Australia $1.28 New Zealand $1.30 Malaysia $4.95 IR £1.11 (inc. VAT)

PRACTICAL ELECTRONICS

APRIL 1982

75p

Ultrasonic Vision System

Stereo Cassette Deck

FREE! 8 PAGE SUPPLEMENT... 6 SIMPLE PROJECTS

PRECISION - by POWERTRAN

THE FIRST WORDS AND THE LAST WORD IN ELECTRONIC KITS

For more than eleven years Powertran have been designing and manufacturing the finest quality electronic kits. All of our now considerable range have featured in the electronics press and literally thousands have been bought and built by contractors in the UK and World-wide.

Our philosophy is always the same – we offer ingenuity and originality in the construction phase by using only top class designers. We offer machines with power, versatility and performance – capability fully equal to their factory built rivals. We offer only the highest quality materials and components throughout to ensure years of useful and reliable service, we offer clear comprehensive and easy to follow construction manuals to place our kits within the scope of the careful first time builder as well as the dedicated enthusiast.

Our hallmark of success lies in the number of our clients who have built our whole range – many assembling several units for others to use often on the professional music scene.

We believe in taking every care throughout – months spent checking and testing the design and development. Vigorous checking of every component, constant pre-despatch quality control, careful packaging . . . even door to door delivery by Securicor!

We are naturally very proud of our Transcendent range of synthesizers designed by Tim Orr and regularly featured in ETI. They represent the best in constructional interest and in musical performance.

TRANSCENDENT POLYSYNTH – A four octave polyphonic synthesiser with outstanding design characteristics and versatility and performance to match.
Complete kit **£275.00** plus VAT (single voice).
Extra voice (up to three more) **£42.00** plus VAT.

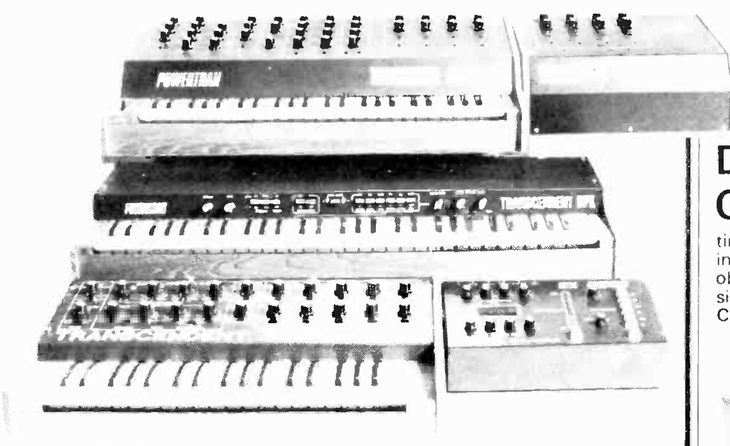
EXPANDER – A new matching 4 voice expander to team up with your polysynth for even a greater range and capability.
Complete kit **£249.00** plus VAT.

TRANSCENDENT DPX – Offers a five octave keyboard with power to match. Two audio outputs (can be used simultaneously) to give harpsichord and piano/honkytonk or reed with strings/brass and both are fully polyphonic. Other features include switchable touch sensitivity and a chorus ensemble unit with strong/mild effect switching. An advanced design made simple with our clearly laid out instruction manual.
Complete kit **£295.00** plus VAT.

TRANSCENDENT 2000 – Although only a 3 octave keyboard the '2000' features the same design ingenuity, careful engineering and quality components of its larger brethren. The kit is well within the scope of the first time builder – buy it, build it . . . play it! You will know you have made the right choice.
Complete kit **£165.00** plus VAT.

1024 COMPOSER – Come right up to the minute with this new design. It will control your synthesiser with a sequence of up to 1024 notes – or an equal selection of shorter sequences. The Composer is mains powered with automatically charged battery to preserve your programme after switch-off.
Complete kit **£85.00** plus VAT.

DEMONSTRATION TAPE – 30 minute demonstration tape of all three synthesizers now available. **£2.00**

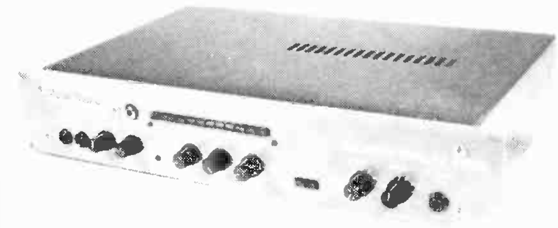


. . . Quite simply the best way to make music

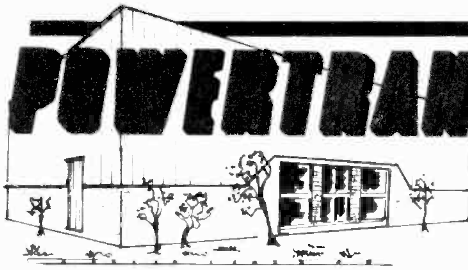
STUDIO QUALITY

DIGITAL DELAY LINE
Our latest kit!

With its ability to give delay times from 0·3 to up to 1600msecs, many powerful effects including phasing, flanging, ADT, chorus, echo and vibrato are obtained. The basic kit is extended in 400ms steps up to 1·6 sec simply by adding more parts to the P.C.B.
Compare with units costing over £1,000!



Complete kit £13.00 plus VAT (400ms delay). Parts for extra 400ms delay £9.50 plus VAT.



WORLD LEADERS IN ELECTRONIC KITS

PRICE STABILITY: Order with confidence irrespective of any price changes we will honour all prices in this advertisement until the end of the month following the month of publication of this issue. (Errors and VAT rate changes excluded
EXPORT ORDERS: No VAT. Postage charged at actual cost plus £1 handling and documentation.
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SECURICOR DELIVERY: For this optional service (U.K. mainland only) add £2.50 (VAT inclusive) per kit. FREE ON ORDERS OVER £100.
SALES COUNTER: If you prefer to collect kit from the factory, call at Sales Counter. Open 9a.m.-12 noon, 1-4.30p.m. Monday-Thursday.

PORTWAY INDUSTRIAL ESTATE, ANDOVER, HANTS SP10 3WN (0264) 64455.

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Simply telephone us with your order and quote your Access or Barclaycard number.
40 page catalogue free – contains full details of all our kits.

PRACTICAL
ELECTRONICS
VOLUME 18 No. 4 APRIL 1982

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

NEWS AND COMMENT

SPECIAL SUPPLEMENT

OUR MAY ISSUE WILL BE ON SALE THURSDAY, 8th APRIL 1982
(for details of contents see page 23)

SPEAKERS

8Ω, 0·3W, 2"; 2·25", 2·5", 3" **80p**
0·3W, 2·5" 40Ω; 64Ω or 80Ω **80p**

DIODES

AA119	15
BA100	15
BY100	24
BY126	12
BY127	12
CRO33	250
OA9	40
OA47	12
OA70	12
OA79	15
OA85	15
OA90	8
OA91	8
OA95	8
OA200	8
OA202	8
1N914	4
1N916	5
1N4001/2	5
1N4003	6
1N4004/5	6
1N4006/7	7
1N4148	4
1N5401	15
1N5404	16
1N5406	17
1N5408	19
1S44	9
1S921	9
6A/100V	40
6A/400V	50
6A/800V	65

BRIDGE RECTIFIERS

(plastic case)

1A/50V	20
1A/100V	22
1A/400V	29
1A/600V	34
2A/50V	35
2A/200V	40
2A/400V	46
2A/600V	65
6A/100V	83
6A/400V	95
6A/600V	125
10A/200V	215
10A/600V	350
25A/200V	240
25A/600V	395
BY164	56
VM18	50

ZENERS

Range: 2V7 to 39V 400mW **8p each**
Range 3V3 to 33V 1 3W **15p each**

VARICAPS

MVAM2	165
MVAM115	158
BA102	30
BB105B	40
BB106	40

Noise Diode
Z5J 195

SCR's Thyristors

0 8A-100V	32
1A/200V	58
1A/400V	70
5A/300V	38
5A/400V	40
5A/600V	48
8A/300V	60
8A/600V	95
12A/100V	78
12A/400V	95
12A/800V	188
BT106	150
BT116	180
C106D	38
TIC44	24
TIC45	29
TIC47	35
2N5062	32
2N5064	38
2N4444	130

DIAC
ST2 25

TRIACS

3A/100V	48
3A/400V	56
3A/800V	85
8A/100V	60
8A/400V	69
8A/800V	115
12A/100V	78
12A/400V	82
12A/800V	135
16A/100V	103
16A/400V	105
16A/800V	220
25A/400V	185
25A/800V	295
25A/1000V	480
30A/400V	525
T2800D	120

SOLDERCON PINS

100	70p
500	325p

OPTO ELECTRONICS

LEDS including Clips	
TIL209 Red 125"	13
TIL211 Green 125"	18
TIL212 Yellow	18
TIL220 ·2" Red	15
0·2" Yel, Grn, Amber	18
Red, Green and Yellow Rectangular LEDs.	29
Triangular LEDs R&G	18
0·2" Flashing LED Red	55
0·2" Bi colour LEDs Red/Green	65
Green/Yellow	80
0·2" Tri colour LEDs Red/Green/Yellow	85
0·2" Red High Bright	59
LD271 Infra Red (emit)	46
TIL32 Infra Red (emit)	52
SFH205 (detector)	91
TIL78 (detector)	54
TIL100	90

7 Segment Displays

TIL321 ·5" C.An	115
TIL322 ·5" C.th	115
DL704 ·3" C.Cth	99
DL707 ·3" C.Anod	99
DL747 ·6" C.Cathod.	180
·8" Orange C.A.	250
FND357 or 500	120
3" Green C.A.	140
±1·3" Red or Green	150
Bargraph 10 seg. Red	225

FERRIC CHLORIDE

1 lb bag Anhydrous
195p + 50p p&p

DALO ETCH RESIST

Pen + Spare tip **90p**

0·5" LIQUID CRYSTAL DISPLAYS

3½ digit	550
4 digit	650
6 digit	750

IL74	45
OCP71	120
ORP12	78
O[illegible]	85
2N5777	45
4N33	135

OPTO SWITCH

Reflective
TIL139 170
Slotted similar to RS 186

ALUM. BOXES

3×2×1"	65
4×2½×2"	85
4×2¾×2½"	103
4×4×2½"	120
5×4×2	105
5×2¾×1½"	90
5×2¾×2½"	130
5×4×1½"	99
5×4×2½"	120
6×4×2"	120
6×4×3"	150
7×5×3"	180
8×6×3"	210
10×4½×3"	240
10×7×3"	275
12×5×3"	260
12×8×3"	295

COPPER CLAD BOARDS

Fibre Glass	Single-sided	Double-sided	SRBP 9·5"×8·5"
6"×6"	90p	110p	95p
6"×12"	150p	195p	

VEROBOARDS 0·1"

	Clad	Plain
2½×3¾"	73p	52p
2½×5"	83p	—
3¾×3¾"	83p	—
3¾×5"	95p	79p
3¾×17"	325p	211p
4¾×18"	425p	—
Pkt. of 100 pins	50p	
Spot Face Cutter	118p	
Pin Insertion Tool	162p	

'VQ' Board	150
'DIP' Board	330
Vero Strip	144
S100 Board	£14

PROTO-DECs

Veroblock	375
S-Dec	350
Eurobreadboard	520
Bimboard 1	695
Superstrip SS2	£13

VERO WIRING PEN and Spool **310p**
Spare Wire (Spool) **75p**; Combs **6p** ea.

SPECIAL OFFER

	1+	50+
NE555	16p	14p
2114L-3	87p	80p
2114L-2	87p	80p
2708	175p	160p
2532	450p	375p
2716	210p	195p
2732	400p	375p
4116	75p	68p
6116	580p	550p
6522	350p	320p
7805 1A/5V	45p	35p

CUSTOMER: How can Watford sell full spec devices so cheaply?
WATFORD: It's simple. By bulk buying (direct from manufacturers where possible), low overheads and smaller margins which give us an edge over our competitors.

ANTEX Soldering Irons

C15W	410
CX17W	425
CCN15W	425
X25W	440
Spare bits	50
Elements	200
Iron stands	160
Heat Shunt	25

Buy with

Just phone your order through, we do the rest.

GAS & SMOKE DETECTORS

TGS812 & 813 **575**
Sockets **40**

ULTRASONIC TRANSDUCERS

40KHz Transmitter & Receiver **395p/pair**

DIL SOCKETS (TEXAS)

	Low profile	Wire wrap
8 pin	8p	25p
14 pin	10p	35p
16 pin	10p	42p
18 pin	16p	52p
20 pin	22p	60p
22 pin	25p	70p
24 pin	25p	70p
28 pin	28p	80p
36 pin	—	105p
40 pin	30p	99p

WATFORD'S Ultimate Monitor IC.

A 4K Monitor Chip specially designed to produce the best from your: Superboard Series I & II, Enhanced Superboard & UK101. As reviewed by Dr. A. A. Berk In Practical Electronics, June 1981.
Price only £15.95 + 50p P&P.

DIL PLUGS (Headers)

14 pin	44
16 pin	49
24 pin	88
40 pin	255

RIBBON CABLE

10 way	33
20 way	40
24 way	50
40 way	70

	IDC Headers with Latcher	IDC Header Socket	PCB Plug Strgt. Pins	PCB Plug Rt. Pins
2×5 way	90p	—	60p	65p
2×8 way	130p	—	70p	78p
2×10 way	145p	—	80p	92p
2×13 way	175p	—	95p	110p
2×17 way	205p	—	110p	135p
2×20 way	220p	—	125p	150p
2×25 way	235p	—	150p	175p
2×60 way	—	—	200p	220p

SPEAKING CLOCK

Full Kit of parts now available **Only: £37.50**

ZERO Insertion Force DIL Sockets

24 way **595p**; 28 way **850p**; 40 way **975p**

EURO CONNECTORS

	Plugs	Socket	Rt. L Plug
DIN41618 31 way	180p	195p	—
DIN41612 2×32 way	270p	320p	370p
DIN41612 3×32 way	370p	410p	450p

'D' CONNECTORS mini. (Cannon type)

Solder Bucket

	Plugs	Sockets	Covers plastic
9 way	95p	125p	145p
15 way	135p	198p	150p
25 way	170p	230p	100p
37 way	290p	398p	185p
PCB Pins			
25 way	200p	245p	—
PCB Pins (right angle)			
25 way	210p	275p	—

TRANSFORMERS (mains Prim. 220-240V)

6-0-6V 100mA; 9-0-9V 75mA; 12-0-12V 75mA **98p**
6VA type: 6V-·5A 6V-·5A; 9V-·4A 9V-·4A; 12V-·3A 12V-·3A; 15V-·25A 15V-·25A **220p**
12VA: 4·5-1·3A 4·5V-1·3A; 6V-1·2, 6V-1·2A 12V-·5A 12V-·5A **295p** (30p p&p)
24VA: 6V-1·5A 6V-1·5A; 9V-1·2A 9V-1·2A; 12V-1A 12V-1A; 15-·8A 15-·8A; 20V-·6A 20V-·6A **330p** (44p p&p)
50VA: 2×6V-4A; 2×9V-2·5A; 2×12V-2A; 2×15V-1·5A; 2×20V-1·2A; 2×25V-2A; 2×30V-0·8A **440p** (60p p&p)
100VA: 2×12V-4A; 2×15V-3A; 2×20V-2·5A; 2×30V-1·5A; 2×40V-1·25A; 2×50V-1A **920p** (60p p&p)

Amphenol Plugs

24 way IEEE **575p**
36 way Centonic Parallel **550p**

EDGE CONNECTORS

Two rows

	·1	·156
2×10 way	—	135p
2×15 way	—	140p
2×18 way	180p	145p
2×22 way	199p	200p
2×23 way	210p	—
2×25 way	225p	220p
2×30 way	245p	—
2×36 way	295p	—
2×40 way	315p	—
2×43 way	395p	—
2×75 way	550p	—

JUMPER LEADS Ribbon Cable Assembly

Length	14pin	16pin	24 pin	40 pin
Single Ended DIP (Header) Lead				
24"	145p	165p	240p	380p
Double Ended DIP (Header) Lead				
6"	185p	205p	300p	465p
12"	198p	215p	315p	490p
24"	210p	235p	345p	540p
36"	230p	250p	375p	595p
Single Ended Socket Lead				
24"	155p	210p	265p	300p
Double Ended Socket Lead				
24"	290p	385p	489p	540p

COMPUTER CORNER

- **VIC 20 MICROCOMPUTER.** Connects directly to a colour TV. 5K RAM expandable to 32K PET type graphics. **£165**
- **CASSETTE DECK** for VIC20 including a free 6 programme Cassette. **£34**
- **EPSON MX SERIES PRINTERS:** Full range available. Please phone for prices.
- **SEIKOSHA GP80A** – Unihammer Printer, gives normal and double width characters as well as dot resolution graphics 8" Tractor feed. Parallel Interface standard. **£195**
- **SOFTY–2.** As reviewed in PE September 1981. The complete microprocessor development system for Engineers & Beginners. New powerful instruction. Accepts any 24 pin 5V single rail EPROM. Supplied fully built, tested & enclosed in a black ABS case. Price incl. encapsulated plug in power supply. **£169**
- **VIDEO MONITOR** 9" fully cased. B&W. Fully guaranteed. Excellent value for money at only **£69**
- **TEX EPROM ERASER.** Erases up to 32 ICs in 15-30 min. **£33**
- **TEX EPROM ERASER** with integral 30 min. Electronic timer **£45**
- **Spare** 'UV lamp bulbs **£9**
- **5V/5A PSU** Ready built and tested **£25**
- Attractive Beige/Brown **ABS CASE** for Superboard/UK101 or Home Brew **£26**
- **Extra 4K of RAM** (8 off 2114L-300nS) **£7**
- **Space Invaders** for Superboard **£6**
- **Full ASC11** coded keyboard type '756' **£39**
- **4 x 4 matrix keypad** (reed switch assembly) **£4**
- **C12 Cassettes** in Library Cases **40p**
- **8½ Fan fold paper** (500 sheets) (no VAT) **£6**
- **9½" Fan fold paper** (500 sheets) (no VAT) **£6**
- **Teleprinter Roll** (no VAT) **£3.50**

(P&P on most of the above items is extra)
Call in at our shop for demonstration of any of the above items. Be satisfied before you buy.

VOLTAGE REGULATORS

		+ve		−ve	
1A	T03				
5V	7805	145p	7905	220p	
12V	7812	145p	7912	220p	
15V	7815	145p	7915	220p	
18V	7818	150p		—	
1A	T0220 Plastic Casing				
5V	7805	50p	7905	55p	
12V	7812	50p	7912	55p	
15V	7815	50p	7915	55p	
18V	7818	50p	7918	55p	
24V	7824	50p			
100mA	T092 Plastic Casing				
5V	78L05	30p	79L05	60p	
6V	78L62	30p		—	
8V	78L82	30p		—	
12V	78L12	30p	79L12	60p	
15V	78L15	30p	79L15	60p	

LM300H	170	LM309K	135
LM304H	160	LM317H	280
LM305H	140	LM317K	350
78H05 5V/5A	650p	LM317P	99
78HG+5 to +24V 5A	599p	LM323K	500
		LM326N	240
79HG −2.25V to −24V 5A	785p	LM723	35
		TBA625B	75

SWITCHES

SLIDE 250V

1A DPDT	14
1A DPDT C/OFF	15
½A DP on/on/on	40

TOGGLE 2A 250V

SPST	33
DPDT	44
4 pole on off	54

PUSH BUTTON
Spring loaded
Latching or Momentary 6A

SPDT c/over	99
DPDT c/over	145

MINIATURE
Non Locking

Push to make	15p
Push break	25p

SUB-MIN TOGGLE

SP changeover	60
SPST on off	54
SPDT c/off	85
SPDT Biased	105
DPDT 6 tags	75
DPDT C/OFF	88
DPDT Biased	145
3 pole c/over	205

ROCKER: 5A, 250V, SPST **28p**
ROCKER: (white) 10A 250V SPDT **38p**
ROCKER: With neon lights red when on. 10A 250V, DPST **85p**
ROCKER: (White) 10A/250V DPDT **72p**
ROTARY: Make your own Multiway Switch. Shafting Assembly accommodates up to 6 wafers. **90p**
Break before make Wafers. Silver contacts. 1 pole/12 way; 2 pole/6 way; 3 pole/4 way; 4 pole/3 way; 6 pole/2 way **65p**
Mains DPST Switch to fit **45p**
Screen & Spacers **6p**
ROTARY: (Adjustable Stop Type) 1 pole/2 to 12 way, 2p/2 to 6 way, 3 pole/2 to 4 way, 4 pole/2 to 3 way **45p**
ROTARY: Mains 250V AC, 4 Amp **56p**

DIL SWITCHES: (SPST) 4 way **70p**; 6 way **85p**; 8 way **90p**; 10 way **146p**; (SPDT) 4 way **190p**.

CRYSTALS

32·768KHz	100
100KHz	270
200KHz	295
455KHz	370
1MHz	295
1·28MHz	392
1·6MHz	395
1·8MHz	395
1·008M	290
1·8432M	220
2·0MHz	240
2·4576M	220
3·2768M	220
3·57954M	150
3·6864M	300
4·0MHz	200
4·032MHz	290
4·80MHz	200
4·194304M	200
4·433619M	120
5·0MHz	200
5·185MHz	300
5·24288M	390
6·0MHz	220
6·144MHz	240
6·5536MHz	200
7·0MHz	200
7·168MHz	250
7·68MHz	200
8·0MHz	200
8·08333M	395
8·867237M	240
9·00MHz	200
9·375MHz	350
10·0MHz	200
10·7MHz	220
10·24MHz	200
12·0MHz	290
12·528MHz	300
14·31818M	320
16·0MHz	250
18·0MHz	240
18·432M	240
19·968MHz	325
20·0MHz	325
24·0MHz	200
24·930MHz	325
26·69M	290
26·670MHz	325
27·648M	330
27·145M	240
27·125MHz	295
38·66667M	290
48·0MHz	270
100·0MHz	375
116·0MHz	300

ASTEC UHF Modulators

6MHz	280
8MHz Wide-bandwidth	425

WATFORD'S UNIVERSAL MICRO EXPANSION SYSTEM

Designed by Watford Electronics, this extremely versatile and economical Expansion System as published in E.T.I., starting from Dec., 81 issue, offers a low cost flexible expansion facility for **ZX81**, UK101, SUPERBOARD, ACORN ATOM, PET, TANGERINE, TRS80, VIDEO GENIE, VIC 20, ECT.

The Motherboard (Interfaces with the Computer) has capacity to accept up to five daughter cards and can be paralleled for even more daughter cards. All PCBs are of Computer grade finish and are supplied in Kit form.

Just look at the expansion possibilities:

MOTHERBOARD – Accepts up to five Daughter Cards **Full Kit: £36.50**

SOUND CARD – Utilising up to three AY-3-8910 Sound chips. (one supplied with every Kit) **Full Kit: £24.95**

PIO CARD – Using two 6520 PIA chips, this Board offers Centronics parallel printer driver, digital to analogue converter and a host of other out-put facilities. **Full Kit: £19.95**

PROM PROGRAMMER – This simple but extremely useful card can blow 2716 or 2732 single rail EPROMS. **Full Kit: £25.95**

PROM CARD – P.C.B. cards for housing four 2716 or two 2732 EPROMS.
(4×2716) **Full Kit: £11.95**
(2×2732) **Full Kit: £11.75**

RAM CARD – 8K RAM card. Accepts 16×2114 RAMs. The Board is supplied fully populated. **Full Kit: £28.50**

(N.B. PCBs may be bought separately)

WATFORD ELECTRONICS

Tel. (0923) 40588 **Telex. 8956095**

KITS, COMPONENTS MICROS & PARTS

THE GARAGE DOOR AT YOUR COMMAND

At last, a kit to enable your motorised garage door to be opened without setting foot from your car, and also enable the lights in your garage and drive to be switched on or off at the touch of a button. A momentary relay output operating the door control circuits (relay closes only while a valid code is transmitted) is indicated by LED. It features two latched outputs with common reset for switching 240V a.c. mains loads via remote opto-isolated solid state switches (1kW maximum). A hand-held transmitter for 9V PP3 battery operation constituting 4 function keys: Open/Close, on 1, on 2, Off, giving a range of approximately 40 feet is included.

As a general purpose remote control in the home for switching lights, television and other appliances. This unit is ideal for the aged or disabled.

£23.75

ALL PRICES EXCLUDE VAT

DISCO LIGHTING KITS

DL1000K
This value-for-money kit features a bi-directional sequence, speed of sequence and frequency of direction change, being variable by means of potentiometers and incorporates a master dimming control. **Only £14.60**

DLZ1000K
A lower cost version of the above, featuring undirectional channel sequence with speed variable by means of a pre-set pot. Outputs switched only at mains zero crossing points to reduce radio interference to a minimum. **Only £8.00**

Optional opto input DLA1 .... **60p**
Allowing audio ("beat")—light response.

DO YOU LONG TO HEAR YOUR DOORBELL RING?

Our latest kit gives you a pleasing three-note harmonically related tone sequence (not a microprocessor controlled buzz or the same old ding dong) at a touch of a button. This kit, based on a new integrated circuit, is supplied complete with a printed circuit board, loudspeaker and drilled box and requires only 9V battery and push button common to most households.

It may also be switched by logic in such applications as car alarms, clocks, toys, P.A. systems, etc. The unit produces a 150mW output and draws less than one 1uA from a PP3 battery when the tone ceases. Supplied complete with circuit and assembly instructions.

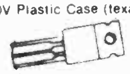
IDEAL PROJECT FOR BEGINNERS— ONLY £5.00

DVM/ULTRA SENSITIVE THERMOMETER KIT

This new design is based on the ICL7126 (a lower power version of the ICL7106 chip) and a 3½ digit liquid crystal display. This kit will form the basis of a digital multimeter (only a few additional resistors and switches are required—details supplied), or a sensitive digital thermometer (−50°C to +150°C) reading to 0.1°C. The basic kit has a sensitivity of 200mV for a full scale reading, automatic polarity indication and an ultra low power requirement—giving a 2 year typical battery life from a standard 9V PP3 when used 8 hours a day, 7 days a week.

Price £15.50

TRIACS



400V Plastic Case (texas)	3A TIC206D	49p
	8A TIC226D	58p
	12A TIC236D	85p
	16A TIC246D	96p
	25A TIC263D	190p
6A with trigger Q4006LT		85p
8A isolated tab TXAL228B		65p
Diac		18p
Opto isolated triac MOC3020 0.6A/400V		110p

MEMORIES AND MICROS — *PRICES SLASHED*

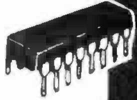
2114	.95	2732	4.80	8035L	5.50
2708	2.25	6810	1.25	M6802P(CPU)	3.85
2716	2.45	6821P	1.25	Z80ACPU	3.30
		6850P	1.50	Z80ACTC	2.90
		6852P	2.55	Z80APIO	2.90

74 LSTTL

LS00	.12	LS14	.48	LS42	.40	LS93	.37
LS01	.12	LS15	.15	LS47	.42	LS95	.48
LS02	.13	LS20	.14	LS51	.15	LS107	.24
LS03	.13	LS21	.15	LS54	.15	LS109	.24
LS04	.14	LS22	.15	LS55	.15	LS112	.24
LS05	.15	LS26	.18	LS73	.20	LS113	.24
LS08	.15	LS27	.15	LS74	.18	LS114	.24
LS09	.15	LS30	.14	LS75	.27	LS123	.51
LS10	.14	LS32	.15	LS76	.21	LS126	.29
LS11	.15	LS37	.17	LS85	.64	LS132	.44
LS12	.15	LS38	.16	LS86	.18	LS160	.40
LS13	.27	LS40	.14	LS90	.32	LS161	.40

CMOS

4000	.14	4026	1.05	4093	.45
4001	.14	4027	.40	4501	.24
4002	.14	4028	.50	4511	.85
4007	.14	4040	.68	4514	1.80
4011	.15	4049	.30		
4012	.17	4050	.30		
4013	.35	4060	.90		
4015	.70	4069	.18		
4016	.30	4070	.24		
4017	65	4071	.22		
4019	.38	4077	.24		
4023	22	4081	.22		
4025	.18				



THE KEY TO YOUR SECURITY IS IN OUR LOCK

If the thought of car thieves, house breakers of people tampering with your electrical and electronic equipment upsets you, have just the kit for you.

Our ELECTRONIC LOCK KIT includes a 10-way keyboard and a special IC which provides a 750mA output to drive a solenoid or relay (not supplied) when four keys are depressed in the correct sequence. This gives over 5,000 possible combinations! The sequence is prewired and may be easily changed by means of a small plug and socket. A "SAVE" function is also available enabling the open code to be stored (especially useful in a car when it is left in a garage for servicing as the open code need not be disclosed). Size: 7x6x3 cms. Power Consumption is 40uA at 5V to 15V d.c.

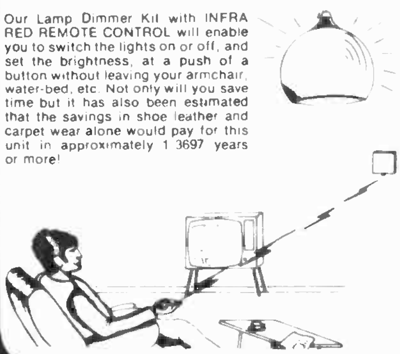
At only £10.50 + VAT, it will make a smaller hole in your pocket than a bunch of keys!

Electric Lock Mechanism £12.50

Suitable for use with existing door locks and above electronic lock kit.

THE PERFECT AID FOR "LAZYITIS"

Our Lamp Dimmer Kit with INFRA RED REMOTE CONTROL will enable you to switch the lights on or off, and set the brightness, at a push of a button without leaving your armchair, water-bed, etc. Not only will you save time but it has also been estimated that the savings in shoe leather and carpet wear alone would pay for this unit in approximately 1 3697 years or more!



This unit has considerable practical uses, especially for the old, infirm and disabled. It works like a conventional dimmer, enabling you to switch the lights on or off, or to dim them to whatever brightness you require, by touch or using the hand-held infra red transmitter. When assembled, it fits into a plaster depth box to replace your conventional switch or dimmer with no rewiring.

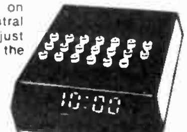
TDR300K Dimmer Kit £14.30
MK6 Transmitter Kit £4.20

We also still sell our highly popular TD300K Touch Dimmer Kit at £7.00 and the LD300K rotary controlled Dimmer Kit at .... only £3.50

All kits contain all necessary components and full instructions. You only need a soldering iron and cutters.

THE MULTI-PURPOSE TIMER HAS ARRIVED

Now you can run your central heating, lighting, hi-fi system and lots more with just one programmable timer. At your selection it is designed to control four mains outputs independently, switching on and off at pre-set times over a 7 day cycle, e.g. to control your central heating (including different switching times for weekends), just connect it to your system programme and set it and forget it— the clock will do the rest.



FEATURES INCLUDE—
- 0.5" LED 12 hour display
- Day of week, am/pm and output status indicators
- 4 zero voltage switched mains outputs
- 50/60Hz mains operation
- Battery backup saves stored programmes and continues time keeping during power failures (Battery not supplied)
- Display blanking during power failure to conserve battery power
- 18 programme time sets
- Powerful "Everyday" function enabling output to switch every day but use only one time set
- Useful "sleep" function—turns on output for one hour
- Direct switch control enabling output to be turned on immediately or after a specified time interval
- 20 function keypad for programme entry
- Programme verification at the touch of a button

THERE HAS NEVER BEEN A CLOCK CAPABLE OF SO MUCH AT SUCH A LOW PRICE—
ONLY £45.00
(including components, assembly and programme instructions in an attractive case)

24 HOUR CLOCK/APPLIANCE TIMER KIT

Switches any appliance up to 1kW on and off at present times once per day. Kit contains: AY-5-1230 IC, 0.5" LED display, mains supply, display drivers, switches, LEDs, triacs, PCBs and full instructions.

CT1000K Basic Kit £14.90
CT1000K with white box (56/131 x 71mm) £17.40
(Ready Built) £22.50

Add 50p postage & packing + 15% VAT to total.
Overseas Customers:
Add £1.60 (Europe), £4.00 (elsewhere) for p&p
Send S.A.E. for further STOCK DETAILS
Goods by return subject to availability.

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VISA — ACCESS and BARCLAYCARD welcome

Telephone: 01-579 9794/2842

Sinclair ZX81 Personal Comp
the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.

New BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

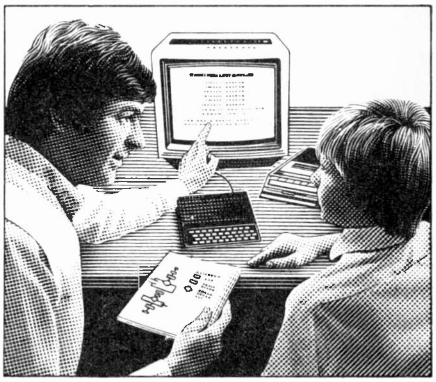
New, improved specification

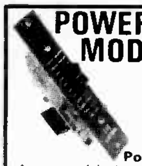
- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.





POWER DIMMING MODULES

- ★ Fully isolated
- ★ Multi channel common wiring lines
- ★ Master dimming over banks
- ★ Remote override
- ★ Dead "kill" and "all on"
- ★ Low voltage feed lines
- ★ Common neutral or live outputs

Power Dimming Modules
A range of isolated digitally controlled dimming modules, complete with panels. Each type requires connection to the supply/reference board.

Slave power controllers (SPC)
Controls up to 1000W via the slider. RFI suppressed/fused.
Slave power unit (SPU)
Controls up to 1000W via a logic signal from a remote slave.
Master controllers (MC)
Will master dim from 1 to a bank of 20 SPC units.
Remote slaves (RS) – (Preset)
Will override an SPC at a remote location to the main system or control an SPU.
Supply/reference board
Provides the necessary supply voltages and signals to all units. Facilities for "Kill" and "all on". Supplies up to any combination of 50 modules.

PRICES (1 of)

SPC	£13.90
SPU	£9.90
MC	£7.20
RS	£8.50
Supply	£18.20

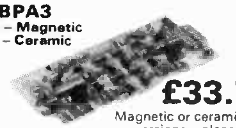
SPECIAL DISCOUNTS
Are available on power dimmers.
Total your order up and deduct:

£100 to £199	20%
£200 to £299	25%
£300 to £399	30%
£400+	40%

3 CHANNEL SOUND/LIGHT CHASER £35.70
LB31000SLC

A high performance sound to light system which automatically switches to a chase when the music ceases. Super sensitive with an anti-interference circuit, the unit will operate from practically any amp and control up to 1,000W/channel, 5HZ to 70K. Controls: bass/mid/treble/master sensitivity/chase speed.

STEREO DISCO MIXER/PREAMP
LBPA3
M – Magnetic
C – Ceramic



£33.70
Magnetic or ceramic deck versions – please state

All the requirements of a stereo disco preamp on one board, left and right deck mixers/tone controls/misc. mixer/tones/mic. auto fade over decks/and P.F.L. The unit can be used with either LB 100/150/250.

NEW! NEW! NEW!
4 CHANNEL SOUND LIGHT AUTO-CHASER
(£49.90) (panels, etc., £9.20)

- ★ Bass/mid/presence/treble
- ★ Automatic level filter control
- ★ Automatic input gain control
- ★ LED monitor drivers
- ★ 10Hz to 30KHz response
- ★ Super sensitive
- ★ Zero reference triggering
- ★ Fascia/LED, etc., available

Phone or write for immediate details of the LB41000SLC.

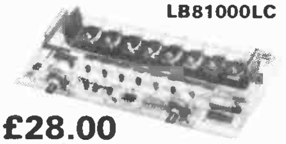
MULTI-4

PRICE REDUCED!
£48.90

The Multi-4 is a comprehensive sound and chase module, offering a wide range of forward, reverse or random effects, with additional sound modulation facilities. Modes of operation are set on control pots which act as electronic switches. The unit has a wide speed range and will accept virtually any sound level input. The Multi-4 also provides monitor circuits for LED driving. The triac outputs may be used to drive up to 4000W of lighting or up to 30 metres of rope lights.

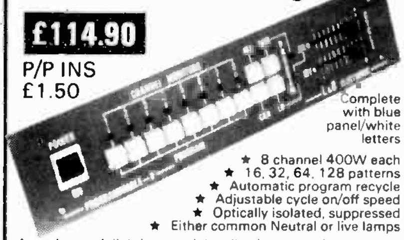
Attractive blue panels with white letters, complete with LED monitors, knobs and mains illuminated switch.
£9.70 EXTRA

NEW! NEW! NEW!
2/4/8 CHANNEL CHASER
LB81000LC



£28.00
An all logic chaser system for use with up to 8 channels at 1,000 watts each. Facilities include footswitch trigger and module cascading (16, 24, 32 channel, etc.), chase speed and re-cycle delay.

PROGRAMMABLE – 8
£114.90
P/P INS £1.50



Complete with blue panel/white letters

- ★ 8 channel 400W each
- ★ 16, 32, 64, 128 patterns
- ★ Automatic program recycle
- ★ Adjustable cycle on/off speed
- ★ Optically isolated, suppressed
- ★ Either common Neutral or live lamps

An advanced lighting module allowing any chase or sequence effects to be programmed, stored and recalled. Up to 128 patterns can then be replayed in the stored order, with control over the cycle on and off time. At the end of the program the system re-cycles to the start to maintain a continuous display. Full monitoring on the control panel over the outputs and control status is provided, and the program may be halted at any time. Although removing the mains supply to the module will delete the stored patterns the use of calculator type push buttons allows speedy programming ready for the following night's performance. The module obviously provides unlimited effects and is a must for all serious lighting shows.

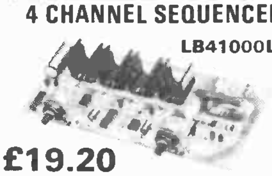
3 CHANNEL SOUND/LIGHT
LB31000SL

£22.70
All the advantages of the SLC without chase.
Controls: bass/mid/treble/master sensitivity.

3-WAY ACTIVE CROSSOVER
LBAC01
£17.90

Bass/mid/treble active crossover with stage booster! Available with crossover points of 200 or 300Hz, and 2K or 3KHz (please specify) LBPSU1 supply for LBAC01. (1 or 2).

4 CHANNEL SEQUENCER
LB41000LS



£19.20
A 4 channel sequence generator for banks of lamps up to 1,000W per channel. Two speed controls, cross effect to provide settings between seconds and rapid burst.

L & B
ELECTRONIC MODULES

PROFESSIONAL ENGINEERING BY PROFESSIONALS

45 Wortley Road, West Croydon Surrey CR0 3EB. Tel. 01-689 4138
Goods by return of Post.

Each module is manufactured from the highest quality components, fully tested, supplied with a connection and circuit diagram and guaranteed for twelve months. All prices shown are **VAT** inclusive. Please include 75p post/packing except where individually stated. To mail order send cheque/P.O./Registered cash/Access number. C.O.D. service £1 extra. For further information send a s.a.e. stating which model.

PLEASE NOTE THIS COMPANY HAS NO CONNECTION WITH LB ELECTRONICS OF HILLINGDON

OVERSEAS DISTRIBUTORS
Enquiries are invited from overseas companies in distributing our high quality products.

PE CAR COMPUTER

This unit was described by Practical Motorist as: "One of the neatest, most comprehensive and most useful of these car computers that we have yet come across . . ."

The PE Car Computer was designed to exceed the specification of all others, both for number of functions and accuracy. As well as the usual functions, it can perform eleven "remaining" type calculations, has a unique "start-stop" mode (used for acceleration timing and the like) and has a combination lock for driving an alarm or ignition cut-out.

The unit is housed in a custom designed box with high quality printed panels having an overall size of 165 x 50 x 80mm deep, and can be fitted above or below the dashboard. The display is liquid crystal for clarity in all lighting conditions.

The kit includes all sensors, wiring, etc and is suitable for all cars except those fitted with diesel or fuel injection engines.

Kit price: £78.50 Assembled Price: £88.50
+ £1 p&p includes VAT.
Send S.A.E. for list of separately available parts.
Goods by return of post.

PIMAC SYSTEMS LTD
20 Bloomfield Road, Moseley, Birmingham B13 9BY.
Tel: 021-449 0384

HOW WOULD YOU LIKE YOUR ZX81 TO LOOK LIKE THIS ?

IT COULD WITH THE CROFTON ZX81 ADAPTAKIT.

ONLY £35.00 plus VAT - total £40.25 plus £2.65 P&P. AND IT ALSO HAS A VIDEO OUTPUT TO DRIVE A STANDARD MONITOR.

SEND FOR DETAILS.

CROFTON ELECTRONICS LIMITED
35 Grosvenor Road, Twickenham, Middlesex TW1 4AD. Tel: 01-891 1923/1513
Telex: 295093.
Up to 28 days for delivery.

PE VOLUME 18 No. 4 APRIL 1982

FAME AT LAST!

Sharp eyed readers will no doubt have noticed the *Telectric* being put through its paces on a certain national TV programme (minus its name of course) and listeners to local radio stations in various parts of the country may have heard the *PE Bandbox* (a recent project) and also an interview with Steven Day and Peter Hutt of Response—the company supplying kits and ready-made Telectrics. It's nice that our projects are attracting attention from the "National media".

Of course our projects can't all be new and innovative and many, like our *PE Quasar Stereo Cassette Deck* in this issue, have been around in similar commercial form for some time. However, this particular project is a first for PE and is one of the few cassette recorder designs available to the hobbyist in kit form—it is also another project that may become a commercial success story in ready-built form at a later date. Hobbyists have the advantage of time and price, thanks to our project.

While talking about price it is interesting to note that when *Telectric* was first designed about three years ago the cost of building it would have been around £300. We have come to expect microprocessors for £5 or less, though we still happily pay relatively high prices for everyday items.

PRICES

We are all well aware of prices these days and we hope that PE can be of assistance in this area. This month we start two new services to readers, the first is a special arrangement with Videotone who are making their high quality cassette tapes available to PE readers on a regular basis at exclusive prices—see page 51—and the second is the appearance of the first readers' ads in *PE Bazaar* (page 45). You can't get an advertisement placed for less than our free readers' ad. service! Judging by the early replies we have received there should be some bargains in *PE Bazaar* and we hope it will lead to the development of a greater interchange of information, components and equipment between hobbyists—we anticipate many more ads. appearing next month when there has been more time for you to send them in.

CLUB

Interchange of information and assistance to all hobbyists are part of the aims of the British Amateur Electronics Club (BAEC) which has been run by dedicated volunteers for many years and offers its members a quarterly newsletter containing articles, letters, news and views on all aspects of our hobby, special concessions from many component retailers and meetings at various venues.

BAEC can give the informal contact between fellow hobbyists that we are unable to arrange via the magazine. It is, therefore, a valuable asset to all who have electronics as their hobby and, among other things, provides valuable help to beginners. They can give advice, loan practical aids and have an extensive library covering most magazines and many technical books. In case our overseas readers are wondering, the club is also open to them. A letter from Cyril Bogod—chairman of BAEC—appears on page 53, contact him for further information.

By the way, we have no formal connection with BAEC but, as a magazine dedicated to the electronics hobbyist, like to give them our encouragement.

Mike Kenward

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Technical Queries

We are unable to offer any advice on the use or purchase of commercial equipment or the incorporation or modification of designs published in PE. All letters requiring a reply should be accompanied by a stamped, self addressed envelope, or international reply coupons, and each letter should relate to **one published project only.**

Components and p.c.b.s are usually available from advertisers; where we anticipate difficulties a source will be suggested.

Back Numbers

Copies of most of our recent issues are available from: Post Sales Department (Practical Electronics), IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF, at 95p each including Inland/Overseas p&p.

Binders

Binders for PE are available from the same address as back numbers at £4·60 each to UK or overseas addresses, including postage and packing, and VAT where appropriate. Orders should state the year and volume required.

Subscriptions

Copies of PE are available by post, inland or overseas, for £13·00 per 12 issues, from: Practical Electronics, Subscription Department, Oakfield House, Perrymount Road, Haywards Heath, West Sussex RH16 3DH. Cheques and postal orders should be made payable to IPC Magazines Limited.

...NEWS &

Edited by Jasper Scott

Beckman Expansion means more jobs

Beckman Instruments is substantially expanding its resistor network manufacturing capacity at its plant in Glenrothes, Scotland. This expansion will provide a total of 100 new jobs.

The first phase of the expansion will immediately provide 40 new jobs for technicians, engineers, supervisors and assembly workers, and the second phase will involve further equipment and provide 60 more jobs.

The investment, backed by Locate in Scotland (LIS), is a result of the decision by Beckman Instruments Inc to concentrate the manufacture of selected models of resistor networks at the most efficient Beckman plants to meet the total worldwide demand for the products.

Managing director Eoin O'Cuilleanain said: "the expansion, which represents a 25% increase in the workforce, is a reflection of the company's confidence in the future and on the quality of work produced by all employees in Scotland. This increase in production capacity will enable us to offer an even more efficient service, with faster deliveries, to our customers worldwide. Without the co-operation of the LIS and the Glenrothes Development Corporation, it is unlikely that the expansion could have been successfully achieved in the current depressed economic environment," he added.

STEP FORWARD

Casio's latest addition to their range of keyboard instruments, the Casiotone 701, represents a major step forward in bringing music making within the reach of the uninitiated.

The biggest advance is in the use of a bar code reader to read and programme specially scored music, enabling playback in three ways:

—automatic playback of the entire piece;
—manual melody playing, guided by lamps above each key (with auto accompaniment;
—"One Key Play" which allows the melody to be played by touching one key. The 701 can also be programmed via the keyboard, and editing facilities are provided. Alternatively, the 701 can be played in the traditional manner, so its easy-play facilities do not limit it for use solely as a beginners instrument.

