

8K ON BOARD MEMORY!

5K RAM. 3K ROM or 4K RAM, 4K ROM (link selectable). Kit supplied with 3K RAM, 3K ROM. System expandable for up to 32K memory.

2 KEYBOARDS!

56 Key alphanumeric keyboard for entering high level language plus 16 key Hex pad for easy entry of machine code.

GRAPHICS!

64 character graphics option — includes transistor symbols! Only £18 20 extra!

MEMORY MAPPED
high resolution VDU circuitry using discrete
TTL for extra flexibility. Has its own 2K
memory to give 32 lines for 64 characters.

KANSAS CITY

low error rate tape interface.

PSI comp 80 **Z80 Based powerful** scientific computer design as published in WIRELESS WORLD



EFFICIENT OPERATION

Why waste valuable memory on sub routines for numeric processing? The number cruncher handles everything internally!

2 MICROPROCESSORS
Z80 the powerful CPU with 15B instruction, including all 78 of the 8080, controls the MM57109 number cruncher. Functions include +, -, ', squares, the last exponentials trie functions inverse etc.

cruncher. Functions include +, -, ', squares, roots, logs exponentials, trig functions, inverses etc. Range 10 99 to 9 x 1999 to 8 figures plus 2 exponent

RESIDENT BASIC with extended mathematical capability. Only 2K memory used but more powerful than most 8K Basics!

1K MONITOR resident in EPROM

SINGLE BOARD DESIGN Even keyboards and power supply circuitry on the superb quality double sided plated through-hole PCB

COMPLETÉ KIT **NOW ONLY** £225 + VAT

Cabinet size 19.0"x15.7"x3.3" Television not included in price

The kit for this outstandingly practical design by John Adams published in a series of articles in Wireless World really is complete. Included in the PSICOMP 80 scientific computer kit is a professionally finished cabinet, fibre-glass double sided, plated-through-hole printed circuit board. 2 keyboards PCB mounted for ease of construction, IC sockets, high reliability metal oxide resistors, power supply using custom designed toroidal transformer. 2K Basic and 1K monitor in EPROMS and, of course, wire, nuts, bolts, etc.

KIT ALSO AVAILABLE AS SEPARATE PACKS
For those customers who wish by agreed their purchase or hold a persentiated cystims the kill is creatible as
apparted packs on POS (16" × 12.5") 643,200. Peir of keybearde 634,800. Firmwere is EPROMS 630,000.
Tervital transfermer and power supply components E17.60, cabinal party ragged, made from steel, really
beautifully flatished E26.300. P.S. Will greatly exhauce only albert single beard computer including OHIO
SUPPRABABLE or which is case to readily medified. Other packs latisful are FREE CATALOGUE.

PSI COMP 80 Memory

Expansion System

Expansion up to 32K all inside the computer's own cabinet!

By carefully thought out engineering a mother board with buffers and its own power supply (powered by the computer's transformer) enables up to 3.8K RAM or 8K ROM boards to be fitted neatly inside the computer cabinet. Connections to the mother board from the main board expansion realist is mediative. socket is made via a ribbon cable

Mother board:

Fibre glass double sided plated through hole PCB 8.7" x 3.0" set of all components including all brackets, fixing parts and ribbon cable with socket to connect to expansion plug £39.90

POWERTAL

8K Static RAM hoard Fibre glass double sided plated through hole P C B 5.6" x 4 8" £12.50 Set of components including IC sockets, plug and socket but excluding RAMs £11.20 £114L RAM (16 required) £5.00 Complete set of board. components. 16 RAMS

£89.50

Fibre glass double sided plated through hole PCB 56"x 48" £12.40
Set of components including IC sockets, plug and socket but excluding ROMs £10.70
2708 ROM (8 required) £6.00 ROM board

Complete set of board, components, 8 ROMs £68.50 ETI VOCODER ★ AND THE RESERVE OF THE PERSON OF THE PERSON

COMP 80



Panel size 19.0" x 5.25". Depth 12.2"

14 CHANNELS! **NOISE GENERATOR! LED PPM METERS! SLEW RATE CONTROL!** 2 OSCILLATORS! VOICED/UNVOICED **DETECTOR!**

COMPLETE KIT ONLY £195 + VAT

Kit includes FREE foot control and test oscillator!

Like all our kits the ETI VOCODER really is complete — fully finished metal work, professional quality components (all resistors 2% metal oxide), nuts, bolts, etc. — even a 13A plugIKits also available as separate packs — See our Free Catalogue.

OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!

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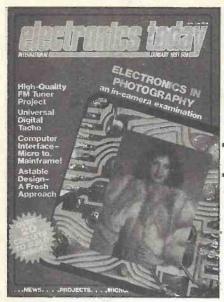
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U.K. ORDERS. Subjectific 15% surcharge for VAT. No charge is made for carriage.

MANY MORE KITS ON PAGE 8

SECURICOR DELIVERY: For this optional service (U.K. mainland only) add £2.50



Watch the birdie p.88

IANUARY 1981 VOL 10 NO

FEATURES

DIGEST MICROBASICS 17

9 New news is good news Monitoring programs

SPOT DESIGNS

And a couple of other spots 27 Sound seasonal ideas

AUDIOPHILE *29 I/O INTERFACE

43 Computer talk

READERS SURVEY

ASTROLOGUE 54 Win The Spaceflight Directory 57 Audience participation

DESIGNER'S NOTEBOOK 72 555 astables

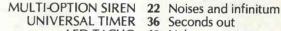
88 Watch the LED birdie

SLR ELECTRONICS TECH TIPS

96 Circuits from your very own selves

ELECTRONICS TOMORROW 102 See-SAW filters

PROIECTS



LED TACHO 49 Light up your revs

AUDIOPHILE FM TUNER 62 Spot the tuning POLYSYNTH 77 The makings of a motherboard

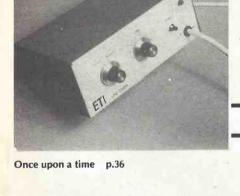
FOIL PATTERNS 110 Rub down foils

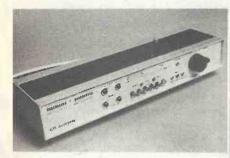
INFORMATION

NEXT MONTH'S ET! 15 What's in February

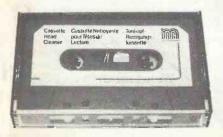
BINDERS 19 Issue protection ETIPRINTS 109 Rubbing down PCBs

COME AND JOIN US 112 Calling all camera operators





Spot the tuning p.62



The hi-fi supermarket p.29

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Why the Sinclair ZX80 is Britain's best-selling

Built: £99.95

Including VAT, post and packing, free course in computing, free mains adaptor.

Kit: £79.95

Including VAT, post and packing, free course in computing.

This is the ZX80. A really powerful, full-facility computer, matching or surpassing other personal computers at several times the price. 'Personal Computer World' gave it 5 stars for 'excellent value'. Benchmark tests say it's faster than all previous personal computers.

Programmed in BASIC – the world's most popular language – the ZX80 is suitable for beginners and experts alike. And response from enthusiasts has been tremendous – over 20,000 ZX80s have been sold so far!

Powerful ROM and BASIC interpreter

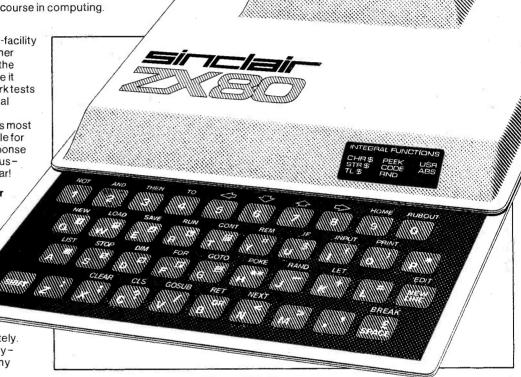
The 4K BASIC ROM offers remarkable programming advantages:

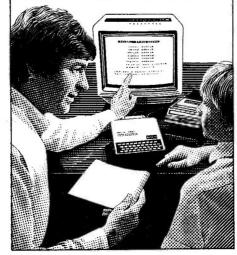
- * Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.
- Unique syntax check. A cursor identifies errors immediately.
- * Excellent string-handling capabilitytakes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison).
- * Up to 26 single dimension arrays.
- * FOR/NEXT loops nested up to 26.
- * Variable names of any length.
- * BASIC language also handles full Boolean arithmetic, condition expressions, etc.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- * Timer under program control.
- * PEEK and POKE enable entry of machine code instructions.
- * High-resolution graphics.
- * Lines of unlimited length.

Unique RAM

The ZX80's 1K-BYTE RAM is the equivalent of up to 4K BYTES in a conventional computer—typically storing 100 lines of BASIC.

No other personal computer offers this unique combination of high capability and low price.





The ZX80 as a family learning aid. Children of 10 years and upwards are quick to understand the principles of computing—and enjoy their personal computer.

The Sinclair teach-yourself BASIC manual

If the specifications of the Sinclair ZX80 mean little to you – don't worry. They're all explained in the specially-written 128-page book (free with every ZX80). The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs.

Kit or built-it's up to you

In kit form, the ZX80 is pleasantly easy to assemble, using a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9V DC nominal unregulated. If not, see the coupon.

Both kit and built versions come complete with all necessary leads to connect to your TV (colour or black and white) and cassette recorder. Plug in and you're ready to go. (Built versions come with mains adaptor.)

ETI JANUARY 1981

personal computer.

Now available for the ZX80... New 16K-BYTE RAM pack



Massive add-on memory. Only £49.95,

The new 16K-BYTE RAM pack is a complete module designed to provide you – and your Sinclair ZX80 – with massive add-on memory. You can use it for those really long and complex programs – or as a personal database. (Yet it can cost as little as half the price of competitive add-on memory for other computers.)

For example, you could write an interactive or 'conversational' program to show people what your ZX80 can do. With 16K-BYTES of RAM, they could be talking to your computer for hours!

Or you can store a mass of data – perhaps in a fairly simple program – such as a name and address list, or a telephone directory.

And by linking a number of separate programs together into one giant, but modular, program, you can achieve the same effect as loading several programs at once.

We're also confident that it won't be long

before you can buy cassette-based software using the full 16K-BYTE RAM. So keep an eye on the personal computer magazines – and brush up your chess perhaps!

The RAM pack simply plugs into the existing expansion port on the rear of the ZX80. No wires, no soldering. It's a matter of seconds and you don't need another power supply. You can only add one RAM pack to your ZX80 – but with 16K-BYTES who could want more!

How to order

Demand for the ZX80 exceeds all other personal computers put together! So use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. We'll acknowledge each order by return, and tell you exactly when your ZX80 will be delivered. If you choose not to wait, you can cancel your order immediately, and your money will be refunded at once. Again, of course, you may return your ZX80 as received within 14 days for a full refund. We want you to be satisfied beyond all doubt—and we have no doubt that you will be.

sinclair zx80

Science of Cambridge Ltd.

6 Kings Parade, Cambridge, Cambs., CB2 1SN. Tel: 0223 311488.

To: Science of Cambridge, FREEPOST 7, Cambridge CB2 1YY.

Remember: all prices shown include VAT, postage and packing. No hidden extras, Please send me:

Qty	Item	Code	Item price	Total £
	Sinclair ZX80 Personal Computer kit(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	02	79.95	
N	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual and mains adaptor.	01	99.95	
	Mains Adaptor(s) (600 mA at 9V DC nominal unregulated).	03	8.95	
	16K-BYTE RAM pack(s)	18	49.95	
	Sinclair ZX80 Manual(s). (Manual free with every ZX80 kit or ready-made computer).	06	5.00	

NB. Your Sinclair ZX80 may qualify as a business expense.

TOTAL: £

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10n, 15n, 22n, 27n 6p; 33n, 47n, 68n, 100n 7p; 150n 10p; 220n, 23 330n 13p; 470n 17p; 680n 19p; 1 μ 22P; 1 μ 5 30p; 2 μ 2 34p, 27 34p, 27 35v; 0.1 μ 6, 0.22, 0.33, 0.47, 0.68, 1.0 μ, 2.2 μ 6, 33, 4.7, 25V; 10, 20V, 6μ 8, 16V; 2 μ 2 4μ 7, 100 50p, 220 80p; 16V; 2 μ 2 4μ 7, 100 50p, 220 80p; 16V; 2 μ 2 4μ 7, 100 50p, 220 80p; 5K0.2 MΩ Single Gang Log & Lin. 29p 5K0.2 MΩ Single Gang D/P Switch 69p 65 5K0.2 MΩ Single Gang B/P Switch 69p 65 5K0.2	EED. ORDERS SSH/CHEQUE/ EDUCATIONAL PORT INQUIRY SEAS ORDERS ad otherwise, all d Football Ground. y, Ample Free Car 5p; 63V: 0.47, 1.0, 00. 220, 25p; 470, 00. 220, 25p; 470, 00. 40p; 2200, 45p; 0, 1500, 30p; 2200 110p; 50V: 4700, 1500, 30p; 2200 110p; 50V: 4700, 1500, 30p; 2200 110p; 50V: 4700, 1500, 30p; 2500 1144350n 295 1144450n 296 1144350n 296 1144350n 296 1144350n 296 1144350n 296 114450n 396 11445	TRANSI AC125 35 AC126 25 AC127 25 AC127 25 AC127 25 AC127 25 AC141 30 AC176 28 AC188 30 AC176 28 AC188 70 ACY18 70 ACY20 75 ACY22 60 ACY21 75 ACY22 75 ACY22 75 ACY22 75 ACY22 175 ACY21 75 ACY	BC1821 10 BC1831 10 BC1841 10 BC1861 20 BC186 30 BC187 26 BC212 10 BC2121 10 BC2121 10 BC213 10 BC214 10 BC213 11 BC214 10 BC213 11 BC214 10 BC213 11 BC214 10 BC213 11 BC214 10 BC213 14 BC3078 14 BC308 14 BC308 14 BC308 14 BC308 14 BC308 15 BC308	BF154 25 BF158 25 BF167 29 BF177 25 BF177 25 BF177 25 BF177 25 BF178 30 BF179 35 BF180 38 BF180 38 BF180 38 BF180 38 BF180 38 BF185 38 BF186 38 BF186 38 BF196 12 BF197 12 BF198 16 BF198 12 BF198 12 BF198 16 BF198 12 BF198 16 BF198 12 BF198 16 BF1	MJE340 54 MJE370 100 MJE371 100 MJE371 100 MJE371 100 MJE371 100 MJE321 95 MJE2255 99 MJE2255 99 MJE2255 90 MJE3055 70 MPF102 66 MPF103 36 MPF105 36 MPF105 36 MPF106 40 MPF106 36 MPF101 36 MPF105 36 MPF101 36 MPF105 36 MPF101 36 MPF105 36 MPF101 36 MPS010 55 MPS010	TIP120 90 TIP121 99 TIP122 99 TIP122 99 TIP141 120 TIP147 120 TIP147 120 TIP147 120 TIP148 45 TIS59 50 TIS44 45 TIS59 50 TIS43 32 TIS46 45 TIS59 50 TIS47 55 TIS91 32 UC734 65 TIS91 32 UC734 65 TIS91 32 UC734 65 TIS91 32 TIX107 11 ZTX108 12 ZTX109 12 ZTX109 12 ZTX109 12 ZTX109 12 ZTX109 12 ZTX109 12 ZTX300 13 ZTX301 15 ZTX301 15 ZTX302 16 ZTX301 15 ZTX302 18 ZTX301 15 ZTX303 19 ZTX301	2N2905A 26 2N2907 26 2N2907 26 2N2907 26 2N2928G 10 2N3011 28 2N3020 45 2N3053 26 2N3054 58 2N3055 48 2N3055 48 2N3055 48 2N3055 10 2N3702 10 2N3702 10 2N3702 10 2N3706 10 2N3706 10 2N3706 10 2N3706 10 2N3706 10 2N3706 10 2N3701 10 2N3706 10 2N3701 10 2N3706 10 2N3701 10 2N3706 10 2N3701 10 2N3706 10 2N3706 10 2N3701 10 2N3706 10 2N37	2N5459 36 2N5485 36 2N5777 45 2N5879 190 2N6027 32 2N6388 150 2S0234 75 3N128 112 3N140 112 40311 60 40313 130 40316 95 40317 60 40320 60 40323 60 40324 100 40324 100 40326 60 40327 70 40348 120 40368 43 40368 43 40369 50 40368 43 40369 70 40408 70 40560
6V: 47 μ. 68, 100 28p; 3V: 100 20p. MYLAR FILM CAPACITORS 100V: 0,001, 0,002, 0,005, 0,01 μF 69 0,015, 0,02, 0,005, 0,056 μF 7p 0,1 μF, 9p. 50V: 0,47 μF CERAMIC CAPACITORS 50V Mange: 0,56 ft 0,10,000 μF 0,015 μF, 0,022 μF, 0,033 μF 0,047 μF 5p. 0,1 μF, 0,2 μF 7p 0,047 μF 5p. 0,1 μF, 0,2 μF 7p 3ILVER MICA (Values in pF) 33, 47, 50, 88, 75, 52, 85, 100, 120, 150, 220 11p each 250, 270, 300, 330, 360, 390, 169, 220 120, 100, 120, 150, 220 120, 150, 80, 75, 100, 120, 150, 220 120, 200, 200, 24, 7MΩ Vert. POLYSTYRENE CAPACITORS: 1000, 120, 150, 150, 470, 600, 800, 820 20 MINIATURE TYPE TRIMMERS 2.56pF, 31 10pF: 10-40pF 2p, 100, 150, 150, 150, 150, 150, 150, 150	522 650 530 1350 531 1350 532 850 545 1450 551 850 592 2572 800 700 910 360 - 821 500 821 500 821 500 821 500 821 1500 825 485 825 485 825 485 825 485 825 485 825 485 825 825 825 825 825 825 826 825 825 827 826	8C1443 30 8C14478 19 8C14478 19 8C14488 19 8C1489 19 8C1489 19 8C153 27 8C1554 27 8C1554 17 8C1558 10 8C1558 10 8C1658 10 8C1670 15 8C1677 15 8C1677 15 8C1677 15 8C1678 10 8C1688 10 8C1688 10 8C1671 11 8C177 15 8C177 11 8C177 11 8C177 11 8C177 11 8C177 12 8C188 10 8C1688 10 8C177 10 8C188 10 8C18	BD1331 48 BD1332 48 BD1333 60 BD135 40 BD136 40 BD137 40 BD137 40 BD138 40 BD140 40 BD144 19 BD145 175 BD1265 110 BD206 110 BD	BPY52 23 BPY53 32 BPY55 32 BPY56 32 BPY64 35 BPY71 20 BFY91 120 BFY91 120 BSX26 34 BSX26 34 BSX28 34 BSX28 34 BSX28 34 BSX28 34 BSY95A 25 BU105 170 BU205 200 BU205 200 BU205 190 BU205 200 BU205 200 B	TIP29A 36 TIP29C 60, TIP29C 60, TIP30C 47 TIP30A 48 TIP30B 50 TIP30C 58 TIP31A 55 TIP31B 48 TIP31C 50 TIP31B 48 TIP31C 50 TIP31B 48 TIP31C 50 TIP31B 48 TIP3	2N1307 65 2N1308 68 2N1613 30 2N1670 150 2N1670 150 2N1670 295 2N2217 45 2N22184 45 2N22204 26 2N22204 26 2N22204 25 2N22204 25 2N22204 25 2N22204 25 2N22369 48 2N23694 50 2N2489 27 2N2489 27 2N24	2N4234 48 2N42264 24 2N42266 15 2N42289 18 2N4314 68 2N44400 18 2N4487 80 2N4889 75 2N4889 75 2N4891 175 2N49921 55 2N49921 55 2N5139 22 2N5139 22 2N5139 28 2N5179 45 2N5180 45 2N5180 45 2N5180 45 2N5180 24 2N5489 38 2N5489 38 2N54	400p 2718-50v 650p 4116 299p IM6402 (UART) 380p MM1702AQ 295p Telephone orders by Access now accepted (£10 min.) LS76 45 LS78 50 LS83 106 LS85 30
100/200pf 250p 25	K4027.4 350 C M8116N	A3048	14 MC1494 14 MC1495 13 MC1495 13 MC1495 13 MC1495 13 MC1495 15 MC3302 90 MC3302 15 MC3302 15 MC3307 15 MC3307 15 MC3307 15 MC3307 16 MC3403 16 MC3403 16 MC3403 17 MC3	900 TBA69000 3500 TCA965 992 TDA10040 992 TD	250 7444 10 290 7445 10 290 7445 10 290 7446 13 310 7447 7 575 7448 7 575 7448 7 575 7448 7 320 7451 2 320 7451 2 320 7454 2 320 7454 2 320 7454 2 320 7454 2 320 7454 2 320 7457 3 320 7457 3 321 7457 3 321 7457 3 322 7457 3 323 7457 3 324 7457 3 327 7458 3 328 7458 3 32	6	74185 349 741121 325 74122 325 748S 60 504 73 5138 240 5138 240 5138 240 5138 240 5138 240 5138 240 5188 210 5188 210 5188 210 5188 210 5188 210 5188 210 5188 210 5188 210 5188 210 5188 210 5188 210 5188 210 5287 328 5288 210 5287 328 5472 1150 5247 5150 5472 1150 5475 1250 5472 1150 5475 1250 5475 1250 5475 1250 5476 1250 5	LS90

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9 KEYPADS 4 x 4 matrix

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SWITCHES TOGGLE: 2A, 250V SPST 33 DPST 34 DPDT

4 pole on/off SUB-MIN TOGGLE SP changeover 60p SPST on / off 54p SPDT biased off 105p DPDT 6 tags 75p DPDT centre off 88p DPDT centre off 145p Push to break 20p SLIDE 250V: 1A DPDT 1A DPDT c/over ½A DPDT 4 pole 2-way 4 pole 2-way 24p PUSH BUTTON DPDT Black Body Red, Blue, Grn., Yell. SRL Latching 125p SRM Momentary 125p

MINI. Non Locking Push to Make 15p Push Break 25p DIL SWITCHES (SPST) 4 way 85p; 6 way 95p; 8 way 115p.

ROTARY: Make your own multiway Switch. Adjustable Step Shafting Assembly. Accommodate up to 6
Waters 65p
Mains Switch DPST to fit 45p
Waters 1 pole / 12 way. 2p / 6 able Stop Shafting Assembly. Accommunate of the Wafers of Stammans Switch DPST to fit Break Before Make Wafers 1 pole / 12 way. 2p / 6 way. 3p / 4 way. 4p / 3 way. 6p / 2 way 56p Arman Synacr and Streen FOTARY: (Adjustable Stop) 1 pols / 2 to 12 way. 4p / 2p / 2 to 6 way. 3 pole / 2 to 4 way. 4p / 2b / 2 to 3 way. 4 pole / 2 to 4 way. 4 pole /

'D' CONNECTORS (Cannon type)

Plugs Sockets Covers
ay 95p 128p
ay 135p 195p
ay 198p 284p
ay 290p 398p

CRYSTALS 100KHz 455KHz MHz .008M 395 392 323 362 362 323 195 290 323 425 323 200 323 392 28MHz 6MHz 8MHz 8432MHz 4576MHz .2768M .57954M .000MHz 4.000MHz 4.032MHz 4.433619M 5.0MHz 5.185M 5.24288M 6.0MHz 6.0MHz 6.5536M 7.680M 8.0MHz 8.08333M 8.867237M 9.375M 10.0MHz 10.7MHz

95p; 8 way 115p. 3/way

TRANSFORMERS (Malins Prim. 220-240V),
6-6 6V; 9-0.9V; 12-0-12V 100mA 95p
3VA: 0-6 V6 8V (PCB mounting) 12V. 3A
15V. 3A
15V. 3A 15V. 25A 15V. 25A
12V. 3A: 15V. 25A 15V. 25A
12V. 45V. 13A 4 5V. 13A, 8V. 12A
12V. 45V. 13A 4 5V. 13A, 8V. 12A
12V. 3A: 12V. 5A: 15V. 4A 15V. 4A; 20V. 3A
20V. 3A
225p (30p p&p)
24VA: 6V. 1.5A 6C. 1.5A: 9V. 1.3A 9V. 1.3A, 9V. 1.3A, 2V. 1A
12V. 1A: 15V. 1A: 15V. 8A 15V. 8A
12V. 1A: 15V. 1A: 15V. 3A 15V. 3A
12V. 3A
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12V. 3A: 15V. 15A: 3CV. 15A
12V. 2A: 15V. 3A: 15V. 3A
12V. 2A: 15V. 3A: 15V. 3A
12V. 2A: 15V. 3A: 15V. 3A
12V. 25A: 40V. 125A: 3CV. 15A
20V. 2.5A
20V. 2.5A: 3CV. 15A: 3CV. 15A
20V. 2.5A
20V. 2.5A: 3CV. 15A: 3CV. 15A
20V. 25A
20V. 25A: 4CV. 15A: 3CV. 15A
20V. 25A
20V. 25A: 4CV. 15A: 5CV. 1A
20V. 25A
20V. 25A: 5CV. 1A
20V

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4½x3½x1½" 0-50μΑ 0-100μΑ 0-500μΑ **595p each**

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TO3 7805 7812 7815 7818 145p 7818 T0220 7805 7812 7815 7818 7824 Plastic Ca 60p 60p 60p 60p 60p 60p
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 Plastic Casing

 5V
 78L05
 30p
 79L05

 6V
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 8V
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 12V
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 15V
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 65p LM300H LM305H LM309K LM317K LM323K LM325N LM326N 170p 140p 135p 350p 550p 240p 240p

OPTO OPTO
LEDs with Clips
TIL209 Red
TIL219 Red
TIL219 Gm. 11
TIL212 Yel, 21
TIL220 Z" Red 1
2" Green, Yellow 3
LOZ71 Intra Red 4
ENTRY SHADEN SHAD 13 17 18 14

18 7 Segment Displays
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30 Tik 307 675
30 Tik 312 3" CA 105
40 Tik 313 3" CC 105
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75 DL 704 3" CC 99
10 DL 707 3" CA 99
225 DL 747 6" CA 180
8" Grange CA 250
55 FND357 Red 120
FND357 Red 120
FND358 Green CA 150
85 6" Green CA 150
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ISOLATORS TIL111/2 TIL111/ TIL117 95

DVM176 LCD 3½ Digits LCD 4 Digits LCD 6 Digits 350 135 135 135 136 130 LS373 LS374 LS375 LS377 LS378 LS379 4054 4055 4056 4057 4059 4060 4061 4063 4066 4067 4068 4069 4071 4072 4073 120 115 790 750 950 1250 480 850 280 570 1050 850 999 350 350 969 960 1600 4500 7580 3200 8882 900 1300 215 215 4200 3300 3300 3315 1855 1856 665 665 690 LS384 LS385 LS386 LS390 LS393 LS395 4075 4076 4077 4078 4081 4082 4085 4086 4093 4094 4095 4096 4098 4099 4160 4161 4162 4163 4174 350 750 28 105 65 75 48 325 85 98 84 225 220 250 90 415 90 90 LS669 LS670 LS673 LS674 CMOS
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4015 82 4041 4042 4043 4044 4045 4046 4047 4048 4049 4050 4051 4052 4053 4510 4511 4512 4513 4514 4515 4516 4517 4518 4519 4002 4006 4007 4008 4009 4010 4011 4012 4013

MUSICA **BUILD THE WORLD FAMOUS** CHROMA-CH

Give your friends a warm welcome. Yes, think how delighted and amazed they will be to hear the musical Chroma-Chime play when they press your

The Chroma-Chime uses a microcomputer to play 24 well-known tunes. The kit is simplicity itself for ease of construction. Absolutely everything needed is supplied, including:

* Resistors, Capacitors, Diodes, Transistors, I.C. Socket and all hardware

★ Texas Instruments TMS 1000 microcomputer

★ Comprehensive kit manual with full circuit details

* Ready drilled and legended PCB included

Plays 24 well-known tunes including: Star Spangled Banner; William Tell Overture,

Greensleeves, Rule Britannia, Colonel Bogey, Oh come all ye faithful. plus many other popular tunes.

- ★ No previous microcomputer experience necessary
- ★ All programming retained is on chip ROM
- ★ Fully guaranteed
- ★ Ideal present any time



TMS 1000N

STEP OF THE PROPERTY OF THE PR MP0027A Micro-computer chip available separately

if required. Full 24 tune spec device fully guaranteed. This angue chip can be used not only for electronic door chimes but for other projects requeng musical couput. Car Horns. Musical Boxes. Alarms.

Amusement Machines. Public Address etc. \$4.95

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CHROMATRONICS

ETI 1/81

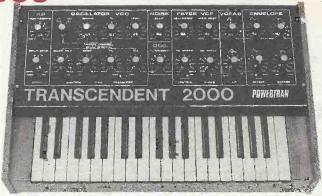
RANSCENDENT 2000 SINGLE BOARD SYNTHESIZER

as a constructional article in ETI, this live performance synthesizer is a 3 octave instrument transposable 2 octaves up or down giving sweep control, a noise generator and an ADSR envelope shaper. There is also a slow oscillator, a new pitch detector, ADSR repeat, envelope shaper. There is also a slow oscillator, a new pitch detector, ADSR repeat, sample and hold, and special circuitry with precision components to ensure tuning stability amongst its many features.

The kit includes fully finished metalwork, fully assembled solid team cabinet, filter sweep The kit includes fully finished metalwork, fully assembled solid team cabinet, filter sweep pedal, professional quality components (all resistors either 2% metal oxide or ½% metal film), and it really is complete — right down to the last nut and bolt and last piece of wire! There is even a 13A plug in the kit — you need buy absolutely no more parts before plugging in and making great music! Virtually all the components are on the one professional quality fibreglass PCB printed with component locations. All the controls mount directly on the main board, all connections to the board are made with connector plugs and construction is so simple it can be built in a few evenings by almost anyone capable of neat soldering! When finished you will possess a synthesizer comparable in performance and quality with ready-built units selling for many times the price.

Comprehensive handbook supplied with all complete kits! This fully describes construction and tells you how to set up your synthesizer with nothing more elaborate than a multi-meter and a pair of ears!

COMPLETE KIT ONLY £168.50 + VAT!



Cabinet size 24:6" x 15.7" x 4.8" (rear) 3.4" (front)

TRANSCENDENT POL

TRANSCANTANT PINYSYATA

SYNTHESIZER

AS FEATURED IN THIS ISSUE!

COMPLETE KIT from £320 + VAT

By brilliant design work and the use of high technology components the Polysynth brings to the reach of the home constructor a machine whose versatility and range of sounds is matched only by ready-built equipment costing thousands of pounds. This latest addition to the famous Transcendent family is a 4 octave (transposable over 7 octaves) polyphonic synthesizer with internally up to 4 voices making it possible to play simultaneously up to 4 notes. An add-on unit permits expansion up to 8 voices. Each voice is a complete synthesizer in itself with 2 VCOs, 2 ADSRs, 1VCA and 1 VCF. Being voltage controlled all voices can be adjusted simultaneously by master controls yet their own pitch and gate signals mean each voice can be operated independently from the keyboard.

Although using very advanced electronics the kit is mechanically very simple with minimal wiring, most of which is with ribbon cable connectors. All controls are PCB mounted and the voice boards plug into PCB mounted sockets. The kit includes fully finished metallwork, solid teak cabinet, professional quality components (resistors 2% metal oxide or 0.5% and 0.1% metal film), nuts, bolts, etc. Complete kit with 1 voice £320, 2 voices £368, 4 voices £464, expansion unit to extend to 8 voices £295 (all prices subject to V.A.T.). A mere fraction of what you would have to pay for a ready-built comparable instrument!

TRANSCENDENT DPX

MULTI-VOICE SYNTHESIZER

Another superb design by synthesizer expert Tim Orr published in **Electronics Today International**

PIECHTRAN

COMPLETE KIT ONLY £299 + VAT!



Cabinet size 36.3" × 15.0" × 5.0" (rear) 3.3" (front)

The Transcendent DPX is a really versatile 5 octave keyboard instrument. These are two audio outputs which can be used simultaneously. On the first there is a beautiful harpsichord or read sound—fully polyphonic, i.e. you can play chords with as many notes as you like. On the second output there is a wide range of different voices, still fully polyphonic. It can be a straightforward piano as a honky tonk piano or even a mixture of the two! Alternatively you can play strings over the whole range of the keyboard or brass over the whole range of the keyboard or brass over the whole range of the keyboard and brass as the lower end (the keyboard is electronically split after the first two octaves) or vice-versa or even a combination of strings and brass sounds simultaneously. And on all voices you can switch in circuitry to make the keyboard touch sensitive! The harder you press down a key the louder it sounds — just like an acoustic piano. The digitally controlled multiplexed system makes practical touch sensitivity with the complex dynamics law necessary for a high degree of realism. There is a master volume and tone control, a separate control for the brass sounds and also a vibrato circuit with variable depth control together with a variable delay control so that the vibrator comes in only after waiting a short time after the note is struck for even more realistic string sounds.

