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PRACTICAL
ELECTRONICS

VOLUME 16 No. 5 MAY 1980

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

NEWS AND COMMENT

OUR JUNE ISSUE WILL BE ON SALE FRIDAY, 9 MAY, 1980
(for details of contents see page 55)

TRIACS

400V Plastic Case (Texas)

3A	49p	16A	90p
8A	58p	20A	165p
12A	85p	25A	190p

6A with trigger 80p
8A isolated tab 65p
Diac 18p

24 HOUR CLOCK/APPLIANCE TIMER KIT

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

CT1000K Basic Kit £14.90
CT1000KB with white box (56/131x71mm) £17.40
Ready Built £22.50

MINI KITS

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

TEMPERATURE CONTROLLER/THERMOSTAT
Uses LM3911 IC to sense temperature (80°C max.) and triac to switch heater. PCB (4 cm.sq.) potentiometer, plus all other components included with instructions.
500W £3.20 1KW £3.50

SOLID STATE RELAY
Ideal for switching motors, lights, heaters etc. from logic. Opto isolated with zero voltage switching. Supplied without triac. Select the required triac from our range. £2.60

BAR/DOT DISPLAY
Displays an analogue voltage on a linear 10-element LED display as a bar or single dot. Ideal for thermometers, level indictors etc. May be stacked to obtain 20 to 100 element displays. Requires 5-20V supply. £4.75

BURST FIRE/PROPORTIONAL TEMPERATURE CONTROLLER
Based on the TDA1024 Zero Voltage Switch this kit contains all the components required to make a "burst fire" power controller or a "proportional temperature" controller enabling the temperature of an enclosure to be maintained to within 0·5°C.
1·5KW £5·25 3KW £5·55

DIGITAL VOLTMETER/ THERMOMETER KIT

Based on the ICL 7106. This Kit contains a PCB, resistors, presets, capacitors, diodes, IC and 0.5" liquid crystal display. Components are also included to enable the basic DVM kit to be modified to a Digital Thermometer using a single diode as the sensor. Requires a 3mA 9V supply. (PP3 battery) £20.75

LEDs

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

DISPLAYS

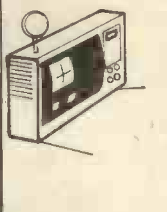
DL304 Red 0.3" c.c. pin compatible with DL704 70p
DL307 Red 0.3" c.a. pin compatible with DL707 70p
DL847 Red 0.8" (pin comp. DL747) c.a. £1.80
DL850 Red 0.8" c.c. (pin comp. DL750) £1.80
DL727 Dual 0.5" c.a. Red £1.50

LIGHTING CONTROL KITS

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

TD300K TOUCHDIMMER. Single touchplate with alternate action. Brief touch switches lamp on and off, longer touch dims or brightens lamps. Neon lamp helps find the switch in the dark. £6.50
TDE/K Extension kit for TD300K for 2-way switching etc. £1.50
TSD300K – TOUCHSWITCH & DIMMER. Single touchplate, small knob controls brightness. £5.50
TSA300K – AUTOMATIC. Single touchplate. Time delay variable 2 secs. to 3½ mins £4.30
LD300K – LIGHTDIMMER KIT. £2.90

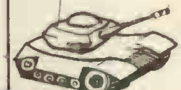
INFRA RED REMOTE CONTROL

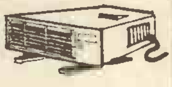


If you've got the ideas, we've got the hardware. Hundreds of uses in the home, shop, business or industry. Our range of ICs and components for Infra-Red remote control enable you to build controllers for applications ranging from heating to Hi-Fi to toys to garage door openers.
Up to 16 channels with three analogue outputs, low component counts and large tolerance of clock frequency eliminate the need for crystals or coils. The systems offer high noise immunity, reliability and low cost.

LD271	IR Emitting Diode	36p
SFH205	Photodiode Detector	95p
SL480	I.C. Pulse Amplifier	£1.40
SL490	Keyboard Controlled Encoder/ Transmitter	£2.40
ML922	10-channel Receiver + 3 Analogue Outputs	£4.20
ML928	16-channel Receiver (4 latched binary outputs)	£1.40
Data sheets (per device)		5p

These ICs can also be used with ultra sonic or radio links, depending on range, cost and speed of operation. For more details why not give us a ring.





ALL COMPONENTS ARE BRAND NEW AND TO SPECIFICATION ADD VAT AT CURRENT RATE TO ABOVE PRICES PLUS 35p P&P
MAIL ORDER – CALLERS WELCOME BY APPOINTMENT.

TK Electronics (P.E.), 106 STUDLEY GRANGE ROAD, LONDON W7 2LX. TEL. 01-579 9794

Access BARCLAYCARD VISA

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35, High Bridge, Newcastle upon Tyne
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EXP300

PB6 Kit

EXP300
550 contacts with two 50-point BUS bars. Size 152x53mm. £6·95.

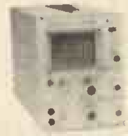
PROTO-BOARD 6 KIT
630 contacts, four 5 way binding posts, accepts up to 6 14 pin DIPs. £10·98.

CSC LOGIC PROBES
LP-2 ECONOMY PROBE

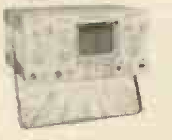
Min. pulse width 300 nanoseconds. 300 KΩ input impedance, tests circuits up to 1·5MHz. Detecting pulse trains or single-shot event in TTL, DTL, HTL and CMOS circuits. £20·95.

LP-1	Memory Probe	£35·65
LP-3	High Speed Memory Probe	£56·75

CSC catalogue available. Please send S.A.E.



CALSCOPE SUPER 6 £186·30
A portable single beam 6MHz bandwidth oscilloscope with easy to use controls. High gain to 10 mv/cm and wide time base range from 1μs to 100 ms/cm. Full specification to request. Please send S.A.E. Professional scopes you can afford.



CALSCOPE SUPER 10 £251·85
A dual trace 10MHz instrument of the very highest performance and quality. It has an accuracy of 3% which is achieved by the use of built-in stabilised power supplies which keep the trace rock steady over a wide range of mains fluctuations. Full specification on request. Please send S.A.E.

SINCLAIR LOW POWER PORTABLE OSCILLOSCOPE SC110 £159.85
The SC110 has a 10MHz bandwidth and sensitivity down to 10mV per division. Full trigger facilities are provided, including bright line, auto with TV line and frame positions. Please send for full spec. and illustrated brochure.

TMK 500 MULTIMETER 30,000 o.p.v. AC volts 2·5, 10, 25, 100, 250, 500, 1000. DC volts. 0·25, 1, 2·5, 10, 25, 100, 250, 1000. DC current 50μa, 5MA, 50MA, 12 amp. Resistance 0-6K, 60K, 6MEG, 60MEG. Decibels. –20 to + 56 db. Buzzer continuity test size, 160 x 110 x 55MM. Batteries & leads Included.
PRICE £25·95.

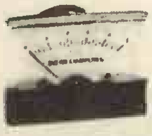
CSC EXPERIMENTOR BREADBOARDS
No soldering modular breadboards, simply plug components in and out of letter/number identified nickel-silver contact holes. Start small and simply snap lock boards together to build breadboards of any size.

SINCLAIR DM350 £83·95
SINCLAIR DM450 £114·95
Size 255x148x40mm.
DM350 3½ digit display DM450 4½ digit display. Both provide six functions in 34 ranges. D.C. voltage 10μV to 1200V (100μV on DM350) A.C. voltage 100μV to 750V. D.C. current 1nA to 10A. A.C. current 1nA to 10A resistance 10mΩ to 20MΩ (100mΩ opn DM350). Accessories for DM350 & 450 as for DM235 below. Full spec. on request. Please send S.A.E.

Sinclair PFM200 frequency meter
Size 157x76x32mm.
Range 20Hz to 200MHz. Accessories and illustration as for PDM35 below. £57·95.

SINCLAIR PDM35 DIGITAL POCKET MULTIMETER
DC volts (4 ranges) 1mV to 1000V AC volts 1V to 500V DC current (6 ranges) 1nA to 200MA. Resistance (5 ranges) 1Ω to 20 MEGΩ. PRICE £39.95 AC Adaptor £4·25 de luxe padded carrying case £1·95 MN 1604 Battery £1·28.
Size 157x76x32mm.

SINCLAIR DM235 BENCH-PORTABLE DIGITAL MULTIMETER.
DC volts (4 ranges) 1mV to 1000V AC volts (4 ranges) 1MV to 750V AC & DC current 1μa to 1000MA Resistance (5 ranges) 1Ω to 20 MEG Ω. **PRICE £60·98.** Carrying case **£8.95.** AC adaptor/charger. **£4·25.** Rechargeable Battery Pack. **£8·95.**
Size 255x148x40mm.



PANEL METERS
DIMS 60MM x 45MM. 50μ amp, 100μ amp 1MA, 5MA, 10MA, 50MA, 100MA, 500MA, 1 amp, 2 amp, 25V dc, 30V dc, 50v AC, 300V ac, "S", "VU" 50-0-50μa, 100-0-100μa, 500-0-500μa. **PRICE £5·95.**

DESOLDERING TOOL £6·45
SUCTION PUMP.

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ALL PRICES INCLUDE POSTAGE AND VAT.

BARCLAYCARD VISA

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Interested in Electronics? Then why not pay us a visit and see our vast range of Test Equipment, Oscilloscopes, PSUs, Computer Equipment, Government Surplus, VDUs, ICs, Transistors, Relays, Motors, Bulbs, Cable Transformers, PCBs, Resistors, Amplifiers, etc., etc.

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Miniature 5V 3 amp PSU, compact fully regulated, + crowbar protection.
£8.50 + P&P 70p

Wire wrap patch panels inc. 10 16 pin and 54 14 pin gold plated DIL WW sockets + 64 TTL and DTL I.C's dim. 6"x7".
£8.95 + P&P 85p

Super value PCB pack. Contents include I.C's res. caps etc., etc. **Guaranteed** to include TTL and CMOS! 6 Boards, Our choice.
£2.50 + P&P 60p

49 key coded QWERTY keyboard, 8 bit output, delayed strobe, 5V rail, TTL output. Ex-equip. untested. Supplied with edge conn. & connection diagram.
£20.00 + P&P £1.60

NE555 10 for **£2.40.** 741 10 for **£1.80.** 1N4004 18 for **£1.00.** 0.125" RED LEDS 12 for **£1.00.** 2N3055H (RCA) 4 for **£2.25.** 1S44/1N4148 50 for **£1.00.** Stock list **50p.**
Where P&P not shown please add 40p per order.
Prices include VAT.

★ ELECTRONIC EQUIPMENT AND COMPONENTS PURCHASED FOR CASH
★ OPEN 9.30 TO 5.30 MONDAY TO SATURDAY ★ RETAIL AND TRADE
★ NO PARKING RESTRICTIONS ★ ACCESS & BARCLAYCARD

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𝄞 – CLEF KITS – 𝄞

High Quality Electronic Musical Instruments under the personal supervision of Specialist Designer A. J. BOOTHMAN.

JOANNA 72 & 88 PIANOS
Six and 7¼ Octave Electronic Pianos with unique Touch Sensitive Action as used in the P.E. JOANNA, which electronically simulates piano key inertia – a feature not available in any other design. Build this widely acclaimed professional instrument, for either domestic or Stage use, from our top quality Component Kits.

SIX OCTAVES – £195
7¼ OCTAVES – £220

P.E. STRING ENSEMBLE
The versatile String Synthesizer with a fantastic sound at an economic price. Split Keyboard facility with a range of impressive voices.

COMPONENT KIT – £164

P.A.'s – SPEAKERS – CABINETS
Units can be supplied to add to the Piano Component Kits, including Domestic or Stage Cabinets and portable tubular legs.

ELECTRONIC ROTOR

Two speed organ rotor simulation plus a three phase chorus generator on a single p.c.b. (8"x5"). Kit includes all components/IC sockets throughout/mains operation and stereo headphone. Driver p.c.b. Easily integrates with existing organ.

COMPONENT KIT – £89

KEYBOARDS
We believe that we have located the best manufacturer of square front Keyboards, as used in our Kits, and can also supply Keyswitch hardware including the industry standard soft plated contact springs.

49 NOTE C-C	£23.80
73 NOTE F-F	£37.00
88 NOTE A-C	£45.00

All Keyboards are easily cut to provide your required length and compass. Quantity enquiries welcome.

BUILDING SERVICE
We are specialists in Electronic Piano Manufacture and can build your Piano for you – see lists.

INFORMATION
Please send S.A.E. quoting items of interest. Telephone BARCLAYCARD orders can be accepted, all prices include V.A.T., carriage & insurance.

VISITS
Are welcome by appointment, otherwise Mail Order Only.

EXPORT
Enquiries welcome – in Australia please contact JAYCAR (Sydney).

Back up TELEPHONE advice is available from the Designer to supplement the clear instructions included with the above Kits.

CLEF PRODUCTS (ELECTRONICS) LIMITED
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AY-5-2376	7.95

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Due to bulk purchase we are able to offer unbeatable prices on INTERSIL CHIPS. Compare our prices below distributors!

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709	30p	NE555	18p
723	33p	NE556	50p
741	17p	RC4136	90p
747	40p	SN76477N	1.95
748	25p	TL071	40p
LM301AN	25p	TL074	1.30
LM311	42p	TL081	35p
LM318	70p	TL082	80p
LM324	35p	TL084	1.10
LM339	35p	TL490. New	1.75
LM380	60p	XR2206	3.00
LM1496	60p	XR2207	3.75
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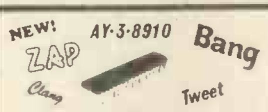
7805/7812	65p	78H05SC	5.75
7905/7912	65p	78HGKC	6.25

UNIVERSAL SCR

C106D 400V 5a	35p



AY3-8910 PROGRAMMABLE SOUND GENERATOR
The AY3-8910 is a 40 pin LSI chip with three oscillators, three amplitude controls, programmable noise generator, three mixers, an envelope generator, and three D/A converters that are controlled by 8 BIT WORDS. No external pots or caps required. This chip hooked to an 8 bit microprocessor chip or Buss (8080, Z80, 6800 etc.) can be solftware controlled to produce almost any sound, it will play three note chords, make bangs, whistles, sirens, gunshots, explosions, bleets, whines, or grunts. In addition, it has provisions to control its own memory chips with two IO ports. The chip requires +5V @ 75ma and a standard TTL clock oscillator. A truly incredible circuit. Only **£8.25 + VAT W/Basic Spec Sheet (4 pages).**
60 page manual with S-100 interface instructions and several programming examples **£1.95 extra (No VAT).**

Texas Instruments Low Profile Sockets

SALE

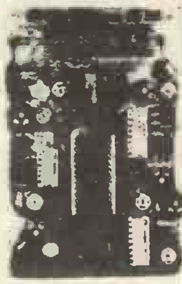
Contacts	Price
8 PIN	.06
14 PIN	.07
16 PIN	.08
18 PIN	.11
20 PIN	.13
22 PIN	.14
24 PIN	.15
28 PIN	.18
40 PIN	.25

THE MOST VERSATILE LIQUID CRYSTAL DISPLAY

	1.24	25+	100+
LCD106	6.45	5.50	5.95

.5" Field effect LCD display featuring 3½ digits, colon, plus/minus sign, 3 decimal points and "LO BAT" indicator. Ideal for DMMs, DPMs, digital thermometers, AM/FM radio readouts. Just look at the features. Ultra low power consumption, high contrast ratio, wide viewing angle, rapid response, proven sealing techniques, superior MTBF, reflective aluminium foil. Over 300,000 already sold! Perfect interface for Intersil 7106 and 7116.
40 PIN DIL

SE 01 Sound Effects Kit NEW



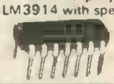
The SE-01 is a complete kit that contains all the parts to build a programmable sound effects generator. Designed around the new **Texas Instruments SN76477** Sound Chip, the board provides banks of MINI DIP switches and pots to program the various combinations of the SLF Oscillator, VCO, Noise, One Shot, and Envelope Controls. A Quad Op Amp IC is used to implement an Adjustable Pulse Generator, Level Comparator and Multiplex Oscillator for even more versatility. The 3¼" x 3" PC Board features a prototype area to allow for user added circuitry. Easily programmed to duplicate **Explosion, Phaser Guns, Steam Trains,** or almost an infinte number of **other sounds.** The unit has a multiple of applications. The low price includes all parts, assembly manual, programming charts, and detailed 76477 chip specifications. It runs on a 9V battery (not included). On board 100MW amp will drive a small speaker directly, or the unit can be connected to your stereo with incredible results! (Speaker not included.)

COMPLETE KIT ONLY £12.50
P&P 50p + VAT

DISPLAY LEDs

DL 704/DL 707	99p
FND 500/FND 510	99p

From T I **TL490 BAR/DOT DRIVER IC.** Drives 10 LEDs with adjustable analog steps. Units are cascadable up to 10 (100 steps). Drives LEDs directly. Great for **voltage, current or audio displays.** Similar in features to LM3914 with specs and circuit notes
ONLY £1.75 NEW!



Ordering information: For orders under £50 add 50p p&p. Add 15% VAT to total. All items are subject to prior sale and therefore subject to availability. Prices are subject to change without notice.

MICRO CIRCUITS
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Tel. Bideford (02372) 79507
Telex 8953084

D.I.Y. KITS FOR SYNTHESISERS, SOUND EFFECTS

BASIC COMPONENTS SETS include all necessary resistors, capacitors, semiconductors, potentiometers and transformers. Hardware such as cases, sockets, knobs, keyboards, etc. are not included but most of these may be bought separately. Fuller details of kits PCBs and parts are shown in our lists.

LAYOUT DIAGRAMS are supplied free with all PCBs unless "as published".

PHONOSONICS

MAIL ORDER SUPPLIERS OF QUALITY PRINTED CIRCUIT BOARDS, KITS AND COMPONENTS TO A WORLD-WIDE MARKET

P.E. 128-NOTE SEQUENCER

Enables a voltage controlled synthesiser to automatically play pre-programmed tunes of up to 32 pitches and 128 notes long. Programs are keyboard initiated and note length and rhythmic pattern are externally variable.

Set of basic component kits, PCBs and layout charts — KIT76-7 £34.58
Set of text photocopies — £1.36

P.E. 16-NOTE SEQUENCER

Sequences of up to 16 notes may be programmed by the use of external panel controls and fed into most voltage controlled synthesisers.

Set of basic component kits, PCBs and layout charts — KIT 86-5 £27.99
Set text photocopies — £1.84

P.E. STRING ENSEMBLE

A multivoiced polyphonic string instrument synthesiser.

Set of basic component kits, PCBs & layout charts — KIT 77-8 £92.89

P.E. JOANNA PLUS ORGAN VOICING

A modified version of the P.E. 5-octave piano that retains all the original facilities and includes switchable organ voicing circuitry.

Set of basic component kits, PCBs & layout charts — KIT 71-7 £119.87
"Sound Design" booklet — £1.00

ELEKTOR ELECTRONIC PIANO

A touch-sensitive multiple-voicing piano using the latest integrated circuit techniques for the keying and envelope shaping, and virtually eliminating "bee-hive" noise hitherto inherent in previous electronic pianos.

5-octave set of basic components and PCBs (as published) — KIT 80-9 £136.41
Additional 3-octave extension and basic parts and PCBs (as published) — KIT 80-10 £54.62
Set of text photocopies — £1.81

P.E. MINISONIC MK2 SYNTHESISER

A portable mains operated miniature sound synthesiser with keyboard circuits. Although having slightly fewer facilities than the large Formant and P.E. synthesisers the functions offered by this design give it great scope and versatility.

Set of basic component kits (excl. KBD R's & tuning pots—see list for options available) and PCBs (incl. layout charts) — KIT 38-25 £76.92
"Sound Design" booklet — £1.00

P.E. SYNTHESISER

The well acclaimed and highly versatile large scale mains operated synthesiser. Other circuits in our lists may be used with it to good advantage.

Main Unit basic component kits, PCBs & layout charts — KIT 23-31 £101.43
Keyboard Unit basic component kits, PCBs & layout charts — KIT 23-32 £60.47
Main Unit set of text photocopies — £5.91
Keyboard Unit set of text photocopies — £2.30

ELEKTOR FORMANT SYNTHESISER

A very sophisticatged synthesiser for the advanced constructor who puts performance before price.

Set of basic component kits, PCBs (as published) — KIT 66-14 £247.60
Set of text photocopies — £7.83

P.E. GUITAR EFFECTS UNIT

Modulates the attack, decay and filter characteristics of a signal from most audio sources, producing 8 different switchable effects that can be further modified by manual controls.

Basic parts with foot switches, PCB & layout chart — KIT 42-3 £10.02
Text photocopy — 28p

ELEKTOR DIGITAL REVERB UNIT

A very advanced unit using sophisticated i.c. techniques instead of mechanical spring lines. The basic delay range of 24 to 90mS can be extended up to 450mS using the extension unit. Further delays can be obtained using more extensions.

Main unit basic component kit and PCB (as published) — KIT 78-3 £53.68
Extension unit basic component kit and PCB (as published) — KIT 78-4 £48.85
Text photocopy — 86p

ELEKTOR ANALOGUE REVERB

Using i.c.s instead of spring-lines the main unit has a maximum delay of up to 100mS, and the additional set extends this up to 200mS. May be used in either mono or stereo mode.

Main unit basic component set — KIT 83-1 £29.49
Additional Delay basic components — KIT 83-2 £20.07
PCB (as publ.) to hold both kits — PCB9973 £4.31
Text photocopy — 67p

P.E. GUITAR MULTIPROCESSOR

An extremely versatile sound processing unit capable of producing, for example, flanging, vibrato, reverb, fuzz and tremolo as well as other fascinating sounds. May be used with most electronic instruments.

Set of basic component kits, PCBs & layout charts — KIT 85-5 £54.37
Set of text photocopies — £2.52

P.E. PHASER

An automatically controlled 6-stage phasing unit with integral oscillator.

Basic components, PCB & chart — KIT 88-1 £10.14
2-Notch extension, PCB & chart — KIT 88-2 £6.36
Text photocopy — 68p

ELEKTOR PHASING & VIBRATO

Includes manual and automatic control over the rate of phasing & vibrato, and has been slightly modified to also include a 2-input mixer stage.

Set of basic components, PCB & layout chart — KIT 70-2 £21.67
Text photocopy — 67p

P.E. PHASING UNIT

A simple but effective manually controlled phasing unit.

Basic components, PCB & chart — KIT 25-1 £3.62
Text photocopy — 28p

PHASING CONTROL UNIT

For use with Phasing Kit 25 to automatically control rate of phasing.

Basic components, PCB & chart — KIT 36-1 £5.21
Text photocopy — 10p

P.E. SWITCHED TONE TREBLE BOOST

Provides switched selection of 4 preset tonal responses.

Basic components, PCB & chart — KIT 89-1 £3.82
Text photocopy — 78p

P.E. TREBLE BOOST UNIT

A simple treble boost unit with manual control depth.

Basic components, PCB & chart — KIT 53-1 £2.76

ELEKTOR RESONANCE FILTER

Allows a synthesiser to produce a more realistic simulation of natural musical instruments.

Set of basic components & PCB (as published) — KIT 82-2 £19.90
Text photocopy — 67p

P.E. GUITAR OVERDRIVE

Sophisticated versatile fuzz unit incl. variable controls affecting the fuzz quality whilst retaining attack and decay, and also providing filtering. Usable with most electronic instruments.

Basic components, PCB & chart — KIT 56-3 £9.35
Text photocopy — 68p

P.E. SMOOTH FUZZ

Basic components, PCB & chart — KIT 91-1 £5.01
Text photocopy — 55p

TREMOLO UNIT

A slightly modified version of the simple P.E. unit.

Basic components, PCB & chart — KIT 54-1 £3.23

GUITAR FREQUENCY DOUBLER

A slightly modified and extended version of the P.E. unit.

Basic components, PCB & chart — KIT 74-1 £4.97
Text photocopy — 39p

P.E. GUITAR SUSTAIN

Maintains the natural attack whilst extending note duration.

Basic components, PCB & chart — KIT 75-1 £5.64
Text photocopy — 38p

P.E. WAH-WAH UNIT

Can be controlled manually or by integral automatic control.

Basic components, PCB & chart — KIT 61-1 £3.99

P.E. AUTO-WAH UNIT

Automatically gives Wah or Swell sounds with each note played.

Basic components, PCB & chart — KIT 58-1 £8.43
Text photocopy — 58p

ELEKTOR WAVEFORM CONVERTER

Converts a saw-tooth waveform into sinewave, mark-space saw-tooth, regular triangle, or square-wave with variable mark-space.

Basic components, PCB & chart, but excl. sw's — KIT 67-1 £9.24

P.E. V.C.F.

A voltage controlled filter extracted from P.E. Minisonic project.

Basic components, PCB & chart — KIT-65-1 £7.88

P.E. RING MODULATOR

Extracted from P.E. Minisonic project.

Basic components, PCB & chart — KIT 59-1 £6.05

ELEKTOR RING MODULATOR

Compatible with the Formant & most other synthesisers.

Set of basic components & PCB (as published) — KIT 87-2 £6.40
Text photocopy — 38p

10% DISCOUNT VOUCHER (PE 83)

TERMS: Goods in current adverts & lists over £50 goods value (excl P&P & VAT). Correctly costed, C.W.O., U.K. orders only. This voucher must accompany order. Valid until end of month on cover of P.E. Does not apply to credit card orders.

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U.K. orders: Keyboards add £2.30 each. Other goods: Under £5 add 25p, under £20 add 50p, over £20 add 75p. Recommended insurance against postal mishaps: add 50p for cover up to £50, £1 for £100 cover, etc., pro-rata. Insurance must be added for credit card orders.

N.B. Eire, C.I., B.F.P.O. and other countries are subject to higher export postage rates.

ADD 15% VAT

(or current rate if changed). Must be added to full total of kits, discount post & handling on all U.K. orders. Does not apply to Exports, or photocopies.

EXPORT ORDERS ARE WELCOME but to avoid delay we advise you to see our list for postage rates. All payments must be cash-with-order, in Sterling by International Money Order or through an English Bank. To obtain list – Europe send 25p; other countries send 50p.

Note that we do not offer a C.O.D. service and that our terms are payment in advance.

PHONOSONICS · DEPT PE83 · 22 HIGH STREET · SIDCUP · KENT DA14 6EH

TERMS: C.W.O., MAIL ORDER OR COLLECTI
BY APPOINTMENT (TEL 01-302 6184)

AND OTHER PROJECTS

PHOTOGRAPHS in this advertisement show two of our units containing some of the P.E. projects built from our kits and PCBs. The cases were built by ourselves and are not for sale, though a small selection of other cases is available.

LIST—Send stamped addressed envelope with all U.K. requests for free list giving fuller details of PCBs, kits and other components.

OVERSEAS enquiries for list: Europe—send 20p: other countries—send 50p.

KIMBER-ALLEN KEYBOARDS AND CONTACTS

KIMBER-ALLEN KEYBOARDS as required for many published projects. The manufacturers claim that these are the finest moulded plastic keyboards available. All octaves are C to C, the keys are plastic, spring-loaded, fitted with actuators, and mounted on a robust aluminium frame.

3 Octave (37 notes) **£25.50** 4 Octave (49 notes) **£32.25** 5 Octave (61 notes) **£39.75**

CONTACT ASSEMBLIES (gold-clad wire) – 1 required for each KBD note:
Type GJ – SPCO **25½p** ea. Type GA – 1 pr of contacts, normally open **24p** ea. Type GB – 2 pr N/O **28½p** ea. Type GC – 3 pr N/O **37½p** ea. Type GE – 4 pr N/O **46½p** ea. Type GH – 5 pr N/O **58½p** ea. Type 4PS – 3 pr N/O plus SPCO **57p** ea.

P.E. NOISE GENERATOR
Extracted from the P.E. Minisonic.
Basic components, PCB & chart — KIT 60-1 **£4.00**

WIND & RAIN EFFECTS UNIT
A slightly modified version of the original P.E. unit.
Basic components, PCB & chart — KIT 28-1 **£4.68**
Text photocopy **28p**

P.E. ENVELOPE SHAPER WITHOUT VCA
Provides full manual control over attack, decay, sustain and release functions, and is for use with an existing VCA.
Basic components, PCB & chart — KIT 44-1 **£5.24**
Text photocopy **49p**

P.E. ENVELOPE SHAPER WITH VCA
Has an integral Voltage Controlled Amplifier, and has full manual control over the A.D.S.R. functions.
Basic components, PCB & chart — KIT 50-1 **£7.34**
Text photocopy **58p**

P.E. TRANSIENT GENERATOR
An ADSR envelope shaper without VCA, and additionally providing Repeat-triggering enabling a synthesiser to be programmed for mandolin or banjo effects.
Basic components, PCB & chart — KIT 63-2 **£7.13**
Text photocopy **58p**

P.E. EXTERNAL-INPUT SYNTHESISER-INTERFACE
Allows external inputs such as guitars, microphone etc., to be processed by synthesiser circuits.
Basic components, PCB & chart — KIT 81-1 **£3.23**

P.E. TUNING FORK
Produces 84 switch-selected frequency-accurate tones with an LED monitor clearly displaying beat-note adjustments.
Set of basic components, incl. power supply, PCBs & charts — KIT 46-3 **£23.32**
Text photocopy **97p**

P.E. TUNING INDICATOR
A simple 4-octave frequency comparitor for use with synthesisers and other instruments where the full versatility of KIT 46 is not required.
Basic components, PCB & chart, but excl. sw. — KIT 69-1 **£8.19**
Text photocopy **58p**

P.E. DYNAMIC RANGE LIMITER
Preset to automatically control sound output levels.
Basic components, PCB & chart — KIT 62-1 **£5.03**

P.E. CONSTANT DISPLAY FREQUENCY COUNTER
A 5-digit counter for 1Hz to 55kHz with 1Hz sampling rate. Readout does not count visibly or flicker due to blanking.
Basic components, PCB & chart — KIT 79-2 **£32.28**
Text photocopy **78p**

P.E. 6-CHANNEL MIXER
A high specification stereo mixer with variable input impedances.
Basic components, (excl. sw's,) and set of PCBs and charts — KIT 90-B **£51.35**
Extra 2-channel set with PCB — KIT 90-9 **£9.69**
Set of Text photocopies **£1.50**

STEREO HEADPHONE AMPLIFIER
Extracted from P.E. 6-channel mixer.
Basic components, PCB & chart — KIT 92-1 **£5.04**

DIGITAL EXPOSURE UNIT
Controls up to 750 watts in ½ second steps up to 10 minutes, with built-in audio alarm.
Basic components, PCBs & charts — KIT 93-3 **£22.40**
Text photocopy **£1.20**

P.E. DISCOSTROBE
A 4-channel light show controller giving a choice of sequential, random, or full strobe mode of operation, and with additional audio input.
Basic components, PCB & chart — KIT 57-2 **£23.79**
Text photocopy **78p**

RHYTHM GENERATORS
Several available, including programmable 16 beat 64000 pattern, 128 beat almost infinite pattern, and pre-programmed 15 pattern using either M252 or M253 rhythm chips. A selection of effects instrument circuits is also available.

P.E VOICE OPERATED FADER
For automatically reducing music volume during talkover – particularly useful for disco work.
Basic components, PCB & chart — KIT 30-1 **£4.37**

TAPE NOISE LIMITER
Very effective circuit for reducing the hiss found in most tape recordings.
Basic components, PCB & chart — KIT 6-3 **£4.13**

AMERICAN EXPRESS — Buy it with Access — BARCLAYCARD VISA

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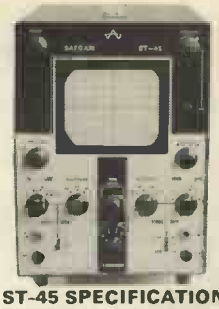

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● 10mv/div ● 5MHz ● BRITISH
● CHOICE OF FRONT PANEL ●

ST-45 SPECIFICATION
VERTICAL SYSTEM
Sensitivity 10mv/div 5v/div in 9 cal. steps
Bandwidth (3dB)
DC Coupled DC 5MHz
AC Coupled 5Hz-5MHz
Risetime 70µsec
Input Impedance 1MΩ +22 PF approx. (for all ranges) 50Ω for 10mv/div 50mv/div
Input coupling AC CND DC
Input volts: 400V max.
Accuracy ±5%

HORIZONTAL SYSTEM
Time base speeds
50ms/div 1µsec/div in 15 cal. steps with X5 Multiplier to 250msec/div and X5 Expansion to 200nsec/div
External – X sensitivity 1v/div
External – X Bandwidth 500KHz
Accuracy ±5%

ACCESSORIES
Passive Probe switched (X1. REF. x10) 100MHz bandwidth **£11.50** + VAT
BNC to 4mm Socket Adaptor **£2.95** + VAT

TRIGGER
Internal 0.5div (10Hz-2MHz), 1 div (2MHz-5MHz)
External 100mv (10Hz-2MHz), 200mv (2MHz-5MHz)
Bright Line Auto
Trace free runs in absence of signal
Trigger Level selects triggering point
Trigger (+)ve and (–)ve slope selection

FRONT PANEL
Black-Silver-White-ST-45-S The Silver Scope
or
Black-Gold-White-ST-45-G The Gold Scope

GENERAL
Power consumption 10VA approx.
Mains selection 200V-220V-240V rms (40Hz-60Hz)
Weight 10lbs 4.5kg approx.
Case aluminium with black pvc finish and black handle, front panel white with black control knobs, black feet and tilt bar.

Safgan Electronics Ltd.,
56 Bishops Wood, St. Johns, Woking, Surrey GU1 3QB

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Please send me.................ST-45-S.................ST-45-G.................Probe.................Adaptor

I enclose PO/Cheque.................(Goods + 15% VAT + £3.00 p&p)

Name.................

Address.................

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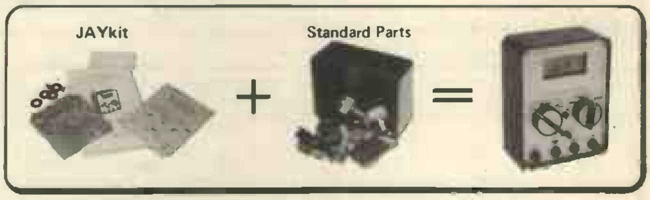


DM-2

DIGITAL MULTIMETER

- DC Volts .... 1mV to 1000V
  AC Volts .... 1V to 500V
  DC Current ...... 0.1mA to 0.2A
  Resistance .... 1Ω to 20MΩ
- 3½ digit LCD
- Auto Low Battery indication
- Auto Polarity & Zero
- 1% accuracy (DC volts)
- Designed around Intersil 7106 IC
- Total cost around £30 (incl. case)

FG-1a

FUNCTION GENERATOR

- 30mV to 10V pk-pk
- 1Hz to 100kHz
- DC coupled
- Sine, Square & Triangle
- Separate TTL output
- Designed around Intersil 8038 IC
- Total cost around £25 (incl. case)

Provided in a JAYkit is a Printed Circuit Board, a punched and lettered Front Panel overlay, a Circuit Diagram and Instruction Sheet and a comprehensive and up to date Component List showing suppliers and current prices. Difficult to obtain pieces of hardware are supplied with the kit.