Features of the 701 include a five octave keyboard with eight-note polyphony, 20 pre-set voices, a chord system enabling one finger accompaniment, and 16 auto-rhythms. It is available at a price of £495 including VAT and p&p from Tempus, 38 Burleigh Street, Cambridge, CB1 1DG. (0223 312866)

Foiled again!

At a time of increasing concern that a limited nuclear war in Europe could be around the corner, a Wales based company appears to be cashing in on present fears with a claim that they have discovered the means of producing a lightweight radiation-proof material.

Sivoh Electronics Ltd., of Faol-Ydnah, Gwent, say that they discovered the materials special properties while experimenting on alternatives to Mica Foil for capacitors. Sivoh claim that the material, known as PROLAFOIL, (for which Patents are at present being applied for) could probably be used to make totally radiation-proof suits. The only obvious drawback at present is cost — production costs are estimated to be around £500 per square metre, though Sivoh say that they are looking into ways to cut that figure by about half.

Whether or not Sivoh succeed in producing a marketable product, the moral question remains — are we, by producing the means to survive a nuclear war (i.e. radiation-proof suits, fallout shelters, etc.) thereby increasing the likelihood of a nuclear disaster?

For further details, see page 51.

TANDY BREAKS INTO 16-BITS

The Tandy Corporation (Branch UK) has announced the introduction of TRS-80 Model 16 to its range of microcomputers.

The Model 16 features sixteen bit technology, dual processor architecture and a multi-user operating system. It is capable of 512K internal RAM memory storage, and 2½ megabytes of disk storage may also be added. This combination of large RAM and disk memory capacity will allow the Model 16 to use more sophisticated software with large file capacities.

The Model 16 desktop computer will be available late in 1982 in two versions, both with 128K memory. A single drive version with 1¼ megabytes of disk storage, and a two-drive version with a total 2½ megabyte storage capacity.

The new TRS-80 Model 16 uses two microprocessors' the Z-80A and the 16-bit MC68000.

For TRS-80 Model II owners, there is the Enhancement Option, which is an upgrade board to 16-bits.

The upgrade board set for the TRS-80 Model II microcomputer provides it with the 16-bit, dual-processor, multi-user power of the TRS-80 Model 16 computer, and will also be available by the end of 1982.

QUASAR CASE

Pictured above is the PE Quasar Stereo Tuner (constructional details published in PE, July '81) now resplendent in a simulated wood cabinet. The cabinet will be available at the end of March for £3.50 (plus £1.50 p&p) from RT-VC, who also supply kits for the Quasar Tuner itself. RT-VC, 21b High Street, Acton, London W3.

MARKET PLACE

Items mentioned are available through normal retail outlets unless otherwise specified. Prices correct at time of going to press.

Briefly...

Two of the United Kingdom's microcomputing pioneers and founder member of the Computer Retailers Association (CRA). Tim Moore and Jon Day, have formed a new company called Kuma Computers to supply working microsystems, proven software, educational books and, it is claimed, *unreserved* personal service.

Blanket invitation goes out to anyone with marketable software to contact Kuma Computers, 11 York Road, Maidenhead, Berks SL6 1SQ.

● ● ● ●

Bruel & Kjaer (U.K.) Ltd., have just issued their 1982 Short Form Catalogue which is free upon application.

It is a 60-page colour illustrated booklet describing the full range of instruments, transducers, microphones and other accessories available for the measurement, analysis and recording of sound (or noise), vibration, strain, acoustic emission, hydro-acoustic signals, mechanical balance and illumination contrast.

B & K are located at: Cross Lances Road, Hounslow, Middlesex TW3 2AE.

● ● ● ●

Grenson Electronics have informed us that they have had to increase the prices of kits for the Bench PSU, featured in our February issue. The complete kit is now priced at £35 plus VAT and £2·40 p&p. The price of the ready built unit has also been increased to £59 plus VAT and p&p.

● ● ● ●

Home Radio have recently moved premises. Personal callers should now go to 169 London Road, Mitcham, Surrey. Their mail order address is still the same: P.O. Box 92, 215 London Road, Mitcham, Surrey.

POINTS ARISING . . .

Microbus (Nov. '81)

There is an error in line 20 of the program for a ZX80 Crosshatch Generator (page 68). It should read as follows:

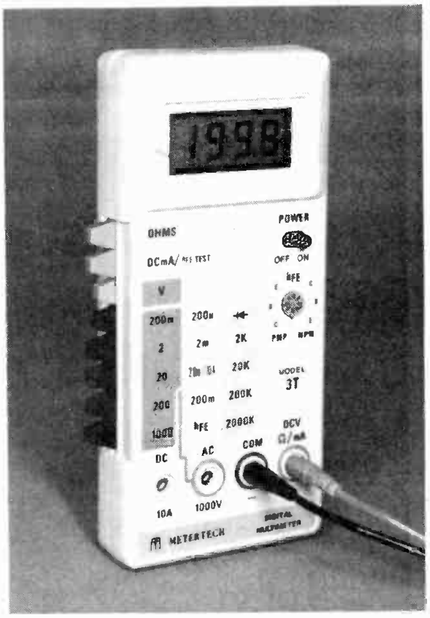
```
20 PRINT CHR $(X);" ";
```

VERSATILE MULTIMETER

Now available from Centemp, the Model 3T (pictured right) is a battery operated $3\frac{1}{2}$ digit hand held digital multimeter with a bold 0·5" liquid crystal display.

The meter provides six functions in 16 ranges permitting measurement of DC voltage, AC voltage, DC current, resistance, Diode/continuity check and an h_{FE} measurement facility. Push button controls allow fast and easy operation whilst small size, robust construction and long battery life make the 3T truly portable. Supplied complete with battery, test leads and instruction manual.

Priced at £49.95 including VAT and p&p, the 3T is available from Centemp, 62 Curtis Road, Whitton, Hounslow, Middlesex TW4 5PT (01-894 2723).



ILLUMINATING

L & B Electronics have recently introduced another unit to their range of lighting control modules. The LB 41000SLC is an advanced 4 channel sound to light modulator with automatic chase, providing bass, middle, presence and treble separation. Using automatic level filters, coupled with a choice of automatic gain control in the input stage, the unit requires virtually no setting-up procedure whilst making excellent separation.

As with the 31000SLC, in the absence of a music signal the module automatically switches to a forward then reverse running chase.

All the usual advantages of L & B modules are incorporated with the addition of LED monitor drivers for each channel. The fused triac output stage will handle resistive loads of up to 750 watts/channel.

The price, £43.39 plus £6.57 VAT. A blue fascia panel complete with LED's, illuminated switch and controls is also stocked at £8.00 plus £1.20 VAT.

For further information contact: L & B Electronics, 45 Wortley Road, West Croydon, Surrey (01-689 4138).

Best of British...

Discom of Evesham have announced the launch of a new British microcomputer, a micro which they say "will take on the world and win".

The 'McCombo' computer has been designed and built by a U.K. development team after eight months' research into the micro market. Research identified a need for a powerful, CP/M based single board computer, small enough to fit inside a terminal or disk drive case. Using McCombo, terminal manufacturers can produce a fully integrated CP/M based system using their own product with little or no development cost.

The board incorporates state of the art technology, including 64k memory chips. It is multi-user in operation, handling up to 4 users.

Discom say that initial trade reaction has been so good that sales of 3000 units are anticipated in 1982. Introductory prices start at under £400.

For further details, contact Discom, Old Manor Farm, Ashton-under-Hill, Evesham, Worcs. (0386 881962).

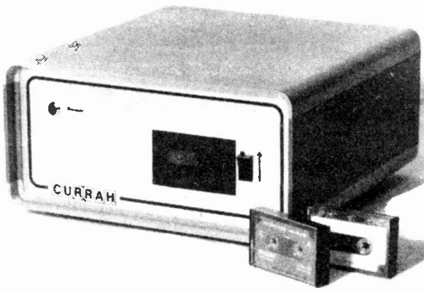
IS YOUR MICRO BAUD STIFF?

There is a versatile memory machine on the market which features read/write speeds and data integrity comparable to disc, but at a fraction of the cost! With up to 64K bytes per side, it will replace disc where access time itself is not too critical.

What is this machine? The 220M Digital Tape Recorder! A low-cost, non-volatile data and program storage system, with rapid software controllable record/replay/fast-wind functions. The machine, which automatically rewinds to verify everything it records, is designed around the well proven Philips Mini-Digital Cassette Recorder, and is available from Currah. Anyone running a 6502 based microcomputer system who cannot afford disc, yet desires a fairly snappy bulk storage medium, should consider the 220M a viable proposition.

The memory unit jacks quickly into your PET or VIC etc., and will run immediately in command mode (no host software required), or can, of course, be manipulated under program control by your computer. Flags are generated by the unit to allow two-way communication. The interface is activated quite simply by SYSn, whereupon the screen will inform you that you are in conversation with the memory unit's operating firmware (CTOS). With no further ceremony there are twenty-one extra BASIC commands in addition to your existing interpreter's repertoire, such as: BS (Basic Save), BL (Basic Load), OF (Open File) or PD (Print Directory—to identify the tape).

With firmware to handle the technicalities, the 220M may be thought of as a fast intelligent cassette recorder, except that it automatically builds up a *directory* of your named files or programs. At the end of a session the directory itself may be *saved*. The operator, therefore, types in which file he wants and the 220M automatically finds and loads it into its Cassette Buffer RAM. This Tardis-like 2K of



RAM is memory mapped into the host computer. Individual variables may be read from a recovered file, and when storing program listings, chunks of software can be appended to each other, thus realising the possibility of a *dynamic* subroutine library.

Encountering the worst access time, when the sought after data is furthest from the directory, rewind might take 60 seconds, but normally would be only a few seconds. Reliability is boasted, and at the time of going to press a version for each of the following machines was anticipated, if not already available:

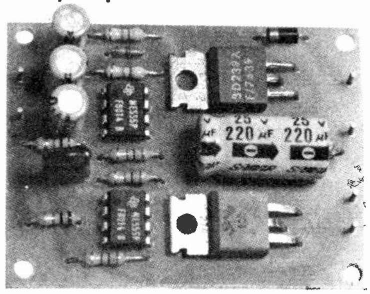
PET 3000 series, 4000 and 8000, UK101, Superboard, AIM65, Tangerine, VIC20, Atari 400 & 800 and Atom, etc.

The sluggish 300 Baud cassette loading of most rudimentary microcomputers makes them clumsy in response to multifarious needs. The 220M, however, would allow the computer to stand-by with no particular software in RAM, ready to load up and run a selected program promptly. The 220M costs £195, and is available from Currah Computer Components Ltd., Graythorpe Industrial Estate, Hartlepool, Cleveland TS25 2DF. Tel: 0429-72996.

BEAT THAT BURGLAR

To complement their Ultrasonic Burglar Alarm module (featured in News & Market Place, October '81) Riscomp Ltd have now introduced a siren module, known as the SL 157.

This siren module was developed to provide a high level warning signal for use with alarms in a wide range of applications. Its operating frequency has been chosen to provide the highest possible acoustible output when used with the horn type of speaker. It can, however, be used with a conventional type of loud speaker with slightly reduced output. A useful feature incorporated is the inhibit facility whereby the connecting of appropriate pins stops the alarm. This feature means that the module may be used as the basis of simple alarm systems or security loop.



The module operates from supply voltages in the range 9–15V, although with reduced output at 9V. Such a supply may be provided from batteries or a suitable mains unit.

The SL 157 is priced at £12·59 including VAT, plus 50 p&p. It is available direct from Riscomp Ltd., 21 Duke Street, Princes Risborough, Bucks, HP17 OAT (08444 6326)

Countdown...

Please check dates before setting out, as we cannot *guarantee* the accuracy of the information presented below.

Seminex Mar. 29–Apr. 2. Imperial College, London. **H1**
Laboratory Edinburgh Mar. 30–31. Ass. Rooms, Edinburgh. **E**
CAD Mar. 30–Apr. 1. Metropole, Brighton. **Z1**
Sensors & Systems Mar. 30–Apr. 1. The Forum, Wythenshawe, Manchester. **T**
ETM Mar. 30–Apr. 1. The Forum, Wythenshawe. **T**
Peripherals Mar. 31–Apr. 2. West Centre Hotel, London. **Z1**
Laboratory Manchester Apr. 7–8. New Century Hall, Manchester. **E**
All Electronics Show Apr. 20–22. Barbican Centre, London. **E**
Communications Apr. 20–23. NEC Birmingham **I**
BEX Brighton Apr. 28–29. **K**
Compec Europe May 4–6. Centre Int. Rogier, Brussels. **Z1**
Scotelex. Jun. 8–10. Roy. Highland Ex. Hall, Ingliston, Edinburgh. **A1**
BEX Leeds Jun. 9–10. **K**
Transducer/Tempcon Jun. 29–Jul. 1. Wemb. Conf. Centre. **T**
BEX Croydon Jun. 30–Jul. **K**
Leeds Electronics Show Jul. 6–8. University. **E**
Laboratory London Sep. 14–16. Grosvenor House. **E**
Two Counties Fair Sep. 15–18. Plymouth Ex. Centre, Millbray, Plymouth, Devon. **T**
Testmex. Oct. 26–28. Wemb. Conf. Centre, London. **T**
Compec Nov. 16–19. Olympia, London. **Z1**

A1 Institute of Electronics, Rochdale, Lancs.
E Evan Steadman, Saffron Walden ✆ 0799 22612
H1 Seminex Ltd., Tunbridge Wells ✆ 0892 39664
I Industrial Trade Fairs, Solihull ✆ 021-705 6707
K Douglas Temple, Bournemouth ✆ 0202 20533
L1 World Trade Centre ✆ 01-488 2400
T Trident Tavistock ✆ 0822 4671
V SDL ✆ Dublin 763871
Z1 IPC Exhibitions, Sutton ✆ 01-643 8040

stereo cassette deck part 1

ANOTHER SEPARATE FOR THE PE QUASAR STEREO SYSTEM

THE PE Stereo Cassette Deck is a versatile low cost system designed around a single p.c.b. The unit has the unusual facility of a variable bias control for optimum recording of all types of tape.

In addition to the basic circuitry a f.e.t. Gate Noise Reduction system has been designed which works on playback in two modes: Flat, all noise reduced in the absence of any signal, and High Frequency, only h.f. noise is reduced at low or no signal levels. This system has proved highly effective with all types of tape; its operation is more fully described later in the text.

The unit is also unusual because most of the switching is carried out electronically, thus reducing the need for complex, noisy and often unreliable switches on the deck mechanism. This design feature enables the p.c.b. to be used with almost any deck since it does not have to be closely coupled to the mechanism for switching purposes. The p.c.b. design is additionally simplified by the use of a LM1818 low noise i.c. in each channel. This i.c. carries the record/play logic switching, pre amps for record and play and VU meter drive. The i.c. also contains an auto record level circuit which is not employed on the p.c.b. shown but can be added as an addition if required—details are given later.

TAPE RECORDING SYSTEM

RECORD: The record/playback and erase heads are inductors with circular metal cores. The cores have narrow gaps at the point of contact with the tape, so that the tape coating provides a low reluctance path to complete the magnetic circuit. The input signals are suitably amplified and are fed to the head, which converts them into a varying magnetic field. As the tape moves across the tape head gap the coating becomes magnetised.

Essentially there are two important factors required for recording:—

BIAS CURRENT: As well as the audio signal a constant frequency above the audio spectrum (50 to 200kHz) is passed through the head. Its amplitude determines the "operating point" of the magnetic recording process. Its function can be compared to the biasing of a transistor. Incorrect biasing in either case will result in distortion, signal deterioration etc. in respect of the tape head severe h.f. loss will also occur.

FREQUENCY EQUALISATION: During recording the record head current is to be boosted at a rate of 6dB/octave below a standard low frequency, and attenuated by 6dB/octave above a standard high frequency. During playback the low frequencies are attenuated and the high frequencies are boosted so that the overall record/playback frequencies are flat. There are several standard sets of turnover frequencies—CCIR, NAB, EIA and DIN. The cassette equalisation standards defined by DIN are the most commonly used; for ferric oxide cassettes it specifies 3dB frequencies of 50Hz (3180µs) and 1326Hz (120µs). The upper turnover frequency for CrO_2 type tapes is 2274Hz (70µs). On the Quasar a separate switch is provided for selecting the equalisation. With CrO_2 type tapes a higher bias current is required for correct "operating point".

PLAYBACK: The recorded flux on the tape induces a proportional current in the playback head. Since the head is inductive it will have a voltage amplitude response that increases by 6dB/octave of frequency. The playback amplifier provides the equalisation necessary to obtain a flat frequency response and sufficient gain to raise the head signal to a usable level.

OTHER CONSIDERATIONS: In an "ideal" magnetic recording system the use of the described complementary equalisation would result in a flat record/playback frequency response. There are several losses and errors associated with tape recording and these must be compensated for.

GAP LOSS (OCCURS ON PLAYBACK): The easiest way to compensate for gap loss is to make use of the head's inductance by tuning it with a capacitor to resonate at approximately 12kHz. During record mode this capacitor must be made ineffective.

TAPE THICKNESS LOSS (OCCURS ON RECORD): Tape thickness loss occurs when the tape coating thickness becomes significant compared to the recorded wavelength, resulting in a 6dB/octave high frequency roll-off. The DIN standard equalisation compensates for this.

BIAS ERASURE (OCCURS ON RECORD): If an excessive bias current setting is used for the record head it will cause high frequency erasure.

BIAS NOISE: This occurs due to the characteristics of the bias oscillator. Any d.c. current flowing through the record head will be modulated as would a signal. Although it is d.c. its noise spectrum will extend into the audio range. An a.c. bias signal can cause an effect similar to d.c. if the a.c. signal contains even harmonics of the fundamental frequency. Distortion, variations of frequency and amplitude of the recording bias will also result in undesirable modulations. To avoid these problems a well designed bias oscillator circuit is essential.

TAPE MODULATION NOISE: Ideally the coating on a piece of recording tape should be perfectly smooth. However in practice this is not the case. As the tape moves past the head variations in the coating thickness causes rapid changes in the tape speed. This modulation causes noise "side-bands" around the audio signal frequency. To minimise this problem always use good quality cassettes.

NOISE REDUCTION SYSTEM: In terms of signal-to-noise ratio the cassette deck is normally the poorest link in the home audio set-up. There are several types of noise reduction systems, each with their own particular drawbacks. Some are so expensive and complex they make the rest of the circuit appear like a "crystal set"—all just for a few extra dB's of noise reduction. For evaluation purposes only, these systems were tried out with the Quasar. Likewise the D.N.R. (dynamic noise reduction) employing dual i.c. and several transistors (per channel) gives the magical few extra dB's at the expense of h.f. loss. Indeed the effectiveness of the D.N.R. was not unlike the function of an h.f. filter.

After careful consideration and objective listening it was decided that the noise was acceptable during quiet passages but was disconcerting during no-signal conditions. From this it was obvious some sort of "gating" that is synchronised to the output signal on playback would offer the best compromise between cost, availability of components, and effectiveness. Indeed under no-signal condition this form of noise reduction beat even the most sophisticated systems hands down.

SPECIFICATION

Mechanism with automatic stop and tape counter with reset button.
Tape Speed: 4·76cm/sec. (1 7/8 in/sec.).
Wow & Flutter: Typically 0·1%.
Drive Motor: 12V d.c. with electrical governor.
Play Torque: 40–75g/cm (DYNAMIC).
Rewind & Fast Forward Torque: 60–140g/cm (STATIC).
Rewind & Forward Time: Less than 100 sec. for C60 tapes.
Bias/Erase Oscillator: Externally variable, frequency 90–100kHz.
Output: (Adjustable) Up to 1 volt r.m.s.
Mic. Sensitivity: 1mV @ 47k.
DIN Sensitivity: 30mV @ 47k.
Frequency Response: 30Hz–12·5kHz (–3dB).
Signal to Noise Ratio:
Noise reduction OFF –50dB
Noise reduction H.F. –56dB
Noise reduction FLAT –70dB
Cross Talk: Typically –50dB.

CIRCUIT DESCRIPTION

The complete circuit diagram of the Quasar is shown in Fig. 1. The LM1818 is a linear low noise i.c. (Fig. 2) containing all the active components for building a tape recorder (excluding bias oscillator).

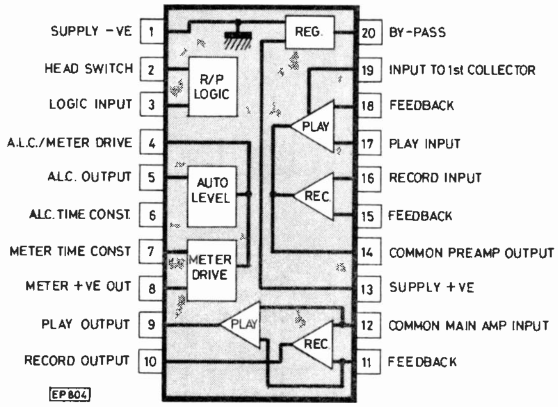


Fig. 2. The LM 1818

The electronic functions on the chip include mic. and playback pre amps, record and playback amplifiers, Automatic Level Control (ALC) and meter driving circuits. Internal electronic switching automatically selects record or play mode. A zero voltage at pin 3 switches on the record mode and a +ve (10V min) switches on the play mode.

RECORD

A recording signal is fed to the switched mic. input socket and when the mic. is used the input is connected directly to the level control VR2. The attenuating network R49 and R50 are connected into the circuit when the mic. plug is removed, thus allowing higher signal levels to be recorded via the 5 pin DIN socket. The input signal to IC1 is via pin 16 and the equalisation network for record and playback is shared. The value of C5 (6n2) and R6 (12k) give the required 70μs DIN equalisation for CrO_2 tape, the addition of R48 (6k8) extends it to 120μs for Fe type tape.

The output of the record pre amp is connected via C12 to pin 4 of the meter/ALC drive and via C11 to pin 12 of the main record amplifier. The amplified output to the head is via C17, L1 and C18; R19 and C22; L1 and C18 form the "bias trapping" circuitry. The resistors R19 and R23 reduce the non-linear effect of the head, while C22 increases the drive at high frequencies (resonance approximately 12kHz). C15 and R15 form a 3000μs equalisation—DIN l.f. end corner frequency. When S1 is in record mode pin 3 is at zero volts and the logic circuit connects pin 2 to earth and selects the record state inside the i.c. S1a also connects R47 to the –ve rail, thus enabling TR9 and TR10 to oscillate at a fixed frequency set by C43. The oscillator output is connected via bias preset PR3 (PR4) and C27 to the head. C27 is low value to prevent "cross-talk" recording between L and R channels.

The erase head voltage is taken from the tapped oscillator coil (L2) and earth with the time constant for meter-drive circuit set by C10 and R13 and the sensitivity via preset PR1. Note that meter is operational on both record and playback states.

PLAYBACK

In play mode S1a prevents oscillation by removing the earth from R47 and R12, and allowing the leakage voltage to switch the logic at pin 3 to "play" operation. Pin 2, which in record state was grounded, now "floats" and is connected to the play input at pin 17 via C4. The other side of the head

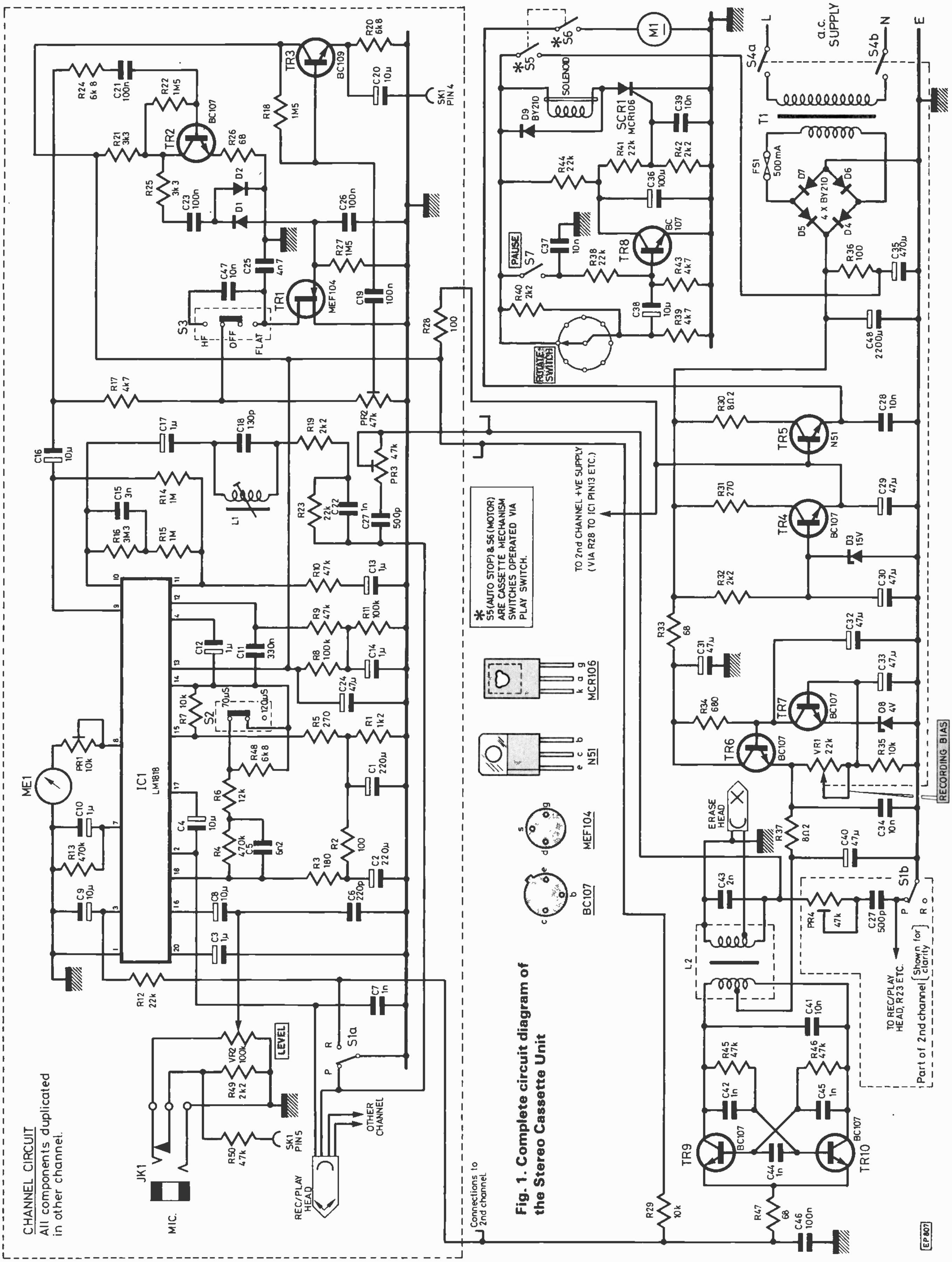


Fig. 1. Complete circuit diagram of the Stereo Cassette Unit

COMPONENTS . . .

Resistors

* R1	1k2 (2 off)
* R2, R28	100 (4 off)
* R3	180 (2 off)
* R4, R13	470k (4 off)
* R5	270 (2 off)
* R6	12k (2 off)
* R7	10k (2 off)
* R8, R11	100k (4 off)
* R9, R10, R50	47k (6 off)
* R12, R23	22k (4 off)
* R14, R15	1M (4 off)
* R16	3M3 (2 off)
* R17	4k7 (2 off)
* R18, R22, R27	1M5 (6 off)
* R19, R49	2k2 (4 off)
* R20, R24, R48	6k8 (6 off)
* R21, R25	3k3 (4 off)
* R26	68 (2 off)
R29, R35	10k (2 off)
R30, R37	8Ω2 (2 off)
R31	270
R32, R40, R42	2k2 (3 off)
R33, R47	68 (2 off)
R34	680
R36	100 ½W
R38, R41, R44	22k (3 off)
R39, R43	4k7 (2 off)
R45, R46	47k (2 off)

Potentiometers

VR1	22k log combined with pull to make switch
* VR2	100k log slider (2 off)
* PR1	10k preset lin (2 off)
* PR2	47k preset (2 off)
PR3, PR4	47k preset (2 off)

Inductors

* L1	Bias trap coil (2 off) (22mH adjustable)
L2	Oscillator coil 114 TO 30035

Switches

S1	2 pole play/record
S2	2 way slide s/w
S3	3 way slide s/w
S4	See VR1
S5, S6	Fitted to cassette mech.

Miscellaneous

Cassette mech.
Dual VU meter (MEI)
Aluminium top cover
Printed fascia
Bracket for S1
Perspex lid
5 off normal cassette piano knobs
1 off record cassette piano knob
TR1 Mains transformer (18V sec)
Fuse holder and 500mA fuse
Case
5 pin DIN socket (SK1)
2 off switched jack sockets (JK1)
p.c.b.

* INCLUDES SECOND CHANNEL COMPONENTS

Capacitors

* C1, C2	220µ 16V elect (4 off)
* C3, C10, C12, C13, C14, C17	1µ to 2µ 16V elect (12 off)
* C4, C8, C9, C16, C20	10µ 16V elect (10 off)
* C5	6n2 (2 off)
* C6	220p polystyrene (2 off)
* C7, C22	1n polystyrene (4 off)
* C11	330n (2 off)
* C15	3n (2 off)
* C18	130p polystyrene (2 off)
* C19, C21, C23, C26	100n (8 off)
* C24	47µ 16V elect (2 off)
* C25	4n7 (2 off)
* C27	500p polyester (2 off)
* C47	10n (2 off)
C28, C34, C37, C39	10n (4 off) axial
C29 to C33, C40	47µ 16V elect (6 off)
C35	470µ 25V elect
C36	100µ 16V elect
C38	10µ 16V elect
C41	10n vert.
C42, C44, C45	1n polystyrene (3 off)
C43	2n polystyrene
C46	100n
C48	2200µ 25V

Semiconductors

* D1, D2	Germanium diodes (4 off)
D3	15V Zener BZY88
D4, D5, D6, D7, D9	BY210 (5 off)
D8	4V Zener BZY88
SCR1	MCR 106
* TR1	MEF104 or MEF101 (2 off)
* TR2	BC107 or equiv. (2 off)
* TR3	BC109 or equiv. (2 off)
TR4, TR6 to TR10	BC107 or equiv. (6 off)
TR5	N51 (TIP 31A equiv)
* IC1	LM1818 (2 off)

Constructor's Note

A complete kit of parts for the Quasar is available from **R&TVC Ltd, 21B High Street, Acton W3 6NG,** price £32·95 plus £2·75 p&p. The cabinet is £4·50 plus £1·50 p&p.

is earthed by S1. C7 is chosen to resonate at approximately 12kHz—thus compensating for "gap loss" previously mentioned. All other functions are the same as in the record state except the corresponding circuitry is selected inside the i.c. The final output is taken from pin 9 via C16.

G.N.R. SYSTEM (GATE NOISE REDUCTION)

With S3 in the "flat" position R17 and TR1 form a simple potential divider. While there is no signal at the junction of C16 and R17 the f.e.t.s resistance is very low (approximately 100Ω)—thus virtually short-circuiting the output level preset PR2. As soon as the signal arrives, independent of the PR2, it is amplified by TR2. To ensure low voltage rectification D1 and D2 are germanium diodes. They rectify the signal and a doubled −ve voltage appears at TR1 gate, which goes high in resistance, thus allowing the signal from PR2 to TR3. The final output is taken via C20. C26 is the memory capacitor for the gating system.

Note: Without signal and S3 in FLAT position, the G.N.R. will reduce all unwanted hum or noise to almost an inaudible level, whilst in h.f. position the higher frequencies will be reduced at low or zero signal only.

AUTO STOP

The rotate switch is an integral part of the deck and is located under the "take up" mechanism. While rotating it is intermittently supplying a d.c. positive voltage to C38. This appears at TR8 base as a square-wave, saturating the transistor and only a very low voltage (Vbe) will occur at the collector. As soon as the switch stops rotating (end of tape) TR8 ceases to conduct and the collector goes "high", and SCR1 is triggered by R41. Immediately the solenoid operates releasing the function keys (PLAY, F.F. or R.W.). The deck switches S5 and S6 also return to the OFF position. During the pause the pinch wheel on the mechanism is partly disengaged and S7 provides a +ve voltage via R38 to hold TR8 in saturated state.

POWER SUPPLY

The rectified output is decoupled by C48. C35 is a "storage" capacitor for the auto stop circuit. The value chosen enables enough energy to be stored (through R36) for one operation of the solenoid. TR4 regulates the voltage to the i.c.s and the G.N.R.

The same voltage is current amplified by TR5 to provide the motor supply. Under normal use TR5 can be operated without a heatsink but a small heatsink may be attached if excessive rewind or fast forward operation is required. (Note: the tab of TR5 is internally connected and must not be shorted to earth nor any other component.)

Transistors TR6 and TR7 form the variable-regulated supply for the bias oscillator; with D8 (4V Zener) it will vary the voltage from 4·5 to 15·5V. When VR5 and VR6 are set correctly the bias oscillator voltage at the head will correspond to the calibration around VR1. R29 ensures correct record/replay logic switching should the bias oscillator supply be below 10V.

NEXT MONTH: CONSTRUCTION

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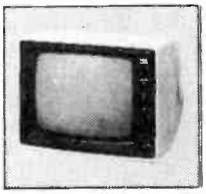

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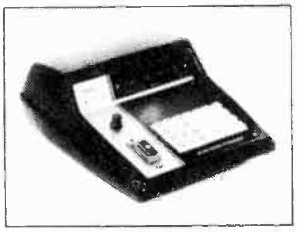

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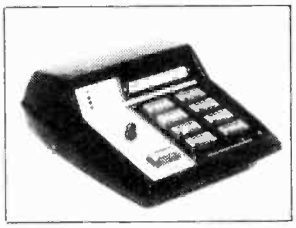

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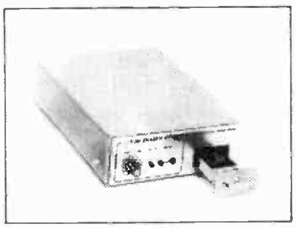

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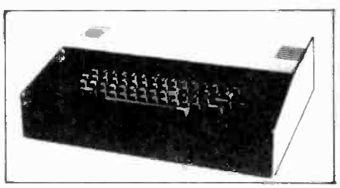

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	25+0.89
2114L-300ns GTE	1.55
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2708 450ns	1+2.25
	25+1.99
2716 450ns	1+2.49
(single +5V)	25+2.25
2716 350ns	6.95
2532 450ns	1+4.50
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2732 450ns	1+3.99
	25+3.80
2732 350ns	7.50
4116 200ns	1+0.74
	25+0.70
	100+0.67
4116 150ns	1+0.93
	25+0.89
4118 200ns	1+3.90
	25+3.45
4118 150ns	6.00
5516 200ns	12.50
6116 200ns	7.95
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6116LP 150ns	10.85
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EF9365P	62.90
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EF9365/6 DATA AND APPLICATIONS	2.00
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ZN432CJ-10	28.09
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ZN432E-10	14.75
ZN447	9.14
ZN448	6.85
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MC14412	7.99
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LM311N	0.89
LM319N	2.20
LM324N	0.30
LM348N	0.59

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LM741CN	0.14
LM747CN	0.70
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REGULATORS	
7805	0.39
7812	0.39
7815	0.39
78L05	0.29
78L12	0.29
78L15	0.29
7905	0.55
7912	0.55
7915	0.55
79L05	0.59
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Z80 SIO-2	10.99
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MK 3886-4	14.47
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6821	1.25
6840	4.20
6850	1.50
6862	6.91
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6880	1.07
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68488	9.11
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68B10	2.00
68B40	4.70
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68000C4	110.00
6500 FAMILY	
6502	4.25
6520	2.99
6522	4.75
6532	6.95
8080 FAMILY	
8085A	5.50
8212	1.70
8216	0.99
8224	1.95
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Device	Price
CMOS 4000 'B' SERIES	
4000	0.11
4001	0.11
4002	0.13
4006	0.60
4007	0.15
4008	0.55
4009	0.28
4010	0.35
4011	0.12
4012	0.15
4013	0.29
4014	0.58
4015	0.58
4016	0.25
4017	0.45
4018	0.58
4019	0.29
4020	0.58
4021	0.60
4022	0.62
4023	0.17
4024	0.35
4025	0.16
4026	0.99
4027	0.30
4028	0.55
4031	1.65
4033	1.60
4034	1.55
4035	0.72
4040	0.54
4041	0.69
4042	0.54
4043	0.59
4044	0.64
4045	1.65
4046	0.68
4047	0.68
4048	0.54
4049	0.26
4050	0.26
4051	0.59
4052	0.68
4053	0.59
4054	1.20
4055	1.20
4060	0.79
4063	0.95
4066	0.34
4068	0.17
4069	0.17
4070	0.17
4071	0.17
4072	0.17
4073	0.19
4075	0.17
4076	0.62
4077	0.22
4078	0.24
4081	0.14
4082	0.19
4085	0.63
4086	0.69
4093	0.39
4502	0.69
4507	0.39
4508	1.90
4510	0.60
4511	0.49
4512	0.60
4514	1.49
4515	1.49
4516	0.69
4518	0.40
4519	0.28
4520	0.69
4521	1.49
4522	1.20
4526	0.70
4527	0.89
4528	0.70
4532	0.65
4541	0.99
4543	0.99
4553	2.90
4555	0.39
4556	0.44
4585	0.62

Device	Price
74LS SERIES	
74LS00	0.10
74LS01	0.11
74LS02	0.12
74LS03	0.12
74LS04	0.12
74LS05	0.13
74LS08	0.12
74LS09	0.12
74LS10	0.12
74LS11	0.12
74LS12	0.12
74LS13	0.22
74LS14	0.39
74LS15	0.12
74LS20	0.12
74LS21	0.12
74LS22	0.12
74LS26	0.15
74LS27	0.12
74LS28	0.15
74LS30	0.12
74LS32	0.12
74LS33	0.16
74LS37	0.15
4LS38	0.15
74LS40	0.12
74LS42	0.34
74LS47	0.39
74LS48	0.60
74LS49	0.59
74LS51	0.14
74LS54	0.15
74LS55	0.15
74LS73	0.19
74LS74	0.16
74LS75	0.24
74LS76	0.20
74LS78	0.19
74LS83	0.44
74LS85	0.65
74LS86	0.15
74LS90	0.30
74LS91	0.75
74LS92	0.34
74LS93	0.34
74LS95	0.43
74LS109	0.21
74LS112	0.21
74LS113	0.23
74LS114	0.19
74LS122	0.39
74LS123	0.39
74LS124	0.99
74LS125	0.25
74LS126	0.25
74LS132	0.45
74LS136	0.28
74LS138	0.34
74LS139	0.35
74LS145	0.75
74LS148	0.90
74LS151	0.39
74LS153	0.29
74LS155	0.39
74LS156	0.38
74LS157	0.31
74LS158	0.31
74LS160	0.39
74LS161	0.39
74LS162	0.39
74LS163	0.39
74LS164	0.47
74LS165	0.99
74LS166	0.84
74LS173	0.70
74LS174	0.47
74LS175	0.49
74LS181	1.28
74LS190	0.49
74LS191	0.49
74LS192	0.49
74LS193	0.46
74LS194	0.39
74LS195	0.39
74LS196	0.59
74LS197	0.65
74LS221	0.54
74LS240	0.89
74LS241	0.89
74LS242	0.79
74LS243	0.79
74LS244	0.65
74LS245	0.89
74LS247	0.63
74LS248	0.63
74LS249	0.63
74LS251	0.40
74LS253	0.39
74LS257	0.40
74LS258	0.39
74LS259	0.79
74LS261	1.95
74LS266	0.23
74LS273	0.75
74LS279	0.39
74LS283	0.44
74LS290	0.54
74LS293	0.45
74LS365	0.34
74LS366	0.36
74LS367	0.34
74LS368	0.49
74LS373	0.74
74LS374	0.74
74LS375	0.47
74LS377	0.89
74LS378	0.69
74LS379	0.64
74LS386	0.28
74LS390	0.54
74LS393	0.59

Device	Price
OIL SOCKETS LOW PROFILE - TIN	
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14 pin	0.09
16 pin	0.09
18 pin	0.13
20 pin	0.14
22 pin	0.17
24 pin	0.19
28 pin	0.25
40 pin	0.29
NEW LOW PROFILE - GOLD	
8 pin	0.22
14 pin	0.29
16 pin	0.31
18 pin	0.33
20 pin	0.35
22 pin	0.40
24 pin	0.42
28 pin	0.54
40 pin	0.81
NEW ZERO - INSERTION FORCE OIL	
24 pin	6.30
28 pin	7.40
40 pin	8.80
CRYSTALS	
1 MHz	2.90
1.008 MHz	2.90
1.8432 MHz	2.20
36864 MHz	2.95
4 MHz	1.65
6 MHz	1.90
8 MHz	1.95
14 MHz	3.45
NEW UHF MOOULATORS	
6 MHz	2.75
8 MHz	4.40
DATABOOKS	
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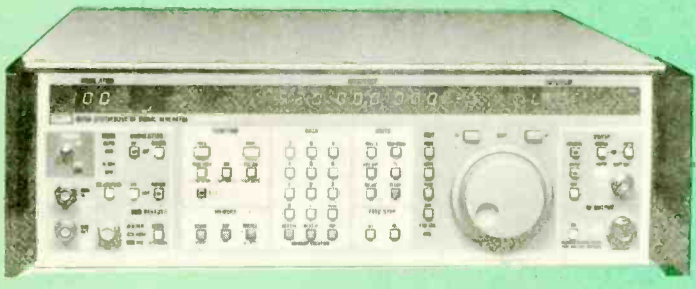

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ULTRASONIC VISION SYSTEM PART 1

Jeremy Bentham & Fred Bentham

THE ROBOT AGE is drawing closer, but the general use of robots is held up because of one major problem: how can a machine "see" the world around it? Research laboratories the world over are working on the problem, yet the systems produced are either elaborate and expensive, or simple and ineffective. This project is an advanced ultrasonic vision system which is within the means of the amateur constructor, yet is sophisticated enough to enable experimentation with computer measurement, image recognition, object tracking, and robot vision.

The use of ultrasonics for imaging is by no means new. It has long been known that bats emit ultrasonic squeaks, and use the resulting echoes to determine the range and position of nearby objects. Man has widely imitated this process, and many designs have been published for simple ultrasonic echo-rangers. Yet these designs ignore two important features of a bat's vision system that make it so accurate.

Firstly, a bat does not transmit a burst of one single frequency, since this frequency may be cancelled out due to the shape of the target. Instead, a burst of many different frequencies is transmitted, so that complete cancellation is unlikely. Secondly, a bat can intelligently move so as to determine the bearing of an object of interest. This permits a map of the surroundings to be formed.

This project incorporates these two improvements so as to form an ultrasonic vision system. The system consists of a rotating transducer unit, and an interface circuit. The system is designed to be coupled to a home computer, which processes and displays the incoming data. Depending on the complexity of the software written, the display can be anything between simple range and bearing information, or a complex radar-type plot. There is tremendous scope for experimentation with the way the incoming data is used: in view of the impending arrival of domestic robots, the unit might well find application as a robot vision system.

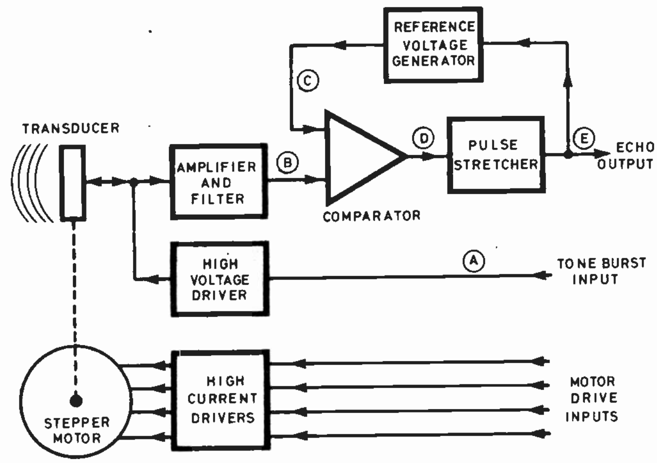
HARDWARE AND SOFTWARE

The vision unit consists of a circuit board, an ultrasonic transducer, and a stepper motor. The unit is designed to plug into the printer port of an Acorn Atom, but it can be driven by any computer with five output lines and one input line (5 volt logic). The unit can be powered from an external 5 volt supply, or from an unregulated supply using the optional on-board regulator. Simple driving software for the Atom is described in Part Two. A typical scan of a room using more complex software and the Atom hi-res graphics is shown in Fig. 4. It is hoped to make this software available on cassette.

DESIGN

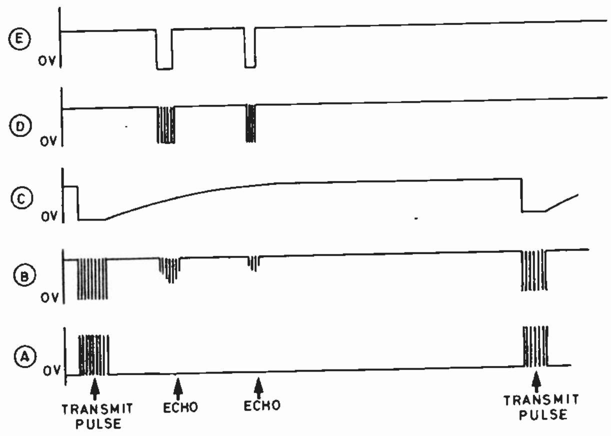
In order to make the system as flexible as possible and to minimise the amount of hardware, it was decided to implement most of the required functions in software. This means that the computer generates the transmit pulse sequence, times the returning echoes, and generates the stepper motor signals. The hardware amplifies the transmit pulse sequence, processes the received echoes, and amplifies the motor drive signals.