To add interest to the sounds and make them more natural there is a chorus / ensemble unit which is a complex phasing system using CCD (charge coupled device) analogue delay lines. The overall effect of this is similar to that of several acoustic instruments playing the same piece of music. The ensemble circuitry can be switched in with either strong or mild effects. As the system is based on digital circuitry digital data can be easily taken to and from a computer (for storing and playing back accompaniments with or without pitch or key change, computer

As the system is dosed on organization of displacements, organization of the composing, etc., etc.).

Although the DPX is an advanced design using a very large amount of circuitry, much of it very sophisticated, the kit is mechanically extremely simple with excellent access to all the circuit boards which interconnect with multiway connectors, just four of which are removed to separate the keyboard circuitry and the panel circuitry from the main circuitry in the cabinet.

Solid took cobinet, professional quality components (all resistors 2% metal oxide), nuts, bolts, etc., even a 13A plugl

MANY MORE KITS ON PAGE 115. MORE KITS AND ORDERING INFORMATION ON INSIDE FRONT COVER

All projects on this page can be purchased as separate packs, e.g. PCBs, components sets, hardware sets, etc. See our free catalogue for full details and prices.

DIGEST

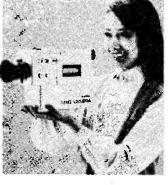
Hitachi MAGic

Historii have developed an experimental colour video camera combined with a video tape, recorder — provisionally christened the 'MAG Camera'. Using high density recording techniques, the combination is little bigger than an 8 mm cine camera. The cassette, using ¼" tape, is almost as small as an audio cassette and allows two hours of recording/playback. The complete unit weighs only 2.6 kg, including a rechargeable battery pack. Watch this space for news on development of the MAG Camera.

Hitachi have also launched a new portable VHS video recorder. The VT 7000 is one of the lightest in the world — just 5.9 kg. All the controls are of feather touch 'IC logic' operation, with a remote control facility. The recorder can be linked up with the VT TU 70 video tuner, which also doubles as an AC power source/charger for the recorder.

If you don't feel like getting up for a bowlful of breakfast telly, you can amuse yourself in bed with Hitachi's new K 2300 portable monochrome set combined with a quartz clock. The set has a 4½" tube and receives both VHF and UHF. Its



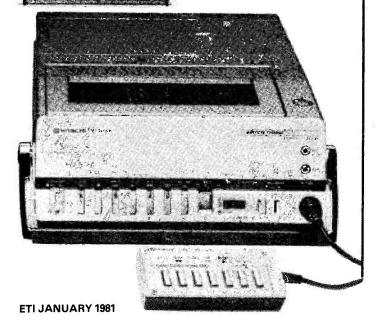


four way power source means that the K 2300 can be used virtually anywhere — bedroom (mains/battery), car, caravan, garden or Santa's grotty (sorry) grotto.

(sorry) grotto.
The quartz clock can be used to switch the TV on or off, so you can use it as a snooze switch at night and a telly alarm in the morning. Also featured is an audio output socket, so that sound recordings can be made (naughty).

Now what about the pound notes? The VT 7000 is £579, the VT TU 70 £159 and the K 2300 £115. All prices include VAT.

Hitachi's new MAG camera (top) combines video camera and recorder. The K2300 portable telly (left) is also an alarm clock. Their new VHS video recorder (below) is one of the lightest portables available.

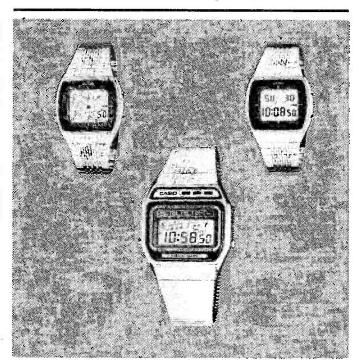


Welsh Chip Shop

Within the next year construction work is to begin on the first Inmos large scale production facility in Newport, Gwent. Production of advanced very large scale integrated semiconductor devices for worldwide distribution should begin in 1982. Inmos is a subsidiary of the National Enterprise Board.

Ace Move

Business must be booming in Bately — Ace Mailtronix Ltd has moved into larger premises at 3a Commercial Street, Batley, West Yorks. WF17 5HJ. The Ace component catalogue, listing approximately 1,000 items, is available for 30p (refundable on orders above £5) to mail order customers. If you're passing through Batley (as one does), call into Ace and collect your copy free.



Anne O'Log Watches

Poor old Anne O'Log died a death when digital watches took off, but now she's in demand again. Casio's new AA81 is a digital watch with hands — nothing strange in that, you may say. However, the AA81 has no moving parts. It's all done with LCDs.

The display offers a choice of digital hours, minutes and seconds plus day and date (automatic calendar) OR hours and minutes on 'hands' plus digital seconds. There is also a wristful of extra features — stopwatch (to 1/100th of a second), daily alarm with variable tone pitch and count-down alarm/timer up to 60 minutes.

The Casio M12 doesn't have a hand in sight. Its speciality is playing tunes — a different one for every day of the week, if you feel the need. Its repertoire includes 'Happy Birthday',

Wedding Bells' and 'Jingle Bells' for those special days in the year. It will also play the Big Ben chimes every hour.

The digitial display shows hours, minutes, seconds, AM/PM (or 24 hour clock), month, date and day (not all at once, of course). When it's sounding off, a musical stave magically appears on the display as the melody is played. AND the M12 features a countdown alarm/stopwatch function.

The Casio AA81 with chrome case, stainless steel bracelet and 18 month lithium battery costs £34.95. The AA83 (same features with stainless steel case and bracelet) costs £49.95 and the AA81G (gold plated) costs £54.95. The M12 costs £26.95 with resin case and strap or you can buy the same watch packaged in a stainles steel case and bracelet for £34.95 (the M1200). Casio's recommended retail prices are the maximum you can expect to pay, so shop around for bargains.

PRACTICAL ELECTRONICS PROJECT 125 WATT POWER AMP KIT

Max. Output power Operating voltage (DC) t nads

50-80 Max 4-16 ohms Frequency response Measured at 100 watts 25 Hz-20kHz Sensitivity for 100 watts 400mV @ 47K Typical T.H.D. @ 50 watts 4 ohms load 205 x 90 and 190 x 36 mm

SPECIFICATIONS

125 watt RMS

Dimensions The P.E. power amp kit is a module for high power applications -disco units, guitar amplifiers, public address systems and even high power domestic systems.

The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, the

output stage uses four 115 watt transistors normally only two would be used, result, a high powered rugged unit The PC Board is backprinted, etched and ready to drill for ease of construction, and the aluminium chassis is preformed and ready to use, supplied with all parts and circuit diagrams.

9.50 plus f 1 00 p&p 125 watt power amp kit

ACCESSORIES AUCESSORIES
Suitable L.S. coupling electrolytic £1.00 plus 20p p&p

Suitable Mains Power Supply Unit **£7.50** plus £2.75 p&p. sufficient for one power amp

PRACTICAL ÉLECTRONICS OCTOBER ISSUE



DIY STEREO BARGAIN PACKS FEATURING FAMOUS BUILT MULLARD PREAMP MODULES



In easy to build form C.B.s backprinted, etched and drilled ready to use

BUILD A 12 WATTS PER CHANNEL STEREO AMPLIFIER ACCESSORIES AND L.S. KIT EXTRA (not available separately)

DIY PACK 1 2 x power amp kits LP1182/ preamp module, suitable for ceramic and auxiliary inputs.

DIV PACK 2 2 x nower amp kits LP1184 preamp module suitable for magnetic ceramic and auxiliary inputs

QIY SPEAKER KIT Two 8" x 5" approx. 4 ohm bass.

£6.00 plus £1.10 p&p

£3.50 plus £1.70 p&p

DIY ACCESSORIES Mains transformer smoothing capacitor rectifier 4 x slider controls, for base, treble and volume

£3.00

ACCESSORIES: Available only at time of purchase of Bargain Packs

12 + 12 WATT AMPLIFIER

KIT NOTE: for use with 4 to 8 ohms speakers.

With up-to-the-minute features To complete you just supply screws, connecting wire and solder. Features include din sockets for ceramic cartridge, microphone, tape or tuner Outputs—tape, speakers and headphones. By the press of a button it transforms into a 24 watt mono disco amplifier with twin deck mixing. The kit incorporates a Mullard LP1183 pre-amp nodule, plus 2 power amplifier assembly kits and mains power supply. Also featured 4 slider level controls, rotary bass and treble controls and 6 push button switches. Silver finish fascia panel with matching knobs. Easy to assemble teak simulate cabinet and ready made metal work. For further information instructions are available price 50p. Free with kit.

Size 9%" x 8%" x 4" approx. £13.95

for use with 4 to 8 ohms speakers.

BSR chassis record deck with manual set down and return, complete with stered . ceramic cartridos

£8,50 plus £2.75 p&p when purchased with amplifier. Available separately £10.50 plus £2.75 p&p 8" SPEAKER KIT. 2 Phillips 8" approx. speakers. £4,75 per

stereo pair plus £1.50 p&p when purchased with amplifier. Available separately £6.75 plus £1.50 p&p

EREO MAGNETIC PRE-AMP CONVERSION KIT all components including P.C.B. to convert your ceramic input on the 12 + 12 amp to magnetic. when purchased with kit featured above. £4.00 separately inc p&p



BSR Manual single play record deck with auto return and cueing lever. Fitted with stereo ceramic cartridge 2 speeds with 45 rom spindle adaptor ideally suited for home or disco use.

£12.25 OUR PRICE plus £2.75 p&p



PHILLIPS RECORD PLAYER DECK GC037



Hi Fi record player deck, 2 speed, damped cueing, auto shut-off, belt drive with floating sub chassis to minimise acquistic feedback, Complete with 6P401 stereo magnetic cartridge-LIMITED STOCK UNBEATABLE OFFER AT

£27.50 complete plus £2.75 p&p

OFFER!

SAVE MONEY by purchasing 12 + 12 amp kit, BSR record deck and speaker kit together for only

PRACTICAL ELECTRONICS CAR RADIO KIT

(Constructors pack 7)



- Easy to build *5 push button tuning
- Modern styling design * All new unused components
- 6 watt output *Ready etched & punched P.C.B.
- * Incorporates suppression circuits

All the electronic components to build the radio, you supply only the wire and solder as featured in the Practical Electronics March issue. Features: Pre-set tuning with five push button options, black illuminated tuning scale, with matching retary control knobs, one, combining on/off volume and tone-control, the other for manual tuning, each set on wood simulated fascia

The P.E. Traveller has a 6 watts output, neg ground and incorporates an integrated circuit output stage, a Mullard IF module LP1181 ceramic filter type, pre-aligned and assembled and a Bird pre-aligned push button tuning unit. The radio fits easily in or under dashboards.

Complete with instructions.

CONSTRUCTORS PACK 7A

Suitable stainless steel fully retractable locking aerial and speaker (approx. 6" x 4") is available as a kit complete £1.95 per pack, p&p £1.00 Pack 7A may only be purchased at the same time as Pack 7

NOTE: Constructor's pack 7A sold complete with radio kit **£15.20** including p&p. FEATURED PROJECT IN PRACTICAL ELECTRONICS



30 + 30 WATT STEREO AMPLIFIER **BUILT AND TESTED**

Viscount IV unit in teak simulate cabinet silver finished rotary controls and pushbuttons with matching fascia, red mains indicator and stereo jack socket. Functions switch for mic magnetic and crystal pickups, tape and auxiliary. Rear panel features fuse holder. DIN speaker and input socket 30 + 30 watts. RMS 60 + 60 watts peak for use with 4 to 8 ohm speakers. Size 14%" x 10" approx.

READY TO PLAY £32.90 plus g3 30 n&r



323 EDGWARE ROAD, LONDON, W.2 21E HIGH STREET, ACTON W3 6NG ACTON. Mail Order only. No callers.

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BARGAIN OFFER!!



ARISTON PICK UP

Ariston pick-up arm manufactured in Japan. Complete with headshell Listed price over £30.00

100 WATT MONO DISCO **AMPLIFIER**

Brushed aluminum, fascia and rotary controls Size approx 14" x 4" x 1014. Five vertical slide controls, master volume, tape leverl, mic level, deck level, PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level controls (PRL) lets YOU hear next disc before fading it in. VU meter monitors output level

76.00 Output 100 watts RMS 200 watts peak. plus £4.00 p&p

50 WATT MONO DISCO AMPLIFIER

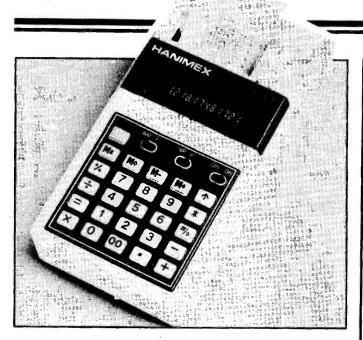
Size appox 13%" x 5¼" x 6¾", 50 watts rms, 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls

fitted with integral push-pull switches. Independent bass and treble controls and master volume

plus £3.20 p&p



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Pocket Printer

animex have launched what they believe to be the smallest and most versatile print and display calculator in the world. The Micro 1226T features a 12 digit green display plus full print-out capability in a 140 x 72.4 x 23.5 mm package weighing only 260 g.

Ultrasound

A new series of matched, low-cost ultrasonic transducers from Impectron are small, light and highly sensitive. They offer excellent performance in applications such as industrial control and intruder detection systems.

The EFR-OCB25K5 and EFR-RCB25K5 are transmitter and receiver respectively, with a nominal centre frequency of 25 kHz. Sensitivity is around -60 dB/V/uBar with mini-

It uses standard 38 mm thermal paper from its own paper store or from a larger paper holder. The keyboard includes a fully addressable four key memory, percentage key, item count key and single and double zero input key. Print-out speed is 1.8 lines per second.

mum bandwidth of 3 kHz. Overall dimensions are 1" long (body length 0.37") by 0.95" diameter for both transducers.

Their internal construction incorporates a compound vibrator (ceramic chip plus conical aluminium resonator) providing sensitivity and bandwidth.

Delivery is ex-stock and application notes for designers are available from Impectron Ltd, Foundry Lane, Horsham, W Sussex RH13 5PX.



Crystal Clear

Ambit International's four new Acompact modules combine a data decoder and LCD display for only £19.95. Two versions (DM180) DM181), based on the ICM 7211, provide simultaneous decoding and display from multiplexed BCD inputs. Hex or Code B displays are also available. Power consumption is 3V5 to 6 V at typically 20 uA in either four or 3½ digit formats.

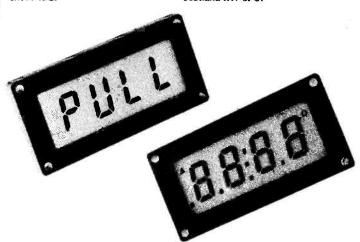
All the modules measure 60 x 30 x 7 mm (12.5 mm LCDs with integral incandescent backlighting) and can be supplied with a panel mounting bezel. For further details contact Ambit International. 200 North Service Road, Brentwood, Essex CM14 4SG.

Beckman Instruments' new model 740 and 742 large area LCDs feature as standard pin connectors bonded to the display. The connectors are also available separately.

The 740 features six digits (½" high) with colons and decimal points in a 2.75" x 1.2" package. The 742 offers eight digits, also ½" high with colons and decimal points, in a 3.7" x 1.2" package.

Power consumption is very low — 50 uW for the 740. Both models offer a wide operating voltage range (3-20 V RMS) and are compatible with available CMOS drive circuits.

For further information contact Beckman Instruments Ltd, Queensway, Glenrothes, Fife, Scotland KY7 5PU.



Ambit International (above) and Beckman (below) displaying themselves.



Autel

E MIDATA and Autelca Ag, the Swiss pay-phone manufacturer, have got together to produce a new pay-phone credit card system. When the customer buys a card, its magnetic strip is pre-coded with an agreed credit value (a number of time units).

To pay for a call you simply insert the card in a slot in the telephone. Its value is displayed on a digital read-out and reduced unit-by-unit at the appropriate rate during the carl. When you hang up, the card is returned coded with its reduced value. If the value should fall to zero



during a call, the card is returned and the display flashes for a few seconds before automatic disconnection. The card is then disposed of and a new one purchased.

MICROS



21114 21114L 221142 22376 2516(5v) 2532 2508 4027 4116 4027 4116 57109 57161 6011 6011 6011 6011 602 6502 6502 6502 6532 6546 6802 6802 6802 6802 6802 6802 6802 680	23.45 3.75 11.55 12.95 12.95 14.95 14.95 12.45 14.95 17.95 12.95 17.95 1	81998 SC/MP2 8080 80886 8155 81LS96 81LS96 81LS97 81LS98 81LS98 81LS98 8212 8212 8212 8251 8253 8255 8257 8259 8678 8259 8678 8259 8678 8259 8678 878 878 878 878 878 878 87	1.80 9.85 5.49 11.85 89.00 11.80 12.80 1.30 1.30 2.45 2.50 4.95 4.95 10.95 4.95 11.96 12.80 1.30 2.45 2.50 4.95 10.95 4.95 10.95 2.95 10.95 2.95 10.95
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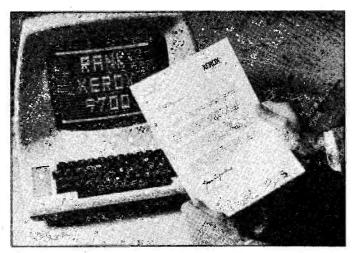
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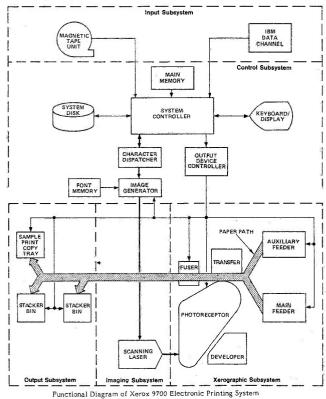
R ank Xerox's new baby, the Xerox 9700, offers the first direct link between computers and the xerographic process. From a digital input, the 9700 can simultaneously produce a business form and the computer-generated text to go on the form.

The input data can be received on-line from an IBM mainframe or off-line via nine-track magnetic tape. Laser technology converts this data into the selected typeface. At the same time, the standard letter or form is called from memory and the two combined, using the same process, printing on both sides of the paper at the rate of two copies per second. Output on A4 paper can be vertical or horizontal, as necessary.

A variety of standard type sizes and faces are available, but the 9700 can also print company logos, signatures and any other shape that can be converted into a digital code using the 90,000 dots per square inch printing format.

Graham Clark, Managing Director of Rank Xerox (UK), said that he hoped to see 100 of the 9700s installed in the UK within three years. Xerox believe a 9700 installation to be feasible in applications where computer technology is linked to a demand for more than 700,000 high quality prints per month.

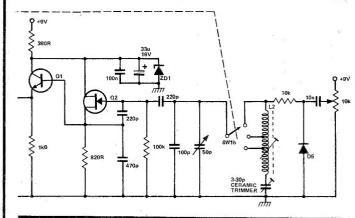
The system will be available with a range of software for sale, lease or rental, a 24 hour service support and free operator training from January 1st 1981. The minimum sale price will be £184,650 and rental options from £5,900 per month-(including 700,000 impressions).

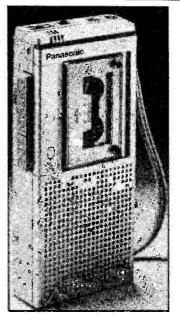


OOPS Tech-Tips

ast month you may have noticed that the circuit diagram for the Direct-Conversion Receiver made a

brave attempt to escape off the edge of the page. We've reprinted the offending end of the diagram, which also shows the values of the capacitors in parallel with ZD1 and a recommended change to the capacitor in series with coil L2.





Micro-Taping

panasonic Business Equipment has announced the introduction of the Panasonic RN-Z01, a new low-priced, mains/battery, two-speed microcassette recorder. Features include one-touch recording with cue and review controls, which allow the tape to be rewound or played on to locate a particular piece of recording. There is also a 'follow-up' feature, which lets you start recording during playback without having to stop the recorder first.

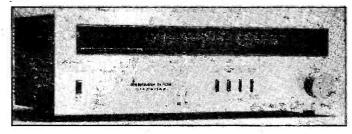
The RN-Z01 measures only 14.25 x 64 x 2.58 cm, weighs only 270 g, is fully compatible with the Panasonic RN-195 transcription machine and comes complete with a cassette and carrying case for only £49.42 plus VAT. It is only available through distributors of Panasonic Business Equipment. For details of local stockists contact Panasonic Business Equipment Ltd, 9 Connaught Street, London W2.

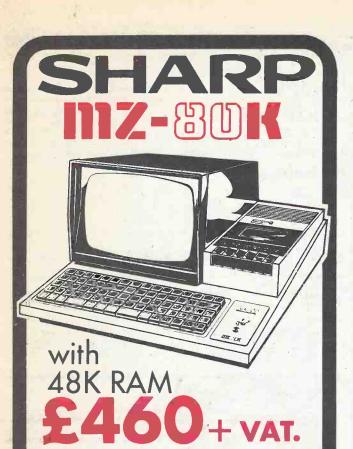
Colour Tuning

Mitsubishi Electric have introduced a new FM/LW/MW tuner, the DA-F630, with an unusual method of tuning indication. When you tune into a mono station, the scale illumination changes from white to orange. When you tune into a stereo station it changes from white to green. As soon as you let go of the tuning control, a locking circuit automatically engages to prevent drift.

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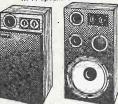
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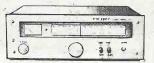
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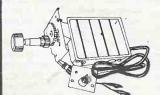


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Only 10 years ago, relatively simple digital circuits occupied acres of boards bristling with components. Now, very often, there's a single, special-purpose chip to do it all. Even if there isn't, a microprocessor can handle most contingencies. So. digital designers face increasingly complex problems as more and more functions are condensed into chip-size logic. Tim Orr's Digital Designers' Circuit Supplement starts you off on the road to making sense of it all.

Drum Sequencer

If you need a lot of banging in your life (perhaps you're a musician), try your hand at the ETI Drum Sequencer. It's designed in two distinct sections. The drum effects unit will simulate high/low tom-tom and bass and snare drum voices, manually triggered by, say, a loudspeaker sensor. The clever bit is the sequential programmer, which will reproduce the drum rhythm of your choice from the effects unit.

Crystal Calibrator

If you need a frequency standard for calibration purposes anywhere in the 100 Hz to 1 MHz range, then you need the February issue of ETI. Our Crystal Calibrator lets you determine the frequency of an unknown crystal or produce an accurate calibration signal for setting up and test applications — a useful piece of test gear.

SPL Meter

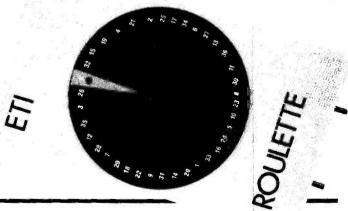
For the first time in a UK electronics magazine, ETI features an accurate, calibrated Sound Pressure Level Meter design based on a special-purpose, but modestly priced, precision microphone insert.

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ETI February also features our engineers' stethoscope design. This useful instrument can be used in a variety of engineering applications to check for faults in moving parts pistons in cylinders, for example.

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MICROBASICS

'Speak to me only with thine software'. Henry Budgett discusses the monitor program that ties together the hardware from previous Microbasics.

f, at this point in the series, you feel that you have got yourself a real microcomputer, then think again. What you have is a collection of hardware that will process, store and transmit data but it has not yet been told how it should do it. Whilst the average person will usually be working in a high level language such as BASIC the actual CPU can only undertand binary numbers. Quite apart from the Interpreter that translates the high level language instructions into the appropriate binary codes there has to be a piece of software called the monitor.

The name 'monitor' is synonymous with the operating system in bigger machines and performs the same tasks as the front panel used to in the days when computers had pretty lights and knobs all over them. The term 'software front panel' is still used in some literature to imply something special.

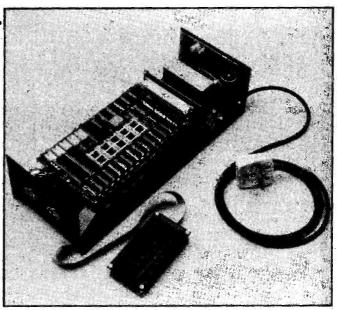
Monitoring The Situation

Before we take a detailed look at one particular monitor and what it does it is necessary to understand the tasks that should be done first. The monitor must be aware of the size and location of the memory, the location of the I/O devices and, most important of all, how to start everything up in the right way.

If we have informed the computer of these facts by writing a short machine code routine and a look-up table that details the various devices and their functions, we can now proceed.

We will assume that our microprocessor is being driven by an ASCII keyboard and that it will display the information on a TV screen. How does the monitor know when a key has been hit on the keyboard? The usual procedure is to operate under interrupts. This is done by causing a special bit in the CPU's status word to be set whenever a key is pressed. The monitor is continually looking at this bit, even if it's doing something else, and when it detects it, whatever is currently happening is suspended and the I/O port that caused the interrupt to occur is examined. It knows which one this is by means of a wonderful device known as the interrupt vector. It can now read the value of the key that was pressed.

What the monitor does with this piece of information depends on the type of monitor that you have. Some are very complex and allow all manner of special things to be done in the way of machine code programming. The one I am going to take a close look at is a good example of the kind of complexity that you can achieve within a very small space.



Microtan 65 with TANBUG and XBUG.

Bugging Your Micro

For historical reasons monitors are generally given BUG as part of their name. TANBUG is the standard monitor supplied with the Microtan 65 computer and, along with its enhancement XBUG, is the basis of the rest of this article.

TANBUG is rather special in that you can plug in either a simple Hex keypad or a full ASCII keyboard and it will detect which one is being used. For the sake of simplicity, assume that the ASCII keyboard is used. As soon as the machine is reset by means of the hardware switch, the internal hardware reset vector jumps straight into the start of the monitor. Being polite, 'user friendly' to use the jargon, the monitor announces its existence and gives you a character on the screen known as a prompt. Within the context of a monitor, the prompt and the cursor can be regarded as the same unless an error has occured and then a '?' is displayed.

Before we can run any programs we first have to write them and thus we need a means of getting information into the memory and changing it if necessary. This is achieved by the M <addr > command which opens the specified address and displays its contents on the screen followed by a prompt. We can now type in the code that we require to replace that currently stored, step back to the previous location, step forward to the next location or go back to the monitor by pressing respectively ESC, LF or CR. These apparently meaningless mnemonics are ESCape. Line Feed and Carriage Return respectively and are interrupted in various ways by the monitor. Let us assume that you have written a program into the memory of your micro using the monitor and that you now wish to run it. In the case of TANBUG simply type 'G < addr > CR'. This tells the CPU to load the CPU's program counter with the specified address, to load the stack pointer with the beginning of the stack area in RAM and to start obeying the instructions. Clever stuff.

Doing It Slowly

The trouble with programs written in machine code is that they tend to run extremely quickly. We can slow them down by writing delay loops but we can also use a monitor command which gives us single steps. Keying S sets the process into one-step-at-a-time mode. After each step has been processed the program stops and goes back to the monitor with a full display of the CPU's registers. You can execute the next step by keying P for proceed. It must be noted that a program step is not just the contents of one address but the complete instruction such as 'jump to address A000'.

Because the main cause of programs crashing is the wrong interpretation of information in the registers, the monitor allows you to adjust their values in much the same way as you can alter the contents of the memory. Even more common than that is the occasional 'bug' that lurks within the code and only jumps out at obscure times. We can catch this by setting a trap for it called a breakpoint. We generally know where the bug comes from but we don't know what causes it to appear so we set the breakpoint to the relevant position in the program and leave it running. When the bug appears and takes the trapped route it trips the breakpoint and this causes a complete printout of all the registers allowing you to find the reasons for its sudden emergence. With the TANBUG monitor you can set up to eight different traps, allowing bug catching on a lavish scale.

Display Your Contents

Keeping track of the program in the depths of the memory is made easy by having a list command. This allows you to display memory contents on the screen in a regular format, making the checking and copying on to paper easy. As the final option in the TANBUG repertoire, we can calculate offsets. Because it is quicker to tell a program to jump back ten steps rather than to tell it the absolute address, there is a relative jump command which allows you to move up to 127 steps in either direction. To use this, merely key in the address of the jump command, the address you wish to get back to and CR. The monitor then gives you the HEX value for the relative jump.

Saving The Day

The basic Microtan 65 is equipped with only 1K of RAM and out of this must be taken the stack requirements for the CPU and the monitor, the 512 bytes of video RAM and some working space. The user is left with about 430 bytes for his programs although it is possible to use the video RAM area to some extent. Because of this limited area it was not thought necessary to include any cassette storage capability on the CPU card; there isn't any space left anyway! Once one enters the realms of expansion with the TANEX card, cassette I/O is essential and the enhanced monitor package, XBUG, supplies this and more.

XBUG is packaged in a 2K EPROM and gives the user three extra functions. These are cassette handling, a line-by-line assembler and a line-by-line translator. The latter two are almost unique and, at this price level, give the system a distinct

edge.

The cassette-handling software allows the saving and loading of named files as well as the verification of saved files against the memory at two speeds. The slow CUTS (Computer Users Tape Standard) 300 baud speed is generally used for important system files, and for any back-up copies because the recordings made are inherently less prone to corruptions. That

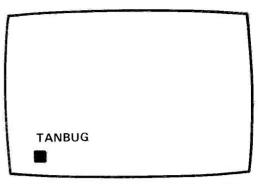


Fig 1. The monitor announces itself to the world and 'prompts' the user to do something. The **1** is replaced by a '?' in the event of an error.

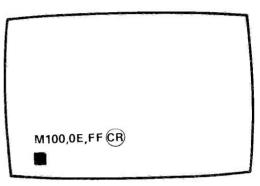


Fig 2. Typing M100 CR opens the specified location and reveals the current value 0E. We have replaced this with FF and closed the location but we could have stepped forward or back through memory by using other commands.

L0400,3 CR 0400 A2 FF 9A E8 86 17 20 B7 0408 A0 0F 20 73 FE 88 10 A9 0410 20 8D E0 03 A9 00 85 00

Fig 3. The monitor will list the program from any given address in blocks of eight bytes per line for up to 256 lines. Here we have selected three.

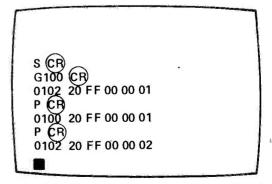


Fig 4. By setting the monitor to operate in single steps, we can inspect the contents of each register in the CPU after each step before proceeding with the P command. The registers are; next address to be executed, CPU status value, low byte of the stack pointer, index X register value, index Y register value and the accumulator value.

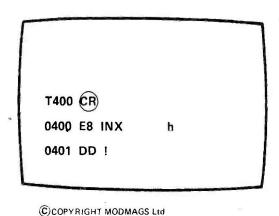


Fig 5. Using the assembler, we define the starting address and the current memory value is displayed. We have overwritten this by keying INX which has been translated into its correct Hex code and the assembler has stepped to the next location in memory. The prompt symbol "!" is used to identify the fact that you are in the assembler mode and the 'h' to the extreme right is the ASCII character that corresponds to the Hex code. This acts as a check.

is not to say that the fast speed, of approximately 2400 baud, is unreliable — one generally uses this for the convenience of loading programs quickly; a program takes eight times longer to load using the CUTS format. The manual gives the setting up information in two programs which should be tried at each tape speed. I use a manual level control tape recorder which also allows the tape speed to be varied slightly, but the system works perfectly on virtually any cassette recorder. The reason that I chose a rather more expensive machine is not because I've got money to burn, but because I receive programs for a wide variety of machines and sometimes the speeds or recording settings vary, hence the need to be able to adjust my system to that of the person who is supplying the tape.

Interpretations Supplied

As mentioned earlier the XBUC monitor is equipped with a simple assembler and dis-assembler. This allows the budding machine code programmer to use assembly language mnemonics rather than the actual Hex codes. The mnemonics are effectively one step towards high level language programming. They allow the programmer to think in logically sounding 'words' rather than in specific Hex codes.

Given a starting address and the appropriate commands, the assembler will convert the op-code and its associated operands into the proper Hex codes. It is quite intelligent too; most common errors are trapped before they can be entered.

