

electronics today

ISSN. 0142-7229

INTERNATIONAL

JANUARY 1981 60p

**ELECTRONICS IN
PHOTOGRAPHY**
an in-camera examination

**High-Quality
FM Tuner
Project**

**Universal
Digital
Tacho**

**Computer
Interface—
Micro to
Mainframe!**

**Astable
Design—
A Fresh
Approach**

**OVER
20
CIRCUITS
TO BUILD
INSIDE!**



...NEWS... PROJECTS... MICRO...

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**

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 to spread their purchase or build a personalised system the kit is available as separate packs eg. PCB (16" x 12.5") £43.20. Pair of keyboards £34.80. Firmware in EPROMS £30.00. Toroidal transformer and power supply components £17.60. Cabinet (very rugged, made from steel, really beautifully finished) £26.50. P.S. Will greatly enhance any other single board computer including OHIO SUPERBOARD for which it can be readily modified. Other packs listed in our 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 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

8K Static RAM board

Fibre glass double sided plated through hole PCB 5.6" x 4.8" **£12.50**
Set of components including IC sockets, plug and socket but excluding RAMs **£11.20**
2114L RAM (16 required) **£5.00**
Complete set of board, components, 16 RAMS **£89.50**

8K ROM board

Fibre glass double sided plated through hole PCB 5.6" x 4.8" **£12.40**
Set of components including IC sockets, plug and socket but excluding ROMs **£10.70**
2708 ROM (8 required) **£6.00**
Complete set of board, components, 8 ROMs **£68.50**



2 MICROPROCESSORS

Z80 the powerful CPU with 15B instruction, including all 7B of the 8080, controls the MM57109 number cruncher. Functions include +, -, ., /, squares, roots, logs, exponentially trig functions, inverses etc. Range 10⁻²⁰ to 9 x 19²⁰ to 8 figures plus 2 exponent digits.

EFFICIENT OPERATION

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

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.

**COMPLETE KIT
NOW ONLY
£225 + VAT**

★ ETI VOCODER ★



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 plug! Kits also available as separate packs — See our Free Catalogue.

POWERTRAN

**OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!
POWERTRAN ELECTRONICS**

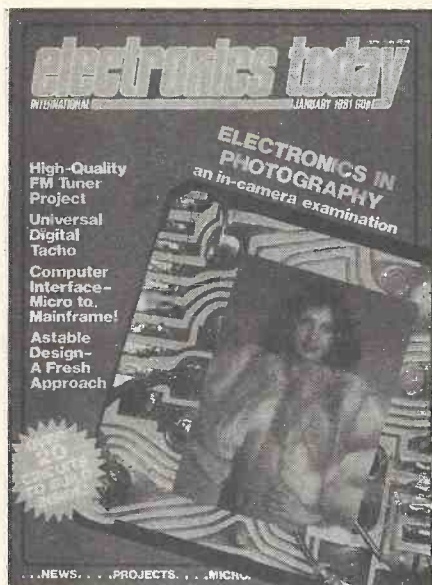
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ANDOVER, HANTS SP10 3NM

ANDOVER
(STD 0264) 64455

PRICE STABILITY: Order with confidence. In respect of any price changes we will honour in this advertisement until February 28th, 1981. If this month's advertisement is mentioned with your order. Errors and VAT rate changes excluded.
EXPORT ORDERS: No VAT. Postage charged at actual cost plus £1 handling and documentation.
U.K. ORDERS: Subject to 18% surcharge for VAT. No charge is made for carriage, or at current rate if changed.

SECURICOR DELIVERY: For this optional service (U.K. mainland only) add £2.50 (VAT inclusive) per kit.
SALES COUNTER: If you prefer to collect kit from the factory, call at Sales Counter, 9 a.m. - 12 noon, 1-4.30 p.m. Monday-Thursday.

MANY MORE KITS ON PAGE 8



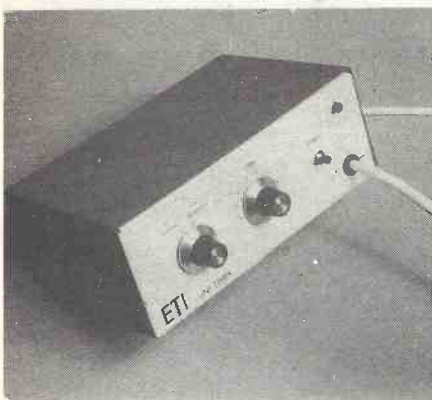
Watch the birdie p.88

electronics today

JANUARY 1981 VOL 10 NO 1 INTERNATIONAL

FEATURES

- DIGEST 9 New news is good news
- MICROBASICS 17 Monitoring programs
- SPOT DESIGNS 27 And a couple of other spots
- AUDIOPHILE 29 Sound seasonal ideas
- I/O INTERFACE 43 Computer talk
- ASTROLOGUE 54 Win The Spaceflight Directory
- READERS SURVEY 57 Audience participation
- DESIGNER'S NOTEBOOK 72 555 astables
- SLR ELECTRONICS 88 Watch the LED birdie
- TECH TIPS 96 Circuits from your very own selves
- ELECTRONICS TOMORROW 102 See-SAW filters



Once upon a time p.36

PROJECTS

- MULTI-OPTION SIREN 22 Noises and infinitum
- UNIVERSAL TIMER 36 Seconds out
- 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 ETI 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 capability—takes 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.)

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.

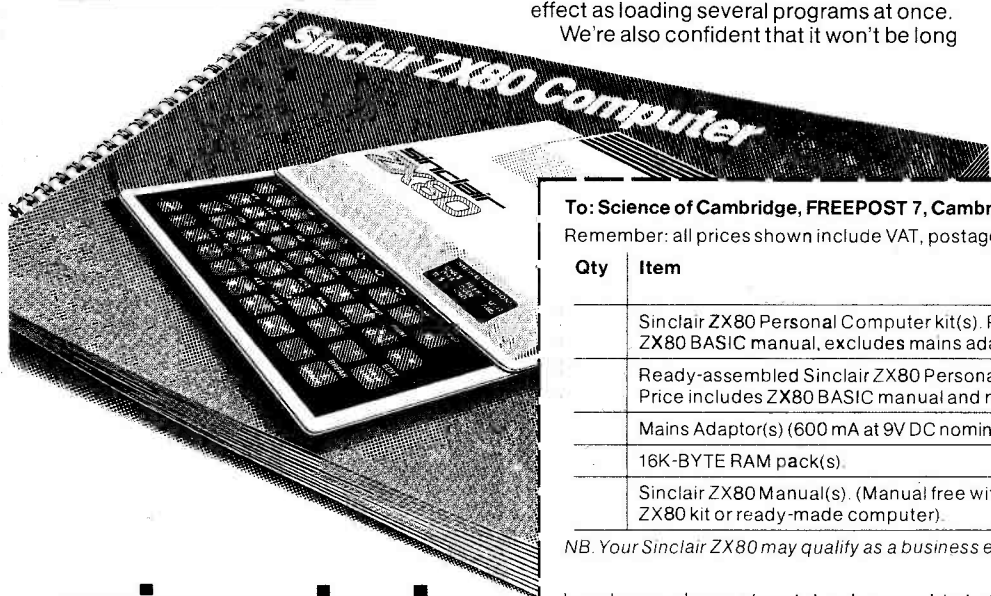
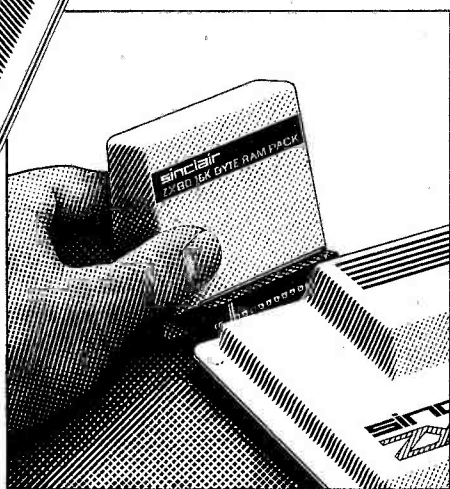
We're also confident that it won't be long

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.



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	
	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: £

I enclose a cheque/postal order payable to Science of Cambridge Ltd for £ _____

Please print

Name: Mr/Mrs/Miss _____

Address _____

FREEPOST – no stamp needed.

ETI/1

sinclair ZX80

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ELECTRONIC CAPACITORS: (Values are in μF) 500V: 10 50p; 47 78p; 250V: 100 65p; 63V: 0.47 1.0 1.5 2.2 3.3 4.7 5.8 8p; 10 15 22 22p; 32 47 50 12p; 63 100 27p; 50V: 50 100 220 25p; 470 32p; 200 30p; 40V: 2 33 8p; 100 12p; 2200 33p; 85 4700 98p; 35V: 10 33 7p; 33p; 470 32p; 25V: 10 22 47 10p; 16 220 25p; 15p; 470 25p; 64 100 35p; 1500 40p; 2200 45p; 3300 77p; 4700 85p; 16V: 10 47 20p; 100 125 85p; 220 330 140p; 200 35p; 1500 1500 30p; 2200 36p; 10V: 10 22 47p; 50 12p; 100 22p.

POLYESTER CAPACITORS: Axial lead type
400V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8, 10n, 15n 9p; 18n 10p; 22n, 33n 11p; 47n, 68n 14p; 100n 17p; 150n, 220n 24p; 330n, 470n 41p; 680n 48p; 1.1 1.5 6.4p; 2.2 8.2p.

POLYESTER RADIAL LEAD CAPACITORS: 250V:
10n, 15n, 22n, 27n 6p; 33n, 47n, 68n, 100n 7p; 150n 10p; 220n, 330n 13p; 470n 17p; 680n 19p; 1.1 2.2p; 1.5 3.0p; 2.2 3.4p.

TANTALUM BEAD CAPACITORS:
35V: 0.1 0.22 0.33 0.47 0.68, 1.0, 2.2 5F, 3.3, 4.7, 25V: 10 20V 6.8 16V: 2.2 4.7, 10 15p; 16V: 2.2 28p; 47, 100 50p; 220 80p; 10V: 15p, 22p, 33 22p; 100 35p; 6V: 47, 68, 100 28p; 3V: 100 25p.

MYLAR FILM CAPACITORS:
100V: 0.001, 0.002, 0.005, 0.01 5p 0.015, 0.02, 0.04, 0.05, 0.056 7p 0.1 1.5F, 50V: 0.47 12p

CERAMIC CAPACITORS 50V:
Range: 0.5p to 10,000pF 4p
0.015pF, 0.022pF, 0.033pF 5p
0.047pF 5p, 0.1 1.5F, 0.2 2.5F 7p

SILVER MICA (Values in pF): 3, 3.3, 4.7, 8.2, 10, 12, 18, 22, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 220, 1 1p each 250, 270, 300, 330, 360, 390, 470, 600, 800, 820 16p each 1000, 1200, 1800, 2000 26p each

POLYSTYRENE CAPACITORS:
10pF to 1nF 8p; 1.5nF to 47n 10p

MINIATURE TYPE TRIMMERS:
2.5-50pF, 3-10pF, 10-40pF 22p
5-25pF, 5-45pF, 60pF, 88pF 30p

COMPRESSION TRIMMERS:
3-40pF, 10-80pF, 25-190pF 30p
100-500pF 45p 400-1250pF 58p

GAS & SMOKE DETECTORS:
TGS 812 & 813 415p; Socket 30p

JACKSONS VARIABLE CAPACITORS:
DILCON 205p 2 x 2.365pF with slow motion Drive 450p
500pF 250p 0.0208/176 35p

RF CHOKES:
1 1/4, 4.7, 10, 22 33 47, 100 200 470 750, 1m 7.5, 5, 10 43m 10 60p each

VERO BOARD:
0.1 0.15 0.1 (aluminium clad) 30p
2 1/2 x 3 86p 50p 47p
2 1/2 x 3 75p 65p - -
3 1/4 x 5 86p 93p 72p
2 1/2 x 17 225p
3 1/4 x 17 255p 260p 210p
4 1/2 x 17 390p

VERO WIRING:
PAP + Spool 350
Spare Spool 85
Ferris Chloride 7

FERRIS CHLORIDE:
1 lb bag Anhydrous 225p - 40g 78p

ULTRASONIC TRANSDUCER:
40KHz 360p pr

COPPER CLAD BOARDS:
Fibre Single-Sided SRBP
Glass sided 5 1/2" x 8 5/8" 95p
6" x 12" 90p 110p 95p
8" x 12" 150p 195p

DIL PLUGS (Leaders):
14 pin 35p; 15 pin 40p
24 pin 85p; 40 pin 295p; available

SOLDER SOCKETS (TEXAS): Low Wire Prof. Wrap
8pin 10p 25p
14pin 12p 35p
16pin 13p 46p
18pin 16p 52p
22pin 22p 65p
22pin 25p 70p
24pin 30p 75p
28pin 35p 85p
36pin - 105p
40pin 40p 105p

EDGES CONNECTORS:
10 way - 1.156
2x10 way - 85p
2x15 way - 99p
2x18 way 115p 120p
2x22 way 130p 135p
2x25 way 148p 160p
2x28 way 170p
2x36 way 194p
2x48 way 210p
2x40 way 232p

DIL SOCKETS (TEXAS): Low Wire Prof. Wrap
8pin 10p 25p
14pin 12p 35p
16pin 13p 46p
18pin 16p 52p
22pin 22p 65p
22pin 25p 70p
24pin 30p 75p
28pin 35p 85p
36pin - 105p
40pin 40p 105p

DIAC: 20
7E SERIES: 350
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12A200V 75150 160
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12A1900V 75150 160
12A2000V 75150 160

TRANSISTORS

AC125	25	BC182L	10	BF154	25	MJE360	54	TP120	90	2N2905A	26	2N5459	36
AC126	35	BC183L	10	BF155	25	MJE370	100	TP121	90	2N2906	26	2N5458	36
AC127	25	BC184L	10	BF170	27	MJE371	100	TP122	90	2N2907	26	2N5777	45
AC128	25	BC181	20	BF171	27	MJE372	100	TP141	120	2N2907A	26	2N5879	190
AC129	25	BC182	20	BF172	30	MJE373	100	TP142	120	2N2908	26	2N6207	32
AC130	25	BC183	20	BF173	30	MJE374	100	TP143	120	2N2909	26	2N6207 3/2	32
AC131	30	BC187	26	BF174	35	MJE375	100	TP144	120	2N2910	26	2N6368	150
AC132	30	BC182	10	BF180	38	MJE376	100	TP145	120	2N2911	26	2N6369	75
AC133	30	BC121	10	BF181	38	MJE377	100	TIP3055	60	2N2912	26	3N128	112
AC134	28	BC212L	10	BF182	38	MJE378	100	MPP102	66	2N2913	26	3N140	112
AC135	28	BC213	10	BF183	38	MJE379	100	MPP103	36	2N2914	26	3N155	48
AC136	28	BC214	10	BF184	38	MJE380	100	MPP104	36	2N2915	26	3N160	60
AC137	28	BC215	10	BF185	38	MJE381	100	MPP105	36	2N2916	26	3N165	60
AC138	28	BC216	10	BF186	38	MJE382	100	MPP106	36	2N2917	26	3N170	60
AC139	28	BC217	10	BF187	38	MJE383	100	MPP107	36	2N2918	26	3N175	60
AC140	28	BC218	10	BF188	38	MJE384	100	MPP108	36	2N2919	26	3N180	60
AC141	28	BC219	10	BF189	38	MJE385	100	MPP109	36	2N2920	26	3N185	60
AC142	28	BC220	10	BF190	38	MJE386	100	MPP110	36	2N2921	26	3N190	60
AC143	28	BC221	10	BF191	38	MJE387	100	MPP111	36	2N2922	26	3N195	60
AC144	28	BC222	10	BF192	38	MJE388	100	MPP112	36	2N2923	26	3N200	60
AC145	28	BC223	10	BF193	38	MJE389	100	MPP113	36	2N2924	26	3N205	60
AC146	28	BC224	10	BF194	38	MJE390	100	MPP114	36	2N2925	26	3N210	60
AC147	28	BC225	10	BF195	38	MJE391	100	MPP115	36	2N2926	26	3N215	60
AC148	28	BC226	10	BF196	38	MJE392	100	MPP116	36	2N2927	26	3N220	60
AC149	28	BC227	10	BF197	38	MJE393	100	MPP117	36	2N2928	26	3N225	60
AC150	28	BC228	10	BF198	38	MJE394	100	MPP118	36	2N2929	26	3N230	60
AC151	28	BC229	10	BF199	38	MJE395	100	MPP119	36	2N2930	26	3N235	60
AC152	28	BC230	10	BF200	38	MJE396	100	MPP120	36	2N2931	26	3N240	60
AC153	28	BC231	10	BF201	38	MJE397	100	MPP121	36	2N2932	26	3N245	60
AC154	28	BC232	10	BF202	38	MJE398	100	MPP122	36	2N2933	26	3N250	60
AC155	28	BC233	10	BF203	38	MJE399	100	MPP123	36	2N2934	26	3N255	60
AC156	28	BC234	10	BF204	38	MJE400	100	MPP124	36	2N2935	26	3N260	60
AC157	28	BC235	10	BF205	38	MJE401	100	MPP125	36	2N2936	26	3N265	60
AC158	28	BC236	10	BF206	38	MJE402	100	MPP126	36	2N2937	26	3N270	60
AC159	28	BC237	10	BF207	38	MJE403	100	MPP127	36	2N2938	26	3N275	60
AC160	28	BC238	10	BF208	38	MJE404	100	MPP128	36	2N2939	26	3N280	60
AC161	28	BC239	10	BF209	38	MJE405	100	MPP129	36	2N2940	26	3N285	60
AC162	28	BC240	10	BF210	38	MJE406	100	MPP130	36	2N2941	26	3N290	60
AC163	28	BC241	10	BF211	38	MJE407	100	MPP131	36	2N2942	26	3N295	60
AC164	28	BC242	10	BF212	38	MJE408	100	MPP132	36	2N2943	26	3N300	60
AC165	28	BC243	10	BF213	38	MJE409	100	MPP133	36	2N2944	26	3N305	60
AC166	28	BC244	10	BF214	38	MJE410	100	MPP134	36	2N2945	26	3N310	60
AC167	28	BC245	10	BF215	38	MJE411	100	MPP135	36	2N2946	26	3N315	60
AC168	28	BC246	10	BF216	38	MJE412	100	MPP136	36	2N2947	26	3N320	60
AC169	28	BC247	10	BF217	38	MJE413	100	MPP137	36	2N2948	26	3N325	60
AC170	28	BC248	10	BF218									

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SWITCHES TOGGLE: 2A, 250V, SPST 33p DPST 34p DPDT 44p 4 pole on/off 54p SUB-MIN TOGGLE SP changeover 60p SPST on/off 54p SPDT biased off 105p DPDT 6 tags 75p DPDT centre off 88p DPDT biased off 145p Push to break 20p	SLIDE 250V: 1A DPDT 14p 1A DPDT c/over 15p 1/2A DPDT 13p 4 pole 2-way 24p PUSH BUTTON DPDT Black Body 12p Red, Blue, Grn., Yell. 14p 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 Stop Shifting Assembly. Accommodate up to 6 Waters 65p Mains Switch DPST to fit Break Before Make Waters. 1 pole/12 way. 2p/6 way. 3p/4 way. 4p/3 way. 6p/2 way 56p Spacer and Screen 6p ROTARY: (Adjustable Stop) 1 pole/2 to 12 way, 2p/2 to 6 way, 3 pole/2 to 4 way, 4 pole/2 to 3 way 45p ROTARY: Mains 250V AC. 4 Amp 56p 'D' CONNECTORS (Cannon type) Plugs Sockets Covers 9way 95p 128p — 15way 135p 195p 150p 25way 198p 284p 170p 37way 290p 398p 185p
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CRYSTALS 100KHz 323 455KHz 383 1MHz 323 1.008M 395 1.28MHz 392 1.6MHz 323 1.8MHz 323 1.8432MHz 362 2.4576MHz 323 3.2768M 323 3.57954M 195 4.000MHz 290 4.032MHz 323 4.433619M 135 5.0MHz 358 5.195M 323 5.24288M 425 6.0MHz 323 6.5536M 220 7.690M 323 8.0MHz 692 8.08333M 362 8.867237M 362 9.375M 323 10.0MHz 323 10.7MHz 323 12MHz 392 14.31818M 362 18MHz 323 18.432M 323 20.0MHz 323 27.648M 323 38.8667M 350 48.0MHz 323 100.00MHz 323	TRANSFORMERS (Mains Prim. 220-240V) 6-0.6V; 9-0.9V; 12-0-12V 100mA 95p 3VA: 0-6V 0.6V (PCB mounting) 150p 8VA: 6V-5A 6V-5A; 9V-4A 9V-4A; 12V-3A 12V-3A; 15V-2.5A 15V-2.5A 215p 12V: 4.5V-1.3A 4.5V-1.3A; 6V-1.2A 6V-1.2A; 12V-0.5A 12V-0.5A; 15V-0.4A 15V-0.4A; 20V-0.3A 235p (30p p&p) 20V-3A 235p (30p p&p) 24VA: 6V-1.5A 6C-1.5A; 9V-1.3A 9V-1.3A; 12V-1A 12V-1A; 15V-8A 15V-8A; 20V-6A 20V-6A 320p (55p p&p) 50VA: 6V-4A 6V-4A; 9V-2.5A 9V-2.5A; 12V-2A 12V-2A; 15V-1.5A 15V-1.5A; 20V-1.2A 20V-1.2A; 25V-1A 25V-1A; 30V-0.8A 30V-0.8A 365p (60p p&p) 100VA: 12V-4A 12V-4A; 15V-3A 15V-3A; 20V-2.5A 20V-2.5A; 30V-1.5A 30V-1.5A; 40V-1.25A 40V-1.25A; 50V-1A 50V-1A 695p (74p p&p). (NB: p&p charge to be added above our normal postal charge.)	ALUM. BOXES WITH LID 3x2x1" 55 2 1/4x5 1/4x1 1/4" 75 4x4 1/2" 75 4x2 3/4x1 1/2" 75 4x5 1/4x1 1/2" 100 4x2 1/2x2" 80 5x4x2" 107 6x4x2" 110 7x5x2 1/2" 185 8x6x3" 185 10x7x3" 240 10x4 1/2x3" 228 12x5x3" 239 12x8x3" 275	PANEL METERS FSD 445p each 60x46x 575 35mm 575 0-50µA 675 0-100µA 675 0-500µA 675 0-1mA 675 0-5mA 675 0-10mA 675 0-50mA 675 0-100mA 675 0-500mA 675 0-1A 675 0-2A 675 0-25V 675 0-50V AC 675 0-300V AC 675 "S" 675 "VU" 675 4 1/4x3 1/4x1 1/2" 595p each
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VOLTAGE REGULATORS 1A TO3 5V 7805 145p 7905 220p 7912 220p 12V 7812 145p 7912 220p 15V 7815 145p 18V 7818 145p 1A TO220 Plastic Casing 5V 7805 60p 7905 65p 12V 7812 60p 7912 65p 15V 7815 60p 7915 65p 18V 7818 60p 7918 65p 24V 7824 60p 100mA TO92 Plastic Casing 5V 78L05 30p 79L05 65p 6V 78L02 30p 9V 78L02 30p 12V 78L12 30p 79L12 65p 15V 78L15 30p 79L15 65p	OPTO LEDs with Clips TL208 Red 13 4 1/4x3 1/4x1 1/2" TL211 Grn. 17 0-50µA TL212 Yel. 18 0-100µA TL220 2" Red 14 0-500µA 2" Green, Yellow or Amber 18 7 Segment Displays TL307 123 10 Green, Yellow 30 TL312 3" CA 105 LD271 Infra Red 40 TL313 3" CC 105 SFH205 Detector 90 TL321 5" CA 115 TL32 infra Red 65 TL322 5" CC 115 TL78 Detector 75 DL704 3" CC 99 BARGRAPY Red 10 DL707 3" CA 99 segments 225 DL747 6" CA 180 LS400 255 8" Orange CA 250 OCP71 125 FND357 Red 120 ORP12 65 FND500 115 ORP61 85 3" Green CA 150 ZNS577 45 3" Green CA 150 2" Red CA 150 3" Green CA 150
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ETI Projects: Parts available for: Digital Test Meter, DM90, 60W Amplifier System. Send SAE plus 5p for list.	LM300H 170p LM337 27p LM305H 140p LM723 30p LM309K 135p TAA550 50p LM317K 350p TBA6258 95p LM323K 550p TDA1412 150p LM325N 240p 78H05 + 5V 65p LM326N 240p 78H05 + 5V to +25V 85p	ISOLATORS IL74 55 DVM176 1885 TL111/2 85 LCD 3 1/2 Digits 775 TL114 95 LCD 4 Digits 875 TL117 110 LCD 6 Digits 980	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">LS245</td> <td style="width: 25%;">350</td> <td style="width: 25%;">LS373</td> <td style="width: 25%;">150</td> <td style="width: 25%;">4016</td> <td style="width: 25%;">35</td> <td style="width: 25%;">4054</td> <td style="width: 25%;">130</td> <td style="width: 25%;">4175</td> <td style="width: 25%;">120</td> <td style="width: 25%;">4522</td> <td style="width: 25%;">150</td> </tr> <tr> <td>LS247</td> <td>135</td> <td>LS374</td> <td>150</td> <td>4017</td> <td>70</td> <td>4055</td> <td>130</td> <td>4194</td> <td>115</td> <td>4526</td> <td>98</td> </tr> <tr> <td>LS248</td> <td>135</td> <td>LS375</td> <td>150</td> <td>4018</td> <td>76</td> <td>4056</td> <td>135</td> <td>4408</td> <td>790</td> <td>4527</td> <td>125</td> </tr> <tr> <td>LS249</td> <td>135</td> <td>LS377</td> <td>199</td> <td>4019</td> <td>48</td> <td>4057</td> <td>2850</td> <td>4409</td> <td>790</td> <td>4528</td> <td>100</td> </tr> <tr> <td>LS251</td> <td>130</td> <td>LS378</td> <td>140</td> <td>4020</td> <td>85</td> <td>4059</td> <td>575</td> <td>4410</td> <td>750</td> <td>4529</td> <td>150</td> </tr> <tr> <td>LS253</td> <td>95</td> <td>LS379</td> <td>215</td> <td>4021</td> <td>90</td> <td>4060</td> <td>110</td> <td>4411</td> <td>950</td> <td>4530</td> <td>90</td> </tr> <tr> <td>LS257</td> <td>95</td> <td>LS384</td> <td>250</td> <td>4022</td> <td>85</td> <td>4061</td> <td>1225</td> <td>4412F</td> <td>1250</td> <td>4531</td> <td>130</td> </tr> <tr> <td>LS258</td> <td>120</td> <td>LS385</td> <td>420</td> <td>4023</td> <td>24</td> <td>4062</td> <td>995</td> <td>4412V</td> <td>1520</td> <td>4532</td> <td>120</td> </tr> <tr> <td>LS259</td> <td>160</td> <td>LS386</td> <td>85</td> <td>4024</td> <td>60</td> <td>4063</td> <td>120</td> <td>4415F</td> <td>480</td> <td>4534</td> <td>510</td> </tr> <tr> <td>LS261</td> <td>450</td> <td>LS390</td> <td>405</td> <td>4025</td> <td>24</td> <td>4066</td> <td>46</td> <td>4415V</td> <td>850</td> <td>4536</td> <td>310</td> </tr> <tr> <td>LS266</td> <td>75</td> <td>LS393</td> <td>140</td> <td>4026</td> <td>180</td> <td>4067</td> <td>430</td> <td>4419</td> <td>280</td> <td>4538</td> <td>145</td> </tr> <tr> <td>LS273</td> <td>180</td> <td>LS395</td> <td>210</td> <td>4027</td> <td>45</td> <td>4068</td> <td>26</td> <td>4422</td> <td>570</td> <td>4539</td> <td>120</td> </tr> <tr> <td>LS275</td> <td>320</td> <td>LS396</td> <td>199</td> <td>4028</td> <td>92</td> <td>4069</td> <td>22</td> <td>4432</td> <td>1050</td> <td>4541</td> <td>150</td> </tr> <tr> <td>LS279</td> <td>88</td> <td>LS398</td> <td>275</td> <td>4029</td> <td>98</td> <td>4070</td> <td>30</td> <td>4435</td> <td>850</td> <td>4543</td> <td>150</td> </tr> <tr> <td>LS280</td> <td>250</td> <td>LS399</td> <td>220</td> <td>4030</td> <td>55</td> <td>4071</td> <td>25</td> <td>4440</td> <td>999</td> <td>4549</td> <td>395</td> </tr> <tr> <td>LS283</td> <td>90</td> <td>LS445</td> <td>140</td> <td>4031</td> <td>185</td> <td>4072</td> <td>25</td> <td>4450</td> <td>350</td> <td>4553</td> <td>399</td> </tr> <tr> <td>LS290</td> <td>130</td> <td>LS447</td> <td>195</td> <td>4032</td> <td>125</td> <td>4073</td> <td>25</td> <td>4503</td> <td>65</td> <td>4564</td> <td>192</td> </tr> <tr> <td>LS293</td> <td>130</td> <td>LS490</td> <td>245</td> <td>4033</td> <td>175</td> <td>4075</td> <td>23</td> <td>4452</td> <td>350</td> <td>4555</td> <td>85</td> </tr> <tr> <td>LS295</td> <td>215</td> <td>LS668</td> <td>105</td> <td>4034</td> <td>213</td> <td>4076</td> <td>85</td> <td>4490F</td> <td>350</td> <td>4556</td> <td>60</td> </tr> <tr> <td>LS298</td> <td>215</td> <td>LS669</td> <td>105</td> <td>4035</td> <td>95</td> <td>4077</td> <td>30</td> <td>4490V</td> <td>750</td> <td>4557</td> <td>425</td> </tr> <tr> <td>LS299</td> <td>420</td> <td>LS670</td> <td>270</td> <td>4036</td> <td>275</td> <td>4078</td> <td>28</td> <td>4501</td> <td>28</td> <td>4558</td> <td>174</td> </tr> <tr> <td>LS300</td> <td>175</td> <td>LS673</td> <td>750</td> <td>4037</td> <td>115</td> <td>4081</td> <td>26</td> <td>4502</td> <td>65</td> <td>4559</td> <td>450</td> </tr> <tr> <td>LS302</td> <td>175</td> <td>LS674</td> <td>850</td> <td>4038</td> <td>110</td> <td>4082</td> <td>25</td> <td>4503</td> <td>65</td> <td>4560</td> <td>199</td> </tr> <tr> <td>LS320</td> <td>270</td> <td></td> <td></td> <td>4039</td> <td>299</td> <td>4085</td> <td>90</td> <td>4506</td> <td>75</td> <td>4561</td> <td>104</td> </tr> <tr> <td>LS323</td> <td>460</td> <td></td> <td></td> <td>4040</td> <td>85</td> <td>4086</td> <td>90</td> <td>4507</td> <td>48</td> <td>4562</td> <td>525</td> </tr> <tr> <td>LS324</td> <td>200</td> <td></td> <td></td> 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<td>4008</td> <td>76</td> <td>4047</td> <td>98</td> <td>4098</td> <td>150</td> <td>4515</td> <td>250</td> <td>4582</td> <td>135</td> </tr> <tr> <td>LS352</td> <td>185</td> <td>4009</td> <td>40</td> <td>4048</td> <td>65</td> <td>4099</td> <td>150</td> <td>4516</td> <td>90</td> <td>4583</td> <td>105</td> </tr> <tr> <td>LS353</td> <td>185</td> <td>4010</td> <td>48</td> <td>4049</td> <td>38</td> <td>4101</td> <td>115</td> <td>4517</td> <td>415</td> <td>4584</td> <td>55</td> </tr> <tr> <td>LS365</td> <td>65</td> <td>4011</td> <td>18</td> <td>4050</td> <td>38</td> <td>4161</td> <td>115</td> <td>4518</td> <td>90</td> <td>4585</td> <td>140</td> </tr> <tr> <td>LS366</td> <td>65</td> <td>4012</td> <td>24</td> <td>4051</td> <td>86</td> <td>4162</td> <td>115</td> <td>4519</td> <td>80</td> <td>40106</td> <td>99</td> </tr> <tr> <td>LS367</td> <td>65</td> <td>4013</td> <td>43</td> <td>4052</td> <td>86</td> <td>4163</td> <td>115</td> <td>4520</td> <td>90</td> <td></td> <td></td> </tr> <tr> <td>LS368</td> <td>65</td> <td>4014</td> <td>80</td> <td>4053</td> <td>86</td> <td>4174</td> <td>110</td> <td>4521</td> <td>210</td> <td></td> <td></td> </tr> <tr> <td>LS369</td> <td>65</td> <td>4015</td> <td>82</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> 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MUSICAL MICRO 24 TUNE DOOR BELL

BUILD THE WORLD FAMOUS CHROMA-CHIME

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 button!

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

ONLY

£11.95

+ 75p p&p
UK ONLY

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



MP0027A Micro-computer chip available separately if required. Full 24 tune spec device fully guaranteed.

This unique chip can be used not only for electronic door chimes, but for other projects requiring maximum output.

Car Horns Musical Boxes Alarms Amusement Machines Public Address etc

£4.95

Please send me ETI 1/81

TO: CHROMATRONICS, RIVER WAY, HARLOW, ESSEX
 Telephone: (0279) 418611

NAME

ADDRESS

I enclose cheque/PO value £
 or debit my ACCESS/BARCLAYCARD account no.

Signature

CHROMATRONICS

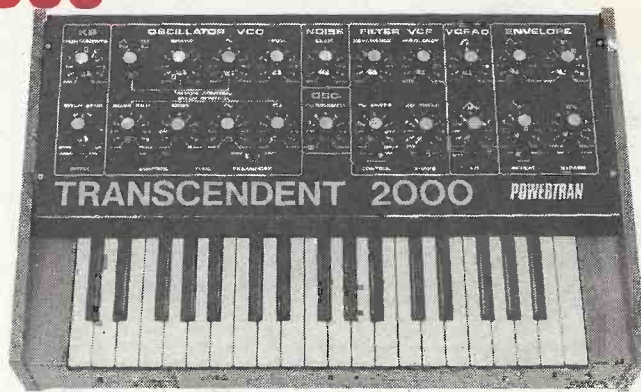
TRANSCENDENT 2000 SINGLE BOARD SYNTHESIZER

Deigned by consultant Tim Orr (formerly synthesizer designer for EMS Ltd.) and featured 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, 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 teak cabinet, filter sweep pedal, professional quality components (all resistors either 2% metal oxide or 1/2% 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)

NEW! TRANSCENDENT POLYSYNTH

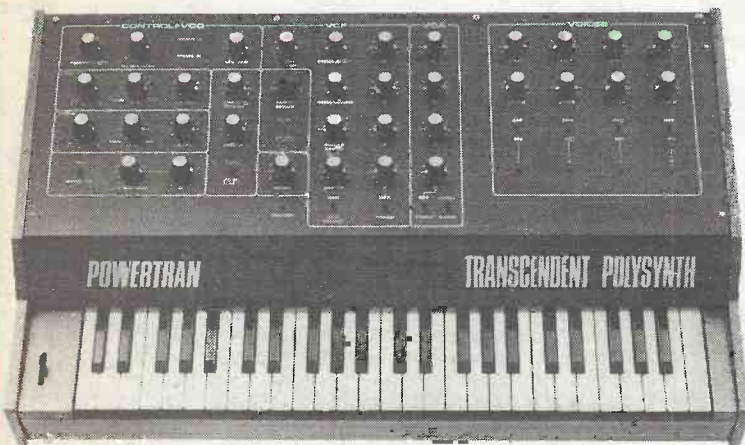
EXPANDABLE POLYPHONIC SYNTHESIZER

**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 metalwork, 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

**COMPLETE KIT
ONLY
£299 + VAT!**



Cabinet size 36.3" x 15.0" x 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 reed 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 should you prefer — strings on the top 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 vibrato 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 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. The kit includes fully finished metalwork, solid teak cabinet, professional quality components (all resistors 2% metal oxide), nuts, bolts, etc., even a 13A plug!

POWERTRAN

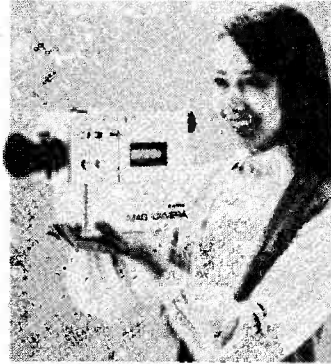
**MANY MORE KITS ON PAGE 115. MORE KITS AND ORDERING
INFORMATION ON INSIDE FRONT COVER**

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

Hitachi 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 1/4" 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.



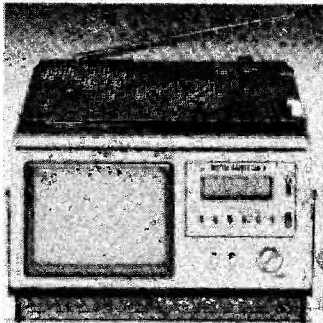
Hitachi have also launched a new portable VHS video recorder. The VT 7000 is one of the lightest in the world — just 5.9 kg. All the controls are of feather touch 'IC logic' operation, with a remote control facility. The recorder can be linked up with the VT TU 70 video tuner, which also doubles as an 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 4 1/2" tube and receives both VHF and UHF. Its

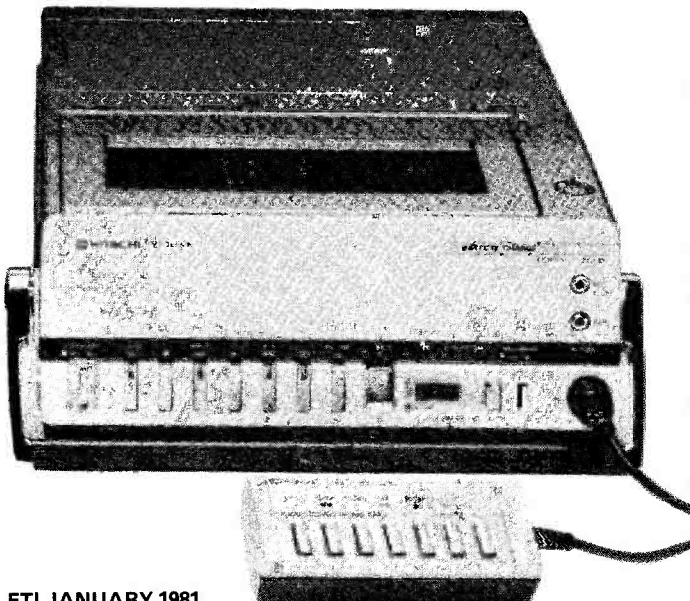
four way power source means that the K 2300 can be used virtually anywhere — bedroom (mains/battery), car, caravan, garden or Santa's grotty (sorry) grotto.

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 VTTU 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.

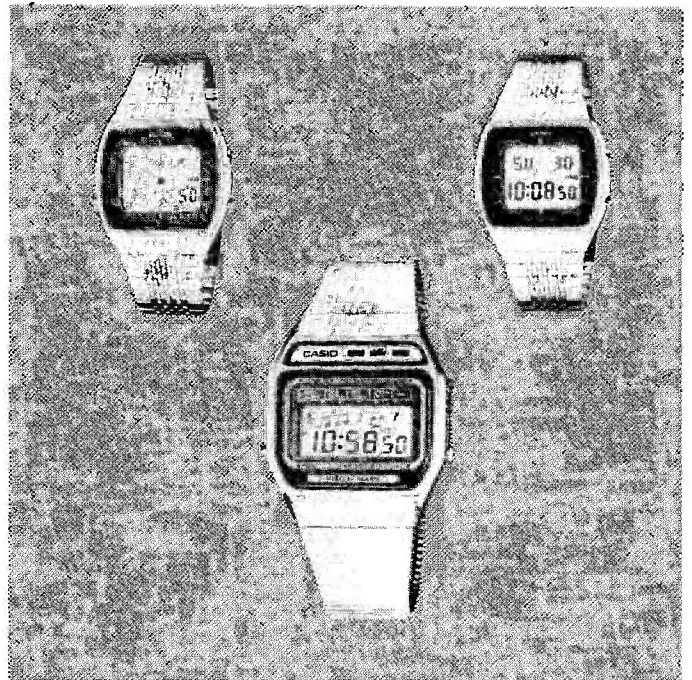


Welsh Chip Shop

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 Batley — 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 digital 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 stainless 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.

NEW

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Max. Output power 125 watt RMS
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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.



AS FEATURED IN PRACTICAL ELECTRONICS OCTOBER ISSUE

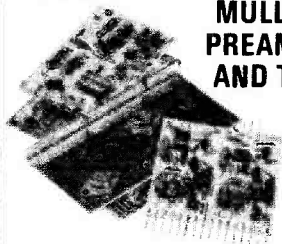
125 watt power amp kit **£9.50** plus £1.00 p&p

ACCESSORIES

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 sufficient for one power amp

DIY STEREO BARGAIN PACKS FEATURING FAMOUS BUILT MULLARD PREAMP MODULES

MULLARD STEREO PREAMP MODULES AND TWO 12 WATT POWER AMPS KITS.

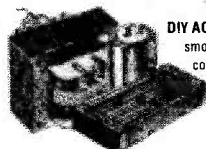


In easy to build form P.C.B.s backprinted, etched and drilled ready to use.

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DIY SPEAKER KIT Two 8" x 5" approx. 4 ohm bass. **£3.50** plus £1.70 p&p



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

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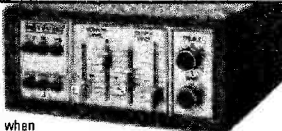
NOTE: for use with 4 to 8 ohms speakers.

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£13.95

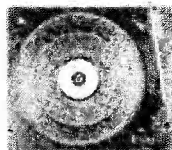
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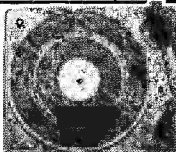


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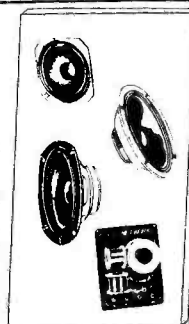
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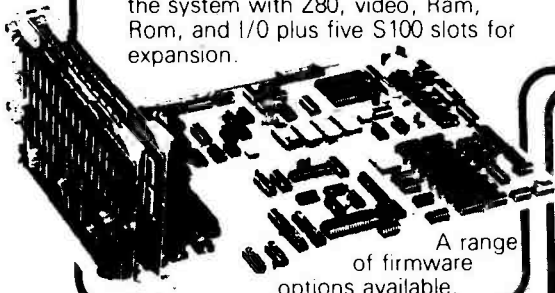
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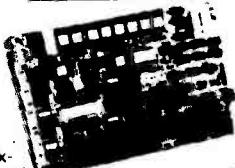
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ELECTRONICS TOMORROW

Dave Raven of Metac Electronics reports on the development and applications of Surface Acoustic Wave devices.

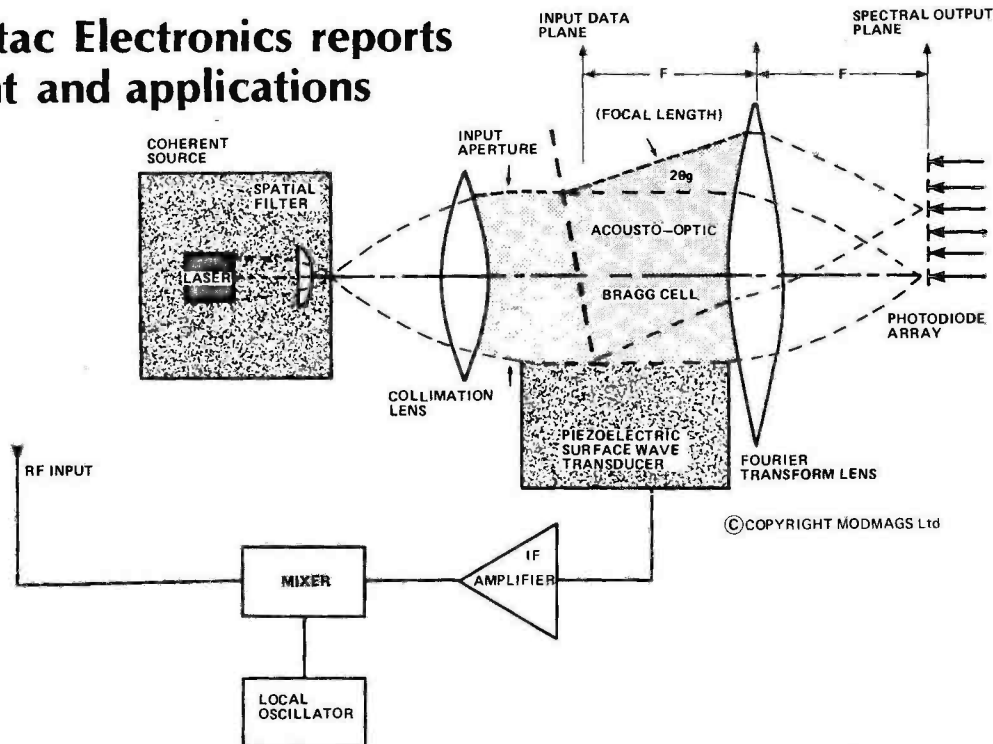


Fig. 1 An integrated optical spectrum analyser incorporating an acousto-optic Bragg cell.

It 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 $^{\circ}\text{C}$. 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 second-generation optical fibre telecommunications. The first generation employs multimode fibres and electroluminescent diodes. The evolving field of integrated optics combines single-mode 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.

ETI

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CHESS CHALLENGER "7" (7 Levels of game)	£73.00
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LEXICON with 6 Long Modules — French/Italian/German/Spanish etc.	£110
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If you write your own programs this library is for you! Most programs in this library are designed to be used either on their own or as subroutines of your programs. Applications range from utility programs such as printer formatting and large-scale plotting to advanced mathematical routines.