Fig. 3 is a complete circuit diagram of the unit. The transmit pulses emerge from bit 6 of the Atom printer port as a normally low signal, pulsed high at the transmit frequency. This signal is fed to the base of TR1 via C1, which blocks any continuous d.c. signal. The high pulses turn on TR1 and drive T1 which is a transformer broadly tuned to 50–60kHz. During transmission the inductive "kick-backs" from the primary are collected by D5 so as to charge up C5 to about 8 volts. This voltage is used as a supply for IC1,2, since they require more than 5 volts. Approximately 350V peak-to-peak is produced by the secondary of T1 to drive the transducer. As the transducer is of the capacitive type, it also



EG805

Fig. 1. Block diagram of system



EG806

Fig. 2. Echo pulses

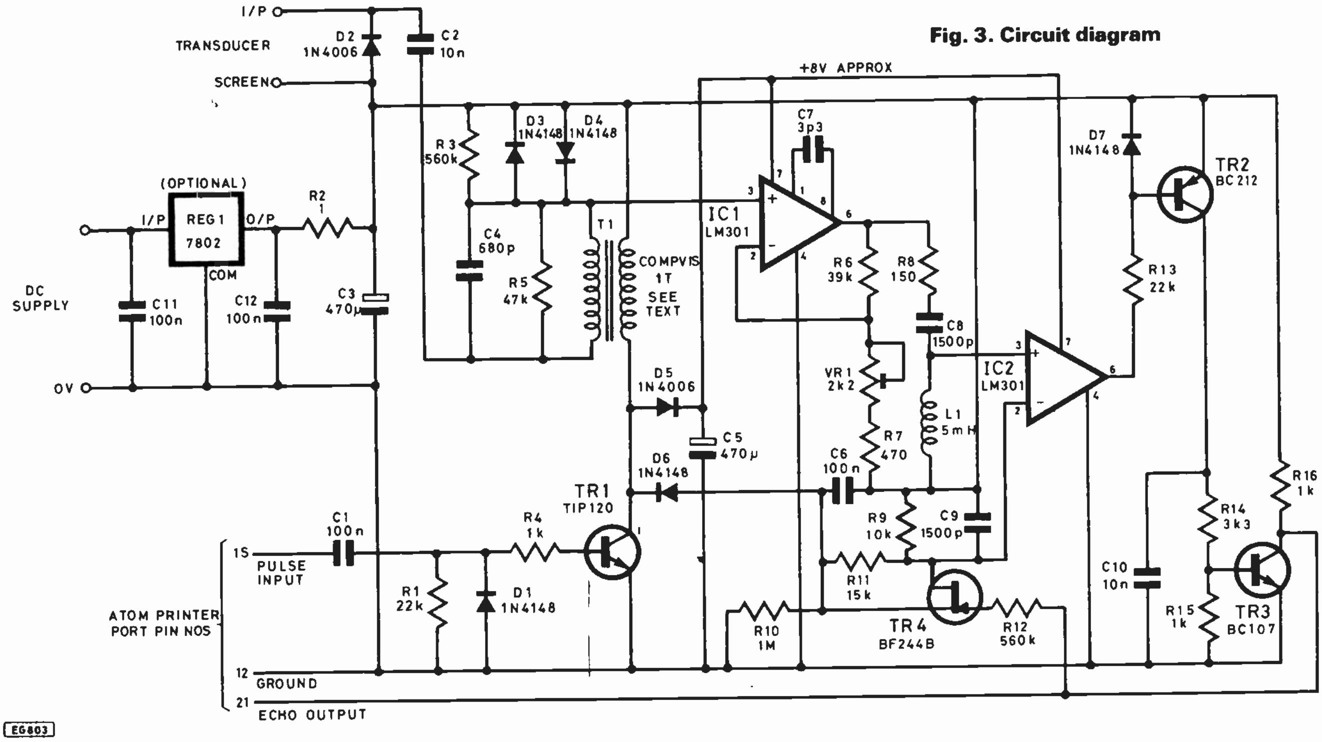


Fig. 3. Circuit diagram

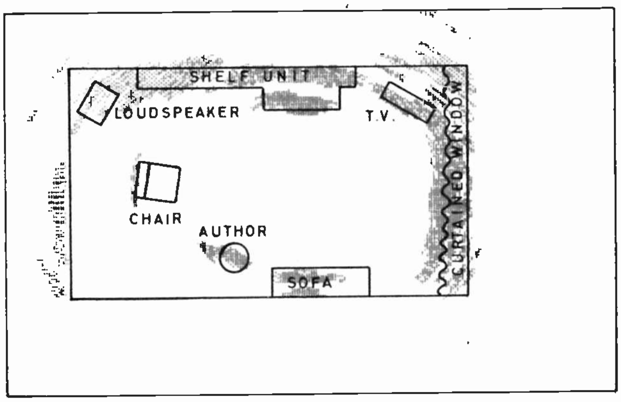
EG803

requires a d.c. polarising voltage, which is supplied by D2 and C2. When the transmission has finished, the oscillations die away quickly due to the damping resistor R5, and the transducer can start receiving.

Echoes picked up by the transducer generate a small signal, which may be as low as 100 microvolts for a distant object. For amplification, the conventional 741 op-amp cannot be used, since it has inadequate gain at 60kHz. Instead, an LM301 is used, and it requires an external compensation capacitor C7. IC1 provides a voltage gain between 20:1 and 80:1 depending on the setting of gain control VR1. The output of IC1 feeds a 60kHz series tuned circuit. As those of you who have studied a.c. circuit theory will know, the tuned circuit not only filters out signals outside the passband, but also acts as a voltage multiplier at the resonant frequency. Since R8, C8, L1, give a Q-factor of approximately 10, we obtain a further voltage gain of 10 around 60kHz.

The amplified and filtered echo is fed to the non-inverting input of IC2, and a reference voltage is fed to the inverting

Fig. 4. A radar-type scan generated by the ultrasonic vision system. A "slice" view at about the height of the back of the chair is produced here



EG808

input. The op-amp acts as a comparator: if the negative peaks of the received echo are more negative than the reference level, the output pulses low. Thus a stream of low pulses at the output indicates that a valid echo is being received. These pulses are fed to TR2, TR3 which stretch the individual pulses so that one echo is seen as one long pulse. (See Fig. 2). These echo pulses are fed into bit 7 (the most significant bit) of the atom printer port. The input is normally high, and is held low for the duration of each received echo.

From the above description it can be seen the reference voltage at the inverting input of IC2 determines the overall sensitivity of the system: if the reference voltage is at 0 volts, the system is least sensitive, and if it is nearly 5 volts, the system has maximum sensitivity. Components D6, C6, C9, R9, R10, R11, R12, TR4, all control the reference voltage so as to give the following features:

1) Hysteresis. When an echo is received, the field-effect transistor TR4 is turned off via R12. This raises the reference voltage, so that the circuit *locks on* to the incoming pulse.

2) Gain profile. During transmission, the switching of TR1 causes C6 and C9 to charge via D6, holding the reference voltage low. During reception, the reference voltage slowly rises as C6 and C9 discharge through R9 and R11. This means that the system gain is low after each transmission, and then slowly rises; this compensates for the fact that nearby objects give bigger echoes than far ones.

Bits 0, 1, 2, 3 of the printer port are outputs for the stepper motor drive. These signals are normally low; when one or more are switched high, the corresponding stepper motor coils are energised. Diodes D8, 9, 10, 11 are to protect the circuit against the inductive kick-back of the coils when de-energising. The stepper motor is a 4-phase unipolar type; although it is a 12 volt motor it is being under-run at 5V to save power. The angle per full step is 7·5 deg., but it can be half-stepped. The required drive signals are described next month.

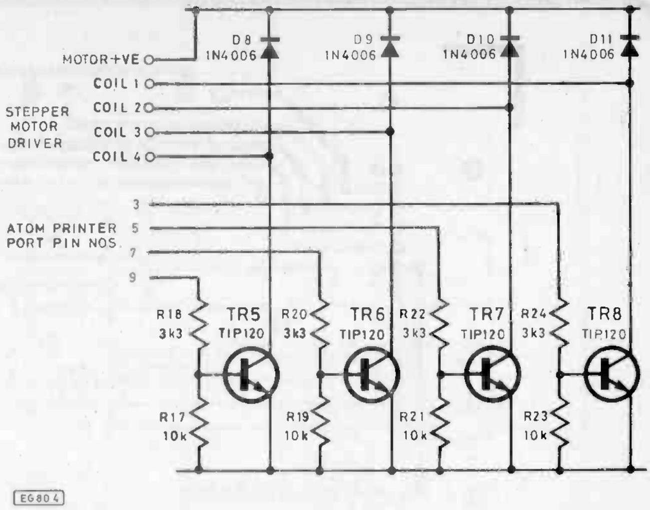


Fig. 5. Interfacing the stepper-motor to the Atom Printer Port

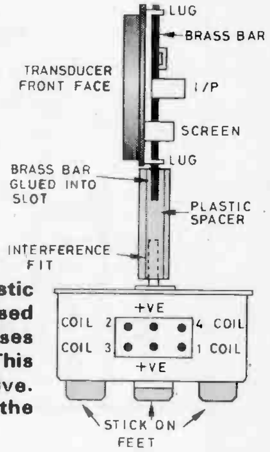


Fig. 6. Mounting the sensor. A plastic spacer with a slot cut in one end, is used to accept the flat brass bar which passes through the transducer's rear lugs. This end of the spacer is joined using adhesive. The other end is a push fit over the motor spindle

COMPONENTS . . .

Resistors

R1, R13	22k (2 off)
R2	½W 5%
R3, R12	560k (2 off)
R4, R15, R16	1k (3 off)
R5	47k
R6	39k
R7	470
R8	150
R9, R17, R19, R21, R23	10k (5 off)
R10	1M
R11	15k
R14, R18, R20, R22, R24	3k3 (5 off)

All resistors ¼W 5% unless otherwise specified

Potentiometers

VR1 2k2 min. hor. preset

Capacitors

C1, C6, C11, C12	100n/250V 10% (4 off)
C2, C10	10n/250V 10% (2 off)
C3, C5	470/63V elect. (2 off)
C4	680p silver mica
C7	3p3 sub. min. plate ceramic

Transistors and Diodes

TR1, TR5–8	TIP120 (5 off)
TR2	BC212 (not L version)
TR3	BC107
TR4	BF244B
D1, D3, D4, D6, D7	1N4148 (5 off)
D2, D5, D8–11	1N4006 (6 off)

Inductors

L1	5mH choke (Repanco CH2)
T1	COMPVIS 1T

Integrated Circuits

IC1, IC2	LM301 (2 off)
REG 1	7805 regulator (not supplied in kit)

Miscellaneous

Polaroid ultrasonic transducer
8-pin d.i.l. socket (2 off)
Stepping motor. Impex 9904–112–31004 12 volt
Ribbon cable with 26-way header
30cm of coaxial cable for transducer
Adaptor to mount the transducer
P.c.b. Compvis 1

Constructor's Note

All parts (or complete kit) available from **Technomatic Ltd.**

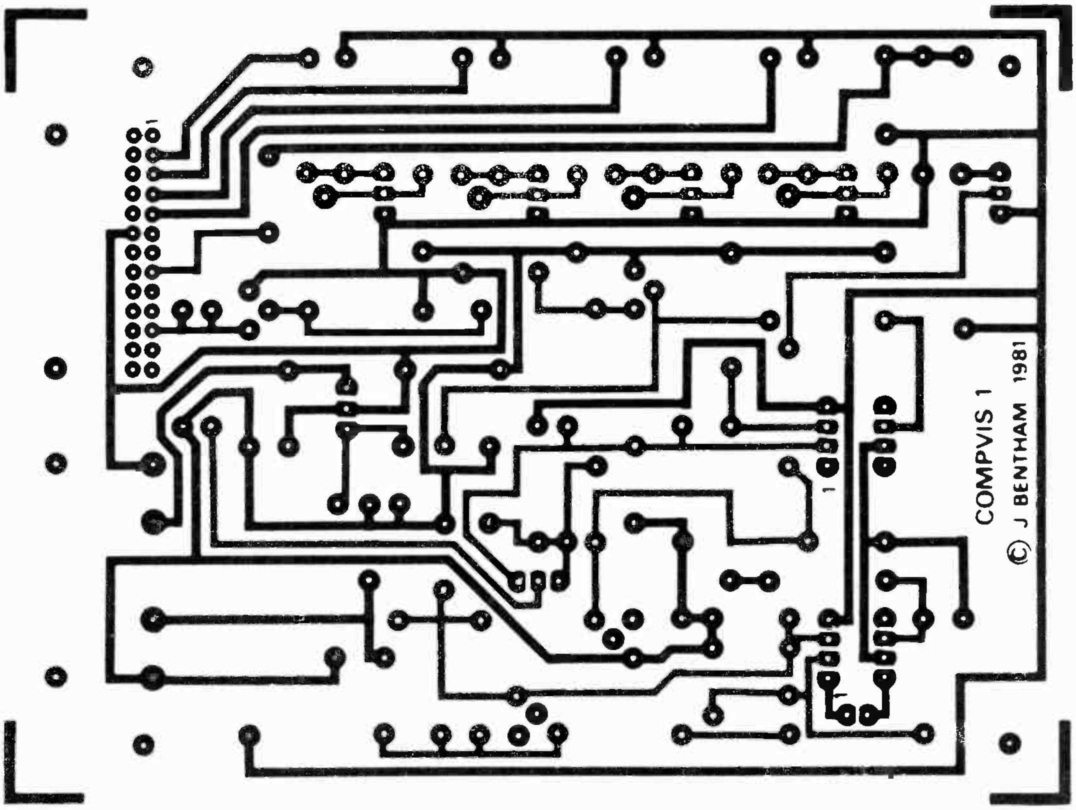


Fig. 7. Printed circuit layout (actual size)

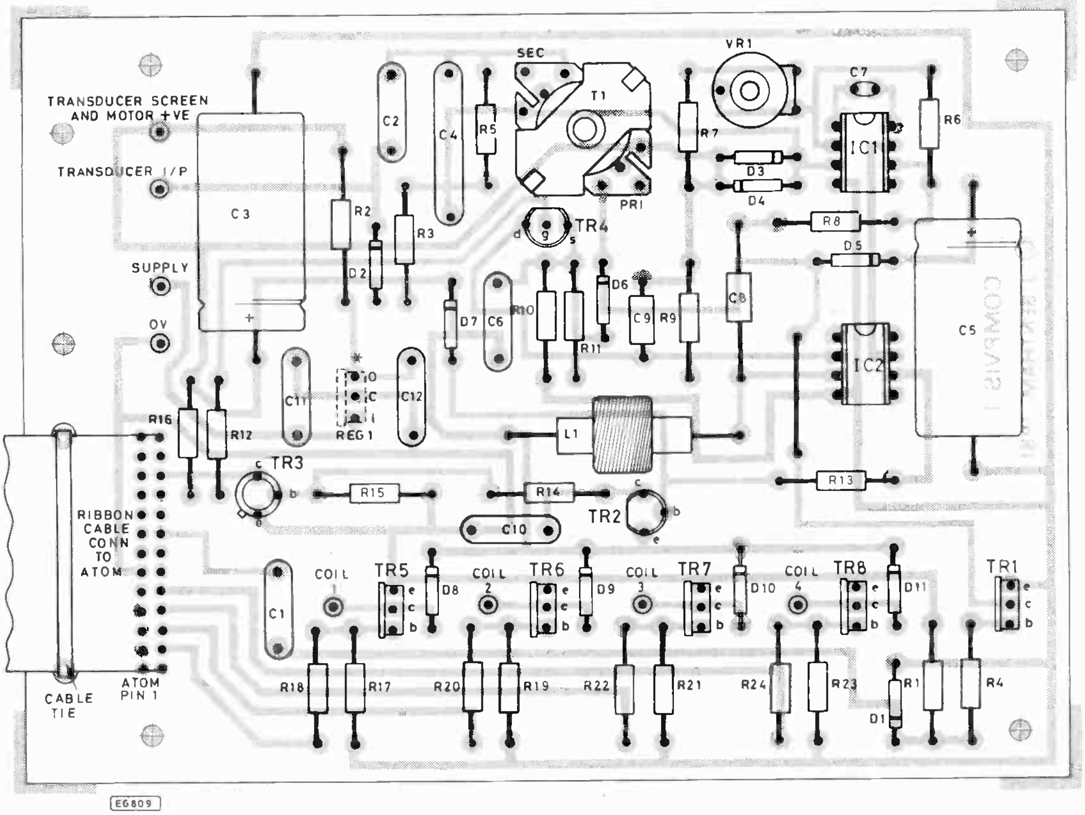


Fig. 8. Component layout

CONSTRUCTION

It is recommended that the p.c.b. be used, otherwise stability problems may occur. Assembly is straightforward, but pay special attention to the diode polarities, and the transistor orientation. The correct orientation for T1 is established by looking at the underside: the primary is wound with thicker wire than the secondary. The regulator IC3 is optional. If a 5 volt regulated supply is available, then IC3 should not be fitted, and its two outer holes on the p.c.b. should be linked together. During transmission, the unit requires 1 amp peak, so the external supply must be capable of this current without distress. For this reason, the supply from the Atom's internal regulators must not be used. The screened cable must be soldered to lugs which push on to the transducer tabs. Do not solder direct to the transducer, as the heat will destroy it. The recommended length for the transducer cable is 30cm., greater lengths may cause problems. Before connecting the screened cable to the p.c.b. connect it to the transducer and fit the transducer to the motor. Measure the resistance between the centre core and the screen of the cable: it should be infinite, since the transducer does not present a resistive load. When connecting the ribbon cable, note the pin 1 identification on the p.c.b. This should correspond to the bottom left pin of the Atom printer port, viewed from the back.

NEXT MONTH Testing and software.

THE MACROCHIP

In recent years the phrase 'solid state' when applied to electronics has been almost universally equated with integrated circuitry and microminiaturisation. An advance in large scale solid state engineering is about to take industry by storm. This advance however has come from the most unlikely source.

The specialist firm of Puchemm & Long which produces conveyor belt systems for the confectionary trade is about to start production of its new solid state drive mechanism for conveyor belts. The principle is simple, but has required some sophisticated engineering to produce the hardware. The drive mechanism is a linear induction motor which instead of using magnetic induction uses an analogous system of electrostatic induction. A rubberized belt acts as an insulator with a high dielectric constant. A large scale solid state drive underneath the belt develops a rapidly changing pattern of electrostatic charge which induces the opposite charge on the belt above. As the driving charge changes the induced charge above it lags behind so that the two charges repel each other providing levitation and propulsion for the belt. A complex pattern of changing charges produced by the macrocircuit ensure a smooth controllable motion of the belt.

There are many advantages of this system over the conventional mechanical belt drive. Total solid state engineering means that there are no moving parts and hence greater reliability and less maintenance. The elimination of the noise and vibration of previous mechanisms improves the environment of the factory floor. The main advantage for the food industry however is the cleanliness of the system. The lack of moving parts means that 'dirty' lubricating oils can be eliminated from the track and little dust is stirred up by the mechanism.

It is not only on the factory floor that this system will find an application. Already P & L have started work on a personnel transport system. A high power version of the sweet makers continuous belts under development as a moving pavement although there is still a considerable number of problems to be overcome. This farsighted project is only the beginning of what could be a revolutionary move away from the wheel. Plans for the future include an electrostatically elevated and propelled automobile. In this development the drive 'chip' is turned upside down and induces its shadow charge on the dielectric which is the road.

The wheel-less car seems a very adventurous project but the P.L. planning department claim that this is only a beginning. However when pressed for details they would say no more than "The sky is the limit". An expression which may have referred to the fact that air itself has a moderately high dielectric constant, or . . . What is the dielectric constant of interstellar hydrogen?

See Page 51 for more details.

Step-by-step fully illustrated assembly and fitting instructions are included together with circuit descriptions. Highest quality components are used throughout.

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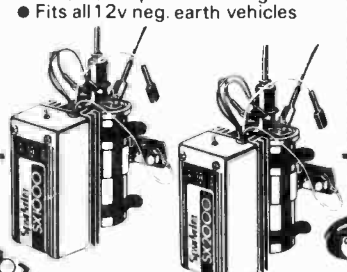

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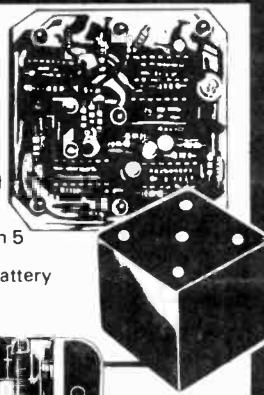

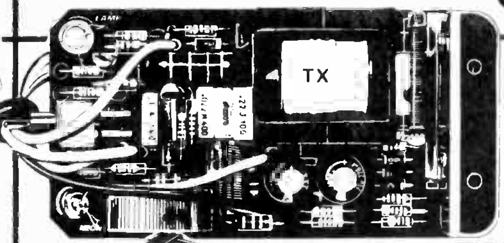

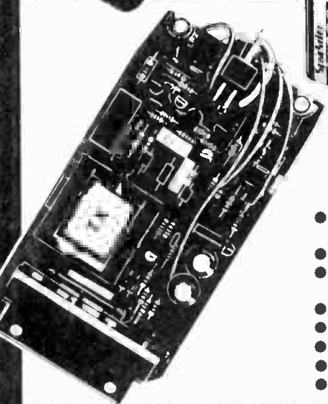

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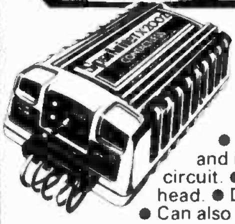

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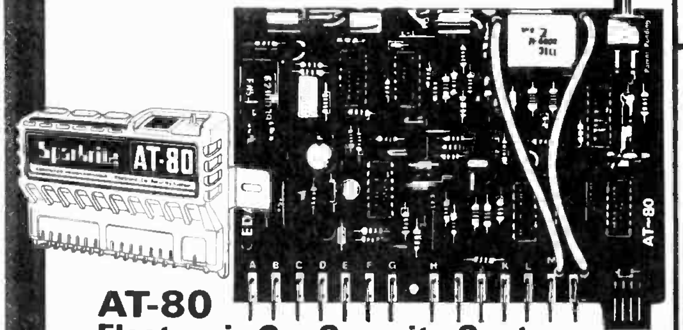
● The ultimate system ● Switchable contactless. ● Three position switch with Auxiliary back-up inductive circuit. ● Reactive Discharge. Combined capacitive and inductive. ● Extended coil energy storage circuit. ● Magnetic contactless distributor triggerhead. ● Distributor triggerhead adaptors included. ● Can also be triggered by existing contact breakers. ● Die cast waterproof case with clip-to-coil fitting ● Fits majority of 4 and 6 cylinder 12v neg. earth vehicles ● Over 150 components to assemble



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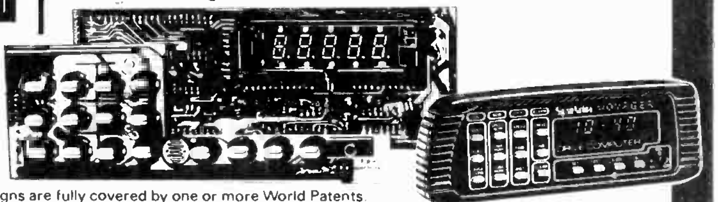

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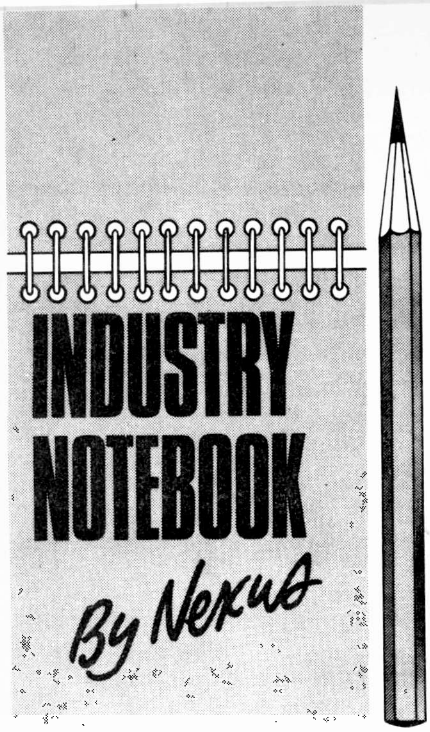

ASLEF Man

Perhaps unfairly, British Rail's modernisation programme has become a joke. The Advanced Passenger Train (APT) caused much merriment recently when its inaugural passenger runs were plagued with technical problems resulting in withdrawal from service. What should have been a technical triumph, though some years late, turned into a farce.

BR is typical of what remains wrong in British industry. On the one hand there is a dedicated team of scientists and engineers beavering away at Derby on developing and testing up-to-date systems with a view to improving efficiency and service. On the other hand, a trade union structure reluctant to admit any change in practices although paying lip-service to the need for progress.

ASLEF Man is the archetype of out-of-date attitudes. For the benefit of overseas readers, ASLEF is the acronym for the Associated Society of Locomotive Engineers and Firemen with a membership of little over 25,000, a sad decline since the great age of steam when, for example, in 1938 there were close on 20,000 steam locomotives running and only 43 diesel and 13 electric locomotives. By 1960 diesel traction was biting into steam and the switch from steam to diesel and electric traction was completed by 1968.

In some respects we can all sympathise with ASLEF Man. Not only has he declined in numbers but his elite qualities in the railway hierarchy of yesteryear are no longer needed. With steam, the driver and fireman, working as a team, were systems managers. Every locomotive was a self-contained energy converter from coal to heat to steam to tractive effort. There was constant balancing of water levels, firebox temperature, steam pressure, against the varying demands of speed, gradients, wind resistance and the clock. The team watched their gauges and, as part of the feedback loop, had to exercise technical judgement based on long experience throughout the journey. Starting as a boy engine cleaner, you could hope to be entrusted with an express passenger train by middle age. Apart from the exercise of technical skill, the job was physically demanding, uncomfortable, and dirty.

Modern ASLEF Man, in association with the guard, is responsible for train and passenger safety as before. The rest of his job, in air-conditioned comfort, is less demanding than driving a car. He can't forget he is no longer a locomotive engineer and as long as he can get away with it will insist on having a 'fireman' in his cab, for thus it was always so.

While ASLEF Man dwells mentally in the past, the electronic boffins at BR laboratories are far into the future. Too far, I suspect, because they have an obsession that modern electronics is the solution to everything. This was apparent at a recent IEE conference on Railways in the Electronic Age. It came out that 'old-fashioned' signalling using electro-mechanical relays has reliability and fail-safe characteristics, developed over decades of in-field experience, very hard to improve by electronic switching and control. If this is true, why bother to change? Our experience with automation and modernisation on British Rail has often been unhappy.

The railway boffins are so far ahead with dreams of microprocessor control for everything that they seem to have overlooked one application of electronics, cheaply and easily installed, that could have saved many accidents and deaths. A radio communications link with every moving train. Well, not quite overlooked, for the conference revealed as something quite remarkably novel that one single-track line in the north of Scotland is now so equipped since overhead lines were brought down by snow. What a breakthrough!

With one vital section of the workforce of the railways with heads mostly buried in the sand, and another with heads often in the clouds, it is no wonder the outfit costs the taxpayer £2 million a day to keep going — when it is going.

New Era

'We are well and truly launched into the competitive era' says Sir George Jefferson, chairman of British Telecom, commenting on the new circumstances under which BT has had its former monopoly powers curbed, if not yet extinguished. BT has accepted the challenge and the equipment suppliers will also need to be more competitive to hold their business with their largest single customer.

Nonetheless, wholly British or British-based companies should retain most of the business which will remain substantial for many years to come. Electronic telephone exchanges alone will account for £600 million over the next three years, spread between GEC, Plessey and STC. By then, BT will have spent £750 million on TXE4 and the improved TXE4/4A exchanges with STC alone.

Then there is BT's new digital network, which has already topped 100,000 miles installed, and this is only the start of a massive digital programme extending through the rest of the decade.

There still remains a big question mark over the highly publicised System X. At home, where BT is full committed to System X, its full implementation according to some forecasts will not be before the turn of the century. This is not a reflection on BT who must, of course, get a full service life from exchanges such as TXE4/4As now being installed. Nor does it mean that subscribers on TXE4/4As will be denied the sort of extra services promised by System X. In fact, further enhancement of TXE4/4As will provide most, if not all, of the facilities of System X.

Where the disappointment arises is in export orders for System X. A business consortium of BT, GEC, Plessey and STC was formed some three years ago to promote exports but no sales have resulted — so far. The Department of Industry has been asked for a grant to adapt System X to better meet overseas requirements but DOI has commissioned an independent study by consultants before committing itself.

Joy in Boredom

When Racal Electronics Group yet again produced a record financial result, half-year pre-tax profits up 45 per cent, the City yawned. What an utter bore, why don't they improve 100 per cent, or even go broke?

The trouble with Racal is that for over a quarter of a century the company has enjoyed a continuous upward growth. None of the dramatic upheavals, the ups and downs so beloved by financial journalists looking for newsy headlines. Racal growth is so regular it has now become routine, if not downright monotonous. And Racal shares have become so blue-chip that they tend to be overpriced. The result is that when, by ordinary standards, Racal produces a cracking result it can even provoke a 'Racal disappoints' comment — Racal shares dropped 33p the day after the results were declared.

The belief that Racal-style management would soon turn Decca round from loss to profit was confirmed in the figures. Most of the increased profit came from the turnround, although some of the former Decca operations are not yet out of the red.

An interesting sidelight is the theory of horses for courses. Racal is a firm believer in sticking to what it knows it can do best, i.e. capital goods. Thus, having acquired Decca, one of the first tasks was to dispose of the domestic television manufacturing unit at Bridgnorth. This was bought by Taiwan's biggest electronics company, Tatung, who know the consumer side of the business and according to latest reports are making a real go of it, turning loss into profit within six months of taking over, production of TV sets having increased almost five-fold and still accelerating with substantial exports to the European mainland envisaged.

Another thoroughly boring outfit is GEC. Their current export order book stands at over £1,000 million, let alone the healthy home order book plus £800 million cash in the bank. Again, this is expected and causes little excitement.

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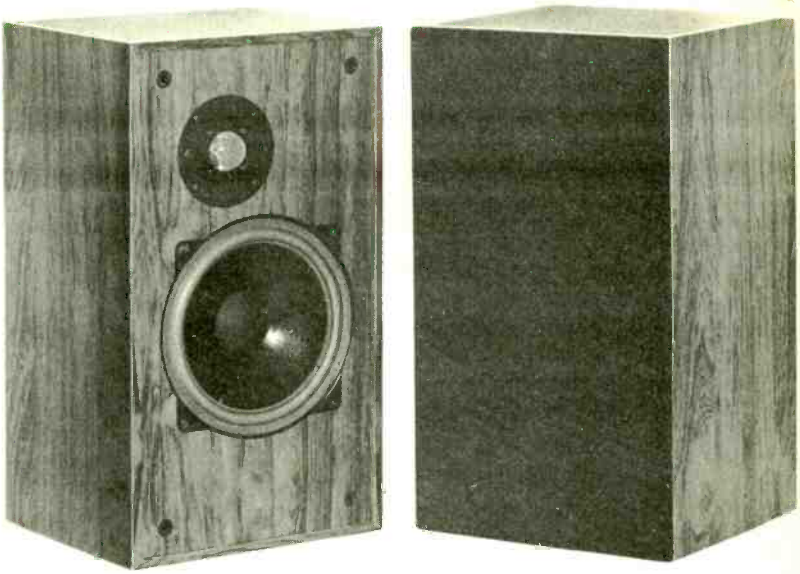

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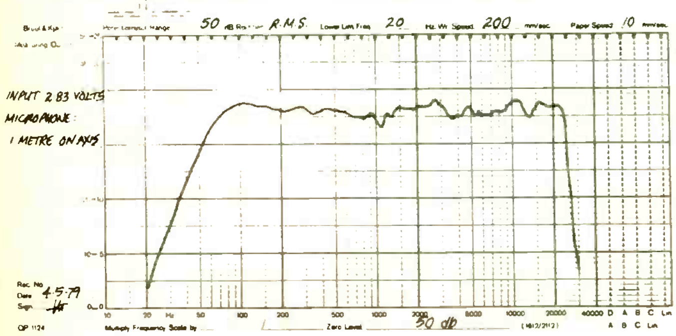
This excellent offer has been arranged by PE as a result of a frustrated export order. The speakers employ Audax drive units and were produced in the UK for a leading European hi-fi company. They are "mirror image" speakers with h.f. drive units mounted to the outside of the sound area.

Specifically designed to meet the need for a high quality moderately sized enclosure these speakers have a high sensitivity, extended bass response and will handle up to 45 watts peak, although they can be used with amplifiers rated as low as 15 watts.

SPECIFICATION: Two way infinite baffle; HIF20ESM bass unit 20cm diam. treated paper foam edged cone; HD100 high frequency unit 25mm soft dome radiator; 8 ohm nominal impedance; 45 watts peak power (35W r.m.s.); 86dB 1 watt 1 meter sensitivity; frequency range 45Hz–22kHz; resonance 80Hz; harmonic distortion ref. 96dB. SPL at 1 meter 3% max. second harmonic 140Hz–22kHz; 1% max. third harmonic 100Hz–22kHz; finished in rosewood p.v.c.; size 470 x 264 x 225mm; capacity 18 litres; weight 8 kilos; connections, DIN sockets and screw terminals.



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PE ENLARGER TIMER

TOM GASKELL B.A. (Hons) ELEC. ENG.

THIS is a project designed primarily with the photographer in mind, but which could be readily adapted to many other uses. It can act as a straightforward stopwatch, counting with an accuracy of 0·1 seconds up to a total of 999·9 seconds duration; this is primarily for use when processing films or developing prints. It can also be made to count down from a preset number to zero, turning on an enlarger lamp during this counting period. To aid in the 'dodging' of prints (selective shading of part of the enlargement) a once-per-second 'bleeper' is provided; alternatively, the bleeper can be used as an alarm for when the count down period has ended. The count down facility can also be switched to repeat. In this mode, a short bleep is sounded when the counter reaches zero, then the unit re-sets itself to the starting value and counts down again. This arrangement simplifies the exposing of 'test strips'. A safelight socket is provided so that when the enlarger control is in the 'focus' position (continuously on), the safelight is turned off. An enlarger meter can then be used to determine the relative brightness of the negative; normally, such meters are adversely affected by the illumination from a safelight. Finally, a brightness control is provided for the l.e.d. display to allow it to be dimmed sufficiently to prevent fogging of the printing paper. Turning this control fully off also turns off the safelight; ideal for use when colour printing.

CIRCUIT DESCRIPTION

The whole enlarger timer is based on one LSI device, a CMOS 4 decade counter/driver i.c. type 7217. This is a 28 pin i.c. of considerable complexity; it isn't cheap, but it does replace dozens of simpler i.c.s.

The 7217 is, essentially, four up/down counters in one package. It has a built-in multiplexed l.e.d. driver circuit, which is fully buffered to remove the need for any external transistor or i.c. current driving stages. It has a tri-state input/output ('I/O') bus, pins 4, 5, 6 and 7, capable of feeding in an input into the device to preset it, or an output from the device (to supply count data to other external circuitry). We shall only be using the 'input state' of the bus in this application. The preset information can be used to either preset the counter, or to preset a register which is then compared with the counter; when the two are equal, an output pin of the i.c. changes state. (We shall not be using this latter function, but you may be able to think of other applications for it!)

To provide an accurate source of clocking pulses for the 7217, a clock signal derived from the 50Hz waveform of the mains is used. D28, D29, D30 and D31 form a conventional bridge rectifier to supply the unregulated d.c. to the circuitry, but we also take one a.c. side of the bridge to IC9b, via R21. D25 and D26 limit the voltage excursions to within the supply rails, give or take a diode voltage drop, and C11 helps to filter out noise on the 50Hz waveform. IC9b is a Schmitt trigger NAND gate, which sharpens up the incoming waveform to the correct logic levels, with no noise spikes or other transient effects. IC2 is a pre-settable 'divide-by-n' counter, as discussed in the 'Digital Design Techniques' series. In this instance it is arranged to divide by 5; the $\overline{Q_2}$ and $\overline{Q_3}$ outputs are fed back to the data input via IC7a and IC7b. This 'data' signal is the 10Hz waveform used to feed both the clock input to IC1, and to IC3. The latter is a decade counter used merely to divide by 10; the 'carry out' signal from IC3 is a 1Hz square wave used to control the 'bleep' oscillator when in the 'bleep seconds' mode.

IC8c and IC8d are connected as a latch. Pressing the 'start' button causes IC8d pin 11 to go to logic 1, which then enables IC9b and allows IC's 1, 2 and 3 to start counting. When the 'start' button is pressed, IC8c is forced to go to logic 0, causing a negative going pulse, derived by C3, D21 and R13, to feed into IC4c. This is pulse stretched by C5, R19 and D23, and is fed into IC5b. If S6 is in the 'up' position, the output of IC5a is at logic 0, so IC5b is disabled. (Pins 9, 10 and 14 of IC1 all have internal 75k pull up resistors). If S6 is in the 'down/time' position, IC5b inverts the stretched pulse, which is inverted again by IC5d and used to strobe pin 12 of IC1. This loads (i.e. presets) the counter with the values of the BCD inputs to the i.c. The preset inputs are provided by S9, S10, S11 and S12; all BCD thumbwheel ('push-push') switches. These are strobed by the digit strobe outputs of IC1 to ensure that each switch feeds data into IC1 in a multiplexed arrangement, in sequence with the multiplexing of the display. D1 to D16 prevent interaction between switches.

By this means, as soon as the start button is pressed (in the 'down/time' mode) the counter assumes the value determined by the thumbwheel switches, then counts down from that value towards zero. Pin 2 of IC1 goes to logic 0 when the value of the counter output is zero. (This happens briefly when the counter is loaded, so the load pulse on Pin 12 is also used to disable the 'zero' output briefly, via pulse stretcher D27, R16, C4 and IC6c. This has a pulse derived from it by C2, D22 and R15. The pulse is enabled by IC4d in order that no output pulse is generated when the device is being reset to zero deliberately; if this were not done, unwanted effects would occur, for example, 'time-up' warning

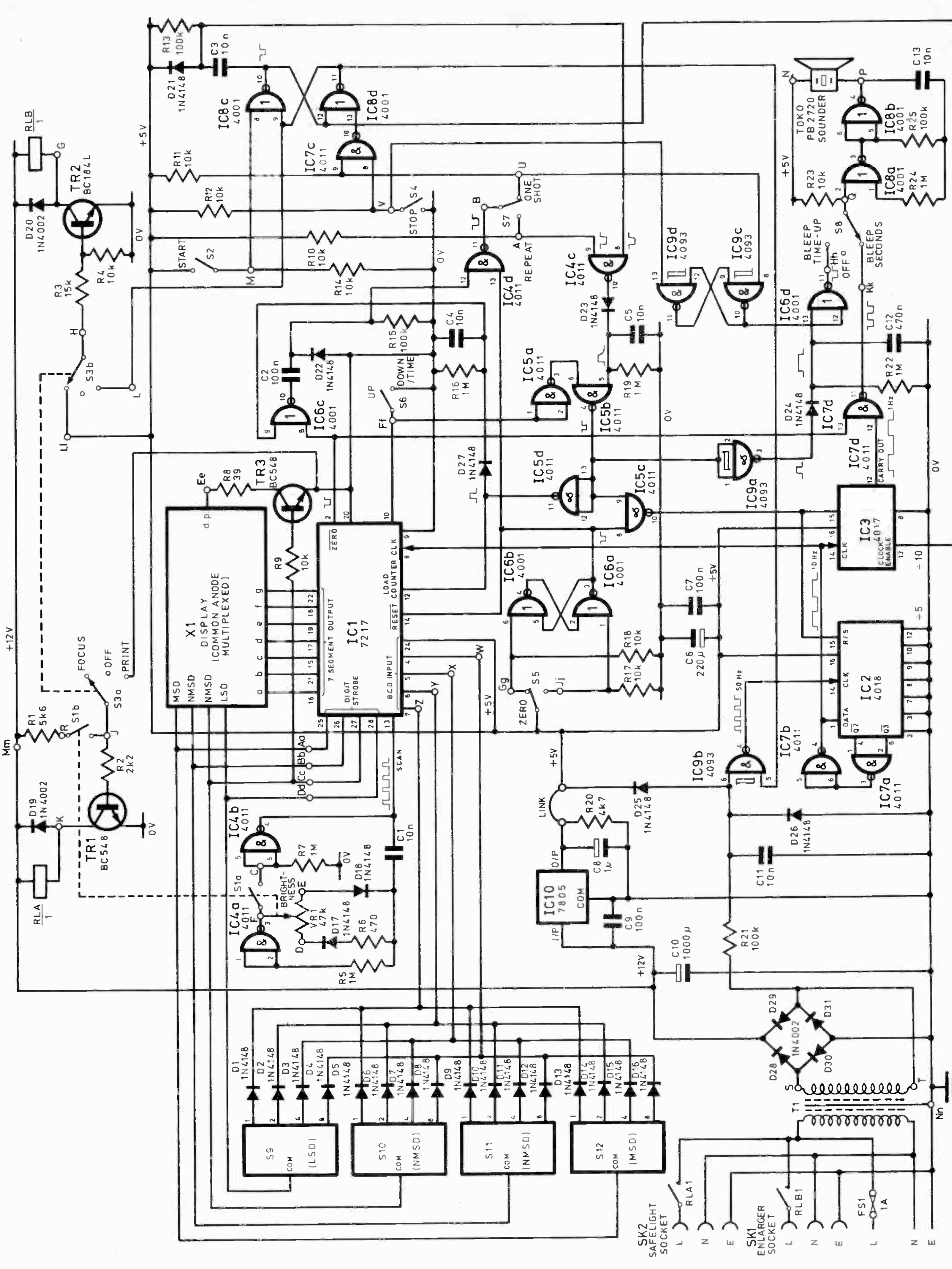


Fig. 1. Circuit diagram of the Enlarger Timer

COMPONENTS . . .

Resistors

R1	5k6
R2	2k2
R3	15k
R4, R9, R10, R11, R12, R14, R17, R18, R23	10k (9 off)
R5, R7, R16, R19, R22, R24	1M0 (6 off)
R6	470
R8	39
R13, R15, R21, R25	100k (4 off)
R20	4k7

All resistors $\frac{1}{3}$ or $\frac{1}{4}$ watt, 5% Carbon

Potentiometers

VR1	47k lin., fitted with double pole single throw switch

Capacitors

C1, C3, C4, C5, C11, C13	10n polyester (6 off)
C2	100n polyester
C6	220µ 25V electrolytic
C7, C9	100n 30V disc ceramic (2 off)
C8	1µ 35V tantalum bead
C10	1000µ 25V electrolytic
C12	470n polycarbonate (or miniature polyester)

Semiconductors

D1 to D18, D21 to D27	1N4148 (25 off)
D19, D20, D28, D29, D30, D31	1N4002 (6 off)
TR1, TR3	BC548 (2 off)
TR2	BC184L
IC1	ICM 7217 (4 decade counter/driver)
IC2	4018 CMOS divide-by-N
IC3	4017 CMOS decade counter
IC4, IC5, IC7	4011 CMOS quad NAND gate (3 off)
IC6, IC8	4001 CMOS quad NOR gate (2 off)
IC9	4093 CMOS quad Schmitt NAND gate
IC10	7805 +5V voltage regulator (plastic package)
DISPLAY XI	4 digit, multiplexed common anode l.e.d. display (or make up from individual common anode 7-segment displays)

Miscellaneous

T1	Mains transformer 9V r.m.s. secondary
1 off	TOKO PB2720 Piezo sounder (available from Ambit)
S2, S4, S5	SPDT pushbutton (momentary) (3 off)
S3, S8	DPDT, centre off, miniature toggle switch (2 off)
S6, S7	SPDT miniature toggle switch (2 off)
Relay RLA, Relay RLB	Miniature relay, 12 volt (nominal) coil, contacts capable of passing 240V a.c. at 1·6A or more
1 off	Knob for VR1
1 off	Global Specialties 'Design Mate' case, DMC1
1 off	Piece of red gelatine or perspex (see text)
1 off	Mains fuseholder, FS1, fitted with 1A fuse (slow blow)
2 off	'European' ('reversed') shuttered mains chassis mounting socket, with mating plug halves
S9, S10, S11, S12	BCD thumbwheels, push-push type preferably, with mounting cheeks and a spacer (for the decimal point)

Threaded spacers, wire, screws, etc., to suit (see text).

bleeps, etc. When enabled, and with S7 in the 'one shot' position, the $\overline{\text{zero}}$ pulse finally feeds into the IC8c, IC8d latch, resetting it and hence preventing any further counting of IC1, 2 or 3. This halting of the count, of course, can also be performed by pressing the 'stop' button, S4.

When S7 is in the 'repeat' position, the pulse-derived $\overline{\text{zero}}$ output of IC1 is fed to IC4c. This has the same effect as pressing the 'start' button did; IC1 is preset to the value on the thumbwheel switches, from which it then counts down. The continual cycle of counting down to zero then jumping to the preset value and counting again, is only stopped by pressing the 'stop' button. The output pin 4 of IC5b (the inverted 'load counter' pulse) is also used to reset IC2 and IC3 via IC5c, and to cause a short bleep to be given out of the sounder. This is done by inverting it via IC9a, pulse stretching it to give a fairly long ($\frac{1}{3}$rd of a second) pulse with D24, R22 and C12, then using it to gate on and off the 'bleep' oscillator via IC6d and S8.

The bleep oscillator is a conventional two-gate circuit formed by IC8a and IC8b directly driving a piezo sounder. IC9c and IC9d form a latch which is set by the $\overline{\text{zero}}$ pulse (in the one-shot mode only) and reset by the 'stop' switch. The output of this latch, IC9c pin 10, feeds into IC6d, and is used to gate on the oscillator to give the 'time-up' signal. When S8 is in the 'bleep seconds' position, the 1Hz signal from IC3 is on via IC7d only when the counter output is NOT zero; this prevents the tone sounding continuously when the counter stops at zero. IC3 has its clock enabled by the 'stop-start' latch of IC8c and IC8d, so that the seconds only bleep when the clock is running. The 'zero' switch S5 is contact debounced by the latch formed by IC6a and IC6b; it is a requirement of the 7217 i.c. that its $\overline{\text{reset}}$ input should be very clean, i.e. noise free. As well as resetting IC1 and gating off the pulse derived 'zero' output as already described, the debounced S5 signal also resets IC2 and IC3 via IC5c.