As a direct complement to the assembler there is a lineby-line translator, which converts the stored Hex into the more meaningful assembly language mnemonics. It is called a 'lineby-line' system because it needs to know the correct start or else it will try to convert Hex data into assembly language mnemonics. In some cases you can have enormous fun disassembling a program to reveal another program which, according to the translator, is complete nonsense! Don't get me wrong, I'm not criticising the limited capability of the translator but rather pointing out that, for a 2K package, it packs one heck of a punch. The nearest equivalent system that I can recall is one supplied with the Rockwell AIM 65 and that takes about 2K on its own just to give an equivalent assembler.

The Next Step

Nowadays the almost universal introduction to high level language programming is through BASIC. With a language like this, a new piece of software is required — the Interpreter. This is, if you like, equivalent to the mnemonic assembler in that it converts the 'English' of the BASIC commands into the Hex code that the CPU needs. To avoid wasteful repetitions of the code, the BASIC will use routines that are already written in the monitor, the cassette-handling routines for example.

This use of standard routines allows the BASIC programmer to call machine code programs from this BASIC program. This is often done to speed execution of a program or to perform a repetitive chore. On my system there is no 'Clear Screen' command in BASIC, so I have a standard machine code routine for this stored in memory, which I call as reauired.

A Close Encounter

I hope to be taking a very close look at one specific computer in the next two episodes. As yet the computer hasn't arrived, but with luck next month will see the first part. The reason for taking a look at a complete computer is to try to explain the systems aspect, ie how all the bits and pieces fit together, rather than continue to inspect the individual elements.

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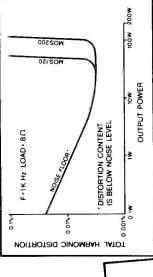
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HY60	30W into 4-80	%\$L0'0	15V/µs	srig	8P001	£7.24 + £1.09	-
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HY200	120W into 0.01% 4-80	0.01%	15V/µs	srig	100dB	£18.44 + £2.77	
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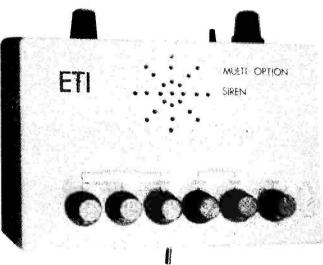
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Warbles, bleeps, rising tones, falling tones and key-shifted tones, with or without vibrato — just a few of the near-infinite variety of sounds generated by our Multi-option Siren. Design by Ray Marston. Project development by Steve Ramsahadeo.



This design has a total of seven variable controls plus six switch-selectable operating modes and can generate such a vast range of different sounds that it is quite difficult to adequately give a written impression of the full capabilities of the project.

The heart of the unit is a tone generator that can have its operating frequency varied over virtually the full audio range by a single tone control. The frequency of this tone generator can also be modulated by either or both of two more generators, the first of these being a vibrato square wave oscillator. Both the vibrato rate and vibrato depth can be varied by individual controls. Thus, a little bit of fast vibrato imposes a 'buzz' sound on the tone, while lots of slow vibrato produces a sound like that of a tinkling piano key.

The second frequency-modulation generator is a very-low-frequency (VLF) oscillator that can produce either a pulse or a ramp waveform. Two mod shape controls allow the rise and fall times of the ramp or the on and off times of the pulse to be independently varied over a wide range to produce a wide variety of frequency-modulation waveforms. The depth of modulation is fully variable by a mod depth control.

Thus, with lots of symmetrical VLF ramp modulation applied, the circuit produces a 'wailing' American police-car sound without vibrato, or the sound of a repeatedly scaled (up and down) piano when lots of slow vibrato is applied. With a little bit of symmetrical VLF pulse modulation applied, the circuit produces the familiar 'dee-dah' British police-car sound without vibrato, or the alternate sounds of the repeated hammering of one piano key followed by the similar hammering of a different key when lots of slow vibrato is applied. The circuit can, of course, generate a virtually infinite variety of sounds between these extremes.

Gating Facilities

In addition to all the above sound generating facilities we've provided the ETI Siren with a number of gating functions. The gate is driven by the VLF oscillator and can be used

to disable the audio output signal during either the leading or the trailing part of the VLF waveform or on alternate VLF-generator cycles. To gain an insight into the functional effect of this gating facility, imagine that the siren controls are set to produce a symmetrical VLF ramp waveform with lots of mod depth and no vibrato.

With the gating circuit turned off, the siren produces the familiar wailing sound. With leading gating applied the siren repeatedly produces a 'peeow' or falling tone sound followed by a blank period. With trailing gating the siren repeatedly produces a 'wheep' or rising tone sound followed by a blank period. With alternate gating the siren repeatedly produces a wail sound followed by a blank period of equal length.

Thus, the gating facility effectively trebles the variety of sounds that our siren can produce — and three times a 'near-infinite variety of sounds' should be enough to satisfy anyone!

The Multi-option Siren circuit needs a 12 V supply, which can be derived either from batteries or from the mains via a suitable supply circuit.

All components are mounted on a single PCB to ease construction. Begin by inserting all low profile components, ie wire links and sockets, followed by resistors, diodes, capacitors and transistors, observing the orientation of all polarised components. Fit the ICs last, taking care when handling the CMOS 555.

If you decide to use the recommended Vero case, drill all the holes to accommodate the potentiometers, switches and loudspeaker vent. Fix the loudspeaker in the upper half of the case and hold it in place with a few drops of the ever faithful Super-glue. The PCB must be centralised, so that the two battery holders can be placed either side. To enable the holders to fit in this way the battery connectors are not used. The power connections are soldered directly onto the studs, so take care not to apply excessive heat. A piece of insulating tape can then be stuck across the connections to stop interference with the front panel.

After a visual check, you will now be able to produce a variety of sound effects that will span the galaxy; yes, you too can have the best battery-powered bird caller in the land.

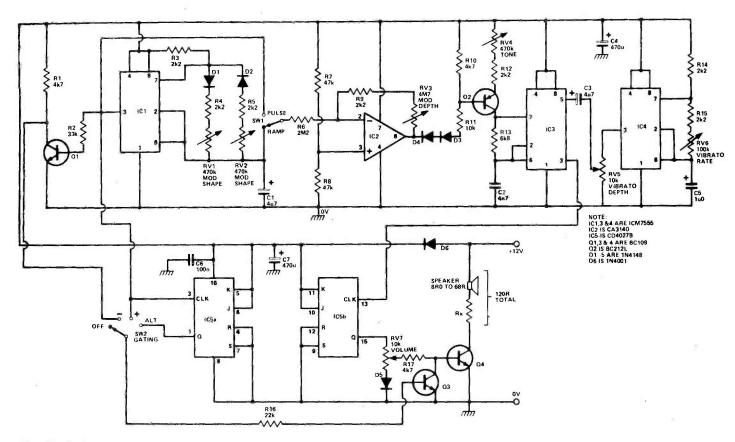


Fig.1 Circuit diagram.

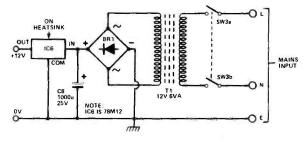
HOW IT WORKS

The heart of the project is the tone generator designed around IC3. This is a fairly conventional 555-type astable, except that C2 charges via R13 and the constant current generator formed by Q2 and its associated resistor and diode networks. Normally, the output of IC2 (feeding D4) is at half-supply volts, so Q2 base is at a couple of volts below the positive supply value. The operating frequency of IC3 is variable via tone control RV4. The output (pin 3) of the IC3 tone generator is divided-by-two to provide a symmetrical waveform (via IC5b) and the resulting audio signal is fed to the speaker via Q4-R17 and volume control RV7.

IC4 is wired as a perfectly conventional 555 type astable and is used as a vibrato generator, with its square wave output being used to frequency modulate the IC3 tone generator via pin 5. The vibrato rate is variable via RV6 and the vibrato depth is variable via RV5.

IC1 is also wired as a 555-type astable, but in this case the charge and discharge times of C1 are independently varied by RV1 and RV2 respectively and the circuit operates at a very low frequency (VLF). The output of the VLF oscillator can be used to frequency-modulate tone-generator IC3 via IC2 and constant-current generator Q2, the pin 3 output being used to provide pulse modulation and the C1 output to provide ramp modulation. The depth of modulation can be varied by mod depth control RV3, which enables the gain of IC2 to be varied from near-zero (RV3 = zero) to approximately x2 (RV3 = 4M7).

The square wave (pin 3) output of the VLF oscillator can also be used to synchronously gate the audio output signal of the siren on and off via Q3. When this transistor is driven to saturation (by a high bias to R16) it kills the input signal to amplifier Q4. If R16 is driven directly from pin 3 of IC1, the audio signal is killed (gated off) when the VLF output is high. If R16 is driven from the collector of inverter Q1, the audio signal is killed when the VLF output is low. If R16 is driven from the output of divide-by-two flip-flop IC5a, the audio signal is killed on alternate VLF cycles.



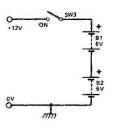
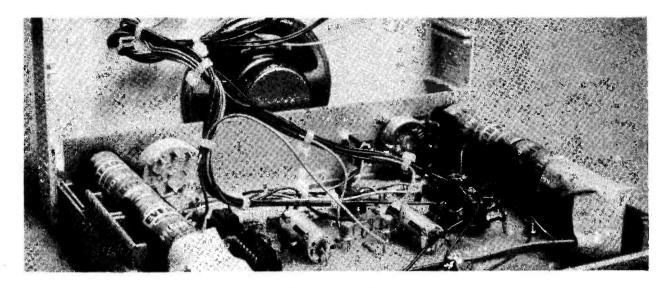


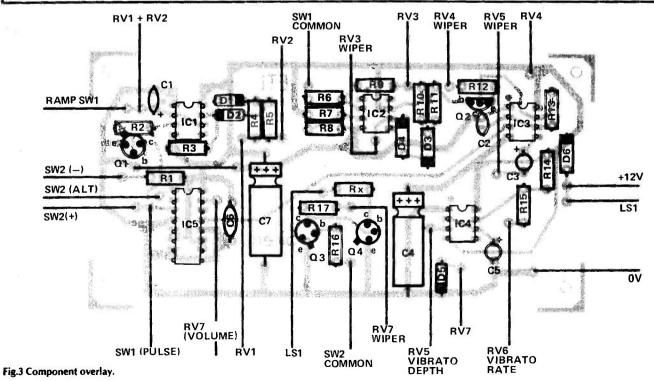
Fig.2 Alternative battery and mains power supply options.

BUYLINES

There should be no problem in obtaining any of the components used in the ETI Siren. All should be available from mail order suppliers advertising in this issue. If you have trouble obtaining a 68R loudspeaker, Technomatic should be able to help.



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	Resistors all 1	4W 5%	C3	4u7 63 V electrolytic PCB type
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1	R2	33k	C5	1u0 63 V electrolytic PCB type
	R3,4,5,9,12,		C6	100n polyester Mullard C280
1	14,15	2k2		
L	R6	2M2	Semiconduct	
1	R7,8	47k	IC1,3,4	ICM7555
	R11	10k	IC2	CA3140
Ĭ.	R13	6k8	IC5	4027B
1	R16	22k	Q1,3,4	BC109
1			Q2	BC212L
	Potentiomete	ers	D1-5	1N4148
	RV1,2,4	470k linear	D6	1N4001
1	RV3	4M7 linear		
	RV5	10k linear	Miscellaneou	us
1	RV6	100k linear	SW1.3	DPST miniature toggle
ł	RV7	10k logarithmic	SW2	1 pole 4 way rotary switch
1	K 1 /	1011 10 8	LS1	68R
1	Capacitors			tery holders (HP7 type) (2 off)
1	C1	4u7 35 V tantalum		rder code 202-21037L)
	C2	4n7 ceramic	Knobs to suit	
			KINDS to suit	(0.011)

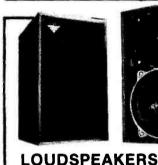


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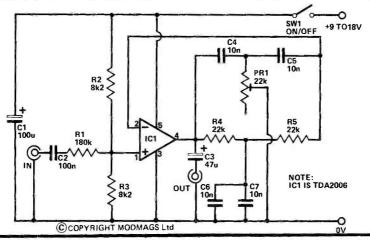
CW Filter

ne of the most desirable features of a communications receiver is a set of really good IF filters for the various modes of modulation. Presumably due to the expense and complexity of such circuitry, this is lacking in many sets. In such cases it is often possible to obtain a worthwhile improvement in performance by using an audio filter with a response tailored to suit the required mode of reception. A filter of this type is of most help for CW (Morse) reception, where only a very narrow bandwidth is needed. In fact, an infinitely narrow bandwidth is the theoretical ideal, since the CW signal is just a single frequency! In practice, a bandwidth of a few hundred Hertz is necessary, since it is very difficult to tune to a signal and stay accurately tuned to it with a narrower bandwidth.

The circuit uses an integrated circuit audio amplifier (TDA2006) in the non-inverting mode, with R2 and R3 being used to bias the non-

inverting input. C4 to C7, R4,5 and PR1 form a T-notch filter, which provides frequency selective negative feedback over IC1. R4 and R5 also bias the inverting input of the device. A T-notch filter allows most frequencies to pass readily, but at and close to its operating frequency it gives a high level of attenuation. Thus, in this case it gives virtually 100% negative feedback and only about unity voltage gain at most frequencies. However, at its operating frequency there is little feedback and high voltage gain. This gives the required narrow passband.

PR1 controls the bandwidth of the filter and a fairly flat response will be obtained at maximum resistance. Decreasing its resistance gives a sharper and narrower response, but too low a resistance will give an unusably sharp response. The circuit might even start to oscillate. R1 attenuates the input signal to a level that gives roughly unity gain at the centre of the passband, but the exact voltage gain depends on the setting of PR1. The output can be fed to low, medium, or high impedance headphones, or a loudspeaker. Current consumption is about 15 mA.



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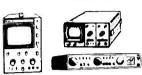
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AUDIOPHILE

It's almost time for Rudolph the red-nosed guinea pig (everyone's had to economise) to drag his sleigh across your roof. If you haven't sent your letter to Santa yet, Ron Harris offers a few sound suggestions.

t's that time of the year again, is it not? Out with the plastic holly, stale booze and cast-iron fruit cake. At work everyone goes around smiling and saying "cheers" too often, all the time checking people over with hungry eyes to see who is gonna grab who at this year's booze-up. Goodwill to all men and all that.

Another quaint little custom widely practised in some social circles is that of spending money that doesn't exist upon things which are totally unnecessary and giving them away to people who don't want them anyway, in return for which you are guaranteed to receive several pieces of ultra-modern junk yourself. Sheer unadulterated lunacy really.

Why not change things this year? As you are most unlikely to get Felicity Kendal, regardless of who you ask (I've written to Santa seven years running with no luck, so far — why should you be any different, eh?), something remotely hi-fi might make the pain and heartache of disappointment a little less hard to bear. Now, unless you're friends with a few dozen Arab Sheiks it is also unlikely that, on the morning of the 25th, you will awaken to find a neatly packaged Meridan, SME or Linn sat sitting beneath the Woolies tree

Audiophile this month is dedicated to providing a few dozen or so ideas for additions and improvements to hi-fi systems of all denominations that are financially feasible, be it your intention to give or to receive. It is *especially* more blessed to give when you can afford it.

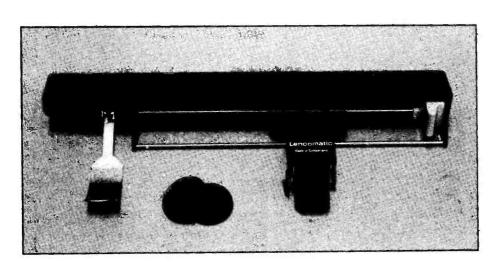
Format For Mats And Things

A glance at any audio emporium will show you that there are more than just a few accessories and gadgets to choose from these days and it would have been totally impossible to cover them all; by the time we published this, someone would have released a hundred more. Beside which, not all the vended items can even remotely meet their manufacturer's claims. I've been very selective, therefore, about which items to include. If you don't find a particular item here, that in itself is no condemnation. However, everything which is included, is recommended!

There is in addition a 'special' section for what I think are 'special' items and these are written up in more detail than the rest. Prices appended to each are typical prices you can expect to pay in the shops, inclusive of VAT. It might be an idea to leave this article lying around with certain items heavily ringed in flourescent yellow, or something. Alternatively be direct and hit a few friends over the head with it — you never know, as well as broken bones you might just get a stylus cleaner or two.

Items appear in no particular order of merit or anything else.

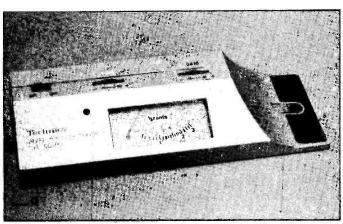
(Oh yes, Merry Thingy and all that.)



Above the Lencomatic record cleaner. This is the most unusual of the hordes of tracking cleaners around the shops these days. Rather than fit it to the deck on a nice plain, ordinary, boring pillar it attaches to the perspex lid and that evil looking tongue rests on the spindle to locate the device! There is a little carbon-fibre brush and a large pad on the business end. Perfect for lazy people or those who wish to aspire to such heights of inaction. The only drawback is the somewhat odd appearance. Price: £8.93.



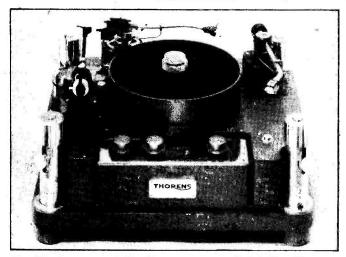
Above: Discguard. I'm always suspicious of things to spray onto records, but this seems harmless enough — if I can overcome the hidebound conservative attitude that the less stuff I put under the stylus, the less will end up stuck all over it! Discguard is a permanent anti-static treatment which is undetectable audibly (we tried it!) and greatly reduces the LP's ability to attract dust. Price:-£4.50.



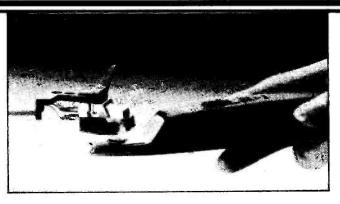
Above: Technics SH-50P1 stylus pressure gauge. A long way from little weights this. A strain gauge measures the downforce present and reads out the tracking weight on a meter. It is accurate to about 0.1g if set-up properly — a reference weight is provided — and looks very very flashy in use. Just the thing to impress the neighbours — and yourself! I like this idea — how about a digital version eh, Technics? Price:- £17.95.



Above: Turntable mats are a favourite tune-up these days and these are consequently a large number of them around. This is one of the newest. The Metrocare has a very high surface tension — VERY high. It grips an LP like a Scotsman grips his drink and thus provide an excellent bond. Price:- £16.75.

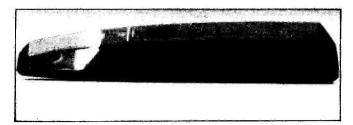


The ultimate accessory? The Thorens Reference deck, built with no compromise whatsoever to price. It weighs 90 kgs, claims to possess unmeasurable rumble and w/f at 0.02%, is a subtle $620 \times 360 \times 510$ mm in size. The chassis is aluminium cast, filled with iron grain. In other words it is very big, very heavy, and very expensive (circa £4,000). Supposed to sound pretty good too.



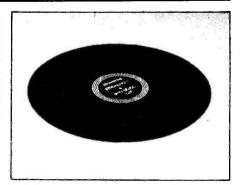
Above (and below!): Now this has got to be the Idea Of The Year! Without passing any comments — and you mucky minded lot out there can keep quiet too — this is a vibrating stylus cleaner from Audio Technica. There is a pad at the end, attached to a vibrator within the body of the device. You lower the stylus onto the pad and leave it alone for a few seconds. The clever little widget meanwhile proceeds to shake all the muck off the stylus!

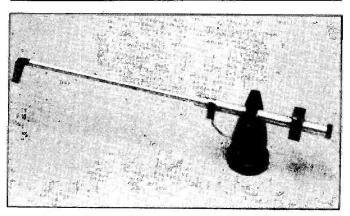
Ingenious in the extreme and it works superbly. Sheer magic. Never in the field of human grooves has so much been cleaned so well by so little. There is a bottle of cleaner supplied to deal with really bad cases of encrustation. Thoroughly and totally recommended. Every home should have two. Price:- £9.95.



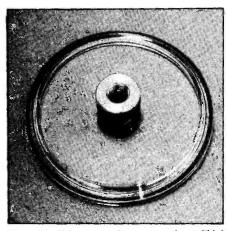
Not all turntable mats are designed to be anti-resonance à là the Metrocare. This Goldring is primarily anti-static and is composed of carbon fibres to provide a leak-path to earth for the charge present on the LP.

Price:- £3.90.





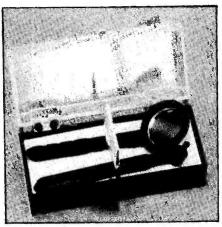
Above: the Exstatic carbon fibre sweep arm. Of all the millions of Dust-Bug descendents available this is my favourite. It looks very classy indeed and does the job better than most. An earthing lead is provided to form a conductive path to ground static encountered in mid-sweep and the counterweight provides playing weight adjustment to optimise tracking. Price:- £8.40.



Above: the Metrocare anti-resonance clamp. This is formed of clear perspex with a brass center. The idea being that it is fitted over the spindle atop your records, to clamp them firmly onto the mat, thus dewarping warps and supressing resonance. Used together with a good turntable mat the clamp can offer a worthwhile improvement in sound quality, especially in the bass. Price:-£4.54

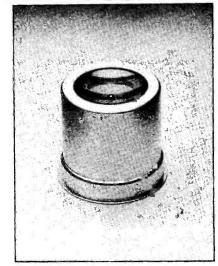
Below: a neat little notion this. As the cleaning tape passes the heads, it rotates a cunningly placed rotary magnet which simultaneously de-magnetises them. The magnet is moved away automatically within the cassette by the spooling action.





Above: a smallie-but-goodie. Just the thing to buy with the change from an LP! The Exstatic stylus care kit only costs 90p and will earn that back with the first wipe of the brush! Go on — you know it makes sense. Make a good present for the person that bought your Des O'Connor Greatest Hits last year. If he plays that sort of stuff, SOMEONE better take care of his stylus and quick!

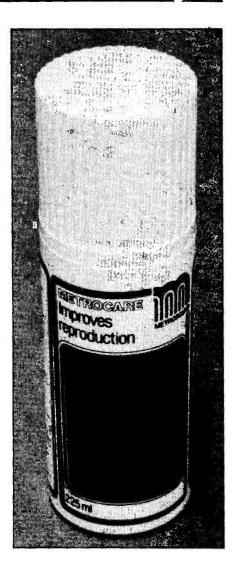
Price:- £0.90.



Above: Triple Checker! Well, it is. A record weight, spirit level and 45 RPM adaptor all in one. That little ball bearing you can see lurking under the glass rolls around in a shallow dish to indicate how level the deck is (inaudibly I might add) and the thing is so heavy no warp will dare defy it! The Triple Checker comes from Goldring and costs;

Price:- £6.00





Above: do you suffer from dirty, ingrained, groove dust? Do your records lack that new-look sparkle? Are your highs too low and your lows distorted? Give your LPs a face-lift with the Metrocare Rejuvenating Fluid!

This is literally applied like a face-pack from

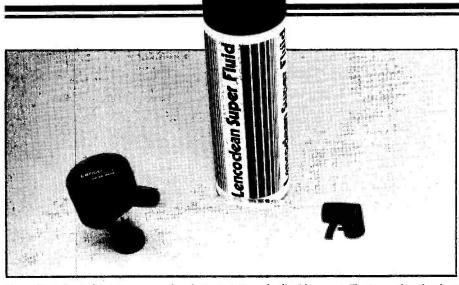
This is literally applied like a face-pack from the bottle, being smeared across the surface and allowed to dry into a thin plastic film. This is then peeled away, taking most of the gunge with it!

Price: £4.24.

Below and left: the Exstatic record brushes. Both consist of carbon fibre bristles, with the wiper possessing a pad down the centre for better dust collection. Both come with a stand.

Prices:- £6.00 and £7.50 (super).





Above: how about playing your record under water? Or under liquid anyway. The Lencoclean has been around a long time and continues to have its followers. It is a wet-playing system, which means that the arm (filled with fluid) tracks ahead of the stylus, dispensing a band of liquid into the groove. Any matter present is held in suspension when the stylus arrives and has minimal effect. No more snap, crackle and pop. No more static. Quiet backgrounds guaranteed.

The penalty to be paid is that once used, always used. Dry playing becomes impossible because the mud in the grooves has to be suspended else it gathers around the stylus somewhat rapidly. As I said, the system has a lot of followers and works superbly. It is up to you whether you take the plunge!

Price:- £5.93.



Left and below: TDK make two head demagnetisers, one very pretty cassette unit (left) which is fully automatic and absolutely beautiful! The conventional unit below (not to scale!) is designed for reel-to-reel mainly and is superbly constructed.

Price:- £11.25 (cassette) £21 (reel-to-reel).

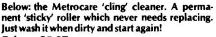


Above: the tracking cleaner for automatic record players. It attaches to the headshell. From Metrocare at Price:-£1.68.

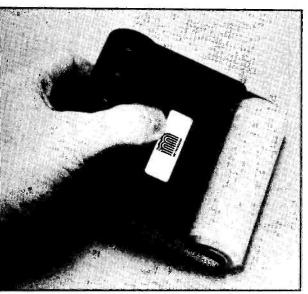


Above: the renamed Spectra mat. Dumpa it is called now apparently, but it is still one of the very best of the turntable mats to be purchased working well on a wide range of decks.

Price:- £19.80.



Price: £5.87.



Offers On Offer

The ETI switchboard has glowed red in the night since we ran our hi-fi system offer a couple of issues back. The most oft asked questions were whether the equipment was purchasable separately and where it could be heard.

The answers are yes — prices below — and at Videotone's showroom in Crofton Park Road (see advert in this issue). We chose the system for its sound vs price performance and if you make the trip to Videotone you'll see what we mean. Take a copy of ETI along and you can buy at the prices quoted below. But be quick about it as time, tide and stock levels wait for no man!

 ST 4120 tuner
 £55 + £3 p&p

 ST 4130 amplifier
 £50 + £3 p&p

 SC 3200 cassette deck
 £75 + £3 p&p

(reduced again from £88. Too good to our readers we are!)

GB2 loudspeakers (pair) £45 + £7 p&p

Incidentally, since Audiophile uses a Coral MC81 quite extensively as a reference, Videotone are prepared to let ETI readers buy one at a good discount on normal prices. An MC81 and H300 head-amp will cost you £44.50 and £45.00 respectively instead of £48.87 (+ p&p) and £51.75 (+ p&p). Add a quid to each for postage as usual and tell them ETI sent you!

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0.6, 0.6	1A 1A 21	2 3.00	.75	1.0	103	4.60	1.05
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0.9, 0.9		5 2.15	.70	3.0	105	8.60	1.20
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0-8-9, 0-8-9		8 3.85	.75	60	107	15.10	1.50
0-15, 0-15		6 2.15	.70	80	118	20.20	1.70
0-20, 0-20		4 2.75		10.0	119	24.10	2.20
	700(DC) 22			60 VOLT (Pri: 220-240) Sec: 0-24-30-40-48-60			
0-15-20, 0-15-20		6 4.60		Sec: 0-24			
0-15-27, 0-15-27		3 4.05		Amos	Ref. No.	Price	P& P
0-15-27, 0-15-27		4 6.10	1.05	0.5	124	3.85	.90
12 AND/OR 24 V	VOLT		1	1.0	126	5.60	1.05
Pri: 220-240 Volts	•			2.0	127	7.55	1.05
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12v 24V	Ref. £		&P	4.0	123	12.35	1.50
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16 8	17 10.:		30	75 150	64	4.10	.90
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60 30	226 33.	35 1.	80	300	53	10.10	1.20
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0.5 112	2.85	.90		Screened)	•	
1.0 79	3.60	.90		Pri. 120/			20/240V
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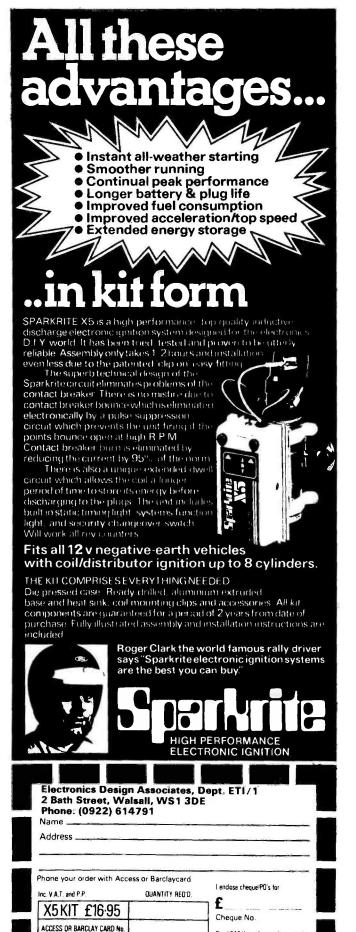
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MD605 Ladies musical alarm chrono. Continuous display of hours, minutes, seconds; optional display of day, date, month. Auto calendar. Chronograph with lap timing facilities, to ½10 sec. 24 hour alarm plays 30 seconds of Beethoven's 'Fur Elise'. Back light. Infinitely adjustable stainless steel strap.

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UNIVERSAL **TIMER**

Our two-range (1-10 and 10-100 min) timer has excellent stability and produces a 30 S pulsed alarm sound

at the end of each timing period.

The unit is mains powered, can switch 15 A mains loads and can give either make or break timing operation.

Design by Ray Marston. Project development by Steve Ramsahadeo.

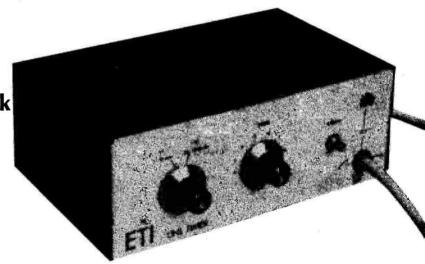
ost analogue (pot controlled) long-period timers published in hobby magazines use a 555 one-shot IC and a large electrolytic capacitor as their main timing elements. Unfortunately, conventional electrolytic capacitors have very wide tolerances (typically -50% to +100%) and suffer from relatively large and unpredictable leakage currents. Consequently, these simple circuits cannot be relied upon to give accurate or repeatable timing periods or to give periods significantly exceeding 15 minutes or so.

Our ETI Universal Timer gets away from the conventional design approach, with its inherent disadvantages, by using an astable clock generator and a divide-by-8192 CMOS counter as its main timing elements, the astable period being controlled by a pot and a highly stable polyester capacitor. Consequently, our timer has excellent accuracy and stability and can fully span the 1 min to 100 mins timing range in two switch-

selected decade ranges.

Our timer has a few other unusual features. It is mains powered and has a relay-switched mains output lead that can be used to feed power to external loads (heaters, lamps, etc); the relay can switch mains currents of up to 15 A and a mode switch enables the timer to give either make or break timing operations of the external loads.

Timing operations are initiated by a push-button start switch and a pulsed-tone alarm sounds for 30 S to give an audible warning on the completion of each timing cycle. The unit has a variety of practical uses in the home, workshop, darkroom, etc.



Construction

Most of the circuitry (with the exception of T1, the relay, the switches and pot) is mounted on a single PCB, the construction of which should present few problems. Note that IC1-3 (CMOS types) should be mounted in suitable sockets and voltage regulator IC4 needs to be fitted with a small heat-

When construction is complete, fit the PCB in a suitable case, together with the mains transformer and the heavy-duty relay (which MUST be fitted in the specified socket) and proceed with the interwiring. Take special care over the interwiring of the relay contacts and SW2 and the mains connections. Finally, drill a small hole (roughtly 4 mm) in the top of the case, bond the PB-2720 acoustic transducer below it and connect it to the rest of the circuitry.

Testing

When the unit is complete, give it a functional test as follows. First, connect the unit to the mains and check that its neon indicator illuminates when SW2 is set to TIMED BREAK position and turns off when SW2 is set to TIMED MAKE. Now set RV1 to its minimum position, set SW1 to the '1-10 min' range and firmly operate PB1. Check that the neon immediately changes state, indicating that the relay has turned on and

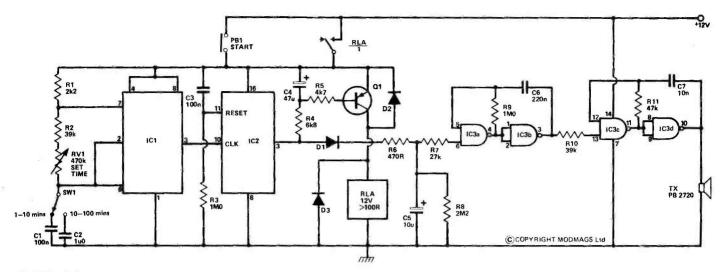


Fig.1 Circuit diagram.

