

# electronics today

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MAY 1980

60p

INTERNATIONAL

THE  
ULTIMATE  
KIT SURVEY



CHORUS MACHINE

**Infra-Red  
Remote Control  
LED VU  
Servo Tester  
Calculated  
Watch Offer**



# TRANSCENDENT 2000 SINGLE BOARD SYNTHESIZER

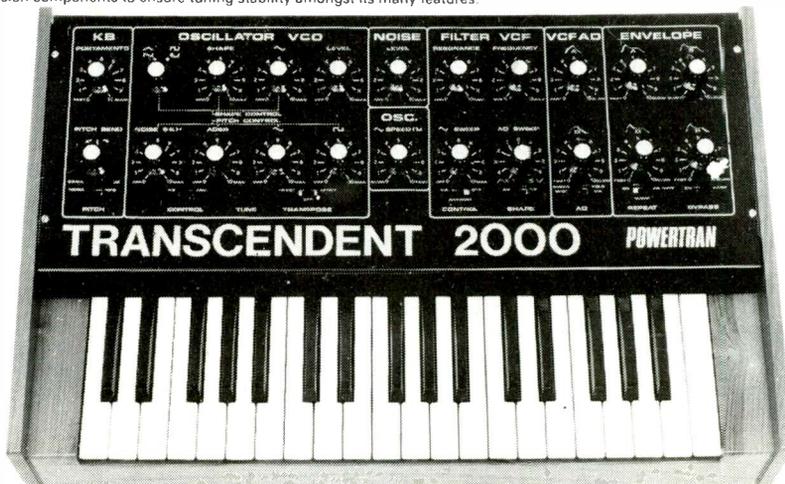
All kits also available as separate packs (e.g. P.C.B., component sets, hardware sets, etc.)  
Prices in FREE CATALOGUE

LIVE PERFORMANCE SYNTHESIZER DESIGNED BY CONSULTANT TIM ORR (FORMERLY SYNTHESIZER DESIGNER FOR EMS LIMITED) AND FEATURED AS A CONSTRUCTIONAL ARTICLE IN ELECTRONICS TODAY INTERNATIONAL.

The TRANSCENDENT 2000 is a 3 octave instrument transposable 2 octaves up or down giving an effective 7 octave range. There is portamento, pitch bending, a VCO with shape and pitch modulation, a VCF with both low and high pass outputs and a separate dynamic 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 trim!) and it really is complete — right down to the last nut and bolt and last piece of wire! There is even a 1.3A 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 easily 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!

**COMPLETE KIT  
ONLY  
£168.50 + VAT!**

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!



Cabinet size 24.6" x 15.7" x 4.8" (rear) 3.4" (front)

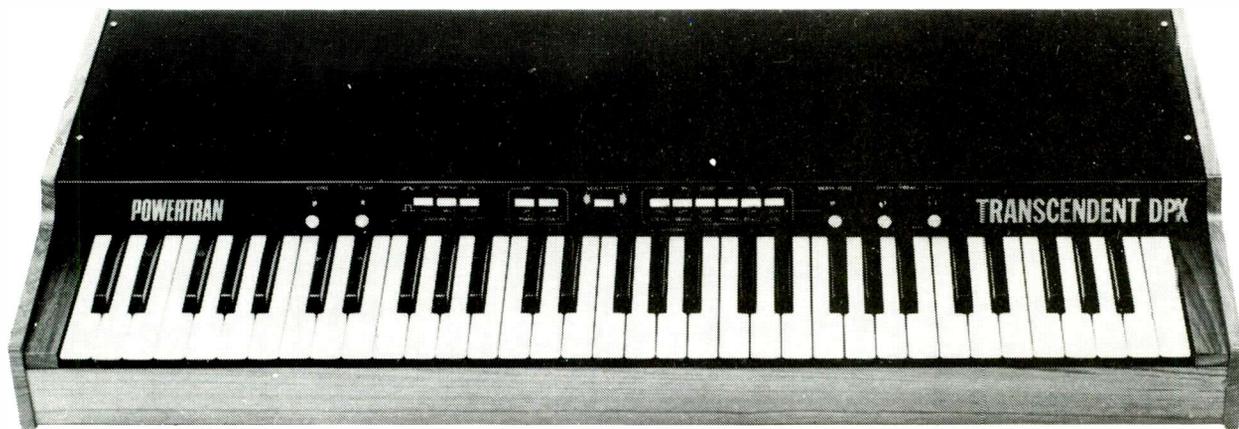
**INCREASED CAPACITY AT OUR BIG NEW FACTORY  
MEANS MANY PRICES DOWN! ALL OTHERS FROZEN!**

**WE'VE MOVED!  
NEW FACTORY UP!  
PRICES DOWN!**

# TRANSCENDENT DPX

**DIGITALLY CONTROLLED, TOUCH SENSITIVE, POLYPHONIC, MULTI-VOICE SYNTHESIZER  
ANOTHER SUPERB DESIGN BY SYNTHESIZER EXPERT TIM ORR — PUBLISHED IN ETI**

The Transcendent DPX is a really versatile new 5 octave keyboard instrument. There 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 or 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 at 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.



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

**COMPLETE KIT ONLY £299.00 + VAT!**

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.

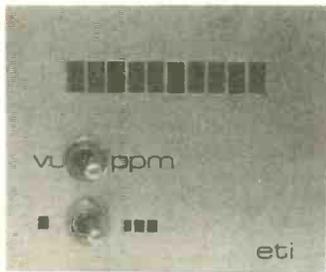
The kit includes fully finished metalwork, solid teak cabinet, professional quality components (all resistors 2% metal oxide), nuts, bolts, etc., even a 1.3A plug — you need buy absolutely no more parts before plugging in and making great music! When finished you will possess an instrument comparable in performance and quality with ready-built units selling for over £1,200!

**POWERTRAN**

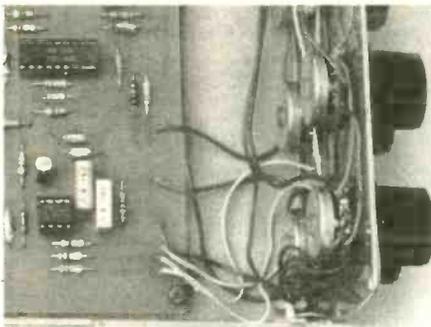
**ORDERING INFORMATION AND MORE KITS  
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If you want to get started in microcomputers - **START HERE!**

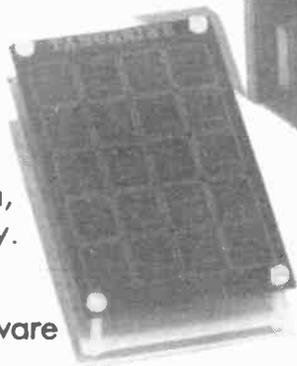
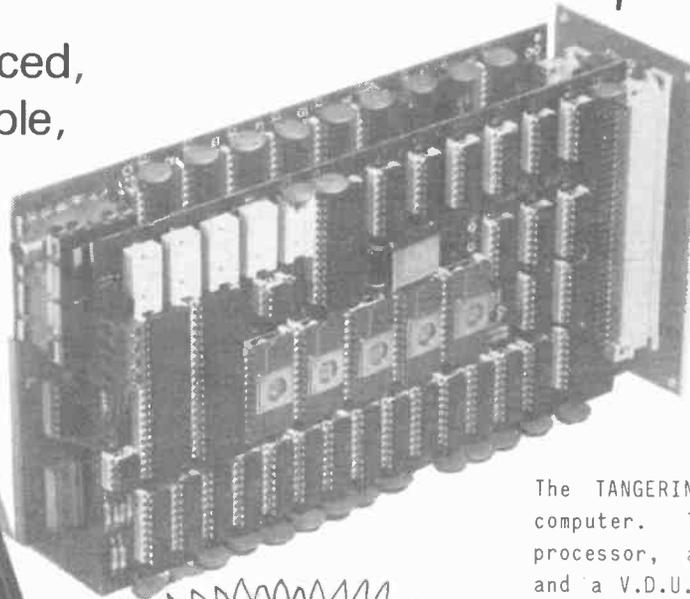
Microtan 65 is the most advanced, most powerful, most expandable, microcomputer available ~ It also happens to be the most cost effective!

An IDEAL educational aid.

### FEATURES

- Based on the powerful 6502 microprocessor.
- Superb 1K monitor - TANBUG
- 1K RAM for user program, stack and display memory.
- Expands into a system.
- 136 page, software/hardware users manual.
- CONNECTS TO AN UN-MODIFIED DOMESTIC T.V. RECEIVER.

Expansion is via TANEX. In its minimum configuration TANEX offers 1K RAM, cassette interface, 16 parallel I/O lines, a TTL serial I/O port, two 16 bit counter timers, data bus buffering and memory mapping. Fully expanded TANEX is powerful, offering 7K RAM, 6K ROM, 8K Microsoft BASIC; 32 parallel I/O lines; two TTL serial I/O ports; a third serial I/O port with RS232 20mA loop. Full modem control and 16 programmable baud rates; four 16 bit counter timers, cassette interface; data bus buffering and memory mapping. Even in minimum configuration TANEX is supplied fully socketed.



**STOP PRESS**  
**72 Key ASCII**

Keyboard including numeric keypad - £49 plus V.A.T.

from

**£69**  
plus VAT

Available as a kit,  
or assembled and tested.

The TANGERINE MICROTAN 65 is a 6502 based micro-computer. The MICROTAN 65 includes a 6502 micro-processor, a superb 1K monitor TANBUG, 1K RAM, and a V.D.U. section which produces an alphanumeric display on an unmodified domestic T.V. receiver of 16 rows by 32 characters. There are two optional I.C. packs, one provides the MICROTAN 65 with lower case alphanumerics (making a total of 128 displayable characters) and the other providing chunky graphics (64x64 pixels).

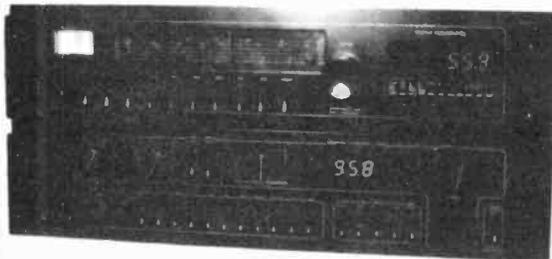
For comprehensive information, price list and details of all MICROTAN products, send coupon & 12p stamp without delay.

**TANGERINE**  
COMPUTER SYSTEMS LIMITED

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TEL. (0353)3633

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Address

# BEWARE! RADIO ACTIVITY



The new MK III FM tuner sitting under the Dorchester multiband AM/FM tuner

Revisions to the Mark III include a centre zero tuning indicator meter and silent preset switching

New 944378-2, the last word in stereo decoders with the KB4437/4438.



Choosing the products to advertise each month can be quite a task at AMBIT, since we tend to introduce at least one new line per week. So it is nearly impossible to say all we would like in this space - other than to bring you as far up to date as possible with current events. The major medium for finding out about what we have to offer is our unique catalogue system, and we ask that you invest in a copy of parts 1, 2 & 3 since many questions we are asked can be readily answered by reference to these.

Each part costs 60p, or £1.60 for all three current editions. We are also launching a new and greatly elongated version of our PRICE LIST, which now includes a large number of quantity listings, and many items not previously listed. The new style price list is a quick reference short form to our general catalogues - available FOC with a large (A4) SAE please.

As a result of the soaring price of oil - and the subsequent huge increases in the cost of wax for Mr Tom Jackson's famous moustache, the Post Office have increased their charges (Feb. 4th). Accordingly, our standard cover charge has been increased to 35p per order (CWO).

## MODULE NEWS

We are at last able to quote for quantities of our modules, following a program of standardization and revision to speed manufacture and test. The following types are the results of the standardization program:

UM1181	5 varicap MOSFET input VHF band 2 tuner/head	£12.00 inc
911225 A	High Performance FM IF system, with switched BW	£23.95 inc
911225 B	Single BW filters, single tuned detector	£14.95 inc
91072 A	DC tuned and single pole switched MW LW tuner	£14.43 inc
91072 B	As type 'A' but with either SW1 or SW2 band	£15.90 inc
92242 A	Combined LW/MW tuner, with FM IF detector section	£29.00 inc
92242 B	As 92242A but with 5.10MHz SW section	£34.00 inc

All are supplied housed in screened metal cases 97x56x24mm, with all connections along a single edge, suitable for verticle or horizontal mounting

Previously advertized units are still available - although there may have been some price changes in the latest edition of the Price List (Date Feb.80). A separate leaflet covering the new range of modules is available from April 80, with an A4 SAE please

## COMPONENTS

### DIGITAL FREQUENCY READOUTS / SYNTHESIZER SYSTEMS

Ambit has the biggest range of digital frequency readout systems for various applications in Broadcast and Communications. Prices range from £18.50 for a complete AM/FM broadcast frequency display (kit of DFM2). Most are detailed in the latest catalogue.

TUNING SYNTHESIZERS are also heavily featured, and we offer our first complete system covering MW/LW/SW2 and FM based on Hitachi parts. The unit is retrofittable to voltage tuned radio systems - and will shortly be incorporated in a complete tuner project. Cost for the synthesiser will be circa £40. A versatile communications system based on the new Mullard 2 IC system is nearing completion, together with 16 station CMOS memory and optical shaft encoder system with fast tune facility. Synthesiser circa £70, memory £50.

### Latest semiconductor news:

CMOS, TTL and LPSN TTL are in stock (ask for our OSTs price leaflet). Some of the very popular types are still "difficult" but we have things like 4011s, 4017s at the time of writing.

RADIO ICs - interesting developments here, we now have the Hitachi HA11225 and the HA12412 ultra high specification members of the CA3089E family. The PLESSEY SL1600 range now includes the SL6600 high performance PLL ABFM IF and detector.

CA3089E	2.11	HA1197	1.61	SD6000	4.31	SL1610	1.84	SL1626	2.80
CA3189E	2.53	CA3123E	1.61	TDA4420	2.59	SL1611	1.84	SL1630	1.86
HA1137W	1.95	TDA1072	3.09	MC1330P	1.38	SL1612	1.84	SL1640	2.17
HA11225	2.47	TBA651	2.53	MC1350P	1.38	SL1613	2.17	SL1641	2.17
HA12412	2.81	TDA1090	3.51	KB4412	2.24	SL1620	2.50	SL6600	4.31
KB4420	1.95	TDA1220	1.61	KB4413	2.24	SL1623	2.80	SL6640	3.16
TBA120S	1.15	TDA1083	2.24	KB4417	2.53	SL1624	3.77	SL6690	3.68
KB4406	0.80	TDA1062	2.24	MC3357P	3.16	SL1625	2.50	MC1496	1.44

TRANSISTORS - New lower prices, wider range, large stocks. Also the world's lowest noise audio devices (2SC2546E and 2SA1084E) first from AMBIT of course. Power MOSFETs & all sorts of other devices. Our 3SK51 MOSFET replaces the 408XX and 40673 families.

BC237-8-9	0.092	2SC1775	0.207	2SA1084E	0.368	BF256	0.437	BFY90	1.03
BC307-8-9	0.092	2SA872A	0.207	2SC2547E	0.391	2SK55	0.368	BF224	0.253
BC413-5	0.115	2SD666A	0.345	2SA1085E	0.391	2SK168	0.402	BF274	0.207
BD414-6	0.126	2SB646A	0.345	2SK133	6.32	3SK51	0.62	BFT95	1.138
BC546-556	0.138	2SD760	0.52	2SJ48	6.32	3SK60	0.667	VN666AF	1.092
BC550-560	0.138	2SB720	0.52	2SK135	7.29	BF960	1.426	2N4427	0.977
BC639-640	0.265	2SC2546E	0.368	2SJ50	7.29	3SK48	1.426	J176	0.747

### RADIO CONTROL:

A special section for all RC fans. New and exciting stuff. KB4445/KB4446 - complete 4 channel RX/TX dig.prop IC pair RF&control in one 4.75p MSL9362/MSL9363 - logic section of a four channel dig.prop link, with switch opt. 3.75p NE5044 - Signetics versatile 7 channel encoder, suitable for mixing etc. £2.14 ea NE544 Signetics famous servo driver IC £2.07 MC3357P as used in RCME design £3.16 ea AMBIT RCRX4 - RCME FM system compatible, complete RX kit with box/connector and AMBIT design screened front end with 27MHz ceramic filter £16.10 (kit) XTALS: FM pairs £3.74 (no splits) TX is fund. 1/2 op frequency, RX 3rd OT-455kHz AM pairs £3.57 (no splits). Both 3rd OT types, again RX IF at 455kHz

NEW LINE - ALPS switches and rotary potentiometers. With a general catalogue that's over 3 inches thick, we cannot begin to offer a comprehensive list of what we can offer - but we are already stocking the keyboard switches, keyswitches, pushbutton switches etc. In particular, the pushbutton switches really put all others in the shade (shadow?) when it comes to quality and price. A special new shortform is being prepared (and may be ready when you read this). All the potentiometers and switches you could ever need from a single source. Keypad switches cost as little as 15p ea (1 off), with a range of two part caps for easy ledging. You must see the shortform catalogue (30p) and our new pricelist for full details of this huge range of components



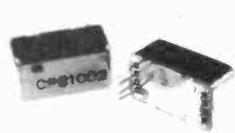
### AMBIT SHOP NOW OPEN

We are gradually getting our caller sales area sorted out, with displays of the products on offer and a browsers corner to sit and study data/catalogues. Call in next time you are in the area - parking outside the door.

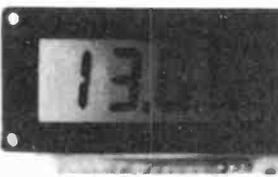
### COMPUTER CAPABILITIES

Ambit has been keeping a low profile on the subject of the MPU and its applications. Interestingly enough, the first project we offer with MPU content does rather more in the way of processing than simply playing a daft game, or looking like an enormous calculator. Our MPU facility and expertise is now for hire on a fully commercial basis. Z80, 6800, 6809, 2650 etc.

Keyboard switch  
SCK41505  
typ 6m ops  
23p each (1.24)



NEW LINE DC/DC+AC converters for fluorescent displays. TOKO CPS series 12v IN, -20 and 3v AC out at 65mA. Thick film design £2.34 ea Qty. prices OA



### GENERAL INFORMATION

Ambit stocks the following ranges of components for ex-stock volume delivery. SIGNAL COILS, CERAMIC, MECHANICAL and CRYSTAL FILTERS, RADIO ICs for AM/FM/SSB, TOROID CORES FOR RADIO and EMI FILTER CIRCUITS, INDICATING AND PANEL METERS, AUDIO ICs, RF TRANSISTORS, FETS, MOSFETS, DIODES (PIN, VARICAP, SCHOTTKY), PASSIVE DBMs (like MO108 etc), IC SOCKETS, LEDs, TRIMMER CAPS, SWITCHES, KEYBOARD SWITCHES, TUNERHEADS, IF AMPS, AM RADIO MODULES, etc etc

NEW LINE DVM176 the definitive ICM7106 LCD OVM module. 3 1/2 digit £22.37 ea.

CM161: LCD 12/24hr alarm clock/day/date/backlight (eq RS308-499) 7mm digits £11.44 each  
CM174: LCD 12hr alarm clock/stopwatch/backlight with 30mm height digits £14.32 each

CATALOGUES 60p ea, all three for £1.60  
PRICES SHOWN HERE INCLUDE VAT  
POST/PACKAGE CHARGE NOW 35p

**ambit**  
INTERNATIONAL

CWO PLEASE - Commercial MA terms on application  
Goods are offered subject to availability, prices subject to change - so please phone and check if in doubt.

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We stock thousands more items. It pays to visit us. We are situated behind Watford Football Ground. Nearest Underground/BR Station: Watford High Street. Open Monday to Saturday. Ample Free Car Parking space available.

**POLYESTER CAPACITORS:** Axial lead type.  
 400V: 1nF, 1.5n, 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; 1.1uF 64p; 2.2uF 82p.  
 600V: 10nF, 12n, 39n, 100n, 150n, 220n 11p; 330n, 470n 19p; 680n, 1.1uF 22p; 2.2uF 32p; 4.7uF 36p.  
 1000V: 10n, 15n, 20n, 22n, 47n, 2n6; 100n, 38n; 470n 53p; 1.1uF 75p.

**POLYESTER RADIAL LEAD CAPACITORS: 250V.**  
 10n, 15n, 22n, 27n 5p; 33n, 47n, 68n, 100n 7p; 150n 10p; 220n, 330n 13p; 470n 17p; 680n 19p; 1.1uF 22p; 1.5uF 30p; 2.2uF 34p.

**ELECTRONIC CAPACITORS:** (Values are in  $\mu$ F) 500V: 10 40p; 47 68p; 250V: 100 65p; 63V: 0.47, 1.0, 1.5, 2.2, 3.3, 4.7, 6.8, 8p; 47, 32, 11p; 63, 100, 27p; 50V: 10, 20, 25p; 47, 32p; 1000 60p; 400V: 22, 33, 6p; 100, 12p; 220, 330, 85p; 470, 98p; 35V: 10, 33, 7p; 330, 47, 32p; 1000, 50p; 25V: 10, 22, 47, 80, 100, 8p; 180, 220, 25p; 150, 470, 25p; 640, 35p; 1000, 33p; 1500, 40p; 2200, 45p; 3300, 77p; 4700, 85p; 16V: 10, 47, 7p; 100, 12.5, 8p; 220, 33, 14p; 470, 20p; 1000, 1500, 30p; 2200, 36p; 10V: 10, 27p; 640, 12p; 1000, 16p.

**TANTALUM BEAD CAPACITORS**  
 0.1uF, 0.22, 0.33, 0.47, 0.68, 1.0, 2.2, 3.3, 4.7, 6.8, 25V: 1.5, 10, 20V: 1.5, 16V: 10, 1.1uF 13p each  
 16V: 15, 22, 25p, 47, 100 50p, 220 70p, 10V: 15, 22, 33, 20p, 6V: 47, 68, 100, 30p, 3V: 100, 20p.

**MYLAR FILM CAPACITORS**  
 100V: 0.001, 0.002, 0.005, 0.01, 1p 6p  
 0.015, 0.02, 0.04, 0.05, 0.056, 0.1 7p  
 0.1uF, 9p, 0.2, 1.1p, 50V: 0.47uF 12p

**CERAMIC CAPACITORS 50V**  
 Range: 0.5pF to 10,000pF  
 0.015uF, 0.022uF, 0.033uF 4p  
 0.047uF, 5p, 0.1uF, 6p, 7p

**SILVER MICA (Values in  $\mu$ F) 3-3, 4.7, 6.8, 10, 12, 18, 22, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 220, 11p each  
 250, 270, 300, 330, 360, 390, 450, 500, 560, 630, 750, 820, 900, 800, 26p each  
 1000, 1200, 1800, 2000 26p each**

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

**MINIATURE TYPE TRIMMERS**  
 2.5-6pF 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 415Sp; Socket 25p

**JACKSONS VARIABLE CAPACITORS**  
 DILICON 175p 0.2 3.65pF with stop motion Drive 395p  
 500pF 225p 0.0208/1.76 32p  
 6.1 Ball Drive 4511/DAF 125p motion Drive 395p  
 Dial Drive 4103 6.1/36.1 650p 25.50pF 250p  
 Drum 54mm 0.1-3.65pF 100, 150pF 335p  
 0.1-3.65pF 275p L 3k310pF 695p  
 0.2 3.65pF 325p 000-3x25pF 490p

**RF CHOKES**  
 1uH 4.7, 10, 22, 33, 47, 100, 200, 470, 750, 10mH, 2.5, 5, 10, 43mH 100 80p each

**VEROBOARD** 0.1 0.15 0.15 (copper clad) (plain)  
 46p 38p 24p  
 2 1/2 x 3 1/2" 55p 50p 31p  
 3 1/2 x 3 1/2" 65p 50p -  
 3 1/2 x 5" 62p 67p 43p  
 2 1/2 x 17" 169p 135p 92p  
 3 1/2 x 17" 218p 180p 120p  
 4 1/2 x 17" 280p - 183p

**VERO WIRING PEN**  
 Plus Spool 325p  
 Spare spool (wire) 80p Comes 7p each

**FERRIC CHLORIDE**  
 1lb bag Anhydrous 125p + 35p P&P

**DALEDTECH RESIST PEN + spare tip 75p**

**COPPER CLAD BOARDS**  
 Fibre Single Double SRBP  
 Glass sided 9.5" x 8.5" 5" x 8.5" 75p 90p 80p  
 6" x 12" 130p 175p

**DIL PLUGS** (Headers)  
 14 pin 39p; 16 pin 40p; 24 pin 85p; 40 pin 375p.  
 Soldercan pins: 100 55p; 500 250p.

**DIL SOCKETS (TEXAS) Low Wire prof. Wrap**  
 8pin 10p 25p  
 14pin 12p 35p  
 16pin 13p 46p  
 18pin 15p 52p  
 20pin 22p 65p  
 22pin 25p 70p  
 24pin 36p 78p  
 28pin 39p 85p  
 36pin 105p  
 40pin 50p 108p

**EDGE CONNECTORS:** (Double type)  
 2x10 way - 85p  
 2x15 way - 99p  
 2x18 way 115p 120p  
 2x22 way 130p 135p  
 2x25 way 149p 160p  
 2x30 way 170p -  
 2x35 way 194p -  
 2x40 way 210p -  
 2x43 way 232p -

**TRIACS**  
 3A200V 49  
 3A400V 50  
 8A100V 54  
 8A400V 64  
 8A800V 108  
 8A100V 25  
 8A400V 39  
 8A800V 43  
 8A300V 48  
 8A500V 58  
 8A600V 85  
 12A100V 42  
 12A300V 59  
 12A500V 92  
 12A800V 120  
 16A100V 40  
 16A400V 105  
 16A500V 120  
 16A800V 235  
 25A500V 235  
 25A800V 295  
 28A00V 120

**DIAC**  
 S12 20

## TRANSISTORS

AC125 25	BC214L 10	BFR81 24	TIP31A 38	2N1671B 120	BD112 95
AC126 25	BC307B 12	BFR98 105	TIP31B 43	2N1660 350	BD158 60
AC127 22	BC308 12	BFX81 45	TIP32A 40	2N2217 43	BD206 110
AC128 20	BC327 12	BFX86 28	TIP32C 55	2N2218A 30	BD222 65
AC141 27	BC338 15	BFX87 28	TIP33A 54	2N2219A 23	BDY56 170
AC142 28	BC339 15	BFX88 28	TIP34A 63	2N2220A 23	BOY60 140
AC176 25	BC441 27	BFY50 21	TIP35A 135	2N2222A 20	BF185 25
AC177 60	BC461 27	BFY51 21	TIP35C 165	2N2368 21	BF327 32
AC18 60	BC472 35	BFY52 21	TIP36C 185	2N2369A 15	BFK39 26
AC19 60	BC516 38	BFY53 28	TIP37C 185	2N2483 28	BFY55 38
AC21 53	BC517 35	BFY71 40	TIP41A 50	2N2484 30	BFY56 32
AC22 60	BC547 10	BRV39 30	TIP42A 64	2N2485 48	BFY81 99
AC28 60	BC548 10	BSX20 39	TIP42B 82	2N2904 24	BSX29 45
AC39 80	BC549C 15	BSX26 75	TIP120 72	2N2905A 22	BSX78 75
AD149 75	BC557 10	BSY95A 18	TIP121 90	2N2906 22	BSY20 40
AD162 42	BC558 10	BU105 115	TIP142 125	2N2907 22	MUE10 130
AF114 60	BC559 10	BU205 125	TIP147 145	2N2907A 22	MUE180 130
AF115 60	BCY40 48	BU208 215	TIP295 60	2N2926G 12	MPU131 45
AF116 60	BCY42 14	E421 158	TIP305 48	2N3011 24	TS74 47
AF117 50	BCY70 14	MD800T 179	TIS43 30	2N3053 19	UC734 50
AF118 75	BCY71 15	MJ491 175	TIS44 45	2N3054 55	UC734 50
AF178 40	BCY72 15	MJ2955 105	TIS45 45	2N3055 48	UC734 50
AF179 40	BCY73 15	MJ340 55	TIS46 45	2N3056 48	UC734 50
AF186 60	BCY74 15	MJ370 58	TIS47 45	2N3057 48	UC734 50
AF239 42	BD132 42	MJ371 54	TIS90 20	2N3058 48	UC734 50
AS221 60	BD133 50	MJ520 65	TIS91 24	2N3059 48	UC734 50
BC107 10	BD135 30	MJ521 74	TX107 11	2N3060 48	UC734 50
BC108 10	BD136 30	MJ522 74	ZTX108 11	2N3061 48	UC734 50
BC108B 10	BD137 30	MJ523 74	ZTX109 11	2N3062 48	UC734 50
BC108C 10	BD138 30	MJ524 74	ZTX110 11	2N3063 48	UC734 50
BC109 10	BD139 30	MJ525 74	ZTX111 11	2N3064 48	UC734 50
BC109B 12	BD140 30	MJ526 74	ZTX112 11	2N3065 48	UC734 50
BC109C 12	BD141 198	MJ527 74	ZTX113 11	2N3066 48	UC734 50
BC114 20	BD142 175	MJ528 74	ZTX114 11	2N3067 48	UC734 50
BC115 20	BD143 175	MJ529 74	ZTX115 11	2N3068 48	UC734 50
BC117 40	BD144 198	MJ530 74	ZTX116 11	2N3069 48	UC734 50
BC119 28	BD145 175	MJ531 74	ZTX117 11	2N3070 48	UC734 50
BC120 26	BD146 175	MJ532 74	ZTX118 11	2N3071 48	UC734 50
BC121 26	BD147 175	MJ533 74	ZTX119 11	2N3072 48	UC734 50
BC122 26	BD148 175	MJ534 74	ZTX120 11	2N3073 48	UC734 50
BC123 26	BD149 175	MJ535 74	ZTX121 11	2N3074 48	UC734 50
BC124 26	BD150 175	MJ536 74	ZTX122 11	2N3075 48	UC734 50
BC125 26	BD151 175	MJ537 74	ZTX123 11	2N3076 48	UC734 50
BC126 26	BD152 175	MJ538 74	ZTX124 11	2N3077 48	UC734 50
BC127 26	BD153 175	MJ539 74	ZTX125 11	2N3078 48	UC734 50
BC128 26	BD154 175	MJ540 74	ZTX126 11	2N3079 48	UC734 50
BC129 26	BD155 175	MJ541 74	ZTX127 11	2N3080 48	UC734 50
BC130 26	BD156 175	MJ542 74	ZTX128 11	2N3081 48	UC734 50
BC131 26	BD157 175	MJ543 74	ZTX129 11	2N3082 48	UC734 50
BC132 26	BD158 175	MJ544 74	ZTX130 11	2N3083 48	UC734 50
BC133 26	BD159 175	MJ545 74	ZTX131 11	2N3084 48	UC734 50
BC134 26	BD160 175	MJ546 74	ZTX132 11	2N3085 48	UC734 50
BC135 26	BD161 175	MJ547 74	ZTX133 11	2N3086 48	UC734 50
BC136 26	BD162 175	MJ548 74	ZTX134 11	2N3087 48	UC734 50
BC137 26	BD163 175	MJ549 74	ZTX135 11	2N3088 48	UC734 50
BC138 26	BD164 175	MJ550 74	ZTX136 11	2N3089 48	UC734 50
BC139 26	BD165 175	MJ551 74	ZTX137 11	2N3090 48	UC734 50
BC140 26	BD166 175	MJ552 74	ZTX138 11	2N3091 48	UC734 50
BC141 26	BD167 175	MJ553 74	ZTX139 11	2N3092 48	UC734 50
BC142 26	BD168 175	MJ554 74	ZTX140 11	2N3093 48	UC734 50
BC143 26	BD169 175	MJ555 74	ZTX141 11	2N3094 48	UC734 50
BC144 26	BD170 175	MJ556 74	ZTX142 11	2N3095 48	UC734 50
BC145 26	BD171 175	MJ557 74	ZTX143 11	2N3096 48	UC734 50
BC146 26	BD172 175	MJ558 74	ZTX144 11	2N3097 48	UC734 50
BC147 26	BD173 175	MJ559 74	ZTX145 11	2N3098 48	UC734 50
BC148 26	BD174 175	MJ560 74	ZTX146 11	2N3099 48	UC734 50
BC149 26	BD175 175	MJ561 74	ZTX147 11	2N3100 48	UC734 50
BC150 26	BD176 175	MJ562 74	ZTX148 11	2N3101 48	UC734 50
BC151 26	BD177 175	MJ563 74	ZTX149 11	2N3102 48	UC734 50
BC152 26	BD178 175	MJ564 74	ZTX150 11	2N3103 48	UC734 50
BC153 26	BD179 175	MJ565 74	ZTX151 11	2N3104 48	UC734 50
BC154 26	BD180 175	MJ566 74	ZTX152 11	2N3105 48	UC734 50
BC155 26	BD181 175	MJ567 74	ZTX153 11	2N3106 48	UC734 50
BC156 26	BD182 175	MJ568 74	ZTX154 11	2N3107 48	UC734 50
BC157 26	BD183 175	MJ569 74	ZTX155 11	2N3108 48	UC734 50
BC158 26	BD184 175	MJ570 74	ZTX156 11	2N3109 48	UC734 50
BC159 26	BD185 175	MJ571 74	ZTX157 11	2N3110 48	UC734 50
BC160 26	BD186 175	MJ572 74	ZTX158 11	2N3111 48	UC734 50
BC161 26	BD187 175	MJ573 74	ZTX159 11	2N3112 48	UC734 50
BC162 26	BD188 175	MJ574 74	ZTX160 11	2N3113 48	UC734 50
BC163 26	BD189 175	MJ575 74	ZTX161 11	2N3114 48	UC734 50
BC164 26	BD190 175	MJ576 74	ZTX162 11	2N3115 48	UC734 50
BC165 26	BD191 175	MJ577 74	ZTX163 11	2N3116 48	UC734 50
BC166 26	BD192 175	MJ578 74	ZTX164 11	2N3117 48	UC734 50
BC167 26	BD193 175	MJ579 74	ZTX165 11	2N3118 48	UC734 50
BC168 26	BD194 175	MJ580 74	ZTX166 11	2N3119 48	UC734 50
BC169 26	BD195 175	MJ5			

# WATFORD ELECTRONICS

## THE DIGITAL FREQUENCY METER with a Difference



- 0-150MHz in 5 ranges
- Large 8-digit display for high accuracy
- Period and time interval facility
- Unit counter up to 99,999,999
- 10MHz crystal timebase
- Hold and reset buttons plus built-in PSU.

All these features and more for less than half the price of an ordinary frequency meter. The DFM2000 has all its components including the displays, switches and transformer mounted on one double sided PC board. Assembly is simplicity itself especially since interwiring has been eliminated. This is a high quality design and will make a truly professional digital frequency meter that any constructor will be proud to own.

Price: Only **£64.50** Kit (P&P 65p). Probes: Optional extra **£8.75**

Full ASCII Coded 56 Key <b>KEYBOARD</b> Type 753 Only <b>£39.95+</b> (incl. data)	<b>SWITCHES</b> Push-button SRL DPDT 125 Latching SRM DPDT Momentary 125	<b>SWITCHES</b> TOGGLE: 2A, 250V SPST 28p DPST 34p DPDT 38p 4 pole on/off 54p	<b>SLIDE 250V:</b> 1A DPDT 14p 1A DPDT c/over 15p 1/2A DPDT 13p 4 pole 2-way 24p
4x4" Keypad 16 Keys. Reed switches. Extremely reliable. Only <b>450p.</b>	<b>DIL SWITCHES</b> 4-way SPST 110 6-way SPST 120 8-way SPST 145	<b>SUB-MIN TOGGLE</b> SP changeover 59p SPST on/off 54p SPST biased 85p DPDT 6 tags 70p DPDT centre off 78p DPDT Biased 115p	<b>PUSH BUTTON</b> Spring loaded SPST on/off 60p SPDT c/over 65p DPDT 6 Tag 85p
ASTEC RF Modulators 250 Special Widebandwidth for Computer 470 Sound Modulator 250	<b>RELAYS</b> RL6 SPCD 175 RL6B DPCO 215	<b>ROTARY:</b> Make your own multiway Switch. Adjustable Stop. Shifting Assembly. Accommodate up to 6 Wafers. Mains Switch DPST to fit 40p Break Before Make Wafers. 1 pole/12 way 2p/6 way. 3p/4 way. 4p/3 way. 6p/2 way 66p Spacer and Screen 6p	<b>MINI. Non Locking</b> Push to Make 15p Push Break 25p Push to c/over 85p
		<b>ROTARY (Adjustable Stop)</b> 1 pole/2 to 12 way. 2p/2 to 6 way. 3 pole/2 to 4 way. 4 pole/2 to 3 way 43p <b>ROTARY:</b> Mains 250V AC. 4 Amp 52p	

<b>CRYSTALS</b> 100KHz 323 455KHz 383 1MHz 323 1.008MHz 395 1.28MHz 392 1.6MHz 323 1.8MHz 323 1.8432MHz 362 2.4576MHz 362 3.2768MHz 323 3.57954MHz 195 4.000MHz 290 4.032MHz 323 4.433619MHz 135 5.0MHz 355 5.185MHz 323 6.5536MHz 200 7.68MHz 323 8.96723MHz 323 9.375MHz 323 10.0MHz 323 10.7MHz 323 12MHz 392 14.3181MHz 300 18MHz 323 18.432MHz 323 20.0MHz 323 27.648MHz 323 48.0MHz 323 100.00MHz 323	<b>TRANSFORMERS</b> (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. 25A 15V. 25A 215p 12V: 4.5V-1.3A. 4.5V-1.3A. 6V-1.2A 6V-1.2A 12V. 5A 12V. 5A. 15V. 4A 15V. 4A. 20V. 3A 20V. 3A 235p (20p 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 (45p 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. 8A 30V. 8A 365p (50p 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 (60p p&p). (N.B. p&p charge to be added above our normal postal charge.)	<b>ALUM. BOXES WITH LIO</b> 3x2x1" 54p 2x4x5 1/2x1 1/2" 72p 4x4x1 1/2" 72p 4x2x4 1 1/2" 70p 4x5 1/2x1 1/2" 88p 4x2 1/2x2 1/2" 72p 5x4x2 1/2" 98p 6x4x2 1/2" 108p 7x5x2 1/2" 145p 8x6x3 1/2" 185p 10x7x3 1/2" 210p 10x4 1/2x3 1/2" 175p 12x5x3 1/2" 215p 12x8x3 1/2" 265p	<b>PANEL METERS</b> FSO 60x46x35mm 0-50µA 0-100µA 0-500µA 0-1mA 0-5mA 0-10mA 0-50mA 0-100mA 0-500µA 0-1A 0-2A 0-25V 0-50V AC 0-300V AC 5" VU 445p each 4 1/2x3 1/2x1 1/2" 0-50µA 0-100µA 0-500µA 595p each
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<b>ETI Projects:</b> Parts available for: Click Eliminator <b>DFM2000</b> Frequency Meter, <b>DM900</b> , Audio Amplifier, <b>60W</b> Amplifier System. Send <b>SAE plus 5p</b> for list.	<b>VOLTAGE REGULATORS</b> 1A TO20 Plastic Casing 5V 7805 75p 12V 7812 65p 15V 7815 65p 18V 7818 65p 24V 7824 65p 100mA TO92 Plastic Casing 5V 78L05 30p 6V 78L02 30p 8V 78L82 30p 12V 78L12 30p 15V 78L15 30p LM300H 170p LM327 270p LM305H 140p LM723 30p LM309K 135p TAA550 50p LM317K 350p TBA625B 95p LM323K 560p TDA1412 150p LM325N 240p 78H05 + 5/5A 595p LM326N 240p	<b>OPTO</b> LEDs with Clips TIL209 Red 13 TIL211 Grn 17 TIL212 Yel. 18 TIL220 2" Red 14 2" Green Yellow or Amber 18 Square LEDs. Red Green, Yellow 36 LD271 infra Red 40 SFH205 Detector 90 TIL32 Infra Red 58 TIL78 Detector 70 BARGRAPH. Red 10 LS400 225 OC71 120 ORP12 63 ORP61 85 2N5777 45 <b>ISOLATORS</b> IL74 48 TIL111/2 85 TIL114 95 TIL117 110 Bargraph 225	<b>7 Segment Displays</b> TIL307 675 TIL312 3" CA 105 TIL313 3" CC 105 TIL321 5" CA 115 TIL322 5" CC 115 DL704 3" CC 99 DL707 3" CA 99 DL747 6" CA 180 FND357 Red 120 3" Green CA 150 5" Green CA 215 LCD 3 1/2 Digit 875 LCD 4 Digit 975
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LS299 420 LS300 175 LS302 175 LS320 270 LS323 450 LS324 200 LS325 320 LS326 330 LS327 315 LS346 185 LS347 150 LS348 190 LS352 185 LS353 185 LS355 65 LS366 65 LS367 65 LS368 65 LS373 180 LS374 180 LS375 150 LS377 199 LS378 185 LS379 215 LS384 50 LS385 420 LS386 85 LS390 140 LS393 140 LS395 210 LS396 199 LS398 275 LS399 230 LS445 140 LS447 195 LS490 150 LS668 105 LS669 105	LS670 270 LS673 750 LS674 850 4000 18 4001 18 4002 24 4006 92 4007 22 4008 82 4009 40 4010 48 4011 24 4012 24 4013 45 4014 85 4015 85 4016 82 4017 82 4018 88 4019 48 4020 99 4021 105 4022 95 4023 25 4024 75 4025 25 4026 180 4027 48 4028 82 4029 105 4030 60 4031 225 4032 125 4033 175 4034 210 4035 125	4036 365 4037 115 4038 118 4039 360 4040 105 4041 80 4042 80 4043 95 4044 95 4045 175 4046 130 4047 98 4048 65 4049 45 4050 48 4051 80 4052 80 4053 80 4054 130 4055 135 4056 135 4057 1900 4058 575 4059 130 4061 1225 4062 995 4063 120 4066 58 4067 430 4068 26 4069 26 4070 30 4071 25 4072 25 4073 25 4075 25 4076 99 4077 48	4078 30 4081 88 4082 28 4085 90 4086 90 4089 150 4093 89 4094 240 4095 105 4096 105 4097 350 4098 115 4099 190 4100 115 4160 125 4161 125 4162 125 4163 125 4174 130 4175 120 4194 125 4408 790 4409 790 4410 790 4411 1020 4412F 1020 4412V 1020 4415F 850 4415V 850 4419 320 4422 870 4432 1050 4435 1050 4440 999 4450 350 4451 350 4452 350 4490F 750 4490V 750	4501 28 4502 125 4503 75 4506 75 4507 80 4508 325 4510 99 4511 150 4512 98 4513 225 4514 265 4515 295 4516 120 4517 450 4518 105 4519 70 4520 115 4521 250 4522 150 4526 150 4527 160 4528 120 4529 175 4530 88 4531 165 4532 140 4534 575	4536 395 4538 160 4539 135 4541 150 4543 175 4549 296 4553 440 4554 175 4555 85 4556 75 4557 425 4558 130 4559 290 4560 235 4561 95 4562 595 4566 190 4568 299 4569 250 4572 48 4580 595 4581 350 4582 150 4583 125 4584 64 4585 140
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# Make sure of your new Heathkit catalogue... write now.



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**HEATHKIT** HEATH ZENITH

Full ASCII coded 56 Key Keyboard	£42.50
4" x 4" Keypads	£4.50
RF Modulators	£2.50
Wideband Modulators	£4.70
Sound Modulators	£2.50

# DIGEST

## Sony Screen Machine

One of the more significant product releases this month was the new Sony C7 video recorder. It has several features which mark it out as the best design yet for home usage. Although Sony themselves placed great emphasis upon the solenoid controls and IR Control System these will bring little more than a yawn to the lips of anyone with the faintest claim to technical knowledge.

Of far greater interest will be the superbly conceived set-up procedure (under MPU control) and the versatile times.

Tuning in most VCRs is both time consuming and patience destroying. The C7, once locked to the set with a panel control, will automatically search the band looking for stations and load any it finds into pre-set locations for easy user access.

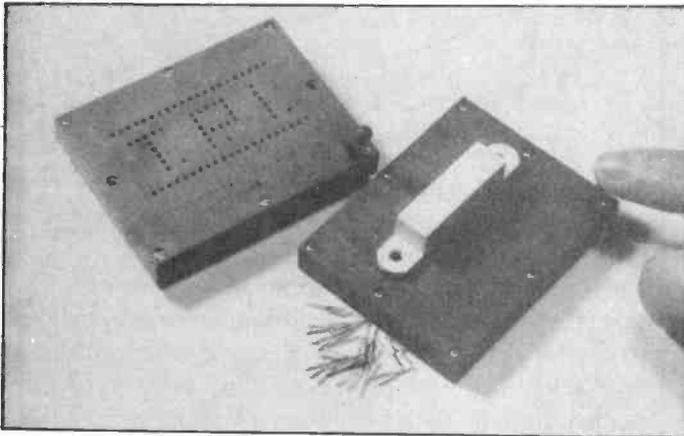
(It's about time someone did something like this anyway).

Curious too is the lack of eulogy over the picture quality which far outstripped its competitors, being all but indistinguish-

able from broadcast. Some new features are provided to help use this, however, like a picture search mode which will accelerate the tape, in vision with the sound

off, to twenty times normal speed. Finding the exact spot you seek is thus facilitated. Freeze frame and slow-motion are also lurking in the circuits.

The C7 will sell for little more than present machinery and is far more refined in several important areas. Should do well.



## Universal Test Socket

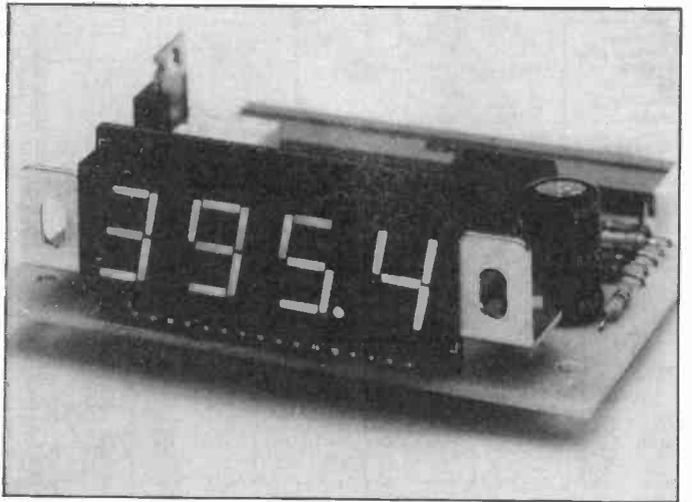
FI have developed a new test socket called the Textool GRID ZIP. It can be either PCB mounted or fixed to front panels using mounting screws. The makers claim an operating life of greater than 25,000 insertions, and one economy feature is the ability to mount more than one device per socket plate, and spare plates can be supplied to increase the utility of the socket.

You can use this test socket with any standard or non-standard device if the leads fit within a 14 x 21 grid (on 0.1" lead centres). The socket consists of a top plate with guide indentations on a 0.1" grid, a camplate to provide the Zero Insertions

Pressure clamping operation and a base plate holding the plated beryllium copper contacts. So, once the top plate has been drilled to take the device leads, contacts are placed in the desired locations in the base plate and the cam assembly is dropped onto them. The resulting 'sandwich' is held together by eight screws running through the edges. In use this means that a device is simply dropped onto the pre-drilled holes and the clamping lever is flicked down to clamp the contacts onto the device leads, so no strain is put onto the device and good electrical contact is ensured, this in turn means extended contact life. Average contact resistance is less than 0.005 ohms. In a production situation, incorrect insertions are virtually eliminated as there is only one set of socket holes.

Micro-Data Systems' 3 digit panel meter combines economy with high performance. Accuracy is 0.05% with resolution to 100 uV and the scale allows four digit resolution of quantities up to 4,000, rather than the 2,000 to which other units are limited. A 5 volt supply is required. The naked PCB construction incorporates a red filter, enabling direct panel mounting without the need for a separate bezel. Prices are from £19.95 (one off) down to £14.95 each, if you can find a use for fifty of them.

Further details from Micro-Data Systems, Office Suite 1, Coach Mews, The Broadway, St. Ives, Huntingdon, Cambs PE17 4BN.



## Technical Queries

We've had an impassioned plea from our automatic telephone answering machine (our receptionist) about an item which we published some time ago in Digest. Although we have suspended our telephone answering service for ETI technical queries, we are still receiving a number

of calls every day from readers asking for technical help. Our receptionist is unable to accept these calls.

Unfortunately we are unable to answer technical questions by telephone. If you are having problems with an ETI project, please write with full details and enclosing a stamped, addressed envelope.

# CHROMATHEQUE 5000



Panel size 19.0" x 3.5". Depth 7.3"

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 or use the internal digital circuitry which produces some superb random and sequencing effects. Each channel handles up to 500W and as the kit is a single board design wiring is minimal and construction very straightforward.

Kit includes fully finished metalwork, fibreglass PCB controls, wire, etc. — Complete right down to the last nut and bolt!

# POWERTRAN

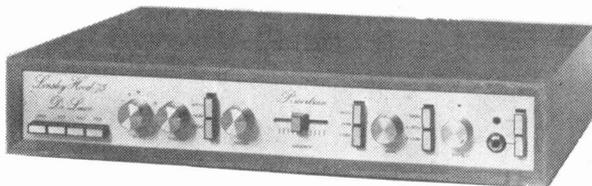
## 5 CHANNEL LIGHTING EFFECTS SYSTEM

COMPLETE KIT

ONLY

£49.50 + VAT!

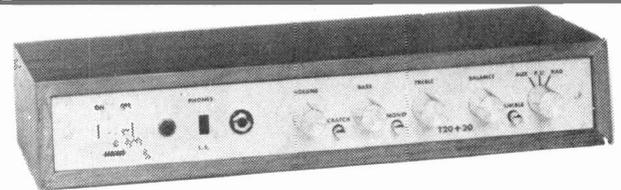
All kits also available as separate packs (eg PCB, component sets, hardware sets etc). Prices in our FREE CATALOGUE.



## DE LUXE EASY TO BUILD LINSLEY HOOD 75W STEREO AMPLIFIER £99.30 + 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 whilst distortion is less than 0.01%.

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! Matching TUNERS and CASSETTE DECK — see our free catalogue!



## 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.

# BLACK HOLE

## THIS MONTH'S FRONT COVER FEATURE!

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 input, 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.

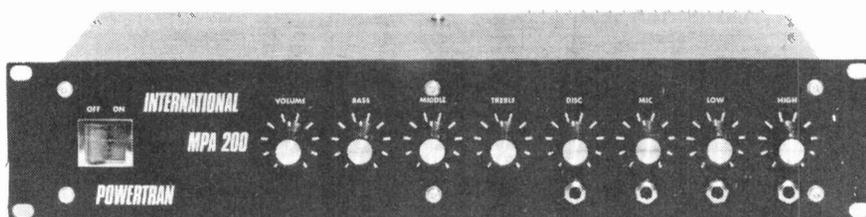
COMPLETE KIT ONLY £49.80 + VAT (single delay line system)

De Luxe version (dual delay line system) also available for £59.80 + VAT

## MPA 200 100 WATT (rms into 8Ω) MIXER / AMPLIFIER

Featured as a constructional article in ETI, the MPA 200 is an exceptionally low priced — but professionally finished — general purpose high power amplifier. It features adaptable input mixer which accepts a wider range of sources such as microphone, guitar, etc. There are wide range tone controls and a master volume control. Mechanically the MPA 200 is simplicity itself with minimal wiring needed making construction very straightforward.

The kit includes fully finished metalwork, fibreglass PCBs, controls, wire, etc — complete down to the last nut and bolt



Panel size 19.0" x 3.5". Depth 7.3"

COMPLETE KIT

ONLY

£49.90 + VAT!

MATCHES THE CHROMATHEQUE 5000 PERFECTLY!

**PRICE STABILITY:** Order with confidence. Irrespective of any price changes we will honour all prices in this advertisement until July 31st, 1980, 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 15% 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, Open 9 a.m.-12 noon, 1-4.30 p.m. Monday-Thursday.

NEW FACTORY ON SAME INDUSTRIAL ESTATE ADDRESS AND PHONE NUMBER UNCHANGED

OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!

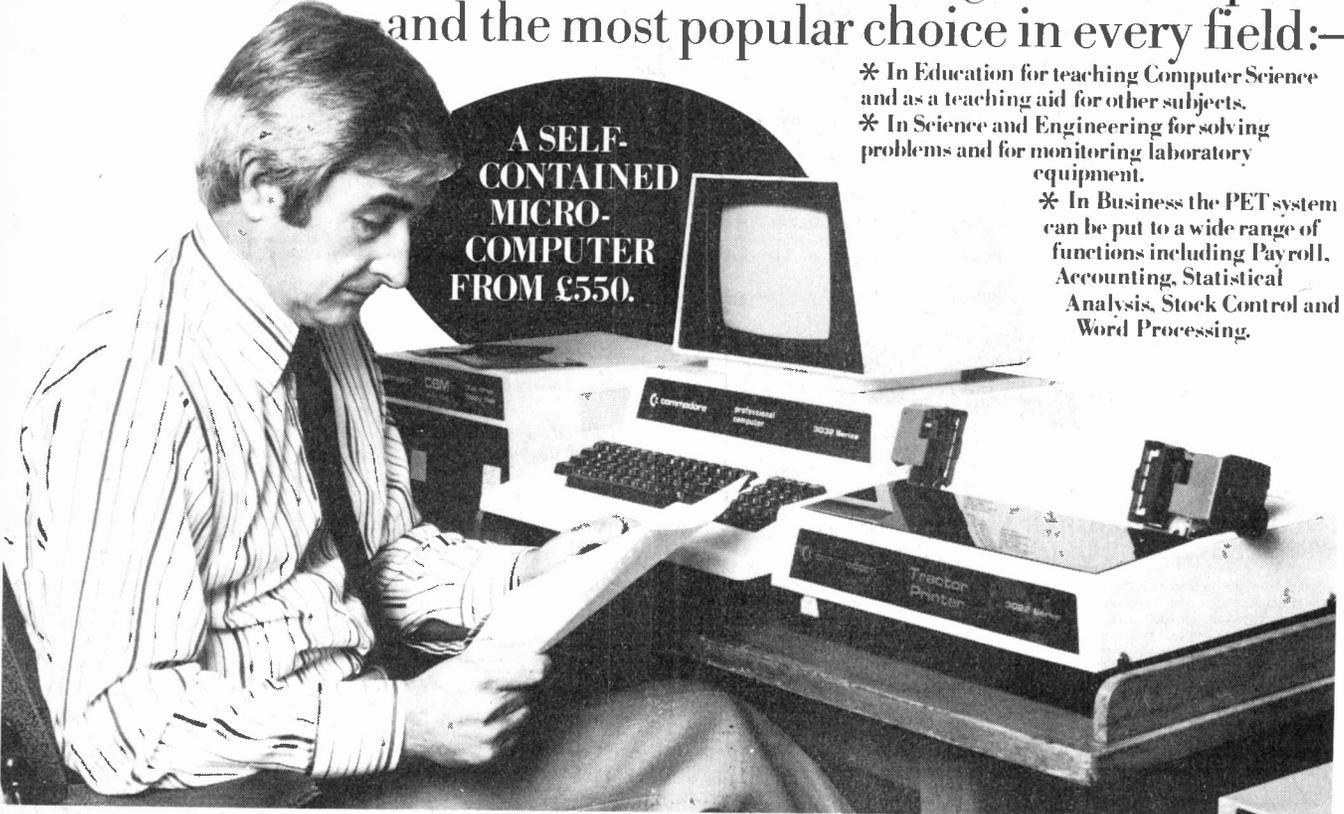
# POWERTRAN ELECTRONICS

PORTWAY INDUSTRIAL ESTATE  
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ANDOVER  
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# Your Commodore PET System

The Commodore PET is Britain's best selling microcomputer and the most popular choice in every field:-



- \* In Education for teaching Computer Science and as a teaching aid for other subjects.
- \* In Science and Engineering for solving problems and for monitoring laboratory equipment.
- \* In Business the PET system can be put to a wide range of functions including Payroll, Accounting, Statistical Analysis, Stock Control and Word Processing.

Not least of its attractions is the price of a PET - from £550 for a self contained unit, to under £2,500 for the complete system including Floppy Disk Unit and high-speed Printer. Ask your nearest Commodore dealer below for details about Commodore hardware, software and training courses.

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\*This is a list of dealers participating in associated advertising and not a full list.

# Commodore

We made small computers big business.

Commodore Information Centre, 360 Euston Road, NW1 3BL, 01-388 5702

ETI MAY 1980



## Calculating Casio

This is a slightly better than usual scientific calculator/chronograph from Casio measuring 6.6 mmH x 70 mmW x 129 mmD. Its electronic buzzer will give hours of amusement to its proud owner as it can be used with its alarm, two countdown alarms, or hourly time signal, and boy, is it loud! Not only that, but this fine piece of technology has a calendar indicating year, month, date and day with a programmed range from March 1st 1976 to December 31st 1999, if they don't make you obsolete by then! "That's all very well", you cry, "but what does it actually do?" Well, 46 scientific functions include: 4 basic calculations, constants for  $+/-/x/\div$ ,  $x^y/x^{1/y}$ , parenthesis calculations up to five levels, accumulation to the memory, fraction calculations, percentage calculations, statistical calculations, obtaining standard deviation sexagesimal to

decimal conversion, trigonometric/inverse trigonometric functions, hyperbolic/inverse hyperbolic functions, common and natural logs, exponentiations (antilogarithms, exponentials, powers and roots), squares, square roots, cube roots, reciprocals, factorials, conversion of coordinate system, sign change, register exchange, Pi entry and scientific notation. (Phew).

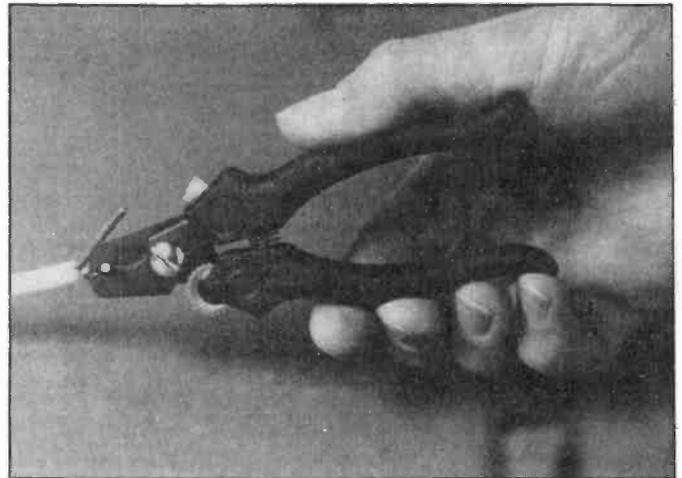
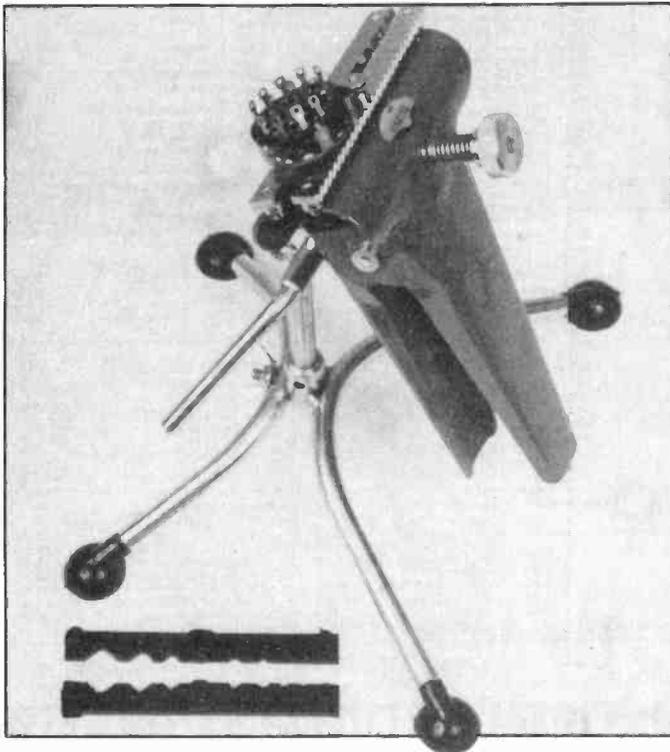
But that's not all — capacity for entry or basic calculations is 8-digit mantissa, or 8-digit mantissa plus 2-digit exponent up to  $10^{\pm 9.9}$ . Fraction calculation capacity is maximum 3-digit mantissa for each integer, numerator or denominator and at the same time maximum 6-digit mantissa for the sum of each part. All this from its one little chip: C-MOS-LSI crystal oscillator. Amazing isn't it? But not quite as amazing as the 144-page instruction book that tells you how to make it do all these things. The normal price is £27.95, or £24.95 from Tempus.

## Third Hand

Have you ever wished, whilst fiddling with your circuitry, that your hands didn't act like a bunch of sausages? Well, Telpro have produced an aid for the harassed electronics handyman in the form of the Multi-Purpose Work Holder. One side has a series of holes for gripping objects from 1 mm in diameter (component leads, etc) to 20 mm in diameter. The reverse side is serrated to hold flat objects such as circuit boards. A spring loaded knob allows the clamp pressure to be varied.

The clamp is mounted on a universal joint allowing  $360^\circ$  rotation and  $180^\circ$  tilt from vertical to horizontal and can be locked in any position. The clamp is detachable from its metal stand which has sucker feet, so that an alternative stand for fitting to a bench vice can be used. This is available as an optional extra. Metal and nylon jaws are supplied with the holder as standard.

So gone are the days of squashing things and dropping them just as you're getting the wire onto the pin... blast! it slipped out of my fingers.



## Stripping News

AB Engineering has produced a new wire stripper and cutter based on their popular AB MK 100 and called the MK 001. It has an improved locking device and features a knurled knob

adjustment to control stripping depth, a retaining clip to keep it closed and a curved cutting edge for clean wire cutting. The price is £1.85 and further details of this and the company's large range of tools are available from: AB Engineering Company, Timber Lane, Woburn, Beds. MK17 9PL.

## MEMorable Big Brother

MEM are to launch two new programmable logic controllers for controlling automatic machinery. Memaster 500 can handle no less than 512 channels and can store up to 4096 logic instructions. If your system requires more than that, doubling the memory capacity is possible at relatively low cost. If your control requirements are a little more modest the smaller Memaster 80 system may be what you need.

Memaster 500 is rather unusual in that it incorporates a digital input filtering system and a timer and counter unit with direct manual adjustment. The controller fits into a standard rack mounting system. Modular design makes for easy servicing. The controlling program can be tested in slow motion and, if necessary, printed out or burned permanently into UVEPROM (ultra-violet erasable PROM).

You can get further details of this sophisticated new PLC system from MEM Electronics Division, Regency House, 101 Hagley Road, Birmingham B16 8LA.

