene Capacitors 63V Wkg. E12 Series Axial Mounting. 10P to 820P-3p 1000P to 10,000-4p 12,000P-5p 1N44-8-2p 1N4002-4p 1N5404-14p W01 bridge-25p OA91-8p AA143-8p W005-20p 1N4006-8p Zener diodes E24 series 3V3 to 33V 400mW-8p 1 watt-12p L.E.D's Red, Green & Yellow 3mm & 5mm-10p 8mm-35p 20mm fuse 0.1A to 5A quick blow-5p Anti Surge-8p High Speed drills 0.8mm, 1.0mm, 1.3mm, 1.5mm, 2mm-20p Expo Reliant drilling machines 12V d.c. with improved 3-jaw chuck-8.50 Nicads AA-80p MP11-£2 PPS-£4.20 Universal Chargers-£6.50 Glass reed switches single pole make contacts-8p Magnets-12p

VAT inclusive. Return postage 20p (free over £5). Lists free.

THE C.R. SUPPLY CO., (DEPT ETI),

127 Chesterfield Road,
Sheffield S8 0RN. Tel. 557771

**COPY DEADLINE MARCH 1988 ISSUE
- 21st DECEMBER 1987**

CLASSIFIED COUPON

ELECTRONICS TODAY INTERNATIONAL, CLASSIFIED ADVERTISEMENT
DEPT, No. 1 GOLDEN SQUARE, LONDON W1R 3AB.

PLEASE DEBIT MY ACCESS/BARCLAYCARD NO. _____ EXPIRY DATE - _____

FOR SALE COMPONENTS WANTED KITS PCB'S OTHERWISE STATE

Rates: Lineage 51p per word (VAT inclusive) minimum £7.65
semi-display £12.20 per single column cm. No reimbursements
for cancellations. All ads must be pre-paid.

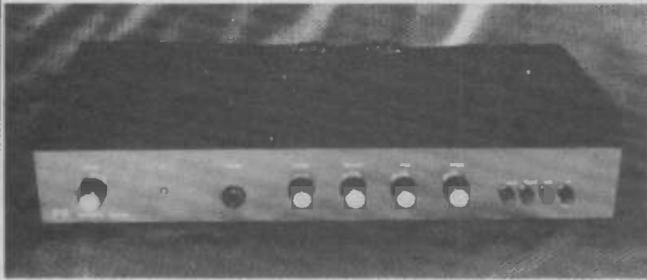
Name

Address

..... Daytime Tel. No:

Signature Date

AUDIOKITS PRECISION COMPONENTS



THE 30+30 INTEGRATED AMPLIFIER

- ★ DESIGNED FOR OUTSTANDING SOUND QUALITY
- ★ VERY HIGH QUALITY COMPONENTS SUPPLIED
- ★ LOW TEMPERATURE GENERATED DISTORTION
- ★ ULTRA LOW NOISE MC STAGE
- ★ STAR EARTHING - MAPPED ON PCB TRACKS
- ★ CLEAN SOUND RIGHT UP TO FULL OUTPUT
- ★ 7 SEPARATELY RECTIFIED POWER SUPPLIES GIVES OUTSTANDING STEREO IMAGERY
- ★ LATEST KITS HAVE IMPROVED HEAT SINKS AND LOWER RESIDUAL NOISE

IMPROVED VERSION ALSO FEATURES

- ★ BULK FOIL RESISTOR (Temp. Coefficient 5ppm/°C) IN CRITICAL PLACES
- ★ HOLCO RESISTORS FOR OUTPUT TRANSISTOR EMITTER RESISTORS
- ★ POLYPROPYLENE AND POLYSTYRENE CAPACITORS
- ★ LONG LIFE ELECTROLYTIC CAPACITORS
- ★ KIMBER CABLE FOR INTERVAL WIRING
- ★ GOLD PLATED PHONO SOCKETS
- ★ EXTRA OUTPUT TRANSISTORS FOR 40 WATT OUTPUT

PRICES Standard 30+30 kit £172 + £6 p&p = £178

Standard with extra o/p transistors £185 + £6 p&p = £191

Improved kit £380 + £6 p&p = £386

Export version to order with 110V or 220V primary transformers. P&P charges by quotation. Delivery 14 to 21 days, but can be longer as lead times for manufacture of case or supply of some top quality parts used in improved version is much greater.