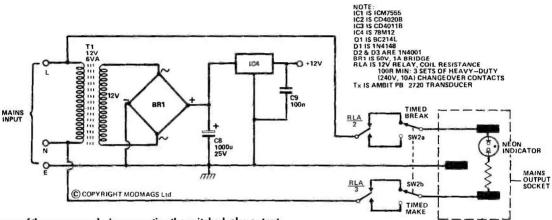


Fig. 2 Circuit diagram of the power supply, incorporating the switched relay output.

the timing period has begun; also check that the relay turns off again at the end of the timing period (roughly one minute) and that the acoustic alarm operates and generates a pulsed-tone signal for roughly 30 S when the timing period is complete.

_BUYLINES

Most of the components used are readily available from suppliers advertising in this issue. In case of difficulty, Watford Electronics can supply the relay specified.

HOW IT WORKS

The circuit comprises four main blocks, these being an astable clock generator (IC1), a multi-stage binary divider (IC2), a relay driver (Q1) and a gated alarm-call generator (IC3), all powered from a 12 V regulated line provided by IC4.

The clock generator is designed around IC1, a CMOS version of the 555 timer. The chip is wired in the astable mode and generates clock signals with periods variable over the 7.3 mS to 732 mS range via RV1 and SW1. The output of IC1 is used to clock the multi-stage CMOS binary counter designed around IC2, which is effectively wired in the 'divide-by-8192' mode; the output (pin 3) of this counter is normally low but goes high on the arrival of the 8192nd clock pulse.

The output of IC2 is used to drive relay RLA on via Q1 and to gate on the alarm-call generator (IC3) via the D1-R6-C5-R8-R7 network. This generator comprises a fast astable (IC3c-IC3d) and a slow astable (IC3a-IC3b). The slow astable is gated on by a momentary high output from IC2 and then gates the fast astable on and off at a rate of about 2 Hz.

The alarm-call generator part of the circuit is permanently connected to the 12 V supply lines, but the IC1-IC2-Q1 parts of the circuit are only connected to the supply rails when PB1 or relay contacts RLA/1 are closed. The complete circuit functions as follows.

Timing operations are initiated by momentarily closing PB1, thereby connecting the supply to the IC1-IC2-Q1 circuitry. As PB1 is closed, a reset pulse is fed to pin 11 of IC2 via C3 and causes the counter's registers to set to zero, driving the output of IC2 low. As IC2's output goes low it drives Q1 and the relay on via R4-R5, thereby causing contacts RLA/1 to close and maintain the supply to the circuitry once PB1 is released.

As soon as PB1 is closed, IC1 starts to oscillate and generate clock pulses, which are then counted by IC2. On the arrival of the 8192nd clock pulse the output of IC2 switches high, turning Q1 and the relay off and causing contacts RLA/1 to open and break the supply connections to IC1-IC2-Q1. The timing sequence is then complete.

C4 imposes a slight turn-off delay on Q1, so that the output of IC2 remains high for 100 mS or so before the relay turns off. This brief high period is sufficient for the IC2 output to fully charge C5 via D1 and R6, thereby activating the IC3 alarm-call generator, which produces an audible pulsed-tone signal in the PB-2720 transducer. Once the relay has turned off, the charge on C5 slowly leaks away via R8 until, after about 30 S, insufficient charge remains to gate IC3a on, at which point the alarm-call generator turns off. The entire operating sequence is then complete.

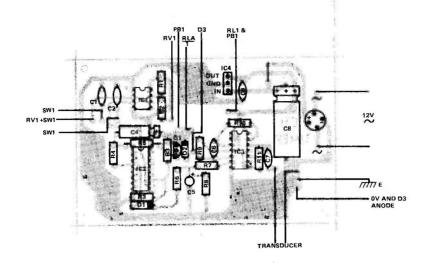
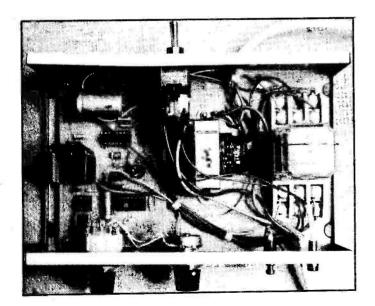


Fig.3 Component overlay.

Resistors all 1/4	W 5%	Semiconduct	ors
R1	2k2	IC1	ICM7555
R2,10	39k	IC2	CD4020B
R3,9	1M0	IC3	CD4011B
R4	6k8	IC4	78M12 or 7812
R5	4k7	Q1	BC214L
R6	470R	BR1	50 V, 1 A bridge rectifier
R7	27k	D1	1N4148
R8	2M2	D2,3	1N4001
R11	47k		
Potentiometer	1		
RV1	470k Linear	Miscellaneou	ıs
Capacitors		SW1	1 pole rotary switch
C1,3,9	100n polycarbonate	SW2	DPDT toggle 15 A 240 V
C1,3,9 C2	1u0 polycarbonate	PB1	momentary push button
C4	47u 25 V axial electrolytic	Tx1	transducer PB 2720
C5	10u 63 V electrolytic PCB type	RLA	12 V coil resistance > 100R. 3 pole changeove
C6	220n polycarbonate		contacts rated at 240 V, 10 A and 11 pin relay
C7	10n polycarbonate		base 15 A rated (see Buylines).
C8	1000u 25 V axial electrolytic	T1	12 V, 6 VA



Construction is fairly straightforward. IC4 needs a small heatsink and CMOS ICs 1-3 should be mounted in sockets.

Calibration

Once the unit is functioning correctly, you can proceed with the scale calibration. The obvious (and very time consuming) way to do this is to check the timing periods obtained by varying RV1 against a stop watch, by trial and error, until suitable RV1 calibration points are found.

Alternatively

If you have access to a reasonably accurate 'scope, a far easier way to calibrate the timing scale is to directly measure the period of the IC1 clock waveform, noting that a period of 7.32 mS corresponds to a timing period of precisely one minute. Thus, 1 min = 7.32 mS, 5 mins = 36.6 mS, 10 mins = 73.2 mS, etc.

The upper timing range of SW1 is approximately a decade up on the lower range, so a single calibration scale can serve for both ranges. The tracking accuracy of the two ranges depends on the relative accuracies of C1 and C2 and will typically be within 10% if good polyester components are used. If you want precise tracking, you can achieve it by replacing C2 with a 820nF polyester capacitor and then padding its value up by trial and error, until precise coincidence of the '5 min' and '50 min' points is obtained on the two range scales. **FTI**

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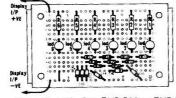
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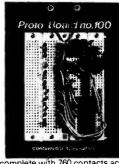
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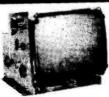
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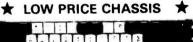
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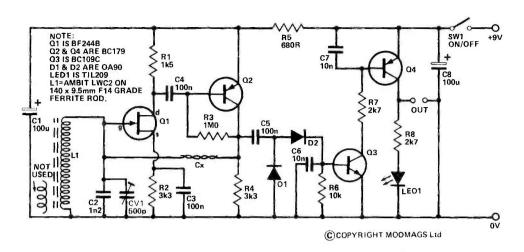
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The output of L1 is direct-coupled to a straightforward common source JFET stage and this in turn feeds a simple common emitter stage. Due to the relatively low frequency involved these can both provide good voltage gain without using tuned circuit loads. The collector

of Q2 is in-phase with the gate of Q1 and if necessary, "twisted pair" Cx can be used to provide regeneration between these two points to boost the sensitivity of the set.

The output from Q2's collector is coupled by C5 to a simple diode modulator circuit which consists of D1, D2, C6 and R6. When the 60 kHz carrier is present a strong DC bias is produced across R6, but this potential quickly decays during the gaps in the carrier (the 1 S markers and other signals are modulated onto the carrier wave in the form of brief pauses in the signal).

Thus Q3 is switched on when the carrier is present, so that Q4 is in turn switched on, giving a high output and causing LED 1 to light up. In the absence of the carrier wave Q3, Q4 and LED 1 all switch off and the output of the receiver goes low.

When initially adjusting the set it is helpful to monitor the output of the detector using a crystal earpiece connected across R6.



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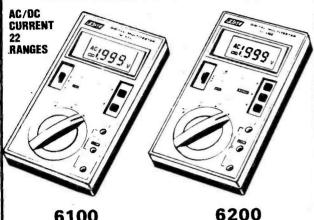
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I/O INTERFACE

Computers share a common failing with man (and woman) — they use a variety of different languages and dialects. This design by Clive Cartlidge lets the Compucolor II talk to a whole new family of computers.

The interface described here was originally built to allow a Compucolor II microcomputer to be connected to any one of four "mainframes" at North Staffordshire Polytechnic. The mainframes in question were a GEC 4082, an HP 2000E, an ICL 2960 and an ICL 2904; both of the latter machines being front ended by 7502 processors. After construction, however, it became obvious that the device had a much wider appeal and could be used in a variety of applications where bit length and parity changes were necessary.

This device was required to overcome the problem that the Compucolor II transmits and receives eight bit characters from its R\$232 port, whereas the mainframes mentioned above all transmit and receive seven bits with an even parity bit added.

The UART is an LSI sub-system which accepts binary characters from either a terminal or a computer and transmits/receives this character with appended control and error detecting bits. All characters contain a start bit, five to eight data bits, one or two stop bits and either an even/odd or a no parity bit. This is all hard wire selectable on the UART together with an operating speed of up to 30 kbaud.

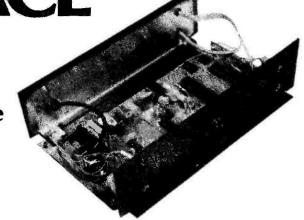
The UART Receiver

The UART requires a clock signal 16 times the designed baud rate. Initialisation is performed by applying a reset pulse to pin 21. This sets the Data Available flag, pin 19, to a logic 0. Reception of data starts when the serial input signal changes from a marking state (logic 1) to a spacing stage (logic 0). This condition constitutes a start bit and it is valid if the serial input line continues to be at logic 0, when centre sampled, eight clock pulses later. If this is not the case, however, and the serial line has returned to logic 1 when sampled, the start bit verification process will be reset. After a genuine start bit has been received and verified by the process above, data bits, parity bit if used and stop bits are received.

On receiving parity and stop bits, the receiver will compare the transmitted parity and stop bits with the 'expected' pattern and indicate any errors by changing the parity error flip-flop and/or the framing error flip-flop to a logic 1.

When a full character has been received, internal logic examines the 'Data Available' line to see if data has been read out. If the line is at a logic 1, the receiver will assume that data has not been read out and the over-run flip-flop will be set to logic 1, indicating an over-run error. If 'Data Available' is set to logic 0, the receiver will assume that data has been read out.

After the Data Available line goes to logic 1, indicating a character has been received, the receiver shift register is ready to accept the next character and has one full character time to remove the first character received.



The Transmitter

The same clock signal may be used for the transmitter as for the receiver. The external reset pulse is also common. When this is applied the 'Transmitter Buffer Empty', End of Character and the Serial Output lines of the device are driven to logic 1. Data occurring on the Data Input lines, pins 26-33, is strobed into the device by a pulse on pin 23, the Data Strobe. Once this has occurred, the Transmitter Buffer Empty (TBMT) flag goes to a logic 0, indicating that a character is being transmitted and the device is unable to accept further characters until this flag returns again to logic 1. The device is double buffered and so when the TBMT flag returns to logic 1, one full character time is available for loading the next character without any loss in transmission speed.

Data transmission is initiated with the transmission of a start bit, data bits, parity bit if required and stop bits. When the last stop bit has been on the line for one bit time, the End of Character flag will go to a logic 1 indicating that a new character is ready for transmission.

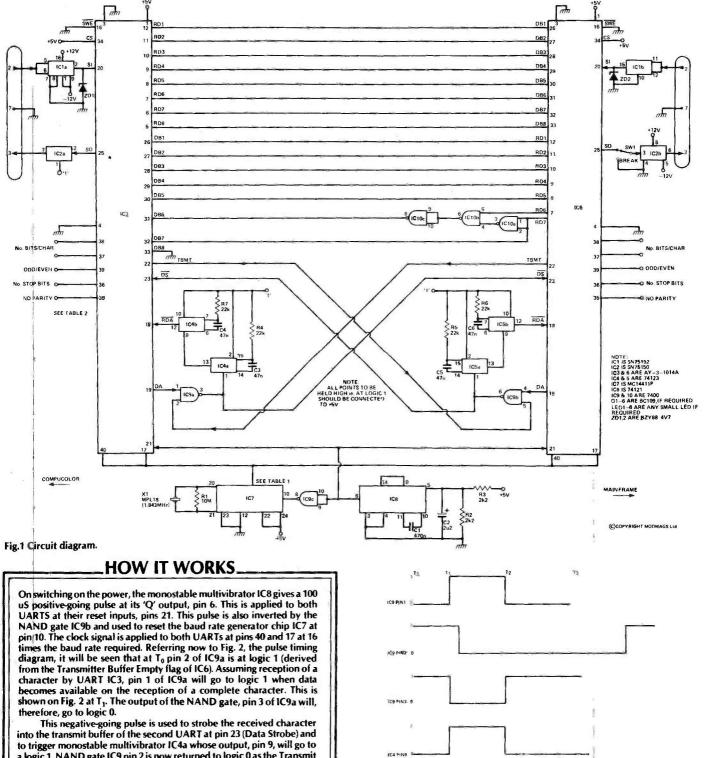
Control bits

The number of bits per character (five through eight) together with a parity bit (odd, even or none) and one or two stop bits can be selected by strapping appropriate pins on the UART to logic 1 or logic 0. These selections apply to both the receiver section and transmitter of the chip.

Code Converter

One particular problem encountered when using this interface was that most of the logging-in data received from the mainframes was in lower case ASCII code. While most terminal devices would simply display this as upper case, the Compucolor II treats lower case code as graphics display information. This difficulty is overcome by the NAND gate code converter (IC10). The circuit's logical function simply drops bit six when bit seven is set to a logic 1, effectively converting lower case code to upper case before it emerges from the interface.

A second problem was encountered when using the device with the HP 2000 Basic system. This was the need for a break key. Break not being a valid ASCII character, it cannot be implemented through the UART. This is easily cured by fitting a push button switch on to the computer side of the interface as shown.



to trigger monostable multivibrator IC4a whose output, pin 9, will go to a logic 1. NAND gate IC9 pin 2 is now returned to logic 0 as the Transmit Buffer Empty flag of UART IC6 will be driven to logic 0, having been filled' with a character. The time delay shown on the diagram is due to chip propagation which proves ample in the design shown. After a timing delay in the first monostable set by timing components C3 and R4, pin 9 on IC4b goes to logic 0 (T2 on the timing diagram). Pin 12 on IC4 follows it and this signal is used to reset the Data Available flag on UART IC3. At this stage, once the Transmitter Buffer Empty line of UART IC6 has returned to logic 1, the circuits are back in their original

states and ready to accept the next character.

This description also applies to characters flowing through the interface in the opposite direction. IC1 and IC2 are both dual level converter chips which convert RS232 levels (usually \pm 12 V) to TTL levels of 0 V and 5 V.

Fig.2 Pulse timing diagram.

BUYLINES

Most of the components required can be ordered from suppliers advertising in this issue. In case of difficulty, advertisers specialising in computer hardware may be of assistance.

The variable regulator (RC4149D) is a Radiospares component — RS No. 306-011.

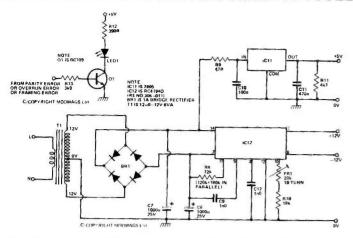
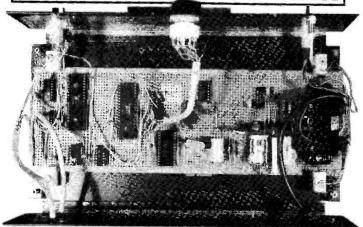


Fig.3 Circuit diagram of the power supply and LED indicators if required.

	1/4 W 5% unless otherwise stated
R1	10M
R2, 3	2k2
R4, 5, 6, 7	22k
R8	72k (120k + 180k in parallel)
R9	47R 2 W
R10	18k
R11	4k7
R12	390R (six if required)
R13	3k9 (six if required)
Potentiomete	er
PR1	20k 10-turn preset
Capacitors	
C1, 11	470n polyester
C2	2u2 35 V tantalum
C3, 4, 5, 6	47n ceramic
C7, 8	1000u 25 V axial electrolytic
C9, 12	1n0 ceramic
C10	100n ceramic
Semiconduct	
IC1	75152
IC2	75150
IC3, 6	AY-3-1014A
IC4, 5	74123
IC7	MC14411P
IC8	74121
IC9, 10	7400
IC11	7805
IC12	RC4194D
Q1	BC109 (six if required)
ŽD1, 2	BZY88 4V7
BR1	1 A bridge rectifier
LED1	0.2" LED (six if required)
Miscellaneou	5



The method of construction is not critical. The author's board is shown above.

Pin No.	Function	User Ba	aud
1	F4	Rate	
1 2	F1 F3	9600	
3	F5	4800 2400	
4	F7	1200	
5	F8	600	
6	F10	200	
7	F9	300	
8	F11	150	
9	F14	75	
10	Reset		
11	NC		
12 13	Ground F13	100.0	
14	F13	109.9 134.5	
15	F6	1800	
16	F4	3600	
17	F2	7200	
18	F15	921.61	кНz
19	F16	1.843 M	
20	Crystal		
21	Crystal		
22	rate select		
23 24	rate select		
-	+5 V		
Table 1 MC 14411P ni	n connections	and clos	k spands
			n specus
Pins 35	Logic 0	Logic 1	
39 39	Parity Odd parity	No parii	
3 9 36	Odd parity One stop bit	Even pa	
30	One stop bit	Two sto	p bits
Character	Pin 37	Pin 38	
Lengths			
5 bits 5 bits	Logic 0	Logic 0	
7 bits	Logic 0	Logic 1	
8 bits	Logic 1 Logic 1	Logic 0	
Table 2.	Logic 1	Logic 1	
	connections (1(3.6)	
1 Vcc Pc 2 NC	ower Supply (+	- 5 V)	
3 Groun	d		
the same of the sa	ed Data Enabl	-	RDE
	ed Data Bits	e	(RD8-RD1)
13 Parity	Error		(PE)
	g Error		(FE)
15 Over r	un		(OR)
16 Status	Word Enable		SWE
17 Receiv	er Clock		(RCP)
	Data Available		RDAV
	vailable		(DAV)
20 Serial I 21 Externa			(St)
	al Reset <u>uitte</u> r Buffer Er	nntv	(XR)
23 Data S	trobe	npty	(TBMT)
	Character		DS (EOC)
25 Serial (Dutput		(SO)
	it inputs		(DB1-DB8)
	Strobe		(CS)
35 No Par	ity		(NP)
36 Numbe	er of stop bits		(TSB)
37-38 Numbe	er of bits per ch	naracter	
39 Odd/Ev	en parity selec	ct	
40 Transm	itter Clock		(TCP)

Table 3.

AY-3-1014A pin connections.

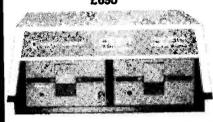
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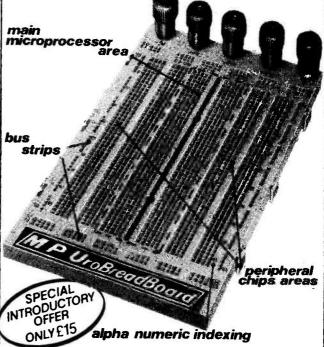
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LED TACHO

A unique two-range tacho that gives an analogue RPM display on a bar of 21 LEDs. The display flashes to indicate an alarm condition when the RPM exceed a preset limit. Design by Ray Marston. Project development by Steve Ramsahadeo.

he ETI Tacho/Alarm is an all solid-state project. It displays engine speed in analogue form (like a conventional tacho) as an illuminated section of a line of 21 LEDs. The length of the illuminated section is proportional to the engine speed, so that half of the scale is illuminated at half of full-scale speed, and so on. In other words, the display is in bar rather than dot form.

The Tacho/Alarm can be used with virtually any type of multi-cylinder petrol engine. It has two speed ranges, each of which can be calibrated by a preset pot to give any full-scale speed range required by the individual owner. Our prototype is calibrated to give full scale readings of 10,000 RPM and 1,000 RPM on a four-cylinder, four-stroke engine. The lower range is of great value when adjusting the engine's ignition and carburation for recommended tick-over speeds. The upper range has adequate resolution (500 RPM per step in our case).

A unique feature of our product is the provision of a visual over-speed alarm facility, which causes the LED display to rapidly flash on and off when the RPM exceed a preset level; the tacho continues to indicate the actual RPM under the alarm condition. Tachos are normally placed directly in front of the driver in sports/racing cars, so this visual alarm system is a highly effective 'attention getter' in such vehicles.

The unit is designed for use only on vehicles fitted with 12 V electrical systems. It can be used with conventional or capacitor-discharge (CD) ignition systems and is wired into the vehicle with three connecting leads. It can be used on vehicles fitted with either negative or positive earth electrical systems.

Construction

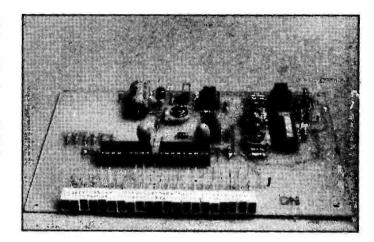
The complete unit, including the 21 LED display, is mounted on a single PCB. Take care over the construction, paying special attention to the following points:

(1) Our prototype uses a display comprising a linear row of 21 square LEDs, mounted horizontally on the PCB. You may prefer to use a semicircular display of LEDs, in which case you can mount the display on a separate board of your own design, with suitable connections to our board. In either case confirm the polarity and functioning of each of the 21 LEDs, by connecting in series with a 1k0 resistor and testing across a 12 V supply, before wiring into place on the PCB. Note that the LED colours can be mixed, if required.

If you use the same display form as our prototype, bend and adjust the LED leads so that each LED slightly overhangs the edge of the PCB when soldered into place.

(2) Seven link connections are made on the PCB. Also note that the external connections to the unit (0 V, \pm ve and CB) are made via solder terminals (Veropins).

(3) Range-changing is achieved via a three-pole two-way



switch. On our prototype we've used a DIL slide switch, mounted directly on the PCB, for this purpose. Some readers may prefer to mount this switch off-board.

(4) Note that the values of C2 and C3 must be chosen to suit the engine type and full-scale RPM ranges required (see the conversion graph). Our prototype, calibrated to read 10,000 RPM and 1,000 RPM on a four-cylinder four-stroke engine, uses C2 and C3 values of 22nF and 220nF respectively.

When the construction is complete, connect the unit to a 12 V supply and check that only LED 1 illuminates. If all LEDs illuminate, suspect a fault in the wiring of IC1.

Calibration

The unit can be calibrated against either a precision tachometer or against an accurate (2% better) audio gennerator that gives a square wave output of at least 3 V peak-to-peak. The method of calibration against an audio generator is as follows.

Connect the tacho to a 12 V supply and connect the square wav. output of the audio generator betweeen the 0 V and CB terminals of the unit. Check against the conversion graph to find the frequency needed to give the required high range full-scale RPM reading on the type of engine in question and feed this frequency into the tacho input. Switch SW1 to its high range (10,000 RPM on our prototype) and adjust PR1 for full-scale reading. Now set the generator to the alarm frequency and adjust PR3 so that the display flashes. Recheck both adjustments.

Now switch SW1 to its low range (1,000 RPM on our prototype), set the required full-scale frequency and adjust PR2 for a full-scale reading on the tacho. Note that the alarm facility is inoperative on this range.

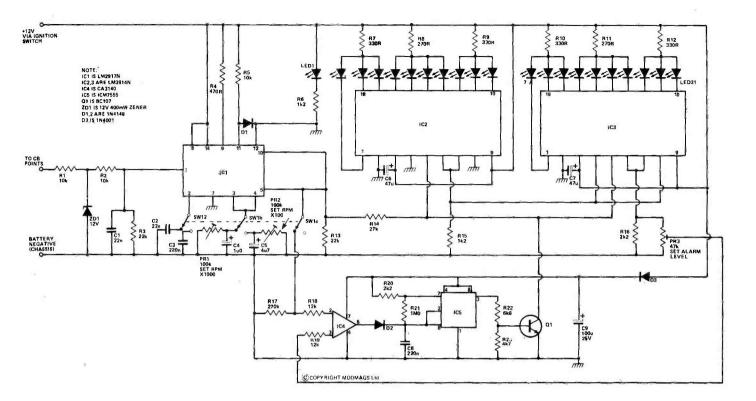


Fig. 1 Circuit diagram.

HOW IT WORKS

The ignition signal appearing on a vehicle's contact-breaker (CB) points has a basic frequency that is directly proportional to the RPM of the engine. Our tacho works by picking up the CB signal, extracting its basic frequency, converting the frequency to a linearly-related DC voltage and then displaying this voltage (and thus the RPM) on a line of 21 LEDs. The basic tacho can thus be broken down, for descriptive purposes, into an input signal conditioner section, a frequency-to-voltage converter section and a LED voltmeter display section.

The input signal conditioner section comprises R1-R2-R3-ZD1-C1. The CB signal of a conventional ignition system consists of a basic RPM-related rectangular waveform that switches alternately between zero and 12 V, onto which various ringing waveforms with typical peak amplitudes of 250 V and frequencies up to 10 kHz are superimposed. The purpose of the input signal conditioner is to cleanly filter out the basic rectangular waveform and pass it on to the F-to-V converter. It does this first by limiting the peak amplitude of the signal to 12 V via R1 and ZD1 and then filtering out any remaining high frequency components via R2-R3-C1. The resulting clean signal is passed on to the input (pin 1) of IC1.

IC1 is a frequency-to-voltage converter chip with a built-in supply voltage regulator. The operating range of the IC is determined by the value of a capacitor connected to pin 2 and by a timing resistor and smoothing capacitor connected to pins 3-4. In our application, two switch-selected presettable ranges are provided. The DC output of the IC is made available across R13 and is passed on to the high-impedance input terminals of the IC2-IC3 LED voltmeter circuit via series resistor R14. R14 is essential to the operation of the alarm section of the tacho.

IC2 and IC3 are LED display drivers. Each IC can drive a chain of 10 LEDs, the number of LEDs illuminated being proportional to the magnitude of the IC's input signal. Put simply, the ICs act as LED colleges

In our application, the two LM3914 ICs are cascaded in such a way

that they perform as a single 20-LED voltmeter with a full-scale range of 2V4. This full-scale value is determined by precision voltage references built into the ICs. The full-scale reference voltage (2V4) is generated across R16 and PR3. The configuration of our voltmeter is such that it gives a bar display, in which LEDs 1 to 11 are illuminated at half-scale or LEDs 1 to 21 are illuminated at full-scale. R7 to R12 are wired in series with the display LEDs to reduce the power dissipation of the two ICs. LED 1 is permanently illuminated so that the RPM display does not blank out completely when the engine is stationary with the ignition turned on.

The alarm section of the tacho is fairly simple. IC4 is wired as a voltage comparator with a stable reference voltage fed to its non-inverting (pin 3) input from PR3 and with an RPM-related voltage fed to its inverting (pin 2) input from R13 via SW1c. The output of IC4 is used to enable or disable astable multivibrator IC5 and the output of IC5 is used to enable or disable the inputs to the IC2-IC3 voltmeter via Q1 and R14.

At low engine speeds (below the alarm level) the input of IC4 is driven high, thereby disabling the IC5 astable by preventing C8 from discharging. Under this condition the output of IC5 is driven low, cutting off Q1 and enabling the tacho circuit to operate in the normal way.

At high engine speeds (at or above the alarm level) the output of IC4 is driven low, thereby enabling the IC5 astable to operate at a rate of roughly 2 Hz and alternately drive Q1 on and off. In the moments that Q1 is cut off, the tacho operates in the normal way, but in the moments that Q1 is driven on its collector pulls the pin 5 input terminals of IC2 and IC3 to near-zero volts and thereby effectively blanks the LED displays. The LEDs flash rapidly under the alarm condition, but continue to indicate RPM values.

The alarm point can be set in any position on the tacho scale by PR3. SW1c is used to disable the alarm section when the tacho is set to its low(1,000 RPM in our prototype) range. Note that the power supply to the alarm is decoupled from the main supply by D3 and C9.

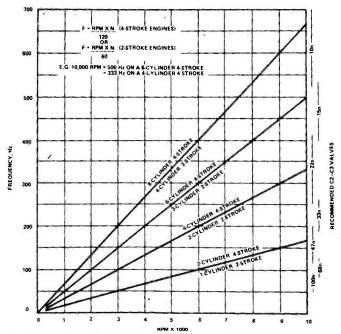


Fig. 2 Conversion graph to determine the values of C2 and C3.

Installation

The completed unit can either be mounted in a special cut-out in the vehicle's instrument panel or (preferably) can be assembled in a home-made housing and clipped on top of the instrument panel. In either case try to fit some kind of light shield to the face of the unit, so that the LEDs are shielded from direct sunlight.

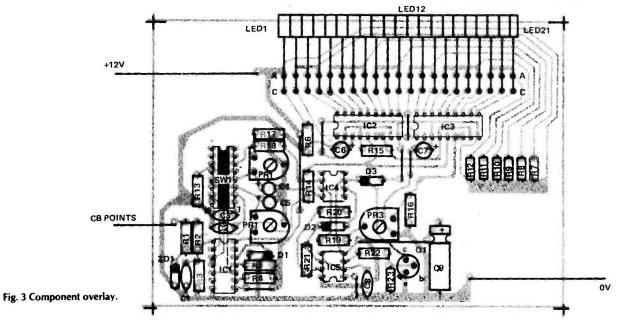
To wire the unit into place, connect the supply leads to the tacho via the vehicle's ignition switch and connect the unit's CB terminal to the CB terminal on the vehicle's distributor. Note that the unit can be fitted to vehicles using either positive or negative earth systems.

The lower range of the tacho is of great value when adjusting the engine for correct tick-over. It is thus advantageous to arrange the tacho housing so that it can be easily dismounted from the instrument panel.

BUYLINES_

All components used in the LED Tacho are common types and should present few problems. The dual-in-line slide switch is stocked by the major mail order companies that advertise in this issue.

Resistors all 1/4 W	/ 5%	C3,8	220n polycarbonate						
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R3,13	22k	C5	4u7 35 V tantalum						
R4	470R	C6,7	47u 16 V tantalum						
R6,15	1k2	C9	100u 25 V electrolytic						
R7,9,10,12	330R								
R8,11	270R	Semiconductors							
R14	27k	IC1	LM2917N						
R16,20	2k2	IC2,3	LM3914						
R17	270k	IC4	CA3140						
R18,19	12k	IC5	ICM7555						
R21	1M0	Q1	BC107						
R22	6k8	ZD1	BZY88 12 V						
R23	4k7	D1,2	1N4148						
Potentiometers		D3	1N4001						
PR1,2	100k miniature horizontal preset	LED1-21	Red, square type.						
PR3	47k miniature horizontal preset	Miscellaneous							
Capacitors		SW1	4-pole 2-way dual-in-line slide switch						
C1,2	22n polycarbonate	PCB, case.							



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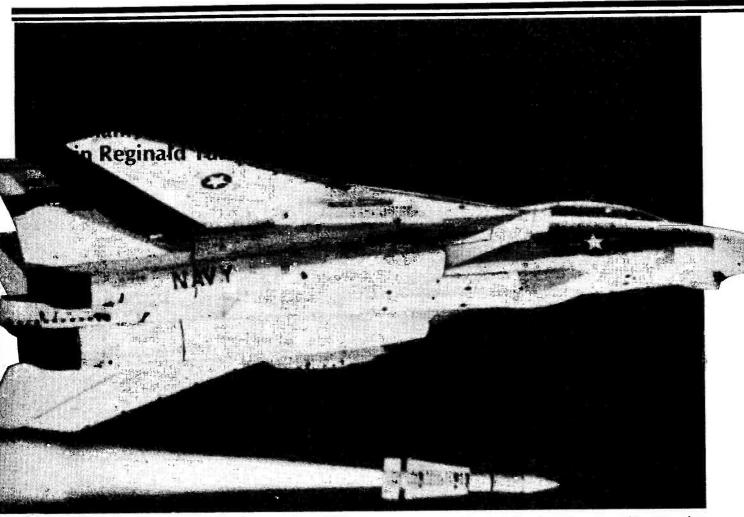
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he cause of the Ariane rocket accident in May 1980 has been found. As I reported in October's Astrologue, the second test flight of the European launcher lasted only two minutes. The vehicle broke up in flight and exploded.