TTLs by TEXAS			93 SERIES			VEROBOARDS			TRANSISTORS			MEMORIES			UART			LOW PROFILE DIL SOCKETS BY TEXAS		
7400	11p	74251	140p	4018	89p	9301	160p	0 1 0.15	BF259	36p	IP30A	24p	2N3442	140p	40361/2	45p	10A	400V	200p	
7401	12p	74259	250p	4019	45p	9302	175p	(copper clad)	BF299	25p	IP30C	60p	2N3553	240p	40364	120p	25A	400V	400p	
7402	12p	74278	290p	4020	100p	9308	316p	2.5 x 3.75"	BF426	25p	IP31A	52p	2N3565	30p	40408	70p	ZENERS			
7403	14p	74279	110p	4021	110p	9310	275p	5 x 5"	AC127/B	20p	IP31C	68p	2N3584	250p	40409	85p	2.7V-33V	9p		
7404	14p	74283	150p	4022	100p	9312	275p	3.75 x 5"	AC176	25p	IP32A	68p	2N3643/4	48p	40410	85p	400mW	9p		
7405	14p	74293	150p	4024	20p	9314	185p	3.75 x 5"	AF116	50p	IP33A	25p	2N3704/5	12p	40411	300p	1W	15p		
7406	32p	74298	200p	4025	20p	9316	225p	3.75 x 1.7"	A0149	70p	IP33C	114p	2N3706/7	14p	40594	105p	TRIACS			
7407	32p	74366	100p	4026	130p	9321	225p	Pat of 100 pins	AU107	200p	IP34A	114p	2N3707/9	12p	40595	105p	3A 400V	60p		
7408	17p	74367	100p	4028	84p	9322	150p	Pin. face cut	BC107/B	11p	IP34C	160p	2N3733	300p	40673	75p	3A 500V	65p		
7409	17p	74368	100p	4029	84p	9334	360p	Spot. face cut	BC109	11p	IP35A	225p	2N3819	25p	40841	90p	6A 400V	65p		
7410	15p	74390	200p	4030	55p	9338	200p	Pin. insertion tool	BC117/B	20p	IP35B	290p	2N4037	65p	40842	90p	12A 400V	85p		
7411	24p	74393	200p	4031	200p	9370	200p	Vero WinPro Pen	BC127	12p	IP36A	270p	2N4058/9	12p	40843	90p	12A 500V	85p		
7412	20p	74490	225p	4033	180p	9374	200p	+ 2 wire spools	BC159	11p	IP36B	340p	2N4061/2	18p	40844	90p	12A 500V	85p		
7413	30p	74490	225p	4034	200p	Combs			BC169C	12p	IP36C	340p	2N4062	18p	40845	90p	12A 500V	85p		
7414	30p	74L500	14p	4035	110p	LINEAR I.C.s			BC172	12p	IP37A	225p	2N4063	18p	40846	90p	12A 500V	85p		
7414	30p	74L502	16p	4036	295p	AY1-0212	600p	NE531	150p	IP37B	225p	2N4064	18p	40847	90p	12A 500V	85p			
7414	30p	74L503	16p	4037	115p	AY1-1313	668p	NE555	22p	IP37C	225p	2N4065	18p	40848	90p	12A 500V	85p			
7414	30p	74L504	16p	4038	120p	AY1-1320	320p	NE556	70p	IP37D	225p	2N4066	18p	40849	90p	12A 500V	85p			
7414	30p	74L505	25p	4039	295p	AY1-5050	140p	NE561B	4.25p	IP37E	225p	2N4067	18p	40850	90p	12A 500V	85p			
7420	17p	74L508	22p	4040	100p	AY3-1270	840p	NE562B	4.25p	IP37F	225p	2N4068	18p	40851	90p	12A 500V	85p			
7421	17p	74L510	20p	4041	80p	AYS-1224	240p	NE565	130p	IP37G	225p	2N4069	18p	40852	90p	12A 500V	85p			
7422	22p	74L511	40p	4042	80p	AYS-1315	600p	NE566	130p	IP37H	225p	2N4070	18p	40853	90p	12A 500V	85p			
7423	34p	74L513	40p	4044	80p	AYS-1317A	775p	NE567	175p	IP37I	225p	2N4071	18p	40854	90p	12A 500V	85p			
7425	30p	74L515	40p	4046	110p	CA3019	80p	NE571	4.25p	IP37J	225p	2N4072	18p	40855	90p	12A 500V	85p			
7426	40p	74L520	20p	4047	100p	CA3046	70p	RC4151	4.25p	IP37K	225p	2N4073	18p	40856	90p	12A 500V	85p			
7427	34p	74L520	20p	4048	55p	CA3048	225p	SAD1024A	1280p	IP37L	225p	2N4074	18p	40857	90p	12A 500V	85p			
7428	36p	74L527	38p	4049	40p	CA3080E	72p	SFF96364	1100p	IP37M	225p	2N4075	18p	40858	90p	12A 500V	85p			
7432	30p	74L530	20p	4050	48p	CA3086	48p	SN76033N	175p	IP37N	225p	2N4076	18p	40859	90p	12A 500V	85p			
7433	40p	74L532	27p	4052	48p	CA3089E	225p	SN76013N	140p	IP37O	225p	2N4077	18p	40860	90p	12A 500V	85p			
7434	35p	74L547	40p	4053	80p	CA3090AQ	375p	SN76013ND	120p	IP37P	225p	2N4078	18p	40861	90p	12A 500V	85p			
7438	36p	74L549	40p	4053	80p	CA310E	90p	SN76023N	140p	IP37Q	225p	2N4079	18p	40862	90p	12A 500V	85p			
7440	17p	74L551	24p	4054	150p	CA3140E	80p	SN76023ND	120p	IP37R	225p	2N4080	18p	40863	90p	12A 500V	85p			
7441	70p	74L555	30p	4055	125p	CA3161E	140p	SN76023ND	120p	IP37S	225p	2N4081	18p	40864	90p	12A 500V	85p			
7442A	60p	74L573	50p	4056	135p	CA3180E	450p	SN76033N	175p	IP37T	225p	2N4082	18p	40865	90p	12A 500V	85p			
7443	112p	74L574	36p	4057	450p	CA3189E	400p	TAA621	275p	IP37U	225p	2N4083	18p	40866	90p	12A 500V	85p			
7444	112p	74L575	45p	4058	115p	CA3190E	400p	TAA641811	225p	IP37V	225p	2N4084	18p	40867	90p	12A 500V	85p			
7445	100p	74L576	45p	4059	115p	CA3190E	400p	TAA641811	225p	IP37W	225p	2N4085	18p	40868	90p	12A 500V	85p			
7446A	83p	74L583	110p	4066	55p	CA3190E	400p	TAA641811	225p	IP37X	225p	2N4086	18p	40869	90p	12A 500V	85p			
7447A	50p	74L585	100p	4067	450p	CA3190E	400p	TAA641811	225p	IP37Y	225p	2N4087	18p	40870	90p	12A 500V	85p			
7448	80p	74L586	100p	4068	27p	CA3190E	400p	TAA641811	225p	IP37Z	225p	2N4088	18p	40871	90p	12A 500V	85p			
7450	17p	74L590	40p	4069	30p	CA3190E	400p	TAA641811	225p	IP37A	225p	2N4089	18p	40872	90p	12A 500V	85p			
7451	17p	74L592	40p	4070	30p	CA3190E	400p	TAA641811	225p	IP37B	225p	2N4090	18p	40873	90p	12A 500V	85p			
7451	17p	74L593	60p	4071	25p	CA3190E	400p	TAA641811	225p	IP37C	225p	2N4091	18p	40874	90p	12A 500V	85p			
7453	17p	74L596	110p	4072	25p	CA3190E	400p	TAA641811	225p	IP37D	225p	2N4092	18p	40875	90p	12A 500V	85p			
7454	17p	74L596	110p	4072	25p	CA3190E	400p	TAA641811	225p	IP37E	225p	2N4093	18p	40876	90p	12A 500V	85p			
7460	17p	74L5107	45p	4073	25p	CA3190E	400p	TAA641811	225p	IP37F	225p	2N4094	18p	40877	90p	12A 500V	85p			
7470	36p	74L5109	80p	4075	25p	CA3190E	400p	TAA641811	225p	IP37G	225p	2N4095	18p	40878	90p	12A 500V	85p			
7472	30p	74L5112	100p	4076	107p	CA3190E	400p	TAA641811	225p	IP37H	225p	2N4096	18p	40879	90p	12A 500V	85p			
7473	34p	74L5113	30p	4077	25p	CA3190E	400p	TAA641811	225p	IP37I	225p	2N4097	18p	40880	90p	12A 500V	85p			
7474	30p	74L5114	40p	4078	25p	CA3190E	400p	TAA641811	225p	IP37J	225p	2N4098	18p	40881	90p	12A 500V	85p			
7475	30p	74L5122	80p	4086	72p	CA3190E	400p	TAA641811	225p	IP37K	225p	2N4099	18p	40882	90p	12A 500V	85p			
7476	35p	74L5123	70p	4089	138p	CA3190E	400p	TAA641811	225p	IP37L	225p	2N4100	18p	40883	90p	12A 500V	85p			
7480	50p	74L5124	180p	4093	80p	CA3190E	400p	TAA641811	225p	IP37M	225p	2N4101	18p	40884	90p	12A 500V	85p			
7481	100p	74L5125	60p	4094	250p	CA3190E	400p	TAA641811	225p	IP37N	225p	2N4102	18p	40885	90p	12A 500V	85p			
7482	84p	74L5126	60p	4095	95p	CA3190E	400p	TAA641811	225p	IP37O	225p	2N4103	18p	40886	90p	12A 500V	85p			
7483A	100p	74L5127	60p	4096	95p	CA3190E	400p	TAA641811	225p	IP37P	225p	2N4104	18p	40887	90p	12A 500V	85p			
7484	100p	74L5133	30p	4097	340p	CA3190E	400p	TAA641811	225p	IP37Q	225p	2N4105	18p	40888	90p	12A 500V	85p			
7485	110p	74L5136	55p	4098	-120p	CA3190E	400p	TAA641811	225p	IP37R	225p	2N4106	18p	40889	90p	12A 500V	85p			
7486	34p	74L5138	75p	4099	200p	CA3190E	400p	TAA641811	225p	IP37S	225p	2N4107	18p	40890	90p	12A 500V	85p			
7489	175p	74L5139	75p	4100	220p	CA3190E	400p	TAA641811	225p	IP37T	225p	2N4108	18p	40891	90p	12A 500V	85p			
7490A	30p	74L5145	120p	4101	250p	CA3190E	400p	TAA641811	225p	IP37U	225p	2N4109	18p	40892	90p	12A 500V	85p			
7491	80p	74L5147	80p	4102	180p	CA3190E	400p	TAA641811	225p	IP37V	225p	2N4110	18p	40893	90p	12A 500V	85p			
7492A	80p	74L5148	175p	4103	180p	CA3190E	400p	TAA641811	225p	IP37W	225p	2N4111	18p	40894	90p	12A 500V	85p			
7493A	30p	74L5151	100p	4104	90p	CA3190E	400p	TAA641811	225p	IP37X	225p	2N4112	18p	40895	90p	12A 500V	85p			
7494	84p	74L5153	60p	4105	99p	CA3190E	400p	TAA641811	225p	IP37Y	225p	2N4113	18p	40896	90p	12A 500V	85p			
7495A	70p	74L5154	200p	4106	90p	CA3190E	400p	TAA641811												

# CALCULATORS.

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 \*TEXAS T157 (Key Prog 8 mem. 150 Keystrokes/50 Prog Steps) **£25.00**

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 TEXAS T150 LCD (Sci/Stat. 2 Con Mem) **£23.00**  
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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.

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 \*TEXAS T158 with Maths/Utilities **£90.00**  
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 \*TEXAS T158 with Applied Statistics **£80.00**  
 \*TEXAS T159 with PC100C & Applied Statistics **£305.00**

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\*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.  
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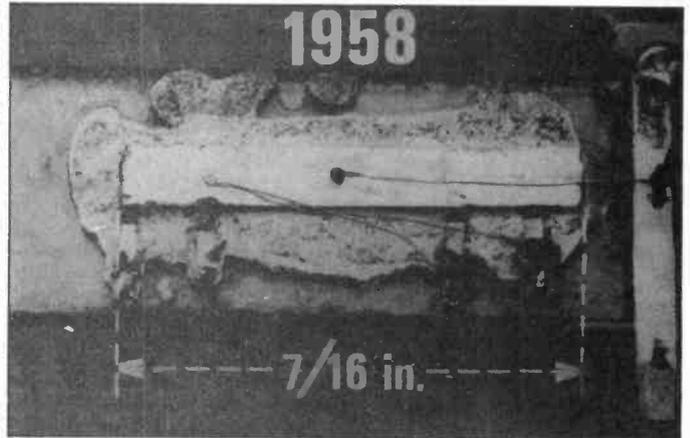
22 Cowper St., London, EC2

## April Fool

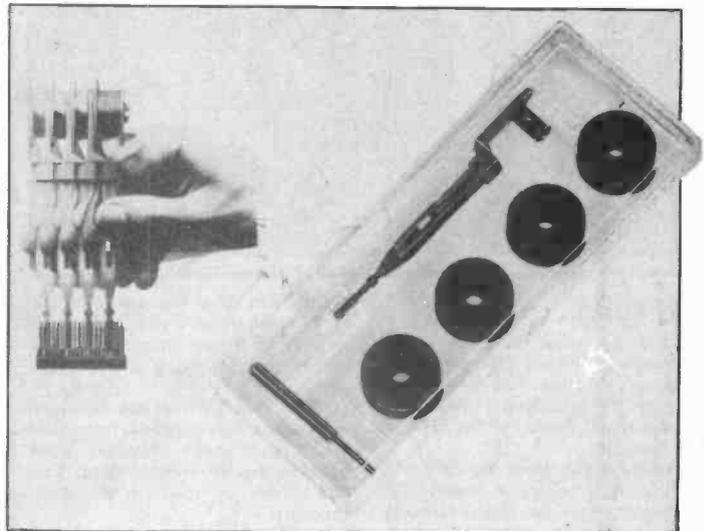
Did you spot our deliberate mistakes (well, that's our story) last month? You may have found the contents page listing a shade inaccurate after the circuit supplement. As the supplement is extra to the magazine, its pages are numbered separately. So, to find

the Touch Dimmer, for instance, take 16 (the size of the supplement) from 87 and there it is on page 71.

We've already had numerous letters and phone calls about the disembodied program listing which appears on the last Tech Tip page. So, you want to know what it is? Have a look at Tech Tips this month.



It had to happen. The integrated circuit is so old that it has earned its place in a museum. Doesn't it make you feel old? The world's first IC, invented by Jack Kilby of Texas Instruments in 1958, is one of three exhibits on loan from TI in Dallas for the 'Challenge of the Chip' exhibition at the Science Museum. The other two are the first silicon transistor and the first single chip microcomputer.



## Wrap Up

This low cost wire wrapping kit caught our eye. We reckoned it was inexpensive enough for any hobbyist or small scale producer to consider buying.

It wraps 30 AWG wire onto standard 0.0025in square posts without stripping or slitting the insulation. It can 'daisy chain' continuously through several points or can be used in the point-to-point mode; it also has a

built-in wire cut-off device for terminating the final connection of each chain.

The JWK-6 kit contains the 'Just Wrap' wrapping tool, the JUW-1 unwrapping tool and four 50ft wire refill cartridges, one each of red, white, blue and yellow insulation for colour coding. All packaged in a sturdy clear plastic box. The 'Just Wrap' kit is available at £18.65 excluding VAT and delivery from: OK Machine & Tool (UK) Ltd, Dutton Lane, Eastleigh, Hants SO5 4AA.

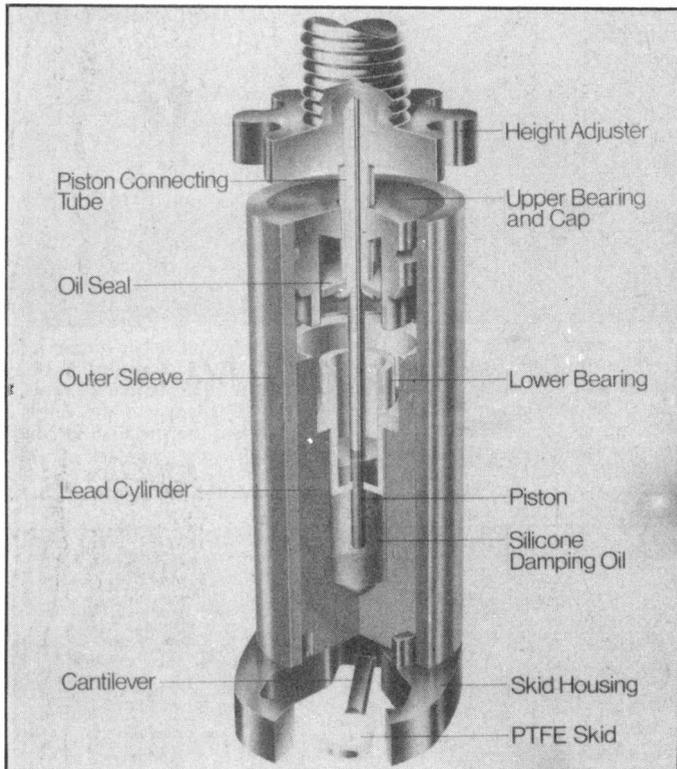
## Warp Factor 1

You may have seen this gadget demonstrated on telly a while ago. The Zerostat Z-track tone arm/cartridge damper has an effective mass of only 1/2 gm. It manages to improve tracking ability, reduce mechanical and acoustic feedback, attenuate unwanted subsonic signals (protecting the amplifier from overloading and the speakers from excessive cone movement) and minimise the effects of record warps.

The Z-track damper fits on to

most head shells. It contains a tiny, silicone fluid-damped piston and rides on a low-friction PTFE skid wide enough to ride on the record surface without tracking. Life expectancy is of the order of 1,000 12" sides. Badly warped records magically become playable and mildly warped records sound as if they were perfectly flat.

The Z-track is adjustable for most tone arm/cartridge combinations. Cost? — £9.95, about the price of two LPs. For further information contact Zerostat Components Ltd, St Ives, Cambs PE17 4LF.



## Creditel

You'll soon be able to make phone calls by credit card. The Post Office has just ordered a quarter of a million plastic telephone credit cards for the likes of you and I.

Charges for using the card will be included on your phone bill. As anyone can use a card to make

a call (just give the operator the card number), it's vital to keep it in one of those important little places where no-one else can get at it.

The Post Office has arranged with some foreign countries that credit card calls may be made back to the UK from abroad. You still have to pay in the end, though.

## Comparatively New

The uA193/293/393 series of dual comparators from Fairchild consists of two independent precision voltage comparators, specifically designed to operate from a single power supply of +2 to +36 volts.

The devices feature a Darlington connected PNP input stage which allows the input common-mode voltage to include ground. Current drain (independent of the

supply voltage rail) is low (400 uA) and offset voltage is only ±2 mV for the military version. Use of a split power supply is also possible.

Applications include simple analogue to digital converters, MOS clock timers and high voltage digital logic gates. The uA193 series comparators are direct replacements for the LM193 family. Further information, application notes, etc are available from Fairchild Camera & Instrument (UK) Ltd, 230 High Street, Potters Bar, Herts EN6 5BU.

# MITRAD (MIDLAND TRADING COMPANY) ZETRON!

Take you into the Eighties with two really superb pieces of modern technology

## GENT'S ALARM CHRONO (12/24 CYCLE)

A really superb watch and module with numerous facilities available. It can be set as a 12 or 24-hour watch with hours, minutes, seconds, a.m./p.m. and weekday indication always on display. A unique calendar is built into the watch. You can have month followed by date or date followed by month. It's entirely up to you. A 24-hour alarm can be set to anytime within a 24-hour period whether in the 12 or 24 cycle.

The chronograph has a twelve-hour capacity and runs at 1/105. Split and lap mode facilities are available.

Battery hatch, mineral glass, long life battery and a closely woven adjustable stainless steel strap finish the watch off with impeccable looks.

**ONLY £16.50!**

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A truly superb timepiece with extreme accuracy. A choice of two colours on this outstanding watch are available. Blue or white.

The calendar in the watch can be set to give a readout in either French or English, with date indication being automatic.

An infinite adjustable stainless steel strap is built in as part of the watch.

The watch is fitted with a long-life battery and comes with luminous marking to aid night-time vision.

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## GENTS CHRONO ALARM (FRONT BUTTON)

Brand new 1980 style. Basic working modes of chronograph. 24 hour alarm and dual time zone. Constant display of hours, mins, secs and weekday indication with am/pm, T2 and A1 flags. Date indication. The chrono runs to 1/10th sec, with the 1/10th's running along the bottom of the watch. It has a twelve hour capacity. The 24 hour alarm system is actuated for a full 60 seconds. Dual timing facilities give the watch the added touch of compactness. Back-light, closely woven adjustable stainless steel strap.

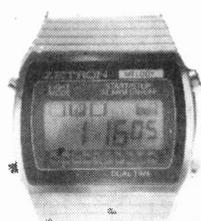
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## GENTS MELODY ALARM CHRONO

Brand new 1980 style. Another unique watch from the Zetron range. Constant display of hours, mins, secs, weekday, am/pm and mode square flag indication. The chrono runs to a 1/10th sec with split and lap mode facilities. Dual timing facilities are available. A musical tune "Yellow rose of Texas" is used as the alarm system, which plays for 20 secs. The tune can also be activated at an instant with the press of a button. Back-light. Another unique feature is the fact that the infinite adjustable stainless steel strap is built in as part of the watch.

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## GENTS MEMORY CALENDAR ALARM CHRONO

LATEST TECHNOLOGY! Constant display of hours, mins, secs, weekday and snooze alarm indication. A further two optional display modes are available, one being the calendar and month, which can be increased or decreased to give the appropriate month of the year. A 1/100th sec chrono with split and lap mode facilities is built into the watch. A 24 hour alarm with a 10 minute snooze function is also standard to the watch. A further feature is the back-light and fully adjustable stainless steel strap.

**VALUE AT £19.95**



## GENTS MELODY MULTI CHIME ALARM CHRONO

Latest technology! Constant display of hours, mins and secs, weekday, date and month with mode and chime indication display. The musical alarm once actuated plays the tune "Oh Suzanna". Two further alarm systems are incorporated in this outstanding watch: (i) 24 hour alarm; (ii) count down alarm. The watch can be set to chime on every full hour. A 1/100th sec chrono is standard to the watch. Can be switched off. Mineral glass face. The watch also has a battery hatch backlight and infinitely adjustable stainless steel strap.

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## LADIES COCKTAIL

Elegance and style for the lady with the discerning taste. In gold or silver finish with matching bracelet. Constant display of hours and mins with month, date, secs, auto calendar and back-light.

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## LADIES SUGAR

Another superb ladies watch with that extremely popular sugar frosted finish. Links can easily be removed from the strap and the clasp has a spring mechanism built in to give a comfortable fitting. Constant display of hours and mins, with month, date, secs, auto calendar and back-light.

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## GENTS CHRONOGRAPH

Probably the best looking chrono on the market. Constant display of hours, mins, secs with am/pm indication. Also month, date and weekday indication. 1/100th and 1/10th sec with split and lap mode facilities. Back-light, closely woven adjustable stainless steel strap.

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## GENTS FRONT BUTTON ALARM

Latest style! Constant display of hours, mins, secs, am/pm, weekday and alarm indication. A further two optional display modes are available. The watch comprises of 7 digits, 12 function and is programmed to the year 2009. The alarm can be set to any time within 24 hours and operates for 30 sec. Back-light and a closely woven adjustable stainless steel strap finish the watch off with a really superb sleek look, only 8mm thick.

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Toggle switch SPST 1 1/2 amp 250V ac	1975	£0.38
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A range of rocker switches SPST — moulded in high insulation material available in a choice of colours ideal for small apparatus	RED	1980	£0.35
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Description	No.	Price
Miniature SPST toggle 2 amp 250V ac	1958	£0.61
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**MEL 11 (TIL81) NPN LIGHT DETECTOR**  
 Silicon Photo Darlington Amplifier — V<sub>CC</sub> 30V V<sub>ECO</sub> 10V I<sub>c</sub> 100mA P<sub>tot</sub> 300mW I<sub>L</sub> Min 0.5 Typ. 2mA I<sub>D</sub> 100mA nA o/n0 1496 £0.29

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1729 Threeway connector black ONLY	£0.23 inc. VAT
1730 Fourway connector black ONLY	£0.28 inc. VAT

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20mm X 5mm chassis mounting	506	£0.18
1 1/4in X 1/4in chassis mounting	507	£0.14
1 1/4in car inline type	508	£0.18
Panel mounting 20mm	509	£0.23
Panel mounting 1 1/4in	510	£0.37

QUICK BLOW 20mm	Type	No.	Price
150mA	611 7p	1A 615 6p	3A 619 6p
250mA	612 6p	1.5A 616 7p	4A 620 10p
550mA	613 6p	2A 617 6p	5A 621 6p
800mA	614 8p	2.5A 618 7p	

ANTI-SURGE 20mm	Type	No.	Price
100mA	622 1A	625 2.5A	628
200mA	623 2A	626 3.15A	629
500mA	624 1.6A	627 5A	630

QUICK-BLOW 1 1/4in	Type	No.	Price
250mA	631	500mA 632	800mA 634

Type	No.	Type	No.
1A	635	2.5A	638
2A	637	3A	639

### NUTS AND BOLTS

**BA BOLTS** — packs of BA threaded cadmium plated screws slotted cheese head Supplied in multiples of 50

Type	No.	Price	Type	No.	Price
1in OBA	839	£1.38	1/2in 4BA	846	£0.37
1/2in OBA	840	£0.86	1/4in 4BA	847	£0.29
1in 2BA	842	£0.75	1in 6BA	848	£0.48
1/2in 2BA	843	£0.52	1/2in 6BA	849	£0.29
1/4in 2BA	844	£0.80	1/4in 6BA	850	£0.24
1in 4BA	845	£0.51			

**BA NUTS** — packs of cadmium plated full nuts in multiples of 50

Type	No.	Price	Type	No.	Price
OBA	855	£0.83	4BA	857	£0.35
2BA	856	£0.55	6BA	858	£0.28

**BA WASHERS** — flat cadmium plated plain stamped washers supplied in multiples of 50

Type	No.	Price	Type	No.	Price
2BA	860	£0.14	6BA	862	£0.14

**SOLDER TAGS** — Hot tinned supplied in multiples of 50

Type	No.	Price	Type	No.	Price
OBA	851	£0.46	4BA	853	£0.25
2BA	852	£0.32	6BA	854	£0.25

### AUDIO LEADS

No.	Type	Price
107	FM indoor Ribbon Aerial	£0.69
113	3.5mm Jack plug to 3.5mm Jack plug. Length 1.5m	£0.86
114	5 pin DIN plug to 3.5mm Jack connected to pins 3 & 5. Length 1.5m	£0.98
115	5 pin DIN plug to 3.5mm Jack connected to pins 1 & 4. Length 1.5m	£0.98
116	Car aerial extension. Screened insulated lead. Fitted plug and socket	£1.44
117	AC mains connecting lead for cassette recorders and radios. 2 metres	£0.78
118	5 pin DIN phono plug to stereo headphone Jack socket	£1.21
119	2+2 pin DIN plugs to stereo Jack socket with attenuation network for stereo headphones. Length 0.2m	£1.04
120	Car stereo connector. Variable geometry plug to fit most car cassettes. 8-track cartridge and combination units. Supplied with inlined fuse power lead and instructions	£0.69
123	6.6m Coiled Guitar Lead Mono Jack plug to Mono Jack plug Black	£1.72
124	3 pin DIN plug to 3 pin DIN plug. Length 1.5m	£0.86
125	5 pin DIN plug to 5 pin DIN plug. Length 1.5m	£0.85
126	5 pin DIN plug to Tinned open end. Length 1.5m	£0.85
127	5 pin DIN plug to 4 Phono Plugs. All colour coded. Length 1.5m	£1.49
128	5 pin DIN plug to 5 pin DIN socket. Length 1.5m	£0.92
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1.5m	£1.21
130	2 pin DIN plug to 2 pin DIN inline socket. Length 5m	£0.78
131	2 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5. Length 1.5m	£0.95
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£1.13
133	5 pin DIN plug to 2 Phono plugs. Connected pins 3 & 5. Length 1.5m	£0.86
134	5 pin DIN plug to 2 Phono sockets. Connected pins 3 & 5. Length 23cm	£0.78
135	5 pin DIN socket to 2 Phono plugs. Connected pins 3 & 5. Length 23cm	£0.78
136	Coiled stereo headphone extension lead. Black. Length 6m	£2.01
178	AC Mains lead for calculators, etc	£0.52

### TRANSFORMERS

MINIATURE MAINS Primary 240V	No.	Price
2021	6V-0-6V 100mA	£1.04
2022	9V-0-9V 75mA	£1.04
2023	12V-0-12V 100mA	£1.20

MINIATURE MAINS Primary 240V with two independent secondary windings	No.	Price
2024	MT280-0-6V 0-6V RMS	£1.84
2025	MT150-0-12V 0-12V RMS	£1.84

1 AMP MAINS Primary 240V	No.	Price	P & P
2026	6V-0-6V 1 amp	£2.88	P & P 45p
2027	9V-0-9V 1 amp	£2.30	P & P 45p
2028	12V-0-12V 1 amp	£2.60	P & P 55p
2029	15V-0-15V 1 amp	£3.16	P & P 66p
2030	30V-0-30V 1 amp	£3.97	P & P 86p

**STANDARD MAINS Primary 240V**  
 Multi-tapped secondary mains transformers available in 1/2 amp, 1 amp, and 2 amp current rating. Secondary taps are 0.19-25-33-40-50V. Voltages available by use of taps. 7. 8. 10. 14. 15. 17. 19. 25. 31. 33. 40. 25-0-25V

No.	Rating	Price	P & P
2031	1/2 amp	£3.91	P & P 86p
2032	1 amp	£5.06	P & P 86p
2033	2 amp	£6.27	P & P £1

2035 240V Primary 0-55V @ 2A Secondary £7.30 P & P £1

**SPECIAL OFFER**  
 2042 240V Primary 0-20V @ 2A Secondary. By removing 5 turns for each volt from the secondary winding any voltage up to 20V @ 2A is easily obtainable. Ideal for the experimenter. £1.50 P & P 86p

### CASES AND BOXES

**INSTRUMENT CASES.** In two sections, vinyl covered top and sides, aluminium bottom, front and back.

No.	Length	Width	Height	Price
155	8in	5 1/2in	2in	£1.73
156	11in	6in	3in	£2.92
157	6in	4 1/2in	1 1/4in	£1.79
158	9in	5 1/2in	2 1/2in	£2.43

**ALUMINIUM BOXES.** Made from bright, anodized aluminium. Each box complete with half-inch-deep lid and screws.

No.	Length	Width	Height	Price
159	5 1/2in	2 1/2in	1 1/2in	£0.85
160	4in	4in	1 1/2in	£0.85
161	4in	2 1/2in	1 1/2in	£0.85
162	5 1/2in	4in	1 1/2in	£0.97
163	4in	2 1/2in	2in	£0.87
164	3in	2in	1in	£0.60
165	7in	5in	2 1/2in	£1.43
166	6in	6in	3in	£1.82
167	6in	4in	2in	£1.18

**SLOPE front aluminium boxes** with black vinyl base and sides & aluminium back, top & front — strong construction easily accessible.

169	2 1/2in	5 1/2in	2 1/2in	12in	3 1/2in	8in	£5.45
168	1 1/2in	7 1/2in	4in	16in	4 1/2in	11in	£8.31

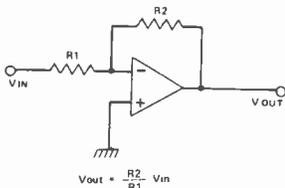
Terms cash with order. Cheques/Postal Orders made payable to Bi-Pak at above address



# PROJECT 80 FILTERS

Not one project but four. The Project 80 VCF can be constructed as any of the most useful configurations. Circuit design by Charles Blakey.

In the first article of this series (February 1980) it was stated the project is suitable for both the enthusiast and the beginner in electronic music. It is reasonable to assume that the enthusiast already has some equipment and so the ETI 80 modules offer the opportunity to extend, or upgrade, their current system. Assuming that the existing equipment is compatible with modules having an exponential frequency control response then one of the problems that is encountered is the level of signals employed. Most of the ETI 80 modules can readily be adapted to accept other signal levels. For example, we could have zero referenced the input to the following filters and omitted the buffer stage, although the high input impedance for some filters may have led to problems with noise pick-up. By including an op amp input stage we have avoided the latter potential hazard and at the same time provided a standard input summer.-

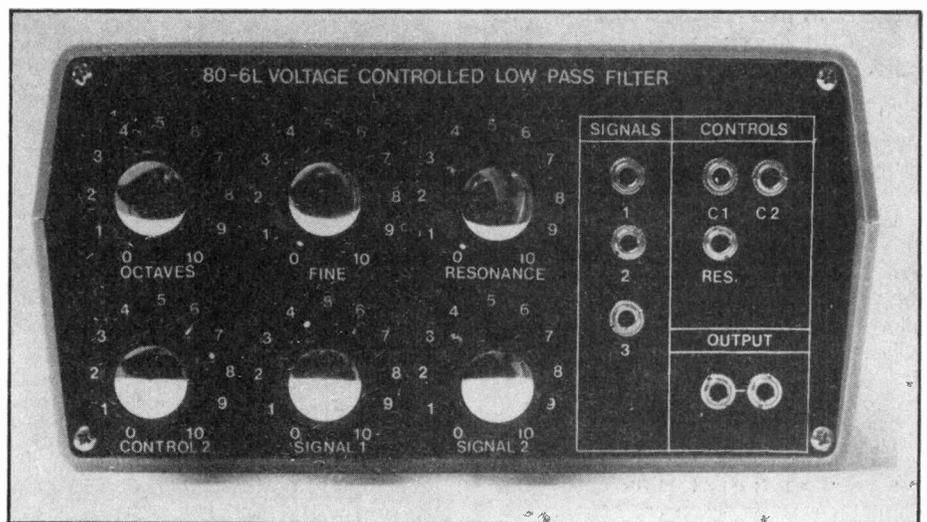


$$V_{out} = \frac{R_2}{R_1} V_{in}$$

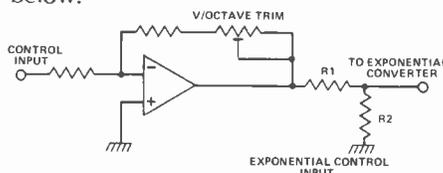
$$\text{with } V_{out} = \frac{R_2}{R_1} V_{in}$$

If one is therefore currently using 5V P-P signals, instead of the 10V P-P employed in this project, then the only change required is to double R2 so that the other components around the special ICs employed remain unchanged. In the case of some synthesisers which combine the worst of both worlds and have very low signal levels and low input impedance then both R1 and R2 can be altered to normalise the input to that of the existing synthesiser.

Likewise, most modules will have a similar buffer at the output which allows the signals to be attenuated to their original level, for example in the case of the 5V signal then R2 has to be halved.



Another minor problem may be the frequency response characteristics, for example, a synthesiser with a 0.5V per octave scale. All ETI 80 modules will have one or more scaling resistors which in the case of the current filter design is of the type shown below.-



where R1 and R2 are scaling resistors to give approximately 18 mV to the exponential converter for each volt applied at the keyboard control input. For the above mentioned example the only change required is doubling R2.

The final problem of compatibility is likely to be power supplies. This is most easily overcome by having separate supplies for the modules employed from this project. In most instances, however, the ETI 80 series can be run from power supplies as low as  $\pm 9V$  but this will require a number of component changes. Digisound Limited

will be pleased to advise readers of these changes.

## Filters

This month we are featuring the four filters most widely used in music synthesisers. They are four pole filters with one volt per octave control of their cut-off, or centre, frequency. Voltage control of signal regeneration is also included.

Filters are normally used in three modes. Firstly, subtractive synthesis, in which partials are subtracted from complex waveforms to effect changes in tone quality. Next, in timbre modulation which allows more complex waveforms to be developed by continuously altering the amplitude of the partials present during the duration of the sound. The latter may be accomplished by using a low frequency oscillator to vary the cut-off frequency of the filter. A widely employed variation of the latter technique is the use of an envelope generator, triggered by the keyboard, to control the cut-off frequency. In this way a tone can be produced, using a low pass filter, which begins with the fundamental

followed by an increasing number of partials. The third technique is resonant synthesis in which the regeneration of the signal is increased to a level which will cause the filter to oscillate on receiving a sharp impulse, eg from an envelope generator set to minimum time constants or from a square wave and so on. This technique is widely used to produce percussive sounds.

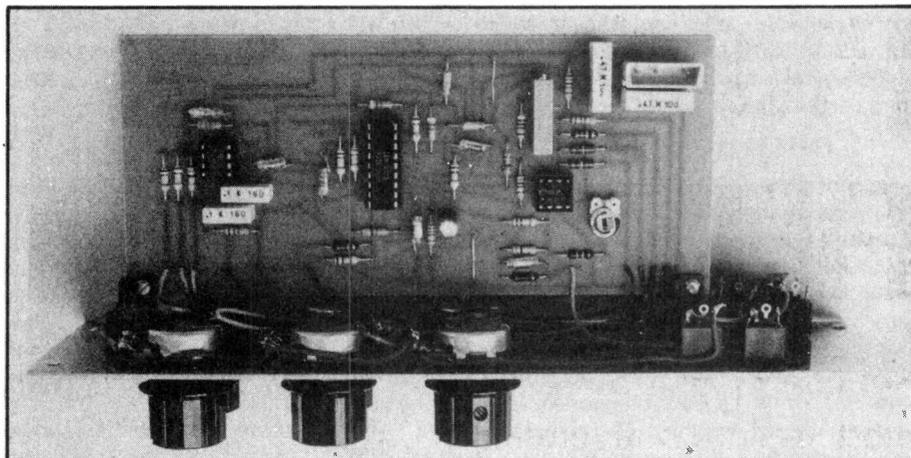
The four filter types provided are:-

**Low Pass Filter.** This will pass all frequencies up to the cut-off point and beyond this the frequencies are sharply attenuated at a rate of 24 dB/octave. By increasing the resonance control a band of frequencies around the cut-off point are emphasised and the more regeneration used the more 'electronic' the sound becomes. Low pass filtering is useful in simulating the tonal characteristics of several conventional instruments.

**High Pass Filter.** This passes all frequencies above the cut-off point and the roll-off below this point is again 24 dB/octave. The effect of high pass filtering is therefore to remove the fundamental and lowest partials and leave only the weak upper partials. It does not therefore find widespread use in subtractive synthesis of waveforms although a sawtooth and a high pass filter will produce some bright string sounds. This filter is also of use in filtering white noise. It is not normal to include resonance control with a high pass filter because of its limited application but since its inclusion has a very small effect on the cost in the current design it has been included. Its effect is the same as with the low pass filter, namely, to emphasise a band of frequencies about the cut-off point.

**Band Pass Filter.** This will pass a band of frequencies at the pole frequency of the filter. It is derived from two poles of high pass followed by two stages of low pass filtering thus giving a roll-off of 12 dB/octave in either side of the centre frequency. The effect of the resonance control in this instance, however, is to emphasise the centre frequency and so effectively increase the roll-off. This filter is used in imitative synthesis but more commonly a number of band pass filters need to be employed to obtain realistic results. Similarly, a more versatile band pass filter may be created by using independent low and high pass filters so that the width of the pass band can be altered over a wide range.

**Phase Shift Filter.** This is an allpass filter with mixing of the original signal to create two deep notches. The effect of regeneration is to sharpen the corners of the notches and effectively increase their depth. The 'phasing' effect is well known and most of the low cost commercial 'phasers' only have two notches. A particular advantage of the design described below is its low



noise but even so we believe that six notches are a minimum for good phasing effects.

## Which Filter?

As one's experience in music synthesisers increases it will be found that good quality filters (low noise and tracking capability) are essential for both innovative and imitative synthesis and that this will usually be achieved by combining various types of filter in series or parallel. Our recommendation for beginners is to start with the low pass filter, which finds the most widespread use in music synthesis, and the state variable filter to be described in the next article since this will have low pass, high pass, band pass and notch responses.

## Filter Design

The design is based on another customised IC from Curtis Electromusic Specialties, namely the CEM 3320, to realise the most important filter types employed in music synthesis. This voltage controlled filter IC has four independent filter stages which may be interconnected to provide a wide variety of filter responses. The pole frequency of the four stages is controlled by a single exponential generator which has a minimum range of ten octaves. The IC also includes a separate transconductance amplifier whose output is connected to the first filter stage and in the present design is used to provide manual or external voltage control of regeneration.

Some music synthesists argue that the ideal filter should have complete cut-off at its pole frequency. Certainly filters with a 24 dB/octave roll-off are considerably more useful than designs with lower roll-off. (12 and 24 dB/octave slopes will be included in the state variable filter design which is featured in the next article of this series). This combination of 24 + 12, or 24 + 24 dB/octave filters will provide the versatility we are aiming for in this project.

Each of the filters has been designed to accept our standard 10V P-P signal level and to output a similar signal level. The term 'similar signal level' is used since allowance has to be made for the enhancement of the centre frequency as the amount of feedback is increased through the resonance control. For example, the band pass filter has an output of about 3V P-P at lowest Q (no feedback) whereas at maximum Q this peak level will approach 11V. The filters are controlled over a 1000:1 frequency range and their lowest frequency is typically in the range 20 to 25 Hz. The standard one volt per octave frequency response is employed and when calibrated the filters will track the oscillators accurately over the important range of the keyboard. Beyond this range the one volt per octave control falls off but this is acceptable for filters. Manual and external voltage control of frequency are provided and the manual adjustment includes both coarse and fine adjustment. One of the external frequency control inputs has an attenuating potentiometer which is required when the filter is used in conjunction with an envelope generator or external waveforms for timbre modulation. Three signal inputs are included to simplify mixing of waveforms prior to filtering. Two of these have attenuating potentiometers and the third is fixed at one third of the maximum gain of the other two inputs. The fixed input may be altered to suit individual requirements and it may be coupled to a potentiometer external to the module.

## Temp. Temper

Although the four filter stages of the CEM 3320 are fully temperature compensated the frequency control input is not. If the methods of construction outlined in the first article are followed then frequency changes due to temperature should not be a problem.

A major advantage gained by using the CEM 3320 is the low signal to noise ratio and also low distortion when compared to popular designs using discrete components.

## Construction

Since the PCB is designed to accept four filter configurations care should be exercised with component placement and both the component overlays and circuit diagrams should be examined if there is any doubt. The spacing between PCB holes for resistors and polystyrene capacitors is 12.5 mm and for the electrolytic capacitors is 2.5 mm. If your component leads are of different lengths to the above then you are putting it in the wrong place!

Note the two wire links on the PCB and take particular care, as always, on orientation of the ICs. The control input to the resonance cell (pin 9 of IC 3) is a low impedance input at near ground potential. The two inputs to this cell, via R6 and R7 shown in Figure 2, can be used for either manual or external voltage control. To have both facilities requires the use of the recommended jack socket method of construction, or some other switching technique which is evident from the following. Dual operation is achieved by connecting a 24k resistor, R7A, to the +15V supply line to RV3 and then taking the output from RV3 via a jack socket to R7, so that the manual control is disabled when the external control is in use. In the latter case R6 need not be installed.

A number of the input and output connections to the PCB have two holes and

this will apply to many of the ETI 80 modules. The second hole may be used for hard wiring but they are intended for future expansion of the system.

## Calibration

A simple check can be made of the frequency control input and whether RV5 and RV6 have been wired up correctly. With IC3 removed and the coarse and fine controls fully anti-clockwise measure the voltage at the junction of R14 and R15 and adjust PR1 to obtain +155 mV. Now turn RV5 (coarse control) fully clockwise and the voltage should be about -25 mV.

Turn off power and insert IC3, power up, turn RV3 (resonance control) fully anti-clockwise and RV5 (coarse control) to about mid position. Measure the voltage at the output of the filter module and adjust PR2 until a zero reading is obtained. This offsets the DC voltage at the output of Pin 10 of IC3.

The last step is to calibrate the filter so that it will track the oscillators. The resonance control feedback resistor has been chosen so that the filter will oscillate when some frequency control is present, thus turning the filter into a low distortion sine wave oscillator. A calibrated VCO should be available at this time which will greatly simplify calibration of the filter. Any of the following techniques may be used in addition to treating it as an oscillator and using the methods described for the VCO.

**1. Beat frequency technique.** Apply about 3V5 to control input 1, which will become the keyboard input, to give a frequency of

about 250 to 300 Hz when RV3 is rotated to the point where oscillation is sustained - as heard through one side of the amplifier. Connect a calibrated VCO to the other side of the stereo amplifier and apply an external control voltage to the VCO until there is zero beating. Increase voltage to both VCO and VCF frequency control inputs by exactly one volt and then adjust PR1 until no beat frequency is heard.

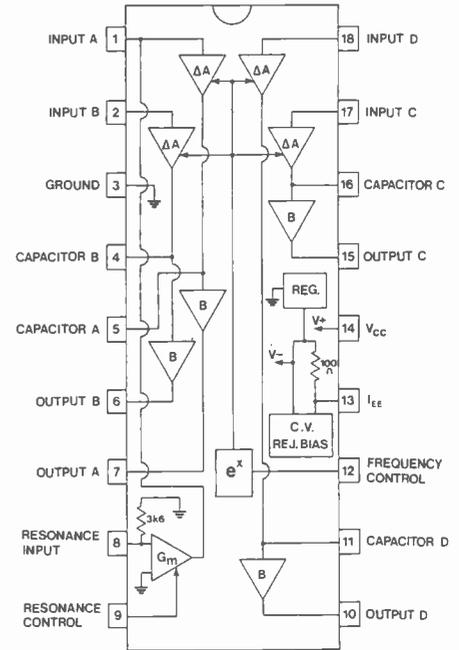


Figure 1. the CEM 3320 pinout.

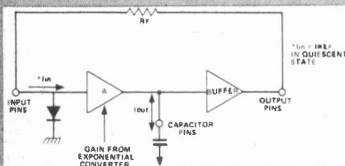
Each of the filter stages of the CEM 3320 contains a variable gain cell followed by a high impedance buffer. The variable gain cell is a current-in, current-out device (as opposed to the traditional voltage-in, current-out type) whose output current,  $I_{out}$ , is given by

$$I_{out} = (I_{REF} - I_{in}) e^{-V_C/V_T}$$

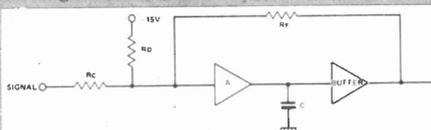
$$\text{where } V_T = kT/q \text{ and } I_{ref} = \frac{0V48 V_{CC} - 1V3}{100k^*}$$

\*±25%

The input to the variable cell is a forward biased diode to ground. The input thus presents a low impedance summing node at a nominal 650 mV above ground. The required input currents may therefore be obtained with resistors terminating at this input node.



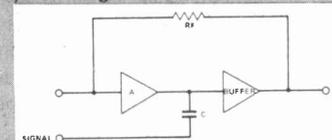
Thus each stage is set up with a feedback resistor,  $R_F$ , from the buffer output to the variable gain cell input and with the capacitor connected to the output of the variable gain cell. In the DC state, the buffer output will always adjust itself so that  $I_{REF}$  flows into the input. For lowest control voltage feedthrough and maximum peak to peak output signal, the quiescent output voltage of each buffer,  $V_{ODC}$ , should be  $0.48 V_{CC} - 0V65$ . In the present design where  $V_{CC}$  is +15 V, the feedback resistors (R21, R24, R26 and R29) are 100k, then the DC output of each buffer will be a nominal +6V5 and  $I_{REF}$  a nominal 60  $\mu A$ . The output impedance of the variable gain cell, although high, has a finite value. This impedance is reflected back to the input as an AC resistance of nominally 1M in parallel with the feedback resistor,  $R_F$ , regardless of control voltage value.



If the first stage of the low pass filter is coupled to a ground-referenced direct coupled signal output, then the quiescent DC output will shift down 0V6 and a capacitor

(C7) is used to avoid this situation. For the first stage the  $I_{REF}$  requirement is met using only  $R_F$  (R21). The subsequent stages should, however, be set for unity gain and since these will have the current from the feedback resistor (nominally 60  $\mu A$ ) as well as the current developed across  $R_C$  by the DC output of the preceding stage (nominally 66  $\mu A$ ) it is necessary to sink the excess current and this is done with a bias resistor,  $R_b$ , of 240 k connected to the negative supply.

For the simplest case, the high pass filter, each stage is shown below



$I_{REF}$  is supplied only through the feedback resistor,  $R_F$ , and the voltage gain is unity, irrespective of the value of this resistor. For best results, however, the impedance of the signal source to stage one should be low compared to  $R_F/4$ .

The band pass filter is derived by connecting two stages of high pass with two stages of low pass filtering. The allpass configuration is used to generate a phase shift filter by taking part of the original

## HOW IT

**2. Lissajours figures.** Same procedure as (1) but outputs from VCO and VCF are coupled to the X and Y inputs of an oscilloscope to generate Lissajours figures, i.e. a stable circle using sine waves when both amplitude and frequency are matched.

**3. Maximum signal amplitude.** Another approach with an oscilloscope is to apply a signal of about 250 Hz from a calibrated VCO to signal input 1 of the filter and observe the output of the filter on the oscilloscope. Apply a voltage to control input 1 of the filter until the point where the output reaches its maximum amplitude is observed. A small amount of resonance will help. Increase control voltage to both VCO and VCF by exactly one volt and adjust PR1 until maximum amplitude is restored.

If an oscilloscope is available then the VCO and VCLFO may be used as a sweep

frequency generator to examine the response characteristics of the filters. These should be connected as shown below.

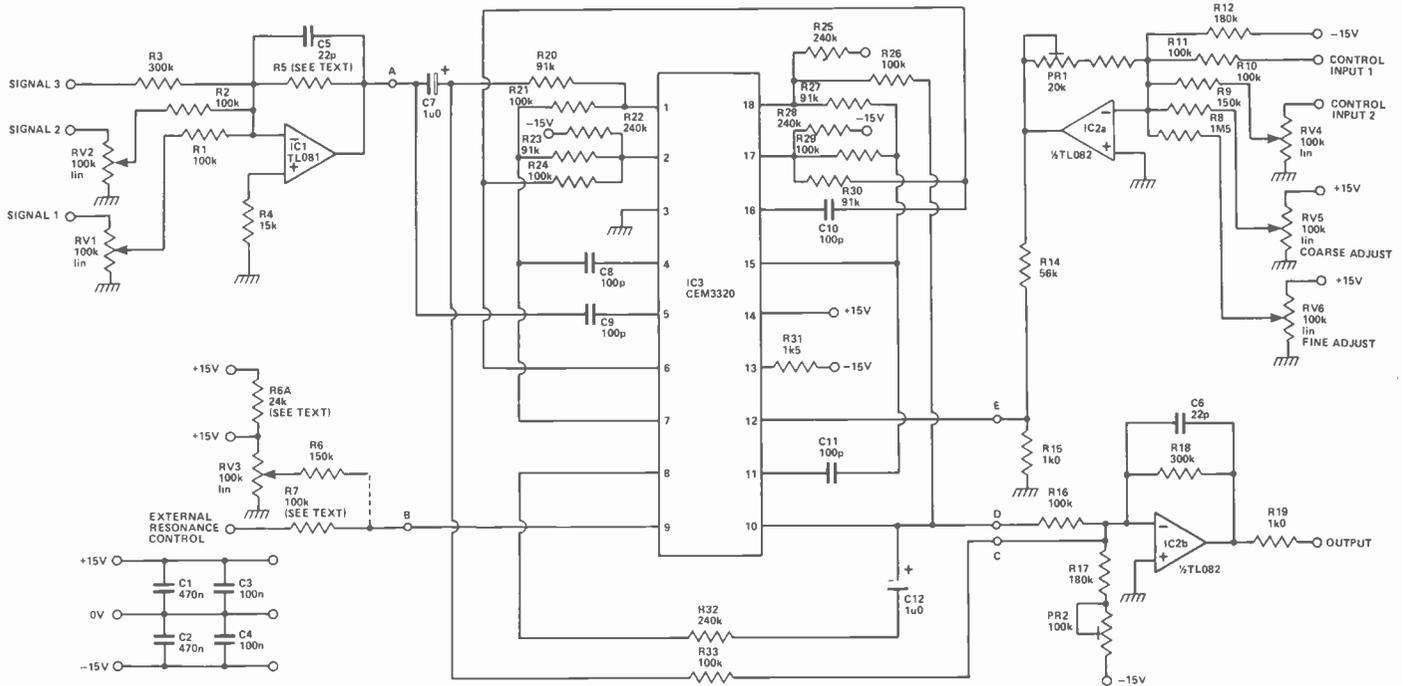
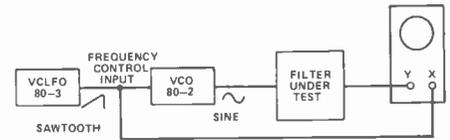


Figure 2. full circuit diagram of the phase-shift filter.

## WORKS

signal, via R33, to the output stage. In both cases the purpose of resistors R20 to R30, when used, is evident from the above discussion.

The CEM 3320 contains a traditional transconductance type of amplifier. It has a separate signal voltage input (pin 8) and since this has an impedance of nominally 3k $\Omega$  the input is referenced to ground and so when the signal is taken from the signal output of the IC a coupling capacitor (C12) is required. The output of the gain cell is connected to stage one of the filter (pin 1) and in this project the amplifier is used to provide voltage control of resonance. In controlling resonance a current is applied to pin 9 using R6 or R7. This input is of low impedance with a potential near ground and its characteristics are such that the transconductance of the cell increases more slowly with increasing current. The latter results in finer resolution as the critical point of oscillation is reached. The amount of signal feedback is governed by R32 and its value has been chosen such that with 100  $\mu$ A of control current (our standard 10 volts via R7) oscillation will just occur, although operating conditions will influence the actual starting point. In other words, we have chosen the value so as to avoid sine waves of large amplitude which would become clipped in the first filter stage and

cause a shift in frequency.

In order to minimise power dissipation the negative supply of the CEM 3320 is regulated at  $-1V_9$  with an internal shunt regulator. This reduces warm up drift of the pole frequencies on powering up as well as allowing virtually any negative supply greater than  $-4V$  to be used. The current limiting resistor,  $R_{EE}$  (R31), must always be included and is calculated as follows

$$R_{EE} = \frac{V_{EE} - 2V_7}{.008}$$

which for our standard  $-15V$  supply requires a resistor of 1k $\Omega$ . A positive supply of  $+15V$  is connected directly to pin 14 but supplies in the range  $+9V$  to  $+18V$  may be used although this will influence both power dissipation and peak to peak output swing.

IC1 forms a conventional input summer for up to three signal inputs, two of which may be attenuated with rotary controls (RV1 and RV2) included on the panel. R5 determines the signal level into the filter and based on an input of 10 V p-p its value has been chosen such that the signal will not be clipped in the filter even when the maximum useful regeneration is applied. IC2b forms the output stage and the signal is amplified by R18 to ensure that the VCF will have approximately unity gain at maxi-

mum resonance. R17 and PR2 allow cancellation of the DC voltage at pin 10 of the CEM 3320. IC2b also serves as a buffer stage for IC3 since the buffers within the filter are not short circuit protected.

The frequency range of the filters is governed initially by the capacitors C8 to C11, which have been selected to provide a lower cut-off frequency in the range of 20 to 25 Hz. The CEM 3320 has an exponential converter within the device which simultaneously controls the current gain of each section. An input of 18 mV/octave is required to pin 12 and an increasing positive control voltage lowers the pole frequency of the filter. Furthermore, for best results the input to pin 12 should be maintained between  $-25mV$  and  $+155mV$ . IC2a therefore provides an input summer for two external control voltages (via R10 and R11), a coarse control (RV5) for a ten octave range and a fine control (RV6) over a one octave range. It also serves to invert the input voltage to the same sense as other modules, namely, an increasing positive voltage increases pole frequency; to sum an offset voltage through R12 to give an initial voltage at pin 12 of approximately  $+155mV$ ; and by adjusting the gain with PR1 to allow the one volt per octave response of the filter to be developed at the junction of R14 and R15.

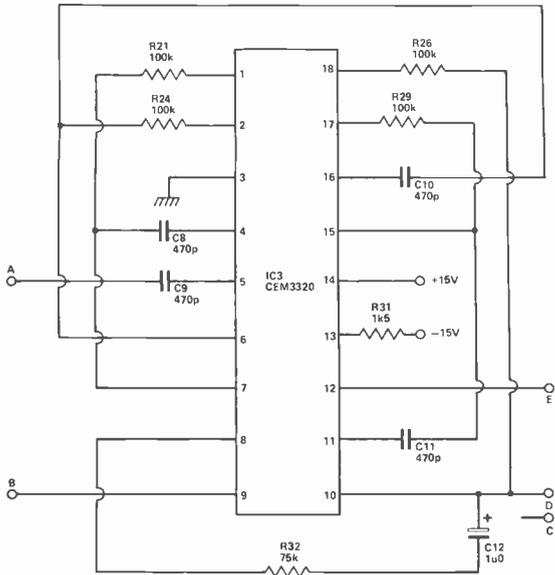
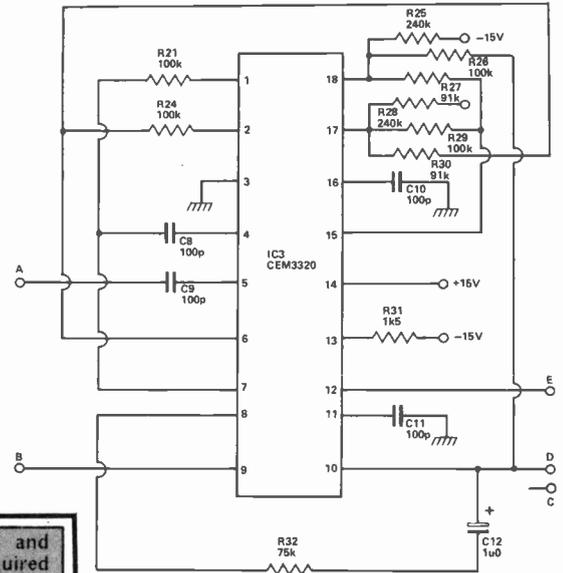
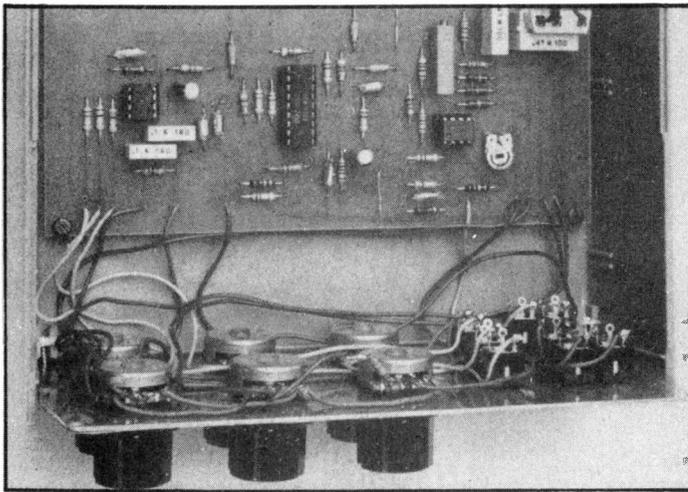
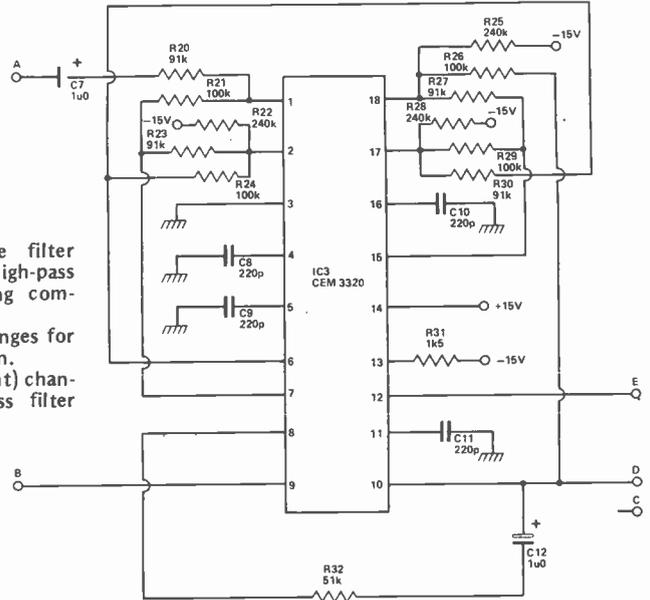


Fig.3. (left) the filter configured for high-pass operation showing component changes. Fig.4. (right) changes for low pass operation. Fig.5. (below right) changes for band-pass filter operation.



### BUYLINES

The PCB and all components shown in the appropriate circuit diagram are available from Digisound Limited for £13.20 per

filter, inclusive of postage, packing and VAT. Please specify filter type required when ordering.

### PARTS LIST

Components common to all filters

RESISTORS, 5%, 1/4W carbon film

R1,2,7,16  
21,24,26,29 100k  
R3,18 300k  
R4 15k  
R6,9 150k  
R8 1M5  
R17 180k  
R19 1k0  
R31 1k5  
R6A 24k

RESISTORS, 1%, 1/4W metal film, 100ppm T.C.