The safelight and enlarger light are both controlled by relays, rather than solid state triac or thyristor circuitry. This has been done because some enlargers (and a few safelights) have a complex and 'unusual' a.c. loading, and can respond badly to the slightly 'chopped' waveform of a solid state switched mains signal. Relay RLA is used to drive the safelight, primarily to obviate the necessity to pass mains voltages through S3a; a safety consideration. Note that S1b is used to switch the safelight off when the brightness control is turned off; S1b and S1a is the double pole switch fixed to the back of VR1.

Relay RLB is used to control the enlarger, and is driven from TR2; chosen to be a BC184L, to ensure that a high enough gain is obtained. Because of the BC184L's high gain, 65mA can be passed through Relay RLB with less than 0·3mA drawn from IC8d. IC1 has an internal oscillator to drive its multiplexing circuitry. In order to provide control over the brightness, though, we must provide an external oscillator with variable mark/space ratio (since this ratio determines the illumination duration of each display digit) and feed this into the IC1 'scan' input. IC4a and IC4b form the

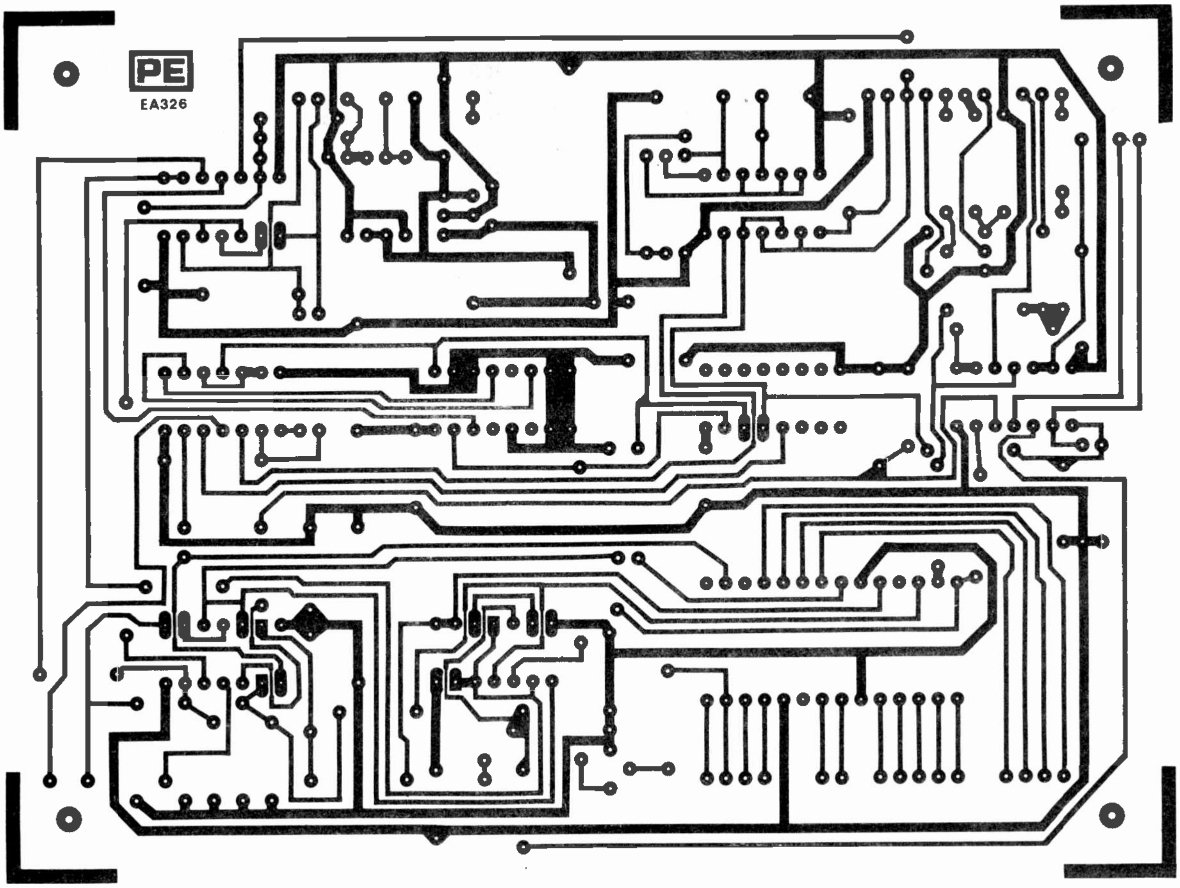


Fig. 2. P.c.b. design

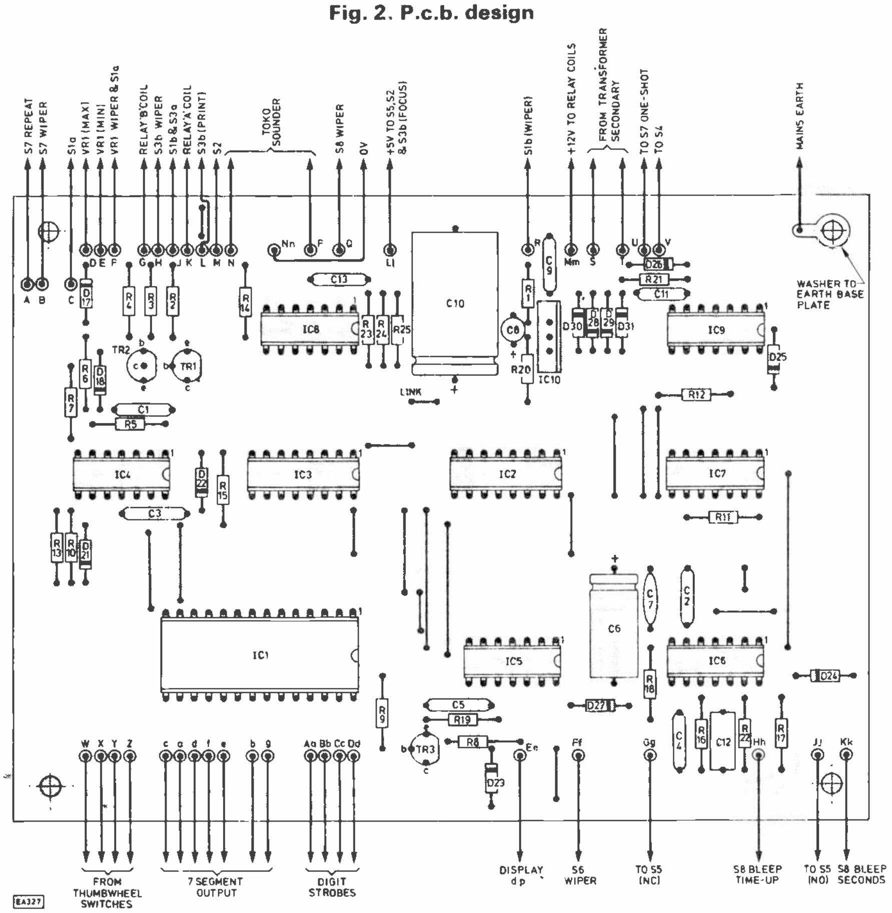


Fig. 3. Component layout

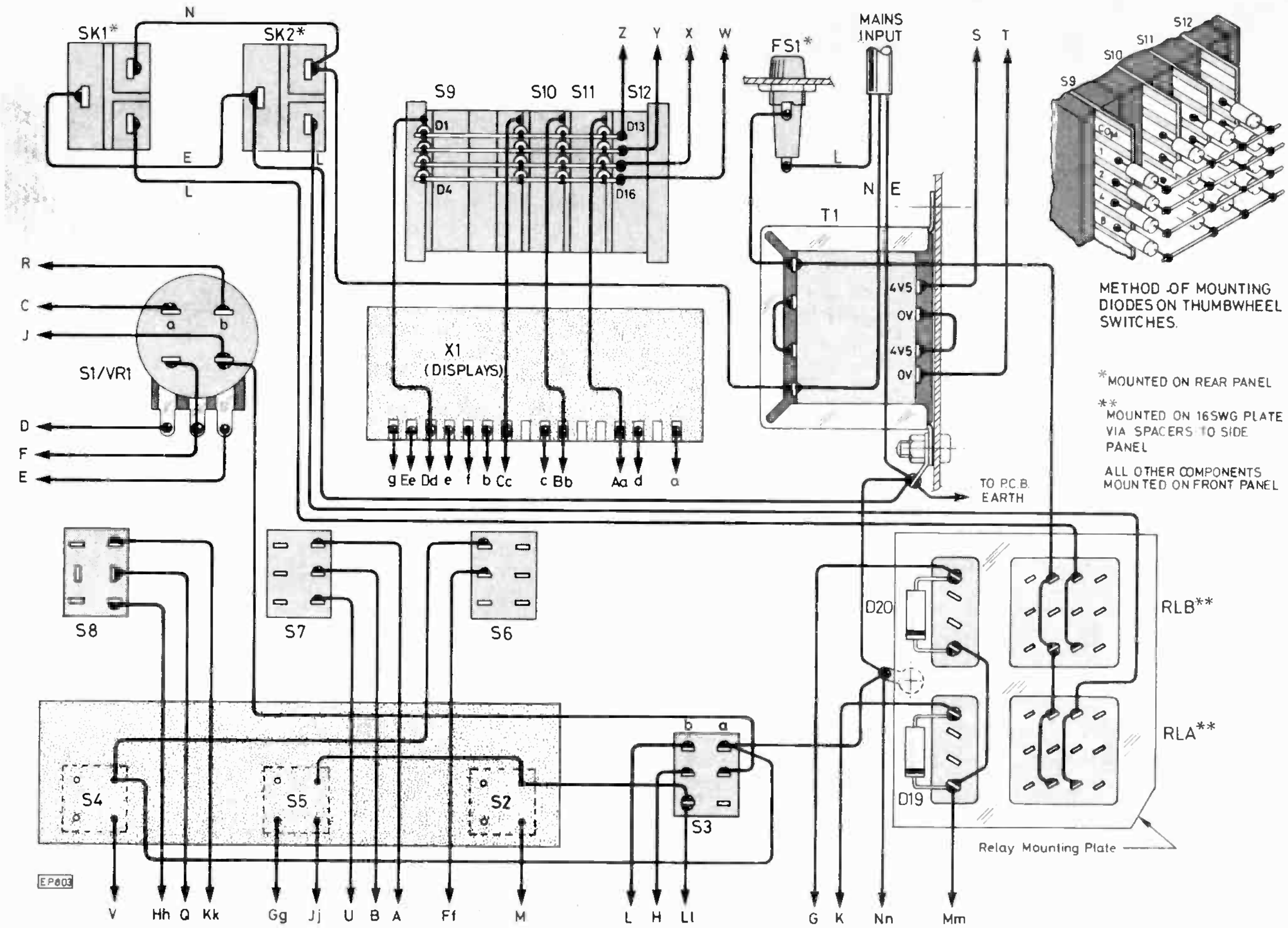


Fig. 4. Wiring diagram

oscillator with VR1 varying the mark/space ratio. S1a fully disables the oscillator for the 'brightness off' position of VR1.

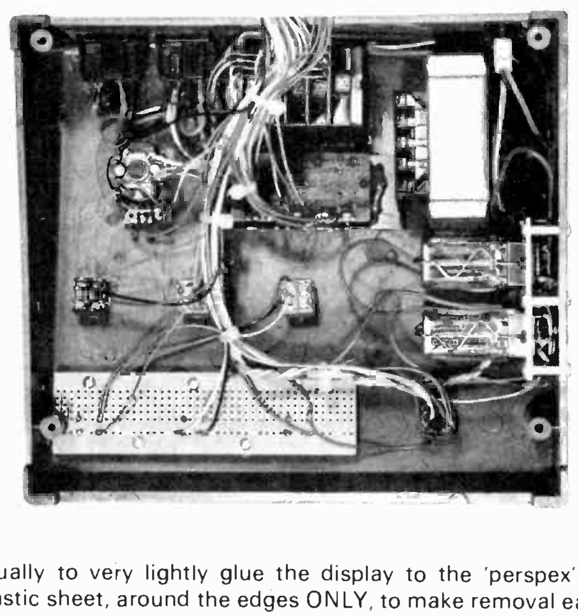
TR3 is used to gate on the 'decimal point' l.e.d. in the display only when the '3rd digit' of the display (units of seconds) is being strobed; this is the only digit of the four which needs the decimal point. Finally, the +5V regulated supply is provided by IC10, a regulator i.c. with C8 and C9 preventing unwanted parasitic oscillations and R20 providing a local guaranteed loading. C10 provides the smoothing for the unregulated d.c. supply, with C6 and C7 providing de-coupling for the +5V supply.

CONSTRUCTION

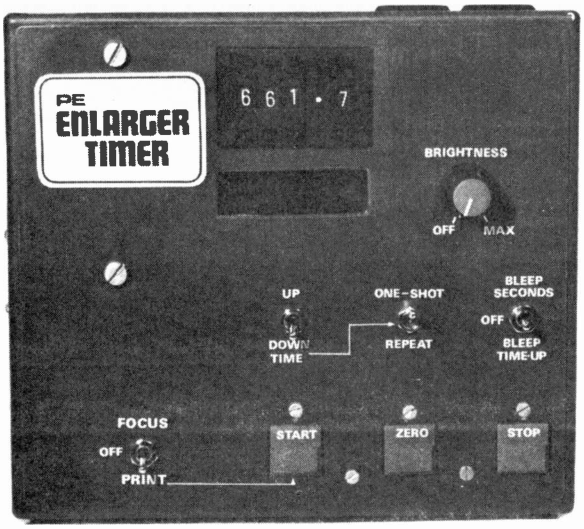
The p.c.b. design for the Timer is shown in Fig. 2 with the component layout shown in Fig. 3.

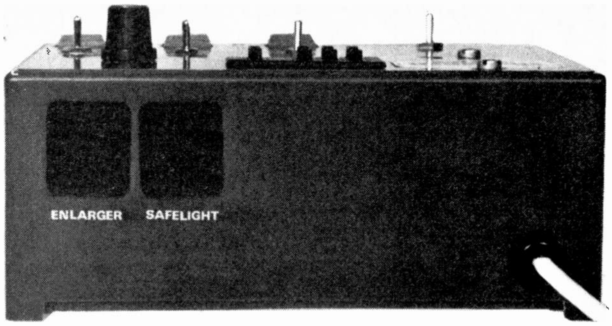
The wire links should be added after all the other components with the exception of the +5V supply link, see later. After the p.c.b. has been soldered and checked the case should then be drilled, cut and filed to suit the switches, connectors, display, etc., to be used; see the photographs for a suggested layout. The prototype used p.c.b. mounting switches for stop, start and zero, so these needed a piece of 'Matchboard' held to the front panel of the case by threaded spacers. The two relays, likewise, were mounted on an aluminium bracket held to the side of the case by threaded spacers.

The cut-out for the display should have a piece of red tinted 'perspex' or transparent plastic glued behind it. The display can then be supported behind this; the easiest way is



usually to very lightly glue the display to the 'perspex' or plastic sheet, around the edges ONLY, to make removal easy if necessary. (A complete multiplexed, display module is ideal for this. If individual 7-segment displays are to be used they will have to be mounted on a spare piece of Matchboard, and wired together). The aluminium base plate of the case should be drilled to enable the p.c.b. to be screwed to it via yet more of those threaded spacers! The





piezo sounder can also be mounted on the base plate, adjacent to the p.c.b., with a hole in the side of the case to let the sound out.

All the component parts should be screwed into the case and baseplate, then the remaining interwiring can be added (Fig. 4). Be careful; there is a lot of this and it is easy to make mistakes. Be especially careful with the mains wiring; keep it well away from the low voltage wiring, and preferably shroud all mains carrying terminals. I suggest that European(IEC) type 'reversed mains' shuttered facility chassis sockets are used for the enlarger and safelight sockets. These are safe outlet sockets for mains distribution, and are readily available along with their mating halves. Remember to earth all metal parts, e.g. the baseplate (via a washer from 0 volts as shown), the transformer case, etc.

The short wire link between the output pin of the voltage regulator and the +5V supply track of the matchboard is left off initially, so that the operation of the +5V supply can be checked without risk to the expensive IC1! Only when this supply is proved to be of the correct voltage should the link be added. Note that diodes D1 to D16 should be soldered to the switches S9 to S12 directly, with the cathodes joined as shown in Fig. 4. This arrangement is quite robust enough if thick tinned copper wire is used to join the cathodes together. D19 and D20 should be soldered across their respective relay coils directly.

There is no setting up required for the enlarger/timer; it requires only switching on and testing out to make sure that all the functions operate correctly. Although the circuit description may sound complex, the use of an LSI 'chip' the 7217, has vastly simplified the circuitry required to perform all the functions required of such a unit. ★

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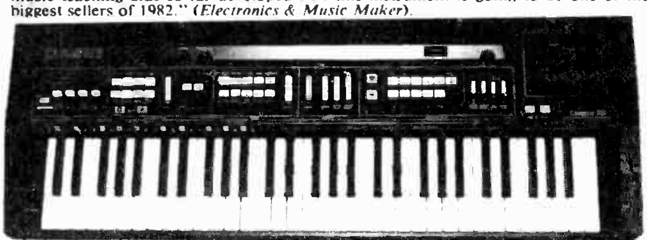

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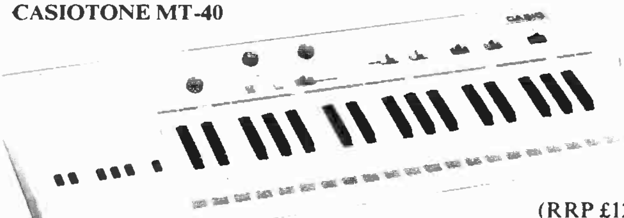

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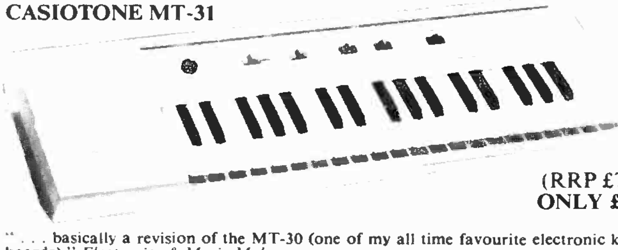

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Semiconductor UPDATE...

FEATURING MC146818 TDS 934 6600 R.W. Coles

MOTEL CLOCK

Anyone who has a disc based home computer such as the TRS80, the Apple or the PET, is probably familiar with the sort of interrupt driven "Real Time Clock" facility which many disc operating systems provide. Personally I have never found this facility at all useful because it is necessary to set the clock to the correct time of day each time the system is powered up and this can become quite a chore. Also, in some software clocks of this type, time is lost during disc access because the interrupts are temporarily disabled by this activity. What is needed is a clock which is independent of the processor power supply and processor interrupts and which will maintain an accurate time and date accessible from any program at any time.

This need has not gone unrecognised and hardware solutions have recently appeared from several CMOS chip manufacturers including National, Mostek, and Motorola. Each company has its own particular clock chip recipe, but for my money, the design which offers most is undoubtedly the Motorola MC146818. Inside the 24 pin plastic package of the Motorola clock chip there is a veritable cornucopia of desirable clock features not matched by any of the other devices available. Hook one of these on to your microprocessor bus and you will gain access to the time of day in seconds, minutes and hours, using either the twelve or the twenty-four hour format, in either straight binary *or* binary coded decimal (BCD). You get day of the week, date, month and year from a 100 year calendar which automatically compensates for the number of days in a month and leap years, and you also get a programmable alarm scheme which will interrupt the processor once per day or periodically at seconds, minutes, or hourly intervals. Actually, three sources of processor interrupt are provided and can be turned on or off under software control. In addition to the alarm interrupt there is a periodic heart-beat interrupt which can be programmed over the range of 30·5 microseconds to 500 milliseconds, and an "End of Update" interrupt which can indicate that a new time or date is now available. Heart-beat interrupts are particularly useful in microprocessor systems for the generation of the timing signals needed for all sorts of real time activities such as communication and sampling. An added bonus is the availability of a square wave output at the heart-beat interrupt rate.

The MC146818 will run from any one of three crystal frequencies to suit the application, but for lowest power consumption a 32·768KHZ crystal is best. At this frequency the clock chip consumes only about 200 micro-watts of power and will survive for very long periods from a simple standby battery supply even when system power is turned off.

Interfacing the Motorola clock to a microprocessor bus is made easier by a built in "MOTEL" circuit designed to provide control signal compatibility with both Motorola and Intel micros, but since the MC146818 uses a multiplexed eight bit data and address, bus interfacing is easiest to processors such as the Intel 8085 and the Motorola 6805 which also have a multiplexed bus structure. Before long a non-multiplexed version of the MC146818 will be available in a bigger package, but if you are eager to use the MC146818 now, it will only require a few extra gates to interface it to a processor such as the 6800 or the Z80.

The device is very simple to access from a microprocessor program since the clock registers appear within 64 bytes of RAM memory, of which 14 bytes are read or write clock registers containing time and control information. The other 50 bytes are available for whatever other use you can dream up. Another useful feature.

At about £15 each these chips will certainly be very popular!

FREE SPEECH?

Probably the most fashionable electronic technique at the moment is speech synthesis, with major semiconductor manufacturers such as Texas, National and General Instruments all championing their own particular coding systems which allow human speed to be compressed into relatively few bytes of Read Only Memory (ROM).

Notice that all these manufacturers are from the USA which means that you get a trans-Atlantic "voice" and that specifying custom words or phrases can be expensive because most of the encoding work is done in the USA. For these reasons it is good to be able to welcome Triangle Digital Services as newcomers to the field, who are British and who have some unique advantages over the competition.

Triangle was set up by British engineer, Peter Rush, to develop a speech synthesis system which was as good as the competition's but more accessible to the smaller users who wished to specify their own vocabularies. The result is the unique TDS 934 chip set which consists of a synthesiser, a speech ROM, a memory decoder, two analogue filters and a regulator. When these chips are assembled as a system, a very versatile speech synthesiser results. The standard ROM supplied contains the words "Oh", one, two, three, four, five, six, seven, eight, nine, point, grammes, kilo, ohms, volts, and amps, and further ROMs can be added to extend the vocabulary to almost any level. Between 5 and 32 words will fit into each ROM, depending on the required quality and complexity, and Triangle will encode the words of your choice at a rate of £30 each.

Users who prefer a complete system can buy the chip set assembled on a Eurocard p.c.b. with space for up to eight ROMs and with a variety of useful features such as a built-in RS232 UART so that words can be selected over a standard serial link for easy interfacing.

The TDS 934 set can also be hooked up to a parallel bus from a microprocessor, or for simple applications the words can be selected by an array of up to 16 switches.

For more information on this British innovation contact: Triangle Digital Services Limited, 23 Campus Road, London E17 8PG.

SUPER SONICS

Despite the tremendous advances in multi-channel proportional radio control systems which have been made since the days of valves, miniaturised remote control devices seemed unlikely until I saw data on a new chip from Commodore International called the 6600. This chip changed all that, because it is actually a remote control transmitter intended for use *inside* a digital wrist watch, alongside the watch chip itself.

The 6600 is not capable of controlling a complete army just yet, but no doubt the Mark III version is already on the drawing board at Commodore, and so it won't be long I am sure! Two versions of the 6600 are already available, one working in the audio region and the other using Ultrasound to generate remote control signals and provide simple on-off-on switching for any two appliances equipped with suitable sound receivers.

The chips use ordinary piezo-electric watch alarm-transducers as transmitters and operate from 1·5 volt battery supplies. The audio version generates two tones, which can be individually selected by watch buttons, at 8KHZ and 5·4KHZ and these tones can be used to control appliances at ranges of up to 40 feet. The ultrasonic version uses a 32·768KHZ watch-frequency carrier which can be modulated at either 128HZ or 256HZ to achieve the same effect.

At present the 6600 devices are available only as chips for the use of watch manufacturers, but no doubt they will eventually appear in 8 pin mini-DIPs for more general use.

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LOGIC PROBE

THIS logic probe is suitable for checking voltage levels in TTL circuits. The probe is powered from the circuit under test and will indicate either a high or low logic level.

CIRCUIT DESCRIPTION

The circuit diagram of the Logic Probe is shown in Fig. 1. When the input voltage to the probe tip is above 2·1V (the 'high' logic state) transistor TR1 is turned on, the l.e.d. D1 is forward biased and illuminated, indicating a 'high' logic level. As TR1 turns on its collector voltage falls and because the input to the probe tip is also connected to one end of resistor R4 the base/emitter junction of the transistor TR2 and the l.e.d. D2 are reverse biased keeping TR2 and D2 turned off.

If the input voltage to the probe tip switches to zero volts (the 'low' logic level) then TR1 receives no bias current and is switched off. With TR1 turned off the l.e.d. D1 is also turned off and the collector voltage of TR1 rises, forward biasing TR2, switching it on and illuminating the l.e.d. D2 indicating a 'low' logic level.

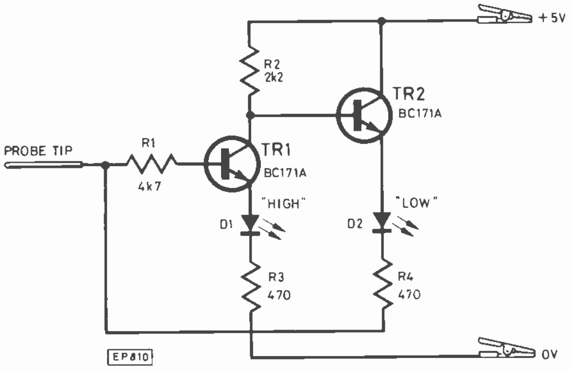


Fig. 1. Circuit diagram

CONSTRUCTION

The Veroboard layout for the probe is shown in Fig. 2. Solder the resistors and wire links first and then the

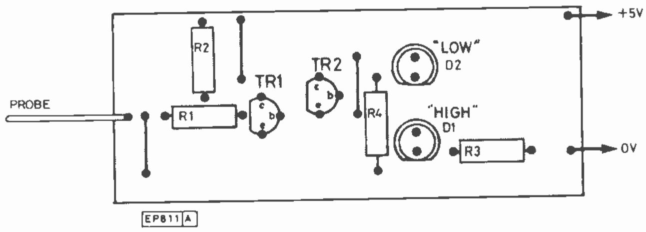


Fig. 2. Veroboard layout

COMPONENTS . . .

Resistors

R1	4k7
R2	2k2
R3, R4	470 (2 off)

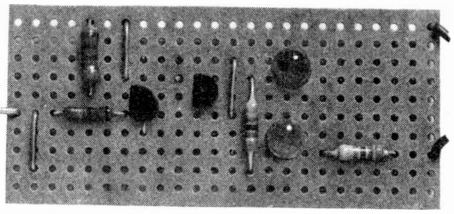
All resistors $\frac{1}{3}$W 10% carbon

Semiconductors

D1	0·2in red l.e.d.
D2	0·2in green l.e.d.
TR1, TR2	BC171A (2 off)

Miscellaneous

Veroboard
Crocodile clips with red and black sleeves.



transistors and l.e.d.s. Take care with the orientation of the semiconductors.

In the prototype a green l.e.d. was used to indicate a 'low' logic level and a red l.e.d. for the 'high' level.

The probe can be made from a piece of tinned copper wire or a wiring pin and the supply leads should be fitted with miniature crocodile clips using red and black insulated sleeves. After soldering the components carefully check the Veroboard tracks for any solder splashes and then cut the tracks as shown in Fig. 2.

If the probe fails to operate when connected to a circuit check the orientation of the l.e.d.s and also check that the breaks in the copper tracks are completely cut.

TRANSISTOR FREE PROJECT

LIGHT DELAY UNIT

THIS simple delay unit enables a light or any other suitable load to be switched off automatically after a predetermined time period. Typical uses for the unit include the switching of staircase or pathway lighting, the delay of a car courtesy light and if correctly rated relay contacts are used, the control of car spotlights in a driveway.

CIRCUIT DESCRIPTION

The two transistors TR1 and TR2 (Fig. 1) are connected as a Darlington pair. This combination uses the current amplified by the first transistor (TR1) as the base current for the second transistor (TR2) where it is again amplified. Together the two devices act as a very high gain transistor with an overall gain determined by the product of their individual gains.

The switch S1 is a push button type and when it is pressed the capacitor C1 is charged to the potential of the supply voltage. The Darlington pair are turned on by the base current flowing through the resistor R1 and as the transistors saturate, their collector voltage falls, increasing the potential across the coil, energising the relay and closing its contacts RLA1.

When S1 is released the capacitor slowly discharges through the base bias resistor R1, maintaining the base current to TR1 and keeping the transistors and the relay turned on. The potential across the capacitor falls as it discharges and the base current to TR1 decreases until there is insufficient current flowing through R1 for TR1 to remain on. As the two transistors turn off, their collector voltage rises reducing the potential across the coil of RLA, de-energising

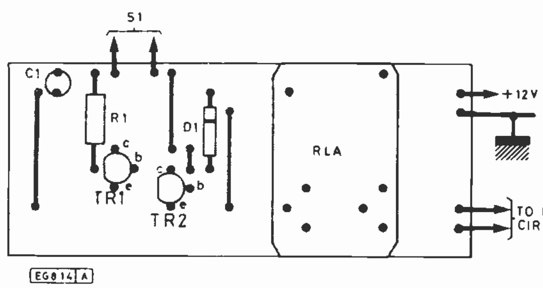


Fig. 1. Circuit diagram

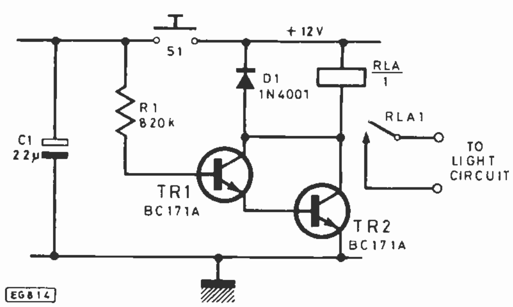


Fig. 2. Veroboard layout

COMPONENTS . . .

Resistor

R1	820k

Capacitor

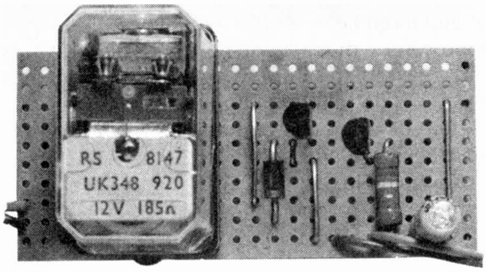
C1	22μ 16V elect.

Semiconductors

TR1, TR2	BC171A (2 off)
D1	IN4001

Miscellaneous

RLA	12V 180Ω heavy duty relay (RS348–920)
S1	push button switch
Veroboard	



the relay and opening its contacts, turning off the power to the load.

The switch S1 must be placed so that the capacitor C1 and the resistor R1 are isolated from the relay coil, otherwise it will discharge through the coil and TR2 as well as into the base of TR1 resulting in a very small time delay.

Although the voltage across the coil falls very slowly and there should be no transient voltages generated as the relay turns off, the diode D1 was included in case the capacitor was accidentally shorted during testing.

The relay specified has heavy duty contacts and is capable of handling currents up to 3 amps. If necessary the contacts can be connected in parallel to increase their current carrying capacity.

CAR SPOTLIGHTS

If the unit is to be used to delay car headlights then the specified relay should not be used. A suitable relay is the RS type 348–835 which can handle loads up to 10 amps.

DELAY TIMES

The delay time for the circuit is determined by the values of R1 and C1 and with the values given a delay of approximately 40 seconds can be obtained before the load is switched off. To increase this time the value of C1 can be increased, but do not increase the value of R1 to a much higher value or there might not be enough current to turn on the relay.

CONSTRUCTION

The Veroboard layout for the delay unit is shown in Fig. 2. After soldering, carefully check all the track breaks have been included and then connect the unit to a 12 volt supply. When S1 is pressed the relay contacts should close and after approximately 40 seconds you should hear the relay drop out.

INSTALLATION

The unit can either be powered from a 12V d.c. mains p.s.u. or from a battery. To delay a house light the leads from the relay contacts should be connected directly across the light switch. This will enable the light to be switched on using the normal switch or delayed using the unit via S1.

When installing the unit in a car it should be powered directly from the battery and not through the ignition or the auxiliary switches otherwise the unit will not work unless the key is left in the ignition switch.

Before fitting the unit to a courtesy light check with the car manual for the suitable place to make the connections.

TRANSISTOR FREE PROJECT

CAR LIGHTS REMINDER

MOST car drivers have at some time returned to their car only to find it won't start because the lights have been left on. This system has been designed to overcome this problem by giving an audible warning as soon as the driver's door is opened, assuming the ignition has been switched off.

CIRCUIT DESCRIPTION

The circuit diagram of the Car Lights Reminder unit is shown in Fig. 1. The transistors TR1 and TR2 are connected as an astable multivibrator with the loudspeaker LS1 used as the collector load of TR2. Capacitors C1, C2 and resistors R3, R4 are the timing components of the circuit and determine the frequency of the output tone.

The positive supply to the circuit is obtained from the light switch via diode D1. The resistor R1 and the Zener diode D3 ensure the supply voltage remains at 9·1 volts.

The earth is connected via the interior light switch on the driver's door and the circuit is earthed only when the driver's door is opened.

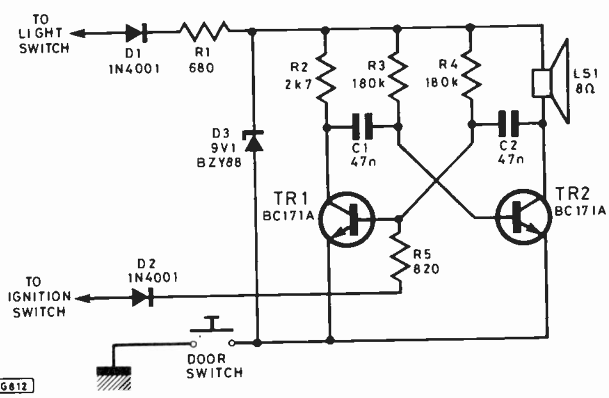


Fig. 1. Circuit diagram

COMPONENTS . . .

Resistors

R1	680
R2	2k7
R3, R4	180k (2 off)
R5	820

All resistors $\frac{1}{3}$W 10% carbon

Capacitors

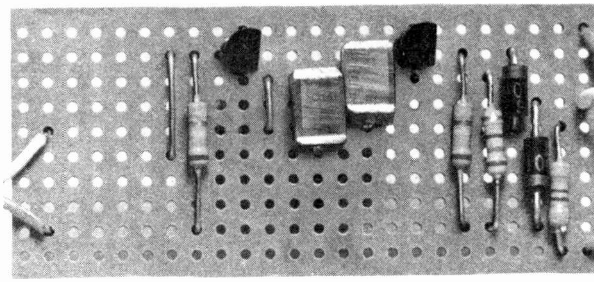
C1, C2	47n (2 off)

Semiconductors

D1, D2	1N4001 (2 off)
D3	BZY88 9V1 Zener
TR1, TR2	BC171A (2 off)

Miscellaneous

LS1	8Ω speaker
Veroboard	



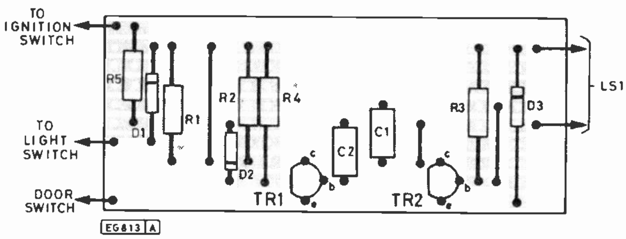


Fig. 2. Veroboard layout

If we assume that the ignition is off and the lights are on, then as the driver's door is opened the circuit will oscillate. As soon as the door is closed the earth is removed and the alarm is switched off. This enables the car lights to be left on for parking purposes without the alarm continuing to sound. The circuit is also disabled via D2 and R5 if the ignition switch is on.

CONSTRUCTION

The Veroboard layout of the unit is shown in Fig. 2. After the components have been soldered, cut the copper tracks as shown and then connect the speaker and the three switch supply leads.

TESTING

Before installing the unit, connect the door and light switch leads across the battery. This should produce an audible output from the loudspeaker, which should cease if the ignition switch lead is now touched to the positive terminal of the battery.

If the unit fails to operate, carefully recheck the resistor values are correct, the orientation of all the semiconductors and ensure the breaks in the copper tracks are in the right places.

TRANSISTOR FREE PROJECT

BATTERY MONITOR

A USEFUL addition to any piece of battery powered test equipment is an indicator to warn the user when the battery voltage is too low for reliable operation.

This circuit will monitor the supply voltage and illuminate an l.e.d. when the battery voltage falls below a preset level.

CIRCUIT DESCRIPTION

The circuit diagram of the voltage monitor is shown in Fig. 1. The unit is connected across the supply rails of the equipment to be monitored and VR1 sets the voltage at which the l.e.d. will be illuminated. When the supply voltage is above this preset value TR1 is turned hard on by R1 and part of VR1 with the result that the collector voltage of TR1 falls, keeping TR2 and the l.e.d. turned off.

As the supply voltage falls the bias current to TR1 decreases until it starts to turn off and its collector voltage rises. When the collector voltage of TR1 reaches 0·5 to 0·6V TR2 starts to turn on. As the base current to TR1 decreases its collector current decreases and TR2 takes more of the current flowing through R2. The collector voltage of TR1 rises until TR2 is turned fully on and TR1 is turned off. When TR2 turns on its collector voltage falls, the

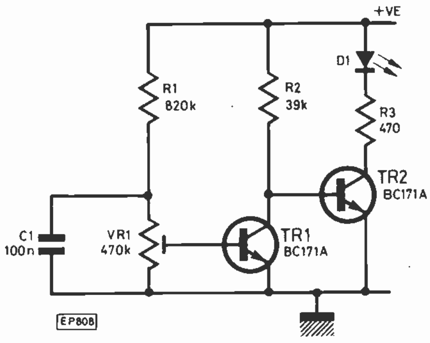


Fig. 1. Circuit diagram

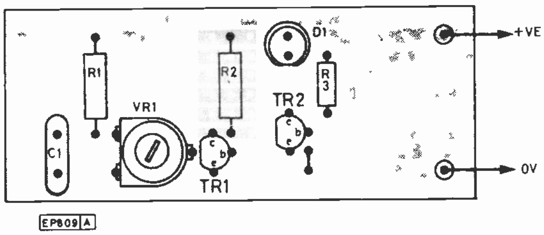
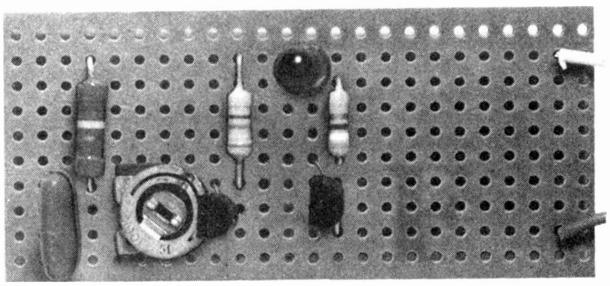


Fig. 2. Veroboard layout



l.e.d. is forward biased and is illuminated. Resistor R3 is a current limiting resistor for the l.e.d.

The capacitor C1 prevents any instability when TR1 and TR2 are switching. The unit is suitable for monitoring supply voltages between 6 and 12V.

COMPONENTS . . .

Resistors

R1	820k
R2	39k
R3	470
VR1	470k min. preset lin.

All resistors $\frac{1}{3}$W 10% carbon

Capacitor

C1	100n polyester

Semiconductors

D1	0·2in red l.e.d.
TR1, TR2	BC171A (2 off)

Miscellaneous

Veroboard

CONSTRUCTION

A suitable Veroboard layout for the Monitor is shown in Fig. 2. The l.e.d. D1 is shown mounted on the board but can be mounted on a front panel and connected to the unit via connecting leads.

SETTING UP

The unit can be set up by connecting it across a supply voltage of the same value at which it is required to give warning. A suitable voltage level can be obtained using either a variable power supply unit or by connecting a preset across the terminals of a battery and then adjusting it's wiper until the required voltage is obtained. The potentiometer VR1 should then be adjusted from the top end of its track until the l.e.d. just starts to glow. The monitor can then be installed into the equipment.

If it is not necessary to constantly monitor the supply voltage a push-to-test switch may be incorporated into the supply line.

TRANSISTOR FREE PROJECT

SOIL MOISTURE METER

THIS Soil Moisture Meter can be used to test the water content of pot plants and help ensure the moisture level is kept constant. The advantage of the unit is that the probes enable the soil beneath the surface to be checked instead of just relying on its surface condition.

CIRCUIT DESCRIPTION

The circuit of the Meter (Fig. 1) has been designed around a differential amplifier which is sometimes referred to as a long tailed pair.

The amplifier has two inputs (via the bases of the transistors TR1 and TR2) and an output (taken from between the two collectors). When both transistors are equally biased

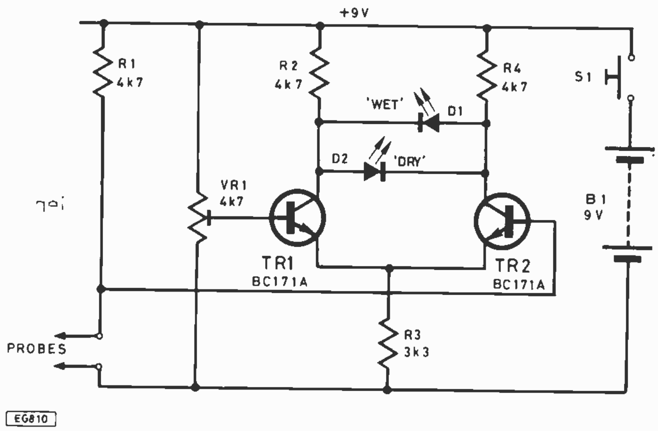


Fig. 1. Circuit diagram

and conducting they equally share the current flowing through the emitter resistor R3. Hence the voltages at their collectors are also equal and as no potential difference exists across the l.e.d.s they are both switched off.

If, however, the bias voltage applied to the base of either transistor is increased then the current through that particular transistor and the emitter resistor increases. This causes a rise in the voltage at the emitters of both transistors with the transistor to which the increased bias was applied still being turned on. At the same time the rise in emitter voltage reduces the base/emitter junction of the other transistor, turning it off. As one transistor turns on, its collector voltage falls, and as the other transistor turns off, its collector voltage rises, causing a potential difference across the collectors.

The transistor TR1 has a potential divider across its base formed by the preset VR1, whilst the resistor R1 and the resistance across the probes formed a second potential divider at the base of TR2.

PROBE RESISTANCE

The resistance across the probes when they are inserted into the soil is dependent upon the amount of moisture present, i.e. the more moisture the lower the 'resistance' of the soil and vice versa.

WET SOIL

When the probes are inserted into very moist soil the resistance across them is very low and so consequently is the voltage. If we assume that VR1 is set to a mid-range position when the switch S1 is pressed, TR1 will start to turn on. The current through R3 will increase causing the emitter voltages of TR1 and TR2 to rise, reducing the bias voltage across the base/emitter junction of TR2 (its base voltage being held by the potential divider R1 and the probe resistance) and TR2 will start to turn off.

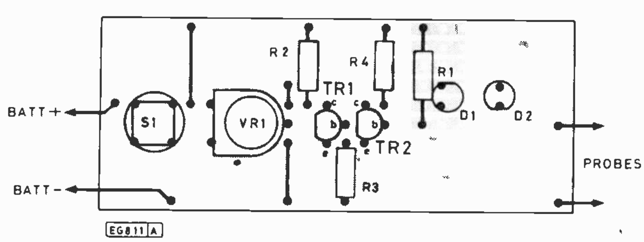


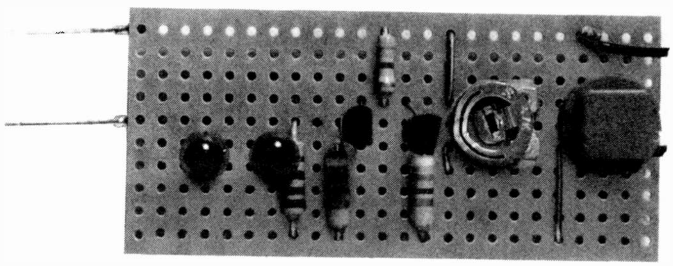
Fig. 2. Veroboard layout

As TR2 turns off, its collector voltage rises whilst the collector voltage of TR1 (as it turns on) falls.

When the difference between the two collector voltages reaches approximately 1·6V the l.e.d. D1 will start to turn on indicating the soil is 'wet' and l.e.d. D2 is reverse biased and remains off.

DRY SOIL

If the probes are now placed in very dry soil, the resistance across them increases and TR2 will start to conduct whilst TR1 will turn off. This will cause the collector voltage of TR2 to drop and the collector voltage of TR1 to rise, switching off D1 and switching on D2, indicating the soil is 'dry'.



The soil 'resistance' value at which the l.e.d.s are illuminated is controlled by the preset VR1 and can be adjusted to suit different plants.

COMPONENTS . . .

Resistors

R1, R2, R4	4k7 (3 off)
R3	3k3

All resistors $\frac{1}{3}$W 10% carbon

Semiconductors

D1	0·2in red l.e.d.
D2	0·2in green l.e.d.
TR1, TR2	BC171A (2 off)

Miscellaneous

Veroboard	
S1	keyboard switch
B1	9V PP3 battery
Battery connectors	

CONSTRUCTION

The Veroboard design for the circuit is shown in Fig. 2. After the components have been soldered, cut the copper tracks as shown and carefully check the orientation of the l.e.d.s. The probes can be made of two suitable lengths of brass rod soldered to the tracks.

Connect the unit to a PP3 battery and set VR1 to its mid position. Check that when S1 is pressed D2 lights, then short out the probes and D2 should be extinguished and D1 should light.