Extensive tests, simulation and examination of wreckage recovered from the sea were necessary to narrow down the range of hypotheses and eventually reproduce on the test-stand the behaviour of the faulty engine.

It was proved that the cause of the engine failure was not external to the engine itself, or due to a foreign body present at ignition or an acoustic 'ground efect' during lift-off.

Accident investigators have found that the failure was due to combustion instability at high frequency (above 2 kHz) in one of the four first stage engines 5.75 S after ignition. The vibration lasted only 0.3 S, but it was so violent that it abruptly altered the characteristics of the fuel injector. Damage to the injector destroyed the engine 64 S after ignition, starting a propulsion bay fire, which destroyed the vehicle 108 S after lift-off.

Fuel Injection

The fuel injector is a very complex element of the rocket design. It is used to deliver almost 250 kg of fuel and oxidant to the combustion chamber through nearly 1,000 orifices. Its failure was probably due to slight variations in component manufacture, although the injectors behaved normally in nearly 200 engine development tests. To resolve the problem, injector manufacturing tolerances are to be altered and injectors will be selected by static firings on the engine test-stand.

The third Ariane vehicle should be equipped with the new injectors and ready for launch by the end of March 1981, if

Trials of the improved AIM-54C Phoenix missile continue. This US Navy photo shows an engineering development model being fired from an F-14 Tomcat fighter at the Pacific Missile Range. Once again, the new model, teamed with the Hughes' AWG-9 RADAR fire control system, behaved perfectly, passing well within the lethal distance of the drone target. The Phoenix is regarded as one of the world's most technologically advanced tactical missiles.

testing proceeds satisfactorily. The fourth and last test flight would then be scheduled for June 1981. The first operational launch could take place in October.

AWOL Satellite

Late last year, RCA's multi-million dollar Satcom III satellite disappeared 14.5 S into the 28 S apogee kick motor burn (to place the satellite in geostationary orbit). A study of the incident has suggested two possible causes.

If, when the motor fired, the exhaust cone broke, hot gases would have melted the back end of the satellite, destroying the communications equipment. Alternatively, if, after the motor fired, the solar array was deployed prematurely, suffering structural damage due to thrust, a total power loss would ensue. As exhaust overheating was observed prior to loss of contact, the review board has opted for the first alternative.

In addition to the cost of the launch and hardware involved, RCA may lose a further \$20 million in expected revenue. However, the venture was insured for around \$77 million

In the meantime, Satcom III's customers can use 11 transponders on another satellite (Comstar D-2) for \$40,000 per transponder — the same as the Satcom usage charge. Comstar D-2's full charge is normally \$70,000 per transponder. RCA will launch a replacement satellite in June 1981.



In Print

Reginald Turnill has been covering spaceflight since the Soviet-US missile race in the post-war years, which developed into the race to land a man on the moon. He reported for the. BBC on every manned spaceflight from Gagarin to the joint Apollo-Soyuz mission in 1975, including the first moon landing. His wealth of first-hand knowledge of the major space

projects reflects in his authoritative writing on the subject. In nearly 400 pages. The Observer's Spaceflight Directory updates and augments the smaller Observer's books on manned and unmanned spaceflight. It includes sections on space programmes in 14 countries, tabulations of manned and unmanned flights and blow by blow accounts of satellites and launch vehicles from Oscar to Skylab and Surveyor to the Space Shuttle. Soviet projects are also covered extensively.

Prize Day

You can win a copy of this magnificent handbook by trying your hand at our simple, free entry competition. All you have to do is complete the crossword by solving the cryptic clues. Most of them offer two means of arriving at the solution and most are fairly simple.

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Closing date for entries — January 31st 1981.

If you don't win the competition, you can get hold of your own copy of The Observer's Spaceflight Directory by Reginald Turnill, published by Frederick Warne, for £7.50 from any good bookshop.

CROSSWORD CLUES -

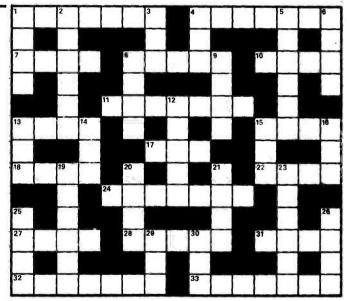
Across

- Messenger of the Gods, first in line from the Sun. (7)
- Car step seen through prisms, (7)
- One of those returned from the Moon in a rocket. (4)
- Such a wing on a variable geometry aircraft. (5) Major or minor, a friend of Goldilocks. (4)
- In Scorpio and in plant a resistor. (7
- Benny's friends in the sky send out streams of gas
- Getting up and down shortly giving lots back. (4)
- Getting on course for the Moon initially in fast limousines. (3)
- Imitations 4: Neil Armstrong 2, giving support. (4) Imitates Bonny and Sam. (4) Troubled SOS in grim for first Mercurial Gemini

- National Oceanic and Atmospheric Administration. 27
- Peenemunde led to Saturn for him. (5) Join Oriental take-off for one. (4)
- The seriousness of the downward pull. (7)
- Enterprise will never be this, Columbia. (7)

Down

- The Vikings headed here and returned in express ramjets. (4)
- Company trek carrying a payload. (6) Plane turn about vertical axis way back. (3)
- In part, it's unlikely to provide a shining example. (3)
- Propulsive force through American street. (6) Shepard or Bean in a Lancaster bomber. (4)
- Liberty Bell did this, we hear five accross the
- channel. (4)
- Geostationary Operational Environmental Satellite leaves. (4)
- At Los Angeles south missile. (5)
 Pasadena's famous laboratories tenth, sixteenth and twelfth. (3)
- So, point to call for help. (3)
- A damp reception for astronauts partly due to phase angle. (3)
- The French southern Launch Escape System. (3)
- French place of departure for Ariane. (6) Graduate back with credit for nebula. (4)
- Brief moment on our satellite. (4) Scheme and French celestial body. (6)
- A single letter pulling down at sea level. (3,1) Southern seaman only coming out at night. (4) Narrow beam fired by futuristic gun. (3)
- Nameless aircraft alias airborne crockery. (3)



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Now you can have LINEAR REGRESSION at your fingertips!

With the FX-3500P, Casio's new low-cost programmable scientific. An abundance of built-in functions, including Linear Regression. Prov. price: UNDER £30.

THE ULTIMATE WATCHES

* STAR BUY FOR 1980 *
Our best selling watch





12 MELODY ALARM CHRONOGRAPHS

Hours, minutes, seconds, am-pm, 12 or 24 hour. Day, date and month auto calendar.

Alarm. 7 melodies, one for each day of the

week. Hourly time signal. With "Big Ben" type

Date memory. Select either "Wedding March' or 'Trinklied' to be played.

Birthday and Christmas Memory.

Countdown alarm. From 1 second to 1 hour.

After zero count continues positively.

rtch. 1/10 second to 1 hour. Net, lap.

Picturesque moving display of notes played Light. Lithium, Glass. Water-resistant cases.

M-12 Resin, s/s trim, M-1200 all s/s 9.0 mm





£19.95

£32.50

LCD ANALOGUE/ DIGITAL

Alarm Chronograph with countdo Analogue. Independent hours and minutes with synchronous digital seconds. Dual time

Digital. Hours, minutes, seconds, day and

Stopwatch. 1/100 second to 12 hours. Net lap and 1st and 2nd place. Start/stop and 10 minute signals

Alarm. For 30 seconds with carousel display.

Countdown Alarm. Normal and net times to 1 hour with amazing "Star Burst" flashing

Time Signal. Half-hourly and hourly chimes. Tone control. Lithium battery. Light. Water-resistant case. 8.65mm thick. Mineral glass.

AA81 Chrome plated AA81G gold plated AA82 stainless steel

AA83 Dress watch, s/s



£29.95

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£39.95

£29.95

for around 40 functions **100 METRE WATER** RESISTANT

Alarm chronographs with countdown Amazing 5-year lithium battery life, Hours,

Amazing 5-year lithium battery life. Hours, minutes, seconds, am/pm, day, date and month. 12 or 24 hour. Time is always visible regardless of display mode.

Stopwatch. 1/100 second to 1 hour. Net.lap, and 1st and 2nd. Start/stop signal, 10 minute signal.

Alarm. Sounds for 30 seconds.

Countdown Alarm. Normal and net times to 12 hours. Start/stop and 10 minute signals. Times signal. Half-hourly and hourly chimes.

Time signal. Half-hourly and hourly chimes.
W-100. All resin. W-150B All s/s. W-150C
(not illustrated) s/s case/resin strap. £29.95

A250. As above but with standard water-resistant case

\$220. As above but with dual tune in lieu of alarms and chimes

F300 Sports Chronograph (right). 8 digits, hours, minutes, seconds, date and day indicator, 1/100 second stopwatch; net, lap and 1st and 2nd place times, to 12 hours. Resin case, s/s trim. Water-resistant. Glass. Light.

£17.95 110QS-37B Metal version

F81 Alarm Chronograph (far right). 8 digit dsplay of hours, minutes, seconds, am/pm and date. 24-hour alarm, hourly chimes, 1/10 second stopwatch to 12 hours; net, lap, 1st & 2nd place. Resin case/strap. Water resist. Mineral glass. Nightlight.

83Q8-41B. S/s jacket version £19.95





£12.95

£15.95

05850

£24.95

£25.00

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LADIES' MODELS with stopwatch or dual time.

87QGL-13B gold plated £24.95. 87QL-13B chrome £16.95. Other ladies' models from £10.95 to £34.95.

Ladies' Alarm Watches. Hourly chimes, calendar LA550 all s/s £24.95, LA551, chrome £19.95 Details on request.

* Providing the advertiser has stocks and we make a small profit!

CHRISTMAS POST Our return of post service means that orders received by 18th December should reach you in time for Christmas, subject to availability

RETURN OF THE SUPERCALCS!

★ NEW MODEL! FX-6100

Clock. Hours, minutes, seconds, am/pm.

Alarm. Alarm signal at pre-set time.

Hourty chimes. Every hour, on the hour. Easily switched

vn alarm. (Repeater time).

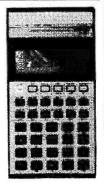
Stopwards. Normal, nepeater time; Stopwards. Normal, net, and lap times to 1/100 second. Calculator. 39 scientific functions. True algebraic logic. 5 level parenthesis, cube roots, standard deviations, R-P and P-R coordinate conversions, sexagesimal conversions, full

memory, %
Approx. 14 months on 2 penlight batteries (AA type). 34 x

3 x 5%inches. (RRP £22.95). £19.95

FX-7100. Card version of above with kiss-touch keys. 3/16 x 2% x 3%. (£27.95). **£24.95**

FX-8100. Specifications as above plus permanently programmed calendar (1976-1999), day, date, month and year. Also has hyperbolics. $\frac{1}{2}$ x 2 $\frac{3}{2}$ x 5 $\frac{1}{2}$. £24.95



CASIOTONE KEYBOARDS

★ NEW MODEL! CT-301 Domestic Keyboard
Polyphonic playing of 14 instruments plus 16 rhythm voices. Dimensions, etc are similar to the CT-201. Woodgrain only. Provisional price; under £300.

CT-201. 29 polyphonic instruments over 4 octaves, 4-sound memory function. 3 x 331/2 x 9%. Weight 15 lbs. Integral amplifier and speaker. AC only. (£285) **£245**

THE SPACE INVADERS ARE BACK!



This time right in your pocket. An action-packed speed game that will give you hours of skilful entertainment and chair-gripping excitement. Never another dull spare moment. Also an 11-note melody calculator, preprogrammed "When The Saints Go Marching In." Full receipts. Also accept memory, %. Auto power-off facility.

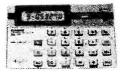
MG-880 (left)

£10.95 (£12.95)

MG-770 (right) Kiss touch

keys. 5/32x3¾x2⅓

£12.95 (F14 95)



-10:58

12 PRE-PROGRAMMED MELODIES

Clock, calendar, 11-note melody maker, calculator, square roots, %. Alarm 1; 7 tunes, one for each day. Alarm 2; a fixed tune. Hourly chimes. Date memories; 4 anniversary

MQ-1200 (below). Desk or bedside. Built-in speaker, Volume control. Nightlight. Powered by three AA size batteries. 19/16x 6 x 2¾ inches.



BEAT lower prices by 5%

M L-90 (right) Kiss keys Stopwatch 7/32 x 2½ x 4½"

£19.95

(£22.95)

Other Casio calculators, P.O.A. Remember, we will

AG.

* '

ALARM CHRONOGRAPHS FROM £37.50 SEIKO



DFT 048 (left) Alarm, countdown alarm hourly chimes, stopwatch to 1/100 second, net, lap, 1st & 2nd.

DFT 038 100 metre water-resistant ver-

£49.95

DER 048 Solar powered (right). Weekly programmable alarm, 16-hour interval count-down alarm timer, hourly chimes, 1/100 cond stoowatch DER 018 100 metre water-resistant ver-

£69.95



£52.50

DUO DISPLAY Analogue / digital watches from £57.50

Send 25p for our illustrated catalogue of latest Casio and Seiko products. Offers are subject to availability

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ETI READER SURVEY

Time for the big one again — our annual nationwide survey of ETI readers. It's your chance to say what you think of us and do your bit to influence what we publish.

All you have to do is fill in the questionnaire overleaf and consign it to its fate at the hands of the Royal Mail. Even now we're preparing for office life to grind to a halt as thousands of questionnaire-laden pigeons start arriving.

Your replies are read and your comments noted. They all go towards shaping ETI in the eighties.

ETI Survey, Modmags Ltd., 145 Charing Cross Road, London WC2H OEE.

1) Please rate the following articles on a scale of 1 (awful to 9 (brilliant). If you didn't read the feature, please score 0.

	SCORE	SCORE READ	SCANNED	SCANNED COMMENTS?
FM TUNER				
LED TACHO				
MULTI-OPTION SIREN		U		
POLYSYNTH			Ĭ	a constant and a cons
UNIVERSALTIMER				
ELECTRONICS TOMORROW				
I/O INTERFACE				
DESIGNER'S NOTEBOOK				
MICROBASICS	,			
ASTROLOGUE				
TECH TIPS				
SLR ELECTRONICS				
SPOT DESIGNS				
DIGEST				
AUDIOPHILE				

Asterisk the single best feature in your estimation.

in addition please make any comments you would like to in the space provided. (Go on — don't be shy!)

ISSUE ISSUES

2) Do you consider yourself a regular reader?

If yes - how long?

Six months or less/1 year/2 years/3 years/longer.

If you've been a reader for longer than a year, how does ETI now compare with ETI a year ago? Circle appropriate comment.

Much better Slightly better No different Slightly worse Much worse Oh my God!

How long do you keep your past copies of ETI? 1 month 6 months 6 month 4

6 months

longer

1 year

Other (please specify) Advertisement Impulse buy How did you become a reader of ETI? Friend's copy By accident

6) How many people read your copy?

PROJECTS

Have you ever built a project from ET1? If yes which did you construct in the last year — please list

16) Which of ETI's special offers did you purchase in the past year?

Is there anything you'd like to see appear as an offer in ETI? If yes, please specify

Yes/No

Yes/No

17) Have you ever bought any goods from ETI mail order? If yes how was the service you received?

Bad

Atrocious

Any problems? (Please specify below)

18) Do you read advertisements in ETI? Frequently Occasionally ADVERTISING

19) Do you find the advertisements in ETI useful when purchasing goods?

Never

20) Have you ever purchased goods from mail order advertisements in ETI?

Neither

(a) Approx. how many times in the last year have you ordered goods from a mail order com-21) If so:-

Yes/No

(b) How many mail order companies have you used during that period?

22) Approx. how much have you spent on electronics in the last year?

23) Approx. how much of this amount was spent as a direct result of seeing an advertisement in ET1?

AUDIO 24) Do you own a stereo system?

Yes/No

Yes/No

25) If yes, how much did your present system cost?

26) Approx. how much do you spend annually on audio equipment?

27) Please list your present system

VIDEO

28) Do you own or rent a videocassette recorder?

Yes/No

Yes/No

Yes/No

29) If not, do you intend owning or renting a VCR within the next year?

劉) Do you own a home computer or microprocessor system? 31) If yes, how much did it cost?

HOME COMPUTING

32) Did you buy it through:(a) Recommendation by other/shop
(b) Article in ETI/other magazine
(c) Advertisement in ETI/other magazine.
Delete where not applicable.

Yes/No

READER PROFILE

These are personal questions which you may find objectionable. Please feel free to tell us to mind our business in that case. Answering them would help us greatly, however, and your co-operation would be appreciated. All info treated strictly as statistics and in confidence.

34) Sex (Male/Female/Undecided) 35) Total annual income (if in full time employment) 36) What is your job title? 37) Do you hold any of these credit cards? 86/No	9) Is there anything you would especially like to see as a project in ETI? 10) In general, if there is a kit available for a project would you purchase that rather that assembling the components yourself? 11) Do you construct using PCBs? 14) Do you construct using PCBs? 15) In general again, do projects constructed from ETI work first time? 12) In general again, do projects constructed from ETI work first time? 13) Please read the list of topics below and indicate how you think coverage of them measur up in the appropriate box About right Should cover Should cover I Total now in future in future ignored.	in ETI? you purchase that rather you purchase that rather you wanted the waste of them mes Should cover them mes Should cover them mes		ioyment) loyment) can Express cetion? ONC	HNC H necessary	ב ספ מ	gree £
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Ram) £2.

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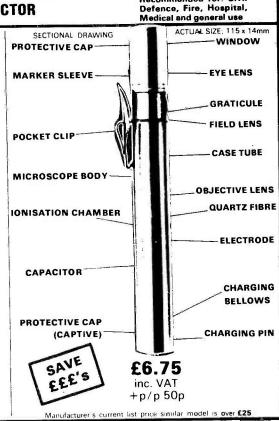
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(2nd turning left past Reading Technical College in King's Road then first right - look on right for door with "Spoked Wheel"



The heart of this unusual FM stereo tuner project is a ready-built type 7254 tuner module available from Ambit International. This module has built-in varicap diodes and is tuned by an externally applied DC voltage. It requires a mere handful of external components, plus a regulated 12 V power supply, to make a ready-to-run tuner unit with switch selection of muting, AFC and mono/stereo functioning. The audio output of the module (about 200 mV RMS) can be fed directly to the input of any stereo audio preamp.

Construction

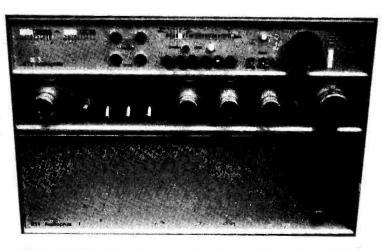
We strongly recommend that you build up the individual units of this project one at a time and interconnect and test them on the open bench before fitting the full set of modules (with or without the optional 'extras') into the final case. Start off by building the power supply unit and check that a stable 12 V is available at the output of IC1.

Next, refer to the basic wiring and interconnection diagram and temporarily wire up the 7254 module as shown,

Spot the Tune

In our Audiophile tuner unit we've provided the basic 7254 module with switch-selected tuning either with one of four preset pots for fixed station selection, or with a 10-turn pot for normal manual tuning. As an optional extra, you can also tune with a special search-and-lock circuit which automatically locates and locks on to strong FM broadcast stations. This circuit is provided with 'search' buttons that can be used to rapidly find the approximate location of a wanted station or reject an unwanted station.

We've designed our FM tuner to cover the 87.5 MHz to 104.5 MHz frequency range, with tuning indication provided on a linear 20-LED frequency scale. We've also provided the unit with a 10-LED signal-strength meter and with an optional stereo audio level indicator with 10 LEDs on each channel. The completed 'full option' unit is exceptionally attractive, with lots of fixed and moving lights, and gives a very impressive performance in the automatic 'search-and-lock' mode.



The Audiophile FM Tuner has been designed to match the Audiophile 4000 preamp and power amplifier (featured in ETI October 1979).

connecting the following components in place: R1, R2, R3, LED 1, SW1, SW2, SW3, SW4, PR1 to PR4, RV1, R4, R5. Note that on our prototype unit we used six interlocking push buttons (including one for the 'automatic' tuning mode) to make SW4 and mounted them on their own PCB, together with multi-turn preset pots PR1-4. Connect the unit to the 12 V power supply, connect an antenna (a few feet of wire should be adequate) and connect the audio outputs of the module to a preamp/power amplifier combination.

Switch the unit on, turn SW4 to position five (manual tuning), SW1 (muting) on, SW2 (AFC) off, SW3 (mono/stereo) to mono and check that the unit can be tuned with RV1. Check that interstation noise is suppressed to a reasonable level when mute switch SW1 is on. If necessary, trim the 100k pot on the 7254 module to obtain satisfactory muting. Check that the unit is functional in the four preset positions of SW4. Finally switch SW3 to the stereo mode and check that LED 1 turns on when a stereo station is tuned in and that stereo noise is not excessive. If necessary, trim the 10k pot on the 7254 to obtain the

correct stereo operation.

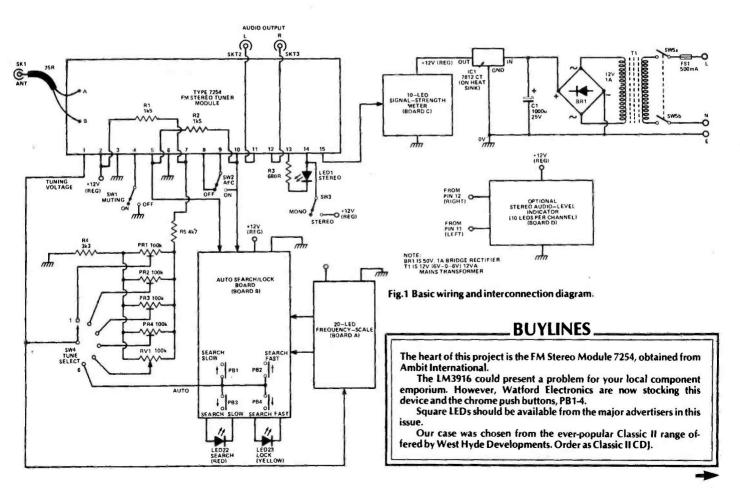
Now make up the 20-LED frequency scale on PCB 'A'. Note that this board uses square LEDs, mounted horizontally. Fit the LEDs in place with great care, ensuring that their front faces are all in line and overhang the edge of the PCB by the thickness of the front panel of your proposed tuner case. When construction is complete, make the connections to the power supply and to pin 1 of the 7254 module. Switch on and adjust PR2 to set 1V75 between point 'A' and ground. Check that the frequency scale can be fully scanned via RV1 in the manual tuning mode, noting that the PCB is fitted upside down in the final tuner case, so that the display moves to he right with increasing tuning voltage and frequency.

Signal Strength Meter

Next, build up the optional LED signal strength meter on PCB 'C', noting that R39 is mounted on the underside of the PCB and that square LEDs are again used. In this instance the LEDs are mounted vertically on the PCB and special care must be taken to establish the LED heights, as follows. Make a mock-up of the signal strength meter section of your final front panel, complete with a cut-out for the 10-LED display, temporarily fit the PCB in its final 'fixed' position behind the front panel, push the two end LEDs into position on the PCB with their faces flush with the front of the panel and then solder into place. Now fix the remaining eight LEDs in place, using a straight edge across the two end LEDs to give the correct height adjustment. When construction is complete, connect the unit to the power supply and to the 7254 module, scan the band in the manual mode and adjust PR3 so that the lowest signal strength LED is barely on with the weakest of input signals; you'll find that only the lowest three to seven LEDs illuminate under most signal conditions.

Auto Search And Lock

The search and lock circuit is an optional 'extra' and requires some care in setting up. Construct the PCB as shown in the overlay, taking care to use good quality (low leakage) tantalum components in the C7 position. Temporarily remove the link from the completed PCB, connect the board into the tuner circuit, TURN THE AFC OFF (SW2), turn SW4 to auto position and switch the unit on. Check that the frequency scale can be scanned up and down using the fast and slow search buttons (PB1-4) and that a selected station remains in tune for a



reasonable time (at least a minute) when the buttons are released. If all is well, insert the link on the PCB.

Switch SW4 to the manual tuning position, tune upwards (with RV1) towards a reasonably strong station and very carefully adjust PR2 so that the search LED (LED 22) is normally on, but turns off and switches lock LED 23 on just as the signal strength indicator goes past its peak reading position. Repeat the action several times, checking that the lock LED acts as an effective 'optimum tuning' indicator.

Now switch SW4 to the auto tuning position, drive the tuning scale fully to the left with the PB4 fast left button and then release PB4. The circuit will now start slowly scanning up the band (to the right), looking for a strong station. When a suitable station is located, the circuit will scan fractionally past the peak signal strength position and then lock on, driving on LED 23. The search LED will subsequently give an occasional flash as a correction pulse is generated to maintain correct tuning. If necessary, trim PR2 very slightly to obtain the same action.

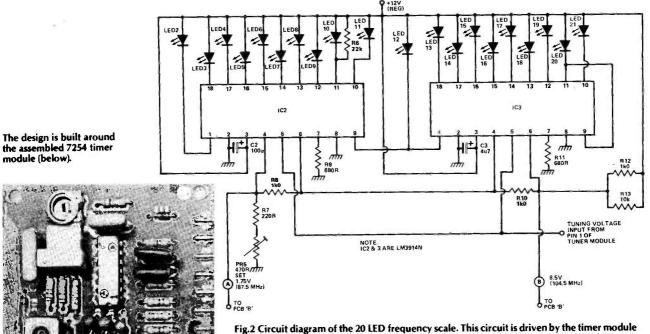
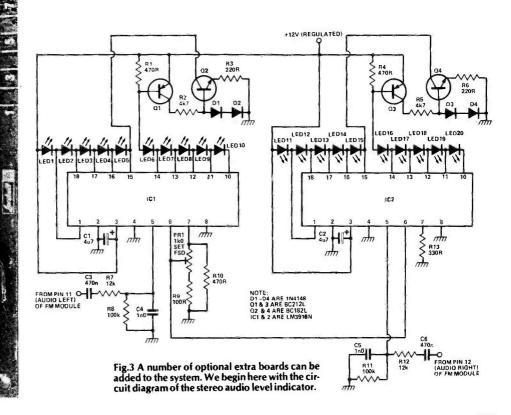
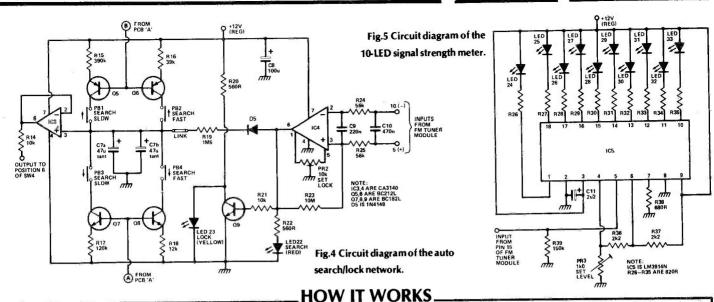


Fig.2 Circuit diagram of the 20 LED frequency scale. This circuit is driven by the timer module (with its ancillary components) and so the component numbering follows on from the module.





The heart of the ETI Audiophile FM Tuner is a ready-built type 7254 FM stereo tuner module with built-in varicap diodes, designed to be tuned with an external DC voltage applied to pin 1. In our application this tuning voltage can be derived from the 12 V regulated power supply line via the R1-R5-PR1-to-PR4-RV1-R4 potential divider or via an auto search-and-lock board. In either case, we use a 20-LED 'voltmeter' circuit to monitor the pin 1 voltage and to thus act as an effective frequency or tuning scale.

The 7254 tuner module has a number of useful output pins. Pin 7 includes an AFC voltage which can be used (via the tuning potential divider) to hold stations on-tune. A voltage proportional to the tuned signal strength is generated at pin 15 and is used in our circuit to drive a 10-LED indicating meter. Tuning meter 'nulling' signals are generated between pins 5 and 10 and are used in our application to control an automatic search-and-lock circuit. Decoded stereo output signals are available at pins 11 and 12 and can be used to drive an optional stereo audio-level indicator as well as for feeding audio signals to an external preamp power amplifier combination. The 20-LED frequency scale is simply an expanded scale LED voltmeter circuit designed around two series-connected LM3914 bargraph ICs operated in the 'dot' mode. The lower and upper limits of the voltmeter scale are determined by fixed reference voltages fed to pin 4 of IC2 (1V75) and pin 6 of IC3 (8V5) respectively via the PR6-R7-R8-R10-R12-R13 potential divider. The input to the voltmeter is fed to pin 5 of the two ICs from the pin 1 tuning voltage of the FM tuner module. This voltage is directly proportional to the tuned frequency, so the voltmeter acts as an effective tuning

The 10-LED signal strength meter is also an expanded scale LED voltmeter designed around an LM3914 bargraph IC, but in this case the IC is operated in the 'bar' mode. The lower and upper limits of the voltmeter scale are determined by fixed reference voltages fed to pins 4 and 6 respectively of the IC. The input voltage to the meter is derived from the pin 15 'signal-strength' output of the FM tuner module.

The stereo audio-level indicators take the form of a pair of virtually identical 10-LED voltmeters with semi-log scales. Each voltmeter is designed around an LM3916 bargraph IC, a VU-scaled version of the LM3914. The full-scale sensitivity of the meters is set at a few hundred millivolts peak (to suit individual tastes) by preset PR1 and audio inputs are fed to pin 5 of each IC from the outputs of the 7254 tuner module via a simple filter network. The audio signals are AC-coupled and the meters respond to the positive halves of the waveform only.

The LEDs are connected to the LM3916 ICs in a most unusual manner in this particular application. The actual ICs are operated in the 'dot' mode, with only one output being low at any moment of time, but the LEDs are connected to each IC in two series-connected groups of five and produce a 'bar' form of display. The purpose of this configuration is to provide current conservation. In a normal 'bar' display, if all 10 LEDs are on and each LED consumes 10 mA, the total current consumption is 100 mA. In the configuration shown in the diagram the currents of each group of five LEDs pass through the series-connected LEDs, so that the circuit consumes a total of only 20 mA when all 10 LEDs are on and consuming 10 mA each.

To understand the operation of the circuit, let's take the example of IC1, remembering that only one output pin can be low at any moment. If pin 1 is driven low by an audio output signal, LED 1 goes on and draws (say) 10 mA from the supply. If pin 18 goes low, series-

connected LEDs 1 and 2 both go on and each passes the same 10 mA of current. Similarly, if pin 15 goes low, series-connected LEDs 1-5 all go on and each passes the total of 10 mA that flows into pin 15 of the IC. If pin 14 goes low only LED 6 is turned on by the IC and passes 10 mA into the chip. This current flows via R1 and Q1 base, however, so Q1 conducts and turns on constant-current generator Q2, which, in turn, draws 20 mA (say) through the whole of the series-connected LED 1 to LED 5 'bar'; six LEDs are thus driven on under this condition and the circuit consumes a total of 20 mA. Similarly, if pin 10 goes low the whole LED 6 to LED 10 'bar' is driven on by the chip and the LED 1 to LED 5 'bar' is driven on by the constant-current generator, so all 10 LEDs are on and the circuit consumes a total of only 20 mA.

The search circuit is quite simple. To understand its operation, assume that the link is broken. Capacitor(s) C7 is a low-leakage tantalum type and is used to store a tuning voltage that can be fed to pin 1 of the 7254 tuner module via the IC3 high-impedance unity-gain buffer amplifier and via SW4. Transistors Q5 to Q8 are all wired as low-level constant-current generators and can be used to charge or discharge C7 via 'search' buttons PB1 to PB4 and thus scan the frequency band of the tuner module. When the buttons are released, C7 tries to store the tuning voltage, but in practice the voltage slowly leaks away via the capacitor imperfections and the operating frequency of the tuner very slowly decays downwards. The 'lock' section of the circuit is driven from the pin 5 and pin 10 outputs of the 7254 module. These pins are intended to drive an analogue tuning meter. If you connect a sensitive volt or current meter between these pins in the polarity shown (it is recommended that you do so to check circuit operation) you'll find that the meter will normally give a positive reading, but that the reading will null or go slightly negative when the 7254 module is precisely tuned to a reasonably strong broadcast station. In our circuit, the pin 5 and 10 outputs of the tuner module are fed to voltage comparator IC4 via a simple filter network in such a way that the IC4 output goes high when a station is not present or is off-tune, but switches low when a reasonably strong station is correctly tuned. Thus, when a station is not present the high output of IC4 slowly charges C7 via R19 and D5 and causes the 7254 tuning voltage to slowly increase as the module 'searches' for a station. Under this condition search LED 22 is driven on via R22. Q9 is also driven on via R21 and turns lock LED 23 off. When a reasonably powerful station is located and correctly tuned the output of IC4 switches low, so C7 is no longer charged via R19. D5 is back-biased under this condition, so C7 does not discharge back into IC4. Simultaneously, LED 22 and Q9 are disabled and lock LED 23 is driven on via R20. Once a station is 'locked' in this manner, C7 very slowly discharges via leakage currents, so the tuning voltage slowly decreases. As soon as a station goes fractionally off-tune, however, the IC4 output switches momentarily high and generates a brief 'correction' or 're-charge' pulse which brings the C7 tuning voltage back up to the correct value. This action is indicated by a brief flash of LED 22.