Jayen Developments, 21 Gladeside, Bar Hill, Cambridge CB3 8DY

To: JAYEN Developments
21 Gladeside, Bar Hill,
Cambridge CB3 8DY
Tel: (0954) 80285

Name ____________

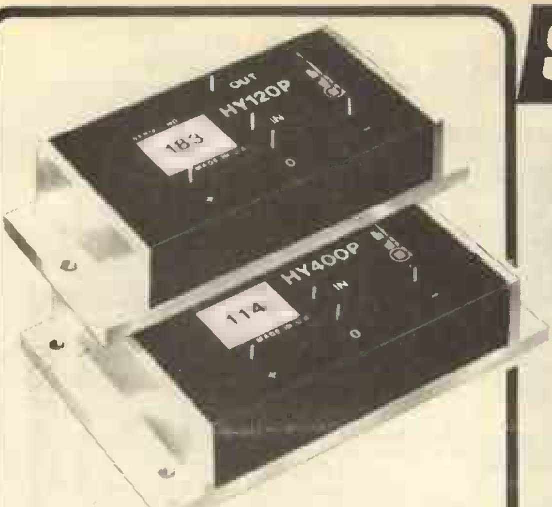
Address ____________

Please send:
☐ DM-2 @ £5.45
☐ FG-1a @ £4.95
(Incl. VAT and P&P)

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

JAYkits

SIMPLY AHEAD - and staying there!



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MADE IN ENGLAND

I.L.P. offer for prompt delivery, a range of O.E.M. Plate Power Amplifiers in three useful output ratings. These units are typical of I.L.P. design and manufacture — encapsulated circuitry, rugged construction, just five pin connections, trouble-free mounting, no output capacitor or other external components to be added, and operation from split line power source. PRICES ARE KEENLY COMPETITIVE, **QUALITY AND MANUFACTURE OF THE HIGHEST POSSIBLE STANDARDS.** *Modules can also be manufactured to customer's own design.*

UNIT PRICE FOR	100 +	250 +	500 +	1000 +	2500 +	5000 +
HY 120P 60W rms 8Ω	£10.30	£9.37	£8.51	£7.74	£7.04	£6.40
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Sizes—
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NO EXTERNAL COMPONENTS
ONLY FIVE PINS TO CONNECT

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Special purchase of factory clearance capacitors enables us to offer: C280 Polyesters (Liquorice Allsorts) at £2 for 100 mixed And Miniature Electrolytics at £1.50 for 100 mixed Pack of each only £3.
These consist of spillages, floor sweepings, cosmetic imperfects etc. As we have no time to sort them they are magnificent value for the constructor.

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Buy our Honeywell Humidity Controller.
Membrane actuated, very sensitive, ⅜" shaft. 250V, 3.75A Contacts. Ideal for greenhouses, centrally heated homes, offices etc. Build your own humidifiers or alarms. Fraction of original cost 90p ea. 3 for £2.

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1 watt and 400MW. £1.50

100 MIXED DIODES

Includes: Zener, power, bridge, germanium, silicon etc. All full spec £4.95
0·2" LEDS with 2 piece clips.
Red 4 for 50p. Green and Yellow 4 for 60p.

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Transmitter and receiver 40 kHz 14 mm dia. £3·25 pair.

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We are the cheapest! 12 for £1.00 100 for £4.20

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DE LUXE FIBRE GLASS PRINTED CIRCUIT ETCHING KITS

Includes 150 sq. ins. copper clad F/G. board 1 lb ferric chloride. 1 dalo etch resist pen. Abrasive cleaner. Etch tray plus instructions. **Special Price £4.95**
1 lb FE. C1. To mil. spec. £1.25
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150 sq. in. Single sided board £2.00
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These cost a fortune! Were made for various music centres. Includes independent and interdependent latching types multi pole c/o etc. Can be modified. Can't be repeated. 3 Banks for £1

Knobs for P/B Switches. Fit 3½ mm sq. shaft. 10 for £1. Chrome or Spun Aluminium Finish.

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MINIATURE LEVEL/BATT. METERS 200µA

F.S.D. as fitted to many cassette recorders 60p

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P.E. APRIL 1979

A superb six stage phaser that really gives your guitar lift off. Equals the best commercial models. Uses latest FET op-amps. Glassfibre p.c.b.

COMPLETE KIT OF ALL PARTS AS SPECIFIED............**£15.95***

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Separate parts: TL062 80p, BF245B 50p, PCB £1.50, 8 pin sockets (not included in kit) 21p each.

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P.E. OCT. 1977

Superb quality, low noise, low distortion sustain unit equal to the very best commercial models. Suits all guitars. Glassfibre p.c.b.

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Pack 4. Diecast box and feet............**£2.00***

Separate parts: XC5053R 50p, RPY58A 75p, Printed circuit board 95p, Footswitch £1.50 each.

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Complete set of semiconductors............**£9.75**
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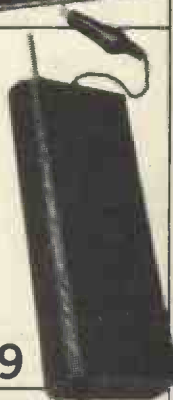

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General coverage receiver. Quartz-synthesised tuning, digital frequency readout. 3-step RF Attenuator. 6-range preselector with LED indicators. SSb and CW demodulation. Speaker. Code oscillator. Batteries (not included) or 12V DC. 20-204.

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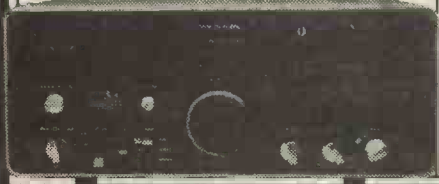

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Shows current gain and electrode open and short circuit. Tests low, medium or high power PNP or NPN types. Go/no-Go test from 5-50mA on power types. **22-024.**

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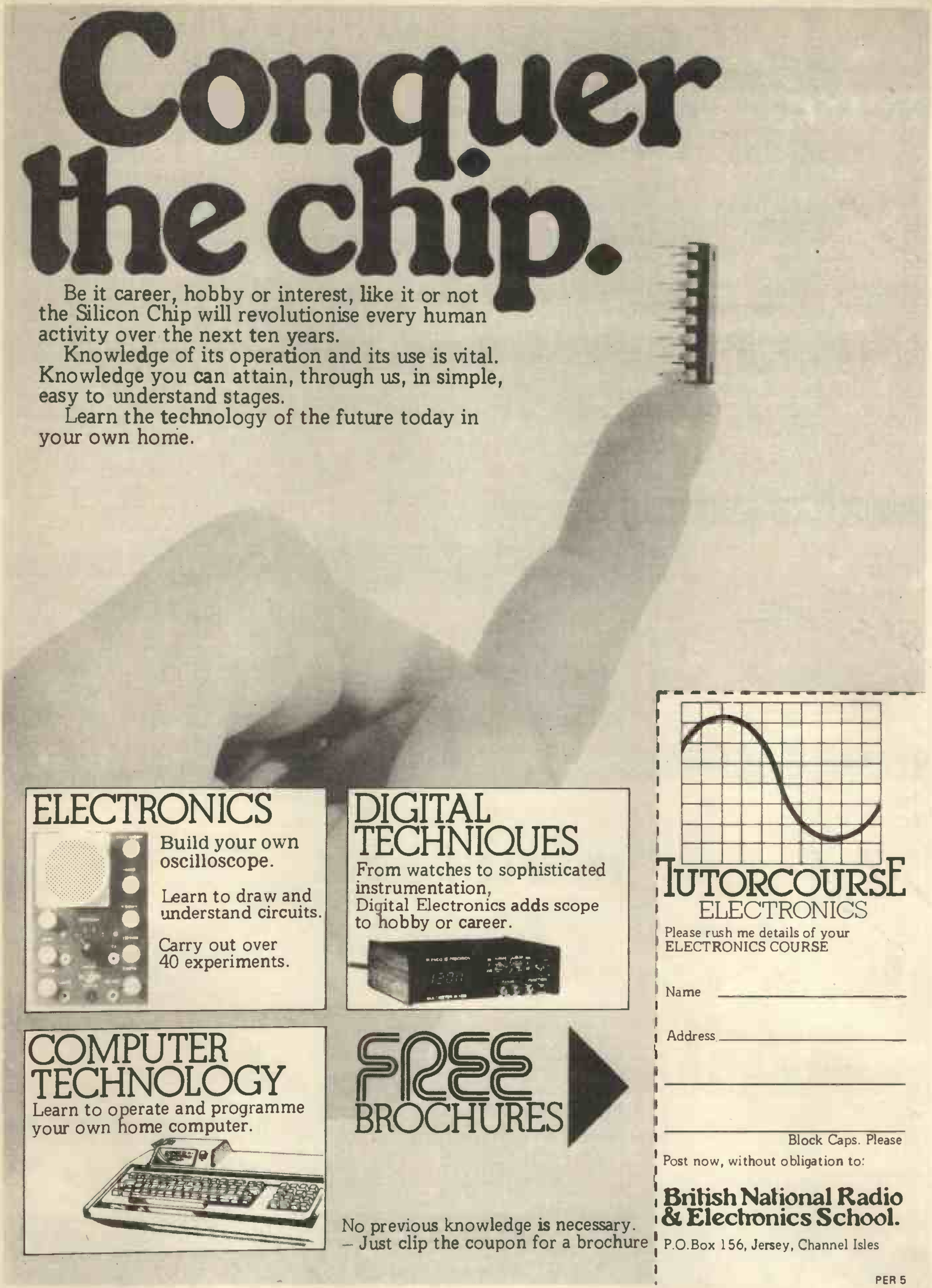
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BP32	Build Metal & Treasure Locators	£1·00
BP35	Handbook of IC Audio Preamplifier & Power Amplifier Construction	£1·25
BP36	50 Cicts use Germ/S11/Zener Diodes	£0·75
BP39	50 Field Effect Trans Projects	£1·25
BP40	Digital IC Equivs. & Pin Connection	£2·50
BP41	Linear IC Equivs. & Pin Connection	£2·75
BP42.	50 Simple LED Circuits	£0·75
BP43	How to make Walkie-Talkies	£1·25
BP45	Projects on Opto-electronics	£1·25
BP46	Radio Circuits Using IC's	£1·35
BP47	Mobile Discotheque Handbook	£1·35
BP48	Electronics Projects for Beginners	£1·35
BP49	Popular Electronic Projects	£1·45
BP50	IC LM3900 Projects	£1·35
BP55	Radio Stations Guide	£1·45
BP160	Coil Design & Construction Manual	£0·75
BP202	Handbook of Integrated Circuits Equivalents & Substitutes	£1·00
BP205	1st Book HI-FI Speaker Enclosures	£0·75
BP213	Circuits for Model Railways	£1·00
BP215	Shortwave Circuits & Gear for Experimenters & Radio Hams	£0·85
BP217	Solid State Power Supply Handbook	£0·85
BP221	28 Tested Transistor Projects	£1·25
BP222	Short-wave Receivers for Beginners	£0·95
BP223	50 Projects using IC CA3130	£0·95
BP224	50 CMOS IC Projects	£0·95
BP225	A Practical Intro to Digital IC's	£0·95
BP225	Build Advanced Short-wave Receivers	£1·20
BP227	Beginners Guide to Building Electronic Projects	£1·25

NEWNES BOOKS

216	Transistors 3rd Ed.	£1·00
218	Radio & Television	£1·25
219	Electronics	£1·15
220	Colour TV 2nd Ed.	£1·15
221	Hi-Fi	£1·15
223	20 Solid State Proj. for Home	£1·95
224	110 Int. Circ. Proj. for Home	£2·95
231	Beginners Guide to Transistors	£2·25
232	Beginners Guide to Electric Wiring	£2·25
233	Beginners Guide to Radio	£2·75
234	Guide to Colour TV	£2·25
235	Electronic Diagrams	£1·80
236	Electronic Components	£1·80
237	Printed Circuit Assembly	£1·80
238	Transistor Pocket Book	£3·90
240	Semiconductor Handbook Part 1	£5·25
241	Semiconductor Handbook Part 2	£4·28
242	Electronics Pocket Book	£3·90
244	Beginners Guide to Integrated Circuits	£2·75
	BI-PAK CMOS Data Book	50p

SWITCHES

Description	No.	Price
DPDT miniature slide	1973	£0·16
DPDT standard slide	1974	£0·17
Toggle switch SPST 12 amp 250V ac	1975	£0·38
Toggle switch DPDT 1 amp 250V ac	1976	£0·48
Rotary on-off mains switch	1977	£0·58
Push switch–Push to make	1978	£0·16
Push switch–Push to break	1979	£0·21

ROCKER SWITCH

A range of rocker switches SPST–moulded in high insulation material available in a choice of colours ideal for small apparatus

Colour	No.	Price
RED	1980	£0·35
BLACK	1981	£0·35
WHITE	1982	£0·35
BLUE	1983	£0·35
YELLOW	1984	£0·35
LUMINOUS	1985	£0·35

Description	No.	Price
Miniature SPST toggle 2 amp 250V ac	1958	£0·81
Miniature SPST toggle 2 amp 250V ac	1959	£0·86
Miniature DPDT toggle 2 amp 250V ac	1960	£0·91
Miniature DPDT toggle centre off 2 amp 250V ac	1961	£1·07
Push-button SPST 2 amp 250V ac	1962	£1·04
Push-button SPST 2 amp 250V ac	1963	£1·09
Push-button DPDY 2 amp 250V ac	1964	£1·34

MIDGET WAFER SWITCHES

Single bank wafer type–suitable for switching at 250V ac 100mA or 150V dc non-reactive loads make-before-break contacts. These switches have a spindle 0·25 in dia. and 30 indexing.

Description		No.	Price
1 pole	12 way	1965	£0·55
2 pole	6 way	1966	£0·55
3 pole	4 way	1967	£0·55
4 pole	3 way	1968	£0·55

MICRO SWITCHES

	No.	Price
Plastic button gives simple 1 pole change over action Rating 10 amp 250V ac	1970	£0·29

OPTOELECTRONICS

NEW INCREASED RANGE—ALL 1ST QUALITY
LEDS (diffused)

O/No.	Type	Size	Colour	Price
1501	ARL209 (TIL209)	3mm (·125)	RED	£0·12
1502	MIL3232 (TIL211)	3mm (·125)	GREEN	£0·22
1503	MIL3331 (OPL212A)	3mm (·125)	YELLOW	£0·22
1504	ARL4850 (FLV117)	5mm (·2)	RED	£0·12
1505	MIL5251 (TIL222)	5mm (·2)	GREEN	£0·22
1506	MIL5351 (MV5353)	5mm (·2)	YELLOW	£0·22
1509	FLV111	5mm (·2)	CLEAR (ill. Red)	£0·13

SUPER 'HI BRITE' TYPE

1521	MIL32	3mm (·125)	RED	£0·12
1522	MIL52	5mm (·2)	RED	£0·12
1514	ORP12	Light dependent resistor		£0·63
1520	OCP71	Photo transistor		£0·40

LED CLIPS

1508/125	pack of 5	125 clips	£0·17
1508/2	pack of 5	2 clips	£0·21

DISPLAYS

DL703 7 segment D P left (30" height) Common Anode
RED Single Digit O/NO. 1523 £0·85
DL707 7 segment D P left (30" height) Common Anode
RED Single Digit O/NO. 1510 £0·92
DL527 7 segment D P left (50" height) Common Anode
RED Two-Digit Reflector O/NO. 1524 £2·08
DL727 7 segment D P right (·510" height) Common Anode
RED Two-Digit Light Pipe O/NO. 1512 £2·07
DL747 7 segment D P left (630" height) Common Anode
RED Single Digit Light Pipe O/NO. 1511 £1·73

OPTO-ISOLATORS

Isolation Breakdown–Voltage 1500–continuous fwd. current 100 mA

CIL74 Single Channel 6 pin DIP standard type–optically coupled pair with infra-red LED Emitter and NPN Silicon Photo Transistor O/NO. 1497 £0·61

CILD74 Multi-Channel 8 pin DIP Two Isolated Channels O/NO. 1498 £1·22

CILQ74 Multi-Channel 16 pin DIP Four Isolated Channels O/NO. 1499 £2·69

MELL II (TIL81) NPN LIGHT DETECTOR

Silicon Photo Darlington Amplifier–VCBO 30V VECO 10V 1c 100mA Ptot 300mW IL Min. 0·5 Typ 2mA 1D 100mA nA O/NO. 1495 £0·29

FUSE HOLDERS AND FUSES

Description	No.	Price
20mm x 5mm chassis mounting	506	£0·18
1¼in. x ¼in. chassis mounting	507	£0·14
1¼in. car inline type	508	£0·18
Panel mounting 20mm	509	£0·23
Panel mounting 1¼in.	510	£0·37

QUICK BLOW 20mm

Type	No.		Type	No.		Type	No.	
150mA	611	7p	1A	615	6p	3A	619	6p
250mA	612	6p	1·5A	616	7p	4A	620	10p
550mA	613	6p	2A	617	6p	5A	621	6p
800mA	614	8p	2·5A	618	7p			

ANTI-SURGE 20mm

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2 5A	628
250mA	623	2A	626	3·15A	629
500mA	624	1/6A	627	5A	630

All 8p each

QUICK-BLOW 1¼in.

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634

All 8p each

Type	No.	Type	No.	Type	No.
1A	635	2/5A	638	4A	641
2A	637	3A	639	5A	642

All 60 each

NUTS AND BOLTS

BA BOLTS–packs of BA threaded cadmium plated screws slotted cheese head. Supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
1in. OBA	839	£1·38	½in. 4BA	846	£0·37
½in. OBA	840	£0·86	¼in. 4BA	847	£0·29
1in. 2BA	842	£0·75	1in. 6BA	848	£0·46
½in. 2BA	843	£0·52	½in. 6BA	849	£0·24
¼in. 2BA	844	£0·60	¼in. 6BA	850	£0·20
1in. 4BA	845	£0·51			

BA NUTS–packs of cadmium plated full nuts in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	855	£0·83	4BA	857	£0·35
2BA	856	£0·55	6BA	858	£0·28

BA WASHERS–flat cadmium plated plain stamped washers supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	859	£0·16	4BA	861	£0·14
0BA	860	£0·14	6BA	862	£0·14

SOLDER TAGS–Hot tinned supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	851	£0·46	4BA	853	£0·25
2BA	852	£0·32	6BA	854	£0·25

TANTALUM CAPACITORS

3137	1MFD	35V	£0·13	3142	4.4MFD	35V	£0·21
3138	22MFD	35V	£0·13	3157	3.3MFD	25V	£0·21
3139	47MFD	35V	£0·13	3143	10MFD	35V	£0·25
3140	1.0MFD	35V	£0·13	3144	22MFD	16V	£0·25
3141	2.2MFD	35V	£0·14	3156	33MFD	35V	£0·13

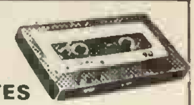
AUDIO LEADS

No.	Type	Price
107	FM indoor Ribbon Aerial	£0·69
113	3·5mm Jack plug to 3·5mm Jack plug length 1·5m	£0·86
114	5 pin DIN plug to 3·5mm Jack connected to pins 3 & 5 length 1·5m	£0·98
115	5 pin DIN plug to 3·5mm Jack connected to pins 1 & 4 length 1·5m	£0·98
116	Car aerial extension screened insulated lead. Fitted plug and socket	£1·44
117	AC mains connecting lead for cassette recorders and radios 2 metres	£0·78
118	5 pin DIN phono plug to stereo headphone. Jack socket	£1·21
119	2 · 2 pin DIN plugs to stereo Jack socket with attenuation network for stereo headphones. Length 0·2m	£1·04
120	Car stereo connector. Variable geometry plug to fit most car cassettes. 8-track cartridge and combination units. Supplied with inlined fuse power lead and instructions	£0·69
123	6·6m Coiled Guitar Lead Mono Jack plug to Mono Jack plug Black	£1·72
124	3 pin DIN plug to 3 pin DIN plug. Length 1·5m	£0·85
125	5 pin DIN plug to 5 pin DIN plug. Length 1·5m	£0·85
126	5 pin DIN plug to Tinned open end. Length 1·5m	£0·85
127	5 pin DIN plug to 4 Phono Plugs. All colour coded. Length 1·5m	£1·49
128	5 pin DIN plug to 5 pin DIN socket. Length 1·5m	£0·92
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1·5m	£1·21
130	2 pin DIN plug to 2 pin DIN inline socket. Length 5m	£0·78
131	5 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5 Length 1·5m	£0·95
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£1·13
133	5 pin DIN plug to 2 Phono plugs. Connected pins 3 & 5. Length 1·5m	£0·86
134	5 pin DIN plug to 2 Phono sockets. Connected pins 3 & 5. Length 23cm	£0·78
135	5 pin DIN socket to 2 Phono plugs. Connected pins 3 & 5. Length 23cm	£0·78
136	Coiled stereo headphone extension lead. Black, length 6m	£2·01
178	AC mains lead for calculators, etc	£0·52

REGULATORS

	Price		Price
Positive			
uA7805 TO220	£0·75	uA7912 TO220	£0·85
uA7812 TO220	£0·75	uA7915 TO220	£0·85
uA7815 TO220	£0·75	uA7924 TO220	£0·85
uA7824 TO220	£0·75	uA7818 TO220	£0·85
uA7818 TO220	£0·75	72723 14 pin DN	£0·52
Negative		uA723C TO99	£0·52
uA7905 TO220	£0·85	LM309K TO3	£1·72

SUPER SOUND
SAVING!
DINDY
LOW NOISE CASSETTES



O/no. 3193	30 min lettertape	£0·38 each
O/no. 301	Dindy C60 tape	£0·41 each
O/no. 302	Dindy C90 tape	£0·52 each
O/no. 303	Dindy C120 tape	£0·75 each

TRANSFORMERS

MINIATURE MAINS Primary 240V

No.	Secondary	Price
2021	6V–0–6V 100mA	£1·04
2022	9V–0–9V 100mA	£1·04
2023	12V–0–12V 100mA	£1·29

MINIATURE MAINS Primary 240V
with two independent secondary windings

No.	Type	Price
2024	MT280–0–6V 0–6V RMS	£1·84
2025	MT150–0–12V 0–12V RMS	£1·84

1 AMP MAINS Primary 240V

No.	Secondary	Price	
2026	6V–0–6V 1 amp	£2·88	P & P 45p
2027	9V–0–9V 1 amp	£2·30	P & P 45p
2028	12V–0–12V 1 amp	£2·00	P & P 55p
2029	15V–0–15V 1 amp	£3·16	P & P 66p
2030	30V–0–30V 1 amp	£3·97	P & P 86p

STANDARD MAINS Primary 240V

Multi-tapped secondary mains transformers available in ½ amp. 1 amp and 2 amp current rating. Secondary taps are 0–19–25–33–40–50V. Voltages available by use of taps. 4, 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 25–0–25V

No.	Rating	Price	
2031	½ amp	£3·91	P & P 85p
2032	1 amp	£5·06	P & P 85p
2033	2 amp	£6·27	P & P £1
2035	240V Primary 0–55V · 2A Secondary	£7·30	P & P £1

SPECIAL OFFER

2042 240V Primary 0–20V · 2A Secondary. By removing 5 turns for each volt from the secondary winding any voltage up to 20V · 2A is easily obtainable ideal for the experimenter.
£1·50 P & P 86p

HEATSINKS

Type	No	Price
TO3 – single heat sink	873	£0·31
TO3 – double heat sink	874	£1·38
Double sided heat sink	875	£1·67
TO5 39 heat sink	876	£0·16
TO18 – heat sink	877	£0·14
TO1 – heat sink	878	£0·09

TERMS CASH WITH ORDER. CHEQUES/POSTAL ORDERS MADE PAYABLE TO BI-PAK AT ABOVE ADDRESS

Send your orders to:-

DEPT. PE5, PO BOX 6, WARE, HERTS. Tel: 0920-3182

***Visit our NEW shop:* 3 BALDOCK ST., WARE, HERTS. Telex: 817861**

EXPERIMENTOR BREADBOARDS FROM CSC

No soldering breadboards. Simply plug components in and out of letter number identified.

Nickel-silver contact holes. Start small and simply snap-lock boards together to build a breadboard of any size.

All EXP Breadboards have two bus-bars as an integral part of the board. If you need more than two buses, simply snap on 4 more bus-bars with the aid of an EXP 4B.

EXP 325 The ideal breadboard for 1 chip circuits. Accepts 8, 14, 16 and up to 22-pin IC's. **ONLY £1·84** 48mm (1.9")

EXP 350 270 contact points with two 20-point bus-bars. **ONLY £3·62** 91mm (3.6")

EXP 300 550 contacts with two 40-point bus-bars. **ONLY £6·61** 152mm (6.0")

EXP 650 For Micro-processors. **ONLY £4·14** 91mm (3.6")

EXP 4B More bus-bars. **ONLY £2·65** 152mm (6.0")

EXP 600 As EXP 300 but accepts 24 pin DIL and over. **ONLY £7·25** 152mm (6.0")

All EXP 300 Breadboards mix and match with 600 series.

ANTEX IRONS

1943	15 watt quality soldering iron with 3/32" bit	**£4·88**
1947	Replacement element for 1943	**£2·18**
1944	Iron coated bit 3/32" for 1943	**£0·53**
1945	Iron coated bit 1/8" for 1943	**£0·53**
1946	Iron coated bit 3/16" for 1943	**£0·53**
1948	18 watt iron with iron coated bit	**£4·59**
1952	Replacement element for 1948	**£2·18**
1949	Iron coated bit 3/32" for 1948	**£0·53**
1950	Iron coated bit 1/8" for 1948	**£0·53**
1951	Iron coated bit 3/16" for 1948	**£0·53**
1931	X25 25 watt Iron, ceramic shaft and another shaft of stainless steel to ensure strength	**£4·88**
1935	Replacement element for 1931	**£1·84**
1932	Iron coated bit 1/8" for 1931	**£0·57**
1933	Iron coated bit 2/16" for 1931	**£0·57**
1934	Iron coated bit 3/32" for 1931	**£0·57**
1953	SK1 soldering Kit – contains 15 watt soldering iron with 3/16" bit plus two spare bits, a reel of solder, heat-sink and a booklet 'How to Solder	**£6·38**
1939	ST3 iron stand made from high grade bakelite chrom plated steel spring, suit all models – includes accommodation for six bits and two sponges to keep the iron bits clean	**£1·86**
1724	Model MLX as X25 iron but 12 volts	**£5·29**

CASES AND BOXES

VERO plastic case box. These boxes consist of top and bottom sections which include fixings points for horizontal mounting PC boards/chassis plates, the two sections are held together by four screws which enter through the base and are concealed by plastic feet.

No.	Length	Width	Height	Price
170	140mm	40mm	205mm	£4·35
171	140mm	75mm	205mm	£4·85
172	140mm	110mm	205mm	£6·30

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

No.	Length	Width	Height	Price
155	8in	5½in	2in	£1·73
156	11in	6in	3in	£2·92
157	6in	4¾in	1¾in	£1·79
158	9in	5½in	2½in	£2·43

ALUMINIUM BOXES made from bright alli, folded construction each box complete with half inch deep lid and screws.

No.	Length	Width	Height	Price
159	5¼in	2¼in	1½in	£0·86
160	4in	4in	1½in	£0·86
161	4in	2¼in	1½in	£0·86
162	5¼in	4in	1½in	£0·97
163	4in	2½in	2in	£0·87
164	3in	2in	1in	£0·60
165	7in	5in	2½in	£1·43
166	8in	6in	3in	£1·83
167	6in	4in	2in	£1·18

SLOPE front aluminium boxes with black vinyl base and sides & aluminium back, top & front – strong construction easily accessable.

169	2½in	5¼in	2¾in	12in	3½in	8in	£5·46
168	2½in	7½in	4in	16in	4½in	11in	£8·21

AUDIO MODULES

AMPLIFIERS

AL10	3 watt Audio Amplifier Module 22-32v supply	£3.63
AL20	5 watt Audio Amplifier Module 22-32v supply	£4.73
AL30A	7-10 watt Audio Amplifier Module 22-32v supply	£5.51
AL60	15-25 watt Audio Amplifier Module 30-50v supply	£6.81
AL80	35 watt Audio Amplifier Module 40-60v supply	£10.67
AL120	50 watt Audio Amplifier Module 50-70v supply	£17.38
AL250	125 watt Audio Amplifier Module 50-80v supply	£25.91

STEREO PRE-AMPLIFIERS

PA12	Supply voltage 22-32v Input sensitivity 300mv suit: AL10/AL20/AL30	£9.63
PA100	Supply voltage 24-36v inputs:– Tape, Tuner, Mag P.U., Suit: AL60/AL80	£20.30
PA200	Supply voltage 35-70v inputs:– Tape, Tuner, Mag P.U., Suit: AL80/AL120/AL250	£20.98

MONO PRE-AMPLIFIERS

MM100	Supply voltage 40-65v inputs: Mag, P.U., Tape Microphone Max. output 500mv	£14.29
MM100G	Supply voltage 40-65v inputs: 2 Guitars. Microphones Max. output 500mv	£14.29

POWER SUPPLIES

PS12	24v Supply suit 2 x AL10, 2 x AL20, 2 x AL30 & PA12/S.450	£1.90
SPM80	33v Stabilised supply – suit 2 x AL60, PA100 to 15 watts	£5.57
SPM120/45	45v Stabilised supply – suit 2 x AL60, PA100 to 25 watts	£7.34
SPM120/55	55v Stabilised supply – suit 2 x AL80, PA200	£7.34
SPM120/65	65v Stabilised supply – suit 2 x AL120, PA200, 1 x AL250, PA200	£7.34
SG30	15-0-15 Stabilised power supply for 2 x GE100MKII	£4.37

MISCELLANEOUS

MPA30	Stereo Magnetic Cartridge Pre-Amplifier-input 3.5mv Output 100mv	£3.76
S.450	Stereo FM Tuner Supply Voltage 20-30v – Varicap tuned	£29.39
STEREO30	Complete 7 watt per Channel Stereo Amplifier Board – Includes amps, pre-amp, power supply, front panel, knobs etc – requires 2050 Transformer	£24.25
BP124	5 watt 12v max. – Siren Alarm Module	£4.43
GE100MKII	10 channel mono-graphic equaliser complete with sliders and knobs	£26.45
VPS30	Variable regulated stabilised power supply 2-30v 0-2 amps	£8.74

TRANSFORMERS

			P&P
2034	1.7 amp 35v suit SPM80	£6.21	£1.21
2035	2 amp 55v	£7.30	£1.47
2036	750mA 17v suit PS12	£3.68	
2040	1.5 amp 0-45v-55v suit SPM120/45, SPM120/55v	£5.98	£1.21
2041	2 amp 0-55v-65v suit SPM120/55, SPM120/65v	£7.82	£1.47
2050	1 amp 0-20v suit Stereo 30	£3.74	£0.75
1725	150mA 15-0-15v suit SG30	£2.04	

ACCESSORIES

139	Teak Cabinet suit Stereo 30, 320 x 235 x 81mm	£9.72
140	Teak Cabinet suit STA15 425 x 290 x 95mm	£8.97
FP100	Front Panel for PA100 & PA200	£2.07
BP100	Back Panel for PA100 & PA200	£1.84
GE100FP	Front Panel for one GE100MKII	£2.05
2240	Kit of parts including Teak Cabinet, chassis sockets, knobs to build 15 watt stereo amplifier	£22.94

SPECIAL OFFERS

MINIDRILL 12v hand held battery-operated mini drill. 7,500 r.p.m. Collet chuck. Ideal for drilling printed circuits or model making. No.1402. **£6.33**

TRANSFORMER 240v Primary 0–20v ● 2A Secondary. By removing 5 turns for each volt from the secondary winding, any voltage up to 20v ● 2A is obtainable. Ideal for the experimenter. No.2042. **£1·50** + 86p. P & P

ANTEX MLX Soldering Iron. Sturdy 25 watt iron complete with: 4½ metres of 2-core cable. Works off a 12 volt battery. Ideal for Car, Boat, Caravan. No.1724. **£5·29**

METAL FOIL CAPACITOR PAKS

16204 – Containing 50 metal foil capacitor like Mullard C280 series – Mixed values ranging from 01uf – 2·2uf. Complete with identification sheet **£1·38**

TRIACS

2 amp volts	TO5 case No.	Price	10 amp volts		
100	TR12A/100	£0·36	100	TR110A/100	£0·88
200	TR12A/200	£0·59	200	TR110A/200	£1·06
400	TR12A/400	£0·82	400	TR110A/400	£1·29

6 amp volts			10 amp volts		
100	TR16A/100	£0·59	400	TR110A/400P	£1·29
200	TR16A/200	£0·70	DIACS		
400	TR16A/400	£0·88	BR100	£0·23 D32	£0·23

SILICON RECTIFIERS

200mA	
IS920 50V	£0.07
IS921 100V	£0.08
IS922 150V	£0.09
IS923 200V	£0.10
IS924 300V	£0.11
1 Amp	
IN4001 50V	£0.05
IN4002 100V	£0.05
IN4003 200V	£0.07
IN4004 400V	£0.08
IN4005 600V	£0.09
IN4006 800V	£0.10
IN4007 1000V	£0.11
1.5 Amp	
IS015 50V	£0.10
IS020 100V	£0.11
IS021 200V	£0.12
IS023 400V	£0.14
IS025 600V	£0.16
IS027 800V	£0.18
IS029 1000V	£0.23
IS031 1200V	£0.28
60 Amp	
IS70/50 50V	£0.86
IS70/100 100V	£0.96
IS70/200 200V	£1.38

3 Amp	
IN5400 50V	£0.16
IN5401 100V	£0.17
IN5402 200V	£0.18
IN5404 400V	£0.19
IN5406 600V	£0.24
IN5407 800V	£0.28
IN5408 1000V	£0.34
10 Amp	
IS10/50 50V	£0.21
IS10/100 100V	£0.24
IS10/200 200V	£0.26
IS10/400 400V	£0.40
IS10/600 600V	£0.48
IS10/800 800V	£0.58
IS10/1000 1000V	£0.69
IS10/1200 1200V	£0.79
30 Amp	
IS30/50 50V	£0.64
IS30/100 100V	£0.79
IS30/200 200V	£1.06
IS30/400 400V	£1.43
IS30/600 600V	£2.02
IS30/800 800V	£2.23
IS30/1000 1000V	£2.65
IS30/1200 1200V	£3.31
IS70/400 400V	£2.01
IS70/600 600V	£2.58
IS70/800 800V	£2.87
IS70/1000 1000V	£3.45

THYRISTORS

600ma Volts	TO 18 Case No.	Price
10	THY600/10	£0.17
20	THY600/20	£0.18
30	THY600/30	£0.23
50	THY600/50	£0.25
100	THY600/10	£0.29
200	THY600/200	£0.44
400	THY600/400	£0.51

1 amp Volts	TO 66 Case No.	Price
50	THY1A/50	£0.30
100	THY1A/100	£0.32
200	THY1A/200	£0.37
400	THY1A/400	£0.44
600	THY1A/600	£0.52
800	THY1A/800	£0.67

3 amp Volts	TO 66 Case No.	Price
50	THY3A/50	£0.32
100	THY3A/100	£0.35
200	THY3A/200	£0.38
400	THY3A/400	£0.48
600	THY3A/600	£0.58
800	THY3A/800	£0.75

5 amp Volts	TO 66 Case No.	Price
50	THY5A/50	£0.41
100	THY5A/100	£0.52
200	THY5A/200	£0.58
400	THY5A/400	£0.66
600	THY5A/600	£0.79
800	THY5A/800	£0.93

5 amp Volts	TO 220 Case No.	Price
400	THY5A/400P	£0.86
600	THY5A/600P	£0.79
800	THY5A/800P	£0.93

7 amp Volts	TO 48 Case No.	Price
50	THY7A/50	£0.55
100	THY7A/100	£0.59
200	THY7A/200	£0.66
400	THY7A/400	£0.71
600	THY7A/600	£0.90
800	THY7A/800	£1.06

10 amp Volts	TO 48 Case No.	Price
50	THY10A/50	£0.59
100	THY10A/100	£0.66
200	THY10A/200	£0.71
400	THY10A/400	£0.81
600	THY10A/600	£1.14
800	THY10A/800	£1.40

16 amp Volts	TO 48 Case No.	Price
50	THY16A/50	£0.62
100	THY16A/100	£0.67
200	THY16A/200	£0.71
400	THY16A/400	£0.89
600	THY16A/600	£1.04
800	THY16A/800	£1.60

30 amp Volts	TO 94 Case No.	Price
50	THY30A/50	£1.38
100	THY30A/100	£1.64
200	THY30A/200	£1.87
400	THY30A/400	£2.06
600	THY30A/600	£4.03

No.	Price
BT101/500R	£0.92
BT102/500R	£0.92
BT106	£1.44
BT107	£1.07
BT108	£1.13
2N3228	£0.81
2N3525	£0.89
BTX30/50L	£0.38
BTX30/400L	£0.53
C106/4	£0.69
BT116	£1.73

ZENER DIODES

400 mw (Bzy88) D007. Glass encapsulated range of voltages available. 1·3v, 2·2v, 2·7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 39v. **No. Z4 10p**

1w-1·5w Plastic and metal encapsulated. Range of voltages available. 1·3v, 2·2v, 2·7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 43v, 47v, 51v, 68v, 72v, 75v, 82v, 91v, 100v. **No. Z13 18p**

10w Metal stud type SO10 case. Range of voltages available. 1·3v, 2·2v, 2·7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 43v, 47v, 51v, 68v, 72v, 75v, 82v, 91v, 100v. **No. Z10 44p**

BRIDGE RECTIFIERS

SILICON 1 amp

Type	No.	Price
50v RMS	BR1/50	£0·23
100v RMS	BR1/100	£0·25
200v RMS	BR1/200	£0·29
400v RMS	BR1/400	£0·41

SILICON 2 amp

Type	No.	Price
50v RMS	BR2/50	£0·52
100v RMS	BR2/100	£0·55
200v RMS	BR2/200	£0·60
400v RMS	BR2/400	£0·67
1000v RMS	BR2/1000	£0·78

SILICON 10 amp

Type	No.	Price
50v RMS	BR10/50	£1·50
200v RMS	BR10/200	£1·70

SILICON 25 amp

Type	No.	Price
50v RMS	BR25/50	£1·90
200v RMS	BR25/200	£2·20

TERMS: CASH WITH ORDER. CHEQUES, P.O.'s PAYABLE TO BI PAK AT ABOVE ADDRESS. ACCESS & BARCLAYCARD ACCEPTED. GIRO ACCOUNT NO. 388 7006. ALL PRICES INCLUDE VAT. PLEASE ADD 50p PER ORDER TO COVER P.&P.