Module includes:	£58.00
*TEXAS T158 with Maths/Utilities	£156.50
*TEXAS T159 with Maths/Utilities	£78.00
*TEXAS T158 with Applied Statistics	£325.00
*TEXAS T159 with PC100C & Applied Statistics	

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SC110 £145.25; PFM200 £52.20; PD135 £32.80; TM352 £56.80; TM35 £112.30; TM353 £86.40; TF200 £188; TG105 £86.50; TF200 £149.50; TP600 £43 (Prescaler increases PFM200 up to 800MHz); DM235 £55; DM350 £76.50; DM450 £102.

WINTER SALE

*TEXAS T159 Calculator (complete as manufacturer's spec. master module, charger, etc.) PLUS statistics module and extra set of 40 Blank Prog. Cards with wallet, etc.	Only £199
---	------------------

*TEXAS T158C Continuous program facility on all 480 Program steps/80 mem even when calculator switched off	£72.00
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*TEXAS T158C + PC100C	£228.00

*HP32E (8 mem. Pro Sci/Stat)	£28.50
*HP32C (as above but con. mem)	£69.50
*HP32E (Advanced Sci with Statistics)	£28.50
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THE REMOTE CONTROL STORY

ONCE UPON A TIME



If you wanted to control any equipment remotely you had to buy a dozen logic ICs, chase around the shops for crystals and expensive ultrasonic transducers and then spend a few days getting the unit to work. Then one day TK began stocking a new system. All you required was one IC, a couple of transistors, resistors and a keyboard for the transmitter and a couple of ICs plus a few capacitors for the receiver, to give you up to 16 on/off (digital) outputs or 10 channels plus three analogue (0-10V) outputs. The SL 490 transmitter/encoder accepts inputs from a keyboard (up to 32 way) and encodes these into a pulse train which may be transmitted using infra red, ultrasonic, radio or even wire links. For the receiver you may use the SL480 pre-amplifier if you want an infra red link or a suitable pre-amplifier for ultrasonic or radio links, and one of the ML920 series decoders depending on the number and type of outputs required. The only adjustment you need to make is to set one preset (by trial or with a 'scope) and that's it.

LD271 IR Emitting Diode	38p	ML926 16-channel receiver/4 momentary binary outputs	1.40
SFH205 Photodiode Detector	85p	ML928 16-channel receiver, 4 latched binary outputs	1.40
SL480 IC Pulse Amp	1.70	ML929 16-channel receiver, 4 latched binary outputs	1.40
SL490 32 Command Encoder/transmitter	2.40		
ML922 10-channel receiver + 3 analogue outputs	4.20		

NEW ML925. A decoder designed for model/toy control, providing a 2-speed drive motor and three position latched steering system or a vehicle with momentary action steering and a third motor, eg. gun turret, winch, etc. Outputs also available for other facilities such as horn, turn indicators, headlights, etc. **2.10**

To make things **EVEN EASIER**, we have designed several new kits —
MK6 — Simple Infra Red TRANSMITTER. A Pulsed infra red source which comes complete with a hand held plastic box. Requires a 9V battery. **4.20**
MK7 — Infra Red RECEIVER. Single channel, range approximately 20 ft. Mains powered with a triac output to switch loads up to 500W at 240Vac, but can be modified for use with 5 to 15V dc supplies and transistor or relay outputs. **9.00**
 (Special Price) MK6 and MK7 together. Order as RC500K **12.50**

MK8 — Coded Infra Red TRANSMITTER. Based on the SL490, the kit includes 2 IR LEDs, measures only 6x21.3cms and requires a 9V (PP3) battery. **5.90**
MK9 — 4 Way KEYBOARD. For use with the MKB kit, to make a 4 channel remote control transmitter. **1.80**
MK10 — 16 Way KEYBOARD. For use with the MKB kit, to generate 16 different codes for decoding by the ML926 or ML928 receiver (MK12) Kit. **5.40**

MK12 — 16 Channel IR RECEIVER. For use with the MKB kit with 16 on/off outputs which with further interface circuitry, such as relays or triacs, will switch up to 16 items of equipment on or off remotely. Outputs may be latched or momentary, depending on whether the ML926 or ML928 is specified. Includes its own mains supply. **11.95**

Now you can buy all the components you require for your infra red system or complete kits from one supplier, at unbeatable prices, and live happily ever after.



CT4000 CLOCK/APPLIANCE TIMER KIT

The CT4000 has been designed to preset the state (on or off) of four outputs at four times per day for up to 7 days in advance, enabling the unit to control tape recorders, appliances, central heating, lights, etc. The times are set on a 0.1" high red LED display by means of a keyboard and the output states are displayed on four LEDs. Each output can switch up to 20mA at 9V. For mains loads use our Solid State Relay Kit (MK2). The kit includes a PCB, keyswitches, IC, a dual LED display, transformer, plus all other components and a printed and drilled box which can also accommodate up to 4 Solid State Relay Kits. **£25.25**

Size: 10.12 x 4.5 cms
Colour: Black.



24HR CLOCK/APP. TIMER KIT

Switches any appliance up to 1KW on and off at preset times once per day. Kit contains AY 5-1230 IC, 0.5" LED display, mains supply, dual LED display, transformer, plus all other components and a printed and drilled box which can also accommodate up to 4 Solid State Relay Kits. **£25.25**

CT1000K Basic Kit **£14.90**

CT1000KB with white box (56; 131 x 71mm) **£17.40**

Ready Built **£22.50**

DIGITAL VOLT/METER/THERMOMETER KIT

Based on the ICI 7106. This kit contains a PCB, resistors, presets, capacitors, diodes, IC and 0.5" liquid crystal display. Components are also included to enable the basic DVM kit to be modified to a Digital Thermometer using a single diode as the sensor. Requires a 3mA 9V supply (PP3 battery) **£19.50**



MINI KITS

These kits form useful subsystems which may be incorporated into larger designs or used alone. Kits include PCB, short instructions and all components.

MK1 TEMPERATURE CONTROLLER/THERMOSTAT
 Uses LM3911 IC to sense temperature (80 C max) and triac to switch heater. 1KW. **£4.**

MK2 SOLID STATE RELAY
 Ideal for switching motors, lights, heaters etc. from logic. Opto-isolated with zero voltage switching. Supplied without triac. Select the required triac from our range. **£2.80**

MK3 BAR/DOT DISPLAY
 Displays an analogue voltage on a linear 10-element LED display as a bar or single dot. Ideal for thermometers, level indicators etc. May be stacked to obtain 20 to 100 element displays. Requires 5.20V supply. **£4.75**

MK4 PROPORTIONAL TEMPERATURE CONTROLLER
 Based on the TDA1024 Zero voltage switch this kit may be wired to form a 'burst fire' power controller or a 'proportional temperature' controller enabling the temperature of an enclosure to be maintained to within 0.5 C. **3KW. £5.55**

MK5 MAINS TIMER
 Based on the ZN1034E Timer IC this kit will switch a mains load on (or off) for a preset time from 20 minutes to 35 hours. Longer or shorter periods may be realised by minor component changes. Maximum load 1KW. **£4.50**

TRIACS

3A	49p	16A	95p
8A	58p		
12A	85p		
8A with trigger	80p		
6A isolated tab	65p		
Diac	18p		

LIGHTING CONTROL KITS

Directly replace conventional light switch and control up to 300W of lighting. No mains rewiring. Insulated touchplates. Easy to follow instructions.

T0300K TOUCHDIMMER. Single touchplate with alternate action. Brief touch switches lamp on and off; longer touch dims or brightens lamp. Neon lamp helps find the switch in the dark. **£8.50**
TDE/K Extension kit for T0300K for 2-way switching, etc. **£2.00**

TSA300K TIME DELAY TOUCHSWITCH
 Turns off after preset delay (2 secs. to 3½ mins.) **£4.30**
LD300K Conventional Lightdimmer **£3.20**

DISCO LIGHTING KITS

Each unit has 4 channels (rated at 1KW at 240V per channel) which switch lamps to provide sequencing effects, controlled manually or by an optional opto isolated audio input.

DL 1000K
 This kit features a bi-directional sequence, speed of sequence and frequency of direction change being variable by means of potentiometers. Incorporates master dimming control. **£14.80**

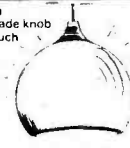
DL21000K
 A lower cost version of the above, featuring unidirectional channel sequence with speed variable by means of a preset pot. Outputs switched only at mains zero crossing points to reduce radio interference to minimum. **£8.00**
 Optional Opto Input **DLA1** **60p**



AND NOW A DIMMER THAT MAKES TOUCH DIMMERS OBSOLETE

Two years ago TK Electronics launched a touchdimmer kit, the T0300K, which made knob controlled dimmers obsolete. This was such a great success that many magazines and more retailers soon produced similar designs. **SO THAT OTHERS MAY FOLLOW.** TK have designed a touch dimmer kit with an Infra Red Remote control enabling you to switch and control the brightness of your lights from the comfort of your armchair etc. (as well as manually by touching the frontplate or by using the TDE/K extension kit.)
 As with all our kits, these come complete with all components including RFI suppression, frontplate, a neon to help you find the switch in the dark and a neat box for the transmitter. The plastic frontplate has no metal parts to touch ensuring complete safety and enabling the plate to be covered with a decorative finish to blend with your room decor.

We have designed the light dimmer unit to fit a standard wall box, the transmitter to fit your hand and the price to fit your pocket.



In two years time everyone will be selling remote control dimmers but you can have your TDR300K kit NOW for only **£14.30** for the dimmer unit and **£4.20** for the transmitter.
 For the more athletic of you the T0300K is still available at **£6.50** and the TDE/K at **£2.00**. **DON'T FORGET** to add 40p P&P and 15% VAT to your total purchase.

INTEGRATED CIRCUITS

555 Timer	21p
741 Op. Amp	18p
AY 5-1224 Clock	£2.60
AY 5-1230/2 Clock/Timer	£4.50
AY 3-1270 Thermometer	£8.20
ICL7106 DVM (LCD drive)	£7.00
LM37/ Dual 2W Amp	£1.40
LM375 Dual 5W Amp	£3.50
LM380 2W Audio Amp	80p
LM382 Dual/low noise Preamp	£1.00
LM386 250mW low voltage Amp	75p
LM1830 Fluid Level Detector	£1.50
LM2901 1/4 Converter (8 pins)	£1.40
LM2917 1/4 Converter (14 pins)	£1.60
LM3909 LED Flasher/Oscillator	80p
LM3911 Thermometer	£1.20
LM3911 Dvt/Bar Driver	£2.10
MM74C911 4 digit display controller	85p
MM74C915 7 segment BCD converter	96p
MM74C926 4 digit counter with 7 seq. n/p	£4.50
556B6 Touchdimmer	£2.50
59263 Touchswitch 16 way	£4.85
SN76477 Complex Sound Generator	£2.52
TBA800 5W Audio Amp	88p
TBA810AS 7W Audio Amp	£1.00
TDA1024 Zero Voltage Switch	£1.20
TDA2020 20W Audio Amp	£2.85
ZN1034E Timer	£1.80

All ICs supplied with data sheets. Data Sheets only 10p each device.

MINI TRANSFORMERS



Standard mains primaries 240V a.c.		
100mA secondaries		
6.0 6V	80p	
9.0 9V	85p	
12.0-12V	90p	

LEDs	
0.1" Red	9p
0.1" Green	12p
0.1" Yellow	12p
0.2" Red	9p
0.2" Green	12p
0.2" Yellow	12p
0.2" clips	3p
Rectangular Red	18p
Rectangular Green	20p
Rectangular Yellow	21p

DISPLAYS



DL304 Red 0.3" c.c. pin comp.	
patible with DL704	75p
DL307 Red 0.3" c.c. pin comp.	
patible with DL707	75p
DL727 Dual 0.5" c.c. Red	£1.50

CMOS

4000	17p	4019	42p	4069	19p
4001	18p	4023	22p	4070	19p
4002	18p	4025	21p	4071	18p
4007	17p	4026	£1.30	4072	26p
4011	19p	4027	40p	4081	20p
4012	17p	4028	50p	4083	54p
4013	38p	4029	80p	4081	24p
4015	75p	4049	38p	4511	90p
4016	35p	4050	40p	4514	£1.80
4017	70p	4060	£1.08	4516	£1.80

BOXES

Moulded in high impact ABS. Supplied with lids and screws. Black.

82	95 x 71 x 35mm	85p
83	115 x 95 x 37mm	95p



RESISTORS

ZENER DIODES		1/4W 10ohm-10M	£12.
400mW 3V-30V	8p	PACK of 10 (one value)	10p
1.3W 7.5-27V	15p	10 Packs (10 values)	80p

D.I.L. I.C. SOCKETS

8 pin	8p	18 pin	17p
14 pin	12p	28 pin	24p
16 pin	14p	40 pin	36p
Soldercon Pins			50p/100

CAPACITORS

Polyester 250V			
D.01	6p	0.22	12p
0.002	6p	0.33	12p
0.033	7p	0.47	15p
0.047	7p	0.68	18p
0.068	7p	1.0	24p
0.1	7p	1.5	27p
0.15	12p	2.2	31p

Electrolytics A Axial R Radial				
63V	10 R	5p	16V 10 R	5p
	2.2 R	5p	22 R	5p
	4.7 R	6p	33 R	5p
	10 R	7p	47 R	6p
	47 R	12p	100 R	6p
25V	22 A	8p	220 R	11p
	47 A	10p	470 R	14p
	100 A	14p	1000 R	20p
	110 A	15p	10V 47 A	8p
	470 A	24p	100 A	8p
	1000 A	34p	220 A	12p

Tantalum (bead)			
35V 0.1	9p	10V 22	20p
0.22	9p	6.3V 33	20p
0.47	9p	47	27p
1.0	9p	3V 100	27p
25V 2.2	10p		
4.7	14p		
10	20p		

Ceramic 50V		1,000pF	4p
100pF	4p	2,200pF	4p
220pF	4p	4,700pF	5p
470pF	4p	10,000pF	5p

VOLTAGE REGULATORS

Available in 5V, 12V & 15V versions.
 78L series 100mA pos **26p**
 79L series 100mA neg **60p**
 78 series 1A pos. (10 values) **80p**

LM317T adjustable 1.2V-37V 1.5A **£1.80**

RECTIFIERS

1N4001 1A/50V	4p
1N4004 1A/400V	8p
1N5401 3A/50V	8p
1N5404 3A/400V	10p
1A 50V Bridge	19p
1A 400V Bridge	22p
3A 50V Bridge	48p
3A 400V Bridge	58p
(Bridge rectifiers are miniature PCB mounting types)	

VMOS POWER FETS

VN10KM 0.5A/60V (T092)	52p
VN66AF 2A/60V (T0220)	88p

TRANSISTORS

BC108	8p	BFY50	20p
BC182	8p	TIP31A	40p
BC182L	8p	1IP32A	40p
BC212	9p	2N3055	45p
BC212L	9p	2N3442	90p
BC337	16p	2N3819	20p

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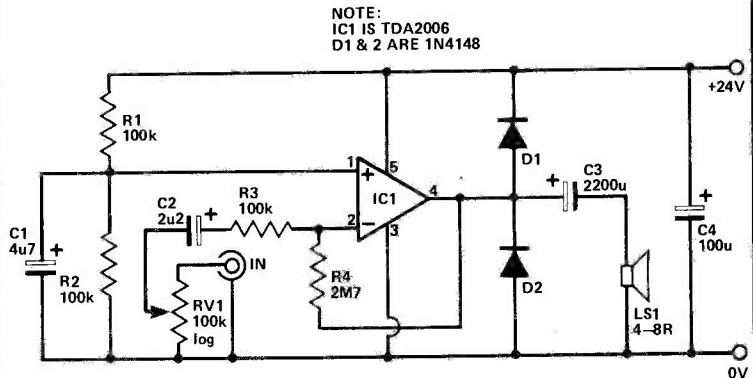


8 Watt Audio Amplifier

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.

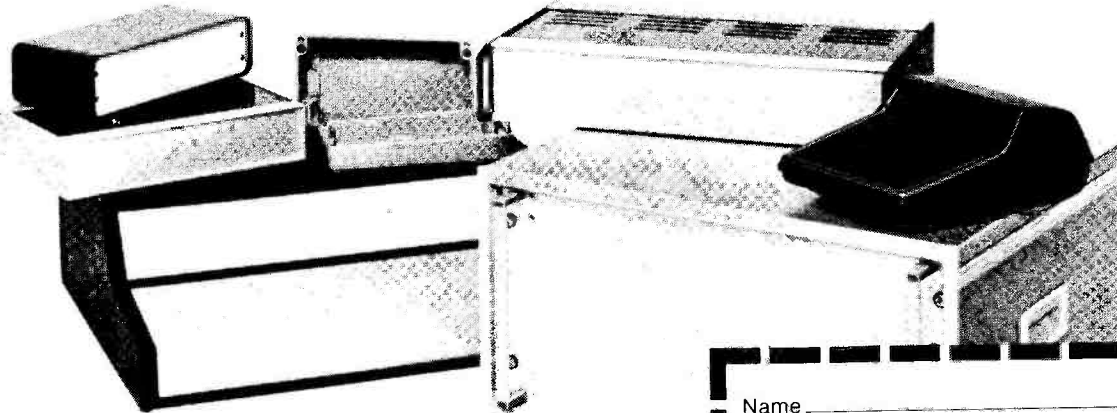
The TDA2006 is in many ways like an operational amplifier, but it has a class B power output stage. In this circuit it is used in the inverting amplifier mode with R1 and R2 forming a potential divider that biases the non-inverting input to half the supply voltage. C1 filters out hum and noise which 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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The facts of the case



West Hyde have one aim in life, to provide a practical solution to the problem of electronic packaging. The fact of the matter is that we have an ideal case for almost every project featured in this magazine. In this advertisement it is impossible to show you our whole range of nearly 1,000 different instrument cases, or our extensive collection of tools and accessories. Please complete the coupon and, in turn, we will send you our free 80-page catalogue and price list.

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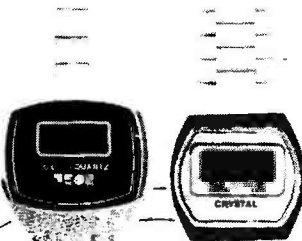
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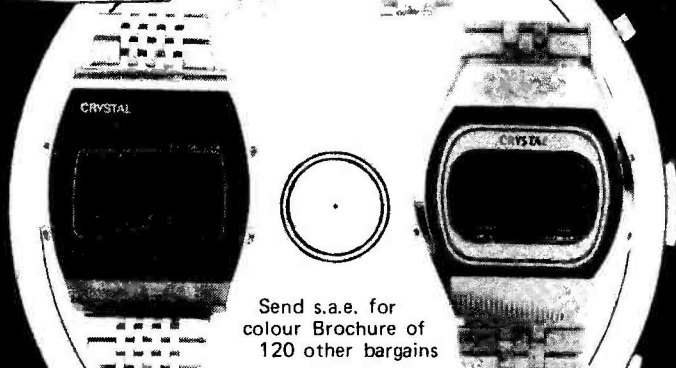
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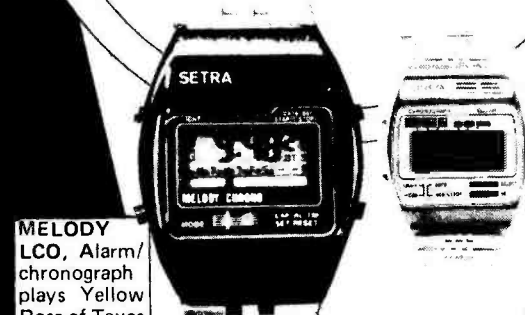


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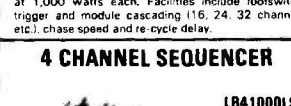



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<p>3 CHANNEL SOUND/LIGHT CHASER LB31000SLC £32.70</p>  <p>A high performance sound to light system which automatically switches to a chase when the music ceases. Super sensitive with an anti interference circuit. The unit will operate from practically any amp and control up to 1,000W/channel. 5Hz to 70K. Controls: bass/mid/treble/master sensitivity/chase speed.</p>	<p>STEREO DISCO MIXER/PREAMP LBPA3 M - Magnetic C - Ceramic £33.70</p>  <p>Magnetic or ceramic deck versions - please state</p> <p>All the requirements of a stereo disco preamp on one board, left and right deck mixers/tones control/mic. mixer/tones/mic. auto fade over decks and P.F.L. The unit can be used with either LB100/150/250</p> <p>Full set of pots - £8.83</p>								
<p>3 CHANNEL SOUND/LIGHT LB31000SL £22.70</p>  <p>All the advantages of the SLC without chase. Controls: bass/mid/treble/master sensitivity.</p>	<p>LPBA2 £17.20 A four channel mixer and tone stage for mics, guitars, etc. Can be used with any LB amps. Set of pots £2.74.</p> <p>LBPA1 £19.50 A stereo high preamp and tone stage for mag. p.u./tape/tuner, etc. Set of pots £3.27.</p>								
<p>2/4/8 CHANNEL CHASER LB81000LC £28.00</p>  <p>An all logic chaser system for use with up to 8 channels at 1,000 watts each. Facilities include footswitch trigger and module cascading (16, 24, 32 channel, etc.), chase speed and re-cycle delay.</p>	<p>3-WAY ACTIVE CROSSOVER LBAC01 £17.90</p>  <p>Bass/mid/treble active crossover with stage booster! Available with crossover points of 200 or 300Hz, and 2K or 3KHz (please specify) LBPSU1 supply for LBAC01 (1 or 2).</p>								
<p>4 CHANNEL SEQUENCER LB41000LS £19.20</p>  <p>A 4 channel sequence generator for banks of lamps up to 1,000W per channel. Two speed controls, cross effect to provide settings between seconds and rapid burst.</p>	<p>POWER AMPLIFIERS Tough dealing power amps for use in sound systems. Open/short circuit protection and fused. Heavy gauge heatinks and rugged o/p devices (all operate down to 4 ohms).</p> <table border="1"> <tr> <th>25W R.M.S.</th> <th>100W R.M.S.</th> <th>150W R.M.S.</th> <th>250W R.M.S.</th> </tr> <tr> <td>20Hz to 80K 0.07% THD 98DB S/N LB75</td> <td>5Hz to 25K 0.1% THD 110DB S/N LB100</td> <td>5Hz to 25K 0.1% THD 110DB S/N LB150</td> <td>5Hz to 25K 0.1% THD 110DB S/N LB250</td> </tr> </table> <p>£11.20 £19.70 £29.20 £43.50 Note all models are available with either 500mV or 775mV sensitivity. Price stable when ordering.</p> <p>LBRLD1 £6.20 A de-thump unit for use with any LB power amps.</p>	25W R.M.S.	100W R.M.S.	150W R.M.S.	250W R.M.S.	20Hz to 80K 0.07% THD 98DB S/N LB75	5Hz to 25K 0.1% THD 110DB S/N LB100	5Hz to 25K 0.1% THD 110DB S/N LB150	5Hz to 25K 0.1% THD 110DB S/N LB250
25W R.M.S.	100W R.M.S.	150W R.M.S.	250W R.M.S.						
20Hz to 80K 0.07% THD 98DB S/N LB75	5Hz to 25K 0.1% THD 110DB S/N LB100	5Hz to 25K 0.1% THD 110DB S/N LB150	5Hz to 25K 0.1% THD 110DB S/N LB250						
<p>1 AND 3 CHANNEL DIMMERS LB31000LD £16.20</p>  <p>Single channel version LB11000LD £7.20</p> <p>Power dimmer units for theatre/stage applications up to 1,000W per channel with on board potentiometer. The unit is also available without rotary pots for use with sliders. LB31000LD (no pots) £15.00 Sliders 75p each.</p>	<p>POWER SUPPLIES</p> <table border="1"> <tr> <th>LB25PS</th> <th>LB100PS</th> <th>LB150PS</th> <th>LB250PS</th> </tr> <tr> <td>£11.20 P/P £1.20</td> <td>£16.20 P/P £1.40</td> <td>£19.00 P/P £1.40</td> <td>£26.50 P/P £1.70</td> </tr> </table>	LB25PS	LB100PS	LB150PS	LB250PS	£11.20 P/P £1.20	£16.20 P/P £1.40	£19.00 P/P £1.40	£26.50 P/P £1.70
LB25PS	LB100PS	LB150PS	LB250PS						
£11.20 P/P £1.20	£16.20 P/P £1.40	£19.00 P/P £1.40	£26.50 P/P £1.70						
<p>ROPE LIGHTS/DRIVER LB41000LC-S £24.20</p>  <p>24 feet ropes Red/Yellow Blue/Green</p> <p>ROPE LIGHTS £45.40</p> <p>A four channel chaser up to 1,000W per channel, with a sound trigger facility. The music input signal modulates the speed of the chase giving an excellent sound/light effect. The unit will control up to 10 ropes with chase speed and trigger level control.</p>	<p>PIEZO HORNS £5.75 P/P 50p</p>  <p>CELESTION LOUSPEAKERS (8 ohms)</p> <table border="1"> <tr> <th>G12-85 (12 inch 85W)</th> <th>G12-100 (12 inch 100W)</th> <th>G10-60 (10 inch 50W)</th> </tr> <tr> <td>£20.70 P/P £1.70</td> <td>£26.45 P/P £1.70</td> <td>£14.70 P/P £1.70</td> </tr> </table>	G12-85 (12 inch 85W)	G12-100 (12 inch 100W)	G10-60 (10 inch 50W)	£20.70 P/P £1.70	£26.45 P/P £1.70	£14.70 P/P £1.70		
G12-85 (12 inch 85W)	G12-100 (12 inch 100W)	G10-60 (10 inch 50W)							
£20.70 P/P £1.70	£26.45 P/P £1.70	£14.70 P/P £1.70							
<p>L & B ELECTRONIC MODULES PROFESSIONAL ENGINEERING BY PROFESSIONALS 45 Wortley Road, West Croydon, Surrey CRO 3EB. Tel. 01-689 4138</p>	<p>NEW - MINI MODULES - NEW Ingeniously designed mini pre-amplifier building blocks for use in music and P.A. applications. You choose the type and number of units you require for your particular system and mount each module via its control direct onto your panel.</p> <p>LBMM1 Pre-amp for mics, guitars etc. LBMM2 Mixer for up to 6 LBMM1/2/3/4/5 LBMM3 Bass/boost/cut for either LBMM1/2/3/4/5 LBMM4 Mid-boost/cut for either LBMM1/2/3/4/5 LBMM5 Treble boost/cut for either LBMM1/2/3/4/5 LBPSU1 ± 15V supply for up to 12 modules LBPSU2 ± 15V regulated for up to 50 modules MM1 £4.50; MM2 £5.20; MM3 £5.70; MM4 £5.70; MM5 £5.70; PSU1 £7.20; RPSU £14.50.</p> <p>Mini Module Discount. Any types between 10 and 24 (quantity) - 20%. 25+ - 30%.</p> <p>Each module is manufactured from the highest quality components, fully tested, supplied with a connection and circuit diagram and guaranteed for twelve months.</p> <p>All prices shown are VAT inclusive. Please include 50p post/packing except where individually stated. To mail order, send cheque/P.O. / registered cash or Access number. C.O.D. service £1 extra. For the new Autumn catalogue send 50p (Full spec. shown).</p>								

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Numerous applications are possible with Crimson modules. For example, a complete Hi-Fi Pre & Power amplifier of 40-125WRMS/channel can be built using our Hardware kits (see Hobby Electronics review, August 1980). Alternatively, Mono or Stereo slave amps of up to 500WRMS can be built into proprietary flight cases, while other uses include active loudspeaker systems such as designed by R.I. Harcourt in Wireless World October/November 1980. Further details of how to use the modules are contained in the Users/Application Manual available at £0.50.

SPECIFICATIONS

Type	O/P8ohms*	O/P4ohms*	PSU	H/Sinks	Slew	S/N	Sensitivity	T.H.D. (typ)	FR	Size
CE 608	38		CP51	50mm	30V/μs	110dB	775mV	0.0035%	1.5Hz-50kHz (3dB)	80 - 120 - 25
CE1004	44	70	CP53	100mm	30V/μs	110dB	775mV	0.0035%	1.5Hz-50kHz (3dB)	80 - 120 - 25
CE1008	66		CP53	100mm	30V/μs	110dB	775mV	0.0035%	1.5Hz-50kHz (3dB)	80 - 120 - 25
CE1704	85	121	CP56	150mm (F.M1)	30V/μs	110dB	775mV	0.0035%	1.5Hz-50kHz (3dB)	80 - 120 - 25
CE1708	125		CP56	150mm (F.M1)	30V/μs	110dB	775mV	0.0035%	1.5Hz-50kHz (3dB)	80 - 120 - 25
CP3000		250	CP56	F.M2	30V/μs	110dB	775mV	0.0035%	1.5Hz-50kHz (3dB)	161 - 102 - 35
CPR1S1	Output	775mV	REG1	20V/μs	70dB	2.8mV/RMS	0.008%		20Hz-20kHz	138 - 80 - 35
MCI1S1	Output	2mV	REG1	65dB	70dB	2.8mV/RMS	0.008%		20Hz-20kHz	80 - 120 - 35
X02 X03	Output	775-250mV	REG1	90dB	30dB	775mV	0.01%		20Hz-20kHz	150 - 50 - 30

*Power output is quoted WRMS and is given for two modules run off the same power supply. Higher powers are obtainable if using one module per P.S.U. or if using a stabilised P.S.U.

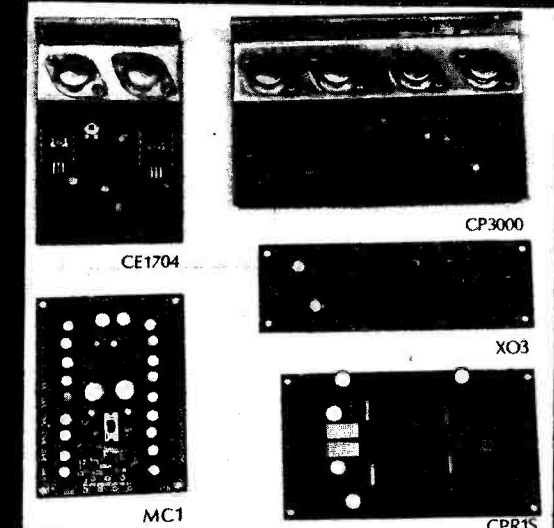
PRICES HELD FROM MAY — TO FEB '80

Power Amplifier Modules	Power Supply Modules	Heatsinks
CE 608	£21.00 CP51 (80VA)	50mm 11.70
CE1004	£24.50 CP53 (150VA)	100mm 12.20
CE1008	£27.50 CP56 (250VA)	130mm 13.50
CE1704	£35.00 REG1	15.30 F.M1
CE1708	£36.00 REG1	12.50 F.M2

Pre-Amplifier Modules	Active Crossovers	Hardware
CPR1	£34.00 X02	19.00 Pre. Amp.
CPR1S1	£44.50 X03	128.30 Power Amp.
MCI	£26.00 Mut	1.75 Thermal Cutouts
MCI1S1	£37.00	

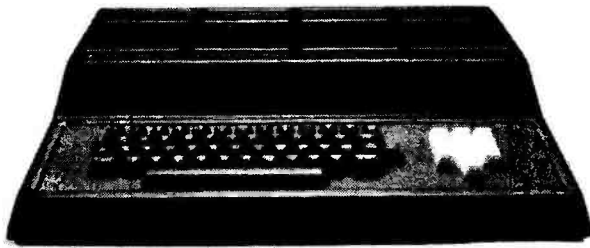
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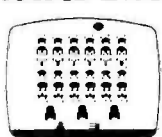
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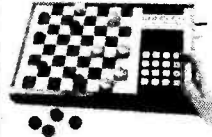
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046A	ETI 80 Dual VCA 100 W Power Amplifier	Aug 80	048B Vocoder Slew Rate Control Vocoder Output Amp Vocoder Input Amp Vocoder PSU Vocoder LED PPM Display
046B	Capacitance Meter US Alarm BGM 100 W Amplifier Logic Tester 100 W Power Amp	Aug 80	048C Cassette Interface ETI 80 Monitor Amp
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Sheets for Sep 79, Dec 79, Jan 80 and April - July 80 are temporarily out of stock. Earlier ETIPRINT sheets are available.

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HOW IT WORKS

Lay down the ETIPRINT and rub over with a soft pencil until the pattern is transferred to the board. Peel off the backing sheet carefully making sure that the resist has transferred. If you've been a bit careless there's even a 'repair kit' on the sheet to correct any breaks!

ETIPRINTS



Pocket Printer

Hanimex 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.

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.

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

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

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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 compact 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 3 1/2 digit formats.

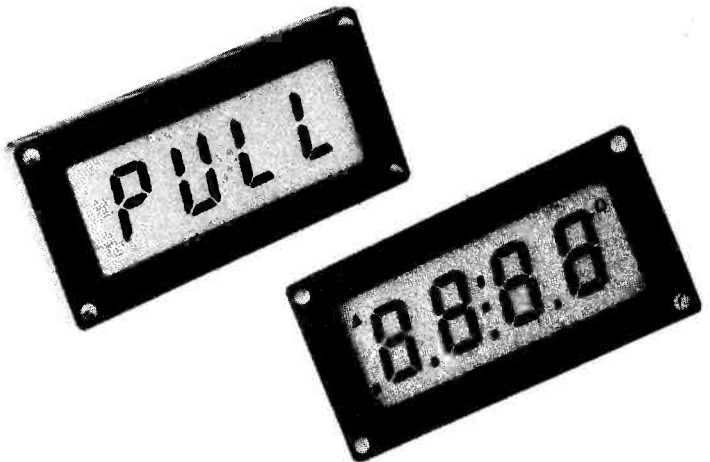
All the modules measure 60 x 30 x 7 mm (12.5 mm LCDs with integral incandescent backlighting) and can be supplied with a panel mounting bezel. For further details contact Ambit International, 200 North Service Road, Brentwood, Essex CM14 4SG.

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 (1/2" high) with colons and decimal points in a 2.75" x 1.2" package. The 742 offers eight digits, also 1/2" 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

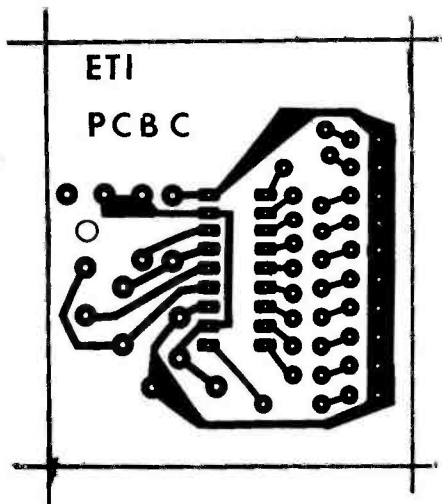
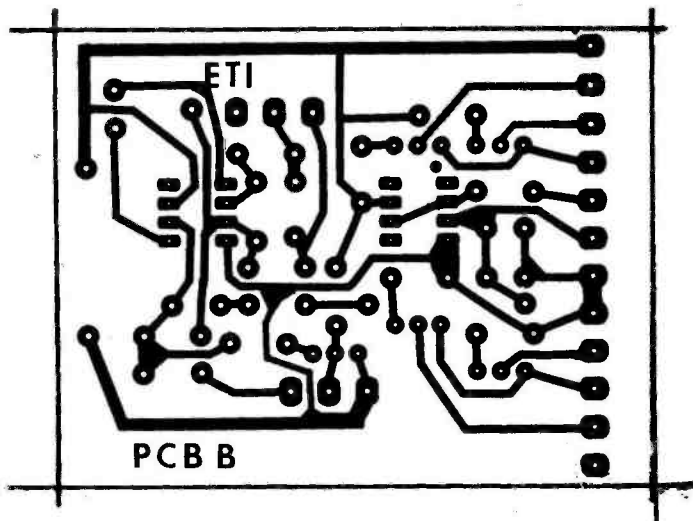
EMIDATA and Autelca Ag, the Swiss pay-phone manufacturer, have got together to produce a new pay-phone credit card system. When the customer buys a card, its magnetic strip is pre-coded with an agreed credit value (a number of time units).

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 call. When you hang up, the card is returned coded with its reduced value. If the value should fall to zero

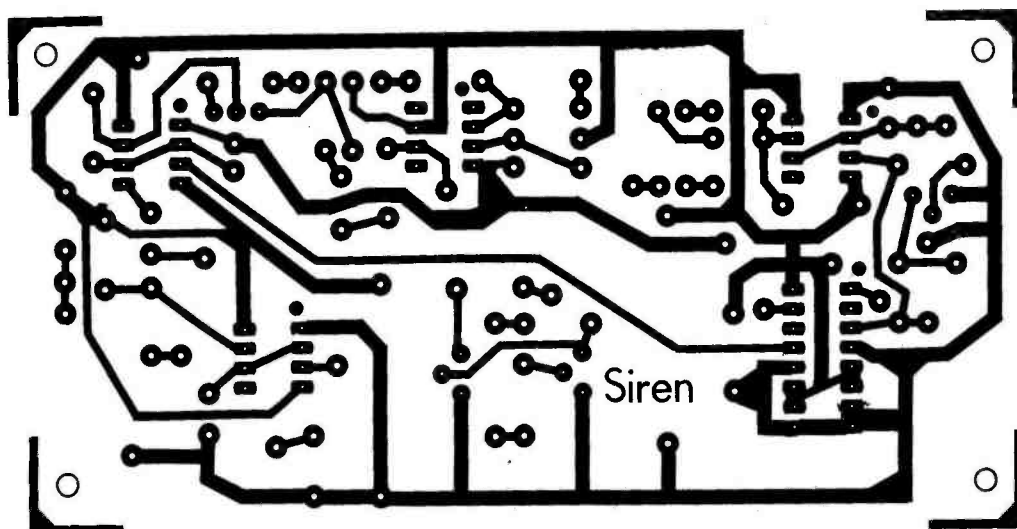
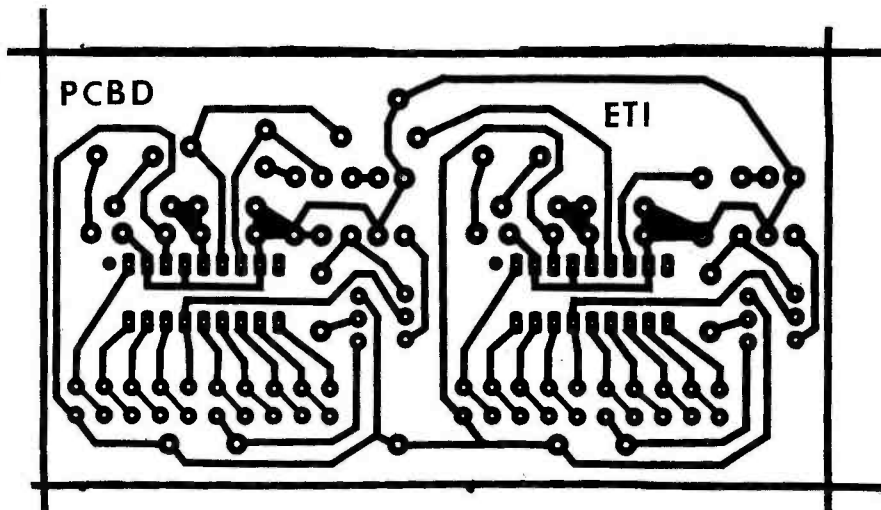


during a call, the card is returned and the display flashes for a few seconds before automatic disconnection. The card is then disposed of and a new one purchased.

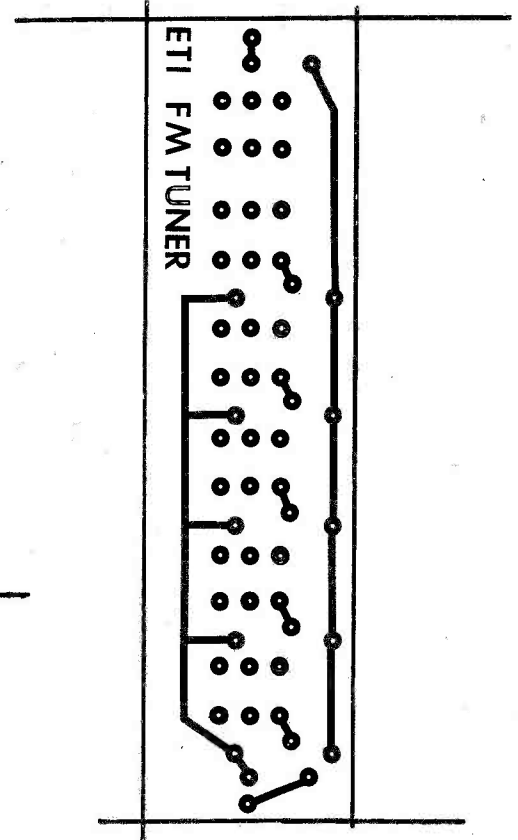
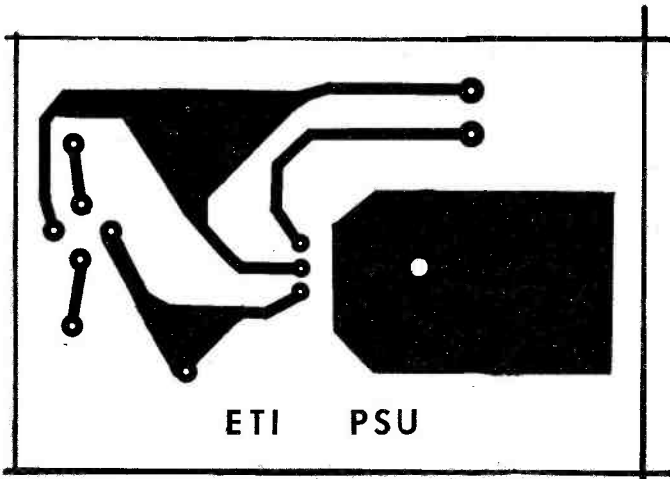
PCB FOIL PATTERNS



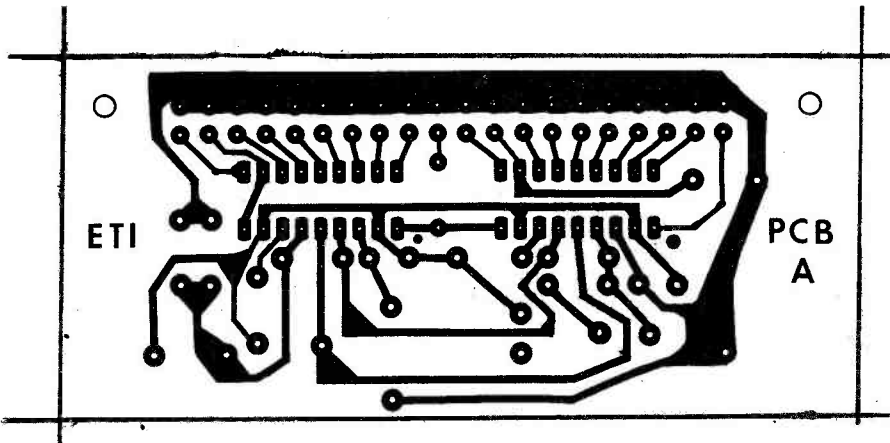
The FM Tuner boards B (above), C (left) and D (below).



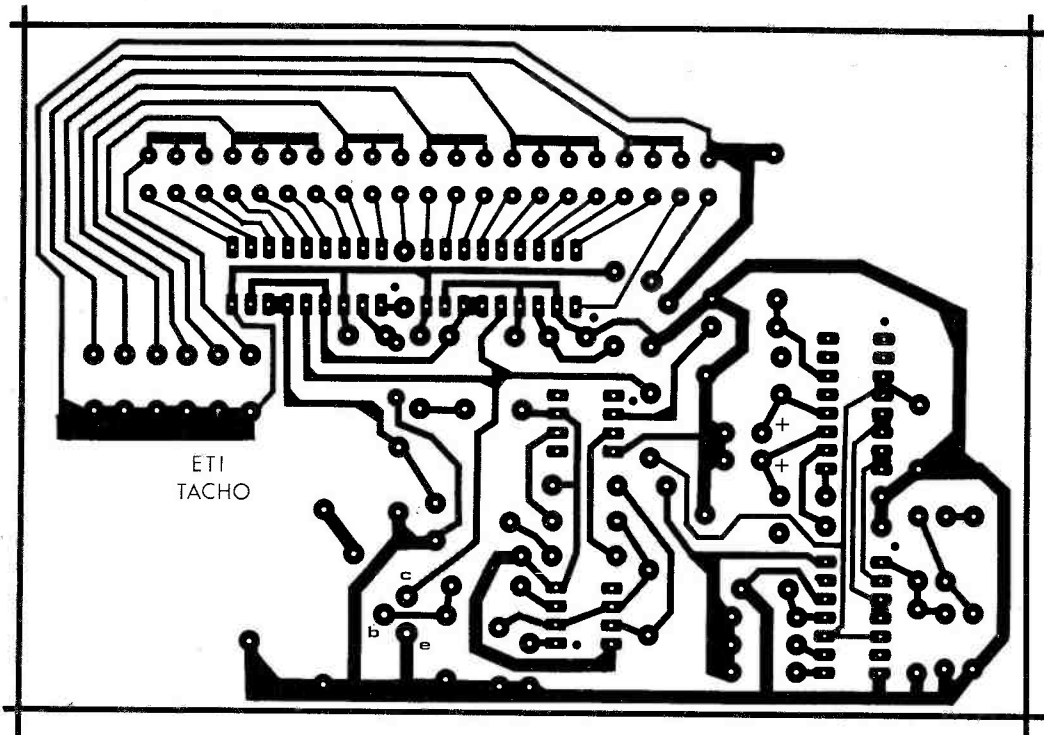
(Above) Multi-Option Siren.