R10,11 100k  
R12 180k  
R13 91k  
R14 56k  
R15 1k0

POTENTIOMETERS

RV1,2,3,4,  
5,6 100k  
PR1 20k multiturn cermet  
PR2 100k carbon

CAPACITORS

C1,2 470n polyester  
C3,4 100n polyester  
C5,6 22p polystyrene  
C12 1u0 PCB electrolytic

SEMICONDUCTORS

IC1 TL 081, or equivalent  
IC2 TL 082, or equivalent  
IC3 CEM 3320

ADDITIONAL COMPONENTS FOR LOW PASS FILTER. 80-6L

RESISTORS 1/4W, 5% carbon film  
R5 36k  
R20,23,27,  
30 91k  
R22,25,28 240k  
R32 51k

CAPACITORS

C8,9,10,11 220p polystyrene  
C7 1u0 PCB electrolytic

ADDITIONAL COMPONENTS FOR HIGH PASS FILTER. 80-6H

RESISTORS 1/4W, 5% carbon film  
R5 24k

R32 75k

CAPACITORS

C8,9,10,11 470p polystyrene

ADDITIONAL COMPONENTS FOR BAND PASS FILTER. 80-6B

RESISTORS 1/4W, 5% carbon film  
R5 33k  
R25,28 240k  
R27,30 91k  
R32 75k

CAPACITORS

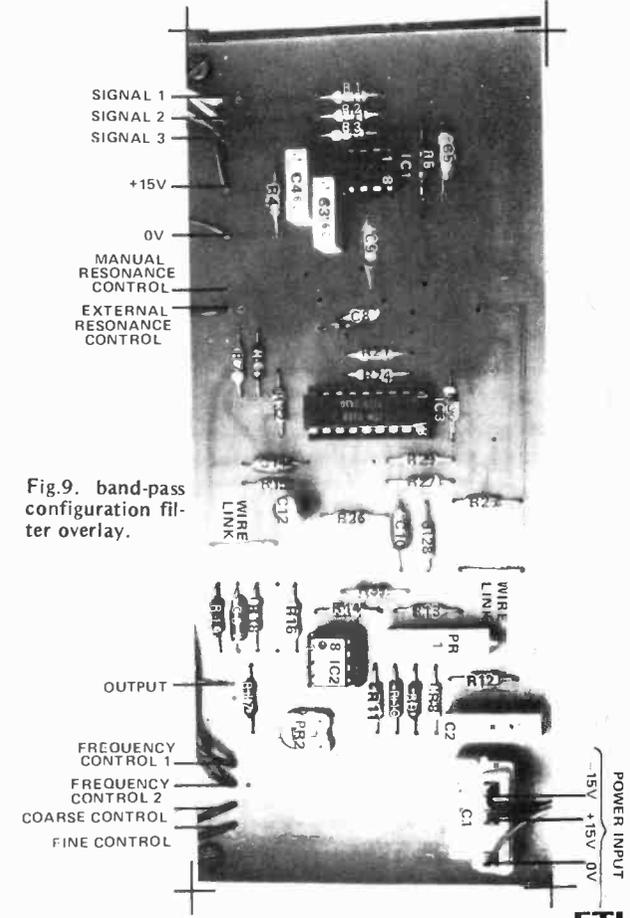
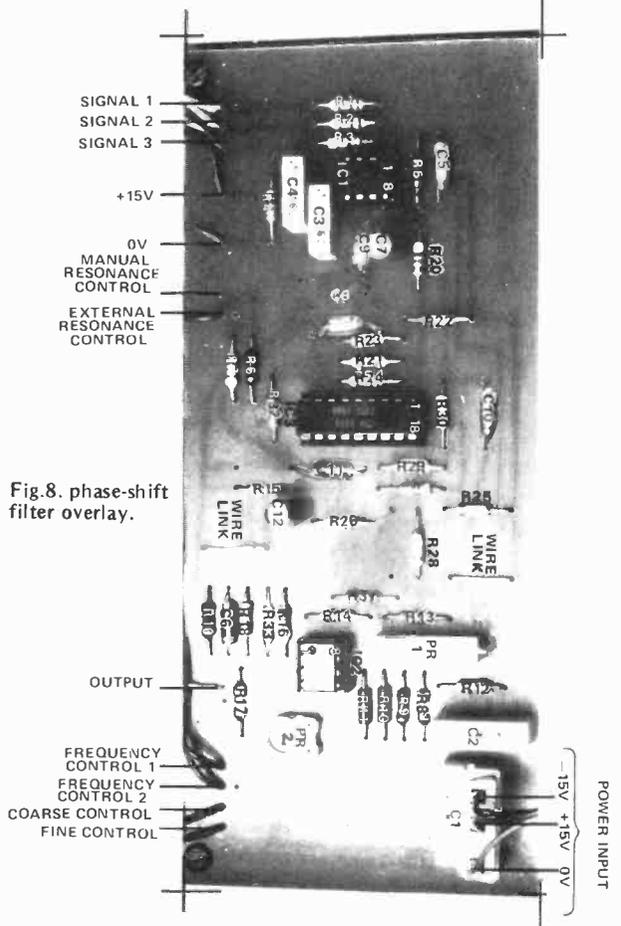
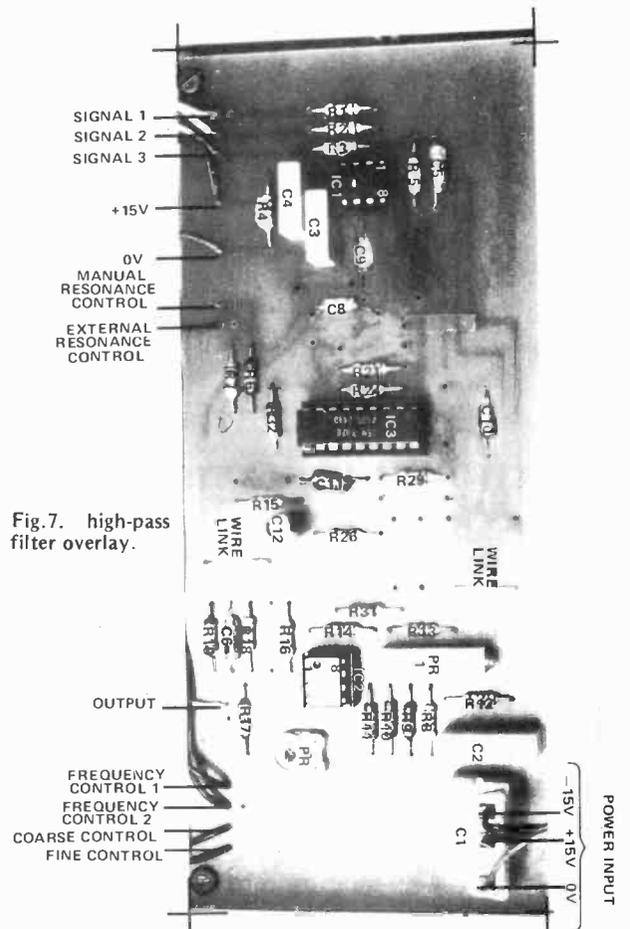
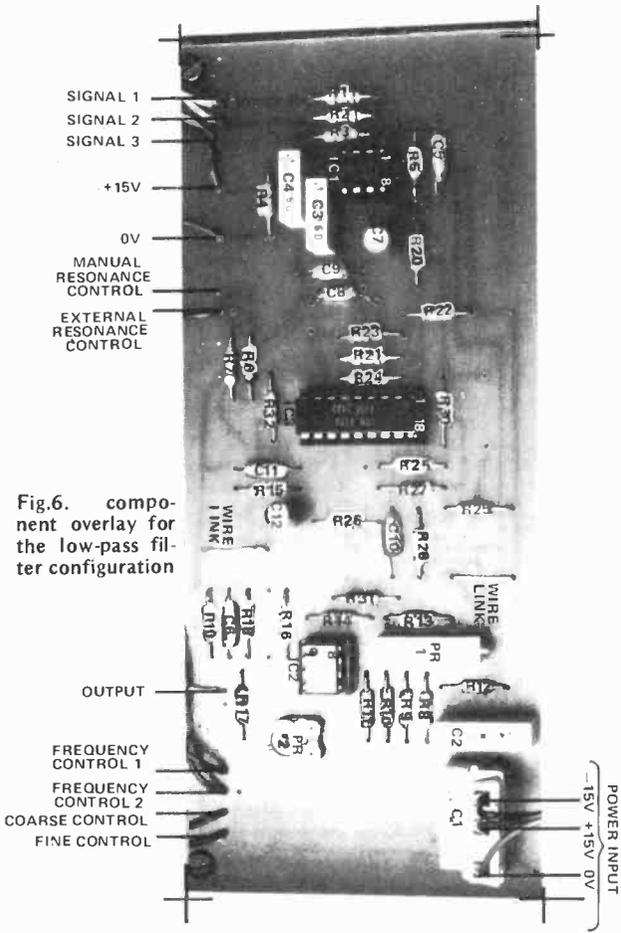
C8,9,10,11 100p polystyrene

ADDITIONAL COMPONENTS FOR PHASE SHIFT FILTER. 80-6P

RESISTORS 1/4W, 5% carbon film  
R5 12k  
R20,23,27,  
30 91k  
R22,25,28,  
32 240k  
R33 100k

CAPACITORS

C8,9,10,11 100p polystyrene  
C7 1u0 PCB electrolytic



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30mA to 3A a.c.

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0 to 2M $\Omega$

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# MICROFILE

**Henry Budgett reveals Nascom's new goodies and the latest club news.**

**A** somewhat slimmer than usual Microfile this month owing to a distinct lack of anything much to talk about, and a surfeit of Tangerine! The springtime is generally supposed to be a time of blossoming forth and judging by my letters file on Computer Clubs they are no exception.

## Clubbed To Death

Taking the pile in no particular order we have Mr J Fieldhouse of 18 Seaford Road, Broadfield, Crawley in West Sussex who informs me of the recent formation of a club. This is open to anyone with an interest in personal computers and it is hoped to hold weekly meetings with a newsletter to be published at regular intervals. If you live in the area contact him at the above address or ring on Crawley 542509. Tony Rycroft of the South Yorkshire Personal Computing Group has moved on and the group secretary, Paul Sanderson of 8 Vernon Road, Totley, Sheffield S17 3QE Tel 0742- 351895, is now the person to contact for details. They hold meetings on the second Wednesday of each month in Room F135 of St George's Building, Sheffield University. Another newly set up organisation is the Anglia Computer User Group which is open to anyone in East Anglia who has an interest in computers for either professional or hobby reasons. Contact can be made to Jan Rejzl at 128 Templemere, Sprowston Road, Norwich NR3 4EQ or by phone on Norwich 402311.

Surrey is the target for the next micro invasion with the Surrey Micro Processor Society run by Mike Patrick of 28 West Drive, Cheam, Surrey. They are holding about two meetings a month with an annual sub of £5, £3 for juniors or OAPs, and currently have around 40 members. The West Midlands Amateur Computer Club have been updated and their vital information is that they meet on the second and fourth Tuesdays of each month. The venue is Elmfield School in Love Lane, Stourbridge and they usually start around 7.30. The sub for the year is £3 or £2 if still in full-time education. For more information contact John Tracey at 100 Booth Close, Kingswinford, West Midlands or ring Brierly Hill 70097. They are well equipped with 8 PETs, 12 N1s, 5 N2s 3 TRS 80s plus about 20 others. Anyone in mid Sussex? Well if there is - and you are interested in micros - contact Bernard Langton who is forming a micro club. Get in touch with him at 228 St Leonards Road, Horsham, Sussex RH13 6AU.

The Grampian Amateur Computer Society, well known for their spelling mistakes, have sent me an update. They meet every second Monday at the Holiday Inn, Bucksburn, Aberdeen and have over 30 members. All their news is published in a regular newsletter and they have their own Acorn. For further information contact the secretary at Orton Cottage, Burnside, Lumphanan, Kincardineshire, Grampian, Scotland. Whilst north of the border I shall mention the



Scottish Amateur Computer Society who have sent me a copy of their Newsletter and Bulletin. They meet on the first Wednesday of each month at the Grosvenor Hotel, Haymarket, Edinburgh at about 7.30 pm. They publish the newsletter quarterly and for further information you should contact the secretary, Alastair Macpherson, at 6 Curriehill Castle Drive, Balerno, Edinburgh 14.

And whilst on the subject of newsletters, did you know that there was an Ohio Scientific UK User Group? Well neither did I. Tom Graves is the man to contact if you own one. C1 or 2 and Superboard are the current interests but they would like to expand to the disc systems. The address to write to is 19a West End, Street, Somerset BA16 0LQ.

## System 80 Makes Two Into One

Nascom have at last turned the single board into a complete system with the launch of System 80. Basically all they have done is to produce a range of boards for the Nasbus and a case to put them all in. However, before you all start to think about long delivery times they do promise that all the boards are in the production state and although the launch is over the next few months they will all arrive.

The starting point is the case which accepts a "2" and its keyboard plus four more boards. Included is space for a power

supply and sockets for printer and cassette. The bad news is that if you own a "1" you won't be able to spend your £85 unless you are prepared to do quite a lot of hacking to fit a bufferboard in, Vero are rumoured to have a rack system on the stocks that may well be the answer.

Next is the good news that Nascom have finally ditched the 16K RAM plane, the one labelled 'Instant Disaster', and produced one that offers a choice of 16, 32 or 48K of dynamic with locatable boundaries and page mode so you could have four on a "2"! Price is £225.

At last they are also announcing some I/O in the shape of a board with three PIOs, a CTC and a UART. Price is £45 for the board and TTL, £8.50 per PIO, £8.25 for a CTC and £16 for the UART. The graphics capability of the "2", not bad anyway, has been expanded out of all proportion with two new boards, a programmable graphics generator at £90 and a dual standard colour board whose price is not yet decided.

For those of you who are not satisfied with lowly cassette storage discs will be here soon. The board has been designed but due to component shortages it will be the last released, probably in July. The controller card is designed to handle up to four 5 1/4" units and will cost £127.50. It should also be possible to use 8" units but no support is planned. A complete dual double-sided, double-density system will set you back £690.

The second major item of news to emerge from the launch is that the "2" will now be sold at £225 but there will be no on-board RAM (4118) other than the video and scratchpad and no free 16K board. Some firms like Henry's are still doing the offer on their own so look out for bargains.

## Tangy Fruit

After last month's little piece on the Microtan 65, which even got the unimpressable Mr Graham converted to micromania (see Kit Survey), I have been so swamped with calls and letters that I'm going to print the address so you can all go and pester them rather than me. Tangerine Computer Systems Ltd., Forehill, Ely, Cambridgeshire. Their telephone number is 0353-3633. The expansion board, Tanex, is now available and the slight delay was caused by one of the nastiest little problems I've heard in a while. The prototype worked, they laid out the board using a distributors data sheet and sent it off to be made up. Result of the exercise was that the PCB didn't work. The reason? Whoever drew up the data sheet muddled up a couple of IC pins and every board had to be scrapped. So a gentle word of warning, only use manufacturers genuine data, not some free give away!

## Post Script

Two late items that arrived. The inaugural meeting of the Croydon Mini/Micro Computer Group is to be held on Tuesday 22nd of April at 7.00pm in the Central Reference Library, Katharine Street, Croydon. Anyone interested should contact Vernon Gifford, 111 Selhurst Road, London SE25 6LH. If you won't be able to attend but are still interested he would like to know your areas of special interest before the meeting if possible.

The second item is to explain why there is no ZX-80 follow-up as promised. Simple really, we haven't got one yet, but perhaps for next issue so don't despair.

ETI

LOW POWER SCHOTTKY TTL — EX STOCK					
Device	Price	Device	Price	Device	Price
74LS00	13p	74LS76	38p	74LS164	100p
01	13p	85	80p	174	65p
02	12p	86	36p	175	65p
03	13p	90	40p	190	100p
04	14p	93	70p	191	100p
05	25p	95	85p	192	100p
08	30p	107	40p	193	100p
09	20p	109	50p	196	100p
10	16p	112	50p	197	100p
11	23p	113	50p	221	100p
12	25p	114	50p	244	220p
13	30p	123	80p	247	100p
14	40p	125	30p	248	100p
20	17p	126	30p	249	90p
21	21p	132	50p	251	90p
26	30p	136	45p	273	165p
27	15p	138	75p	279	50p
28	30p	139	80p	283	100p
30	15p	151	45p	290	90p
32	17p	153	65p	298	100p
37	20p	155	90p	352	93p
38	30p	156	90p	353	110p
40	17p	157	70p	366	110p
47	52p	158	70p	367	50p
49	52p	160	100p	368	60p
73	40p	161	100p	374	55p
74	33p	162	100p	386	180p
75	32p	163	130p		36p

LOW PROFILE DIL SOCKETS			
8 Pin	8p	18 Pin	12p
14 Pin	9p	20 Pin	13p
16 Pin	10p	22 Pin	15p
24 Pin	16p	28 Pin	19p
40 Pin	30p		

VERO PRODUCTS		VEROBOARD PCBs	
Vero Wiring Pen (inc. 1 spool wire)	248p	2.5" x 5"	65p
2 x Spare Spools	85p	2.5" x 3.75"	54p
Spot Face Cutter	95p	2.5" x 17"	198p
Veroblock Breadboards	283p	3.75" x 5"	65p
		3.75" x 17"	250p

CALCULATORS			
Textet 1500	375p	Brain Wave	770p
Textet 1800	640p	Trader	900p
Scientific 2001	725p	LCD 300	940p

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- ★ Resistance ..... 1Ω to 20MΩ
- ★ 3 1/2 digit LCD
- ★ Auto Low Battery indication
- ★ Auto Polarity & Zero
- ★ 1% accuracy (DC volts)
- ★ Designed around Intersil 7106 IC
- ★ Total cost around £30 (incl. case)

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- ★ DC coupled
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Jay Development, 21 Gladeside, Bar Hill, Cambridge CB3 8DY

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Address \_\_\_\_\_

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 DM 2 @ £5.45  
 FG 1a @ £4.95  
 (Incl. VAT and P&P)

Money to be refunded if the kit is returned within 10 days.

JAYkits

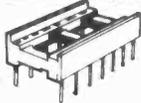
# STEVENSON

## Electronic Components

### OPTO

LED's	0.125in.	0.2in	each
Red	TIL209	TIL220	10p
Green	TIL211	TIL221	15p
Yellow	TIL213	TIL223	15p
Clips	3p	3p	
<b>DISPLAYS</b>			
DL704	0.3 in CC		130p
DL707	0.3 in CA		130p
FND500	0.5 in CC		100p

### SKTS



Low profile by Texas

8 pin	10p	18 pin	16p	24 pin	22p
14 pin	12p	20 pin	18p	28 pin	26p
16 pin	13p	22 pin	20p	40 pin	38p
3 lead T018 or T05 skt. 12p each.					
Soldercon pins: 100 for 60p.					

### PCBS

#### VEROBOARD

Size in.	0.1in.	0.15in.	Vero	Cutter 110p.
2.5 x 1	16p			
2.5 x 3.75	52p	45p		
2.5 x 5	60p	55p	Pin insertion	
3.75 x 5	70p	70p	tool 150p.	
3.75 x 17	250p	210p		
SS pins/100	45p	45p		
Fibreglass board:			80p each.	
Alfac -			33p per sheet.	

### RESISTORS

Carbon film resistors. High Stability, low noise 5%.

E12 series. 4.7 ohms to 10M. Any mix:	each	100+	1000+
0.25W	1p	0.9p	0.85p
0.5W	2p	1.5p	1.3p
Special development packs consisting of 10 of each value from 4.7 ohms to 1 Megohm (650 res) 0.5W £8.50. 0.25W £5.30.			

### METAL FILM RESISTORS

Very high stability, low noise rated at ¼W 1%. Available from 51ohms to 330k in E24 series. Any mix:

	each	100+	1000+
0.25W	4p	3.7p	3.5p
<b>POTENTIOMETERS</b>			
Preset vertical or horizontal 100 ohms - 1M			
			6p
Rotary 5K-2M2 Log or Lin single			30p
Rotary 5K-2M2 Log or Lin double			90p
Slide 60mm travel 5k-500k Log or Lin, single			60p
Suitable knobs for above with coloured caps in red, blue, green, grey, yellow and black. Rotary controls 16p each. Slide type 12p each.			

### MISC.

Murata Ultrasonic Transducers	350p pair
64mm 8 ohm speakers	100p each
64mm 64 ohm speakers	100p each
SRB 17W soldering iron	430p each
Reel of 22swg solder (39.6m)	320p each
Desoldering tool	510p each
Precision screwdriver set	170p each
Titan Electric drill	1095p each
Miniature 606 and 909 at 100mA transformers	110p each

### SWITCHES

<b>TOGGLE</b>		
Standard	SPST 36p	DPDT 50p
Miniature	SPDT 75p	DPDT 85p
Subminiature	SPST 58p	DPDT 78p
<b>SLIDE</b>		
Standard		DPDT 17p
Miniature		DPDT 16p
<b>ROCKER (10A rating)</b>		
SPST	34p each.	SPST 46p each.
<b>ROTARY</b>		
1P12W, 2P6W, 4P3W or 3P4W		51p each
Key operated DPDT (Yale key)		395p each
<b>PUSH</b>		
Non locking - push to make		16p each
- push to break		22p each
Locking - SPST		75p each
- DPDT		100p each

### REGULATORS

LM309K	140p	
LM317T	220p	
LM323K	480p	
LM723	40p	
100mA + ve	1A + ve	1A - ve
78L05 30p	7805 70p	7905 85p
78L12 30p	7812 70p	7912 85p
78L15 30p	7815 70p	7915 85p

### TRANSISTORS

AC127	22p	BC548	11p	TIP32C	60p
AC128	22p	BCY71	16p	TIP2955	66p
AC176	22p	BCY72	15p	TIP3055	53p
AD161	40p	BD131	40p	ZTX107	12p
AD162	40p	BD132	40p	ZTX108	12p
BC107	12p	BD139	33p	ZTX300	14p
BC108	10p	BD140	33p	ZTX500	15p
BC108C	12p	BFY50	23p	2N3053	25p
BC109	12p	BFY51	23p	2N3054	56p
BC109C	12p	BFY52	23p	2N3055	50p
BC147	9p	MJ2955	100p	2N3702	9p
BC148	9p	MPSA06	16p	2N3704	9p
BC177	16p	MPSA56	16p	2N3819	20p
BC178	16p	TIP29C	60p	2N3904	10p
BC182	10p	TIP30C	48p	2N3906	10p
BC182L	10p	TIP31C	50p	2N5459	33p
BC184	10p	<b>DIODES</b>		2N5777	50p
BC184L	10p	1N914	4p	1N4006	7p
BC212	10p	1N4148	3p	1N5401	14p
BC212L	10p	1N4002	5p	BZY88ser.	8p
BC214L	10p	1N4148	£1.50 per 100.		

### CAPACITORS

High quality foil type. 63V working. 5% tol.

22pf to 100pf	7p each
1500pf to 0.01uF	9p each

### TANTALUM BEAD

0.1, 0.15, 0.22, 0.33, 0.47, 0.68

1 & 2.2uF @ 35V	10p each
4.7, 6.8, 10uF @ 25V	18p each
22 @ 16V, 47 @ 6V, 100 @ 3V	22p each

### MYLAR

0.001, 0.01, 0.022, 0.033, 0.047, 0.068, 0.1

0.068, 0.1	4p each
	5p each

### POLYESTER

Mullard C280 series

0.1, 0.15, 0.22	8p each
0.33, 0.47	12p each
0.68	17p each
1.0uF	22p each

### CERAMIC

Plate type 50V. Available in E12 series from 22pF to 1000pF and E6 series from 1500pF to 0.047uF

25V	10	22	33	47	6p each
					8p each
					16p each
					20p each
					6p each
					8p each
					12p each
					18p each
					28p each

### PACKS

Specially developed packs intended for development work.

¼W CF resistor, 10 each value E12 series	
4.7 ohm to 1 Megohm (650 total)	530p each
¼W CF resistor, 10 each value E12 series	
4.7 ohm to 1 Megohm (650 total)	850p each
¼W MF 1% resistor, 10 each value E24 series	
51 ohms to 330k (930)	2950p each
Preset potentiometers 5 each value from 100 ohms to 1 Megohm (65)	390p each
Polyester capacitors 5 each value 0.1 to 2.2uF (70)	690p each
Ceramic plate capacitors 10 each value 22pF to 0.01uF (310)	575p each

### CONNECTORS



#### DIN PLUGS AND SOCKETS

	plug	chassis socket	line socket
2 pin	8p	8p	12p
3 pin	12p	10p	12p
5 pin 180°	12p	11p	17p
5 pin 240°	14p	11p	22p

#### JACK PLUGS AND SOCKETS

	unscreened	screened	socket
2.5mm	10p	15p	8p
3.5mm	10p	16p	9p
Standard	16p	30p	19p
Stereo	23p	39p	22p

#### 1mm PLUGS AND SOCKETS

Suitable for low voltage circuits, Red & Black. Plugs: 7p each. Sockets: 8p each.

#### 4mm PLUGS AND SOCKETS

Available in blue, black, green, brown, red, white and yellow. Plugs: 12p each. Sockets: 13p each.

### CMOS

4000	20p	4023	20p	4054	120p	4502	120p
4001	20p	4024	50p	4060	120p	4507	60p
4002	20p	4025	20p	4063	120p	4508	330p
4006	90p	4026	160p	4066	60p	4510	80p
4007	20p	4027	45p	4068	20p	4511	90p
4008	95p	4028	85p	4069	20p	4512	80p
4011	30p	4029	85p	4070	20p	4516	80p
4012	20p	4031	220p	4071	20p	4518	80p
4013	35p	4033	150p	4072	20p	4520	80p
4014	80p	4036	350p	4073	20p	4527	90p
4015	80p	4039	300p	4075	20p	4528	90p
4016	30p	4040	110p	4076	90p	4529	150p
4017	65p	4041	85p	4077	20p	4531	150p
4018	90p	4042	80p	4078	20p	4532	130p
4020	100p	4043	95p	4081	20p	4538	160p
4022	100p	4046	110p	4082	20p	4543	110p
		4048	60p	4086	75p	4566	170p
		4049	45p	4093	60p	4588	120p
		4050	45p	4095	110p	4589	420p
		4051	70p	4098	120p	4581	330p
		4053	80p	4501	20p	4585	110p

### LSTTL

74LS00	16p	74LS47	80p	74LS126	45p	74LS175	90p
74LS01	22p	74LS48	90p	74LS132	80p	74LS190	90p
74LS02	16p	74LS54	22p	74LS136	50p	74LS191	90p
74LS03	22p	74LS73	35p	74LS138	75p	74LS192	90p
74LS04	16p	74LS74	35p	74LS139	75p	74LS193	90p
74LS08	22p	74LS75	40p	74LS151	60p	74LS195	90p
74LS10	22p	74LS76	40p	74LS155	65p	74LS196	90p
74LS13	38p	74LS78	45p	74LS156	80p	74LS197	85p
74LS14	65p	74LS83	68p	74LS157	70p	74LS221	100p
74LS16	22p	74LS85	85p	74LS158	65p	74LS251	70p
74LS20	22p	74LS86	40p	74LS160	75p	74LS266	35p
74LS21	22p	74LS90	40p	74LS161	68p	74LS290	80p
74LS22	28p	74LS93	55p	74LS162	80p	74LS365	55p
74LS27	28p	74LS95	65p	74LS163	80p	74LS366	55p
74LS30	22p	74LS107	45p	74LS164	80p	74LS367	55p
74LS32	30p	74LS114	40p	74LS165	80p	74LS368	55p
74LS37	40p	74LS123	80p	74LS173	135p	74LS386	50p
74LS42	60p	74LS125	45p	74LS174	95p	74LS670	200p

### TTL

7400	12p	7442	40p	7493	30p	74157	40p
7402	12p	7445	50p	7496	38p	74164	55p
7404	14p	7447	50p	74121	29p	74165	55p
7408	16p	7448	45p	74123	40p	74174	55p
7410	14p	7473	23p	74125	38p	74177	50p
7413	24p	7474	23p	74126	36p	74190	50p
7414	39p	7475	26p	74132	46p	74191	50p
7420	14p	7476	25p	74141	48p	74192	50p
7427	22p						

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# INFRA RED REMOTE CONTROL SYSTEM

Make things happen at a distance without lifting a finger. There is no limit to the application of our ultra-versatile IR60 control system. Part 1: receiver

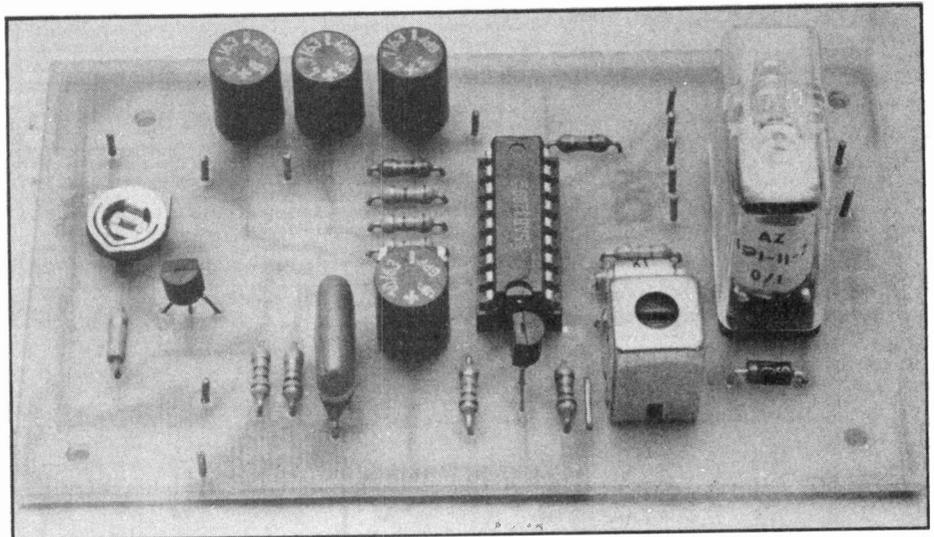
**M**ulti function hand-held remote-control facilities are the 'in-thing' in modern Hi-Fi systems and music centres, but also have lots of other potential applications in domestic fields such as lighting and heating control, home security control, etc. We have never published a **really** sophisticated remote control system in ETI - until now.

Like all good modern remote control systems, our system uses an infra-red data link which is highly efficient, gives a good range, is not unduly directional and which, unlike ultrasonic systems, is remarkably interference-free. (Ultrasonic systems are, incidentally, now regarded as rather quaint, even though they do still occasionally appear in amateur-designed form in some of the other electronic magazines).

So what is so special about our system and what does it do? The system comprises two basic units, a hand-held 16-key transmitter and a mains-powered receiver-decoder unit. The two units together give control of three independent 64-step analogue channels, 16 'selector' channels, two bistable channels, and one on/off relay channel or switch. The hand-held unit is powered by a PP3 battery, which gives an operating life of about six months in normal use and gives a typical control range of about 15 metres.

The control system uses state-of-the-art LSI chips in the transmitter and receiver and is highly sophisticated in both technology and performance. The outputs of the receiver consist of three analogue voltages, one relay output, one 4-bit binary output and two single-bit binary outputs. How you interface these outputs to external devices is largely up to you: a few notes on the subject are given in this month's 'Designer's Notebook': we'll also be presenting some suitable interface projects and systems in future issues of ETI.

The control action of the system is very sophisticated and is best understood by referring to Tables 1 and 2, which give detailed descriptions of the transmitter switch functions and the receiver output functions



Receiver board of the IR60. Details of the transmitter will follow next month.

SWITCH NUMBER	PIN CODE	FUNCTION	RECEIVER OUTPUT ACTION
1	1c	STANDBY (OFF)	Turns relay RLA off.
2	2c	ON	Turns relay RLA on.
3	1b	MUTE	Reduces volume output level rapidly to zero.
4	83a	VOLUME +	Increases volume output level.
5	83b	VOLUME -	Decreases volume output level.
6	83c	ANALOGUE 1 +	Increases Analogue 1 output level.
7	83d	ANALOGUE 1 -	Decreases Analogue 1 output level.
8	84a	ANALOGUE 2 +	Increases Analogue 2 output level.
9	84b	ANALOGUE 2 -	Decreases Analogue 2 output levels.
10	1d	RESERVE 1	Switches Reserve 1 (RSV1) output between high and low states on alternate operations.
11	2d	RESERVE 2 / ON	Switches Reserve 2 (RSV2) output between high and low states on alternate operations: Turns RLA on.
12	2a	PROGRAM STEP + / ON	Increments binary channel-select output by one step per operation: Turns RLA on.
13	2b	PROGRAM STEP - / ON	Decrements binary channel-select output by one step per operation: Turns RLA on.
14	5a	CHANNEL 1 / ON	Sets binary output to 0000 (Channel 1) state: Turns RLA on.
15	6d	CHANNEL 8 / ON	Sets binary output to 1110 (Channel 8) state: Turns RLA on.
16	8d	CHANNEL 16 / ON	Sets binary output to 1111 (Channel 16) state: Turns RLA on.

Table One: receiver output functions of the IR60.

OUTPUT FUNCTION	TRANSMITTER CONTROL SWITCHES	DESCRIPTION
STANDBY (OFF)	1,2,11,12,13,14, 15,16.	Relay output that can be used to switch power to external circuitry. The relay can be turned on via transmitter switches 2,11,12,13,14,15 or 16. The relay can be turned off via STANDBY (OFF) switch 1 only.
VOLUME	3,4,5. (also 1 and 2)	An analogue output that can be varied from 0V to approximately 14 volts in 64 discrete steps. SPAN time (from min to max or vice versa) is approximately 8 seconds. Output level can be increased by pressing and holding transmitter switch 4 or decreased via switch 5: when these switches are released the prevailing level is stored and maintained. The output can be rapidly reduced to zero by operating MUTE switch 3 or STANDBY (OFF) switch 1; subsequently touching switch 4 returns the 'sound' output to its previous level. The analogue output voltage can be used to control voltage-controlled attenuators, amplifiers, filters, etc.
ANALOGUE 1	6,7.	An analogue output (similar to VOLUME) that can be varied from 0V to 14 volts in 64 discrete steps. Output level can be increased via transmitter switch 6 or decreased via switch 7.
ANALOGUE 2	8,9.	An analogue output (similar to VOLUME) that can be varied from 0V to 14V in 64 discrete steps. Output level can be increased via switch 8 or decreased via switch 9.
RESERVE 1	10. (also 1).	A bistable output that switches between low (0V) and high (14V) states on alternate operations of switch 10. The output switches to the high state when STANDBY (OFF) switch 1 is operated.
RESERVE 2	11. (also 1).	A bistable output that switches between low and high states on alternate operations of switch 11. The output switches to the low state when STANDBY (OFF) switch 1 is operated.
CHANNEL-SELECT OUTPUTS	12,13,14,15 and 16.	A 4-bit binary output that can be put into 16 possible states; the output can be used to select any one of 16 channels via a suitable decoder/multiplexer. Channel 1 (0000) can be selected directly via switch 14. Channel 8 (1110) can be selected directly via switch 15. Channel 16 (1111) can be selected directly via switch 16. The output/channel selector can be incremented upwards one step at a time via transmitter switch 12, or downwards via switch 13.

Table 2: transmitter control switch functions.

respectively. Note that several of the transmitter switches give multi-function operation.

## Construction: The Receiver Unit

Before committing yourself to the construction of this project, note that access to an oscilloscope may be required when initially setting up the system. If you have such access, you can proceed with reasonable confidence. Full constructional details of the complete receiver unit are given in the present article: details of the transmitter construction and setting up procedure will be given next month.

The receiver unit is built up on three separate PCB's and the unit is uncased. This method of construction allows the receiver unit to be built into an existing Hi-Fi outfit, etc.

Start construction by building the power supply board. Note that Q4 must be mounted on a suitable heat sink. We recommend the use of a 35 volt component in the C16 position, even though our prototype is fitted with a 25 volt device. Check that the completed unit produces an output of about 14 volts.

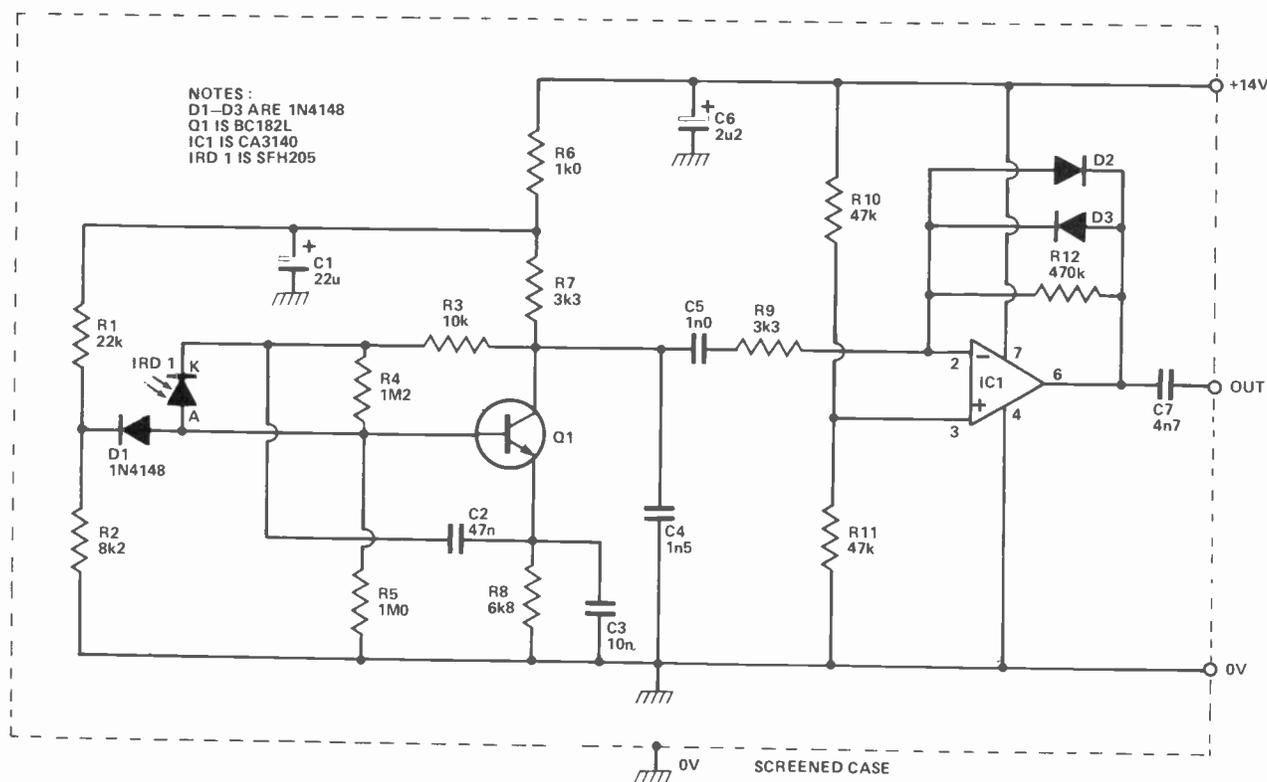


Fig. 1. Full circuit diagram for the receiver-preamp PCB of the control system. Note the orientation of the SFH 205 shown right as it is a little unusual.



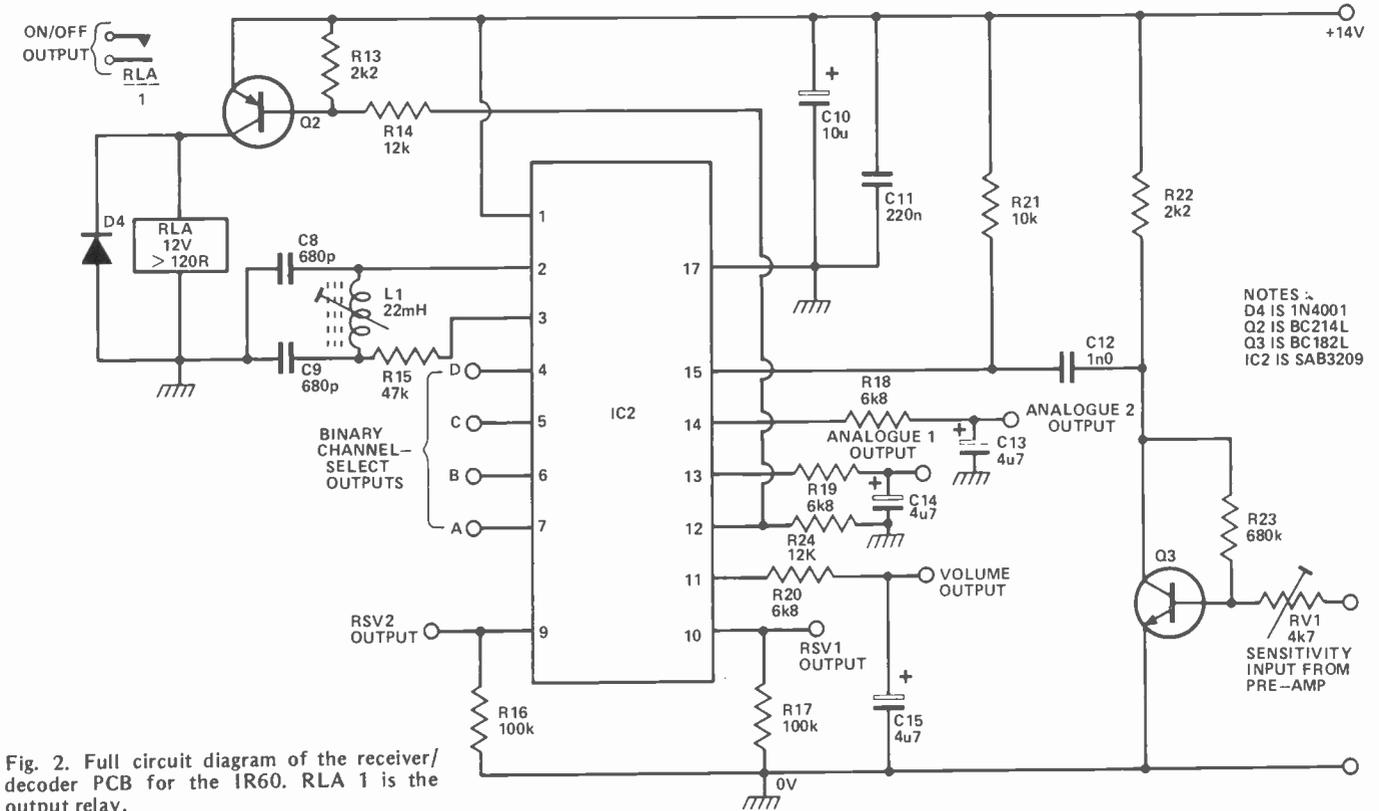


Fig. 2. Full circuit diagram of the receiver/decoder PCB for the IR60. RLA 1 is the output relay.

## HOW IT WORKS

The coded infra-red signal from the transmitter is detected and amplified by the receiver unit and ultimately causes some receiver output function to occur. The receiver unit comprises three main sections, the infra-red receiver preamplifier, the main receiver/decoder unit and the power supply.

The transmitted IR code signal has a basic frequency of about 30 kHz (half of the transmitter clock frequency) and is detected by IRD1 in the receiver preamp and amplified first by Q1 and then by IC1. A problem in designing IR preamplifiers is that the circuit not only has to provide high gain for long range operation but also must not saturate when the transmitter is placed only a few inches from the receiver.

With the latter point in mind, R1-D2-D1 and C2 are used to prevent the bias point of Q1 shifting under heavy drive conditions. D2 and D3 clip the level of the final IC1 output signal, to prevent overdriving of following stages. The values of C2-C3-C4-C5 and C7 are chosen to make the preamplifier

reasonably frequency selective, thereby ensuring a good low-noise figure. The pre-amp unit must be mounted in a screened case.

The output of the preamp is further amplified by Q1 on the main receiver/decoder board and then fed to the pin 15 signal input terminal of IC2, the P-MOS LSI receiver chip. This chip is provided with a clock oscillator (L1-C8-C9-R15) which is tuned to the transmitter clock frequency (double the serial code frequency). The chip checks the serial code input signal for correct number of bits, bit duration, etc, processes it and then 'dumps' the resulting code signal into a register, from which it is then converted into a useful output action.

The IC2 outputs from pins 4 to 7 form a 4-bit binary signal that can be used to externally select any one of 16 channels. The outputs of pins 9, 10 and 12 are single-bit signals that can be set high or low via the transmitter commands: the output of

pin 12 is used to activate a relay (which can be used for switching power to an external circuit, etc) via Q2.

The IC provides three analogue output signals (at pins 11, 13 and 14). Each of these outputs takes the form of a 1 kHz (approx) square wave that can have its mark/space ratio (and thus its mean level) varied over a full span in 64 discrete steps via the transmitter command signals. These variable mark/space signals are converted to DC analogue voltages via low-pass filters (C13-R18, C14-R19, C15-R20) and can be used to control external voltage-controlled attenuators and amplifiers (for remote gain control) and filters (for remote tone control), etc.

The preamp and main receiver/decoder boards are each powered from a regulated 14 volt supply derived from the mains via T1-D5-D6-C16 and series-regulator network Q4-ZD1-R25. The circuit is required to supply current up to only a couple of hundred milliamps.

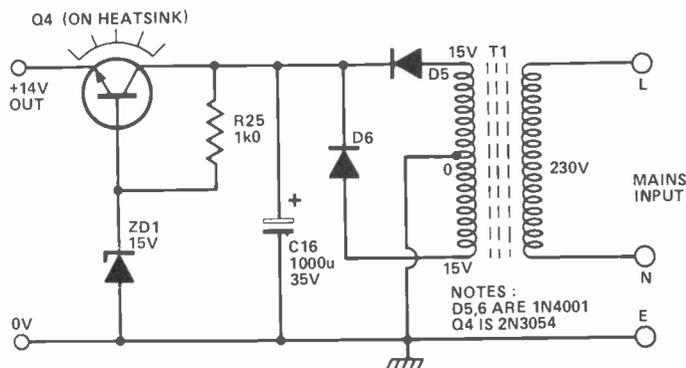
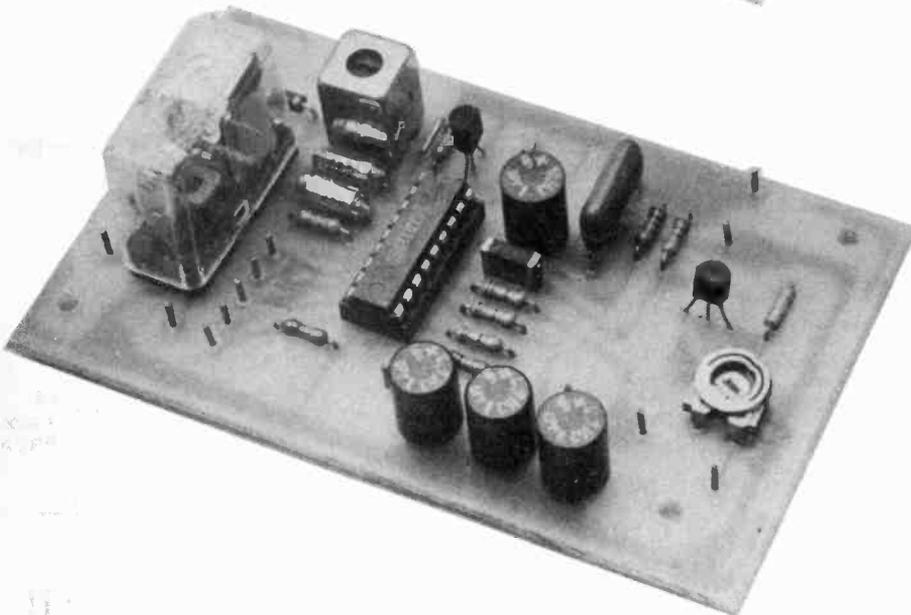
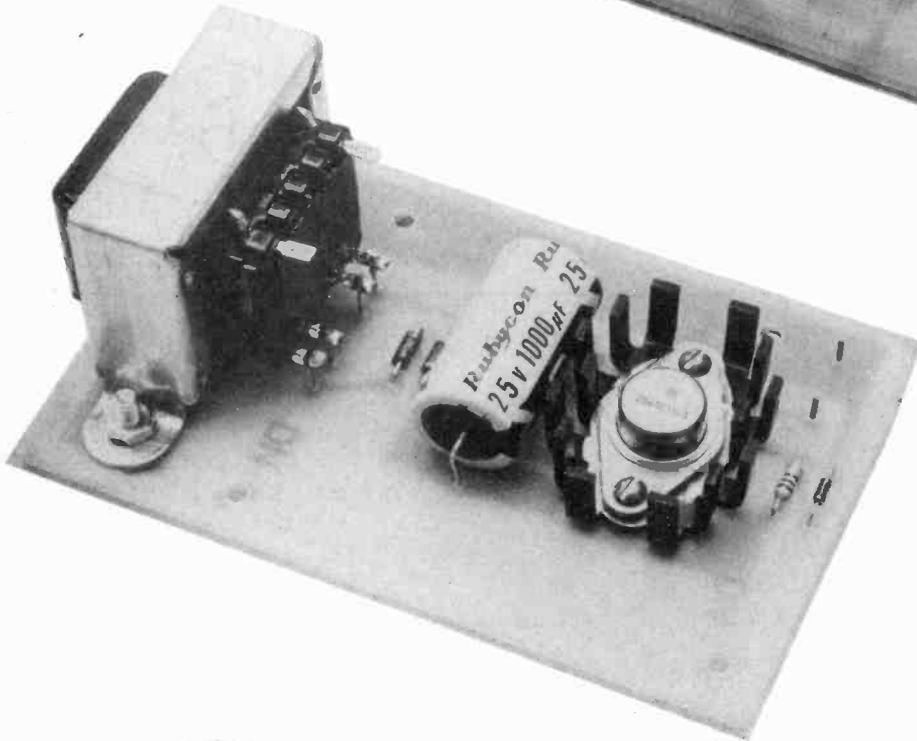
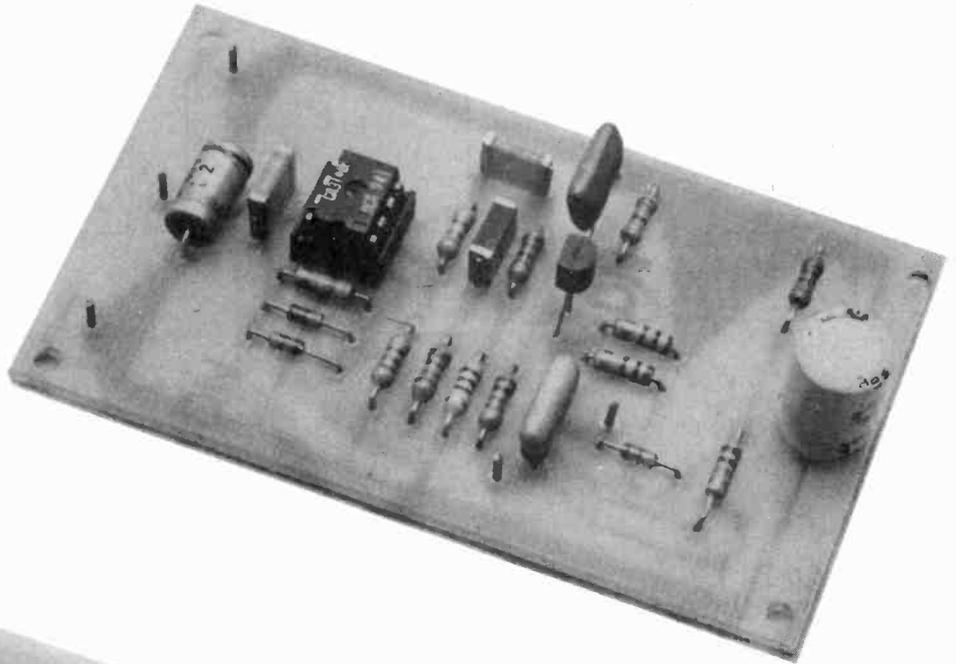


Fig.3. (left) circuit diagram of the PSU for the IR60 system.

## BUYLINES

The SAB3209 IC could present a problem for your local component emporium. However, Electrovalue and Watford Electronics are stockists for this IC. The relay and infra-red detector can also be purchased from Watford Electronics. L1 was obtained from Ambit International. All other components are common types and should not pose any problem.

Next, build the pre-amp PCB as shown on the overlay. The odd positioning of C1 on this PCB was caused by a last-minute correction to our prototype: this mod is also responsible for the two empty holes on one side of the board. When construction is complete you can fit the PCB into a screened case (dare we suggest a tobacco tin?), which must be grounded to the zero volts line. The infra-red detector (I RD1) can either be mounted external to the case or can be mounted on the inside, looking out through a suitable aperture. Take special care to connect I RD1 to the circuit in the correct polarity.

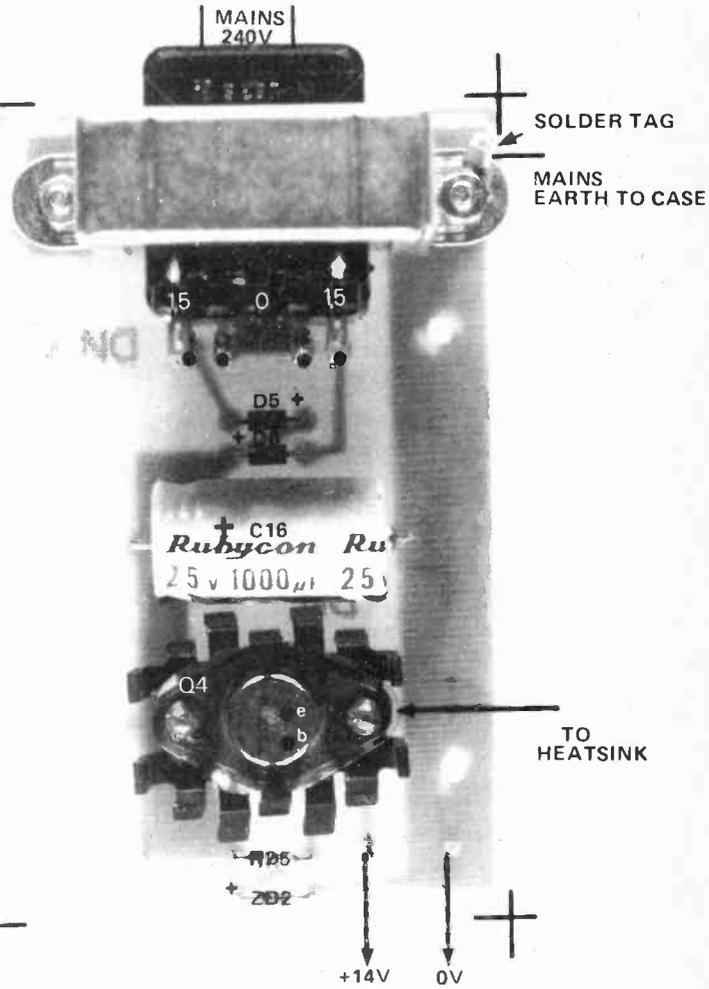
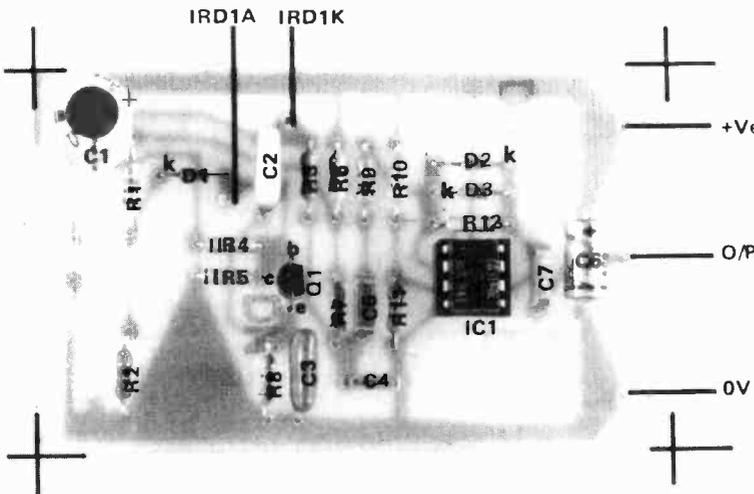


Shown here are the three PCBs which comprise the IR60 receiver system.

Top: the preamp board.  
Left: a PSU suitable for driving the system.  
Below: the decoder board.

## Finishing Off

Finally, build up the main receiver/decoder board, complete with relay RLA. When construction is complete, make the supply connections to the board and the pre-amp and connect the pre-amp output to the receiver/decoder input terminal using screened cable. Switch the unit on and use your 'scope to check that an approximately 60 kHz clock signal (adjustable via L1) appears on the pin 3 of IC2. You can also check that signal-input pin 15 is at 14 volts DC with half a volt or so of noise (adjustable via RV1) superimposed on it. If the two points above check out OK your receiver unit is probably functioning correctly.



## PARTS LIST

### RESISTORS All 1/4W, 5%

R1	22k
R2	8k2
R3,21	10k
R4	1M2
R5	1M0
R6,25	1k0
R7,9	3k3
R8,18,19,20	6k8
R10,11,15	47k
R12	470k
R13,22	2k2
R14,24	12k
R16,17	100k
R23	680k

### POTENTIOMETERS

RV1	4k7 min horiz preset
-----	----------------------

### CAPACITORS

C1	22u 63V PCB electrolytic
C2	47n polyester
C3	10n polyester
C4	1n5 polycarbonate
C5	1n0 polycarbonate
C6	2u2 63V electrolytic
C7	4n7 polycarbonate
C8,9	680p polystyrene
C10	10u 63V PCB electrolytic (Siemens type)
C11	220n polyester
C12	1n0 polycarbonate
C13,14,15	4u7 63V PCB electrolytic (Siemens type)
C16	1000u 35V electrolytic

### SEMICONDUCTORS

IC1	CA3140
IC2	SAB3209
Q1,3	BC182L
Q2	BC214L
Q4	2N3054
D1-3	1N4148
D4-6	1N4001
IRD 1	SFH205
ZD1	15V 400mW zener

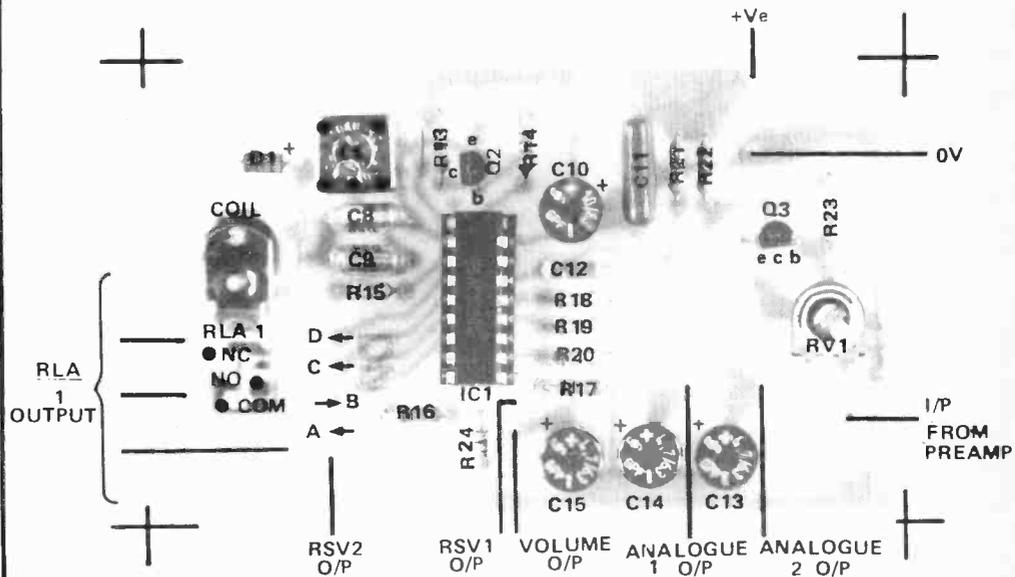
### MISCELLANEOUS

RLA	12V > 120R SP C/O PCB relay
L1	22 mH variable coil type 87BN132 HM2
T1	15-0-15 8VA

Screened case 115 x 65 x 35 mm

These overlays are for the PCBs in the receiver system. Reference to these and the photos on the facing page should facilitate construction.

Next month: Transmitter details.



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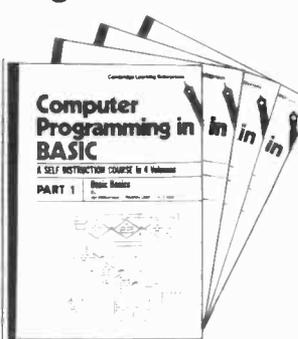
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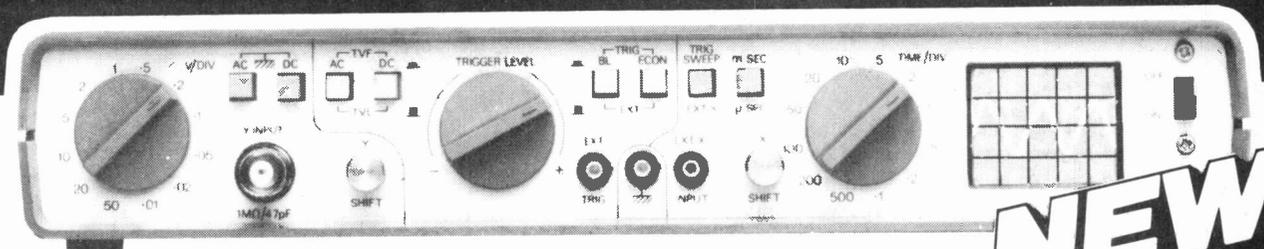
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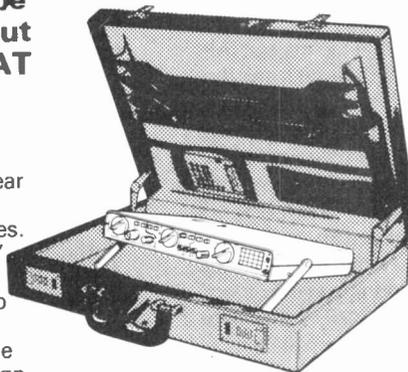


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# HEISENBERG'S UNCERTAINTY PRINCIPLE

It affects all aspects of electronics. It is a fundamental concept as basic as ABC to a physicist and this is the easiest way to find out more about it. A.Lipson explains.

Most people who read a lot of science fiction (as I must confess I do) have probably heard of Heisenberg's Uncertainty Principle at some time or other, but the vast majority are, if you'll pardon the pun, very uncertain as to its nature. Well, never fear; a paragraph or two hence you, too, will be able to confuse friends, relatives and the cat...

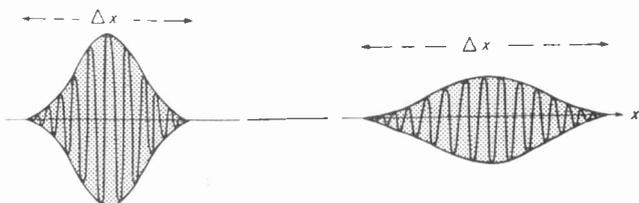
## Exactly Where?

The uncertainty principle as such was first stated by a German physicist, Werner Karl Heisenberg, in the late 1920s. He said, essentially, that it is impossible to measure both the position and momentum of a particle simultaneously. Now this wasn't quite such a stupid statement as it sounds - what he actually meant by this was that, in measuring either the position or momentum of a particle, you must necessarily be affecting the other in a way which is unpredictable and, in the case of small particles such as electrons, significant. At this point the reader may feel inclined to cry out 'Ah, but I can tell exactly where something is just by looking at it and that doesn't affect its momentum, does it?'. Well, sorry to disappoint you, but you're wrong on two counts. You cannot tell *exactly* where something is just by looking at it - there is a slight uncertainty of the order of the wavelength of the light you are using - and even looking at a thing *does* affect its momentum. Light, you see, is made up of particles. In order to look at an object, it is necessary to bounce some light particles - called photons - off that object. Now these particles carry momentum, and so when they bounce off the object, they must necessarily change its momentum, as well. For normal objects, as large as the ones we're used to, this doesn't make a lot of difference, but if you start working on the atomic scale, with electrons, etc, then a photon or two can make a lot of difference. Before we say any more, let's have a look at the basic equation that Heisenberg actually used (No need to get worried - it's the only equation we'll see, and isn't all that difficult to understand).



$$\Delta p \times \Delta x \geq \frac{h}{2\pi}$$

In this equation, the symbol  $\Delta p$  stands for the uncertainty in the momentum of an object,  $\Delta x$  stands for the uncertainty in the object's position, the symbol  $h$  stands for a constant (known as 'Planck's Constant') and the symbol  $\geq$  means 'is at least as big as'. Heisenberg said, then, that if we find the product of the uncertainties in position and momentum, then they will be at least as big as  $\frac{h}{2\pi}$ , which has a value of about  $1.05 \times 10^{-34}$  joule seconds. (Exactly why it is measured in units called joule-seconds is rather irrelevant to the present discussion, so we shall leave it for some other time). Now, as you can see, this is a pretty small value approximately given by a zero followed by a decimal point and thirty three more zeros before we put a 1 down. This explains why we do not see the effects of the uncertainty principle in real life - given the uncertainty in position or momentum of an object that we have found experimentally, the uncertainty in the other can still be incredibly small. Let us take the case of the magazine you are presently holding. We will suppose, for the sake of simplicity, that, using a very good microscope you can measure its position accurate to within one wavelength of light, or about 0.00005 centimetres (which is about as accurate as you could get, using light). Then we find from the uncertainty principle that the magazine must have a momentum whose uncertainty must be at least  $\frac{h}{2\pi \times \Delta x}$  or about 0.000000000000000000000000000002 kg m s<sup>-1</sup>.