SETTING UP

To adjust the unit, fill a plant pot with soil and add water until it is sufficiently moist. Insert the probes into the soil, press S1 and adjust VR1 until D1 is just off and D2 is illuminated.

SNAP INDICATOR

DECIDING who was first when playing snap or quiz games often results in an argument. This circuit overcomes the problem by using an l.e.d. to indicate the winner. Each player has a push button and whoever presses first, lights their own l.e.d. whilst inhibiting the other players!

CIRCUIT DESCRIPTION

The circuit diagram of the Snap Indicator is shown in Fig. 1. With the battery connected the transistors (TR1 and TR2) are turned off because both switches (S1 and S2) are

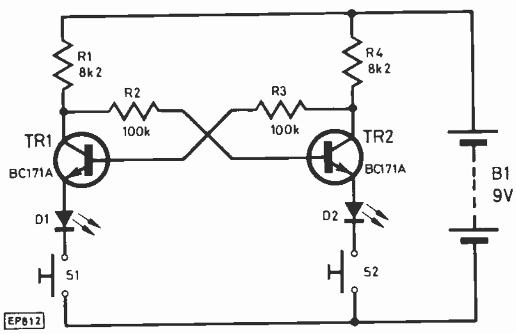


Fig. 1. Circuit diagram

open and so no collector current flows through either transistor.

With both transistors turned off there is no potential difference across either of the l.e.d.s and they remain off.

If SI is closed first transistor TR1 is turned on by the bias current flowing through resistors R4 and R3. The current flowing through TR1 illuminates the l.e.d. D1 and the collector voltage of the transistor falls as the transistor saturates.

If S2 is now closed there is insufficient voltage at the base of TR2 to turn it on and the l.e.d. D2 remains off. For TR2 to turn on TR1 must be off. Once either of the transistors is turned on then the other is automatically held off.

The current flowing through each transistor and their l.e.d.s is limited by the resistors R1 and R4. As soon as the push buttons are released the circuit returns to its standby state ready for the next go.

CONSTRUCTION

The Veroboard layout for the circuit is shown in Fig. 2. The switches are shown mounted on the board but they can be connected off the board using wires if necessary. If hand held switches are to be used then a more suitable type is the RS miniature push-button type (337–914).

Solder the components onto the Veroboard and then add the links using tinned copper wire. Carefully check the orientation of the l.e.d.s before soldering them into place. Remember there is a flat on the side of the l.e.d.s body nearest to the cathode and also the lead of the cathode is longer. After soldering cut the tracks of the Veroboard as shown and then solder the battery connector in position.

There is no need to include an on/off switch in the supply line as the current drawn by the Snap Indicator when both switches are off is negligible.

COMPONENTS . . .

Resistors	
R1, R4	8k2 (2 off)
R2, R3	100k (2 off)
Semiconductors	
D1	0·2in red l.e.d.
D2	0·2in green l.e.d.
TR1, TR2	BC171A (2 off)
Miscellaneous	
S1, S2	keyboard switch (2 off)
PP3 battery	
Battery connectors	
Veroboard	

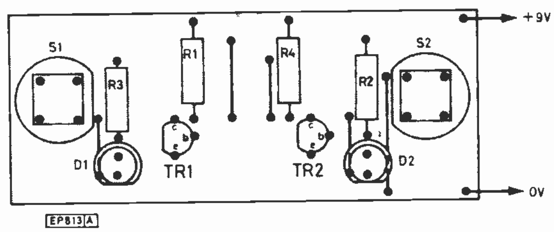
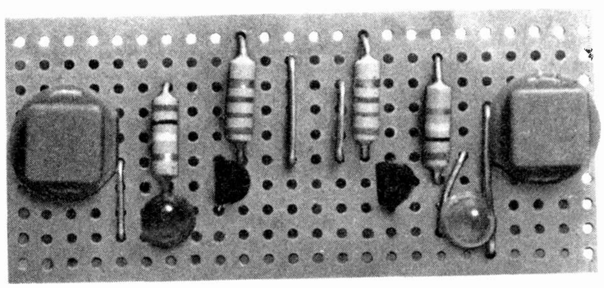


Fig. 2. Veroboard layout



TESTING

After checking the components and track breaks connect the indicator to a PP3 battery. With both switches open the l.e.d.s should be off. Pressing either S1 or S2 should light its respective l.e.d. and once the l.e.d. is on pressing the other switch should have no effect on the second l.e.d. which should remain off.

Medium Resolution Graphics

N.A.Climpson

THE STANDARD UK 101 has an interesting character set consisting of the alphanumerics and 154 graphics characters with each character based on an 8×8 dot matrix. When displayed each row of the matrix is in fact repeated so that every column of the character is represented by 16 dots, although this will not concern us here. Whilst a certain amount of manipulation of the 154 graphics characters can give dramatic effects on the screen it is impossible to achieve very high pixel resolution and it is difficult to work out which character will fill a particular slot to the best effect. For plotting purposes some $\frac{1}{4}$ square graphics can be used but the $\frac{3}{4}$ filled characters are missing so that every possibility of plotting is not available. In addition the format of the characters is such that squares are not square but elongated vertically.

One method of achieving higher resolution is to use one of the recently available programmable graphics generators by which the precise character required to fill a slot to best effect can be defined in memory. One disadvantage is that these boards are expensive, and another is that the software to define and select a character to fit a specific situation is quite complicated.

FOUR TIMES RESOLUTION

This article describes an alternative approach, easily and cheaply implementing medium resolution pixel graphics on the UK 101 using a fixed set of 256 alternative characters, giving an improvement in resolution of *four times* over the standard character set.

If we imagine the standard character slot to be divided into two portions vertically and four horizontally we now have eight blocks to fill; the size of one of these blocks representing the ultimate resolution of this system. (See Fig. 2). To fill these eight spaces with all possible combinations of characters will require 2^8 or 256 characters, and since each row of a character is defined by one 8 bit byte in the character generator (see Fig. 1), we will require 2048 bytes of storage for the new characters. By this means we can achieve a horizontal resolution of 2×48 and a vertical resolution of 4×16; a total of 6144 individually addressable points on the screen, and furthermore each picture element is now nearly square. The storage requirements for the 256 new characters are simply fulfilled by a 2716 EPROM.

The order in which the characters are stored in the EPROM is important so that the appropriate character can easily be selected by software. The system used here is shown in Fig. 2 where the number of the character is represented by a binary count starting in the top left corner. Thus for example character 0 would be all blank, 255 would be all white, 64 would have only the bottom left space filled and 65 would have the bottom left and top left occupied.

Having programmed an EPROM with the correct pattern of bits, the complete listing of which is shown in Table 1, it would be possible to plug it into the existing character generator socket with some minor wiring changes. This would mean however that the standard graphics set including the alphanumerics would not be available. The solution proposed here is to mount the standard and alternative character generators on a small sub-board which then plugs into the character generator socket on the main board. Selection of either one of the character sets is by software control, but it is unfortunately not possible to mix characters from the two sets on the screen at the same time.

HOW IT WORKS

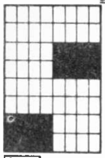
The circuit design of the new board is shown in Fig. 3. You will notice that the address lines and data lines to the two chips are paralleled up and are fed from a d.i.l. plug. This d.i.l. plug is inserted in the character generator socket on the main board, the original character generator having moved to the sub-board. The chip selects for the two devices are wired differently from each other and are not connected to the main board. With pins 20 and 21 wired as shown it requires a high on pin 18 to select the standard character generator and a low on pin 18 to select the 2716. The signal for these pins is derived from the Q output of a 7474 D-type edge triggered flip-flop. This is acting as a latch in that it holds a high or low logic level on its output until it receives a clock pulse which transfers the data on the data input to the Q output and inverted to the $\overline{Q}$ output. Since $\overline{Q}$ is back connected to the data input the output at Q is alternately high and low. The clock input is derived from an unused partially address decoded line on the main board. There are several of these available and a convenient one is pin 14 on U20. This is decoded to a 1K block starting at D800 Hex or 55296 decimal. Any address issued in this range with a dummy POKE or PEEK will cause the 7474 to change state and hence select the other character set. The address 55555 decimal is in this range and is an easy one to remember.

The reset of the 7474 is connected to the reset line of the 6502 processor on the main board so that on RESET the standard character set is always selected.

CONSTRUCTIONAL DETAILS

The printed circuit design for the board is shown full size in Fig. 5. As you can see the board is tightly packed to keep the size to a minimum and will require some care in construction. An additional problem is that no suitable d.i.l. plug appears to be commercially available and it will be necessary to make your own directly onto the board. Proceed as follows.

Obtain a 24-pin d.i.l. header plug. These are rather like d.i.l. i.c. sockets except they have stronger pins and are designed to plug into i.c. sockets. Into each socket of the d.i.l. header (except 18, 20 and 21) is pushed a 1cm. length of 24 s.w.g. hard brass wire. When complete the wires are put through the holes for the d.i.l. plug in the circuit board so that the d.i.l. header is on the plain side of the board. Solder the pins to the pads keeping the solder close to the board. Trim the pins on the circuit side of the board to an even 3·5mm. length, remove the d.i.l. header and push onto the trimmed pins. Put a blob of solder on the pins on the plain side of the board as close as possible to the board to take any removal strains and then trim the excess length of pin off as short as possible. Remove the d.i.l. header.


EP714

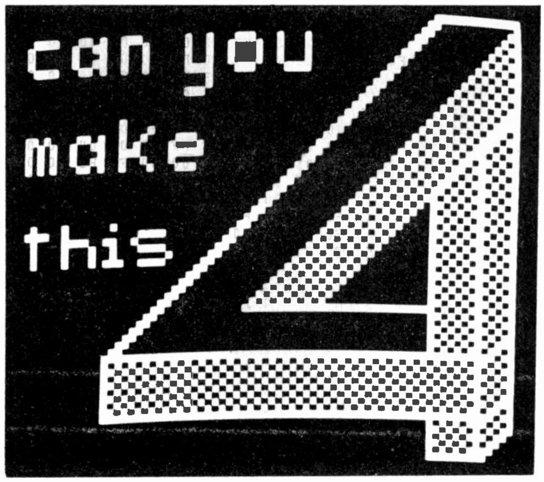
BIT PATTERN IN CHARACTER GENERATOR	HEXADECIMAL EQUIVALENT
0000 0000	00
0000 0000	00
0000 1111	0F
0000 1111	0F
0000 0000	00
0000 0000	00
1111 0000	F0
1111 0000	F0

Fig. 1. Character 72 in the new character set

1	2
4	8
16	32
64	128

EP715

Fig. 2. Arrangement of characters in new character set



Solder on the two 24-pin and one 14-pin sockets in the usual way followed by the two flying wires. The wire from pin 11 on the 7474 should be soldered carefully to the top of the leg of pin 14 on U20. The wire from pin 10 should be soldered to the printed circuit track going to pin 40 on the 6502 processor U8. Fig. 4 shows the place to solder it, but remember that if you leave the 6502 in place while doing this you should be using a good quality soldering iron which has a well earthed tip.

Remove the character generator U41 from the main board and fit to the sub-board in its appropriate place and *correct orientation*. Fit the 7474 and 2716 EPROM and plug the sub-board into the character generator socket on the main board with the d.i.l. header in place. This completes the construction.

SOFTWARE

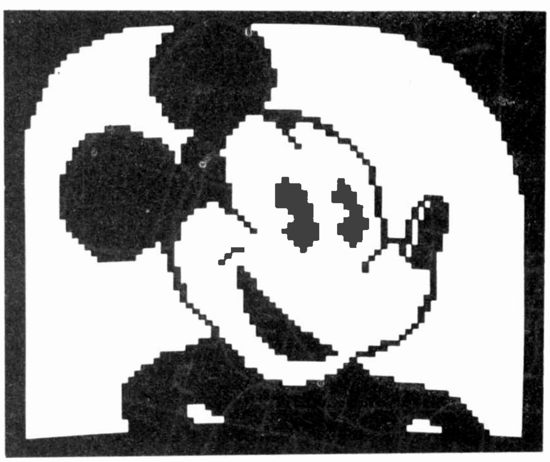
Although we now have higher resolution we are still using the old character slots to put one of 256 characters onto the screen at any one time. The heart of the software is to decide which character best represents the desired point to plot and to select the required character bearing in mind the character already occupying the slot.

Two programs are listed which use the character selection algorithm, one in BASIC to plot functions and a hybrid program in BASIC and machine code to draw pictures on the screen.

Table 2 is a program for plotting any mathematical function on the screen and will be described in some detail since it contains the routine needed for any plotting in medium resolution graphics.

The subroutine starting at line 1000 is the character selection and plotting portion.

X and Y are the new medium resolution co-ordinates relative to screen origin. X can range from −48 to +48 and Y from −32 to +32.



Line 1000 calculates the number of lines down the screen and the position across the screen of the standard character slot that X and Y fall in.

Line 1005 calculates the position of the individual $\frac{1}{8}$ character within the large character slot.

Line 1006 calculates the binary number of the character needed in this slot ignoring the character already there.

Line 1010 gets the present character in the slot.

Line 1012 decides the new character to put on the screen with reference to the one already there.

Line 1100 displays it.

Not strictly necessary in this program, but put in for completeness, are lines 1011, 1015 and 1017. These are used if the calculated $\frac{1}{8}$ graphics is to be deleted from the character that is already on the screen. The choice between subtracting and adding a character is controlled by flag D.

The function to be plotted is placed in a subroutine starting at line 2000, in this case an ellipse calculation, and the dimensions of the ellipse are controlled in lines 45-100.

POKE 55555,1 in lines 40 and 220 switches to the new character set at the start and back to the standard set at the end.

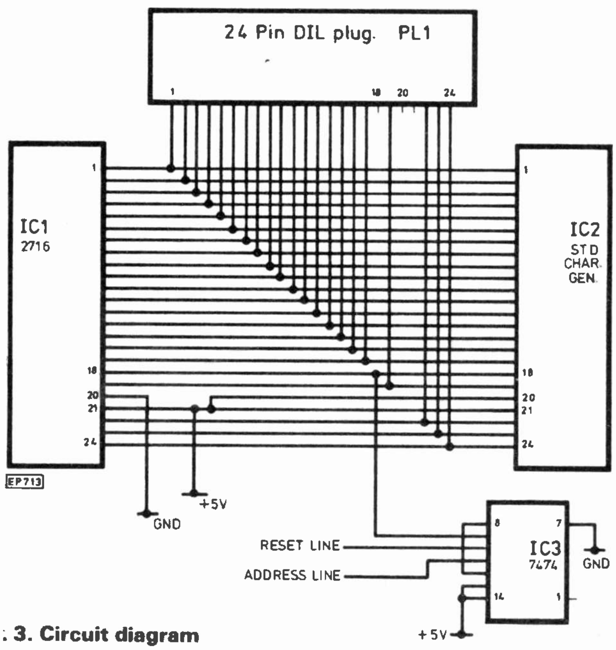


Fig. 3. Circuit diagram

000	00	00	00	00	00	00	00	00	F0	F0	00	00	00	00	00	00
010	0F	0F	00	00	00	00	00	00	FF	FF	00	00	00	00	00	00
020	00	00	F0	F0	00	00	00	00	F0	F0	F0	F0	00	00	00	00
030	0F	0F	F0	F0	00	00	00	00	FF	FF	F0	F0	00	00	00	00
040	00	00	0F	0F	00	00	00	00	F0	F0	0F	0F	00	00	00	00
050	0F	0F	0F	0F	00	00	00	00	FF	FF	0F	0F	00	00	00	00
060	00	00	FF	FF	00	00	00	00	F0	F0	FF	FF	00	00	00	00
070	0F	0F	FF	FF	00	00	00	00	FF	FF	FF	FF	00	00	00	00
080	00	00	00	00	F0	F0	00	00	F0	F0	00	00	F0	F0	00	00
090	0F	0F	00	00	F0	F0	00	00	FF	FF	00	00	F0	F0	00	00
0A0	00	00	F0	F0	F0	F0	00	00	F0	F0	F0	F0	F0	F0	00	00
0B0	0F	0F	F0	F0	F0	F0	00	00	FF	FF	F0	F0	F0	F0	00	00
0C0	00	00	0F	0F	F0	F0	00	00	F0	F0	0F	0F	F0	F0	00	00
CD0	0F	0F	0F	0F	F0	F0	00	00	FF	FF	0F	0F	F0	F0	00	00
0E0	00	00	FF	FF	F0	F0	00	00	F0	F0	FF	FF	F0	F0	00	00
0F0	0F	0F	FF	FF	F0	F0	00	00	FF	FF	FF	FF	F0	F0	00	00
100	00	00	00	00	0F	0F	00	00	F0	F0	00	00	0F	0F	00	00
110	0F	0F	00	00	0F	0F	00	00	FF	FF	00	00	0F	0F	00	00
120	00	00	F0	F0	0F	0F	00	00	F0	F0	F0	F0	0F	0F	00	00
130	0F	0F	F0	F0	0F	0F	00	00	FF	FF	F0	F0	0F	0F	00	00
140	00	00	0F	0F	0F	0F	00	00	F0	F0	0F	0F	0F	0F	00	00
150	0F	0F	0F	0F	0F	0F	00	00	FF	FF	0F	0F	0F	0F	00	00
160	00	00	FF	FF	0F	0F	00	00	F0	F0	FF	FF	0F	0F	00	00
170	0F	0F	FF	FF	0F	0F	00	00	FF	FF	FF	FF	0F	0F	00	00
180	00	00	00	00	FF	FF	00	00	F0	F0	00	00	FF	FF	00	00
190	0F	0F	00	00	FF	FF	00	00	FF	FF	00	00	FF	FF	00	00
1A0	00	00	F0	F0	FF	FF	00	00	F0	F0	F0	F0	FF	FF	00	00
1B0	0F	0F	F0	F0	FF	FF	00	00	FF	FF	F0	F0	FF	FF	00	00
1C0	00	00	0F	0F	FF	FF	00	00	F0	F0	0F	0F	FF	FF	00	00
1D0	0F	0F	0F	0F	FF	FF	00	00	FF	FF	0F	0F	FF	FF	00	00
1E0	00	00	FF	FF	FF	FF	00	00	F0	F0	FF	FF	FF	FF	00	00
1F0	0F	0F	FF	FF	FF	FF	00	00	FF	FF	FF	FF	FF	FF	00	00
200	00	00	00	00	00	00	F0	F0	F0	F0	00	00	00	00	F0	F0
210	0F	0F	00	00	00	00	F0	F0	FF	FF	00	00	00	00	F0	F0
220	00	00	F0	F0	00	00	F0	F0	F0	F0	F0	F0	00	00	F0	F0
230	0F	0F	F0	F0	00	00	F0	F0	FF	FF	F0	F0	00	00	F0	F0
240	00	00	0F	0F	00	00	F0	F0	F0	F0	0F	0F	00	00	F0	F0
250	0F	0F	0F	0F	00	00	F0	F0	FF	FF	0F	0F	00	00	F0	F0
260	00	00	FF	FF	00	00	F0	F0	F0	F0	FF	FF	00	00	F0	F0
270	0F	0F	FF	FF	00	00	F0	F0	FF	FF	FF	FF	00	00	F0	F0
280	00	00	00	00	F0	F0	F0	F0	F0	F0	00	00	F0	F0	F0	F0
290	0F	0F	00	00	F0	F0	F0	F0	FF	FF	00	00	F0	F0	F0	F0
2A0	00	00	F0	F0	F0	F0	F0	F0	F0	F0	F0	F0	F0	F0	F0	F0
2B0	0F	0F	F0	F0	F0	F0	F0	F0	FF	FF	F0	F0	F0	F0	F0	F0
2C0	00	00	0F	0F	F0	F0	F0	F0	F0	F0	0F	0F	F0	F0	F0	F0
2D0	0F	0F	0F	0F	F0	F0	F0	F0	FF	FF	0F	0F	F0	F0	F0	F0
2E0	00	00	FF	FF	F0	F0	F0	F0	F0	F0	FF	FF	F0	F0	F0	F0
2F0	0F	0F	FF	FF	F0	F0	F0	F0	FF	FF	FF	FF	F0	F0	F0	F0
300	00	00	00	00	0F	0F	F0	F0	F0	F0	00	00	0F	0F	F0	F0
310	0F	0F	00	00	0F	0F	F0	F0	FF	FF	00	00	0F	0F	F0	F0
320	00	00	F0	F0	0F	0F	F0	F0	F0	F0	F0	F0	0F	0F	F0	F0
330	0F	0F	F0	F0	0F	0F	F0	F0	FF	FF	F0	F0	0F	0F	F0	F0
340	00	00	0F	0F	0F	0F	F0	F0	F0	F0	0F	0F	0F	0F	F0	F0
350	0F	0F	0F	0F	0F	0F	F0	F0	FF	FF	0F	0F	0F	0F	F0	F0
360	00	00	FF	FF	0F	0F	F0	F0	F0	F0	FF	FF	0F	0F	F0	F0
370	0F	0F	FF	FF	0F	0F	F0	F0	FF	FF	FF	FF	0F	0F	F0	F0
380	00	00	00	00	FF	FF	F0	F0	F0	F0	00	00	FF	FF	F0	F0
390	0F	0F	00	00	FF	FF	F0	F0	FF	FF	00	00	FF	FF	F0	F0
3A0	00	00	F0	F0	FF	FF	F0	F0	F0	F0	F0	F0	FF	FF	F0	F0
3B0	0F	0F	F0	F0	FF	FF	F0	F0	FF	FF	F0	F0	FF	FF	F0	F0
3C0	00	00	0F	0F	FF	FF	F0	F0	F0	F0	0F	0F	FF	FF	F0	F0
3D0	0F	0F	0F	0F	FF	FF	F0	F0	FF	FF	0F	0F	FF	FF	F0	F0
3E0	00	00	FF	FF	FF	FF	F0	F0	F0	F0	FF	FF	FF	FF	F0	F0
3F0	0F	0F	FF	FF	FF	FF	F0	F0	FF	FF	FF	FF	FF	FF	F0	F0
400	00	00	00	00	00	00	0F	0F	F0	F0	00	00	00	00	0F	0F
410	0F	0F	00	00	00	00	0F	0F	FF	FF	00	00	00	00	0F	0F
420	00	00	F0	F0	00	00	0F	0F	F0	F0	F0	F0	00	00	0F	0F
430	0F	0F	F0	F0	00	00	0F	0F	FF	FF	F0	F0	00	00	0F	0F
440	00	00	0F	0F	00	00	0F	0F	F0	F0	0F	0F	00	00	0F	0F
450	0F	0F	0F	0F	00	00	0F	0F	FF	FF	0F	0F	00	00	0F	0F
460	00	00	FF	FF	00	00	0F	0F	F0	F0	FF	FF	00	00	0F	0F
470	0F	0F	FF	FF	00	00	0F	0F	FF	FF	FF	FF	00	00	0F	0F
480	00	00	00	00	F0	F0	0F	0F	F0	F0	00	00	F0	F0	0F	0F
490	0F	0F	00	00	F0	F0	0F	0F	FF	FF	00	00	F0	F0	0F	0F
4A0	00	00	F0	F0	F0	F0	0F	0F	F0	F0	F0	F0	F0	F0	0F	0F
4B0	0F	0F	F0	F0	F0	F0	0F	0F	FF	FF	F0	F0	F0	F0	0F	0F
4C0	00	00	0F	0F	F0	F0	0F	0F	F0	F0	0F	0F	F0	F0	0F	0F
4D0	0F	0F	0F	0F	F0	F0	0F	0F	FF	FF	0F	0F	F0	F0	0F	0F
4E0	00	00	FF	FF	F0	F0	0F	0F	F0	F0	FF	FF	F0	F0	0F	0F
4F0	0F	0F	FF	FF	F0	F0	0F	0F	FF	FF	FF	FF	F0	F0	0F	0F
500	00	00	00	00	0F	0F	0F	0F	F0	F0	00	00	0F	0F	0F	0F
510	0F	0F	00	00	0F	0F	0F	0F	FF	FF	00	00	0F	0F	0F	0F
520	00	00	F0	F0	0F	0F	0F	0F	F0	F0	F0	F0	0F	0F	0F	0F
530	0F	0F	F0	F0	0F	0F	0F	0F	FF	FF	F0	F0	0F	0F	0F	0F
540	00	00	0F	0F	0F	0F	0F	0F	F0	F0	0F	0F	0F	0F	0F	0F
550	0F	0F	0F	0F	0F	0F	0F	0F	FF	FF	0F	0F	0F	0F	0F	0F
560	00	00	FF	FF	0F	0F	0F	0F	F0	F0	FF	FF	0F	0F	0F	0F
570	0F	0F	FF	FF	0F	0F	0F	0F	FF	FF	FF	FF	0F	0F	0F	0F
580	00	00	00	00	FF	FF	0F	0F	F0	F0	00	00	FF	FF	0F	0F
590	0F	0F	00	00	FF	FF	0F	0F	FF	FF	00	00	FF	FF	0F	0F
5A0	00	00	F0	F0	FF	FF	0F	0F	F0	F0	F0	F0	FF	FF	0F	0F
5B0	0F	0F	F0	F0	FF	FF	0F	0F	FF	FF	F0	F0	FF	FF	0F	0F
5C0	00	00	0F	0F	FF	FF	0F	0F	F0	F0	0F	0F	FF	FF	0F	0F
5D0	0F	0F	0F	0F	FF	FF	0F	0F	FF	FF	0F	0F	FF	FF	0F	0F
5E0	00	00	FF	FF	FF	FF	0F	0F	F0	F0	FF	FF	FF	FF	0F	0F
5F0	0F	0F	FF	FF	FF	FF	0F	0F	FF	FF	FF	FF	FF	FF	0F	0F
600	00	00	00	00	00	00	FF	FF	F0	F0	00	00	00	00	FF	FF
610	0F	0F	00	00	00	00	FF	FF	FF	FF	00	00	00	00	FF	FF
620	00	00	F0	F0	00	00	FF	FF	F0	F0	F0	F0	00	00	FF	FF
630	0F	0F	F0	F0	00	00	FF	FF	FF	FF	F0	F0	00	00	FF	FF
640	00	00	0F	0F	00	00	FF	FF	F0	F0	0F	0F	00	00	FF	FF
650	0F	0F	0F	0F	00	00	FF	FF	FF	FF	0F	0F	00	00	FF	FF
660	00	00	FF	FF	00	00	FF	FF	F0	F0	FF	FF	00	00	FF	FF
670	0F	0F	FF	FF	00	00	FF	FF	FF	FF	FF	FF	00	00	FF	FF
680	00	00	00	00	F0	F0	FF	FF	F0	F0	00	00	F0	F0	FF	FF
690	0F	0F	00	00	F0	F0	FF	FF	FF	FF	00	00	F0	F0	FF	FF
6A0	00	00	F0	F0	F0	F0	FF	FF	F0	F0	F0	F0	F0	F0	FF	FF
6B0	0F	0F	F0	F0	F0	F0	FF	FF	FF	FF	F0	F0	F0	F0	FF	FF
6C0	00	00	0F	0F	F0	F0	FF	FF	F0	F0	0F	0F	F0	F0	FF	FF
6D0	0F	0F	0F	0F	F0	F0	FF	FF	FF	FF	0F	0F	F0	F0	FF	FF
6E0	00	00	FF	FF	F0	F0	FF	FF	F0	F0	FF	FF	F0	F0	FF	FF
6F0	0F	0F	FF	FF	F0	F0	FF	FF	FF	FF	FF	FF	F0	F0	FF	FF
700	00	00	00	00	0F	0F	FF	FF	F0	F0	00	00	0F	0F	FF	FF
710	0F	0F	00	00	0F	0F	FF	FF	FF	FF	00	00	0F	0F	FF	FF
720	00	00	F0	F0	0F	0F	FF	FF	F0	F0	F0	F0	0F	0F	FF	FF
730	0F	0F	F0	F0	0F	0F	FF	FF	FF	FF	F0	F0	0F	0F	FF	FF
740	00	00	0F	0F	0F	0F	FF	FF	F0	F0	0F	0F	0F	0F	FF	FF
750	0F	0F	0F	0F	0F	0F	FF	FF	FF	FF	0F	0F	0F	0F	FF	FF
760	00	00	FF	FF	0F	0F	FF	FF	F0	F0	FF	FF	0F	0F	FF	FF
770	0F	0F	FF	FF	0F	0F	FF	FF	FF	FF	FF	FF	0F	0F	FF	FF
780	00	00	00	00	FF	FF	FF	FF	F0	F0	00	00	FF	FF	FF	FF
790	0F	0F	00	00	FF	FF	FF	FF	FF	FF	00	00	FF	FF	FF	FF
7A0	00	00	F0	F0	FF	FF	FF	FF	F0	F0	F0	F0	FF	FF	FF	FF
7B0	0F	0F	F0	F0	FF	FF	FF	FF	FF	FF	F0	F0	FF	FF	FF	FF
7C0	00	00	0F	0F	FF	FF	FF	FF	F0	F0	0F	0F	FF	FF	FF	FF
7D0	0F	0F	0F	0F	FF	FF	FF	FF	FF	FF	0F	0F	FF	FF	FF	FF
7E0	00	00	FF	FF	FF	FF	FF	FF	F0	F0	FF	FF	FF	FF	FF	FF
7F0	0F	0F	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF

Table 1. EPROM program

Lines 30-40 are a machine code subroutine to fill the screen with the zero character, which is a blank in the new set.

This program runs very slowly since it is in BASIC and contains long calculations to plot each point but it will give an idea of the method used to manipulate the $\frac{1}{8}$ square graphics. Some experimentation with the functions and step sizes could prove most interesting.

In the second program the plotting algorithm is in machine code and only returns to BASIC for the option menu and instructions. Some examples of the sort of pictures that can be drawn are shown and have been photographed straight off the television screen.

Fig. 4. Connection of reset line

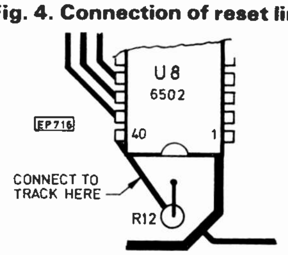


Table 2. Plotting program

```
1 REM ** BASIC MEDIUM RESOLUTION GRAPHICS ***
2 REM    ***** PLOTTING ALGORITHM  ******
5 O=53259+8*64+24
30 DATA 162,00,138,157,00,208,157,00,209
31 DATA 157,00,210,157,00,211,232,208,241,96
33 FORI=565TO583:READA:POKEI,A:NEXT
40 POKE11,53:POKE12,2:POKE65555,I:X=USR(X)
45 A=20:B=30
50 FOR TH=0 TO 6.3 STEP .1
60 GOSUB 2000
80 GOSUB 1000
90 NEXT
100 A=A+1:B=B-1:IF B=0 THEN 200
110 GOTO 50
200 POKE 11,186:POKE 12,255:X=USR(X)
210 FOR I=1 TO 16:PRINT:NEXT
220 POKE 55555,1:END
999 REM * SELECT CHARACTER AND PLOT OR UNPLOT
1000 XP=INT(X/2):YP=INT(Y/4)
1005 XD=X-XP*2:YD=Y-YP*4+1
1006 CH=2^((YD-1)*2+XD)
1010 SC=PEEK(O+YP*64+XP)
1011 IF D=1 THEN 1015
1012 ST=SC OR CH
1013 GOTO 1100
1015 CH=255-CH
1017 ST=SC AND CH
1100 POKE O+YP*64+XP,ST
1500 RETURN
1999 REM * FUNCTION TO BE PLOTTED:ELLIPSE HERE
2000 R1=A*A*B*B
2010 R2=A*A*SIN(TH)*SIN(TH)+B*B*COS(TH)*COS(TH)
2020 R=SQR(R1/R2)
2030 Y=INT(R*SIN(TH)+.5)
2040 X=INT(R*COS(TH)+.5)
2050 RETURN
```

```
10 REM **** DRAWER IN BASIC/MACHINE CODE *****
20 REM **** HAVE YOU PROTECTED MEMORY AT 6500***
30 COSUB 5000
40 PRINT"          *********************
50 PRINT"          * MEDIUM RESOLUTION *
60 PRINT"          *                   *
70 PRINT"          *  GRAPHICS DRAWER  *
80 PRINT"          *********************
90 PRINT:PRINT:PRINT:PRINT:PRINT
100 PRINT"                         By Nigel Climpson
110 PRINT:PRINT" A 25 sec delay whilst poking machine code"
199 REM POKE MACHINE CODE
200 M=6528
210 READ A$:IF A$="LAST" THEN 1095
220 FOR I=1 TO 16:S=ASC(MID$(A$,2*I-1,1))-48
230 IF S>9 THEN S=S-7
240 T=S*16:S=ASC(MID$(A$,2*I,1))-48:IF S>9 THEN S=S-7
250 T=T+S:POKE M,T:T=0:M=M+1:NEXT:GOTO 210
1095 POKE 21000,16
1100 GOSUB 5000
1110 PRINT:PRINT" OPTION MENU":PRINT
1120 PRINT"    1)    Start a new picture.":PRINT
1130 PRINT"    2)    Load a masterpiece from tape.":PRINT
1140 PRINT"    3)    Save present picture to tape.":PRINT
1150 PRINT"    4)    Change speed of cursor.":PRINT
1160 PRINT"    5)    Display instructions.":PRINT
1170 PRINT"    6)    Exit from programme.":PRINT
1180 GOSUB 5010
1190 ON CH GOTO 2000,2250,2500,2750,3000,3250
2000 POKE 11,128:POKE 12,25:X=USR(X)
2010 COTO 1100
2249 REM LOAD FROM TAPE
2250 GOSUB 5000
2260 PRINT"TURN ON TAPE RECORDER IN LOAD MODE"
2270 POKE 11,50:POKE 12,27:X=USR(X)
2280 GOTO 1100
2499 REM SAVE TO TAPE
2500 GOSUB 5000
2510 PRINT"TURN ON TAPE RECORDER IN SAVE MODE"
2520 POKE 11,213:POKE 12,26:X=USR(X)
2530 GOTO 1100
2749 REM CHANGE SPEED
2750 GOSUB 5000
2760 PRINT"ENTER CURSOR SPEED (1-9)";
2770 GOSUB 5010
2780 PRINTCH
2790 POKE 7096,CH*5+1
2800 POKE 11,131:POKE 12,27:X=USR(X)
2610 GOTO 1100
2999 REM DISPLAY INSTRUCTIONS
3000 GOSUB 5000
3010 PRINT"  The cursor is moved in the following manner":PRINT
3020 PRINT"                      KEY 1"
3030 PRINT TAB(24);CHR$(16)
3040 PRINT TAB(8);"KEYS 1&3 ";CHR$(23);SPC(6);CHR$(16);
3050 PRINT SPC(6);CHR$(17);" KEYS 1&4"
3060 PRINT TAB(19);CHR$(23);SPC(4);CHR$(16);SPC(4);CHR$(17)
3070 PRINTTAB(21);CHR$(23);SPC(2);CHR$(16);SPC(2);CHR$(17)
3080 PRINT TAB(23);CHR$(23);CHR$(16);CHR$(17)
3090 PRINT TAB(5);"KEY 3 ";CHR$(22);" ";CHR$(22);" ";CHR$(22);
3100 PRINT" ";CHR$(22);" ";CHR$(22);" ";CHR$(22);" ";CHR$(22);
3110 PRINT CHR$(187);CHR$(18);" ";CHR$(18);
3120 PRINT " ";CHR$(18);" ";CHR$(18);" ";CHR$(18);" ";
3130 PRINT CHR$(18);" ";CHR$(18);" KEY 4"
3170 PRINT TAB(23);CHR$(21);CHR$(20);CHR$(19)
3180 PRINT TAB(21);CHR$(21);SPC(2);CHR$(20);SPC(2);CHR$(19)
3185 PRINTTAB(19);CHR$(21);SPC(4);CHR$(20);SPC(4);CHR$(19)
3190 PRINT TAB(8);"KEYS 2&3 ";CHR$(21);SPC(6);CHR$(20);
3195 PRINT SPC(6);CHR$(19);" KEYS 2&4"
3200 PRINTTAB(24);CHR$(20)
3210 PRINTTAB(22);"KEY 2"
3212 PRINT" Press any key";
3215 GOSUB 5010:GOSUB 5000:PRINT
3220 PRINT"            KEY 5 TO PLOT":PRINT:PRINT
3225 PRINT"            KEY 6 TO UNPLOT ":PRINT:PRINT
3230 PRINT"            KEY 7 TO RETURN TO MENU":PRINT:PRINT
3235 PRINT"  Press any key"
3247 GOSUB 5010:GOTO 1100
3249 REM GOOD-BYE
3250 GOSUB 5000
3260 PRINT" Thanks for playing.Bye for now Picasso."
4998 END
4999 REM CLEAR SCREEN
5000 FOR I=1 TO 16:PRINT:NEXT:RETURN
5009 REM GET CHARACTER FROM KEYBOARD
5010 POKE 11,186:POKE 12,255:X=USR(X):CH=PEEK(531)-48:RETURN
6000 DATA AD00D8A900A89900D09900D19900D299
6010 DATA 00D3C8D0F18DB41BA9808DB01B8DB11B
6020 DATA A97F8D00DFAD00DFC9FFF03948ADB41B
6030 DATA F0034C321A68C97FF047C9BFF055C9EF
6040 DATA F048C9DFF056C95FF034C96FF039C9AF
6050 DATA F03EC99FF043C9F7F048C9FBF04CC9FD
6060 DATA D0034CA81AA9008DB51B203D1A20C91A
6070 DATA A9FF8DB51B203D1A20C91A4CA019CEB0
6080 DATA 1BCEB11B4CE519CEB11BEEB01B4CE519
6090 DATA EEB01BEEB11B4CE519EEB11BCEB01B4C
6100 DATA E519A0FF8CB41B4CE519A0008CB41B4C
6110 DATA E519A9008DB51B203D1A4CB519ADB01B
6120 DATA 29018DB21BADB11B29038DB31B0A186D
6130 DATA B21BAAA901CAE0FFF0030AD0F88DB61B
6140 DATA A91085F9A9C885FAADB01B4A1865F985
6150 DATA F99002E6FAADB11B4A4AAAA9401865F9
6160 DATA 85F99002E6FACAD0F2A000B1F9AEB51B
6170 DATA D0060DB61B4CA51A48ADB61B49FF8DB6
6180 DATA 1B682DB61B91F960A000B900D099001C
6190 DATA B900D199001DB900D299001EB900D399
6200 DATA 001FC8D0E5AD00D860AEB81BCEB71BD0
6210 DATA FBCAD0F860A9FF8D0502201F1B201F1B
6220 DATA A00084F9A91C85FAA93A20EEFFB1F94A
6230 DATA 4A4A4A20001BB1F9290F20001B4C0E1B
6240 DATA 186930C93A300318690720EEFF60C8D0
6250 DATA DCE6FAA5FAC920D0D4A9008D050260A9
6260 DATA 108DB91BA0FFCAD0FD88D0FACEB91BD0
6270 DATA F560A9FF8D0302A90085F9A91C85FAA0
6280 DATA 0020BAFFC93AD0F920EEFF20BAFF2067
6290 DATA 1B0A0A0A8DBA1B20BAFF20671B186D
6300 DATA BA1B91F94C731B20EEFFC9419002E907
6310 DATA 290F60C8D0D5E6FAA5FAC920D0CDA900
6320 DATA 8D0302A000AD00D8B9001C9900D0B900
6330 DATA 1D9900D1B9001E9900D2B9001F9900D3
6340 DATA C8D0E5A9004C95190DF00520F9535441
6350 DATA LAST
```

Table 3. Drawer in M/C and BASIC

Note to CEGMON users:

In the *Plotting Algorithm* program line 200 will need to read:

200 POKE 11,70:POKE 12,251:X=USR(X)

In the *Graphics Drawer* program line 5010 will be:

5010 POKE 11,70:POKE 12,251:X=USR(X): CH=PEEK(533)−48:RETURN

In line 6280 change two occurrences of BAFF to 46FB

In line 6290 change BAFF to 46FB

If your character generator has been supplied as an EPROM, then cut the track joining pin 18 on IC1 and IC2, leaving IC2 connected to pin 9 of the 7474. Connect pin 18 of IC1 to pin 8 of the 7474.

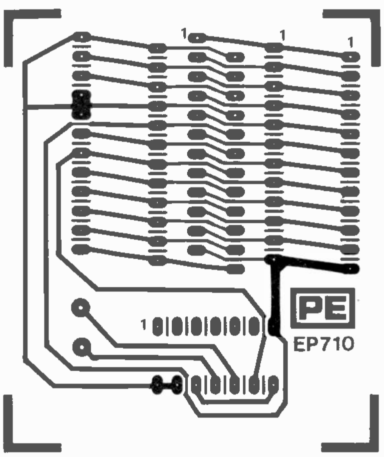


Fig. 5. Printed circuit layout

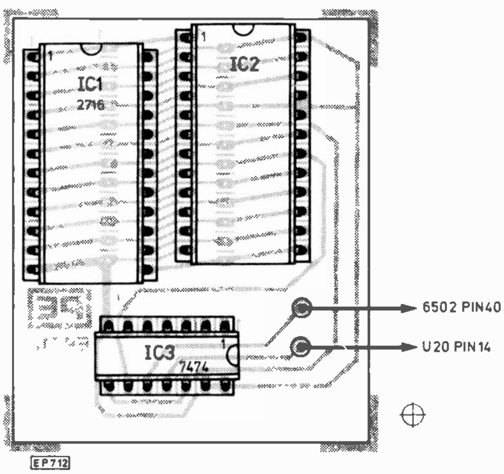


Fig. 6. Component overlay

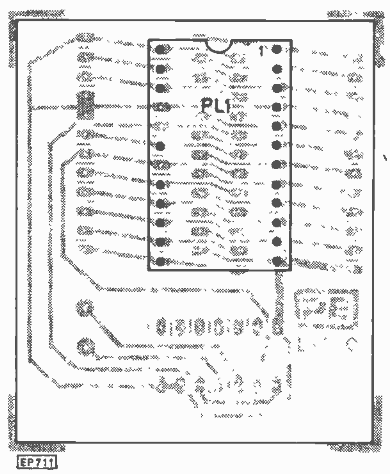


Fig. 7. Position of PL1

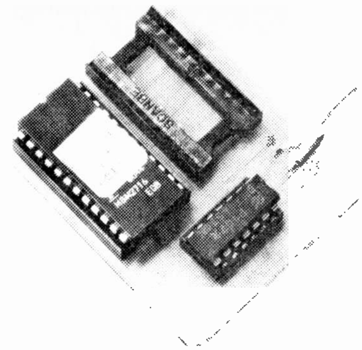
COMPONENTS...

Integrated circuits

IC1	2716
IC2	Standard Char. Gen. ROM
IC3	7474

Miscellaneous

24-way d.i.l. socket (2 off)
24-way d.i.l. plug
14-way d.i.l. socket
Printed circuit board



The program was originally intended for joy-stick control which explains the rather clumsy cursor movement keys, but on the standard keyboard I do not think that there are any better options.

The subroutine at line 5000 is to clear the screen and can be substituted by a more rapid routine if available.

To sum up then, this is a method of implementing $\frac{1}{8}$th square graphics in a simple and non-destructive way. This system works equally well with the Superboard II but requires a differently encoded EPROM since for reasons best known to the manufacturers, the wiring between the character generator and the data serialiser is slightly different in the two machines. The Superboard requires each character row to be encoded in reverse. The software illustrated here will also have to be adjusted.

Thanks are due to the author's colleagues Dr. J. Ogle and D. Hazelden for ideas on the hardware and software of this project.

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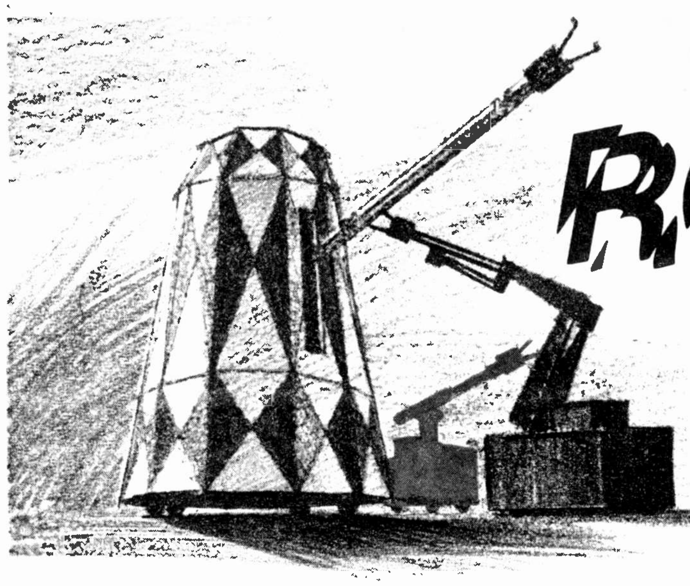


PE ROBOTS

PART 6

RICHARD BECKER · TIM ORR
RICHARD MONKHOUSE

THIS month, which represents the final part of the Robots series of articles, we look at the software and final assembly procedures.

SOFTWARE DESCRIPTION

Here are brief notes on some aspects of the control software for the robot.

Decoding the keyboard data via an interrupt routine

The clock pulses from the keyboard decoder are fed to one of the PIA's interrupt inputs. Each time an interrupt occurs, the new data bit from the keyboard decoder is read and shifted into a temporary data store by the software. When 56 bits have been received, the micro's internal button status bytes are updated. Synchronisation with the transmitted sequence is assured by resetting the bit count when a 'start' bit is decoded by the keyboard decoder. See Fig. 6.1a.

Jump node subroutine

To make button command controlled jumps from one part of the program to another easy to modify and expand, a special subroutine was written. This is entered with the X register pointing to the start of a particular jump table (Fig. 6.1c). If any of the listed button states are found, then the matched jump is made, otherwise the subroutine returns control to the part of the software it was called from. See Figs. 6.1b and 6.1c.