BARCLAYCARD VISA

PE VOLUME 16 No. 5 MAY 1980

FREE

FOR the second time we are giving away a set of 120 Stickies with an issue. Back in October 1978 we presented a similar set of TTL Stickies, this time it's the CMOS versions. By popular request we have been able to repeat this free gift, which we are sure all constructors will find useful. On the cover we have indicated that they are worth 60p; in fact, the sheet would cost you 80p. However, Concept Electronics also supply an instruction leaflet and a plastic wallet so, to be totally fair, we have reduced this figure. You will, however, find full instructions on using your Stickies on page 47—the only thing you don't get from us is the plastic wallet. Page 47 also gives full details on ordering more!

SPECIAL

It has been our policy over the last couple of years to arrange a number of special offers for readers. Last month we carried the Videotone GB3 offer (speakers which will go well with the PE Congress), this month we have the Edukit offer. It is our policy to offer excellent products at prices that we believe cannot be bettered at the time.

The Edukit offer gives a saving of only just over £1, but on an item that is true value for money at its normal price, it is not possible to make a better offer—a saving of £1 is, after all, worth having! The problem we are constantly aware of is that on high technology products—particularly watches—the prices have fallen dramatically over the past few years and continue to do so. In the face of these reducing prices it is natural that some offers can be bettered over a period of time. At present, our offers have always been the best price for at least four months, and in most cases have never been bettered. We do not believe the Edukit offer will ever be bettered.

Readers must, however, realise that in this area of high technology it may always be prudent to wait for an indefinite period for prices to fall—it could be said that no one in their right mind would have bought a colour TV, a calculator or a watch yet! Perhaps some will take the view that it's better to wait; we believe that on this type of product one must decide when the price paid gives a worthwhile return and then buy. The use of the equipment over a period will normally compensate for the higher price. A watch now, or no watch for four months and a small saving?

VALUE

Whilst on the subject of value for money we believe that PE gives just that, and it would appear that most of you do too. Because of this we are often asked by readers if the latest issue is on sale, as they have been unable to obtain copies. At the time of writing we have not experienced any publishing difficulties for some time. We would urge those readers that have been finding copies difficult to come by, to place a firm order with their newsagent. In the highly unlikely event that such an order fails to provide a regular copy please contact us directly.

A subscription service is also available and will be particularly interesting to foreign readers—full details are given below.

Mike Kenward

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Dorset BH15 1JG
Phone: *Editorial* Poole 71191

We regret that lengthy technical enquiries cannot be answered over the telephone (see below).

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Telex: 915748 MAGDIV-G

Make Up/Copy Dept.: 01-261 6601

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 Practical Electronics.

All letters requiring a reply should be accompanied by a stamped, self addressed envelope and each letter should relate to **one published project only.**

Components are usually available from advertisers; where we anticipate supply 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 75p each including Inland/Overseas p&p.

Binders
Binders for PE are available from the same address as back numbers at £4·10 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 £10·60 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.

Market Place

Items mentioned are usually available from electronic equipment and component retailers advertising in this magazine. However, where a full address is given, enquiries and orders should then be made direct to the firm concerned. All quoted prices are those at the time of going to press.

by David Shortland and Jasper Scott

IT'S A GAS

A new gas soldering iron has been introduced by Kam Circuits, which has some obvious advantages over the conventional electric soldering iron. Being cordless, it is ideally suited to outdoor work, or any situation where a power supply is not readily accessible. Also, there is no danger of electric current leakage.

The SW–M uses ordinary gas lighter fuel and operates by flameless combustion of the fuel. One complete fill can provide a maximum of four hours continuous use. There is a wattage range of 20-60W, and a different wattage can be obtained simply by changing tips.

The SW–M costs £17·06 + VAT and p&p. and is available direct from: **Kam Circuits Ltd., Porte Marsh Road, Calne, Wilts. Tel. (0249 812585).**

SUPERMASTER 20

The latest instrument to be introduced by Alcon is the Miselco SuperMaster 20, a 20kΩ/V a.c. and d.c.) unit with 1·5 per cent d.c. and 2 per cent a.c. accuracy figures.

This general-purpose instrument can cope with d.c. voltages from 100mV to 1000V and currents from 50μA to 3A; a.c. voltages from 10V to 1000V and currents from 1mA to 3A (f.s.d.). With resistance ranges from 200Ω f.s.d. up to 20MΩ f.s.d. in six ranges and power measurable from −10dB to +61dB, the SuperMaster 20 is capable of coping with most general measurement problems.

Range switching is effected using a simple slider switch to select d.c., a.c. or resistance ranges, whilst a single main ceramic rotary switch selects the actual range desired.

The most important advance which this instrument represents is the inclusion of an electronic cut-out module, itself replacable, capable of provding movement protection both simply and reliably.

The cut-out is resettable by returning a small red button to the reset position. Operation of the cut-out occurs when the applied energy exceeds that which the meter range identifies by a factor, and the same action releases the reset button to indicate activation.

The cut-out is battery operated and amplifies the signal applied to the meter movement to actuate an electromechanical switch if necessary. It does not have to rely on mechanical acceleration of the movement needle to obtain switching, in fact the needle hardly moves even inserting current on an ohms range.

This cut-out can be tested in-situ simply by pressing a second (black) button marked 'Test' which promptly causes the cut-out to actuate, providing the 15V battery powering the cut-out is in good order.

The a.c. bandwidth is 20kHz and the instrument may be used as simple signal analysis system if the optional Universal Signal Injector (USI) capable of supplying a 1kHz-modulated, 500kHz, 20V peak output rich in harmonics and detectable up to 500MHz is used.

A further optional item is a 30kV probe extending the d.c voltage range up to 30kV for TV servicing and the like.

Power is by internal batteries for both resistance and the optional USI feature, and for the cut-out system. Meter protection diodes are also provided and the equipment is fused in the resistance and current ranges.

The SuperMaster 20 is supplied with leads, prods, and instructions, at a price of £65·95 incl. VAT. The USI version is available at £67·85 (VAT included) and the 30kV probe is £14·37 inclusive.

Alcon Instruments Limited, 19 Mulberry Walk, London SW3 (352 1897).

TAPE HEAD CLEAN-UP

A new formula Tape Head Cleaning Fluid has been developed by BIB Research Laboratories, and is now the latest addition to the BIB Audiophile Edition range of hi-fi accessories.

The new fluid safely removes tape oxide deposits, dust and dirt from tape heads, capstans and pinch rollers of all types of tape recorders. Available in 56ml bottles, the fluid is non-toxic and non-flammable.

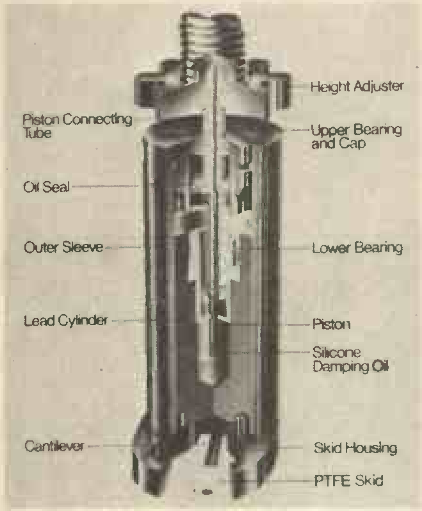
The rrp is £2·65 per bottle (including VAT), and the fluid should be on sale at all normal retail outlets.

BIB Hi-fi Accessories Ltd., Wood Lane End, Hemel Hempstead, Herts, HP2 4RQ.

ZEROSTAT Z-TRACK

The latest addition to a wide range of up-market hi-fi accessories from Zerostat is their Z-Track tonearm/cartridge damper, which is intended to reduce the ill effects of warped discs.

Most pick-up systems have a low frequency resonance which can be excited by the effects of warped discs or mechanical feedback. Large quantities of infra-bass energy are generated, which can harm loudspeaker bass units and result in poorer sound quality.



The Z-Track, which has an effective mass of only half a gram and fits virtually any tonearm/cartridge combination, relies on a minute silicone liquid damped piston which moves in a cylinder incorporated in the main body. The main body is in turn carried on a PTFE skid which is wide enough to ride the record surface without tracking. Hence the damping action of the fluid on the cylinder controls resonances.

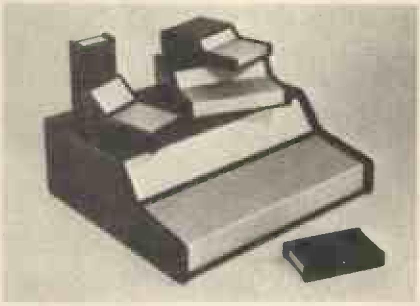
As well as improving the sound quality of mildly warped records and enabling previously unplayable records to be played, there is an added advantage. The improved tonearm/cartridge stability enables one to use a lighter tracking weight, which again helps to improve sound quality. We have also found that the Z-Track gives noticeable improvements even with relatively cheap systems.

The Z-Track retails at £9·95, and is available from dealers or direct from: **Zerostat Components Ltd., Edison Road, Industrial Estate, St Ives, Huntingdon, Cambs.**

BOCON CASES

West Hyde Developments have recently added to their 'Bocon' range of high quality instrument cases. The latest additions are the Bocon 'Desk' and Bocon 'Commander' cases.

The 'Desk' series, which is available in four sizes, is moulded in black a.b.s. and uses a tongue and groove method of construction, with a one-piece anodised aluminium front panel. There is provision inside the case for chassis and p.c.b. mounting.



The 'Commander' comes in two sizes, the larger being designed to accommodate most proprietary keyboards, with a rear aperture large enough to accept a 19" rack frame 3U high. It is made from black foam plastic and has anodised aluminium panels. The smaller 'Commander' which is moulded in black a.b.s. is suitable for keypads and smaller displays.

Prices range from £7·14 for the smallest 'Desk' case to £77·50 for the large 'Commander'. Further details are available from: **West Hyde Developments Ltd., Unit 9, Park St. Industrial Estate, Aylesbury, Bucks HP20 1ET. Tel (0296) 20441.**

EQUALISER

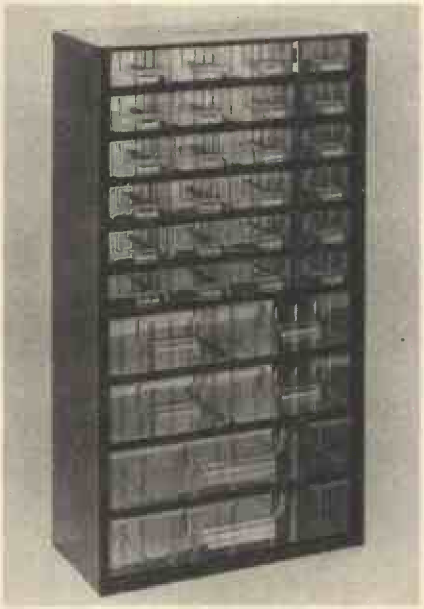
Bandridge Ltd of London have come up with a mid-priced stereo frequency equaliser, the FE5, which is aimed at both the top and the middle of the hi-fi market. It is expected to retail at under £80.

The FE5 has five slider frequency controls per channel, ranging from 60Hz to 10KHz, so that a very wide range of fine tonal adjustment is possible. When the FE5 was connected between the pre-amp and power-amp stages of a fairly low cost amplifier, the sound quality was much enhanced, and the range of tonal adjustment greatly improved. However, it must be pointed out that with most amplifiers it is not possible to get between these two stages; but when the FE5 was connected in the alternative manner—between the tape output and tape monitor input the results were almost as good, and the range of tonal adjustment was still much improved.

For further details and information on price and availability, contact: **Bandridge Ltd., 1 York Road, London SW19. Tel: 01-543 3633.**

BOXED IN

Here's an alternative to that ever increasing pile of tatty tobacco tins—the RAACO 30 AJF storage unit, which is available from Toolrange. This thirty drawer storage cabinet which can either be free standing or wall mounted is made from enamelled steel, with



transparent plastic drawers. Its overall size is 555 × 307 × 146mm, and each unit comes complete with assorted drawer dividers and labels.

The price per unit is £19·25 + VAT and delivery, and it is available direct from: **Toolrange Ltd, Upton Road, Reading, Berks.**

4½ DIGIT DMM

Gould Instruments Division has introduced a new 4½-digit multimeter, the DMM12, which features a liquid-crystal display, a measurement accuracy of 0·05 per cent and a built-in electronic technique for making true root-mean-square (r.m.s.) measurements on a.c. signals. Using components specifically selected for high stability and low-noise performance, the DMM12 has 27 measurement ranges for a.c. and d.c. voltage, current and resistance, and is also available with optional probes for radio-frequency and high voltage measurements.

Maximum reading is 19999, and maximum resolutions on current, voltage and resistance measurements are 10μV, 10nA and 100mΩ, respectively.

The l.c.d. incorporates separate positive or negative polarity indication plus a decimal point. Over-range and 'battery low' are also indicated using the display.

The true r.m.s. sensing a.c./d.c. convertor used in the DMM12 can accept waveforms with a crest factor (peak/r.m.s. ratio) of up to 4:1 at full scale, and a combined a.c./d.c. facility is available to measure a.c. waveforms with a d.c. content. The true r.m.s. value measures the energy content of an a.c. waveform, and hence makes the DMM12 ideally suited to power-system measurements.

Standard models are mains/line powered but option BP12 gives portability with rechargeable cells.

For further information contact: **Gould Instruments Division, Roebuck Road, Hainault, Essex.**

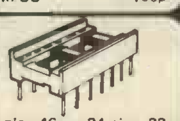
STEVENSON
Electronic Components

OPTO

LED's	0.125in.	0.2in	each
Red	TIL209	TIL220	10p
Green	TIL211	TIL221	15p
Yellow	TIL213	TIL223	15p
Clips	3p	3p	

DISPLAYS		
DL704	0.3 in CC	130p
DL707	0.3 in CA	130p
FND500	0.5 in CC	100p

SKTS



Low profile by Texas

8 pin	10p	18 pin	16p	24 pin	22p
14 pin	12p	20 pin	18p	28 pin	26p
16 pin	13p	22 pin	20p	40 pin	38p

3 lead T018 or T05 skt. 12p each.
Soldercon pins: 100 for 60p.

PCBS

VEROBOARD

Size in.	0.1in.	0.15in.	Vero
25 x 1	16p	—	Cutter 110p.
2.5 x 3.75	52p	45p	
2.5 x 5	60p	55p	Pin insertion
3.75 x 5	70p	70p	tool 150p.
3.75 x 17	250p	210p	
SS pins/100	45p	45p	

Fibreglass board: 80p each.
Alfac – 33p per sheet.

RESISTORS

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

E12 series. 4.7 ohms to 10M. Any mix:

	each	100+	1000+
0.25W	1p	0.9p	0.85p
0.5W	2p	1.5p	1.3p

Special development packs consisting of 10 of each value from 4.7 ohms to 1 Megohm (650 res) 0.5W £8.50. 0.25W £5.30.

METAL FILM RESISTORS

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

	each	100+	1000+
0.25W	4p	3.7p	3.5p

POTENTIOMETERS

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

MISC.

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

SWITCHES

TOGGLE

Standard	SPST 36p	DPDT 50p
Miniature	SPDT 75p	DPDT 85p
Subminiature	SPST 58p	DPDT 78p

SLIDE

Standard . . . . . . DPDT 17p
Miniature . . . . . . DPDT 16p

ROCKER (10A rating)
SPST 34p each. SPST 46p each.

ROTARY
1P12W, 2P6W, 4P3W or 3P4W 51p each
Key operated DPDT (Yale key) 395p each

PUSH
Non locking - push to make 16p each
- push to break 22p each
Locking - SPST 75p each
- DPDT 100p each

REGULATORS

LM309K	140p
LM317T	220p
LM323K	480p
LM723	40p

100mA + ve		1A + ve		1A – ve	
78L05	30p	7805	70p	7905	85p
78L12	30p	7812	70p	7912	85p
78L15	30p	7815	70p	7915	85p

TRANSISTORS

AC127	22p	BC548	11p	TIP32C	60p
AC128	22p	BCY71	16p	TIP2955	66p
AC176	22p	BCY72	15p	TIP3055	53p
AD161	40p	BD131	40p	ZTX107	12p
AD162	40p	BD132	40p	ZTX108	12p
BC107	12p	BD139	33p	ZTX300	14p
BC108	10p	BD140	33p	ZTX500	15p
BC108C	12p	BFY50	23p	2N3053	25p
BC109	12p	BFY51	23p	2N3054	56p
BC109C	12p	BFY52	23p	2N3055	50p
BC147	9p	MJ2955	100p	2N3702	9p
BC148	9p	MPSA06	16p	2N3704	9p
BC177	16p	MPSA56	16p	2N3706	9p
BC178	16p	TIP29C	60p	2N3819	20p
BC182	10p	TIP30C	48p	2N3904	10p
BC182L	10p	TIP31C	50p	2N3905	10p
BC184	10p			2N3906	10p
BC184L	10p			2N5459	33p
BC212	10p			2N5777	50p
BC212L	10p				
BC214L	10p				

DIODES

1N914	4p	1N4006	7p
1N4148	3p	1N5401	14p
1N4002	5p	BZY88ser.	8p

1N4148 £1.50 per 100.

CAPACITORS

POLYSTYRENE

High quality foil type. 63V working, 5% tol.
22pf to 100pf . . . . 7p each
1500pf to 0.01uF . . . . 9p each

TANTALUM BEAD

0.1, 0.15, 0.22, 0.33, 0.47, 0.68
1 & 2.2uF @ 35V . . . . 10p each
4.7, 6.8, 10uF @ 25V . . . . . . 18p each
22 @ 16V, 47 @ 6V, 100 @ 3V . . 22p each

MYLAR

0.001, 0.01, 0.022, 0.033, 0.047 . . . 4p each
0.068, 0.1 . . . . 5p each

POLYESTER

Mullard C280 series
0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1. 6p ea.
0.15, 0.22 . . . . 8p each
0.33, 0.47 . . . . 12p each
0.68 . . . . 17p each
1.0uF . . . . 22p each

CERAMIC

Plate type 50V. Available in E12 series from 22pF to 1000pF and E6 series from 1500pF to 0.047uF . . . . 2p each

MINIATURE TRIMMERS

Miniature film type, in 1.4pF – 5pF, 2pF – 22pF, 2pF – 22pF, 2pF – 10pF, 5.5pF – 65pF. 22p each

RADIAL LEAD ELECTROLYTICS

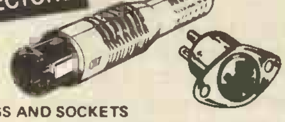
63V	0.47	1.0	2.2	4.7	10	6p each
			22	33	47	8p each
	100					16p each
			220			20p each
25V	10	22	33	47		6p each
	100					8p each
		220				12p each
				470		18p each
	1000					28p each

PACKS

Specially developed packs intended for development work.

¼W CF resistor, 10 each value E12 series 4.7 ohm to 1 Megohm (650 total)	530p each
½W CF resistor, 10 each value E12 series 4.7 ohm to 1 Megohm (650 total)	850p each
¼W MF ½% resistor. 10 each value E24 series 51 ohms to 330K (930)	2950p each
Preset potentiometers 5 each value from 100 ohms to 1 Megohm (65)	390p each
Polyester capacitors 5 each value 0.01 to 2.2uF (70)	690p each
Ceramic plate capacitors 10 each value 22pF to 0.01uF (310)	575p each

CONNECTORS



DIN PLUGS AND SOCKETS

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

JACK PLUGS AND SOCKETS

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

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4mm PLUGS AND SOCKETS

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20

CMOS

		4023	20p	4054	120p	4502	120p
		4024	50p	4060	120p	4507	60p
		4025	20p	4063	120p	4508	330p
		4026	160p	4066	60p	4510	80p
		4027	45p	4068	20p	4511	90p
4000	20p	4028	85p	4069	20p	4512	80p
4001	20p	4029	85p	4070	20p	4516	80p
4002	20p	4031	220p	4071	20p	4518	80p
4006	90p	4033	150p	4072	20p	4520	80p
4007	20p	4036	350p	4073	20p	4527	90p
4008	95p	4039	300p	4075	20p	4528	90p
4011	30p	4040	110p	4076	90p	4529	150p
4012	20p	4041	85p	4077	20p	4531	150p
4013	35p	4042	80p	4078	20p	4532	130p
4014	80p	4043	95p	4081	20p	4538	160p
4015	80p	4046	110p	4082	20p	4543	110p
4016	30p	4048	60p	4086	75p	4566	170p
4017	65p	4049	45p	4093	60p	4558	120p
4018	90p	4050	45p	4095	110p	4559	420p
4020	100p	4051	70p	4098	120p	4581	330p
4022	100p	4053	80p	4501	20p	4585	110p

LSTTL

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

TTL

		7442	40p	7493	30p	74157	40p
		7445	50p	7496	38p	74164	55p
7400	12p	7447	50p	74121	29p	74165	55p
7402	12p	7448	45p	74123	40p	74174	55p
7404	14p	7473	23p	74125	38p	74177	50p
7408	16p	7474	23p	74126	36p	74190	50p
7410	14p	7475	26p	74132	46p	74191	50p
7413	24p	7476	25p	74141	48p	74192	50p
7414	39p	7485	55p	74145	48p	74193	50p
7420	14p	7486	18p	74148	90p	74194	50p
7427	22p	7490	30p	74150	55p	74196	50p
7432	18p	7492	30p	74154	68p	74197	50p

LINEAR

		LM10	400p	LM3909	72p	TBA800	80p
		LM301A	30p	LM3914	280p	TBA810S	110p
		LM308	70p	LM3915	280p	TDA1008	350p
709	40p	LM318	85p	LM3911	120p	TDA1022	630p
741	18p	LM324	52p	LM13600	160p	TDA1024	120p
747	50p	LM339	55p	MC1496	80p	TDA2020	360p
748	35p	LM348	100p	LM1458	40p	TL071	75p
7106	850p	LM377	170p	LM1830	180p	TL072	135p
AY-1-0212	660p	LM378	230p	MC3340P	135p	TL074	200p
CA3046	70p	LM3795	410p	MC3360P	135p	TL081	45p
CA3080	75p	LM380	80p	MM57160	650p	TL082	85p
CA3130	90p	LM381	140p	NE531	110p	TL084	125p
CA3140	50p	LM382	120p	NE555	23p	TL170	60p
FX209	820p	LM383	200p	NE556	60p	XR2206	390p
ICM7555	100p	LM386	90p	NE566	120p	XR2207	450p
ICM7556	POA	LM387	120p	NE567	120p	ZN414	80p
LF347	135p	LM389	100p	NE570	420p	ZN419	POA
LF351	45p	LM391	170p	NE571	460p	ZN424	150p
LF353	85p	LM1310	140p	NE5537	POA	ZN425E	420p
LF355	92p	LM2917	280p	RC4136	100p	ZN460	360p
LF356	95p	LM2924	160p	SAD1024	1310p	ZN1034	230p
LF357	92p	LM3900	60p	SN76477	230p		

MICRO

		2112	220p	CPU's		SUPPORT	
		2114LP	420p	6800	650p	6810	350p
		4116	620p	8080A	610p	6821	600p
		2708	680p	Z80	1090p	6850	550p
21L02	120p	2716	1980p			AY5-1013	370p

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INDUSTRY NOTEBOOK

By Nexus

Two-way Streets

The Soviet military intervention in Afghanistan cannot be ignored in the context of the electronics industry. Its immediate result is that east-west detente has been dented if not yet dead. Hardening of political attitudes has led to a re-appraisal of defence capability in the West and, while any increase in armaments is regrettable, there is no denying that any increased defence expenditure is good news for the electronics industry.

Defence was the spur to the development of microminiature techniques and many of the later microelectronics devices which are now commonplace in civil applications. It is interesting to compare the attitude of armed services and the industrial and commercial world to the 'chip' and other recent developments. In the services there are no arguments about job loss or other so-called drawbacks resulting from technology advance, and this is for the elementary reason that for personal survival it is advisable to be on the winning side. In any conflict, other things being equal, the best equipped force in fire power and accuracy must win. The civilian equivalents are productivity and skills, and it is difficult to understand why such simple logic is ignored by so many otherwise sensible people engaged in the economic and commercial war for world markets which, after all, is with us now and always.

In military jargon electronics is a major constituent of a concept called a force multiplier. The one-shot kill with artillery or missile is clearly better and more economical than a three-shot kill. Periodic re-fits and up-dates of electronic equipment multiply the effectiveness of fighting platforms of ships, aircraft and armoured fighting vehicles. The hull of a frigate may be twenty years old, but with modern equipment it could be ten times more efficient in offence and defence than when first commissioned. Re-fits to take advantage of modern technology, though expensive in themselves, are economic in prolonging the life of the even more expensive platforms such as ships.

The whole of the military market in the West is beset by political and economic as well as technical problems. NATO, main bulwark in Europe against possible Warsaw Pact attack, suffers from a chronic lack of standardisation in weapons and systems. Those of the fifteen nations in NATO who have industrial capability prefer to make their own. Sheer costs in R & D have forced a number of European co-operative projects into being, the most spectacular at the moment being the Anglo/German/Italian Tornado swing-wing aircraft. Thus a number of two-way streets between nations have been established.

The dominant supplier, however, is still the United States, but despite a number of Memoranda of Understanding the transatlantic street is still very much one-way with a flood of material into Europe and only a trickle in the reverse direction. Some two years ago there were high hopes in the UK that there would be an adjustment of the balance. In electronics, UK firms could bid for the first time on equal terms for important contracts in the United States. The Sincgars-V frequency-hopping radio system was the occasion and Marconi and Plessey are involved with US partners. Since then there has been little action. Moreover, for political reasons, nothing is likely to happen during the run-up to the presidential election at the end of this year.

If we are just playing at soldiers this hardly matters. But if the military threat is real then standardisation and interoperability should now receive top priority. A more liberal policy on two-way streets would inevitably lead to some firms winning and some losing but we should all gain in the end. The danger now, with protective attitudes to one's own defence industries, is that the politicians who may be responsible for involving us in a future conflict will also be guilty of ensuring that we lose it.

Musical Chairs

The international semiconductor industry which seemed to be settling down has recently had a spate of top management changes. David Marriott resigned from the GEC-Fairchild venture where he was managing director. Newly knighted Sir Robert Clayton, chairman of the same company resigned from this and a number of other GEC companies because of possible conflict of interests as he is now with the National Enterprise Board. Dr. Melvyn Larkin, a top Motorola executive is now re-vamping Plessey's solid state interests.

Mick Adams who was general manager of Plessey Semiconductors has switched to Signal Technology Ltd. a joint venture of Plessey and Anderson Laboratories specialising in surface acoustic wave (SAW) devices. Wilf Corrigan has resigned his presidency of Fairchild in the USA and C. Lester Hogan, one of the old-time 'greats' in the business, has re-emerged as an adviser to Fairchild where he was president from 1968 to the mid-70s.

Dr. Steve Forte, head of marketing and sales, has left General Instrument Microelectronics and is now heading up the European operation of American Microsystems. Forte is being replaced at GIM by two people, surely the best endorsement that Forte was earning his corn. The mobility of executives in the world of solid state always results in more than usual cross-fertilisation of ideas and marketing strategies. It also often signals that new companies are being formed by those who have pulled out but have not yet announced their intentions.

An example, though in a different field, is Dennis Taylor who resigned from managing directorship of Hewlett-Packard in the UK later to emerge as chairman and managing director of the re-vamped Sinclair Electronics and in February last as chairman of a new company, Measurand, in the transducer business.

Fibre Optics

Optical communications links are having a further boost with two new projects. First is the innovative application of an experimental fibre optic submarine cable in the 600-fathom deep Loch Fyne in Scotland. Both STC and the British Post Office see the idea as potentially feasible for submarine cables in the 1990s. Second is the studies now being undertaken in France for the first European fibre optic 'wired' city with Biarritz as the experimental location, chosen because of its particular problems with TV reception. The results of the study contract are expected to be ready for presentation to the French PTT by next June.

Bright news, also, for all potential fibre optics users. The UK company Pilkington has developed a new method of making the fibre which is expected to slash present production costs by 20-30 per cent. The technique is secret but has been reported as 'brilliantly simple' and allows lengths of up to 10km to be drawn.

Carve-up

Some call it rationalisation, some a carve-up. But whatever the label the new decade of the 80s is off to a flying start with both EMI and Decca now having changed hands, with Thorn and Racal in command but still leaving GEC as the giant. Racal's Ernie Harrison has been plugging the idea of a major rationalisation of Britain's electronics industry since the mid-70s. Now his dreams are coming true but only at a heavy price, having been pushed to almost double his opening bid for Decca by the intervention of GEC.

Harrison's cherished ambition to lead Racal as the second force in electronics, however, has not deflected him from hedging his bets by expansion in the United States. Absorbing Decca will have stretched Racal's resources for the time being but it is doubtful whether the appetite for acquisition will be satisfied for long. Once Decca is digested the old hunger will return.

Power Supplies for M.P.Us

Alan Clements B.Sc. Ph.D. Part 2

IN this final part of a p.s.u. design for a processor system is presented.

POWER SUPPLY FOR A SMALL MICROPROCESSOR SYSTEM

A typical modular microprocessor system requires three power supply rails plus a common ground rail. These power rails furnish all the modules to which they are connected with power at three voltage levels: −12V, +12V and +5V. In the example considered here all regulation is carried out within the power supply module itself and not on the individual circuit modules of the microprocessor system. By not putting the regulators on the logic circuit boards, the reliability of the system is enhanced. If a regulator increases the temperature of a module by 10°C, the average failure rate of components in the vicinity of the regulator will double.

Before beginning to design a power supply it is necessary to calculate the maximum current demand of the system. As the power supply is intended for an open-ended project, it is difficult to calculate an exact value of the total current requirements. If we assume a maximum memory size of 32K, built with 450µs, 4K-bit static RAM chips, the current consumed by the memory will be approximately 3·5 amps. Allowing a further 3·5 amps for the CPU and VDU modules, the total current demand is approximately 6 amps.

The design of a power supply is often complicated by the lack of suitable components. For example, a digital system can be constructed from a wide range of commonly available building blocks, while the mains transformer used in a power supply must be selected from the often very limited range in a manufacturer's catalogue. Of course it is possible to order a transformer wound to a given specification, but this is not cost-effective unless several systems are being made.