Energy and mass are equivalent. The position of a particle, therefore, cannot be measured with absolute certainty. There must always be an uncertainty of  $\Delta x$  in the measurement of  $x$ .

### Speedy Accuracy

In other words, the most accurately you can measure the velocity of this object will *still* give an uncertainty of approximately 0.0000000000000000000000000000001 metres per second. This isn't much.... no wonder we don't notice the effects of the uncertainty principle in everyday life - they are too small! It's a different matter on the atomic scale, though. Suppose we want to measure the position of an electron accurate to, say, the width of an atom. If we work this one out (in case anyone out there does want to, the width of a hydrogen atom is about  $10^{-10}$  metres, and the mass of an electron is  $9 \times 10^{-31}$  kg) we find that the uncertainty is something pretty big - roughly a million metres per second. As a result, while the uncertainty principle seems to have little direct use in our lives, it is pretty important to physicists!

### Effective Measurement

In fact, once you start thinking about it, all the uncertainty principle says is that it is impossible to measure something without affecting it in some way and this is almost common sense. As we have seen, looking at something to check its position must necessarily affect its momentum. It is impossible to measure the voltage across, say, a capacitor, without removing a little of the charge, and so lowering the voltage. You cannot check the pressure in a car tyre without the gauge you use removing a little of the air, and so on.

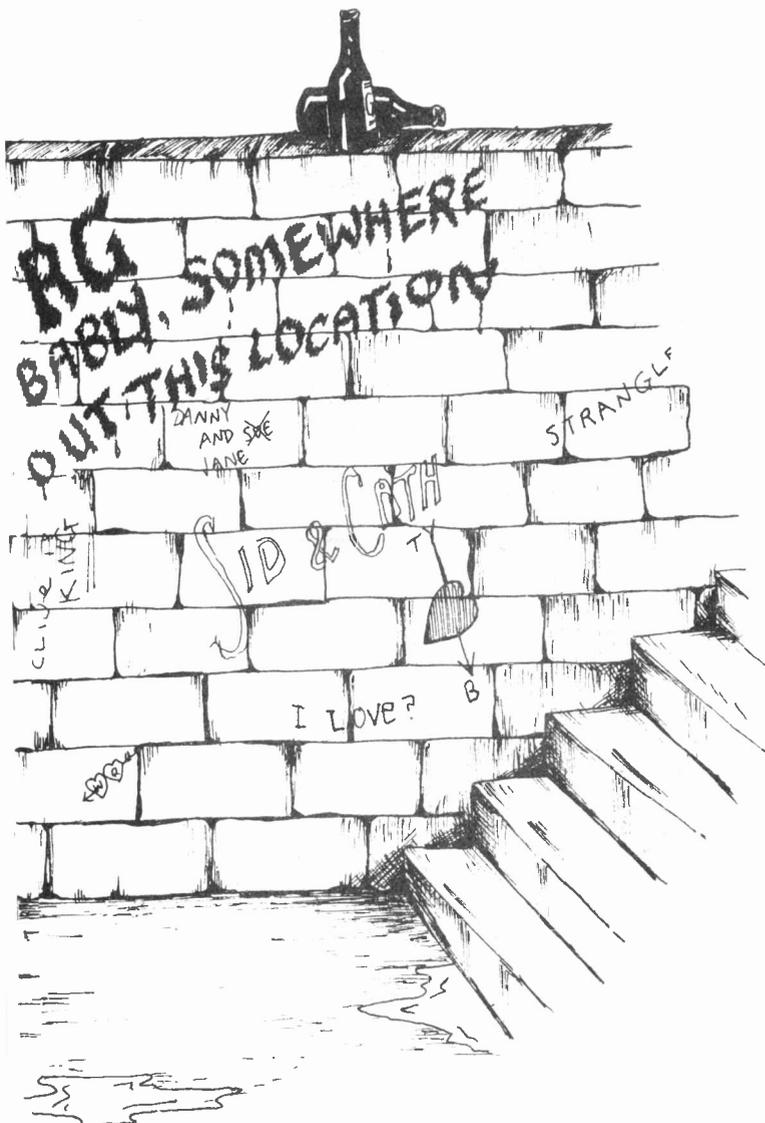
### Impossible Position

Heisenberg's Uncertainty Principle is that it is impossible to measure position or momentum of an object without affecting the other in a random and unpredictable way. In the same vein, Albert Einstein once proved from the uncertainty principle that it is impossible to measure both the energy and time involved in an interaction. This is rather less obvious than the other cases we have examined, but it is indeed so.

### How Smart Is Alec?

The uncertainty principle, then, means that we can no longer, in physics, talk of the exact position, momentum, etc of a particle; we can only talk in terms of probabilities - where a particle is likely to be, what the average velocity of a bunch of particles is likely to be under given circumstances, and so on. That is, until some smart Alec comes along and proves it all wrong.....

ETI



# ETI JUNE 1980

WHAT TO LOOK FORWARD TO  
IN OUR NEXT ISSUE!  
ON SALE MAY 2<sup>ND</sup>.

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## DESIGNERS HANDBOOK

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Now this is the one that even we've been waiting for. Many is the rainy Sunday that has passed with the enthusiast huddled intent over his workbench. Many too are the times he has howled loud into the storm when a project fails to operate for the want of one small piece of circuitry to link this with that or that with this, that or the other.

Information to allow him to design his own circuits quickly and simply is sadly lacking. Books take everything too seriously and at too much length. Looking anything up takes hours — by which time the rain has stopped and . . . . .

Next month we present our Analogue Designers Handbook from the man of many nodes, Tim Orr. He presents the quick and easy way to amplifiers, filters, oscillators etc. etc. — and they'll be all your own work! Can you afford to miss it?

---

## DRUM SYNTHESISER PROJECT

---

No, I don't believe you've never heard one of these. Just about every single produced in the last millenium has those noises all over it. You know, those noises — the ones that sound like a cat being stepped on backwards at great speed.

If you really don't know what we're going on about you'd better read ETI next month hadn't you?

---

## HOUSE WIRING

---

So you think you know how it's done eh? Just wait until you pull the bathroom cord one day and the toast pops up: switch on the hall light only to have the TV burst into life . . . . . Before long the house is a mass of ripped out wiring and is echoing to the sound of slamming front doors as enraged spouses storm into the sunset. Don't do it until you've read our superb article from Ray Marston next month!

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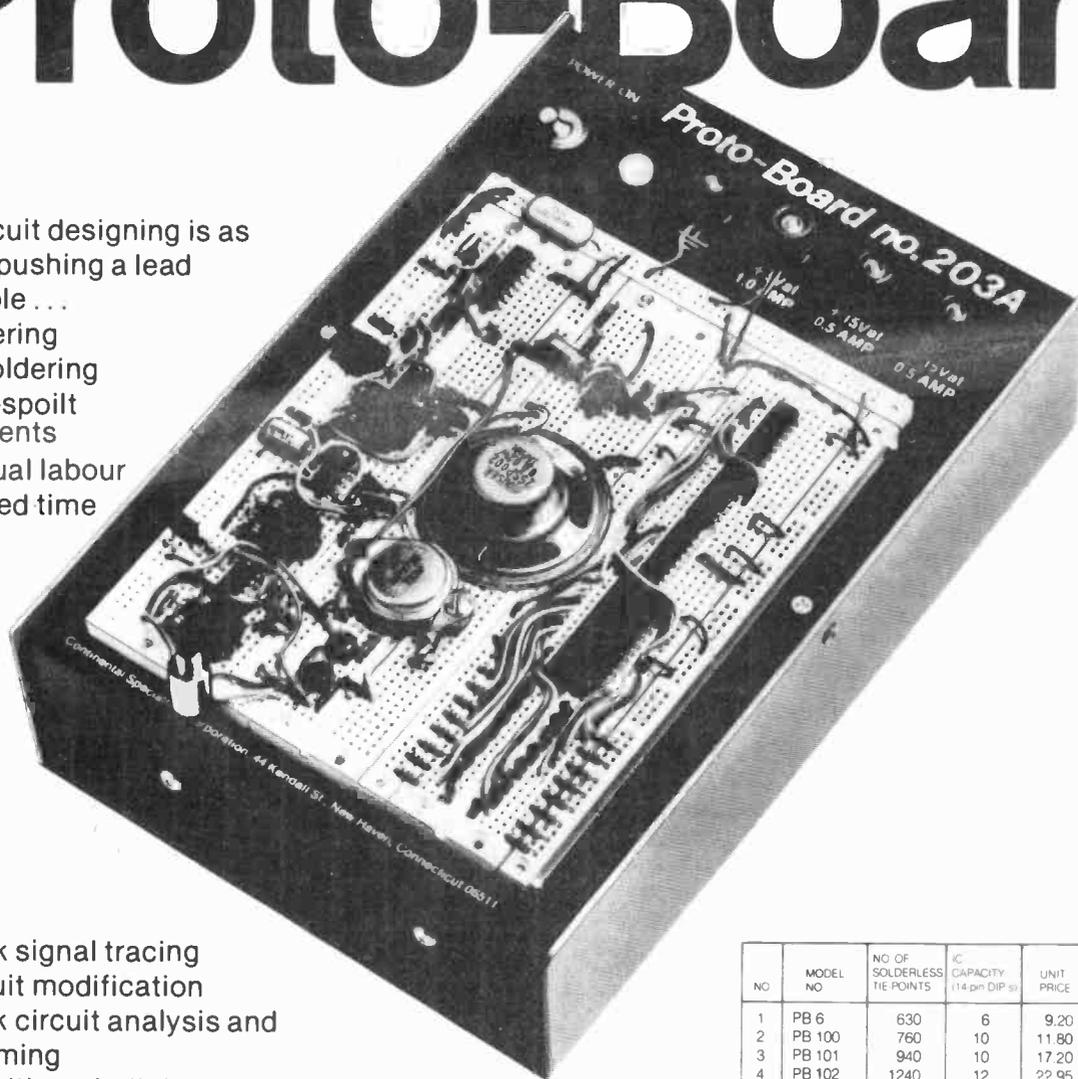
Better forget the Star Trek reaction pods. Throw away the tickets to another Universe. Instead read our explanation of the real truth (?) behind around and for anti-matter.

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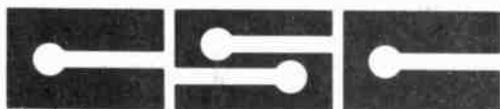


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# AUDIOPHILE

What have lovely Latin ladies got to do with metal? What has D-day got to do with hi-fi? Confused? You won't be after this month's episode of... Audiophile. Ron Harris tries to put some iron in his system with Sony's new TCK 55 II

It all started with a phone call one dark and rainswept Tuesday. 'Metal' said the voice on the phone. 'Well no-one's perfect' said I defensively. 'No no metal tapes' said the voice hurriedly. 'Plastic poodles' said I not wishing to appear dim. 'Why did you say that?' enquired the voice, a little hurt. 'I dunno, seemed to fit somehow' said I, reddening rapidly. 'Look here, if you persist upon being silly.....' 'You started it mush. What metal anyway?.....' that was the magic question and the golden key to communication. It transpires that the voice belonged to Mr. Sony (UK) wishing to discourse upon the subject of iron tapes and machines to play them on. Our telephone operator introduced him as a, quote, geezer wot wants to iron someit art wiv yer, unquote. Articulate our switchboard.

Despite this highly inauspicious genesis the word about heads to pass ferric substances across at 1/78 IPS managed to find an editorial ear and this month's Audiophile came, screaming, into the world.

## Some Sony Day

As the sidehead says the machine I'm looking at is a new model from Sony, the TCK55 II. One of a range of metal-ready decks. Sony get themselves a fair few mentions herein, simply because they have a superb PR department and make some excellent hi-fi (or is that the influence of the PR men again?). Whenever we've needed something quickly (which is always) or have cried out into the night for assistance, they have been one of first people to put out a helping hand - so once I had decided it was time to take a look at reasonably priced (i.e. less than a Rolls) example of this new fangled metallic machinery it came as no surprise to find them ready and able to help at shorter than short notice.

It was also they who gave birth, in this country, to the Elcaset - a tape format much beloved of this particular editorial personage. I find it hard to forgive you lot out there for killing it off the way you did. Why did not hordes of you besiege hi-fi shops and hand over vast sums of money to procure an EL7? It was a magnificent medium and one that I will long defend as having been all that cassettes were *supposed* to have been.

Still, people see things differently I suppose. I dare say that there is *one* Englishman, somewhere, who remembers D-day for walks in the park, kisses in the sunshine and falling gently in love with a beautiful Latin lady over a candlelit dinner, treasuring the day for the warmth in her eyes...

## Switch In Appearance?

Metal tapes look set to provide that vital step-up in cassette performance that has been missing so far. At a price. Their transient handling and H.F. extension is far enough superior to the more normal oxide blends to be acknowledged as a new standard of performance.

It is the fact that much higher levels of signal can be recorded at high frequencies (over 6 dB at 15 kHz) for the same distortion figure that gives the new formulation a much cleaner top end performance and transient behaviour. Distortion overall should also be lower.

Equalisation for the new type has been standardised at 70 uS (the same curve as for CrO<sub>2</sub> tapes) but bias has to be around 10 dB higher, due to the iron's much higher coercivity. Erase heads too must therefore be capable of more 'muscle' to achieve a satisfactory 'wipe-out'.

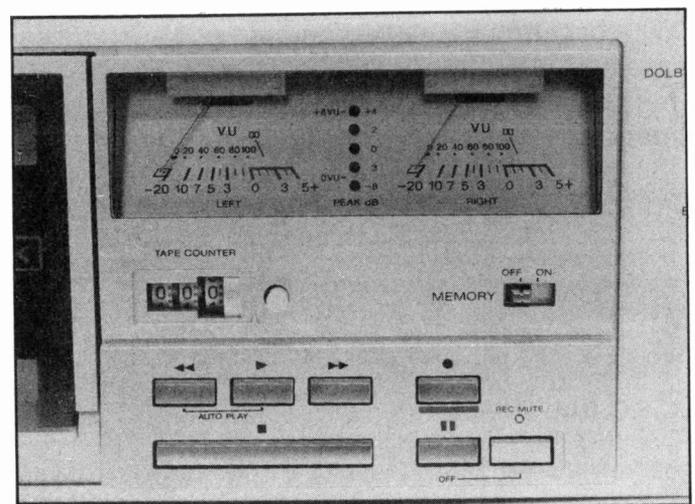
This extra electronics manifests itself, as usual, as an extra switch on the front panel! In the case of TCK55 II considered here an extra slide position on both the bias and equalisation selectors.

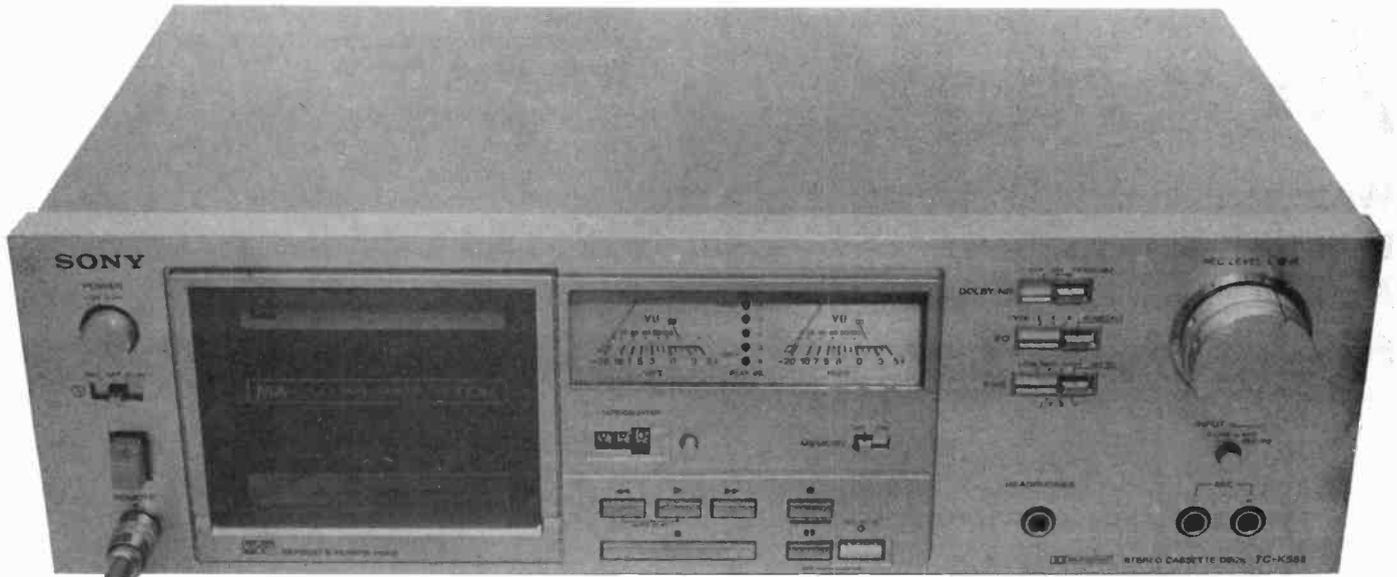
## Facilitating Uses

This machine offers a goodly number of features, for its price, and one of the nicest is called 'AUTO-PLAY'. Pressing both the Rewind and Play buttons causes the machine to rewind to the start of the tape then begin playing automatically. No more standing by the deck counting down the seconds while your tea goes cold.

Of course if we could all remember to reset the memory to 000 every time, then that function could serve this requirement too, but do we? No chance! A simple and useful addition then, and like all the best ideas obvious once you see it!

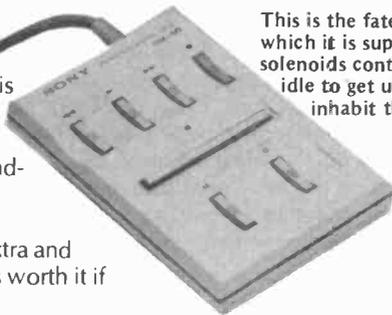
Metering too is well thought out here. Normal VU meters monitor each channel for average readings and a centre bar of LEDs reads peak level. Between the two it is easy to obtain a good setting - and to see how woefully slow VU meters are! With metal tapes you set higher than normally and peaks up to +4 dB produced no audible distortion or compression, thereby proving both the tape and head circuitry.





This is the fateful machine itself. The remote control unit (RM50) is shown plugged into that which it is supposed to be plugged into. Control is by DC voltages passed via the cable to the solenoids controlling the functions. Very useful too if your legs have dropped off, or are just too idle to get up to push the buttons. The cable is more than long enough— unless you happen to inhabit the Albert Hall.

The control panel is solenoid operated and full remote control is thus possible via a hand-held function selector (RM-50) which front panel. This is an extra and costs around £20, but is worth it if you're as lazy as I am.



The controls work smoothly and positively and I could not possibly fault them. Somehow though I didn't like them at all. No criticism implied they were just not to my taste.

As usual with this company's offerings the whole n operates with a smoothness and efficiency that is totally pron. nal. It makes me almost wish a button would drop off or somet anything to show some fallibility in those inscrutable Oriental designers.

### Mute Point

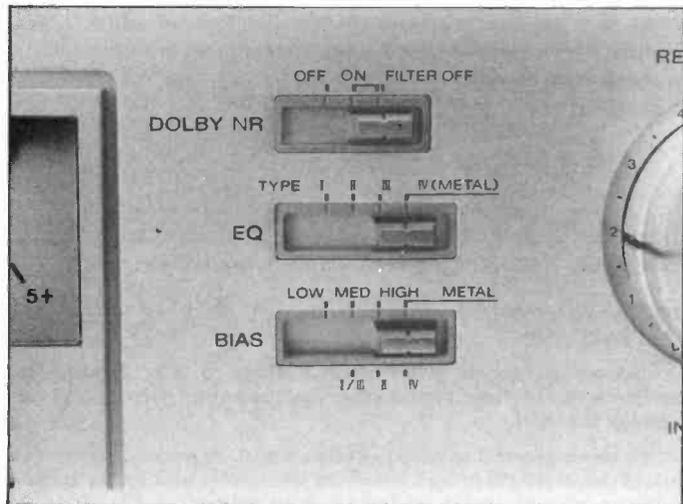
Another unusual feature is the 'REC. MUTE' which provides for four-second blank periods to be inserted into the recordings auto-

matically. Sony say it is useful for removing radio commercials and the like. I contend the point not at all, being totally confused by the thing.

Making recordings on the TCK55 II proved to be very easy indeed, with the LED metering quickly proving its worth in use. I tried the machine with a wide selection of tapes, from Sony's own new AHF and Metal to TDKs SA and MAR formulations. Generally speaking the best results came from their own brand and Maxell. EXCEPT when I reached the iron settings. More of that in a moment.

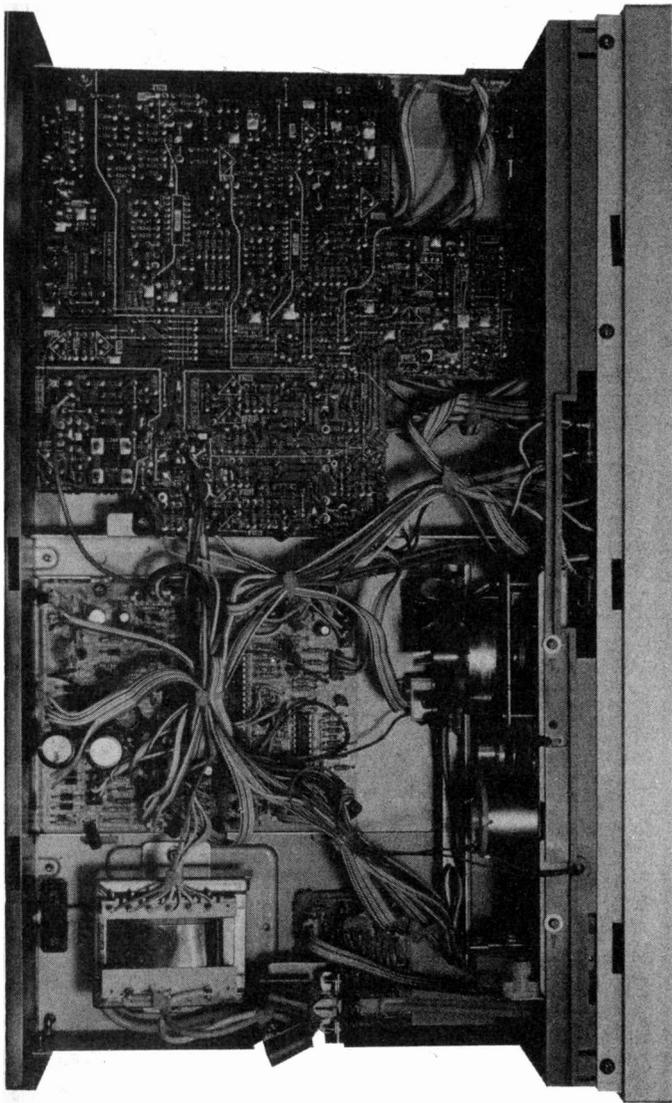
### Wow-What Flutter?

On test the TCK55 II came out very well indeed. Taking an extract from the results:- (overleaf)



Far left: a close-up of the metering provided on the TCK55 II and the control panel beneath it. Note the LED column which reads peak level better than meters ever could. Not a new idea, but well executed here.

Left: the bias and equalisation controls. Sony provide a useful table which gives recommended settings for a wide variety of tape types in their instruction book. The numerals on the panel refer to this table. Strangely my sample of the machine seemed over-biased for Sony's own metal tape, preferring instead TDK's formulation. There's loyalty for you!



Above: oh how unfair! The TCK 55 II stripped naked before the world. PCB construction is to a commendably high standard.

TABLE ONE :- TEST RESULTS

Input sensitivity (line)	90 mV
Wow and Flutter (DIN)	±0.08%
Frequency response:-	
TDK SA tape	30 - 16 kHz ±2 dB
SONY AHF tape	33 - 15 kHz ±3 dB
SONY METAL tape	40 - 15 kHz ±4 dB
TDK METAL tape	26 - 18 kHz ±2 dB
MAXELL UDXL 1 tape	30 - 16 kHz ±3 dB
MAXELL XDXL 2 tape	30 - 16 kHz ±2 dB
Spooling time (C60)	1 min. 4 sec.
Distortion (333 Hz):-	
METAL tape at Dolby level	0.9%
SONY AHF at Dolby level	1.6%
Dynamic Range (TDK METAL)	+67 dB
S/N ratio, Dolby on, TDK METAL, (10 kHz)	-64 dB

see text  
see text

I don't propose to spend weeks mulling over those figures, just the interesting ones need to be mentioned. Firstly that W/F rating I didn't believe and so I did it again. OK so now I believe it. Just. It's pretty good!!!

I am surprised by the Sony metal tape results and would listen to claims that I had some bad tapes. TDK metal performed superbly at all times.

Using TDK metal really showed what a difference this tape is capable of making to a sound system. With care taken in the recording stages this £200 cassette deck produced results that were all but indistinguishable from the original disc. There remains none of the tell-tale compression, dullness or lack of life that would betray an average recording.

This is not the first metal deck I've listened to, but if one includes the price in the consideration, then it is certainly the most impressive. Even a year ago this standard of sound from a cassette at £200 would have been nonsense, an ad. man's dream.

## Sound Out

I compared the TCK55 II to an EL7 Elcaset machine and a Revox B77 reel-to-reel and on sound alone it was difficult to tell them apart. The Revox was running at 7½ ips and undoubtedly turned in the most accurate reproduction of the three. It would, however, take a good pair of ears and very high quality source material to allow it to be reliably distinguished from the far cheaper TCK55 II. Even then only on a good day with the wind in the right direction....

I would very much like to lay hands and ears on the TCK75, a machine which a little bird tells me is better yet and more versatile, albeit at higher cost. However, there can be no doubt that the TCK55 II itself is an imposing statement of the quality reproducible from the (high price) medium of metal tapes. It performs exceedingly well on the more mundane formulations too and can be highly recommended to anyone in search of a tape machine to add to his domestic sound system.

## Moaner's Return

Following my moan in the February issue about the non-availability of racks for Pioneer systems (unless you want to shell out a few hundred pounds for a complete system) I had a few interesting phone calls. It seems that Britain, for the time being, is the odd man out as far as Pioneer racks are concerned. I'm told that most European countries will supply Pioneer racks as separate items. However, if you have problems with the foreign lingo, why not go west, young man? If you should find yourself in the Republic of Ireland in the near future, make a bee-line for 41 Fitzwilliam Street in Dublin. There you'll find the emporium of Radio Import Ltd, who will be more than happy to flog you a brand new Pioneer rack on its own. Get in touch with them for latest prices, but as a guide the Rolls-Royce of the range - the CB 900 - will set you back a shade over £100. Sounds expensive, but a CB 900 from Pioneer on this side of the Irish sea will be around £90 when it finally becomes available - in about three months.

Ian Graham

## Let Us Say

Below an epistle from a man of taste who is undeservedly threatened by his own brother due to an unsatiable craving to play bass guitar. There are problems, however. Read on....

25th February 1980

Dear Audiophile,

**I have an electric guitar which I intend to 'play' through my brother's Hi-Fi system. However we have been told that to do so will damage the Hi-Fi.**

**Is this correct? If so what can I do about it? At present my brother brandishes a length of lead plumbing whenever I pick up my guitar - other people only do this when I touch the strings.**

While on the subject, how about a project for a guitar practice amp - with a headphone output for the sake of neighbours' sanity?

Finally, we entirely agree with your opinions about Felicity Kendal. We strongly suggest that you attempt to have published the enclosed picture. This will help convert those unbelievers who may have been unconvinced by the previous photo - A commendable effort but not as fine a likeness as she deserves.

Yours faithfully,  
L Rickwood.  
Norwich

26th February 1980  
Dear Sir,

Bass guitars and hi-fi don't mix. Sad, but true. Attempts to replay said stringed thing in this manner will probably result in one wall of your room being re-papered with a pair of speaker cones.

Good for the decor but lousy on the music. This is due to the amount of energy that the guitar will produce and the shape of the note. With no processing, i.e. recording, disc cutting etc. etc. (and no automatic level control!!!) you are more than liable to blow the bass speakers straight out of the cabinets.

As this is the point at which I suspect your kin will begin to rearrange your anatomy this is a Bad Thing. By all means use a pair of good dynamic headphones with the amplifier - this you will not damage. The headphones should survive better than your ears and are therefore safe!

I enclose a circuit for a practice amplifier we haven't got around to publishing, but which Hobby Electronics shortly will, - it might interest you more than that length of lead plumbing. Buy yourself a good 12" PA speaker to go with it.

As to a better picture of Felicity.....

ETI

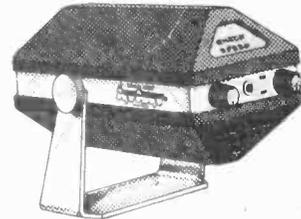


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0.6-0.6	1A 1A	212	2.95	70	1.0	103	4.55	1.00		
9-0-9	100	13	2.25	65	2.0	104	7.25	1.15		
0.9-0.9	330 330	235	2.10	65	3.0	105	8.55	1.15		
0-8-9, 0-8-9	500 500	207	2.70	70	4.0	106	10.80	1.25		
0-8-9, 0-8-9	1A 1A	208	3.80	70	6.0	107	15.05	1.45		
0-15, 0-15	200 200	236	2.10	65	8.0	118	20.15	1.65		
0-20, 0-20	300 300	214	2.70	85	10.0	119	24.05	2.15		
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1.0	0.5	213	2.70	.85	75	64	4.05	.85		
2	1	71	3.20	.85	150	4	5.55	1.00		
4	2	18	4.00	.85	Input/Output Tapped 0-115-210-220-240V					
6	3	70	5.55	.90	300	53	10.05	4.15		
8	4	108	7.40	1.15	500	67	10.80	1.45		
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Amps	Ref. No.	Price £	P&P	400	153	16.25	1.55			
0.5	112	2.80	.85	600	154	18.55	1.55			
1.0	79	3.55	.85	1000	156	37.05	3.15			
2.0	3	5.55	1.00							
3.0	20	6.25	1.15							
4.0	21	6.55	1.15							
5.0	51	9.55	1.15							
6.0	117	11.05	1.15							
8.0	88	14.30	1.45							
10.0	89	16.55	1.45							

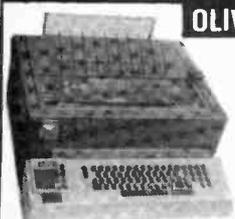
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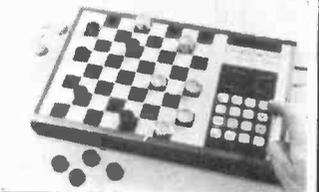
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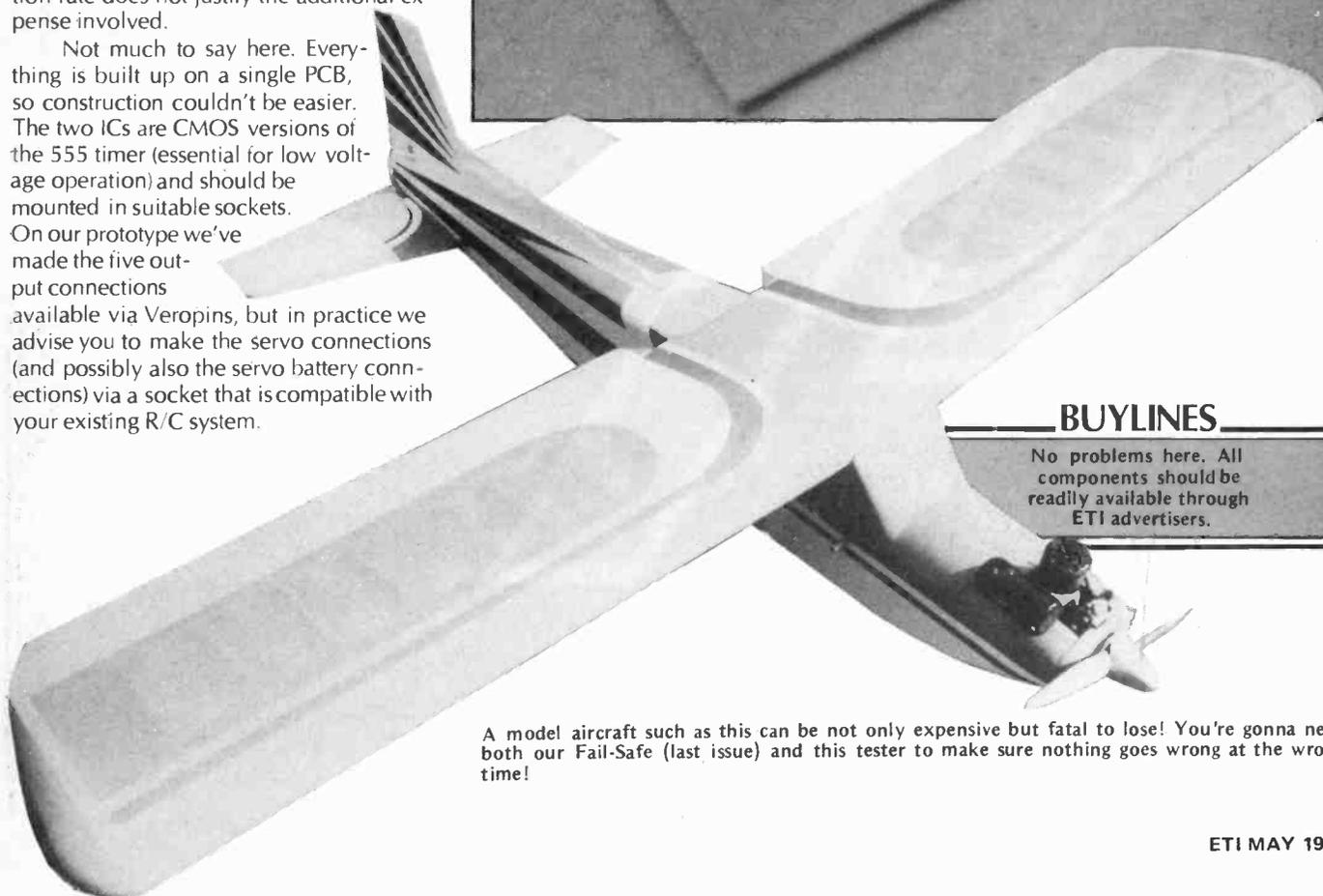
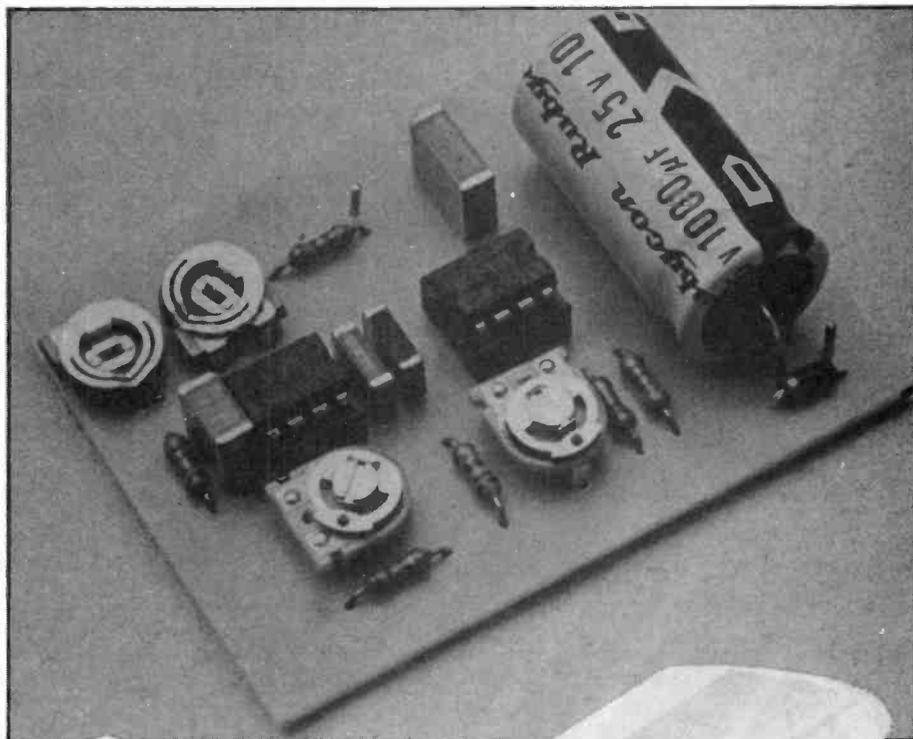
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So your radio control has lost control and you have no way of knowing whether the offending component is receiver or servo. Fear not. All is not lost yet, ETI's Project Team provide the answer.

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The entire test set is built up on a single PCB and can be powered from all servo supplies in the 3 to 12 volts range. As you can see from the photos, we've not bothered to box the unit, since its probable utilisation rate does not justify the additional expense involved.

Not much to say here. Everything is built up on a single PCB, so construction couldn't be easier. The two ICs are CMOS versions of the 555 timer (essential for low voltage operation) and should be mounted in suitable sockets. On our prototype we've made the five output connections available via Veropins, but in practice we advise you to make the servo connections (and possibly also the servo battery connections) via a socket that is compatible with your existing R/C system.



## BUYLINES

No problems here. All components should be readily available through ETI advertisers.

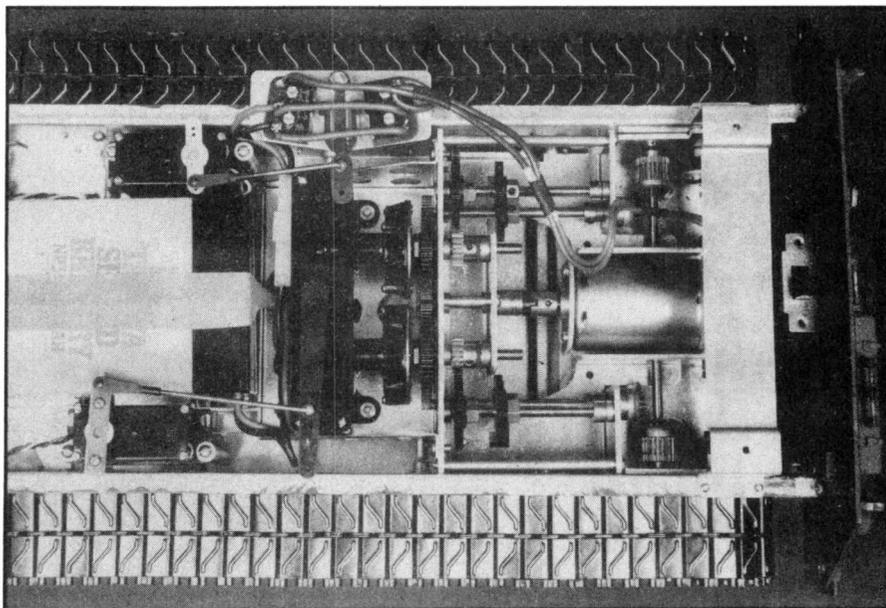
A model aircraft such as this can be not only expensive but fatal to lose! You're gonna need both our Fail-Safe (last issue) and this tester to make sure nothing goes wrong at the wrong time!

## HOW IT WORKS

In a conventional multi-channel 'proportional' radio control system a variable-width (1 mS to 2 mS) pulse is passed to each servo via the transmitter — receiver — decoder 'link' roughly once every 20 mS (the frame time). The pulse width of each channel is variable at the transmitter (via a joy-stick, etc) and determines the position of the servo. At 1 mS the servo may, for example, be full left, at 1.5 mS 'neutral' and at 2 mS full right.

Our servo test set works by internally generating a conventional positive control pulse at a normal frame rate and feeding the pulse directly to the servo input. The unit is powered from the servo's own battery supply via the D1—C1 decoupler network. Circuit operation is quite simple. IC1 is wired as a free running astable multivibrator and acts as the 'frame' generator. The frame length is variable from 13 mS to 28 mS via RV1 and is used to trigger pulse-generating monostable IC2 via C3. The output pulses of IC2 are fed to the servo input via amplitude control RV2. The output pulse widths are variable over the nominal range 1 mS to 2 mS via RV3 but can be 'trimmed' over a limited range via RV4.

IC1 and IC2 are CMOS versions of the 555 timer and give stable operation at supply potentials down to about 3 volts.



Above: the Servo layout on the ETI Leopard Tank used for our R/C project last year. Servo failure here could result in total destruction of a very expensive model — and whoever happened to be in the way when those metal tracks cease to obey commands!

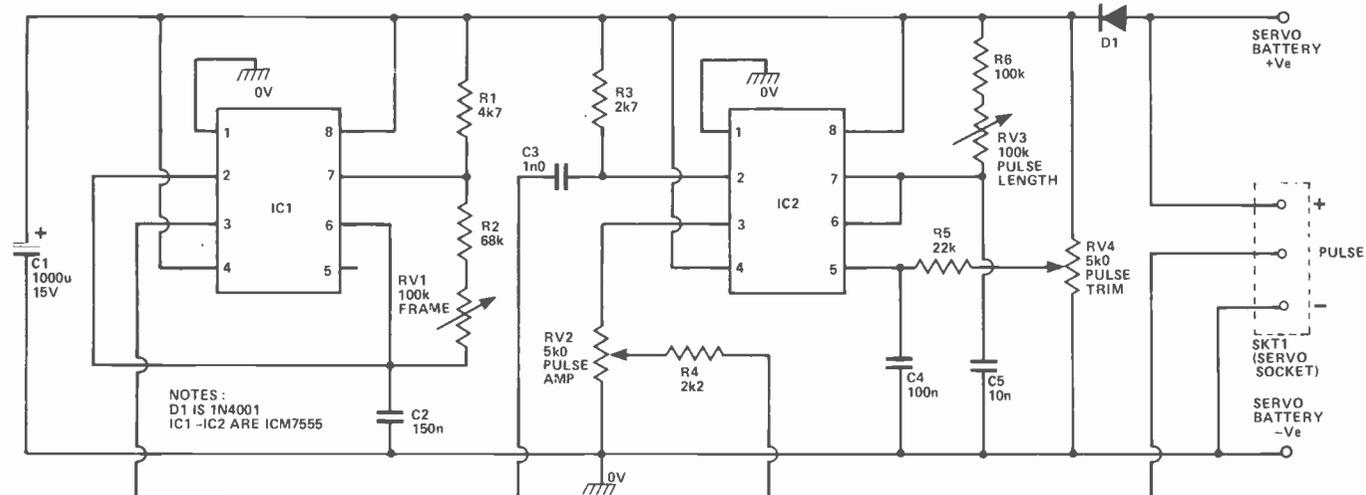


Fig.1. Full circuit diagram for the Servo Tester.

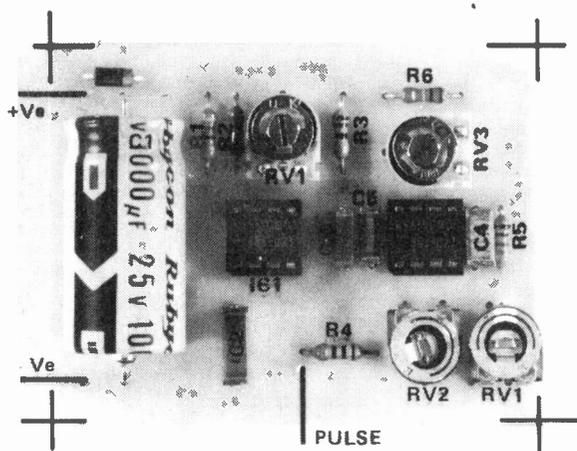


Fig.2. (left) the component overlay for the unit.

## PARTS LIST

### RESISTORS All ¼W, 5%

R1	4k7
R2	68k
R3	2k7
R4	2k2
R5	22k
R6	100k

### POTENTIOMETERS

RV1,3	100k min horiz preset
RV2,4	4k7 or 5k0 min horiz preset

### CAPACITORS

C1	1000u 25V electrolytic
C2	150n polycarbonate
C3	1n0 polycarbonate
C4	100n polycarbonate
C5	10n polycarbonate

### SEMICONDUCTORS

IC1,2	ICM7555
D1	1N4001

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The ZX80 is pleasantly straightforward to assemble, using a fine-tipped soldering iron. Once assembled, it immediately proves what a good job you've done. Connect it to your TV set...link it to an appropriate power source\*...and you're ready to go.

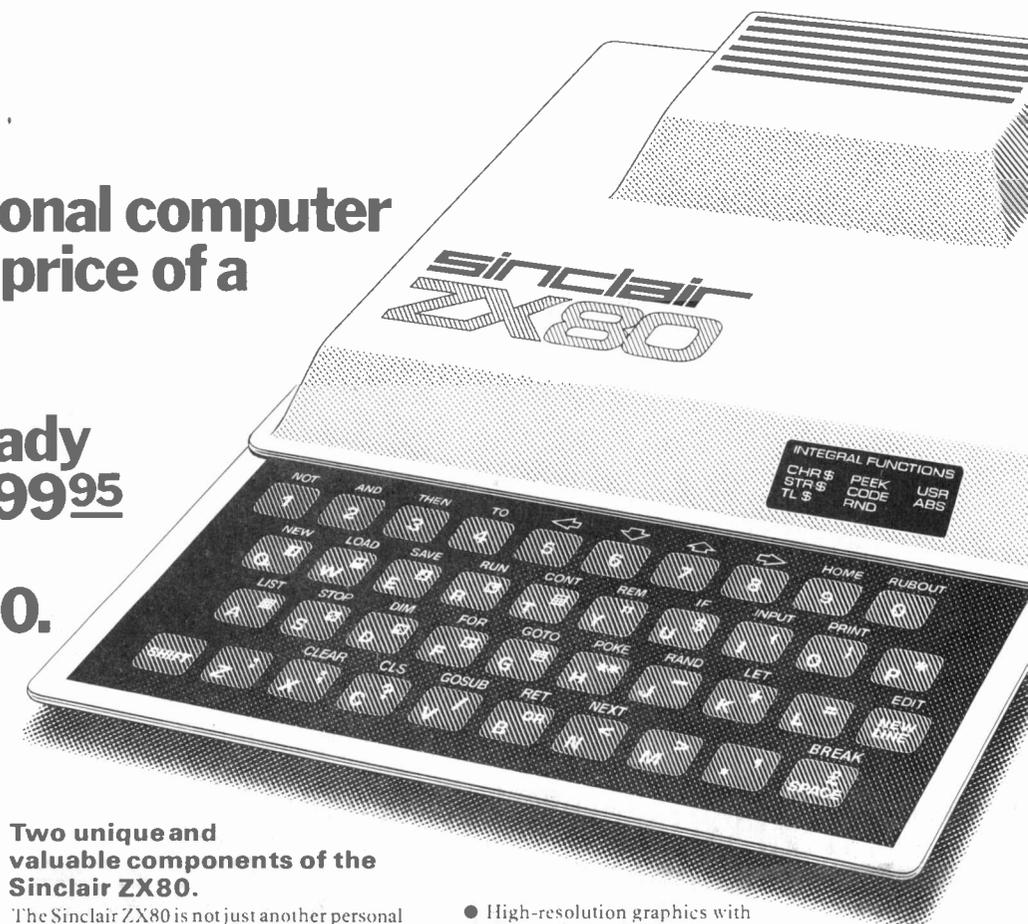
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- FREE course in BASIC programming and user manual.

### Optional extras

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- Additional memory expansion boards allowing up to 16K bytes RAM. Extra RAM chips also available—see coupon.

\*Use a 600 mA at 9 V DC nominal unregulated mains adaptor. Available from Sinclair if desired—see coupon.



### Two unique and valuable components of the Sinclair ZX80.

The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter; and the Sinclair teach-yourself BASIC manual.

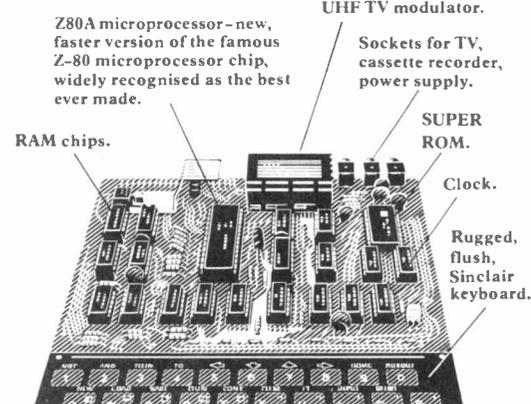
### The unique Sinclair BASIC interpreter... offers remarkable programming advantages:

- 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. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability—takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input to request a line of text when necessary. Strings do *not* need to be dimensioned.
- 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, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- 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, USR causes jump to a user's machine language sub-routine.

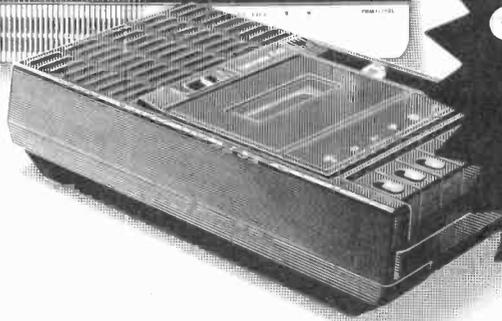
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

### ...and the Sinclair teach-yourself BASIC manual.

If the features of the Sinclair interpreter listed alongside mean little to you—don't worry. They're all explained in the specially-written 128-page book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming—from first principles to complex programs. (Available separately—purchase price refunded if you buy a ZX80 later.) A hardware manual is also included with every kit or built machine.



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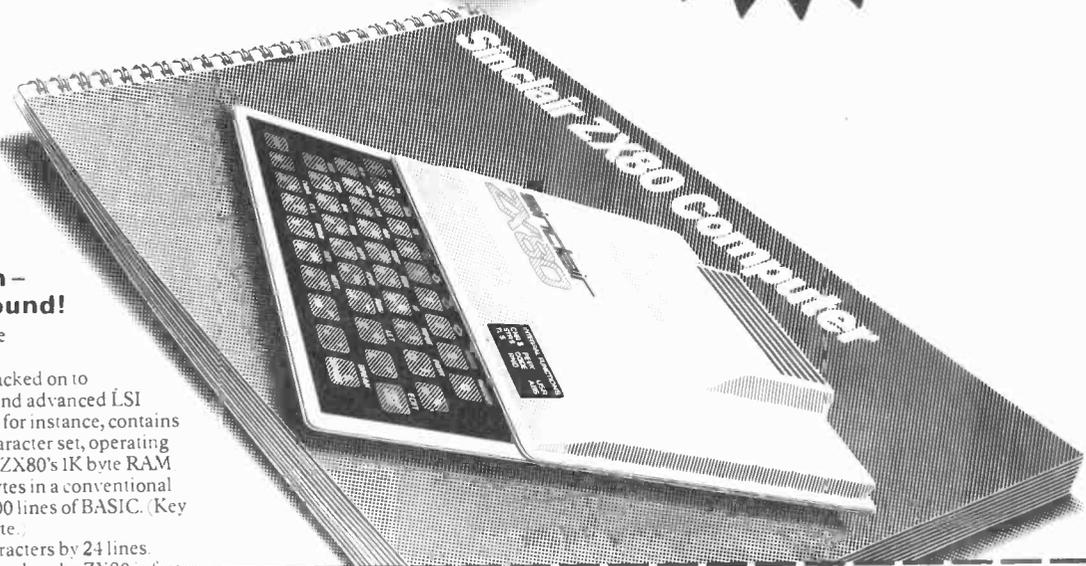
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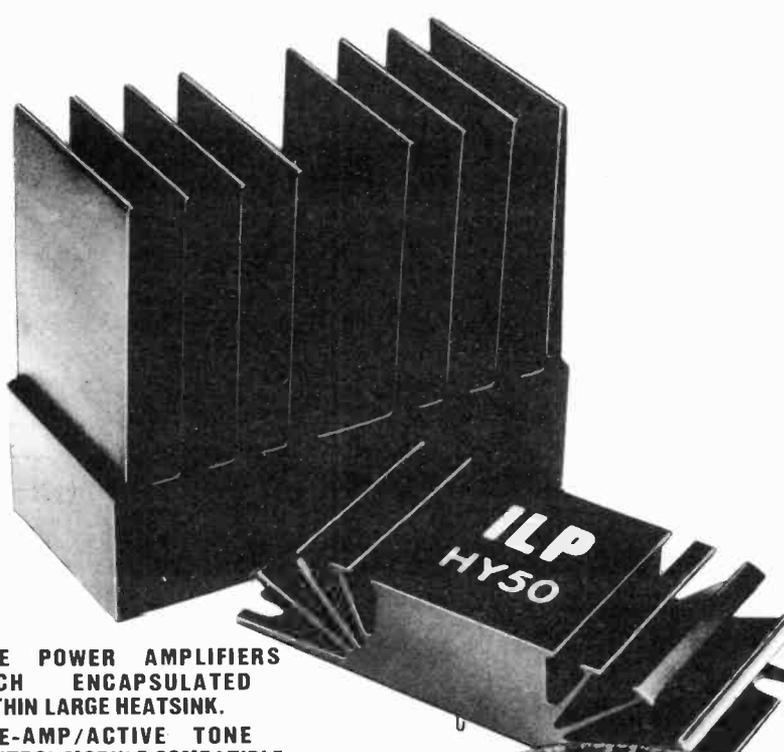
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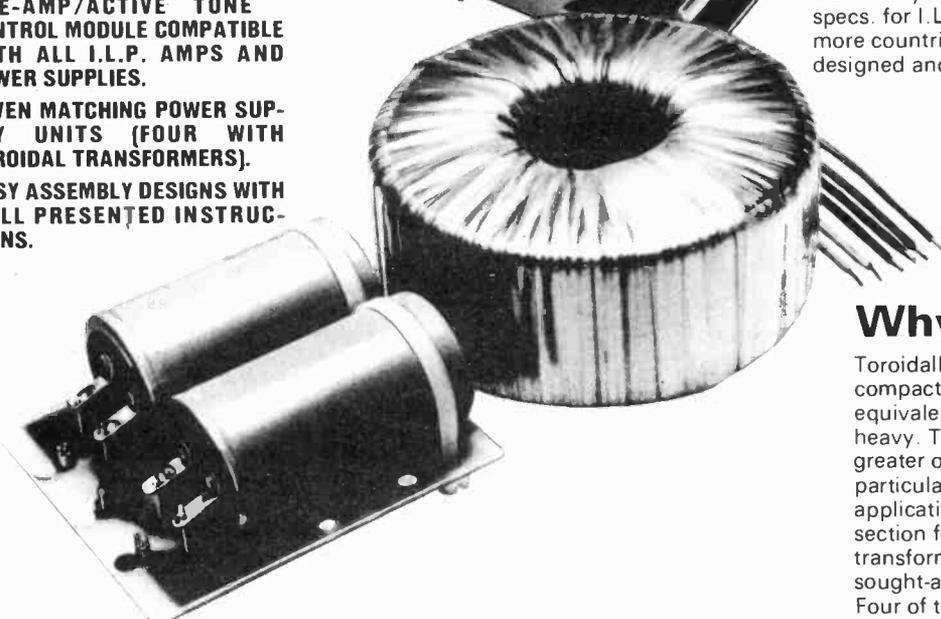


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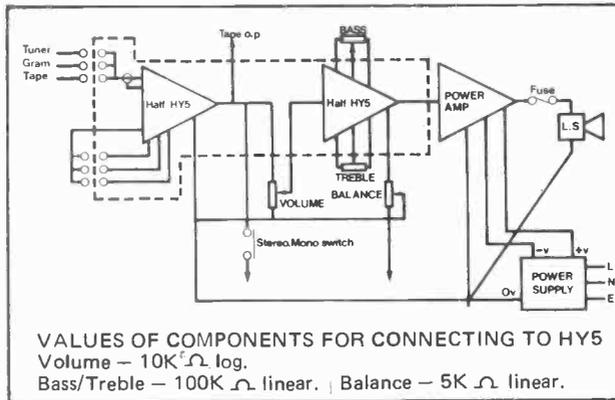
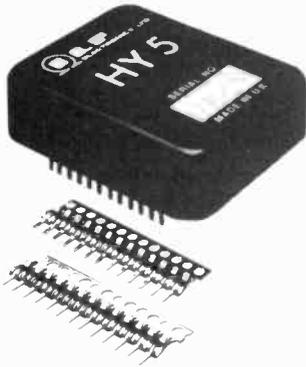
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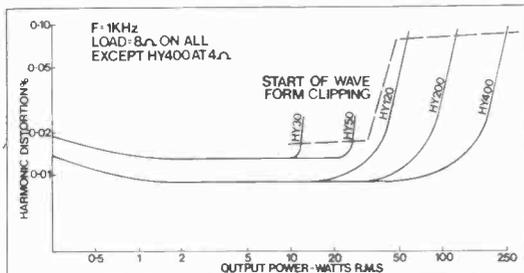
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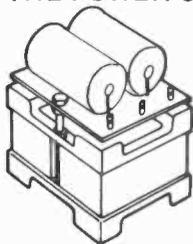
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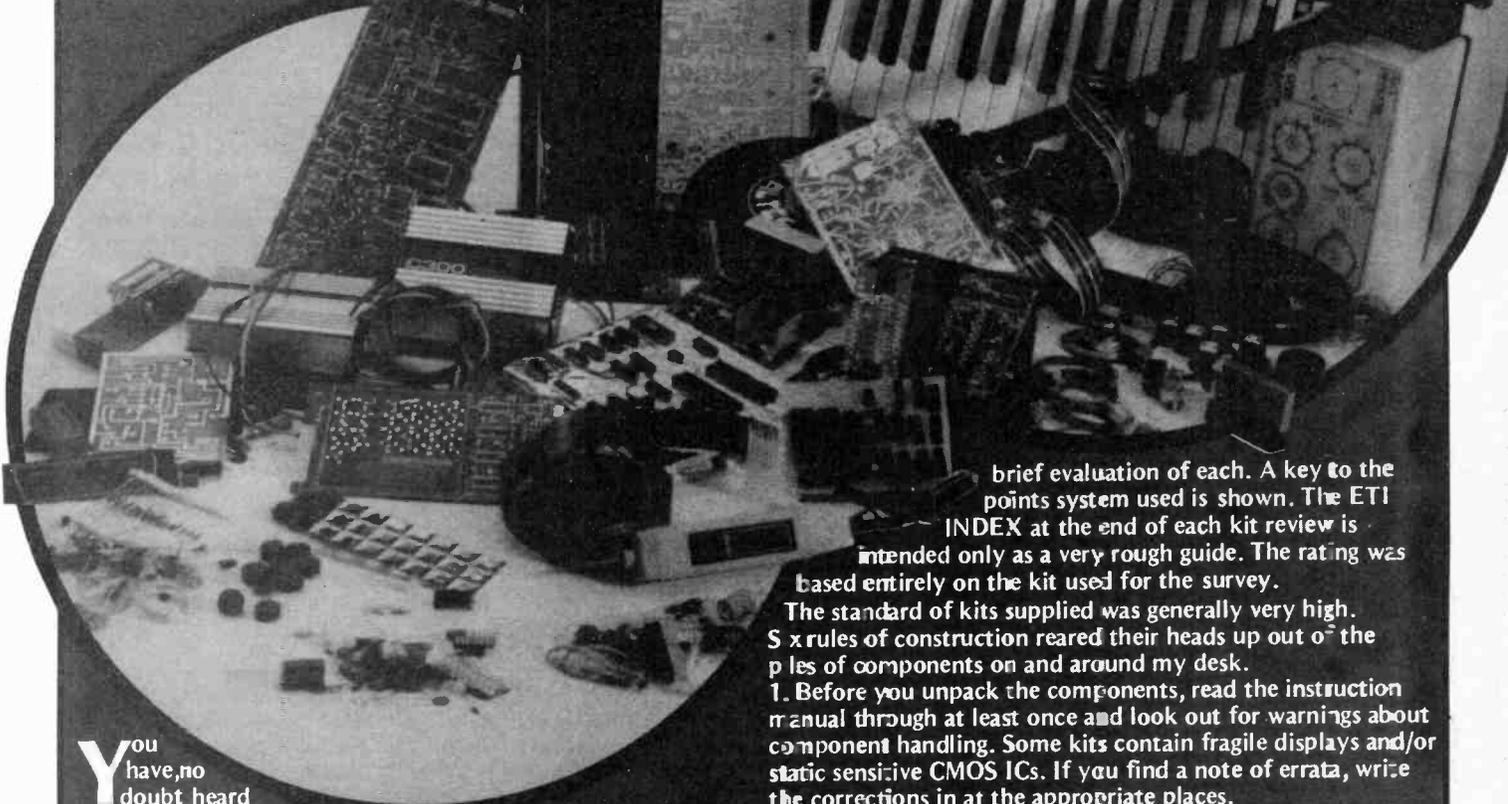
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# KIT SURVEY

By Tom Gresham



**Y**ou have no doubt heard

of the much-quoted phrase, first uttered by French philosopher Rene Descartes — I pay income tax, therefore I am. If you want to stop your wallet slimming faster than you feed it, one way of curtailing the financial anorexia is to buy the kit version of your favourite amplifier, electronic ignition, computer, etc. The range of kits available seems to be endless. We decided to get as many of them as possible together in one place to find out what you get for your money.

I invited about 40 companies to send me kits for our survey. All accepted my invitation, but only 20 or so came up with the goods in time. Some were awaiting delivery of components (main transformers, displays, etc.) and were unwilling to send part kits. Others seemed reluctant to take advantage of some free publicity.

You'll notice that there are few kits in the audio or hi-fi market. In the earliest stage of preparation of the survey it was decided to exclude any kit built from modules. This automatically excluded some of the household names in high quality amplifier design. It would also have been impractical to include loudspeaker kits, each requiring a cabinet. This pruning of the available merchandise was necessary to cut down the size of the survey to something manageable.

I built as many of the kits as time permitted and made a

brief evaluation of each. A key to the points system used is shown. The ETI INDEX at the end of each kit review is intended only as a very rough guide. The rating was based entirely on the kit used for the survey.

The standard of kits supplied was generally very high. Six rules of construction reared their heads up out of the piles of components on and around my desk.

1. Before you unpack the components, read the instruction manual through at least once and look out for warnings about component handling. Some kits contain fragile displays and/or static sensitive CMOS ICs. If you find a note of errata, write the corrections in at the appropriate places.
2. Check that the kit is complete. Work your way down the component list and tick off each component as you check it.
3. Have a look at the PCB. Make sure there are no solder bridges between tracks.
4. Make sure you have the right tools for the job. If you try to build a microcomputer board with a hot poker or an oxyacetylene torch, you're likely to come to grief. For the fine work I invested in a low voltage (6 volts at 1 amp) iron with a fine tip and used 22 swg solder. (A temperature-controlled soldering station is even better). You'll also need long-nosed pliers, sidecutters, a couple of small screwdrivers (one slot and one Philips) and a pair of wire strippers.
5. When you begin construction, follow the instructions in the correct order. It's sometimes tempting to leave a particularly difficult or tedious part of the kit and work on something a little more interesting.
6. Don't be too eager to plug in the finished kit and try it before you've checked it properly for mistakes. Look for blobs of solder bridging across PCB tracks. Check that diodes, electrolytic capacitors, transistors and ICs have all been put in the right way round. Where possible use IC sockets. It's not only extremely difficult to unsolder an IC from a board but, if you're using a double-sided board, you can irreparably damage the board.