Note in the IC4 comparator circuit that a small amount of hysteresis is provided by R23. Also note that the trip point of IC4 can be varied over a narrow range with PR2, to compensate for slight offsets in the pin 5 to 10 outputs of the 7254 module and allow correct locking to be obtained. If a circuit fails to lock correctly, it may be that the offset of these outputs is excessive. This effect may be overcome by wiring a shunt resistor (value determined by experiment) between the relevant pins of the tuner module.

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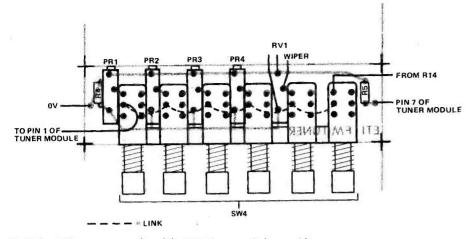
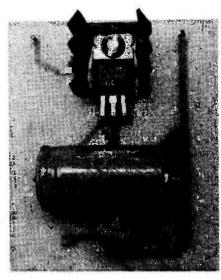


Fig.6 (above) Component overlay of the SW4 six-way switch assembly.



The power supply board — couldn't be simpler.

ANGLÉ BRACKET PCB

Fig.7 (above) Component overlay of the LED tuning scale.

+12V 12V AC Ø/P

Fig.8 (above) Component overlay of the PSU. And this is how the whole jigsaw goes together (below).

PARTS LIST.

and Tuning Scale
¼ W 5%
1k5
680R
3k3
4k7
22k
220R
1k0
10k

Potentiometers

PR1-4 PR5 100k 3/4 in. 20-turn cermet preset 470R miniature horizontal preset

100k 10 turn linear RV1

Capacitors

1000u 25 V electrolytic 100u 16 V electrolytic PCB type 4u7 35 V tantalum C1 C2 **C3**

Semiconductors

7812 IC1 LM3914N IC2,3 50 V 1A bridge rectifier TIL209 BR1

LED 1 square LEDs (yellow) **LED 2-21**

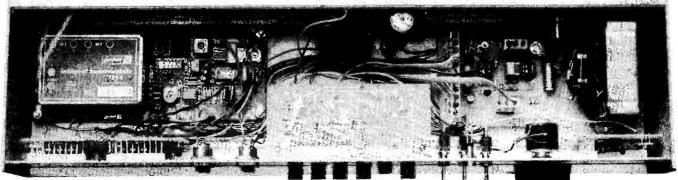
Miscellaneous

6-0-6 12 VA transformer SW1-3

SPDT miniature toggle 2 pole changover interlocking push button (6-way SW4

assembly)

SW5 DPDT miniature toggle (optional)
7254 FM module (see Buylines), PCB 'A', fuse and holder, phono sockets (X2).



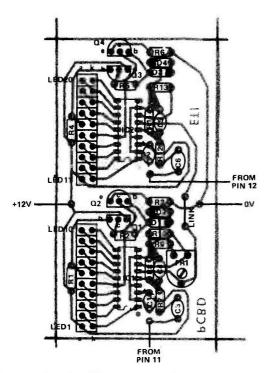


Fig.9 Component overlay of the stereo audio level indicator.

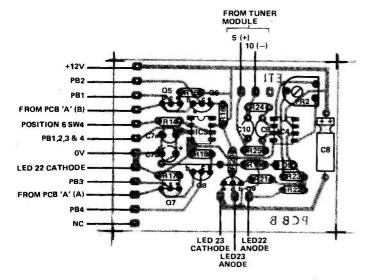


Fig.10 Component overlay of the auto search-lock network.

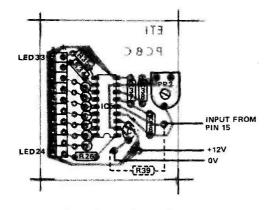
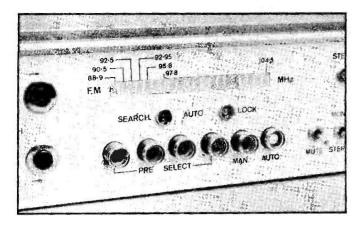


Fig.11 Component overlay of the signal strength meter.

Stereo audio leve	lindicator
Resistors all 1/4 W	504
R1,4,10	470R
R2,5	4k7
R3,6	220R
R7,12	12k
R8,11	100k
R9	100R
R13	330R
Potentiometers PR1	1k0 miniature horizontal preset
Capacitors	
C1,2	4u7 35 V tantalum
C3,6	470n polycarbonate
C4,5	1n0 polycarbonate
Semiconductors	
IC1,2	LM3916N (see Buylines)
Q1,3	BC212L
Q2,4	BC182L
D1-D4	1N4148
LED 1-20	square LEDs (red)
Miscellaneous PCB 'D'	
Auto search/lock	
	- 0/
Resistors all 14 W	
R14,21	10k
R15	390k
R16	39k
R17	120k
R18	12k_
R19	1M5
R20,22	560R
R23 R24,25	10M 56k
Potentiometers	
PR2	10k miniature horizontal preset
Capacitors	47u 16 V tantalum
C7a,b C8	100u 25 V electrolytic
C9	220n polycarbonate
C10	470n polycarbonate
Semiconductors	
IC3,4	CA3140
Q5,6	BC212L
Q7,8,9	BC182L
D5	1N4148
LED 22,23	T1L209
Miscellaneous	
PB1-4	momentary push buttons (see Buylines)
PB1-4 PCB 'B'.	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
PB 1-4 PCB 'B'. Signal Strength M	eter
PB 1-4 PCB 'B'. Signal Strength M Resistors all 14 W	eter
PB 1-4 PCB 'B'. Signal Strength M Resistors all '4 W R26-35	eter 5%
PB1-4 PCB 'B'. Signal Strength M Resistors all 14 W R26-35 R36,37	eter 5% 820R
PB1-4 PCB 'B'. Signal Strength M Resistors all ¼ W R26-35 R36,37 R38	eter 5% 820R 2k2
Miscellaneous PB1-4 PCB 'B'. Signal Strength M Resistors all 14 W R26-35 R36,37 R38 R39 Potentiometers PR3	eter 5% 820R 2k2 680R
PB1-4 PCB 'B'. Signal Strength M Resistors all '4 W R26-35 R36,37 R38 R39 Potentiometers PR3 Capacitors	5% 820R 2k2 680R 150k 1k0 miniature horizontal preset
PB1-4 PCB 'B'. Signal Strength M Resistors all 14 W R26-35 R36,37 R38 R39 Potentiometers PR3 Capacitors	eter 5% 820R 2k2 680R 150k
PB1-4 PCB 'B'. Signal Strength M Resistors all 14 W R26-35 R36,37 R38 R39 Potentiometers PR3 Capacitors C11 Semiconductors	eter 5% 820R 2k2 680R 150k 1k0 miniature horizontal preset 2u2 35 V tantalum
PB1-4 PCB 'B'. Signal Strength M Resistors all '4 W R26-35 R36,37 R38 R39 Potentiometers PR3 Capacitors C11 Semiconductors C5	eter 5% 820R 2½2 680R 150k 1k0 miniature horizontal preset 2u2 35 V tantalum LM3914N
PB1-4 PCB 'B'. Signal Strength M Resistors all 14 W R26-35 R36,37 R38 R39 Potentiometers PR3 Capacitors C11 Semiconductors	eter 5% 820R 2k2 680R 150k 1k0 miniature horizontal preset 2u2 35 V tantalum



The tuning scale is mounted above the switch assembly, which takes care of manual and auto timing. The search and lock indicators can also be seen.

When using the auto search-and-lock facility, note that the circuit always scans (searches) to the right and will only fully lock on to signals of reasonable strength (it may temporarily lock to weak signals). To rapidly locate a required station, the search buttons may be used to set the tuning scale slightly to the left of the known position. The search buttons can also be used to unlock from an unwanted station. Also note that the AFC facility must be turned off when the auto search-and-lock circuit is in use.

Stereo Audio Level Indicator

The stereo audio level indicator is an optional item and gives an attractive visual indication of the tuner's audio output signals. The circuit is built on PCB 'D' and uses 10 square LEDs on each channel. These LEDs are mounted vertically on the PCB, their heights being adjusted in the same way as for the signal strength indicator board. When construction is complete, wire the unit into place (connect its 0 V rail directly to the power supply common terminal) and give the unit a functional check. PR1 (on PCB 'D') is simply adjusted so that the display does not run off the scale when strong peak audio signals are present.

Casing The Tuner

When all of the modules have been fully tested on the open bench they can be fitted together in a suitable cabinet, noting that all supply connections must be taken directly to the power supply module (to avoid hum loops, etc.). If you decide to use the 'Classic II' case that we have used in our prototype, note the following constructional points.

The 'Classic II' case is provided with PCB mounting slots and these are used to hold the power supply and the signal strength and audio level boards in place. The basic 7254 tuner module, the SW4 PCB, the search-and-lock board (PCB 'B') and mains transformer T1 are all mounted on the case baseplate with '4' inch stand-off pillars. The tuning scale (PCB 'A') is mounted on the front panel with angle brackets that are epoxied to the rear face of the panel.

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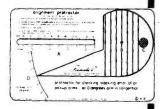
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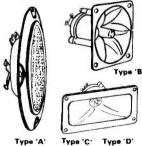
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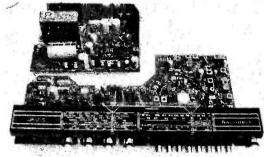


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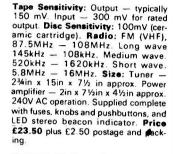
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DESIGNER'S NOTEBOOK

Ray Marston devotes this month's Notebook to a discussion of special applications for 555 or 7555 astable circuits.

he old-fashioned 555 timer, or its modern CMOS counterpart, the ICM7555, can readily be used as a highly stable and cost-effective astable multivibrator. Usually, the device is merely used to generate simple square waves, but in practice it is readily capable of performing some fairly fancy tricks: it can, for example, be used to generate useful ramp and sine waveforms and can be gated on and off in a variety of ways.

Gating The 555/7555 Astable

The 555/7555 astable can be gated on and off in a variety of ways, to produce a variety of output waveforms. Figure 1 shows the basic connections and the equivalent circuit of the standard 555/7555 astable, it is necessary to understand the operation of this basic circuit in order to appreciate the action of the various gating methods. In the following discussions, a

12 V supply rail is assumed in all circuits.

The first point to note about the Fig. 1 equivalent circuit is that the IC contains a three-resistor potential divider, two voltage comparators, a flip-flop, a transistor and an output buffer. The divider ratios are such that one-third of the supply voltage (ie. 4 V) is set on the lower comparator and two-thirds of the supply voltage (ie. 8 V) is set on the upper comparator. The circuit action is such that, in each operating cycle, C1 first charges up to 8 V through R1-R2, at which point the upper comparator activates the flip-flop and turns the pin 7 transistor on; the transistor then discharges C1 through R2 until the C1 voltage falls to 4 V, at which point the lower comparator activates the flip-flop and turns the pin 7 transistor off, causing C1 to recharge through R1-R2. The operating cycle is then complete and repeats ad infinitum. A ramp waveform with an amplitude that swings between 4 V and 8 V is generated across C1 and a rectangular waveform is generated at output pin 3.

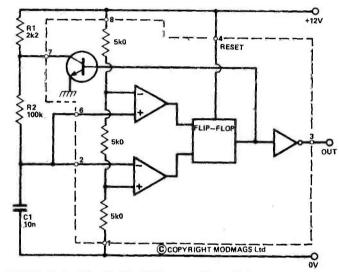
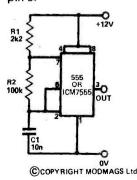
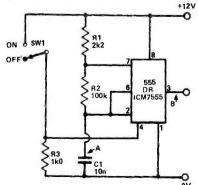


Fig.1b Equivalent circuit of the 555-type astable multivibrator.

The conventional way of gating the 555/7555 astable is with the pin 4 reset terminal, as shown in Fig. 2. When this pin is pulled to ground (by a 1k0 resistor), the flip-flop output is driven high, thus discharging C1 through R2 and the transistor and also driving the pin 3 output low. The resulting circuit waveforms are shown in the diagram. Note that, when the astable is gated on, the first half cycle is considerably longer than the succeeding half cycles. Also note that, when the astable is first gated off, the C1 voltage takes a substantial time to decay to zero. The pin 3 output is zero under the off condition.





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Fig.1a Basic circuit of the 55-type astable multivibrator.

Fig.2 Conventional way of gating the 555 astable, with resultant waveforms.

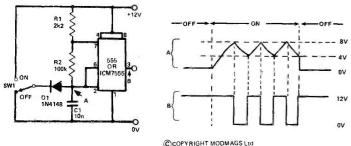


Fig.3 Basic method of gating the 555 astable using C1, with resultant waveforms. Note that the period of the first half-cycle is longer than that of the succeeding half-cycles.

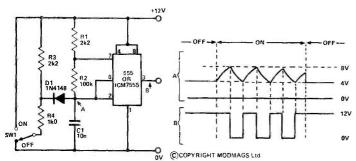


Fig.4 Modification of the C1 gating scheme, giving constant-period half-cycles.

Alternative Methods

One alternative method of gating the 555/7555 is shown in Fig. 3. Here, when the circuit is gated on, D1 is back-biased and the astable operates in the normal way, but when the circuit is gated off D1 shorts out C1 and pulls point A to ground; in practice, of course, SW1 can be replaced by an electronic switching waveform (the output of a CMOS gate, etc.) Note in this circuit that, when the astable is gated on, the first half cycle is again considerably longer than the succeeding half cycles, but that the C1 voltage falls abruptly to zero at gate-off. Also note that the pin 3 output is high in the off state.

Figure 4 shows how the above circuit can be modified so that the duration of the first half cycle is almost equal to that of the succeeding half cycles. This is achieved by choosing the R3-R4 values so that the C1 voltage is only a fraction below 4 V (one-third of supply volts) under the off condition. A substantially different set of waveforms can be obtained by choosing the R3-R4 values so that the C1 voltage is a fraction below 8 V (two-thirds of supply volts) under the off condition, as shown in Fig. 5.

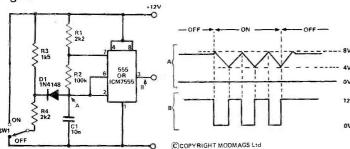


Fig.5 This slight modification of the C1 gating scheme produces a considerable change in the circuit output waveforms.

It should be appreciated that the 555/7555 astable can only oscillate if its timing capacitor (C1) is free to swing between the 4 V and 8 V switching levels. This simple fact makes it possible to voltage-gate the astable by using the circuit of

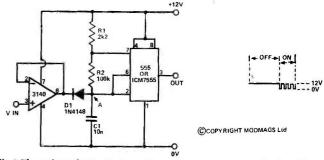


Fig. 6 The voltage-controlled astable produces an output only when V_{LV} exceeds two-thirds supply (8 V in this example).

Fig. 6. Here, the circuit produces output waveforms only when the input voltage exceeds 8 V. The circuit can be made to trigger at other levels by giving the op-amp an appropriate voltage gain factor.

Finally, an alternative method of gating the 555/7555 astable is shown in Fig. 7. Here, the circuit is gated off by driving the C1 voltage above 8 V by D1. A feature of this circuit is that its 'B' output is low under the off condition.

Asymmetrical Astables

The basic 555/7555 astable generates near-symmetrical output waveforms, provided that R2 is large relative to R1 (giving near-equal C1 charge and discharge time constants). Figures 8 to 10 show alternative methods of generating non-symmetrical waveforms. In Fig. 8, C1 charges through R1-R2 but discharges through R2 in parallel with R3-D1, to produce the waveforms shown. In Fig. 9, C1 charges through R1 and R2 in parallel with R3-D1, but discharges through R2 only; this circuit is useful for providing narrow output pulses at the 'B' terminal.

Finally, in Fig. 10, C1 charges through R1-R3-D2 and discharges through D1-RV1-R1-R2, to produce narrow output pulses at the 'B' terminal. This circuit is useful for generating variable-frequency constant-width pulses.

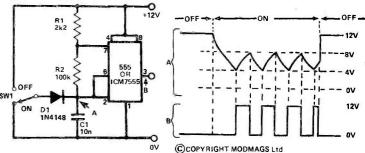


Fig.7 This C1 gating scheme produces a 'B' output that is low in the off condition.

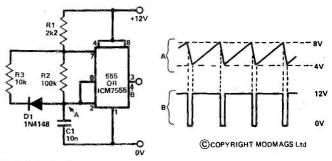


Fig.8 A method of producing a non-symmetrical fixed-ratio from the 555 astable.

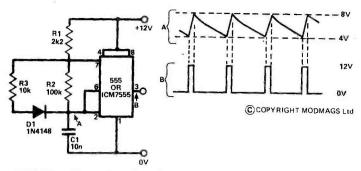


Fig.9 Alternative method of producing a non-symmetrical fixed-ratio output from the 555 astable.

555/7555 Sine Wave Generation

Figure 11 shows how a sine wave signal can be obtained from a 555/7555 astable. Here, the symmetrical ramp waveform of C2 is buffered by Q1 and then AC coupled to the R1-R2-D1-D2 divider/limiter network. This network attenuates the ramp signal and then non-linearly removes the ramp's positive and negative peaks, to produce a sine-shaped waveform of about 1 V peak-to-peak amplitude at the output terminal. The distortion level of the resulting sine wave is typically of the order of 3% and its frequency can be varied from a few cycles per minute to several hundred kilohertz by suitable choice of the C2 value.

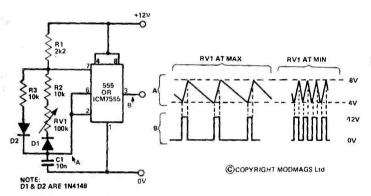


Fig. 10 A method of producing a non-symmetrical variable-ratio output from the 555 astable.

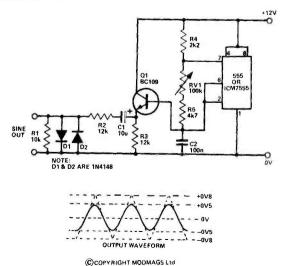


Fig.11 A 555 sine-wave generator with a range of 83 Hz to 1.4 kHz (via R1).

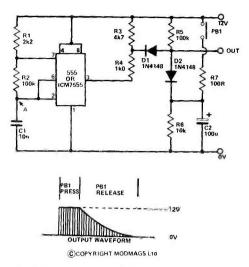


Fig. 12 A method of amplitude-modulating the pin 3 output of the 555 astable in music and sound generator applications.

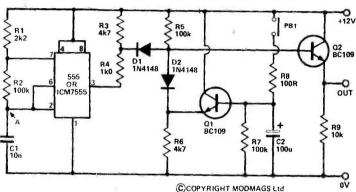


Fig. 13 A modification of the Fig. 12 circuit to give extended decay times and a buffered output.

AM Output

Figure 12 shows how the pin 3 square wave output of the 555/7555 astable can be amplitude-modulated to produce the typical attack-hold-decay envelope of a simple musical instrument or of a special-effects sound generator. The heart of the unit is the diode AND gate, or mixer, formed by D1-D2-R5. One input of this gate is fed from the output of the astable via R3-R4 and the other from across R6. The basic action of this gate is such that (ignoring the diode volt drops) its output amplitude is equal to the lesser of the two inputs.

Thus, when D1 is fed with the square wave output of the astable, the peak output of the unit will be zero when the R6 voltage is zero, or 5 V when the R6 voltage is 5 V, etc. In our circuit, R6 is shunted by electrolytic capacitor C2. Thus, when PB1 is pressed, a large voltage is applied to R6 and a large-amplitude square wave output is available. When PB1 is released, the R6 voltage and the square wave output amplitude decay exponentially to zero (with a time constant of R6-C2), as shown in the diagram. The R3-R4 network is used to apply a slight offset bias to the rectangular input waveform, to ensure a full cut-off of the output waveform after PB1 is released.

Finally, Fig. 13 shows how the above circuit can be modified to give extended display times (via emitter follower Q1) and a buffered audio output (via emitter follower Q2).



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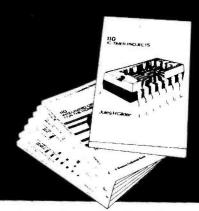
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POLYSYNTH

Part 2: This month we continue the Polysynth project with details of the motherboard and control boards. Design and development by Tim Orr



olyphonic portamento has been provided by using a voltage controlled slew limiter for each pitch voltage (Fig.10,11). The slew rate is controlled by the IABC current and the timing capacitor CB.

Slew Rate =
$$I_{ABC}$$
 C_B VS⁻¹

An LM13600 OTA is used to charge and discharge C_B . The OTA is contained in a feedback loop of two op-amps to reduce the differential offset voltage change between the input and the output. The circuit generates a voltage change of about 100 uV over its full range of 0 to -4 V at all slew rate settings.

With the portamento pot fully clockwise, the pitch of the notes will not be noticeably slewed. As the pot is rotated anticlockwise the slew limiting will become very obvious. At its slowest rate, a four octave transition will take about 2 S.

Volume Control

The audio outputs from all voices are mixed into IC13, Fig.10. This is a voltage controlled amplifier. With the master volume control anticlockwise the output will be fully off.

Pitch Bend

The pitch bend joystick is shown in Fig.12. Note that the offset lever has to be cut short to avoid fouling the pitch bend plate. This lever is adjusted so that with the joystick in the centre, the voltage on the pot wiper is zero.

Panel Boards

SP10 3NM

Board PS5 generates all the common synthesiser parameters and PS6 the individual parameters. Most of the panel controls merely generate DC voltages. However, there are three modulation oscillators which are used to produce VCO vibrato, VCF sweep and pulse width modulation of the VCO square wave output. Note that the pulse width modulation pots (RV2,4) are dual function.

Clockwise they are connected to the modulation oscillator and anticlockwise they produce a manual control ranging from one-to-one square wave to a very thin pulse. In the centre of the pot movement there is a mechanical 'click'.

A pseudo-random noise source (IC5,6) with a low frequency boost has also been included as a sound source. Boards PS5 and PS6 connect to PS4 via preformed 12" flexible jumper links. Make certain that these links are clamped to the boards with self-adhesive ribbon cable clamps, as these will take the strain of the cables as they are flexed.

.BUYLINES_

Powertran Electronics can supply a complete kit of parts for each option of the Transcendent Polysynth

 1 voice
 £320

 2 voices
 £368

 4 voice
 £464

 4 voice expansion kit
 £295

All prices are exclusive of VAT.

Powertran Electronics, Portway Industrial Estate, Andover, Hants

Note: The price of the 4 voice expansion kit was shown incorrectly last month. The correct price is £295.

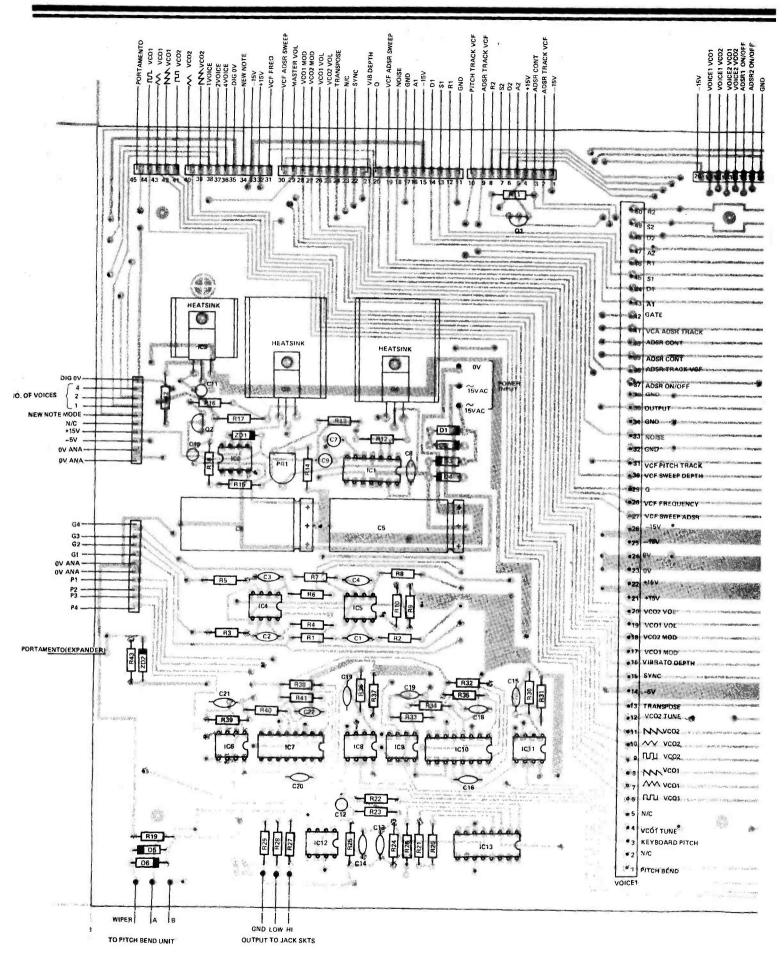
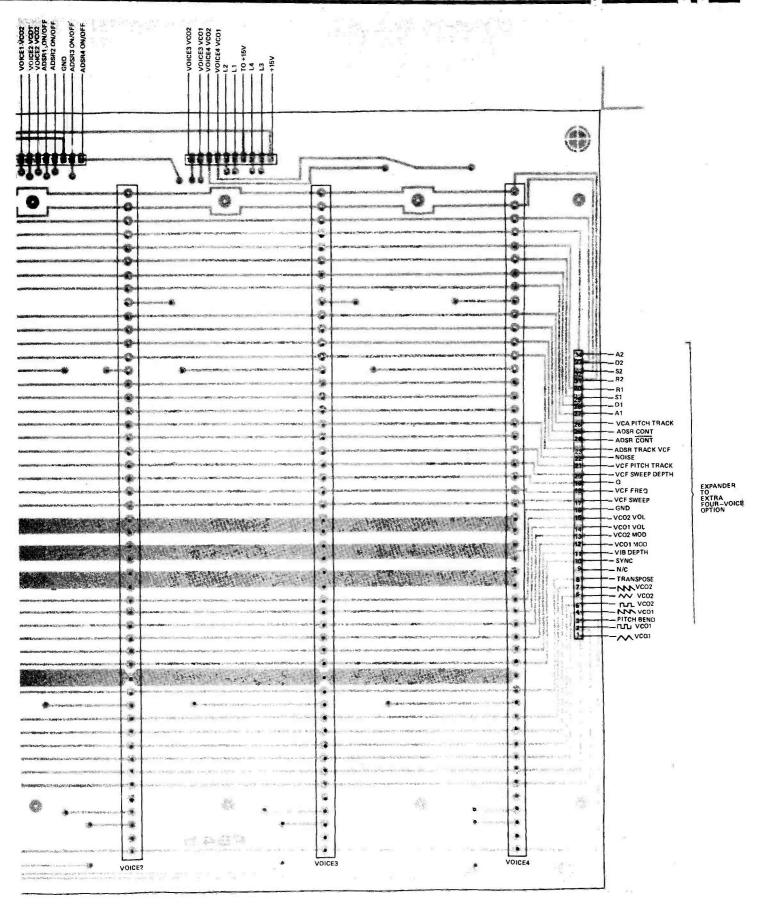


Fig.1 Component overlay of the motherboard (PS4). The circuit diagram was published last month.



PARTS LIST: PS4

Resistors all ¼ W 5%	unless otherwise stated	C8	330p ceramic
R1,3,5,7	1M0	C13	
R2,4,6,8	1k5	C14,16,18,20,22	1n0 polycarbonate
R9	1k2	C15,17,19,21	220n polycarbonate
R10,26,30,33,36,39	15k	C13,17,19,21	470p ceramic
R11,32,35,38,41	100k	C	
R12,17	1R0 2 W	Semiconductors'	· · ·
R13	12k 2% metal oxide	IC1	723 (DIL)
R14	10k 2% metal oxide	IC2,12	741
R15,18	10k 0.5% metal film	IC3	7905
	TOR U.5 76 metal film	IC4,5	1458
R16,20,21,27,29,31,	110	IC6,8,9,11	LF353
34,37,40	1k0	IC7,10,13	LM13600
R22,23,25	22k	Q1,2	BC212L
R19,24,28	10k	Q3	TIP30A
R42	100R 1 W	Q4	TIP29A
R43	270k	ZD1	10 V
-1		ZD2	5V1
Potentiometers		D1,2,3,4	1N4002
RV33	10k linear (single axis joystick)	D5,6	1N4148
PR1	10k cermet preset	,-	
Capacitors		Miscellaneous	
C1,2,3,4	1n0 ceramic		DIL sockets, 14 pin DIL socket, 3 off 16 pin D
C5,6	2200u 25 V electrolytic	sockets 2 off heatsin	ks (RS 401-964 or equivalent), TV5 heatsink, co
C7,9,10,11,12	10u 16 V tantalum	necting pins, self-adh	ocive cline

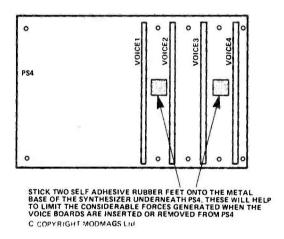


Fig.2 Plugging in the voice boards could damage the motherboard if it is not cushioned as shown.

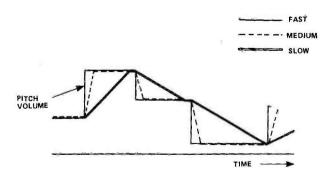


Fig.3 The effect of variable slew limiting (portamento) on pitch voltage.

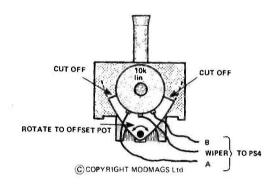


Fig.4 Mechanical details of the joystick pitch bend control.

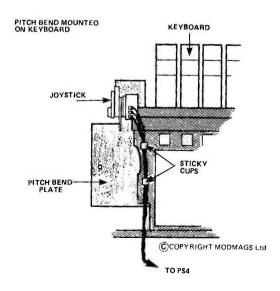
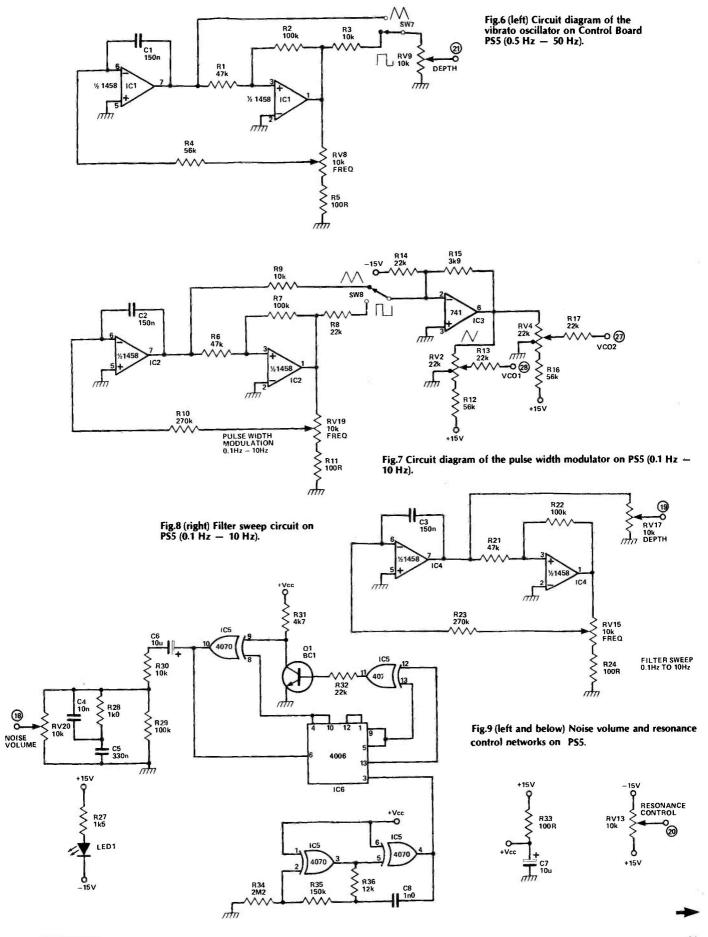


Fig.5 Mounting the joystick pitch bend control (RV33) on the end of the keyboard.