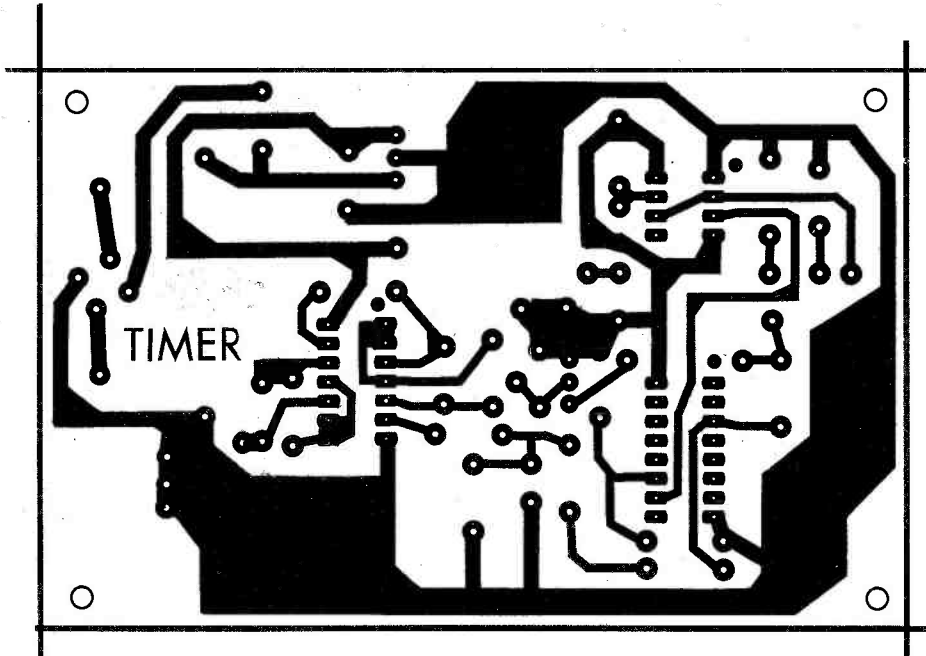


The FM Tuner PSU (above), switch assembly board (right) and PCB A (below).



(Below) LED Tacho.





(Above) Universal Timer.



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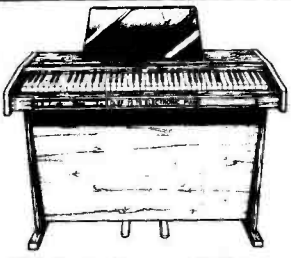
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		4068/9	22p	57p	AF124	35p	BF181	8p	ZTX300/1	14p
		4070B/1	22p	7492/3	AF125/6	35p	BF183	34p	ZTX302/3	18p
		4072/3	22p	7494	AF127	35p	BF184/5	25p	ZTX304	23p
		4081/2	26p	7495	AF139	40p	BF194/5	12p	ZTX311	18p
		4086	80p	7496	AF239	44p	BF196/7	12p	ZTX500/1	15p
		4510	100p	7497	BC107/B	10p	BF198	10p	ZTX502	20p
		4511B	100p	74100	BC109	10p	BF200	23p	ZTX503	17p
		4516/B	105p	74105	BC117	23p	BF224B	14p	ZTX504	24p
		4520/B	105p	74107	BC140	20p	BF244B	+22p	ZN696/7	20p
				74109	BC142/3	30p	BF258	26p	ZN698	20p
				74110	BC147/8	10p	BF259	40p	ZN706	14p
				74111	BC149	10p	BF259	30p	ZN914	20p
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				74125/6	BC169C	13p	BF263	25p	ZN1306	30p
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				74141/5	BC173	6p	BF265/6	20p	ZN1613	25p
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				74154	BC182L	+8p	BF269	22p	ZN2219	23p
				74155	BC183B	10p	BF270	50p	ZN2222A	23p
				74156	BC184	10p	BF271	12p	ZN2369	17p
				74157	BC186	25p	BF272	22p	ZN2484	25p
				74160	BC187	25p	BF273	150p	ZN2646	48p
				74161	BC188	15p	BF274	210p	ZN2904/5	21p
				74162/3	BC207/9	13p	BF275	110p	ZN2906/7	21p
				74164/5	BC212	10p	BF276	52p	ZN2926G	10p
				74166	BC212L	+6p	BF277	110p	ZN3053	20p
				74173	BC213L	10p	BF278	10p	ZN3054	40p
				74174/5	BC214	+8p	BF279	10p	ZN3055	45p
				74176/7	BC238	18p	BF280	40p	ZN3442	140p
				74180	BC261B	25p	BF281	45p	ZN3702	20p
				74181	BC301/3	32p	BF282	45p	ZN3711	11p
				74182	BC328	17p	BF283	25p	ZN3772	+80p
				74190	BC338	17p	BF284	60p	ZN3773	250p
				74191	BC346	40p	BF285	92p	ZN3819	21p
				74192/3	BC477	35p	BF286	40p	ZN3820	40p
				74194	BC478	20p	BF287	42p	ZN3823	70p
				74195	BC479	23p	BF288	40p	ZN3866	65p
				74196	BC547/8	12p	BF289	42p	ZN3903/4	15p
				74197	BC557/8	14p	BF290	40p	ZN3906	15p
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<p>BUZZERS. Miniature solid state type, 2 voltages available, 8 or 12 vdc 75p each. LD10 12 volt buzzer, 50 x 30mm 55p. Carriers 12V DC Miniature alarm siren £7.85, 12V DC SIREN, all metal rotary type, high pitched wail, £8.50. Rotary alarm siren, 12V DC, red plastic unit with mounting bracket, 68 x 75mm £4.50.</p>	<p>TOOLS. SOLDER Sucker, good suction, ultra nozzle £4.99. Side cutters 5" £1.45. Pliers 5" £1.45. WRENCH DRIVER 8" LONG 50p. INTAMA 16 pin IC test clip £1.85. 5 PIECE precision screwdriver sets, individual handles, £1.05. JUMPER TEST LEAD SETS 19 pairs all leads with insulated cores each end 90p. CROWDING TOOL, a combination type for crimping red, blue and yellow terminations also incorporates a wire stripper (6 gauges) and wire cutter, insulated handles, only £2.30.</p>	<p>COPPER LAMINATED PRINTED CIRCUIT BOARD. Fibreglass Single Sided type (approx. 2mm thick) 150x95mm 40p, 200x90mm 55p. Double-sided Fibreglass 1mm thick, 180x135mm 45p. PAXOLIN BASED TYPE: (2mm thick), 180x135mm 40p, 200x200mm 50p.</p>	<p>RANK ARENA stereo cartridge pre-amplifier modules, suitable for magnetic cartridges, new, supplied with connection details, £1.95.</p>	<p>PROJECT BOXES. Sturdy ABS black plastic boxes with brass levers and lid. 75x96x35mm 65p, 95x7x35mm 75p, 115x9x37mm 87p.</p> <p>VERO HAND HELD BOX. 60p each. 24in x 3.7 in tapered, with screws 65p each.</p> <p>VERO POTTING PLASTIC Boxes with lid and screws 70x50x20mm, black, 43p each.</p>	<p>NH55 M/METER. 2,000 opv. 1KV AC/DC Volts, 100ma DC, Resistance 0-10K, 0-1 Meg, £5.50.</p>
<p>RELAYS. 2 types both operate on 12V DC, sealed plastic case types, 1-350 ohm with 2 make 5 amp contacts 75p, 2-1,000 ohm with 2 changeover, 1 amp contacts 75p.</p>	<p>MICROPHONES. Min. Tie pin. Del. used with cassette (suggested) £4.95. Low cost condenser ECM105 Omel, 600Hzms, on/off switch standard jack plug £2.95. EMS07 Condenser, uni, 600Hzms, 30-10kHz, highly polished metal body, £7.95. EM704 stereo condenser, mkt, UNI-DIR, 6000Hzms, 50-15000 Hz, internal variable, 212 ohm/imp, £12.25. EMS08 Condenser, cardioid, uni, 600Hzms or 50k, heavy chromed copper case, £12.95. DYNAMIC P.A. Mkt, mobile radio etc., 10mm switch 50k imp, £3.75. CASSETTE replacement microphones with replacement 35-10mm 40p. GRUNING Electrical inserts, with built in FET preamp 3.6V DC, £10.00.</p>	<p>TAPE HEADS. Mono cassette, £1.75. Stereo cassette £3.90. Standard B track stereo £1.95. 8SH MM 1330 1/2 track 50p. BSR SP90 1/2 track £2.10. TD10 dual head assembly 2 heads both 1/2 track R/P with built in erase £1.25.</p>	<p>FINNED HEATSINKS. Supplied indented 4mm thick, 27mm high, 75x124mm 60p, 150x124mm 95p. Smaller version 2.7mm thick, 75x108mm 48p. TRANSISTOR SOCKETS T05 or T018 9p each, T03 type 15p each.</p>	<p>35 WATT RMS STEREO SPEAKER SYSTEM. Monitor, Speaker, Tweeter (controlled) in black heavy alloy cabinet, 7 1/2" x 4 1/2" x 4" £35.75 pair P&P £1.95.</p>	<p>YN360 M/METER. 20,000 opv., 1KV AC/DC Volts, 250ma DC, Resistance ranges to 20 Meg, also has built-in transistor tester with leakage and gain ranges £12.50.</p>
<p>SPECIAL OFFER SEMICONDUCTORS. 2N6582 SCR 10p. 6X504 opto isolator 25p. CA3130 95p. CA3020 45p. TDA1151 25p. 741 22p. 723 35p. NE555 24p. NE555 50p. CD4069 15p. IN4005 10 for 30p. 00238 20p. 90438 20p. 7415 35p. 7414 75p. 91A33A 3mm LED displays 45p. Mkt. LDH 30p. LEDS 0.2" CLEAR 15p. GREEN 12p. RED 10p. Infra-red clear LED 30p. MPU131 PUTs, 40V, 200ma, 375mW 15p. 2K3773 £1.70. Texas R102B T103 Power trans. 50p. T64343 SCR 45p.</p>	<p>NEW STOCK ITEM — We are now stocking Expo metal hand-held drills, these are a precision British-made tool. Ideal for P.C. board drilling, model makers etc. They operate on 12V DC. Drill bit supplied in plastic hinged case, with drill and 21 accessories, drills, sanders, rasers, buffers, etc. complete kit only £17.25. Drill only £7.25. Drill stand in sail varnished drill press £12.95 (postage 65p).</p>	<p>SWITCHES. Sub. min. Toggles. SPST 8x5x7mm, 42p. DPDT (8x7x7) 55p. DPDT Centre off (12x11x9mm) 77p.</p> <p>PUSH SWITCHES (16x6mm), red top, push in make 15p each, push on break version black vinyl 17p each.</p> <p>SLIDE SWITCHES all OPDT 15x8x12mm 13p, 10x11x9mm 13p, 22x13x8mm 13p, 22x12x8 centre off 14p. Multiple slider double action (12 tags) 29x9x9x1mm 25p.</p>	<p>ALUMINIUM PROJECT BOXES. 18 SW.G. with fitted lid and screws. AB1 3x2x1 52p. AB2 4x3x1 50p. AB3 4x3x2 66p. AB4 6x4x2 74p. AB5 6x4x3 92p. AB6 8x6x2 105p. AB7 8x6x3 112p.</p>	<p>SPECIAL OFFER DEMAGNETIZER. Curved probe type, suitable for reel to reel or cassette machines, operates on 240V AC only £1.95.</p>	<p>HANDY BENCH VICE. 1" jaw opening £2.95, 6" £12.95.</p> <p>MOTORISED ALARM BELLS. 65ma, 80dB £7.95.</p> <p>AUDIOSONIC CAR STEREO CASSETTE PLAYERS. 3 watts per channel output, HiFi output amp., auto-stop mechanism (Japanese) £12.50.</p>
<p>LED VU METERS. Unlike sophisticated logic control circuit with adjustable rise and decay times via external capacitor. Spec: Response — 20Hz to 100kHz. Tolerance within ± 10%. Operates on 12-15V DC, 82mm long. Same high.</p> <p>MONO VERSION £6.95 STEREO VERSION £10.95</p>	<p>10 pin D.I.J. SWITCHES only 42p each.</p> <p>RIBBON CABLE 8-way single core miniature 22p per metre.</p>	<p>ROTARY SWITCHES (water) 3P4W, 4P2W, 2P6W and 1P12W all 35p each.</p> <p>INCADS. AA size 1.2 volts 500ma £1.10 each.</p>	<p>ANTEX SOLDERING IRONS. All 240V AC. Model C 15 watts £3.95. Model ICX 17 watts £3.95p. Model X25 25 watts £3.95p. ST3 SOLDERING IRON STAND, suits all Antex irons £1.65.</p>	<p>POWER SUPPLIES. Switched type plugs into a 13 amp socket has 3-4, 5.6, 7.5 and 9 volts 0 c out at either 100 or 400ma switchable £3.45. HC244H stabilised power supply 3-6 7.5-9V DC at 400ma, has polarity reversing and on off switch and is fully regulated to give exact voltage from no load to maximum current £5.50.</p>	<p>TRANSISTORS, REC/SENDER. 40KHz £3.50 pair.</p>

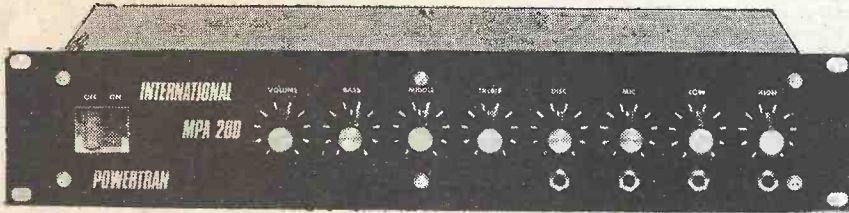
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Panel size 19.0" x 3.5". Depth 7.3"

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CHROMATHEQUE 5000 5 CHANNEL LIGHTING EFFECTS SYSTEM

This versatile system featured as a constructional article in ELECTRONICS TODAY INTERNATIONAL has 5 frequency channels with individual level controls on each channel. Control of the lights is comprehensive to say the least. You can run the unit as a straightforward sound-to-light or have it strobe all the lights at a speed dependent upon music level or front panel control and construction very straightforward.

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POWERTRAN

**SYNTHESIZER KITS ON PAGE 8. MORE KITS AND ORDERING
INFORMATION ON INSIDE FRONT COVER.**

All kits also available as separate packs (e.g. PCB, component sets, hardware sets, etc.). Prices in our FREE CATALOGUE.



**DE LUXE EASY TO BUILD LINSLEY HOOD
75W STEREO AMPLIFIER £85.00 + VAT**

This easy to build version of our world-wide acclaimed 75W amplifier kit based upon circuit boards interconnected with gold plated contacts resulting in minimal wiring and construction delightfully straightforward. The design was published in Hi-Fi News and Record Review and features include rumble filter, variable scratch filter, versatile tone controls and tape monitoring while distortion is less than 0.01%.



T20 + 20 20W STEREO AMPLIFIER £33.10 + VAT

This kit, based upon a design published in Practical Wireless, uses a single printed circuit board and offers at very low cost, ease of construction and all the normal facilities found on quality amplifiers. A 30 watt version of this kit (T30 + 30) is also available for £38.40 + VAT.

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Above 2 kits are supplied with fully finished metalwork, ready assembled high quality teak veneer cabinet, cable, nuts, bolts, etc. and full instructions — in fact everything!

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The BLACK HOLE designed by Tim Orr, is a powerful new musical effects device for processing both natural and electronic instruments, offering genuine VIBRATO (pitch modulation) and a CHORUS mode which gives a "spacey" feel to the sound achieved by delaying the input signal and mixing it back with the original. Notches (HOLES), introduced in the frequency response, move up and down as the time delay is modulated by the chorus sweep generator. An optional double chorus mode allows exciting antiphase effects to be added. The device is floor standing with foot switch controls, LED effect selection indicators, has variable sensitivity, has high signal/noise ratio obtained by an audio compander and is mains powered — no batteries to change! Like all our kits everything is provided including a highly superior, rugged steel, beautifully finished enclosure.

COMPLETE KIT ONLY £49.80 + VAT (single delay line system)

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Cabinet size 10.0" x 8.5" x 2.5" (rear) 1.8" (front)



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K001 50V ceramic plate capacitors. 5%, 10 of each value 22pF to 1,000pF. Total 210. **£3.69.**
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K003 Polyester capacitors. 10 each of these values 0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1, 0.15, 0.22, 0.33, 0.47µ. 110 altogether for **£5.07.**

K004 Mylar capacitors. min 100V type 10 each all values from 1,000pF to 10,000pF. Total 130 for **£4.05.**

K007 Electrolytic capacitors 25V working small physical size. 10 each of these popular values 1, 2, 4, 7, 10, 22, 47, 100µF. Total 70 for **£3.59.**

K008 Extended range, as above, also including 220, 470 and 1000µF. Total of 100 for **£6.05.**

K021 Miniature carbon film 5% resistors CR25 or similar. 10 of each value from 10R to 1M. E12 series. Total 810 resistors **£6.15.**

K022 Extended range. Total 850 resistors from 1R to 10M **£8.50.**

K041 Zener diodes 400mW 5% BZY88. etc. 10 of each value from 2.7V to 36V. E24 series. Total 280 for **£16.37.**

NEW K051 LED's — 10 each red, green & yellow 3mm & 5mm, with clips. Total 60 LED's for **£8.95.**

BUZZERS, MOTORS & RELAYS

Z401 Powerful 6V DC buzzer, all metal construction. 50mm dia x 20mm **85p.**

Z402 Miniature type buzzer, 6, 9 or 12V, only 22 x 15 x 16mm. Very neat **65p.**

Z450 Miniature 6V DC motor, high quality type 32mm dia x 25mm high, with 12mm spindle. Only **£1.**

A372 Audible Warning device — solid state circuit drives high efficiency transducer to give high output. Voltage read 4-18V. Can also be driven direct from TTL or CMOS. Module size 45 x 21 x 12mm. Comprehensive data supplied **£1.50.**

WH82 Heavy Duty 12V relay, ideal for car use — single 15A make contact. Coil 25R in sealed metal can with mounting bracket **85p.**

WH90 D.L. Reed relay SPCO 2.4-10V. 200R coil. Only **£2.20.**

FSRA60 Latching relay 2 x 10A contacts, 1M² 1B. Coil is 250R, and rated 60V ac, but works on 18-24 DC. Solid Encapsulation with screw terminals makes it ideal for use. **£1.20.**

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SPEC Output voltage 0-28V
Output current 20mA-2A
Source impedance OR1
Open circuit ripple 10mV

Send SAE for full details of the many ways this useful module can be used, together with price list of parts for various options. Only **£7.75.**

IN4004 & 6 DIODES

Special purchase of 1A recs. Russian made. Packed in boxes of 300, **£8.50** per box, 4 boxes **£30.00**; 10 boxes **£75.00.**

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0.22µF 12V 8mm dia. Ideal for decoupling 100 for **£2.75**; 1000 **£20.00.**
0.05µF 12V 15mm dia 100 **£1.50**; 1000 **£12.00.** Pack of disc ceramics, assorted values and voltages — 200 for **£1.00.**

TRANSFORMERS

Mains primary 50V 20A sec **£20.00.** Mains pri 110V 15A sec **£30.00**; 20A **£40.00.**

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Made by Piber. types PL40CP & PL60C. Silty prices for superb goods!!!

PL40CP — 69 x 16 x 9mm, 40mm slide length 20R, 2k or 10k in only. Prices (any mix) 1-24 20p; 25-99 17p; 100+ 14p.

PL60C — 84 x 10 x 7mm, 60mm slide length. 5k, log, only. Prices 1-24 25p; 25-99 22p; 100+ 17p.

CALC CHIPS 60p!!!

New full spec. supplied with data. Type MK50321 — full function inc memory. Only 60p

DISPLAYS

8 and 9 digit 7-segment bubble type for above chips — most have minor faults, dud segment, etc. Mixture of 2 or 3 different types with data. 5 for **£1.00.**

NICADS

Ex-equip size C approx. **£1 each**; 10 for **£8.00.**

COMPONENT PANELS

Z525 Contain: 11 800mA 60V 2N5061 SCRs, 11 6VB zeners, 11 1N4004 diodes plus Rs, Cs, etc. Only **£1.**

Z529 74 Series ICs — Gates and complex logic, 20 asstd. ICs on panels **£1**; 100 ICs **£4.**

Z527 2x6V reed relays, 6x 25030 or 2S230 6x400V reeds, plus Rs. Only **50p.**

TTL, LINEAR, OPTO

All new full spec — Fairchild/SGS: TTL: 5400, 5401, 5402, 5403, 5404, 5405, 5410, 5421, 5430, 5450, 5451, 5453, 5460

— All 12p ea. 5470, 5472, 5474, 5475, 5476, 5480, 5486, 5490, 54107, 54121, 54122 — all 20p ea. 5482, 54126 — 40p ea. Others (74S, H) on B/L 12 (SAE please).

LINEAR: 9665 or 9666, 7 x 50V Darlingtons in 16 DIL 60p; 75452 or 4 dual periph driver 70p; XK1444 7 CMOS P-channel buffers, 15V 16 DIL 24p.

OPTO: Isolators, FCD831 60p; TLL115/118 60p; FPE100/106 Infra red LED **£2.50**; FND847 7 seg 8" CA **£2.00**; FND850 CC **£2.00.** (Data on request for linear & opto devices).

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The following values only at **£3.50/1,000**, per value 47R, 82R, 18R, 39R, 56R, 220R, 1k, 4k7, 18k, 33k, 39k, 47k, 220k, 390k, 560k, 880k, 820k.

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0.1W miniature type, open construction. All values from 100R to 1M, vertical or horizontal mounting. All at **£0.42.**

The following values only at **£0.3**: 470R, 470R^{1/2}, 500R, 1k, 1k5, 2k, 2k2, 2k5, 4k7, 10k. Also some PVR enclosed type at **£0.42**: 150R, 200R, 2kV.

POTS

5k lin, 100k lin; 220k lin; 500k log; 1M lin. All with std. bush and spindle. **14.**

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All 5mm pitch. Value/Voltage			
0.47/50	.022	47/40	.026
1/50	.024	100/16	.022
2.2/50	.024	100/40	.027
4.7/25	.042	220/63	.048
10/16	.021	330/25	.048
10/40	.023	1000/16	.06
22/25	.023	2200/40	.32
47/25	.025	8mm 16mm pitch.	

MiniBox Polysters

Value/Voltage/Pitch			
1/100/7.5	.024	033/250/10	.028
068/250/10	.024	22/100/15	.036
022/400/10	.024	33/100/15	.046
01/630/7.5	.022	47/100/15	.052
01/100/7.5	.022		

ZENERS. 400mW 5% 2V4 3V6 4V7 6V2 6V8 7V5 8V2 11V 12V 14V 18V 24V. All at **£0.3**

LED'S

3mm red	.065	5mm yellow	.09
3mm yellow	.08	5mm green	.09
3mm green	.08	3mm clips	.02
5mm red	.06	5mm clips	.02

MINIATURE CERAMIC CAPS

Thompson; CSF miniature type in the following values

3.9pF,	4.7pF,	22pF,	33pF,
47pF,	47pF,	47pF,	68pF,
82pF,	100pF,	560pF,	2700pF.
All 5% except 10%, 120%.			

Prices, up to 200pF **£7/1000**
100pF **£9/1000**
560pF **£6/1000**
2700pF **£9/1000**
Samples on request (see please).

Mullard min. ceramics:

33pF 5% 100V			£7/1000
330pF 2% 100V			£8/1000
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Stettner min. ceramics

330pF 5% 63V			£7/1000
022µF 63V			£14/1000
Lenco 047µF 63V			£16/1000

SEMICONDUCTORS

741, 12, 655, 19, 740, 108, 7405 09; 74L74, 21, 4001, 17, 4011, 17, S1 signal diode like

IN4148 by T10g bandoleried reeds of 10k **£80/1k** **£10k**; IN4002 **£25/k**; IN4006 **£34/k**; IN4007 **£36/k**; Ge signal diode DK14 **£20/k**; SCRs 2P4M (C10BD) 4A 400V. 26 2N5060, BA 30V

.15 CR201 1A 200V. 18. Send see for latest bulk buyers list.

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Texas T151 111	£28.95

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See Page 11 September E.T.I.



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FX81	£13.95	FX510	£18.95		
FX330	£15.95	FX3200	£20.95		
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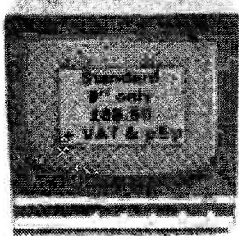
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MN2. 200 ¼ & ½-watt Resistors.	MN24. 100 asstd. small springs.
MN3. 100 1 & 2-watt Resistors.	MN25. 50 asstd. pop rivets.
MN4. 50 Wirewound Resistors.	MN26. 50 asstd. insulated crimps.
MN5. 100 metal oxide Resistors. 1%, 2% and 5%.	MN27. 200 items, grommets, spacers, cable markers, plastic screws, sleeving, tie wraps etc.
MN6. 12 asstd. potentiometers.	MN28. 20 asstd. fuses 1¼" 20mm etc.
MN7. 25 asstd. skeleton pre-set Resistors.	MN29. 75mts equipment, wire, asstd. colours and sizes.
MN8. 50 asstd. Electrolytic Capacitors.	MN30. 3 x 2m length, 3 core, mains cable.
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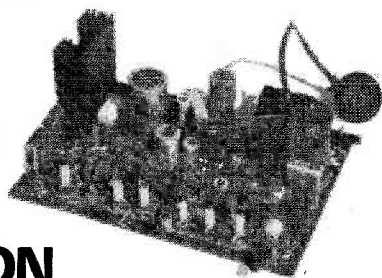
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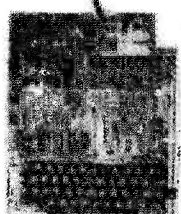
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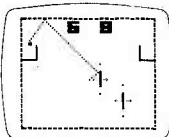
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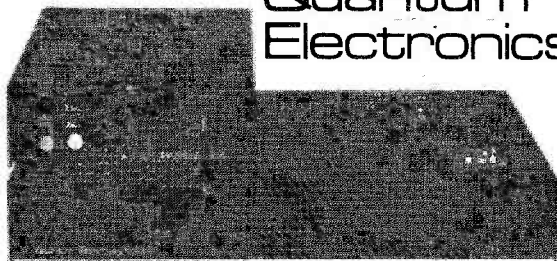
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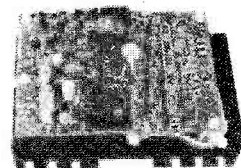
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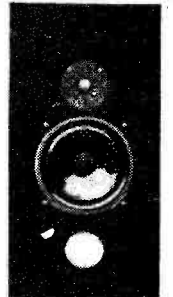
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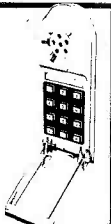
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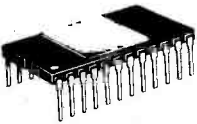
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LS155	85	4054	130
LS156	95	4055	135
LS157	95	4058	28
LS158	85	4059	28
LS160	120	4060	30
LS161	95	4071	25
LS162	110	4072	25
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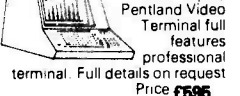


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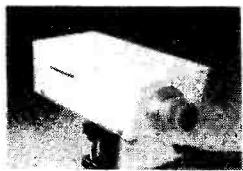
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ETI ADVERTISEMENT INDEX

AITKEN BROS	86	L & B ELECTRONICS	106
ALTEK INSTRUMENTS	42	LINSAC	107
AMBIT INTERNATIONAL	53	MACLIN-ZAND	27
AUDIO ELECTRONICS	14, 28 & 42	MANOR SUPPLIES	107
AURA SOUNDS	85	MAPLIN	124
BAYDIS	33	MARSHALLS	52
BI-PAK SEMICONDUCTORS	48	MAYWARE LTD	70
BK ELECTRONICS	71	MICROCIRCUITS	99
BNRS	41	MICRODIGITAL	14
BOSS INDUSTRIAL	47	MICROTYPE	108
BUTTERWORTHS	76	MINKITS	70
CALCULATOR SALES & SERVICE	116	MINIM AUDIO	93
CAMBRIDGE LEARNING	69	MITRAD	34 & 35
CASTLE ELECTRONICS	16	MOUNTAINDENE	103
CHILTMead	61	NIC MODELS	117
CHORDGATE	116	NTC	114
CHROMASONICS	46 & 47	PARNDON ELECTRONICS	112
CHROMATRONICS	7	T. POWELL	93
CLEF PRODUCTS	114	POWERTRAIN	2, 8 & 115
CODESPEED	107	PROGRESSIVE RADIO	114
COMP, COMP, COMP	122 & 123	PROTON ELECTRONICS	113
CRIMSON ELEKTRIK	107	QUANTUM ELECTRONICS	118
CROFTON ELECTRONICS	117	RAPID ELECTRONICS	100
C.S.C.	33, 39	J. W. RIMMER	76
DELTA TECH & CO	113	RISCOMP LTD	76
DISPLAY ELECTRONICS	40	R.T.V.C.	10
DORAM ELECTRONICS	75	SAXON ENTERTAINMENTS	100
EDA	33	SCIENCE OF CAMBRIDGE	4 & 5
ELECTRONIZE DESIGN	42	SILICA SHOP	108
ELECTRO SUPPLIES	60	SURETRON SYSTEMS	118
ELECTROVALUE	100	SWANLEY ELECTRONICS	117
EXPERIMENTAL ELECTRONICS	112	TANGERINE	94 & 95
GENERAL NORTHERN MICROCOMPUTERS	52	TECHNOMATIC	26
GREENBANK	87	TEMPUS	56
GREENWELD	116	TIMEDATA	113
HAPPY MEMORIES	60	TK ELECTRONICS	104
HEATH ELECTRONICS	86	TRANSAM COMPONENTS	12
HENRY'S RADIO	52, 60, 101	UNILAB	113
ILS	93	VIDEOTONE	25
ILP	20, 21, 70	WATFORD ELECTRONICS	6 & 7
KEELMORE LTD	106	WEST HYDE DEVELOPMENTS	105
LB ELECTRONICS	119	WILMSLOW AUDIO	108

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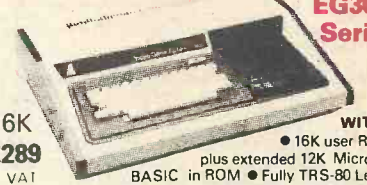
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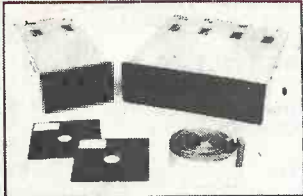
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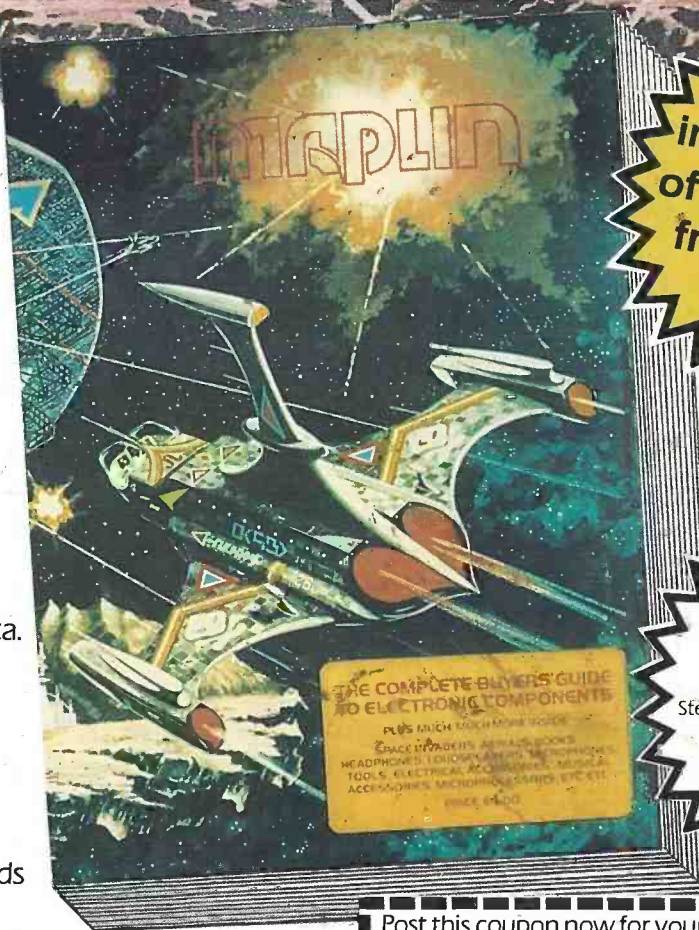
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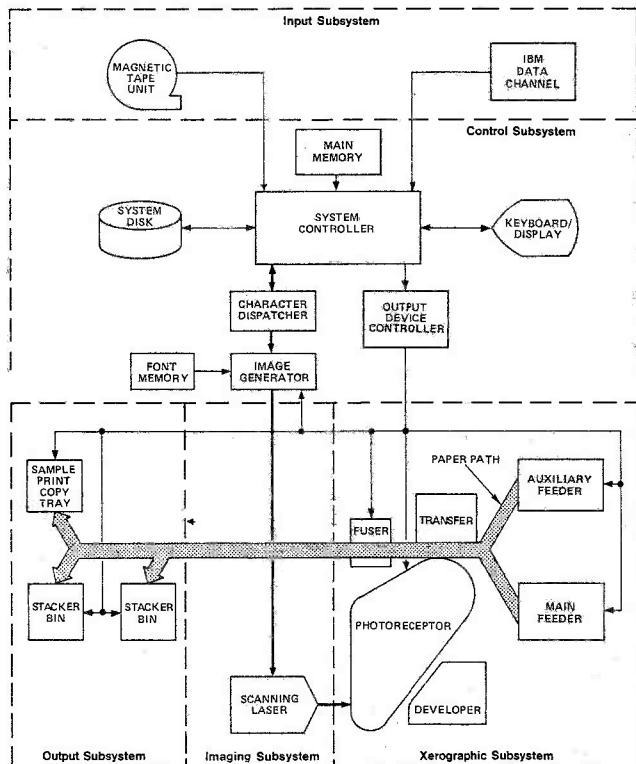
Rank Xerox's new baby, the Xerox 9700, offers the first direct link between computers and the xerographic process. From a digital input, the 9700 can simultaneously produce a business form and the computer-generated text to go on the form.

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).

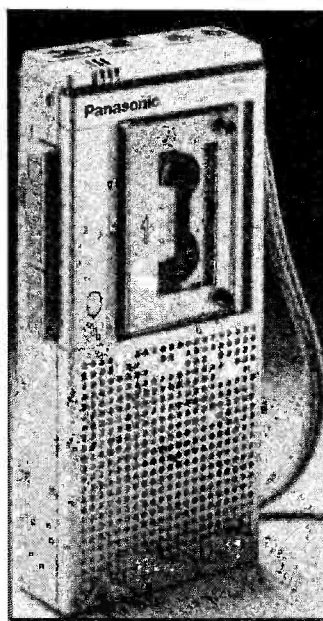
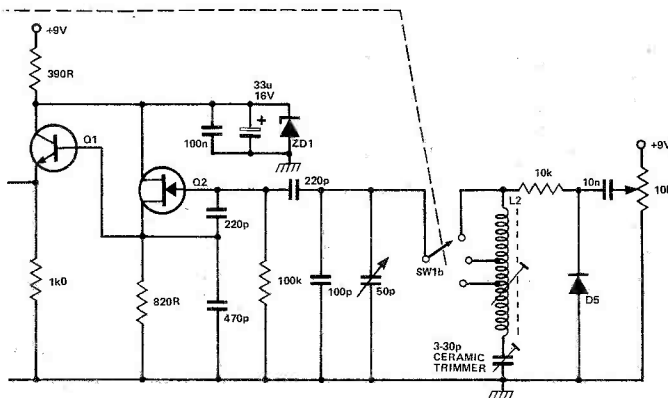


Functional Diagram of Xerox 9700 Electronic Printing System

OOPS Tech-Tips

Last 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 micro-cassette 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.

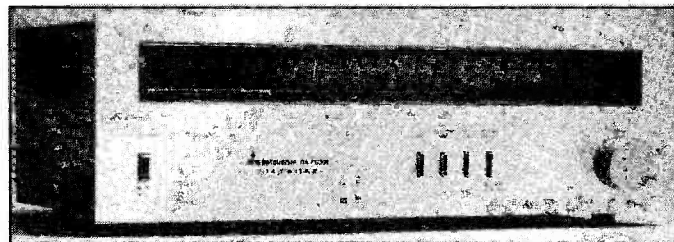
The RN-Z01 measures only 14.25 x 64 x 2.58 cm, weighs only 270g, is fully compatible with the Panasonic RN-195 transcription machine and comes complete with a cassette and carrying case for only £49.42 plus VAT. It is only available through distributors of Panasonic Business Equipment. For details of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

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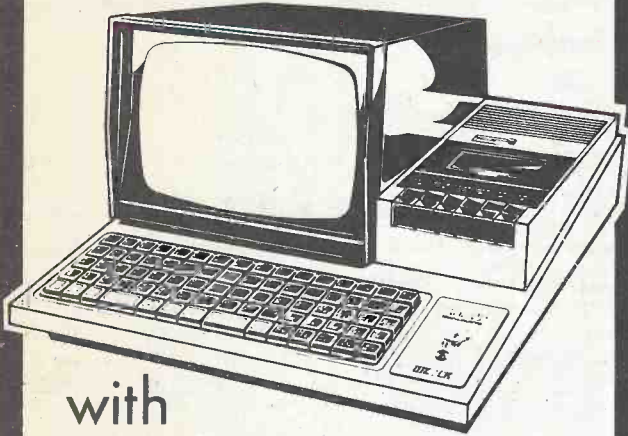
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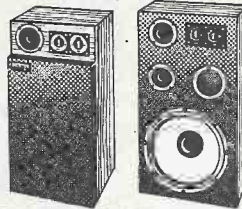
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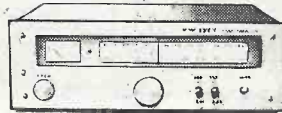
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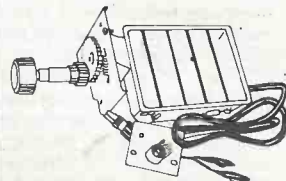
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Drum Sequencer

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.

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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

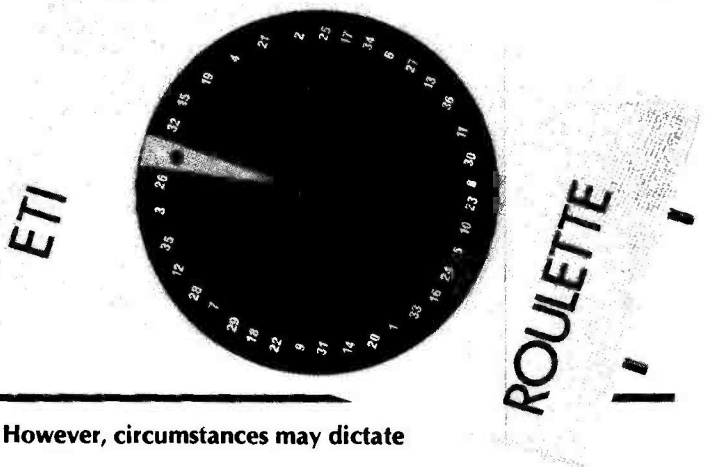
For the first time in a UK electronics magazine, ETI features an accurate, calibrated Sound Pressure Level Meter design based on a special-purpose, but modestly priced, precision microphone insert.

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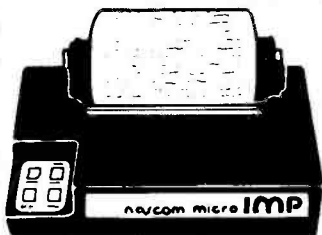
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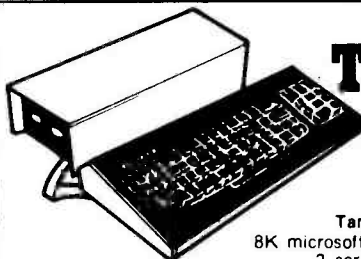
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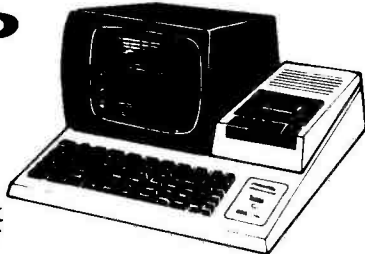
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MICROBASICS

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

If, 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 understand 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.

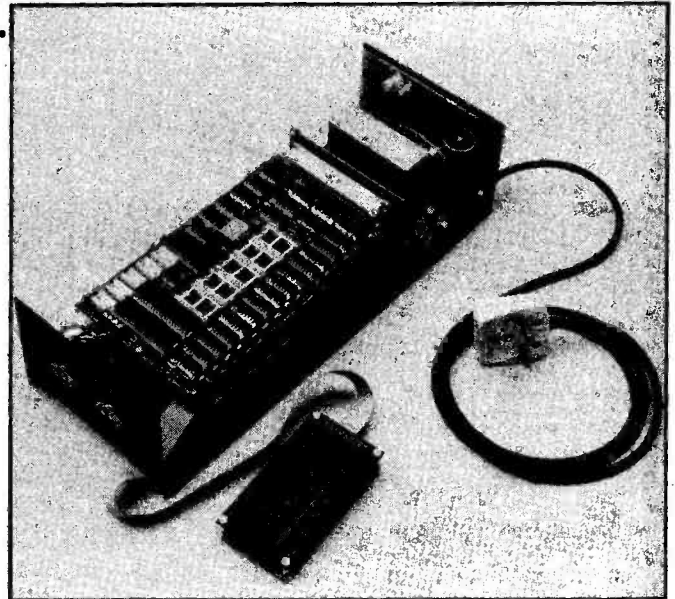
Monitoring The Situation

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 occurred 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

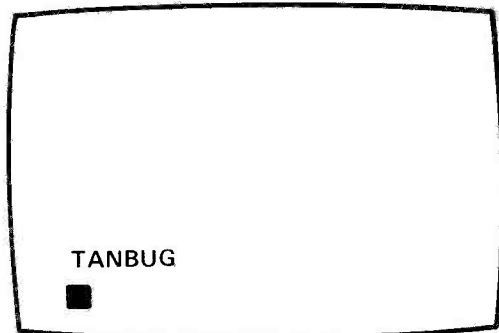


Fig 1. The monitor announces itself to the world and 'prompts' the user to do something. The ■ is replaced by a '?' in the event of an error.

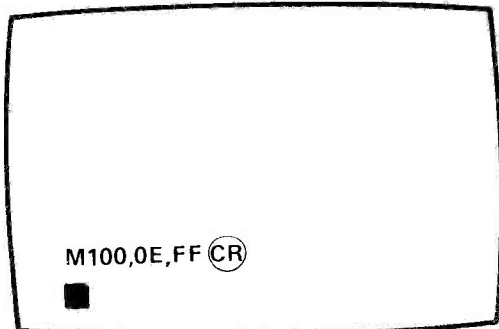


Fig 2. Typing M100 CR opens the specified location and reveals the current value 0E. We have replaced this with FF and closed the location but we could have stepped forward or back through memory by using other commands.

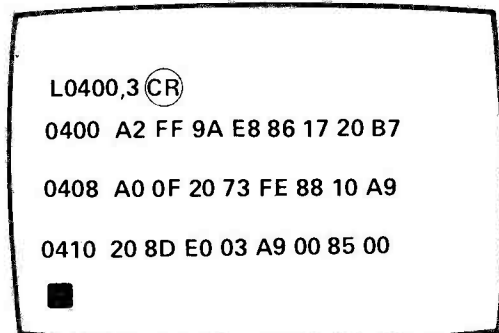


Fig 3. The monitor will list the program from any given address in blocks of eight bytes per line for up to 256 lines. Here we have selected three.

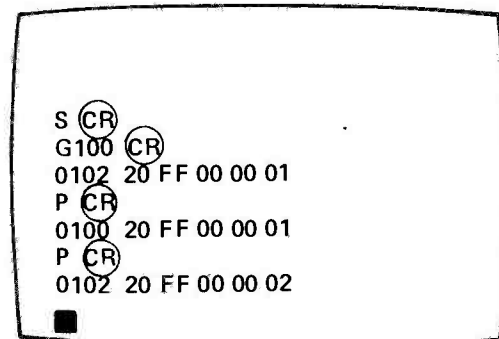
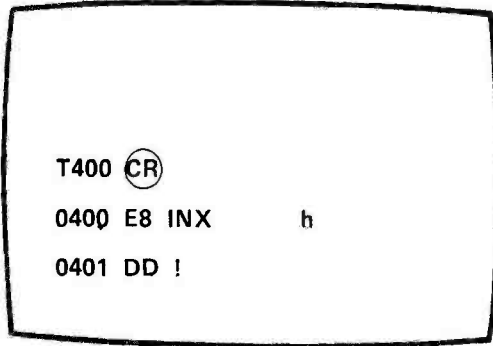


Fig 4. By setting the monitor to operate in single steps, we can inspect the contents of each register in the CPU after each step before proceeding with the P command. The registers are; next address to be executed, CPU status value, low byte of the stack pointer, index X register value, index Y register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



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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 XBUG 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 line-by-line translator, which converts the stored Hex into the more meaningful assembly language mnemonics. It is called a 'line-by-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 dis-assembling 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 required.