A suitable component is a 9V, 5·5A transformer, with the secondary winding arranged as two separate 4·5V windings which must be connected in series. Unfortunately, this transformer has a secondary winding with a rating of only 5·5A, which in a bridge rectifier configuration amounts to a d.c. output of 0·62 × 5·5A = 3·41A. As this current is insufficient to supply the estimated needs of the microprocessor system, it is necessary to connect the secondary windings of two such transformers in parallel, to provide a d.c. output of approximately 6·8A. When connecting the secondary windings of two transformers in parallel, it is vital that the windings are connected in phase. If the two transformers are identical no problem should arise if the start of the primary winding of the first transformer is connected to the start of the primary winding of the second transformer, and the finish of the primary winding is treated similarly. The secondary windings must also be connected in the same way so that the output voltages across both secondaries are in phase.

TESTING THE WINDINGS

When constructing the power supply it is advisable to make a simple test before the secondary windings of the two transformers are finally connected in parallel. Solder the start of the two secondaries together and connect an a.c. voltmeter between the, as yet, unconnected terminals of the two secondaries.

Apply a.c. power to the primaries of the two transformers. If the transformers have been connected together correctly, the meter should have a very low reading—the difference between the nominally identical secondary voltages. If, however, the windings have been incorrectly connected, the voltmeter reads twice the r.m.s. voltage of one winding, and the connection between the secondaries must be reversed.

The peak voltage at the output of the transformer secondary is 9 × 1·41V = 12·7V. The silicon bridge rectifier selected for use in this power supply has an unusually low forward voltage drop of 1·25V, which leaves approximately 11·4V across the terminals of the smoothing capacitor. If we allow a maximum peak to peak ripple of 3V under full-load conditions, the minimum voltage across the smoothing capacitor is 8·4V.

The value of the smoothing capacitor is given by

$$C = i/\frac{dv}{dt} = 6{\cdot}8/300\mu F = 22{,}000\mu F.$$

The maximum working voltage of the capacitor must be greater than the peak voltage across the transformer secondary plus a margin to allow for variations in the mains input. A suitable capacitor is a 'computer grade capacitor' with a value of 22,000µF, a voltage rating of 25V, and a maximum ripple current rating of 14A at 65°C. Note that the tolerance in the value of an electrolytic capacitor is usually in the range +80% to −20% of the nominal capacitance. The maximum ripple current through a capacitor is given by $222V_rC$, which in this case amounts to 222 × 3 × 0·022A = 14·6A. This value is slightly greater than the rated ripple current of the capacitor. The maximum ripple current rating of a capacitor is strongly temperature dependent, a 14A rating at 65°C corresponding to a 20A rating at 25°C. As long as the ambient temperature within the power supply module is kept below 40-50°C no problems should arise.

BRIDGE RECTIFIER

The only other critical component in the power supply is the bridge rectifier. The rectifier chosen is a 25A silicon bridge rectifier with a peak inverse voltage of 50V, and a forward voltage drop of 1·2V at a current of 12·5A. If

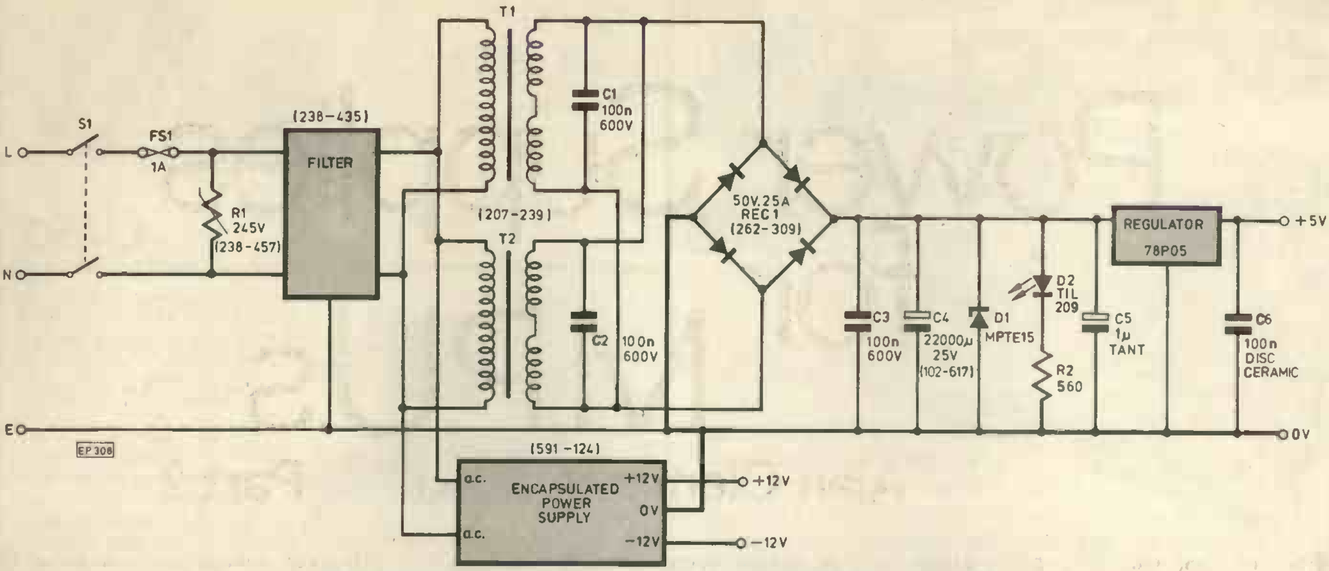


Fig. 10. Circuit diagram of the power supply. The numbers in parenthesis are R.S. stock numbers

this rectifier is to be operated at its full rated current of 25A, it is necessary to mount the rectifier on a heat sink with a thermal resistance of 0·8°C per watt. When operating at an average load current of 7A, the rectifier can function comfortably at a case temperature of 100°C. Bolting the rectifier to the chassis of the power supply should provide sufficient thermal dissipation. The peak forward current rating of the rectifier is 300A, which is 44 times the average maximum load of the power supply, and provides an ample safety margin in this application.

CIRCUIT

The circuit diagram of the power supply is given in Fig. 10. A generous measure of transient prevention is applied to the main 8V supply. Six transient suppression devices are fitted as follows:

1. A zinc oxide voltage dependent resistor is connected across the mains input of the power supply.
2. A filter network between the mains input and the transformers provides 35db of attenuation to frequencies between 150kHz and 30MHz.
3. Small capacitors of 0·1µF are connected across the secondary windings of the transformers, and across the output terminals of the bridge rectifier.
4. A tranzorb is connected across the output terminals of the 8V power supply. The rating of this must be greater than the maximum voltage which normally occurs across the output. This is the maximum no-load voltage of 11·4 plus 10 per cent to allow for mains variations, i.e. 12·6V.

   The tranzorb which has the closest stand-off voltage above this value is the MPTE15 which has a clamp voltage of 20·6V at a forward current of 10A.

In the power supply no additional protection in the form of current limiting or crowbar overvoltage protection is applied to the 8V supply. Any additional protection may be implemented by choosing monolithic 5V regulator, with suitable characteristics.

REGULATOR SELECTED

The regulator selected for this power supply is a Fairchild A78P05, a 5V 10A hybrid device in a standard TO-3 package. This regulator has the following characteristics;

(i) Internal thermal overload protection.
(ii) Internal short-circuit current limitation.
(iii) 70W power dissipation at a 25°C case temperature.

At a nominal 8·5V input the regulator dissipates (8·5-5·0) x 6·5 = 22·75W full-load. From the A78P05's data sheet it can be seen that the regulator can dissipate 30W at a case temperature of 100°C. If we assume ambient temperature of 25°C, the temperature differential between the regulator case and the ambient air is 75°C. The thermal resistance between the case and the air is therefore

$$\frac{75°}{25W} = 3°C/W.$$

As the maximum value of case to ambient thermal resistance is at least 30°C/W, the regulator must be mounted on a heat sink with a thermal resistance of less than 3°C/W.

From Fig. 10 it can be seen that a 1µF solid tantalum capacitor is connected between the regulator's input and ground. A 0·1µF ceramic capacitor should be similarly connected between the regulator's output and ground to improve its transient response.

It must be admitted that although the monolithic regulator is widely employed in microprocessor power supplies, some authorities avoid them like the plague. The monolithic regulator normally has a tolerance of ±4%. To this tolerance must be added the effect of any voltage drop between the regulator's output terminal and the various i.c.'s V_{cc} terminals plus the droop in the regulator's output at full load (typically 50mV at 25°C and 250mV at 150°C for a 10A load). Clearly, unless the regulator is selected from a batch (expensive) problems may arise. Another disadvantage of this type of regulator is its lower reliability than that of regulators constructed from discrete components. A failure rate of 5% in monolithic regulators operating at high currents (but within their operating limits) has been reported.

The requirements of the +12V and −12V power supplies are very modest. Most microprocessor systems are designed to use, as far as possible, components requiring only a single +5V supply. An exception to this is the RS232C drivers in serial data links which require a +12V and a −12V supply at approximately 20 mA. To simplify the design of the +12V and −12V supplies, an encapsulated power supply is used. This power supply, a single component, is able to supply both the +12V and −12V rails with a current of up to 250 mA. The specified encapsulated power supply has internal protection against the effects of short circuits. ★

FRANK W. HYDE

THE SALYUT 6 RADIO TELESCOPE

Some details of this radio telescope were given in SPACEWATCH in a previous issue. More information has been released and it is now possible to understand how important to the Soviet Space programme this venture was. It is claimed (and rightly so) that the 10 metre diameter aerial was the largest attempted in space. The unsuccessful attempt to deploy it correctly took place at the end of the long period sojourn of cosmonauts Ryumin and Lyakhov aboard Salyut-6. A space walk was necessary to free the after-dock port for future visits of the Progress supply vehicles. It was during this attempt that the Salyut-6 began to oscillate. The aerial was freed on August 15th 1979.

Both Ryumin and Lyakhov underwent extensive training in the techniques of assembling and operating the telescope before they made their extended flight on Salyut-6. They began by practising on lightweight models moving on to more sophisticated equipment at a subsequent stage. The first stage was carried out over a water tank under simulated conditions of weightlessness. Other training involved the accurate pointing of the telescope, the use of the controls and the techniques necessary. They also visited the observatory in the Crimea. The final task was to become familiar with the actual packages of the full scale KR-10, which weighed about 200kg. The largest of the packages was the aerial itself which folded up to about one metre and weighed 100kg.

The two cosmonauts had already been operating on board Salyut-6 some months before Progress-7 arrived with the telescope. Also with the packages came a new film, a training film for the erection and operation of the telescope. This they studied very carefully before beginning operations. Then the packages were transferred to Salyut-6. The various modules were set up, the control panel, the wiring and recording systems and receivers. The actual operation of the assembly was two way; from the ground and via television cameras set on Progress-7 and viewed from Salyut-6. After the successful erection of the aerial, several days were spent calibrating the telescope. The operation of the telescope requires two people.

The completed telescope was operated in conjunction with the 22 metre installation at the space station in the Crimea. The joint operations were timed so that when the Salyut-6 was on the opposite side of the Earth the two aerial systems formed an interferometer with a base line of more than 8,000 miles. Part of the programme undertaken by the cosmonauts was the observation of the emission from Cassiopeia-A, Pulsars, in particular P/RO 239 and cosmic plasma. Part of the observing time was spent on radio-cartography, observing temperatures, humidity and weather conditions.

RENDEZVOUS WITH HALLEY'S COMET

As previously reported, the full mission funds were curtailed for this project. General scientific opinion was that only if the full programme to procede from Halley on to Temple-2 was followed could the results truly justify the expenditure. NASA has now made a new plan and it is hoped that the Carter Administration will press for this, for it is after all a joint European and United States venture.

This mission was to gather information preparatory to a landing and return from a selected comet with material for analysis. Since such material is believed to be the oldest in the Solar system it would be, as one scientist put it, 'more valuable than a ton of rocks from Mars'.

It is widely held among comet specialists that a mission to a comparatively young and active comet like Halley together with an old comet such as Temple-2 or Encke with access to the nucleus would be well justified, since a young comet like Halley has much local atmospheric activity which cannot be seen again this century, not in fact till late in the 21st century. Perhaps the situation is best summed up by Joseph Veverka of Cornell University. He said 'Halley is important because it retains the spectacular activity of fresher comets and the only one we can look at is this century'. He went on, 'the basic fact is that without a rendezvous with a nucleus we will not be able to interpret our Halley data correctly, simply because we do not now know anything about nuclei and would know very little after a fly-by. You will go zooming off at 57km a second having learned very little about the heart of a comet. In fact you will have learned so little about the nucleus that you could not interpret the data of the fly-by. This situation would be a disaster'.

The mission, which involved joint cooperation between the European Space Agency and NASA, is dependent to a considerable extent on participation in particular by Europe in the solar electric development. If the original mission is to be modified there could be the possibility that Europe would not have a part in the later mission. This must cause NASA some concern because it is a distinct possibility that Europe could mount a project of her own. The uprated launcher for the Ariane could accomplish this. Europe would be independent of the USA. It is this aspect which bothers the Americans, for in the modified budget conditions they could not guarantee Europe a part of the probe development if the solar electric propulsion is dropped for one reason or another.

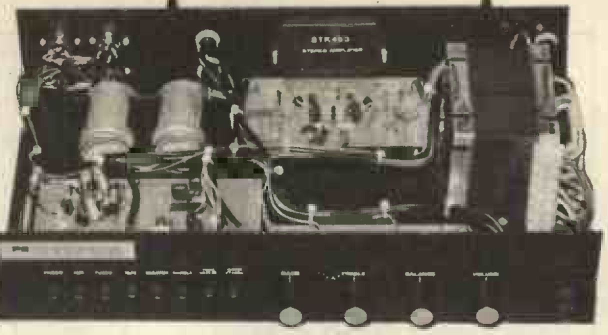
The mission to Halley and other comets is on old 'must' for all interested in space. As early as 1973 positive schemes were ready. With the present advent of the shuttle, the plan would be to launch two solar electric vehicles from a shuttle in about July 1985. The spacecraft would set course directly to Halley's comet. Two spacecraft would reach the vicinity of the comet in November 1985, the distance then being about 75 million miles from Earth. In order to avoid the debris surrounding the comet a probe would be released to penetrate the coma and pass within 1,000 miles of the nucleus, while the spacecraft turned off toward the sunward side. The other spacecraft would launch its probe through the tail. One spacecraft would go on to rendezvous with comet Temple or one of the other suitable comets. On command the spacecraft could be brought within 30 miles of the nucleus and stay with it for perhaps a year. It would be possible to 'see' objects as small as a tennis ball. Actual contact would also be possible if it were considered useful. Most important of all, it will bring to light the mystery of the comet. Is it solidly packed ice and particles; is it a loose conglomeration; or packed so tight that it glows under solar radiation and gives up some in a vast cloud of glowing dust to produce a tail?

Alternative schemes have been put forward by other companies. Goddard Space Flight Centre have a different approach to the comet missions, which does not involve such a tight fiscal programme and can be done much simpler, even as late as preparing in 1983. Robert W. Farquhar and William H. Wooden have already made a considerable study of the possibilities and they suggest a way. They consider that a boomerang trajectory would be not only an economic proposition but would result in the gathering of data at considerably less cost than other methods. They suggest that a spacecraft should be launched into a trajectory that first intercepts Halley and then returns to the vicinity of the Earth a year after launch. This would make it possible to retarget the spacecraft to another comet after the Halley fly-by. By using a series of such manoeuvres the trajectory can be reshaped by successive Earth swing-by impulses.

One suggestion is a piggyback launch of two spacecraft toward a post peri-helion encounter with Halley's comet in March 1986. One spacecraft would be directed to a close fly-by of the comet nucleus, while the other would be directed through the tail area. Following this event the Earth swing-by technique would be used to retarget one of the spacecraft to Comet Borrelly in January 1988 and the other to Comet Temple-2 in September 1988. The efficiency of this scheme is striking. In three years four comet encounters would take place.

PE congress

30W I.C. STEREO AMPLIFIER



PART 2

GRAHAM JACKSON

A BRIEF description of the pre-amp was given last month showing that a discrete transistor op-amp was to be employed for the phono and tone control stages. The following refers to one half of the pre-amp, the second channel is of course identical.

PHONO INPUT

Firstly the phono stage (Fig. 8) is based around transistors TR1-5, the RIAA equalisation network consisting of C2 to C5, and R4, 6, 7. Capactor C6 is switched in or out by S1, and when switched out the response falls below 100Hz so acting as a rumble filter. This facility is incorporated in the phono stage so that the low frequency rumble content of any input is not grossly amplified prior to filtering. The phono stage runs off ±15V, this voltage being dropped from the nominal ±30V supply by R16 and R28 and decoupled by C7 and C14.

Phono connection is d.c. coupled to the input stage, no capacitor being required as the input offset voltage is very small. An active collector load in the form of a constant current source comprised of TR5 and D1, 2, is employed which gives very good linearity and low distortion compared with a resistive load. This also allows for high input overload margins at high frequency as available drive current for the feedback network, whose impedance falls with frequency, is independent of output voltage.

For example the impedance of the network at 20kHz is approximately 1500 ohms. If therefore a 1k load resistor was used, for a negative swing it would run out of drive capability at about 1000/(1500 + 1000)V or $0{\cdot}4V_{supply}$, obviously not satisfactory, leading to asymetric slew limiting. It would also give, on a 15V supply, a mean current of 15mA through the resistor with no signal or 30mA with a peak positive signal which would have to be supplied in addition to output and network drive current by TR4. However with a constant current source set at 10·7mA, 0·7mA of drive current is still available with a full negative swing of −15V at 20kHz.

In order to limit the standing current in the phono stage to approx 10mA it is followed by a buffer amp with a gain of two to give a possible output swing of about 56V peak to peak under high input conditions giving a good margin of overload. The tuner and auxiliary inputs are also fed to this stage via an input switching matrix; the gain is set by R22 and 23. It can be seen that this stage is based on TR6 to TR8, and also has an active collector load for TR7. This uses simplified configuration as this circuit does not have to have a high open loop gain. It may also be switched as a scratch or low pass filter, and TR22 is used to negate the impedance of the feedback network so that this stage will have a 12dB/octave roll off. The 3dB point has been chosen as 8kHz. Without TR22 the response is as shown in Gordon King's tests last month.

A similar but separate stage has been used for tape input buffering, differing in that it has unity voltage gain and no filter capability. This arrangement has the advantage that monitoring of the tape recorder's own output is possible while recording with, if necessary, scratch filtering being active on the record input. Alternatively an additional tape socket switch may be fitted to allow dubbing, or monitoring of one input whilst recording a different signal on the other.

The tone control circuitry uses the same design philosophy as the disc input stage except that it runs on ±30V and has a collector load current of 5mA. The feedback network consists of the tone controls and supporting components in the Baxandall configuration. This stage may be bypassed by the tone defeat switch if desired.

POWER SUPPLY

The negative and positive rails (Fig. 9) are separately derived and regulated. A.C. from the transformer which has a 34-0-34V winding is rectified by D24 to 27, the 0V centre tap being returned to ground. Smoothing is accomplished by TR19 and 21, for the negative rail and TR18 and 20, for the positive. The circuits are similar except that one is the mirror of the other. For the positive side TR20 acts as a constant current source for reference diode D18, a 30V Zener type. This is used to give a reference for the base of TR18 which is connected as an emitter follower. Bias current for diodes D20 and 21 is returned to ground via R61; this configuration therefore prevents ripple current being injected into the Zener diode which would impair regulation. Transistors TR18 and 19 should be mounted on a small aluminium heat sink.

CONSTRUCTION

It is recommended that the published layout is followed to avoid ground loops. It can be seen from Fig. 12 that all of the stages described above will mount on this one board in-

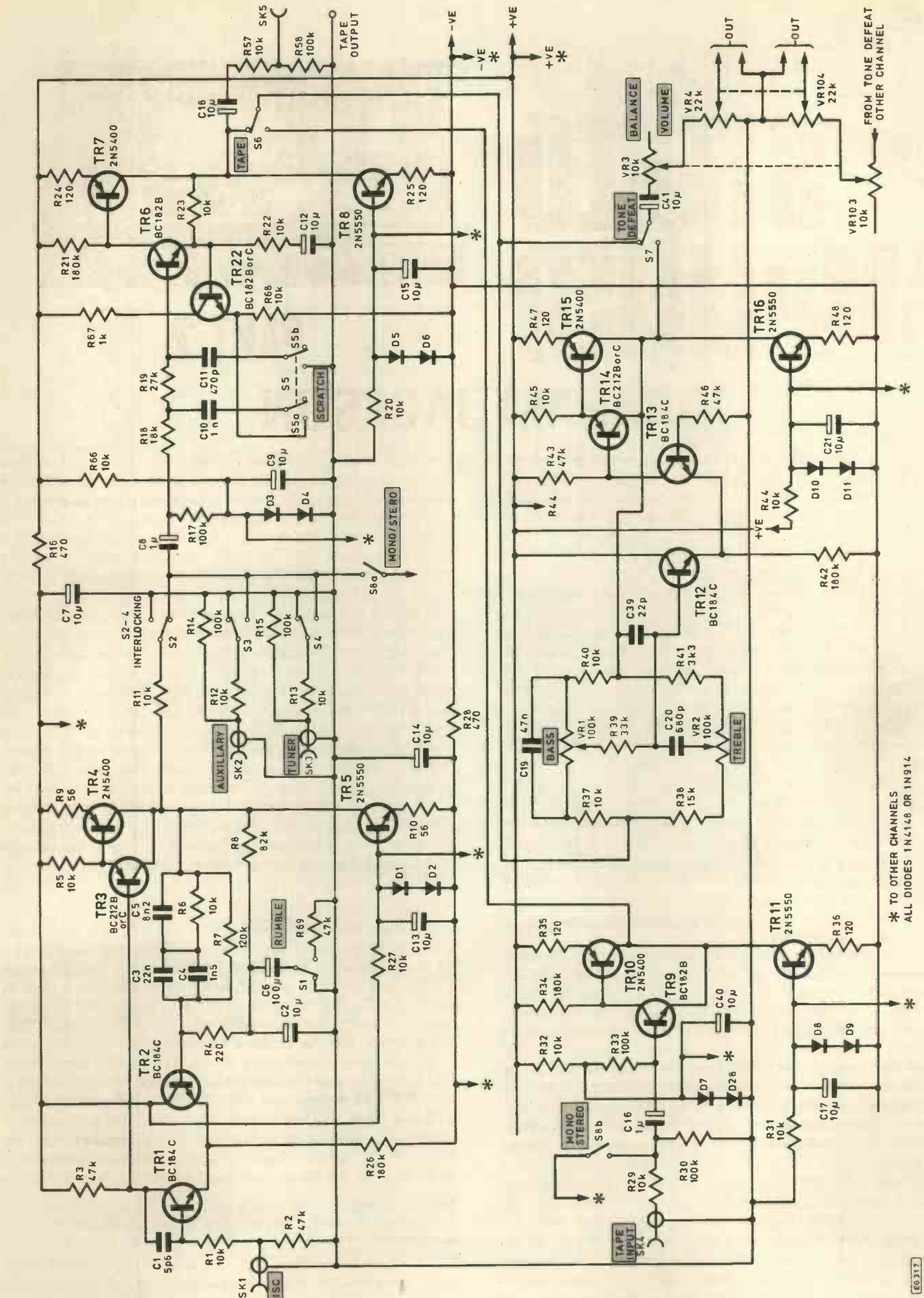


Fig. 8. Circuit diagram of one channel of the PE Congress pre-amplifier

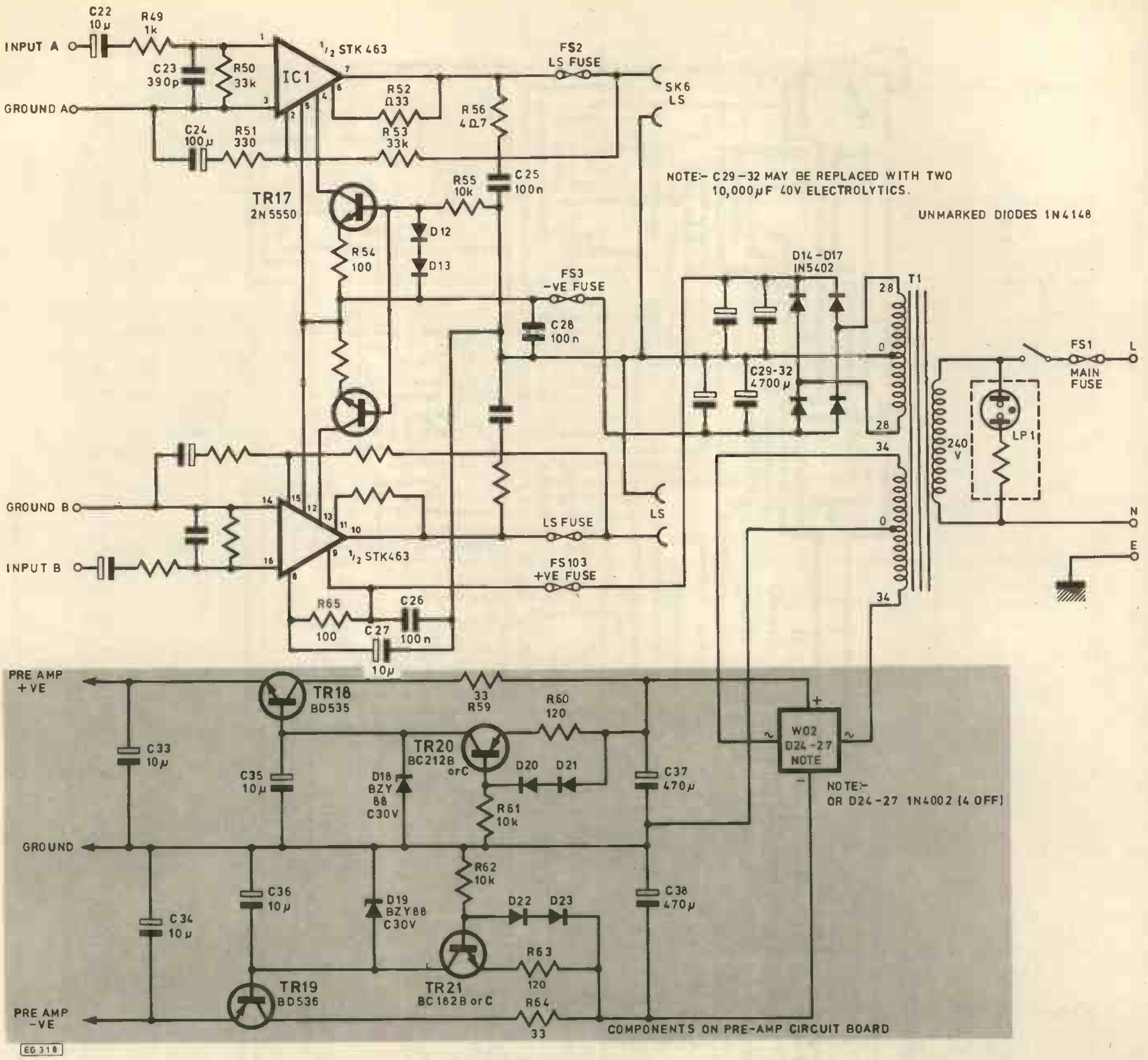


Fig. 9. Circuit of the main amp. and power supplies for the PE Congress

cluding the function switches and bass and treble controls. The phono input sockets should be mounted on a separate p.c.b. (together with R14-114, R15-115, R29-129, R30-130, R57-157, R58-158 and C18-118) so that they can be isolated from the chassis; this is important to prevent ground loops.

When building the pre-amp board good solder joints are essential for proper operation. Remember, if they don't look aesthetic they are no good, see Fig. 10. Do not use too much solder, make sure the joint is covered, use an iron with a small bit and good heating capability and cored 22swg solder. Also ensure that wires are cropped well back. A good quality pair of small side cutters are an essential piece of equipment for this type of project.

It is recommended that all resistors are inserted first, not all at once, as it will be difficult to solder the leads. Do small sections at a time. Then use some of the cropped resistor wires to put in the wire links. Next insert the transistors and diodes. Transistors TR18 and 19 need a small heatsink un-

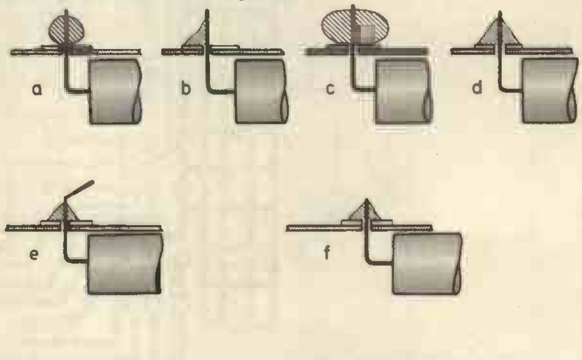


Fig. 10. Joints shown in a, b and c are badly soldered and not acceptable. The joint in d is correct. Trimming of component leads must be as shown in f and not like e

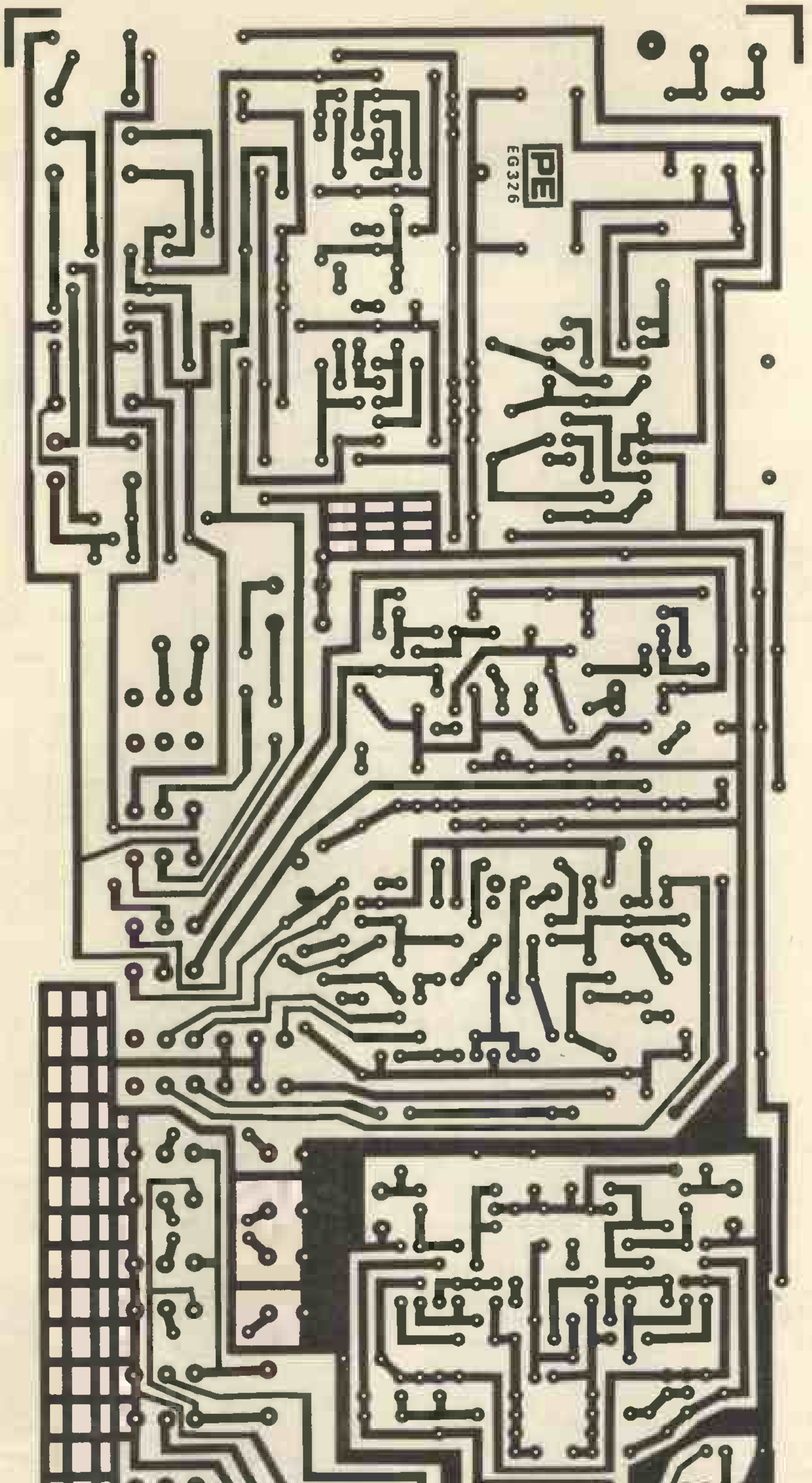
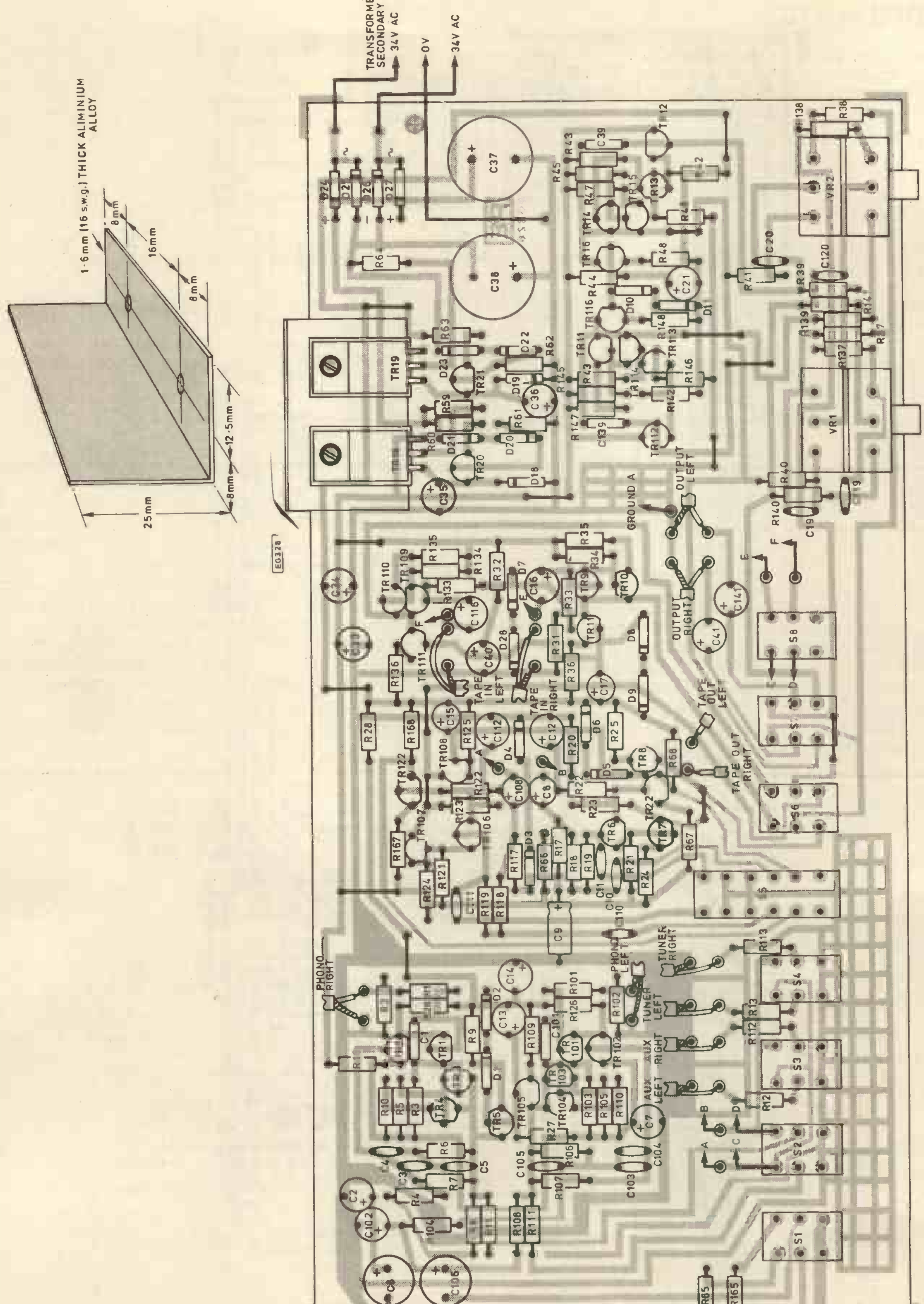


Fig. 11. Printed circuit board design for the pre-amplifier (copyright Wicca Electronic Systems Ltd.)