ETI VIRTUOSO PREAMP KITS, PCB'S AND ALL PARTS AVAILABLE.

ETI System A Preamp & Power Amp

ETI Audio Design Preamp & Power Amp

Amazing how many ETI readers are still building system A and Audio Design pre and power amps, many years later. Most are using higher grade parts recommended and supplied by Audio Kits and enjoying much better sound quality than the original design. Special parts list available on request.

For details of Audio Kits components and kits, please send SAE (9" x 4") (overseas 3 IRCs) to:

AUDIOKITS, 6 Mill Close, Borrowwash, Derby DE7 3GU. Tel: 0332 674929

SONY SPEAKERS

MODEL
Z-3000
20 WATT
2-WAY

made in UK

Size 41.5 x 25 x 17cm approx.
Impedance 6 ohm nominal.

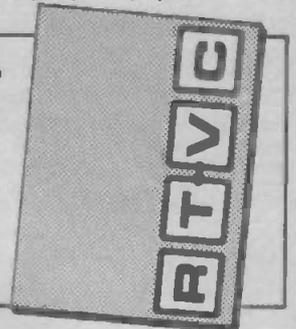
Finished in simulated black teak with matching grille.



£20.95
per pair + p&p £3.95

JUST OUT
16-page 1988
CATALOGUE

Send 50p (cheque or P.O.) and 230 x 325mm s.a.e.



RTVC

All mail to RTVC, 21 HIGH STREET, ACTON W3 6NG. Callers to Acton or 323 Edgware Rd, London W2. Please allow 14 days delivery.

Payments to RTVC Ltd. Order by Access - tel: 01-992 8430.

BORELAND

ELECTRONIC ENGINEERS LTD

26, North Road, Edmonton, London N9 7QY.
Tel: 01-805 5494

ELECTRONIC COMPONENT SPECIALISTS

- | | |
|----------------------|----------------|
| RESISTORS | POTENTIOMETERS |
| CAPACITORS | SWITCHES |
| DIODES | BATTERIES |
| INTERGRATED CIRCUITS | CONNECTORS |
| LEDS | SOCKETS |
| TRANSFORMERS | CASES |
| RELAYS | BOOKS |
| CRYSTALS | ETC. |

SEND LARGE S.A.E. FOR PRICE LIST

ADVERTISERS' INDEX

Audiokits	82	Rackz Mounting Products	78
BK Electronics	IFC	Riscomp	78
Boreland Electronics	82	R.T.V.C.	82
Cirkit UK	73	Satellite TV House Ad	62
Cricklewood Electronics	82	SMJ Electronics	36
Display Electronics	IBC	Solex	19
Electromech	31	Specialist Semicon Devices	46
Greenbank Electronics	78	Stewarts of Reading	51
Hart Electronics	6	Subscriptions	11, 12
Henry's Audio Electronics	73	TJA Development	78
Maplin Electronics	OBC	TK Electronics	10
Microkit	78	Wilmslow Audio	57
PC Publishing	36	XEN Electronics	51
Pineapple Software	45	Zenith Electronics	57

CRICKLEWOOD

ELECTRONICS LTD

WRITE OR PHONE NOW FOR OUR FREE,
1987/1988

PINK COMPONENTS CATALOGUE



**HUNDREDS OF LOWER PRICES
HUNDREDS OF NEW DEVICES**

from the U.K.'s number one 100% components shop - no gimmicks, no gadgets, no computers, just millions of components, all easily available by mail order, calling at shop, or credit card telephone orders. Just pick up, or a pen, to get the catalogue (no SAE required) - posted FREE to any country on the globe.