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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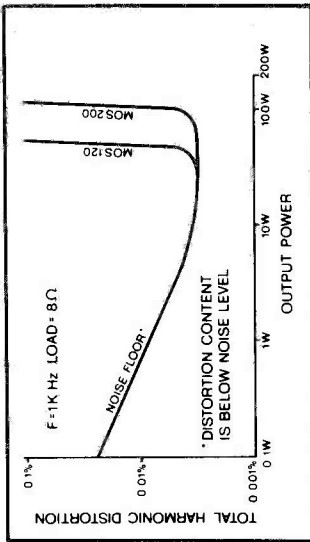
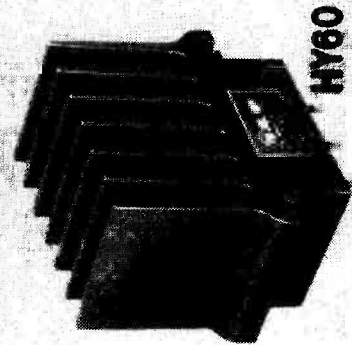
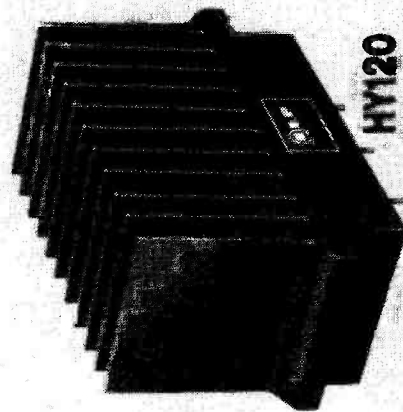
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Model	Output Power RMS	Distortion Typical at 1KHz	Slew Rate	Rise Time	Signal/Noise Ratio DIN AUDIO	Price & VAT
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MOS200	120W into 4-8Ω	0.005%	20V/μs	3μs	100dB	£33.46 + £5.02

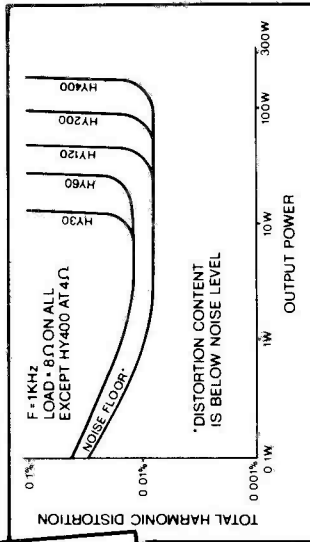
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CHOOSE AN I.L.P. BIPOLAR POWER AMP where power and price are first consideration while maintaining optimum performance with hi-fi quality and wide choice of models. From domestic hi-fi to disco and P.A., for instrument amplification, there is an I.L.P. Bipolar to fill the bill, and as with our new Mosfets, we have encapsulated Bipolars within our New Profile extrusions with their computer-verified thermal efficiency and improved mounting shoulders. Connections are simple, via five pins on the underside and with our newest pre-amps and power supply units, it becomes easier than ever to have a system layout housed the way you want it.

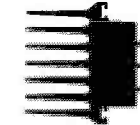
Model	Output Power RMS	Distortion Typical at 1KHz	Slew Rate	Rise Time	Signal/Noise Ratio DIN AUDIO	Price & VAT
HY30	15W into 4-8Ω	0.015%	15V/μs	5μs	100dB	£6.34 + 95p
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HY120	60W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£15.20 + £2.28
HY200	120W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£18.44 + £2.77
HY400	240W into 4Ω	0.01%	15V/μs	5μs	100dB	£27.68 + £4.15



Load impedance both models 4Ω; -∞ Input sensitivity both models 500mV
Input impedance both models 100KΩ
Frequency response both models 15Hz-100KHz-3dB



Load impedance all models 4Ω; -∞ Input impedance all models 100KΩ
Input sensitivity all models 500mV
Frequency response all models 15Hz-50KHz-3dB



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The introduction of standard heatsink extrusion for all I.L.P. power amplifiers achieves many advantages: - Research shows they provide optimum thermal dissipation and stability. Slotted shoulders allow easy mounting; standardisation enables us to keep our prices competitive. Surfaces are matt black, anodised for lower thermal conductivity. Extrusions vary in size according to module number.

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Sizes - HY6 - 45 x 20 x 40 mm. HY66 - 90 x 20 x 40 mm. Active Tone Control circuits provide ± 12 dB cut and boost. Inputs Sensitivity - Mag. PU. - 3mV; Mic. - selectable 1-12mV; All others 100mV. Tape O/P - 100mV. Main O/P - 500mV. Frequency response - D.C. to 100KHz - 3dB.

HY6 mono £5.60 + 84p VAT Connectors included

HY66 stereo £10.60 + £1.59 VAT Connectors included

B6 Mounting Board for one HY6 78p + 12p VAT

B66 Mounting Board for one HY66 99p + 15p VAT

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Of the eleven power supply units which comprise our current range, nine have toroidal transformers made in our own factory. Thus these I.L.P. power supply units are space-saving, more efficient and their better overall design helps enormously when assembly building. All models in the range are compatible with all I.L.P. amps and pre-amps with types to match whatever I.L.P. power amps you choose.

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• THE FOLLOWING WILL ALSO DRIVE I.L.P. PRE-AMPS

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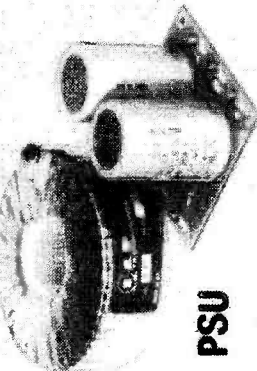
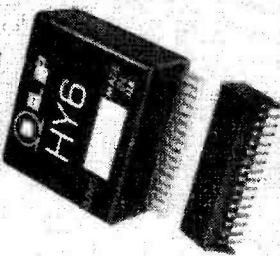
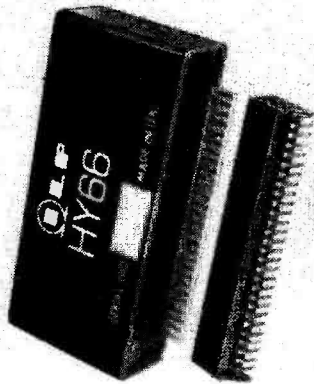
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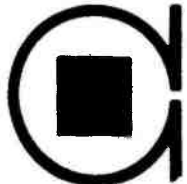
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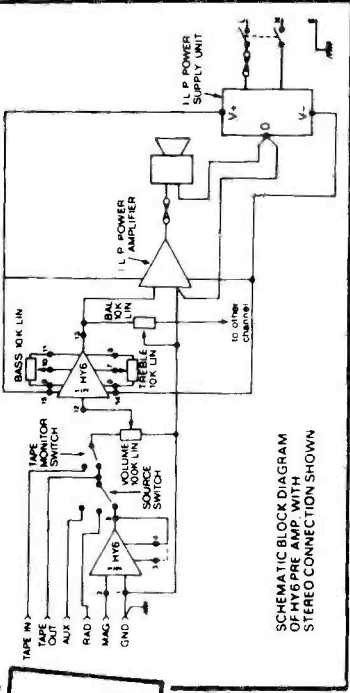


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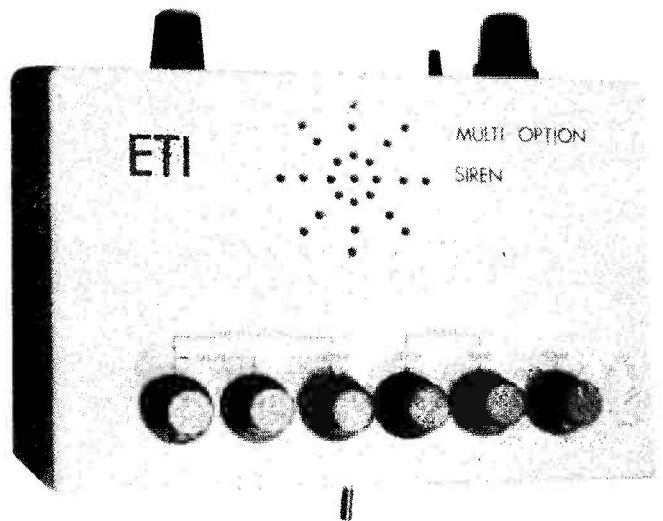
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MULTI~OPTION SIREN

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.

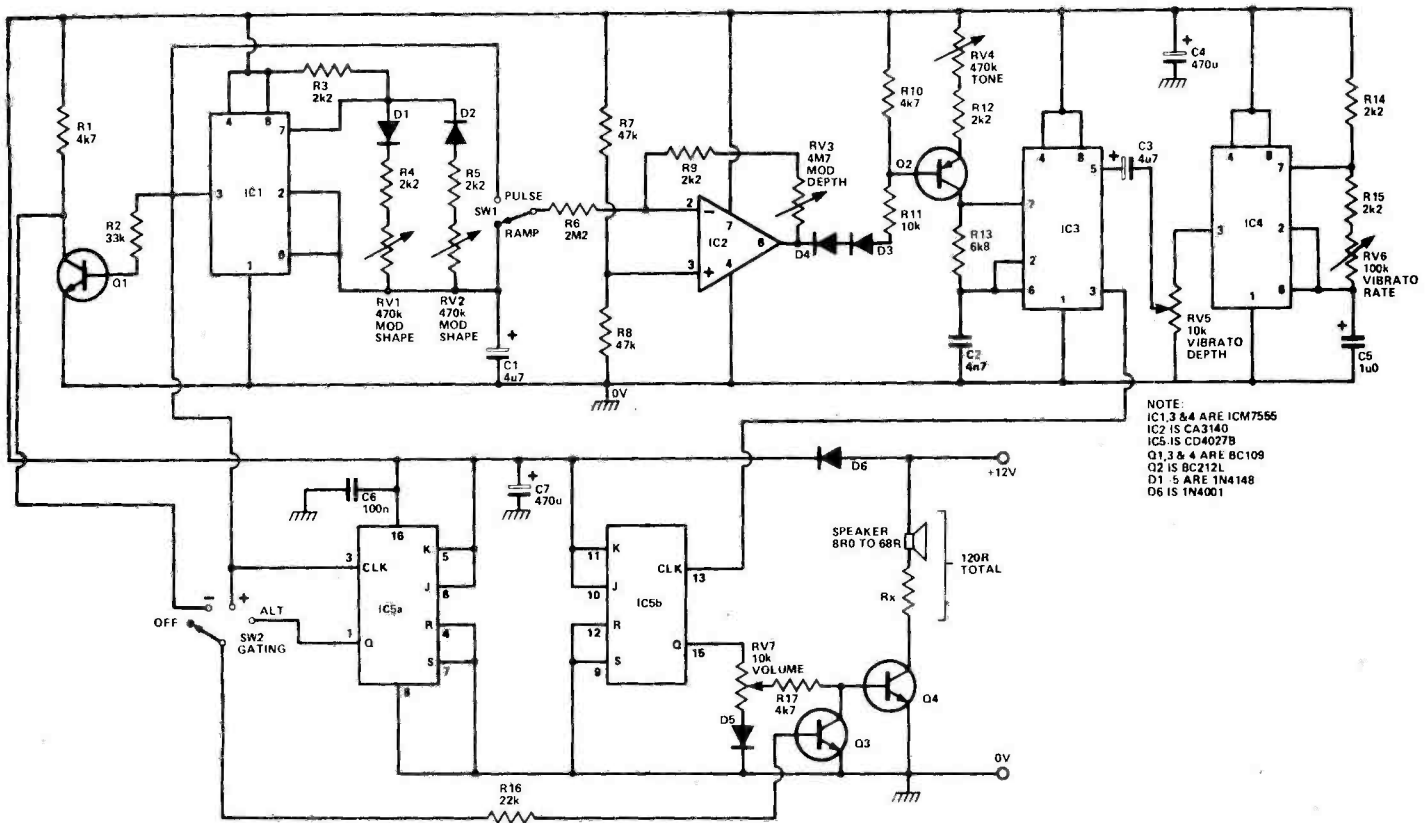


Fig. 1 Circuit diagram.

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.

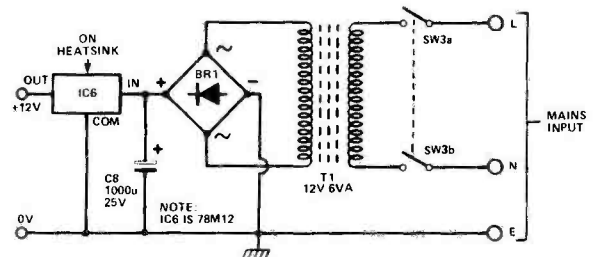
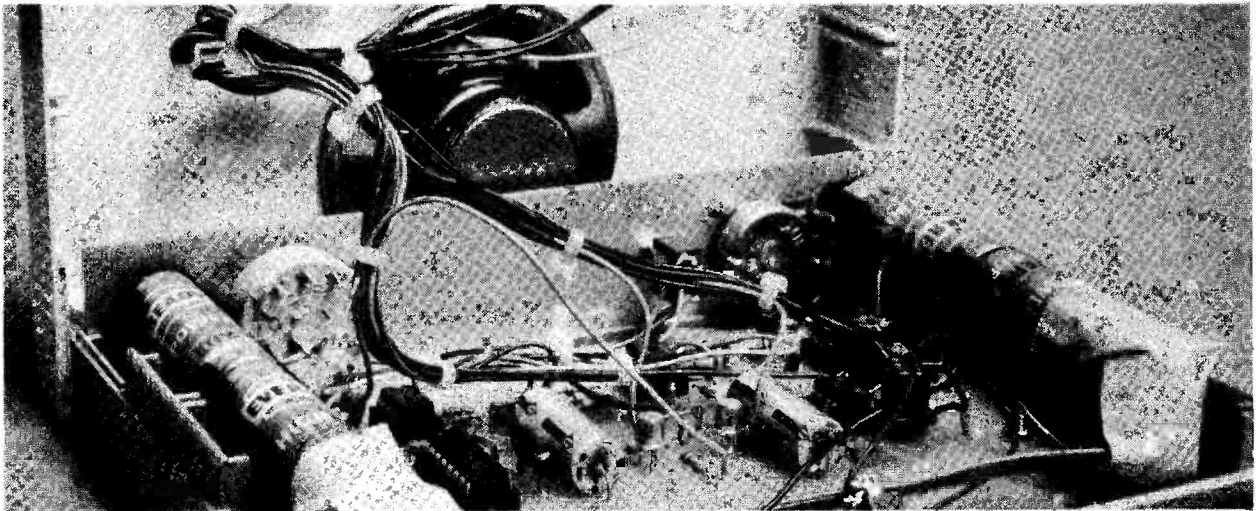


Fig. 2 Alternative battery and mains power supply options.

BUYLINES

There should be no problem in obtaining any of the components used in the ET1 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.



PARTS LIST

Resistors all 1/4W 5%		C3	4u7 63 V electrolytic PCB type
R1,10,17	4k7	C4,7	470u 25 V axial electrolytic
R2	33k	C5	1u0 63 V electrolytic PCB type
R3,4,5,9,12,14,15	2k2	C6	100n polyester Mullard C280
R6	2M2	Semiconductors	
R7,8	47k	IC1,3,4	ICM7555
R11	10k	IC2	CA3140
R13	6k8	IC5	4027B
R16	22k	Q1,3,4	BC109
Potentiometers		Q2	BC212L
RV1,2,4	470k linear	D1-5	1N4148
RV3	4M7 linear	D6	1N4001
RV5	10k linear	Miscellaneous	
RV6	100k linear	SW1,3	DPST miniature toggle
RV7	10k logarithmic	SW2	1 pole 4 way rotary switch
Capacitors		LS1	68R
C1	4u7 35 V tantalum	4 Section battery holders (HP7 type) (2 off)	
C2	4n7 ceramic	Vero Case (order code 202-21037L)	
		Knobs to suit (8 off)	

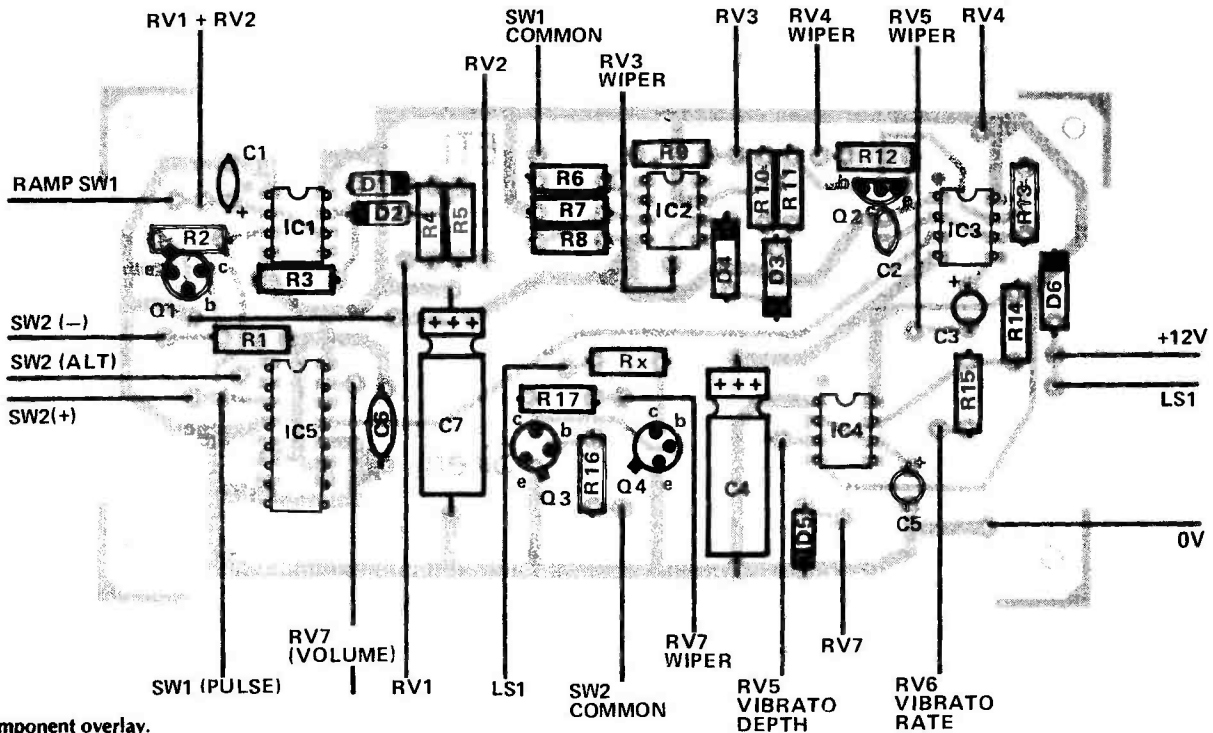


Fig.3 Component overlay.

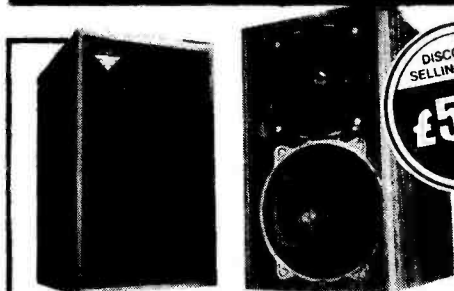
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<tr><td>7409</td><td>19p</td><td>74500</td><td>14p</td><td>4031</td><td>200p</td></tr> <tr><td>7410</td><td>15p</td><td>74502</td><td>16p</td><td>4034</td><td>200p</td></tr> <tr><td>7411</td><td>24p</td><td>74504</td><td>18p</td><td>4035</td><td>110p</td></tr> <tr><td>7412</td><td>24p</td><td>74504</td><td>18p</td><td>4036</td><td>25p</td></tr> <tr><td>7413</td><td>40p</td><td>74505</td><td>20p</td><td>4039</td><td>285p</td></tr> <tr><td>7414</td><td>40p</td><td>74508</td><td>22p</td><td>4040</td><td>100p</td></tr> <tr><td>7414</td><td>40p</td><td>74509</td><td>21p</td><td>4041</td><td>80p</td></tr> <tr><td>7416</td><td>27p</td><td>74510</td><td>20p</td><td>4042</td><td>80p</td></tr> <tr><td>7417</td><td>27p</td><td>74511</td><td>20p</td><td>4043</td><td>90p</td></tr> <tr><td>7421</td><td>40p</td><td>74513</td><td>40p</td><td>4044</td><td>90p</td></tr> <tr><td>7422</td><td>22p</td><td>74520</td><td>50p</td><td>4046</td><td>110p</td></tr> <tr><td>7423</td><td>34p</td><td>74521</td><td>40p</td><td>4048</td><td>55p</td></tr> <tr><td>7425</td><td>30p</td><td>74527</td><td>38p</td><td>4049</td><td>45p</td></tr> <tr><td>7426</td><td>34p</td><td>74530</td><td>20p</td><td>4050</td><td>45p</td></tr> <tr><td>7427</td><td>34p</td><td>74532</td><td>20p</td><td>4051</td><td>110p</td></tr> <tr><td>7428</td><td>38p</td><td>74537</td><td>30p</td><td>4052</td><td>80p</td></tr> <tr><td>7430</td><td>17p</td><td>74538</td><td>38p</td><td>4053</td><td>80p</td></tr> <tr><td>7432</td><td>30p</td><td>74542</td><td>70p</td><td>4054</td><td>150p</td></tr> <tr><td>7433</td><td>40p</td><td>74547</td><td>75p</td><td>4055</td><td>125p</td></tr> <tr><td>7437</td><td>35p</td><td>74555</td><td>24p</td><td>4059</td><td>600p</td></tr> <tr><td>7438</td><td>35p</td><td>74555</td><td>24p</td><td>4059</td><td>600p</td></tr> <tr><td>7440</td><td>17p</td><td>74573</td><td>50p</td><td>4060</td><td>115p</td></tr> <tr><td>7441</td><td>70p</td><td>74574</td><td>27p</td><td>4063</td><td>120p</td></tr> <tr><td>7442</td><td>60p</td><td>74575</td><td>36p</td><td>4066</td><td>50p</td></tr> <tr><td>7443</td><td>112p</td><td>74576</td><td>45p</td><td>4066</td><td>450p</td></tr> <tr><td>7444</td><td>112p</td><td>74578</td><td>40p</td><td>4067</td><td>450p</td></tr> <tr><td>7445</td><td>100p</td><td>74588</td><td>40p</td><td>4069</td><td>20p</td></tr> <tr><td>7446</td><td>93p</td><td>74586</td><td>40p</td><td>4070</td><td>30p</td></tr> <tr><td>7447</td><td>75p</td><td>74590</td><td>40p</td><td>4071</td><td>25p</td></tr> <tr><td>7448</td><td>80p</td><td>74592</td><td>70p</td><td>4072</td><td>25p</td></tr> <tr><td>7450</td><td>17p</td><td>74593</td><td>60p</td><td>4075</td><td>25p</td></tr> <tr><td>7451</td><td>17p</td><td>74593</td><td>60p</td><td>4075</td><td>25p</td></tr> <tr><td>7453</td><td>17p</td><td>74597</td><td>110p</td><td>4076</td><td>107p</td></tr> <tr><td>7454</td><td>17p</td><td>74597</td><td>110p</td><td>4076</td><td>107p</td></tr> <tr><td>7456</td><td>17p</td><td>74597</td><td>110p</td><td>4076</td><td>107p</td></tr> <tr><td>7470</td><td>36p</td><td>745113</td><td>90p</td><td>4086</td><td>72p</td></tr> <tr><td>7472</td><td>30p</td><td>745114</td><td>45p</td><td>4093</td><td>180p</td></tr> <tr><td>7473</td><td>30p</td><td>745122</td><td>45p</td><td>4093</td><td>180p</td></tr> <tr><td>7474</td><td>30p</td><td>745123</td><td>45p</td><td>4094</td><td>250p</td></tr> <tr><td>7475</td><td>38p</td><td>745124</td><td>180p</td><td>4095</td><td>95p</td></tr> <tr><td>7476</td><td>32p</td><td>745125</td><td>60p</td><td>4096</td><td>95p</td></tr> <tr><td>7480</td><td>50p</td><td>745126</td><td>60p</td><td>4097</td><td>340p</td></tr> <tr><td>7481</td><td>100p</td><td>745132</td><td>60p</td><td>4099</td><td>200p</td></tr> <tr><td>7482</td><td>80p</td><td>745133</td><td>60p</td><td>4099</td><td>200p</td></tr> <tr><td>7483a</td><td>90p</td><td>745136</td><td>65p</td><td>40100</td><td>220p</td></tr> <tr><td>7484</td><td>100p</td><td>745138</td><td>65p</td><td>40101</td><td>132p</td></tr> <tr><td>7485</td><td>110p</td><td>745139</td><td>75p</td><td>40102</td><td>180p</td></tr> <tr><td>7486</td><td>34p</td><td>745145</td><td>110p</td><td>40103</td><td>180p</td></tr> <tr><td>7489</td><td>210p</td><td>745147</td><td>220p</td><td>40104</td><td>95p</td></tr> <tr><td>7490A</td><td>30p</td><td>745148</td><td>175p</td><td>40105</td><td>120p</td></tr> <tr><td>7491</td><td>80p</td><td>745151</td><td>80p</td><td>40106</td><td>90p</td></tr> <tr><td>7492A</td><td>46p</td><td>745153</td><td>60p</td><td>40107</td><td>60p</td></tr> <tr><td>7493A</td><td>36p</td><td>745154</td><td>200p</td><td>40108</td><td>470p</td></tr> <tr><td>7494</td><td>84p</td><td>745155</td><td>40p</td><td>40109</td><td>80p</td></tr> <tr><td>7495A</td><td>70p</td><td>745156</td><td>90p</td><td>40110</td><td>300p</td></tr> <tr><td>7496</td><td>65p</td><td>745157</td><td>60p</td><td>40114</td><td>250p</td></tr> <tr><td>7497</td><td>180p</td><td>745158</td><td>60p</td><td>4502</td><td>120p</td></tr> <tr><td>74100</td><td>130p</td><td>745160</td><td>90p</td><td>4503</td><td>70p</td></tr> <tr><td>74107</td><td>34p</td><td>745161</td><td>75p</td><td>4507</td><td>55p</td></tr> <tr><td>74109</td><td>58p</td><td>745162</td><td>110p</td><td>4508</td><td>120p</td></tr> <tr><td>74116</td><td>200p</td><td>745163</td><td>100p</td><td>4510</td><td>95p</td></tr> <tr><td>74118</td><td>130p</td><td>745164</td><td>90p</td><td>4511</td><td>120p</td></tr> <tr><td>74119</td><td>210p</td><td>745165</td><td>140p</td><td>4512</td><td>80p</td></tr> <tr><td>74120</td><td>110p</td><td>745166</td><td>180p</td><td>4514</td><td>250p</td></tr> <tr><td>74121</td><td>34p</td><td>745173</td><td>110p</td><td>4515</td><td>300p</td></tr> <tr><td>74122</td><td>48p</td><td>745174</td><td>100p</td><td>4518</td><td>100p</td></tr> <tr><td>74123</td><td>60p</td><td>745175</td><td>100p</td><td>4518</td><td>100p</td></tr> <tr><td>74125</td><td>75p</td><td>745181</td><td>320p</td><td>4520</td><td>100p</td></tr> <tr><td>74126</td><td>60p</td><td>745190</td><td>100p</td><td>4521</td><td>250p</td></tr> <tr><td>74128</td><td>75p</td><td>745191</td><td>100p</td><td>4526</td><td>108p</td></tr> <tr><td>74132</td><td>75p</td><td>745192</td><td>100p</td><td>4527</td><td>150p</td></tr> <tr><td>74136</td><td>75p</td><td>745193</td><td>100p</td><td>4532</td><td>140p</td></tr> <tr><td>74137</td><td>50p</td><td>745194</td><td>100p</td><td>4532</td><td>140p</td></tr> <tr><td>74141</td><td>50p</td><td>745196</td><td>120p</td><td>4534</td><td>550p</td></tr> <tr><td>74142</td><td>200p</td><td>745197</td><td>90p</td><td>4536</td><td>375p</td></tr> <tr><td>74145</td><td>90p</td><td>745221</td><td>120p</td><td>4538</td><td>120p</td></tr> <tr><td>74147</td><td>190p</td><td>745240</td><td>175p</td><td>4543</td><td>180p</td></tr> <tr><td>74148</td><td>130p</td><td>745241</td><td>175p</td><td>4543</td><td>320p</td></tr> <tr><td>74150</td><td>130p</td><td>745242</td><td>175p</td><td>4543</td><td>320p</td></tr> <tr><td>74151A</td><td>70p</td><td>745243</td><td>170p</td><td>4560</td><td>200p</td></tr> <tr><td>74153</td><td>70p</td><td>745244</td><td>150p</td><td>4569</td><td>250p</td></tr> <tr><td>74154</td><td>120p</td><td>745245</td><td>260p</td><td>4572</td><td>40p</td></tr> <tr><td>74155</td><td>90p</td><td>745247</td><td>140p</td><td>4583</td><td>110p</td></tr> <tr><td>74156</td><td>90p</td><td>745251</td><td>140p</td><td>4585</td><td>150p</td></tr> <tr><td>74157</td><td>70p</td><td>745252</td><td>90p</td><td>4724</td><td>250p</td></tr> <tr><td>74159</td><td>190p</td><td>745257</td><td>160p</td><td>40097</td><td>90p</td></tr> <tr><td>74160</td><td>100p</td><td>745258</td><td>160p</td><td>14411</td><td>1100p</td></tr> <tr><td>74161</td><td>100p</td><td>745259</td><td>160p</td><td>14411</td><td>1100p</td></tr> <tr><td>74162</td><td>100p</td><td>745266</td><td>100p</td><td>14412</td><td>1100p</td></tr> <tr><td>74163</td><td>100p</td><td>745273</td><td>170p</td><td>14500</td><td>700p</td></tr> <tr><td>74164</td><td>120p</td><td>745279</td><td>60p</td><td>14500</td><td>700p</td></tr> <tr><td>74165</td><td>130p</td><td>745283</td><td>90p</td><td>14589</td><td>290p</td></tr> <tr><td>74166</td><td>120p</td><td>745298</td><td>160p</td><td>AD536</td><td>£13</td></tr> <tr><td>74167</td><td>200p</td><td>745323</td><td>400p</td><td>AD581J</td><td>1400p</td></tr> <tr><td>74170</td><td>240p</td><td>745348</td><td>200p</td><td>AD752A</td><td>600p</td></tr> <tr><td>74172</td><td>450p</td><td>745348</td><td>200p</td><td>DM8123</td><td>175p</td></tr> <tr><td>74173</td><td>120p</td><td>745367</td><td>70p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74174</td><td>90p</td><td>745367</td><td>70p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74175</td><td>85p</td><td>745368</td><td>100p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74176</td><td>90p</td><td>745373</td><td>150p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74177</td><td>90p</td><td>745374</td><td>150p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74178</td><td>160p</td><td>745375</td><td>120p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74180</td><td>93p</td><td>745377</td><td>160p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74181</td><td>160p</td><td>745378</td><td>140p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74182</td><td>90p</td><td>745390</td><td>120p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74184A</td><td>150p</td><td>745393</td><td>120p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74185</td><td>150p</td><td>745399</td><td>200p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74186</td><td>500p</td><td>745445</td><td>400p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74188</td><td>325p</td><td>745670</td><td>140p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74190</td><td>120p</td><td>745670</td><td>140p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74191</td><td>120p</td><td>745670</td><td>140p</td><td>DM8131</td><td>375p</td></tr> <tr><td>74192</td><td>100p</td><td>4001</td><td>15p</td><td>75322</td><td>300p</td></tr> <tr><td>74193</td><td>100p</td><td>4002</td><td>20p</td><td>75324</td><td>375p</td></tr> <tr><td>74194</td><td>120p</td><td>4006</td><td>95p</td><td>75325</td><td>375p</td></tr> <tr><td>74195</td><td>95p</td><td>4007</td><td>20p</td><td>75361</td><td>300p</td></tr> <tr><td>74196</td><td>95p</td><td>4008</td><td>80p</td><td>75365</td><td>200p</td></tr> <tr><td>74197</td><td>80p</td><td>4009</td><td>12p</td><td>75451-2</td><td>72p</td></tr> <tr><td>74198</td><td>150p</td><td>4010</td><td>50p</td><td>75451-2</td><td>72p</td></tr> <tr><td>74199</td><td>150p</td><td>4011</td><td>20p</td><td>8726</td><td>160p</td></tr> <tr><td>74201</td><td>160p</td><td>4012</td><td>25p</td><td>8728</td><td>250p</td></tr> <tr><td>74251</td><td>140p</td><td>4013</td><td>50p</td><td>8795</td><td>180p</td></tr> <tr><td>74252</td><td>250p</td><td>4014</td><td>84p</td><td>8797</td><td>180p</td></tr> <tr><td>74278</td><td>290p</td><td>4015</td><td>84p</td><td>81195</td><td>120p</td></tr> <tr><td>74279</td><td>110p</td><td>4016</td><td>45p</td><td>81196</td><td>140p</td></tr> <tr><td>74283</td><td>140p</td><td>4017</td><td>89p</td><td>81197</td><td>140p</td></tr> <tr><td>74284</td><td>360p</td><td>4018</td><td>89p</td><td>81198</td><td>140p</td></tr> <tr><td>74285</td><td>360p</td><td>4019</td><td>45p</td><td>9602</td><td>220p</td></tr> 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SERIES</p> <table border="1"> <tr><td>9302</td><td>160p</td><td>74504</td><td>80p</td><td>745114</td><td>120p</td></tr> <tr><td>9302</td><td>160p</td><td>74504</td><td>80p</td><td>745124</td><td>120p</td></tr> <tr><td>9308</td><td>310p</td><td>74505</td><td>75p</td><td>745132</td><td>160p</td></tr> <tr><td>9310</td><td>275p</td><td>74508</td><td>75p</td><td>745133</td><td>75p</td></tr> <tr><td>9311</td><td>275p</td><td>74510</td><td>75p</td><td>745138</td><td>225p</td></tr> <tr><td>9312</td><td>180p</td><td>74520</td><td>80p</td><td>745139</td><td>225p</td></tr> <tr><td>9313</td><td>180p</td><td>74525</td><td>80p</td><td>745174</td><td>250p</td></tr> <tr><td>9316</td><td>225p</td><td>74532</td><td>90p</td><td>745174</td><td>250p</td></tr> <tr><td>9321</td><td>225p</td><td>74537</td><td>90p</td><td>745175</td><td>320p</td></tr> <tr><td>9322</td><td>150p</td><td>74564</td><td>80p</td><td>745194</td><td>350p</td></tr> 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<tr><td>BF65</td><</tr></table>	BF40	25p	TIP30A	48p	BF41	25p	TIP30C	48p	BF42	25p	TIP31A	52p	BF43	25p	TIP31B	52p	BF44	25p	TIP31C	62p	BF45	25p	TIP32A	62p	BF46	25p	TIP32C	62p	BF47	25p	TIP33A	90p	BF48	25p	TIP33B	90p	BF49	25p	TIP33C	90p	BF50	25p	TIP34A	115p	BF51	25p	TIP34B	115p	BF52	25p	TIP34C	115p	BF53	25p	TIP35A	125p	BF54	25p	TIP35B	125p	BF55	25p	TIP35C	200p	BF56	25p	TIP36A	270p	BF57	25p	TIP36B	270p	BF58	25p	TIP36C	340p	BF59	25p	TIP41A	65p	BF60	25p	TIP41B	65p	BF61	25p	TIP41C	75p	BF62	25p	TIP42A	82p	BF63	25p	TIP42B	82p	BF64	25p	TIP42C	82p	BF65
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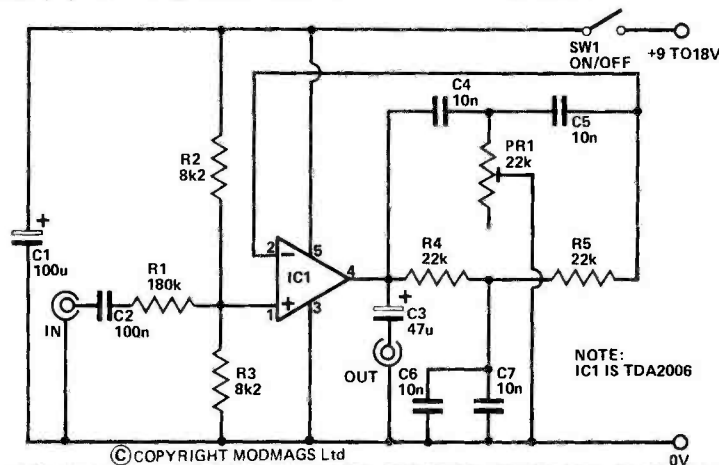
CW Filter

One 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.

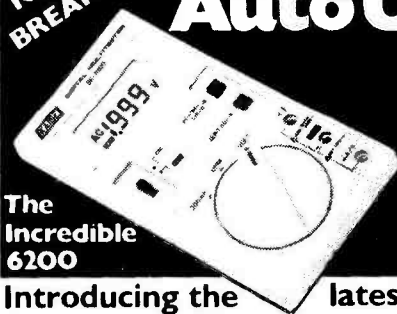
The circuit uses an integrated circuit audio amplifier (TDA2006) in the non-inverting mode, with R2 and R3 being used to bias the non-

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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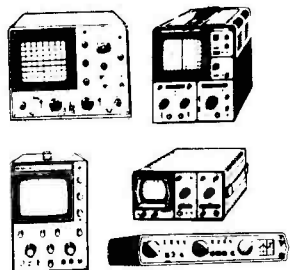
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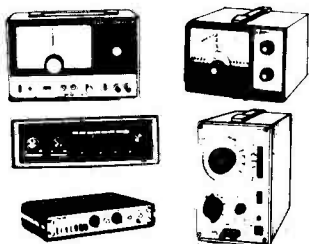
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TG200DM

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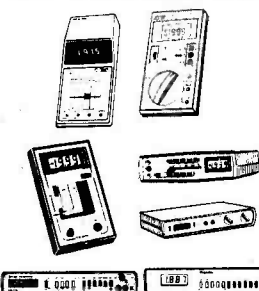


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Plus large range of 5mV/PL259/ATC leads/plugs/adaptors/connectors always in stock.
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HAND HELD

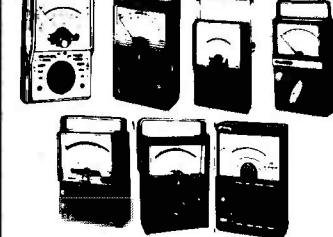
- (UK post etc. 85p)
TM352 3 1/2 Digit LCD plus 10 ADC and Hfe checker **£54.95**
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AUDIOPHILE

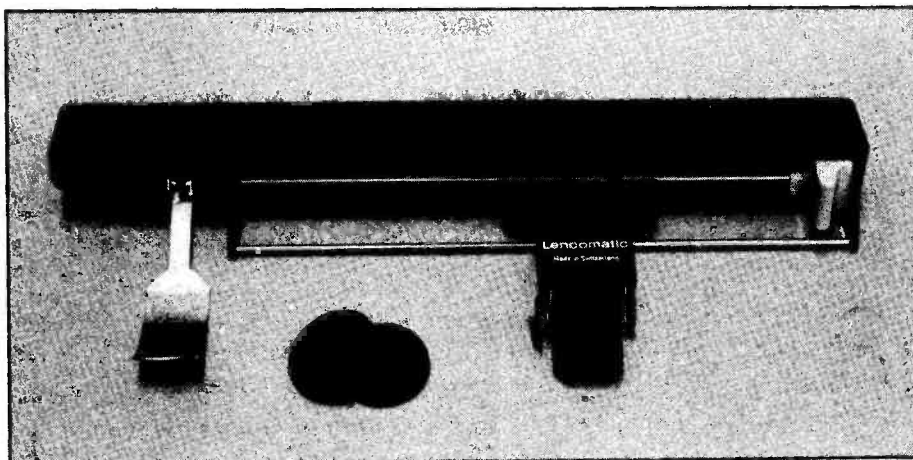
It's almost time for Rudolph the red-nosed guinea pig (everyone's had to economise) to drag his sleigh across your roof. If you haven't sent your letter to Santa yet, Ron Harris offers a few sound suggestions.

It'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.



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.

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!

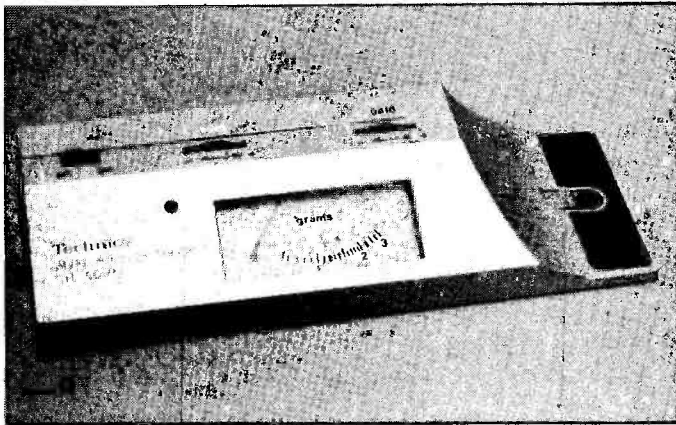
There is in addition a 'special' section for what I think are 'special' items and these are written up in more detail than the rest. Prices appended to each are typical prices you can expect to pay in the shops, inclusive of VAT. It might be an idea to leave this article lying around with certain items heavily ringed in fluorescent 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: 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. →

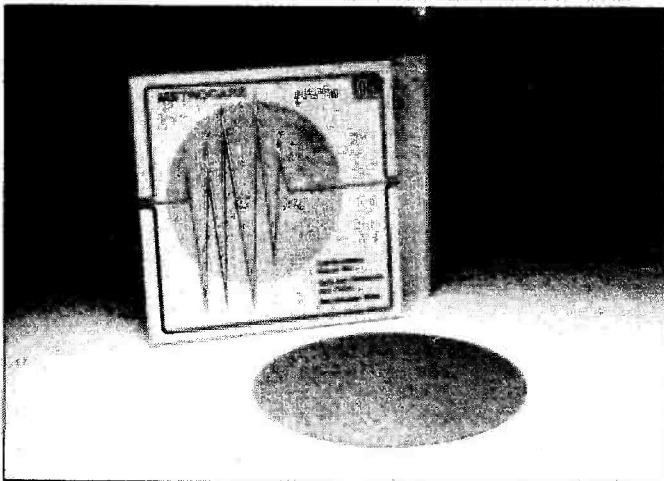


Above: Technics SH-50P1 stylus pressure gauge. A long way from little weights this. A strain gauge measures the downforce present and reads out the tracking weight on a meter. It is accurate to about 0.1g if set-up properly — a reference weight is provided — and looks very very flashy in use. Just the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

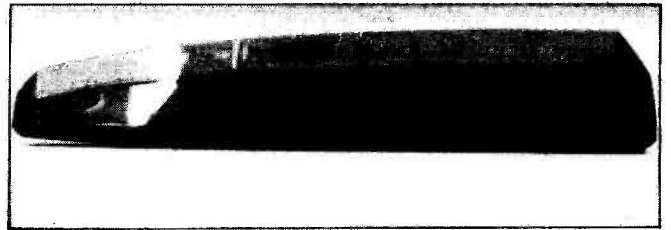


Above (and below!): Now this has got to be the Idea Of The Year! Without passing any comments — and you mucky minded lot out there can keep quiet too — this is a vibrating stylus cleaner from Audio Technica. There is a pad at the end, attached to a vibrator within the body of the device. You lower the 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.

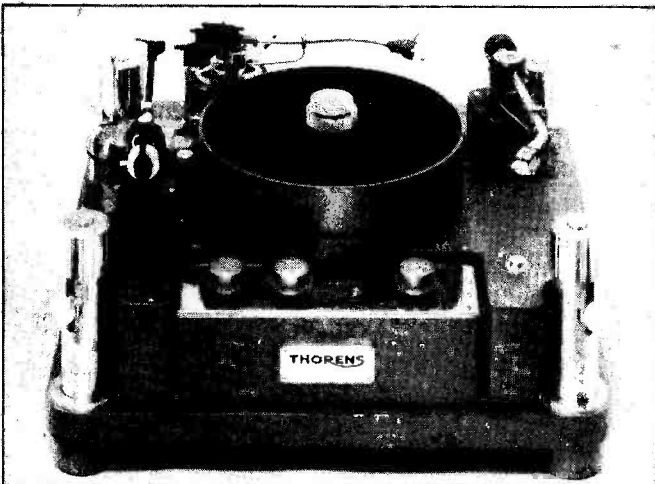
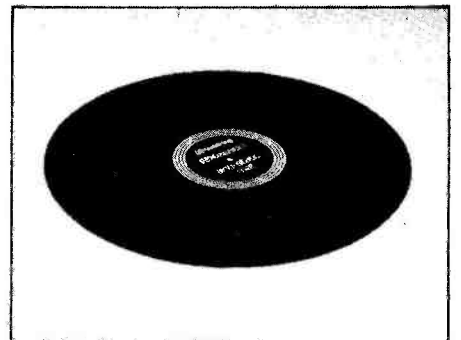


Above: Turntable mats are a favourite tune-up these days and these are consequently a large number of them around. This is one of the newest. The Metrocare has a very high surface tension — VERY high. It grips an LP like a Scotsman grips his drink and thus provide an excellent bond. Price:- £16.75.

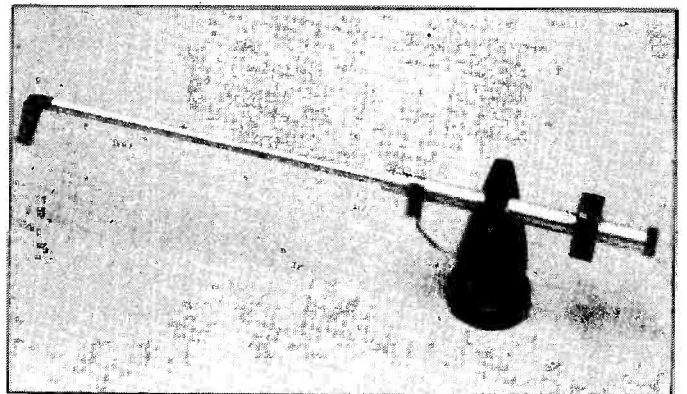


Not all turntable mats are designed to be anti-resonance à la the Metrocare. This Goldring is primarily anti-static and is composed of carbon fibres to provide a leak-path to earth for the charge present on the LP.

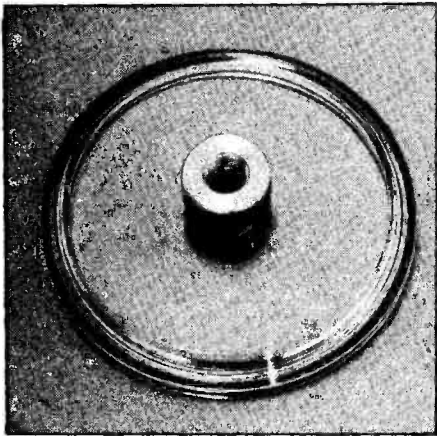
Price:- £3.90.