LINKS C&D ARE WIRE LINKS ON UNDERSIDE OF BOARD
LINKS A, B, E & F ARE ON COMPONENT SIDE

Fig. 12. Component layout and wiring of the pre-amplifier board

COMPONENTS . . .

Unfortunately there were some omissions and inaccuracies in the components list published last month. The following list gives the additional values and corrected specifications:

Resistors

R7–107	120k
R11–111	10k
R18–118	18k
R57–157	10k
R58–158	100k
R65	100 1w
R66	10k
R68–168	10k
R69–169	47k

Semiconductors

TR14–114	BC212B or C
D28	1N4148

Note: TR3, 103 and TR20 to 22 and 122 can be either B or C types, and D24–27 can be 4 x 1N4002.

Capacitors

C1–101	5p6 ceramic
C2–102	10µ elect 35V
C6–106	100µ elect 16V
C10–110	1n ceramic
C11–111	470p ceramic
C20–120	680p ceramic
C21	10µ elect 35V
C26	100n mylar
C28	100n mylar
C39–139	22p ceramic
C40	10µ elect 35V
C41–141	10µ elect 35V

Note: all electrolytics except C9 are radial, C29 to C32 may be replaced by two 10,000µ elect 40V types.

Miscellaneous

SK1 to 5, SK101 to 105 phono sockets (5 pairs)
SK6–106 phono sockets (4 off).
T1 125VA mains transformer 28-0-28V plus 34-0-34V (off load voltages).

Components supplied by Wicca will be as shown above. We apologise for these inaccuracies. Also please note Wicca's new address: 24 Hillcrest Parade, The Mount, Coulsdon, Surrey.

derneath; they must be isolated by using mica washers as this heatsink is common to both devices. The heatsink should be fabricated from aluminium and sprayed matt black. This heatsink will run quite hot.

The capacitors can then be inserted. Make sure that the electrolytics are correctly polarised, many of them can be instantly damaged if powered up when they are wrongly connected. If this happens they must be replaced, not reinserted. Take great care not to strain the leads when fitting ceramic capacitors. The switch and tone controls may then be inserted and flying leads connected.

Screened lead must be used for all signal leads. The preamplifier may be used independently only requiring a volume and balance control and mains transformer to complete. In this design the 34-0-34V winding is incorporated on the main supply transformer, saving the need for a separate transformer. When powering up first check that there is +30V on the positive rail measured with respect to ground and −30V on the negative rail, and then that there is ±15V on the phono stage. Voltages to be ±5 per cent.

Many of the transistors run quite warm; this need give no cause for alarm. It is suggested that transistor orientation and type, diode orientation and capacitor polarities are all double checked before power is applied.

Next month. Main amp circuit description and construction.

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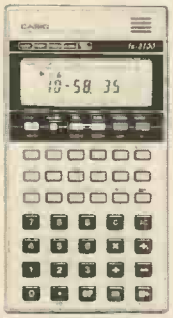

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ML-71 £22.95. MQ-12 £19.95. MQ-6 £19.95. AQ-2200 £19.95. AQ-1500 £15.95.

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FX-81 £12.95. FX-100 £15.95. FX-330 £15.95. FX-310 £17.95. FX-510 £19.95. FX-2600 £19.95. FX-3200 £21.95. FX-501P £54.95. FX-502P £74.95. FA-1 £19.95. Plus M.P. £5.

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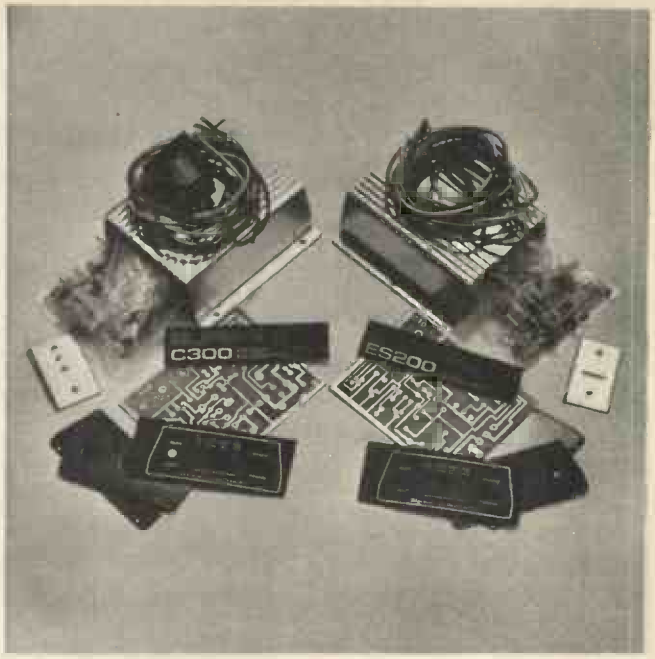
Surefire Electronic Ignition REVIEW



MOST of the electronic ignition kits currently available are either inductive or capacitive discharge types. These systems have been designed to overcome the problems of inefficient sparking and the rapid deterioration of the ignition timing due to wear, normally associated with conventional systems.

In a conventional system when the contact breakers close the ignition coil stores energy which is released across the spark plugs as the contacts open. This rapid high voltage switching causes arcing, contact wear and a reduction in the amount of energy available to the plugs.

With an inductive electronic system the coil current is switched by the unit and only a small timing current flows across the contact breakers. The coil is used in the same way as a conventional system. This method greatly reduces contact breaker wear and ensures a good spark.

The capacitive discharge system differs from the inductive type by transforming the battery voltage to about 400V and storing this charge in a capacitor rather than the coil. When the contact breakers open the stored energy is released to the coil from the capacitor.

We recently had the opportunity to assess two units from the Suretron range; the ES200 (inductive) and the C300 (capacitive) systems. The ES200 is the kit version of the ES2000 ready built unit which along with the C300 received very favourable comments in a recent "*Which*" report.

CRITERIA

Probably the most important criteria for judging any kit is whether it is designed for the totally inexperienced builder. Identification of piece parts should be easy and present no ambiguity. Component quality should be excellent and assembly instructions and illustrations should be sufficient so that the builder need have no electronic preknowledge, or requirement to refer to a circuit diagram, in order to produce a working piece of equipment.

Also essential is diagnostic back-up so that faults can be rectified if the unit is malfunctioning.

All of this adds up to step-by-step instruction pioneered by Heath and emulated here by Suretron Systems Ltd.

KIT PACKS

Having purchased a kit, be it the ES200 or C300, the first thing to do is to check that everything is there. This is facilitated since all the piece parts come in transparent plastic packs which need not be broken when ticking of contents against the listed contents in the assembly instructions. Besides being listed further identification is possible since a board assembly detail pin-points all of the components.

Assembly is the simple business of splitting the packs and popping in components according to the assembly detail and then soldering.

The iron required should be at least 25W and for those new to soldering instructional notes are included.

A first time builder invariably overlooks the correct placement of polarised components such as electrolytic capacitors and semiconductors. The instructions make very clear with illustrations which way round they should be inserted into the printed circuit board.

The C300 kit is a conventional CD system with an output thyristor switching the coil. Being heatsink mounted it is too easy in the assembly to get a short circuit unless care is taken. This problem area is got round with a graphic exploded detail which is simplicity itself to follow.

IN CAR ASSEMBLY

When wiring to the outside world in an engine compartment siting of the unit determines lead lengths to coil and supply input. Fortunately optimum lead lengths were decided upon so that cutting, stripping and terminating could all be done on the table top without the onus of lifting the bonnet.

With everything completed it only remains to be fitted and set up. To site the unit for optimum performance a list of requirements are set out in the comprehensive fitting instructions.

Before any supply connections are made a number of prewiring checks are made and then in-circuit wiring can be completed. Again for those not electronically minded this is physically delineated for single and double coils and where electronic tachometers are included.

If everything has gone well it only remains to 'tweak' the surrounding electrics such as plug gap, timing resetting and then it's off for improved efficiency motoring. If there are problems then a comprehensive fault finding table is supplied.

Finally, if all else fails you can return your unit to Suretron for either fault diagnoses or repair. A standard charge of £5 will cover this, postage and insurance.

The ES200 unit is suitable for 12V negative earth vehicles only, whilst the C300 can be supplied for either positive or negative earth systems. Voltage or current impulse tachometers will also function with the ES200 unit. However, the C300 system will require a compensator for all current impulse tachometers and some of the voltage contact types. A complete list of checks and type of compensators required is supplied with the kit.

Another useful feature of both systems is an electronic/conventional/off switch to enable the car to be switched back to the conventional system in the event of a breakdown or for comparison tests, electronic tuning etc. The off position disables the ignition and acts as an anti-theft device.

PRICES

The ES200 kit is priced at £13·95 and the C300 is £17·95. If a compensator is required these are priced at £3·90 (All prices include VAT and p&p).

Suretron Systems (UK) Ltd., Piccadilly Place, London Road, Bath BA1 6PW. ★

SPLIT·PHASE TREMOLO

THIS article describes a tremolo unit for insertion between a musical instrument and one or two amplifiers. The unit has two outputs, each of which is modulated in antiphase relative to the other, thereby enabling an effect similar to, although not as good as, that achieved by a rotary cabinet.

Three controls are provided; a depth control, a rate control, and an in/out switch. When the depth is at its minimum setting, or the switch is set 'out', the signal presented at the input, is in turn presented at the two outputs with equal amplitude. With the switch set 'in', as the depth is increased the two outputs are modulated in antiphase at a frequency controlled by the rate control, VR2. It is possible to omit the circuitry associated with one channel, to produce a simpler, cheaper single channel unit.

CIRCUIT

The circuit comprises an 8038 function generator chip, of which both the squarewave and sinewave are utilised, the former to drive an l.e.d. to give a visible indication of the operating frequency, the latter to provide the control signal to the modulators. The sinewave output, or rather a fraction which is determined by the setting of the depth potentiometer VR1, is fed to the drain of a field effect transistor, TR1, which is used as the in/out controller. When the switch is in the 'out' position, the gate of TR1 attains a voltage of around +3V relative to its source, so turning hard on, shunting the sinewave drive from the 8038. If the in/out switch is now set to 'in' position, the applied voltage at TR1 gate drops −5V relative to TR1 source, over a period of a few seconds, cutting off TR1, permitting a gently increasing amount of the sinewave drive to reach the next stage, TR2. TR2 is connected as a phase-splitter, generating two signals of equal amplitude, but of opposite phase, at its emitter and at its collector. These two signals are fed to a pair of 741 operational amplifiers, IC2 and IC3, which serve the dual purpose of providing the low impedance necessary to drive the modulator chips, and of providing the level shifting necessary to match the outputs from the transistor's emitter and collector to the control nodes of the modulator chips. Each 741 is arranged to provide a gain of 2. The modulators are integrated circuits expressly designed for use in this application, and have the property of providing a gain that is proportional to the logarithm of the voltage presented at their control nodes. Such a response is necessary in audio applications to match the logarithmic response of the ear. The two modulators denoted as ICs 4 and 5, are MC3340s.

The whole circuit with two modulators installed, taks a current of around 80mA at a supply voltage of 12V (Fig. 1).

POWER SUPPLY

To keep the power supply simple, a single rail 12V supply is used, which is split in the simplest possible way to give a dual supply of ±6V. Splitting is achieved using a pair of resistors to provide the centre point, and a pair of capacitors to provide a.c. bypass (Fig. 2).

J. McCarthy

34

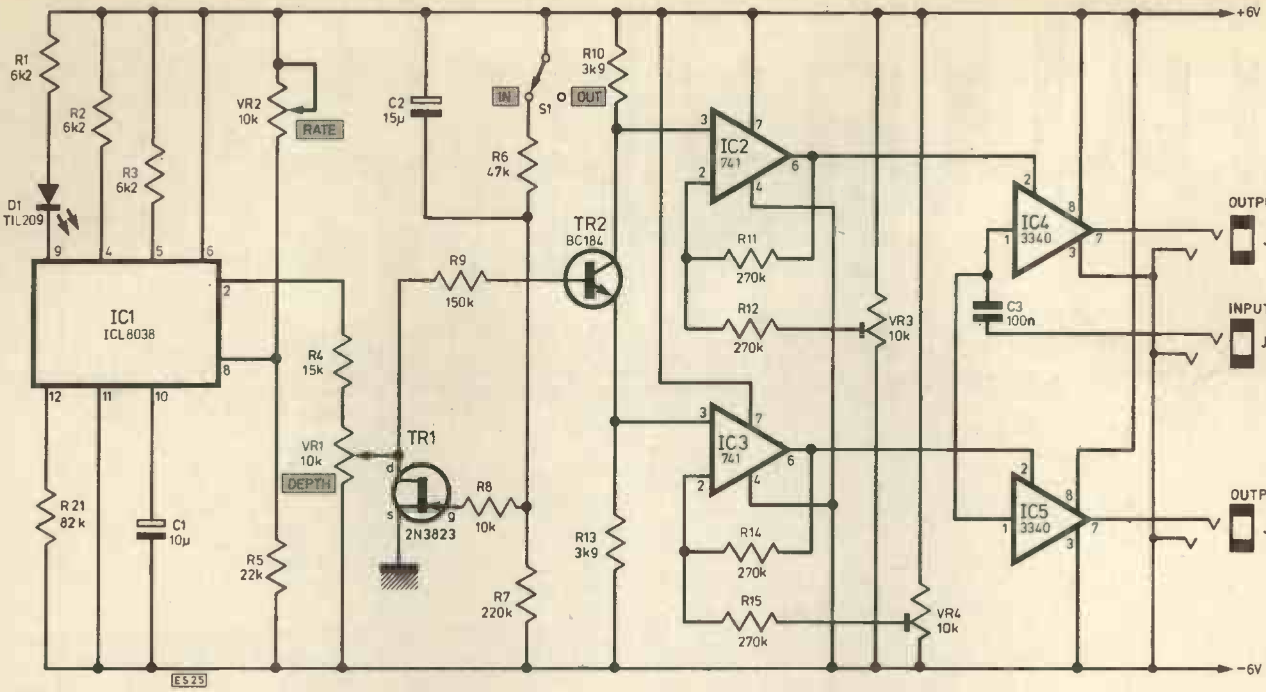


Fig. 1. Circuit of tremolo. A foot switch can be used for S1

COMPONENTS . . .

Capacitors

C1	10µ electrolytic 25V
C2	15µF electrolytic 16V
C3	100n
C4, 5, 7	100µ electrolytic 25V (3 off)
C6	470µ 50V

Resistors

R1, 2, 3	6k2 (3 off)
R4	15k
R5	22k
R6	47k
R7	220k
R8	10k
R9	150k
R10, 13, 16	3k9 (3 off)
R11, 12, 14, 15	270k (3 off)
R17	5k6
R18	2k2
R19, 20	220

All resistors $\frac{1}{4}$W 5%

Potentiometers

VR1, 2	10k linear potentiometers (2 off)
VR3, 4	10k presets (2 off)

Semiconductors

IC1	ICL 8038
IC2, 3	741 (2 off)
IC4, 5	MC 3340 (2 off)
IC6	723
TR1	2N3823
TR2	BC184/107/108/109 etc
D1	TIL 209 l.e.d.
D2–5	1N4001 (4 off)

Transformer

T1	12V at 250mA

Miscellaneous

Box $6\frac{3}{4}$in x $4\frac{3}{4}$in x $2\frac{1}{4}$in (RS 509-995)

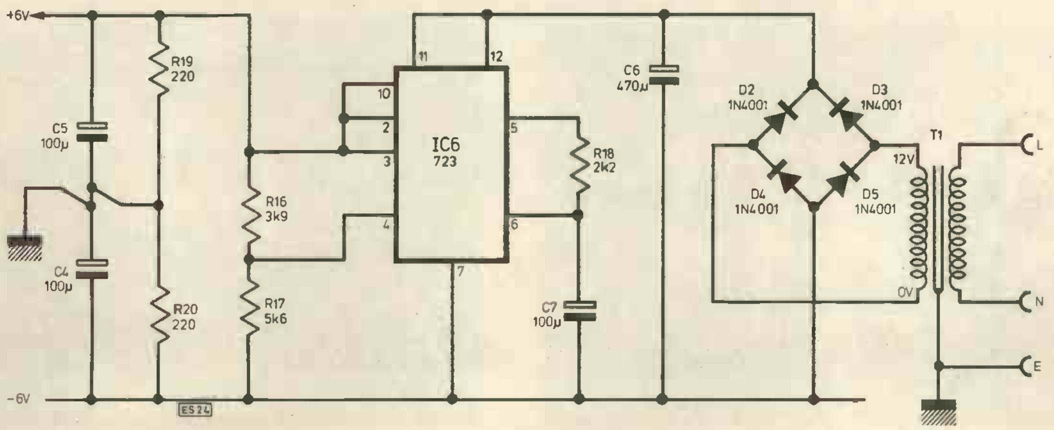


Fig. 2. Power supply

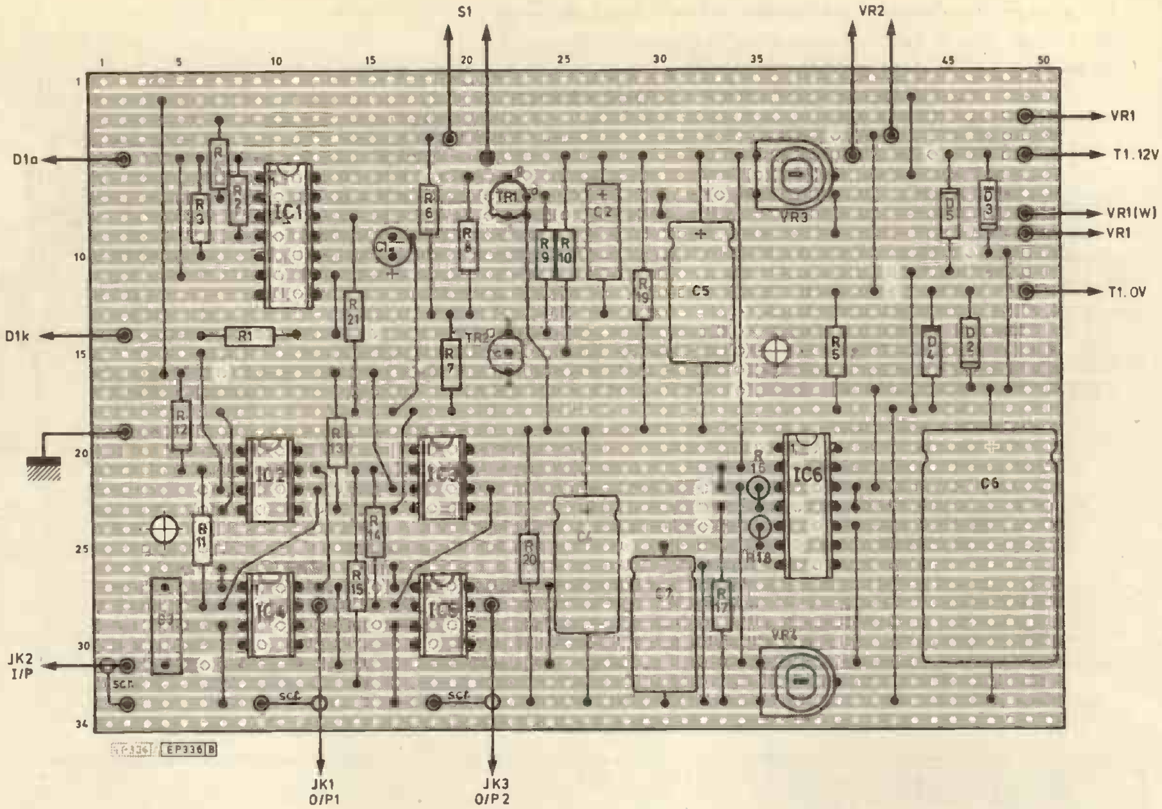
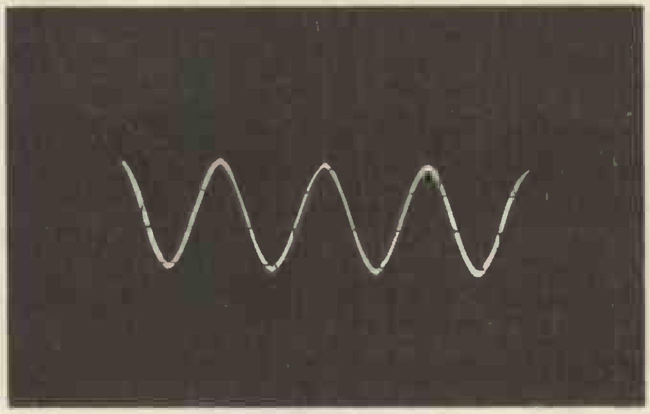
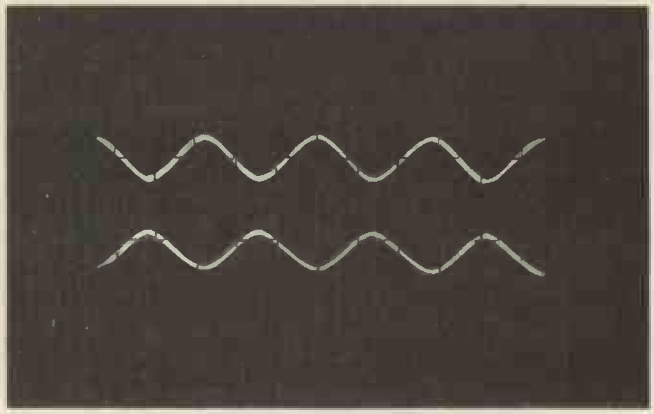


Fig. 3. Small component layout

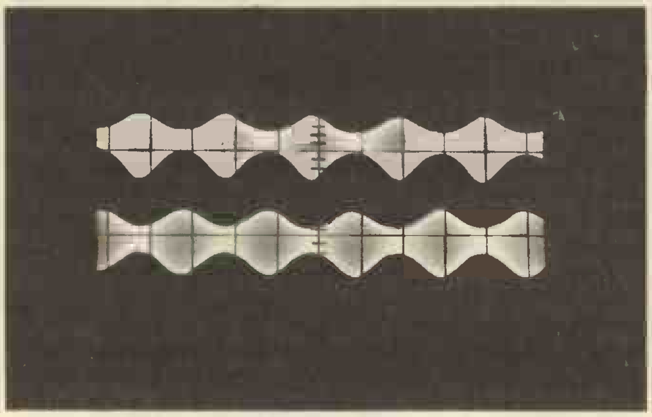
Oscillograms



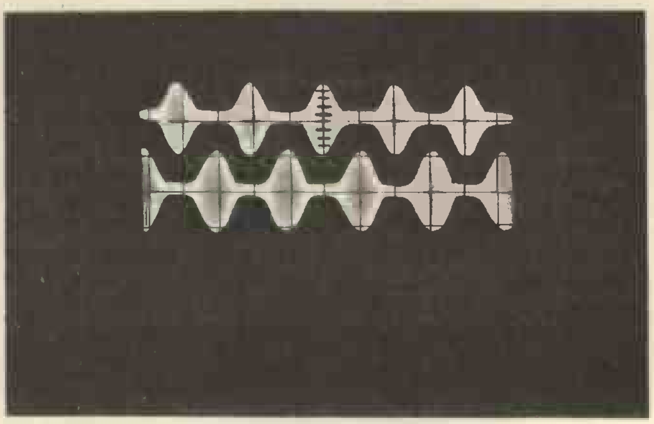
Output at pin 2 of IC1



Collector/emitter outputs of TR3



Outputs of IC4/IC5 at 50% modulation



Outputs of IC4/IC5 fully modulated

The power supply itself comprises a 12V transformer, a diode bridge, and a capacitor for smoothing, generating an off load voltage of around 17V across C6. This is fed to a 723 stabiliser integrated circuit, whose control resistors have been chosen to provide a stabilised output voltage of around 12V. Note that, although the circuit of the tremolo requires a stabilised power supply, the actual value of the supplied voltage is not critical, so it is not necessary to adjust the 723s control resistors to attain an exact 12V supply. It should be noted that, although the 723 is running at less than half of its rated power dissipation, it does get quite warm, and free access of air is advised.

CONSTRUCTION

Construction is not particularly critical, although to minimise hum pickup the use of screened wire for signal paths is recommended, as is the use of an earthed metal box. Those who wish to use the device on stage will probably not need to be advised to use a very robust box!

SETTING UP

After construction has been completed, and the usual checks on wiring, etc., have been made, the unit will require some adjustment of the two presets VR3 and VR4. Initially, these two presets should be set to their mid-positions, and the unit powered up. The l.e.d. should be observed to be flashing at a frequency of between 0·2Hz and 5Hz, and it should be possible approximately to cover this range by adjustment of the rate control. At this point a signal source of around 1V peak-to-peak, preferably a static source, such as a signal generator, is required. Additionally, either an oscilloscope or a stereo amplifier is required. If it is necessary to use a stereo amplifier, a pair of headphones will render setting up a little easier. With the depth control at its minimum position, i.e., with the slider at the "earthy" end, adjust VR3 and VR4 until output signals of the same amplitude as that of the input signal, are observed. As the depth control is advanced, modulation of the output signals to a depth determined by the depth control should be observed. At maximum depth, it may be necessary slightly to readjust VR3 or VR4 until the period of signal cut-off is the same for both channels.

For those readers who have access to an oscilloscope and a signal generator, the following waveforms may be observed.

MODIFICATIONS

It is possible to remove several components to produce a single channel version, namely IC3, IC5 and their associated components: TR2s emitter resistor should be retained. If the gentle build up of tremulant provided by the circuitry around TR1 is not required, the in/out switch may be wired from VR1 slider to earth, and TR1, R6, R7, R8 and C2 omitted. ★

News Briefs

NASCOM LAUNCH SYSTEM 80

MOVING into the "packaged desk top microcomputer" market, which Nascom consider to be dominated by either highly priced or inflexible products, this entirely UK owned company announced to the press at the end of February, the launch of System 80. This being a *systems* application of their Nascom 2 single board microcomputer.

Flexibility is the key word, because inside the tough, if rather austere, glass-reinforced plastics case is a five card Nasbus motherboard, allowing virtually any configuration based on the following:

Nascom 2
Providing Z80 CPU with 8K Microsoft BASIC, cassette interface, TV/video output, and QWERTY keyboard.

I/O Board
When fully populated houses 3×MK3881 P10, 1×MK3882 Counter/Timer, and 1×6402 UART.

Dynamic RAM Card
16K, 32K and 48K options, with full on-board chip support. Based on 4116 Dynamic RAM.

Programmable Character Generator
High resolution user defined graphics from 2K byte static RAM. These can be mixed with standard characters by relocating the Nascom Graphics ROM to this board. Compatible with Colour Board.

Colour Board
High or low resolution for PAL, SECAM, NTSC or RGB. High resolution uses 6K RAM giving 16 colours. Foreground and background colours are definable on a 96×48 matrix (4608 points). Low resolution reduces the matrix to 48×48 using 3K RAM.

Floppy Disc Controller
Capable of running up to four Siemens double density, double sided 5¼in. mini floppy disc drivers, using the 1791 i.c. Real time loop transfer.

A buyer's starting point would be the cabinet, incorporating PSU module (3A or 5A depending upon choice of boards), and up to four of the 8 × 8in. expansion boards.

System 80 appears to give an unprecedented degree of flexibility for the price, and would facilitate the continual growth of a system without recourse to unsightly add-ons. Such resilience removes the necessity of knowing in advance the direction in which expansion of a system might need to go. An expansion box is currently being designed to enable another five-board unit to be added to the system.

These expansion boards are being released over a four month period, the last to appear being the Floppy Disc Controller.

Three sample configurations and their prices are: 32K system—£505, 96K system—£785, and a 48K system with twin 5¼in. double density/sided soft sectored floppy discs—around £1270, giving ½M byte of memory.

With some 15,000 Nascom 1s sold, and 3000 Nascom 2s so far, NM's three years experience in micro board design, culminating in System 80, should establish the company firmly among the leading European microcomputer manufacturers.

MICRO PROMPT

The hardware and software exchange point for PE computer projects

LIVE CURSOR AND LINE EDIT

One of the limitations of the 101 which sets it apart from the more expensive machines is its lack of an editor. For example, somewhere in a long PRINT statement you may discover you've missed out a semicolon. If you have already hit Return, the only way to correct the line is to retype it all.

Now there is a Screen Monitor and Line Editor, created by Roger Cuthbert, which makes an impressive addition to the UK101's capabilities.

An example of its use is as follows. You wish to change the length of the time delay produced by the statement

105 FOR T = 1 TO 5000 : NEXT

from about five seconds to ten seconds. It is necessary to change the 5 to a 10. Having previously loaded the machine code Line Editor program, the following rules would apply to change line 105.

type **LIST 105**
The line must be listed separately because this is a single line editor.

type **CTRL E**
Causes entry into Line Editor mode. A flashing cursor is then seen.

type **CTRL K**
to move the cursor up (if necessary).

type **CTRL I**
to move the cursor right until it is over the character to be deleted. In this case the 5.

type **RUB OUT**
The 5 disappears, and the rest of the line closes up to remove the space which would otherwise remain.

type **10**
The 10 will insert itself into the line, with all the characters to the right automatically moving along to make room.

type **RETURN**
whilst the cursor is still within the edited line to "digest" the correction.

The full set of Editor cursor controls are shown in Table 1. If you forget to LIST the line separately, you end up with several statements strung together!

Table 1. Moving the cursor in Edit mode

CTRL K	up one line
CTRL J	down one line
CTRL I	right one character space
CTRL H	back space one character

It is easy to see how time saving this feature would be to someone developing sophisticated software on the 101.

In the system as we reviewed it, there were three re-entry points after a reset, which had to be accessed by pressing M for Monitor. These were as follows:

Cold Start BASIC	$1FEE
Warm Start BASIC	$1FFA
Extended Monitor	$1FF4

When first loading the Editor from cassette, however, the 101 jumps straight to: MEMORY SIZE? and so is "user transparent" at that stage.

The foundation stone of the Editor is the Screen Monitor, which allows mobility of the cursor in all directions. Out of editing mode, cursor control is achieved during program execution by printing special character strings, followed by a semicolon. See Table 2.

Table 2. Using the screen Monitor. With the exception of Rub Out, cursor movements do not overwrite existing characters. The semicolons used in the PRINT statements prevent automatic line feed.

Clear Screen	Direct keyboard—CTRL L Program control— PRINT CHR$ (12);
Rub Out	Now works anywhere on screen, and is not stop-limited to single line
Back Space	Direct keyboard—Back spaces without deletion (Edit mode only) Program control— PRINT CHR$ (8);
Move Right	Direct keyboard—(Edit mode only) Program control— PRINT CHR$ (9); The PRINT implementation will work in command mode
Move up	Direct keyboard—(Edit mode only) Program control— PRINT CHR$ (11);
Range Left	Places cursor at beginning of line. Program control— PRINT CHR$ (13);
Line feed	Direct keyboard—(Edit mode only) Program control— PRINT CHR$ (10);

Example: To Home Cursor, say, H$.
H$=CHR$(13):FOR J=1 to 15:H$=H$+CHR$(11): NEXT
From then on PRINT H$

This software is to be available on cassette from Comp Shop, and may also be incorporated in a revised Monitor ROM for the 101.

DESTROY-CHAMP

This is the second CHAMP program submitted by Peter Davies of Birmingham. The user controls a ground base and must destroy UFOs flying overhead.

Destroy

Address	Data	Mnemoic	
200	42	JUN 2	
1	05	05	
2	00	NOP	
3	42	JUN 2	- interrupt vector
4	48	48	
5	20	FIM 0	- start address for dash
6	00	00	
7	22	FIM 2	
8	00	00	Clears RAM register 0
9	23	SRC 3	
A	D0	LDM 0	
B	E0	WRM	
C	73	1523	
D	09	09	
E	22	FIM 2	
F	08	08	Stores ground base in RAM
210	23	SRC 3	
1	D8	LDM 8	
2	E0	WRM	
3	63	INC 3	
4	23	SRC 3	
5	D3	LDM 3	
6	E0	WRM	
7	21	SRC 1	Move dash across screen
8	D2	LDM 2	
9	E0	WRM	
A	61	INC 1	
B	61	INC 1	
C	0B	SB 1	
D	22	FIM 2	
E	0E	0E	Writes digits for number of hits
F	23	SRC 3	
220	A1	LD 1	
1	E0	WRM	
2	63	INC 3	
3	23	SRC 3	
4	A0	LD 0	
5	E0	WRM	
6	0A	SB0	
7	2A	FIM A	
8	EE	EE	- Speed of dash
229	52	JMS 2	
A	40	40	
B	A1	LD1	Test for start of dash
C	14	JZ	
D	31	31	
E	0D	DIN	
F	42	JUN 2	
230	07	07	
1	2E	FIM E	
2	33	33	
3	B4	XCH 4	
4	8E	ADD E	Randomly determines when dash starts
5	B4	XCH 4	
6	A4	LD 4	
7	BE	XCH E	
8	7E	1S2 E	
9	3C	3C	
A	42	JUN 2	
B	2E	2E	
C	52	JMS 2	
D	40	40	
E	42	JUN 2	
F	38	38	
240	0C	E1N	
1	50	JMS 0	
2	B1	B1	Display Subroutine
3	7A	152 A	
4	40	40	
5	7B	152 B	
6	40	40	
7	C0	BBL 0	
8	22	FIM 2	Interrupt Subroutir
9	08	08	
A	23	SRC 3	
B	E9	RDM	
C	F6	RAR	
D	F6	RAR	
E	12	JC	Test for hit
F	58	58	
250	23	SRC 3	
1	DD	LDM D	
2	E0	WRM	Stores 1 eight for miss
3	63	INC 3	
254	23	SRC 3	
5	DF	LDM F	
6	E0	WRM	
7	02	BBS	
8	22	FIM 2	
9	06	06	
A	2E	FIME	
B	A0	A0	Stores 3 eights for hit
C	23	SRC 3	
D	DF	LDM F	
E	E0	WRM	
F	63	INC 3	
260	7E	ISZ E	
1	5C	5C	
2	0B	SB1	

Address	Data	Mnemoic	
3	64	INC 4	Increments number of hits
4	D7	LDM 7	
5	B0	XCH 0	
6	A4	LD 4	
7	B1	XCH 1	
8	30	FIN 0	
9	0A	SBO	
A	02	BBS	
B			
C			
D			
E			
F			
270	7E		Data for number 1 – F for hits
1	0C		
2	B6		
3	9E		
4	CC		
5	DA		
6	FA		
7	0E		
8	FE		

The ground base is represented by a ⊔ on the bottom of the 5th display digit. The U.F.O's are rapidly moving dashes which move across the top of the display. When the dash is above the base and a key is pressed simultaneously, the display around the base lights up to indicate a hit, and the right-hand most digit increases by one to show the number of hits. The explanation of the program is provided next to it.