CRICKLEWOOD ELECTRONICS LIMITED

40 CRICKLEWOOD BROADWAY, LONDON NW2 3ET

Tel: 01 450 0995 & 01 452 0161 Telex: 914977



COMPUTER WAREHOUSE

1000's OF
BARGAINS
FOR CALLERS

THE "ALLADINS' CAVE OF COMPUTER AND ELECTRONIC EQUIPMENT"

HOT LINE DATA BASE

DISTEL

The ORIGINAL FREE OF CHARGE dial up data base. Buy, browse or place YOUR OWN AD for goods or services to sell. 1000's of stock items, spares and one off bargains. Updated daily. ON LINE NOW. CCITT, 8 bit word, no parity. For 300 baud modems call 01-679 1888 For 1200-75 baud modems call 01-679 6183

FREE

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

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

LIMITED QUANTITY - DON'T MISS THIS OFFER!!!

ONLY £29.95 OR £24.94 if purchased with ANY of our VIDEO MONITORS. Supplied BRAND NEW with full instructions and 2 YEAR warranty. Post and packing £3.50 *When used with colour crt.

COLOUR & MONOCHROME MONITOR SPECIALS

SYSTEM ALPHA 14" COLOUR MULTI INPUT MONITOR

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

This must be ONE OF THE YEARS BEST BUYS. PC USER Supplied BRAND NEW and BOXED, complete with DATA and 90 day guarantee. ONLY £159.00 as above OR IBM PC Version £165.00 15 Day 'D' sct £1.00. BNC sct 75p BBC interface cable £5.50

DECCA 80 16" COLOUR monitor. RGB input.

Little or hardly used manufacturer's surplus enables us to offer this special converted DECCA RGB Colour Video TV Monitor at a super low price of only £99.00, a price for a colour monitor as yet unheard of! Our own interface, safety modification and special 16" high definition PIL tube, coupled with the DECCA 80 series TV chassis give 80 column definition and quality found only on monitors costing 3 TIMES OUR PRICE. The quality for the price has to be seen to be believed! Supplied complete and ready to plug direct to a BBC MICRO computer or any other system with a TTL RGB output. Other features are: internal speaker, modular construction, auto degaussing circuit, attractive TEAK CASE, compact dimensions only 52cm W x 34 H x 24 D, 90 day guarantee. Although used units are supplied in EXCELLENT condition. ONLY £99.00 + Carriage

DECCA 80, 18" COLOUR monitor. Composite video input. Same as above model but fitted with Composite Video input and audio amp for COMPUTER, VCR or AUDIO VISUAL use. ONLY £99.00 + Carr.

REDIFFUSION MARK 3, 20" COLOUR monitor. Fitted with standard 75 ohm composite video input and sound amp. This large screen colour display is ideal for SCHOOLS, SHOPS, DISCOS, CLUBS and other AUDIO VISUAL applications. Supplied in AS NEW or little used condition ONLY £145.00 + Carr.

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

12" KGM 320-1 B/W bandwidth input, will display up to 132 x 25 lines £32.95
12" GREEN SCREEN version of KGM 320-1, Only £39.95
9" KGM 324 GREEN SCREEN fully cased very compact unit. Only £49.00

Carriage and insurance on all monitors £10.00

DC POWER SUPPLY SPECIALS

GOULD OF443 enclosed, compact switch mode supply with DC regulated outputs of +5v @ 5.5a, +12v @ 0.5a, -12v @ 0.1a and -23v @ 0.2a. Dim 18 x 11 x 6 cm. 110 or 240v input. BRAND NEW only £16.95

GOULD G6-40A 5v 40 amp switch mode supply NEW £130.00
AG-DC Linear PSU for DISK drive and SYSTEM applications. Constructed on a rugged ALLOY chassis to continuously supply fully regulated DC outputs of +5v @ 3 amps, -5v @ 0.6 amps and +24v @ 5 amps. Short circuit and overvoltage protected. 100 or 240v AC input. Dim 28 x 125 x 7 cm NEW £49.94
Carriage on all PSUs £3.00