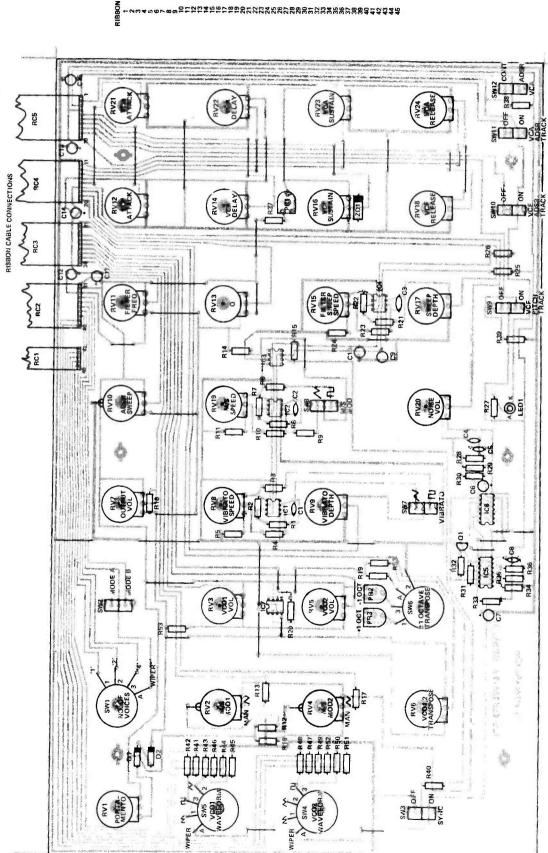
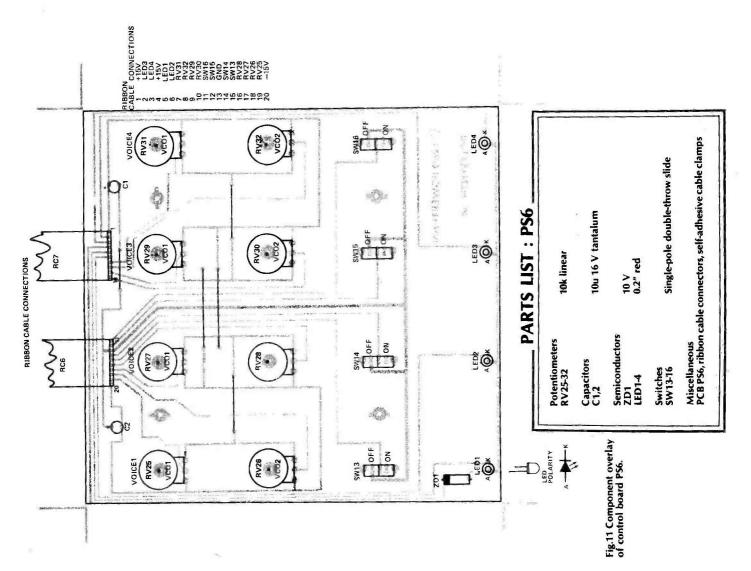
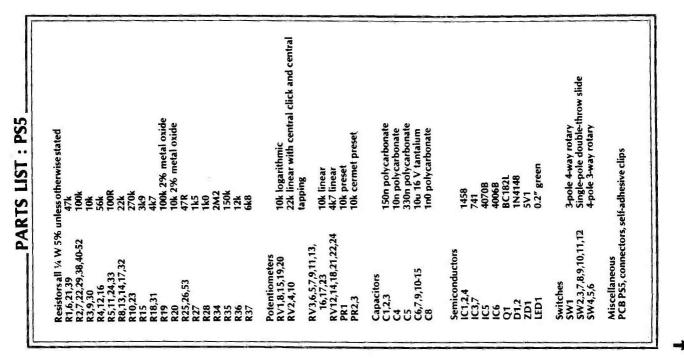
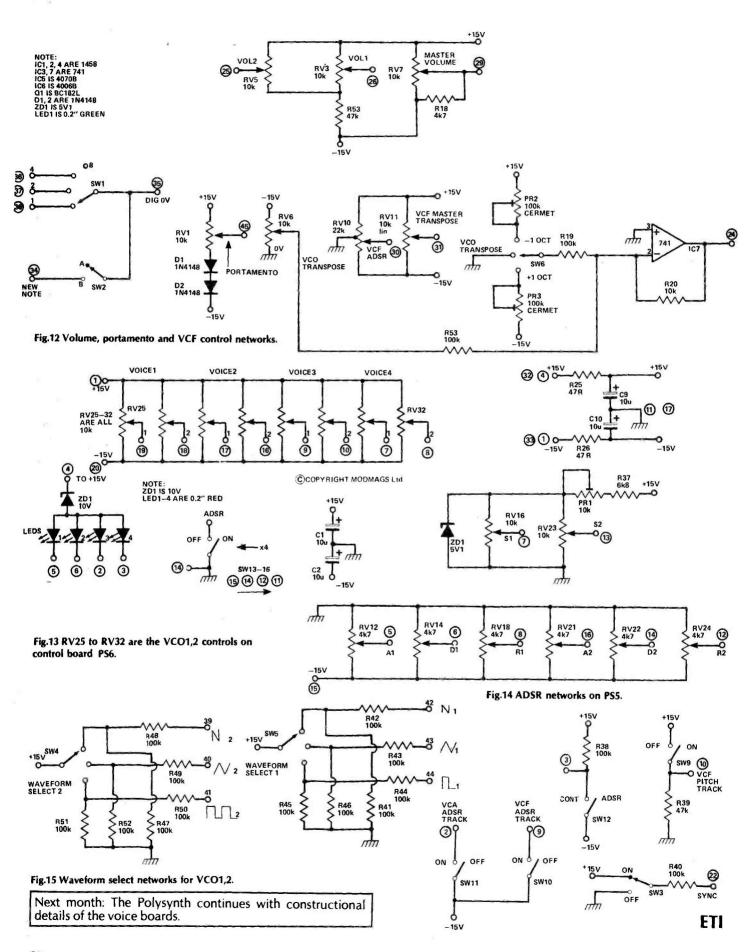


Fig.10 Component overlay of control board PS5.

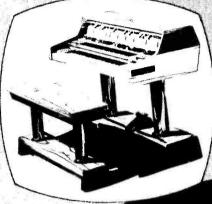








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2½"×1" pack at 5]
2½"×3¾"
2½"×5"
2½"×17"
53"
3¾"×5"
3¾"×17"
54,7"×17,9"
6,1" Pialaboard
100 strips
1 32.788KHz 74p 53p 62p £1.85 62p 88p £2.49 £3.14 £3.23 £9.95 £3.62 £3.92 £3.92 £3.92 £3.92 £3.92 190.0 KHz 200.0 KHz 204 8 KMz 262.144 KHz 307.2 KHz 312.5 KHz 455.0 KHz 0.1" Plainboard (no strips)
34"×2%" 38p
34"×5" 59p
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Pis issertien teel £1.28 £4.95 £3.62 £3.92 £4.25 £4.25 £3.62 £3.82 1.000 MHz 1.000 MHz 1.000 MHz 1.5 MHz 1.5 MHz 1.8 MHz 1.8432 MHz 1.8432 WHZ 2.000 MRz 2.097152 MHz 2.4578 MHz 2.500 MHz 2.50250 MHz 3.800 MHz 3.2768 MHz 3.2768 MHz 4.000 MHz 4.000 MHz 4.096 MHz 4.096 MHz 4.4304 MHz 4.400 MHz 4.500 MHz SOLDERCON PINS ID 50s 1000 E3.95

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SLR ELECTRONICS

The humble 35 mm SLR camera has changed a great deal in recent

years. Ian Graham investigates one aspect of electronics in photography, the development of camera

electronics.

he point and shoot' phenomenon was for many years associated with cheaper non-reflex cameras, designed to be idiotproof, with ease of film loading and exposure in mind. Now, however, most manufacturers have at least one automatic SLR(single lens reflex) model in their range.

The 35 mm SLR is the most popular and versatile camera type in use today. It's versatile, because a typical SLR offers a range of interchangeable lenses and matched add-ons — motor-drive, power winder, electronic flash, bulk film pack, databack, etc. Further, because the viewfinder shows the image seen through the lens, the effect of any lens can be seen immediately — the photographer sees what the film 'sees'.

Meter Manual

In a manual TTL (through the lens) meter, light passes through the lens and is reflected by a mirror up to a prism at the top of the camera and out through the viewfinder eyepiece. Photocells mounted on the prism measure the brightness of the incoming light. Film speed and, typically, shutter speed are preset by the photographer. Adjusting the aperture of the lens causes a needle visible in the viewfinder to move towards a + (over exposure) or a - (under exposure). When the needle is central, the film will be exposed correctly when the shutter release is pressed.

However, this system cannot be used to operate an automatic system. It's easy to see why. You switch on the meter and compose your picture. The automatic meter selects the appropriate shutter speed (in an aperture priority system). When you press the shutter release, the mirror up, it is not seeing the view through the lens any more. The end result is a wrongly exposed film. The answer is to provide some means of storing or remembering the meter measurement during the exposure. One method involves the use of a capacitor to store the meter



control voltage.

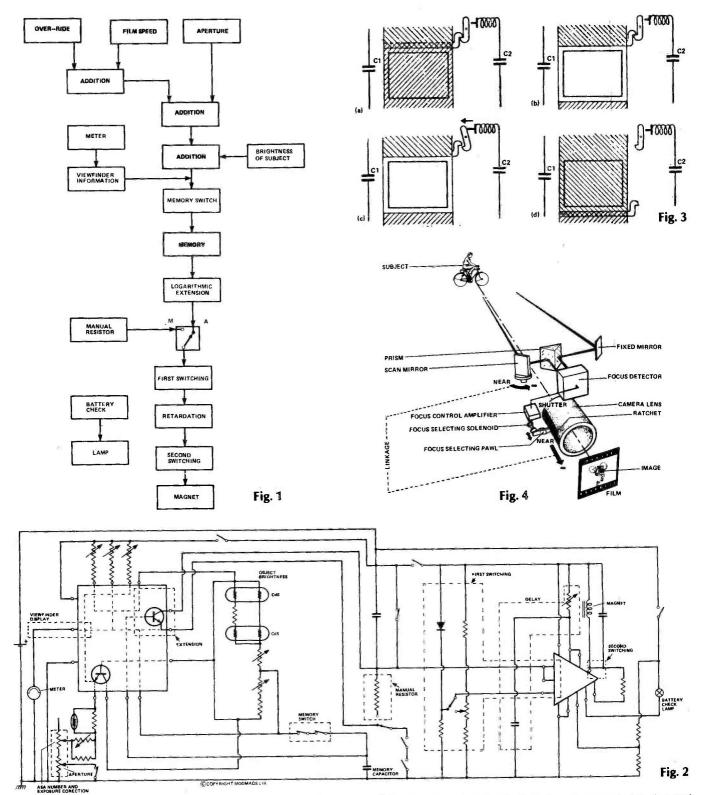


Fig. 1 Block diagram of the manual/automatic exposure control employed by the Minolta XE-1.

Fig. 2 Circuit diagram of the exposure control system used by the Minolta XE-1.

Fig. 3 Mamiya's moving coil electronic shutter consumes a tenth the power of electromagnetic systems. In addition, the consumption remains constant whatever the shutter speed. Up to 100,000 exposures can be made with one 6 V silver oxide cell. (a) The shutter is closed. The moving coil energising capacitor (C2) is normally charged. Current is not flowing. (b) The first blind moves, opening the shutter when the shutter release button is pressed. The exposure time control capacitor (C1) begins to charge. The latch holds back the second

blind. The charge time of C1 is determined by the shutter speed. (c) The instant of exposure. When C1 reaches a preset voltage, C2 discharges, energising the moving coil. This releases the second blind. (d) The second shutter blind moves, closing the shutter. C2 charges in a very short time, consuming very little power—ready for the next exposure.

Fig. 4 Konica developed the first self-focusing camera — the C35 AF. Light from the subject passes through two windows on the front of the camera on to two mirrors, one fixed and one moveable. When the shutter release is pressed, the moveable mirror turns until the two images coincide on the focus detector. A focusing control signal is then used to focus the lens correctly — all within 80 ms.

Direct Measurement

The Olympus OM-2 uses TTL metering, but its SBC (Silicon Blue Cell) sensors face the film, and so they measure the light actually reaching the film emulsion during the exposure. This makes the memory device used in other cameras obsolete. The OM-2's system doesn't have to remember its light reading, because the reading is taken during the exposure itself. Its advantage is that it can compensate for changes in light levels after the beginning of the exposure. By eliminating a memory device power consumption is reduced.

Also, in flash photography, the sensors can follow the flash intensity as it increases in fractions of 1/10,000 S and cut off the camera's flash unit when the correct exposure is reached. Of

course, a dedicated flash system is needed.

The OM-2 manages to combine centre and average exposure weighting. At high shutter speeds (over 1/60 S) the light level reading is taken from the shutter curtain. Its reflective coating pattern produces a centre-weighted reading. At lower speeds (below 1/15 S) the measurement is made directly from the whole film surface.

Logarithms

The shutter speed settings follow the simple geometric progression 1 S, ½ S, ¼ S, ... 1/250 S, 1/500S, 1/1000 S. If, for ease of calculation, we start with a meter circuit output of 0V1 and double it for each successive stop on the shutter speed dial, by the time we reach the last speed setting, the output voltage would be:

$$0V1 \times 2^{10} = 102V4$$

Because of the size, weight and expense of batteries, no camera can use a 100 V supply.

The answer is logarithmic compression of the voltage steps, so that the maximum power requirement is given by:

$$0V1 \times 10 = 1 V$$

In practice, most of the cameras available now derive their supply requirements from a single 6 $\,\mathrm{V}\,$ silver oxide cell or two 1V5 silver oxide cells.

Metering

One exception is the Konica FS-1, powered by four alkaline-manganese penlight cells. However, the FS-1 is no ordinary camera. It looks much the same as any other, except for the lack of a wind-on lever. It doesn't need one — it has its own built-in power winder, yet the combination is smaller and much lighter than a conventional SLR plus add-on winder.

The four size AA cells power the winder and camera electronics. The obvious advantage is that the photographer need carry only one spare set of batteries. Normally camera and winder batteries are not interchangeable.

Processing

The FS-1 employs a digital CPU (Central Processing Unit) together with support ICs to take care of light measurement, exposure calculation and motor control to provide total electronic control. The tiny CPU manages to pack in more than 1100 gates and 250 transistors, impossible to fit inside a camera just a few years ago.

Information from the Gallium Arsenide Phosphide photocell about the light level is compared with preset values for film speed and shutter speed to compute the appropriate aperture (f/stop). This analogue value is converted to a digital input for the f/stop register. The aperture information is also displayed in the viewfinder.

The Pentax ME Super has a wind-on lever, but no shutter

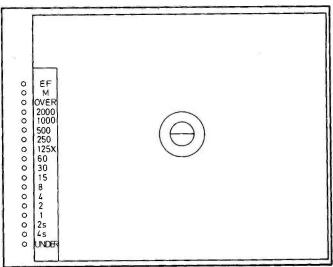


Fig. 5 The Pentax ME Super displays data by means of a three-colour line of LEDs. At 1/60 S and above, the speed selected by the camera will turn on the appropriate green LED. If you see green, it's OK to shoot. If the camera selects 1/30 S or below, the LED lit is yellow, warning you that, although the exposure is correct, there is a danger of blur due to camera shake. At each end of the scale there is a red LED to indicate under or over exposure. If exposure compensation is being used, a red EF LED comes on. Manual operation is similarly shown (green LED).

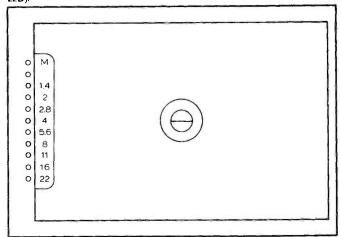


Fig. 6 The Konica FS-1 uses a simple all-red LED display to give details of aperture selected, underlover exposure, battery check, flash ready and manual mode.

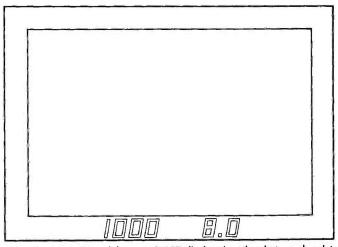


Fig. 7 The Canon A-1's alphanumeric LED display gives the photographer data on just about all the camera's functions — aperture, shutter speed, under/over exposure, flash ready, manual mode, B setting, out of range and operating error. There's even an automatic brightness control to match the display brightness to that of the image in the viewfinder.

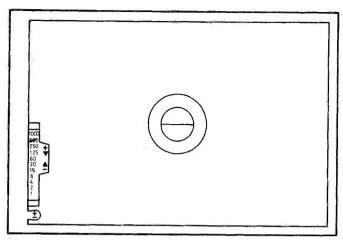


Fig. 8 The Olympus OM-2's bright viewfinder display shows the shutter speed by means of a needle on a scale. Information about under/over exposure, flash ready, exposure compensation, etc is also shown. When you switch to manual, the shutter speed scale disappears and you are left with the conventional needle display described earlier. When the camera is switched off, the viewfinder display disappears completely.

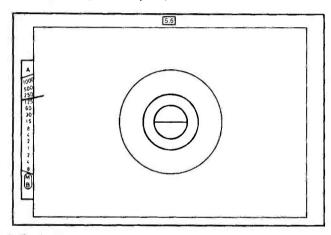


Fig.9 Like the OM-2, the Nikon FE's display of shutter speed is a needle-onscale type. The Silicon Photodiodes used in the FE are filtered to match the spectral response of the human eye.

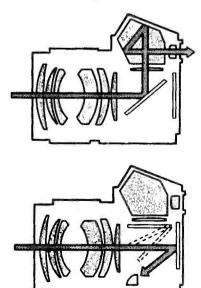


Fig.10 With the mirror in the down position (top), the Nikon FE looks much the same as any other camera, but when the mirror flips up (above) a light reading is taken directly from the film plane.

speed dial. In manual mode, shutter speeds are selected by pressing one of two buttons on the top of the camera — one causes the shutter speed selected to increase one LED at a time, the other causes it to decrease, until the desired speed is reached.

Multi-mode

Up to now I have been describing cameras using either shutter speed priroity or aperture priority. But, it is possible to have both. In fact, the Canon A-1 has no less than five automatic programmes:

- 1. Shutter speed priority useful for action photography.
- 2. Aperture priority useful if you know that your subject is not going to get up and run away.
- 3. Stopped down with the meter reading the light entering the lens, accessories which don't couple directly to the camera electronics can be used.
- 4. Programmed the camera decides the shutter speed and aperture.
- 5. Flash using a flashgun which couples directly to the camera electronics, automatic flash photography is possible.

The viewfinder alphanumeric LED display gives a complete run-down on just about everything. The A-1's self-timer allows selection of a 2 S or 10 S delay. As the timer is completely electronic, it can be cancelled at the touch of a button, unlike most mechanical self-timers.

The A-1 and the Nikon FE (an aperture priority model) both have a memory lock facility. Suppose you are photographing your loved one (or wife) against a bright window. Click — and there you have an interesting silhouette. The meter has exposed the film for the bright window, not for the subject.

With the A-1 and FE, you can take a correct exposure reading from the subject's face, turn on the memory lock and take the picture. The meter will 'remember' the correct exposure until the lock is turned off.

Screen Data

The information displayed in the viewfinder and the method of display varies enormously from camera to camera. Some give full alphanumeric data on everything. Others rely on a very simple three-LED system — red, green, red meaning under-exposed, correct and over-exposed (manual TTL system).

Typically, slight pressure on the shutter release button switches the meter on. Some cameras still use an on/off switch mounted on the camera body. If yours does, remember to switch it off! The first-pressure type is foolproof, even with an absent-minded photographer to contend with. Table 1 is a quick guide to a few popular automatic mode 35 mm SLRs, giving details of the camera's electronic systems. It is by no means exhaustive and is not intended to be used as a buyers' guide.

The space available for components and PCBs inside the camera is severely limited. Nowadays the circuitry is commonly mounted on and in flexible, paper-thin, plastic film PCBs, which can be wrapped round the familiar shape of the major features of the camera under the thin metal skin. The flexible tracks greatly reduce the number of flying leads and solder joints necessary. The fewer connections, the less chance there is of a broken wire or a dry joint.

Finally . . .

The microprocessor is only now beginning to make an impression on amateur photography, so the camera is probably at the simple four-function pocket calculator stage. Look what has happened to calculators in a very few years — LCD displays, programmable, sound effects, talking displays, etc. It will be interesting to watch how the designers transfer this kind of technology to cameras.

		ior		Table. 1 A comparison of SLRs with automatic pr		used by some popular 35 mn
Canero	Model	Viewinder Information	Studen	, Auto transi	e weet	<i>Qonet</i>
Canon	A-1	A-LED Aperture Shutter Speed Manual Override Flash Ready B Setting Over/Under Exposure Out of Range Operating Error	EHC	Aperture Priority Shutter priority Pre-Programmed Stopped Down Flash	TTL SPL) Centre Weighted Full aperture	6 V Silver Oxide Cell
Fujica	AX-5	LED Aperture Exposure Mode Over/Under Exposure Battery Check	EHC	Aperture Priority Shutter Priority Pre-Programmed Stopped Down Flash	TTL SPD & Centre-Weighted Full Aperture	6 V Silver Oxide Cell
Konica	FS-1	LED Aperture Flash Ready Over/Under Exposure Manual Override Automatic Mode Battery Check	EVM	Sharrer Priority	TTI GaAsP Centre Weighted Full Aperture	Four Alkaline- Manganese Cells
Minolta	XG9	Exposure LEDs Shutter Speeds	FHC	Aperture Priority	CdS Centre Weighted Full Aperture	Two 1V5 Silver Oxide Cells
Nikon	ft.	Shutter Speed Scale Aperture/Meter Needle	ÈVM	Aperture Priority	TTI SPD Centre-Weighted Full Aperture	Two 1V5 Silver Oxide Cells
Olympus	OM-2N	Exposure Index (Manual) Shutter Speed (Auto)	EHC	Aperture Priority	TTL ST SPD: 1- CdS Centre-Weighted Full Aperture	Two 1V5 Silver Oxide Cells
Pentax	ME Super	Aperture Shutter Speeds Exposure LEDs Over/Under Exposure Flash Ready	EVM	Aperture Priority	TTL GPD Centre-Weighted Full Aperture	Two 1V5 Silver Oxide Cells
ř			KE	Y:		
		Viewfinder Information Shutter	E — el H — h V — vo C — cl	ectronic orizontal ertical loth	D	
		Meter	SPD — GaAsP CdS —	metal Through The Lens Silicon Photodiode — Gallium Arsenic Cadmium Sulphide Gallium Photodio	le Phosphide	

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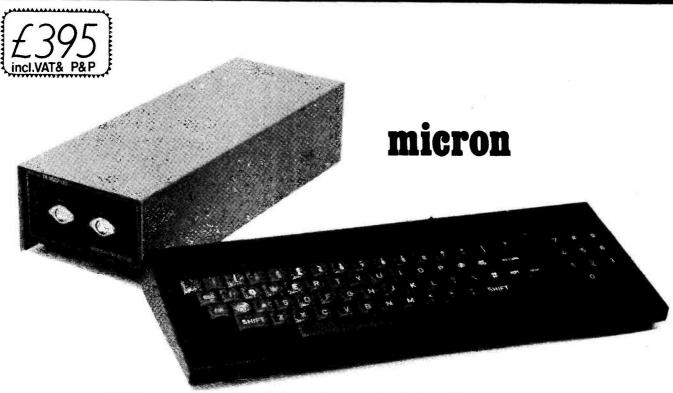
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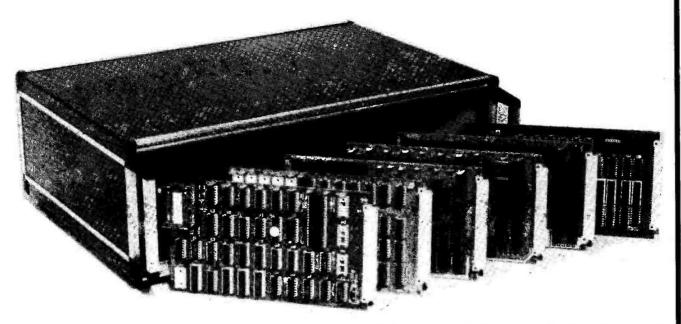
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The Microtan system is rapidly becoming accepted as the ultimate approach to personal computing. Start with Microtan 65, a 6502 based single board computer, and expand to a powerful system in simple and in-expensive stages. The Microtan system is a concept and not an afterthought, this means expansion is easy and very efficient! Unlike many other systems, you'll find it difficult to outgrow Microtan, and you won't be wasting your money on a product that will only last you a few months! When you are ready to expand, Tanex is waiting. The features offered by Tanex are tremendous, and you can start into them for just £49.45! Cassette interface, 16 I/O lines, two 16 bit counter timers, data bus buffering, memory mapping and a further 1K of RAM are standard. From thereon expansion is simple, just plug in extra integrated circuits to get yourself 8K of RAM, a further 16 I/O lines and two more counter timers a serial I/O line with RS232/20mA loop and full modem control, XBUG - a firmware package containing cassette file handling routines, plus a line-by-line assembler (translator) and dis-assembler, PLUS 10K EXTENDED MICROSOFT BASIC, a suped-up version of the Basic as used by major manufacturers such as Apple, Tandy and Nascom, NO OTHER LOW COST MICROCOMPUTER OFFERS YOU THIS SUPERB PACKAGE. O.K. so you want more memory, try Tanram for size! Upto 40K bytes on one board starting for as little as £50.60. RAM freaks will be pleased to hear that our system mother board offers page memory logic which will support 277K Bytes, satisfied? To house these beautiful modules you can choose between our mini-rack (as used on Micron), which accepts Microtan and Tanex, or our system rack pictured above. The system rack will support 12 modules. What are these extra modules? Well for starters there's a couple of I/O modules, parallel and serial offering upto 128 I/O lines organised as 16 8 bit ports and 8 serial I/O ports respectively. Shortly we'll be introducing high definition (256x256) colour graphics, A to D and D to A modules, IEEE 488 Bus interface, a PROM programmer, disc controller and TANDOS - a 6502 CPM system. So there's plenty to keep you busy. Send for more details, and find out how you can get started ALL PRICES QUOTED INCLUDE V.A.T. for just £79.35!

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_

TECH TIPS

Click Eliminator Auto Threshold

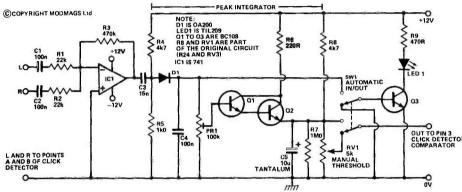
S.P. Cobbold, Cambridge

This circuit is designed to increase the versatility of the 'ETI Click Eliminator'. It automatically adjusts the threshold level for greater sensitivity during extended quiet passages, while

reducing the sensitivity during peak transient levels.

The left and right channels are added and amplified by the

operational amplifier IC1, which largely cancels the antiphase signals of the click. C1 and C2 decouple any DC offset voltage from the input amplifiers. D1 and C4 hold the peak level of the higher frequency audio signals and pass this to C5 through Q1 and Q2, giving a rise time of



approximately 3 mS and a hold time of the order of 5 S. No buffer is required for C5 as the comparator of the click detection circuit has a JFET input. R4 and R5 bias the peak integrating section to give a minimum of approximately 0V5 on C5 when the preset PR1 is adjusted for optimum click detection. This adjustment is best performed using a badly scratched record (borrow a friend's if necessary) and setting PR1 to the point where the loudest click is just removed from a section of loud music.

Q3 and LED1 give a visual indication of operation by changing from dull to bright with the music signal when switched to automatic.

It can be seen from the rise and hold times of the peak integrator that large transients in the middle of a quiet passage (eg a cymbal crash) may cause a single inappropriate click detection before the integrator charges up. Conversely, a series of clicks in very rapid sucession may be ignored. However, I have found these two faults far more acceptable than the severe distortion caused by repeated spurious click detection when unexpectedly high transient levels pass the manually set threshold.

Shop Doorbell

R. Gamester, Chesham

This unit was designed to give a remote indication of a shop door opening. The bell rings once as the door opens and a flashing LED indicates that the door is open. To prevent the unit being repeatedly triggered, a time

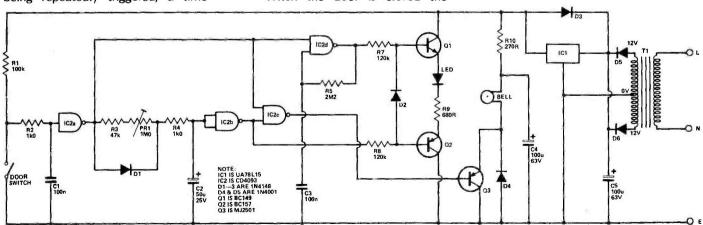
delay operates from the closing of the door for a period of 20-30 S, during which time the LED is constantly illuminated.

When the door opens, C2 charges quickly through D1 and IC2b turns Q2 on. The oscillator (IC2d) is running and interrupts the LED by switching Q1 on

When the door is closed the

oscillator is stopped, leaving Q1 on. This gives a constant indication until C2 discharges through R3, PR1 and R4.

The bell is a standard 3 V vibrator type and is powered by C4, this being discharged through the armature by Q3. IC2c generates the drive pulse, its duration being the charge time of C2.



Tech-Tips is an ideas forum and is not aimed at the beginner. We regret we cannot answer queries on these items. ETI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for. Drawings should be as clear as possible and the text should preferably be typed. Circuits must not be subject to copyright, Items for consideration should be sent to ETI TECH-TIPS, Electronics Today International, 145 Charing Cross Road, London WC2H 0EE.

Simple Combination Lock

M.D. Chapman, Sale

Although this circuit uses surprisingly few components, the unit provides up to nine code elements and a billion-toone chance of random operation.

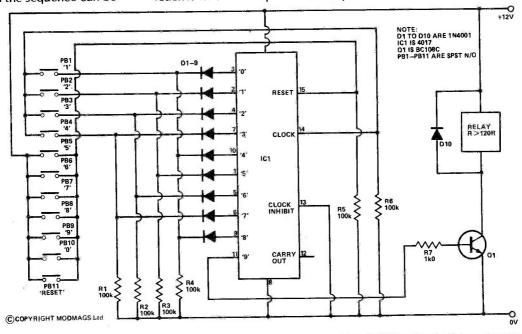
The first nine outputs of the decade counter (IC1) are fed via the diode OR gates (one for every different number used in the code) to the selected switches. As shown on the circuit diagram the combination sequence is 123412341. However, both the numbers and the sequence can be

modified by rewiring the output diodes (D1-9) to different switches. To change the number of active code switches (ie. numbers 1234 in this case), you will have to either remove or add to the number of diode OR gates.

Operation is very simple. As the counter sequences through its outputs 0-9 it provides a logic 1 to one of the four diode OR gates, thereby making one of the active switches live. When this live switch is pressed it provides the clock pulse to increment the counter one step. This, then, provides a logic 1 to the next OR gate, making the next digit in the code live, which in turn, when pressed, provides the next clock pulse and so on until the counter reaches its tenth output. Once output

nine goes high it turns on Q1, therebyswitching the relay and desired load. Since only one of the outputs is high at any one time, only one of the keys will move the counter and, should any dud key (ie. keys 567890 in this case) be pressed, this will reset the counter to zero, making guesswork ineffectual.

When selecting the code sequence, it is worth remembering that in order to maintain a nine element code the effect of switch bounce should be minimised by avoiding the use of any number consecutively, ie. codes such 123343222. However, if necessary, the clock input can be debounced to allow such a sequence.



5 V TTL Supply

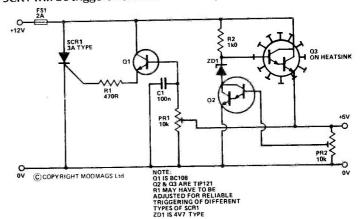
D. McIntyre, Camberley

The circuit shown was designed to eliminate expensive accidents with TTL caused by inadvertently turning up the knob on the (heavily smoothed) train controller normally used as a bench PSU. It is provided with crowbar protection just in case, though.

Power Darlington Q3 is biased to just over 5 V by ZD1 and Q2 (this does not have to be a Darlington, although the output will not be as stable if it is not). Any change in output voltage is sensed by Q2 and it adjusts ZD1's reference level accordingly. Any change in input voltage is adjusted by normal zener operation. The output level may be set using PR2 and it will

remain fairly stable ($\pm 0V5$) for a change in input from 8 V to 12 V. If, for some reason, the output voltage should rise above the preset level to, say, 6 V, SCR1 will be triggered and the

fuse will blow. This trigger level may be set by PR1. C1 reduces the (extreme) sensitivity to noise. SCR1 is not critical, but it should be capable of sinking the required current.