KEYBOARD WITH CHARACTER

The following is a table of characters directly available from the 101 keyboard, submitted to Prompt by Richard Schofield of Horsham, Sussex.

CHAR.	L.H.SHIFT	CTRL
a	Q	
b	R	
c	S	
d	T	
e	U	
f	V	
g	W	
h	X	
i	Y	
j	Z	
k		
l		,
m		-
n		.
o		/
p		0
q		1
r		2
s		3
t		4
u		5
v		6
w		7
x		8
y		9
z		:
{		;
		N
≡		L
↗		Q
↖		W
↔		R
↕		T
~		Y
↙		U
		O
↕		P
@	P	
		↑
		RETURN
↘		S
⊔		G
^		K
		Z
£		X
↔		V

GAMES GALORE

The 101 software gap closes. Here is a marathon contribution from *Mr. A. Knight* of Cleveland, who sent us eight games programs to look at, with permission to publish one of them; not that we could have found room to list them all anyway!

Nim

A computer version of the game where matchsticks must be removed from a pile, each player seeking to avoid removal of the final one. Although this is man versus machine, Compukit always grants its inferior human opponent the choice of how many rows of matches and the maximum lengh of any row. The game is enhanced by good graphics, and a "Resign" key is thoughtfully designated to avoid the pointless continuation of a game already lost. Difficult to win without *threatening* to remove ROMs!

Noughts & Crosses

Standard game versus the computer, three levels of play. The highest level is classified as unbeatable, so I can only suggest playing this level late at night when the machine is tired. One can return to the lowest level of play to repair one's ego, since winning is easy. Level Two is ideal. The machine keeps a cumulative score board for series playing, and the information is well presented on the screen.

Mastermind

Based on original game. The computer tells you how many attempts it took you to crack its randomly selected code number. Each time you test a number, an asterisk appears for each correct digit, and a criss-cross symbol for any digit the code includes but in a different position.

La Passe-Temps

Beat the machine to four-in-a-row on any axis, but the 6 × 7 playing grid is subject to gravity, so that the machine's marker and yours have to be dropped from the top of each column, to fall as far down as they can.

Difficult and addictive. The challenge, is *not* being made to look silly by a p.c.b. full of chips. The only consolation is that you can see the computer getting worked up when you make life difficult for it. A cumulative score is registered.

Armless Bandit

You are playing with "software money", and the bandit pays out for three or four of a kind in adjacent slots.

Periodical free spins allow a "hold" facility, but this is subject to a reaction test. The space bar sends the wheels tumbling round, and the pay out value of all symbols is constantly displayed, along with your dwindling cash balance. Good screen layout.

Hangman

Excellent graphics! Alphabet appears at bottom of screen so that letters can be selected by a mobile pointer. The clues, and target names, e.g. TV programme, book title, etc., can be altered quickly since they are listed as block data statements.

Don't get hung, there is a macabre animated ending! The only disappointment is that you don't find out what the name or title was if you fail. Presumably it is then saved for another game.

Stud Poker

Man versus machine in standard five card stud game, with £5,000 cash in hand at outset. Good screen format, but note, this program requires 8K RAM. The question is—would it pay out *real* money if you hooked up a good enough printer?

Blackjack

Play two hands against the dealer, which is the 101. You start with £100 and the winner is the first to reach £250. This program can be cut to run on a 4K machine by erasing the lines which contain the instructions on how to play.

These programs seem to be carefully thought out, and protected against most incorrect key presses which can cause an annoying jump to Command Code. We decided to publish the listing for Le Passe-Temps because it was reasonably short and great fun to play, but owing to lack of space, this will appear in the next Prompt. The programs would seem good value for money and details of how to obtain them can be found in the advertising pages of this issue.

ALLIED USERS' GROUP

The OSI UK User Group published their first quarterly newsletter in December last year and have kindly sent us a copy. This group can accommodate 101 users.

The OSI group's Newsletter One contained useful information on memory locations and BASIC routine entry points, much of which will be common to both C2 and 101 users. These two groups should have a lot to offer each other.

A year's membership of the OSI UK Group costs £5 and naturally includes the newsletter. Details are available from George Chkiantz and Richard Elen, 12 Bennerley Road, London SW11 6DS.

GAMES FOR CHAMP

Three programs have been written for CHAMP by *T. Smales,* who is willing to part with copies of their listings upon receipt of a large s.a.e., plus, if possible, any exchange programs fellow CHAMP users may care to include.

The programs are: *Shoot Game, Reaction Timer,* and *Moon Landing.* Write to Mr. Smales at 15 Nayland Ave., Gresford, Wrexham, Clwyd.

ANIMATED GRAPHICS

BY P. HOUGHTON

MEMORY MAPPED VIDEO

THE screen of the UK 101's TV or VDU may be thought of as a block or memory resembling an array of adjoining boxes, about a thousand in all, each identified by a number:

The "boxes" are numbered consecutively as shown in Fig. 1, starting at number 53248 and finishing at number 54271. We can put any character in any of the boxes by using the POKE instruction. For example:

```
1Ø POKE 53985, 6
```

followed by RUN, should cause the graphic character number 6 ▣ to appear near the centre of the screen.

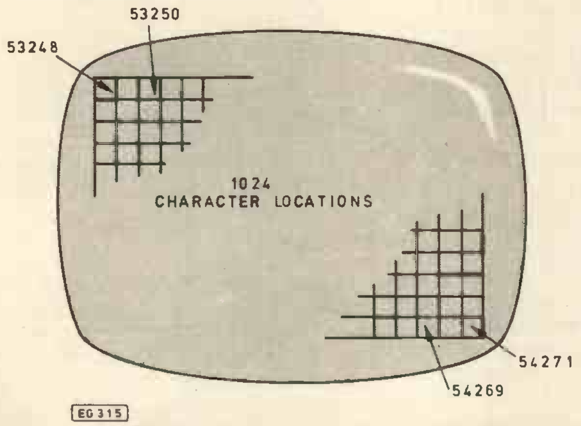
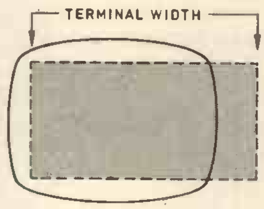


Fig. 1. Character slot grid produced by the 101's memory mapped video RAM. The numbers indicate sample RAM addresses at which a character must be stored to occupy that position on the screen.

Fig. 2. In reality the character grid's so called "Terminal Width", when at maximum setting, will be too wide for the average TV screen. Therefore a range of RAM addresses will be surplus, having no visible effect.



Now a word of caution: Not all the boxes that may be filled are visible on the TV screen. A little experiment with the POKE instruction may be necessary to prevent your graphics disappearing off the side of the screen! See Fig. 2.

MOVE IT

Now suppose we want to move the character we have just put on the screen, say, to the right. All we have to do is to use the POKE instruction again with the number of the box immediately to the right of location 53985. This will be:

```
POKE 53986, 6
```

but we have to empty the previous box to give the impression that the one character moved. This is done by putting a blank (graphic or ASCII character number 32) in the previous box. The full program becomes:

```
1Ø POKE 53985, 6        put character in box 53985
2Ø POKE 53986, 6        put character in next box
3Ø POKE 53985, 32       erase previous box
```

Now, the problem is that if we run this as it stands, the program is executed so rapidly that we don't notice the character transfer itself. Let us slow things down with a time delay instruction:

```
1Ø POKE 53985, 6
2Ø FOR Z = 1 TO 1ØØ STEP Ø·1
3Ø NEXT Z
4Ø POKE 53986, 6
5Ø POKE 53985, 32
```

MOVE IT MORE

We can extend the basic idea to make the character move along a line to the right by incorporating a loop in the previous program:

```
1Ø LET X = 53985                 Choose "box" at
                                   which to start.
2Ø POKE X, 6                     Put character in box
3Ø FOR Z = 1 TO 1ØØ STEP Ø·1 }
4Ø NEXT Z                    }   time delay
5Ø POKE X, 32                    erase box
6Ø LET X = X + 1                 pick next box to right
7Ø GO TO 2Ø                      loop back to line 2Ø
```

Notice that once the character has "disappeared" from the right-hand side of the screen, it re-appears some seconds later at the left-hand side but on the next line down. This feature can be very useful.

This idea can be extended to move a graphic in any direction. The following diagram shows how. Contained in each box is the number which must be *added* to the number of the previous box in order to effect a move.

−65	−64	−63
−1	HERE	+1
+63	+64	+65

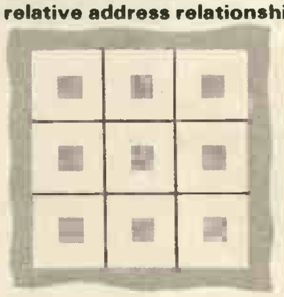
Fig. 3. In relation to any one character slot on the screen, the adjoining boxes will have these relative addresses.

As an example, if the number of the centre box is 53985, then executing:

```
1Ø LET X = 53985
2Ø POKE X, 6
3Ø POKE (X + 1),  6
4Ø POKE (X + 65), 6
5Ø POKE (X + 64), 6
6Ø POKE (X + 63), 6
7Ø POKE (X − 1),  6
8Ø POKE (X − 65), 6
9Ø POKE (X − 64), 6
1ØØ POKE (X − 63), 6
```

should cause the pattern of Fig. 4 to appear.

Fig. 4. The effect of POKEing the same graphic symbol to a group of adjacent character slots, using the relative address relationship.



KEYBOARD CONTROL

When writing your own computer games, it is useful to be able to move characters about the screen by pressing nominated keys, each controlling a different direction of movement. The strategy for achieving this is to:

(a) Disable the keyboard so that keys accidentally pressed have no effect.
(b) Test for certain keys having been pressed.
(c) Upon detection of the correct key branch in the program to a subroutine that causes the graphic to move in the required direction.

As an example, suppose we wish to invent a game which required us to control the graphic for an aircraft on the TV screen.

We require sideways movement as well as up and down. The nominated keys might be:

key "1" . . . move left
key "2" . . . move right
key "3" . . . move up
key "4" . . . move down

(a) We can disable the keyboard using the special instruction

POKE 530, 1

(b) The keyboard may be treated as memory location 57088. The instruction POKE 57088, 127 selects the *numerical* row of keys on the keyboard. We can test if a particular key has been pressed, with the instruction PEEK (57088) =

If PEEK (57088) = 127 then key 1 has been pressed.
If PEEK (57088) = 191 then key 2 has been pressed.
If PEEK (57088) = 223 then key 3 has been pressed.
If PEEK (57088) = 239 then key 4 has been pressed.
Values for other keys are given in the Compukit manual.

(c) Suppose that key 1 has been pressed and detected. We must now branch to a program subroutine to move the graphic to the left. If we use graphic No. 239 ( ) and its original box was X, then the subroutine might take the form:

```
100 LET X = X -1          new box number
200 POKE (X + 1), 32      erase old box
300 POKE X, 239           graphic to new box.
```

I will now give an example of a simple game called "TARGET INTERCEPT" which I have constructed using the above techniques.

TARGET INTERCEPT

A target appears on the screen in a random position. A missile also appears, again in a random position. The missile may be steered left, right, up or down by keys 1, 2, 3 and 4 respectively. The missile must be steered to hit the target. The missile is given only limited fuel so that the shortest route should be chosen. Running out of fuel ends the game. A hit is registered with a message and an indication of the fuel left before impact.

```
10 FOR Z = 53250 TO 54270
20 POKE Z, 32                             clears screen.
30 NEXT Z
40 LET T = 50                             T = fuel allowance.
50 LET N = INT(1000*RND(1) + 53248)       Random box for
                                            target.
60 POKE N, 6                              Target into box.
70 LET X = INT(1000*RND(1) + 53248)       Random box for
                                            missile.
75 LET Y = 237                            Missile graphic.
80 POKE X, Y                              Missile to random
                                            box.
85 LET T = T - 1                          Fuel burning.
87 IF T = 0 THEN 320                      If fuel used then
                                            320.
90 IF X = N THEN 340                      Check for hit.
100 POKE 530, 1                           Disable keyboard.
110 POKE 57088, 127                       Select number
                                            keys.

120 IF PEEK (57088) = 127 THEN 240
130 IF PEEK (57088) = 191 THEN 170        Test for which key
140 IF PEEK (57088) = 223 THEN 200        has been pressed.
150 IF PEEK (57088) = 239 THEN 280
160 GO TO 100

170 LET X = X + 1
180 POKE (X - 1), 32                      Move right.
190 GO TO 75

200 LET X = X - 64                        Move up, change
210 Y = 236                               graphic to 236.
220 POKE (X + 64), 32
230 GO TO 80

240 LET X = X - 1
250 Y = 239                               Move left, change
260 POKE (X + 1), 32                      graphic to 239.
270 GO TO 80

280 LET X = X + 64
290 Y = 238                               Move down,
300 POKE (X - 64), 32                     change graphic
310 GO TO 80                              to 238.

320 PRINT "OUT OF FUEL . . . TARGET NOT
     DESTROYED"
330 GO TO 350
340 PRINT "TARGET DESTROYED, WELL DONE"
345 PRINT "YOU HAD"; T; "GALLONS OF FUEL LEFT"
348 PRINT "FROM THE ORIGINAL 50 GALLONS"
350 END
```

Note: Some early 101s have slightly different video RAM mapping to that detailed here and elsewhere in prompt. We hope to clarify the differences in a future issue.

News Briefs

CLUB CHANGE

THE West Midlands Amateur Computer Club meet at 7.30 pm on the second and fourth Tuesday of each month, now at Elmfield School, Love Lane, Stourbridge, West Midlands.

Annual subscription is £3 for 1980 and visitors are allowed a free visit to see what it's all about. With 60 members, there are 8 PETs, 12 Nascom 1s, 5 Nascom 2s, 3 TRS 80s, 4 Newbear 7768s, a Sharp MZ80, 2 Apples, plus 12 other assorted systems. What! No Compukits! Or are *they* merely "assorted systems"?

The Club Secretary is John Tracey, 100 Booth Close, Kingswinford, West Midlands.

MORE ON ULAs

THE feature on ULAs in the February issue provided only a superficial view of these versatile bipolar LSI chips. In scope, since their inception in 1972 by Ferranti, hundreds of designs have been completed covering a wide range of applications.

To supplement the information we published, Ferranti have available a technical handbook, price £1, which provides in depth information on device technology and product range. This can be obtained from Ferranti Electronics Limited, Fields New Road, Chadderton, Oldham, OL9 8NP.

GLC AND CB

THE Greater London Council is considering asking Londoners if they would like to see the introduction of legalised Citizens' Band Radio in this country.

The benefits to society that CB can offer have already been propounded, but a well worn argument against, is that criminals would use it during bank robberies. *Law abiding criminals are presumably at present precluded from robbing banks by the absence of legal CB!* Sir Horace Cutler said: "There is growing pressure for the legalisation of CB radio and the GLC wants to study the implications for London".

Infra-Red CONTROLLER

Malcolm Plant

OTHER than radio, two electronic methods are in common use for the remote control of electrical equipment in the home: one uses ultrasonics as the carrier of the control information and the second uses infra-red waves which, like radio but unlike ultrasonics, are electromagnetic in nature. Incidentally, if ultrasonic waves were capable of transmission over distances comparable with radio and light there would be an unacceptable delay in the propagation of the control signal for terrestrial application since sound travels at only 330 metres per second (approximately) compared with light which travels the same distance in about one microsecond!

The availability of low-cost ultrasonic transducers which are already tuned to selected frequencies, commonly 40kHz, makes ultrasonics a popular choice for a short-range control system. But since infra-red light-emitting diodes are also generally available, an opto-electronic control system offers two attractive features not met by ultrasonics: infra-red, like light, can be focused by lenses therefore improving the range over which control is possible and, secondly, the infra-red l.e.d. output can be easily modulated so that a precisely tuned control system is possible which is much less prone to false triggering than an ultrasonic system. Indeed, so popular have infra-red control systems become that purpose-designed i.c.s. now facilitate the design of sophisticated multi-channel control systems which are a feature of an increasing number of domestic TV receivers and hi-fi systems.

This design uses infra-red l.e.d.s and lenses in a "tuned" system providing two independent channels for switching on and off mains appliances rated at not more than 750W. Improvement in range largely depends upon the choice of l.e.d. and on the lenses, particularly in the hand-held transmitter unit which, of necessity, has to be small. The receiver is fitted with an adjustable lens head which facilitates alignment of the transmitter and receiver.

CIRCUIT DESCRIPTION

The transmitter circuit shown in Fig.1 is based on a 555 timer wired as an astable multivibrator giving a rectangular output waveform with a mark-space ratio of 15:1. The switches S1 and S2 select resistors R1 and R2, respectively, which cause the circuit to oscillate at 33kHz and 25kHz, respectively. These two switches are double-pole, push-to-make momentary action types so that the 9V power supply is operated simultaneously with the selection of the resistor.

Note that, provided the two frequencies are stable, their precise values are not important since each channel is tuned individually in the receiver circuit. The infra-red l.e.d. is forward-biased for a brief period of about 2·5µs when the output of the 555 timer is near 0V. The average power dis-

A two channel remote control system capable of switching mains loads of up to 750W.

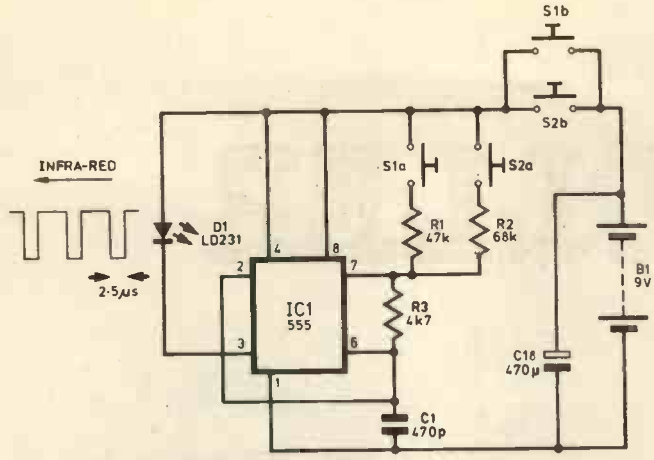


Fig. 1. Circuit diagram of the Transmitter

sipation in the diode is therefore small and it does not require a resistor in series with it.

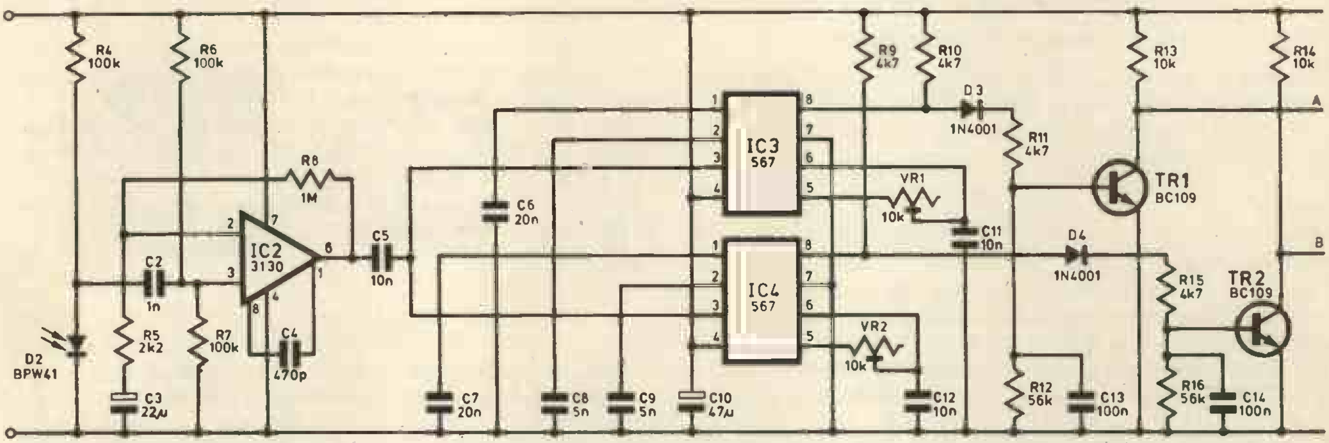
The receiver circuit of Fig. 2 uses one op amp, IC2, two phase-lock loops, IC3 and IC4, a dual monostable, IC5, and a dual JK flip-flop, IC6, with the object of switching on and off a mains relay when the photodiode, D2, is exposed briefly to the infra-red beam from the transmitter. The op amp is connected as a conventional non-inverting capacitor-coupled amplifier whose gain is set by the ratio of resistor values, R5: R8.

The amplified signal at pin 6 of the op amp, now very like a sine wave but at a frequency of either 25kHz or 33kHz, is passed on to both input pins (3) of the phase-lock loops, IC3 and IC4, via capacitor, C5.

The external components, VR1 and C11 of IC3, and VR2 and C12 of IC4, determine the capture frequency of the phase-lock loops, VR1 allowing tuning to 25kHz and VR2 to 33kHz. When capacitor C5 passes a signal of frequency 25kHz into IC3, the latter's output voltage at pin 8 drops sharply to zero. Likewise if IC4 received a signal of frequency 33kHz, the voltage at pin 8 of IC4 falls sharply. The fall in voltage switches off transistors TR2 or TR3 so that the voltage at points A or B sharply rises. Either of these fast rising voltages triggers the edge-triggered monostables in the dual package, IC5.

Components R17 and C15, and R18 and C16, provide a positive signal at pins 6 and 10 of about 0·5 seconds duration. IC5 has the task of providing a cleaner pulse with which to operate the dual flip-flop, IC6. Alternate pulses from the monostable set the flip-flop outputs, pins 2 and 14 first high and then low thereby controlling the relays, RLA and RLB, in the collector loads of transistors TR3 and TR5. Thus, mains loads can be switched on and off by means of the normally open relay contacts of RLA and RLB.

The mains power supply shown in Fig. 3 provides a stabilised 10V d.c. output. The secondaries of T1 should be wired in parallel. This supply is a conventional series voltage regulator using a 741 as an active control element to maintain output voltage at the selected Zener voltage, D7,



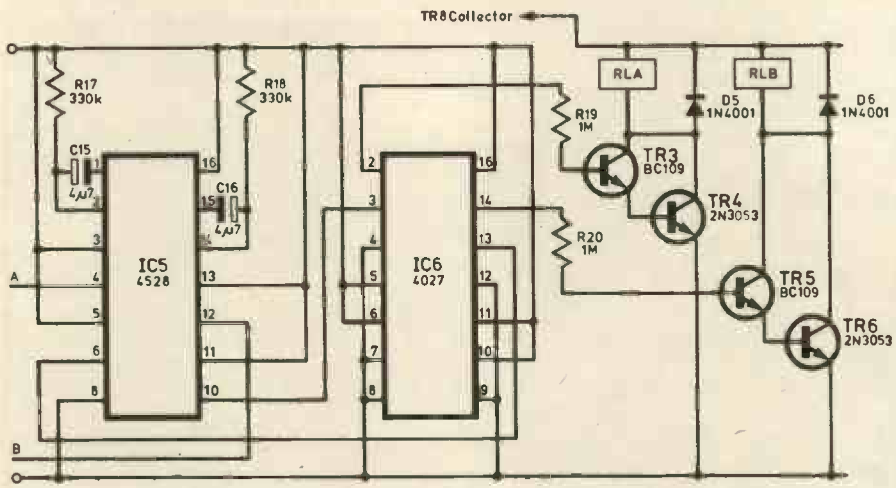


Fig. 2. Circuit diagram of the Receiver Unit

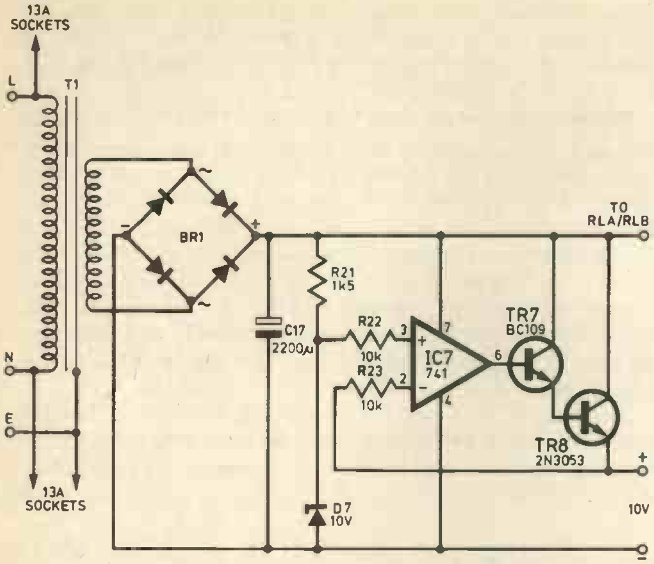


Fig. 3. Power supply circuit diagram

regardless of varying loading of the regulator. Note that the voltage to drive the relays is taken from the unregulated line to ensure that the higher voltage present on this line reliably operates the relays.

OPTICS

Attention must be paid to the optics of this opto-electronic control system as well as to the electronic aspects. Fig. 4 indicates the important features of the lens system required. Since the infra-red l.e.d. produces a wide angle beam, a convex lens of short focal length and large diameter is used. Similarly, the convex lens which focuses the energy onto the photodiode in the receiver unit should

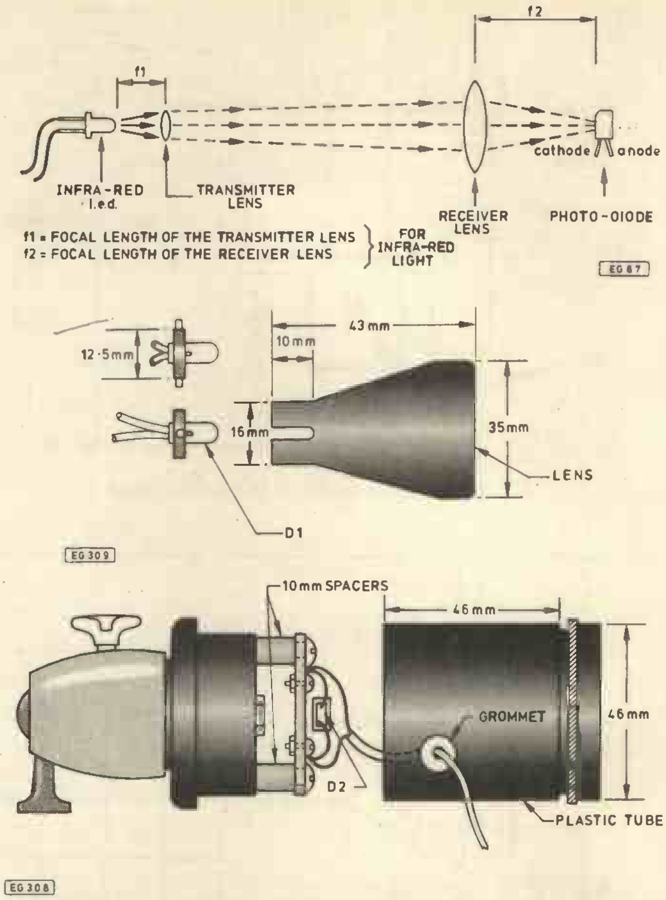


Fig. 4. Construction and mounting details for the optical lenses and infra-red devices (D1.D2).

COMPONENTS . . .

Resistors

R1	47k
R2	68k
R3, R9, R10, R11, R15	4k7 (5 off)
R4, R6, R7	100k (3 off)
R5	2k2
R8, R19, R20	1M (3 off)
R12, R16	56k (2 off)
R13, R14, R22, R23	10k (4 off)
R17, R18	330k (2 off)
R21	1k5

All resistors ¼W 10% carbon

Potentiometers

VR1, VR2	10k 20 turn trimmer (2 off)

Capacitors

C1, C4	470p polystyrene (2 off)
C2	1n polystyrene
C3	22µ 16V tant
C5, C11, C12	10n polyester (3 off)
C6, C7	20n polyester (2 off)
C8, C9	5n polystyrene (2 off)
C10	47µ 16V tant
C13, C14	100n polyester (2 off)
C15, C16	4µ7 16V tant (2 off)
C17	2200µ 25V elect
C18	470µ 25V elect

Semiconductors

D1	LD 231 or LD 242 infra-red l.e.d.
D2	BPW41
D3, D4, D5, D6	IN4001 (4 off)
D7	10V 400mW Zener
TR1, TR2, TR3, TR5, TR7	BC109 (5 off)
TR4, TR6, TR8	2N3053 (3 off)
IC1	555
IC2	3130
IC3, IC4	567 (2 off)
IC5	4528
IC6	4027
IC7	741
BRI	1·6A in line bridge rectifier

Lenses

Two convex lenses each of focal length 3 to 5cm are required. The transmitter lens should be 20mm dia and the receiver at least 40mm dia.

Miscellaneous

T1	15-0-15V 0·2A
TO5 heatsink for TR8	
RLA, RLB	185Ω 240V 3A relays
S1, S2	d.p. push to make
B1	PP3 battery
Two switched 13A sockets	
Suitable cases	
Veroboard	

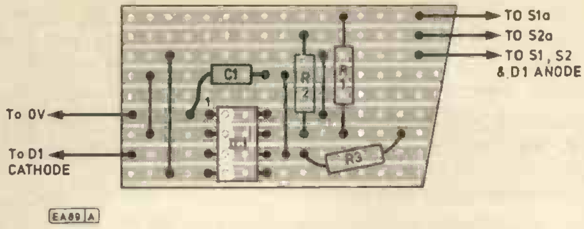


Fig. 5. Veroboard layout for the Transmitter

Internal view of the Transmitter

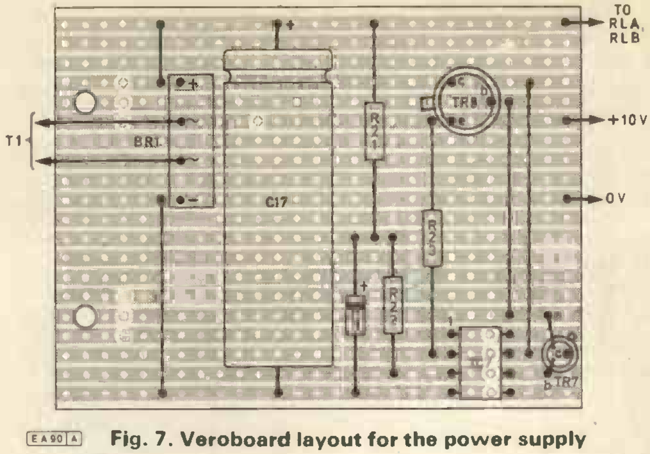


Fig. 7. Veroboard layout for the power supply

have a short focal length for this will give it a wide angle of acceptance and make it more tolerant of deviations in the beam from the transmitter.

To facilitate focusing both the l.e.d. and the photodiode must be capable of slight adjustment along the lens axes. Remember that the focal length of a convex lens is slightly longer for infra-red than for visible light. The overall purpose of the optical system is to produce a parallel, or collimated, beam from the transmitter and for the receiver optics to focus this beam onto the photodiode.

ASSEMBLY

Three pieces of Veroboard are required for assembling the circuits and these are shown in Figs. 5, 6 and 7 for the transmitter, receiver and power supply, respectively. The usual precautions are required when using 0·1 matrix Veroboard, in particular, care should be taken to sever the tracks at the points indicated on the circuit layouts, make the use of holders for the i.c.s and carefully check the completed circuit to ensure that solder has not inadvertantly joined together adjacent tracks.

The p.s.u. and the receiver board are fitted into the base of the receiver case as shown in the photograph, together with the aluminium panel for the two relays. Wires are required externally for connection to the mains and to the photodiode in the optical pick up head mounted on the case. The construction of the pick up head is also shown opposite. Note that adjustment is provided for the lens to be moved slightly towards or away from the photodiode to facilitate focusing.