KEYBOARDS

Manufacturer's BRAND NEW surplus

DEC LA34 Uncoded keyboard with 67 quality gold plated switches on X-Y matrix - ideal micro conversions etc. £24.95
AMKEY MPNK-114 Superb word processor chassis keyboard on single PCB with 116 keys. Many features such as On board Micro, Single 5v rail, full ASCII coded character set with 31 function keys, numeric keypad, cursor pad and 9600 baud SERIAL TTL ASCII OUTPUT! Less than half price
Only £99.00 with data. Carriage on Keyboards £3.50



DON'T MISS THE CPM Deal OF the CENTURY

The FABULOUS CPM TATUNG PC2000 Professional Business System

A cancelled export order and months of negotiation enables us to offer this professional PC, CPM system, recently on sale at OVER £1400, at a SCOOP price just over the cost of the two internal disk drives! Or less than the price of a dumb terminal!

Not a toy, the BIG BROTHER of the EINSTEIN computer, the DUAL PROCESSOR PC2000 comprises a modern stylish three piece system with ALL the necessities for the SMALL BUSINESS, INDUSTRIAL, EDUCATIONAL or HOBBYIST USER. Used with the THOUSANDS of proven, tested and available CPM software packages such as WORDSTAR, FAST, DBASE2 etc, the PC2000 specification, at our prices, CANNOT BE BEATEN!

The central processor plinth contains the 84K, Z80A processor, DUAL TEAC 55F 5W" Double sided 40/80 track disk drives (1Mb per drive), PSU, 4K of memory mapped screen RAM, disk controller, RS232, CENTRONICS and system expansion ports, and if that's not enough a ready to plug into STANDARD 8" DRIVE port for up to FOUR 8" disk drives, either in double density or IBM format. The ultra slim 92 key, detachable keyboard features 32 user definable keys, numeric keypad and text editing keys, even its own integral microprocessor which allows the main Z80A to devote ALL its time to USER programs, eliminating "lost character" problems found on other machines. The attractive, detachable 12" monitor combines a green, anti-glare etched screen, with full swivel and tilt movement for maximum user comfort. Supplied BRAND NEW with CPM 2.2, user manuals and full 90 day guarantee. Full data sheet and info on request.

PC2000 System with CPM Etc. COST OVER £1400

PC2000 Business System with CPM and 'Ready to Run' FAST Sales and Purchase ledger, supports up to 9000 Accounts, VAT etc. COST OVER £1700

PC2000 Wordprocessor System with CPM and TEC FP25 daisywheel printer

NOW only £399

NOW only £499
Carriage & Insurance £12.00

NOW only £799

MODEMS

Join the communications revolution with our super range of DATA MODEMS, prices and specifications to suit all applications and budgets.....

BRAND NEW State of the art products
DACOM DSL2123 Multi standard 300-300, 1200-75 Auto answer etc £268.00
DACOM DSL2123AQ Auto dial, smart modem with multi standard AUTO SPEED detect and data buffer with flow control etc. £365.00
DACOM DSL2123GT The CREAM of the intelligent modems auto dial, auto call, index, buffer etc etc. £498.00
Steabeck SB1212 V22 1200 baud FULL DUPLEX, sync or async, optional auto dial £485.00
TRANSDATA 307A Acoustic coupler 300 baud full duplex, originate only, RS232 interface £49.00

Ex BRITISH TELECOM full spec, CCITT, ruggedised, bargain offers. Sold TESTED with data. Will work on any MICRO or system with RS232 interface.
MODEM 13A 300 baud unit, only 2" high fits under phone. CALL mode only £45.00
MODEM 20-1, 75-1200 baud. Compact unit for use as subscriber end to PRESTEL, TELECOM GOLD, MICRONET etc. £39.95 +pp £6.50
MODEM 20-2 1200-75 baud. Same as 20-1 but for computer end £65.00 +pp £6.50
DATEL 2412. Made by SE Labs for BT this two part unit is for synchronous data links at 1200 or 2400 baud using 2780/3780 protocol etc. Many features include 2 or 4 wire working, self test, auto answer etc. COST OVER £800. Our price ONLY £199 +pp £8.00
DATEL 4800, RACAL MPS4800 baud modem, EX BT good working order, ONLY £295.00 +pp £8.00