## ACORN COMPUTERS

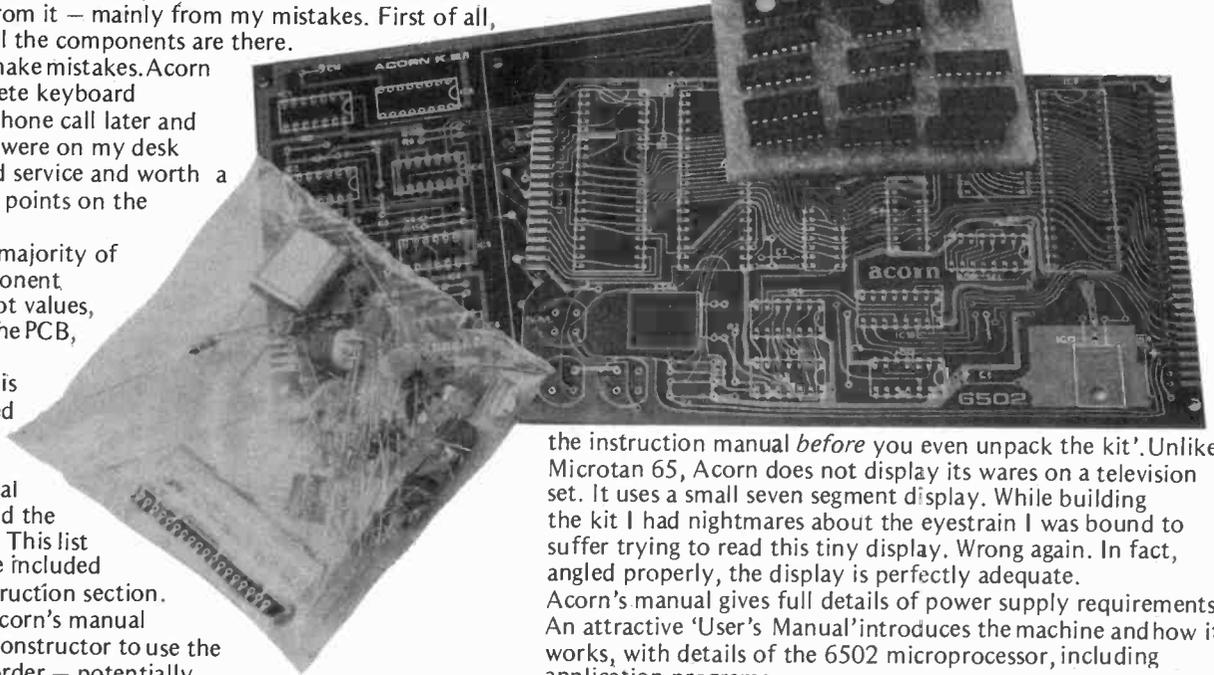
Company	Acorn Computers Ltd, 4A Market Hill, Cambridge.		
Kit	Acorn Microcomputer		
Price	£70.20		
Complexity	C	Instruction Manual	2
Circuit Diagram	1	Finish	3
Contents	0	Fault-Finding Guide	0

This was the first microcomputer kit that I tackled and I learnt a lot from it — mainly from my mistakes. First of all, *do* check that all the components are there.

Companies do make mistakes. Acorn sent an incomplete keyboard assembly. One phone call later and the missing bits were on my desk next day — good service and worth a couple of bonus points on the ETI Index.

As with the majority of these kits, component positions, but not values, are marked on the PCB, so a good, clear components list is essential. I turned from the construction part of the manual to the end to find the components list. This list should, I feel, be included within the construction section.

The layout of Acorn's manual encourages the constructor to use the sections out of order — potentially disastrous. So, the second of the cardinal rules 'read



**POINTS ARISING**

	COMPLEXITY
	CIRCUIT DIAGRAM
	CONTENTS
	INSTRUCTION MANUAL
	FINISH
	FAULT-FINDING GUIDE

the instruction manual *before* you even unpack the kit'. Unlike Microtan 65, Acorn does not display its wares on a television set. It uses a small seven segment display. While building the kit I had nightmares about the eyestrain I was bound to suffer trying to read this tiny display. Wrong again. In fact, angled properly, the display is perfectly adequate. Acorn's manual gives full details of power supply requirements. An attractive 'User's Manual' introduces the machine and how it works, with details of the 6502 microprocessor, including application programs.

ETI INDEX 8C

## ALTEK

Company	Altek, 1 Green Lane, Walton-On-Thames, Surrey.		
Kit	Shadow VLF/TR discriminating metal locator		
Price	£79.70		
Complexity	B		
Circuit Diagram	1		
Contents	3		
Instruction Manual	3		
Finish	3		
Fault-Finding Guide	0		

ETI featured this most discriminating of metal locators in the March 1980 issue. The project was an instant success, the demand far surpassing even Altek's own expectations.

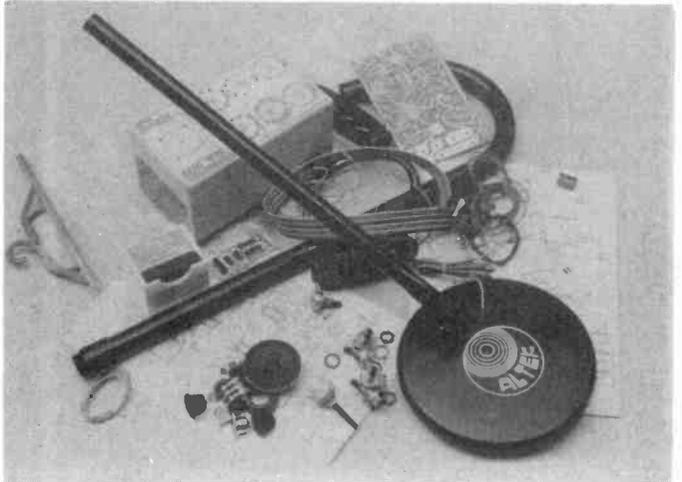
The kit includes all the necessary hardware — a case for the electronics, handle, adjustable shaft and search head. I've had a number of phone calls and letters from DIYers who want to make their own search head to save some money. Altek are reluctant to release full details of the coil assembly, understandably. They have also told me that even if full details were published, the coil assembly would be beyond the capabilities of most home constructors, requiring sophisticated test gear to set it up properly.

The kit assembly instructions assume some electronics experience, but if you do run into problems, Altek are just a phone call away. Construction doesn't pose any particular problems. The plastic case supplied is not drilled, so a bit of elbow grease is called for. Altek make things as easy as possible by marking the hole centres on the case and providing a paper drilling template. Before you start ventilating your case, notice

that the PCB mounting bosses are closer together at one end of the case than the other, so the case has a front and a back.

Before you rush out and dig up your back garden, remember that use of a metal locator requires a licence. Altek's kit includes an application form. You can buy the shadow VLF/TR Quad Mode Discriminator (to give it its full title) manual from Altek for £1. If you're starting out in metal locating and find the VLF/TR kit a little on the pricey side or you'd like to cut your teeth on something a little less complex, there are metal locators in Altek's range to suit just about everyone's needs and pocket.

ETI INDEX 10B



A (beginners) B (requires some experience) C (advanced)  
 0 (not included) 1 (included)  
 0 (important components missing) 1 (components missing, but the kit is buildable) 2 (the odd resistor missing) 3 (complete)  
 0 (useless) 1 (poor) 2 (satisfactory) 3 (excellent)  
 0 (very untidy) 1 (looks homemade) 2 (neat and tidy) 3 (professional)  
 0 (not included) 1 (included)

## CATRONICS

Company	Catronics Ltd, Communications House, 20 Wallington Square, Wallington, Surrey SM6 8RG.		
Kit	40 W 2 m Power Amplifier		
Price	£22		
Complexity	B		
Circuit Diagram	1		
Contents	3	Finish	1
Instruction Manual	2	Fault-Finding Guide	0

When you unpack your 2 m Power Amplifier kit, hold the PCB up to the light and find that there are no component mounting holes, don't write a nasty letter to Catronics demanding a drilled PCB. The components are mounted on the *fall* side of the board. Before you pick up your soldering iron, read the instruction leaflet. Two points are worthy of note. If the power transistor is cracked, chipped or broken, run for the hills. The transistor contains beryllia, a toxic compound, so read the warning carefully. Secondly, before you begin, note that the heatsink and case should be taped together, so

that you can drill the mounting holes. Input and output holes also have to be drilled in the blank case. Thereafter construction is no problem. The component overlay is a little difficult to follow, but the inclusion of a photo of the PCB is very helpful.

Catronics, the VHF communications specialists, also supply a complete kit for the ETI VHF Airband Converter (Dec1979). ETI INDEX 7B



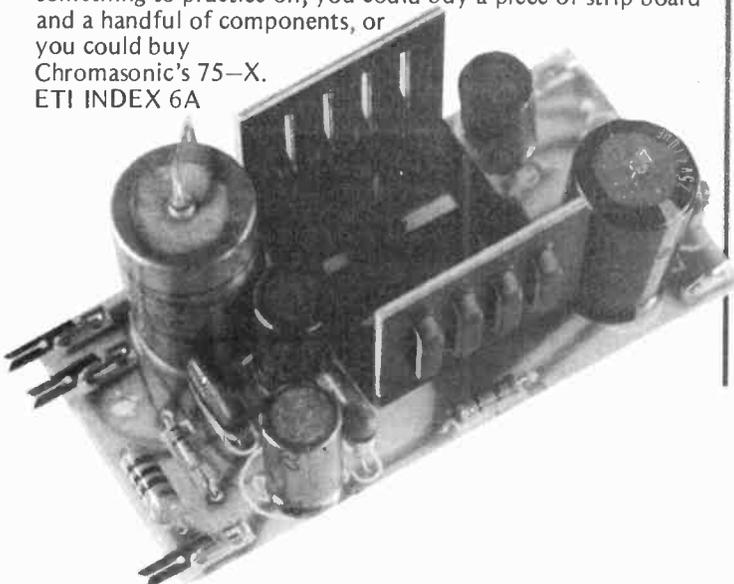
## CHROMASONIC ELECTRONICS

Company	Chromasonic Electronics, 56 Fortis Green Road, Muswell Hill, London N10 3HN.		
Kit	75-X 10 Watt Audio Amplifier		
Price	£3.95 + VAT		
Complexity	A	Instruction Manual	2
Circuit Diagram	1	Finish	0
Contents	3	Fault-Finding Guide	0

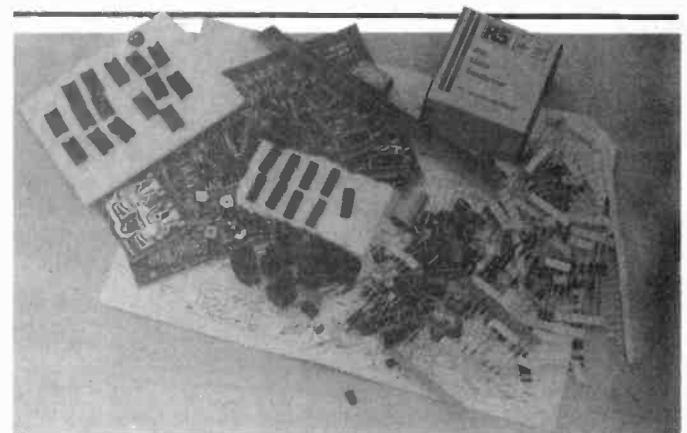
Chromasonic sent me a sample of their 75-X 10 watt audio amplifier. They also have a 7 watt version – the 75-B – based on the TBA10AS IC. The heart of the 75-X is a TCA940. The first step of construction is to snip off three unwanted pins of the IC. Take a few seconds to identify the right pins. You'll feel very silly if you cut the wrong ones. Thereafter construction is very straightforward.

Neither a power supply nor a loudspeaker are included in the kit. However, circuit diagrams are provided for the amplifier itself, a suitable power supply and tone control network.

If you've never soldered a joint in your life and you want something to practice on, you could buy a piece of strip board and a handful of components, or you could buy Chromasonic's 75-X. ETI INDEX 6A



## CLEF PRODUCTS

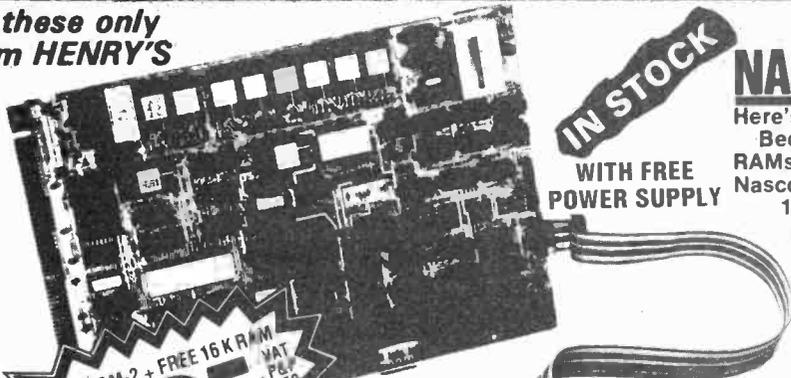


Company	Clef Products (Electronics) Ltd, 16 Mayfield Road, Bramhall, Cheshire SK7 1JU.		
Kit	Electronic Rotor CPK 1200.		
Price	£89.00		
Complexity	C	Instruction Manual	2
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	0

When I considered including electronic organs, pianos, etc in the kit survey I had nightmares about crates of woodwork and keyboard assemblies walling me in behind my desk. So, I asked Clef Products if they could simply send me a sample PCB and component packs.

They sent an electronic rotor – a device designed to electronically simulate a two speed mechanical rotor – speaker system and also provide a three-phase chorus generator to enhance organ tones and produce a string chorus effect. For your £89 you get a large bag bulging with boards and components. An 8" x 5" PCB contains the full rotor – chorus

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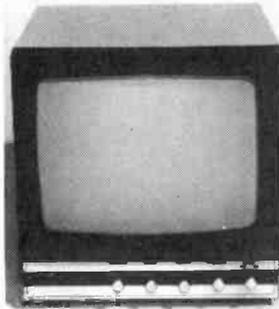


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system, using some twenty ICs. Sockets are provided for all of them — that's what I like to see. (Have you ever tried desoldering a duff chip?). The second (2¼" x 2") board carries components for the low impedance stereo headphone driver circuit. Mains power supply components are also supplied.

The PCBs are labelled with component values, rather than numbers. Some legends are a little indistinct, so a full components listing is given as a double check. All nine controls are included as preset pots on the PCB, but you can replace

them with external pots, if necessary. Holes in the PCB allow operation of the presets if you want to keep the controls on-board.

If you already have an electronic organ, you can add on this unit for some interesting effects, or you could use it as an experimenters' kit for use with your own signal source. A system interconnection diagram is provided, showing the unit placed between the signal source and existing power amplifiers.

ETI INDEX 9C

## COMPU-TECH SYSTEMS

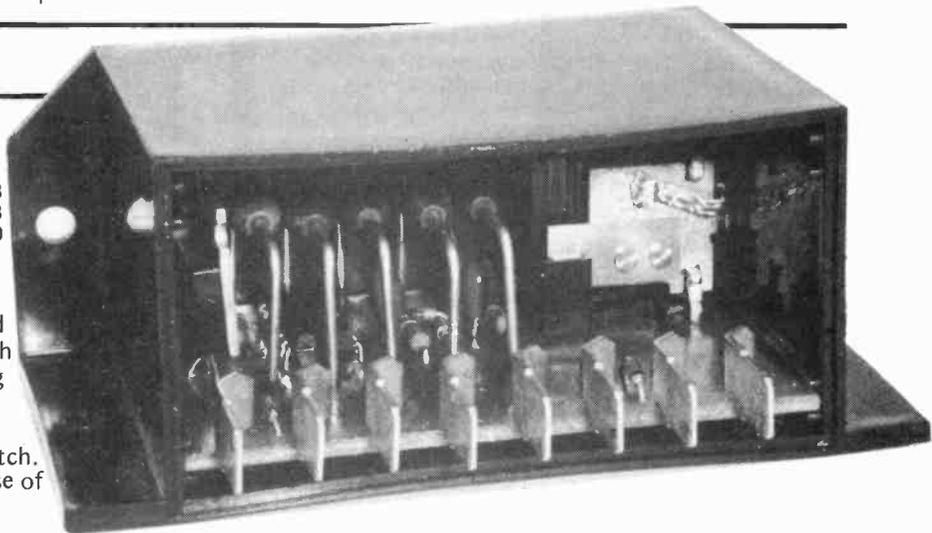
Company	Compu-Tech Systems.		
Kit	Car Security System		
Price	£11.95 + Siren (£7.75)		
Complexity	B	Instruction Manual	3
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	0

This design from Compu-Tech was published in ETI last month. It's an add-on unit for the ETI car alarm (also designed by Compu-Tech) published in December 1978. The original unit protected both the car itself (by monitoring all doors and disabling the ignition when set) and the car's accessories. There is an entry and exit delay before the horn is sounded, so you don't have to fit any external switch.

Construction is quite straightforward and the use of the familiar Incar connectors allows the unit to be fitted easily to almost any car.

The later add-on unit allows simultaneous sounding of the horn and flashing of lights and brake lights when the alarm is activated, whilst maintaining complete isolation between these circuits when in normal use.

Both kits are constructed on compact PCBs, housed in attractive, weather resistant plastic cases. A complete kit of



parts for the original alarm unit is still available from Compu-Tech for £14.75 (PCBs only — £1.00 each). You can buy a complete kit of parts for the add-on system for £11.95 (siren £7.75 extra and PCBs only £1.00 each). Both kits and siren are available for £29.95 all inclusive (a saving of £4.50).  
ETI INDEX 10B

## CONTINENTAL SPECIALTIES CORPORATION

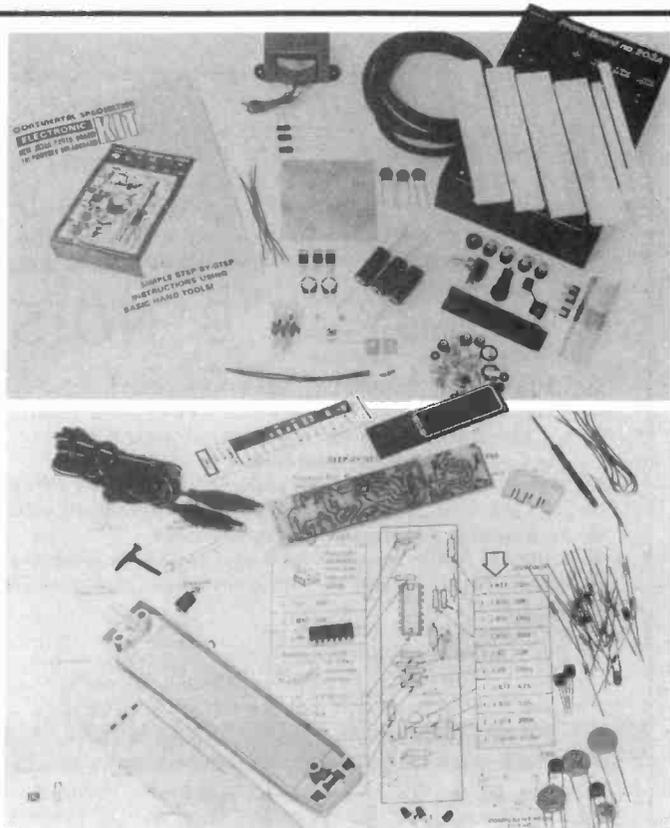
Company	Continental Specialties Corporation, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.		
Kit	Logic Probe Kit LPK-1		
Price	£11.92 + VAT		
Complexity	A		
Circuit Diagram	1		
Contents	3	Finish	3
Instruction Manual	3	Fault-Finding Guide	1

CSC, better known for their Proto-Board and Experimenter Systems, say you can build this full-performance logic probe kit 'in just a few hours of easy assembly'. I think even a newcomer to project building should be able to have a working probe in a lot less than a few hours with the aid of CSC's excellent, step-by-step instruction manual. The most difficult operation is persuading the PCB to fit inside the compact case — so no constructional problems here.

The 203A 'powered' Proto-Board is now also available as a kit (the 230AK) — a sturdy box with a large area of Proto-Board on top and a 5 V at 1 A and separate internally adjustable 7–18 V at 0A5 supplies inside.

The 230AK kit came in handy when I finished my Microtan computer kit. The 5 volt, 1A outlet was the perfect power supply. Then I used my completed logic pins probe kit to inspect the logic state of the computer chip pins.

ETI INDEX 11A



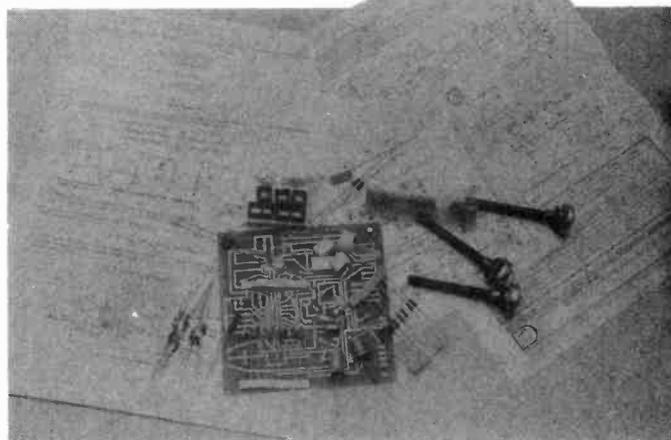
## DIGISOUND

Company	Digisound Ltd, 13 The Brooklands, Wrea Green, Preston, Lancashire PR4 2NQ.		
Kit	24 dB per octave low pass VCF		
Price	£18.08		
Complexity	B	Instruction Manual	3
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	0

Digisound sent me a kit from outside the ETI 80 range (the modular synthesiser series which we began in February this year). They sent a 24 dB/octave low pass voltage controlled filter with voltage control of resonance. Coarse and fine pot controls give a range of  $\pm 5$  octaves and  $\pm 1$  octave respectively.

With the PCB and component pack you will receive two important pieces of paper. The first gives some general notes on construction with details of Digisound's technical service, should you be unable to get your kit working. The second includes a circuit diagram, component overlay, component lists and more detailed construction, testing and calibration notes. For calibration you'll need a previously calibrated VCO.

Digisound's kits seem to have a lot less paperwork with



them than other kits of comparable cost and complexity. However Digisound manage to pack a great deal of useful information into a small space and yet keep it perfectly readable and understandable.  
ETI INDEX 10B

## ELECTRONIC DESIGN ASSOCIATES

Company	Electronic Design Associates, 82 Bath Street, Walsall WS1 3DE.		
Kit	Sparkrite X5 inductive discharge Electronic Ignition		
Price	£16.95		
Complexity	A	Instruction Manual	3
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	1

This spark of genius arrived well packaged with separate component packs. The instructions include a 'how to solder' section and the parts list gives resistor colour codes, so you're not likely to go wrong unless you're colour blind. EDA also operate an after-sales technical advice service, just in case you *do* have any problems. If you're not often under the bonnet of your Rolls, don't worry, fitting instructions are included.

All in all a useful, attractive and easy to build kit. When it's finished you don't have to bolt it on somewhere. It comes complete with clips, so that you can simply push it on to your coil. Connection is then a matter of attaching a few wires to the existing circuitry and you're off. No more cold morning push starts.

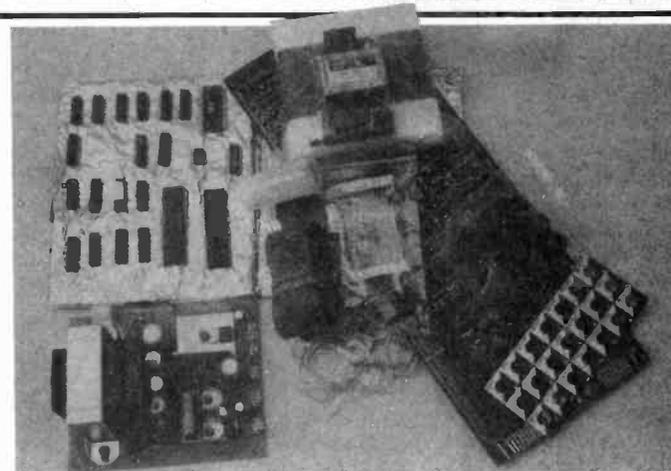
ETI INDEX 11A



## GP INDUSTRIAL ELECTRONICS

Company	GP Industrial Electronics, Skardon Works, Skardon Place, North Hill, Plymouth PL4 8HA.		
Kit	Softy EPROM Programmer		
Price	£115 + PSU (£23)		
Complexity	C		
Circuit Diagram	1		
Contents	3		
Instruction Manual	1		
Finish	3		
Fault-Finding Guide	1		

Henry Budgett of Computing Today, anxious to put his expert computing knowledge to good use, got cracking on this one (and soon wished he hadn't). He reports that the PCB is double-sided but not plated through, so you have to make some two hundred connections before you can put the first



# KIT FINDER

	Acorn Computers	Altek Instruments	Ambit International	Aura Sounds	Cambridge Kits	Catronics	Chromasonic	Chromatronics	Clef Products	Comp Comp Comp	Compu-Tech Systems	CSC	Crofton Electronics	Digisound	Electronic Design Associates	Electro-Tech Components	GJD Electronics
ALARMS											■						■
AMPLIFIERS						■											
CASSETTE DECKS																■	
COMPUTING	■									■							
DICE																	
DOLBY																	
DOOR CHIMES								■									
ELECTRONIC IGNITION															■		
GAMES																	
LIGHT SHOW																	
METAL LOCATORS		■															
RADIO CONTROL			■														
SYNTHESISERS				■					■					■			
TELETEXT																	
TEST GEAR			■										■				
TIMERS					■												
TUNERS						■											
TV CAMERA													■				

The addresses of companies who did not supply kits for the survey, but who are included in the quick index, are shown below. The addresses of companies who did supply kits are shown with the appropriate kit report.

Ambit International,  
200 North Service Road,  
Brentwood, Essex.

Aura Sounds,  
14-15 Royal Oak Centre,  
Brighton Road,  
Purley, Surrey.

Cambridge Kits,  
45 Old School Lane,  
Milton,  
Cambridge CB4 4BS

Chromatronics,  
River Way,  
Harlow, Essex.

Comp Comp Comp.,  
14 Station Road,  
New Barnet,  
Herts EN5 1QW

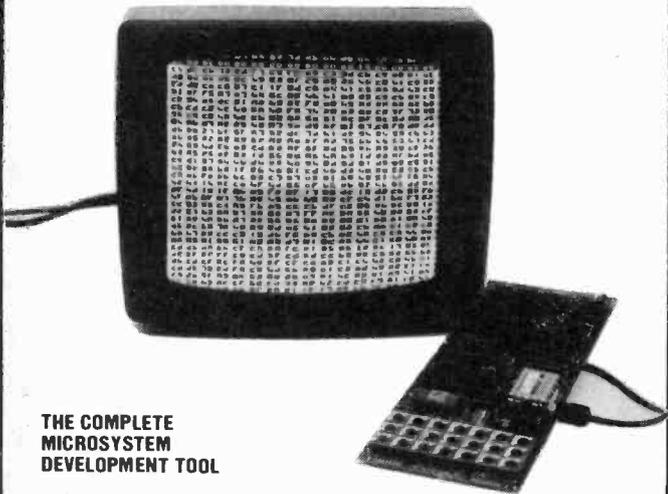
Crofton Electronics Ltd.,  
35 Grosvenor Road,  
Twickenham,  
Middlesex.

Electro-Tech Components Ltd.,  
364 Edware Road,  
London W2

GMT Electronics,  
Freeport,  
Birmingham B19 1BR



## SOFTY INTELLIGENT EPROM PROGRAMMER



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### GP INDUSTRIAL ELECTRONICS LIMITED

Skardon Works, Skardon Place, North Hill, Plymouth PL4 8HA.  
Telephone: Plymouth (0752) 28627

## BUILD YOUR OWN METAL DETECTOR VLF/TR VCO/TR IB/TR BFO...

Pre-aligned search heads — test equipment not required. Literature available in return for SAE. Manuals and parts sold separately; write or phone for price. Export welcome; write for quote.



Shadow TR/1B

**Shadow VLF/TR.** Full specification discriminator, not just ferrous/nonferrous indication. It works by measuring the conductivity of the target; now you can reject nails bottle caps even aluminium foil and ring pull tabs! Full ground effect exclusion over normal or high permeability soils. The head is thermally and capacitively shielded.

4 modes: deepseeking VLF plus 3 TR discriminating ranges. Push button "memory" tuning. Performance equals commercial detectors costing £200! As described in ETI.

**Complete kit now only £79.70 inc. VAT & post!**  
**Individual parts:** Search head £21.33 PCB £6.80 Case £5.33 Adjustable shaft assy. £5.10 LM393 £1.12. Manual (gives more info. than ETI article — and extra function) £1.12. All inc. VAT & post! (Other parts also available separately)

**Shadow TR/1B** (illustrated). A true transmit receive/induction balance detector at a budget price for anyone who doesn't need discrimination. Waterproof and thermally insulated search head. Good sensitivity. Built-in speaker and headset jack. **Complete kit £25 + VAT** (post & Pkg. £1.80).

**Shadow TV/VCO.** An advanced version of the TR/1B. Use as a sensitive IB machine or switch to VCO mode when the sound changes to a varying pitch, allowing easier use over mineralised ground and enabling detection of negative, high permeability anomalies. **Kit price £29 + VAT** (post £1.80).

**Matching stereo headphones for all Shadow models £4.90 + VAT** (post paid).

**Beginners BFO model.** A very detailed assembly manual and pre-wound coils make this an ideal first project. Simple high efficiency circuit. Full size (not a toy) but weighs only 300gms (10.5oz) with battery! **FREE STETHOSCOPE HEADSET** with every order. **ALTS kit: £12 + VAT** (post £1.80). Padded high Z headphones £4.50 + VAT (post paid).

**Shell Kit.** Consists of the (hard to find) hardware items, for detectors of your own design. Fully adjustable shaft with handle; search head mouldings (int. diam. 185mm) with hinge assembly, special clips to mount your own control housing (any box is suitable). Completely non-metallic and undrilled. With assembly instructions **£8.25 + VAT** (post £1.50).

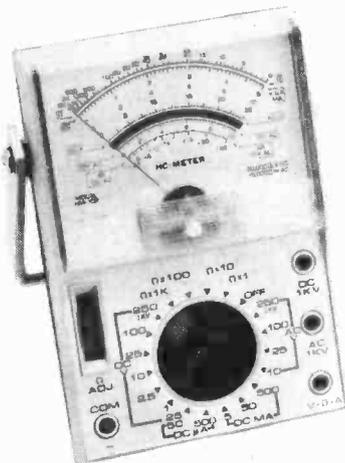
## ALTEK (ETI), 1 Green Lane Walton-on-Thames Surrey

Order by post or phone (24 hours). Access & Visa Cards quote number. Callers by appointment only please. Phone (093 22) 44110 anytime

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### Specification:

Voltage

**Model HM-102**  
DC: 0.25, 1, 2.5, 10  
25, 100, 250, 1000  
AC: 10, 25, 100,  
250, 1000

Sensitivity

DC: 20,000 Ohms/Volt  
AC: 10,000 Ohms/Volt

Decibels

-20 to +20 db

OC Current

50, 500µA

Ohmmeter

5, 50, 500mA  
30 Ohms centre scale

Power Supply  
Size  
Weight (incl. battery)

Four Ranges:  
0.6 k.Ohms  
0.60 k.Ohms  
0.600 k.Ohms  
0.6 M.Ohms  
Single 1.5V cell  
135 x 91 x 39mm  
280 gms.

Mirrored scale  
Overload protection  
Carrying handle doubles  
as bench stand

**Model HM-101**  
DC & AC 10, 50  
250, 1000

2,000 Ohms/Volt

-10 to +22 db

100mA

60 Ohms centre scale

Two ranges:  
0-10 k.Ohms  
0-1 M.Ohms

Single 1.5V cell  
90 x 60 x 29mm  
92 gms.

Mirrored scale



Delivered price. £13.99 U.K. £15.99 Export £5.95 U.K. £7.95 Export  
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**Also available:** Delpak voltage regulators and power supplies, Delpak keypads and keyboards, Futaba keyboard switches, Futaba vacuum fluorescent displays, I.Cs. from OKI; Power amplifiers, filters, stereo image width control, compressor/expander, active crossovers, power supplies, plus all pots, switches, etc.

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Luton LU1 1DF. Tel: (0582) 28887  
Send large S.A.E. for details

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Natural Bio Electric signals are monitored by an electrode attached to the leaf. When amplified and filtered, a VCO, VCA and other exclusive synthesiser circuits are controlled by the potential to produce tracking sequences of notes. These follow in pitch, rhythm and volume the ever changing signal.

Components include: 6IC's, 3 Transistors, 11 Diodes, 19 Capacitors, 50 Resistors, PCB, L.S., all Hardware and professional teak finish case.

Output available for either audio amplification or a directly coupled signal from the biological amplifier for use with oscilloscope or chart recorder.

A Biological Amplifier and Sound Synthesiser in one Instrument.

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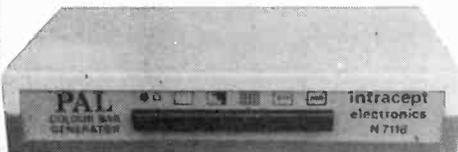
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- ★ Size only 8" x 5½" x 1½"
- ★ Ready-built and tested version —

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## NASCOM 1 & 2 COLOUR GRAPHICS BOARD

- ★ Runs on a Minimum Nascom 1 or 2
- ★ 8 Background and 8 Foreground Colours
- ★ Continuous shapes may be constructed using the 3072 Colour addressable cells.
- ★ Text and Colour Graphics may be mixed anywhere on Screen.
- ★ The complete kit, including Test programs only

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WAVERTREE, LIVERPOOL 15

TEL: 051-733 3042

# 2 !!LOOK!! SUPERB NEW KITS!



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high performance electronic ignition, to add power, economy, reliability, sustained smooth peak performance, instant all weather starting, to your car.

Surefire has sold in its thousands in ready made form from big name accessory firms, but it is now available in quality kit form to fit all vehicles with coil ignition up to 8 cylinders.

**ES200.** A high performance inductive discharge ignition incorporating a power integrated circuit (special selection); electronic variable dwell circuit (maximises spark energy at all speeds); pulse processor (overcomes contact breaker problems). Coil governor (protects coil). Long burn output. Negative earth only. Compatible with all rev. counters.

**C300.** In it's ready built form (C3000) it came top of all systems tested by an independent national authority July '79. A high energy capacitive discharge ignition incorporating a high output short circuit proof inverter, top grade Swedish output capacitor, pulse processor circuit, transient overload protection. Fast rise bidirectional output ideal for fuel injection, sports carburation, oily engines. Compatible with most rev. counters. (Low cost adaptors available for rare cases).

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**What's in the kits.** Surefire's own precision anodised aluminium extruded case. P.C. mounted security changeover switch, static timing light. Special selection Motorola semi-conductors. Capacitors, resistors etc. selected after 5 years experience. Glass fibre pcb. solder, complete down to last washer.  
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Name

Address

\*Phone order with Access/Barclaycard VAT and P & P inc.

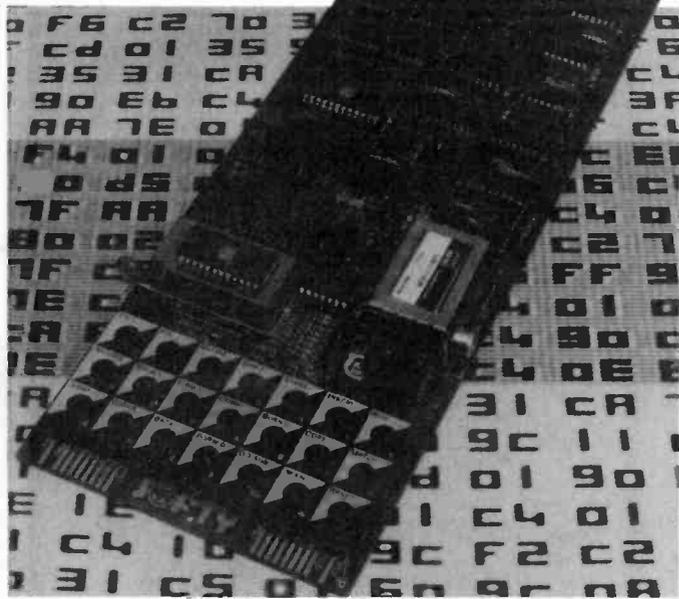
Quantity required

ES200: Neg	⊖	£13.95	
C300: Pos	⊕	£17.95	
C300: Neg	⊖	£17.95	
Tacho Adapt. TCI		£3.90	

Enclose cheq/PO's  
£  
Chq No.

component in. The parts list is incomplete (not listing the modulator or the hardware — nuts, bolts, keys, etc). Constructional notes are almost non-existent. However, a warning is included for the constructor — ‘A professional level of understanding is expected and assumed.’

This is definitely *not* a kit for beginners as a thorough knowledge of computer systems is required to build it into your system. At £115 it's a bit pricey, especially if you don't understand what you're doing. If you *do* end up with an expensive book-end, send it back to GP Industrial Electronics with a cheque for £20. They'll sort it out and charge you for any parts they think you've shuffled off to the great reject bin in the sky.  
ETI INDEX 9C



## HEATHKIT

Company	Heathkit, Bristol Road, Gloucester GL2 6EE		
Kit	Quartz Clock Timer GC-1415		
Price	£43.63		
Complexity	B	Instruction Manual	3
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	1

Heathkit's excellent instruction manual greatly simplifies construction of this sophisticated quartz clock/timer, bringing it within the range of ability of more constructors. That makes sound economic sense. The more people who are capable of building the kit, the bigger the potential market.

Although it's not the simplest of kits, Heathkit's manual assumes nothing. It starts from the basics with notes on soldering. The kit is intended for installation in your car (a mounting bracket and adhesive pads are supplied), but, with the addition of a 12 volt DC supply, you have a 12 hour, 4 digit clock with trip-timer and stopwatch functions attractive enough to grace your mantelpiece (at home, not in the car!). If you *are* going to fit it in your car, full fitting instructions are given for negative earth vehicles.

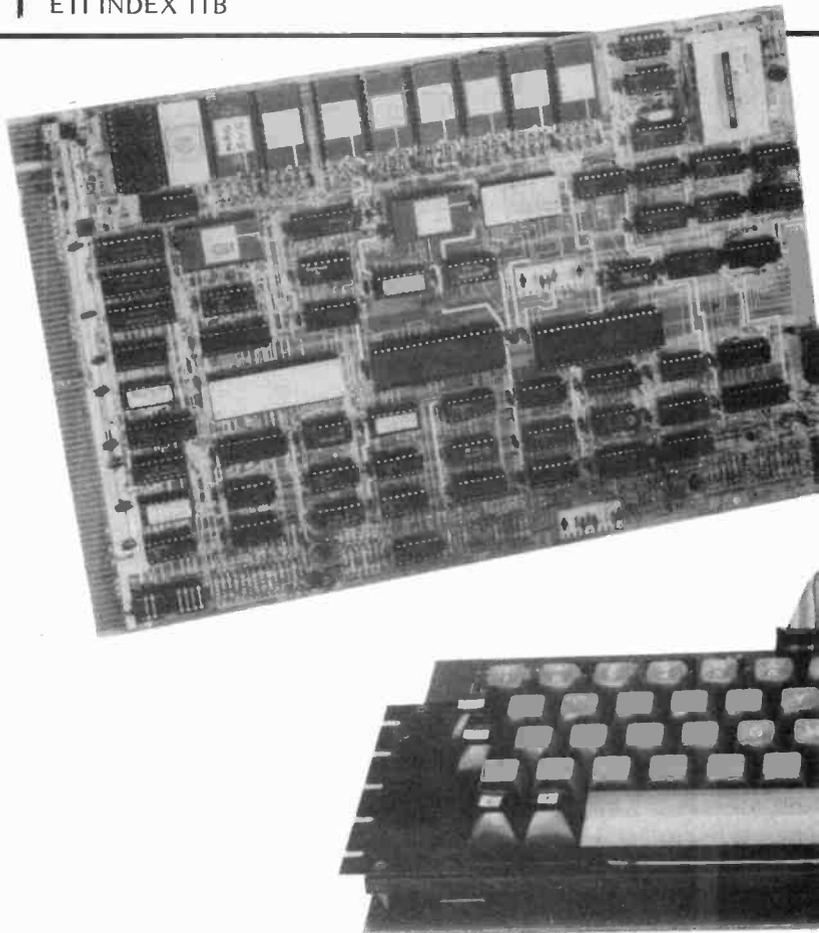
I haven't a great deal to say about this kit — the sign of satisfaction and trouble-free construction, well-known to be typical of the well-prepared and presented Heathkit products.  
ETI INDEX 11B

## HENRY'S RADIO

Company	Henry's Radio, Computer Kit Division, 404 Edgware Road, London W2.
Kit	Nascom 2
Price	£295 + VAT
Complexity	C
Circuit Diagram	1
Contents	2
Instruction Manual	3
Finish	3
Fault-Finding Guide	1

If you're not already acquainted with Nascom 2 or anything of comparable constructional complexity, opening the boxes of boards and seemingly endless bags of components can be a traumatic experience. There are an awful lot of holes in the PCB that have to have something soldered into them. Where to begin the endurance test?

The manual offers good advice. 'Do *not* begin construction now. Read through all the documentation at least twice.' Construction times can range from under 10 hours to over 40, 30 hours being the average. The manual advises you not to work for more than 2 or 3 hours at a stretch — good advice. It then goes through each stage of construction with diagrams, where necessary. This isn't the sort of kit that you can start on the dining room table and clear the bits away every time dinner, tea, supper, etc come around. That's the easiest way to lose bits and destroy chips. Find a place where everything can lie undisturbed for days at a time. It also helps if you



## INTEGREX

Company	Integrex Ltd, Portwood Industrial Estate, Church Gresley, Burton On Trent, Staffordshire DE11 9PT.		
Kit	Dolby Noise Reducer		
Price	£50.48		
Complexity	C	Instruction Manual	2
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	0

If you bought a cassette deck without Dolby noise reduction and don't feel like trading it for a machine with Dolby, you could build the Integrex Dolby Noise Reducer as a separate unit. Integrex claim that their design is the only 'add-on' Dolby processor kit in the world.

Integrex's preface to the construction notes advises you to check that all the components have been packed and sent in good condition. It may seem obvious, but it's always worth reminding the newcomer to kit-building. The remainder of the instruction leaflet takes the form of a reprint of the magazine article describing the system. One useful feature is the inclusion of a note of the most common constructional errors — collect one bonus point as you pass go in lieu of a point for the absent troubleshooting guide.

## INTRACEPT ELECTRONICS

Company	Intracapt Electronics Ltd, 203 Picton Road, Liverpool L15 4LG.		
Kit	Nascom colour graphics board		
Price	£22.50		
Complexity	B	Instruction Manual	2
Circuit Diagram	1	Finish	2
Contents	3	Fault-Finding Guide	0

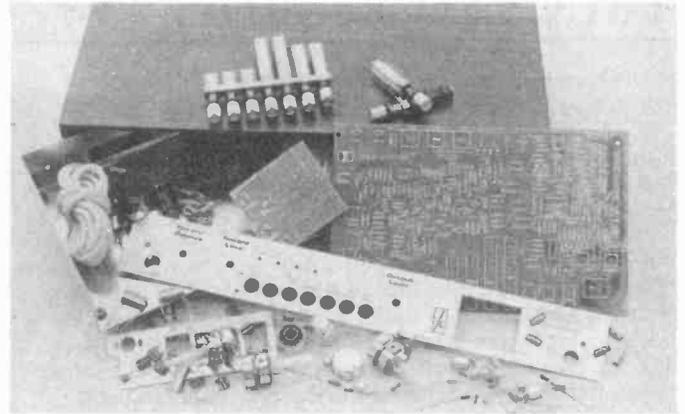
If you already have a Nascom 1 or 2, this kit enables you to produce colour graphics under software control. The background can be set to one of eight colours (including black and white) by altering the contents of address 0C00 or by

have a high SQ (stamina quotient) or BT (boredom threshold) because there is a lot of intricate soldering to get through before you come to the interesting bit — switching on. The only serious error a careless constructor might make is in the connection of the keyboard to the processor PCB. It is possible to plug the keyboard into the wrong position. Then, at switch-on you find you no longer have a working keyboard. This was drawn to my attention by a recent phone call to Computing Today from an electronics engineer who, of course, ignored the instruction manual. Being a professional, he didn't need to read the manual. He blew up his keyboard. 'Read through all the documentation at least twice.'

Because of the non-availability of 4118 chips, Nascom 2s are currently being supplied without the 4118s, but with a free 16K dynamic RAM board. When 4118s are again available, Nascom 2 buyers will be able to get hold of them at the special price of £80 + VAT for the 8K.

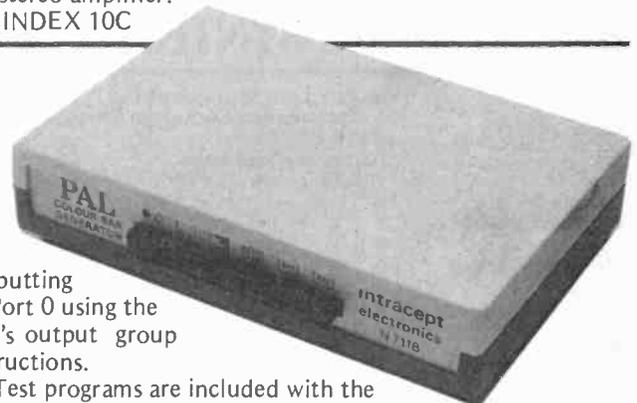
Henry's Radio are also offering a free power supply. If you get your Nascom 2 from Nascom, without 4118s and without the 16K RAM board you can expect to pay £225.

ETI INDEX 10C



The PCB and components come with all the necessary hardware — an aluminium chassis and an attractive mahogany sleeve. The unit matches other Integrex products in both appearance and electronically, in terms of input/output signal parameters and standardised DIN sockets. So, having built your Dolby system you can then build a matching FM tuner and stereo amplifier.

ETI INDEX 10C

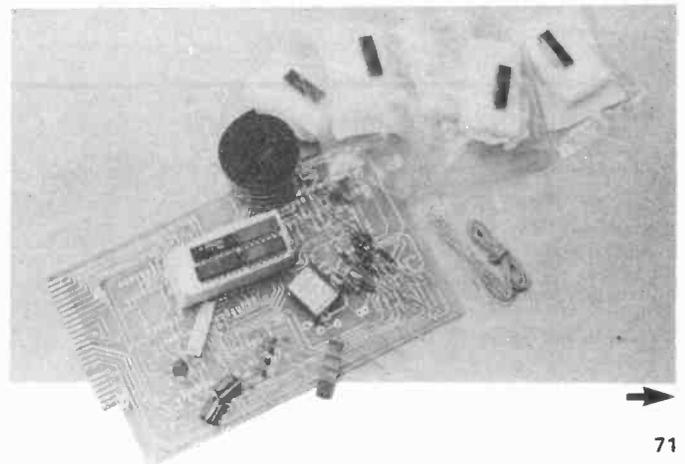


outputting to Port 0 using the Z80's output group instructions.

Test programs are included with the instructions to ensure that the board is functioning properly (Nasbug and Nas-Sys versions are supplied). The colour graphics modulator may be used with Nascom 1 or 2 and the appropriate alterations to Nascom's main board in order to use the colour graphics option are given, together with a testing procedure.

Intracapt also supply a colour bar generator kit primarily for the field service engineer. It's a useful diagnostic tool for troubleshooting colour telly faults. It can display the standard waveforms and colour bar pattern. From them, if you know what you're doing, you should be able to spot decoder faults (incorrect matrixing, ident, colour balance, demodulator phasing, delay line adjustment, etc.). The five patterns available (blank raster, grey scale, cross-hatch, colour bar and red raster) should enable a service engineer to accurately adjust and service colour television in the home.

ETI INDEX 8B

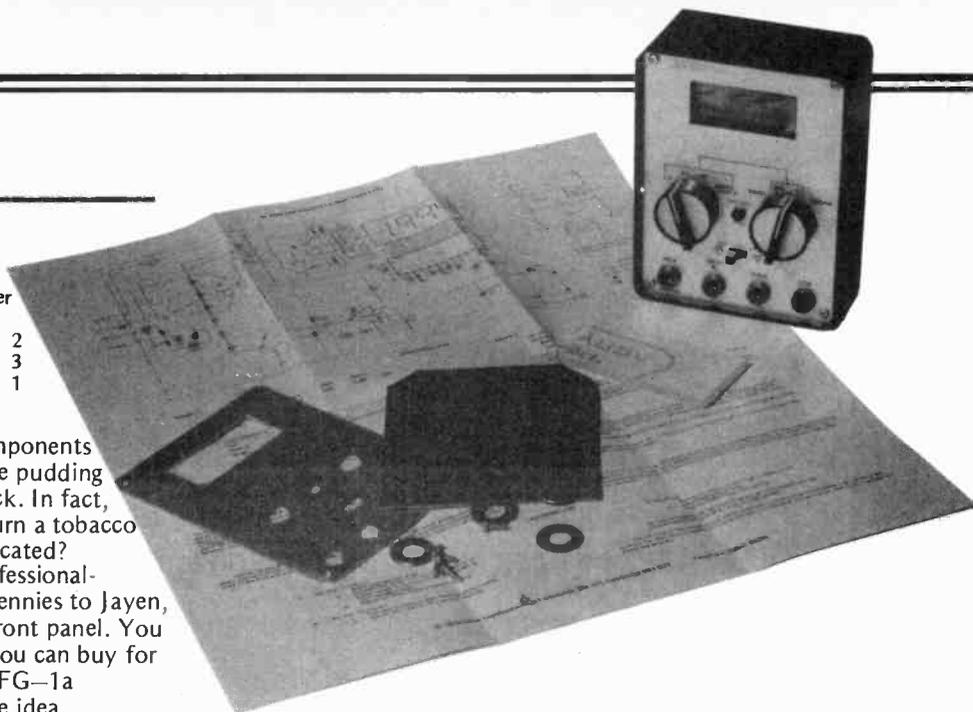


## JAYEN DEVELOPMENTS

Company	Jayen Developments, 21 Gladeside, Bar Hill, Cambridge CB3 8DY.		
Kit	Jaykit DM-2 Digital Multimeter		
Price	£5.45		
Complexity	B	Instruction Manual	2
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	1

I must confess that the idea of a kit without components struck me as about as useful as a handful of rice pudding for resurfacing the M1. However, I take it all back. In fact, it's not a bad idea at all. What do you need to turn a tobacco tin project into something a shade more sophisticated? You could start with a well-made PCB and a professional-looking front panel. Well, if you send off your pennies to Jayen, that's exactly what they send you — PCB plus front panel. You also get a shopping list for components, which you can buy for £23.75 from an address given by jayen. Jaykit's FG-1a Function Generator is also sold in this form. Nice idea.

ETI INDEX 10B



## JEREMY LORD SYNTHESISERS

Company	Jeremy Lord Synthesisers Ltd, 3 Charterhouse, Eltringham Street, London SW18 1TD.		
Kit	Bioactivity Translator		
Price	£27.35		
Complexity	B		
Circuit Diagram	1		
Contents	3		
Instruction Manual	2		
Finish	3		
Fault-Finding Guide	0		

This instrument has been getting a lot of publicity recently in the national Press and on radio. It works on the principle that plants generate minute electrical potentials which the translator can amplify and use to control a synthesiser. The sound output follows the signals from the plant in pitch, rhythm and volume.

In practice, however, the device responds more to movement of the plant. I suspect this has something to do with the design of electrodes used — based loosely around a common or garden hairclip and conductive foam pads. However, the principle is sound and the system works.

What's it like to build? Construction posed no problems. The PCB fits neatly into the smart teak finish case and a self-adhesive plastic sheet gives the front panel a professional appearance. It's a self-contained unit — you don't have to plug it into your amplifier. Synthesiser, amplifier, controls, batteries and loudspeaker are all housed in a single box.

ETI INDEX 9B

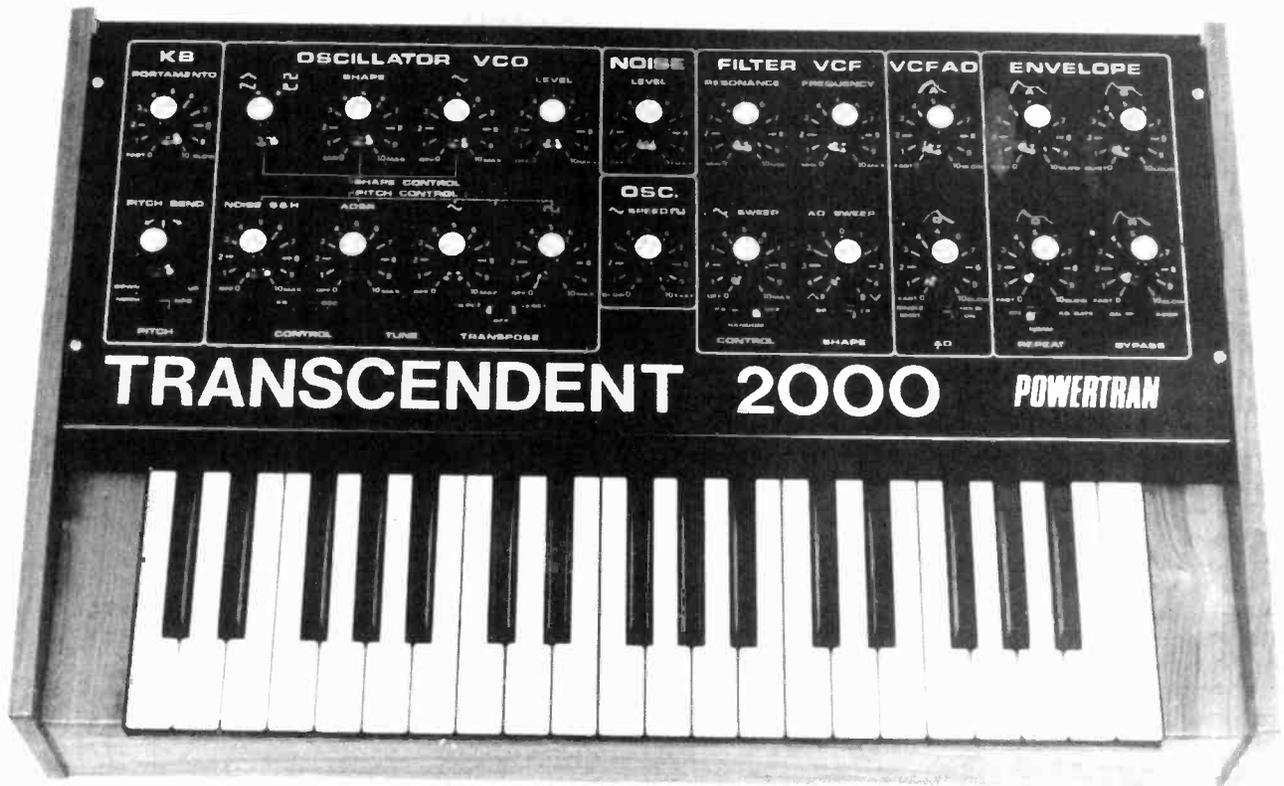


## NIC

Company	NIC, 61 Broad Lane, London N15.		
Kit	Pinball Wizard		
Price	£39.30		
Complexity	B		
Circuit Diagram	1		
Contents	3		
Instruction Manual	3		
Finish	2		
Fault-Finding Guide	0		

The Pinball Wizard black and white TV game was featured exclusively in the November 1979 issue of ETI. NIC purchased 500 of the games chip used in this kit. As Pinball Wizard has been selling well, I should get in touch with NIC as soon as possible, to avoid disappointment.

The chip does most of the work, so there are few extra components on the board, simplifying construction. You can buy everything you need from NIC for £39.30, or you could invest in just the basic kit of PCB and components for £28.90. The box and controls are £6.50 extra and the mains adaptor another £3.90.



## POWERTRAN ELECTRONICS

Company	Powertran Electronics, Portway Industrial Estate, Andover, Hants SP10 3NM.		
Kit	Transcendent 2000		
Price	£168.50 + VAT		
Complexity	C	Instruction Manual	3
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	0

Powertran Electronics sent us a Transcendent 2000 single board synthesiser to have a look at. It's a 3 octave instrument transposable 2 octaves up or down giving an effective 7 octave range. Features include portamento, pitch blending, a VCO with shape and pitch modulation, a VCF with both low and high pass outputs and a separate dynamic sweep control, amongst many, many others.

It's definitely not a beginners' kit, although we can't give you a full account of any constructional difficulties, because Powertran wouldn't let us build it. However, I can tell you that the kit comes absolutely complete, right down to the mains plug. The components are separated into 16 packs, each with a separate component listing, greatly facilitating component checking.

ETI INDEX 10C

The game includes pinball, basketball and breakout options, selected by push button. The star was undoubtedly breakout. Everyone here at ETI who borrowed the game became hopelessly addicted to breakout. You find that you have to have just one more game to try to get the maximum score of 864 by demolishing two walls of bricks with seven balls . . . and then just one more game . . . and then . . .

NICs shop is packed with goodies, from a car alarm kit to computer kits (Nascom 2 and the UK101) including the Heathkit H14 Line Printer. Why not pop round for a browse.

ETI INDEX 9B



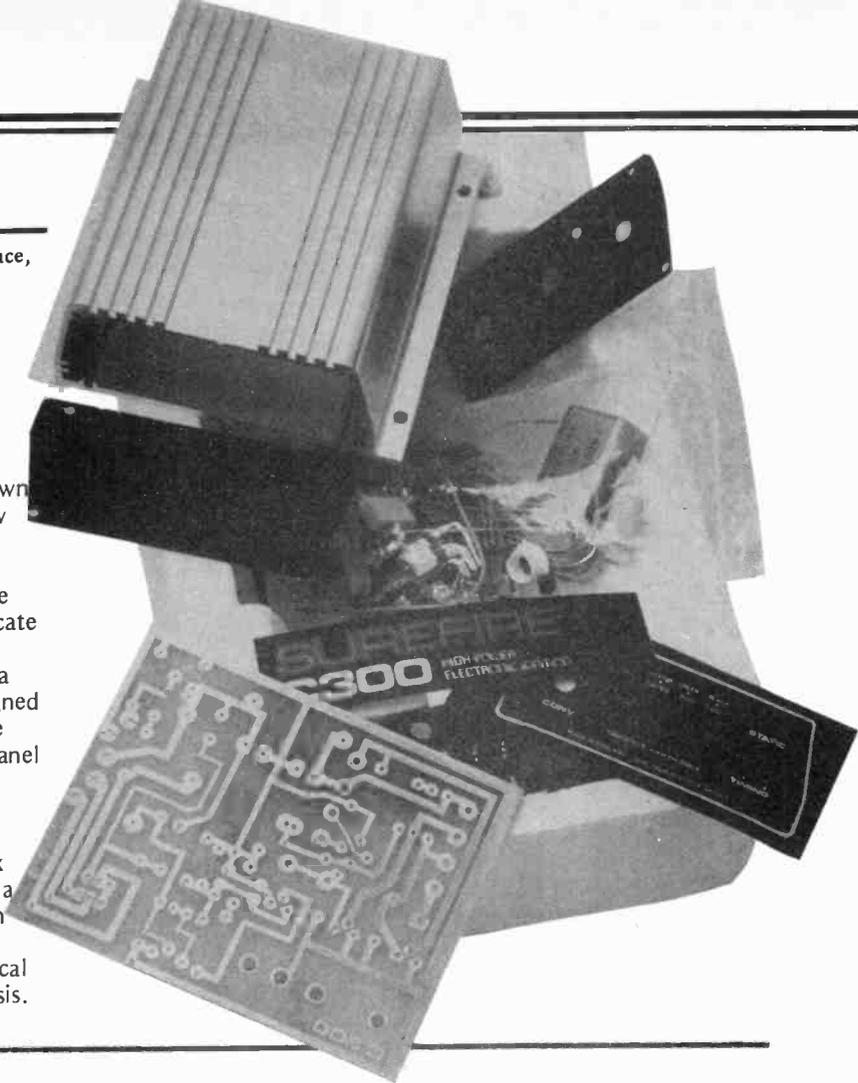
## SURETRON SYSTEMS

Company	Suretron Systems (UK) Ltd, Piccadilly Place, London Road, Bath BA1 6PW.
Kit	Surefire C3000 Electronic Ignition
Price	£17.95
Complexity	A
Circuit Diagram	1
Contents	3
Instruction Manual	2
Finish	3
Fault-Finding Guide	1

Construction is straightforward — just work your way down the list of assembly instructions. Copious diagrams show how components should be mounted. One group of components must be mounted very close to the PCB as a choke is mounted above them. Be careful how you hold the board when you're trying to persuade the choke pins to locate properly in the holes. When they snap into position, I can assure you that the pointed pins go through fingertips like a hot soldering iron through butter. Although the kit is designed for negative earth vehicles, alterations are given for positive earth vehicles. When construction is complete Suretron's panel stickers give the kit a professional finish.

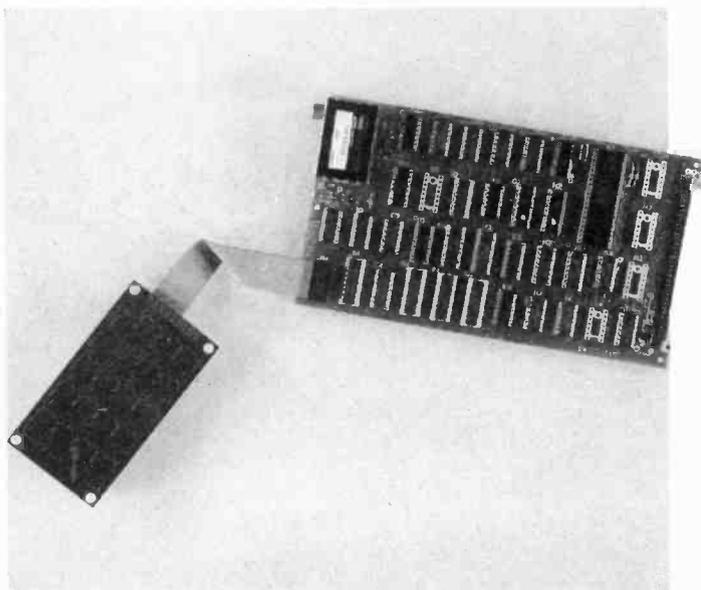
Fitting your new space-age electronic ignition system involves drilling a few holes in your precious auto-not-so-mobile. If you follow all the instructions, but the little box still suffers rejection problems from your motor, a flick of a switch returns the engine to conventional ignition operation until you can sort out the trouble.

If problems persist Suretron operate a telephone technical service or you can return the unit to them for fault diagnosis. ETI INDEX 10A



## TANGERINE COMPUTERS

Company	Tangerine Computers, Forehill, Ely, Cambs.
Kit	Microtan 65
Price	£69 + VAT
Complexity	C
Circuit Diagram	0
Contents	3
Instruction Manual	3
Finish	3
Fault-Finding Guide	0



The arrival of this kit on my cluttered desk made a little bit of history at ETI. It kindled in my well-thumbed grey cells something approaching enthusiasm for computing — something which I had previously thought impossible. I grasped Microtan in both hands and made for the wilds of Staines. The kit is presented in the form of a ring binder. Open the first page and there is your basic kit. Free the PCB from its cling-film and underneath it you find the components, neatly laid out on double sided tape, making component checking as easy as falling off a soldering iron. Construction shouldn't pose any problems, as it's just a matter of identifying the component and plugging it into the position marked on the PCB. I reckon if I, with no past experience of computing, or computer kits, can build this kit and have it working in an evening of not very arduous soldering, then anyone can. Mind you, before I started, I equipped myself with a fine tipped iron and very fine solder.