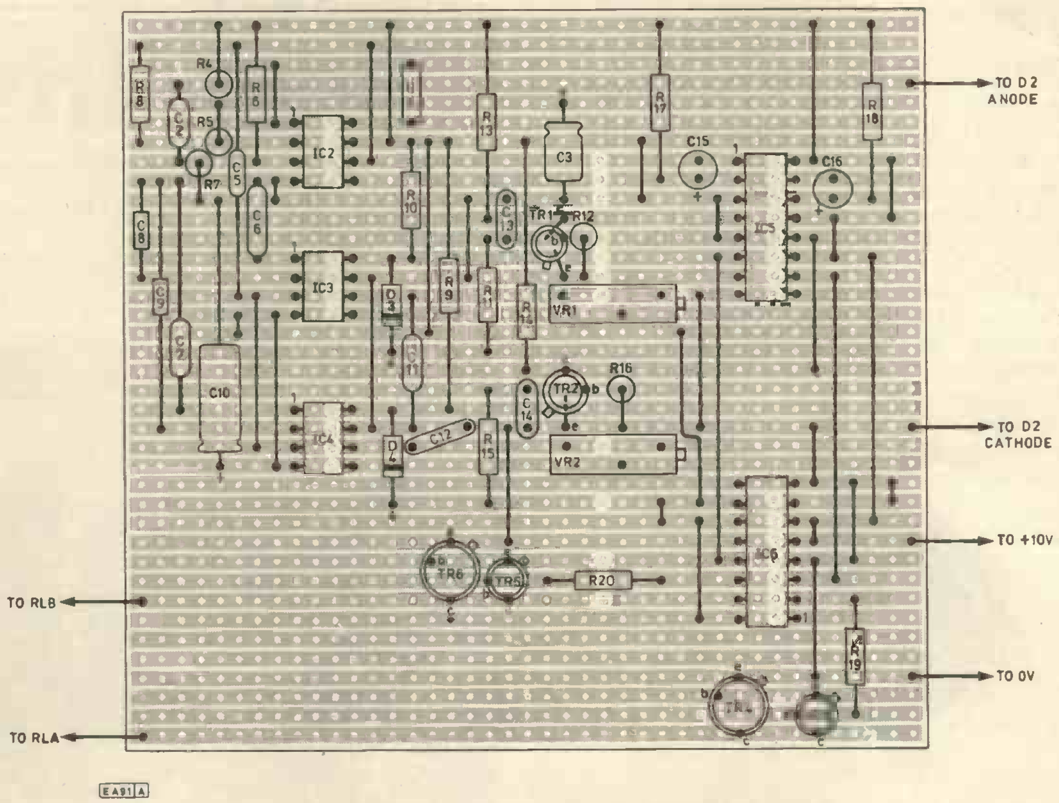
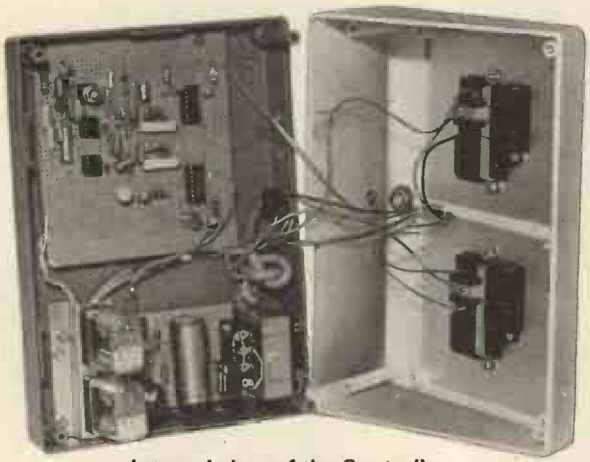


Fig. 6. Veroboard layout for the Receiver

The transmitter components; two switches and PP3 battery will fit into the case recommended provided the Veroboard is cut to the shape shown in Fig. 6. The infra-red l.e.d. fits into a wooden, hand-formed holder which projects from the end of the unit. The l.e.d. can be moved a small distance along the axis of the tube to help in setting up the system and a clamp is provided to tighten the l.e.d. in place after adjustment is made.

TESTING

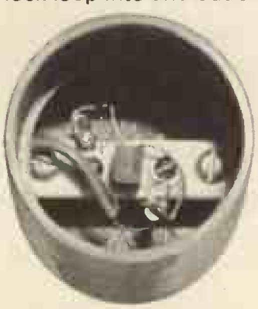
The operation of the transmitter circuit can be checked out before the receiver has been completed if an oscilloscope is available. The oscilloscope should be connected between pin 3 and ground (IC2) and the waveform noted as switches S1 and S2 are pressed. Note for future reference which switch produces the higher frequency, i.e. 33kHz. If a scope is used to measure these frequencies it does not matter if the measured frequency is more or less than the nominal frequency by 1kHz. Also observe the mark-space ratio of the waveform is about 15:1 and check that the l.e.d. is wired correctly in the circuit, cathode to pin 3 of IC1.



Internal view of the Controller

Once you have very carefully checked all the wiring to the various components in the receiver unit, particular care is needed in checking the mains connections to the transformer and mains sockets, the receiver unit can be plugged into the mains whereupon the relays may be heard to energise depending upon the states of the outputs of the flip flops of IC6.

Two small holes should be drilled in the case in line with the trimmers VR1 and VR2 for the next stage of setting up. With the transmitter activated by pressing one of the "transmit" switches, and set at a distance of about a metre away from the receiver optics, one of the trimmers in the receiver is adjusted until one of the relays is heard to operate. A whole turn of the trimmer screw will bring the associated phase-lock loop into and out of its capture band.



Internal view of the pick up head

Patience is needed in finding the position on the trimmer when the receiver circuit latches onto the transmitted signal frequency but the process is eased slightly if a high impedance voltmeter is connected between pin 8 and ground (0V) of IC2 or IC3; set at 10V d.c. the voltage will fall to zero when the receiver is responding to the transmitted infra-red signal.

Do not attempt to find the setting of the trimmer for maximum sensitivity at this stage but repeat the preliminary setting up procedure for the other channel of the control system by adjusting the other trimmer when the second switch in the transmitter is operated.

Once the two receiver relays are operating reliably when the transmitter is operated at a distance of a metre or so, the system may be tuned to maximum sensitivity for which you will need the help of a patient friend. You will find it much easier to operate the system if the transmitter switch is kept pressed and the transmitter beam is waved across the field in front of the receiver optics head. Practice will improve your performance here. With the friend operating the screwdriver or the transmitter, increase the separation of the two units by a metre or so at a time and make slight adjustments to each trimmer in turn until the receiver can be operated reliably at the maximum range of the system. Once this maximum has been reached the collimation of the optical system can be attended to. Very small adjustments to the separation of the photodiode and its convex lens and the l.e.d. and its lens ought to improve the range. The general idea being to place the l.e.d. and the photodiode at the principal focus of the respective lens for the infra-red light being used. In this way the transmitter produces a parallel beam of infra-red light and the receiver optics focuses this beam onto the photodiode at its principal focus. Of course, the whole of this alignment and tuning procedure can be made much more interesting if a lamp is plugged into the sockets on the receiver unit. ★

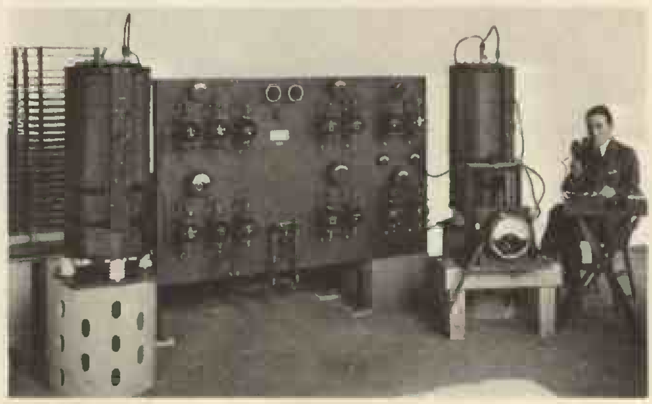
News Briefs

FIRST ON THE AIR

THE first *woman* in the world to broadcast on radio, Mrs. Winifred Collins, celebrated the 60th anniversary of her historic achievement as guest of honour of GEC-Marconi Electronics Ltd., last February.

The photograph shows Marconi engineer Mr. W. T. Ditcham, said to be the world's very first broadcaster, at the 6KW transmitter used in his original experiments.

Photograph courtesy of GEC-Marconi Electronics.



USING YOUR FREE STICKIES

A SHEET OF 120 CMOS STICKIES, WORTH 60p, IS GIVEN FREE INSIDE THIS ISSUE

NO doubt you will by now have found your free sheet of STICKIES. The ones you have are for the popular 4000 series of CMOS i.c.s plus a few blank 14 and 16 pin ones that can be filled in as required. Sheets of TTL (7400 series) are also available—details later.

FAULT FINDING

Having constructed a piece of equipment it helps with circuit checking and fault finding if each i.c. has its corresponding label attached. Each pin is then either labelled or its internal connection is shown in schematic form.

P.C.B. LAYOUT

STICKIES are also very useful for designing p.c.b.s. Simply stick them down on a sheet of paper and join the pins with pencil lines. They then provide immediate identification of each i.c. and its pins and form a reference for the i.c. size and pin positions.

PROTOTYPING

Many amateurs and professionals employ some type of plug in breadboard for phototyping. When using unfamiliar i.c.s STICKIES can provide an immediate pin reference, helping to speed up interwiring and eliminate mistakes. Of course once the i.c. is labelled it can be used later and the STICKIES will always provide pin identification without recourse to charts or reference books.

STORAGE

STICKIES should be stored away from direct sunlight avoiding extremes of temperature and humidity. The adhesive used is a general purpose removable type which is suitable for use between −40 and +70 degrees C.

The data printed on STICKIES has been carefully checked and is believed to be entirely reliable; however, no responsibility can be assumed for inaccuracies.

ABBREVIATIONS

Some abbreviations have been used on STICKIES which may not be obvious to all readers. These are:

Ast	Astable
B/D	Binary/Decade control
BI	Blanking Input
C	Capacitor
CD	Clock Delay
CE	Clock Enable
CF	Cascade Feedback
CI	Carry In
Clk	Clock
CO	Carry Out
com	common
D	Data
DD	Data Disable
DEI	Display Enable In
DEO	Display Enable Out
DFI	Display Frequency In
DFO	Display Frequency Out
En	Enable
ER	External Reset
G	V_{SS}
Inh	Inhibit
J	Jam
LD	Latch Disable
LE	Latch Enable
LT	Lamp Test
MR	Master Reset
OD	Output Disable
OE	Output Enable
OO	Oscillator Out
Psubscript	Parallel
PE	Preset Enable
PH	Phase
P/S	Parallel/Serial control
Pty	Polarity
R	Reset
RI	Recirculation In
RM	Recirculation Mode
Rtr	Retrigger
S	Set
Ssubscript	Serial
Str	Strobe
T/C	True/Complement Control
Tr	Trigger
UCS	Ungated C Segment Out
U/D	Up/Down Control
V	V_{DD}
ε	Sum
Ω	Resistor

Inverted functions are shown by a bar, thus, $\overline{A}$. For outputs, this indicates active low. For inputs, it means that the circuit operates on the negative-going transition. Where an IC is used for a pair of identical functions, the division is shown by a broken line. Multiple inputs or outputs are always numbered 0 through n.

MORE!

We are sure you will find your 120 free ones very useful and will in due course need some more. Please don't write to P.E., be thankful for the 60p's worth we have given you and next time send your money to Concept Electronics, 8 Bayham Road, Sevenoaks, Kent. The cost, including an information sheet, plastic wallet, VAT and postage is 80p for a sheet of 120 (either 7400 or 4000 series—state which is required).

Alternatively, a 480 label pack is available for £2·80. Concept will also give discount for quantity orders, their 'phone number is 0293 514110.

DYNAMIC SEMICONDUCTOR TESTER

Michael Tooley B.A. **David Whitfield** B.A. M.Sc.

A reliable means of checking some of the ever increasing variety of semiconductor devices is a valuable asset in any electronic constructor's workshop. Not only does this help with fault finding but it also provides a means of checking surplus and unmarked devices so that they may be salvaged for future use. The circuit to be described provides a means of testing the vast majority of semiconductor diodes, bipolar and field-effect transistors both junction and insulated gate types. It will handle germanium and silicon devices and has facilities for both n.p.n. and p.n.p. transistors.

Measurements are made under actual working conditions. Diode current is measured under forward and reverse bias and this facility also provides a means of testing and identifying transistor junctions. Transistor testing is carried out under dynamic conditions with the transistor performing in oscillator circuits at audio and radio frequencies.

It is possible to obtain an estimate of the relative gain of the device under test and also to ascertain its suitability for high frequency, linear, or switching applications.

CIRCUIT DESCRIPTION

The basic arrangement of the transistor tester is shown in Fig. 1 with the complete circuit shown in Fig. 2. The transistor under test is operated in common emitter mode with stabilised base bias provided by silicon diodes D3 to D6. Four diodes are used in order to cope with the reversal of the supply polarity which occurs when changing from p.n.p. to n.p.n.

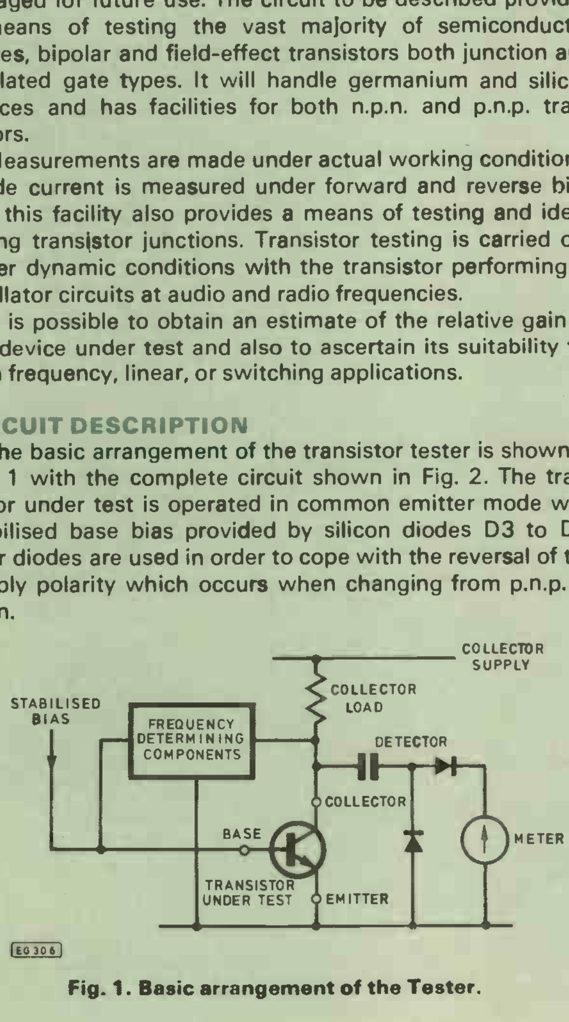


Fig. 1. Basic arrangement of the Tester.

The frequency determining components are connected in the feedback path between collector and base. For audio frequency operation these consist of a "Twin-T" network which provides oscillation at a frequency of approximately 1·5kHz. For radio frequency operation the resistive collector load, R7, is replaced by an inductive load, L1, and feedback is via a quartz crystal. Oscillation occurs at the fundamental resonant frequency of the quartz crystal. This should be in the range 6MHz, to 10MHz, but the exact frequency is immaterial. Surplus crystals of recent manufacture should prove to be quite satisfactory for this purpose, alternatively a new 10MHz crystal can be purchased ex-stock from several sources relatively cheaply.

The output of the oscillator is applied to a detector formed by D7, D8, and C10. The resulting direct current output is measured on the meter. Zener diode, D9, ensures that the l.e.d., D10, operates only when the supply is above 8V. Hence the l.e.d. also serves as a battery condition indicator. The battery should be replaced whenever the l.e.d. fails to illuminate after the instrument is switched 'on'.

CONSTRUCTION

The circuit is built in two parts. The resistors, capacitors and other small components are mounted on a small printed circuit board which is located in the base of the plastic case. The layout of the p.c.b. is shown in Fig. 3 with the corresponding component layout shown in Fig. 4.

Care should be exercised to avoid excessive heat when soldering the crystal to the printed circuit board and constructors may, if desired, use an appropriate HC6/U socket. The switches, meter, and semiconductor connecting sockets are mounted on the detachable front panel. The semiconductor connecting sockets are soldered to the small printed circuit board which is located in a rectangular cut-out in the front panel. Before assembling the front panel components, it is recommended that the front panel be lettered using dry transfers and then given a coat of clear protective lacquer.

The front panel components may be wired to the p.c.b. by means of a length of multi-way ribbon cable. This should be kept as short as possible whilst still allowing easy removal of the front panel, thus permitting access to the p.c.b. The interconnecting leads have, for clarity, been labelled 1 to 17 whilst those leads to the semiconductor sockets are labelled

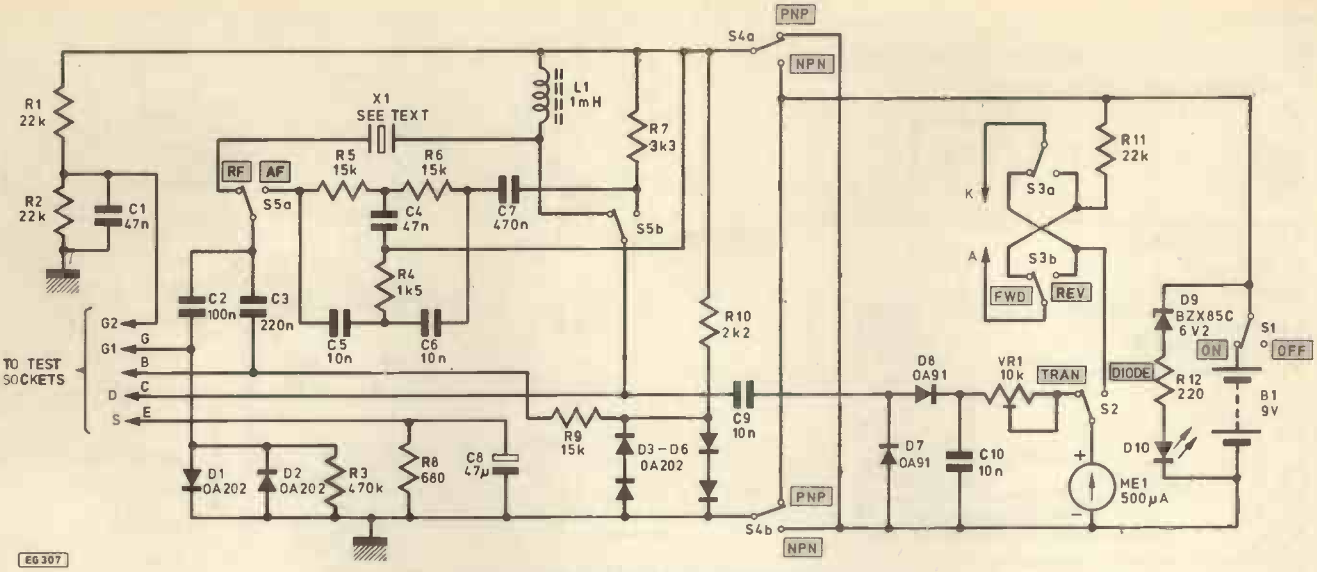


Fig. 2. Circuit diagram of the Tester.

C, B, E, G, S, G1, G2 and D. The layout and wiring diagrams of the front panel components is shown in Fig. 5. In order to simplify the task for those constructors who prefer to manufacture their own printed circuit boards, the main printed circuit and the semiconductor mounting board have been designed so that they may be etched as one board and then cut into two.

INITIAL CHECKS AND USING THE SEMICONDUCTOR TESTER

Carefully check the p.c.b. and wiring before connecting the supply. Connect a known silicon diode, such as a 1N4001, 1N4002 etc, to the diode test sockets. Make sure that the cathode, marked with a stripe, is connected to the socket marked 'k'. Use the front panel switches to select 'DIODE', 'REV' and switch the tester 'ON'. The l.e.d. should be illuminated and there should be no discernible reading on the meter. Now select 'FWD', a reading of between 400 and 500 should appear on the meter. If this is not the case recheck the wiring. When testing an unknown diode, if the 'FWD' and 'REV' readings are the same then the diode is short circuit. If no reading is obtained in either direction the diode is open circuit. The 'REV' setting may be used to check leakage current. It is also possible to select matched pairs of diodes by comparing the 'FWD' and 'REV' indications.

Zener diodes of less than 9V rating will produce a large reading in the 'FWD' direction (as for a normal silicon diode) and a smaller reading in the 'REV' position. The larger the reading in the 'REV' position the smaller the Zener voltage. A rough estimate of the Zener voltage is thus possible if reference can be made to known Zener diodes. Light emitting diodes can also be checked using the diode test sockets in the normal way. However, since the forward current supplied by the tester is low, they will not illuminate brightly.

Insert a known silicon n.p.n. general purpose transistor. An unused BC107, BC108 or BC109 is recommended for this purpose. The TO18 3-lead bipolar transistor socket should be used in this case. Take care to align the transistor correctly. The tab indicates the emitter connection on the recommended types. Select 'TRANSISTOR', 'NPN', and 'AF' using the front panel switches. Switch the instrument 'ON' and check that the l.e.d. is illuminated. An indication of between 200 and 400 should be produced on the meter.

COMPONENTS . . .

Resistors

R1, R2, R11	22k (3 off)
R3	470k
R4	1k5
R5, R6, R9	15k (3 off)
R7	3k3
R8	680
R10	2k2
R12	220

All ¼W 5% carbon

Capacitors

C1, C4	47n polyester (2 off)
C2	100n polyester
C3	220n polyester
C5, C6, C9, C10	10n polyester (4 off)
C7	470n polycarbonate
C8	47μ 16V electrolytic

Diodes

D1 to D6	OA202 (6 off)
D7, D8	OA91 (2 off)
D9	BZY85C6V2
D10	TIL209 l.e.d.

Miscellaneous

Transistor sockets; TO5 (1 off), TO18 3 lead (2 off), TO18 4 lead (1 off)
1mm sockets (5 off)
VR1 miniature horizontal skeleton pre-set 10k
Meter 500μA Maplin type "2in PAN"
Miniature toggle switch d.p.d.t. (3 off)
Miniature toggle switch s.p.d.t. (2 off)
L1 1mH miniature radio frequency choke
X1 HC6/U quartz crystal in the range 6MHz to 10MHz (see text)
Case. Vero part number 75-1798K
Snap connector for PP3 type battery
P.c.b.

Constructor's Note

Components and p.c.b. are available from **Howard Associates, 59 Oatlands Avenue, Weybridge, Surrey KT1 9SU.**

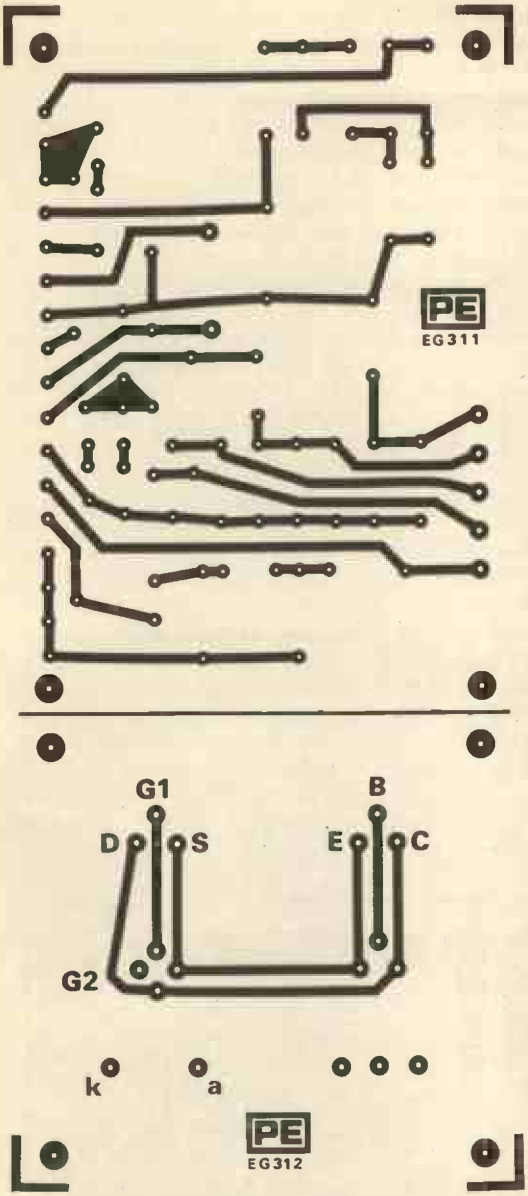


Fig. 3. P.c.b. designs.

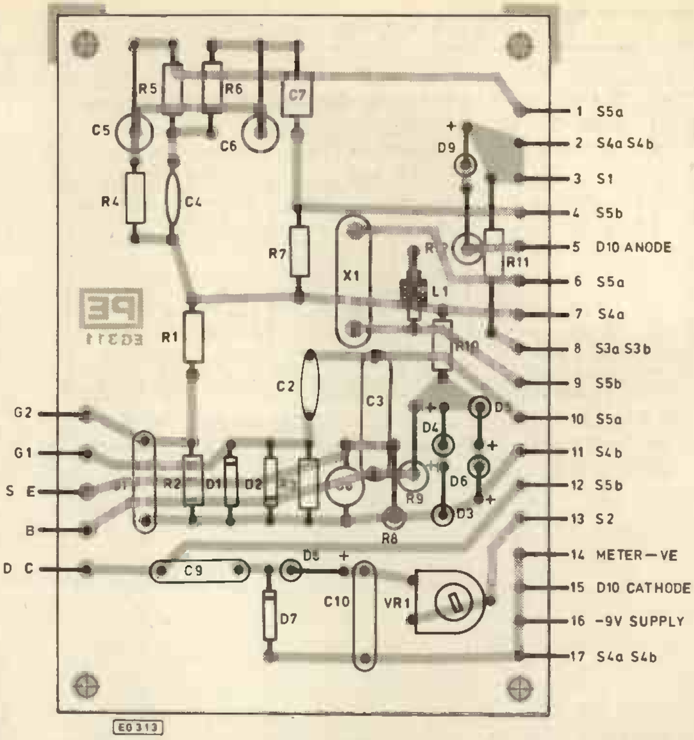


Fig. 4. Component layout of the p.c.b.

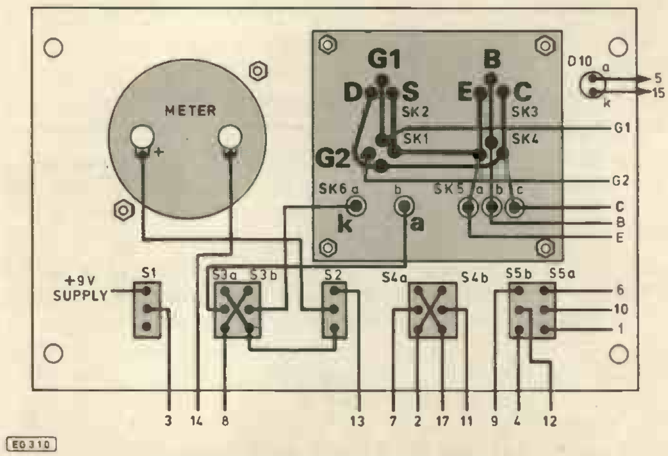
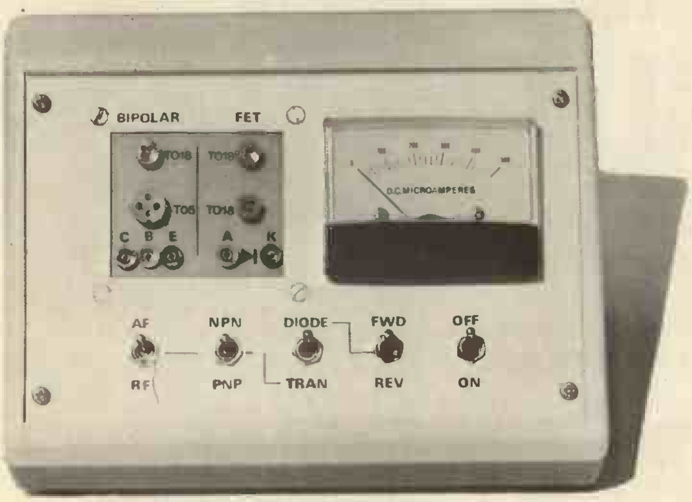
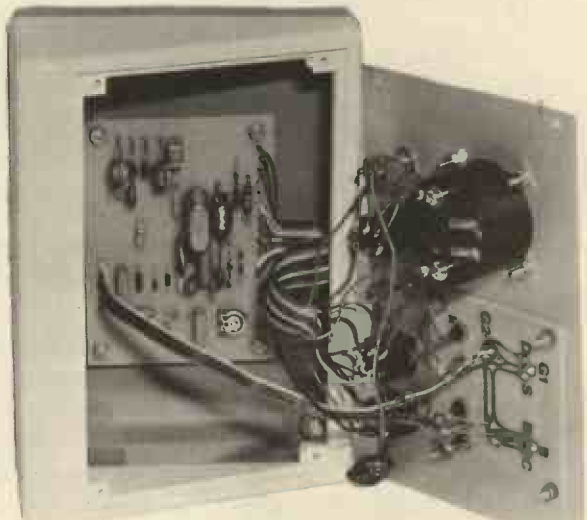


Fig. 5. Front panel wiring diagram.



Front panel layout.



Internal view of the Tester.

READING ON 'RF' TEST	READING ON 'AF' TEST: None	Low	High
None	Trensistor defective or very low gain	Low gain device for low frequency (eg: audio) use	High gain device for low frequency applications
Low	Low gain switching transistor	Low gain device suitable for use over a wide frequency range	High gain device for audio use
High	Transistor for linear high frequency applications	Transistor for r.f. use and high speed switching	High gain device suitable for use at audio and radio frequency

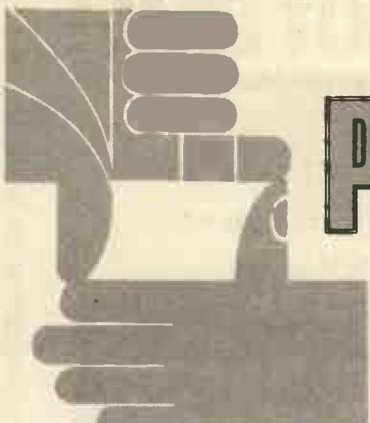
TABLE 1 provides a simple rule-of-thumb method for identifying unmarked transistors but exceptions may well be found.

Now select 'RF' operation and again check that a reading is produced. This may be slightly larger than that produced in the 'AF' position and should be between 300 and 500 on the meter scale. If either reading is excessive, VR1 may be adjusted accordingly to produce a suitable reading of around 400 on the meter. Note that the reading on the meter gives only a relative indication. It does not indicate current or voltage gain directly. If one of the recommended types of transistor is used and fails to give an indication on one or both test positions the p.c.b. and wiring should be carefully re-checked.

Matched pairs of transistors can readily be selected by comparing readings in the 'AF' position. Where an unmarked transistor is to be tested it is recommended that the junctions first be identified using the diode test sockets. Transistor testing can then follow once the connections and polarity of the device have been established.

The f.e.t. testing facility can similarly be checked using a known device. A 40673 or similar type will be satisfactory and found to be representative of most dual-gate devices. A 2N3819 is recommended for use as a test specimen of junction gate types. Select the appropriate 4-lead or 3-lead sockets for dual gate and single gate types respectively. Use the 'NPN' setting for n-channel devices and the 'PNP' setting for p-channel devices. F.e.t.s designed specifically for high frequency applications, particularly junction types, may fail to give an indication in the 'AF' test position. This is because a voltage gain of 30 or more is required to produce oscillation in the 'AF' test position. If the f.e.t. has a low value of mutual conductance this value of voltage gain will not be achieved using the value of collector load provided in the test circuit.

Occasionally, when testing an unknown bipolar transistor, no indication is produced in one or other position of the 'AF'/'RF' selector. This does not necessarily mean that the device is defective. It simply means that the transistor exhibits a very low value of current gain. Older germanium transistors often have current gains of less than 50 and will fail to produce an indication. Modern silicon types will nearly always produce an indication at one or both of the test frequencies. Switching transistors with relatively low values of current gain coupled with good frequency response may sometimes fail to produce an indication in the 'AF' position and yet produce a large reading in the 'RF' position. This effect can be quite useful when trying to identify unmarked transistors as shown in Table 1. ★



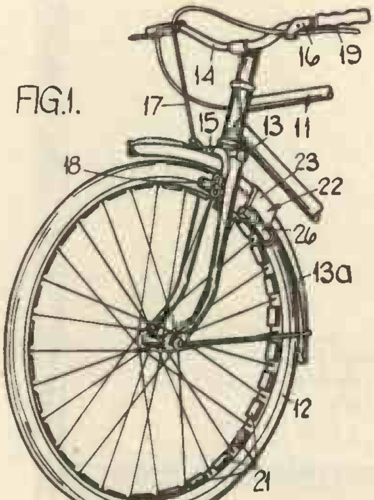
PATENTS REVIEW...

Copies of Patents can be obtained from :
the Patent Office Sales, St. Mary Cray, Orpington, Kent   Price 95p each

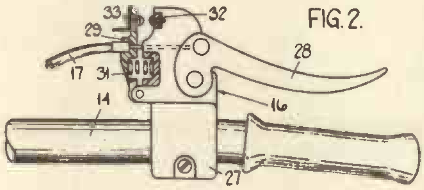
ELECTRIC BICYCLE

The British company Lucas, of Birmingham, has been granted a string of patents over recent years for electric bicycles. The basic idea is to provide a bicycle with batteries built into the frame which can be pre-charged overnight and topped up during downhill or with-the-wind travel by a small generator. During difficult travel, for instance up hill or against the wind, the batteries can be discharged through a motor to assist the cyclist. Most of the Lucas patents now issuing relate to detailed improvements on the basic system so it is likely that before long an electric bicycle will be offered for sale. Moreover at least one Japanese company (Matsushita) also has a similar cycle under advanced development.

It is widely believed that the delay in commercial launch stems only partly from the expense of suitable batteries, because it is feared that under current legislation such cycles might fall foul of a punitive road tax. Commercial launch may therefore coincide with the promised end to vehicle road tax.



The latest Lucas patent (BP 1 554 161, issued under the old laws) proposes a novel approach to combined braking and power generation. As shown in Figure 1 the bicycle wheel rim is of conventional shape but carries a series of permanent magnets 21. A generator stator 22 is secured on the front wheel frame fork and carries a series winding 26 which is connected to the bicycle battery by a full-wave rectifier. This connection is via a normally open charge switch which is incorporated in the handlebar brake control. When the switch is closed the rotating magnets generate AC in the winding 26 to charge the battery, while at the same time producing a braking effect due to increased magnetic drag.



The brake control has a two stage action as shown in Figure 2. In the first stage, only the charge switch is closed to slow the bike and top up the battery charge. In the second stage, a conventional caliper brake functions in well known manner to provide extra mechanical braking. The idea is of course for the cyclist to use only the first braking stage wherever possible and so conserve energy. The second stage brake is only used in an emergency, where magnetic braking is insufficient.

MORE ON MULTIPLEX

It seems hardly credible that there is anything new left to patent in the design of multiplex stereo radio decoders. But Philips of Eindhoven in new British patent application 2 021 361 (filed under the new laws and dating back to 17 May 1978) lays claim to novelty in a modified circuit. It is interesting to note that Philips cite the new modification as applicable to the Technics ST8080 receiver manufactured by Matsushita of Japan. Although Matsushita and Philips are known to have some joint development projects e.g. on transistor technology, the patent suggests the possibility of unsung cooperation in other areas such as hi fi receiver designs.

In a stereo receiver the pilot tone (at 19KHz) must be rejected or it will confuse the automatic gain control (and any Dolby circuitry). Moreover any unwanted components which originate from the multiplex stereo signal may influence the frequency of the phase locked oscillator used for decoding.

Figure 1 shows the modified circuit layout. FM discriminator 4 outputs a composite of the multiplex stereo signal and pilot tone components.