Servoing and deadband

On replay, the control of the robot to follow the stored data consists of a simple servo loop with a deadband, i.e. if the measured position is greater than the desired position plus the deadband, then the minus solenoid is activated.

i.e.	MP > DP+DB	:—	−SOL	ON
also	MP<DP	:—	+SOL	ON
and	DP<MP<DP + DB	:—	BOTH OFF	

As soon as an axis reaches the correct position, its appropriate solenoids are switched off. When all solenoids have reached their correct position, the software fetches the next position down from the sequence memory, and the process continues.

A full source listing (with comments!) of the control software is available from Powertran.

Fig. 6.1a. Interrupt Service Routines

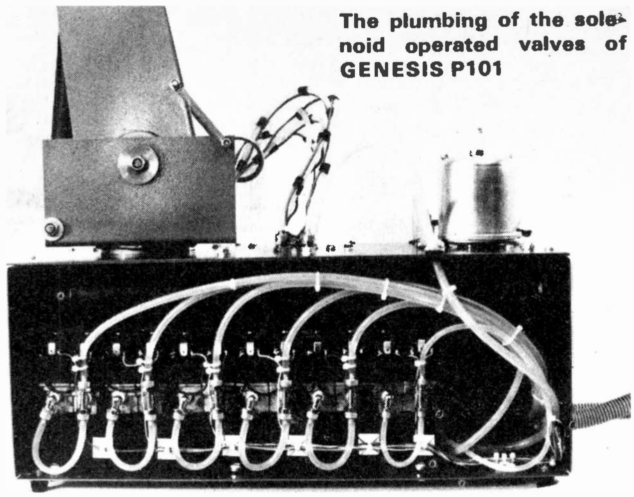
```
*GET KEY AND EXTERNAL DATA
KBEX     JSR     BUSIN
         LDA B   PIABD       (THIS ALSO CLEARS
                              INTERRUPT)
         AND B   #%Ø1111111
         STA B   PIABD
         LDA A   PIAAD       GET DATA
         PSH A
         ORA B   #%1ØØØØØØØ
         STA B   PIABD
         JSR     BUSOUT
         PUL A
         RTS

*TRANSFER/CHECK BUTTON DATA
TRNFER   LDA B   #7
         LDX     #BTSØ
         STX     FROMX
         LDX     #BUTNS
         STX     TOX
         JSR     MOVE
         RTS

*INTERRUPT SERVICE ROUTINE
INTSER   JSR     KBEX        GET DATA AND CLEAR
                              INTERRUPT
         STA A   KBEXD
         AND A   #%ØØØØØØ1Ø  GET START BIT
         BNE     INT1        LOW MEANS START
         LDA A   #56         INITIALISE BIT COUNT
         STA A   BITCNT
         CLR     BTRFLG      CLEAR ALL READY FLAG
INT1     LDA A   KBEXD
         ROR A
         ROL     BTS6
         ROL     BTS5
         ROL     BTS4
         ROL     BTS3
         ROL     BTS2
         ROL     BTS1
         ROL     BTSØ        SHIFT DATA IN
         DEC     BITCNT
         BEQ     ALLDON
         RTI
ALLDON   LDA A   BTRFLG
         BNE     INT2
         INC A
         STA A   BTRFLG      SET READY FLAG
         JSR     TRNFER
INT2     RTI

*INTERRUPT VECTOR
         ORG     #FFF8
         FDB     INTSER

*RESTART VECTOR
         ORG     $FFFE
         FDB     START
         END     START
```

Fig. 6.1b. Jump Node Subroutine

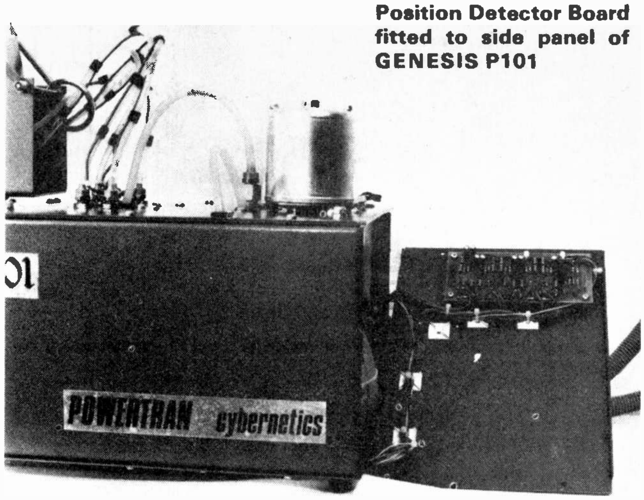
```
*SEARCH JUMP TABLE POINTED TO BY
*X AND JUMP IF NECESSARY
NODE     LDA A   Ø, X
         CMP A   #$FF        END OF CURRENT TABLE?
         BEQ     NODE2
         JSR     TSTBUT
         BEQ     NODE3       HAVE WE GOT A MATCH?
         INX                 NO
         INX
         INX
         INX
         BRA     NODE
NODE3    LDX     2, X        FIX STACK
         LDS     #TOS        ALL SOLENOIDS OFF
         JSR     SOLOFF      MAKE MATCHED JUMP
         JMP     Ø, X
NODE2    RTS

*TEST PARTICULAR BUTTON BYTE FOR
*MATCH AGAINST TABLE ENTRY
TSTBUT   STX     TEMPX2
         LDX     #BUTNS
         JSR     ADDAX
         LDA A   Ø, X
         LDX     TEMPX2
         CMP A   1, X
         RTS

*ADD A TO X
ADDAX    STX     TEMPX1
         CLR B
         ADD A   TEMPX1+1
         STA A   TEMPX1+1
         ADC B   TEMPX1
         STA B   TEMPX1
         LDX     TEMPX1
         RTS
```

Fig. 6.1c. Jump Node Tables

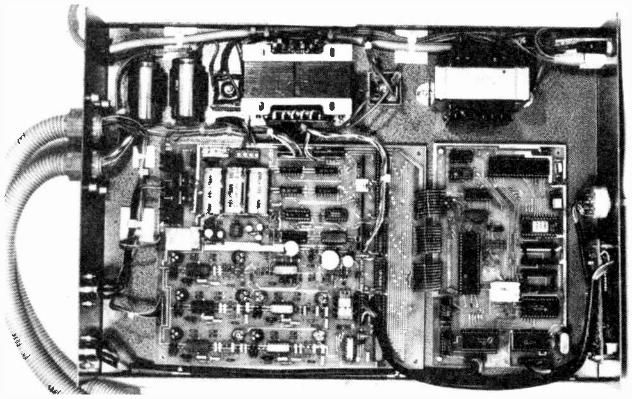
```
*JUMP TABLES
*INITIAL COMMAND NODE
F81C ØØ8Ø    JT1    FDB    $ØØ8Ø, SQM
F82Ø Ø18Ø           FDB    $Ø18Ø, SQP
F824 ØØ1Ø           FDB    $ØØ1Ø, EDIT
F828 Ø2Ø8           FDB    $Ø2Ø8, CLRMEM
F82C ØØ2Ø           FDB    $ØØ2Ø, RPTP
F83Ø ØØ4Ø           FDB    $ØØ4Ø, PLAY
F834 Ø12Ø           FDB    $Ø12Ø, MCOM
F838 Ø28Ø           FDB    $Ø28Ø, MOCTRL
F83C FF             FCB    $FF

*PLAYBACK CONTROL NODE
F83D ØØ1Ø    JT2    FDB    $ØØ1Ø, EDIT
F841 Ø12Ø           FDB    $Ø12Ø, MCOM
F845 Ø14Ø           FDB    $Ø14Ø, PAUSE
F849 ØØ4Ø           FDB    $ØØ4Ø, PLAY
F84D ØØ2Ø           FDB    $ØØ2Ø, RPTP
F851 FF             FCB    $FF

*EDIT CONTROL NODE
F852 Ø1Ø4    JT3    FDB    $Ø1Ø4, STEPP
F856 ØØØ4           FDB    $ØØØ4, STEPM
F85A Ø12Ø           FDB    $Ø12Ø, MCOM
F85E ØØØ8           FDB    $ØØØ8, WAIT
F862 Ø1Ø8           FDB    $Ø1Ø8, INSERT
F866 Ø11Ø           FDB    $Ø11Ø, DELETE
F86A ØØ2Ø           FDB    $ØØ2Ø, RPTP
F86E ØØ4Ø           FDB    $ØØ4Ø, PLAY
F872 ØØ1Ø           FDB    $ØØ1Ø, EDIT
F876 Ø24Ø           FDB    $Ø24Ø, SLOW
F87A FF             FCB    $FF

*PAUSE WAIT NODE
F87B Ø14Ø    JT4    FDB    $Ø14Ø, PAUSE2
F87F ØØ1Ø           FDB    $ØØ1Ø, EDIT
F883 Ø12Ø           FDB    $Ø12Ø, MCOM
F887 ØØ4Ø           FDB    $ØØ4Ø, PLAY
F88B ØØ2Ø           FDB    $ØØ2Ø, RPTP
F88F FF             FCB    $FF

*MOTOR CONTROL NODE
F89Ø Ø12Ø    JT5    FDB    $Ø12Ø, MCOM
F894 FF             FCB    $FF
```



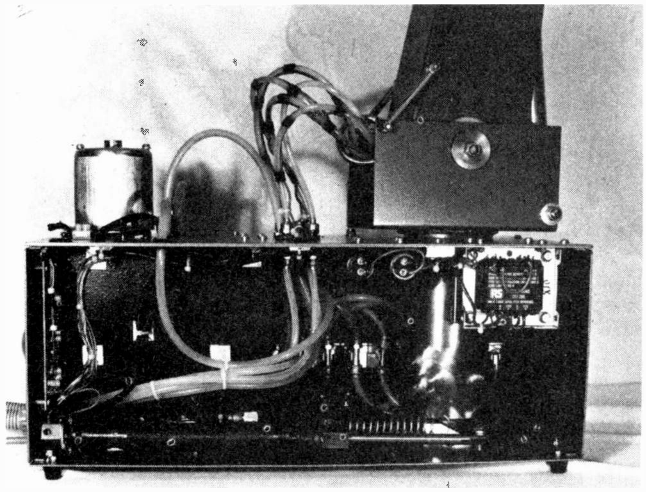
The plumbing of the solenoid operated valves of GENESIS P101



Position Detector Board fitted to side panel of GENESIS P101



Processor Box showing Interface Board, Processor Board, Data Display Board (mounted vertically next to switch), power supplies for electronics and hydraulic pump. The signals to and from the robot are carried in 2 flexible conduits.



More of the hydraulics of GENESIS P101

CONSTRUCTION OF THE ROBOTS

Despite the very large number of components making up each of the Genesis range of robots, construction is very straightforward, requiring no tools other than the screwdrivers and spanners found in most constructors' tool boxes. For convenience, in both packing and assembly, each kit is divided into a number of packs, each containing the parts for one section only of the machine together with its fixing components, so there's no chance of fitting the parts incorrectly. All details of assembly are covered in the handbook supplied with the kit. The prospect of assembling an hydraulic system may seem daunting, but with the components designed for these machines, no blowlamps, wrenches or similar tools of the plumbing trade are required. The fixed pipework is 8mm diameter flexible, clear polythene tube and the pipework on the arms is 5mm and 6mm flexible, clear nylon tube. The tube, which can be cut with scissors, is terminated with screw-on fittings (Figs. 6.2 and 6.3). The fittings which screw into the hydraulic cylinders are sealed with nylon washers whilst the larger fittings as used on the solenoid operated valves and non-return valve have tapered threads which are sealed by wrapping about 5 turns thin PTFE tape round them before screwing in.

After filling with oil, operation of the robots can be checked by applying 12V to the solenoids, either directly or via the Direct Solenoid Controller Board.

POWER-UP, TESTING AND CALIBRATION

There are several electronic units that comprise the robot system, and they are in some respects interdependent. That is, it will be difficult to test the boards in isolation, they have to be tested as a system. Wire up the interface board and the processor board (Tables 6.1–6.6). Do not insert any of the integrated circuits, other than the voltage regulators, which are soldered in anyway. Unplug index plugs PL2, 3, 5, 8, 9. Power-up the unit and test the supply rails. Check that you have two lots of +5V, a +12V rail (approximate) and a −9V rail. Refer to the circuit diagram of the interface board for these voltages. There should be very little current drain and so none of the components should be getting hot! Turn off the power and insert all i.c.s up to number IC7 on the interface board. Recheck the power supply rails. Turn off, and insert the rest of the i.c.s except IC21. Turn on and recheck the power supply rails. If everything is okay then the interface board has been safely powered up. There are a few things that can now be tested. IC5 pin 8, should be a low distortion sinewave of about 4Vpp amplitude, 100Hz frequency. The same sinewave will appear at IC6 pin 4 which is the power driver i.c. Pin 7 of IC5 is a stable voltage reference of +2·4V.

Now insert the i.c.s on the processor board. Power-up and test the supply rails. The heat sink on the interface board (+5V rails) will now begin to warm up but it should never

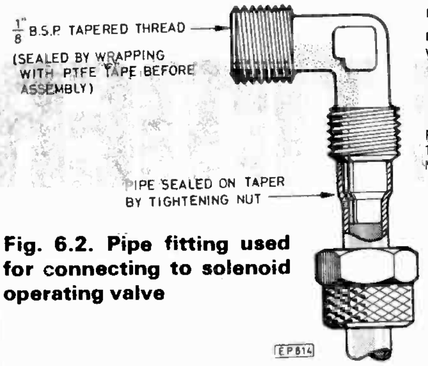


Fig. 6.2. Pipe fitting used for connecting to solenoid operating valve

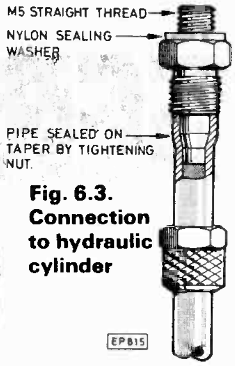


Fig. 6.3. Connection to hydraulic cylinder

Fig. 6.4. Processor Box PSU wiring

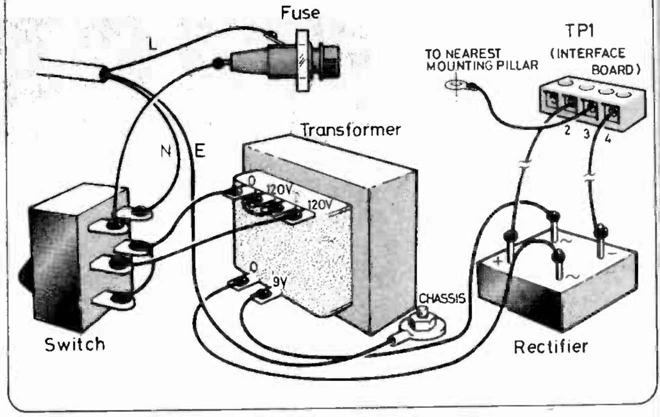


Table 6.1. Input wiring of Processor Box

Molex plug No.	DIN Skt pin	Signal
PL7–1	1	+12V
PL7–2	5	+5V
PL7–3	2	GND
PL7–4	4	—
PL7–5	3	DATA INPUT

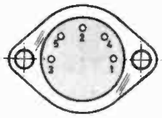


Table 6.2. Infra-red data link (Mobile only)

Molex plug No.	Receiver PCB No.	Signal
PL7–1	1	+12V
PL7–2	2	+5V
PL7–3	3	GND
PL7–4	4	–9V
PL7–5	5	DATA

Table 6.3. Display Board wiring

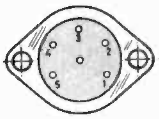
Molex plug No.	Display Board Pin No.	Signal
PL5–9	1	DA3
PL5–3	2	DAØ
PL5–10	3	GND
PL5–7	4	DA2
PL5–5	5	DA1
PL5–6	6	DA5
PL5–1	7	+5V
PL5–8	8	DA4
PL5–2	9	DA7
PL5–4	10	DA6

Table 6.4. Baud rate wiring

Molex plug No.	Switch Contact	Signal
PL11–1	12	9600
PL11–2	11	4800
PL11–3	10	2400
PL11–4	9	1200
PL11–5	—	—
PL11–6	—	—
PL11–7	8	600
PL11–8	7	300
PL11–9	—	—
PL11–10	c	select

Table 6.5. Interface Board wiring

Molex plug No.	Destination		Signal
PL1–1	Solenoid common		+Vcc
PL1–2	+ Vcc (bridge rectifier or battery)		+ Vcc
PL1–3	—		—
PL1–4	0V (bridge rectifier or battery)		GND
PL2–1	S3+		SOLENOID VALVE
PL2–2	S3–		SOLENOID VALVE
PL2–3	S4+		SOLENOID VALVE
PL2–4	S4–		SOLENOID VALVE
PL2–5	S5+		SOLENOID VALVE
PL2–6	S5–		SOLENOID VALVE
PL2–7	S1–		SOLENOID VALVE
PL2–8	S2+		SOLENOID VALVE
PL2–9	S2–		SOLENOID VALVE
PL2–10	—		—
PL3–1	M13–4L, M13–4R Motor board		GND (MOBILE ONLY)
PL3–2	M13–2L Motor board		BL (MOBILE ONLY B Left)
PL3–3	M13–1L, M13–1R Motor board		STOP left and right
PL3–4	M13–5L Motor board		AL (MOBILE ONLY A Left)
PL3–5	M13–2R Motor board		BR (MOBILE ONLY B Right)
PL3–6	M13–5R Motor board		AR (MOBILE ONLY A Right)
PL3–7	—		—
PL3–8	SØ+		SOLENOID VALVE
PL3–9	SØ–		SOLENOID VALVE
PL3–10	S1+		SOLENOID VALVE
PL8–1	RPD pin No. 20	Detector coil 4	
PL8–2	—	—	
PL8–3	—	—	
PL8–4	RPD pin No. 22	Detector coil 2	
PL8–5	RPD pin No. 23	Detector coil 1	
PL8–6	—	—	
PL8–7	—	—	
PL8–8	RPD pin No. 24	Detector coil 0	
PL8–9	—	—	
PL8–10	RPD pin No. 21	Detector coil 3	
PL9–1	RPD pin No. 17	+12V	
PL9–2	RPD pin No. 16	–9V	
PL9–3	—	—	
PL9–4	RPD pin No. 18	OSC	
PL9–5	RPD pin No. 19	GND	
PL10–1		GND	
PL10–2	—	—	
PL10–3		'6' spare analogue i/p	
PL10–4		'7' spare analogue i/p	
PL10–5		'8' spare analogue i/p	



240° DIN Socket (6 Pin)

Table 6.6. RS232 wiring

Molex plug No.	DIN skt pin	Signal
PL12–1	3	GND
PL12–2	2	$\overline{CTS}$
PL12–3	5	$\overline{RXD}$
PL12–4	4	RTS
PL12–5	1	$\overline{TXD}$
PL6–4	centre	RS232 Enable

become too hot to touch. The CMOS battery back-up will eventually charge up from 3·6V to 4·0V, but this may take an hour or so. A few things can be tested. The micro-processor should be generating a clock. Test IC1 pin 37; a 1MHz TTL level square wave should be generated. If the RS232 interface parts are fitted then the Baud rate generator can be tested. Test the wiper of the Baud rate selector switch. A TTL level squarewave at 16 times the Baud frequency will be seen. Next connect the position detector board into the system via molex connectors M8 and M9 on the interface board. There are 3 tags on the position detector coils. The braid of the screened cable goes to the common tag. As the coils are bifilar wound it does not matter which coil is the primary and which the secondary. Test the supply rails for a safe power-up and check for outputs which will be 100Hz sinewaves. The sinewave level will alter as the extension of the respective hydraulic actuator is changed. Next plug in the display board (molex connector M5). Upon power-up the bleeper will bleep several times. This will indicate that the program is to some extent operative. Pressing the Reset button on the processor board will repeat this event. Again recheck the supply rails. The next section to be tested is the Remote Control Unit. This will enable you to manipulate the robot and also to calibrate the presets in the system. There are two types of control unit: one is an infra-red device and the other is connected via a wire link. The infra-red unit has two analogue channels and an infra-red driver circuit, and is only intended for use with the M101 robot. All the test waveforms are shown in the timing diagram. Adjust VR1 for a clock frequency of 2KHz (IC10 pin 3). Presets VR2 to VR5 are only included on the M101 unit. Adjust VR2 so that the ramp waveform seen at IC8 pin 14 reaches a maximum of 2·4V. In fact, check that the Vref voltage *is* +2·4V. Put the steering pot (VR7) in its central position and adjust VR5 so that the potential on the wiper of VR7 is +1·2V. Repeat the procedure for VR3, IC8 pin 1, VR4 and VR6. These two circuits are both analogue to digital converters. VR6 and VR7 should produce full range changes in their output codes. This can be seen by monitoring the $\overline{Q}$ outputs of IC9 pins 2 and 12.

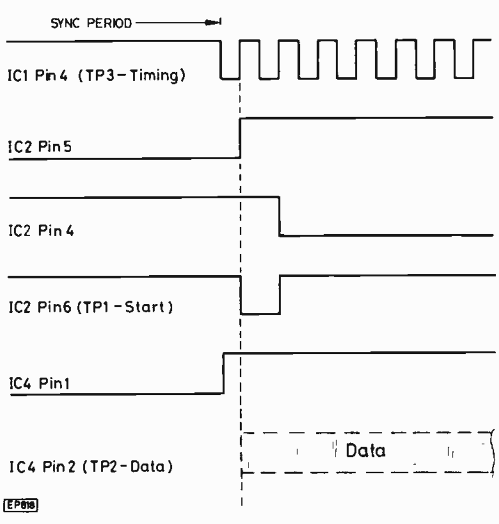


Fig. 6.5. Interface Board. Data decoding

INFRA-RED RECEIVER

Next the infra-red receiver, which is only used on the M101 unit is to be tested. Plug in the unit (molex PL7) and test the power supply rails. Check that the voltage regulator on the infra-red board is working. Check that the potential between the +12V rail and the emitter of T1 is 15V. Turn on the infra-red transmitter and point it at the receiver, using a separation of about three feet. You will be able to see the received data at IC1 pin 8 and IC2 pin 7. This data is then squared up by the comparator IC2 pins 1, 2, 3. Look at IC2 pin 1 and adjust VR1 so that nice clean waveforms are seen. Now move the transmitter away to a distance of 12 feet and readjust VR1 for the best output. The l.e.d. D5 will indicate that data is being received. You can use this as an indication of data being received. If you adjust VR1 so that it is too sensitive then the receiver will pick up noise and so generate erroneous commands. If you make it too insensitive, then the operating range will be limited. Optimum operation is at about twelve feet. Now that the manual control system is working the system can be tested. Connect the solenoids to the interface board via molex connectors PL2, PL3, plug in IC21 and power-up. For the M101 unit *do not connect the motor control* molex's PL13 as this may result in the robot dashing off and destroying itself! Upon power-up the robot arm may move which will indicate that there is life in the beast. Try out the manual control unit. Press SEQ+ a few times. The display should count up. SEQ– should make it count down. If nothing happens then test that the data is being received correctly, Fig. 6.5. Once this is working press EDIT on the control unit. The record l.e.d. on the display board will turn on and a bleep will be heard. Now you can directly manipulate the robot arm. Try moving the arm in all its axes. If nothing happens ask the following questions:

Is there any hydraulic pressure?

Can you hear the solenoid valves clicking on and off?

Is the common rail connected to the solenoids?

Do any control voltages appear at the solenoid drivers inputs (IC15 to 18, of the interface board)?

Do these voltages appear at the drivers output?

Are the drivers red hot?

DETECTOR CALIBRATION

When the arm actions are working it is then time to calibrate the detector circuits. Measure the voltage on pin 9 of the ADC chip (IC20). It should be +1·25V. The input range of the ADC should be twice this; that is 0V to +2·5V. Look at IC7A pin 14 and fully extend and then retract axis 0. The voltage at this point should move. Move the axis so that the voltage is at its most negative. Adjust VR2A so that the voltage is 0V. Now move the axis to its other extreme and adjust VR1A so that the voltage is +2·5V. Now return to the 0V end and readjust VR2A for an output voltage of –10mV, and then return to the +2·5V end and readjust VR1A for an output voltage of +2·51V. Now as the axis is moved, the position feedback voltage will change from –0·01V to +2·51V. Repeat this calibration process for all the other axes which have position feedback. The record mode can now be tested. Clear all memory locations. Enter EDIT mode. Move the robot arm to a position, Press INSERT. A bleep will be heard. Move the arm to another position, and press INSERT. This may be repeated until all 32 memory locations have been used up. When 24 have been used the memory full lamp will come on. When the sequence is complete, press the PLAY button. The robot will then step through the recording. The PLAY lamp will also come on. Press LOOP and the robot will repeat the sequence continuously. To use

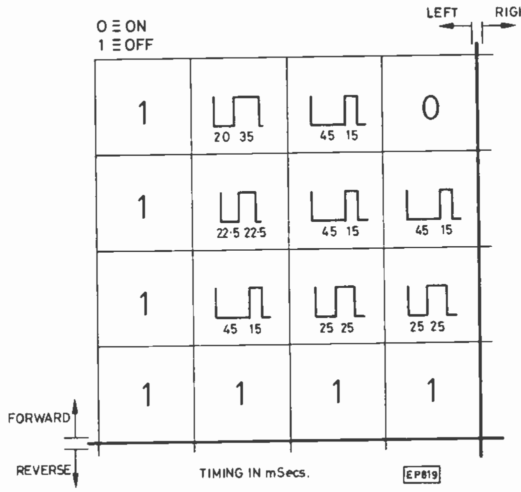


Fig. 6.6. Mark-space modulation chart. One of four quadrants (repeated symmetrically) Signal A

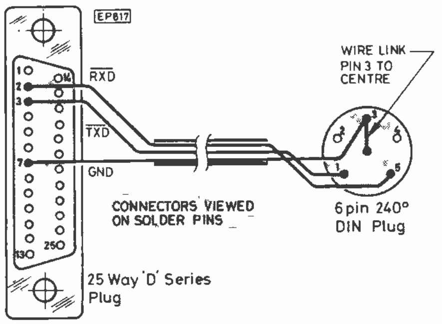


Fig. 6.7. RS232 lead. Note: The robot receives data on the $\overline{RXD}$ line, and transmits on the $\overline{TXD}$ line. It may be necessary to swap these two wires if your unit works the other way round

an external computer to control the robot, make up a lead as shown in Fig. 6.7. Plugging this in automatically puts the processor into RS232 mode.

When testing the motor control (M101 version only), jack the robot up in the air on blocks—*you don't want the thing zooming off leaving a trail of destruction!* Plug in the molex connectors (PL13) and turn on the power. Press MOTOR on the control unit. All three indicator l.e.d.s should turn on and the motors may start to rotate, this being determined by the speed and direction controls on the control unit. Centre the steering control and move the direction control. This should make the robot move forwards and backwards. There are three velocities which are obtained by using mark-space modulation. Steering is also obtained by using differential mark-space modulation, Fig. 6.6. Turn off the infra-red transmitter and the motors should stop. This is caused by the motor stop circuit IC2 pin 3 on the interface board which stops the robot when it travels out of control range. ★

THE MACROCHIP (page 28)

Did you fall for it? Puchemm & Long! Just remember, it is our April issue so please don't ring us for more details like BBC Wales did the last time we published on April Fool.

Thanks to our reader Iain James for sending this in.

FOOLED AGAIN! (page 14)

You may have noticed that PROLAFOIL is an anagram of a particularly seasonal phrase—try reading the name and address of the company backwards.

Strictly Instrumental

by K. Lenton-Smith

THE American Federal Trade Commission once asserted that a certain inventor's claim that his instrument was an "organ" and that it could produce an "infinite number" of tone combinations was questionable.

The inventor, a quiet person who normally kept out of the limelight, decided to contest the government. The Trade Commission decided on an impartial panel which would listen to both an expensive pipe organ and the electric organ in question to see whether they could detect any difference. Both players were hidden from view and the speaker cabinets were concealed among the organ pipes in the Rockefeller Chapel, University of Chicago.

The jurors heard a number of test pieces played on these instruments and their answers were wrong in 10 cases out of 30. The organ's inventor was vindicated: it had been accepted as a true musical instrument. The Commission decided that the electro-mechanical device could be termed an organ but the company concerned should desist from claiming an infinite number of tones — as it could only produce 253,000,000!

THE ORGAN MAN

The year was 1937 and the inventor was Laurens Hammond. It was probably a turning point for electronic music (though Hammond called them electric organs) and was an enormous achievement in many ways, especially considering amplifier and speaker systems of the day.

Very few people have been responsible for *creating* an industry: George Eastman and Henry Ford are examples in other fields but undoubtedly Laurens Hammond laid the keel for the electronic music industry we have today. Born in 1895, he took an interest in engineering from an early age. He proposed a method of automatic transmission to the Renault Motor Co. when 14 years old and graduated from Cornell University with a degree in mechanical engineering in 1916. He served with the American Expeditionary Force in the First World War, acting as interpreter to the Commander, General Pershing.

Back in civilian life, Hammond became chief engineer to a marine engine concern but worked on his own ideas privately. Appropriately enough, his mother's maiden name was Idea Strong. His first success, a 'tickless clock', provided money enough to set himself up in business.

MOTOR

His mind turned to making a motor that would revolve in phase with the 60Hz supply: having succeeded, he found that a patent had been filed elsewhere. Even so, he discovered an application for his small, efficient motor and applied for his first patent — a three-dimensional movie system. Public interest was intense but only for a short period, despite his simplifying the method by using red and green spectacles (anaglyph principle).

Another early idea was a 'power pack' for operating dry battery receivers from the a.c. supply. This project went well — until complaints started to flood in that the convertors were exploding and throwing acid over furniture and carpets! He was next to concentrate on perfecting a mains-driven electric clock and in 1928 formed the Hammond Clock Company. Profits soared over three years but the Depression saw not only his competitors going out of business but his own clocks being given away as a promotion for Wrigley's chewing gum.

Determined to survive, he produced a device for shuffling playing cards into four heaps: built into a bridge table, it was priced at $25 but even at this level was difficult to sell when money was scarce.

Because of his connections with the cinema, he noted the revival of interest in the pipe organ. Used for accompanying the films of the day, cinema organs grew in complexity as more and more effects were required for silent movies. The quest for larger instruments culminated in the mammoth organ in the Convention Hall, Atlantic City: installed in 1932, it had seven manuals, over 1200 stops and 32882 pipes.

FLUTE

Surely, the organ was a product that could benefit from his synchronous motor, he reasoned. As a child, Hammond had seen the Teleharmonium (the first complex-tone generator), knew its principles and was determined to build a smaller and highly reliable instrument. After lengthy experimentation, he managed to produce a flute tone by using his motor to drive a contoured steel wheel in front of a permanent magnet.

Like those before him, he had produced an electrical waveform but he had also found out how it could be converted to a musical sound: the tiny current from a winding on the magnet was fed into a radio amplifier (the valve by now being well established). The very next day, he and his team began to explore the possibilities of conventional musical tones by electric synthesis.

Trial and error convinced him that 91 tone wheels were sufficient to produce all the musical sounds familiar to the ear. Accurate gearing had to be evolved for the twelfth-root of two ratios between tonewheel shafts but this was not a particularly difficult task for a clock company. An old piano keyboard was wired so that partials could be keyed with fundamentals — a veritable cat's cradle! Hammond's concept of an invention was coloured by his experience as a manufacturer: the product had to be rugged. The eventual solution was to key nine pitches and allow the player to mix these as he wished.

TRAILBLAZER

The patent for Model A was filed in 1934 and the instrument first available early in 1935. Many famous musicians bought the Model A, priced at $1250: though small compared with a pipe organ, the cost was three times that of a Plymouth car in 1935. The Model B was produced in 1936 (merely a change in cabinet styling) and it was the claims for this organ that led to the story heading this article. Because very few organs from other origins existed at the time, the Hammond Organ was by now a household word for a new and exciting experience in music.

Harmonic synthesis methods were used from the earliest Hammonds but the first purely electronic synthesiser was produced in 1939 — the Novachord. Another idea from the fertile mind of Laurens Hammond, this six-octave keyboard instrument was capable of producing woodwind, brass, plucked and bowed strings, piano and organ tones. Based on master oscillator and divider strings with a wide range of envelope control and harmonic content, the Novachord was extremely popular in the field of broadcasting at the time.

His next instrument appeared in 1940. This was the Hammond Solovox, with a three-octave keyboard (capable of six octaves) designed to supplement the piano. Small dance bands used these instruments, attached below the piano keyboard, to add extra solo voices (of which it had 12) to the ensemble.

During the war years, the company produced large numbers of organs for the allied services and was also designing and manufacturing flight control systems, gyroscopes, light and infra-red sensing equipment and aerial cameras.

The few commercial organs available at the time had not been designed for use in the home as a first priority. Wartime servicemen had developed a taste for the Hammond, so the company decided to introduce the very first home spinet model in 1949 — the first of the M Series. Ethel Smith was among the many famous instrumentalists who helped to popularise these small, self-contained models. Their great success prompted other manufacturers to follow suit.

By 1953 organs had outstripped clock manufacture, so the name was changed to the Hammond Organ Company. Laurens Hammond was determined to maintain his lead in the field and expanded his engineering staff. New instruments continued to make their appearance, percussion being introduced on Models B–3, C–3 and the M Series spinets. A self-contained console model, A–100, dispensed with the PR–40 tone cabinet required by earlier console organs. Model RT, a full concert instrument, was introduced and had an unique pedal solo system combining the synthesis methods used in the Novachord and Solovox.

The energetic founder retired in 1960, leaving others to continue the concern to which he had given so much impetus.

THE CHIP

Theatre organ sounds with an ultramodern pedestal console were introduced with the X–66 in 1965. The X–77 was produced in recognition of the influence of jazz organists: essentially this was a new version of the popular B–3 but with extra tonal facilities and power output.

The beginning of the company's watershed was in 1967, when the J–Series all transistor organs first appeared: these were the first all-electronic tab-controlled Hammonds. The Piper Autochord made its debut in 1970 as the first automatic chording instrument: the circuitry provided the bass line so no pedals were fitted.

LSI circuitry was first incorporated in the Phoenix organ in 1972. This was a tab-controlled organ but later that year the Concorde became the first LSI/drawbar instrument. Many Hammond enthusiasts averred that nothing would ever equal the sound from tonewheel generators although I was impressed when I heard this organ at its presentation concert.

The company had to march with the times — the call for greater portability and consideration of the steeply rising costs of precision engineering. In turning from tonewheels to LSI, the company had created its own challenge: it handled that situation with flair, as subsequent models have proved.

No doubt Laurens Hammond was also pleased that this radical changeover had been so successful as this happened a year before his death in 1973. He left behind him a massive international industry, part of which bears his name and has continued in his inventive vein with the success and prestige it has always merited.

Readout...

Calling Members

Sir—Congratulations on your excellent stand at 'Breadboard 81', and I am only sorry that your fascinating Robot was not handing out B.A.E.C. forms, so obviously it was not programmed correctly!

I would appreciate it if you could mention in your very popular magazine the following B.A.E.C. members, as unfortunately their addresses have been mislaid, and I am holding for them a complete set of the B.A.E.C. 982 Newsletter.

O. Josephs (BE 81544)
R. P. Horne (BE 81546)
J. R. Woods (BE 81548)
A. Brookman (BE 81550)

If any of these members see this announcement, I would appreciate it if they would contact me at the address given below and send me their membership card, and address, of course, and I will then forward them their complete sets of 1981 Newsletters.

I appreciate your help, and would like to congratulate you on your excellent magazine for electronics enthusiasts.

Cyril Bogod,
B.A.E.C.
"Dickens",
26 Forrest Road,
Penarth,
S. Glam.

Too Much Detail?

Sir—Since you have stated from time to time that you welcome feedback from readers, may I make a few comments which may be helpful.

General layout is good and regular features such as Market Place, Microbus, Spacewatch, etc. are obviously of greater or less interest to readers depending upon their outlook.

The weakest point so far comes in the constructional projects. It looks as if these are being presented in their full length merely in order to pad out the magazine. Are you really so short of material? To take one current example, how many readers are actually going to build an industrial robot? Very few I imagine. An article on the current state of the art, such as the first in the series, could have usefully been followed by an outline description with a block diagram of the available kits. It was hardly necessary to give such very detailed instructions unless it was to save the kit maker the cost of printing.

A similar criticism must also apply to other projects i.e. Ranger, etc. and Bandbox appears to be going the same way.

If you print p.c.b. layouts then how about a good article about making them from magazine articles. You seem to have ignored this, at least in the last three or four years. This could be linked with an offer from one of your advertisers.

The index to each volume is welcome but would be of much more use if it was a pull-out. Surely this is not too difficult to arrange?

CB? Yes, well it is in the news at the moment but don't go overboard, there are plenty of specialist mags dealing with it. In any case it will soon be the domain of a small band of enthusiasts. Remember the skateboard?

I hope these remarks have been of some use. I do not despair of the magazine entirely. If I did I would not have bothered to write to you. Best of luck for the future.

I. R. L. Morom,
Redditch.

Thanks for your comments—we are always pleased to see constructive criticism of this kind.

When I first took over as Editor of PE some four years ago, I felt (as you do) that much of the constructional information could be dispensed with. I was quickly put right by many readers who pointed out that this was the strength of PE. You would perhaps be surprised how many readers want even more constructional information on all our projects! Don't forget that in many cases there would be no kits without the magazine articles to launch them. We are not short of material, but we will not lower our standards just to cram more in. However, we have now managed to add to the number of editorial pages to give us a little more space for everything.

Point taken on p.c.b.s; what are other readers feelings on a pull-out index? Remember it would then take four pages rather than the two-and-a-half it took last year. Rest assured we won't go over the top on CB—Ed.

Unsatisfactory Update

Sir—When I first started reading Practical Electronics, it seemed to me that Semiconductor Update was one of the most useful features in the magazine. Until, that is, I tried to get some of the components described therein.

Take the November 1981 column for example. It describes an 8-channel, automatic-sampling ADC chip, the AD7581, that "does not cost an arm and a leg". This device sounds so good that it probably makes all other ADCs of equal accuracy obsolete, but so far as the hobbyist is concerned, it doesn't cost anything because it isn't obtainable. I picked this one example because it happens to be a device I would use, but the same is true of nearly all devices featured in Semiconductor Update.

A possible solution would be for you to give retailers who advertise in PE some advance notice of which devices are to be featured in Semiconductor Update, and then to mention in the column the names of any retailers who expressed an interest in stocking those devices. This isn't a perfect answer, but it would probably be better than the present unsatisfactory situation.

Dr. N. J. D. Jacobs,
Brentwood,
Essex.

The problem is that companies are not willing to stock items that may not sell—and who can blame them. If 'Update generates an interest then suppliers will take stock.

Of course many items mentioned are only just on the market—we like to be "up to date"—and it is often some time before they are available even from industrial distributors.—Ed.

MICRO PROMPT

The hardware and software exchange point for PE computer projects

SIMPLE SAVE BY NAME

Sir—This program enables you to name all your programs and load them back from tape by name. It will work on both the UK101 and Superboard 11 computers.

To use it just add two lines to your programs both Rem's the first contains the program name the second is just padding.

eg: 5 REM NAME# (Enclose the*
6 REM program name
*with * and #)*

After putting these two lines at the beginning of your program save in the usual way.

ie: Type SAVE (return) then LIST (return).

The program will then be stored on tape. When the computer comes back with OK stop the tape, type PRINT "POKE 515, Ø" restart the tape and press return. (This is used when loading back the program to switch off the load flag to stop any other information being loaded.)

If you use the same line numbers in your programs as in SEARCH program, not only will it load but while loading the SEARCH program will be automatically deleted leaving the entire memory for use.

```
 10 REM *SEARCH#
 20 REM
 30 FORX = 1TO24: PRINT: NEXT:
    INPUT "Programme name"; N$
 40 PRINT "Press play on tape"
 50 FORT = 1TO3000: NEXT:
    PRINT "Searching for"; N$
 60 X$ = " ": F = 0: CA = 61440:
    POKE515, 1
 70 WAIT CA, 1: P = PEEK (CA + 1)
 80 IFF = OANDP <> 42THEN70
 90 IFP = 42THENF = 1: GOTO70
100 IFP = 35THEN160
110 IFP= 32THEN70
120 IFLEN(X$) > 7THEN60
130 X$ = X$ + CHR$(P): IFX$ <>
    N$THEN70
140 POKE515, 0: PRINT "Loading";
    X$
150 GOTO180
160 POKE515, 0: PRINT "Found '";
    X$; "'"
170 GOTO60
180 LOAD
OK
RUN
```

```
Programme name? 3D
Press play on tape
Searching for 3D
Found 'SEARCH'
Found 'HEX'
Loading 3D
```

D. I. Swift,
Doncaster.

SECRET SCREENWRITING

Sir—I wonder if your readers would be interested in a simple extension of the "secret" key polling sub-routine by J. M. Leach of Deal, Kent, for the UK101 published last March.

This program based on the New Monitor allows you to write direct to the screen with full control of the cursor, viz:

RUB OUT: Moves Cursor LEFT: Retyping corrects any mistakes
CTRL RUB OUT: Moves Cursor UP
SPACE: Moves Cursor RIGHT
CTRL=/—: Moves Cursor DOWN
RETURN: Moves Cursor to LEFT margin and DOWN one line ie. carriage return.

```
10  GOSUB 100
15  REM HAS RETURN BEEN
    ENTERED?
20  IF A = 13 THEN 60
25  REM HAS RUB OUT BEEN
    ENTERED?
30  IF A = 28 THEN 62
35  REM HAS CTRL RUB OUT
    BEEN ENTERED?
40  IF A = 220 THEN 64
45  REM HAS CTRL =/— BEEN
    ENTERED?
50  IF A = 237 THEN 66
55  ? CHR$(A); : GOTO 10
60  ? CHR$(10); : ? CHR$(13); :
    GOTO 10
62  ? CHR$(8); : GOTO 10
64  ? CHR$(11); : GOTO 10
66  ? CHR$(10); : POKE 10
100 POKE 11,0 : POKE 12,
    253 : X = USR(X) : A = PEEK
    (531) : RETURN
```

CTRL L Clears the screen as normal and returns the cursor to the home position (top left hand corner). This program allows messages to be displayed on the VDU and changed as required.

The alteration of line 55 to 55? A; : ? CHR$(A); : GOTO 10 allows the values of A to be printed out so that new IF A = "" statements can be devised.

Revd. P. R. Miller,
Milton Keynes.

SOFT INVERSE VIDEO

Sir—By connecting the circuit shown in Fig. 1, to the video circuit of the Compukit, software control of inverse video is possible, which extends the flexibility of the already extensive graphics. Programs can then include routines for displaying selected areas of the screen inversely (black letters on white background).

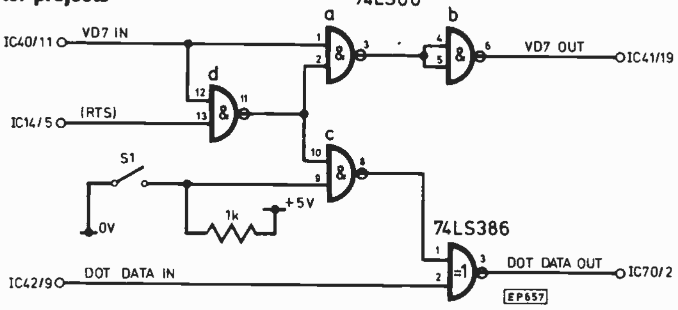


Fig. 1. Selective inverse video. S1 gives full field inverse, which could be made into another software option by using a second latch

This is achieved by inserting an exclusive OR gate in the video line between IC42 and IC70. Its inverting input is controlled by software, operating a latch (this may be the inherent latch in IC14 RTS as shown in Fig. 1, or from a latch provided by any of the published Compukit Extension Projects).

The display data line 7 (VD7) is used for selectivity. When the latch (RTS) is low, VD7 in = VD7 out and the display is normal. When (RTS) is high AND VD7 in is high, then VD7 out is low. Characters having a value above 127 are reduced in value by 128 and displayed inversely.

This is shown by the following program which displays "UK101" in black, onto a white rectangle, below which is displayed "UK101" in white.

```
5 FOR I = 1TO16 :?:NEXT
10 A = 53400 : POKE 61440,81
20 FOR I = A + 64 TO A +79: READ
B
30 POKE I,B: POKE I+ 320,B:
NEXT:GOSUB 100
40 A=A+64 : GOSUB 100: A=A+64:
GOSUB 100
50 GOTO 50
60 DATA32,32,85,32,75,32,32,32,49,32,
48
70 DATA32,49,32,32,32
100 FOR I = A TO A + 15 : P =
PEEK(I)
110 P = P+ 128: POKE I, P: NEXT:
RETURN
```

Line 10 operates (RTS) latch and line 110 puts VD7 high over selected rectangle. Normal video can be restored by Warm Reset or in program by Poking 61440,17

AUTO-RUN

Sir—When loading a BASIC program it is tedious to have to wait until the program is loaded from cassette to avoid loading unwanted noise at the end.

Typing POKE515,0:RUN followed by Return in immediate mode after the program has been SAVED, records the latter on the tape. The recorder is then switched off, and on loading the program, the LOAD flag is turned off, and the program RUNS AUTOMATICALLY.

Roger Darbishire,
King's Lynn, Norfolk.

CEGMON COMPATIBLE TRACE

Here is a trace program for UK101 which runs under CEGMON without destroying the printing format. It should also run on the Superboard and under other monitors, providing the CTRL C routine is at HEX FB94. It takes advantage of the fact that BASIC stores any number to be output at locations HEX 0100 to 0105 in decimal digits.

After you've cold started, try this:

FOR I=256 TO 261:? CHR$ (PEEK(I));: NEXT

The result will be the last number output, i.e. the number of free bytes. The program is adapted from the one in the CEGMON manual.