SPECIAL OFFER

MODEM TG2393. Ex BT, up to 1200 baud full duplex 4 wire or half duplex over 2 wire line. ONLY £85.00 PER PAIR +pp £10.00

For more information contact our Sales Office.

MATRIX PRINTERS

SPECIAL BULK PURCHASE of these compact, high speed matrix printers. Built in Japan for the Hazeltine Corporation this unit features quality construction giving 100cs bidirectional, full pin addressable graphics, 6 type fonts, up to 95° single sheet or tractor paper handling, RS232 and CENTRONICS parallel interface. Many other features. BRAND NEW and BOXED. COST £420. Our price Only £199.00

RECHARGEABLE BATTERIES

Dry Fit MAINTENANCE FREE by Sonnenschein & Yuasa
A300 07191315 12v 3Ah NEW £13.95
A300 07191312 6v 3Ah NEW £9.95
A300 07191202 6-0-6v 1.8Ah TESTED Ex Equip £5.99

VDU TERMINALS

Standard VDU data entry terminals

at give away prices!!
OUME OVT108 Current product, state of the art terminal with detachable keyboard, 12" Green screen, 2 page RAM, TVI 925, Hazeltine, ADM5A emulations, software setup, 25 x 80, Clock, Swivel and tilt base, Printer port, Function keys etc. BRAND NEW and BOXED AT ALMOST HALF PRICE ONLY £425.00
AJS10 - EX RENTAL, Z80 controlled, 15" green screen 24 x 80 display, graphics, cursor addressing, printer port etc. Very good condition TESTED complete with manual only £225.00
ADDS 520 - Dumb terminal, used, 12" b/w SCREEN, RS232 interface and printer port. TESTED. ONLY £125.00. Carriage on terminals £10.00
100's of other terminals in stock. CALL for more details.

SURPLUS SPECIALS ON PRESTEL - VIEWDATA - TELEX

PLESSEY VUTEL ultra compact unit, slightly larger than a telephone features A STANOARD DTMF TELEPHONE (tone dial) with 5" CRT monitor and integral modem etc for direct connection to PRESTEL VIEWDATA etc. Designed to sell to the EXECUTIVE at over £600! Our price BRAND NEW AND BOXED at only £99.00

DECCAFAX VP1 complete Professional PRESTEL system in slimline desk top unit containing Modern, Numeric keypad, CPU PSU etc Connects direct to standard RGB colour monitor. Many other features include Printer output, Full keyboard input, Cassette port etc. BRAND NEW with DATA. A FRACTION OF COST only £55.00

ALPHATANTEL. Very compact unit with integral FULL ALPHA NUMERIC keyboard. Just add a domestic TV receiver and you have a superb PRESTEL system and via PRESTEL the cheapest TELEX service to be found! Many features: CENTRONICS Printer output, Memory dialling etc. Supplied complete with data and DIY mod for RGB or Composite video outputs. AS NEW only £125.00

Post and packing on all PRESTEL units £8.50

EX-STOCK INTEGRATED CIRCUITS

4164 200 ns D RAMS 9 for £11 4116 ns £1.50 2112 £10.00 2114 £2.50 2102 £2.00 6116 £2.50 EPROMS 2716 £4.50 2732 £3.00 2764 £4.95 27128 £5.50 6800 £2.50 6821 £1 68A09 £8 68B09 £10 8085A £5.50 8088 £15 8088 £8 NEC765 £8 WD2793 £28 8202A £22 8251 £7 8748 £15 Z80A DART £6.50 Z80A CPU £2.00. Thousands of IC's EX STOCK send SAE for list.