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 x 360 x 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: 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 de-warping warps and suppressing 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

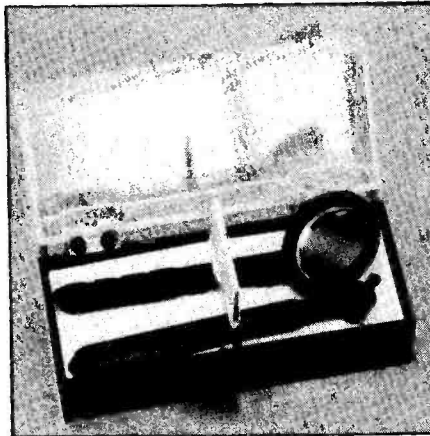
Below: a neat little notion this. As the cleaning tape passes the heads, it rotates a cunningly placed rotary magnet which simultaneously de-magnetises them. The magnet is moved away automatically within the cassette by the spooling action.

Price:- £3.50.



Above: one for those always in the dark. A light from Goldring, which fits onto the dust-cover (or cupboard door) wherein lurks the record deck and switches on as you open the door! A little mercury switch does the work, leaving you free to return to whatever it is you were doing in the dark

Price:- £12.00.



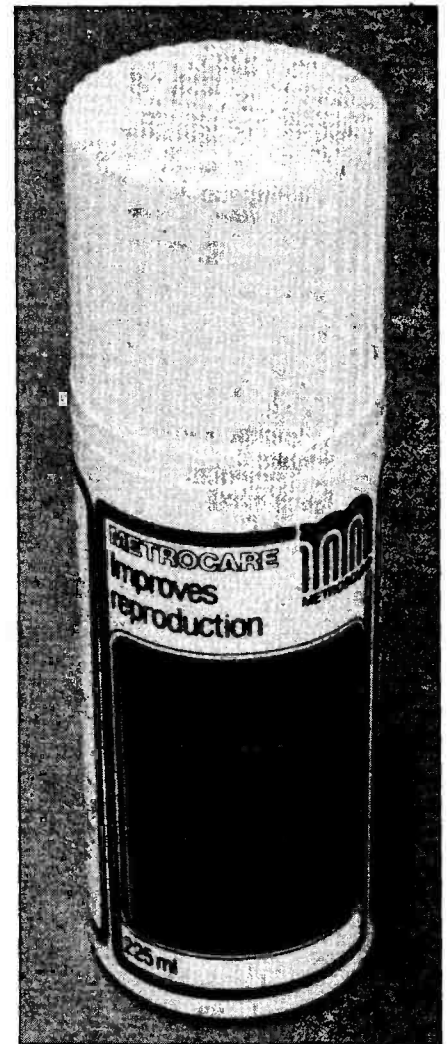
Above: a smallie-but-goodie. Just the thing to buy with the change from an LP! The Exstatic stylus care kit only costs 90p and will earn that back with the first wipe of the brush! Go on — you know it makes sense. Make a good present for the person that bought your Des O'Connor Greatest Hits last year.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



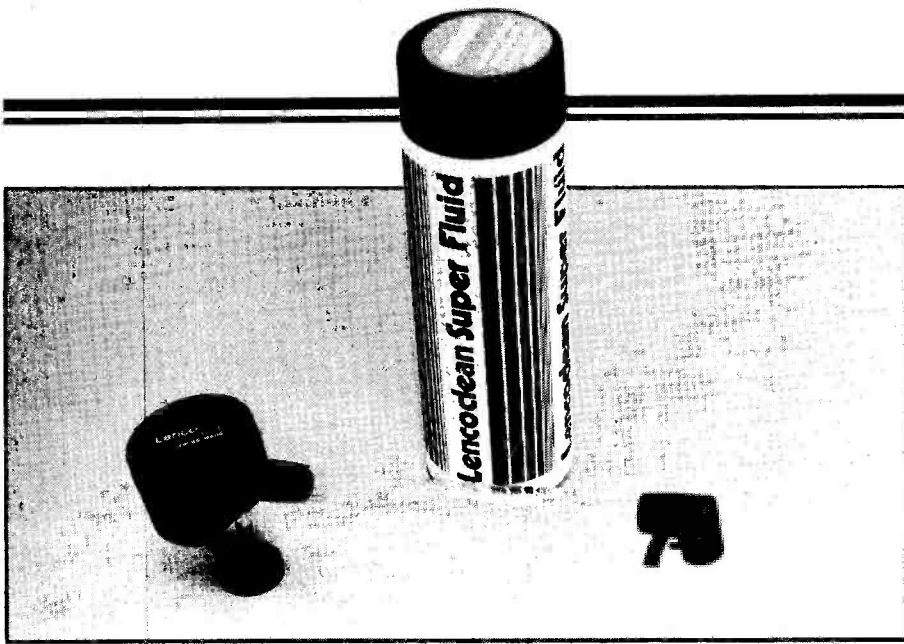
Above: do you suffer from dirty, ingrained, groove dust? Do your records lack that new-look sparkle? Are your highs too low and your lows distorted? Give your LPs a face-lift with the Metrocare Rejuvenating Fluid!

This is literally applied like a face-pack from 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).

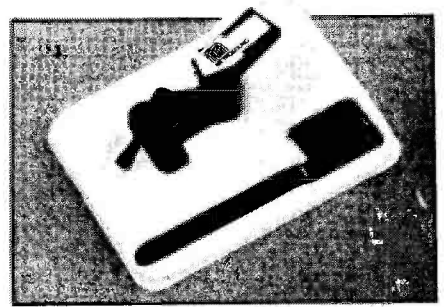




Above: how about playing your record under water? Or under liquid anyway. The Lencoclean has been around a long time and continues to have its followers. It is a wet-playing system, which means that the arm (filled with fluid) tracks ahead of the stylus, dispensing a band of liquid into the groove. Any 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.

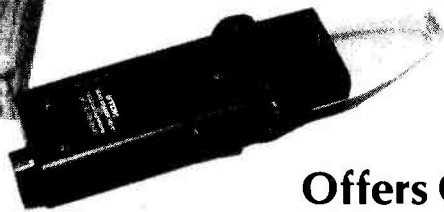


Above: the tracking cleaner for automatic record players. It attaches to the headshell. From Metrocare at Price:- £1.68.



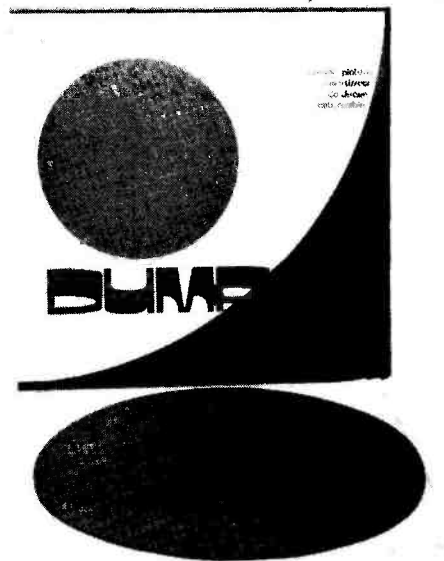
Left and below: TDK make two head demagnetisers, one very pretty cassette unit (left) which is fully automatic and absolutely beautiful! The conventional unit below (not to scale!) is designed for reel-to-reel mainly and is superbly constructed.

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



Below: the Metrocare 'cling' cleaner. A permanent 'sticky' roller which never needs replacing. Just wash it when dirty and start again!

Price:- £5.87.



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.

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!

ETI

ETI JANUARY 1981

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3.0-3	200	238	2.60	.70
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0.9-0.9	100	13	2.30	.70
0.9-0.9	330 330	235	2.15	.70
0.9-0.8-9	500 500	207	2.75	.75
0.8-9-0.8-9	1A 1A	208	3.85	.75
0.15-0.15	200 200	236	2.15	.70
0.20-0.20	300 300	214	2.75	.90
20.12-0.12-20	700(DC)	221	3.50	.90
0.15-20, 0.15-20	1A 1A	206	4.60	1.05
0.15-27, 0.15-27	500 500	203	4.05	.85
0.15-27, 0.15-27	1A, 1A	204	6.10	1.05

12 AND/OR 24 VOLT

Pri: 220-240 Volts

12v	Amps	24V	Ref.	Price £	P&P
0.5	0.25	111		2.30	.75
1.0	0.5	213		2.75	.90
2	1	71		3.25	.90
4	2	18		4.05	.85
6	3	70		5.60	.95
8	4	108		7.40	1.20
10	5	72		8.25	1.20
12	6	116		8.85	1.20
16	8	17		10.85	1.30
20	10	115		13.85	1.50
30	15	187		16.85	1.50
60	30	226		33.35	1.80

30 VOLT (Pri: 220-240V)

Sec: 0.12-15-20-24-30V

Amps	Ref. No.	Price £	P&P
0.5	112	2.85	.90
1.0	79	3.60	.90
2.0	3	5.80	1.05
3.0	20	6.30	1.20
4.0	21	6.80	1.20
5.0	51	9.60	1.20
6.0	117	11.10	1.20
8.0	88	14.35	1.50
10.0	89	16.60	1.50

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50 VOLT (Pri: 220-240V)

Sec: 0.19-25 33-40-50V

Amps	Ref. No.	Price £	P&P
0.5	102	3.60	.90
1.0	103	4.60	1.05
2.0	104	7.30	1.20
3.0	105	8.60	1.20
4.0	106	10.85	1.30
6.0	107	15.10	1.50
8.0	118	20.20	1.70
10.0	119	24.10	2.20

60 VOLT (Pri: 220-240V)

Sec: 0.24-30 40-48-60

Amps	Ref. No.	Price £	P&P
0.5	124	3.85	.90
1.0	126	5.60	1.05
2.0	127	7.55	1.20
3.0	125	11.10	1.30
4.0	123	12.35	1.50
5.0	40	14.15	1.60
6.0	120	17.60	1.60

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VA (Watts)	Ref. No.	Price £	P&P
20	113	2.85	.90
75	64	4.10	.90
150	4	5.60	1.05

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0-115-210-220-240V

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1000	84	18.60	1.60

Also 1500/2000/3000VA

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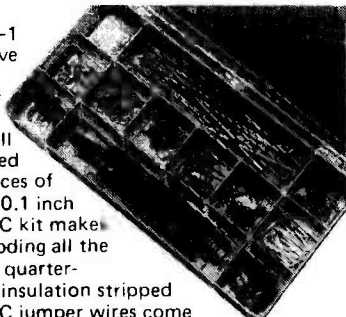
VA (Watts)	Ref. No.	Price £	P&P
60	149	6.60	1.05
100	150	7.60	1.30
200	151	11.10	1.30
250	152	13.30	1.50
350	153	16.30	1.60
1000	156	37.10	3.20

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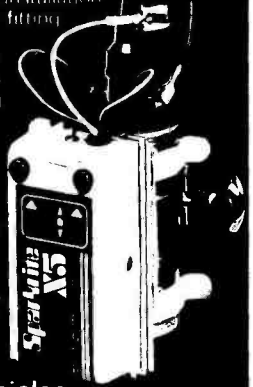
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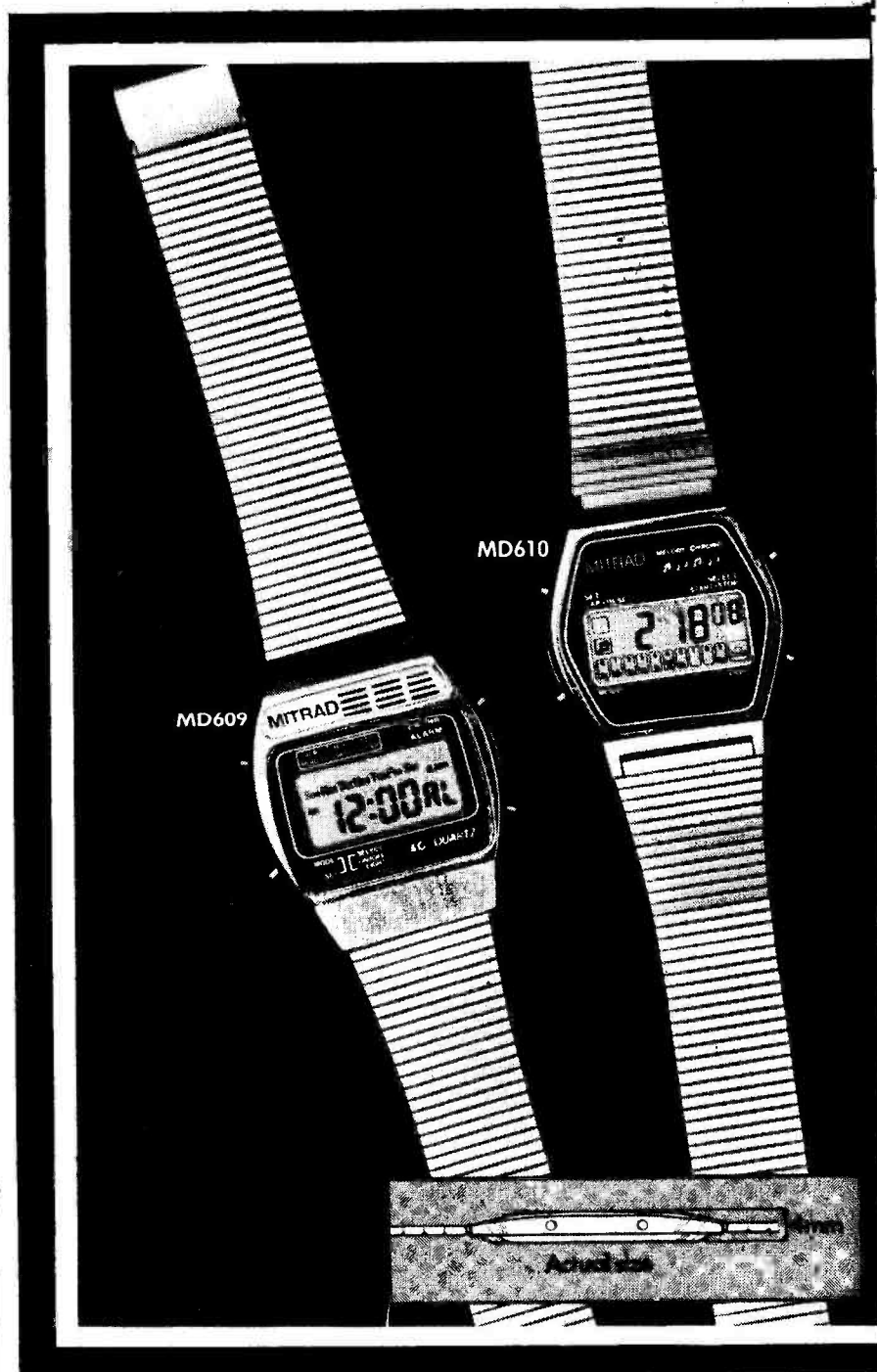
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UNIVERSAL TIMER

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.

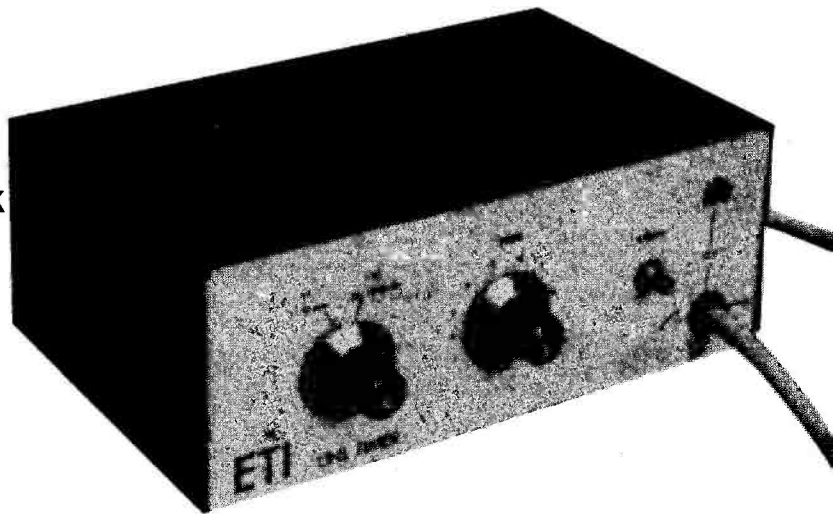
**Project development by
Steve Ramsahadeo.**

Most 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-sink.

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 (roughly 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

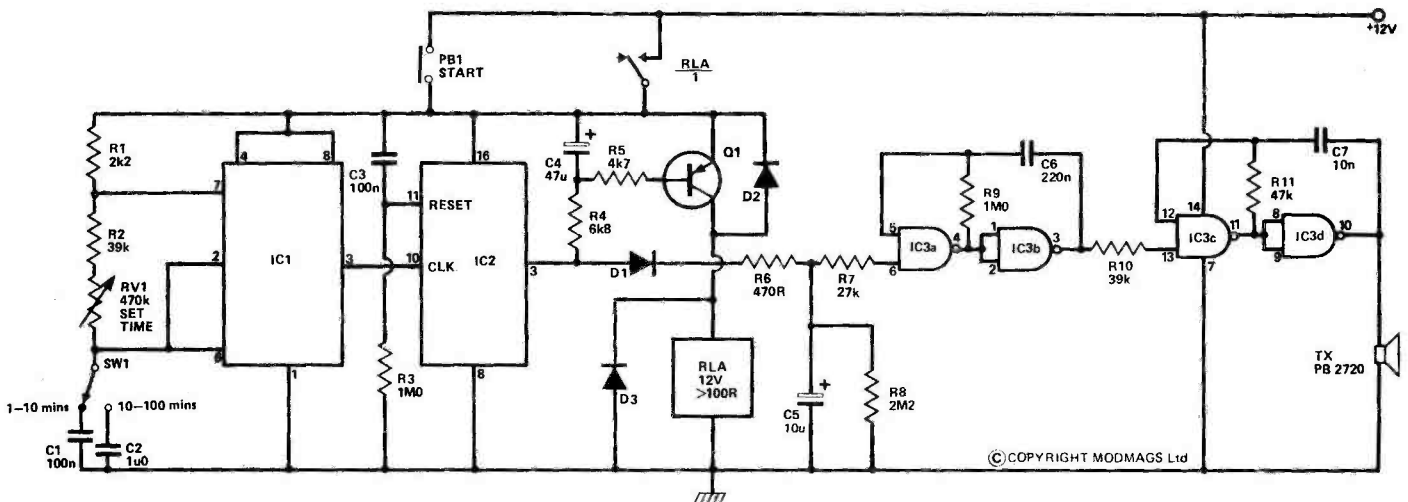
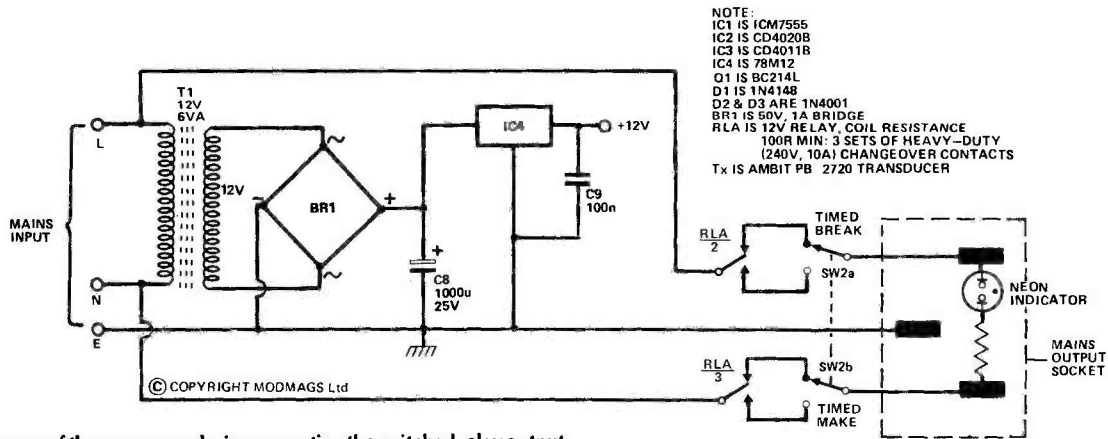


Fig.1 Circuit diagram.



NOTE:
 IC1 IS ICM7555
 IC2 IS CD4020B
 IC3 IS CD4011B
 IC4 IS 78M12
 Q1 IS BC214L
 D1 IS 1N4148
 D2 & D3 ARE 1N4001
 BR1 IS 60V, 1A BRIDGE
 RLA IS 12V RELAY, COIL RESISTANCE
 100R MIN; 3 SETS OF HEAVY-DUTY
 (240V, 10A) CHANGE-OVER CONTACTS
 TX IS AMBIT PB-2720 TRANSDUCER

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.

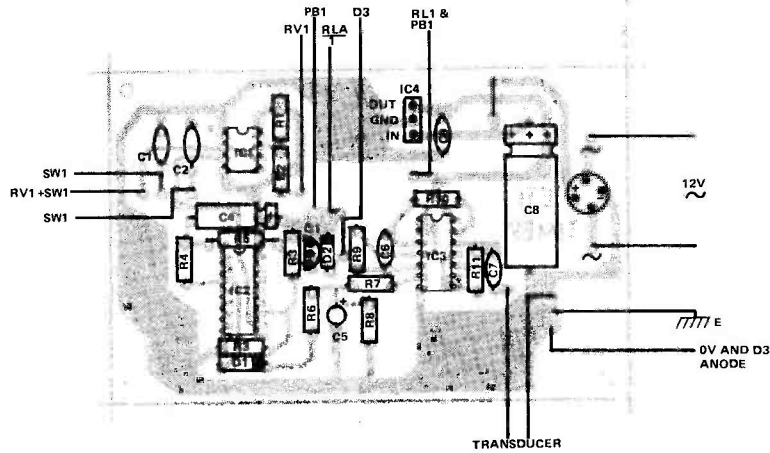


Fig.3 Component overlay.

PARTS LIST

Resistors all 1/4 W 5%

R1	2k2
R2,10	39k
R3,9	1M0
R4	6k8
R5	4k7
R6	470R
R7	27k
R8	2M2
R11	47k

Potentiometer

RV1 470k Linear

Capacitors

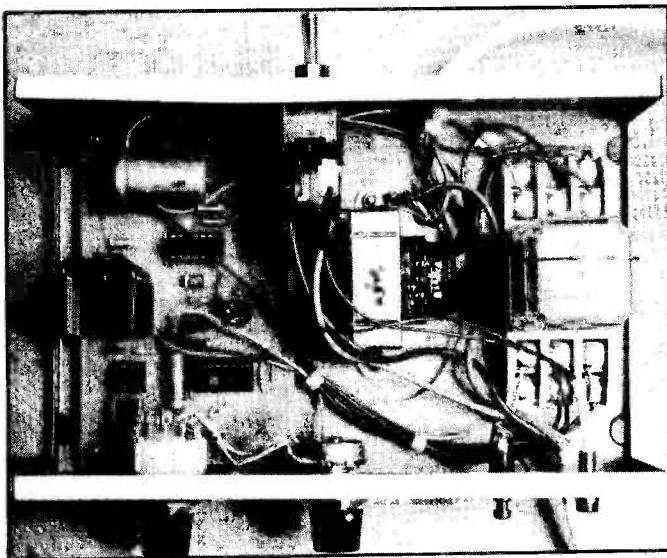
C1,3,9	100n polycarbonate
C2	1u0 polycarbonate
C4	47u 25 V axial electrolytic
C5	10u 63 V electrolytic PCB type
C6	220n polycarbonate
C7	10n polycarbonate
C8	1000u 25 V axial electrolytic

Semiconductors

IC1	ICM7555
IC2	CD4020B
IC3	CD4011B
IC4	78M12 or 7812
Q1	BC214L
BR1	50 V, 1 A bridge rectifier
D1	1N4148
D2,3	1N4001

Miscellaneous

SW1	1 pole rotary switch
SW2	DPDT toggle 15 A 240 V
PB1	momentary push button
Tx1	transducer PB 2720
RLA	12 V coil resistance > 100R. 3 pole changeover, contacts rated at 240 V, 10 A and 11 pin relay base 15 A rated (see Buylines).
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. **ETI**

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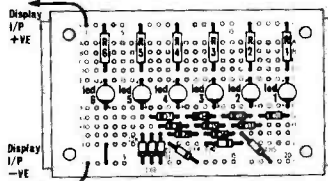
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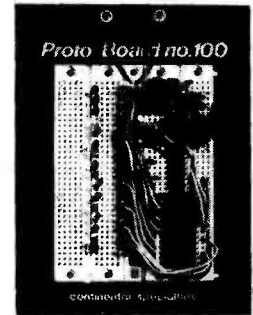
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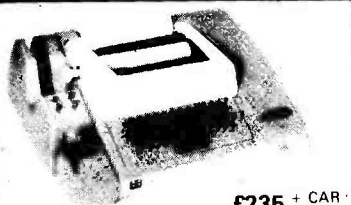
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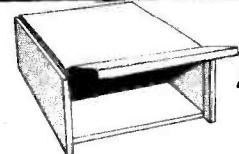
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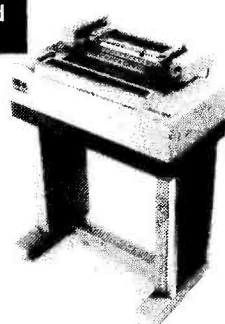


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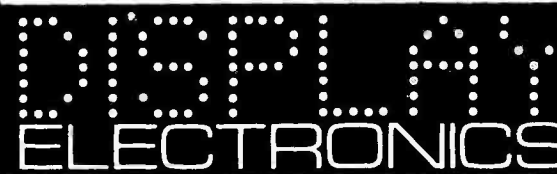
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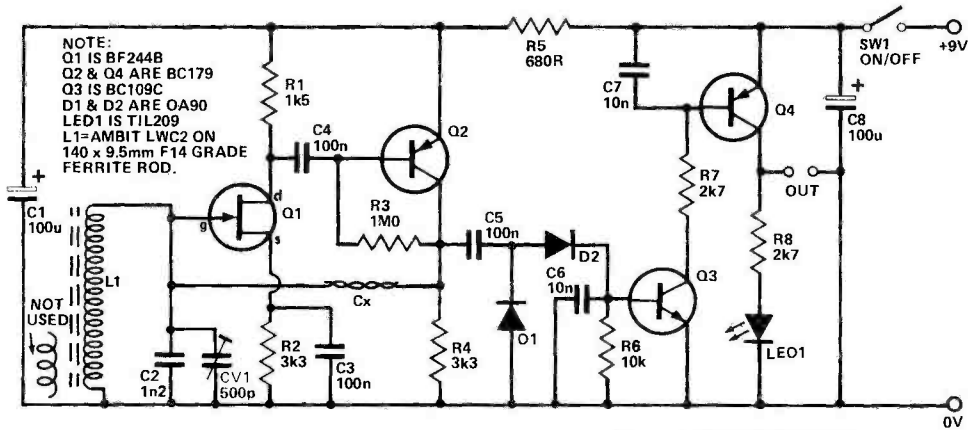
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60 kHz Time Receiver

This receiver gives reception of the atomic clock time signals transmitted by the Rugby MSF transmitter on 60 kHz. At this very low radio frequency it is not necessary to use a superhet. A ferrite aerial is used with L1, an ordinary LW broadcast band aerial coil, and the relatively high tuning capacitance of C2 and C3 is used to reduce the resonant frequency to the appropriate figure. The receiver is tuned by CV1 and by adjusting the position of L1 on the ferrite rod.

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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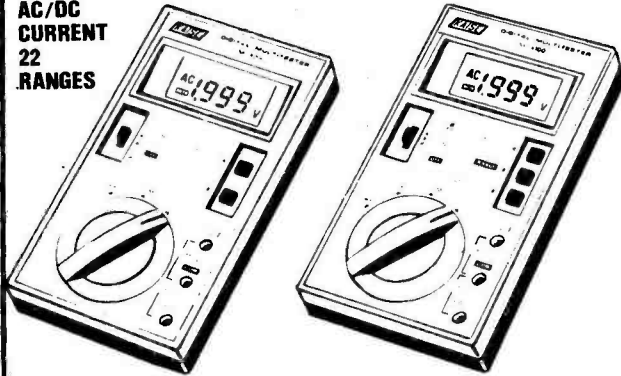
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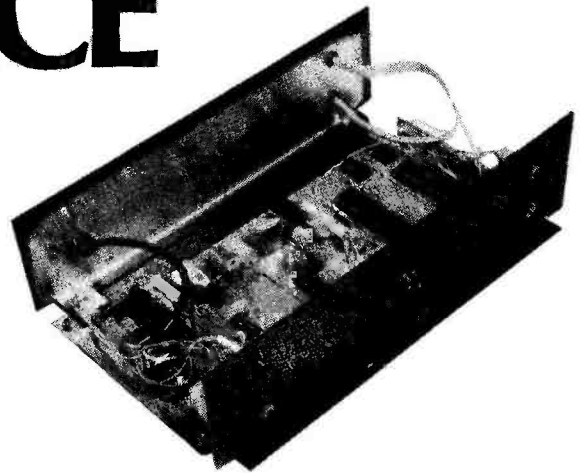
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I/O INTERFACE

Computers share a common failing with man (and woman) — they use a variety of different languages and dialects. This design by Clive Cartledge 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 RS232 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. →

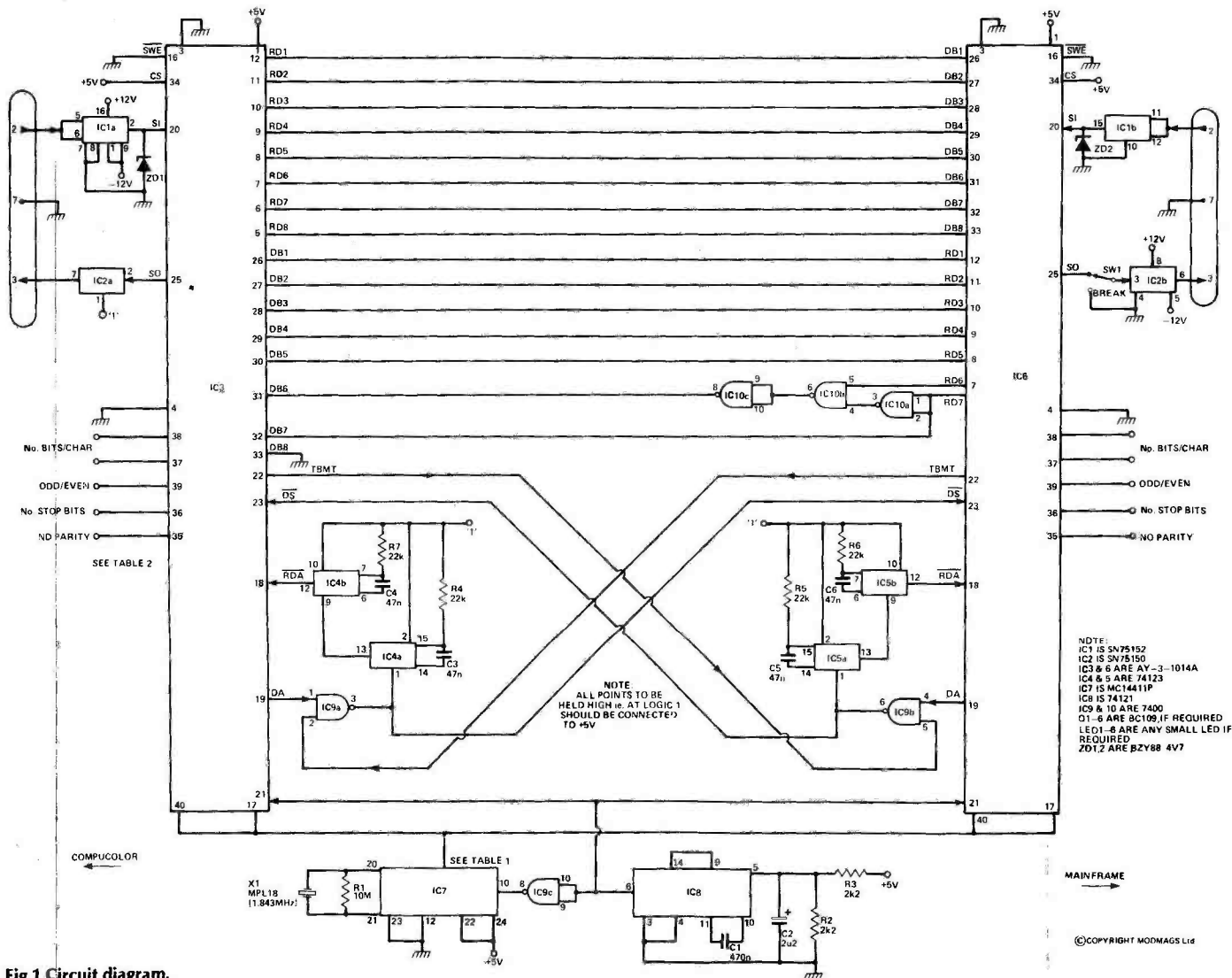


Fig.1 Circuit diagram.

HOW IT WORKS

On switching on the power, the monostable multivibrator IC8 gives a 100 μ s positive-going pulse at its 'Q' output, pin 6. This is applied to both UARTs at their reset inputs, pins 21. This pulse is also inverted by the NAND gate IC9b and used to reset the baud rate generator chip IC7 at pin 10. The clock signal is applied to both UARTs at pins 40 and 17 at 16 times the baud rate required. Referring now to Fig. 2, the pulse timing diagram, it will be seen that at T_0 pin 2 of IC9a is at logic 1 (derived from the Transmitter Buffer Empty flag of IC6). Assuming reception of a character by UART IC3, pin 1 of IC9a will go to logic 1 when data becomes available on the reception of a complete character. This is shown on Fig. 2 at T_1 . The output of the NAND gate, pin 3 of IC9a will, therefore, go to logic 0.

This negative-going pulse is used to strobe the received character into the transmit buffer of the second UART at pin 23 (Data Strobe) and 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 Transmitter 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 (T_2 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 ± 12 V) to TTL levels of 0 V and 5 V.

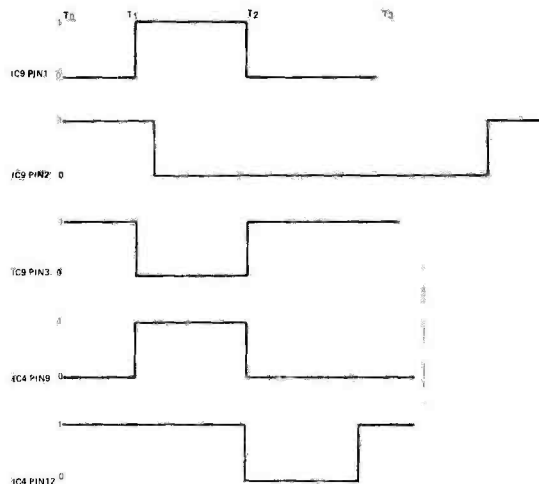


Fig.2 Pulse timing diagram.

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.

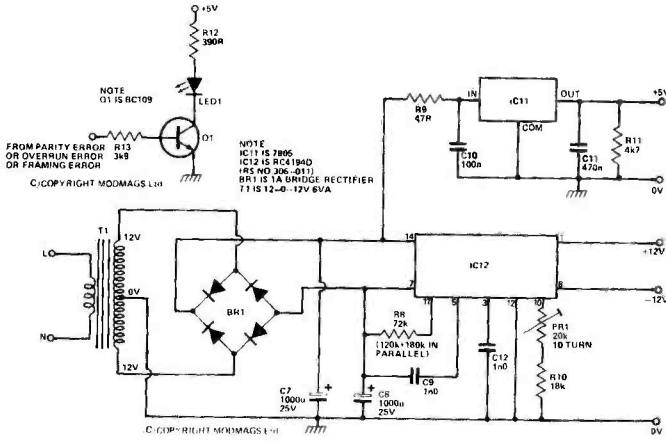


Fig.3 Circuit diagram of the power supply and LED indicators if required.

PARTS LIST

Resistors all 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)

Potentiometer

- PR1 20k 10-turn preset

Capacitors

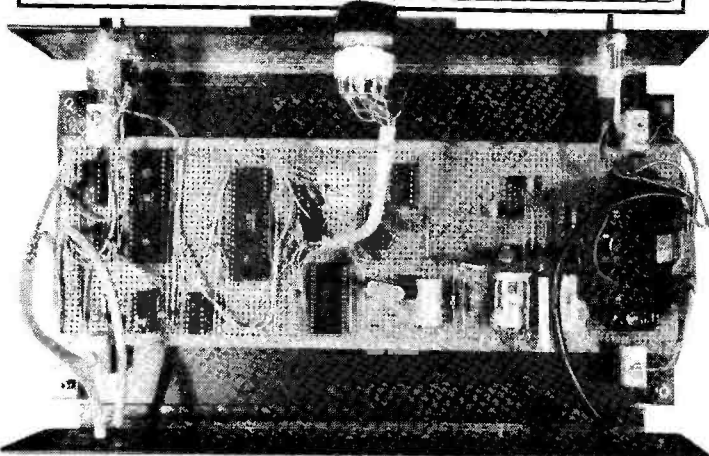
- C1, 11 470n polyester
- C2 2u2 35 V tantalum
- C3, 4, 5, 6 47n ceramic
- C7, 8 1000u 25 V axial electrolytic
- C9, 12 1n0 ceramic
- C10 100n ceramic

Semiconductors

- 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)
- ZD1, 2 BZY88 4V7
- BR1 1 A bridge rectifier
- LED1 0.2" LED (six if required)

Miscellaneous

- XTAL MPL18 (1.843 MHz), 12-0-12 6 VA transformer, Veroboard, SW1 SPCO pushbutton, SW2 DPDT toggle, case.



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

Pin No.	Function	User Baud Rate
1	F1	9600
2	F3	4800
3	F5	2400
4	F7	1200
5	F8	600
6	F10	200
7	F9	300
8	F11	150
9	F14	75
10	Reset	
11	NC	
12	Ground	
13	F13	109.9
14	F12	134.5
15	F6	1800
16	F4	3600
17	F2	7200
18	F15	921.6 kHz
19	F16	1.843 MHz
20	Crystal	
21	Crystal	
22	rate select	
23	rate select	
24	+5 V	

Table 1

MC14411P pin connections and clock speeds

Pins	Logic 0	Logic 1
35	Parity	No parity
39	Odd parity	Even parity
36	One stop bit	Two stop bits

Character Lengths

Character Lengths	Pin 37	Pin 38
5 bits	Logic 0	Logic 0
5 bits	Logic 0	Logic 1
7 bits	Logic 1	Logic 0
8 bits	Logic 1	Logic 1

Table 2.

UART control connections (IC3,6).

1	Vcc Power Supply (+5 V)	
2	NC	
3	Ground	
4	Received Data Enable	RDE
5-12	Received Data Bits	(RD8-RD1)
13	Parity Error	(PE)
14	Framing Error	(FE)
15	Over run	(OR)
16	Status Word Enable	SWE
17	Receiver Clock	(RCP)
18	Reset Data Available	RDAV
19	Data Available	(DAV)
20	Serial Input	(SI)
21	External Reset	(XR)
22	Transmitter Buffer Empty	(TBMT)
23	Data Strobe	DS
24	End Of Character	(EOC)
25	Serial Output	(SO)
26-33	Data Bit inputs	(DB1-DB8)
34	Control Strobe	(CS)
35	No Parity	(NP)
36	Number of stop bits	(TSB)
37-38	Number of bits per character	
39	Odd/Even parity select	
40	Transmitter Clock	(TCP)

Table 3.

AY-3-1014A pin connections.

CHROMASONIC electronics

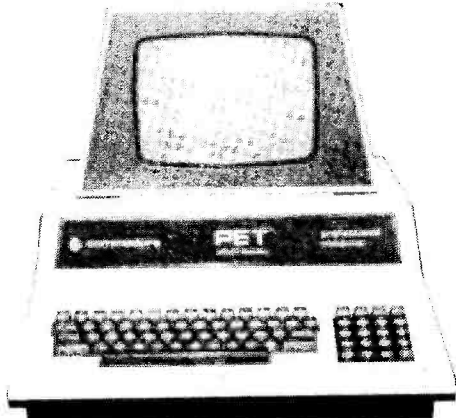
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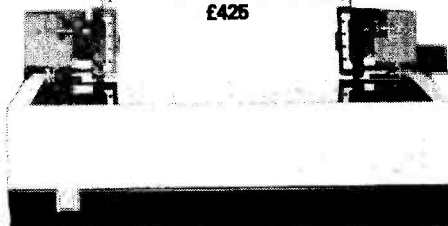
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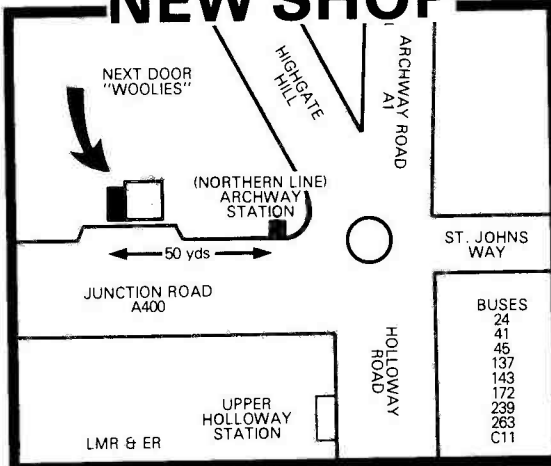


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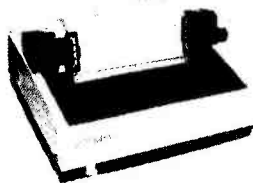
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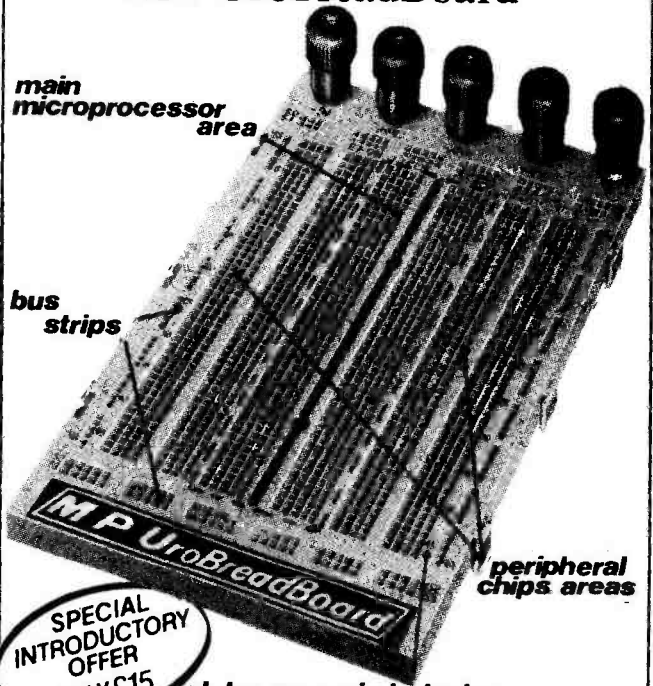
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163	4in	2 1/2in	2in	£0.98
164	3in	2in	1in	£0.67
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400	TR16A/400	£0.88			

DIACS

BR100	£0.23	D32	£0.23
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SILICON RECTIFIERS

200mA					
IS920 50V	£0.07	3 Amp	IN5400 50V	£0.16	
IS921 100V	£0.08		IN5401 100V	£0.17	
IS922 150V	£0.09		IN5402 200V	£0.18	
IS923 200V	£0.10		IN5404 400V	£0.19	
IS924 300V	£0.11		IN5406 600V	£0.24	
			IN5407 800V	£0.28	
			IN5408 1000V	£0.34	

1 Amp					
IN4001 50V	£0.05	10 Amp	IS10/50 50V	£0.21	
IN4002 100V	£0.05		IS10/100 100V	£0.24	
IN4003 200V	£0.07		IS10/200 200V	£0.26	
IN4004 400V	£0.08		IS10/400 400V	£0.40	
IN4005 600V	£0.09		IS10/600 600V	£0.48	
IN4006 800V	£0.10		IS10/800 800V	£0.58	
IN4007 1000V	£0.11		IS10/1000 1000V	£0.69	
			IS10/1200 1200V	£0.79	

1.5 Amp					
IS020 150V	£0.10	30 Amp	IS30/50 50V	£0.64	
IS021 200V	£0.11		IS30/100 100V	£0.79	
IS022 300V	£0.12		IS30/200 200V	£1.06	
IS023 400V	£0.14		IS30/400 400V	£1.43	
IS025 600V	£0.16		IS30/600 600V	£2.02	
IS027 800V	£0.18		IS30/800 800V	£2.23	
IS029 1000V	£0.23		IS30/1000 1000V	£2.65	
IS031 1200V	£0.28		IS30/1200 1200V	£3.31	

60 Amp					
IS70/50 50V	£0.86		IS70/400 400V	£2.01	
IS70/100 100V	£0.96		IS70/600 600V	£2.56	
IS70/200 200V	£1.38		IS70/800 800V	£2.87	
			IS70/1000 1000V	£3.45	

THYRISTORS

600ma	TO 18 Case	Price	7 amp	TO 48 Case	Price
10 THY600/10		£0.17	50 THY7A/50		£0.55
20 THY600/20		£0.18	100 THY7A/100		£0.59
30 THY600/30		£0.23	200 THY7A/200		£0.65
50 THY600/50		£0.25	400 THY7A/400		£0.71
100 THY600/100		£0.29	600 THY7A/600		£0.90
200 THY600/200		£0.44	800 THY7A/800		£1.06
400 THY600/400		£0.51			

1 amp	TO 86 Case	Price	10 amp	TO 48 Case	Price
50 THY1A/50		£0.30	100 THY10A/50		£0.59
100 THY1A/100		£0.32	100 THY10A/100		£0.66
200 THY1A/200		£0.37	200 THY10A/200		£0.71
400 THY1A/400		£0.44	400 THY10A/400		£1.14
600 THY1A/600		£0.52	600 THY10A/600		£1.40
800 THY1A/800		£0.67			

3 amp	TO 66 Case	Price	16 amp	TO 48 Case	Price
50 THY3A/50		£0.32	50 THY16A/50		£0.62
100 THY3A/100		£0.35	100 THY16A/100		£0.67
200 THY3A/200		£0.38	200 THY16A/200		£0.71
400 THY3A/400		£0.48	400 THY16A/400		£0.89
600 THY3A/600		£0.55	600 THY16A/600		£1.04
800 THY3					

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.