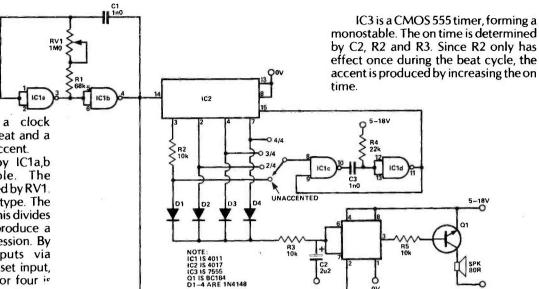


Accenting Metronome

P. Hill, London

The circuit consists of a clock generator determining the beat and a monostable producing the accent.

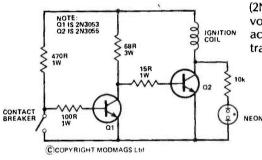
The clock is formed by IC1a,b configured as an astable. The frequency or tempo is adjusted by RV1. C1 must be a non-polarised type. The clock pulses are fed to IC2. This divides and decodes the clock to produce a high at each output in succession. By feeding one of the outputs via monostable IC1c,d to the reset input, division by one, two, three or four is possible, thus selecting the beat.



Contact Breaker

E. P. Young, Plymouth

The contact breaker carries a mere 25mAwhen the ignition coil is charging up for the induction of high voltage to produce a spark in the spark plug. Further, without the induced EMF across the CB from the primary winding of the ignition coil, the life of the CB will be greatly increased.



A cheaper power transistor (2N3055) is chosen instead of the high voltage type. A neon bulb is used across collector-emitter to protect the transistor from a high induced EMF.

Simple VCR

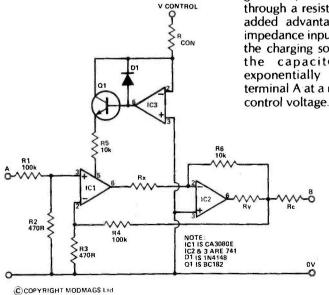
S. Draper, Sudbrooke

This circuit is a simple voltage-controlled resistor, which may be used in a variety of applications (it was originally designed as a portion of a voltage-controlled envelope generator). It has two big advantages over the often-used FET type circuit—a large control range (10,000:1) and a predictable voltage-current characteristic.

The voltage differential between terminals A and B is amplified and converted to a current by OTA IC1, the gain of which is controlled by the current flowing into it at pin 5. The resulting current is fed to current multiplier IC2, which multiplies it by a factor of R_X/R_y and feeds it to terminal B. This means that the current flowing into or out of terminal B is proportional to the voltage difference between terminals A and B and to the control current generated by voltage-current converter IC3.

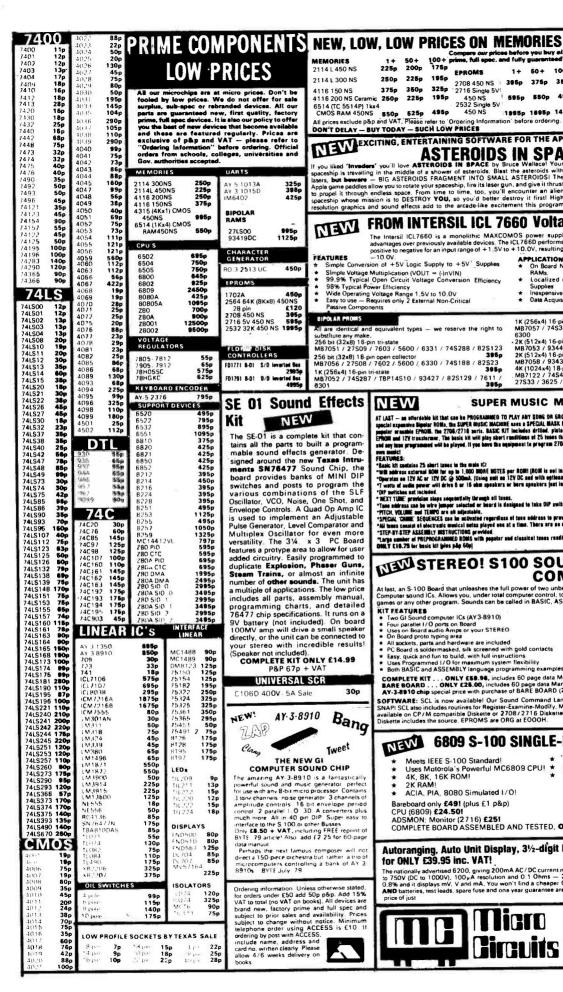
The formula for the circuit resistance is as follows:

$$R = \frac{200R_{CON}R_{Y}}{19.2V_{CON}R_{X}} + Rc$$



This means that with a constant applied voltage, the output current will be proportional to the control voltage and the effective resistance is inversly proportional to same.

In circuits such as an envelope generator, where a capacitor is charged through a resistor, this circuit has the added advantage of having a high impedance input and so does not load the charging source. In this example, the capacitor would charge exponentially to the voltage on terminal A at a rate determined by the control voltage.



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ELECTRONICS TOMORROW

SPECTRAL OUTPUT INPUT DATA **Dave Raven of Metac Electronics reports** on the development and applications (FOCAL LENGTH) of Surface Acoustic APERTURE 1 Wave devices. ACOUSTO -OPTIC BRAGG CELL COLLIMATION RF INPUT Fig. 1 An integrated optical spectrum analyser incorporating an acousto-C)COPYRIGHT MODMAGS Ltd optic Bragg cell. MPLIFIE MIXER LOCAL OSCILLATOR

t was at HMS Vernon (the Royal Navy's experimental station at Portsmouth) that wireless staff produced the first "Tuned Shunts" receiving circuit at the beginning of the 1900s. Ever since there has been an increasing demand for higher frequency tuners, filters and delay lines. Surface acoustic wave (SAW) devices have been with us now for over 10 years and are in common use for colour television receivers. They can be incorporated in bandpass filters for radio-frequency receivers, TV intermediate-frequency amplifiers and frequency synthesisers. Others serve as dispersive delay lines in linear frequency-modulated chirp radar, microscan receivers, as tapped delay lines in biphase-coded waveform generators and correlators and as convolvers with memory and programmable matched filters. Most of the applications for SAW devices occur in the high-frequency range. Crystal and LC filters both overlap the bandwidth and frequency range of SAW filters.

However, in the frequency region of 30 to 500 MHz and bandwidth range of 0.1% to 30% only SAW filters simultaneously offer reproducibility, reliability, low cost, selectivity and small size. The techniques used for producing SAW devices are similar to other solid-state devices so that low cost and high repeatability can be achieved. Once the mask has been designed, filters from one production to the next can be easily produced with identical characteristics. On the other hand, LC and discrete crystal filters require laborious tuning procedures.

Under The Surface

Until recently most SAW devices were fabricated on two particular substrate materials, lithium niobate and ST-cut quartz. Lithium niobate can achieve a large coupling coefficient but it has poor temperature stability. Frequency shifts are — 90 parts per million per °C. So it is used mostly for wider fractional bandwidth devices. A reasonable range of bandwidths is from 3% to 50% of centre frequency.

Quartz has a zero temperature coefficient at room temperature, but a low coupling coefficient. Minimum loss filters can be fabricated for bandwidths below 4%. Wide band devices are less desirable in quartz due to the much higher insertion loss. The physical constraints of the size of the substrate rule out filters at low frequency. A filter with a 100 MHz centre frequency, 40 dB side lobes, and a 0.1% bandwidth would require a four inch long substrate.

Thin Films

When comparing the fabrication of SAW devices to other solid-state devices, it should be pointed out that single crystal piezoelectric materials are not as easily produced in the same manner as, say, silicon slices for microchip production. The surface states of these materials are critical and, to enable cheaper volume production of SAW devices, development work is being carried out to produce thin film piezoelectric material. Research at Nottingham University in the Department of Electrical and Electronic Engineering is being carried out on

producing thin film piezoelectric materials. One such material, zinc oxide, is of particular interest.

In addition to producing SAW devices it is possible to exploit both the optical and piezoelectric properties of zinc oxide. Work at Nottingham on producing thin film material using silicon with a layer of zinc oxide sputtered onto the surface has further shown that high quality device structures can be produced. Suggested applications are integrated optical spectrum analysers, acoustically scanned image devices, convolvers with surface controlling junctions and storage correlators. One other piezoelectric material which showed promise was gallium arsenide. Work has been carried out to produce a tapped delay line and, incorporated on the same slice, a field effect transistor which could be modulated by the surface acoustic wave.

Integrated Optics

The development of electro-optical components is a major new area for thin film technology and during the next 10 years integrated optics will become as familiar as integrated electronic circuitry. Once again it is at the materials stage that most of this work is taking place and it will be largely determined by the fabrication techniques and suitable film structures. It has been known for some time that techniques normally used in the production of electronic devices can also be used to form optical waveguides and components. The waveguiding is based on the creation of a localised region having a higher refractive index than the surrounding medium, leading to modes of propagation in which the light undergoes total reflection at each interface. Here once again, gallium arsenide is a promising material for the development of integrated optics and, as with attempts to combine an acoustic device with an electrical one, gallium arsenide fulfills the vast majority of requirements for optical circuits, in the emission and detection of light as well as modulation and guiding. Further, it should be possible to integrate the optics and electronic circuitry.

The Generation Game

Integrated optics can best be described as a kind of secondgeneration optical fibre telecommunications. The first generation employs multimode fibres and electroluminescent diodes. The evolving field of integrated optics combines singlemode fibres with laser diodes to increase information handling capacity, with control also at the optical level. The basic building blocks for an integrated optical circuit have reached an advanced state of development, where complete circuits are being attempted.

As always in high technology, a major role for integrated optics is seen in electronic warfare. An integrated RF spectrum analyser is used to detect RF pulsed signals from a dense signal spectrum. A leading application of integrated optics is in coherent optical signal processing. One approach to an integrated optical spectrum analyser incorporates most of the techniques discussed throughout the article, a piezoelectric zinc oxide transducer and integrated optics. A radio frequency signal is mixed with a coherent optical-signal carrier in a device known as an acousto-optic Bragg cell. The heterodyned RF signal is converted by a transducer into a surface elastic wave that travels through the Bragg cell. The wave alters the refractive index, producing a grating effect that deflects the optical beam. An array of photo detectors provides individual responses for each frequency—resolution cell.

SAW devices and integrated optics promise some very exciting developments in the next decade and once again it demonstrates how important and closely related the whole subject of physics is to electronics.

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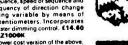
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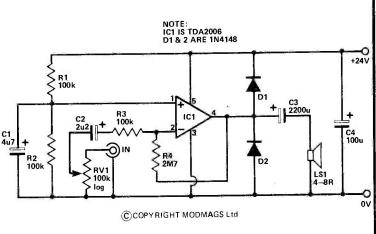


8 Watt Audio Amplifier

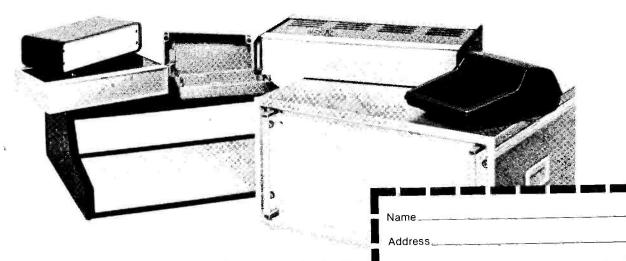
Using a modern audio power amplifier IC, it is easy to produce an amplifier giving several watts of output with quite good quality. This amplifier is based on the TDA2006 and gives about 8 W RMS into an 8R speaker, or 12 W when using a 4R load. At most output powers the distortion is typically only a fraction of one percent, but it does rise significantly at higher output levels.

The TDA 2006 is in many ways like an operational amplifier, but it has a class B power output stage. In this circuit it is used in the inverting amplifier mode with R1 and R2 forming a potential divider that biases the non-inverting input to half the supply voltage. C1 filters out hum and noise which might otherwise be coupled from the supply lines to the non-inverting input via the bias circuit. The inverting input is biased by R4 and together with R3 this resistor forms a negative feedback circuit, which sets the voltage gain and input impedance of the amplifier. As would be the case with an operational amplifier, the voltage gain is equal to R4 divided by R3 and the input impedance is equal to R3. With the values shown this gives a voltage gain of 27 times and an input impedance of 100k. However, within reason these figures can be modified by changing the values of R3 and R4. RV1 is the volume control and does of course shunt the input impedance of the circuit as a whole (down to as little as 50k with the specified values).

As the TDA2006 has a supply ripple rejection ratio of 50 dB, it is not essential to use a very well smoothed supply, but it is important that the device's 30 V maximum supply voltage rating is not exceeded. The maximum average supply current is a little over 500 mA when using an 8R speaker and about 800 mA when using a 4R load. The TDA2006 should be mounted on a substantial heatsink, but has thermal shutdown circuitry, which protects it against overheating. It also incorporates output current limiting circuitry.



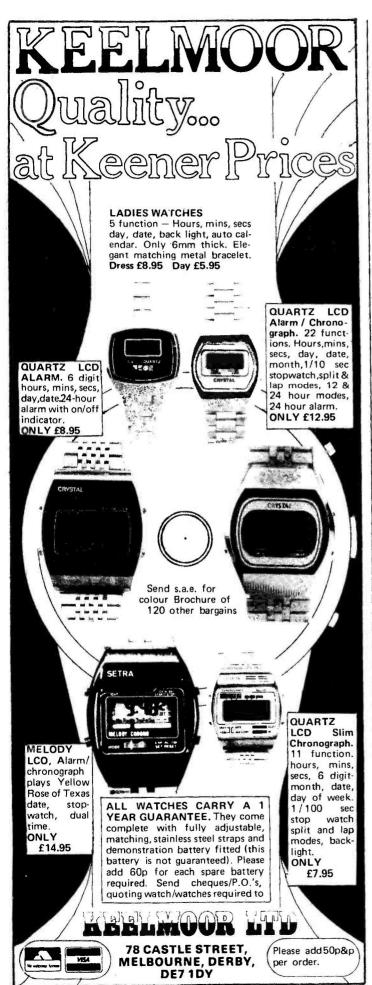
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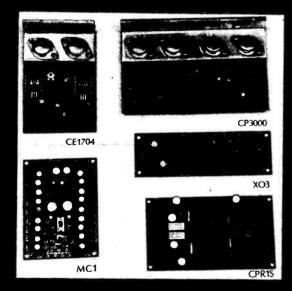
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SPECIFICATIONS

CE 608	38		CPS1	50mm	30 V / 15	110dB	775mV	0 0035%	1 5Hz 50Khz (3dB)		120 : 25
CE1004	44	70	CPS3	100mm	30V145	110dB	775mV	0 0035%	1 5Hz 50Khz i 3dB)		· 120 · 25
CE 1008	65		CPS3	100mm	30V/u5	110dB	775mV	0 0035%	1 5Hz 50Khz (3db)		120 - 25
CE 1704	85	121	CPS6	150mm FM1		110dB	775mV	0 0035%	1 5Hz 50Khz (3dB)		· 120 · 25
CE1708	125		CPS6	150mm FM1		110dB	776mV	0 0035%	1 5Hz 50Khz 1 3dB1	80	· 120 · 25
CP3000	12.5	250	CPS6	FM2	MVAS	110dB	775mV	0.0035%	1 5Hz 50Khz (3dB)	161	102 - 35
CPANS	Output	11mV	REG1		3VAIS	70ctB	2 8mV RMS	0 008%	20Hz 20Khz	138	BO - 35
MCNES	Output	2mV	DEC.			65/1R	70mV 150	0.008%	20Hz 20Khz	80	· 120 · 35
XO2 XO3	Qutpul	775 2500mV	REGI		94.45	90dB	775mV	0.01%	C over points are set	150	50 20
*Powe	r output i	hetoup a	WRM	S and is a	iven for	two m	odules run	off the sa	me power supp	ply.	Higher
					D C	II arif.	ueina a etah	iliond D S	11		-

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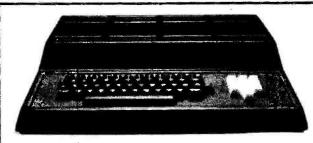
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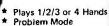
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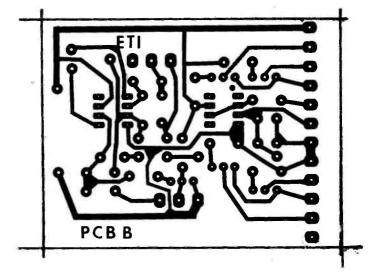
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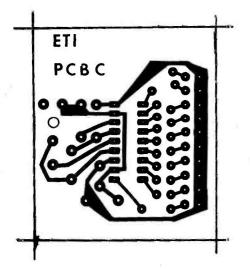
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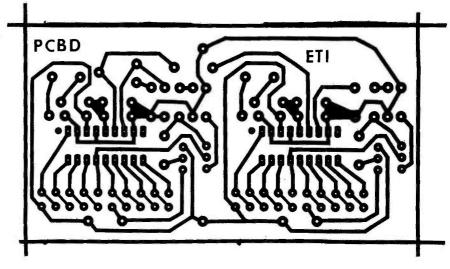


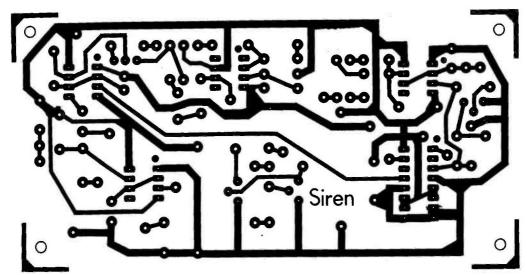
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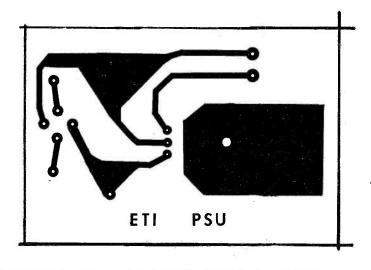


The FM Tuner boards B (above), C (left) and D (below).

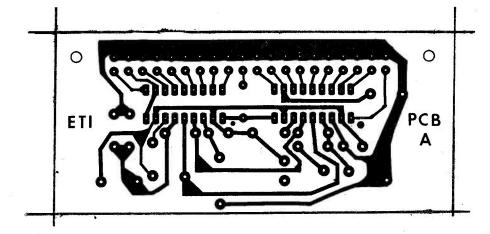


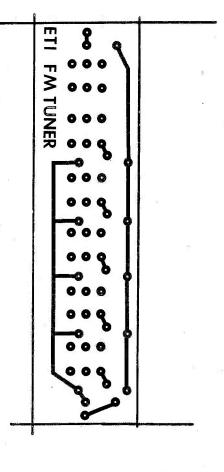


(Above) Multi-Option Siren.

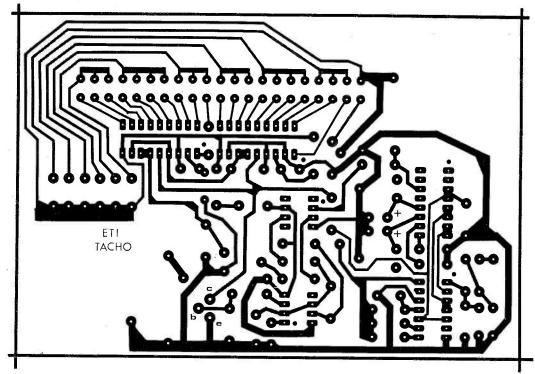


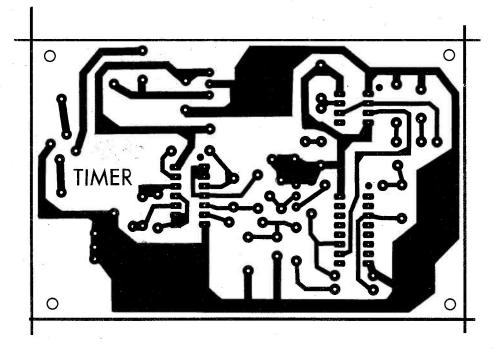
The FM Tuner PSU (above), switch assembly board (right) and PCB A (below).





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nF 9p; 330 nF 10p; 470 nF 11p; 680 nF	TBA 810S 110p	DIL SOCKETS	4516/8	105p	74105	43p	BC117	23p	BF224B	14p	ZTX504 24p
12p; 1uF 14p; 1.5 uF 16p; 2.2 uF 20p; 3.3uF 15p*; 4.7uF; 15p*	ZN414 90p ZN1034E 220p	8 pin *8p	4520/8	105p	74107	22p	BC140	20p	BF244B	*22p 26p	2N696/7 20p 2N698 20p
J.Sur teha, 4.701. Teha	21110045 220p	14 pin ★9p	TTL	40.	74109 74110	34p 40p	BC142/3	30p	BF25B BF259	40p	2N706 14c
ELECTROLYTIC CAP (uF/V)	DIODES	16 pin ★10p	7400/1	16p	74110	84p	BC147/8 BC149	10p	BFR39	30p	2N914 20p
1/25 to 47/25 6p ; 68/25 7p ; 100/35,	OA47 8p	18 pin 16p	7404/5	16p	74121	25p	BC157#8	12p	BFR40	20p	2N918 35p
150/25 8p; 160/25: 5p*; 200/12:	OA91 7p	22 pin 20p 24 pin 21p	7406	18p	74122	30p	BC159	12p	BFR79	32p	2N1302/3 35p
6p; 250/12 7p; 220/25 10p; 470/25. 500/30 10p*; 470/40 mini 15p;	OA200 6p	28 pin 25p	7407	25p	74123	50p	BC167	14p	BFRBO	20p	2N1304 35 p 2N1306 30 p
640/16: 8p : 1000/10 8p *: 1000/25	OA202 9p	40 pin 35p	740B	22p	74125/6	42p	BC169C	13p	BFX29 BFX84	25p 25p	2N1308 35
24p: 1500/25: 24p*; 2200/6.3 10p*	1N916 5p		7409	13p	74132 74141/5	65p	BC171 BC173	10p	BFX85/6	20p	2N1613 25
ZENER DIODES (400mW)	1N4001/2 4p	THYRISTOR C106D 40p	7410	13p	74150	85p	BC177/8	16p	BFX87/8	25p	2N1711 13p
2V7 to 33V 8p	1N4003 5p	(4A/4000V)	7413	21p	74151	65p	BC179	16p	BFX88	25p	2N1B93 25p
VEROBOARDS (.1" copper)	1N4004/5 6p		7414	45p	74153	43p	BC1828	10p	BFY50/1	20p	2N2217 16; 2N2219 23;
2 5" x 5" 65p 3.75" x 5" 75p	1N4006/7 8p	CMOS AE	7416	20p	74154	66p	BC1B2L	*8p	BFY52	22p	2N2219 23 ₁ 2N2222A 23 ₁
RESISTORS (5% E12)	1N5400 13p 1N5401 14p	4000 16p 4001B 20p	7417	25p	74155 74156	46p 42p	BC183B BC184	10p	BRY39 BSX19	12p	2N2369 17
10 Ohms to 10 Mohms 1.5p	1N5401 15p	40018 16p	7420 7421	*14p	74157	36p	BC186	25p	BSX20	22p	2N24B4 25
PRESETS (.15W HORIZONTAL)	1N5404 16p	4006B 75p	7422	26p	74160	57p	BC187	15p	BU205	150p	2N2646 46
100 Ohms to 2 Mohms 7p POTENTIOMETERS (1/4W)		4007 ★16p	7427	20p	74161	65p	BC207/9	13p	BU 20B	210p	2N2904/5 21 2N2906/7 21
Linear & Log Scales	BRIDGE	4008 65p 4009 42p	7428	28p	74162/3	60p	BC212	10p	MJ2955 MJE340	110p 52p	2N2906/7 21 ₁ 2N2926G 10 ₁
4K7 to 2M2 33p	RECTIFIERS WO2M 20p	4009 42p	7430	16p	74164/5 74166	56p 95p	BC212L BC213L	*8p	MJE2955	110p	2N3053 20
LF356N 85p	W06M 30p	4011B 20p	7432 7433	28p 38p		110p	BC213L	10p	MJE3055	80p	2N3054 40
LINEAR LM301AN 30p	1A/50V 22p	4012 25 p	7433	14p	74174/5	55p	BC214L	*8p	MPF102	45p	2N3055 45
CIRCUITS LM308N +38p	1.5A/75V 22p	4013B 45p	7438	18p	74176/7	70p	BC238	18p	MPF104/5		2N3442 140 2N3702 to
709-8 28p LM318N 120p 710-14 35p LM318H 120p	1A/200V 32p 1A/400V 34p	4014/5B 80p 4016 44p	7440	13p	74180	35p	BC261B	23p	MPF 106 MPSA06	45p 26p	2N3702 to 2N3711 11
710-14 35p LM318H 120p 741-8 22p LM324N 57p	1A/400V 34p 2A/100V 40p	4016 70p	7441	52p	74181 74182	60p 45p	BC301/3 BC328	32p	MPSA56	26p	2N3772 *80
747-14 50p LM339N 52p	2A/400V 55p	401B 85p	7442	60p	74190	50p	8C33B	17p	MPSU06	60p	2N3773 250
748-8 35p LM348N 90p	3A/100V 55p	4019 50p	7444	100p	74191	90p	8C461	40p	OC28/35	92p	2N3B19 21
CA3018 70p LM377N 175p	3A/600V 65p	4020B 100p	7445	64p	74192/3	50p	8C477	35p	TIP29	40p	2N3B20 40 2N3B23 70
CA302BA 85p LM3B0N 90p CA3046 50p LM3B1N +120p		4021/2 95p 4023 22p	7446	65p	74194	70p	BC478	20p	TIP29B	42p 40p	2N3B23 70
21.0054	VOLTAGE REGULATORS	4023 22p 4024B 55p	7447A	50p	74195 74196	68p	BC479 BC547/8	23p 12p	TIP30B	42p	2N3903/4 15
CA3054 40P LM382N 120p CA3080E 75p LM1310N 115p	7805 70p	4025 20p	744B 7450	52p	74190	45p	BC54778	12p	TIP31A	+30p	2N3906 15
CA3130E 90p LM1458N #40p	7812/15 70p	4027 50p	7451/3	13p	74198	120p	BC557/8	14p	T!P32	40p	2N4037 45
CA3140E 40p LM3900N *50p	7818/24 70p	4028 70p	7454	10p	74199	90p	BC559	14p	TIP33	65p	2N5457/8 40
CA3090AQ LM3909N 75p	7905 80p	4029 90p	7460	13p	TRANSIST		BCY70	18p	TIP33C	70p	2N6027 30 3N128 50
#200p MC1496P 80p	7912/15 80p 7918/24 80p	4030 55p 4035 110p	7470	20p	AC126/7	22p 20p	BCY71/2 BD115	18p 58p	TIP34A TIP35B	75p 200p	2N5459 40
LF351N 44P NE531 120p			7472	19p	AC128				CA3090A		-
MINIMUM 4001B 15p 4016			.5p ZD5V Sp ZD9V					16V 3p	SN76115		
25 PCS 4007A 13p 4017A FACH 4011B 15p 7420	40p 7490 13p 0A91	23p 1N4007 5.5p 1N5404	6p ZD9V BF24						680nF po		
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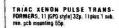
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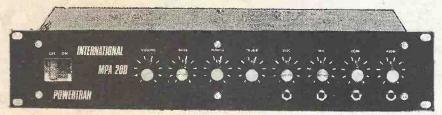
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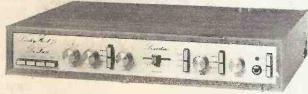
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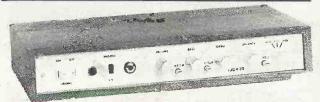
SYNTHESIZER KITS ON PAGE 8. MORE KITS AND ORDERING INFORMATION ON INSIDE FRONT COVER.



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0/40	.023	1000/16	.06
22/25	.023	2200/40 #	.32
17/25	.025	*8mm 16mm	
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. c.c cge.			
1/100/7.5	.024	.033/250/10	.028
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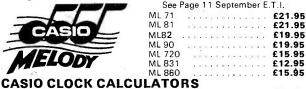
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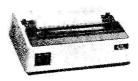
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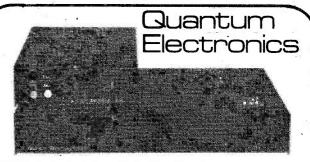
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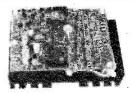
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ETI ADVERTISEMENT INDEX

AITKEN BROS	86
ALTEK INSTRUMENTS	42
AMBIT INTERNATIONAL	53
AMBIT INTERNATIONAL AUDIO ELECTRONICS 14, 28 & AURA SOUNDS	42
AURA SOUNDS	85
BAYDIS	33
BI-PAK SEMICONDUCTORS	48
DIVELECTIONISCO	/ 1
BNRS	41
BOSS INDUSTRIAL	47
BUTTERWORTHS	76
CALCULATOR SALES & SERVICE 1	116
CAMBRIDGE LEARNING	69
CASTLE FLECTRONICS	16
CHILTMEAD	61
CHORDGATE 1	116
CHROMASONICS 46 &	47
CHILTMEAD CHORDGATE CHROMASONICS CHROMATRONICS CLEF PRODUCTS CHROMATRONICS CLEF PRODUCTS CLEF PRODUCTS CHROMATRONICS CLEF PRODUCTS CLEF P	7
CLEF PRODUCTS	14
CODESPEED	החו
COMP. COMP. COMP 122 & 1	23
COMP, COMP, COMP . 122 & 1 CRIMSON ELEKTRIK 1 CROFTON ELECTRONICS 1	07
CROFTON FLECTRONICS 1	17
C.S.C	30
DELTA TECH & CO 1	13
DISPLAY ELECTRONICS	40
DORAM ELECTRONICS	75
EDA	23
FLECTRONIZE DESIGN	12
ELECTRONIZE DESIGN ELECTRO SUPPLIES	60
FI FCTROVALUE 1	00
ELECTROVALUE 1 EXPERIMENTAL ELECTRONICS 1	12
GENERAL NORTHERN MICROCO	12
PUTERS	
GREENBANK	92
GREENWELD 1	16
GREENWELD	60
MEATH ELECTRONICE	90
HEATH ELECTRONICS HENRY'S RADIO 52, 60, 1	00
ICE 52, 60, 1	01
ICS 20, 21,	93
VEELMORE ITS	/0
KEELMORE LTD 1 LB ELECTRONICS 1	U6
LD ELECTRONICS 1	19

INICIALITADEY	
L&BELECTRONICS 100	6
LINSAC 10	7
MACLIN-ZAND	7
MANOR SUPPLIES 10	7
MARSHALLS 5	•
MAPLIN 12 MARSHALLS 5 MAYWARE LTD 7 MICROCIRCUITS 9	'n
MICROCIRCUITS	6
MICRODIGITAL 14	1
MICROTYPE 108	2
MINKITS 70	,
MINIM AUDIO 93	2
MITRAD 34 & 3!	
MOUNTAINDENE	
NIC MODELS	,
PARNDON ELECTRONICS 112 T POWELL 93	•
T DOMELL	2
T. POWELL 93 POWERTRAIN 2, 8 & 115	2
DDOCDESSIVE DADIO 11	,
DDOTON ELECTRONICE 113	•
PROGRESSIVE RADIO 114 PROTON ELECTRONICS 113 QUANTUM ELECTRONICS 118	,
RAPID ELECTRONICS 100	`
I M DIRARED	,
J. W. RIMMER 76 RISCOMP LTD 76	•
DIVO	'
R.T.V.C	′
SAXON ENTERTAINMENTS 100 SCIENCE OF CAMBRIDGE 4 & 5	'
SCIENCE OF CAMBRIDGE 4 & S	•
SILICA SHOP 108	5
SURETRON SYSTEMS 118 SWANLEY ELECTRONICS 117	5
SWANLEY ELECTRONICS 117	
TANGERINE 94 & 95	•
TECHNOMATIC 26)
TEMPUS 56	į
TIMEDATA 113 TK ELECTRONICS 104	,
TK ELECTRONICS 104	ŀ
TRANSAM COMPONETS 12	
UNILAB 113	
VIDEOTONE 25	j
WATFORD ELECTRONICS 6 & 7	
WEST HYDE DEVELOPMENTS 105	
WILMSLOW AUDIO 108	,
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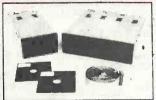
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