DISK DRIVES

Japanese 5 1/4" half height 80 track double sided disk drives by TEAC, CANON, TOSHIBA etc. Sold as NEW with 90 day guarantee. ONLY £85.00
TEC FB-503 Double sided HH 40 TRK NEW £75.00
SUGART SA400 SS FH 35 TRK £65.00
SIEMENS FDD100 SS FH 40 TRK £65.00
carriage on 5 1/4" drives £5.50

Brand NEW metal 5 1/4" DISK CASES with internal PSU.
DSK1 for 2 HH or 1 FH drive £29.95 +pp £4.00
DSK2 for 1 HH drive £22.95 +pp £3.50
DIABLO 3 As DSK1 LESS PSU £12.95 +pp £2.50
DSK4 As DSK2 LESS PSU £10.95 +pp £2.00
B' IBM format TESTED EX EQUIPMENT.
SHUGART 800/801 SS £175.00 +pp £8.50
SHUGART 851 DS £250.00 +pp £8.50
TWIN SHUGART 851 2 Mb total capacity in smart case, complete with PSU etc. £595.00
MITSUBISHI M2894-83 B' DS1 Mb equiv. to SHUGART SA850R. BRAND NEW at £275.00 +pp £8.50
DYSAN 8" Alignment disk £29.00 +pp £1.00
Various disk drive PSUs's Ex Stock SEE PSU section.

HARD DISK DRIVES
DRE/DIABLO Series 30 25 Mb front load £525.00
Exchangeable version £295.00, ME3029 PSU £95.00
DIABLO 44/DRE4000A, 8 5/8" 5 Mb for £750.00
CDC HAWK 5+5 Mb £795.00. CDC 9762 80 MbrMO3 etc. £2500.00, £495.00.
PERTEC D3422 5-45 Mb £495.00
RODIME 5 1/4" Winchester ex-stock for £150 CALL
Clearance items - Sold as seen - No guarantee
ICL 2314 BRAND NEW 14" Mb Removable pack hard disk drive, cost over £2000 with data ONLY £99.00
BASF 6172 B' 23Mb Winchester £199.00

Unless stated all drives are refurbished with 90 day guarantee. Many other drives and spares in stock - call sales office for details.

All prices quoted are for U.K. Mainland, paid cash with order in Pounds Sterling PLUS VAT. Minimum order value £1.00. Minimum Credit Card order £10.00. Minimum BONA FIDE account orders from Government Depts., Schools, Universities and established companies £20.00. Where post and packing not indicated please ADD £1.00 + VAT. Warehouse open Mon-Fri 9.30-5.30, Sat 10.30-5.30. We reserve the right to change prices and specifications without notice. Trade, Bulk and Export

32 Biggin Way, Upper Norwood, London SE19 3XF
Telephone 01-679 4414 Telex 894502 Data 01-679 1888



1988 BUYER'S GUIDE TO ELECTRONIC COMPONENTS

Maplin

ET14 88

AVAILABLE NOW IN ALL W.H. SMITH STORES GET YOUR COPY NOW!

GET YOUR COPY OF THE NEW MAPLIN CATALOGUE ON SALE NOW!

Send to Maplin Electronic Supplies Ltd, P.O. Box 2, Rayleigh, Essex S56 8LR.
Post Code
Pick up a copy from any W.H. Smith for just £1.50 + 40p p & p. If you live
outside the UK, send £2.75 or 12 International Reply Coupons 1 enclose £2.00.



UNIQUE



Make your own
DIGITAL WATCH KIT
1/2 PRICE OFFER
ONLY £1
SEE INSIDE COVER.
NO SOLDERING.
SUITABLE FOR
AGES 10+

VISIT OUR NEW SHOP IN BRISTOL NOW OPEN AT 302 GLOUCESTER ROAD Tel: (0272) 232014

NEW! RADIO CONTROL MODELS + 100'S OF NEW PRODUCTS AT LOW, LOW PRICES £1.60