Once it's working you can plug in extra ICs to give lower case and graphics options. If you find hexadecimal machine code as baffling as I do, you can add an expansion unit (TANEX) and a BASIC interpreter, so that you can talk to the machine through an ASCII keyboard in something resembling English. The excellent manual, also included in the ring binder, gives a few sample programs. Within hours of getting my hands on this kit, I was blissfully blasting marauding aircraft out of the sky with my telly-bound missile.

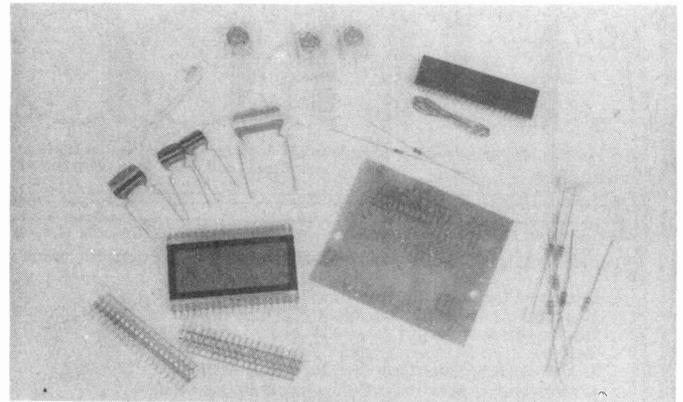
I've quite arbitrarily given this kit a bonus of five on the ETI INDEX for getting just about everything right and providing excellent value for money. I'd recommend Microtan 65 to anyone with a modicum of soldering experience and an interest in computing.

ETI INDEX 14C

## TK ELECTRONICS

Company	TK Electronics, 106 Studley Grange Road, London W7 2LX.		
Kit	DVM/Thermometer		
Price	£20.75 + VAT		
Complexity	B	Instruction Manual	2
Circuit Diagram	1	Finish	2
Contents	3	Fault-Finding Guide	0

This kit was featured as a Kit Review subject in Hobby Electronics (October 1979). HE built the digital thermometer version. When you've decided which version of the kit you want to construct you have to build a decimal point driver. Three circuits are suggested — two give a fixed DP and the third a floating point. The thermometer uses a fixed DP. No provision is made for the DP driver on the board and its components are not included with the kit, but this shouldn't cause any problems, especially if you have the typical constructors' junk box of components.



The diode sensor proved to be reliable and the thermometer appeared to be sensitive to temperature changes  
ETI INDEX 8B

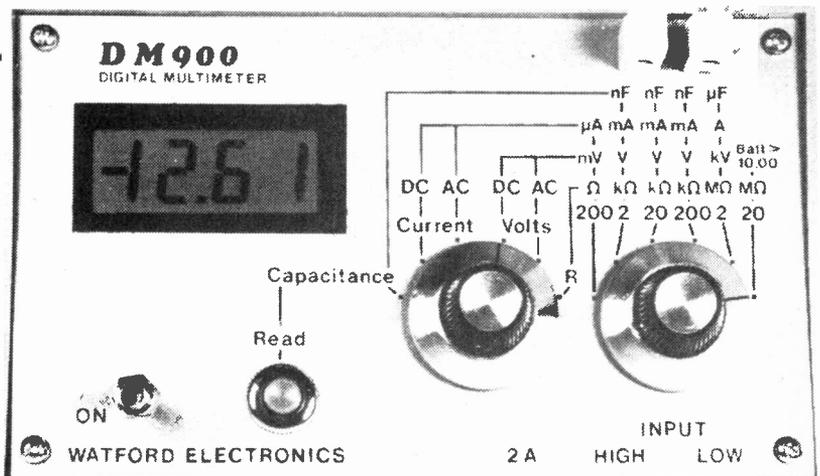
## WATFORD ELECTRONICS

Company	Watford Electronics, 33-35 Cardiff Road, Watford, Herts.		
Kit	DM 900 Digital Multimeter		
Price	£60 + VAT		
Complexity	C	Instruction Manual	2
Circuit Diagram	1	Finish	3
Contents	2	Fault-Finding Guide	1

I hope you know your colour code for resistor tolerances. Watford's DM 900 kit uses 1, 2 and 5 per cent resistors and there's no explanation of the coding in the instructions. The only minor irritation to mar this otherwise well presented kit was that the complement of 64 single-ended Vero pins was about thirty short. The PCB, although double-sided, does not have plated through holes. So, links between the top and under side of the board are made by Vero pins.

Construction is fairly straightforward, being a matter of finding a component on the parts list and soldering it into the correct position marked on the PCB. You'll have to drill the plastic case to take the three test sockets, although the front control panel comes ready drilled and with the meter scales marked.

You can buy the kit assembly instructions separately for £1.00 (free with kit) if you have an alternative supply of



components. However, if you are not building the DM900 from Watford's kit, don't skimp on components to save a few pence. Get the best. You can't expect to make an accurate meter if you use, for instance 10% or even 5% resistors throughout.  
ETI INDEX 9C

## WILLIAM STUART SYSTEMS

Company	William Stuart Systems, 137 Billericay Road, Herongate, Brentwood, Essex.		
Kit	Videograph		
Price	£26.95 + cabinet and controls £12.95		
Complexity	B	Instruction Manual	3
Circuit Diagram	1	Finish	3
Contents	3	Fault-Finding Guide	1

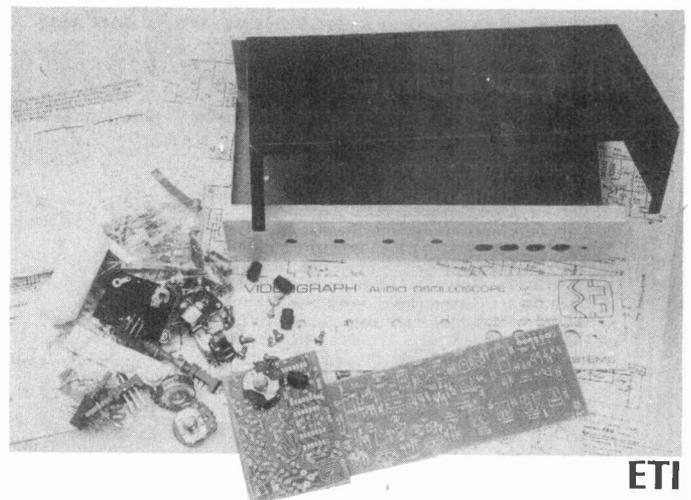
If you want to buy a Christmas present for your hi-fi system, this luxury box of tricks is a bit out of the ordinary. It actually displays sound waves in colour on any normal television set. Left and right hand channels are shown in contrasting colours. Press a button to invert one channel. Peak signals make the background cycle through eight colours.

The Videograph also has a test signal generator. You can record the clean square wave on your cassette recorder, playback the signal through Videograph and actually see the distortion introduced by your system. You can actually see the flutter, wow, low frequency and transient response of your recorder, amplifier, etc.

Construction is a matter of plugging components into two

well-marked PCBs according to the clear instruction sheets. The chassis is pre-drilled with an attractive front panel. William Stuart Systems offer a repair service if things go drastically wrong.

ETI INDEX 11B



ETI

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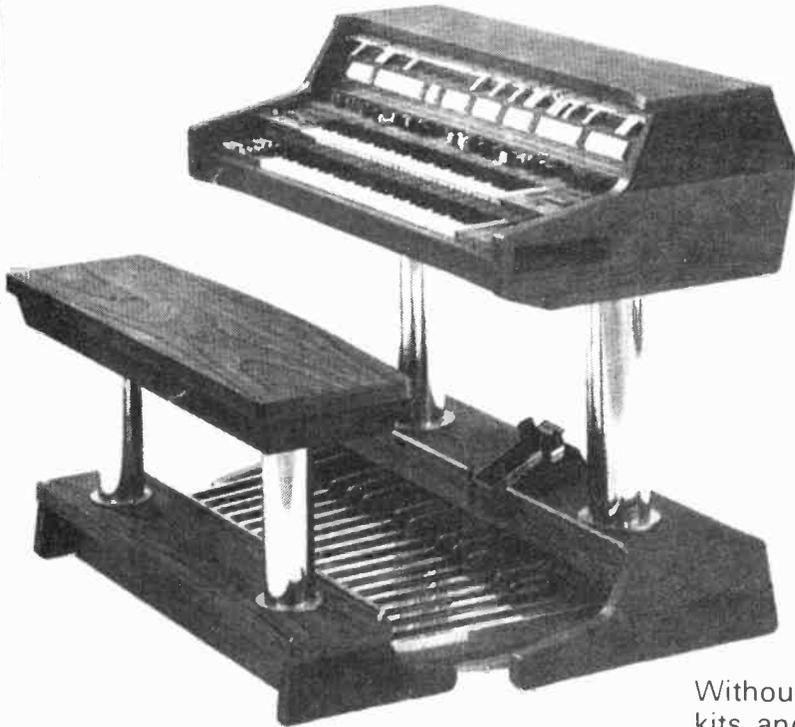
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# LED VU METER

An excellent way to watch what goes on in those secretive screened leads. Can be adapted to various levels of operation.

This unit will not replace the conventional VU or PPM meter; no LED display could fulfill the spec. However, with an output in 3 dB steps and a choice of a dot or bar display, it will make a useful and attractive addition to any audio system.

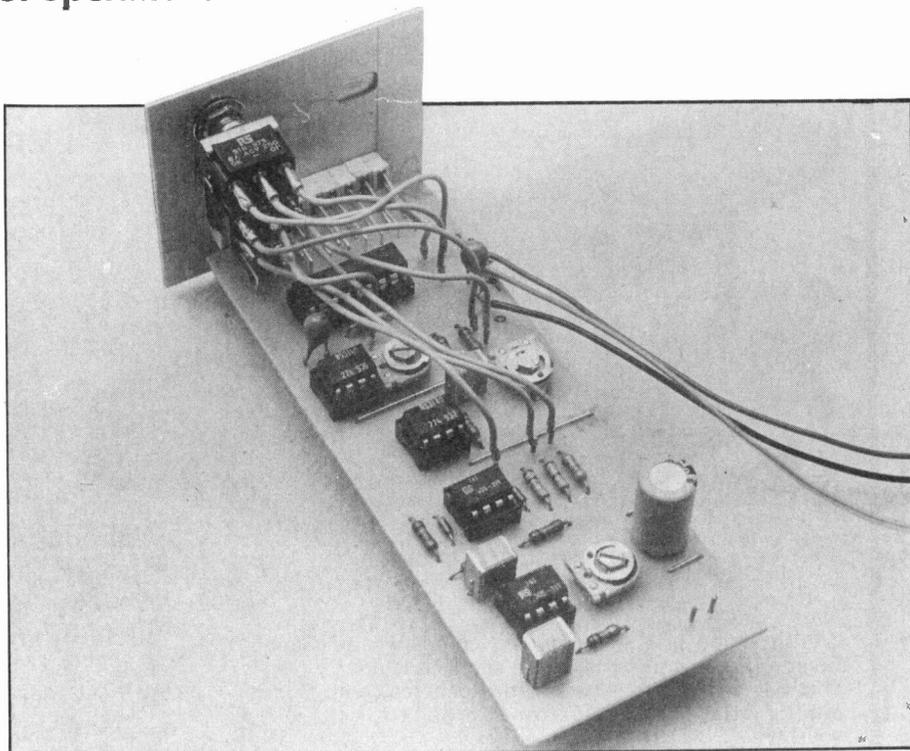
## 5 Into 1 = 10

With the log function achieved directly inside IC5, the use of four separate op-amps to condition the signal may seem extravagant. However, the circuit design precludes the use of a conventional quad op amp package like the 324 and the final circuit exploits the good, all-round, economical performance of the 741s and the extremely high input impedance of the 3140s. The display consists of ten LEDs and these can be illuminated in a dot or bar format. Selection is by a SPDT switch, or a wire link may be permanently connected. Sensitivity of the unit is high. The gain of the first amplifier stage is adjustable and a full scale reading can be obtained with an output of just a few millivolts.

To keep down cost and avoid complex circuitry, a half-wave rectifier has been used. The meter has switchable resistors giving a peak programme response with fast attack and slow decay and a volume unit response with slower approximately equal response times. The response characteristics for each mode may easily be changed by selection of a few resistors and have little interaction with each other.

## Construction And Setting Up

Use of our PCB makes construction simplicity itself and results in quite a compact and attractive unit. The PCB has been designed to accommodate stackable rectangular LEDs as shown in our photos. However, any type and colour of LEDs may be used. There are only four wire links to be inserted and the remaining components may be inserted as they come to hand. It is good practice to leave the semiconductors until last and use of sockets for the ICs makes substitution for fault-finding easy. Although ICs 3 and 4 feature FET input



stages, these are well protected and no special handling precautions are required.

When completed, the unit may be set up by short-circuiting the input and, with a DC-coupled 'scope or sensitive voltmeter connected to the output (pin 6) of IC4, adjusting RV2 until the output reaches 0 V. Then apply the maximum signal you wish to indicate and with the unit set to VU adjust RV1 for a full scale reading. Now switch to PPM and adjust RV3 until a full scale reading is just obtained. The unit will cover a wide range of input levels, though for very high input signal levels you may have to attenuate the driving signal. A simple resistive divider will easily accomplish this. Do yourself a favour and have a peak at better VU today.

## BUYLINES

The 3915 is available from Technomatic. Stackable rectangular LEDs are available from Watford Electronics. The other components should be readily obtainable.

## PARTS LIST

### RESISTORS All 1/4W, 5%

R1,10	100k
R2,3,4	10k
R5	2M7
R6	10M
R7,9	22k
R8	47k
R11	1k0

### POTENTIOMETERS

RV1	10k min horiz. preset
RV2,3	100k min horiz. preset

### CAPACITORS

C1,2	470n polycarbonate
C3	100u electrolytic
C4	100n polycarbonate
C5,6	10u tantalum

### SEMICONDUCTORS

IC1,2	741
IC3,4	3140
IC5	LM3915
D1,2	1N4148
LEDs	any LED

### MISCELLANEOUS

PCB, DPDT switch, SPDT switch, connectors, etc.

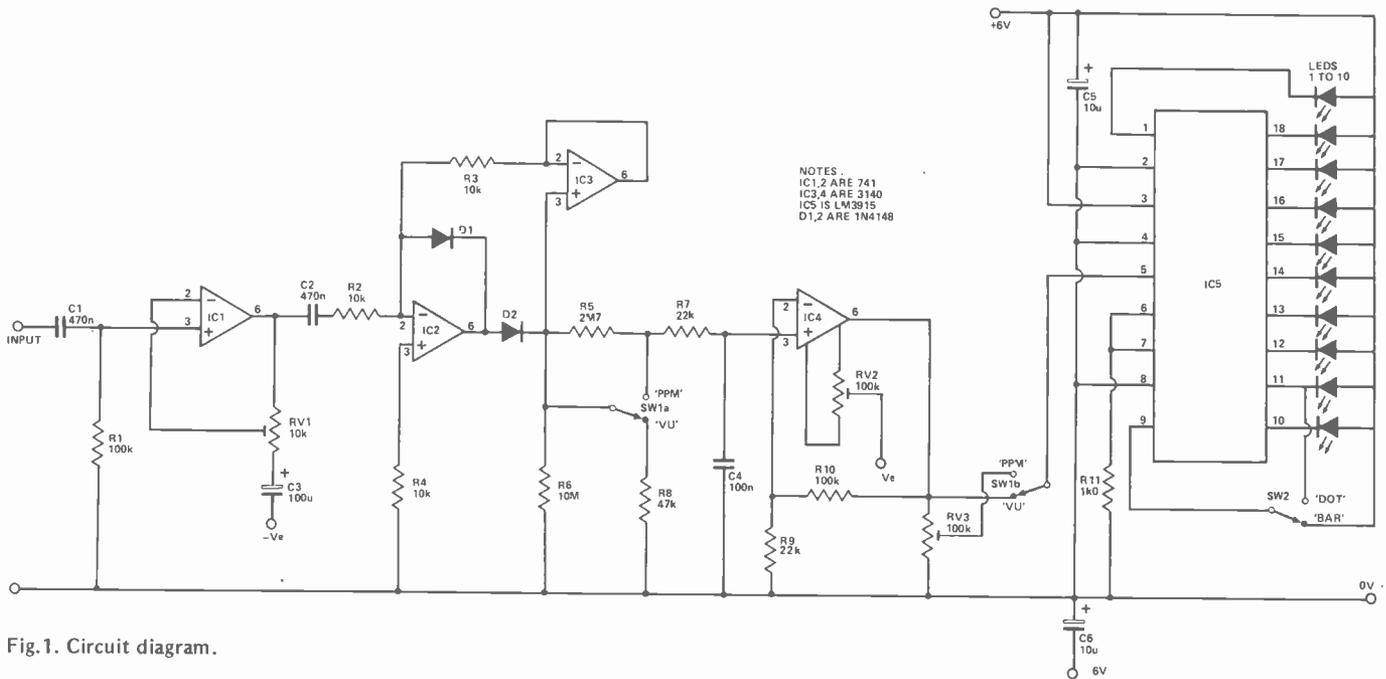


Fig. 1. Circuit diagram.

### HOW IT WORKS

The circuit consists of an AC amplifier driving a half-wave rectifier whose output charges a capacitor via a switched resistor network. The charge on the capacitor is then amplified and drives the bargraph chip either directly or via a potentiometer.

The signal is input via C1 to the non-inverting input of IC1, which is connected as a variable gain AC-coupled amplifier. This arrangement avoids offset problems when the gain is increased which would severely limit the usefulness of the stage.

The output of IC1 drives the half-wave rectifier built around IC2. The circuitry here follows fairly conventional lines except for the inclusion of IC3 in the feedback loop. Use of this BIFET chip with its negligible input current enables high values of resistance and a low value (100n) of storage capacitance to be used with the consequent advantage of a relatively low current drive producing a high rate of voltage change. Without IC3 in circuit and with SW1a in the 'PPM' position, C4 would charge quickly via R7 but would discharge almost as fast

through R7 and R3. In the final circuit, the charge path is via R7, but the discharge path is via R7 and R6, giving a fast attack and slow decay time. Diode D1 acts as a clamp for a positive input and prevents IC2 from going into saturation. In the 'VU' mode, C4 charges via R5 and R7 and discharges through R5, 7, 6, 8. The ratios of these resistors produce almost equal attack and decay times.

As any load on C4 would interfere with the time constant of the RC network, another BIFET op-amp is used as a non-inverting amplifier with a gain of about five. Offset adjustment is provided for this stage with RV2; enabling the output to be accurately zeroed. Owing to the greater insertion loss of the RC network in the 'VU' mode, RV3 is included so that a full scale reading can be obtained for the same overall input level in both modes.

The bargraph chip IC5 handles the display. The input signal from SW1b is applied to pin 5, about 1V2 gives a full scale reading. The internal resistor chain gives an output in 3 dB steps; the ten LEDs pro-

viding a 30 dB range, a ratio of 32:1. No attempt has been made to 'tailor' the response of this chip as the LM3916 with an internally set VU response should be available in the future. It will probably be a pin for pin, plug-in replacement.

A power supply of plus and minus six volts is recommended. A lower voltage may restrict the output swing of IC4 making a full scale reading unobtainable in the 'PPM' mode. Too high a positive supply may result in destruction of IC5 through excessive dissipation. Absolute maximum dissipation for this chip is 660 mW. If you use a positive supply greater than 6 V then the LEDs should be returned to the positive supply via a dropper resistor or a zener diode. IC5 produces either a 'dot' or 'bar' display depending on the connection of pin 9 to pin 11 or to the positive supply. Although SW2 is shown on the circuit diagram, the connection may be made permanently with a wire link.

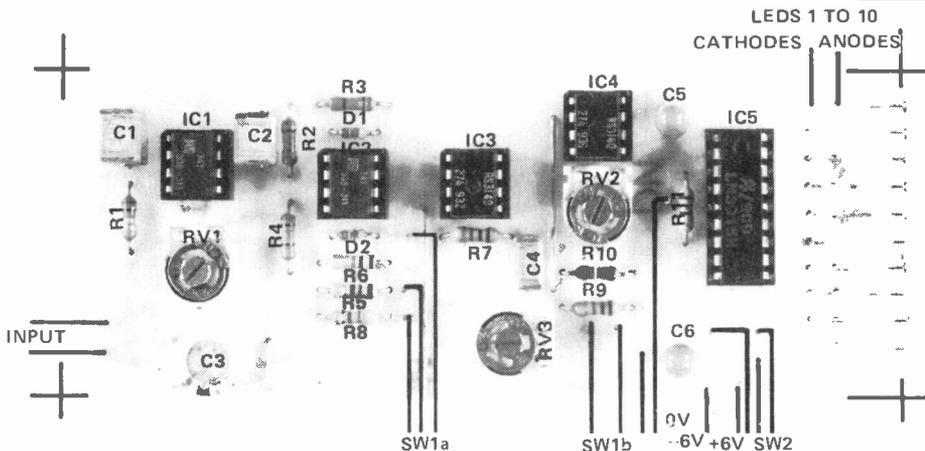
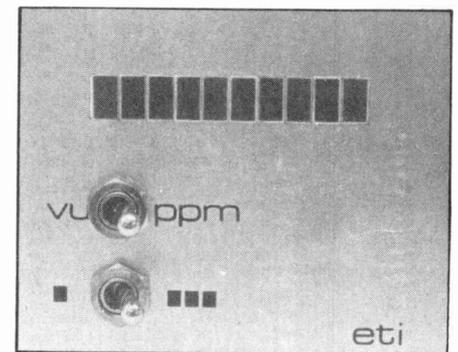


Fig. 2. Component overlay. The rectangular LEDs are all mounted along the right edge of the board.



Use of stackable LEDs makes for an attractive panel layout.



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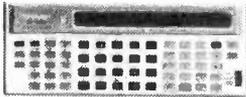
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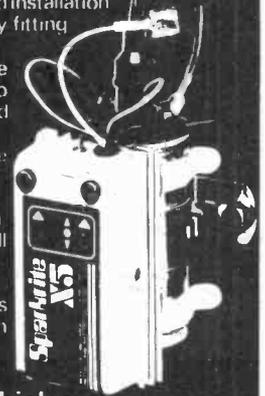
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# DESIGNER'S NOTEBOOK

Ray Marston devotes this month's 'Notebook' to an in-depth look at the Siemens IR60 system that forms the basis of the infra-red remote control system described in this issue.

The infra-red remote control project is based on the Siemens IR60 system that is copiously described in Siemens data books and applications notes. Now, the uninitiated amongst you might think that the ETI design team deserves absolutely no credit for merely converting an application note into a real-life project. Those professional design engineers amongst you who are familiar with so-called 'Applications Notes' may, however, well feel otherwise. Let me explain.

## Application Notes

One of the most important lessons that the aspiring design engineer must learn is that manufacturer's data and application notes must **never** be regarded as sources of pure facts. In reality, they are simply propaganda sheets that are designed, within legal constraints, to help boost the sales of the manufacturer's products. They are designed to emphasise the good features of the product but play down or ignore its deficiencies.

Data/application sheets vary considerably in quality from one manufacturer to another. One of the major American companies, for example, produces notes with excellent descriptive texts, but 30% of their application circuits don't (and could never) work. Japanese notes come in pidgin English interspersed with Croatian technical terms.

The upshot of all this is that when we tried to use the Siemens IR60 system we first had to spend three days decyphering the text and then spent another six days (literally) debugging the system. Still, enough of this waffle: The IR60 system is very good, so let's look at it.

## The IR60 System

IR60 is a sophisticated infra-red remote control system that is capable of handling sixty code instructions (in practice 30 of these instructions are not decoded by the system's receiver but are read out on a serial interface, from which they can be fed to auxiliary decoder circuitry). The system is designed around two 18-pin P-MOS LSI packages and has exceptionally high immunity to false operation through noise, etc. The manufacturer claims system operating ranges of 30 - 40 metres. The receiver has three analogue outputs, one 4-bit (16 channel) binary output, three single-bit outputs and a serial interface for additional versatility.

The system is specifically designed to give remote control of

INST NO.	KEY CODE	SERIAL CODE FED CBA	FUNCTION	RECEIVER OUTPUT ACTION
0	1a	000 000	NORMAL POSITION/ON.	Volume sets to 1/3, Analogue 1 and 2 set to 1/2. RLA on. Volume reduces rapidly to zero. Turns RLA off. Switches RSV1 output between high and low states on alternate operations. Increments binary channel-select output by one step per operation: Turns RLA on. Decrements binary channel-select output by one step per operation: turns RLA on. Turns RLA on. Switches RSV2 output between high and low states on alternate operations: Turns RLA on.
1	1b	001 001	QUICKTONE	
2	1c	010 010	STANDBY	
3	1d	011 011	RESERVE 1	
4	2a	100	PROGRAM STEP +/ON	
5	2b	101	PROGRAM STEP -/ON	
6	2c	110	ON	
7	2d	111	RESERVE 2 /ON	Not evaluated by SAB3209 receiver, but read out at serial interface.
8	3a	001 000		
9	3b	001 001		
10	3c	010 010		
11	3d	011 011		
12	4a	100		
13	4b	101		
14	4c	110		
15	4d	111		
16	5a	010 000	CHANNEL 1 / ON	
17	5b	001	CHANNEL 2 / ON	
18	5c	010	CHANNEL 3 / ON	
19	5d	011	CHANNEL 4 / ON	
20	6a	100	CHANNEL 5 / ON	
21	6b	101	CHANNEL 6 / ON	
22	6c	110	CHANNEL 7 / ON	
23	6d	111	CHANNEL 8 / ON	
24	7a	011 000	CHANNEL 9 / ON	
25	7b	001	CHANNEL 10 / ON	
26	7c	010	CHANNEL 11 / ON	
27	7d	011	CHANNEL 12 / ON	
28	8a	100	CHANNEL 13 / ON	
29	8b	101	CHANNEL 14 / ON	
30	8c	110	CHANNEL 15 / ON	
31	8d	111	CHANNEL 16 / ON	

Table 1. Relationships between transmitter key codes and receiver actions on basic instructions.

modern TV sets but can in practice be used to control a whole range of domestic and industrial devices. The infra-red remote control system featured in this month's issue of ETI is based on the IR60 system, but uses only 16 of the 60 available instructions and has an effective range of only (!) 15 metres.

The essence of the action is that the SAB 3210 transmitter chip receives input 'instructions' via an 8-row (1 to 8) by 4-column (a to d) matrix that can be activated by key switches. Each key can thus be allocated an instruction number, which in turn is related to a key code number (2d, 8a, etc). Whenever a key is operated the IC detects the action and generates a start-bit plus 6-bit serial code word which is transmitted to the receiver via the infra-red link, where the word may or may not be decoded may or may not cause some useful action to be performed.

The transmitter can produce 32 basic code words using 1-row/1-column key combinations, plus another 32 extension words

INST NO	KEY CODE	SERIAL CODE FED CBA	FUNCTION	RECEIVER OUTPUT ACTION		
32	81a	100 000	Not evaluated by SAB3209 receiver, but read at serial interface.			
33	81b	001				
34	81c	010				
35	81d	011				
36	82a	100				
37	82b	101				
38	82c	110				
39	82d	111				
40	83a	101 000			VOLUME + VOLUME - ANALOGUE 1 + ANALOGUE 1 - ANALOGUE 2 + ANALOGUE 2 - ANALOGUE 3 + ANALOGUE 3 -	Increases volume output level. Decreases volume output level. Increases analogue 1 output level. Decreases analogue 1 output level. Increases analogue 2 output level. Decreases analogue 2 output level. Not evaluated by SAB3209 receiver, but available on SAB4209 receiver.
41	83b	001				
42	83c	010				
43	83d	011				
44	84a	100				
45	84b	101				
46	84c	110				
47	84d	111				
48	85a	110 000	Not evaluated by SAB3209 receiver, but read out at serial interface.			
49	85b	001				
50	85c	010				
51	85d	011				
52	86a	100				
53	86b	101				
54	86c	110				
55	86d	111				
56	87a	111 000	Not used Not used. END instruction. Not permitted, due to ambiguity in biphas code.			
57	87b	001				
58	87c	010				
59	87d	011				
60	-	100	-	-		
61	-	101	-	-		
62	-	110	-	-		
63	-	111	-	-		

Table 2. Relationships between transmitter key codes and receiver actions on Extension instructions.

when using a 2-row/1-column key combinations in which '8' always forms one of the two rows. For the benefit of those readers who may wish to modify the ETI system, the relationships between instruction numbers, key codes, transmitter codes and receiver output functions are shown in Table 1 for the basic codes and in Table 2 for the Extension codes.

### Transmitter Connections

The method of connecting keys to the SAB 3210 for the 32 basic codes is quite straightforward, as shown in the manufacturer's basic application circuit of Fig. 1. Use of the extension instructions calls for a slightly more complex approach, with pairs of diodes connecting row-8 and one other row to one of the four columns so that actuation of a key connects two rows to one column. Fig. 2 shows the manufacturer's diagram for making a 60 key matrix, using both basic and extension connections.

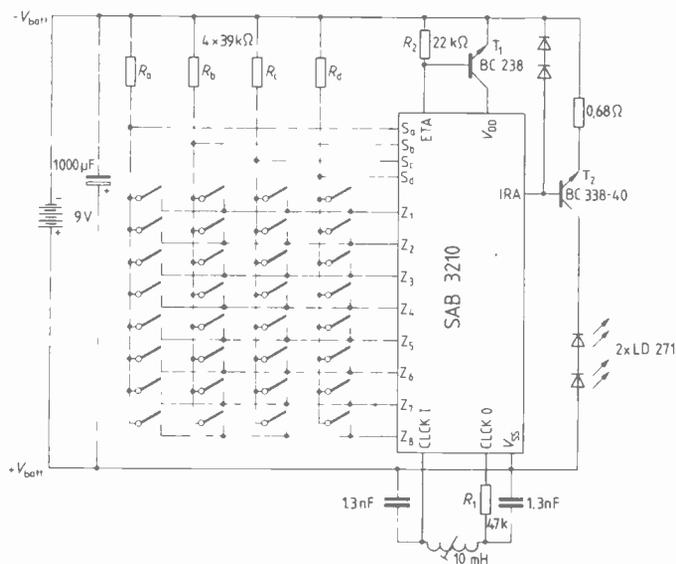


Fig.1. Manufacturer's application circuit, showing method of connecting keys for the 32 basic codes.

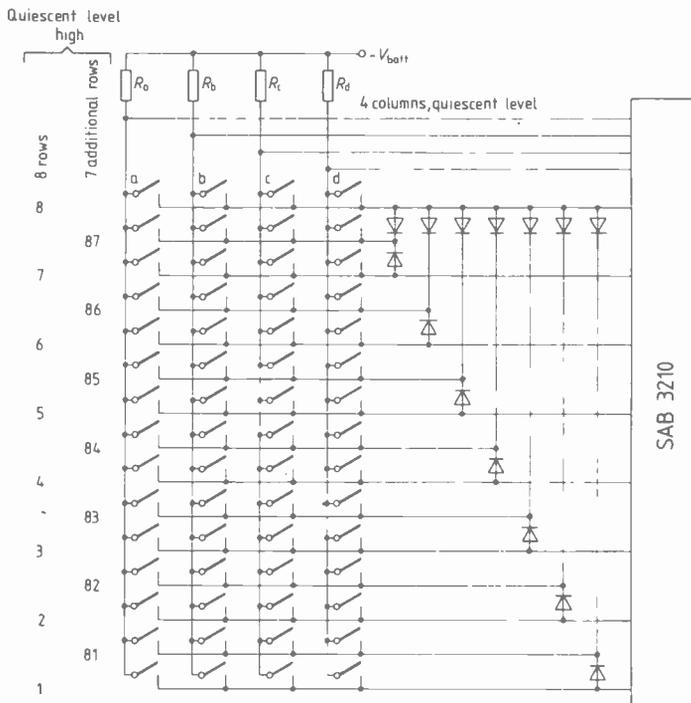


Fig.2. Manufacturer's diagram showing connections for a 60-key matrix using both basic and extension instructions.

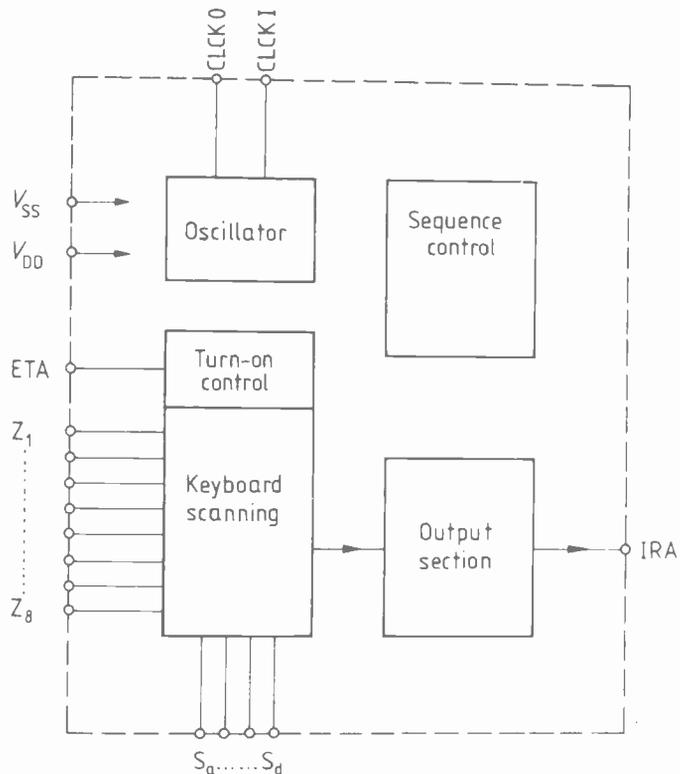


Fig.3. Block diagram (left) and pin notations (right) of the SAB3210 transmitter IC.

Fig. 3 shows the pin connections and the simplified block diagram of the SAB 3210 IC, which incorporates (amongst other things) a keyboard scanner circuit. When we were developing our

prototype unit on Microdeck we found that the deck's intercapacitance between pin 16 (the '8' row) and ground caused the scanner to 'see' the '8' row as a closed switch whenever the transmitter was activated, thus causing the incorrect code to be transmitted when basic operation was required (it took us two days to discover the cause of the incorrect operation). We overcame this bug by trying pin 16 of the IC high with a 220k resistor: for good measure, we tied pins 11 and 12 (rows 3 and 4) high as well.

One reason it took us so long to trace this fault was because of the unusual nature of the Biphase serial code sent out by the transmitter. Fig. 4 is a reproduction of the manufacturer's timing/waveform diagram. What happens here is that the transmitted signal carries 'imaginary' markers: a pulse immediately following the marker is regarded as a '1'. Thus, the biphase signal shown in Fig. 4 is, reading from F to A, equal to 100 110.

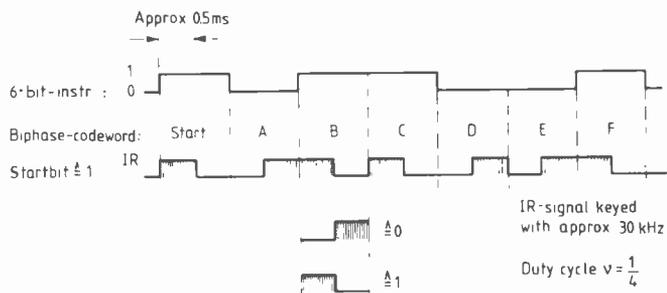


Fig.4. Reproduction of the manufacturer's transmitter timing/waveform diagram.

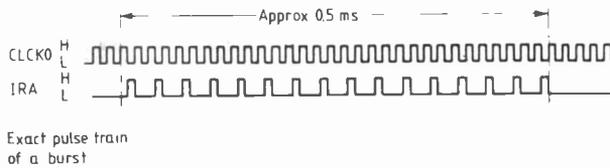


Fig.4. Reproduction of the manufacturer's transmitter timing/waveform diagram.

## The Receiver Pre-Amplifier

The manufacturer produces a special pre-amplifier chip, the TDA 4050, for use with the IR60 system. Using this chip, they claim control ranges of up to 30 - 40 metres. We played with his chip for a couple of days but never managed to stop the damn thing oscillating. We then noticed the small print in the application data that said that the pre-amplifier 'should advantageously be mounted in a double-screened case', at which point we gave up and designed our own pre-amp.

One of the problems involved in IR pre-amp design is that the circuit must not only provide very high gain for long-range operation, but also must not saturate when the transmitter is placed only a few inches from the receiver. Our unit works well in both respects.

As a matter of general interest, we've reproduced the manufacturer's TDA 4050 pre-amp applications circuits in Fig. 5. The TDA 4050 IC should be available from Electrovalue.

## Receiver/Decoder Circuits

The basic IR60 system is designed for use with the highly sophisticated SAB 3209 receiver IC. This chip checks the incoming code signal for 'sense' (number of bits, bit duration, etc), processes it and then both 'dumps' the resulting code signal at the serial interface and simultaneously passes it on to a register, from which it is

then used to control the binary and analogue outputs. The processing action gives a very high immunity against noise and against signals of the wrong carrier frequency.

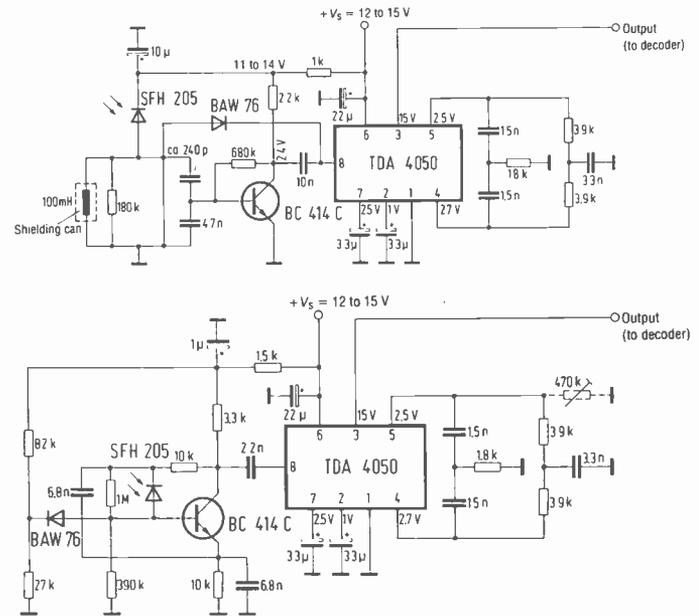


Fig.5. Two Siemens applications circuits showing methods of using the TDA4050 IR pre-amplifier IC.

Fig. 6 shows the pin designations of the SAB 3209 receiver IC, which provides three analogue, one 4-bit binary and three single-bit outputs. Siemens make a similar receiver chip, the SAB 4209, which has four analogue outputs: this chip is unlikely to be available through amateur electronics dealers, but could be of interest to those of our readers who are professional design engineers.

### Pin connection

Pin No.	Pin designations
1	$V_{SS}$ , supply voltage +12 V
2	CLCKO, clock output
3	CLCKI, clock input
4	PRGD, program control output
5	PRGC, program control output
6	PRGB, program control output
7	PRGA, program control output
8	PC, program change strobe input/output
9	RSV2, spare output
10	RSV1, spare output
11	VOLU, volume control output
12	ONOFF, standby output
13	BRIG, brightness output
14	COLO, color contrast output
15	RSIG, signal input, remote control
16	DLEN, I-bus input/output
17	$V_{DD}$ , supply voltage 0 V
18	DATA, I-bus input/output

Fig.6. Pin designations of the SAB3209 receiver IC.

Siemens produce a number of 'special' (professional) support chips for use with the IR60 system. Fig 7, for example, shows the standard receiver application circuit, which also illustrates the use of the SAB 3211 display decoder/driver chip, which gives a visual readout of the selected binary-coded 'channel' number on a multi-segment LED display.

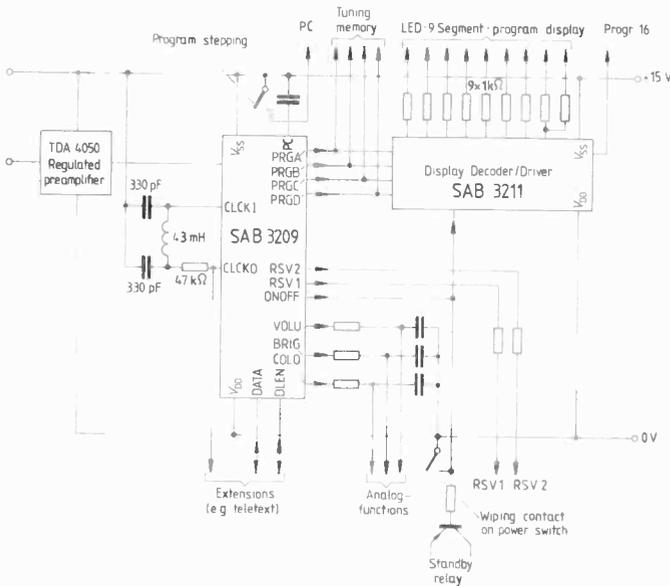


Fig. 7. Siemens SAB3209 receiver application circuit, which also shows the use of the 'special' SAB3211 chip.

Another 'special' IC is the SAB 3271 receiver chip, which specifically decodes the transmitted 6-bit serial instruction code signal into the form of six parallel outputs, which can be decoded by additional circuitry to make all 60 'instructions' available for external use.

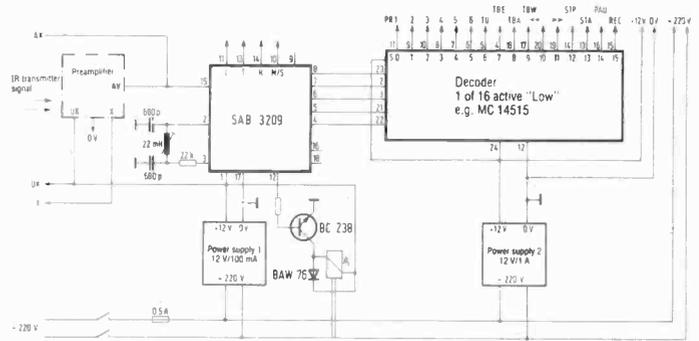


Fig. 8. Siemens circuit showing the method of decoding the 4-bit binary output to give 16 output channels.

## Interface Circuits

Interfacing the outputs of the SAB 3209 receiver to external circuitry calls for a certain amount of individual ingenuity. The signal-bit outputs can each be used to drive a relay via a transistor buffer, as already shown in the ETI remote control system elsewhere in this issue. The 4-bit binary output can be decoded into sixteen 'selector' channels by using the Siemens circuit as shown in Fig. 8. ICs such as the CD4066 can be used as on/off signal switches, driven from the outputs of the above channel selector.

The three analogue output channels can be used to control voltage-controlled attenuators or amplifiers (for volume control) and filters (for tone control, etc) by using some of the many circuits shown in previous issues of ETI. The VCA article shown in the March '80 issue gives some useful circuits.

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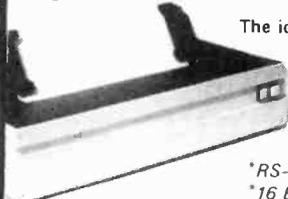


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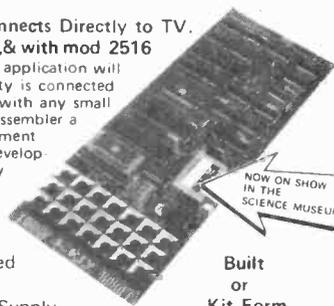


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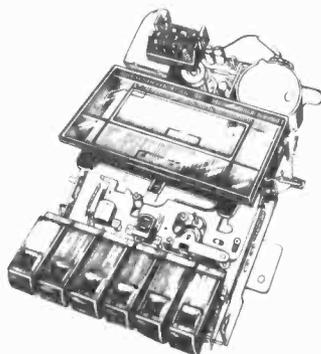
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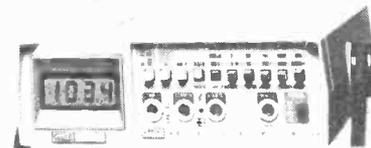
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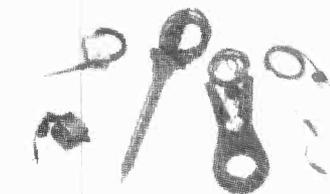
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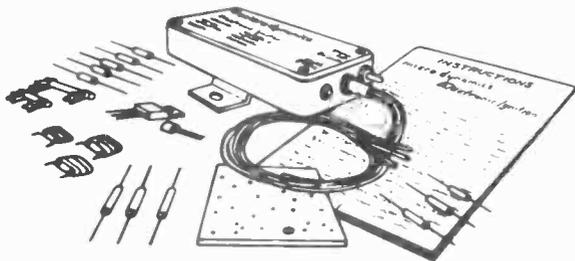


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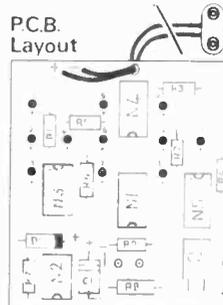
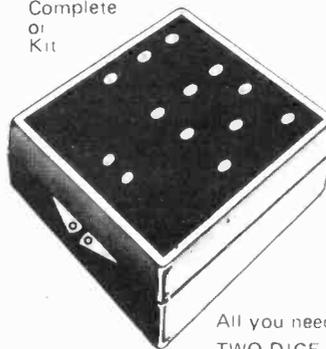


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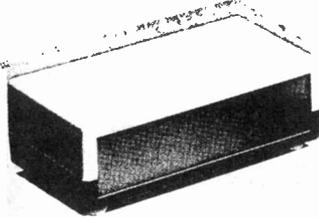
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K114	15 XK8116 (BF241) transistors
K115	18 SP1218 (2N3702) transistors
K116	10 MPSL01 NPN 140V TO92
K117	10 BF450 PNP TV IF amp transistor
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		47/16 A .025
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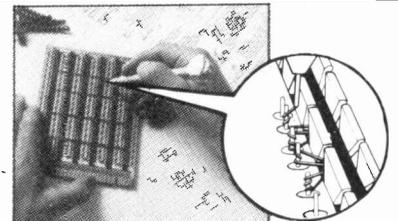
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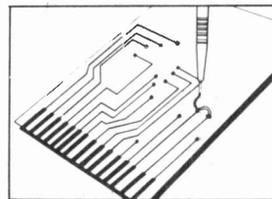
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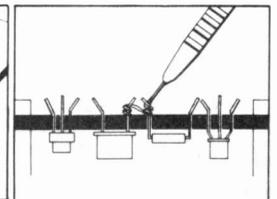
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# THE BLACK HOLE

Tim Orr, the prolific producer of music machines, presents the Black Hole Chorus Machine. Choose chorus effect or vibrato and control it all by footswitch.

The black hole is a musical effects device for processing natural and synthetic sounds. It has two modes of operation, chorus and vibrato. In the chorus mode the input signal is delayed (12 mS) by an analogue delay line. It is then mixed back with the original signal. This delay time is not long enough for a distinct second image to be heard, but it is noticeable, particularly as the time delay is slowly modulated. The sound produced by this process has a sort of 'spacey' feel to it as though the input signal was being accompanied by a faint chorus. What is, in fact, happening is that a comb filter has been produced (Fig. 1) with notches spaced at about every 90 Hz. As the delay time is modulated these notches move up and down in frequency producing a colouration of the sound similar to phasing. This, coupled with the short time delay, produces the 'spacey' colouration known as a chorus effect. A manual speed control allows the user to vary the modulation speed. A slow modulation is best suited for guitar and keyboard instruments, whereas a faster speed, which introduces a noticeable pitch modulation, works well on vocals. Another chorus mode is available to switch in a second delay line modulated in antiphase.

The vibrato mode is essentially the same as the chorus; the only things that change are the modulation waveform (triangular sweeps for the chorus sinusoidal sweeps for the vibrato) and the frequency range. As this is 2 to 13 Hz, a definite pitch modulation is produced. The controls that effect the vibrato are speed and modulation depth. The vibrato is not just pure frequency modulation, there is also amplitude modulation which produces a slightly more interesting effect.

The vibrato/chorus selection is made with a footswitch. Two LEDs indicate which effect has been selected and also the modulation speed. The input amplifier has a manual level control plus a high impedance-high level/low impedance-low level selector switch, thus enabling a wide range of input levels to be accommodated. The largest input level is 4V5 rms, and the smallest level for overload is 5 mV rms; a range of nearly 60 dB. An overload LED indicates the onset of distortion.

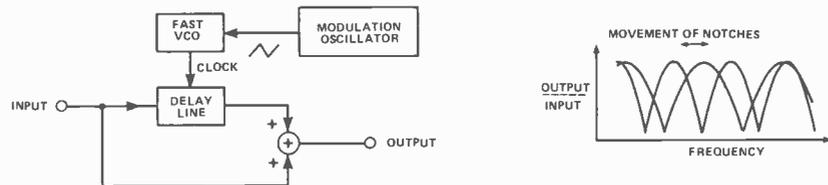


Fig.1. Block diagram of a comb filter.

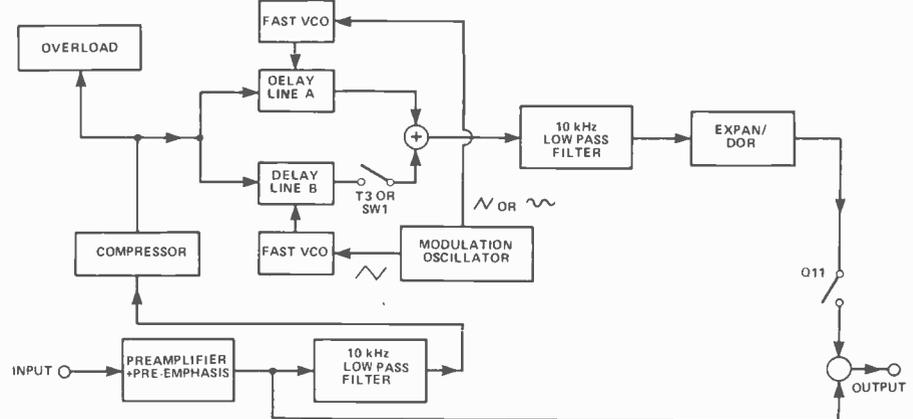


Fig.2. Block diagram of the Black Hole choraliser system.

	LOW	HIGH
MAXIMUM INPUT LEVEL	1.25Vpp	13Vpp
MAXIMUM INPUT LEVEL SENSITIVITY	15mVpp	150mVpp
INPUT IMPEDANCE	10k	110k
SIGNAL TO NOISE RATIO	68dB	74dB

MAXIMUM OUTPUT LEVEL	1Vpp
OUTPUT IMPEDANCE	600ohms
VIBRATO SPEED	2 - 13 Hz
CHORUS SPEED	0.3 - 3.3 Hz

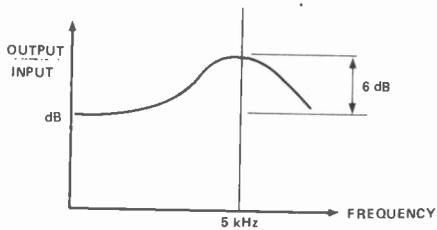
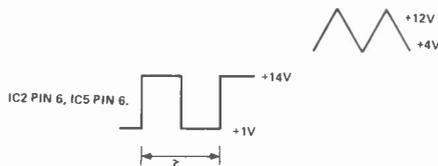


Fig.3. (top) Performance specification.

Fig.4. (above) Frequency response of pre-emphasis, IC11 pins 5, 6, 7.

- REMOVE ALL ICs. TEST FOR ±15V AT IC9,10. THE UNREGULATED RAILS WILL BE APPROXIMATELY ±22V. REPLACE ALL ICs AND RECHECK PSU.
- IC11 PIN 1,7 AND IC12 PIN 1,7, WILL HAVE THE AUDIO INPUT SIGNAL WITHOUT ANY DC BIAS.
- COMPRESSOR OUTPUT. IC13 PIN 10, HAS A DC BIAS OF APPROX. +7V PLUS THE AUDIO INPUT SIGNAL.
- FAST VCO. IC1 PIN 6 AND IC4 PIN 6



T VARIES FROM ABOUT 22μS TO 28μS, IT BEING SWEEP BY THE MODULATION OSCILLATOR IC7.

- DELAY LINE OUTPUT  
VIEW PR1 WIPER

INJECT A 1 kHz SINWAVE. VARY ITS AMPLITUDE SO THAT IT IS 2Vpp AT THE VIEWING POINT. ADJUST PR2 SO THAT THE WAVEFORM IS SYMMETRICALLY BIASED BETWEEN THE TWO CLIPPING LEVELS. NEXT ADJUST PR1 SO THAT THE CLOCK SIGNAL IS NULLED. REPEAT FOR DELAY LINE B, USING PR3,4, VIEWING PR3 WIPER.

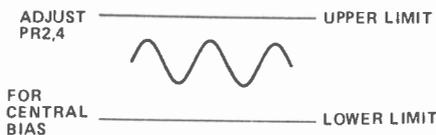
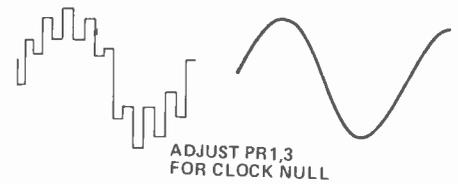


Fig.5. (above and above left) Alignment notes.



- POST FILTER. IC15 PIN 7 RECOVERED AUDIO SIGNAL WITH NO DC BIAS.
- EXPANDER. IC13 PIN 7 RECOVERED AUDIO SIGNAL WITH +5V DC BIAS
- OUTPUT SIGNAL. IC15 PIN 1 INJECT A 500 Hz SINWAVE INTO THE UNIT. A MODULATED OUTPUT SIGNAL WILL BE SEEN

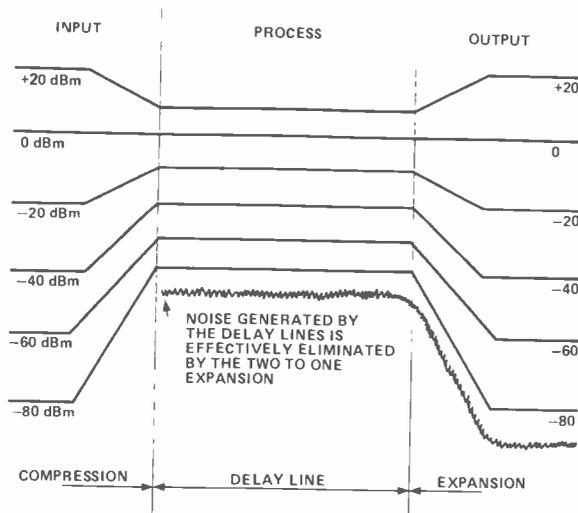
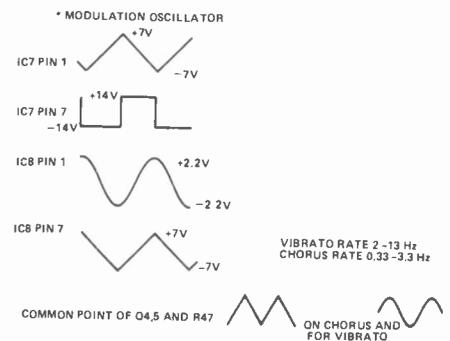
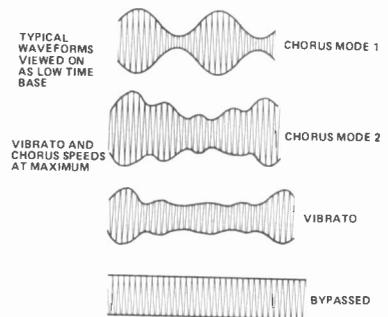
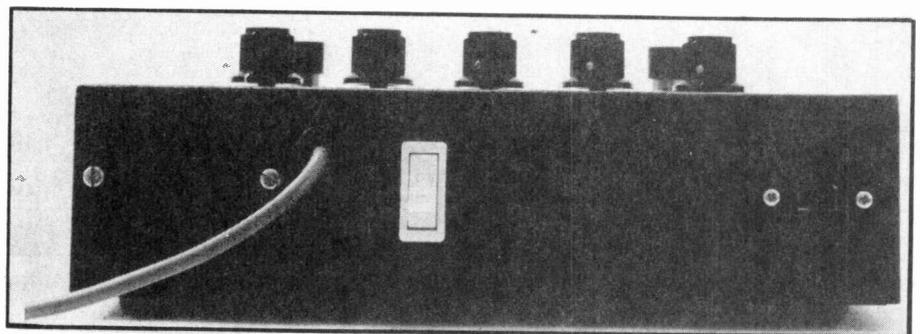


Fig.6. (left) Using a compander system to remove delay line noise.

You don't want to have to fumble for a lot of controls on the rear panel, so it's plain and simple — power on/off. No chance of accidentally hitting the power switch when you're operating Black Hole by footswitch.



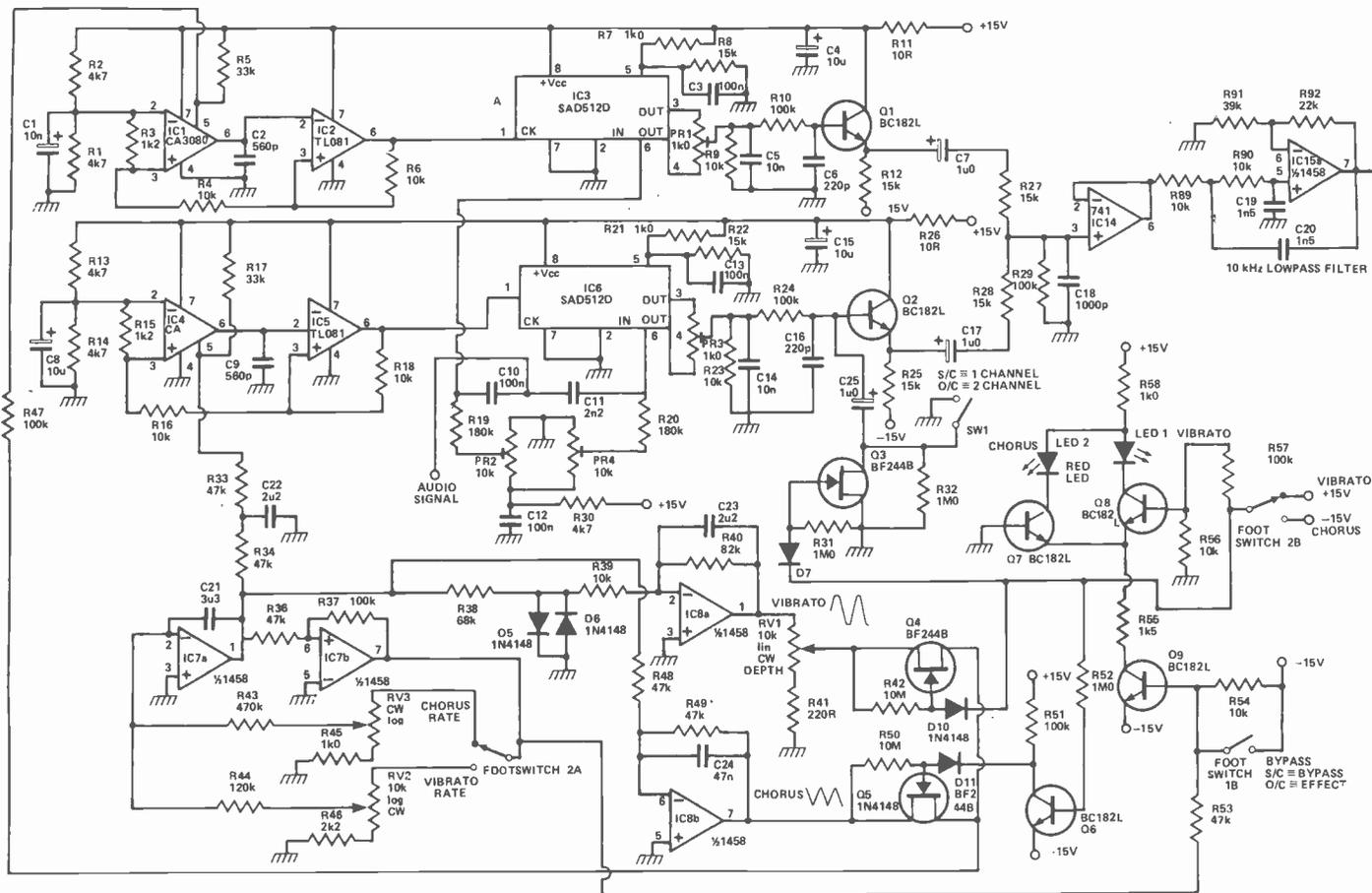


Fig. 7. Circuit diagram. This circuit includes the footswitch controls for bypass, vibrato and chorus and vibrato rate.