The ET1 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

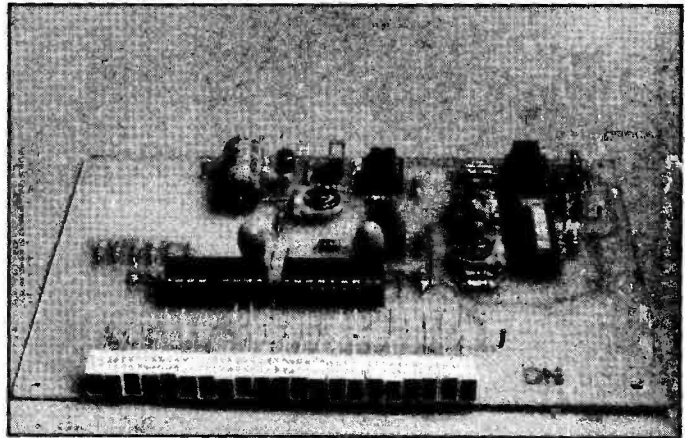
The complete unit, including the 21 LED display, is mounted on a single PCB. Take care over the construction, paying special attention to the following points:

(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 1k Ω 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, +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 generator 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 wave output of the audio generator between 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. →

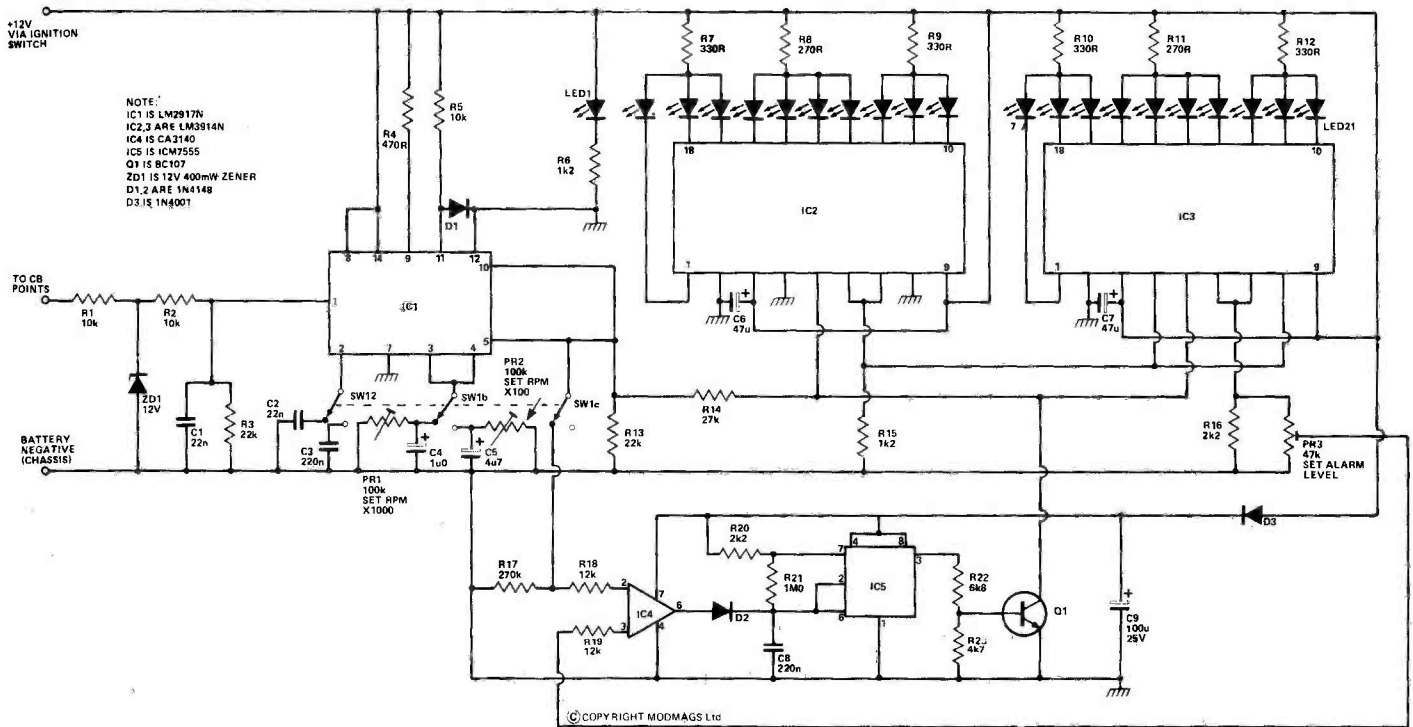


Fig. 1 Circuit diagram.

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 tachometer 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 tachometer 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-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 tachometer.

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 voltmeters.

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 tachometer 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 an 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 tachometer 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 tachometer 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 tachometer scale by PR3. SW1c is used to disable the alarm section when the tachometer 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.

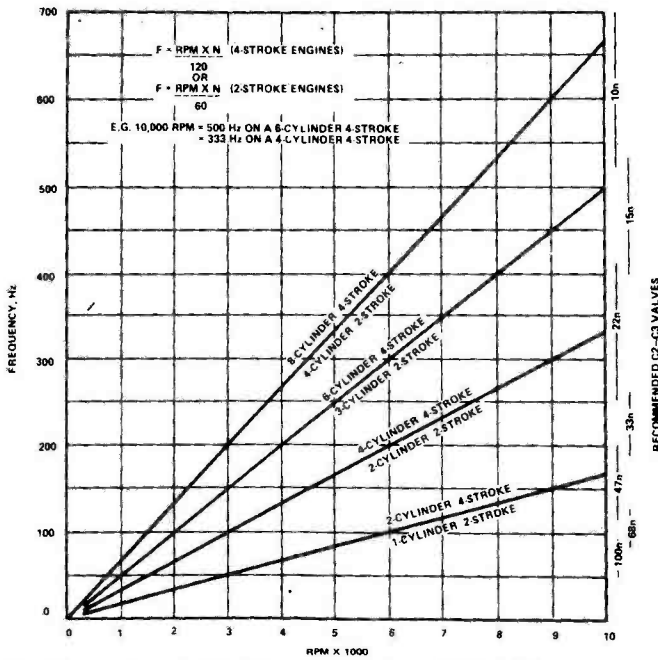


Fig. 2 Conversion graph to determine the values of C2 and C3.

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.

PARTS LIST

Resistors all 1/4 W 5%

R1,2,5	10k
R3,13	22k
R4	470R
R6,15	1k2
R7,9,10,12	330R
R8,11	270R
R14	27k
R16,20	2k2
R17	270k
R18,19	12k
R21	1M0
R22	6k8
R23	4k7

Potentiometers

PR1,2	100k miniature horizontal preset
PR3	47k miniature horizontal preset

Capacitors

C1,2	22n polycarbonate
------	-------------------

C3,8

C3,8	220n polycarbonate
C4	1u0 35 V tantalum
C5	4u7 35 V tantalum
C6,7	47u 16 V tantalum
C9	100u 25 V electrolytic

Semiconductors

IC1	LM2917N
IC2,3	LM3914
IC4	CA3140
IC5	ICM7555
Q1	BC107
ZD1	BZY88 12 V
D1,2	1N4148
D3	1N4001
LED1-21	Red, square type.

Miscellaneous

SW1	4-pole 2-way dual-in-line slide switch
PCB, case.	

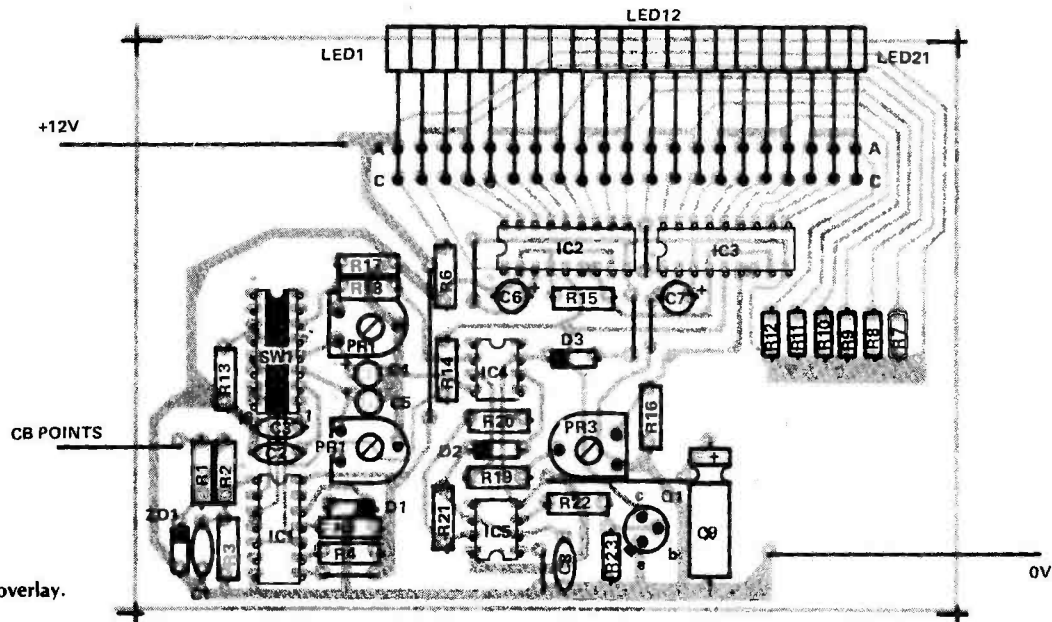


Fig. 3 Component overlay.

enter the computer age video genie system

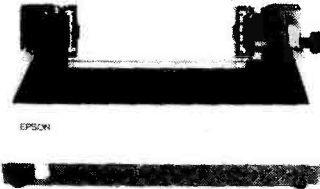
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<p>FAMCHILD FMD10 0.25" Mini red 7 segment display. Common anode. 50p 5 for £2.50</p>																																						
<p>LP1171 & LP1179 MODULES MULLARD LP1171 and LP1179 tuning heart and IF modules which form the basis of a quality AM/FM tuner. Full medium long-wave and YIF coverage. May be used as the basis of a quality portable or tower. Supply 8V at 15mA output 70mV at 20K. Pair ES.75. SUPPLIED COMPLETE WITH DATA LP1157 Medium & Long Wave Tuner, module-board £2.50 LP1186 Varicap ES.60</p>																																						
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<p>12VHT RE-CHARGEABLE BATTERY. 6 volt 4.5 amp/h. Size 8" x 3 1/4" x 1 1/4" at full price. Brand new £7.50, post 50p. MIN. EDGE INDICATORS WITH LAMP. 0-100 MICRO AMP 6 for £6.50 INDICATOR METERS. 200 Micro. 1 1/4" x 1 1/4" x 1/4". 8 for £5</p>																																						
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14-0-14V	1.5 amp		£2.50																																			
12V	1 amp		£2.50																																			
<p>2W MIN. W/W VOL. CONTROLS 10R-47K. 10 for £6</p> <p>10 TURN POTS. 47K-100K. 10 for £17.50</p>																																						
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LSG 16 Signal Generator	£ 49.00
LSG 231 FM Stereo Signal Generator	£169.00
LCG 397U PAL B Pattern Generator	£189.00
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LAG 26 Audio Generator	£ 60.00
LAG 170A Audio Generator	£119.00
LDM 170 Distortion Meter	£225.00
LFM 39A Wow/Flutter Meter (Dist)	£249.00
LFM 39A Wow/Flutter Meter (Dist)	£299.00
LAV 191 Audio Tester	£249.00
LAG 125 Low Distortion Audio Generator	£229.00
GENERAL TEST GEAR	
LCR 740 LCR Bridge	£135.00
LTC 906A Transistor Checker	£ 90.00
LVT 72 Fet Transistor Checker	£119.00
LTC 907 Transistor Checker	£139.00
LAT 47 Attenuator	£135.00
LAT 45 Attenuator	£ 75.00
LFG 1300 Sweep/Function Generator	£299.00
AMATEUR RADIO	
LDM 815 DIP Meter	£ 43.00
LIM 870A Antenna Impedance Meter	£ 41.00
LPM 880 RF Power Meter	£ 69.00
LPM 885 SWR/Watt Meter	£ 44.00
LAC 895 Antenna Coupler	£ 85.00
LAC 896 Antenna Coupler	£ 41.00
LAC 897 Antenna Coupler	£ 41.00

The new Marshall's 80/81 catalogue is now available. A veritable treasure house of components, test gear, tools, etc.



Lots of old friends, but also many new products including leader test gear, Crimson Hi Fi Modules, Rechargeable Ni Cad batteries and chargers (very competitive). More components including SN74ALS series, new tools etc. Available by post, UK 75p post paid: Europe 95p post paid: Rest of world £1.35 post paid.

SINCLAIR INSTRUMENTS

Digital Multimeter	
PDM35	£ 34.50
DM235	£ 52.50
DM350	£ 72.50
DM450	£ 99.00
Digital Frequency Meter	
PFM200	£ 49.80
Low Power Oscilloscope	
SC110	£139.00

NEW

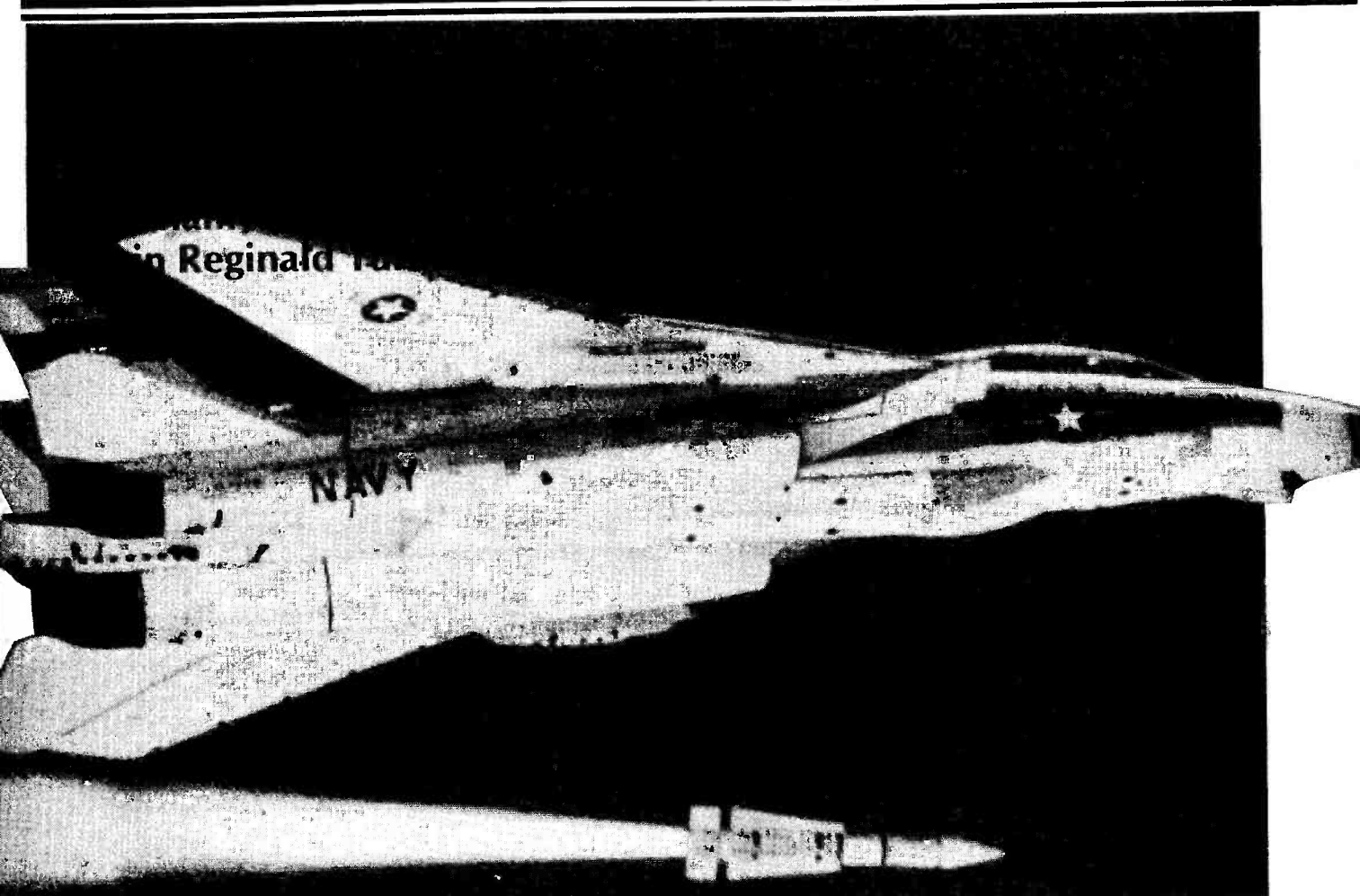
TF200	Frequency Meter	£145.00
TGF105	Pulse Generator	£ 85.00

CRIMSON ELEKTRIK HI FI MODULES

CE608	Power Amp	£20.09
CE1004	"	£23.43
CE1008	"	£26.30
CE1704	"	£33.48
CE1708	"	£33.48
CPS1	Power Unit	£19.52
CPS3	"	£23.52
CPS6	"	£30.00
CPR1	Pre Amp	£32.17
CPR1S	Pre Amp	£42.52

All Prices + VAT + postage/packaging

Don't forget! We also carry an impressive range of semi-conductors, passive components, electro-mechanical components, tools etc.



The 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 effect' 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.

When you've solved all the clues (here's the nasty bit), give each letter of the alphabet a number (A-1, B-2, . . . Y-25, Z-26), add up the numerical value of all the solutions, write that number in the space provided on the coupon and send your entry to:

ASTROLOGUE CROSSWORD,
ETI,
145 Charing Cross Road,
London WC2H 0EE

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.

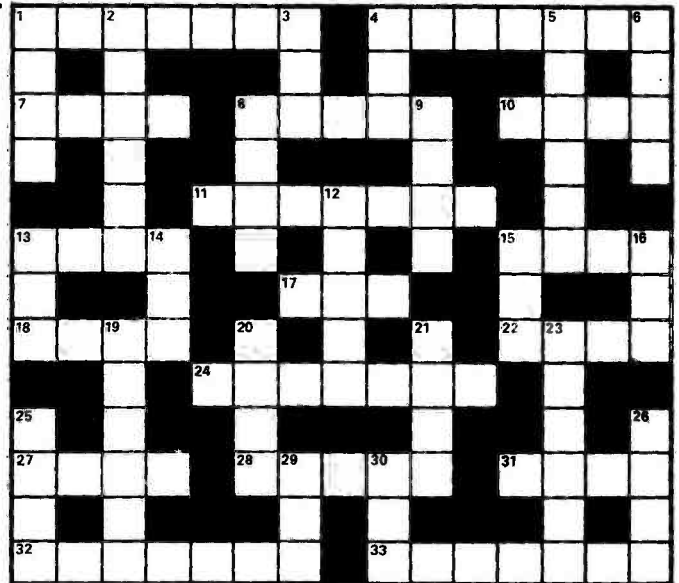
CROSSWORD CLUES

Across

1. Messenger of the Gods, first in line from the Sun. (7)
4. Car step seen through prisms. (7)
7. One of those returned from the Moon in a rocket. (4)
8. Such a wing on a variable geometry aircraft. (5)
10. Major or minor, a friend of Goldilocks. (4)
11. In Scorpio and in plant a resistor. (7)
13. Benny's friends in the sky send out streams of gas. (4)
15. Getting up and down shortly giving lots back. (4)
17. Getting on course for the Moon initially in fast limousines. (3)
18. LEM — 4: Neil Armstrong — 2, giving support. (4)
22. Imitates Bonny and Sam. (4)
24. Troubled SOS in grim for first Mercurial Gemini man. (7)
27. National Oceanic and Atmospheric Administration. (4)
28. Peenemunde led to Saturn for him. (5)
31. Join Oriental take-off for one. (4)
32. The seriousness of the downward pull. (7)
33. Enterprise will never be this, Columbia. (7)

Down

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



NAME

ADDRESS

NUMERICAL VALUE

ETI

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.**

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★ **STAR BUY FOR 1980** ★

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LCD ANALOGUE/DIGITAL

Alarm Chronograph with countdown
Analogue. Independent hours and minutes with synchronous digital seconds. Dual time ability.
Digital. Hours, minutes, seconds, day and date.

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 display.

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



AAB1
Analogue Display



AAB2
Digital Display

AAB1 Chrome plated **£29.95**

AA81G gold plated **£49.95**

AA82 stainless steel **£39.95**

AA83 Dress watch, s/s **£44.95**

12 MELODY ALARM CHRONOGRAPHS

Countdown alarm. Date memories.

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 tune.

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

Birthdays and Christmas Memory.

Countdown alarm. From 1 second to 1 hour. After zero count continues positively.

Stopwatch. 1/10 second to 1 hour. Net, lap, etc.

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 thick.



£19.95



£32.50

A250. As above but with standard water-resistant case

£24.95

£25.00

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

£17.95

F81 Alarm Chronograph (far right). 8 digit display 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.

£19.95

£12.95

£15.95

£19.95

£12.95

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100 METRE WATER RESISTANT

Alarm chronographs with countdown
 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.

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**



£24.95



£25.00

RETURN OF THE SUPERCALCS!

★ **NEW MODEL! FX-6100**

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

Alarm. Alarm signal at pre-set time.

Hourly chimes. Every hour, on the hour. Easily switched off.

Countdown alarm. (Repeater time).

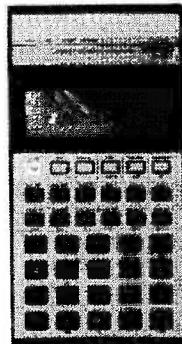
Stopwatch. Normal, net, and lap times to 1/100 second.

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). 3/4 x 3 x 5 1/2 inches. (RRP £22.95) **£19.95**

FX-7100. Card version of above with kiss-touch keys. 3/16 x 2 1/2 x 3 3/8. (E27.95) **£24.95**

FX-8100. Specifications as above plus permanently programmed calendar (1976-1999), day, date, month and year. Also has hyperbolics. 1/4 x 2 3/4 x 5 1/2. **£24.95**



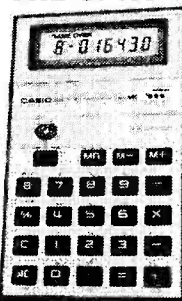
CASIOTONE KEYBOARDS

★ **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 33 1/2 x 9 3/8. Weight 15 lbs. Integral amplifier and speaker. AC only. (E285) **£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, pre-programmed "When The Saints Go Marching In". Full memory, %. Auto power-off facility.

MG-880 (left)

1/2 x 2 1/2 x 4 1/2"

£10.95

(£12.95)

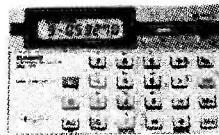
MG-770 (right)

Kiss touch keys

5/32 x 3 3/8 x 2 1/2"

£12.95

(£14.95)



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 tunes.

MQ-1200 (below). Desk or bedside. Built-in speaker, Volume control. Nightlight. Powered by three AA size batteries. 1 9/16 x 6 x 2 1/4 inches.

£19.95

(£22.95)



ML-90 (right)

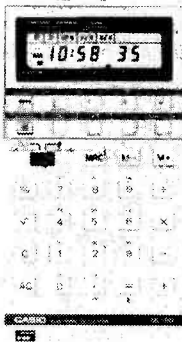
Kiss keys

Stopwatch

7/32 x 2 1/2 x 4 1/2"

£19.95

(£22.95)



Other Casio calculators, P.O.A. Remember, we will **BEAT** lower prices by 5%

SEIKO ALARM CHRONOGRAPHS FROM **£37.50**



£37.50

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

DFT 038 100 metre water-resistant version

£49.95

DER 048 Solar powered (right). Weekly programmable alarm, 16-hour interval countdown alarm timer, hourly chimes, 1/100 second stopwatch.

DER 018 100 metre water-resistant version.

£69.95



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DUO DISPLAY Analogue/digital watches from £57.50

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

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

Price includes VAT and P&P. Send your company order, cheque, P.O. or phone your ACCESS or BARCLAYCARD number to:

TEMPUS

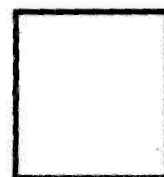
Dept. ETI, FREEPOST
 164-167 East Road
 Cambridge CB1 1DB
 Tel: 0223 312866

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 0EE.

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	READ FULLY	SCANNED OVER	COMMENTS?
FM TUNER				
LED TACHO				
MULTI-OPTION SIREN				
POLYSYNTH				
UNIVERSAL TIMER				
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?

Yes/No

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

3) 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!

4) How long do you keep your past copies of ETI?
1 month 3 months 6 months 1 year longer

5) How did you become a reader of ETI?

By accident Friend's copy Impulse buy Advertisement Other (please specify)

6) How many people read your copy?

PROJECTS

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

Yes/No

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

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

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

Yes/No

Good Fair OK Poor Bad Atrocious

Any problems? (Please specify below)

ADVERTISING

18) Do you read advertisements in ETI?
Frequently Occasionally Never

19) Do you find the advertisements in ETI useful when purchasing goods?
Yes No Neither

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

Yes/No

21) If so:-

(a) Approx. how many times in the last year have you ordered goods from a mail order company?
(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 ETI?

£

AUDIO

24) Do you own a stereo system?

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

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

Yes/No

HOME COMPUTING

30) Do you own a home computer or microprocessor system?

Yes/No

31) If yes, how much did it cost?

£

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.

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.

8) Are there any you intend to build from this issue?
If yes which? Yes/No

9) Is there anything you would especially like to see as a project in ETI?
Please specify. Yes/No

10) In general, if there is a kit available for a project would you purchase that rather than assembling the components yourself? Yes/No

11) Do you construct using PCBs?
If yes, do you etch your own? Yes/No

12) In general again, do projects constructed from ETI work first time? Yes/No

SUBJECTIVE MATTER

13) Please read the list of topics below and indicate how you think coverage of them measures up in the appropriate box

	About right now	Should cover less in future	Should cover more in future	Totally ignore
PROJECTS				
FEATURES				
HOME COMPUTING				
AUDIO				
EQUIPMENT REVIEWS				
SPACE FACT				
SCIENCE FICTION				
GENERAL SCIENCE				
MILITARY ELECTRONICS				
ANY OTHER (SPECIFY)				

13) More specifically, there are many types of project we can present in ETI. What is your interest in these examples, and what sort of emphasis should we place on each?

	LESS NEEDED	RIGHT NUMBER NOW	LET'S HAVE MORE
TEST GEAR			
SOUND EFFECTS			
GAMES			
MUSIC			
AUDIO			
BIOFEEDBACK			
MOTORING			
COMPUTING			

15) Have you ever used the ETI postal enquiry service?
If yes how did you find it? Yes/No

Brilliant Good Fair Atrocious Non-existent
Please outline below any problems you have encountered when dealing with us below

33) How old are you? £

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?
Barclaycard Access American Express

38) To what level were you in full time education?
CSE 'O' Level 'A' Level ONC HNC Degree

39) What do you like about ETI?

40) and dislike?

41) Any suggestions for improvement?

42) Any comments to make? (Please include separate sheet if necessary!)

43) The competition. (Otherwise known as the Bad Guys!)

On an arbitrary scale of 100 with ETI scoring 50, please rate the competition against us.

	REGULAR	READ SOMETIMES	USED TO	NEVER	RATING
RADIO CONSTRUCTOR					
WIRELESS WORLD					
TELEVISION					
VIDEO					
PRACTICAL COMPUTING					
COMPUTER AGE					
PRACTICAL WIRELESS					
PRACTICAL ELECTRONICS					
PERSONAL COMPUTER WORLD					
BYTE					
ELEKTOR					
EVERYDAY ELECTRONICS					
COMPUTING TODAY					
HOBBY ELECTRONICS					
VIDEO TODAY					
WHAT VIDEO					
ETI					50

Thank you for your time and patience!

Name
Address

SPECIAL OFFERS

TO LAUNCH OUR MAIL ORDER DEPT.

SEMI CONDUCTORS: 2N2222A 8 for £1, 2N6385 50p, 2N5061 15p, BC182 (TO5) 15 for £1, BC212L (TO5) 15 for £1, BC714L (TO5) 15 for £1, BF245 fet 20p, BU208 £1.50, MJE340AT 50p, 741 (8 pin DIL) 8 for £1, 555 5 for £1, 723 Reg. 25p, Dual 741 30p. **EXTRA SPECIAL LIMITED OFFERS:** 2708 450ns £3.50, 8080A £3, EM4402 (4k Static Ram) £2.

RESISTORS: Carbon Film 1/4w 5% £3/1000 Our Mix. Metal Oxide 1/2w 2% £2/Our Mix. Rectangular Presets (W/W and Cermet) 10/£1 Our Mix. Wirewounds 2w, 4w, 6w, 10w, 40/£1 Our Mix.

CAPACITORS: 100 Disc Ceramic (40 values) £1.50. 100µf 63 volt Radial 12p each 15/£1, 1µf 100 volt Radial Polyester 20p. Can Electrolytic. 680µf 63 volt 25p, 10,000µf 25 volt £1, 3300µf 63 volt £1, 4700µf 63 volt £1.50, 12000µf 25 volt 75p. Computer Type. 1000µf 160 volt £1.50, 1500µf 100 volt £1.50, 11000µf 25 volt £1.25, 21000µf 40 volt £2, 47000µf 25 volt £2.

MISC ITEMS: Pack of 9 Slide Switches 50p, 10 Clear Mains Neons £1, .1" Pitch Edge Connectors Double sided 43 way £1, 48 way £1.50, 500R Ten Turn Pots £1, 15 Turn Dials £1.50, 16 way Low Profile i/c Sockets 10/£1, 7 way DIL Switch 80p.

All prices include VAT. Please add 30p P&P. Large S.A.E. for List

ELECTRO SUPPLIES

MAIL ORDER DEPT.
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Bowness Mill, Shawclough Road
Waterfoot, Rossendale, Lancs.
Tel: Rossendale 5556

RETAIL SHOP
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6A Todd Street
Manchester
(next to Victoria Stn.)
Tel: 061-834 1185

Happy Memories

4116 200ns	£2.95	2114 200ns	£3.45
2114 450ns	£2.95	2716 5 volt	£7.95
2708 450ns	£4.75		

MEMOREX SOFT-SECTORED MINI-DISCS for PET, TRS-80, etc. Supplied in **Free Library Case**
£19.95 per 10

Low Profile I.C. Sockets by Texas

Pins	8	14	16	18	20	22	24	28	40
Pence	10	11	12	16	17	20	21	28	37

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Principle:

The dosimeter is an ionisation chamber type using a quartz fibre electroscope as the indicating element. A microscope is used to project the image of the moving quartz fibre element on to a graticule scale. The quartz fibre is mounted on a wire electrode, which in turn is supported by a high quality insulator. When the instrument is charged, positive charges distribute themselves over the wire electrode and quartz fibre causing the fibre to bend away from the electrode. The fibre will take up a position depending on the amount of charge on the system.

When the surrounding air in the ionisation chamber is ionised negative ions will be attracted to the positively charged electrode thereby reducing its charge. The resulting fibre movement will be related directly to the quantity of radiation producing the ionisation. The fibre movement can thus be calibrated directly in roentgen units and the rate of movement of the fibre will be proportional to the roentgens received per unit time.

Construction:

The microscope, electroscope and ionisation chamber are housed in an outer skin which may be of brass or aluminium. At one end of the tubular case is fixed a charging assembly, and at the other an eye-piece window.

Each dosimeter is provided with protective end cap translucent window so that the cap need not be removed for reading.

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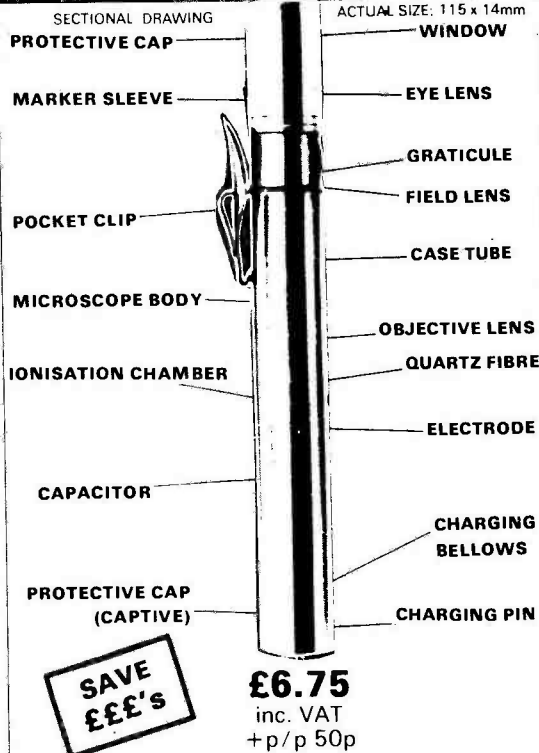
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(2nd turning left past Reading Technical College in King's Road then first right — look on right for door with "Spoked Wheel")

AUDIOPHILE FM TUNER



A high performance stereo tuner with preset and manual tuning facilities, LED tuning and signal strength scales. Optional extras are an automatic search-and-lock tuning facility and a stereo LED audio level indicator. Design by Ray Marston. Development by Steve Ramsahadeo.

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

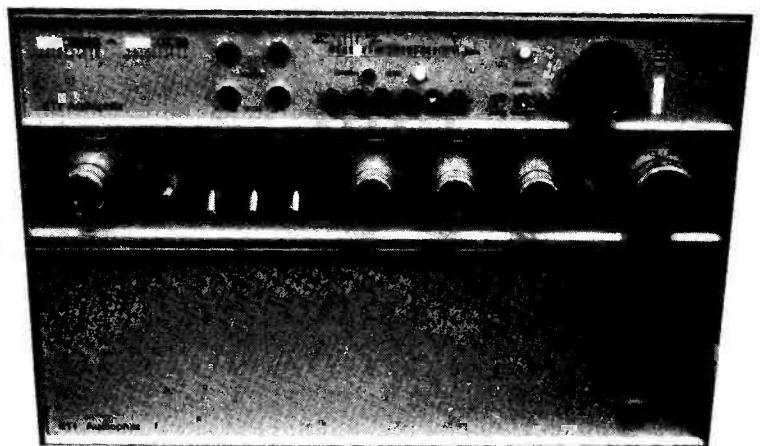
We strongly recommend that you build up the individual units of this project one at a time and interconnect and test them on the open bench before fitting the full set of modules (with or without the optional 'extras') into the final case. Start off by building the power supply unit and check that a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

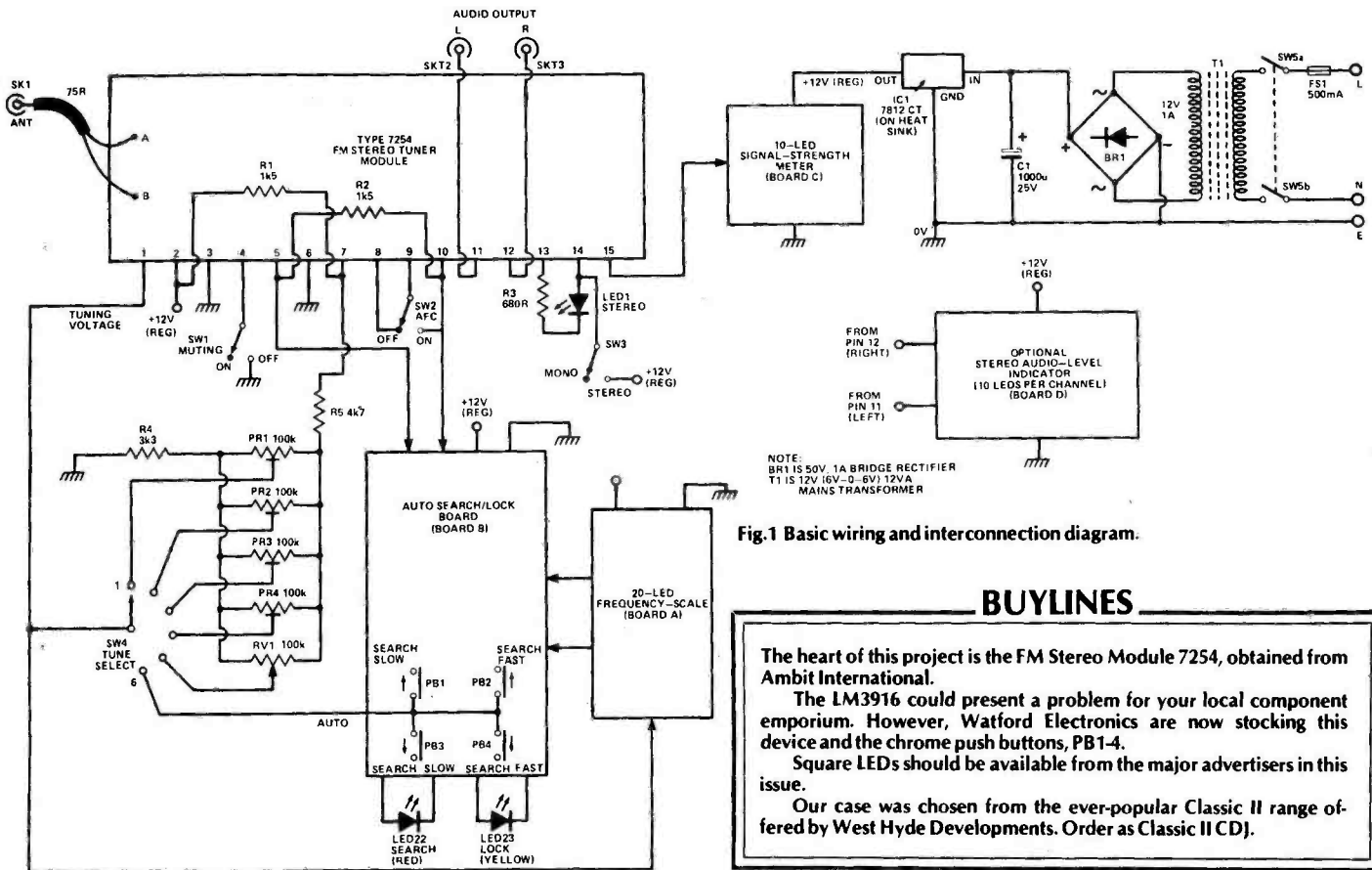


Fig.1 Basic wiring and interconnection diagram.

BUYLINES

The heart of this project is the FM Stereo Module 7254, obtained from Ambit International.

The LM3916 could present a problem for your local component emporium. However, Watford Electronics are now stocking this device and the chrome push buttons, PB1-4.

Square LEDs should be available from the major advertisers in this issue.

Our case was chosen from the ever-popular Classic II range offered by West Hyde Developments. Order as Classic II CDJ.

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.

The design is built around the assembled 7254 timer module (below).

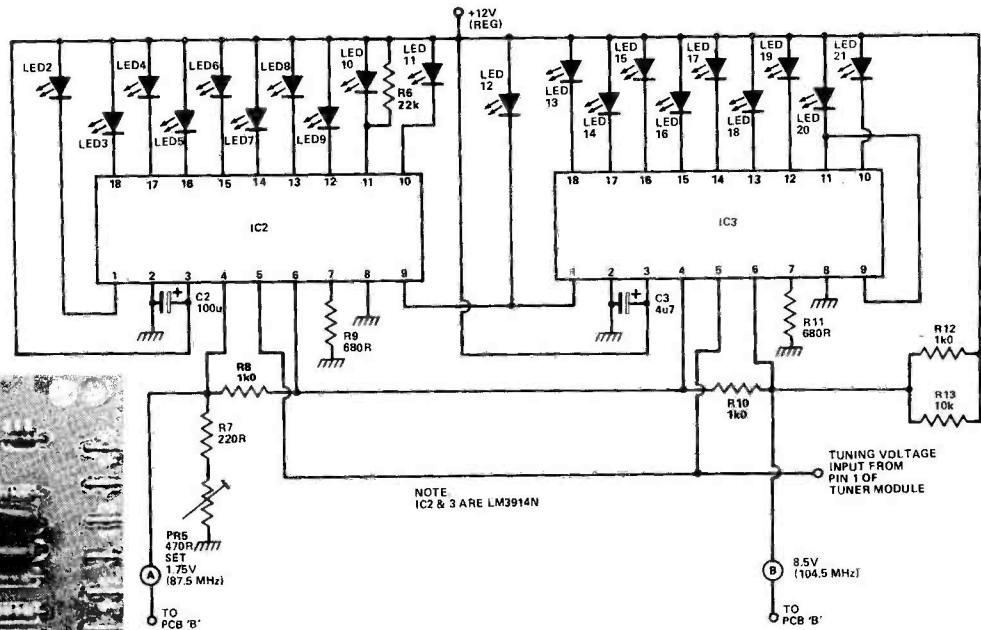
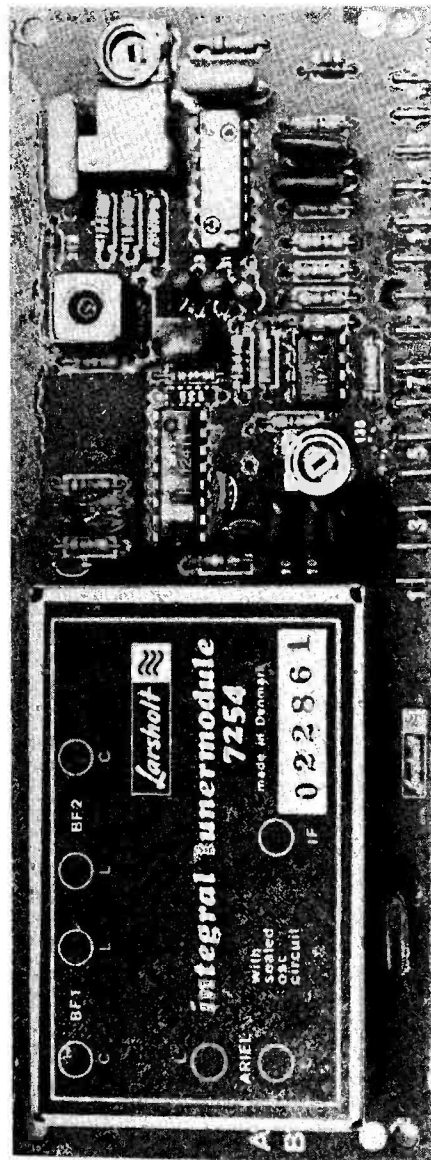


Fig.2 Circuit diagram of the 20 LED frequency scale. This circuit is driven by the timer module (with its ancillary components) and so the component numbering follows on from the module.

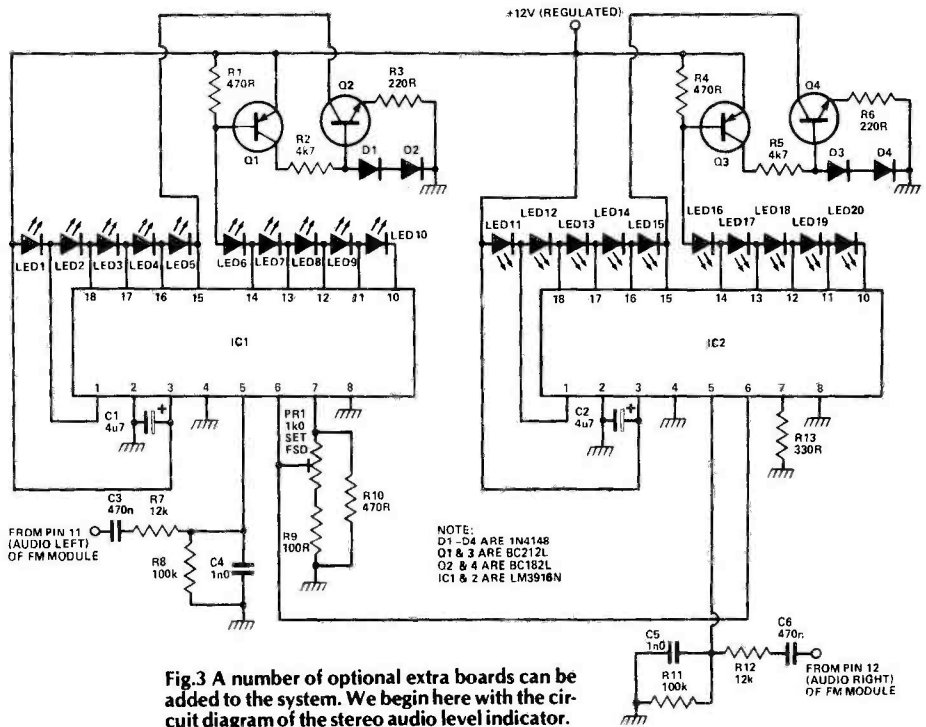


Fig.3 A number of optional extra boards can be added to the system. We begin here with the circuit diagram of the stereo audio level indicator.