0294	A9	FF		LDA	£FF	
0296	85	5F		STA	5F	
0298	A9	80		LDA	£80	
029A	85	64		STA	64	set CTRL 0 flag (don't print)
029C	20	53	B9	JSR	B953	force current line no. into 0100–0105
029F	A2	05		LDX	£05	
02A1	BD	00	01	LDA	0100,X	get digits of line no. and
02A4	9D	36	D0	STA	D036,X	'poke' to top right corner of screen
02A7	CA			DEX		
02A8	D0	F7		BNE	02A1	
02AA	C6	64		DEC	64	reset CTRL 0 flag
02AC	4C	94	FB	JMP	FB94	do CTRL C check (exit)

If your screen is not 48 characters wide, then byte 02A5 can be changed from HEX 36. HEX 20 should suit even a 25 column screen.

As the program is in page 2 of memory, it is unaffected by a COLD START. It can be moved elsewhere but for ease of use it should start at XX94, i.e. any memory location ending in 94. As listed, it is turned on by POKE 541,2 and turned off by POKE 541,251. When a BASIC program is running, the current line number will be displayed at the top right corner of the screen, and the extra routine does not slow program execution too much, even in a long FOR–NEXT delay loop.

A simple modification will permit single-stepping line by line through a program, waiting until a key is pressed before going to the next line. Make the following changes:

02AC	20	00	FD	JSR	FD00	wait for key to be pressed
02AF	4C	94	FB	JMP	FB94	do CTRL C check (exit)

As the program occupies only 27 bytes, it's hardly worth putting it on cassette. Enter the program by RESET M 0294 then enter each byte (HEX pair) followed by RETURN. You can then COLD or WARM start as required.

Here is a subroutine which can be called from BASIC, which will scroll the screen contents down instead of up. This has applications in games where it is desired to create an impression of moving forward through obstacles, or of falling missiles etc.

To use the scroll-down routine from BASIC, try

10 POKE 11,204 : POKE 12,2
20 FOR I = 1 TO 32 : X = USR(X) : NEXT

or for new BAS 1/3 chips:

10 FOR I = 1 TO 32 : CALL 716 : NEXT

To scroll diagonally, POKE 727 with 63 or 65 before calling the routine. It works by loading every screen byte in sequence starting at the bottom, and storing it at a location which is greater by HEX 40 (64 decimal). It ends when the byte loaded is CF, which is what it sees when it leaves the top of the screen, despite the fact that there are no memory locations from CFOO to CFFF.

02CC	A0	FF	LDY	£FF	
02CE	A9	00	LDA	£00	
02D0	85	13	STA	13	
02D2	A9	D7	LDA	£D7	(D3 for 16 line screen)
02D4	85	14	STA	14	
02D6	A9	40	LDA	£40	
02D8	85	15	STA	15	
02DA	A9	D7	LDA	£D7	(D3 for 16 line screen)
02DC	85	16	STA	16	
02DE	B1	13	LDA	(13),Y	
02E0	C9	CF	CMP	£CF	
02E2	F0	0B	BEQ	02EF	
02E4	91	15	STA	(15),Y	
02E6	88		DEY		
02E7	D0	F5	BNE	02DE	
02E9	C6	14	DEC	14	
02EB	C6	16	DEC	16	
02ED	D0	EF	BNE	02DE	
02EF	60		RTS		

As it stands, the contents of the top line will be left over the other lines. An extra routine to clear the top line is:

02F0	A2	40		LDX	£40
02F2	A9	20		LDA	£20
02F4	9D	00	D0	STA	D000,X
02F7	CA			DEX	
02F8	D0	FA		BNE	02F4
02FA	60			RTS	

POKE 11 with 240 to let X=USR(X) know where to jump.

The following gives an effect of travelling through stars:

```
10 S=53248 : N=5
20 FOR I=0 TO N*RND(1) : POKE
   S+63*RND(2),46 : NEXT
30 CALL 716 : CALL 752 : POKE S,32 :
   GOTO 20
```

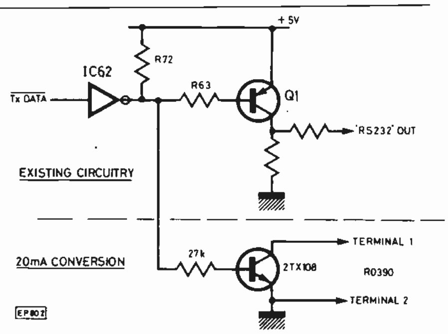
This works nicely even if the direction of scrolling is altered during the execution of the program, by POKEing 727 with 63 or 65, depending on which SHIFT key is pressed.

David Henniker, Edinburgh.

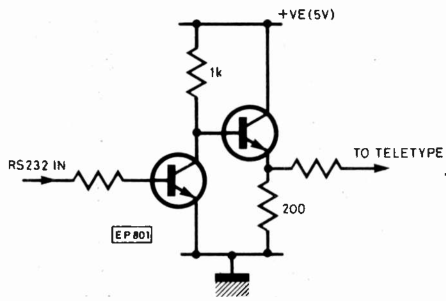
390 SUGGESTIONS

UK 101-to-Data Dynamics 390 problems? Try the following:

1) Make either 110 Baud rate mod' of March/June 1980. Break connection between IC62/12 and R72/R63, then reconnect R72/R63 to Tx DATA (IC62/13), to remove data inversion. At the inside rear of the 390 is a 4-terminal block. Connect twin cable to the two left-hand terminals (facing block). Other end of the cable to pins 3 and 7 of J3 (RS232 out). A reduction in value of R65 cures any drop-outs. *M. C. Saltmarsh, Chelmsford.*



2) To obtain the required voltage swing from Compukit's serial output, the following circuit is recommended by *S. Burton, York.*



3) Clock IC57 from C5. Connect IC58/4 to IC58/5. Break between IC57/12 and IC58/4. ACIA will now transmit at 110 Baud. The 390 may require buffering and inverting. A circuit is supplied by *B. J. Hill, Birmingham.*

VIDEO CONVERSION

By D. P. GOULDER

THE UK101 displays 48 characters per line on 16 lines. This conversion allows the user to select an optional 48 × 32 format. The characters become much more legible, and the doubling of the vertical resolution on display is a useful improvement when plotting graphs or drawing diagrams. Program listings provide double the information per page.

The VDU RAM is increased from 1K to 2K bytes, and is controlled by a modified version of the *new* monitor PROM, so that the line edit facility is available.

In order to check that the display being used has enough resolution for 32 lines, take IC60 pin 12 to +5V momentarily: two identical 16 line pages are displayed.

This conversion includes a means of selecting the three different monitor PROMS, (old 16 line, new 16 line, and new 32 line). Whilst Reset is held, this switch may be operated without losing programs.

One p.c.b. would be required; 8 new i.c.'s and the new PROM are required. Power can be obtained from the existing PSU.

HARDWARE

The current machine has 1K VDU RAM from DØØØ to D3FF. The hardware counting chain scans this onto the screen. C7 is not used, so each horizontal line is repeated (see p7, Fig. 2 in the manual).

The converted machine has 2K VDU RAM, DØØØ to D7FF. C7 is now used, and C14 is used to select between the two half pages, DØØØ–D3FF and D4ØØ–D7FF. All the other counters are used as before.

A three way switch is provided to select between the three monitors. Six t.t.l. i.c.'s, two 2114's (for the extra RAM) and a new 2716 EPROM are required. If Reset is held while switching monitors, followed by warm start, programs are not lost. Thus program development can be carried out with 32 lines while setting up display graphics for 16 lines eg. for games.

IC102 and IC103 switch the counter outputs from IC60, 61 and 30 so that C7 is brought into use for 32 lines. They are activated by the three way switch. A change is needed to the $\overline{VA}$ signal generated by IC56 (currently active low when DØØØ–D3FF selected, to enable the CPU to access the VDU RAM). IC56/2 is taken to +5V, instead of A10. $\overline{VA}$ becomes $\overline{VA}'$ active for DØØØ–D7FF, $\overline{VA}'$ is used to activate IC105, which takes the place of the switch formed by pins 9, 10, 11 of IC55. IC104 is used to decode A10 and $\overline{Ø2}$ into the memory select signals $\overline{M1S}$, $\overline{M2S}$, for the two page "halves".

The $\overline{RVE}$ and $\overline{WVE}$ signals also have to be changed to $\overline{RVE}'$, $\overline{WVE}'$ to allow 2K VDU RAM. IC106 provides this decoding replacing part of IC20's function.

IC101 provides six inverters required in various places in the circuit. IC107–110 are the 4 VDU RAM chips (two of which are already on the main p.c.b.: IC39, 40).

Besides the connections for data and address lines to the VDU RAM and the ROM'S, some 25 connections have to be made to the main p.c.b. along with a number of track cuts. (The prototype board is "piggy-backed" on two pillars on the main p.c.b. and the connections made with ribbon cable). The track cuts are needed to disconnect the lines from IC60, 61, 30 to

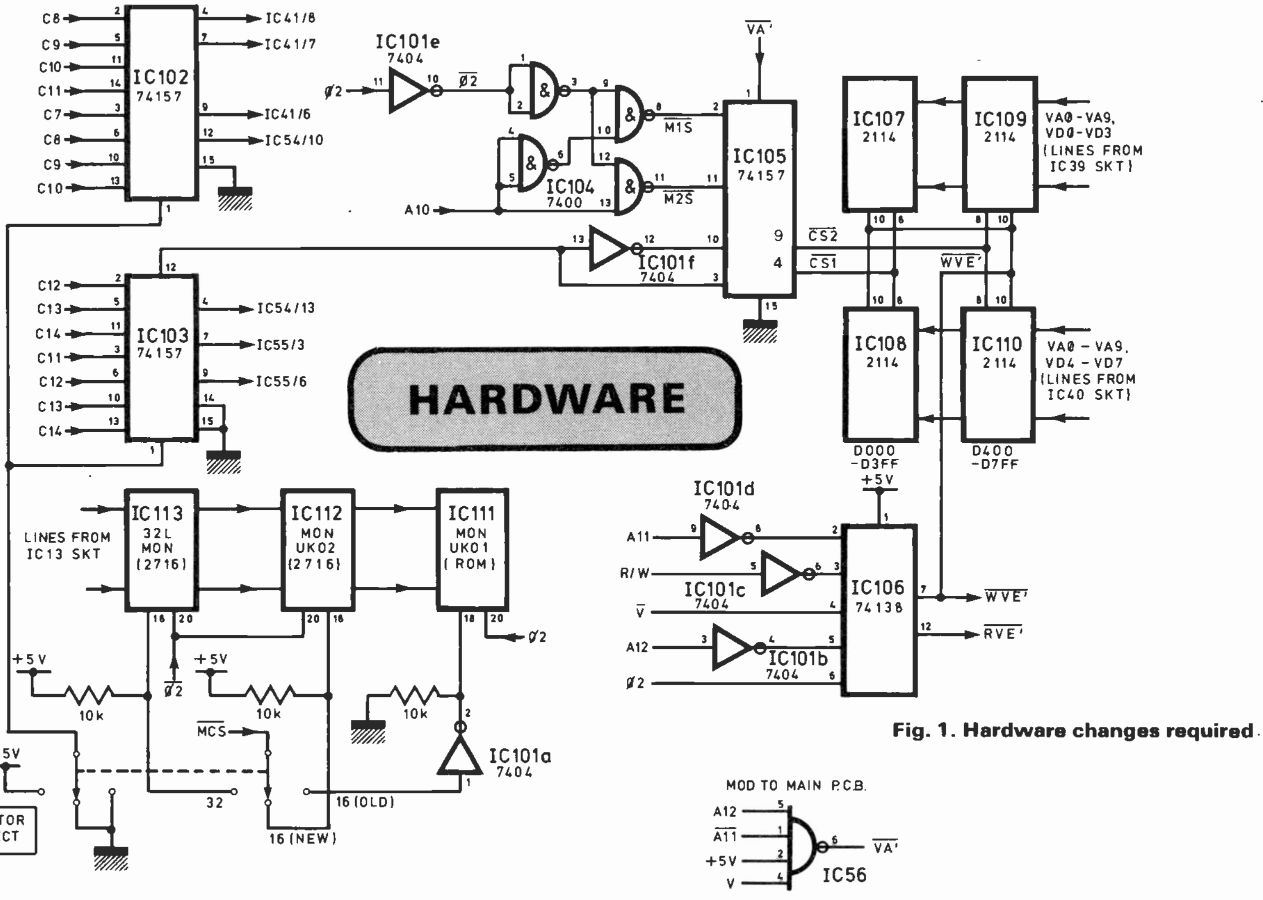


Fig. 1. Hardware changes required

IC41, 54, 55, and to disconnect A10 from IC56, and WVE, $\overline{WVE}$, $\overline{RVE}$.

SOFTWARE

The program in the new monitor requires alteration to:

Screen print routine — to allow 32 lines

Clear screen routine — to allow 32 lines (and optionally remove the scroll when the top of the screen is blank)

More Display

Up one line routine — to allow 32 lines

Form Cursor Address routine — to allow 2K VDU RAM

A total of 36 bytes require to be altered.

The firmware changes required are detailed below. The new program should be put into a 2716 (2K) EPROM, using the same address as the existing monitors (F8ØØ–FFFF).

The monitor program is completely unchanged except for the 36 bytes detailed.

Additionally, the byte at FB5B (currently FF) can be changed to ØØ if desired. This removes the rather irritating scroll up on the screen every time the top line becomes blank for any reason.

POWER SUPPLY

No problems have been found driving the new board from the existing PSU, although the regulator is already mounted on a large heat sink outside the case. A simple 5V, 1A PSU using a 7805 3-terminal regulator could however be constructed if required. All the i.c.'s should be LS types.

CIRCUIT

The sockets for IC39, 40 were used to obtain the VDU data and address lines. Similarly, the socket for IC13, to obtain connections for the monitor ROM and PROMS.

The pin connections for +5V and 0V to all the i.c.'s are also listed below.

Ribbon cable forms a suitable flexible means of interconnection between the boards.

GENERAL

The prototype is made up on a piece of veroboard, about 205 × 102mm, with the i.c.'s all on d.i.l. sockets. Quite a bit of wiring is involved, so careful checking of all connections is essential.

A few 100n ceramic capacitors should be connected between +5V and 0V to aid decoupling.

Fig. 2. Firmware changes required

POWER

+5V	IC101/14, IC102/16, IC103/16, IC104/14 IC105/16, IC106/16, IC107–IC110/18, IC11–IC113/24
0V	IC101/7, IC102/8, IC103/8, IC104/7, IC105/8 IC106/8, IC107–IC110/9, IC111–IC113/12

CONNECTIONS TO NEW BOARD

IC60/12 (C7)
IC60/11 (C8)
IC61/14 (C9)
IC61/13 (C10)
IC61/12 (C11)
IC61/11 (C12)
IC30/14 (C13)
IC30/13 (C14)
IC56/6 ($\overline{VA'}$)
IC18/5 ($\overline{V}$)
IC8/22 (A12)
IC8/20 (A11)
IC8/19 (A10)
IC8/39 (Ø2)
IC8/34 (R/W)

—ALL INPUTS TO NEW p.c.b.

IC41/8
IC41/7
IC41/6
IC54/10
IC54/13
IC55/3
IC55/6
$\overline{RVE'}$—CONNECT IN PLACE
$\overline{WVE'}$—OF EXISTING $\overline{RVE}$, $\overline{WVE}$

—OUTPUTS FROM NEW p.c.b.

(PLUS 5V, ZERO VOLTS)

VA0–VA9, VD0–VD7 (FROM IC39, 40 SOCKETS)

ALL CONNECTIONS FROM MONITOR (IC13) SOCKET, EXCEPT PINS 18, 20

IC19/6 ($\overline{MCS}$) FOR MONITOR SELECT SWITCH

—BUS CONNECTIONS

SOFTWARE CHANGES (TO NEW MONITOR)

ADDRESS (ABSOLUTE)	ADDRESS (PROM)	CHANGE BYTE FROM	CHANGE BYTE TO (HEX)	ROUTINE
FACA	2CA	1Ø	2Ø	SCREEN PRINT
FAF1	2F1	1Ø	2Ø	
FB2D	32D	D4	D8	CLEAR SCREEN
FB61	361	D4	D8	MOVE DISPLAY
FB85	385	D3	D7	UP ONE LINE

NEW ROUTINE

Delete routine from FB8D (38D) to FBAB (3AB)
(This routine forms the cursor address and stores it in ØØE3, ØØE4)
REPLACE WITH:

```
FB8D  38D  A9  1A     LDA  #$1A
      38F  85  E4     STA  $E4
      391  AD  Ø8 Ø2  LDA  $Ø2Ø8
      394  ØA         ASL  A
      395  ØA         ASL  A
      396  ØA         ASL  A
      397  ØA         ASL  A
      398  26  E4     ROL  $E4
      39A  ØA         ASL  A
      39B  26  E4     ROL  $E4
      39D  ØA         ASL  A
      39E  26  E4     ROL  $E4
      3AØ  6D  Ø7 Ø2  ADC  $Ø2Ø7
      3A3  69  ØD     ADC  #$ØD
      3A5  85  E3     STA  $E3
      3A7  6Ø         RTS
      3A8  EA         NOP
      3A9  EA         NOP
      3AA  EA         NOP
FBAB  3AB  EA         NOP
```

TRACK CUTS (ORIGINAL p.c.b.)

DISCONNECT CONNECTIONS BETWEEN:

IC60/11 (C8)	AND	IC41/8
IC61/14 (C9)	,,	IC41/7
IC61/13 (C10)	,,	IC41/6
IC61/12 (C11)	,,	IC54/10
IC61/11 (C12)	,,	IC54/13
IC30/14 (C13)	,,	IC55/3
IC30/13 (C14)	,,	IC55/6
IC56/2	,,	A10
IC20/12	,,	$\overline{RVE}$
IC20/7	,,	$\overline{WVE}$

MODIFICATION ON ORIGINAL p.c.b.

CONNECT IC56/2 TO +5V

SOFTWARE

telectric Electricity COST MONITOR

STEPHEN DAY B.Sc. C.Eng. M.I.E.E.

PART TWO

DETAILS of the display p.c.b. are shown in Figs. 9, 10, and 11. All links through the board should be soldered first and those underneath the l.e.d. displays should be cropped short on the component side. The top end of each seven segment display is marked with a coloured spot. The pins for attaching the connecting wires to the main p.c.b. are inserted from the component side so that they protrude inwards from the front panel. The legs of the push buttons are left full length and are also used to solder the connecting wires onto.

FRONT PANEL CUT-OUTS

Dimensions for the cut-outs in the front panel are shown in Fig. 12. The shape of the cut-out for the 13A socket can be adjusted to suit any particular make. The best way to mark out the front panel is first to cover it with strips of masking tape. This can then be drawn on and it also protects the surface from scratching during cutting. The rocker switch S1 is fitted through from the front of the panel before soldering the connecting wires to it. The display p.c.b. is held in place by making two plastic brackets from the spare plastic cut from the front panel holes as in Fig. 13. These are glued together with instant (cyanoacrylate) glue and then to the back of the front panel during final assembly after testing.

Fig. 14 shows how $1\frac{1}{2}$ turns of the neutral lead to the 13A socket are wound onto the current transformer after removal of the low voltage winding with a knife or wire cutters. Correct loading of the current transformer was discussed in Part 1 of this article. The voltage developed across the load resistor should be measured with a high impedance meter >10k or else using an oscilloscope when the peak to peak voltage will be $2{\cdot}83 \times$ r.m.s.

THE MICROPROCESSOR

The 8035 microprocessor is one of a range of single chip microcomputers first manufactured by Intel. The internal architecture of the chip is shown in Fig. 15. The program counter contains the address of the next location to be read from the program memory. The contents of this memory location are decoded in the instruction decode register and then the instruction is executed, which might be to increment one of the data registers or to use the ALU to logical AND the accumulator with data contained in the next bytes of the program, etc. There are in fact nearly one hundred different instructions which the 8035 will execute making programming straightforward and efficient in program memory usage.

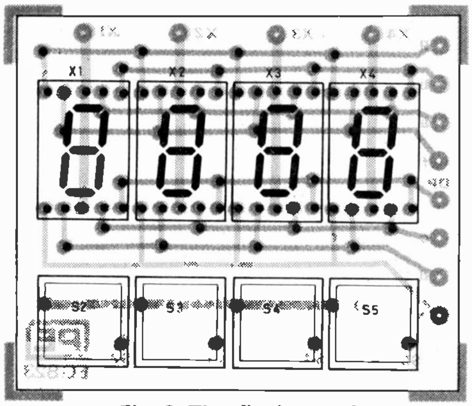


Fig. 9. The display p.c.b

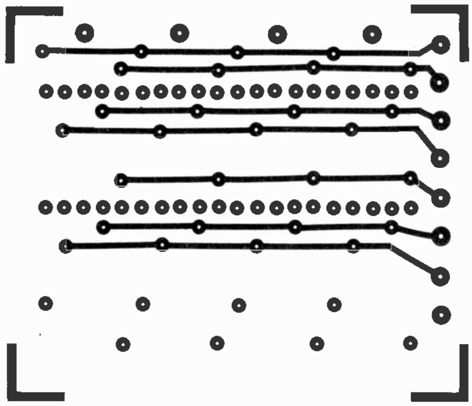


Fig. 10. P.c.b. topside

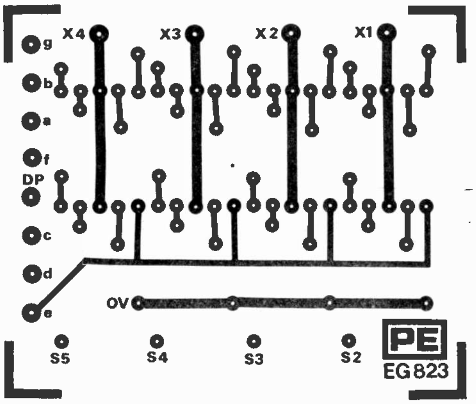
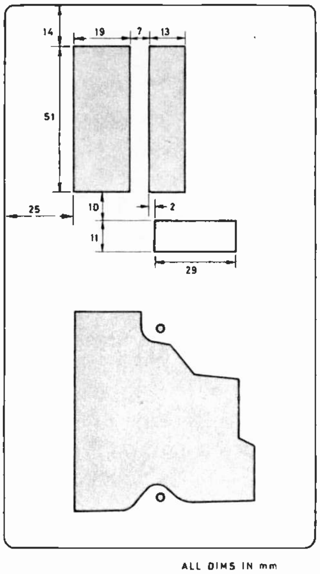


Fig. 11. P.c.b. underside



EG822

Fig. 12. Front panel cut-outs

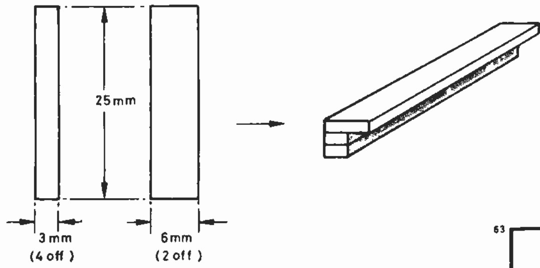
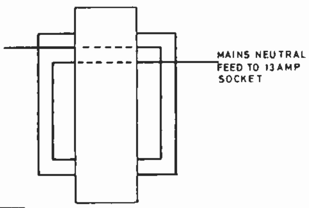


Fig. 13. Making brackets to hold display p.c.b

EG831



EG832

Fig. 14. Winding current transformer primary

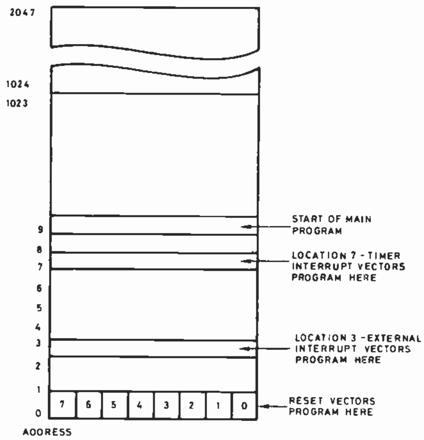


Fig. 17. External program memory map

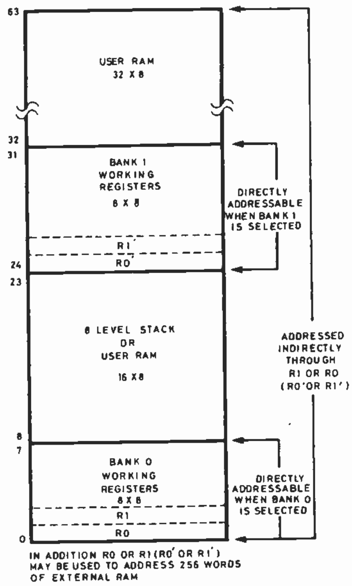
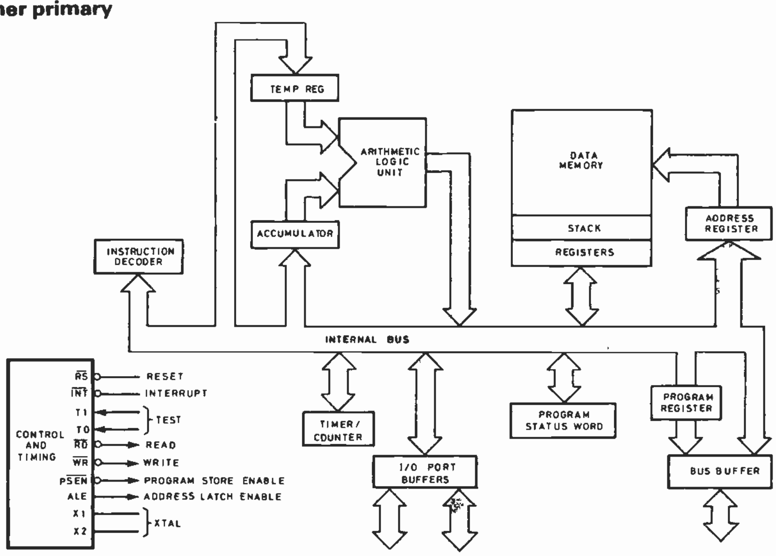


Fig. 16. Chip data memory



EG829

Fig. 15. Internal architecture

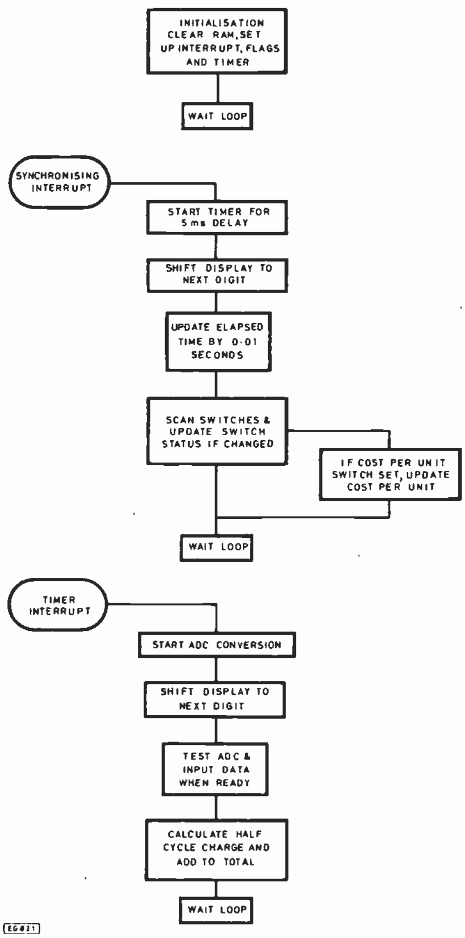


Fig. 20 (right). Software flowchart

EG821

The on-chip data memory is 64 bytes and the division of this into two working register banks, stack and user RAM is shown in Fig. 16. The addressing modes for access to this memory area are also shown. The program is stored in EPROM and certain locations are reserved for special functions as shown in Fig. 17. When power is switched on the reset pin is held low by a capacitor until it has charged up and then the processor gets its first byte of program information from location zero. This will be a jump instruction to the start of the main program. As this is a two byte instruction, location 1 is also accessed.

The test inputs are provided which can be used to

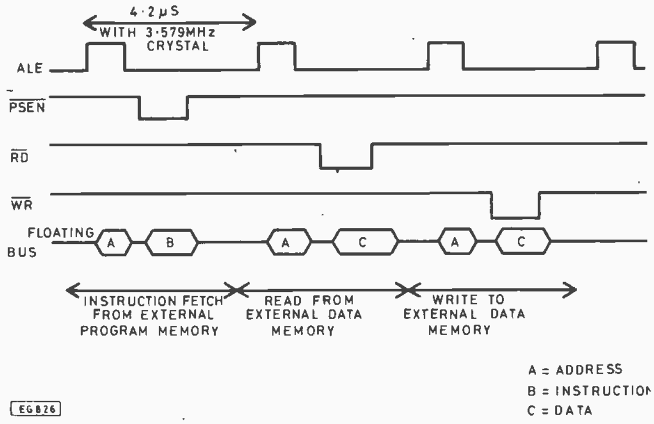


Fig. 18. Timing of external memory control signals

monitor external functions, the T1 input being used to test when the ADC conversion is complete. A low input to the interrupt pin causes the processor to terminate its current program sequence, store the next program address on the stack and then jump to location 3 where it gets the address of the interrupt service routine.

The relative timing of the external memory control signals is shown in Fig. 18. The falling edge of the address latch enable is used to strobe the address into the latch for both external data and program memory cycles. Program store enable occurs only during a program memory fetch and is used to enable the tri-state output buffers of the EPROM. The read and write signals are used to strobe data to or from external data memory.

In this particular implementation the two I/O ports are used to drive the display so that data from the ADC and the switches is read by considering them to be external data memory (memory mapped I/O). Also, as there are only two devices to select, a single address line can be used for each (a technique known as linear selection). This makes decoding easy as it is necessary to have only address line zero low for the ADC (address = 11111110) and address line one low for the switches (address = 11111101).

THE A/D CONVERTER

The ADC 0804 is a CMOS, 8-bit, successive approximation A/D converter with an accuracy of ± 1 bit and it will convert with an input voltage in the range of 0 to 5V in about 100 microseconds. It has control signals and a bus drive capability which makes it directly compatible with the 8035 microprocessor. The timing diagram of Fig. 19 shows how it is controlled. When addressed with $\overline{CS}$ low, a $\overline{WR}$ pulse starts the conversion and $\overline{INTR}$ goes low when the

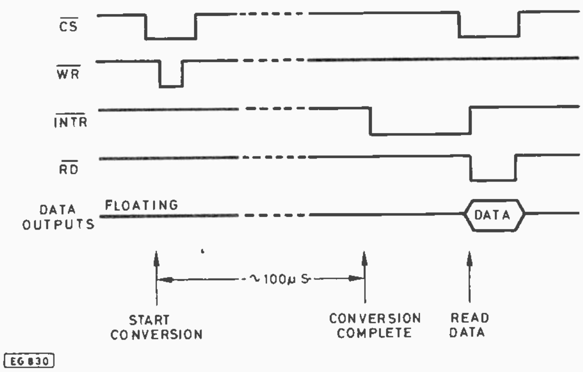


Fig. 19. A to D conversion timing

conversion is complete. This is tested by the micro and the data is read from the outputs by addressing with $\overline{CS}$ and $\overline{RD}$ low.

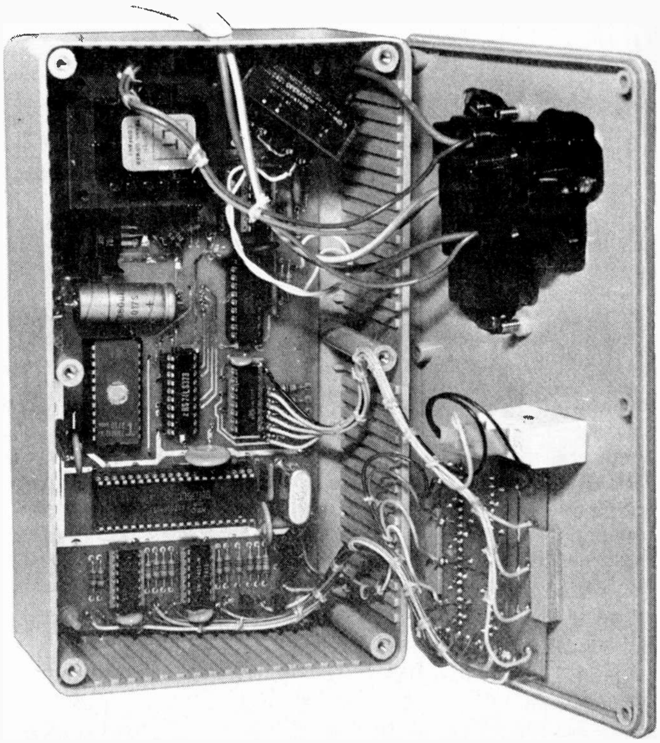
THE SOFTWARE

The flowchart of Fig. 20 shows diagrammatically all the functions which must be implemented in the software. When power is turned on, the initialisation routine is first executed, which ensures that data memory is cleared and that the display buffer contains the letters E, n, t, for the initial display. The internal flags are set and interrupts enabled. The processor then waits for the first interrupt by a sync pulse. When this interrupt occurs, the on-chip timer is loaded with a count value which will give a delay of 5 milliseconds in order to locate the peak of the sinusoidal mains voltage waveform and the counter is started. The next function is to change the data at output port 1 for the next digit in the display and then to shift the active bit of port 2 along one place to turn on this digit. The elapsed time is updated by one hundredth of a second.

Finally, before entering another loop to wait for the timer, the switches are scanned. If it is found that the switch conditions have changed, no immediate action is taken. Instead, the new switch condition is confirmed on the next mains cycle, 10ms later, to allow switch bounce to settle. The time to execute the above sequence is about 2ms so that there is a wait of 3ms for the timer to count out.

When the timer interrupt occurs, the ADC is started. The display is then updated as before and, as this is done every 5ms, it gives a flicker free multiplex frequency of 200Hz. The ADC is tested and when it is ready the digitised value of the current is read in via the bus. The sequence is completed by calculating the incremental charge for this half cycle and adding it to the running total for display. This calculation requires a four digit by four digit BCD multiplication and the time to execute this part of the program is about 3·5ms so there is a further wait of 1·5ms before the next sync pulse interrupt and the whole process is repeated.

Kits of parts and complete Telectrics are available for purchase. See advert in this issue for details. Although construction is straight forward, a full service facility will be provided for anyone who has problems. ★



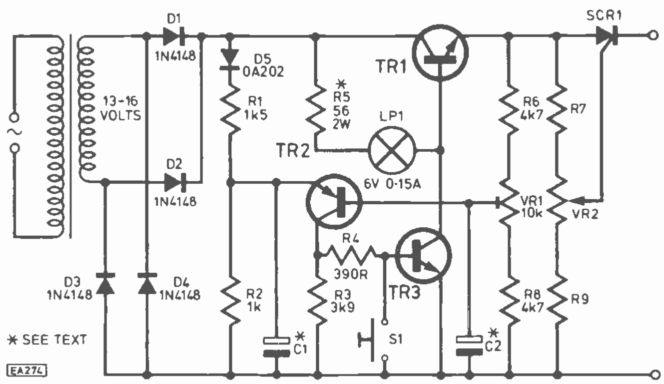
A selection of readers' original circuit ideas.

Why not submit *your* idea? Any idea published will be awarded payment according to its merits.

Each idea submitted must be accompanied by a declaration to the effect that it has been tried and tested, is the original work of the undersigned, and that it has not been offered or accepted for publication elsewhere. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought.

Articles submitted for publication should conform to the usual practices of this journal, e.g. with regard to abbreviations and circuit symbols. Diagrams should be on separate sheets, not inserted in the text.

OVERLOAD CUTOUT FOR THYRISTOR SPEED CONTROL



THIS circuit was designed to protect a thyristor-based model railway speed control. When the current drawn exceeds the value set by VR1, the supply is cut off completely, and remains off until reset by S1. The circuit is fast acting—it will close down for a short-circuit at very low speed settings—thus providing some protection against running an engine up to a set of 'closed' points.

TR1 is a conventional series regulator, but with deliberately poor regulation, so that the emitter voltage falls as the set maximum current is approached. TR2 compares the collector and emitter voltages of TR1. As the voltage on VR1 slider falls, TR2 switches on, switching on TR3, and shunting TR1 base current. The voltage on TR1 emitter falls further, and the process continues until TR1 is completely cut off.

C1 and C2 require some care in selection, since they provide partial smoothing of the voltages across TR2. C2 = 10µ gives a rapid response: C1 should be selected from nominal 100µ items to give minimal a.c. voltage across TR2 base-emitter at the chosen current limit.

Although VR1 gives a fair range of adjustment, the value of R5 may need to be altered for wide variations. The value shown provides a range of about 0·5 A to 2 A, at the expense of high power dissipation in TR1 near the current limit. For current limits above about 1 amp, the value of R5 should be decreased, in order to limit dissipation.

The transistors selected are as follows:

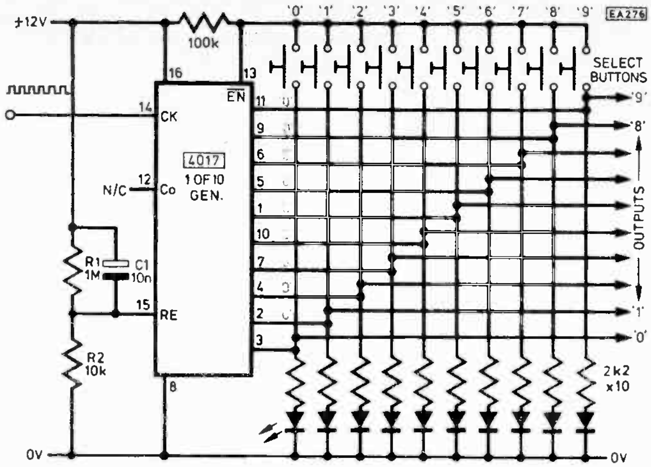
TR1—depends on current limit. A 6 W device will supply up to $1\frac{1}{2}$ A; a 15 W type up to 2 A.

TR2—any of ACY 17 to 21 or BCY 30 to 34 will do.

TR3—any of BFY 50, 51 or 52.

W.S. Lymath
South Wirral
Cheshire.

BUTTON SELECTOR



OFTEN it is desirable to replace the function of a rotary multi-position switch with the equivalent in push buttons. The advantages are evident in the push button car radio, where it's better to jab than to twiddle.

The circuit presented here performs the same 1 of n selecting function as the multi-position switch, whilst similarly cancelling previous selections.

The circuit uses the 4017, 1 of 10 selector, but one can easily make it into a 1 of less-than-ten, by just ignoring superfluous components.

Assume the last button to be pressed was the '0' button (or that the unit has been reset). A logic '1' will be standing on the No. 3 pin, the '0' l.e.d. will be alight, and all other outputs will be low.

If now the No. 4 button is pressed. Because the '10' pin and its associates are low, a low will be put on the otherwise high ENABLE-bar input. This will allow the unit to start clocking. When the logic '1' output steps up to the ten pin, it disenables the '13' pin, by placing a logic '1' on it. It remains so, whether or not the finger remains on the button.

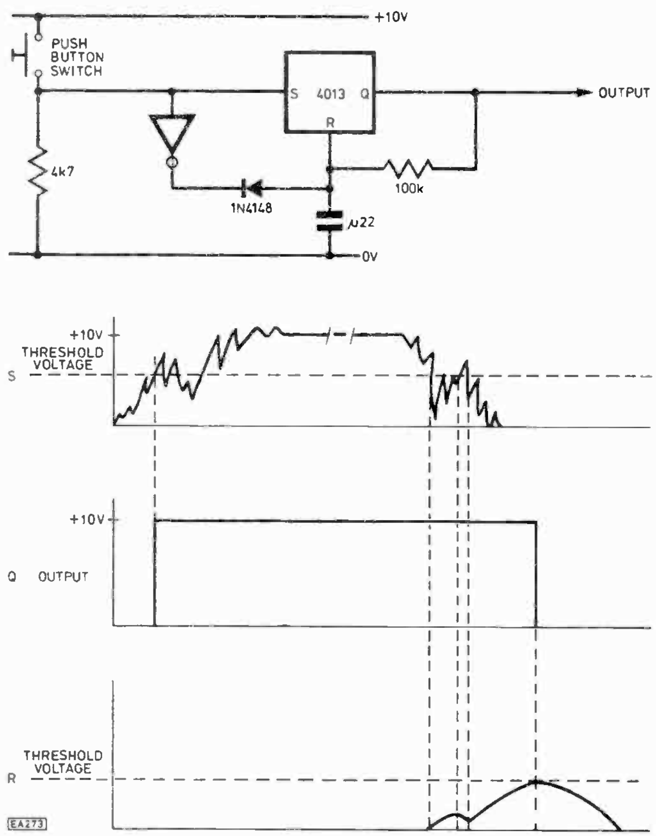
Thus we have a 1 of n, self cancelling, remembering, data selector.

The unit has a self resetting function at switch-on, via the components R1, R2 and C1. By delivering a pulse to pin 15, it causes the stepper to stand with the '0' output line high, and all others low.

For eight or less outputs, the slightly cheaper 4022, 1 of 8 counter may be substituted.

Ron Mellor
Peakhurst,
New South Wales.

SWITCH DE-BOUNCE



DURING the design and construction of a TV pattern generator, I decided to use electronic switching of the video output patterns. The device used was a CMOS 4013 decade counter. The clock input is a simple push button switch. In anticipation of nasty switch bounce problems, I devised this circuit shown. The aim is to set a latch when the switch is closed and not permit it to reset until after the switch has been released.

When the switch is closed the Q output of the 4013 will become latched up. An inverter and diode will prevent the reset input from going high. When the switch is released, the set input will bounce back to a low state and the inverter output will go high, permitting the Q output to charge up the capacitor on the reset input through the 100k resistor. When this charge reaches the threshold level of the reset input, the Q output will be reset and the circuit will be ready to do some more debouncing. The graphs, show the input and output voltages. The choice of time constant 220n × 100k is arbitrary and subject to variation, depending on how bad the switch is.

B.T. Black
Upper Stratton
Swindon

OCTAVE BANK FOR VCOs

THE use of multi-turn potentiometers for tuning the VCOs in synthesisers such as the Minisonic 2 is often not suitable for live performance situations. The octave bank described here gives quick, accurate and temperature stable octave switching.

The circuit consists of a Zener diode reference voltage, a resistor ladder and a buffer amplifier. The Zener value chosen is 5·6V since at this voltage the diode has an almost zero value of temperature coefficient, making the reference very stable. This voltage is then applied to the resistor divider which provides eight voltages at equal intervals from zero to −7V, the slider of VR1, the multi-turn cermet preset, being used as the −7V reference. The amplifier then provides buffered outputs at one volt intervals, which can be fed into the control nodes of the VCOs to be controlled.

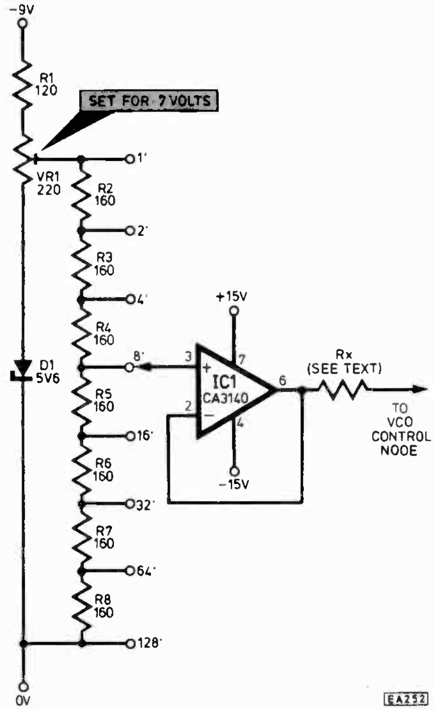
The circuit is designed for use with synthesisers having a 1 volt/octave control law and thus for the Minisonic 2 the standard summing resistor of 47k should be used for R_x. For synthesisers having a different control law relationship, R_x can be replaced by a preset of a suitable value, this can also be used to make the 'octave' span variable.

The circuit requires a stablised supply of −9V and will draw just under 15mA from the rail.

All resistors should be 1% metal oxide or cermet film, if possible those in the ladder should be selected to be as close as possible. VR1 should be a cermet multi-turn preset potentiometer. The value of the summing resistor R_x is especially critical as this determines the actual span of the octaves provided by this circuit to the controlled VCOs. Trimming can be effected by replacing R_x with a cermet multi-turn preset potentiometer, in the case of the Minisonic 2 the value would be 100k.

In order to control more than one VCO, additional contacts should be added in parallel with S1, and a buffer amplifier/voltage follower as for IC1 added per extra oscillator.

Martin Russ,
Manchester.



SOUND-TO-LIGHT CONVERTER

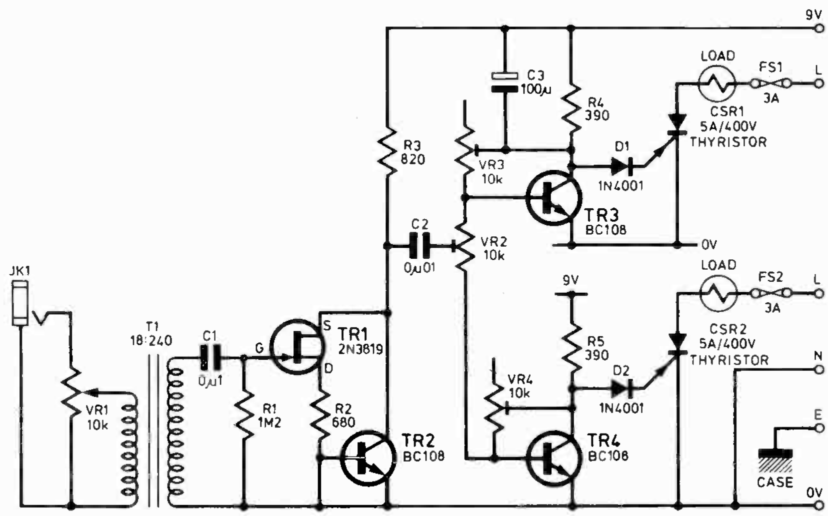
THIS circuit evolved from an idea in *(PE)* July 1976, for a simple sound to light converter in which the light was turned off in time to the music. This circuit is incorporated as one of the lamp drivers.