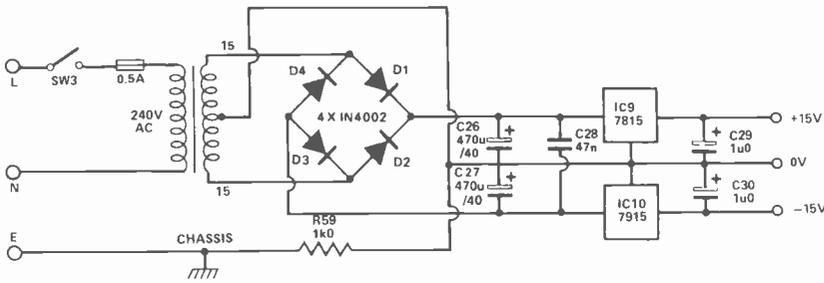
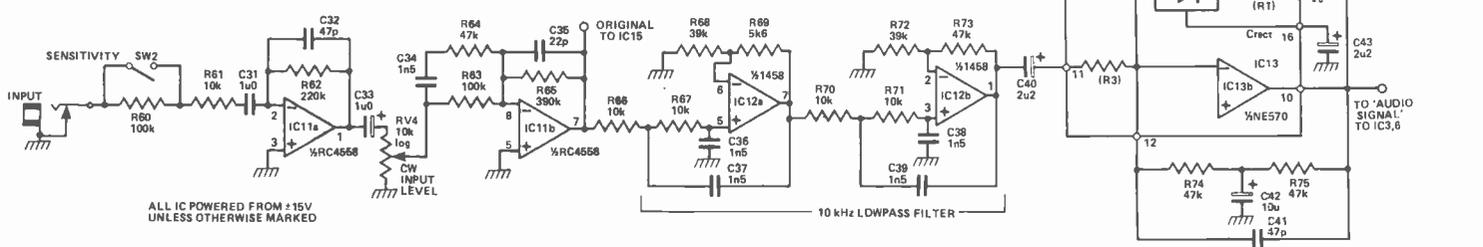
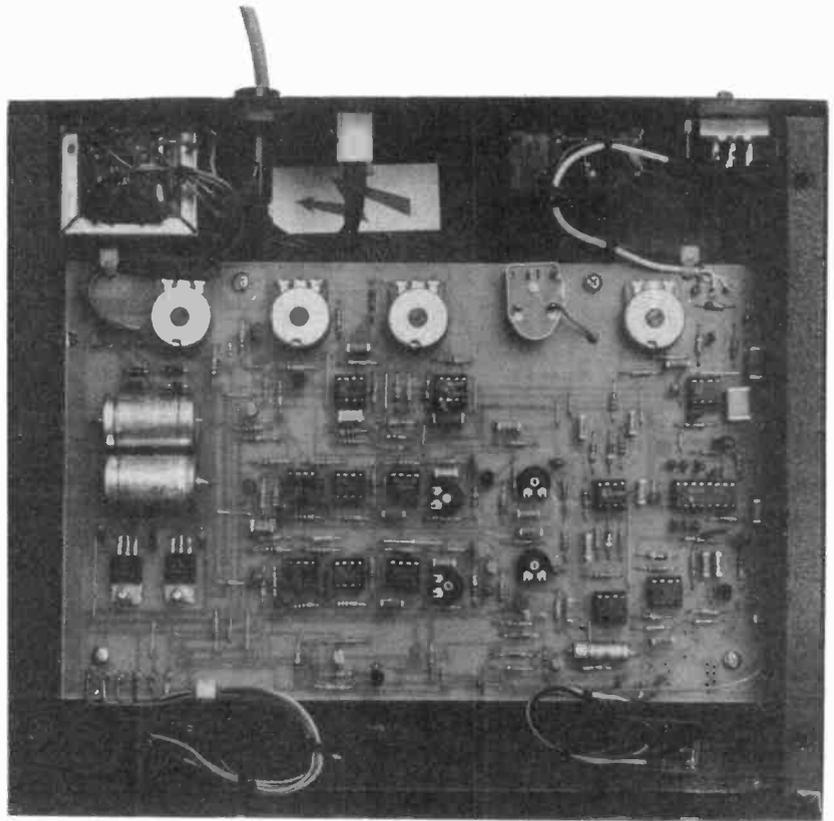
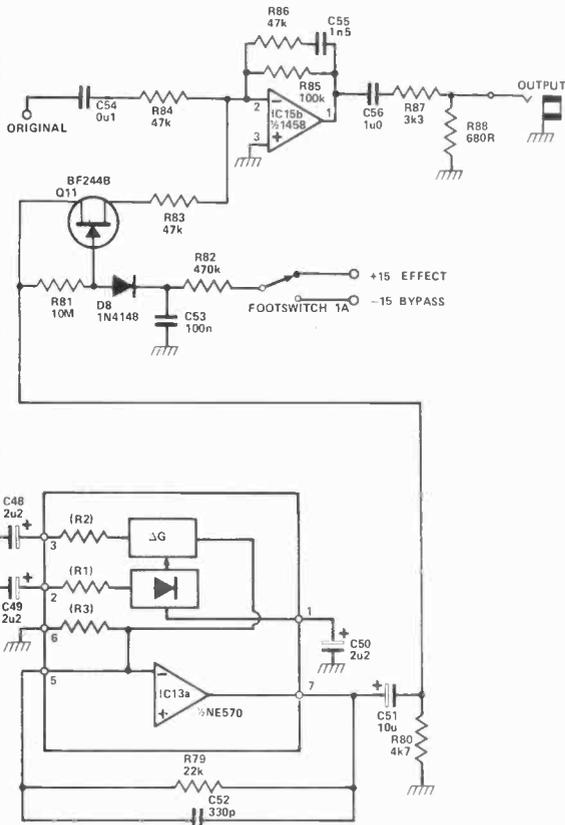


Fig. 8. (left) Circuit diagram of the Black Hole's power supply.

Fig. 9. (below) This part of the circuit, the input amplifier, includes a 10 kHz low pass filter section built around IC12.





The inside story. Here the PCB has been built and installed in the case with the power supply. Just screw on the base-plate and it's ready to go.

## HOW IT WORKS

The Input amplifier (Fig.9) is a low noise Op Amp device, the RC4558 (IC11, pins 1,2,3). With SW2 closed the input impedance is 10 k and the first stage gain is +26 dB. With SW2 open circuit, the input impedance is 110 k and the gain is +6 dB. IC11, pins 5,6,7 forms a pre-emphasis circuit that is used to enhance the higher frequencies of the input signal (Fig.4). A de-emphasis circuit (IC15, pins 1,2,3) corrects the frequency response at the output and in doing so attenuates unwanted high frequency noise generated by the delay line and the compander. After pre-emphasis the signal is filtered by a 10 kHz 4 pole lowpass filter (IC12) to eliminate aliasing effects that can be caused by the delay line. A compander (compressor/expander) system has been employed to improve the overall noise performance (Fig.5). This ensures that the delay lines are always driven with a relatively large signal and that when there is no input signal, the output noise from the delay lines is expanded downwards thus rendering it inaudible. A simple overload detector circuit (Q10) is used to indicate the onset of distortion.

The delay lines are clocked by high frequency VCOs, IC1,2 and IC4,5. The VCO is a simple triangle/square wave relaxation oscillator running at about 45 kHz. The current into pin 5 of the CA3080 determines the oscillation frequency and this current is modulated by the slow oscillator

IC7. Audio signals are fed into the analogue delay lines (IC3,6), the delay time being determined by the relationship,

$$\text{Delay time} = 512 / \text{clock frequency},$$

which in this case is about 12 ms. The outputs of the two delay lines are prefiltered by R10,C6 and R24,C16, then mixed together and filtered by a 10 kHz lowpass filter, IC15, pins 5,6,7. The signal is then expanded by the NE570 chip after which it is mixed with the original signal at IC15, pins 1,2,3, having first passed through a 'silent' analogue switch (Q11) which is ON when the effect is selected and OFF when bypassed. The modulation oscillator operates over two frequency ranges, one selected by the chorus speed control, the other by the vibrato speed control. IC7 is a low frequency triangle/squarewave relaxation oscillator. When the chorus mode has been selected the modulation waveform is a sine wave, being generated by IC8, pins 1,2,3. This signal is routed via switch Q4 to the high frequency VCO driving delay line A, whilst delay line B is disabled by Q3 which shunts the audio signal to ground. A simple LED control circuit Q7,8,9 indicates whether the unit is bypassed or in either the chorus or vibrato mode as well as indicating the modulation speed.

A standard two rail power supply provides a regulated +15 V at 70 mA and -15 V at 30 mA from two voltage regulators IC9,10.

## BUYLINES

A complete kit of parts for the Black Hole choraiser is available from Powertran Electronics. A single delay machine costs £57.30 and a dual delay machine £68.80 (prices include VAT and post). See Powertran's advert elsewhere in this issue for their full address.

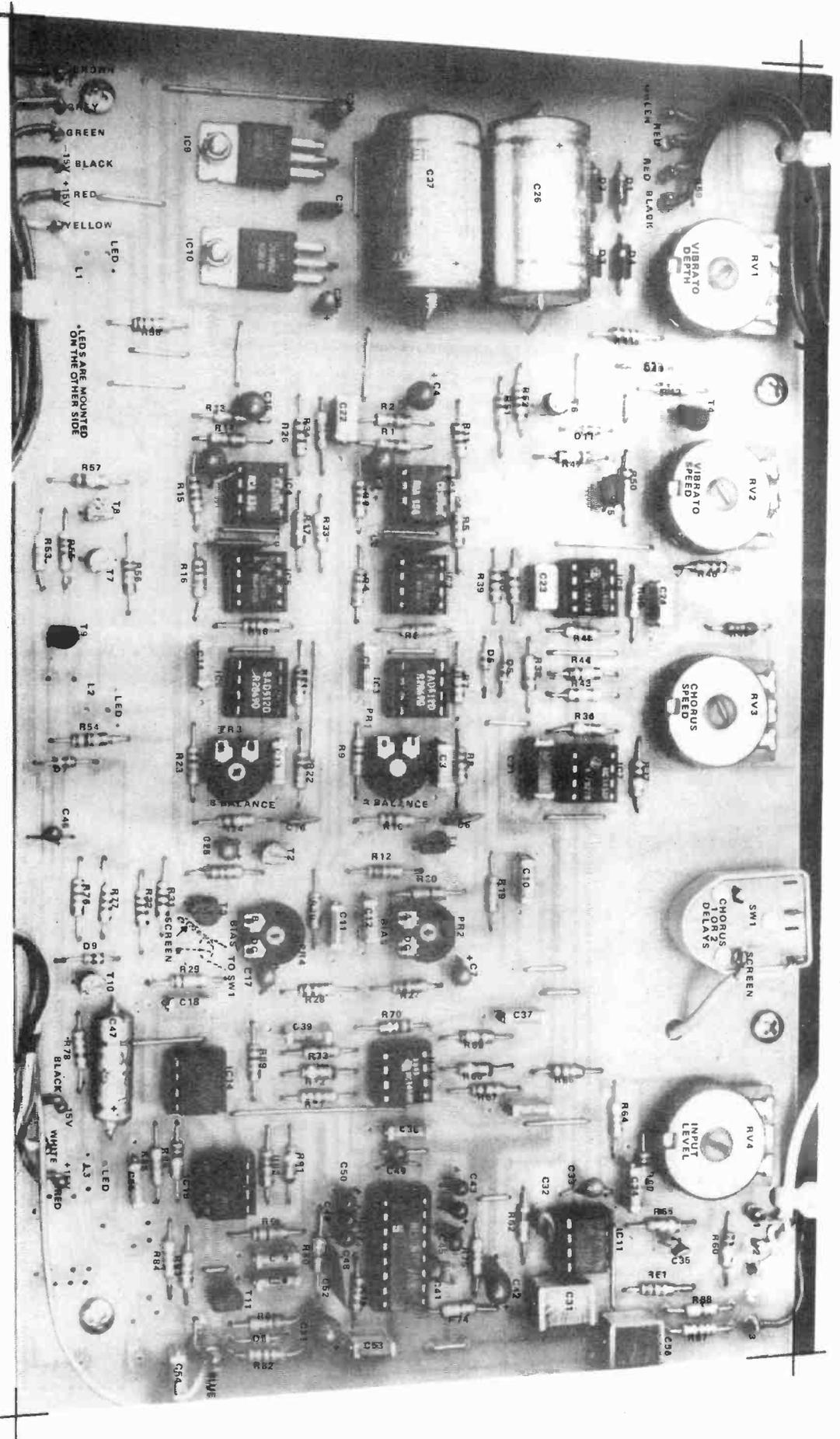


Fig.10. Component overlay. Double check the orientation of ICs, diodes and electrolytic capacitors.

# PARTS LIST

<b>RESISTORS</b> All 1/4W, 5%		R40	82k	C3,10,12,13,		<b>SEMICONDUCTORS</b>	
R1,2,13,14,		R41	220R	53,54	100n	IC1,4	CA3080E
30,80	4k7	R42,50,81	10M	C5,14	10n	IC2,5	TL081CP
R3,15,21	1k2	R43,82	470k	C6,16	220p ceramic	IC3,6	SAD512D
R4,6,9,16,		R44	120k	C7,17,25,29,		IC7,8,12,15	1458CP
18,23,39,54,		R46,77	2k2	30,33	1u0 16V tantalum bead	IC9	78M15
56,61,66,67,		R55	1k5	C11	2n2	IC10	79M15
70,71,76,89,		R62	220k	C18	1n0	IC11	RC4558NB
90	10k	R65	390k	C19,20,34,		IC13	NE570N
R5,17	33k	R68,72,91	39k	36,37,38,39,		IC14	741CP
R7,45,58,59	1k0	R69	5k6	55	1n5	Q1,2,6,7,8,	
R8,12,22,25,		R78,87	3k3	C21	330n	9,10	BC182L
27,28	15k	R88	680R	C22,23	220n	Q3,4,5,11	BF244B
R10,24,29,		<b>POTENTIOMETERS</b>		C24	47n	D1-4	1N4002
37,47,51,57,		RV1	10k lin PC mounting	C26,27	470u 40V electrolytic	D5-11	1N4148
60,63,85	100k	RV2,3,4	10k log	C28	47n 63V ceramic	LED 1-3	0.2" red LED
R11,26	10R	PR1,3	1k0 horiz preset	C31,56	1u0	<b>MISCELLANEOUS</b>	
R19,20	180k	PR2,4	10k horiz preset	C32,41	47p ceramic	8 pin low profile DIL socket (x12), 16 pin	
R31,32,52	1M0	<b>CAPACITORS</b>		C35	22p ceramic	low profile DIL socket, SPDT slide switch,	
R33,34,36,		C1,4,8,15,		C40,43,44,		DPST rotary switch, mains switch, DPDT	
48,49,53,64,		42,51	10u 16V tantalum bead	45,46,48,49,		footswitch and cap (x2), 1/4" jack socket	
73,74,75,83,		C2,9	560p ceramic	50	2u2 16V tantalum bead	(x2), 20 mm OAS fuse and holder, 15-0-	
84,86	47k			C47	10u 40V electrolytic	15 V mains transformer, PCB, case to suit,	
R38	68k			C52	330p	1/2" 6BA tapped pillar (x4).	

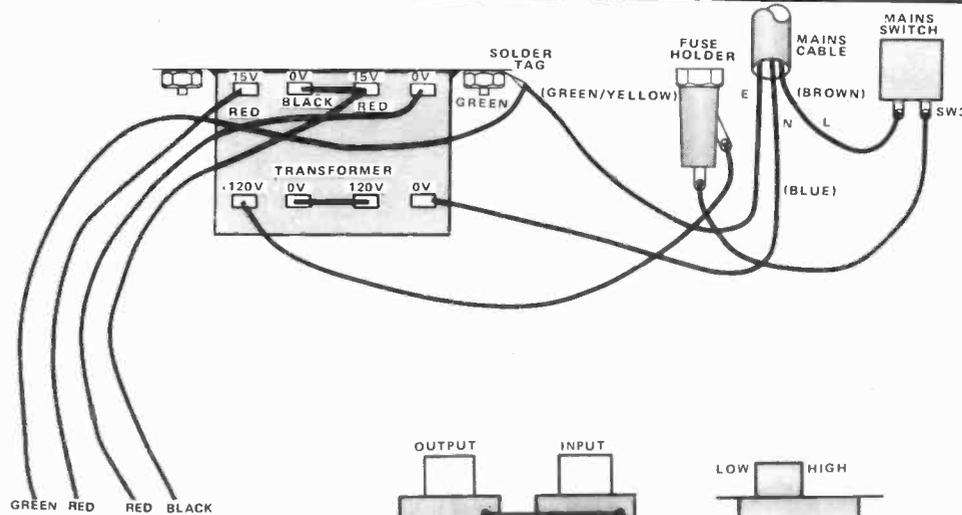


Fig. 11. Power connection details.

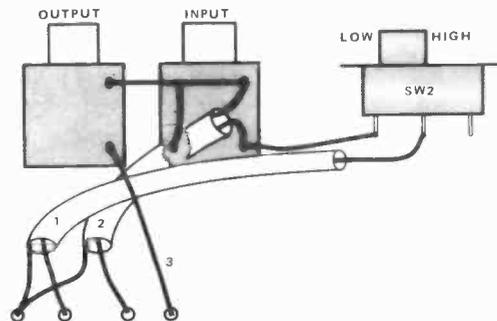


Fig. 13. Input and output connections to PCB.

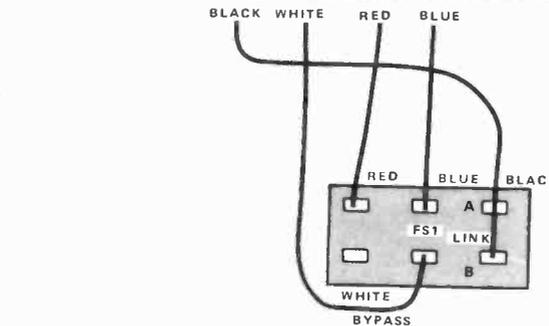


Fig. 12. Wiring plan for Footswitch 1.

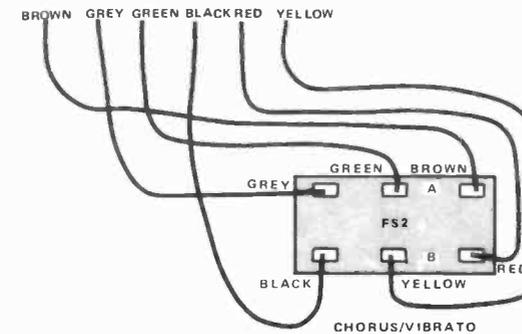


Fig. 14. Connections from Footswitch 2 to the PCB.



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0 2" clips	3p	
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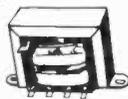
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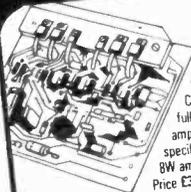
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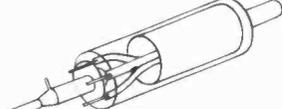
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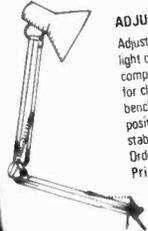
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# RAVEN ON

As the chip industry experiences problems in maintaining its rate of growth Dave Raven explains why and casts a glance at bubble memories.

In complete contrast to most manufactured goods integrated circuit pricing has remained on a steady, decreasing spiral. There is, however, a school of thought which sees this rapidly coming to an end.

With the ever increasing effects of inflation, which is not of course exclusive to the UK, the end of the manufacturers experience learning curve is in sight. The cost of producing linear devices is already said to be rising in the States and signals indicate that digitals will soon follow. This stems from a theory which says that every time accumulated experience doubles, costs and, therefore, prices go down by about 25 per cent. With the pressure from increasing demand for ICs, manufacturers have more than doubled accumulated experience every year, which pushed prices downwards. This theory has apparently proved valid in the industry for many years.

In effect, what is being suggested is that if, from the inception of the IC industry, 10 million devices have been sold by the end of a given year, it would have to sell 10 million devices the following year in order to lower prices by as much as 25 per cent. The following year 20 million devices must be sold to achieve another 25 per cent reduction. Clearly a point must be reached where this rate of growth could not be maintained. The suggestion is that the time has now arrived.

Accumulated shipments of Integrated Circuits reached 11.4 billion units in 1978. During 1979 the total sales of ICs was expected to reach about 5 billion units. If it is assumed that the United States IC industry ships 6.5 billion devices in 1980, it will have taken two years to double accumulated shipments. Therefore, if the theory holds true the price of ICs will have dropped by an average of 25 per cent. Inflation, however, over the two year period is going to more than off set the 25 per cent price declines and could even exceed this. Technically, the digital integrated circuits have a more favourable price outlook than linear, since it is still possible to shrink more circuitry into a silicon slice. Designers are, however, experiencing increasing difficulties with the physical limitations posed by one millionth of a metre gate lengths and the effects of stray capacitance and in addition the demands being made on chip manufacturers for a host of new consumer products which appear each year.

To illustrate some of the technical difficulties that have to be overcome in producing 1 micron lines, it is best to explain the techniques that can be used to produce these. The cheapest method is to use photolithography, which is well established for device fabrication. Using a procedure called 'float off' it is possible to define very narrow channels which are chemically etched and a metal is evaporated through the channel producing a very narrow line. The problems that can arise, however, are shown in the photographs and are not easily overcome even with the very sophisticated manufacturing techniques in use today.

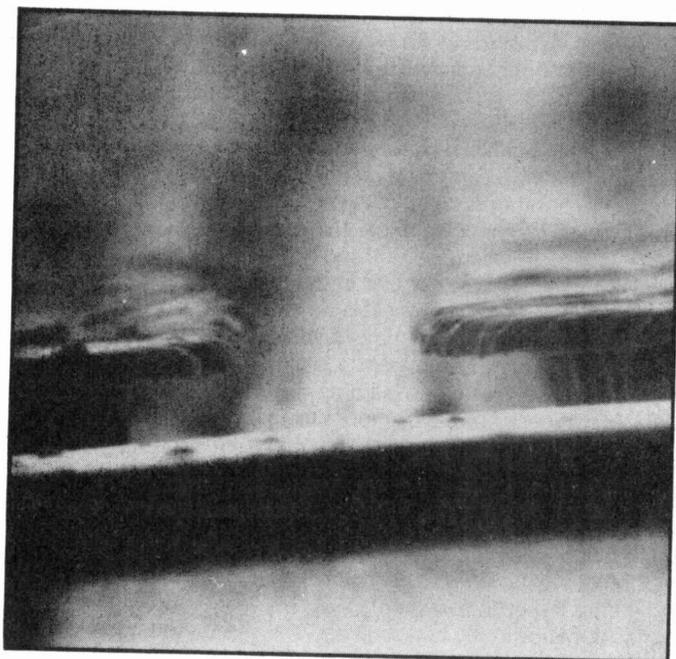


PHOTO 1: an etched channel before deposition of metal to complete the gate.

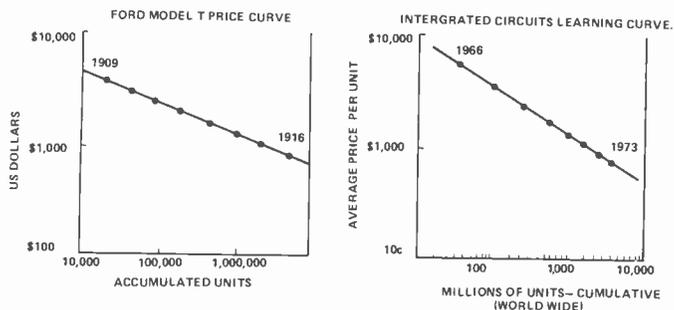


Fig.1. Similarities between price trends for the Model-T Ford and integrated circuits.

The first photograph shows the etched channel before metal is deposited. Distance between the overhang is approximately two microns. The second photograph illustrates the metal deposited through the channel. Photograph three is an example of what can go wrong when the edges of the overhang break down, causing an electrical short. Each ledge is approximately 1.5 microns. This example is somewhat crude in present day technology. However, it serves to show quite clearly the mechanical effects of fabricating devices using these very tiny dimensions.

Electron beam lithography is improving the yield of integrated circuits plus increasing the chip density, thus overcoming many of the earlier problems. Once again, however, this equipment is not cheap and will further increase the already heavy capital investment required. The author of a recent article in an American device technology magazine produced comparisons between the product-

ion of Ford motor cars and integrated circuit production. The graphs clearly show that production costs are related to the accumulated experience. I would imagine this can be repeated using a host of other products, washing machines for example, which offer a similar picture.

## Making Bubbles

The accumulated expertise of chip manufacturers has been most significant in solid state memories with the rapid development of random-access and read only memories, charged-coupled devices and magnetic-bubble memories. Storage capacities of memory devices will continue to increase through 1980. However, an end is in sight to the straight-line growth curve of semiconductor memory densities. Instead of memory capacity doubling every two years this will stretch out to three and four years now that the limits of optical lithography are under pressure.

One of the most exciting developments which has been progressing quietly during the past few years is bubble memories. Already announcements are being made of quarter-million-bit bubble memories which could be followed by a megabit device this year and then a 4 megabit memory in the mid 1980's. Bubbles will soon begin to encroach on markets now dominated by the other technologies. With the larger storage densities and the non-volatile memory, this means data can be retrieved even after power loss. Bubble memories occupy less space than either semiconductor memories or floppy discs for the same storage capacity. Access times are in milliseconds which is comparable to other magnetic storage devices but very much slower than semiconductor memories.

At present bubble devices cannot provide portable storage which means a chip cannot be removed and filed away then later plugged into another system. With present costs and performance characteristics, magnetic bubbles seem to pose the biggest threat to storage systems between 300,000 and 3 million bits of data storage. They will threaten the lower end of the tape cassette, floppy disc and fixed-head disc markets. The fabrication and operation of bubble devices was for a long time quite a mystery to me which has prompted me to write about them. It is almost as difficult to accept as the holes theory was when learning about transistors.

Most magnetic bubble memories use a magnetic garnet crystal grown on a non-magnetic substrate. When no magnetic field is applied to the magnetic garnet film, domains in the thin film form serpentine patterns of upward (positive) and downward (negative) magnetization. It is possible to actually see the magnetic patterns using red light and polarising microscope, which greatly simplifies development work. When a magnetic field is applied by sandwiching the chip between two permanent magnets, the magnetic bias expands domains in the bias direction and shrinks those polarised in the opposite direction. At a certain field strength, the serpentine patterns shrink to small cylindrical magnetic domains or 'bubbles'. Typical bubble diameters range from 2 to 30 micrometers determined by the material and the bias.

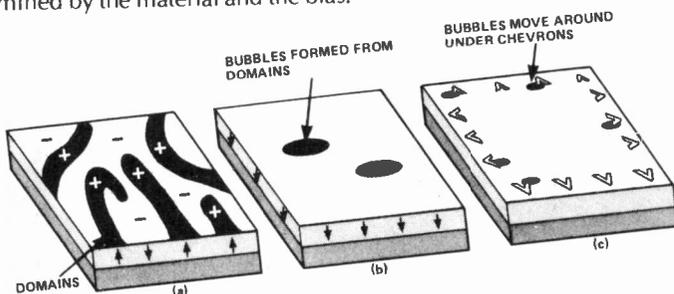


Fig.2(a). serpentine patterns occur naturally in the crystal.  
(b) the bubbles form from domains when a bias is applied, from a permanent magnet.  
(c) the bubbles move around under the chevrons when a rotating field is applied.

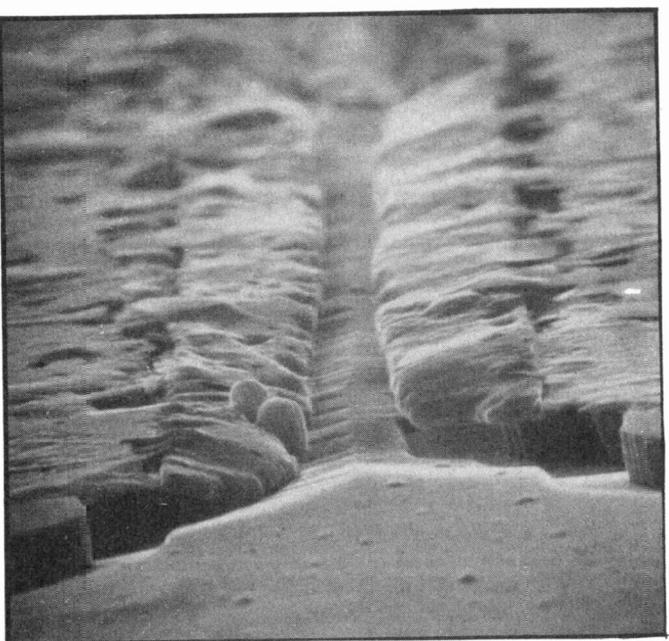
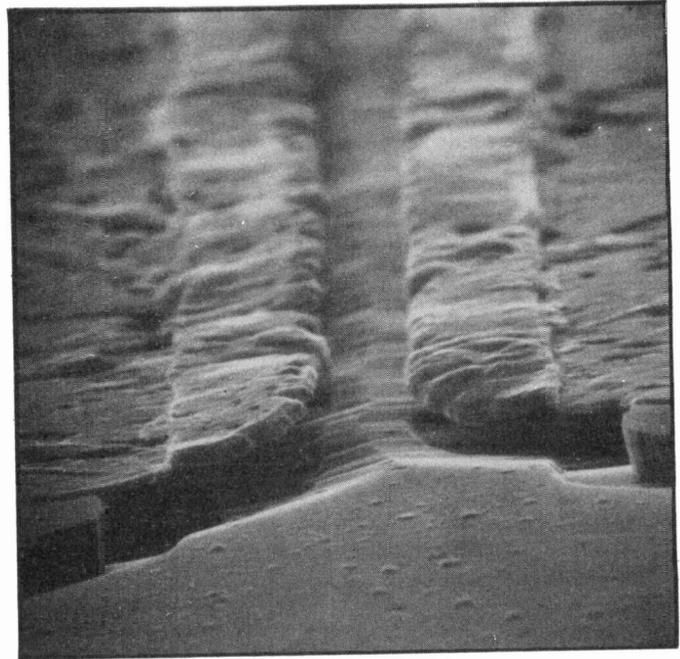


PHOTO 2 (top): the channel following metal deposition.

PHOTO 3 (above): breakdown! The overhang has collapsed.

In memory or logic devices the bubbles can be used to represent data, since the presence of a bubble can signify a binary 1 and the absence of a bubble can signify a binary 0. Bubbles can be generated by altering the bias field with a current pulse through a small conductive loop deposited on the chip. The current pulse produces a magnetic field opposite to that of a bias field thus producing a new bubble. Conversely, bubbles can be annihilated by applying a local field in a direction aiding the bias field. New techniques in magnetic bubble technology will eliminate the bulky field coils and permalloy layer by using a pair of conducting layers instead of magnets to move the bubbles. These and other improvements will further reduce the size, weight and manufacturing cost of bubble memories and will also speed data flow and increase bit densities.

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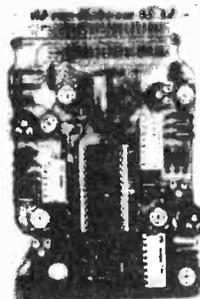
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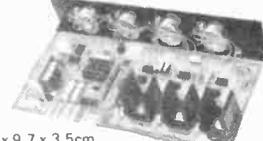
**LB31000SL SOUND TO LIGHT. A SUPERB PERFORMING SYSTEM AT AN INCREDIBLY LOW PRICE.**

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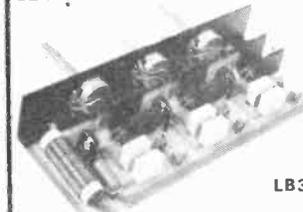
### LB81000LC

19 x 9.5 x 3cm.

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LB250	LB150	LB100	LB25
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**LBRLD1.** Relay delayed speaker connecting device placed between Amp & Speaker

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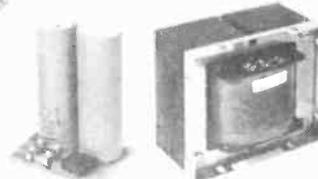
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**LBPA3-M (magnetic deck inputs) £30.70**

**LBPA3-C (ceramic deck inputs) £30.70**

**LBPA3-M**

20.4 x 9.5cm



**LB250PS**

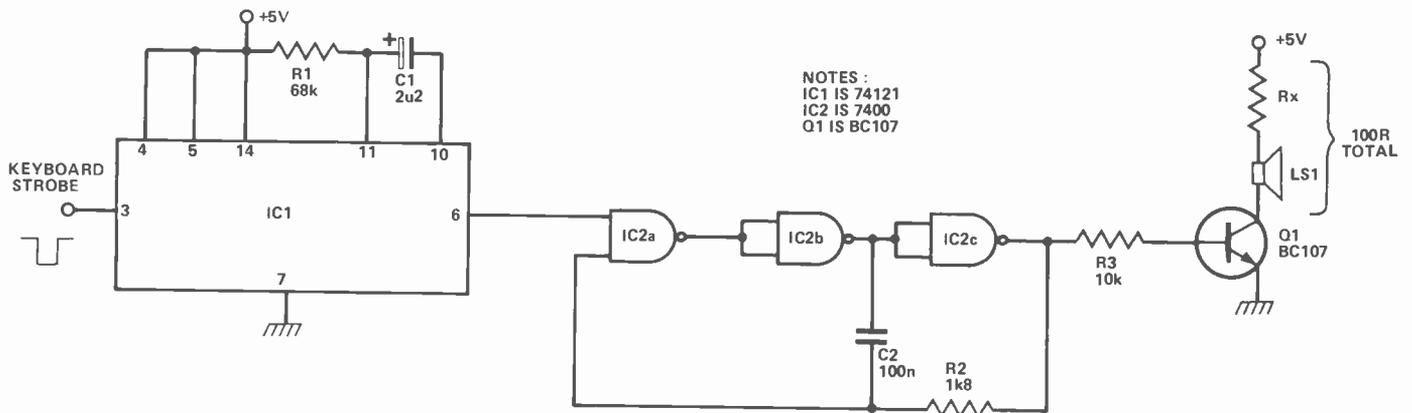
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# TECH TIPS



## Keyboard Audio Feedback

JA Tarlton, Nottingham.

When typing data into a computer it can become a nuisance if the operator has to keep looking up at the VDU screen merely

to check if the character typed has been accepted. This often occurs when the keyboard lacks a positive feel.

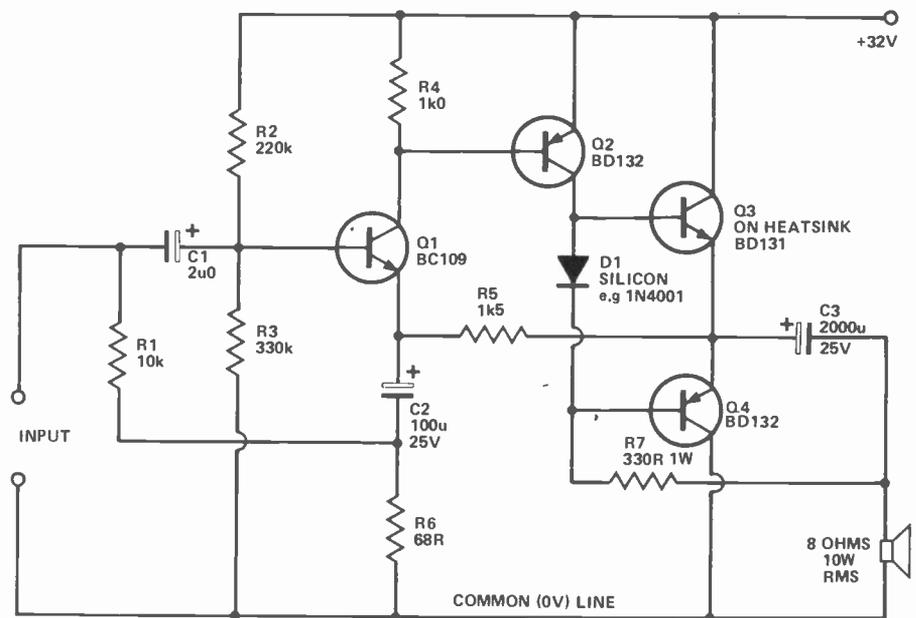
This circuit provides a positive indication of keyboard operation. It consists of a monostable multivibrator with a duration

of approximately 100 ms and a TTL oscillator running at 2 kHz feeding a loudspeaker. In operation the strobe signal from the keyboard triggers the monostable which in turn switches the oscillator on, producing a tone from the loudspeaker.

## Simple Ten Watt Amplifier

A Hiley, Woking.

This is an extremely simple and inexpensive general purpose amplifier. The design is conventional, the only point of interest being that the output transistors are under-biased: This means that there is no possibility of thermal runaway - it should, however, introduce large amounts of distortion, but, in fact, due to the high level of negative feedback employed, the distortion is reasonably low. Frequency response is extremely good.



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.



## Memory Test-T159

JK Porter, Gravesend.

The game is basically a test of mental agility and determines how many digits the player can successfully retain in his memory, whilst having to do deductive thinking at the same time. Because you can pre-set the level of difficulty, the game is suitable for all ages, and at its upper skill level it is very difficult indeed.

A series of numbers will be shown, each being displayed for about one second. This is an example:

0.7849

The numbers to watch are the first three digits of the mantissa, that is, the 7, 8 & 4. Deduce the number's highest digit, and remember it. In this case, it is the 8, since you ignore the last digit. If, as in 0.5884, the highest digit occurs twice, only remember it once. Do this for all the numbers flashed at you, (determined by the number you place in Memory 0 at the beginning of the game). So, if you choose to have 6 numbers displayed, you will eventually remember 6 digits. When the program stops, multiply all these digits together. By subtracting the number now in Memory 4, you can see how far you are, and if too high, or too low. (Positive number, too high; negative number, too low).

### PROCEDURE

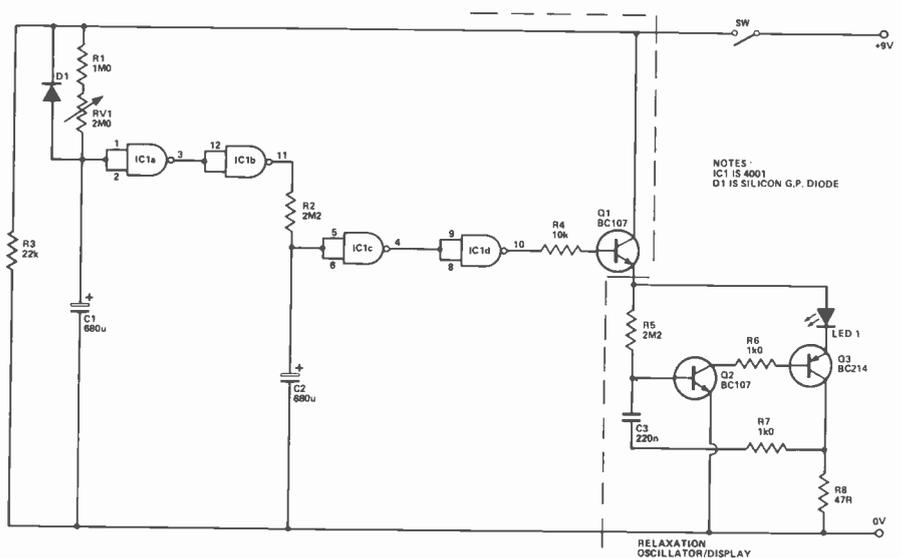
1. LRN. Key in program. LRN. RST.
2. 2nd FIX 4.
3. I STO 4.
4. Quantity of numbers you wish to be shown, e.g. 6 STO 0, You will be shown 6 numbers.
5. Key in all-decimal number, e.g. 0.675432. R/S.
6. Game runs.
7. When program halts, multiply together the requisite digits. Subtract from this the quantity held in Memory 4 to find the result.
8. Continue from 3.

LOC	CODE	KEY			
00	34 6	SUM 6	14	32 2	STO 2
01	33 6	RCL 6	15	61 1	SBR 1
02	35	Yx	16	32 3	STO 3
03	30	2nd $\pi$	17	33 1	RCL 1
04	85	=	18	22	x t
05	-35	INV Yx	19	33 2	RCL 22
06	05	5	20	76	2nd $x \geq t$
07	85	=	21	22	x t
08	-49	INV 2nd INT	22	33 3	RCL 3
09	36	2nd PAUSE	23	76	2nd $x \geq t$
10	34 6	SUM 6	24	51 5	GTO 5
11	61 0	SBR 0	25	33 7	RCL 7
12	32 1	STO 1	26	39 4	2nd PRD 4
13	61 1	SBR 1	27	51 6	GTO 6
			28	86 5	2nd LBL 5
			29	39 4	2nd PRD 4
			30	86 6	2nd LBL 6
			31	56	2nd DSZ
			32	71	RST
			33	00	0
			34	81	R/S
			35	71	RST
			36	86 0	2nd LBL 0
			37	55	X
			38	01	1
			39	00	0
			40	85	=
			41	32 5	STO 5
			42	49	2nd INT
			43	-61	INV SBR
			44	86 1	2nd LBL 1
			45	33 5	RCL 5
			46	-49	INV 2nd INT
			47	61 0	SBR 0
			48	-61	INV SBR

## Cascade Timer

P R G Reynolds, Benfleet.

This device will give timing periods in excess of one hour, using the minimum of external components, together with an inexpensive CMOS integrated circuit. The high input impedance of CMOS circuits is used to provide two cascaded timing networks. Network RV1-C1-R1 gives a variable time delay before sending output 1 low. This output is buffered and inverted, before initiating the timing sequence associated with the second network, R2-C2. Output 2 is again fed to the second buffer before connection to an output display via Q1. A flashing display was chosen in this case for two reasons. First, to conserve current in an already economical circuit. Second, a flashing display is more immediately noticeable. However, there is no reason why an alternative display should not be used.



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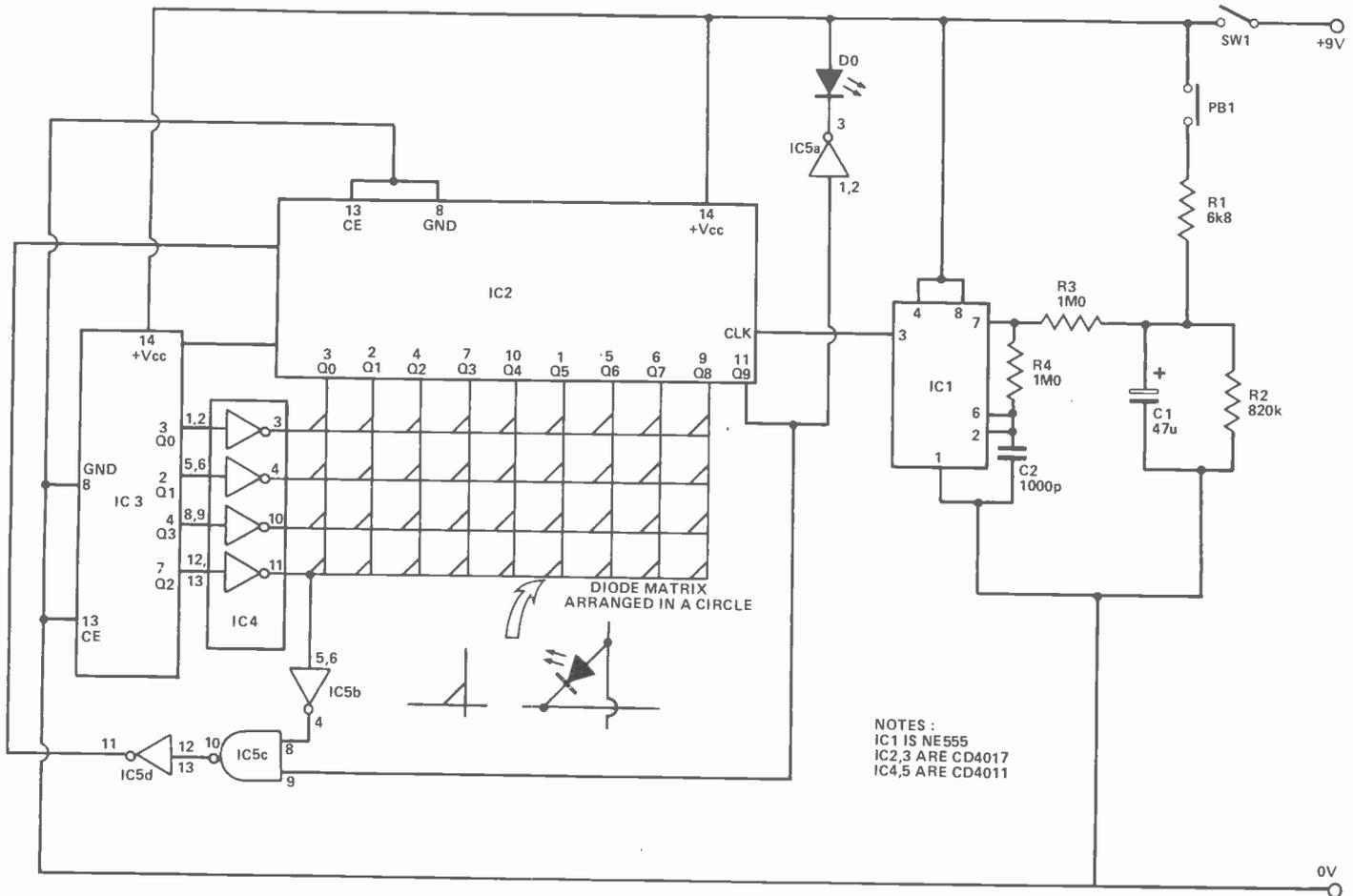
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### Electronic Roulette

AC Dickens, Leicester.

The advantage of this design over ten number versions, is that all 37 numbers are catered for, as in a conventional game, and the electronic circuit remains cheap and simple.

Initially, when PB1 is depressed, C1 charges via R1. The voltage on IC1 pin 7 rises, causing IC1 to start generating pulses which rapidly increase in frequency. IC2 & IC3 are decade counters, arranged so that each one of the 36 red LEDs in the matrix is illuminated in turn. The gates of IC5 are arranged so that D<sub>0</sub> (which is green in my circuit) is illuminated after D<sub>1</sub>, and followed by D<sub>1</sub>. Hence an apparent cir-

cular motion is generated. After the 'wheel' has been spun, PB1 is released. C1 now discharges via R2 and R3, so that the 'wheel' apparently slows down and then stops at one of the 37 numbers, each of which has an equal probability of occurring. The running time, and speed of 'revolution' can easily be altered by changing the value(s) of appropriate capacitor(s) or resistor(s).

### Cassette Tape Preamp

R Willis, Felsted.

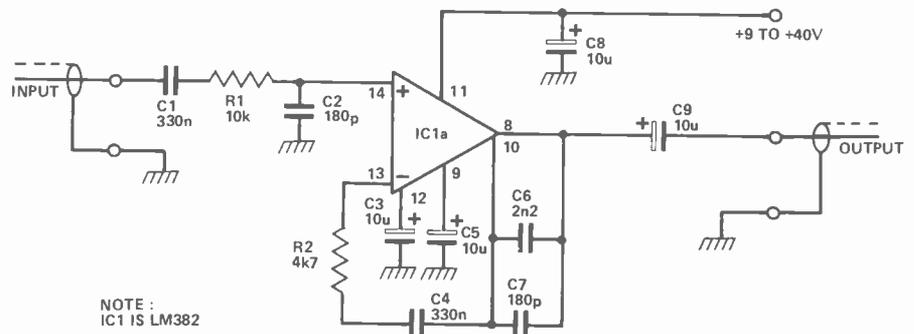
Preamp circuits utilising the LM382 low-noise preamp chip have been used in ETI before. However, when using them in conjunction with a cassette player the results can be disappointing as the cassette equalisation was to NAB standards.

This circuit is equalised for the Philips cassette system and will provide a high quality output of about 100 to 200 mV when driven from a stereo tape head.

The circuit will work on supply voltages from +10 V to +40 V, taking about 10 mA and is suitable for industrial, PA, do-

mestic, portable and automatic application. In operation R1-C1 and R3-C11 provide RF immunity. R2-C4 and C15-C16 provide the 120 uS time constant. C3-C5-

C12-C14 decouple the internal feedback loop of the IC and C8 decouples the supply line. C1-C8-C10-C17 AC couple the input and output screened wires.



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Size 9 1/4" x 8 3/4" x 4" approx with kit **£13.95**  
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**TWO WAY SPEAKER KIT** To suit above amp. Comprising 2, 8" approx Phillips base unit, and 2, 3 1/2" approx tweeters with 2 crossover capacitors **£4.95** p&p £1.65

Available only to first time purchasers of the 12 + 12 kit.

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**£30.60** p&p £3.20

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50 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

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Five vertical slide controls, master volume, tape level, mic level, deck level. PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level control (PFL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak

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Stereo pair 350 kit. System consists of 13" x 8" approx. woofer with rolled surround. 3 1/2" Goodman tweeter crossover components and circuit diagram. Frequency response 20 Hz to 20 KHz. Power handling 15 watts RMS 20 watts max 8 ohm impedance

**£18.25** Per stereo pair p&p £4.20

**BSR P200** **£25.50**

Belt drive chassis turntable unit semi-automatic, cueing device. p&p £3.00

Shure M75 6 Magnetic Cartridge to suit. **£7.95**

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ETIPRINTS are a fast new aid for producing high quality printed circuit boards. Each ETIPRINTS sheet contains a set of etch resistant rub down transfers of the printed circuit board designs for several of our projects.

ETIPRINTS are made from our original artwork ensuring a neat and accurate board. We thought ETIPRINTS were such a good idea that we have patented the system (patent numbers 1445171 and 1445172).

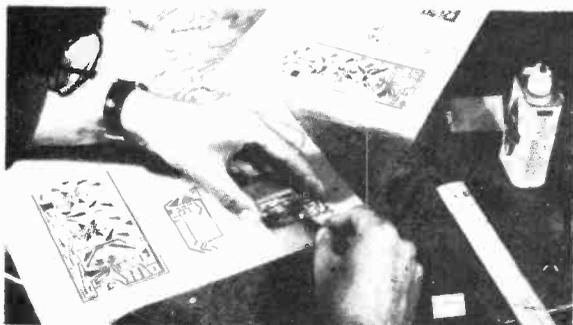
## PARTS LIST

Shown below is the listing for the last year's ETIPRINTS.

Earlier sheets are available, ring Tim Salmon for details.

<b>033</b>	LED Audio Display (2 boards) (topside pattern) Bench Amp NICD Charger	Aug 79	<b>036D</b>	Power Switch Selector (double sided)	Nov 79	<b>039A</b>	Hum Filter Logic Probe	Dec 79
<b>034</b>	Cable Tester Reaction Tester Speech Compressor Preamp Power Supply Rectifier & De-Thump Board Power Amp (2) (price £1.60)	Nov 79	<b>037A</b>	Encoder (double sided)	Dec 79	<b>039B</b>	Long Period Timer Rain Alarm Touch Switch Flash Trigger Pseudo Random Noise Gen	Dec 79
<b>035</b>	Oven Leakage Detector Pinball Wizard	Nov 79	<b>037B</b>	Decoder (top side)	Dec 79	<b>039C</b>	Function Generator	Dec 79
<b>036A</b>	3 x Display Board Relay Activator Points Controller	Nov 79	<b>037C</b>	Decoder (bottom side)	Dec 79	<b>049A</b>	ETI 80 - VCO and VCLFO	Feb 80
<b>036B</b>	Data Distributor (double sided)	Nov 79	<b>038A</b>	Long Period Timer Rain Alarm Touch Switch Flash Trigger Pseudo Random Noise Gen	Dec 79	<b>040B</b>	ETI 80 - PSU Tuning Fork Filter Coin Toss	Feb 80
<b>036C</b>	Train Speed Controller Track Cleaner & Electronic Pot (double sided)	Nov 79	<b>038B</b>	Hum Filter Dice Logic Probe	Dec 79	<b>041A</b>	ETI Audiophile ETI VCA Signal Trace ETI HC Electromyogram	Mar 80
			<b>038C</b>	Function Generator	Dec 79	<b>041B</b>	VCM Heater Controller	Mar 80
			<b>039</b>	Buffer Moving Coil Preamp Process Controller	Jan 80	<b>042A</b>	300W Amp Module	Apr 80

## 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!*

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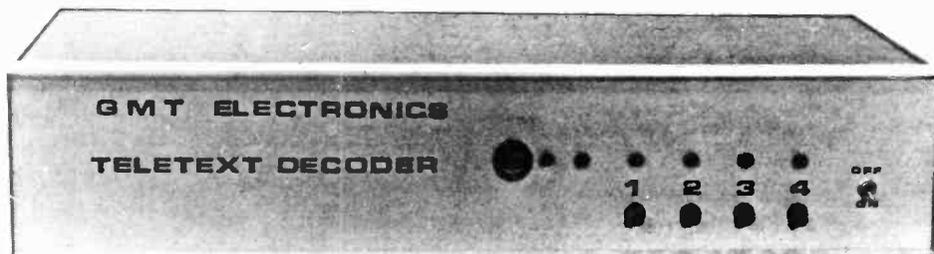
CAPACITORS				Electrolytic Axial Leads				Electrolytic Radial Leads				Miniature Low Value				Polyester Radial Leads				
-10% to +50% Tol.				-10% to +50% Tol.				-10% to +50% Tol.				Polyethylene, Axial, 1% Tol., >63V DC Wkg.				Dipped Type, C280/352 Style				
µF	V.d.c.	16	25	40	63	µF	V.d.c.	10	16	25	35	40	50	63	µF	352	360	µF	352	360
1.0	16			40	63	4.7	16								001	7	1	7	7	9
1.5	16			9	9	5.6	16								0022	6	7	15	8	10
2.2	16			9	9	1.0	16								0033	6	7	33	11	11
3.3	16			9	9	1.5	16								0047	6	7	47	14	14
4.7	16			9	9	2.2	16								0068	6	7	68	17	17
6.8	16			9	10	3.3	16								01	6	8	1.5	21	21
10	16			9	10	4.7	16								022	6	8	2.2	35	35
15	16			9	10	6.8	16								033	6	8	3.3	47	47
22	16			9	10	10	16								047	6	8	4.7	63	63
33	16			9	10	15	16								068	6	8	6.8	100	100
47	16			9	10	22	16								1	6	8	1	150	150
68	16			9	10	33	16								022	6	8	2.2	220	220
100	16			9	10	47	16								033	6	8	3.3	470	470
150	16			9	10	68	16								047	6	8	4.7	680	680
220	16			9	10	100	16								068	6	8	6.8	1000	1000
330	16			9	10	150	16								1	6	8	1	1500	1500
470	16			9	10	220	16								022	6	8	2.2	2200	2200
680	16			9	10	330	16								033	6	8	3.3	3300	3300
1000	16			9	10	470	16								047	6	8	4.7	4700	4700
1500	16			9	10	680	16								068	6	8	6.8	6800	6800
2200	16			9	10	1000	16								1	6	8	1	10000	10000

Trimmers				Electrolytic Can Type				4000 Buffered C-MOS - High Speed				7400 T.T.L.				LINEAR				Voltage Regulators			
250V D.C. Wkg. Film Dielectric, Miniature				High Ripple, 1EC Grade 1, Low E.S.R. Cap HR + µF + Volts				4000 Buffered C-MOS - High Speed				7400 T.T.L.				LINEAR				Voltage Regulators			
Value	Order Code	Value	Order Code	Value	Order Code	Value	Order Code	Value	Order Code	Value	Order Code	Value	Order Code	Value	Order Code	Value	Order Code	Value	Order Code	Value	Order Code		
1.4 - 4.1µF	20	1.4 - 4.1µF	20	1.4 - 4.1µF	20	1.4 - 4.1µF	20	1.4 - 4.1µF	20	1.4 - 4.1µF	20	1.4 - 4.1µF	20	1.4 - 4.1µF	20	1.4 - 4.1µF	20	1.4 - 4.1µF	20	1.4 - 4.1µF	20		
2 - 20pF	20	2 - 20pF	20	2 - 20pF	20	2 - 20pF	20	2 - 20pF	20	2 - 20pF	20	2 - 20pF	20	2 - 20pF	20	2 - 20pF	20	2 - 20pF	20	2 - 20pF	20		
2 - 20pF	22	2 - 20pF	22	2 - 20pF	22	2 - 20pF	22	2 - 20pF	22	2 - 20pF	22	2 - 20pF	22	2 - 20pF	22	2 - 20pF	22	2 - 20pF	22	2 - 20pF	22		
5.5 - 59.5pF	31	5.5 - 59.5pF	31	5.5 - 59.5pF	31	5.5 - 59.5pF	31	5.5 - 59.5pF	31	5.5 - 59.5pF	31	5.5 - 59.5pF	31	5.5 - 59.5pF	31	5.5 - 59.5pF	31	5.5 - 59.5pF	31	5.5 - 59.5pF	31		

CASES - Boss Industrial Mouldings				OPTO ELECTRONICS				SWITCHES				SEMICONDUCTORS			
Small Desk Console - Boss Industrial Mouldings				Light Emitting Diodes, Individual				Miniature Toggle - Honeywell				Semiconductors			
Part No.	Order Code	Part No.	Order Code	Part No.	Order Code	Part No.	Order Code	Part No.	Order Code	Part No.	Order Code	Part No.	Order Code		
W161 D96, H39 (57)	214	125 (3mm) Red	16	SPDT	67	IN814	5								
W215 D130, H47 (73)	308	125 (3mm) Green	16	SPDT	81	IN4001	5								
		125 (3mm) Yellow	20	SPDT	81	IN4002	5								
		Panel Mounting Clip to suit	3	SPDT	90	IN4007	9								
		2" x 5mm Film Red	16	DPDT	99	IN4008	9								
		2" x 5mm Film Green	16	DPDT	111	IN4009	9								
		2" x 5mm Film Yellow	20	DPDT	123	IN4010	9								
		Panel Mounting Clip to suit	5	DPDT	116	IN4011	9								
		Photoreistors	95	DPDT	116	IN4012	9								
		ORP12	95	DPDT	116	IN4013	9								
		ORP61	95	DPDT	116	IN4014	9								
		Phototransistors	220	DPDT	116	IN4015	9								
		OCPT1	195	DPDT	116	IN4016	9								
		BPX25	195	DPDT	116	IN4017	9								
		BPX29	195	DPDT	116	IN4018	9								
		Photocoupler	165	DPDT	116	IN4019	9								
		FCDB20	165	DPDT	116	IN4020	9								
		HARDWARE		DPDT	116	IN4021	9								
		D.I.L. Sockets		DPDT	116	IN4022	9								
		8 Pin Low Profile Socket Tin	12	DPDT	116	IN4023	9								
		14 Pin Low Profile Socket Tin	14	DPDT	116	IN4024	9								
		16 Pin Low Profile Socket Tin	16	DPDT	116	IN4025	9								
		Heatsinks		DPDT	116	IN4026	9								
		Individual Type for 1 x T05 50 C/W	12	DPDT	116	IN4027	9								
		Individual Type for 1 x T06 10 5 C/W	26	DPDT	116	IN4028	9								
		Individual Type for 1 x T03 7 2 C/W	26	DPDT	116	IN4029	9								
		Individual Type for 1 x T0126 17 C/W	26	DPDT	116	IN4030	9								
		Individual Type for 1 x T0220 17 C/W	26	DPDT	116	IN4031	9								
		P.C.B. Components		DPDT	116	IN4032	9								
		Dialo Pen, Blue Ink, Slow Drying	98	DPDT	116	IN4033	9								

RESISTORS				VERO ELECTRONICS PRODUCTS				Skeleton Presets, Miniature				Skeleton Presets, Standard			
Carbon Film, Fixed				2.5" x 5", 1" pitch Veroboard				0.1W, E3 Values, 100R-1M, Lin. Horizontal Mounting				0.2W, E3 Values, 100R-4M7, Lin. Horizontal Mounting			
Value	Order Code	Value	Order Code	Value	Order Code	Value	Order Code	Value	Order Code	Value	Order Code	Value	Order Code		
0.25W, E24 Values, 10R-10M, 5% Tol.	2 each	100/100 (Mult 10/Value)	Res RD4	71	200-21069J	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H		
0.5W, E12 Values, 10R-4M7, 10% Tol.	3 each	100/100 (Mult 10/Value)	Res RD4	75	200-21072D	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H		
		100/100 (Mult 10/Value)	Res RD4	85	200-21076C	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H		
		100/100 (Mult 10/Value)	Res RD4	68	200-21078H	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H		
		100/100 (Mult 10/Value)	Res RD4	135	200-21084E	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H		
		100/100 (Mult 10/Value)	Res RD4	107	203-21013A	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H		
		100/100 (Mult 10/Value)	Res RD4	147	203-21015F	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H		
		100/100 (Mult 10/Value)	Res RD4	44	203-21087G	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H		
		100/100 (Mult 10/Value)	Res RD4	100	200-21341D	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H		
		100/100 (Mult 10/Value)	Res RD4	109	200-21339F	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H		
		100/100 (Mult 10/Value)	Res RD4	109	200-21340G	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H	8	Min. Preset H		

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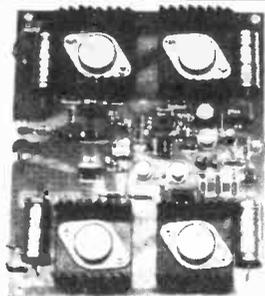
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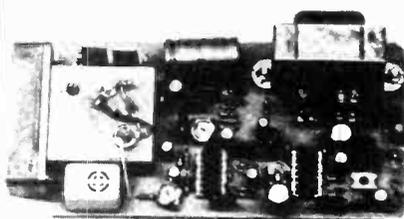
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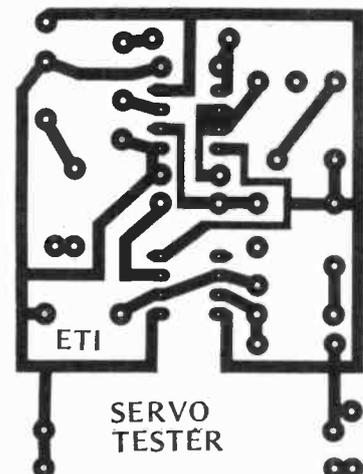
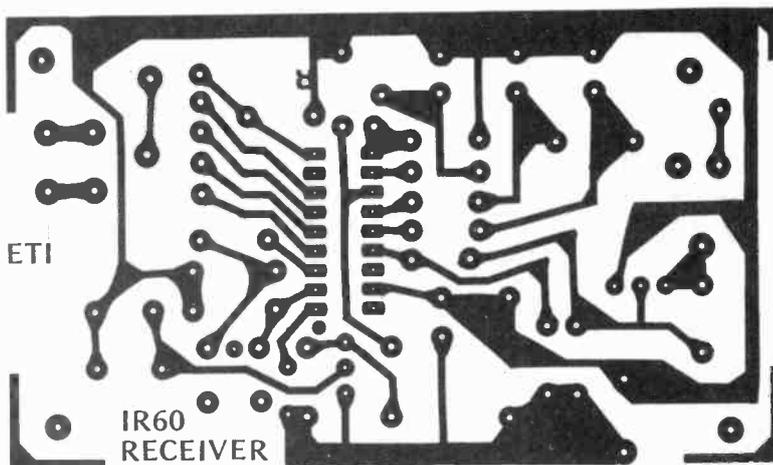
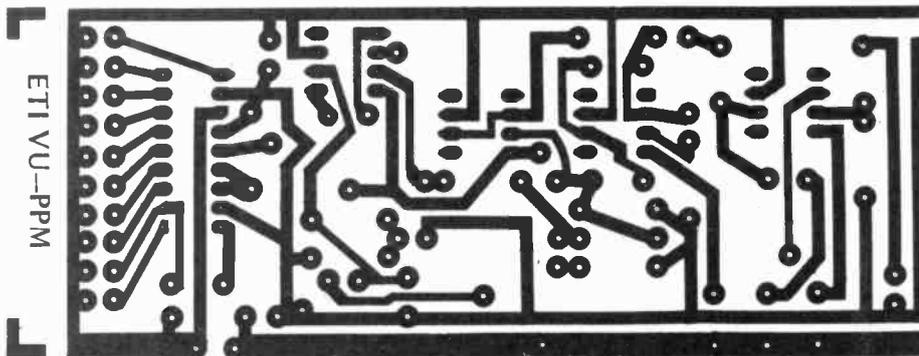
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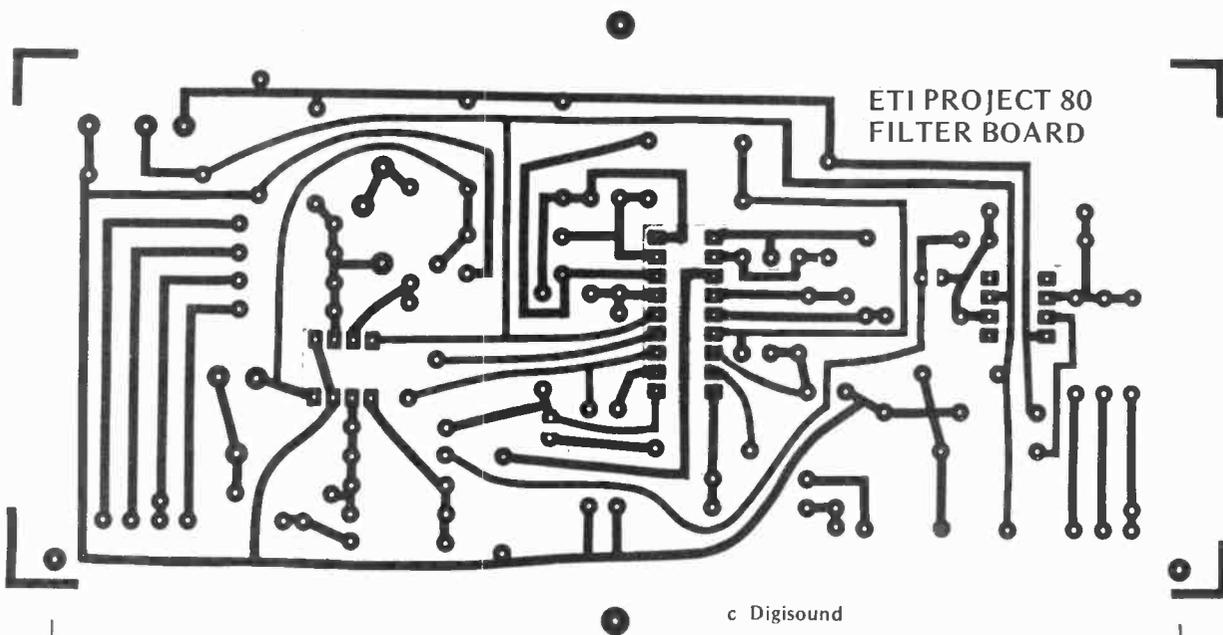
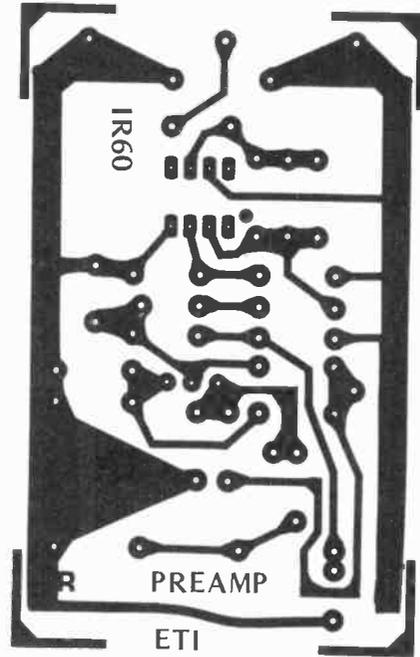
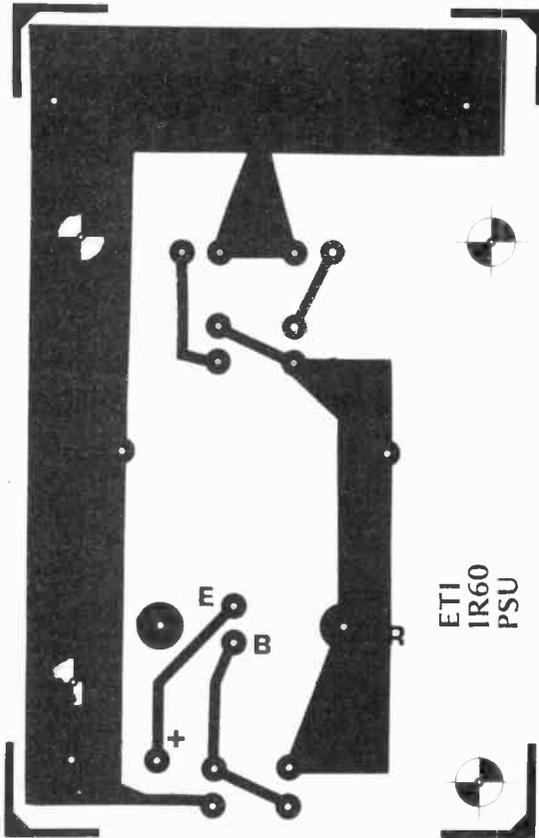
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# PCB FOIL PATTERNS

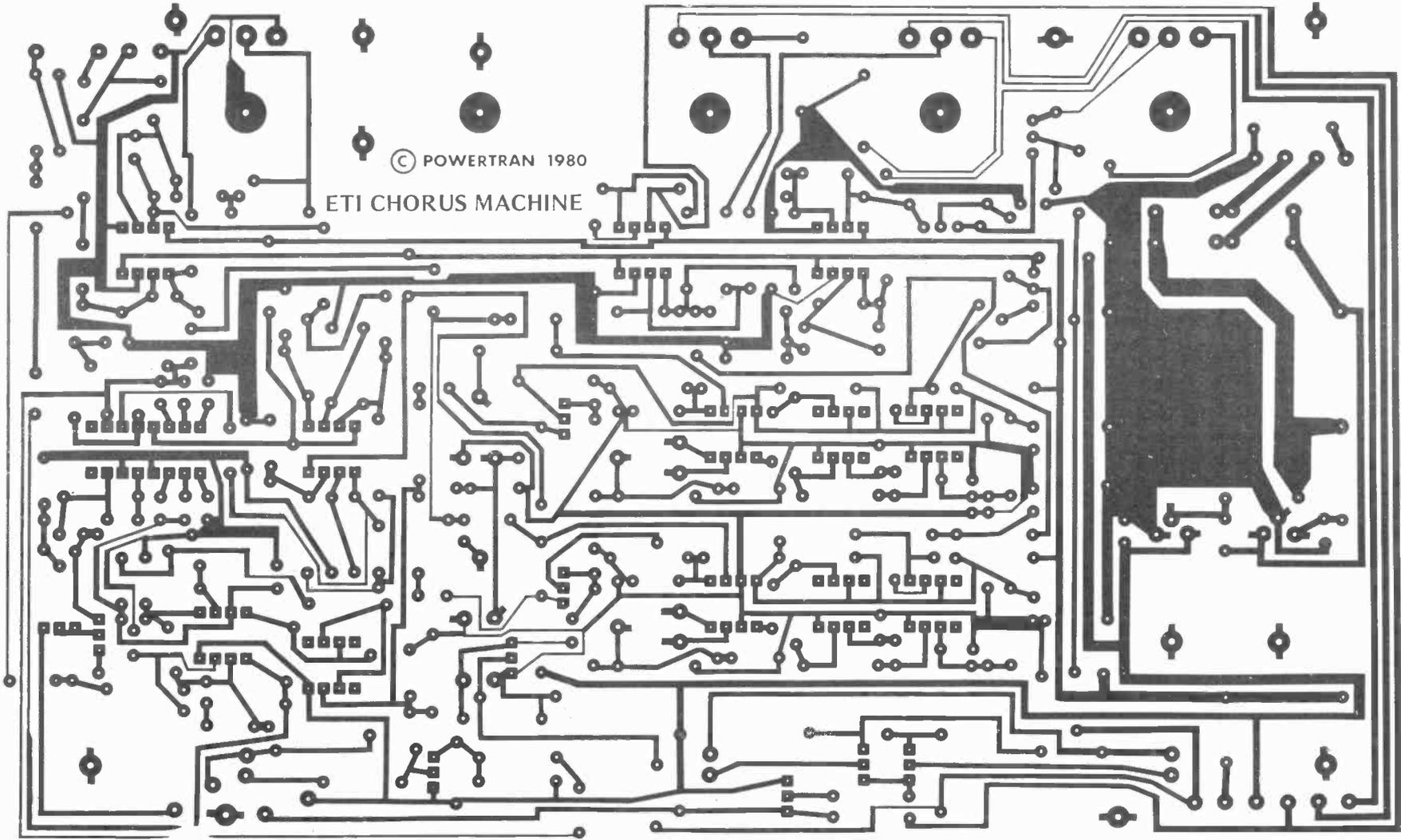
Shown below are the foil patterns for the months projects. The Black Hole PCB is shown overleaf. The Infra-Red remote control project will be concluded next issue — at which time details of the transmitter circuit and PCB will be given.