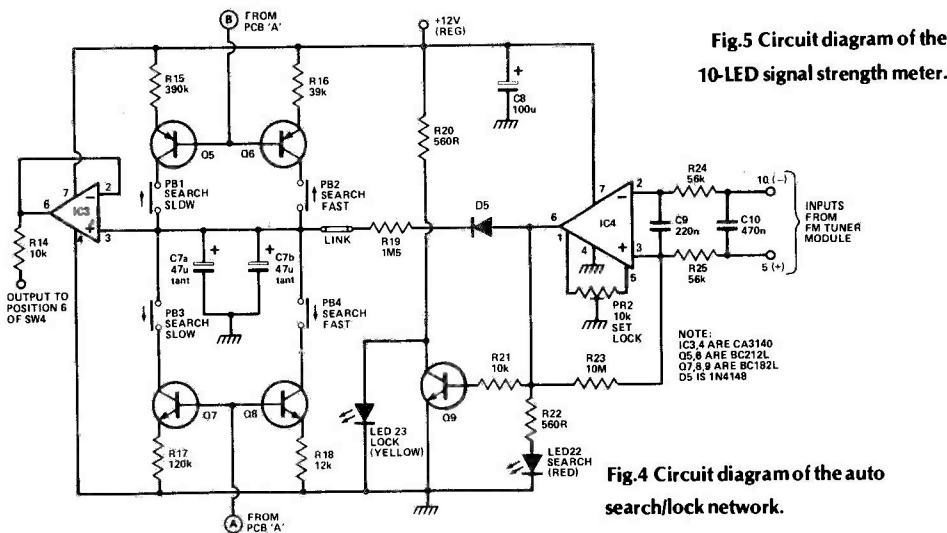


Fig.4 Circuit diagram of the auto search/lock network.

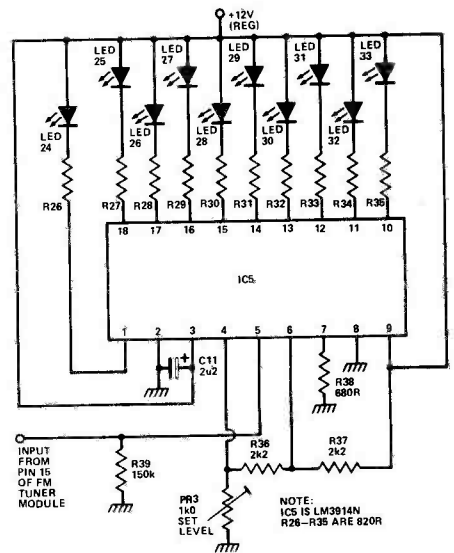


Fig.5 Circuit diagram of the 10-LED signal strength meter.

HOW IT WORKS

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 scale.

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 by 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.

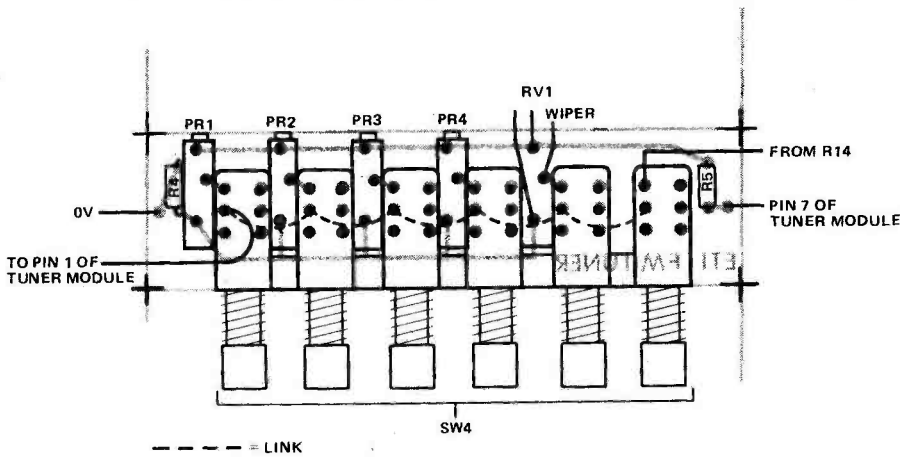
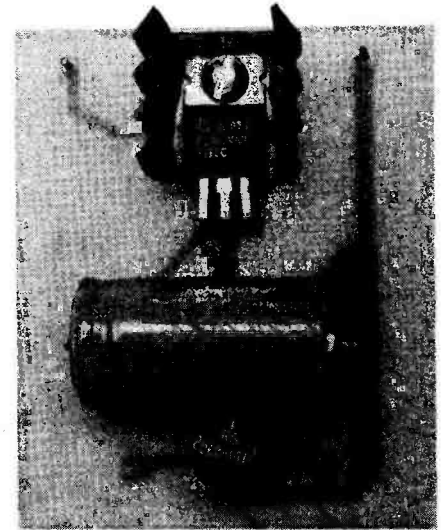


Fig.6 (above) Component overlay of the SW4 six-way switch assembly.



The power supply board — couldn't be simpler.

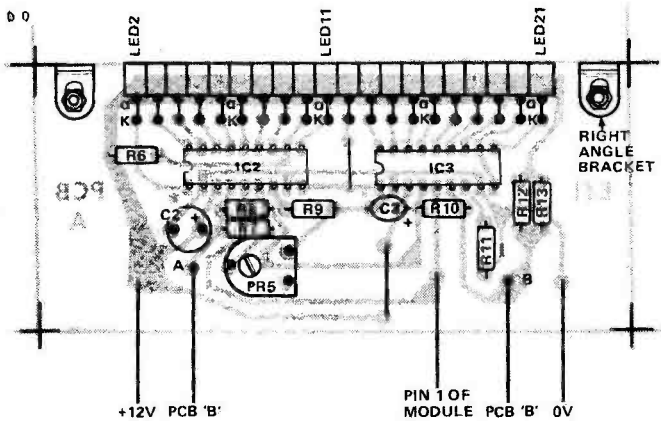


Fig.7 (above) Component overlay of the LED tuning scale.

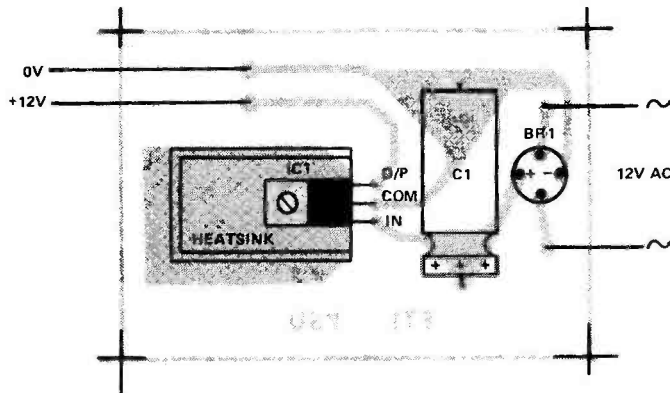


Fig.8 (above) Component overlay of the PSU.

And this is how the whole jigsaw goes together (below).

PARTS LIST

FM Module and Tuning Scale

Resistors all ¼ W 5%

R1,2	1k5
R3,9,11	680R
R4	3k3
R5	4k7
R6	22k
R7	220R
R8,10,12	1k0
R13	10k

Potentiometers

PR1-4	100k ¼ in. 20-turn cermet preset
PR5	470R miniature horizontal preset
RV1	100k 10 turn linear

Capacitors

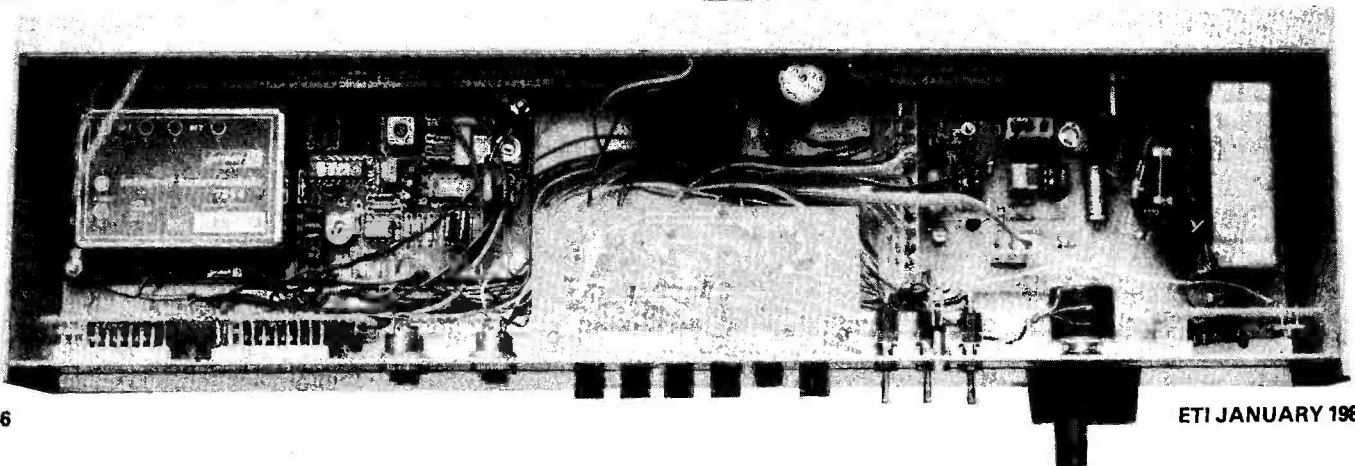
C1	1000u 25 V electrolytic
C2	100u 16 V electrolytic PCB type
C3	4u7 35 V tantalum

Semiconductors

IC1	7812
IC2,3	LM3914N
BR1	50 V 1A bridge rectifier
LED 1	T1L209
LED 2-21	square LEDs (yellow)

Miscellaneous

T1	6-0-6 12 VA transformer
SW1-3	SPDT miniature toggle
SW4	2 pole changover interlocking push button (6-way assembly)
SW5	DPDT miniature toggle (optional)
7254 FM module	(see Buylines), PCB 'A', fuse and holder, phono sockets (X2).



PARTS LIST

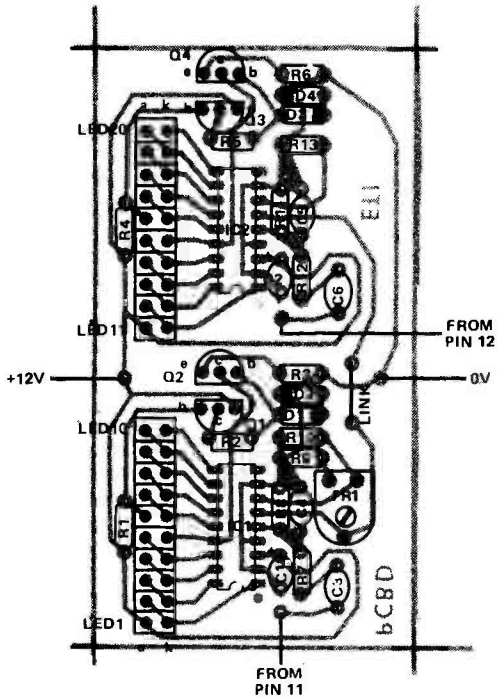


Fig.9 Component overlay of the stereo audio level indicator.

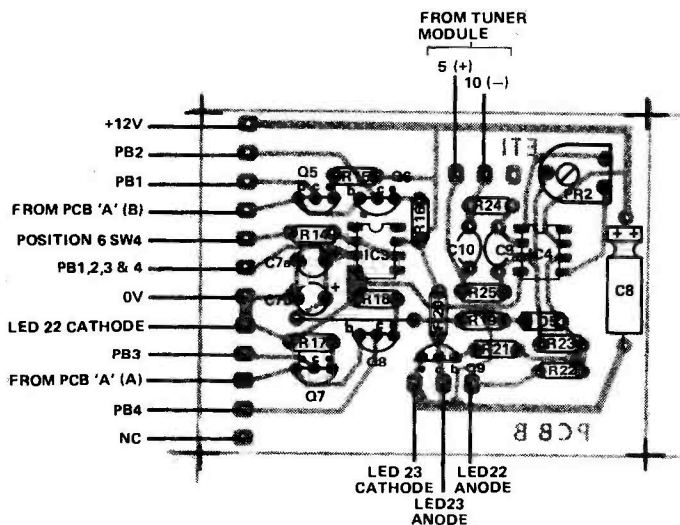


Fig.10 Component overlay of the auto search-lock network.

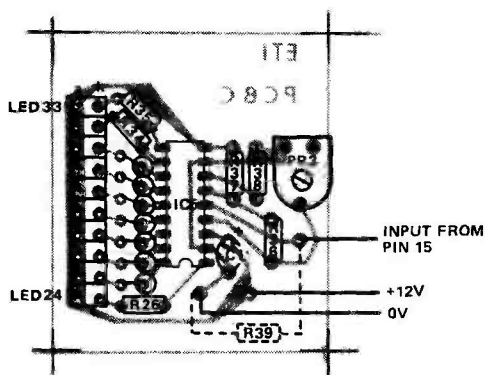


Fig.11 Component overlay of the signal strength meter.

Stereo audio level indicator

Resistors all 1/4 W 5%

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

Resistors all 1/4 W 5%

R14,21	10k
R15	390k
R16	39k
R17	120k
R18	12k
R19	1M5
R20,22	560R
R23	10M
R24,25	56k

Potentiometers

PR2	10k miniature horizontal preset
-----	---------------------------------

Capacitors

C7,a,b	47u 16 V tantalum
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	TIL209

Miscellaneous

PB1-4 momentary push buttons (see Buylines)

PCB 'B'

Signal Strength Meter

Resistors all 1/4 W 5%

R26-35	820R
R36,37	2k2
R38	680R
R39	150k

Potentiometers

PR3	1k0 miniature horizontal preset
-----	---------------------------------

Capacitors

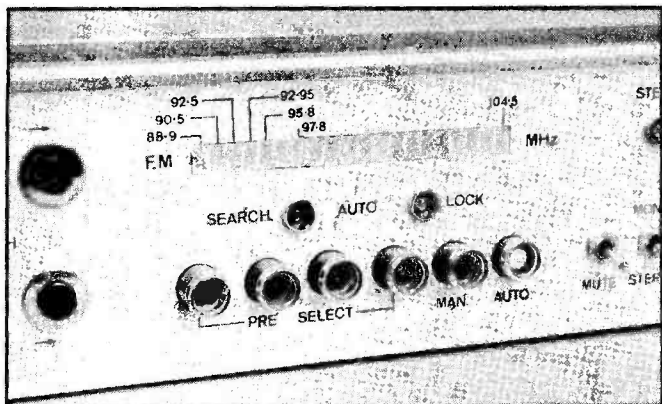
C11	2u2 35 V tantalum
-----	-------------------

Semiconductors

IC5	LM3914N
LED 24-33	square LEDs (green)

Miscellaneous

PCB 'C'



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 1/4 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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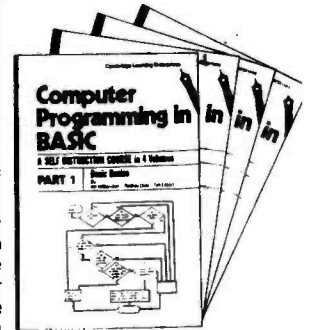
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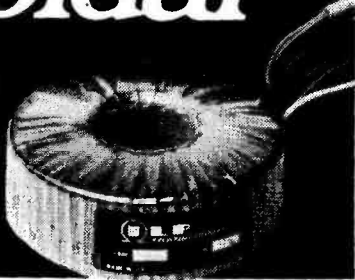
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3X013	15+15	2.66
3X014	18+18	2.22
3X015	22+22	1.81
3X016	25+25	1.60
3X017	30+30	1.33
3X028	110	0.72
3X029	220	0.36
3X030	240	0.33

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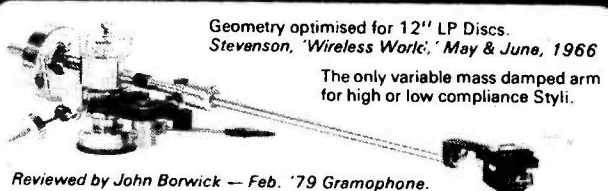
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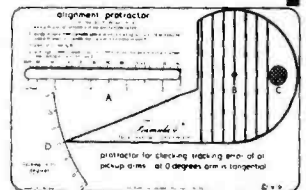
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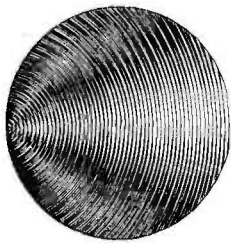
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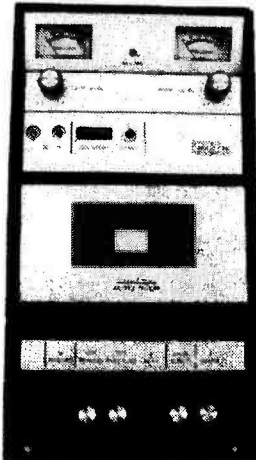
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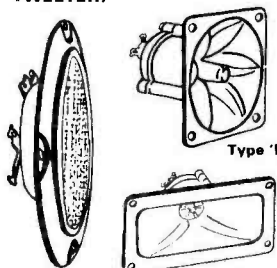
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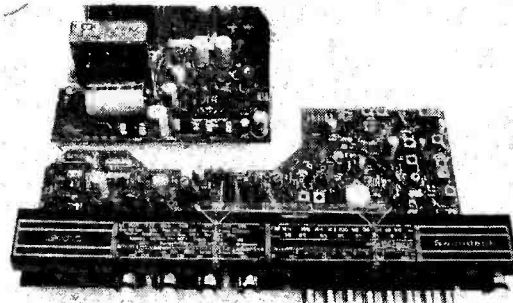


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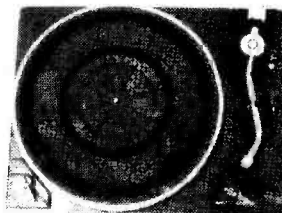
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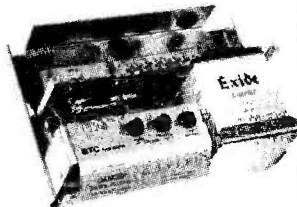
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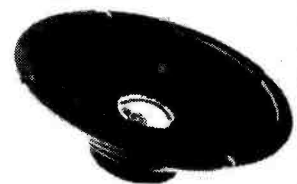
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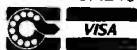
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DESIGNER'S NOTEBOOK

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

The 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.

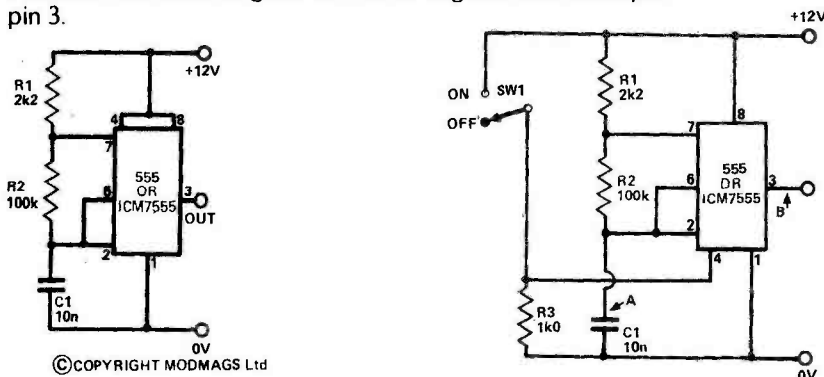


Fig.1a Basic circuit of the 55-type astable multivibrator.

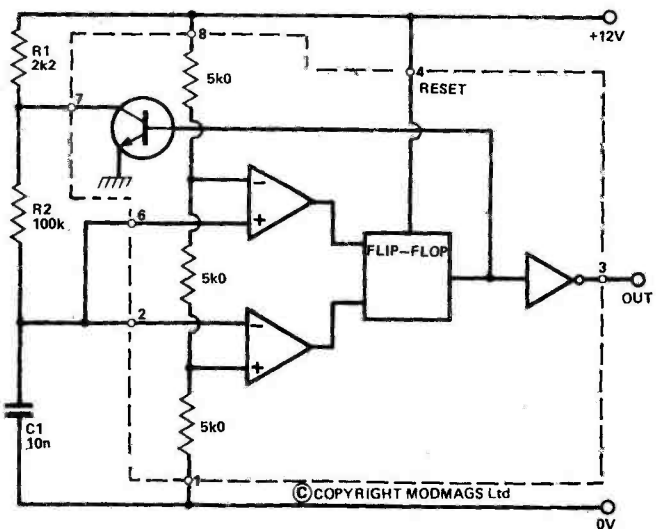


Fig.1b Equivalent circuit of the 555-type astable multivibrator.

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 1k resistor), the flip-flop output is driven high, thus discharging C1 through R2 and the transistor and also driving the pin 3 output low. 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.

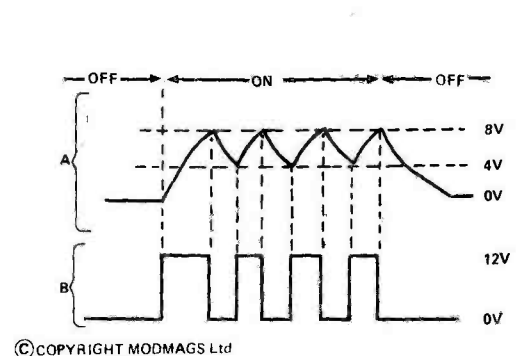


Fig.2 Conventional way of gating the 555 astable, with resultant waveforms.

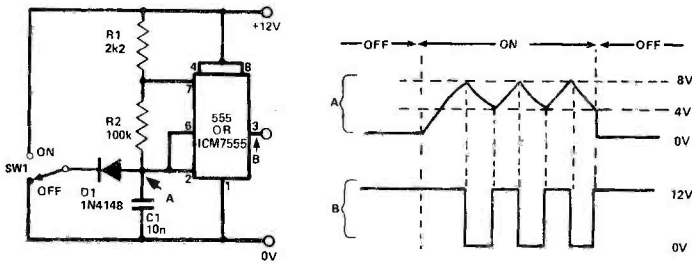


Fig.3 Basic method of gating the 555 astable using C1, with resultant waveforms. Note that the period of the first half-cycle is longer than that of the succeeding half-cycles.

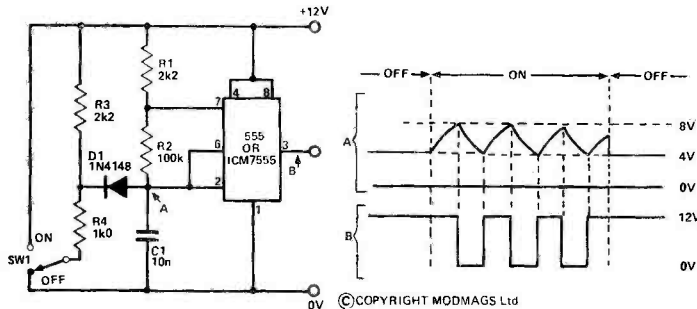


Fig.4 Modification of the C1 gating scheme, giving constant-period half-cycles.

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.

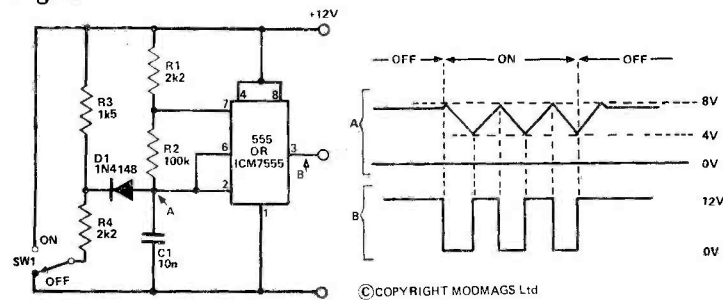


Fig.5 This slight modification of the C1 gating scheme produces a considerable change in the circuit output waveforms.

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

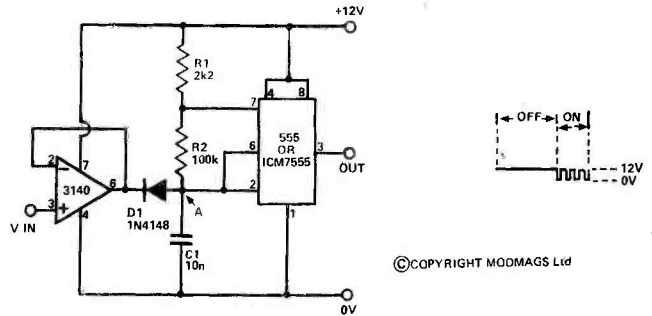


Fig.6 The voltage-controlled astable produces an output only when V_{IN} exceeds two-thirds supply (8 V in this example).

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.

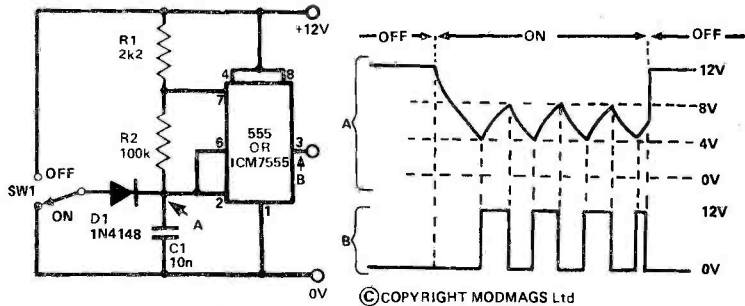


Fig.7 This C1 gating scheme produces a 'B' output that is low in the off condition.

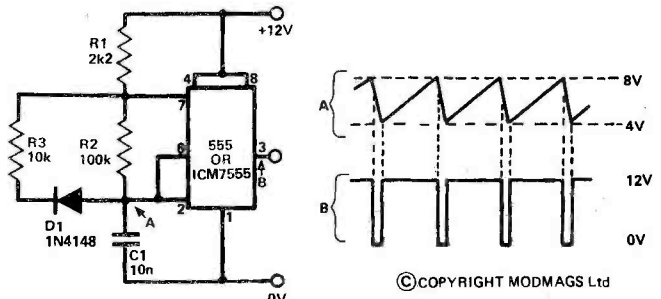


Fig.8 A method of producing a non-symmetrical fixed-ratio from the 555 astable.

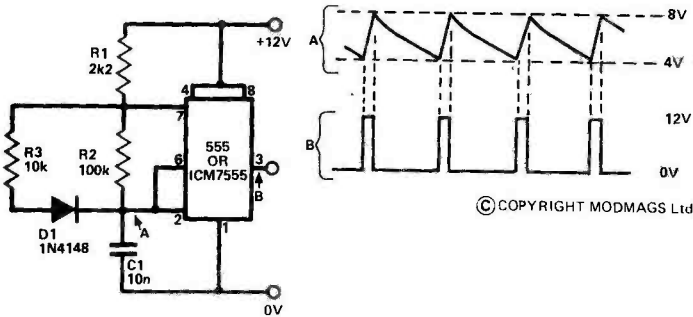


Fig.9 Alternative method of producing a non-symmetrical fixed-ratio output from the 555 astable.

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.

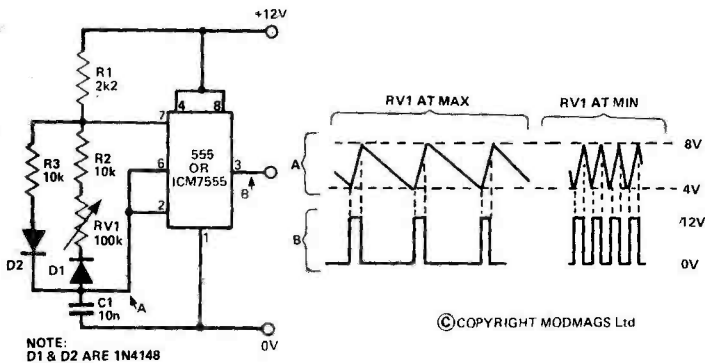
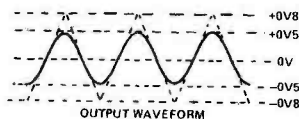
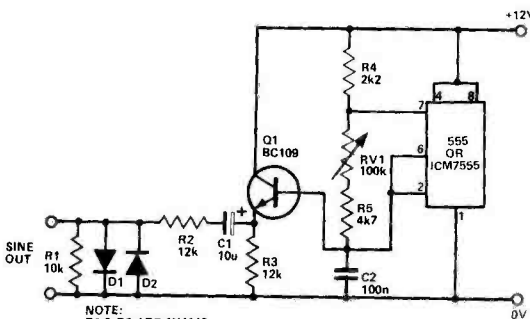
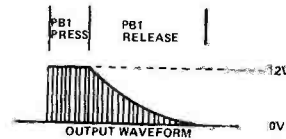
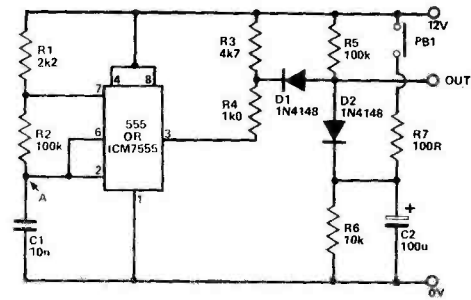


Fig.10 A method of producing a non-symmetrical variable-ratio output from the 555 astable.



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



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

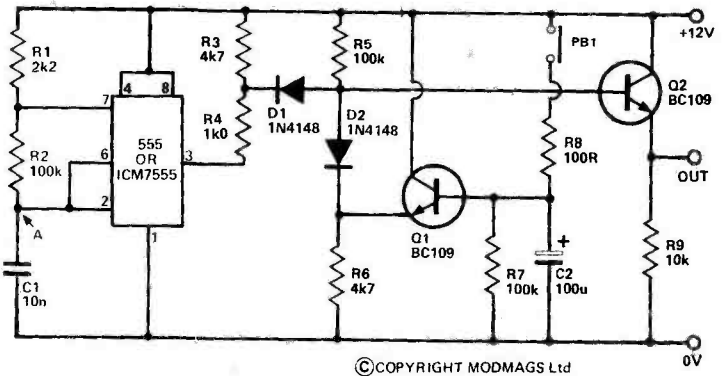


Fig.13 A modification of the Fig.12 circuit to give extended decay times and a buffered output.

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). **ETI**

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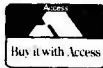
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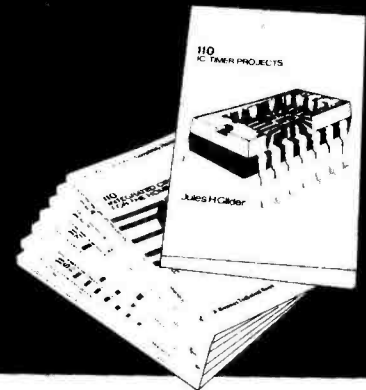
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POLYSYNTH

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



Polyphonic 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 I_{ABC} current and the timing capacitor C_B .

$$\text{Slew Rate} = \frac{I_{ABC}}{C_B} \text{ VS}^{-1}$$

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 μV over its full range of 0 to -4V 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

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 voices	£464
4 voice expansion kit	£295

All prices are exclusive of VAT.

Powertran Electronics, Portway Industrial Estate, Andover, Hants SP10 3NM

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

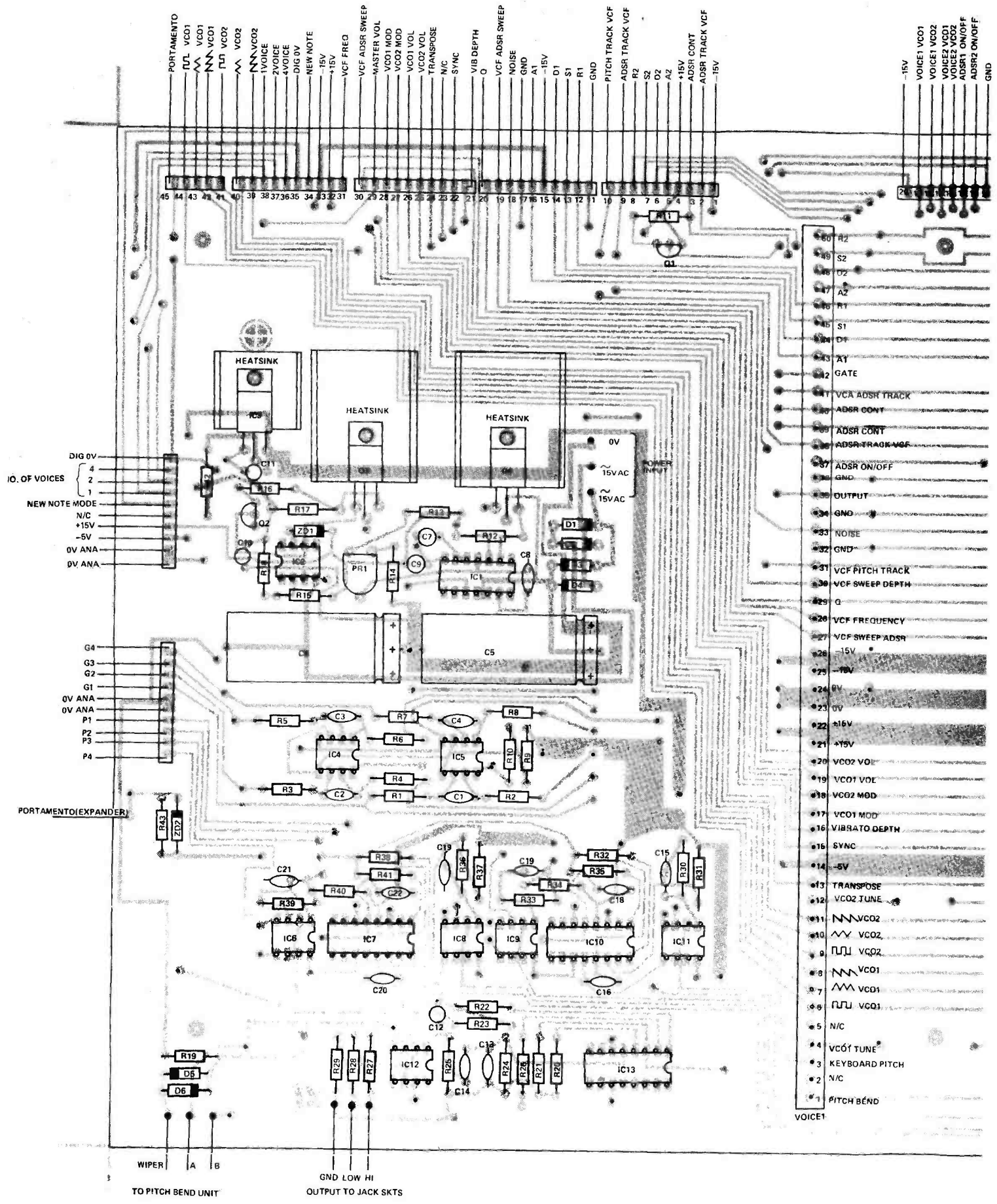
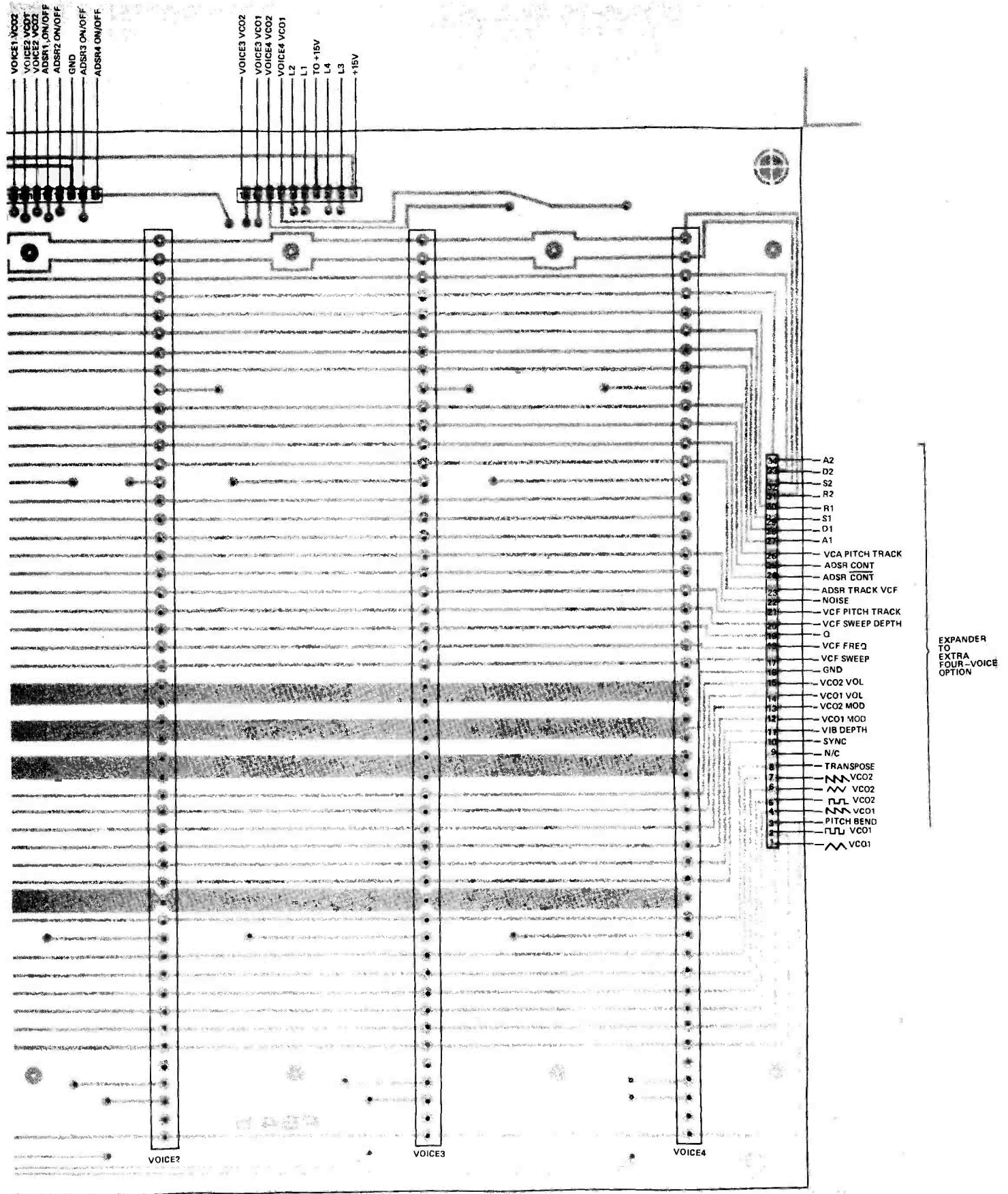


Fig.1 Component overlay of the motherboard (PS4). The circuit diagram was published last month.



PARTS LIST : PS4

Resistors all 1/4 W 5% unless otherwise stated

R1,3,5,7	1M0
R2,4,6,8	1k5
R9	1k2
R10,26,30,33,36,39	15k
R11,32,35,38,41	100k
R12,17	1R0 2 W
R13	12k 2% metal oxide
R14	10k 2% metal oxide
R15,18	10k 0.5% metal film
R16,20,21,27,29,31, 34,37,40	1k0
R22,23,25	22k
R19,24,28	10k
R42	100R 1 W
R43	270k

Potentiometers

RV33	10k linear (single axis joystick)
PR1	10k cermet preset

Capacitors

C1,2,3,4	1n0 ceramic
C5,6	2200u 25 V electrolytic
C7,9,10,11,12	10u 16 V tantalum

C8

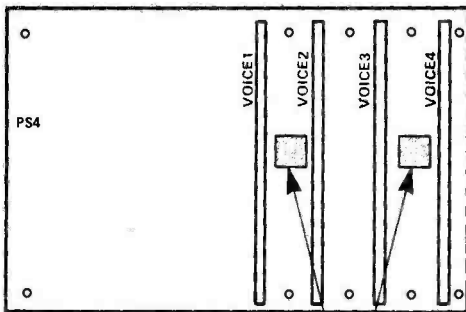
C13	330p ceramic
C14,16,18,20,22	1n0 polycarbonate
C15,17,19,21	220n polycarbonate
	470p ceramic

Semiconductors

IC1	723 (DIL)
IC2,12	741
IC3	7905
IC4,5	1458
IC6,8,9,11	LF353
IC7,10,13	LM13600
Q1,2	BC212L
Q3	TIP30A
Q4	TIP29A
ZD1	10 V
ZD2	5V1
D1,2,3,4	1N4002
D5,6	1N4148

Miscellaneous

PCB PS4, 8 off 8 pin DIL sockets, 14 pin DIL socket, 3 off 16 pin DIL sockets, 2 off heatsinks (RS 401-964 or equivalent), TV5 heatsink, connecting pins, self-adhesive clips.



STICK TWO SELF ADHESIVE RUBBER FEET ONTO THE METAL BASE OF THE SYNTHESIZER UNDERNEATH PS4. THESE WILL HELP TO LIMIT THE CONSIDERABLE FORCES GENERATED WHEN THE VOICE BOARDS ARE INSERTED OR REMOVED FROM PS4
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Fig.2 Plugging in the voice boards could damage the motherboard if it is not cushioned as shown.

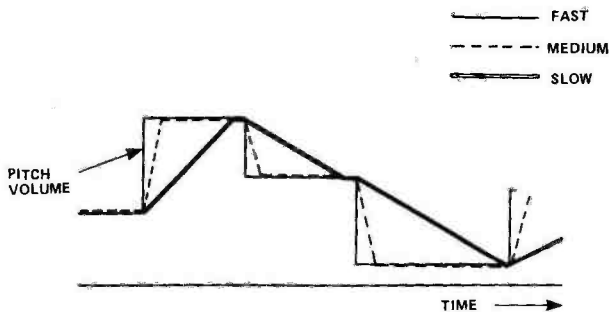


Fig.3 The effect of variable slew limiting (portamento) on pitch voltage.

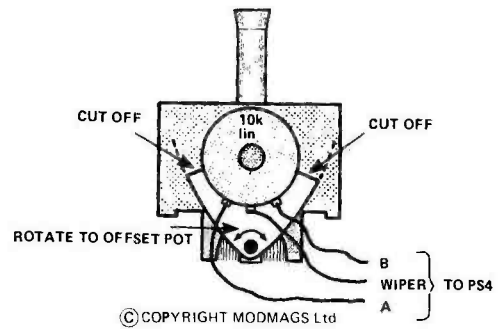


Fig.4 Mechanical details of the joystick pitch bend control.

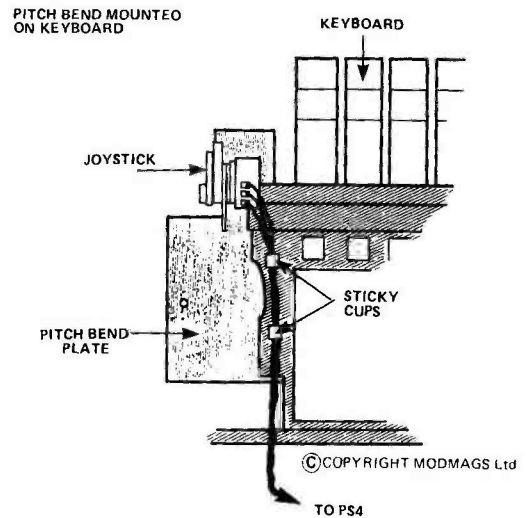


Fig.5 Mounting the joystick pitch bend control (RV33) on the end of the keyboard.

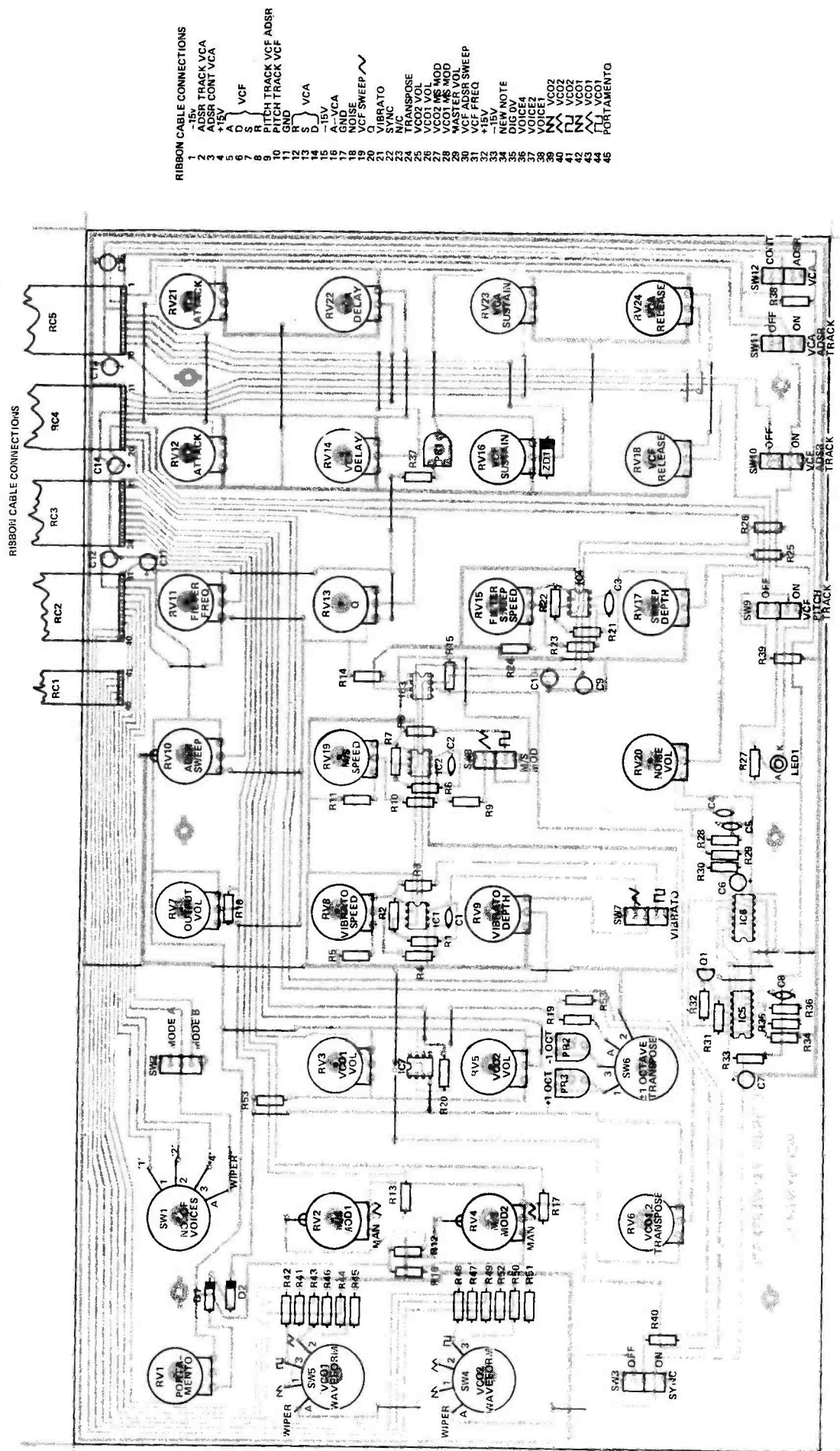


Fig.10 Component overlay of control board PSS.