The potentiometer VR1 acts as a master level control for the unit which is connected directly to a loud-speaker. The transformer is used to protect the 'speaker' in the event of any short circuits. Transistors TR1 and TR2 form a buffer amplifier, the output of which is fed to VR2. This preset adjusts the balance between the two lamp drivers.

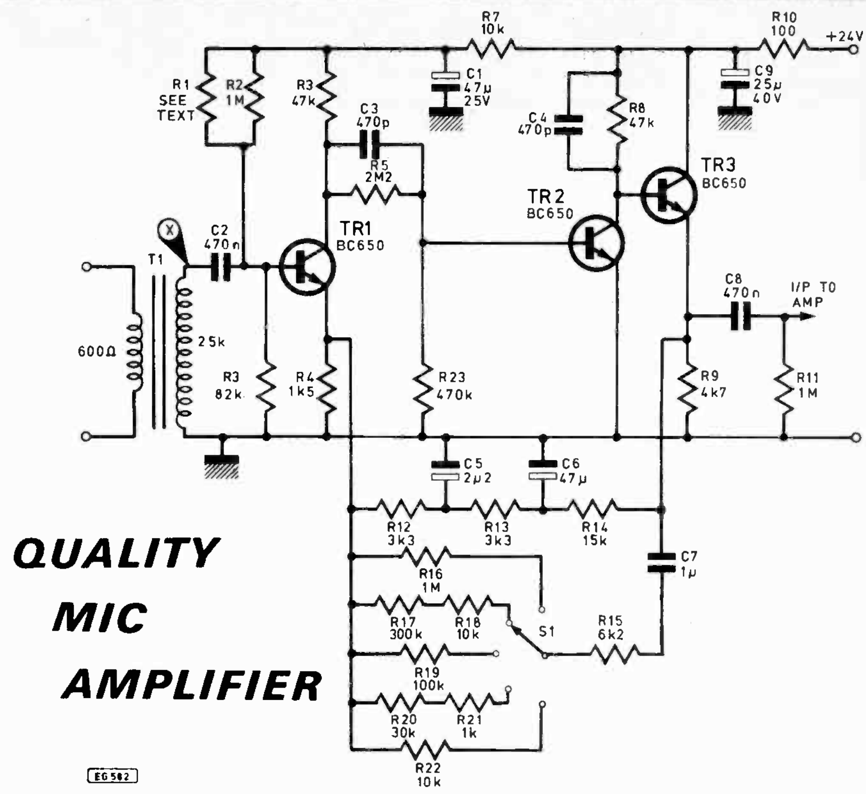
The bias on the driver transistors TR3 and TR4 is set by VR3 and VR4 respectively, and C3 ensures that the thyristor is normally turned on.

With the bias presets correctly set, careful adjustment of VR2 will yield a very pleasing light display when different coloured bulbs are used for each channel.

A. W. Cunningham,
Leven,
Fife



QUALITY MIC AMPLIFIER



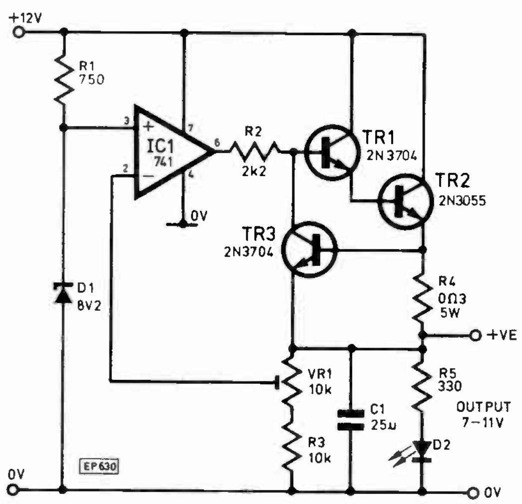
THIS amplifier has a frequency response of 20Hz to 25kHz, with a noise figure of –62db, making it suitable for high fidelity applications. As will be seen, the output impedance is low, by virtue of the emitter follower, and may be connected via a (screened) lead to other equipment. If required the input transformer may be omitted, and microphones of 47/50k used in an unbalanced input arrangement, connected directly to the point marked 'X' on the circuit diagram. Using high impedance microphones will mean that the input lead must not be much longer than about 1 metre, otherwise the high frequencies will tend to become attenuated, and the input will be more susceptible to hum problems. The amplifier should be powered from a well smoothed, low impedance supply.

The input transformer used in the prototype has a turns ratio of 6·45:1. This represents a bonus because it gives a voltage gain in the order of 16db, and since the transformer does not contribute noise the input to the amplifier is increased by 16db before the possibility of any noise arises. The first transistor base feed resistor R1, as will be seen, is 1M. In most cases this resistor on its own will be found to be too high a value, in order to obtain symmetrical clipping of the output. This should be experimentally paralleled with values of 2M2 or upwards. Using an oscilloscope, and before fitting the input transformer, check with a 1kHz tone fed into the point 'X' that a resistor is chosen that gives a symmetrically clipped output. Once this has been established, it may be permanently soldered in. If a tone generator and oscilloscope are not to hand the 1M resistor may be used alone; however, the overload point will be reached more quickly.

The a.c. part of the feedback loop has a five way switch in series to select different series resistors. The overall gain is thus selectable from 20db to 60db in 10db steps. The resistors for the 30db and 50db positions will have to consist of two preferred values in series, as the actual values are unobtainable through normal retail outlets, and if more than one amplifier is to be built, it is suggested that they be 2% tolerance to match the gains. R.f. interference is inhibited by means of the 470p in parallel with the collector load of the second transistor. The fairly high values of base and collector resistance around the first two stages help to keep the noise down by reducing the d.c. current flow. The 1M at the output ensures there is no d.c. voltage on the output of TR3.

Tony Sercombe,
Surbiton, Surrey.

9V POWER SUPPLY



THIS unit was originally designed to run battery driven items requiring 9V or less from a 12V car supply. The voltage output is adjustable and stable over wide load fluctuations—up to the current limit of the 2N3055 provided the sinking on this is adequate.

The Zener provides a stable reference at pin 3 of IC1 and VR1 is adjusted to provide the output voltage.

Output from the i.c. is applied to TR1–TR2 turning on the latter sufficiently to maintain a constant voltage at the output irrespective of load. The output current flows through R4, which is made up of resistance wire. The design limit is fixed by the value of this resistor and when the load current reaches this the voltage developed switches on TR3 which in turn closes down TR1 and TR2.

S. A. R. Guest,
Grampound,
Truro.

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	1X012	12 + 12	1 25		
	1X013	15 + 15	1 00		
	1X014	18 + 18	0 83		
	1X015	22 + 22	0 68		
	1X016	25 + 25	0 60		
	1X017	30 + 30	0 50		
50 VA 80 × 35mm 0 9 Kg Regulation 13°	2X010	6 + 6	4 16	£5 83 + £1 10 P P	£4 93 + £1 10 P P
	2X011	9 + 9	2 77		
	2X012	12 + 12	2 08		
	2X013	15 + 15	1 66		
	2X014	18 + 18	1 38		
	2X015	22 + 22	1 13		
	2X016	25 + 25	1 00		
	2X017	30 + 30	0 83		
	2X028	110	0 45		
	2X029	220	0 22		
	2X030	240	0 20		
80 VA 90 × 30mm 1 Kg Regulation 12%	3X010	6 + 6	6 64	£6 51 + £1 43 P/P	£5 47 + £1 43 P/P
	3X011	9 + 9	4 44		
	3X012	12 + 12	3 33		
	3X013	15 + 15	2 66		
	3X014	18 + 18	2 22		
	3X015	22 + 22	1 81		
	3X016	25 + 25	1 60		
	3X017	30 + 30	1 33		
	3X028	110	0 72		
	3X029	220	0 36		
	3X030	240	0 33		
120 VA 90 × 40mm 1 2 Kg Regulation 11%	4X010	6 + 6	10 00	£7 55 + £1 43 P P	£6 38 + £1 43 P P
	4X011	9 + 9	6 66		
	4X012	12 + 12	5 00		
	4X013	15 + 15	4 00		
	4X014	18 + 18	3 33		
	4X015	22 + 22	2 72		
	4X016	25 + 25	2 40		
	4X017	30 + 30	2 00		
	4X018	35 + 35	1 71		
	4X028	110	1 09		
	4X029	220	0 54		
	4X030	240	0 50		
160 VA 110 × 40mm 1 8 Kg Regulation 8%	5X011	9 + 9	8 89	£9 92 + £1 43 P P	£8 44 + £1 43 P/P
	5X012	12 + 12	6 66		
	5X013	15 + 15	5 33		
	5X014	18 × 18	4 44		
	5X015	22 + 22	3 63		
	5X016	25 + 25	3 20		
	5X017	30 + 30	2 66		
	5X018	35 + 35	2 28		
	5X02E	40 + 40	2 00		
	5X028	110	1 45		
	5X029	220	0 72		
	5X030	240	0 66		

TYPE	SERIES No	SECONDARY Volts	RMS Current	PRICE inc VAT	PRICE ex VAT
225 VA 110 × 45mm 2 2 Kg Regulation 7%	6X012	12 + 12	9 38	£[illegible] 83 + £1 73 P P	£10 06 + £1 73 P/P
	6X013	15 + 15	7 50		
	6X014	18 + 18	6 25		
	6X015	22 + 22	[illegible]		
	6X016	25 + 25	4 50		
	6X017	30 + 30	3 75		
	6X018	35 + 35	3 21		
	6X026	40 + 40	2 81		
	6X025	45 + 45	2 50		
	6X033	50 + 50	2 25		
	6X028	110	2 04		
	6X029	220	1 02		
	6X030	240	0 93		
300 VA 110 × 50mm 2 6 Kg Regulation 6%	7X013	15 + 15	10 00	£13 67 + £1 73 P/P	£11 66 + £1 73 P/P
	7X014	18 + 18	8 33		
	7X015	22 + 22	6 82		
	7X016	25 + 25	6 00		
	7X017	30 + 30	5 00		
	7X018	35 + 35	4 28		
	7X026	40 + 40	3 75		
	7X025	45 + 45	3 33		
	7X033	50 + 50	3 00		
	7X028	110	[illegible]		
	7X029	220	[illegible]		
	7X030	240	1 25		
500 VA 140 × 60mm 4 Kg Regulation 4%	8X016	25 + 25	10 00	£18 17 + £2 05 P/P	£15 53 + £2 05 P/P
	8X017	30 + 30	8 33		
	8X018	35 + 35	7 14		
	8X026	40 + 40	6 25		
	8X025	45 + 45	5 55		
	8X033	50 + 50	5 00		
	8X042	55 + 55	4 54		
	8X028	110	4 54		
	8X029	220	2 27		
	8X030	240	2 08		
625 VA 140 × 75mm 5 Kg Regulation 4%	9X017	30 + 30	10 41	£25 10 + £2 20 P P	£21 54 + £2 20 P/P
	9X018	35 + 35	8 92		
	9X026	40 + 40	7 81		
	9X025	45 + 45	6 94		
	9X033	50 + 50	6 25		
	9X042	55 + 55	5 68		
	9X028	110	5 68		
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MOBILE SERVICE IN SPACE

From time to time mention has been made in *SPACEWATCH* of the plan to service satellites in orbit or retrieve them from their orbits and carry out service on board a space station or even aboard the Shuttle as well as return them to Earth. This is now a well advanced pilot programme. A vehicle module has already been operated in simulated conditions for this work at heights of 300m.

The task is directed in the first instance to the servicing of the Solar Maximum Mission spacecraft which is already degraded. It is expected that the space shuttle astronauts will be the first to use the system. The date set is 1983. As with much of the space programme the whole scheme is dependent on the funding available.

The procedure adopted for the servicing activity will be as follows. The Shuttle will approach the spacecraft to be serviced and stand off at a distance of about 300 feet. The astronaut will be deployed from the orbiter and dock with the satellite. Manoeuvering jets will be used to stabilise the satellite and the astronaut will attach him/herself to the satellite, then call for the orbiter manipulator arm to dock with the special attachment placed by the astronaut. When the orbiter takes over, the astronaut will detach and fly by the side of the satellite to photograph the operation. When the satellite is safely secured to the support cradle on board the orbiter the astronaut, still in the manoeuvering unit, will carry out the necessary repairs. Having done this he will fly back into the payload bay and be released from the manoeuvering unit. The replacement of the various fuses, which caused the degradation of performance, will then be carried out and the necessary checks with ground station completed, after which the satellite will be replaced in its correct orbital configuration and the observatory in full operation.

The manoeuvring unit itself is rather like a special chair. The control and life support systems are carried in the cradle unit with the astronaut in a suit designed for extra-vehicular activities. In the case of the Solar Maximum Satellite the docking mechanism is carried in front of the astronaut and attached to the chest. The necessary controls are all within suitable controlling distance.

The docking and stabilising of a spacecraft for repair involves a number of special actions. For example in the case of the Solar Maximum Satellite which has a controlled rotation speed of the order of 0·8 to 0·9 deg/sec. it would not present a great problem. Attachment by the astronaut of special clamps to the outer edge of one of the solar panels would be sufficient and up to much higher rates of rotation also. Having nulled the rotation the astronaut is then able to reset his position and attach the grapple unit to the spacecraft. A number of alternative techniques are being developed because it is possible that conditions will change for individual spacecraft. Also there is the condition prevailing for the Solar Maximum Satellite for there is no special provision for dealing with the screws holding the units in place. In zero gravity with a moving vehicle a special technique will be required.

There is some speculation too about the difference in dealing with a spacecraft retrieved for return to earth and one to be returned to the Shuttle for repair. The clearance for example in the case of the Solar Maximum vehicle can be as little as 5 inches for the solar panels so that great care will be needed to avoid damage. It is being considered now whether it would be more prudent to bring the spacecraft back to earth in any case. This would call for a greater load facility of some 4,000lb. It is clear that a number of options are available and it is necessary to be able to fly alongside and move round an orbiting vehicle without disturbing its flight parameters. There are hazards such as the orbiter's exhaust which could be heating up the vehicle and disturb control. So far many aspects have been studied and these will be dealt with in order of priority against time and financial options. What is important is that the thinking from the early days and dreams of fully manned units operating in space for maintenance is now in sight. This alone is a great fiscal advantage.

FRANCE AND SPACE

France is developing her Spot satellite system. It is an Earth observation programme and will be operated by SPOT IMAGE, a commercial marketing group privately financed. The technical details will remain with the French Government. They will retain, under the CNES (Centre Nationale d'Etudes Spaciales), 34% of the shareholding. CNES will be responsible for the areas of manufacture and development. A United States subsidiary will be established for the benefit of users in America. It is stated that this is not a move to compete with the United States Land-Sat system. The data available from Spot-Sat will be compatible with Land-Sat.

France has said that they have found a market for Spot-Sat data among users looking for a truly commercialised system which does not function with or is not associated with, government bureaux control. There have been approaches by some who are now in the Land-Sat market who are not happy with the possible influence that American Government policies might have on existing contracts particularly with regard to delays under the present administration.

The first of the operational satellites will be in 1984 launched by an Ariane-2 launcher. A second Spot vehicle has been approved by the French government to guarantee services throughout the 1980's. The design of the Spot vehicle will be a multimission platform. It will be fitted with two HRV (High Resolution Visible) range instruments. The optical instruments consist of a 20 metre resolution instrument in a multispectral mode and a 10m. mode resolution instrument in black and white. The multispectral mode covers green, red and near infra-red bands.

These have been selected to satisfy several mission objectives.

—Consistent relationship between spectral reflectance and vegetational properties.

—Compatible interpretation of the spectral signatures obtained by the Spot satellite and the Land-Sat D8 mapper.

—Improved radiometric sensitivity and resolution for surface-water work.

—Good discrimination within areas of vegetation of different types.

—At least one band to enable deep water penetration.

The markets expected to want these services are those of oil and mining exploration, topographic and land use, coastal studies and not least those who need crop and environment monitoring.

It is possible to provide stereoscopic images by processing two different orbital passes. Using the two resolutions, multispectral images can produce the appearance of enhancement better than the multispectral image.

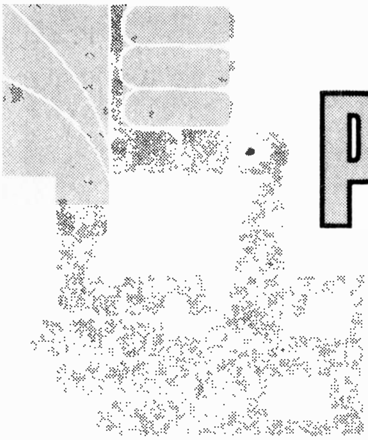
CONTROL STATIONS

The central control will be at the CNES space centre at Toulouse. This will receive the direct transmissions from the spacecraft's earth coverage when in sight of the station. Images recorded earlier on tape recorders will also be collected during other passes. A second ground station will be at Kiruna, Sweden, with identical facilities. Other ground stations operated by countries with their own stations will be able to receive data when the spacecraft is within the beam of their aerials.

A MEETING OF THE AMERICAN AERONAUTICAL SOCIETY

Speaking at a meeting Robert S. Cooper, director of Defence Advanced Research Projects Agency, said:

'We have built a fatal flaw into our satellite systems and it is time we recognised this fact!' He was emphasising his contention that not enough attention was being given to the development of robotics. He claimed that it was necessary now to set up programmes to ensure that spacecraft could operate entirely independent of human ground control. He characterised current spacecraft operation as retarded technology. It was necessary to have surviveable space systems. He claimed also that it was a tragedy that with all the current facilities available for launching in America, countries were turning to other centres for launching facilities. He cited a recent Presidential directive in support of the Space Shuttle and space transport system.



PATENTS REVIEW...

Copies of Patents can be obtained from:
the Patent Office Sales, St. Mary Cray, Orpington, Kent. Price £1·60 each.

PUSS-PROOF ALARM

British patent application 2 074 314, from American District Telegraph Company of New York, offers some interesting information on burglar alarms. The patent is aimed at improving passive infra-red detection systems, and lists a string of US patents on known systems of this type. Essentially an infra-red sensor trips an alarm if the infra-red reflection pattern in a room is disturbed by an intruder. But it has proved difficult to make the alarm sufficiently sensitive to detect an intruder on the other side of the room from the detector, but not so sensitive that it goes off accidentally, for instance if the office cat prowls past.

The patented solution (*Fig. 1*) is a complex arrangement of spherical mirror segments. A large segment 12, a smaller segment 14 and two still smaller segments 16 are all mounted round a common optical axis 18. The mirrors all focus on an infra-red detector 20 which is supported on a U-shaped arm 44 (*Fig. 2*) mounted on tabs 46. The mirror segments are made of acrylic, with a coating of aluminium.

Fig. 3 explains the basic circuit. Detector 20 is a dual thermopile with its two elements connected in phase opposition. The detector output is amplified at 120, fed to threshold circuit 122, integrated at 126 and fed to second threshold 128. Logic 130 trips alarm 132 when the thresholds are exceeded. Background disturbance indicator 124 senses slow variations in radiation and lights l.e.d. 134 if it exceeds a threshold level. Variations of sensitivity due to ambient temperature changes are compensated by the circuit of *Fig. 4*

The mirror complex produces a sensitivity field pattern in azimuth shown in *Fig. 5*. Long central pattern 100 is created by large mirror 12 and has a range of 150ft. and beam width of 2·5°. Intermediate pattern 102 is provided by medium-sized mirror 14 and has a range of 80ft. and beam width of 5°.

The two short patterns 104 are provided by small mirrors 16 and have a range of 20ft. and 9° beam width.

The inventors claim that this arrangement provides the same sensitivity to an intruder at 100ft. range as to an intruder at 25ft. range, with the shorter, more divergent beams insensitive to small movements, for instance by animals.

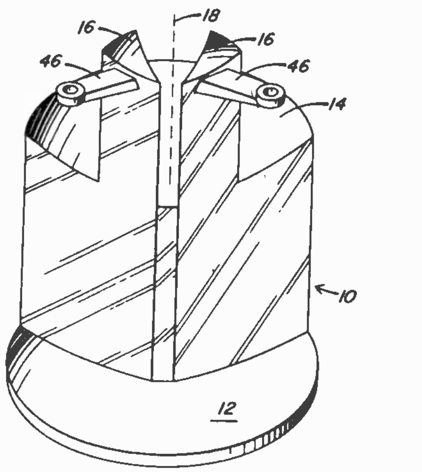


Fig. 1

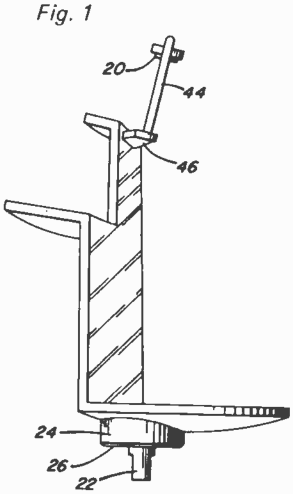
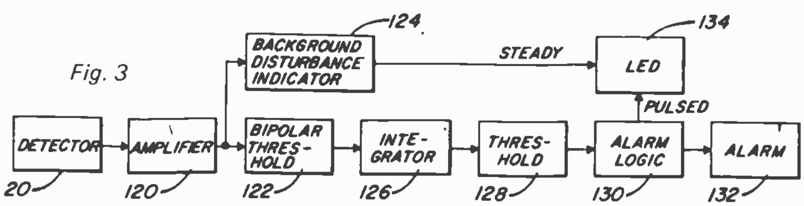


Fig. 2

Fig. 3



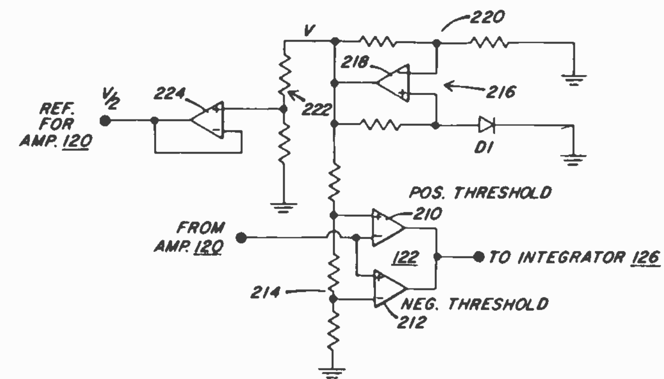
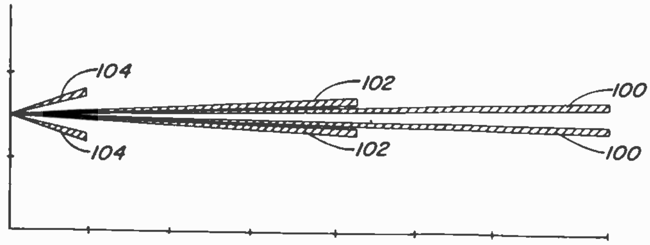


Fig. 4

Fig. 5



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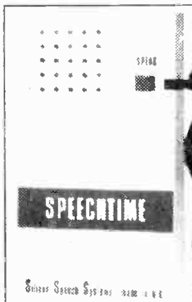

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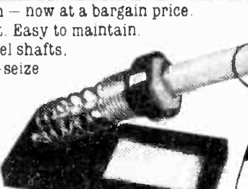

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As featured in PE March & April 82

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7494	40p
7495A	50p
7496	45p
7497	120p
74100	85p
74107	22p
74109	30p
74116	60p
74118	75p
74119	90p
74120	70p
74121	27p
74122	45p
74123	40p
74125	40p
74126	40p
74128	40p
74132	30p
74136	32p
74141	65p
74142	200p
74145	50p
74147	100p
74148	75p
74150	60p
74151A	45p
74153	45p
74154	60p
74155	50p
74156	50p
74157	50p
74159	100p
74160	60p
74161	60p
74162	60p
74163	60p
74164	50p
74165	55p
74166	55p
74170	140p
74172	300p
74173	65p
74174	60p
74175	60p
74176	50p
74177	70p
74178	100p
74180	50p
74181	130p
74182A	90p
74184A	90p
74185	120p
74186	500p
74188	325p
74190	50p
74191	50p
74192	50p
74193	50p
74194	70p
74195	60p
74196	60p
74197	60p
74198	100p
74199	100p
74221	60p
74259	150p
74278	150p
74279	80p
74283	75p
74284	200p
74285	200p
74290	200p
74293	100p
74298	100p
74365	40p
74366	40p
74367	40p
74368	55p
74390	100p
74393	100p
74490	120p

74LS SERIES

74LS00	11p
74LS01	12p
74LS02	12p
74LS03	12p
74LS04	12p
74LS05	15p
74LS08	14p
74LS09	15p
74LS10	15p
74LS11	15p
74LS12	15p
74LS13	25p
74LS14	40p
74LS15	30p
74LS20	15p
74LS21	15p
74LS22	15p
74LS26	15p
74LS27	16p
74LS28	16p
74LS30	14p
74LS32	14p
74LS33	16p
74LS37	16p
74LS38	16p
74LS42	36p
74LS47	40p
74LS48	80p
74LS51	15p
74LS55	30p
74LS73	25p
74LS74	16p
74LS75	24p
74LS76	20p
74LS83	45p
74LS85	55p
74LS86	16p
74LS90	28p
74LS92	40p
74LS93	30p
74LS95	45p
74LS96	100p
74LS107	45p
74LS109	30p
74LS112	34p
74LS113	30p
74LS114	30p
74LS122	42p
74LS123	50p
74LS124	120p
74LS125	30p
74LS126	30p
74LS132	45p
74LS133	30p
74LS136	30p
74LS138	34p
74LS139	36p
74LS145	75p
74LS147	160p
74LS148	90p
74LS151	30p
74LS153	40p
74LS154	90p
74LS155	40p
74LS156	40p
74LS157	35p
74LS158	36p
74LS160	40p
74LS161	40p
74LS162	40p
74LS163	40p
74LS164	45p
74LS165	100p
74LS166	90p
74LS170	90p
74LS173	70p
74LS174	45p
74LS175	50p
74LS181	140p
74LS190	50p
74LS191	50p
74LS192	50p
74LS193	48p
74LS194	40p
74LS195	50p
74LS196	60p
74LS197	65p
74LS221	60p
74LS240	80p
74LS241	80p
74LS242	80p
74LS243	80p
74LS244	65p
74LS245	90p
74LS251	40p
74LS253	40p
74LS257	45p
74LS258	40p
74LS259	90p
74LS260	24p
74LS266	25p
74LS273	70p
74LS279	45p
74LS280	250p
74LS283	45p
74LS293	50p
74LS298	160p
74LS299	400p
74LS323	250p
74LS324	180p
74LS348	150p
74LS352	100p
74LS353	100p
74LS363	160p
74LS364	160p
74LS365	32p
74LS367	32p
74LS368	50p
74LS373	70p
74LS374	70p
74LS375	50p
74LS377	70p
74LS378	60p
74LS390	55p
74LS393	60p
74LS399	200p
74LS445	110p
74LS540	135p
74LS541	135p
74LS640	200p
74LS641	200p
74LS642	200p
74LS643	200p
74LS644	250p
74LS645	250p
74LS668	200p
74LS669	200p
74LS670	170p

74S SERIES

74S00	60p
74S02	60p
74S04	60p
74S05	75p
74S08	75p
74S10	60p
74S11	60p
74S20	60p
74S30	60p
74S32	90p
74S37	60p
74S74	90p
74S85	300p
74S86	180p
74S112	90p
74S113	90p
74S114	90p
74S124	300p
74S132	160p
74S133	75p
74S138	225p
74S139	225p
74S157	250p
74S163	300p
74S174	250p
74S175	320p
74S188	350p
74S189	350p
74S194	350p
74S200	450p
74S201	400p
74S225	550p
74S241	400p
74S260	70p
74S261	300p
74S262	£10
74S287	350p
74S288	350p
74S373	400p
74S374	400p
74S471	650p
74S474	400p
74S571	900p
74S573	900p

74C SERIES

74C00	28p
74C04	20p
74C08	28p
74C10	28p
74C14	90p
74C20	28p
74C42	95p
74C48	143p
74C73	57p
74C74	59p
74C76	57p
74C85	134p
74C90	99p
74C95	106p
74C107	127p
74C151	255p
74C157	229p
74C160	140p
74C161	115p
74C162	115p
74C163	115p
74C164	108p
74C173	93p
74C174	93p
74C175	99p
74C192	115p
74C193	115p
74C194	120p
74C195	106p
74C221	120p
74C902	70p
74C912	800p
74C922	450p
74C923	500p
74C925	600p
74C928	600p

74ALS SERIES

74ALS00	60p
74ALS02	60p
74ALS04	75p
74ALS08	60p
74ALS10	75p
74ALS20	75p
74ALS32	75p
74ALS74	90p
74ALS138	150p
74ALS139	150p
74ALS157	150p
74ALS175	250p
74ALS244	375p
74ALS373	450p
74ALS374	450p

93 SERIES

9301	160p
9302	175p
9308	316p
9310	275p
9311	275p
9312	160p
9314	165p
9316	225p
9321	225p
9322	150p
9334	360p
9368	250p
9370	300p
9374	200p

4000 CMOS

4000	12p
4001	14p
4002	15p
4006	65p
4007	16p
4008	60p
4009	30p
4010	30p
4011	14p
4012	16p
4013	35p
4014	60p
4015	60p
4016	30p
4017	45p
4018	60p
4019	32p
4020	60p
4021	65p
4022	60p
4023	18p
4024	36p
4025	20p
4026	130p
4027	30p
4028	60p
4029	75p
4030	40p
4031	170p
4032	125p
4033	180p
4034	160p
4035	80p
4036	295p
4038	120p
4040	55p
4041	70p
4042	55p
4043	60p
4044	70p
4045	120p
4046	70p
4047	75p
4048	55p
4049	27p
4050	27p
4051	60p
4052	80p
4053	60p
4054	130p
4055	125p
4056	120p
4059	500p
4060	90p
4063	100p
4066	35p
4067	400p
4068	18p
4069	16p
4070	16p
4071	16p
4072	16p
4073	16p
4075	16p
4076	60p
4077	26p
4078	20p
4081	16p
4082	16p
4086	72p
4089	150p
4093	40p
4094	150p
4095	95p
4096	95p
4097	340p
4098	90p
4099	90p
40102	150p
40103	180p
40105	120p
40106	45p
40109	100p
4501	28p
4502	70p
4503	50p
4504	75p
4506	35p
4507	40p
4508	200p
4510	65p
4511	50p
4512	65p
4514	150p
4515	150p
4516	75p
4518	40p
4520	70p
4521	150p
4526	75p
4527	90p
4528	75p
4532	90p
4534	500p
4536	300p
4538	120p
4539	110p
4543	100p
4553	290p
4555	45p
4556	45p
4560	180p
4566	180p
4568	300p
4569	180p
4572	30p
4583	90p
4584	45p
4585	100p
40014	90p
40085	90p
40097	90p
40163	100p
40174	90p
40175	100p
40193	115p
14495	400p
14599	290p

LINEAR I.Cs

AN103	200p
AY1-0212	600p
AY1-1313	668p
AY1-1320	320p
AY1-5050	140p
AY3-8910	700p
AY3-8912	650p
AY5-1224A	240p
AY5-1315	600p
AY5-4007D	520p
CA3028A	120p
CA3019	80p
CA3046	70p
CA3048	225p
CA3059	300p
CA3080E	72p
CA3086	48p
CA3089E	225p
CA3090AQ	375p
CA3130E	90p
CA3140E	50p
CA3160E	100p
CA3161E	190p
CA3162E	450p
CA3189E	300p
CA3240E	120p
CA3280G	120p
DAC1408-8	200p
HA1366	300p
HA1388	270p
ICL7106	850p
ICL8038	300p
LC7120	350p
LC7130	350p
LF347	160p
LF351	48p
LF353	100p
LF356P	95p
LF357	120p
LM10C	425p
LM301A	27p
LM310	300p
LM311	75p
LM318	150p
LM319	225p
LM324	45p
LM335Z	140p
LM339	65p
LM348	75p
LM358P	75p
LM377	175p
LM380	75p
LM381AN	180p
LM382	120p
LM386	95p
LM387	120p
LM389	95p
LM393	100p
LM394	350p
LM709	36p
LM710	50p
LM711	100p
LM725	350p
LM733	100p
LM741	18p
LM747	70p
LM748	35p
LM1871	375p
LM1872	375p
LM1886	700p
LM1889	350p
LM2917	200p
LM3302	140p
LM3900	55p
LM3909	95p
LM3911	130p
LM3914	210p
LM3915	225p
LM3916	225p
LM13600	125p
M51513L	300p
M51516L	500p
MB3712	250p
MC1310P	150p
MC1458	40p
MC1495L	350p
MC1496	70p
MC3340P	120p
MC3401	90p
MC3403	120p
OK50398	750p
ML920	800p
MM57160	620p
NE531	150p
NE555	20p
NE556	50p
NE564	420p
NE565	130p
NE566	155p
NE567	140p
NE570	425p
NE571	425p
NE5534A	250p
PLL02A	500p
RC4136	70p
RC4151	200p
RC4558	60p
S566B	260p
SAD1024A	1250p
SFF96364	800p
SL490	350p
SN76477	175p
SP8515	750p
TA7120	200p
TA7204	250p
TA7205	200p
TB7120	200p
TA7204	250p
TA7222	200p
TA7310	200p
TBA621AX1	275p
TBA641BX1	300p
TBA651	200p
TBA800	90p
TBA810	100p
TBA820	90p
TBA920	200p
TBA950	300p
TC9109	£10
TCA210	350p
TCA220	350p
TCA940	200p
TDA1004A	300p
TDA1008	320p
TDA1010	225p
TDA1022	550p
TDA1024	120p
TDA1034B	250p
TDA1170	300p
TDA2002V	325p
TDA2020	320p
TL071/81	45p
TL072/82	75p
TL074	130p
TL084	110p
TL094	200p
TL170	50p
TL430C	70p
UAA170	170p
UA2240	300p
ULN2003	100p
ULN2004	100p
UPC575	400p
UPC592H	200p
UPC1156H	300p
XR2206	300p
ZNA234	£14
ZN414	90p
ZN419C	225p
ZN423E	150p
ZN424E	135p
ZN425E	350p
ZN427E	625p
ZN1034E	200p
ZN1040E	700p

VOLTAGE REGULATORS

FIXED PLASTIC

1A	+ve		−ve	
5V 1A	7805	•50p	7905	55p
12V 1A	7812	•50p	7912	55p
15V 1A	7815	•55p	7915	60p
18V 1A	7818	•55p	7918	60p
24V 1A	7824	•55p	7924	60p
5V 100mA	78L05	30p	79L05	65p
12V 100mA	78L12	30p	79L12	70p
15V 100mA	78L15	30p	79L15	70p

OTHER REGULATORS

LM309K 1A 5V	135p	78HGKC	600p
LM317K	325p	78HOSKC	550p
LM317T 1A Adj	200p	78MGT2C	140p
LM337T	225p	78GUIC	200p
LM323K 3A 5V	500p	79GUIC	225p
LM723 150mA Adj	37p	79HGKC	700p
TL494	400p	TL497	300p
78S40	300p	LM305H	250p

OPTO-ELECTRONICS

2N5777	45p	ORP60	120p
OCP71	180p	ORP61	120p
ORP12	120p	TIL78	55p

OPTO-ISOLATORS

ILD74	130p	TIL111	90p
MCT26	100p	TIL112	90p
MCS2400	190p	TIL113	90p
ILQ74	240p	TIL116	90p

LEDS

0.125"		0.2"	
TIL32	55p	TIL220 Red	13p
TIL209 Red	11p	TIL222 Gr	15p
TIL211 Gr	13p	TIL228 Yel	22p
TIL212 Ye	18p	Rectangular LEDs (R, G, Y)	30p
TIL216 Red	18p	NSB5881	670p
		TIL311	600p
		TIL312/3	110p
		TIL321/2	130p
		TIL330	140p
		7750/60	200p

DISPLAYS

3015F	200p
DL704	140p
DL707 Red	140p
FND357	120p
FND500	90p
FND507	90p
MAN3640	175p
MAN4640	200p

DRIVERS

9368	250p
9370	300p
UDN6118	320p
UDN6184	320p

CPUs

1802CE	750p
2650A	£12
6502	450p
6502A	650p
6800	370p
6802	425p
6809	£10
6809E	£15
8035	750p
8039	850p
8080A	350p
8085A	550p
INS8060	£11
TMS9980	£20
Z80	370p
Z80A	450p
Z80B	£16
8088	£19

SUPPORT DEVICES

3242	800p
3245	450p
6522	500p
6532	775p
6551	650p
6821	160p
6845	£10
6847	£10
6850	180p
6852	370p
6875	600p
8154	950p
8155	800p
8205	320p
8212	180p
8216	180p
8224	220p
8226	250p
8228	250p
8243	450p
8250	850p
8251	350p
8253	800p
8255	350p
8257	800p
8259	800p
8279	950
TMS9927	£18
Z80PIO	300p
Z80APIO	350p
Z80CTC	300p
Z80ACTC	350p
Z80ADART	800p
Z80ADMA	£12
Z80SIO-1	£14

CRT CONTROLLER

CRT5037	£18
SFF96364	£8
MC6845	£10
MC6847	£10

MEMORIES

2101A	400p
2102-3L	120p
21078	500p
2111A	300p
2112-A	300p
2114-2L	160p
2114-4L	130p
2147	450p
4027-3	300p
4116-20	200p
4118-3	500p
4118-4	450p
4164-2	650p
5101	300p
6116P-3	900p
6514-45	300p
6810	200p
7489	210p
74S189	325p
74S201	350p
74S289	325p
93415	600p
93425	600p

ROMs/PROMs

74S188	325p
74S287	300p
74S288	225p
74S387	325p
74S471	650p
74S473	850p
74S474	650p
74S570	650p
74S571	650p
74S573	950p

EPROMs

1702A	500p
2708	300p
2716 (+5V)	300p
2564	£25
2516 (+5V)	300p
2532	550p
2732	550p
2716-300n	500p
2732-300n	750p

UARTs

AY-3-1015P	300p
AY-5-1013P	350p
IM6402	450p
TR1602	300p
COM8017	300p

CHARACTER GENERATORS

RO-3-2513UC	750p
RO-3-2513LC	700p
SN74S262AN	£10

MODULATORS

6MHz UHF	375p
8MHz UHF	450p

INTERFACE ICs

AD558CJ	775p
AD561J	£14
AM25S10	350p
AM26LS31	160p
AM26LS32	190p
COM8116	800p
DAC80-V	£20
DM8131	375p
DP8304	450p
DS8832	250p
DS8833	225p
LF13201	450p
MC1488	55p
MC1489	55p
MC3418	950p
MC3446	300p
MC3480	850p
MC3486	500p
MC4024	325p
MC4044	325p
MC14411	£7
MC14412	£9
MM58174	£12
ULN2003A	100p
ULN2004A	100p
75107	160p
75110	160p
75112	160p
75114	160p
75115	160p
75150P	140p
75154	140p
75182	230p
75324	250p
75361	150p
75365	150p
75451/2	72p
75453/4	72p
75491/2	70p
8T26	120p
8T28	120p
8T95	120p
8T97	120p
81LS95	90p
81LS96	90p
81LS97	90p
81LS98	90p
9602	220p
9637AP	160p
ZN425E-8	350p
ZN426E-8	350p
ZN427E-8	650p
ZN428E-8	500p

DISC CONTROL

FD1771	£20
FD1791	£30
FD1793	£32
FD1795	£35
FD1797	£37
WD1691	£15
WD2143	550p

CRYSTALS

32.768KHz	100p
100KHz	300p
200KHz	370p
1.0MHz	320p
1.008MHz	350p
1.8432MHz	250p
2.00MHz	250p
2.45760MHz	250p
2.5MHz	250p
3.276MHz	150p
3.5795MHz	100p
3.686MHz	300p
4.00MHz	150p
4.194MHz	250p
4.43MHz	125p
5.0MHz	175p
6.0MHz	150p
6.144MHz	150p
7.0MHz	150p
7.168MHz	200p
8.00MHz	175p
8.86MHz	175p
10.00MHz	175p
10.7MHz	250p
12.0MHz	250p
13.0MHz	350p
14.3168M	150p
16.00MHz	250p
18.00MHz	250p
18.432	200p
19.968MHz	390p
20.00MHz	175p
24.0MHz	350p
26.690MHz	300p
27.145MHz	250p
38.6667MHz	350p
48.0MHz	300p
55.5MHz	400p
115MHz	350p

KEYBOARD ENCODER

AY-5-2376	600p
74C922	500p

DIL SWITCHES

4 Way	90p
6 Way	105p
8 Way	120p
10 Way	150p

TEXTOOL ZIF SOCKETS

24 Pin	£6
28 Pin	£8
40 Pin	£10

TELETEXT

SAA5020	£6
SAA5030	£9
SAA5041	£16
SAA5050	£6

WIRE WRAP SOCKETS BY TEXAS

8 pin	25p	18 pin	50p	24 pin	70p
14 pin	35p	20 pin	60p	28 pin	80p
16 pin	40p	22 pin	65p	40 pin	100p

LOW PROFILE DIL SOCKETS BY TEXAS

8 pin	9p	18 pin	16p	24 pin	24p
14 pin	10p	20 pin	18p	28 pin	26p
16 pin	11p	22 pin	22p	40 pin	30p

TRANSISTORS

AD161/2	45p
BC107/8	13p
BC109C	14p
BC117	20p
BC147/8	9p
BC149	10p
BC157/8	10p
BC159	11p
BC169C	12p
BC172	12p
BC177/8	17p
BC179	18p
BC182/3	10p
BC184	11p
BC187	30p
BC212/3	11p
BC214	12p
BC237	15p
BC327	16p
BC337	16p
BC338	16p
BC461	25p
BC477/8	30p
BC516/7	40p
BC547B	14p
BC548C	12p
BC549C	16p
BC557B	14p
BC559C	16p
BCY70	18p
BCY71/2	22p
BD131/2	50p
BD135/6	40p
BD139	40p
BD140	40p
BD189	60p
BD232	60p
BD241	60p
BD242	60p
BF244B	35p
BF256B	50p
BF257/8	32p
BF259	36p
BF337	30p
BFR39	25p
BFR40/1	25p
BFR79	25p
BFR80/1	25p
BFX29	40p
BFX30	27p
BFX84/5	40p
BFX86/7	27p
BFX88	27p
BFX89	150p
BFY50	24p
BFY51/2	24p
BFY56	33p
BFY90	80p
BRY39	45p
BSX19/20	24p
BU104	225p
BU105	190p
BU108	250p
BU109	225p
BU126	150p
BU180A	120p
BU205	200p
BU208	200p
BU406	145p
BUX80	600p
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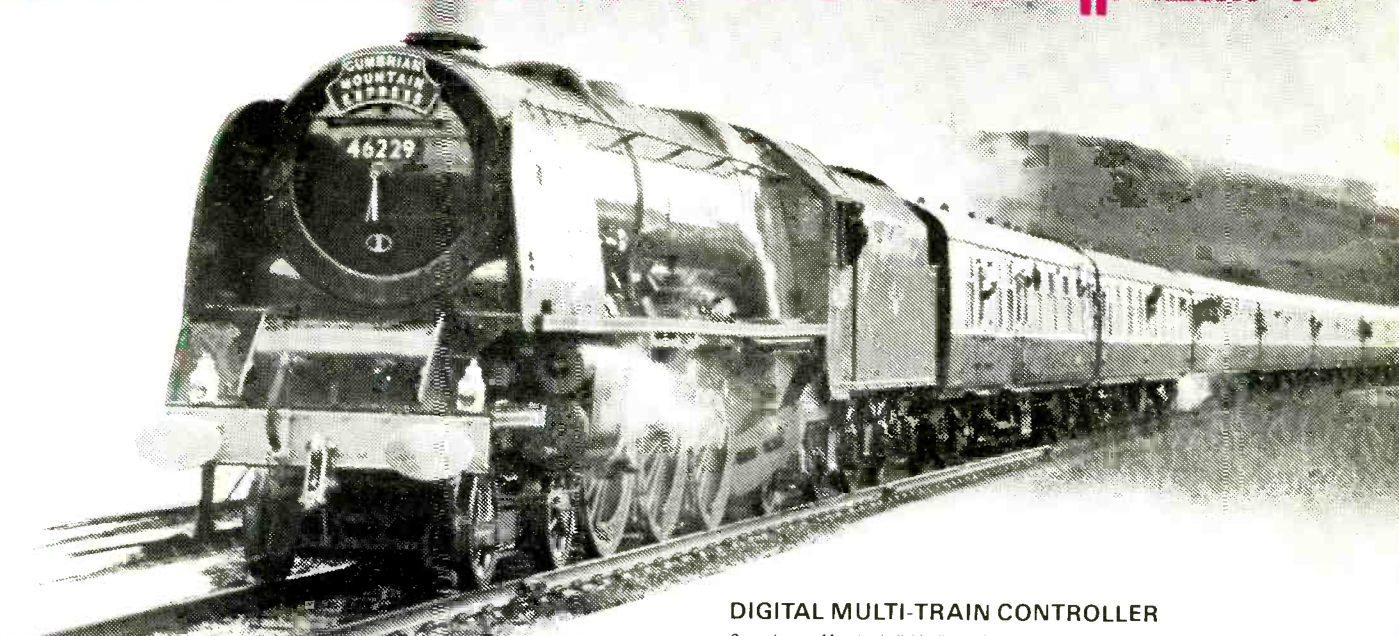

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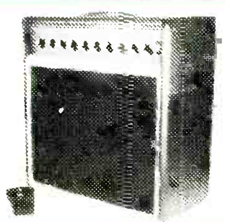

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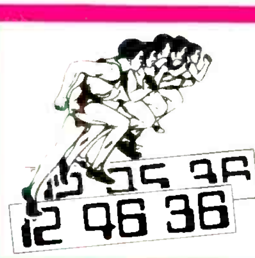

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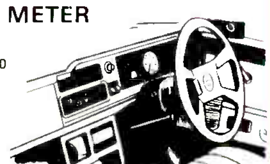

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