Companies producing boards of ETI projects should note that both the Chorus Machine and Voltage Controlled Filter PCBs are copyrighted to Powertran and Digisound respectively — and may not thus be reproduced other than by individuals for their own usage in a one-off basis.





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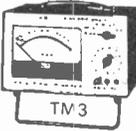
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PROM WASHING SERVICE: 50p each prom

## COMPUTER BOARDS

The following is an extract from our leaflet ref. 'MP4', which is available free on request (a 9" x 6" SAE helps, but is not essential). See Microprocessor section for the right for board prices.

For many people the wide choice of micro-processors now available presents a difficult choice. To understand any particular microprocessor in depth a development system is almost essential, however, in the past to understand more than one several separate development systems have had to be purchased.

The reason that separate systems, one for each processor, have been necessary is due to the fact that individual microprocessors have their own individual features. In one case to access memory a separate read strobe and write strobe is required, in another a 'read/write' line is used in combination with a combined strobe called 'valid memory address and phi-2'. With some processors, the same address bus can be used for both memory and input/output ports, under the control of a 'memory request' or an 'input/output request' control line.

Naturally, if a development system takes advantage of any of the particular unique features of any particular microprocessor, this makes it more difficult to graft some other unrelated microprocessor onto the same bus at a later date.

A Universal Micro System provides a basic bus structure on which any one micro-processor can be connected. The system uses a CPU (Central Processor Unit) card which is separate from the rest of the system, and this allows the same memory and interfaces to be retained when a different MPU is used.

The basic system bus consists of data and address buses together with read and write strobes. By locating the data input (Keyboard) and output (VDU) in the memory space then such chips as the 8080/Z80 family, which normally use input/output ports, can now be used without any fundamental change to the bus (and as a bonus, users of these MPU's have all the ports entirely free for their own purposes).

The range of p.c.b.'s includes boards to implement a memory-mapped VDU, cassette interface, keyboard interface, PROM programmer, and a number of RAM and ROM cards. All the cards are of International Size 114 x 203 mm (4 1/2" x 8") except for the larger power PSU A power supply card. This latter card is sized so that it can be bolted to the side of a standard 4" chassis module which is then compatible with the other cards. The cards have a standard 43-way edge connector, with one position used for polarisation.

We do not propose to defend the (relatively) small number of bus connections (42), against such standards as the S100 - 100 position bus. The S-100 bus, as it originated in America, is bigger and better than the more expensive. In the same way, a Ford 'Granada' is bigger and better than a Ford 'Cortina', but it doesn't mean a Cortina isn't good value for money.

The International Size modules are available in 1U, 1.5U, 2U, 3U, 1U 1/2, 1.5U 1/2, 2U 1/2, 3U 1/2 rack and a variety of customising them to suit the firm's 'R.S.' (Reliability Standards) policy. It is possible to complete the purchaser's assembly of computer modules virtually.

**NEW! 'ISBUS-1.1'**

Low-cost commercial quality computer back board, 13" x 4 3/4" approx. for the International Standard (114x203mm) cards. Double sided connector, it can be used with the 43-way connector specified for the computer boards we advertise. (Pin 37 is used for polarisation.) Takes up to 13 cards on 1" centres, and provides for 4 power rails, 58 parallel address/data etc. bus lines and 3 daisy chains.

Expiry glass, tinted, price £11.50. More details in our free leaflet 'ISB-1.1'.

## CMOS

These cut prices for Amateur Users and Export. Note: Industrial users - quantity prices available. Mostly Motorola, RCA

4000	15p	4042	75p	4089	£1.50	4419	£2.68	4532	£1.27
4001	17p	4043	94p	4093	63p	4422	£5.00	4534	£5.13
4002	17p	4044	90p	4094	£1.90	4431	T8A	4536	£3.69
4006	£1.05	4045	£1.45	4095	£1.05	4433	£11.32	4537L	£13.23
4007	18p	4046	£1.28	4096	£1.05	4435	£7.93	4538	£1.25
4008	87p	4047	87p	4097	£7.72	4451	£2.67	4539	91p
4009	50p	4048	50p	4098	£1.10	4450	£2.67	4541	£1.14
4011	18p	4049	48p	4099	£1.45	4452	T8A	4543	£1.59
4012	18p	4050	48p	43061	M/S	4461	£2.18	4549	£3.69
4013	42p	4051	72p	43010	£2.50	4462	£2.42	4552	£10.55
4014	86p	4052	72p	43011	£1.61	4490P	£6.54	4553	£3.87
4015	89p	4053	72p	43012	£2.12	4490VP	£3.48	4554	£1.19
4016	45p	4054	£1.10	43013	£2.12	4507	£6.95	4556	179p
4017	89p	4055	£1.28	43014	£1.09	4501	17p	4556	78p
4018	89p	4056	£1.34	43015	£1.06	4502	91p	4557	£3.86
4019	48p	4057	£25.70	43016	£1.61	4503	99p	4558	£1.14
4020	99p	4058	£4.80	43017	63p	4505	£5.71	4559	£3.69
4021	91p	4059	£1.15	43018	£5.36	4506	51p	4560	£1.84
4022	86p	4061	£15.67	43019	£1.02	4507	59p	4561	65p
4023	86p	4062	£1.00	43020	£1.00	4508	£2.48	4562	£5.35
4024	66p	4063	£1.09	43021	£1.40	4510	99p	4566	£1.59
4025	19p	4064	M/S	43022	£1.40	4511	£1.38	4568	£2.38
4026	£1.80	4065	M/S	43023	£1.40	4512	81p	4569	£2.57
4027	45p	4066	£3.80	43024	£1.18	4514	£2.65	4570	25p
4028	81p	4067	£7.29	43025	£1.48	4515	£2.99	4572	£5.74
4029	99p	4068	20p	43026	£1.08	4516	£1.08	4581	£2.32
4030	58p	4069	20p	43027	£1.08	4517	£3.82	4582	98p
4031	£2.05	4070	23p	43028	£1.08	4518	£1.02	4583	76p
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4036	£2.45	4075	23p	43033	£1.08	4524	M/S	4598	£2.65
4037	£1.00	4076	23p	43034	£1.08	4526	£1.08	4599	£6.95
4038	£1.08	4077	23p	43035	£1.08	4527	£1.52	4700	£1.75
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4040	£1.05	4079	21p	43037	£1.08	4529	£1.14		
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## 74C

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74C10	24p	74C58	£1.04	74C176	£1.10	74C910	£6.78	80C35	54p
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74C14	£1.41	74C60	£1.22	74C196	£1.04	74C912	£7.13	80C37	54p
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74C20	24p	74C62	£2.46	74C221	£1.36	74C915	£1.10	82C19	£4.13
74C22	24p	74C63	£3.67	74C223	£1.73	74C918	£1.06	88C29	£1.93
74C24	24p	74C64	£2.20	74C224	£1.73	74C921	£1.83	88C30	£1.93
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## MODULATORS

UM111	E36 UHF Ch.36	£2.50
UM112	E36 UHF Ch.36	£2.50
UM121	UHF Ch.36 Vision	£2.50
UM122	UHF Ch.36 Vision	£2.50
UM123	FM Source Sub-carrier Modulator	£2.50

## SWITCH MODE PSUs

AC 522/15 5V/10A	£69.90
AC 322/15 5V/5A 12V/1A -12V/1A	£8.00
AC 542/15 5V/20A	£99.20
AC 942/15 5V/10A 12V/2A -12V/2A -5V/0.1A	£126.50

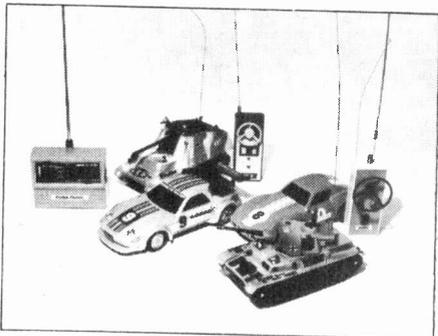
## MICROPROCESSORS

<b>COMPUTER BOARDS</b>		<b>6800 MPU</b>		<b>6801 MPU</b>	
114 x 203 mm fiberglass, with gold plated edge connector.	£7.95	6801 (128 x 8 RAM)	£2.97	6801 (128 x 8 RAM)	£3.75
8088/8085 CPU £7.95		6801A (128 x 8 RAM)	£3.96	6801B (128 x 8 RAM)	£3.08
8088/8085 CPU £7.95		6801C (128 x 8 RAM)	£2.64		
Z80 CPU card	£7.50	6802 MPU	£12.00		
VDU 'G' set	£7.50	6802 PIA	£8.22		
VDU 'G' (theta)	£7.50				
EPROM Programmer	£7.95	<b>CMOS</b>		<b>CMOS</b>	
8k PROM board (5204A)	£5.95	COSMAC CDP 1802CE	£9.85	COSMAC CDP 1802CE	£10.85
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2k RAM board (1024)	£7.95	COP 1864	£7.25		
2k RAM board (2144)	£7.95	<b>STATICS (Mostly 450Ns)</b>		<b>STATICS (Mostly 450Ns)</b>	
8k RAM board (2144)	£7.95	2101-256 x 4	£1.20	2101-256 x 4	£1.20
TAPE interface	£7.50	2102-1K x 1	£2.25	2102-1K x 1	£2.25
Keyboard interface	£7.50	2111-256 x 4	£1.95	2111-256 x 4	£1.95
PSU 5v -12v -12v board	£7.50	2112-256 x 4	£2.25	2112-256 x 4	£2.2

**Next  
Month**

# Hobby Electronics

## RADIO CONTROL MODEL SURVEY



It's been quite some time since we had a 'toy' feature, so we thought it was a good excuse to look at the latest crop of remote control cars, tanks, boats and other vehicles that have been flooding into the toy shops in the last few months.

Many of these so-called 'toys' are quite sophisticated, in fact a couple of them are far too good for youngsters. We reckon any kid getting one of these for a present hasn't a chance of playing with it if there is an adult around. This was more than borne out by the HE staff, literally queuing up to play with them. Find out how we got on in next month's exciting feature (providing we can tear them away from tearful office staff).

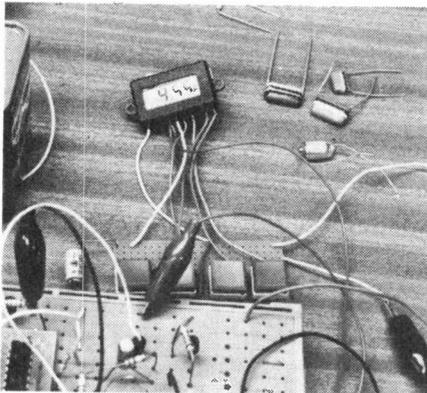
## CONTEST

Yes, another of our famous devil-may-care contests. Prizes galore, instant stardom, just some of the things that happen in our competitions. We can't reveal the details yet (we're not too sure of them ourselves). What we can say is that the first prize will be a superb, Heathkit type build-it-yourself goodie and that if you miss it you will never forgive yourself.

## CROSSOVERS

Now for the first time anywhere. The complicated bits in loudspeakers, the Crossover Networks, will be explained as never before. Learn the intimate secrets of these cunning little circuits. Now you will be able to look any 'Audiophile' in the eye and know what he's talking about, you may even be able to tell him a thing or two.

## MINICLOCK

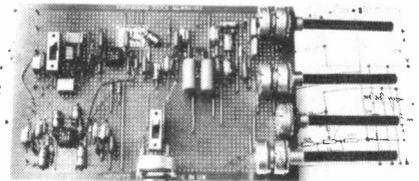


Time for a really alarming project. We promise no 'wind-ups' with this crystal controlled, battery powered, LCD display travelling alarm. It will fit snugly into the palm of your hand. Ideal for the 'travelling man', this neat little timepiece will reliably inform you of the correct time anywhere in the world. (Yes folks, a truly international clock, we absolutely guarantee it will work anywhere in the world.)

The built-in alarm will remind you of that all-important business lunch or just tell you it's time to get up. Never be late again, never be at a loss at parties, impress your friends . . . . .

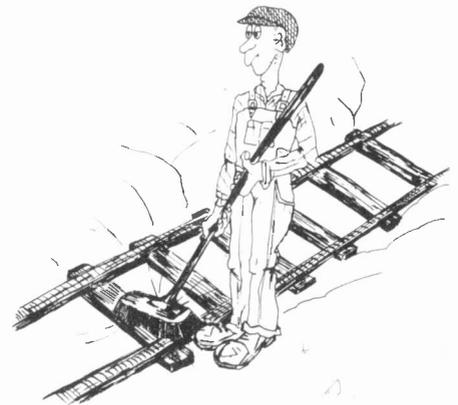
The copywriter for this project has just been retired due to an overdose of corny cliches. Seriously though, don't miss next month's HE, or you'll live to regret it.

## SYSTEM 5080



To conclude the fabulously popular 5080 modular Hi-Fi system we are presenting the last word in Pre-Amplifier designs PLUS an amazing speaker system that will really complement the PA and PSU modules. For less than the price of a half decent ready built amplifier the 5080 system will bring the world of true Hi-Fi into your living room. (And if that sounds a bit schmaltzy just wait till you hear the amp at full tilt . . . . .)

## TRACK CLEANER



Troubled by tarnished tracks? Confounded by corroded connections? HE to the rescue, our supersonic, high-voltage grime-beater will get rid of those bits that clog your contacts and leave your model railway running so smoothly you'll wonder how you ever shunted your steamer without it.

The May issue will be on sale April 11th

The items mentioned here are those planned but circumstances may affect the actual contents

# SEIKO

# NEW CASIO CALCULATORS AND WATCHES

## TSi Alarm Chronograph



With countdown alarm. Hours, minutes, seconds, alpha day and date on upper display; and day, date, month, alarm and hourly chimes. Countdown alarm (upper display). Stopwatch from 1/100 sec to 12 hours; net, lap, and 1st & 2nd place times. Stainless steel. Glass.

**Only £57.50**

## TS7 Alarm Chronograph

100M Water Resistant. Suitable for swimming, water skiing etc. Hours, minutes, seconds, day, date and month. Programmable weekly alarm. Interval alarm timer up to 16 hours. Hourly chimes. Stopwatch, 1/100 second to 20 minutes, then seconds to 12 hours. Upper display — lap times. Lower display — Total time.



**Only £74.95**

## TS5 World Time / Alarm



Two Alarms, local and world time (dual tones). Hourly chimes. Normally displays hours, minutes, seconds, day; or optionally hours, minutes, day, date, month. World time mode displays an atlas with each of the 19 time zones highlighted when selected. Date and summer time functions.

**Stainless £79.95**  
**Gold Pl £99.95**

## H127 Analogue / Digital

Independent analogue display. Digital hours, minutes, seconds, day, and date, month, 1/100 second stopwatch to 20 minutes, then seconds to 12 hours; net lap and 1st & 2nd place. Single counter to 9,999 or dual counter to 99.

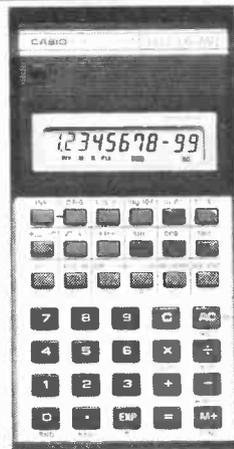


(£95) **£69.95**

**SEIKO.** The world's largest manufacturer of high quality watches. Solid stainless steel cases and bracelets, unless otherwise stated. Scratch resistant glass. Splash resistant. Typically 2 year + battery life. Accuracy: ± 15 seconds per month or better.

## BARGAIN BASEMENT

Clearance offers while stocks last.  
**95QS,32B.** Chrome plated version of 95QS-36B above. **£16.95**  
**CQ-82** Clock, 4 alarms (one with snooze), calculator **£13.95**  
**HQ-21** Clock, calculator **£8.95**  
**UFO Master Blaster Station** (RRP £24.95) Was **£22.50**  
**Granstand Adam.** 4 games, one as "Simon says", was **£22.50**  
**Granstand 4-in-1.** Was **£22.50** **£16.95**



## FX-100 SCIENTIFIC

LCD, 10 digits, 44 scientific functions, 6 levels ( ), standard deviations, coordinates conversions, sexagesimal conversions, fractions, cube roots, FIX, SCI, NORM, ENG, RND and RAN (random number). 7,500 hours battery 3/4 x 3 x 5 1/2 inches.

**£15.95** (£17.95)

## MELODY 81

(ML-81) (RRP £24.95) **£22.95**

More musical than the Melody 80



## ML-81, 11 Note Melody Maker

Clock, 200 year auto calendar. Two musical alarms, countdown timer and hourly chimes. 1/10 second stopwatch measuring net, lap, and 1st & 2nd place times to 24 hours. Calculator with full memory, %, square roots. 1 year battery life from two RW42 batteries. 5/16"x4 1/2"x2 1/4"

## ML-71

(24.95) **£22.95**

As ML-81 but 1 alarm, No √, 3/16"x3"x2 1/4"



## AQ-2200

**£19.95** (£21.95)

Permanent display of full month calendar. Clock, alarm, hourly chimes. Stopwatch from 1/10 second to 12 hours; net, lap, 1st & 2nd place times. Calculator with full memory, %, √, 1 year batteries 9/32x2 3/4x4 1/2"



## MQ-12

(RRP £21.95) **£19.95**

Card version of AQ2200. No √, 3/16"x3"x2 1/4"



**MQ-6 £19.95.** **HR-10 Mini Printer £29.95.** **FX-81 £12.95.** **FX-80 £13.95.** **FX-330 £15.95.** **FX-310 £17.95.** **FX-510 £19.95.** **FX-2600 £19.95.** **FX-3200 £21.95.** **FX-501P £54.95.** **FX-502P £74.95.** **FA-1 £19.95.** Master Pack deal + **£5.**

## ILLUSTRATED CATALOGUE

Casio and Seiko products. Send 25p to: TEMPUS (Information and Service Centre), 19-21 Fitzroy Street, Cambridge CB1 1EH.



## CASIO PW-81

6 digit clock, 24-hour alarm, hourly chimes. 8 digit calculator, with full memory. % 3/16x3 3/4x2 1/4"

**£14.95** (£17.95)

## 83QS-41B ALARM CHRONOGRAPH

Stainless steel encased, mineral glass, water resistant, 3-YEAR BATTERY. Hours, minutes, seconds, date, am/pm, or hours, minutes, alpha day, date, am/pm. 24-hour alarm, hourly chimes. Stopwatch measures net, lap and 1st and 2nd place from 1/10 second to 12 hours. (£29.95)

**£24.95**



(Similar to illustration)

## F-80 Alarm Chronograph



Black resin case, mineral glass. Water resistant. 3 YEAR BATTERY. Hours, minutes, seconds, date, am/pm, or hours, minutes, alpha day, date am/pm. 24 hour alarm, hourly chimes. Stopwatch from 1/10 second to 12 hours; net, lap and 1st and 2nd place. Nightlight.

**£19.95** (£24.95)

## 95QS-36B Chronograph

Stainless steel, mineral glass. Water resistant. 5 YEAR BATTERY. Hours, minutes, seconds am/pm and day (12 or 24 hours). Dual time (12 or 24 hour). Day, date, month and year calendar. Stopwatch from 1/100 sec to 7 hours; net, lap and 1st & 2nd place times.

(£24.95) **£19.95**



## 111QS-34B

Superbly finished chrome plated case, mineral glass. Water resistant. Comprehensive display, hours, minutes, seconds, am/pm, day and date. Button for nightlight.

**£14.95** (£17.95)  
F-8C Black resin cased version. **£19.95**

**F-200 Sports.** Now only **£12.95**

## Ladies' Casio watches



**L-10**  
Disco  
**£12.95**



**L-20**  
Chrome  
**£14.95**



**87QL-188**  
s/s  
**£27.95**

All display hours, minutes, seconds, am/pm; And day date and month. Stopwatch / dual time facility.

## RETURN OF POST SERVICE

Postal and telephone orders received before 4.00 p.m. will normally be despatched the same day by FIRST CLASS POST.

Send your order by FREEPOST (2nd class post — no stamp required). Please phone urgent orders or use first class mail.

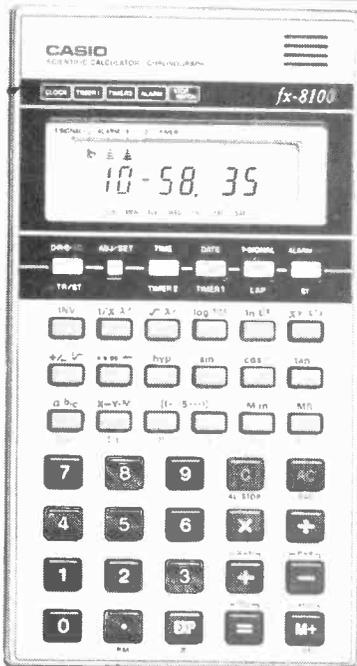
PRICE includes VAT, P&P. Send your Company Order, Cheque or P.O. or phone your ACCESS or B'CARD number to:

# TEMPUS

Tempus (Dept. ETI)  
FREEPOST, 164-167 East Road  
Cambridge CB1 1BR. Tel. 0223 312866

Our retail shop will be moving soon. Personal callers, please telephone first for details.

# Casio's new SUPERCALC!



You always wanted a calculator that does everything except make tea —

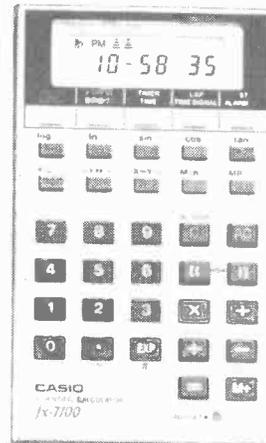
**HERE IT IS!**

**CASIO FX-8100 (left) 46 scientific functions, clock, calendar, alarm, countdown alarm, interval alarm timer, hourly chimes, 1/100sec stopwatch.**

ONE YEAR BATTERY LIFE approx. (continuous use). LC Display; 8 digit mantissa plus 2 digit exponent. 5 level parentheses, full access memory. Trigs, logs, hyperbolics, standard deviations, co-ordinate conversions, sexagesimal to decimal conversions, fractions, percentages, cube roots, sign change, register exchange, Pi entry etc. CLOCK displays hours, minutes, seconds, am/pm and day. CALENDAR pre-programmed to 1999; day, date, month and year. 24-hour ALARM, hourly chimes. Countdown ALARM TIMER, interval (repeater) alarm timer or 1/100 second STOPWATCH measuring net, lap and first and second place times to 10 hours. 6.6 x 70 x 129mm (1/4 x 2.3/4 x 5.1/8 inches). Leatherette wallet. RRP £27.95.

**All this for ONLY £24.95!**

# It's got the lot!



**Casio FX-7100**

RRP £27.95  
**ONLY £24.95**

**FX-7100 (above).** Card version of the FX-8100. ONE YEAR BATTERY LIFE, 8 digit display and 39 scientific functions (does not have hyperbolics, fractions or calendar function). With clock, alarm, and hourly chimes. Interval alarm timer or 1/100 sec stopwatch. Wallet. 3/16 x 2 1/8 x 3 3/8 inches.

## CASIO ★★★★★ Star Buys ★★★★★ SEIKO

### CASIO 81QS-35B ALARM CHRONOGRAPH



**ONLY £29.95**

RRP £34.95

Stainless steel, mineral glass, water resistant. 5-YEAR BATTERY. Hours, minutes, seconds and day. Day, date, month and year calendar pre-programmed to 2029. 12- or 24-hour display. 24-hour alarm, hourly chimes, stopwatch from 1/100 second to 7 hours, measuring net, lap and first and second place times. Backlight for night time viewing.

### CASIO C-80 CALCULATOR WATCH



**ONLY £24.95**

RRP £29.95

Black resin, mineral glass, water resistant. FINGER-TOUCH KEYBOARD. Hours, minutes, seconds, am/pm and day. Day, date and month auto calendar pre-programmed to 2009. Professional 24-hour stopwatch measuring net, lap and first and second place times to 1/100 second. Dual time, 24-hour. 8 digit calculator. Backlight for night-time viewing. 44.9 x 35.8 x 10.2mm.

### SEIKO TS2 ALARM CHRONOGRAPH



**ONLY £47.50**

Stainless steel encased, Glass, splash resistant. 2-YEAR BATTERY. Comprehensive display of hours, minutes, seconds, day, date and month. 24-hour alarm and hourly chimes. Stopwatch from 1/100 second to 20 minutes, then seconds to 20 hours. Upper display — lap times, lower display — total time. 8mm thick — 8.8mm including front buttons.

Please send cheques, postal orders. Company orders or phone your ACCESS or BARCLAYCARD number to:

## TEMPUS

(mail order only)  
Tempus  
(Dept. ETI)  
FREEPOST  
164-167 East Road  
Cambridge CB1 1BR

(Catalogues, information and service centre)  
Tempus  
19-21 Fitzroy Street  
Cambridge CB1 1EH

Telephone: 0223 312866

Prices include VAT and Post and Packing

To: Tempus (Dept. ETI), FREEPOST, 164-167 East Road, Cambridge CB1 1BR ET1 5

Please send me .....

Remittance enclosed £ .....

Access or Barclaycard number .....

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Post code .....

**FM/AM STEREO TUNER AMPLIFIER CHASSIS**

Originally designed for installation into a music centre. Supplied as two separate built and tested units which are easily wired together.

**Note** Circuit diagram and interconnecting wiring diagrams supplied.

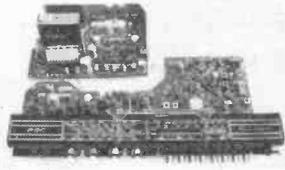
**Rotary Controls** Tuning, volume, balance, treble and bass.

**Push Button Controls** Mono, Tape, Disc, A.F.C., FM (VHF), LW, MW, SW.

**Power Output** 7 watts RMS per channel into 8ohms (10 watts music).

**Tape Sensitivity** output typically 150mv. Input 300mv for rated output.

**Disc Sensitivity** 100mv (ceramic cartridge).



**Stereo Beacon Indicator** LED or bulb.  
**Size** Tuner — 2¼" x 15" x 7½" approx. Power amp. 2" x 7½" x 4½" approx.  
**Price £22.00** + £2.50 Postage and Packing.

**J.V.C. TURNTABLE**

J.V.C. Turntable supplied complete with an Audio Technica AT10 stereo magnetic cartridge.

★ S' shaped tone arm.

★ Belt driven.

★ Full size 12" platter.

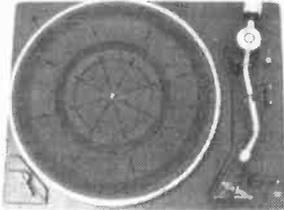
★ Precision callibrated counter balance weight (0-3 grms).

★ Anti-skate (bias) device. Nylon thread weight.

★ Cut-out template supplied.

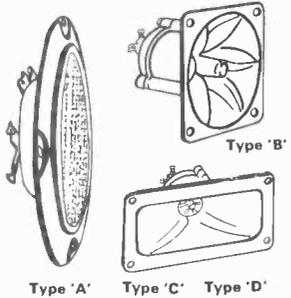
Size — 12¾" x 15¾" (approx.).

**Price £29.90** + £2.50 Postage and Packing.



**PIEZO ELECTRIC TWEETERS — MOTOROLA**

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



**Type 'A'** 3" round with removable wire mesh. Ideal for bookshelf hi-fi speakers. **Price £3.80 each.**

**Type 'B'** 3½" super horn. For general purpose speakers, disco, and P.A. systems, etc. **Price £4.80 each.**

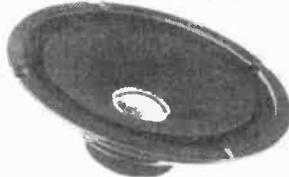
**Type 'C'** 2" x 5" wide dispersion horn. For hi-fi systems and quality disco etc. **Price £6.20 each.**

**Type 'D'** 2" x 6" wide dispersion horn. Frequency response extending down to mid-range (2000 c/s) suitable for hi-fi systems and quality disco. **Price £9.00 each.**

Post and Packing, all types, 15p each (or S.A.E. for Piezo leaflets).

**LOUDSPEAKER**

High quality full range 8" loudspeaker. 10 watts RMS. 8OHM. Rolled surround with aluminium centre dome. **Price £3.50 each** + 75p Postage and Packing.



**STEREO MAGNETIC CARTRIDGE BARGAIN**

Acos M6EX stereo magnetic cartridge with tapered bi-radial diamond styli. Tracks between 1 and 2 grms. Retail price **£27.00**. **Special Price £7.90** — Post free.

**LIGHT DIMMER CONTROL 800 watt (ready built)**

240v/800watt light dimmer switch. This smart white unit readily replaces existing square switch plates.

**Price £3.90** + 30p Postage and Packing.

Similar to above with additional facility of photo-cell to switch light(s) on automatically at the onset of darkness, and off during daylight.

**Price £4.30** + 30p Postage and Packing.

**DE-SOLDERING PUMP**



This de-soldering pump made to a very exacting specification is ideal for the removal of small components from printed circuit boards, etc. Comes complete with spare PTFE tip. **£5.30** post free.

**RESISTANCE SUBSTITUTION DISC**

A neat swivelling disc (65mm diam.) provides close tolerance substitution of 36 preferred values. From 5ohm to 1meg.ohm. Complete with leads and croc-clips. **Price £4.50** — Post free.

**B.K. ELECTRONICS**

37 Whitehouse Meadows  
Eastwood, Leigh-on-Sea  
Essex, SS9 5TY

★ S.A.E. for components list etc. ★ Official orders welcome ★ All prices include V.A.T. ★ Mail order only. ★ All items packed (where applicable) in special energy absorbing PU foam.

**DIGISOUND**

**KITS AND SPECIAL PRODUCTS FOR ELECTRONIC MUSIC**

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SSM 2020 Dual Voltage Controlled Amplifier	365p
SSM 2030 Voltage Controlled Oscillator	485p
SSM 2040 Voltage Controlled Four Stage Filter	485p
SSM 2050 Voltage Controlled Transient Generator	365p

Complete set of Application Notes and Specifications for the above at 50p post paid, or 30p if added to an order for components. No VAT on data and stamps will be accepted in payment.

**I.Cs FROM CURTIS ELECTROMUSIC SPECIALTIES**

CEM 3310 Voltage Controlled Transient Generator	400p
CEM 3320 Voltage Controlled Four Stage Filter	390p
CEM 3330 Dual Voltage Controlled Amplifier	400p
CEM 3340 Voltage Controlled Oscillator	600p

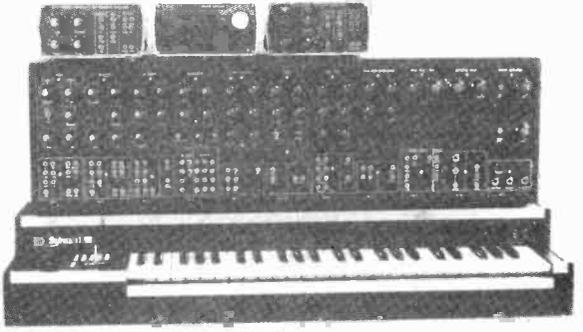
Complete sets of Application Notes and Specification for the above at 50p post paid, or 30p if added to an order for components.

TEL LABS Q81, 1k, 1% 3500ppm temperature compensating resistor **185p**

**OTHER COMPONENTS (Prices in pence)**

741-8	23	LF 351	38
723-14	40	TL 081	38
1458-8	44	MC 34002/TL 082	65
LF 347	130	CA 3080E	63
LM 348	90	LM 13600	125

All other components used in our kits are available separately and these are listed in the March 1980 price list — sent with orders or on receipt of 15p in stamps.



**KITS FOR ETI 80 MODULAR SYNTHESISER.** Components as specified in the issue of ETI listed, which also contains the constructional details for the kits. Glass fibre and roller tinned PCB. I.C. sockets.

KIT 80-1 ± 15V Power Supply (Feb. 80)	£16.70
KIT 80-2 Voltage Controlled Oscillator (Feb. 1980)	£16.10
KIT 80-3 Voltage Controlled Low Frequency Oscillator (Feb. 1980)	£16.10
KIT 80-4 Voltage Controlled Mixer (March 1980)	£21.10
KIT 80-6 Voltage Controlled Filters (May 1980)	£11.50

**PCBs SEPARATELY:**

KIT 80-1	£1.60	KIT 80-4	£2.60
KIT 80-2/80-3	£2.10	KIT 80-6 (All types)	£1.60

PCB and Kit for 80-5 (Processor) available shortly.

9 x 3 inch panels for modules 80-2, 80-3, 80-4, and 80-6L to the design shown in ETI and made from white plastic coated steel with black lettering are available at £2.50 each.

PLEASE ADD 30p P&P TO TOTAL ORDER AND THEN ADD VAT AT CURRENT RATE



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**NEW STOCKS BELOW MANUFACTURERS' PRICES.** Postage & packing add 50p per order. Prices incl. V.A.T.

**SN74141N IC 50p ea.**  
**BCD** Decimal Decoder-Driver 10 for 44p ea. 100 for 40p ea. 1,000 for 35p ea.  
**DISPLAYS** by Hewlett-Packard. Seven segment DL707 (5082-750) 96p. Common anode half inch red display brand new in maker's cartons 6 for £5.50 for 70p ea. 500 for 60p ea.  
**TV SOUND.** High quality sound through your hi-fi. Simply plug into your aerial socket. £6.50, as reviewed Popular Hi-Fi.  
**BURROUGHS 8 DIGIT** Panalex calculator display 7 segment 0.25" digits. Neon type with red velvet socket and date. £1.95 ea. 10 for £17.  
**HONEYWELL PROXIMITY DETECTOR** integral amplifier 8V DC £3.50 ea. 10 for £30.  
**MULLARD TBA800.** IC audio amplifier 95p ea. 10 for £8. 100 for £70. 500 for £300.  
**RCA CA308B.** FM IF £1.50, 10 for £12.  
**RCA CA3090AQ.** FM decoder £2.50, 10 for £20, 100 for £175.  
**BU 205 TEXAS.** £1.50 ea. 10 for £12, 100 for £100 per 1,000 85p ea.  
**2N3055** 80V version TO3 power 10 for £3.50, 100 for £28, 500 for £125.  
**BU208** TO3 Texas TV power transistors £1.75 ea. 10 for £15, 100 for £120, 1,000 for £1 ea.  
**MC1310P-SN76115N** FM stereo decoder £1.20 ea. 10 for £1 ea. 100 for 85p ea.  
**MULLARD AD161-AD162** Matched pairs. 1 pair 80p, 10 pairs £8, 100 pairs £50.  
**Cartons of 600 pairs £250 EX-STOCK.**  
**RADIATION DETECTORS** Quartz Fibre Dosimeters. Pen type with clip with lens and scale 0-5R. Originally over £5 **OUR PRICE 95p EACH.** 10 for £8. 100 for £70. **ORP12** light dependent resistance Mini Type. 2 for £1. 10 for £4.50, 100 for £40.  
**TV TUNERS** by Mullard UHF 38 mcs size 34x24x1 1/4 £2.50 ea. 10 for £20, 100 for £175, 500 for £750, 1,000 for £1,250.  
**MULLARD TUNER MODULES** with data LP1171 combined AM/FM IF strip £3.50. LP 1179 FM front end with AM tuning gang, used with LP1171 £3.50. LP1171 and 79 pair £5.75, 10 pairs for £50, 100 pairs for £400.  
**CA3085 RCA POSITIVE VARIABLE REG.** 5volt 100mA variable 1.8-24V 55p ea. 10 for £5, 100 for £35, 1,000 for £300.  
**MULLARD LP1157** AM tuner modules with circuit £2.50 ea. 10 for £20, 100 for £175.  
**LUSTRAPHONE RIBBON MIKE £1.50.** + pre amp on chassis 3x2x1in. 10 for £12.50.  
**TAA8618** (14 pin DIL) IC TV sound and FM amplifier-detector by ATES on p.c. board with other parts. Complete with data & connections 60p. 10 for £5, 100 for 40p ea. 500 for 35p ea.

**MARRIOTT TAPE HEADS** Quarter track  
 Type Each Per 10 Per 100  
 XRPS18 R/Replay £3.00 £25.00 £200.00  
 XRPS36 R/Replay £4.00 £35.00 £175.00  
 RSP63 1/2 track £2.25 £20.00 £175.00  
 XES11 Erase £1.25 £11.00 £100.00  
**MAJNS TRANSFORMERS** all 200/250V IN  
 Type Current Size Price  
 12V 100mA 1 1/2 x 1 1/2 x 1 1/2 £0.95  
 12V 500mA 1 1/4 x 1 1/4 x 1 1/4 £1.35  
 12V 2amps 2 1/4 x 2 1/4 x 2 1/4 £2.50  
 Per 10 less 10%. per 100 less 20%  
**STEREO CASSETTE TAPE HEAD.** High quality replacement for most manufacturers' record/replay with mounting bracket £2.95.  
**DYNAMIC MICROPHONE.** Low imp. Foster insert. £1.45, 10 for £11, 100 for £100.  
**UHF TUNER BY GEC.** 38mc/s with slow motion tuning. Size 5x3x2in. £3 ea. 10 for £25.  
**TWO GANG MINIATURE VARICAP TUNER** 500pf with tuning knob, size 3x1 1/2 x 1 1/2in. £1.25 ea. 10 for £10, 100 for £85.  
**ATES U1452 AUDIO IC AMPLIFIER 14 PIN DIL.** 300m watts 55p ea. 10 for £4.50, 100 for £35, 1,000 for 30p ea.  
**GENERAL ELECTRIC 2+2 watt IC stereo audio chips** with circuit & data £1.95 ea.  
**RCA CD4029AE** 16 pin DIL. presettage up down counter 85p each, 25 for £15, 100 for £50, 1,000 for £355 (in anti static tubes of 25).  
**UHF TV TUNER** (preamp) with BF180 55p each. Built on PC board 2x2in (sold without data) 10 for £4.50, 100 for £35, 1,000 for £250.  
**HELICAL 10 TURN POTS BY M.P.C.** 2.5 watts 5% tolerance, type MM105. British made. 47 ohms / 100 / 220 / 470 1k / 2.2k / 4.7k / 10k. All at our price £1.95 ea. Manufacturers list price £3.80. Quantities:  
 Per 10 £1.50 ea.  
 Per 100 £1.25 ea.  
 Per 1,000 £1.00 ea.  
**WIRE WOUND MINIATURE M.P.C. controls**  
**BRITISH MADE M/2/13 ALL AT 60p each**  
 47 ohms 2.2k Per 10 50p ea.  
 220 4.7k Per 100 45p ea.  
 470 10k Per 1000 40p ea.  
 1k 4.7k  
**RELAYS** min open type. 6/9v change over 85p. P 10 75p ea. P 100 65p. P 1,000 50p ea. Min. 9/12v 2p cover 200 ohm £1.20.  
**TBA625** ATES voltage regulators 55p ea. 5 volts 100mA/amps (TO99) per 10 £4.50, per 100 £39, 16 PIN low profile DIL sockets 12p, 10 for £1, 100 for £8, 1,000 for 6p ea.  
**THYRISTORS** Motorola 2N5061 0.3 amp 60 volt 19p, 10 for 15p ea. 100 for 13p ea. 1,000 for 11p ea. 10,000 for 10p ea.  
**ULTRASONIC TRANSDUCERS** 40 KC's. Pair at £2.95, 10 pairs at £2.50 pair

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# QUESTION?

1. Is your hobby home computing or electronics?
2. Do you understand the application of IC's, Transistors, Diodes, etc?
3. Have you used or applied analogue or digital techniques?
4. Are you applying TTL Logic to your home computer?
5. Are you programming your home computer using simple software techniques?

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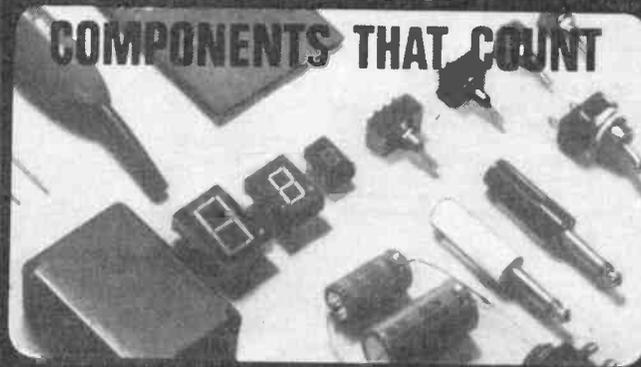
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# ELECTROVALUE

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<b>ISKRA</b> RESISTORS	<b>RADIOHM</b> POTENTIOMETERS	<b>BREADBOARDS</b> SOLDER TOOLS
	<b>OPTO-ELECTRONICS</b>	<b>SWITCHES</b> CATALOGUE 10

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PCB's 300 x 150 mm	D/S £1.73	Etch Resist Pen	£1.14
SRBP S/S £1.38	D/S £2.13	Breadboards	
F/Glass S/S £1.96	D/S £2.13	Bimboard 12x9.23	
Positive resist 75cc	£1.67	Eurobreadboard	£6.56 net
Ferric Chloride 500 g	£3.46	T-DeC	£5.18

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Sld. SPDT 65p	DPDT 89p	Smiths TS100	£14.43 net
Min. SPDT 66p	DPDT 92p	Wavechange, Lorlin, 1P12W, 2P5W, 3P4W, 4P3W	46p each

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 1, 1.5, 2.2, 3.3, 4.7µF, 10, 15, 22, 33, 42µF 8p each, 1µ 12p, 15µ 15p, 22µ 18p, 33µ 21p, 47µ 27p, 68µ 34p, 10mm PCM 1µ 37p.  
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 1/40 24p, 1/100 15p, 2.2/25 24p, 2.2/63 15p, 4.7/16 24p, 4.7/40 15p, 10/25 15p, 10/40 18p, 22/25 18p, 22/40 18p, 22/63 19p, 47/10 18p, 47/25 18p, 47/40 18p, 47/63 20p, up to 1000/16V 36p, then 1000/25V 49p to 47/16 65p.  
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2N5457-9	45p	BB104	70p	OC29	£1.23		
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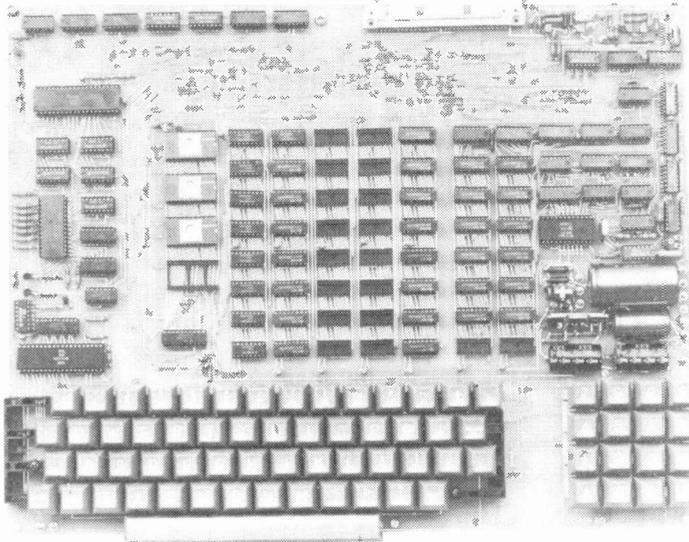
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2N3006	5p	74C20	25p	BC171A	5p	2N3053	15p
1N4305	5p	74C08	25p	TIS92	10p	BF160	5p
BZ79C12	10p	74C10	20p	TIS93	10p	4013	30p
BC212B	5p	MC4049	35p				
SN76550	5p						
IC 7451	10p						

BC172	5p	MC4001	15p	BC337	8p	2N3704	5p
BZ884V7	10p	MC4012	15p	BC327	8p	2N5447	5p
BZ8813V	10p	MC4020	25p	BC251	5p	2N5449	5p
2N3006	5p	74C20	25p	BC171A	5p	2N3053	15p
1N4305	5p	74C08	25p	TIS92	10p	BF160	5p
BZ79C12	10p	74C10	20p	TIS93	10p	4013	30p
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74122	12p	74C74	18p		
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<b>PRESETS (.15W Horizontal)</b> 100 ohms to 2 Mohms	8p	W02M	20p
<b>POTENTIOMETERS (1/4W)</b> Linear & Log Scale		W06M	30p
4.7 Kohms to 2.2 Mohms	30p	<b>VOLTAGE REGULATORS</b>	
<b>VEROBOARDS (0.1" Copper)</b> 2.5" x 5"	55p	7805	70p
3.75" x 5"	65p	7812/15	70p
<b>ZENER DIODES (400mW)</b> 2.7V to 33V	8p	7818/24	70p
<b>CERAMIC CAP (50V)</b> 33pF to 47nF	3p	7905	90p
<b>POLYSTYRENE CAP (50V)</b> 10pF to 1,000pF	5p	7912/15	90p
<b>POLYESTER CAP (100V)</b> 1nF to 68nF	6p	7918/24	90p
100nF, 150nF	7p	<b>DIODES</b>	
220nF, 330nF	8p	BY127	10p
470nF, 9p 680nF, 10p		OA47	8p
1uF, 14p 2.2uF, 20p		OA91	8p
3.3uF, 22p 4.7uF, 24p		OA200	6p
<b>ELECTROLYTIC CAP (uF/V)</b> 1/25 to 47/25	6p	OA202	9p
68/50, 100/35	8p	1N916	5p
150/25, 200/12	9p	1N4148	4p
220/25, 250/12	10p	1N4001/2	4p
470/25, 500/30	13p	1N4003	5p
1000/10, 14p 1000/25, 22p		1N4004/5	6p
1500/25, 26p 2200/6, 20p		1N4006/7	8p
		1N5400	13p
		1N5401	14p
		1N5402	15p
		1N5404	16p

<b>OPTO/DISPLAY</b>	16 pin	14p
2N5777	55p	18 pin
OC71	65p	22 pin
ORP12	60p	24 pin
DL704	110p	28 pin
DL707	110p	40 pin
0.125" & 0.2"		
<b>LEDS:</b>		
Red	10p	
Green	14p	
Yellow	14p	
.125" Clip	3p	
2" Clip	4p	
<b>DIL SOCKETS</b>		
B pin	11p	
14 pin	13p	

<b>VOLTAGE REGULATORS</b>	
7805	70p
7812/15	70p
7818/24	70p
7905	90p
7912/15	90p
7918/24	90p
<b>DIODES</b>	
BY127	10p
OA47	8p
OA91	8p
OA200	6p
OA202	9p
1N916	5p
1N4148	4p
1N4001/2	4p
1N4003	5p
1N4004/5	6p
1N4006/7	8p
1N5400	13p
1N5401	14p
1N5402	15p
1N5404	16p
<b>LINEAR CIRCUITS</b>	
709-8	40p
709-T05	40p
710-14	33p
741-8	22p
747-14	48p
748-8	44p
CA3018	70p
CA3028A	85p
CA3046	85p
CA3054	40p
CA3080	40p
CA3130	100p
CA3140	5p
2A/50V	40p
2A/100V	42p
2A/200V	48p

LM308N	60p	4066	50p	7491	45p
LM318N	200p	4069	18p	7492	30p
LM324N	75p	4070/1	18p	7493	35p
LM339N	60p	4072/3	18p	7494	50p
LM348N	90p	4081/2	18p	7495	40p
LM377N	175p	4086	80p	7496	50p
LM380N	90p	4510	100p	7497	200p
LM381N	140p	4511	100p	74100	70p
LM382N	130p	4516	100p	74105	43p
LM1310N	150p	4518	100p	74107	40p
LM3900N	55p	4520	100p	74109	40p
LM3909N	70p	4528	100p	74110	40p
MC1496P	85p			74118	90p
NE531	150p	TTL		74121	26p
NE555	25p	7400/1	13p	74122	30p
NE556	60p	7402/3	13p	74123	30p
NE566	140p	7404/5	13p	74125/6	37p
TBA641B	200p	7406/7	20p	74132	48p
TBA800	75p	7408/9	13p	74141	50p
TBA810S	110p	7410	13p	74145	55p
ZN414	100p	7411	18p	74150	78p
ZN1034	220p	7412	15p	74151	48p
		7413	27p	74153	43p
		7414	31p	74154	90p
		7416/7	25p	74155	46p
		7420	14p	74156	40p
		7421/2	17p	74157	43p
		7427	20p	74160	64p
		7428	25p	74161	55p
		7430	14p	74162/3	64p
		7432	18p	74164	78p
		7433	24p	74165	70p
		7437/8	15p	74166	85p
		7440	10p	74173/4	70p
		7441	56p	74175	60p
		7442	51p	74176	64p
		7443	70p	74177	60p
		7444	80p	74180	50p
		7445	75p	74181	80p
		7446	65p	74182	45p
		7447	55p	74190	70p
		7448	62p	74191	70p
		7450	10p	74192	50p
		7451/3	13p	74193	64p
		7454	10p	74194	70p
		7460	13p	74195	57p
		7470	20p	74196	100p
		7472	21p	74197	80p
		7473	28p	74198	135p
		7474	24p	74199	90p
		7475	34p		
		7476	30p	<b>TRANSISTORS</b>	
		7480	25p	AC126/7	23p
		7485	80p	AC128	23p
		7486	25p	AC12B/176	42p
		7490	36p		

AC153	30p	BF184	25p	ZTX303	24p
AC176	23p	BF185	25p	ZTX304	27p
AC187/B	23p	BF194/5	12p	ZTX311	19p
AD149	70p	BF196/7	12p	ZTX341	22p
AD161/2	40p	BF224B	14p	ZTX500/1	16p
AF114	30p	BF244B	35p	ZTX503	21p
AF124	45p	BF258	34p	ZTX504	28p
AF125	35p	BF259	40p	ZTX504	35p
AF126/7	37p	BF299	32p	2N696	25p
AF139	40p	BF340	32p	2N697	25p
AF239	47p	BF379	32p	2N698	35p
BC107/8	10p	BF380	20p	2N706	14p
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BC117	25p	BF394	25p	2N918	35p
BC142/3	30p	BF397/8	25p	2N1131	20p
BC147/8	10p	BFY50	22p	2N1132	13p
BC149	10p	BFY51/2	22p	2N1302	35p
BC157/8	12p	BFY53	10p	2N1303	40p
BC159	12p	BRV39	60p	2N1304	50p
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BC169C	13p	BSX20	22p	2N1306	30p
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BC207/9	13p	MPF106	50p	2N2484	30p
BC212/3	12p	MPSA06	26p	2N2646	55p
BC214	12p	MPSA06	26p	2N2904	23p
BC214L	14p	MPSU06	61p	2N2905	23p
BC238	18p	OC28	92p	2N2906	20p
BC261B	20p	OC35	92p	2N2907	20p
SUPER BC478		OC72	20p	2N2926G	11p
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BC328	17p	TIP298	48p	2N3054	50p
BC338	17p	TIP30	40p	2N3055	50p
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BC477	27p	TIP31	40p	2N3702 TO	
BC478/9	27p	TIP32	40p	2N3711	11p
BC547/8	14p	TIP33	60p	2N3712	150p
BC549	14p	TIP33C	80p	2N3773	250p
BC557/8	15p	TIP34A	90p	2N3819	20p
BC559	15p	TIP35B	240p	2N3820	40p
BCY70	18p	TIP36B	280p	2N3823	70p
BCY71/2	18p	TIP41A	60p	2N3866	90p
BD115	58p	TIP42A	60p	2N3903/4	14p
BD121/3	75p	TIP2955	70p	2N3905/6	14p
BD124	81p	TIP3055	55p	2N4037	45p
BD131 TO		ZTX107/B	13p	2N4058/9	14p
BD140	42p	ZTX109	13p	2N4060/1	14p
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BC107/8/9C	10p	2N2926(E)	11p	
BC147/8/9	7p	2N3053	16p	
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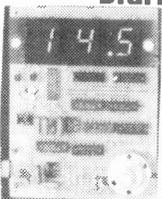
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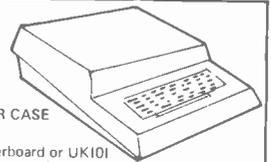
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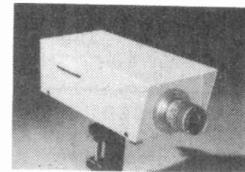
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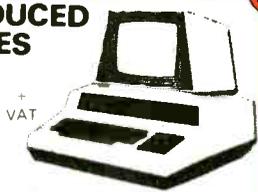


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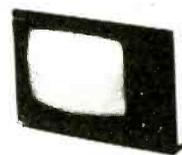


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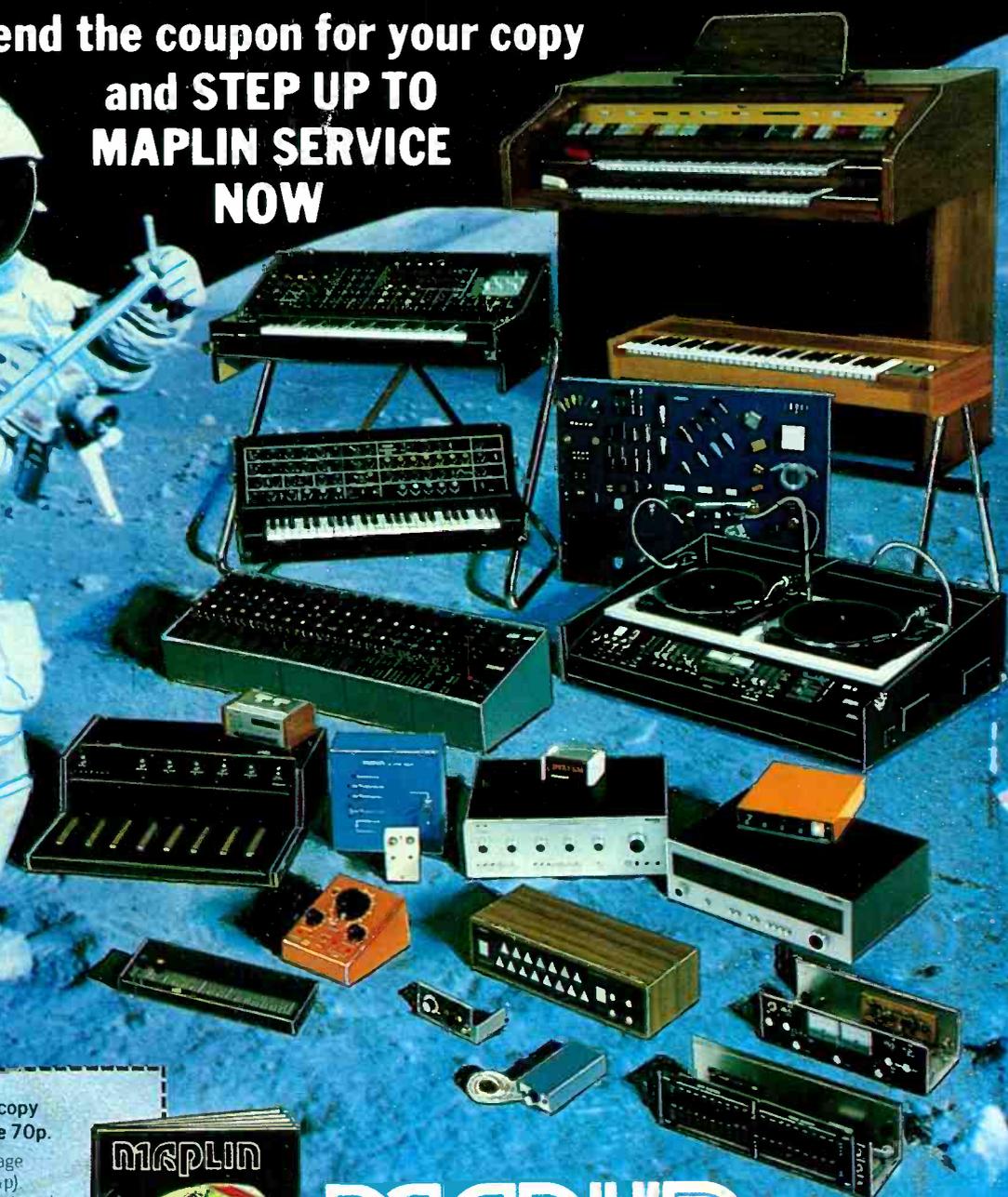


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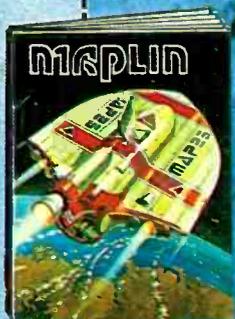


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