PARTS LIST : PS5

Resistors all 1/4 W 5% unless otherwise stated

- R1,6,21,39 47k
- R2,7,22,29,38,40,52 100k
- R3,9,30 10k
- R4,12,16 56k
- R5,11,24,33 100R
- R8,13,14,17,32 22k
- R10,23 270k
- R15 3k9
- R18,31 4k7
- R19 100k 2% metal oxide
- R20 10k 2% metal oxide
- R25,26,53 47R
- R27 1k5
- R28 1k0
- R34 2M2
- R35 150k
- R36 12k
- R37 6k8

Potentiometers

- RV1,8,15,19,20 10k logarithmic
- RV2,4,10 22k linear with central click and central tapping

- RV3,6,5,7,9,11,13,16,17,23 10k linear

- RV12,14,18,21,22,24 4k7 linear

- PR1 10k preset

- PR2,3 10k cermet preset

Capacitors

- C1,2,3 150n polycarbonate
- C4 10n polycarbonate
- C5 330n polycarbonate
- C6,7,9,10-15 10u 16 V tantalum
- C8 1n0 polycarbonate

Semiconductors

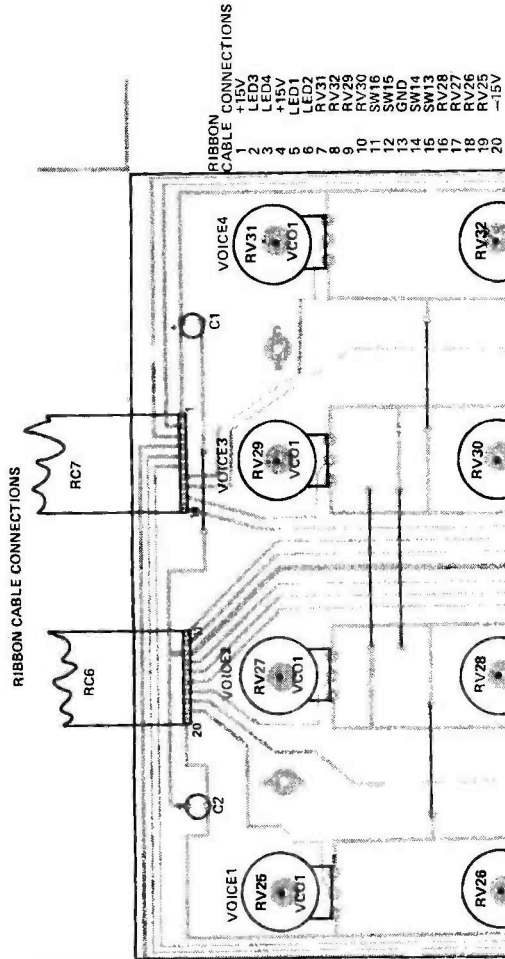
- IC1,2,4 1458
- IC3,7 741
- IC5 40708
- IC6 4006B
- Q1 BC182L
- D1,2 1N4148
- ZD1 5V1
- LED1 0.2" green

Switches

- SW1 3-pole 4-way rotary
- SW2,3,7,8,9,10,11,12 Single-pole double-throw slide
- SW4,5,6 4-pole 3-way rotary

Miscellaneous

- PCB PS5, connectors, self-adhesive clips



PARTS LIST : PS6

Potentiometers

- RV25-32 10k linear

Capacitors

- C1,2 10u 16 V tantalum

Semiconductors

- ZD1 10 V
- LED1-4 0.2" red

Switches

- SW13-16 Single-pole double-throw slide

Miscellaneous

- PCB PS6, ribbon cable connectors, self-adhesive cable clamps

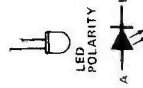


Fig.11 Component overlay of control board PS6.

NOTE:
 IC1, 2, 4 ARE 1458
 IC3, 7 ARE 741
 IC5 IS 4070B
 IC6 IS 4006B
 Q1 IS BC182L
 D1, 2 ARE 1N4148
 ZD1 IS 5V1
 LED1 IS 0.2" GREEN

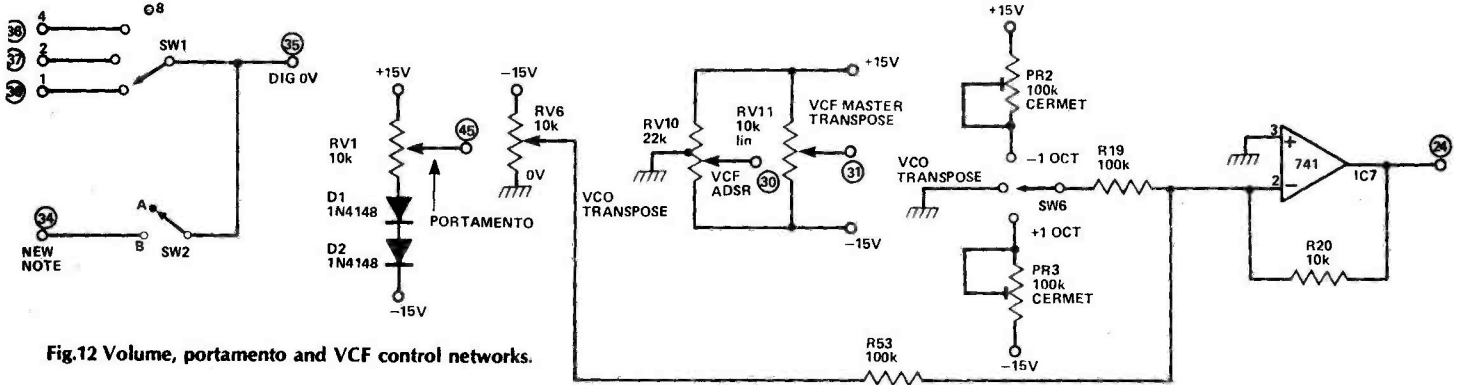
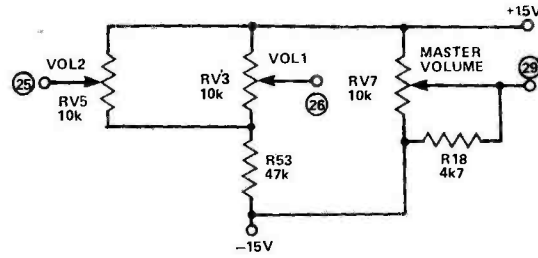


Fig.12 Volume, portamento and VCF control networks.

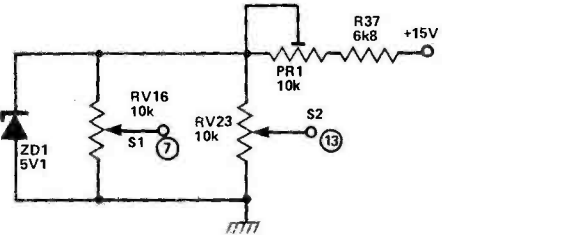
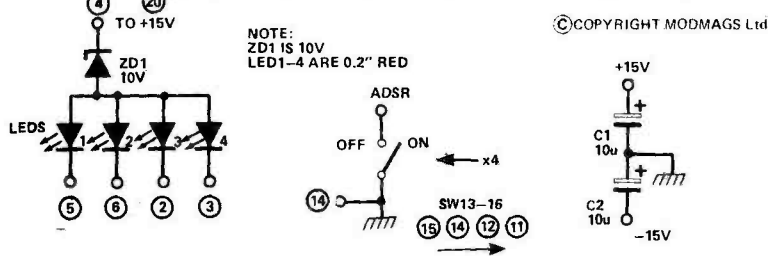
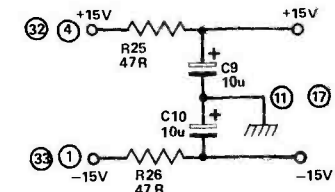
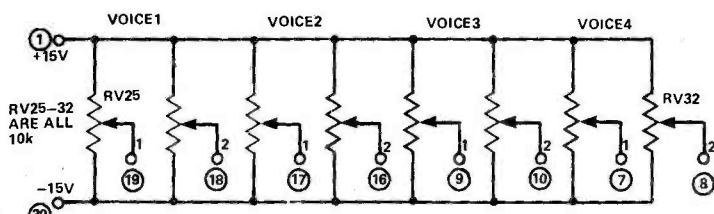


Fig.13 RV25 to RV32 are the VCO1,2 controls on control board PS6.

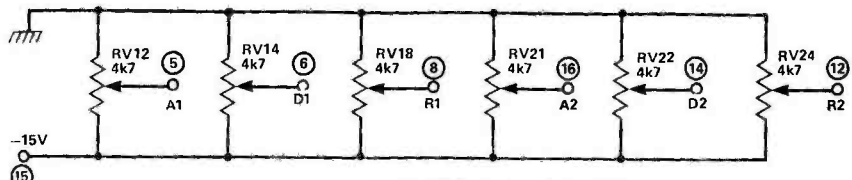


Fig.14 ADSR networks on PS5.

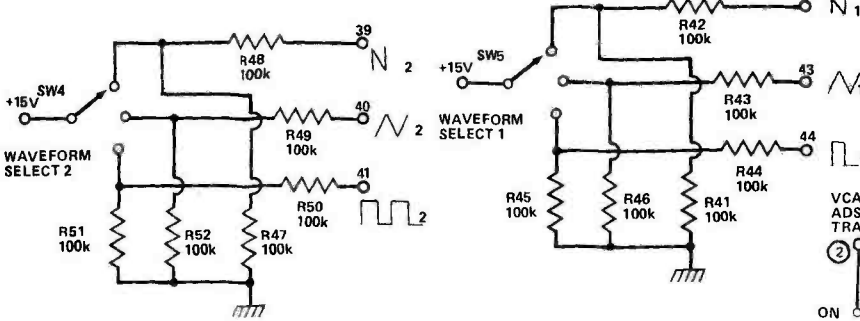
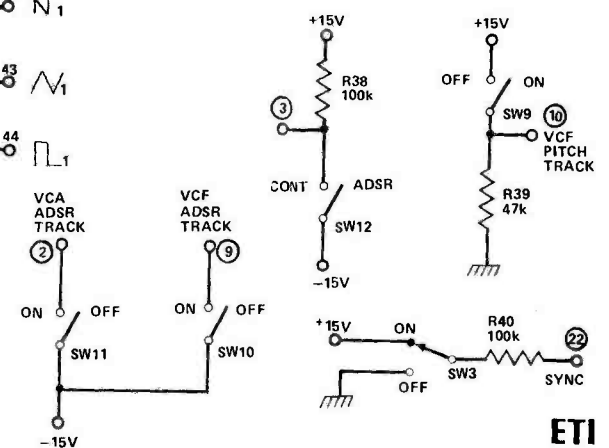


Fig.15 Waveform select networks for VCO1,2.



Next month: The Polysynth continues with constructional details of the voice boards.

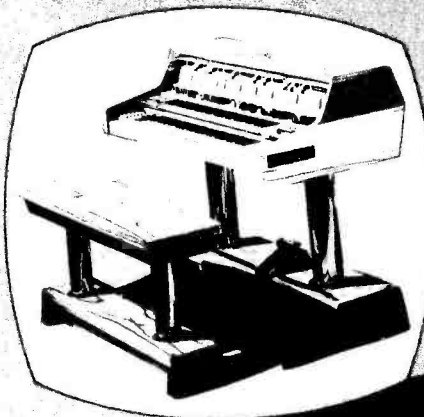
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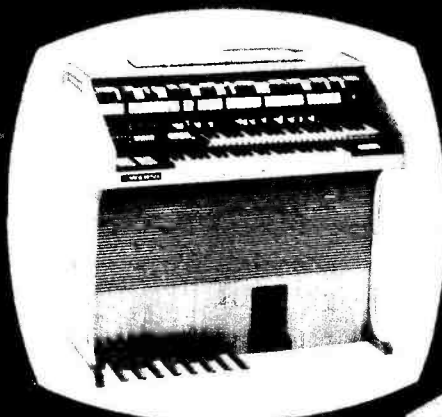
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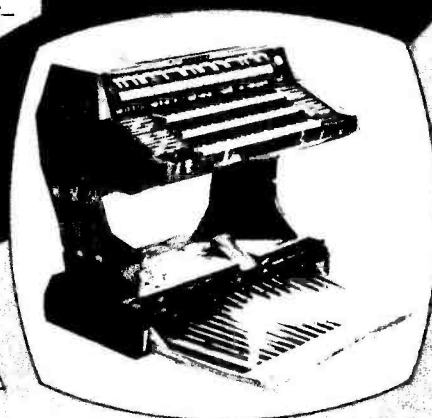


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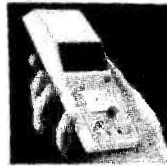
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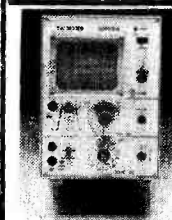
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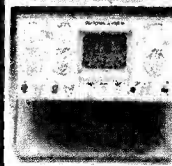
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4008	90p	4047	£1.71	4100	£1.92	4538	£1.20
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4021	£1.10	4063	£1.85	4162	£1.54	4507	55p
4022	£1.00	4066	55p	40161	£1.54	4506	50p
4023	27p	4067	£7.21	40163	£1.54	4508	£2.90
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4026	£3.25	4070	30p	40182	£3.03	4512	£1.50
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4031	£4.31	4076	£1.07	40257	£2.31	4518	£1.00
4032	£1.31	4077	25p	4108	90p	4519	£1.80
4033	£2.63	4078	25p	4109	90p	4520	£1.80
4034	£2.00	4081	27p	4162	90p	4521	£2.50
4035	£1.10	4082	27p	4163	90p	4522	£1.11
4037	£1.99	4085	£1.35	4174	90p	4526	£1.00
4038	£1.20	4086	£1.35	4175	£1.15	4527	£1.90
4039	£2.78	4089	£2.91	4194	£1.16	4528	£1.20
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		74C31	57p	74C374	£1.79	74C921	£17.07	18.432 MHz	£3.23
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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.

The 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.



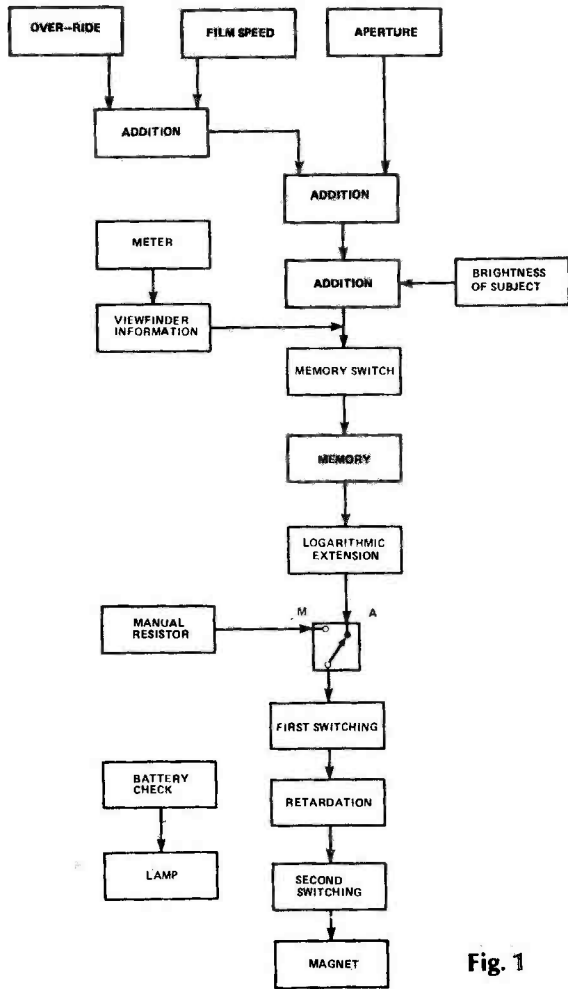


Fig. 1

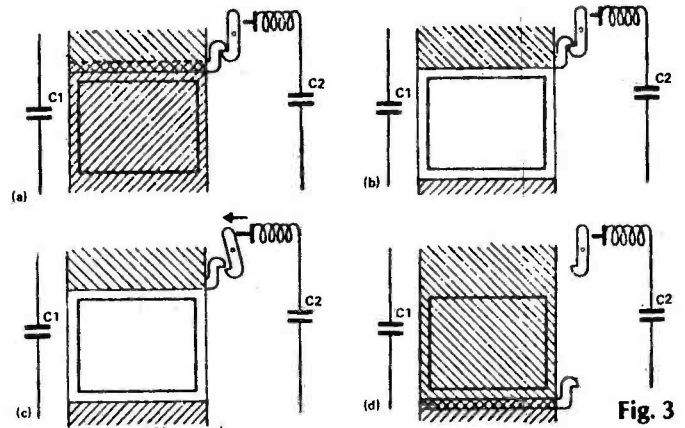


Fig. 3

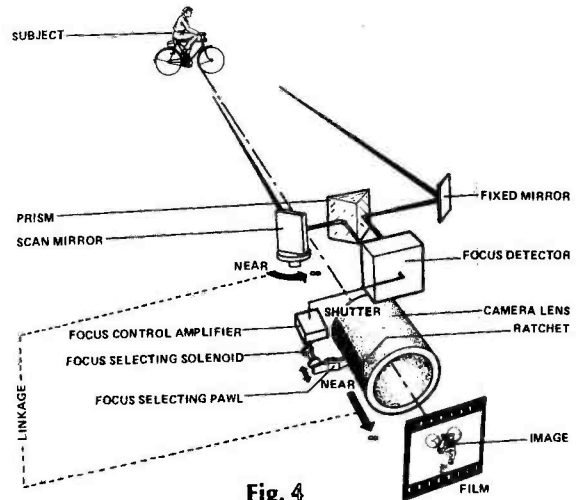


Fig. 4

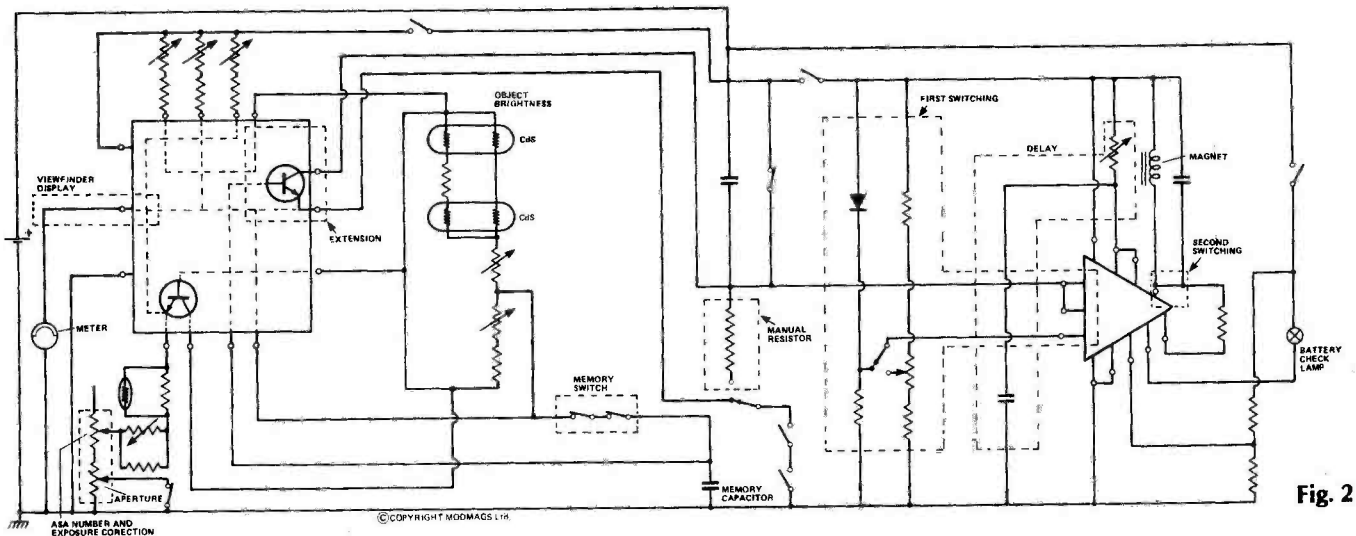


Fig. 2

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 (C1) 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, 1/2 S, 1/4 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 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

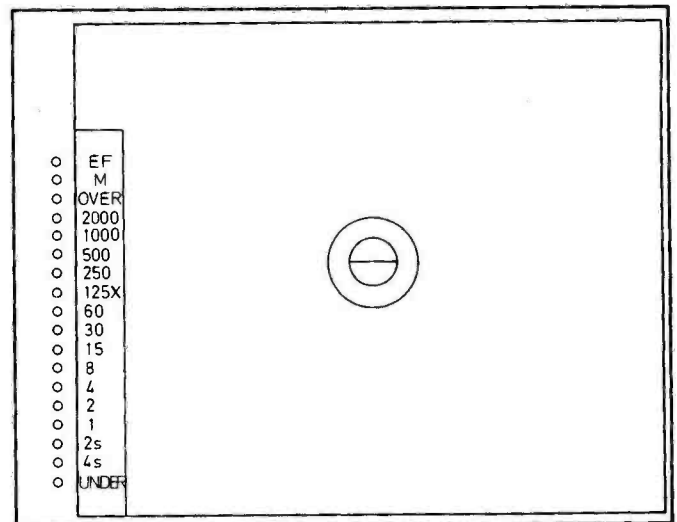


Fig. 5 The Pentax ME Super displays data by means of a three-colour line of LEDs. At 1/60 S and above, the speed selected by the camera will turn on the appropriate green LED. If you see green, it's OK to shoot. If the camera selects 1/30 S or below, the LED lit is yellow, warning you that, although 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).

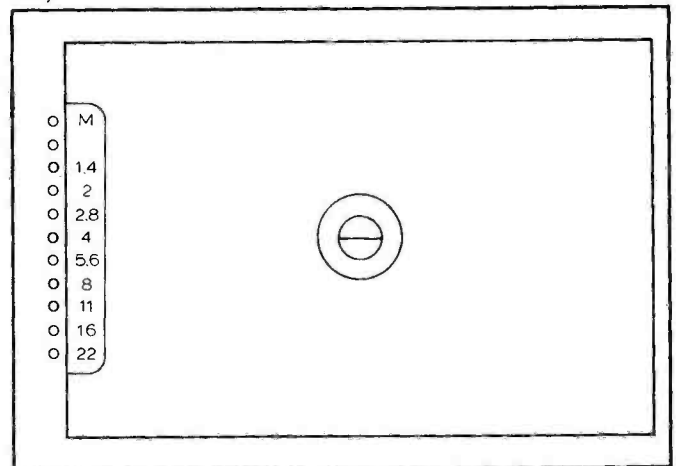


Fig. 6 The Konica FS-1 uses a simple all-red LED display to give details of aperture selected, under/over exposure, battery check, flash ready and manual mode.

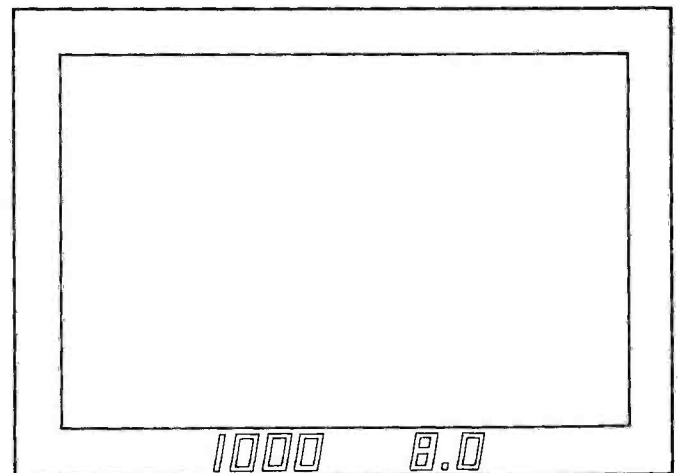


Fig. 7 The Canon A-1's alphanumeric LED display gives the photographer data on just about all the camera's functions — aperture, shutter speed, under/over exposure, flash ready, manual mode, B setting, out of range and operating error. There's even an automatic brightness control to match the display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

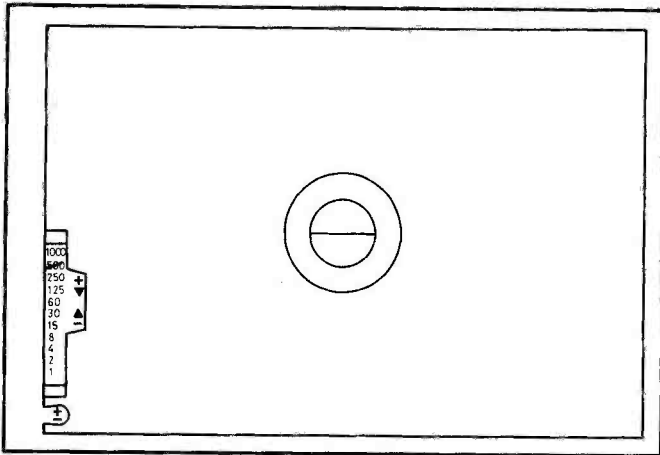


Fig. 8 The Olympus OM-2's bright viewfinder display shows the shutter speed by means of a needle on a scale. Information about under/over exposure, flash ready, exposure compensation, etc is also shown. When you switch to manual, the shutter speed scale disappears and you are left with the conventional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

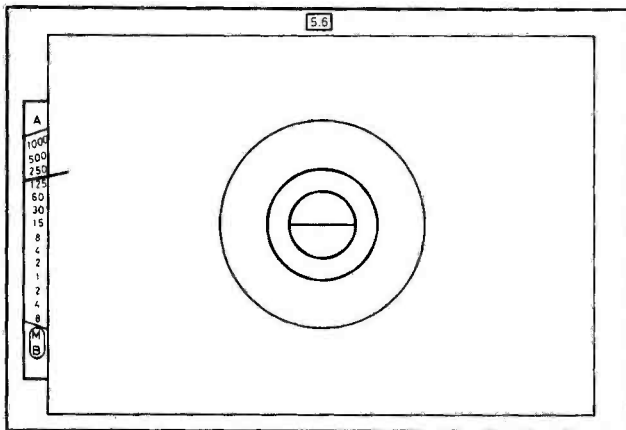


Fig. 9 Like the OM-2, the Nikon FE's display of shutter speed is a needle-on-scale type. The Silicon Photodiodes used in the FE are filtered to match the spectral response of the human eye.

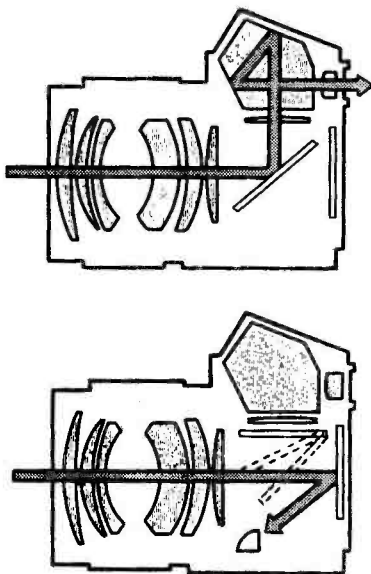


Fig. 10 With the mirror in the down position (top), the Nikon FE looks much the same as any other camera, but when the mirror flips up (above) a light reading is taken directly from the film plane.

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 priority 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.

Table 1 A comparison of the electronic systems used by some popular 35 mm SLRs with automatic programmes.

Camera	Model	Viewfinder Information	Shutter	Auto Exposure	Meter	Power
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 SPD 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	Shutter Priority	TTL GaAsP Centre-Weighted Full Aperture	Four Alkaline-Manganese Cells
Minolta	XG9	Exposure LEDs Shutter Speeds	EHC	Aperture Priority	TTL CdS Centre-Weighted Full Aperture	Two 1V5 Silver Oxide Cells
Nikon	FE	Shutter Speed Scale Aperture/Meter Needle	EVM	Aperture Priority	TTL SPD Centre-Weighted Full Aperture	Two 1V5 Silver Oxide Cells
Olympus	OM-2N	Exposure Index (Manual) Shutter Speed (Auto)	EHC	Aperture Priority	TTL SPD + 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

KEY:

Viewfinder Information
Shutter

Meter

A-LED — alphanumeric LED
E — electronic
H — horizontal
V — vertical
C — cloth
M — metal
TTL — Through The Lens
SPD — Silicon Photodiode
GaAsP — Gallium Arsenide Phosphide
CdS — Cadmium Sulphide
GPD — Gallium Photodiode

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Thorn-Sylvania Scope Tube 5" SE5J £17.50 (Callers only)

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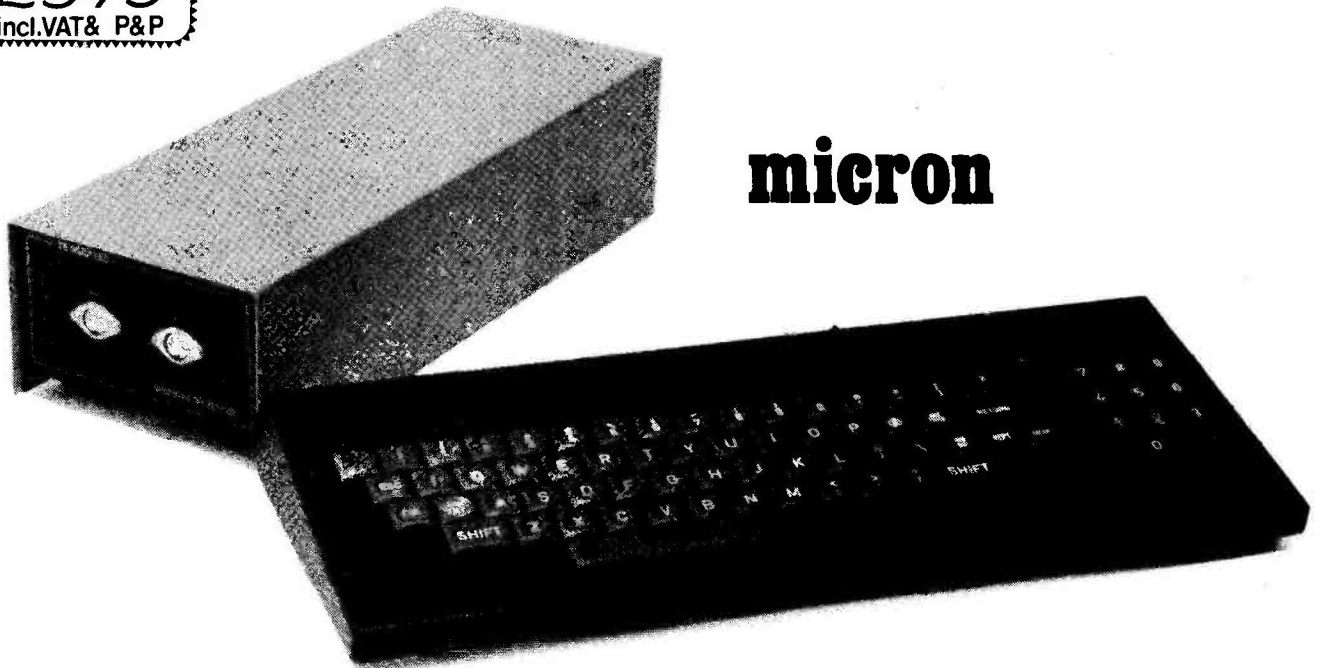
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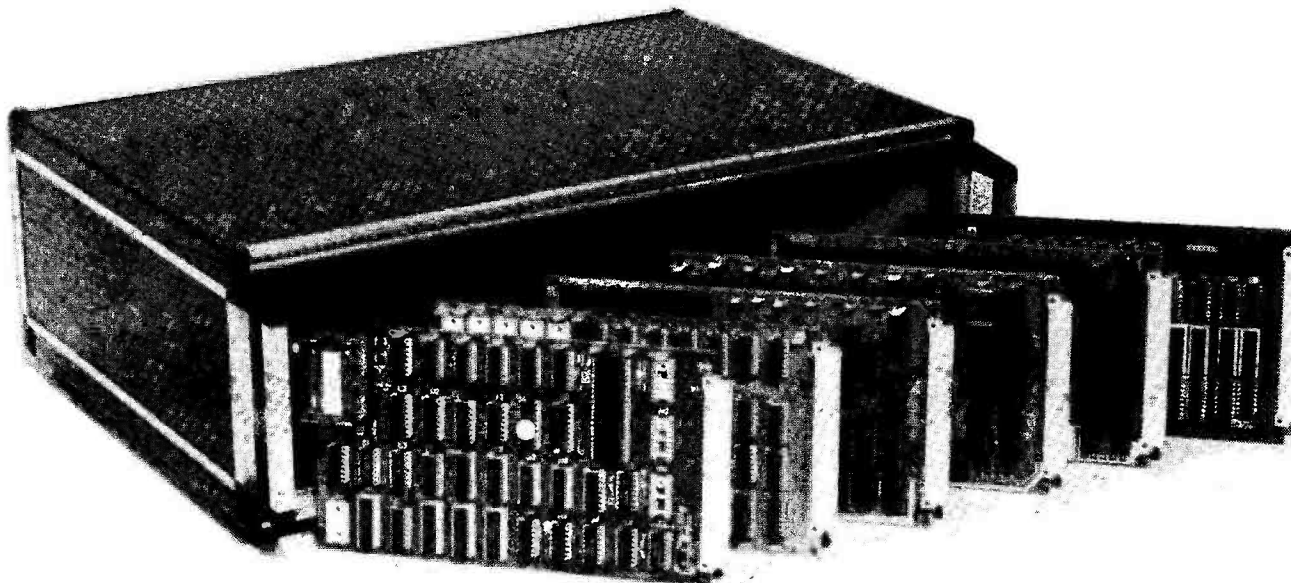
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TECH TIPS

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

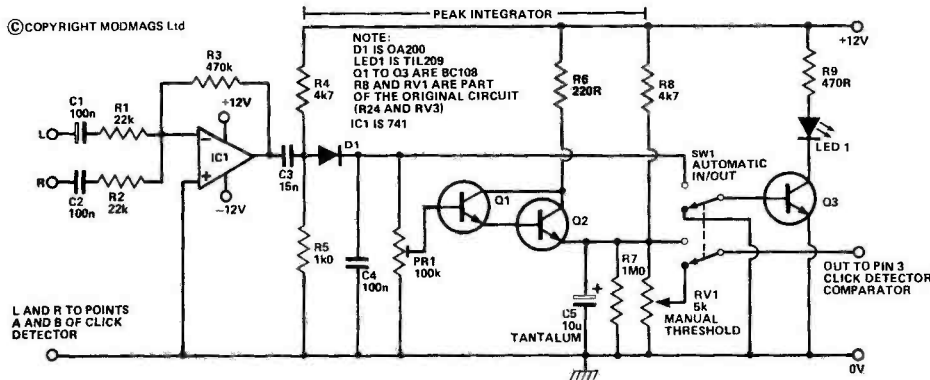
reducing the sensitivity during peak transient levels.

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 3mS 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 succession 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

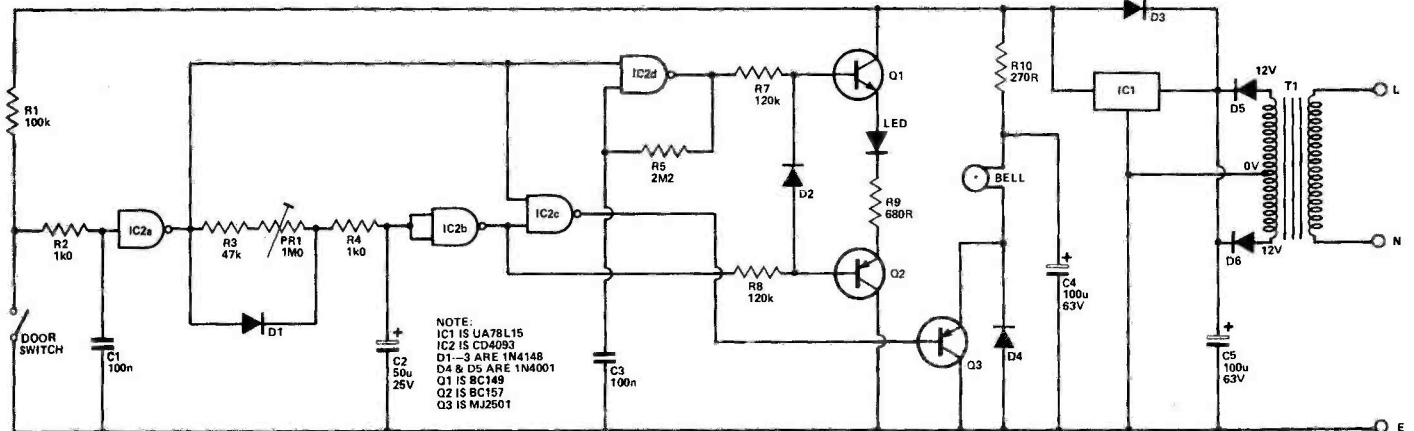
delay operates from the closing of the door for a period of 20-30 S, during which time the LED is constantly illuminated.

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 and off.

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-to-one chance of random operation.

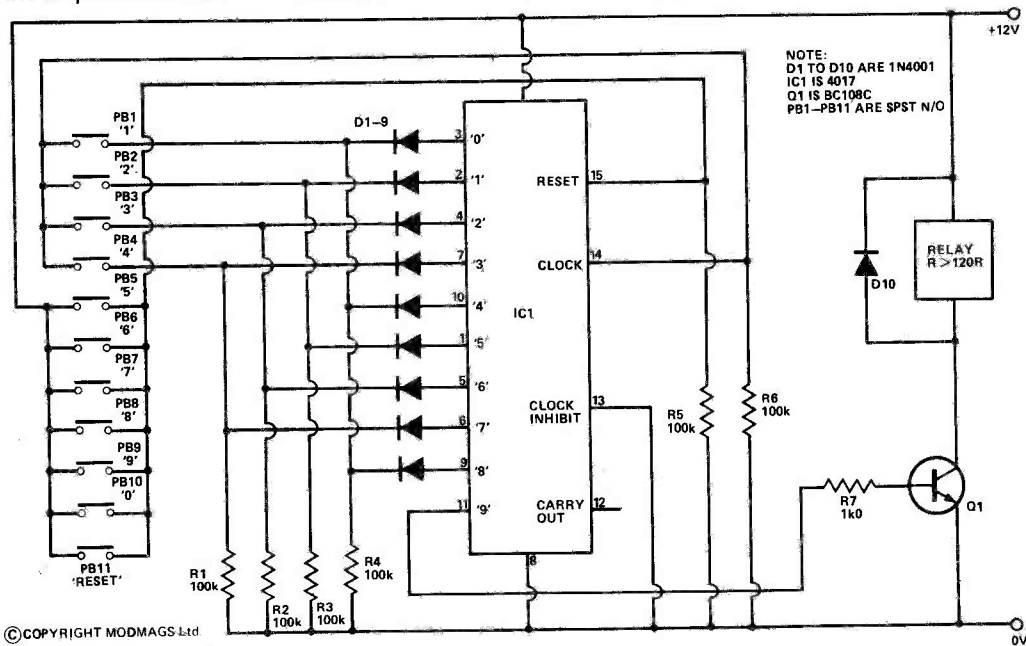
The first nine outputs of the decade counter (IC1) are fed via the diode OR gates (one for every different number used in the code) to the selected switches. As shown on the circuit diagram the combination sequence is 123412341. However, both the numbers and the sequence can be

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, thereby switching 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

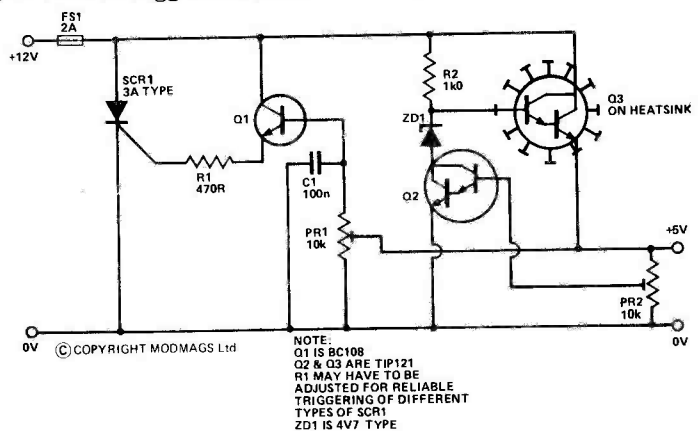
D. McIntyre, Camberley

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.

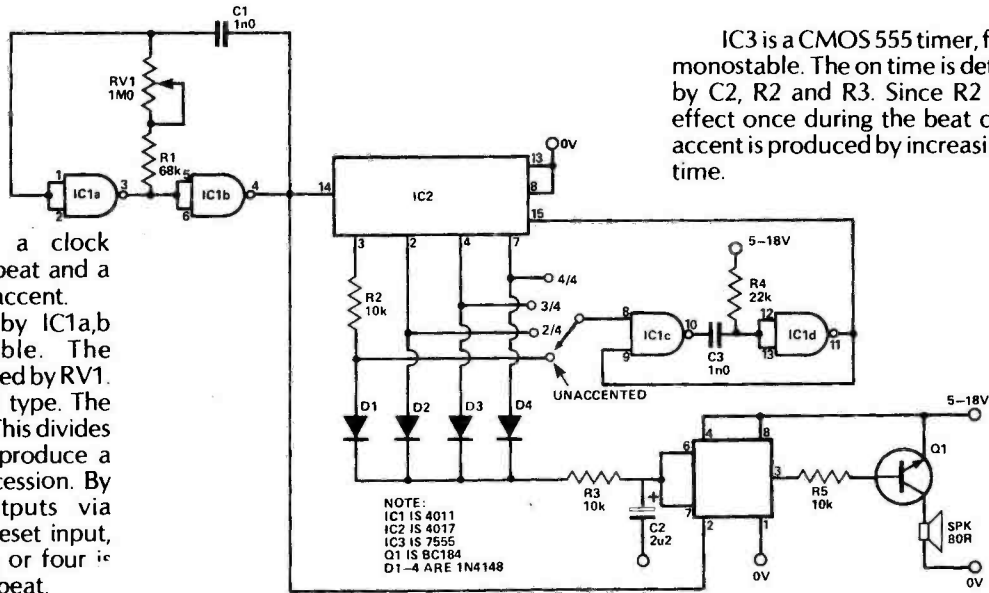


Accenting Metronome

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.



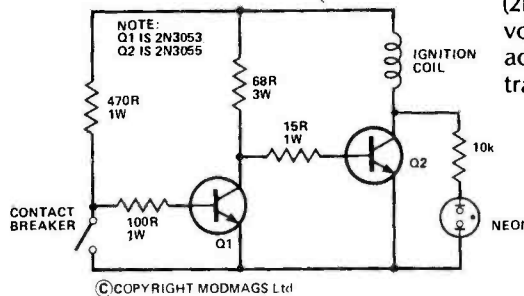
IC3 is a CMOS 555 timer, forming a monostable. The on time is determined by C2, R2 and R3. Since R2 only has effect once during the beat cycle, the accent is produced by increasing the on time.

NOTE:
IC1 IS 4011
IC2 IS 4017
IC3 IS 7555
Q1 IS BC184
D1-4 ARE 1N4148

Contact Breaker

E. P. Young, Plymouth

The contact breaker carries a mere 25mA when 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.



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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

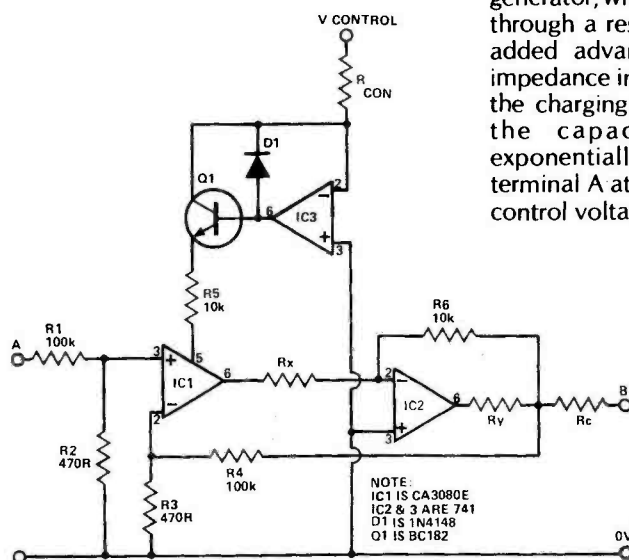
S. Draper, Sudbrooke

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:

$$R = \frac{200R_{CON}R_y}{19.2V_{CON}R_x} + R_c$$



NOTE:
IC1 IS CA3080E
IC2 & 3 ARE 741
D1 IS 1N4148
Q1 IS BC182

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

7400

Table listing various electronic components like resistors and capacitors with their specifications and prices.

74LS

Table listing integrated circuits such as 74LS00, 74LS01, 74LS02, etc., with their prices.

74C

Table listing CMOS integrated circuits like 74C00, 74C01, 74C02, etc.

CMOS

Table listing a wide variety of CMOS components and their prices.

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Table listing various microchips and components under categories like MEMORIES, UARTS, BIPOLAR RAMS, CPU'S, CHARACTER GENERATOR, EPROMS, VOLTAGE REGULATORS, KEYBOARD ENCODER, SUPPORT DEVICES, and INTERFACE LINEAR.

Table listing various integrated circuits and components under categories like LINEAR IC'S and INTERFACE LINEAR.

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Table listing various memory chips like 2114 450 NS, 2114 L 300 NS, 4116 150 NS, etc., with prices.

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