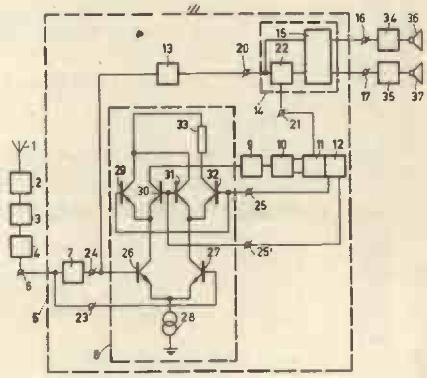


Fig.1

Decoder 5 includes pilot rejection filter 7, synchronous detector 22 and matrix 15 for separating the left and right channel signals L,R for amplification at 34, 35 and reproduction by loudspeakers 36,37. Decoder 5 includes a phase-locked oscillator 10 which produces a 76KHz signal. This is halved and fed to one input of demultiplexer 14. The oscillator phase is locked by double-balanced phase detector circuit 8 which includes a differential amplifier 26, 27, 28. A first input of the differential amplifier is coupled directly to the stereo decoder and the second input is coupled to the output of pilot tone rejection filter 7. The composite signal including the 19KHz pilot tone is thus applied to one input of the differential amplifier and the composite signal without the 19KHz pilot is applied to the second input. The in-phase components of the composite signal which are common to both inputs cancel one another so that only the 19KHz signal component appears at the output. This output is therefore free from any signal components originating from the audio content of the composite signal. The phase locking of the oscillator 10 is thus rendered immune from disturbance by any such residual components.

PE POPULAR PROJECTS...

CONTENTS

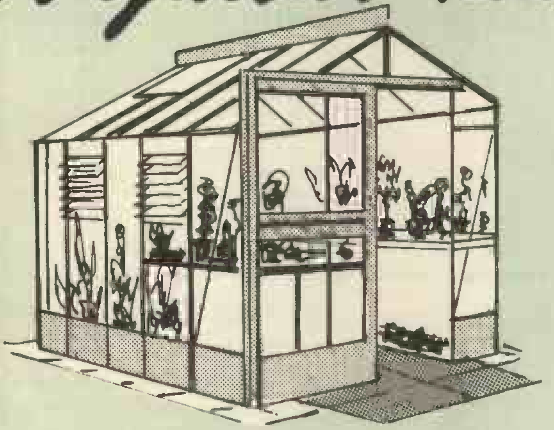
A PRACTICAL ELECTRONICS Publication...

With electronics playing such an important role in every aspect of modern living PE have pleasure in presenting the pick of some of its most popular projects in this 96-page book. Two of these projects are completely new, the remainder are as originally published in PE save for the incorporation of certain desginer approved amendments or corrections.

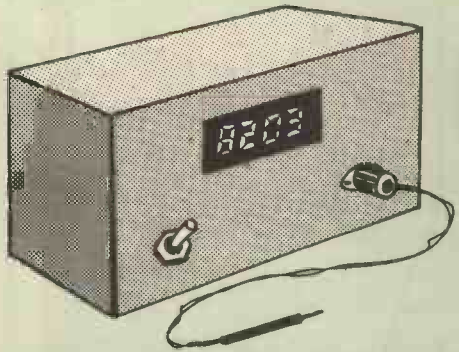
Our new book *PE Popular Projects* is now on sale at newsagents and component stores; the contents of this book are shown above. The book costs £1·25 from retail outlets and is also available for £1·50, UK post paid or £1·80, overseas surface post paid, from Post Sales Department (PE Popular Projects), IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF.

Next Month

MASTERTUNE
for Guitar Tuning



GREENHOUSE TEMPERATURE CONTROLLER



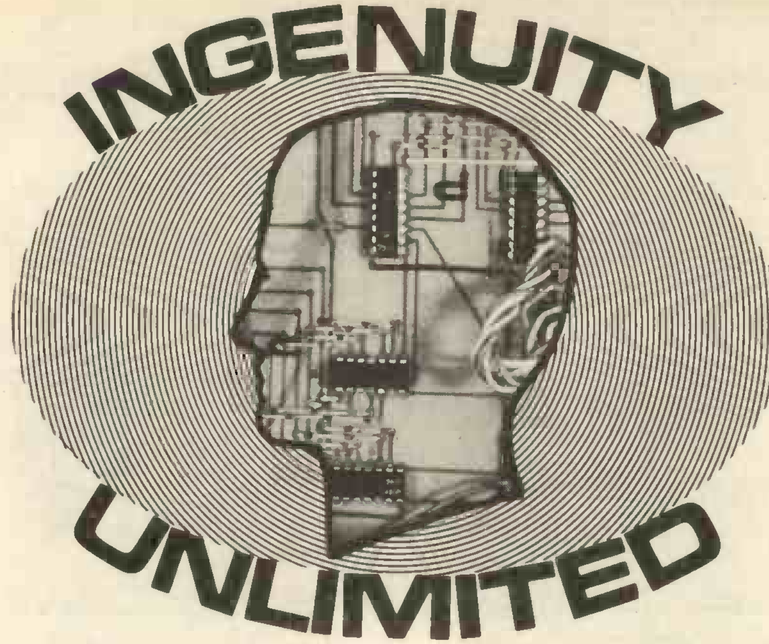
DIGITAL TACHOMETER

Using a reflective opto switch, the r.p.m. of almost any revolving object can be displayed digitally. All that is required is the application of sticky tape to the shaft or wheel to be measured, to act as an optical marker.

Also: BENCH POWER SUPPLY UNIT

PRACTICAL
ELECTRONICS

OUR JUNE ISSUE WILL BE ON SALE FRIDAY, 9 MAY, 1980



A selection of readers' original circuit ideas. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought.

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

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.

Each idea submitted must be accompanied by a declaration to the effect that it is the original work of the undersigned, and that it has not been accepted for publication elsewhere.

RHYTHM GENERATOR FOR MINISONIC

IN view of the cost of rhythm generator i.c.s, synthesiser buffs may be interested in this cheap alternative. Using only three logic i.c.s the circuit produces a sequence of four 'notes' in its basic form.

A low frequency square wave is fed into the clock input (Fig. 1) and the two flip-flops produce complementary outputs at one half and one quarter of the clock frequency. These, together with the clock pulses, are gated as shown to generate a sequence of four pulses A,B,C,D, which then repeat. The functioning of the logic can be readily understood by referring to Fig. 1b.

Each of the output pulses is attenuated to the desired voltage level and fed to the unity-gain inverter, IC4, thus giving the negative-going control voltages necessary for the Minisonic oscillators. The prototype was constructed using TTL but in view of the heavy current requirements and consequent unsettling effects on power supplies, it may be advantageous to replace the above chips with the corresponding CMOS equivalents. A suitable clock is shown in Fig. 2; it is a quite ordinary astable multivibrator (TR1 and TR2), TR3 buffering the output, with the advantage that the mark and space lengths of the output waveform are individually controlled by VR1 and VR2. BC548s are plastic BC108s—about the cheapest transistor on the market.

The output voltage may also be used to control the centre frequency of the Minisonic filter which, when fed with white noise, will produce a wide range of interesting effects. With added envelope shaping of each output pulse, realistic drum sounds can be produced.

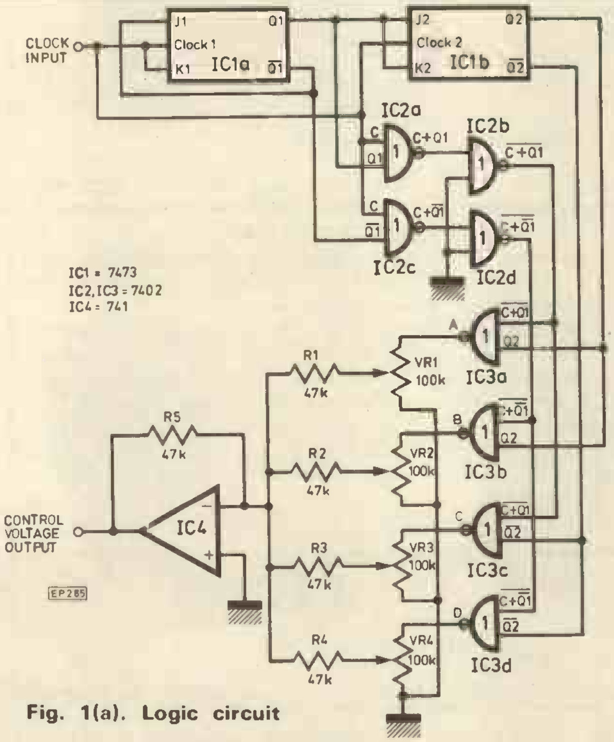


Fig. 1(a). Logic circuit

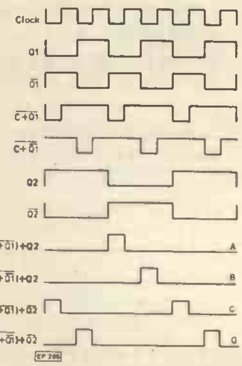
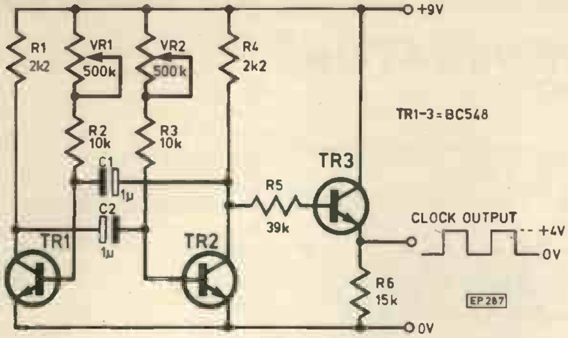


Fig. 1(b). Timing diagram

Fig. 3 shows the circuit used for triggering the Minisonic Envelope Shapers. The monostable on the input allows the envelope shaper to complete its excursion before the end of each control pulse from the rhythm generator, thus, in use, the monostable period plus the ES decay period should be less than the "mark" period of the clock waveform (see Fig. 4). TR1 in Fig. 3 then just acts as a switch controlled by the monostable output in order to supply the −9V trigger pulses required by the Minisonic Envelope Shaper. Other designs of envelope shaper using positive trigger pulses may be controlled directly from the monostable—both systems are at work in the author's synthesiser.

The versatility may be improved as follows: a multi-way switch can be added so that the reset pins of IC1 are connected to a given output, A,B,C,D. Thus the cycle length is selectable, either one-one-one-, one-two-one-two, one-two-three-one-two-three, or one-two-three-four-etc. A further multi-way switch can be added to change the order of A,B,C,D, so that, for example, a given sequence could be reversed. By suitably gating the clock together with the "gaps" in the output pulse-train, an extra



◀ **Fig. 2 Clock**

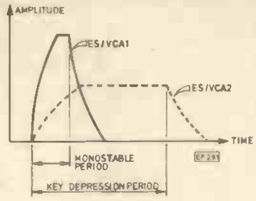


Fig. 6

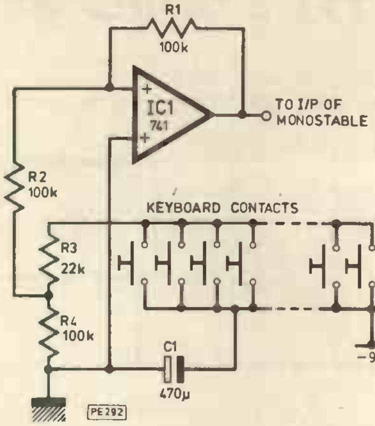
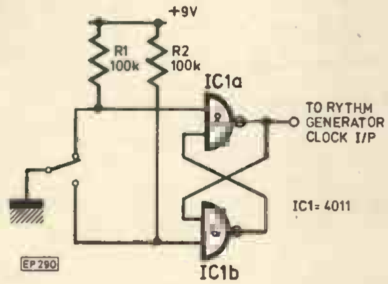


Fig. 7



◀ **Fig. 5**

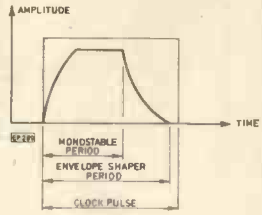


Fig. 4

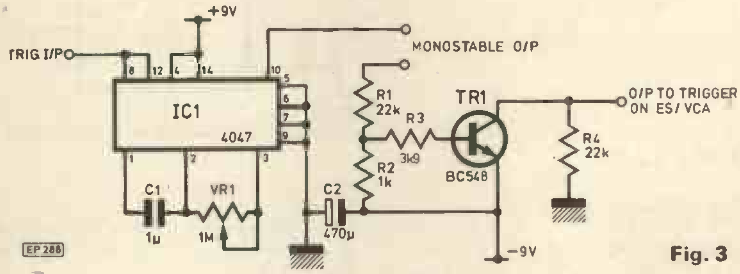


Fig. 3

set of four control voltages can be derived, providing an eight note sequence. In order to tune each note of a sequence, the "stepping" circuit of Fig. 5 may be used, temporarily substituted for the clock.

With the monostable and trigger circuit of Fig 3 attached to ES/VCA1, and using ES/VCA2 in parallel, it is possible to simulate a full Attack-Decay-Sustain-Release envelope, even though the existing envelope shapes are just Attack-Sustain-Release (see Fig. 6). This greatly increases the versatility of the Minisonic as it makes it possible to produce sounds like pianos, harpsichords, trumpets, or any sound which requires a louder portion (or "thump") at the beginning of the envelope. The trick is to feed an oscillator into both VCAs in parallel and set the volume control of the first to give a higher output than the second; the volume control on the second then sets the sustain level. The monostable period should be kept short when simulating conventional instruments, as should the attack and decay times of ES1. The outputs of both VCAs can then be mixed into the filter to complete the sound treatment.

Indeed, if the voltage control envelopes of both shapers can be mixed into the envelope inverter and used to control the VCF, the effect can be quite startling, not least in the field of imitating brass instruments. The sustain time is as long as the key is depressed.

If a two-pole keyboard assembly has been used, providing −9V trigger voltages, the circuit of Fig. 7 can be used to change these to positive voltages to trigger the monostable. The divider chain R3 and R4 is necessary to prevent damage to the 741 from applying too high a voltage to its input. If however the HF Oscillator and Detector circuit has been used in the Minisonic, then the circuit of Fig. 7 is superfluous as the output of IC2 in the HF Detector can be used to trigger the monostable directly.

A. R. Bradford,
Erdington,
Birmingham.

CAR BATTERY CHARGE INDICATOR

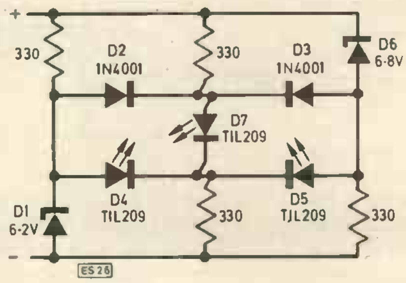
Although numerous circuits for this application have been published, this one is unique in that it provides separate indication of under, over and correct voltage without the use of transistors of i.c.s.

When the voltage is below 11·7 volts, the under voltage l.e.d. (D4) lights. When the voltage is between 11·7 and 14·2 volt, the correct voltage l.e.d. (D7) lights. When over 14·2 volt, the over voltage l.e.d. (D5) lights.

Only one l.e.d. is ever on at a time, and transitions are remarkably sharp.

Average current taken is 50-60 ma. All l.e.d.s must be the same colour, and the two diodes silicon.

A. Dames,
Kings Heath,
Birmingham.



TTL STAIRCASE GENERATOR

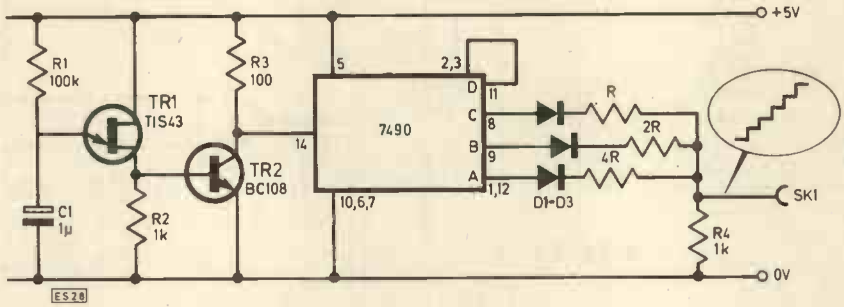


Fig. 1

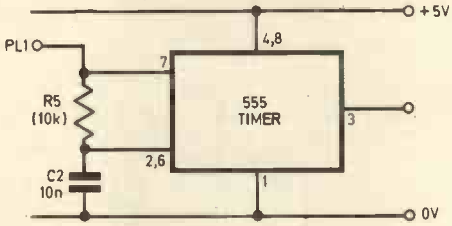


Fig. 2

THIS staircase generator is built around a **TTL** 7490 i.c. (Fig. 1). The frequency is controlled by a standard u.j.t. oscillator followed by a switching transistor to ensure clean pulses are applied to the counter. The frequency is wide up to 100kHz. The binary coded decimal output from the decade counter is used to pass current through resistors 4R, 2R, and R forming the upper arm of a voltage divider. The resistors are in the ratio 4:2:1 to give linear increments but may be altered to provide interesting cyclic effects especially if passed through the oscillator shown below (Fig. 2).

Possible values for these are:

4R = 22k + 18k

2R = 10k + 10k

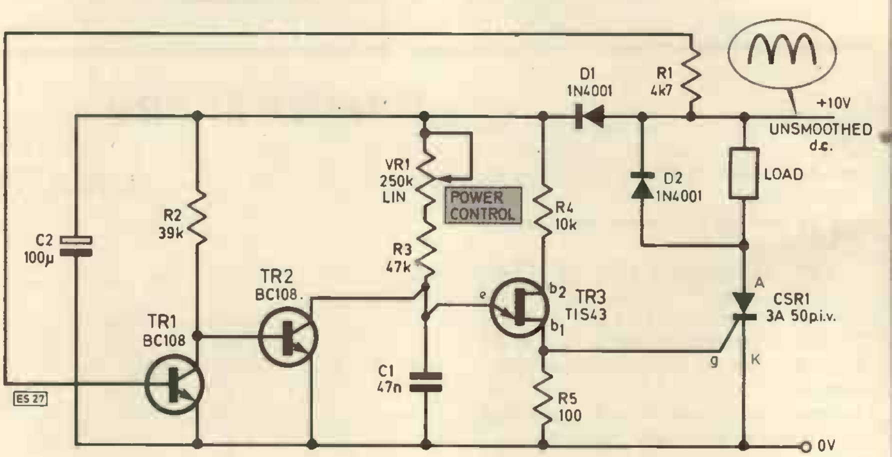
R = 10k

As the lower limb has a fixed value, the output voltage is proportional to the current through these resistors. The number of steps is dependent on the BCD output from the i.c. gives eight steps.

The decade counter, 7490, may be substituted by a 4-bit binary counter 7493 and a full 16 steps made available with the addition of another diode and suitable resistor. The diodes are necessary to any outputs that go low upsetting the voltage of the divider.

B. Bell,
Poole,
Dorset.

SIMPLE D.C. POWER CONTROLLER



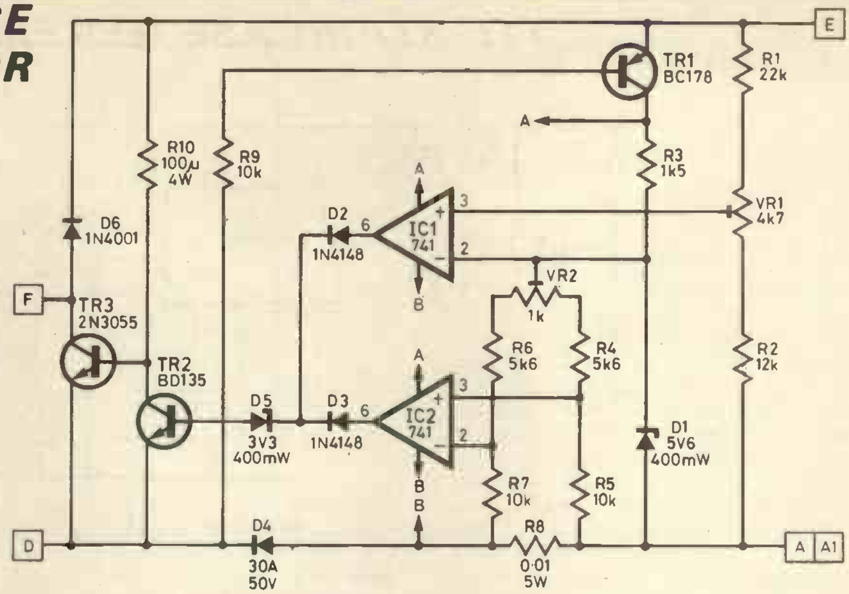
THE circuit consists of a zero voltage detector (TR1 and TR2), a unijunction transistor oscillator and a thyristor for controlling the power to the load from an unsmoothed d.c. power source.

If the supply voltage is above about 1V then TR1 will conduct hard and hence TR2 will be switched off. When the supply voltage falls below 0·7V TR1 will turn off and TR2 will conduct, discharging C1. Hence, at the start of each half cycle C1 will have been discharged through TR2. As the supply voltage starts to rise, TR2 will switch off and C1 will start to charge through R3 and VR1 until the voltage at the emitter of TR3 is sufficient to cause conduction, at which point a pulse will be applied to the gate of CSR1 causing it to conduct. By varying VR1, the point in the mains cycle at which this occurs can be varied from near the end of the half cycle to near the beginning, hence giving phase related triggering of the SCR.

CSR1 is provided with a small heatsink when used at near maximum current. The circuit has been used successfully for controlling low voltage motors and lamps. By charging R1, VR1 and R4 the circuit can readily be adapted for working at different supply voltages.

J. M. Lucas,
Allestree,
Derby.

CURRENT/VOLTAGE REGULATOR



THE circuit shown is for current/voltage control of a car dynamo.

IC1 operates as the voltage regulator, comparing a fraction of the potential across the battery with a reference voltage generated by D1. The output of IC1 controls the current to the field coils of the dynamo via D2, D5, TR2 and TR3.

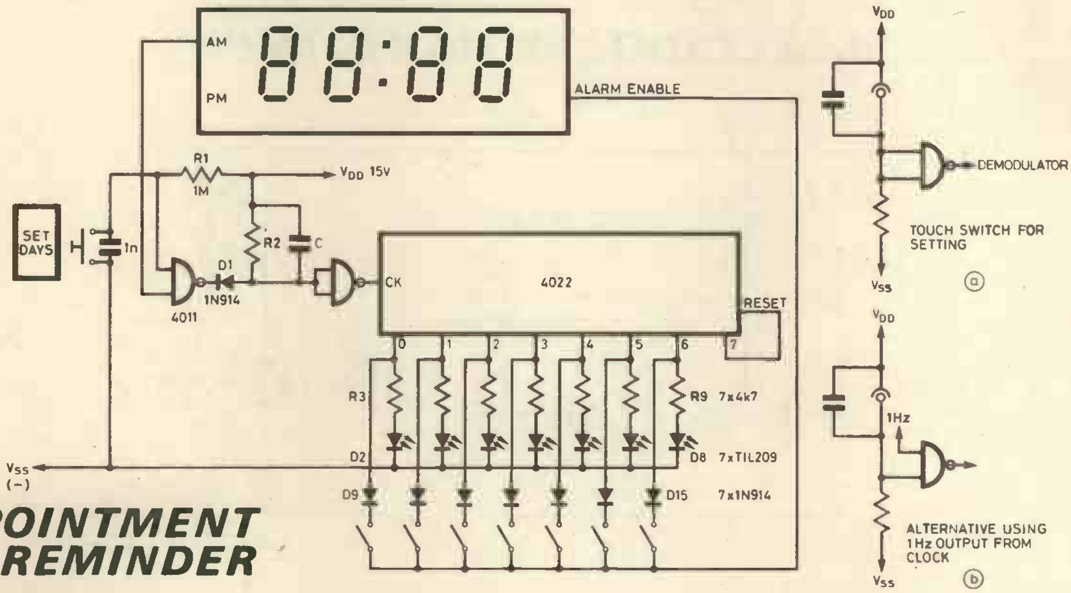
IC2 limits the charging current to prevent overloading of the dynamo. The charging current is sensed by the potential drop across series resistor R8. When this reaches a limit set by VR2, IC2 comes out of negative saturation and reduces the field current by means of D3, D5, TR2 and TR3.

D4 acts as the cut-out, preventing reverse flow of battery current through the dynamo. R9 and TR1 switch on the supply to the regulator when the dynamo output rises above a few volts, thus preventing excessive drain on the car battery when the engine is stationary. The negative saturation output of IC1 and IC2 will be a few volts above the negative line; D5 prevents this voltage from turning on TR2. D6 suppresses any positive-going transients from the field coils which might damage TR3. The circuit shown is suitable for positive earth vehicles.

In the prototype, R8 was wound from 0·7m of 18 s.w.g. enamelled copper wire. This was for a maximum dynamo output of 22 amps, and should be adjusted as necessary for other dynamo current ratings. TR3 and D4 should be mounted on a substantial heat sink. The circuit can be housed in an old regulator casing, the terminals being wired to the circuit as shown. It should be remembered that the negative line carries the full dynamo output and so should be fairly substantial.

VR1 should be adjusted to give an output of 14·2 volts and VR2 adjusted to give the required maximum current.

A. J. Chadwick
Stockport
Cheshire



APPOINTMENT REMINDER

THIS circuit can be added to a digital alarm clock in order to operate the alarm on only selected days of the week, as a reminder of an appointment, or, if used as an alarm clock, it can be silenced on Saturday or Sunday—or both! In addition, the day of the week is indicated by whichever l.e.d. is lit. As many clocks have a pulsating output on AM or PM indicators, a demodulator is included in the circuit.

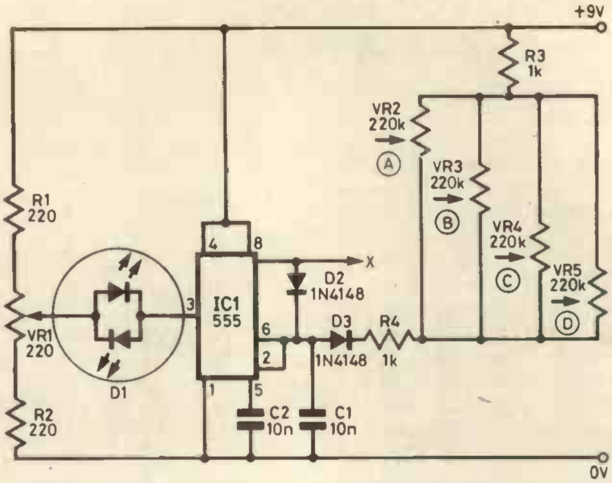
The time constant CR should be longer than the pulse width, to obtain a steady output. If a non-fluctuating output is available on an AM indicator, the demodulator will not be essential (although it does debounce the set switch) and the diode and R and C can be omitted. If the high signal is on PM, the output from the demodulator must be inverted. The 4022 will then be clocked at midnight, either by the AM indicator coming on, or the PM indicator going off. The days are set by pressing the set switch repeatedly until the correct day is indicated. Setting must be done when the AM/PM indicator is high.

On the days selected by closing the appropriate switches, a high is fed to the Alarm Enable input, and the alarm sounds at the time set.

If a high enable signal is not suitable for the clock used, then an inverter might be needed.

A. M. Tucker
Dorchester
Dorset

FOUR STATE INDICATOR



THE circuit shown enables a two-colour l.e.d. to be converted into an indicator capable of showing four states, by four different colours. For those not familiar with a two colour l.e.d., it consists of two l.e.d.s, one red and one green, built into a conventional 0·2in l.e.d. package, the two diodes being connected back to back. This device is not very common, but is available from the larger component suppliers.

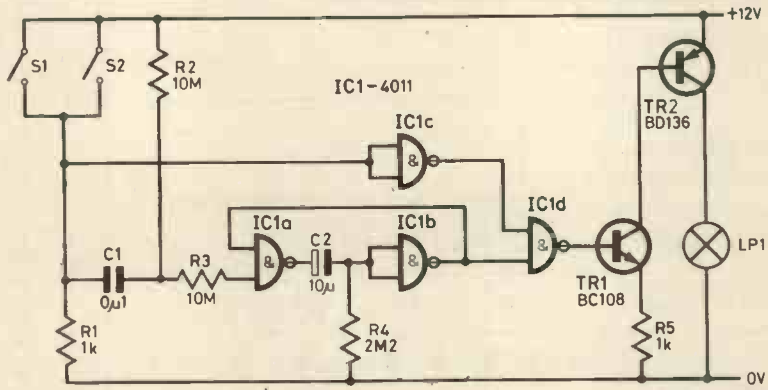
The circuit consists of a variable mark-space oscillator based on a NE555 timer integrated circuit operating at about 300Hz. The timing capacitor C1 charges via the upper half of the preset in circuit, R3, and D2, and discharges through D3, R4, and the lower half of the preset, thus the four presets VR2-5 set the mark-space ratio.

Initially C1 is temporarily replaced by a 2·2μF capacitor, which slows down the oscillator. VR1 is then adjusted so that with one of the four timing presets in circuit, both the red and green l.e.d.s glow with equal brightness. R1 and R2 ensure that D1 is not damaged in this procedure. The correct C1 is then placed in circuit, and each of four timing presets adjusted so that the colours red, orange, yellow and green are obtained when the appropriate point A, B, C, or D is connected to X. The different colours are produced by switching the red and green l.e.d. on alternately in various ratios.

The switching necessary to select one of the colours by connecting A. B. C. or D to X can be performed by either using a four way switch, or a CMOS 4016 quad switch i.c. The circuit does not function very well with supply voltages of less than 7 volts, and if operation over 9 volts is required, R1, R2 and VR1 should be selected so that a maximum current of 20mA flows through D1 in either direction.

V. V. Shah,
Wellingborough,
Northants.

CAR COURTESY LIGHT TIMER



THE diagram shows the circuit of a simple courtesy light timer which will hold the interior light on for approximately 15 seconds after the car doors have been closed. This allows ignition keys and seat belts to be easily found in the dark.

IC1a and IC1b form a monostable whose period is set by R4 and C2, and is triggered when the door switches S1, S2 are opened by closing the car doors. R2, R3 and C1 debounce the signal from the door switches so that the monostable does not trigger when the door is first opened. Operation of the interior light before the monostable has been triggered is ensured by wiring IC1c and IC1d to perform an OR function on the signal from the door switches and the output of the monostable. IC1d drives the interior light LP1 via TR1 and TR2.

The circuit shown is for positive earth vehicles with IC1 being a 4011. For negative earth vehicles IC1 should be a 4001, C2 should be reversed and TR1 and TR2 should be replaced by their complements.

The period of the monostable is given approximately by 0·6 RC but will probably have to be adjusted by altering R4 or C2 because of the tolerance of C2 and the spread of transfer voltage for IC1.

The circuit can be made small enough to fit into the courtesy light housing. The quiescent current is a few microamps.

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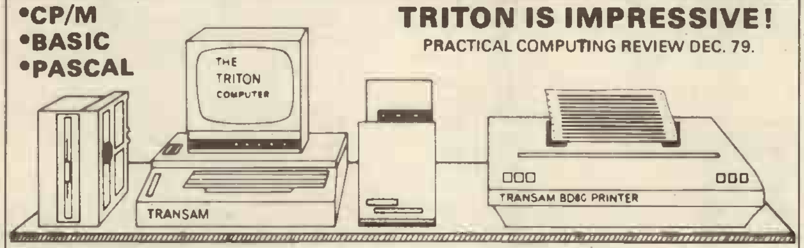

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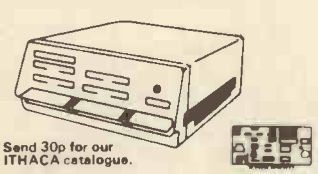

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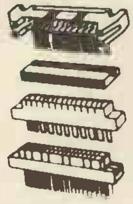

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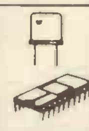

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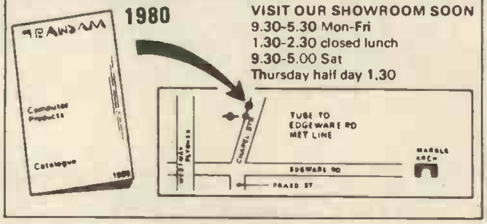

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Strictly Instrumental

by K. Lenton-Smith

Manufacturing concerns face many problems in this era of rising costs, industrial unrest and highly variable exchange rates. In addition, common sense dictates that they should only make what they can reasonably hope to sell: those in the electronic music field, whether manufacturing or providing components, are no exception. Expediency must therefore be one of the main considerations when deciding what to offer to the public. Perhaps the finished article is not quite what the makers had intended originally but, though understandable, compromises do not suit all prospective purchasers.

CASEWORK

The design of today's electric guitar is often ugly and decidedly gaudy, possibly to match the shrieks they are made to produce in public performance (groups have been known to destroy their guitars on stage!). In this instance, the ferocious and jagged shapes available are largely in keeping with their purpose as most purchasers probably aspire to group fame.

Organs, rather than the more functional synthesiser, are mostly destined for the home performer whose instrument will become part of the furniture—in every sense. I do not feel that the mass of multi-coloured controls, looking like something from a space-age comic, are necessary or desirable. Colour coded stop tabs (White for Flutes, Red for Reeds and Yellow for Strings) have been a standard for a long time and are totally sensible, but every additional gimmick seems to have yet another colour devoted to its control button. The end result might be better used as a CTV test transmission card than as furniture to grace a living room. No doubt this trend is a selling point, but I much prefer yesterdays console with its sober black and white controls.

R.U. CHIPS

Most of these perform well when producing Latin-American rhythms, but give them the apparently simple task of a Fox Trot, Quickstep or Waltz pattern and they are highly disappointing. I wonder whether musicians used to these devices are ever consulted at the design stage: more often than not, as the pulses are divided down into small increments—perhaps even demi-semiquavers—the designer tries to put too much into these simple patterns and the result is even more boring and repetitive-sounding than ever. Rather than set down my objections by means of musical notation, I would suggest that the M252 and M253 chips are typical in this respect.

A simple Fox Trot pattern would be preferable, for example, as it is quite easy for a player to get off the downbeat accidentally and so make the 'twiddles' in the second bar sound worse than ever. The various instruments—damped Twin-T oscillators that can be built round a gate—are simple to build: what would be useful is an updated version of a programmable unit (P.E. published just such a circuit some years ago) that would allow the user to set it up exactly as required.

YEARS AHEAD?

Philips unveiled the TDA1008 in 1978, this divider-keyer being covered by your reporter in this column at the time. Up to that date, the AY-1-0212 had been the standard TOS for polyphonic instruments, but this device from Philips required an input frequency of some 4MHz to enable it to be used to the full. One of the AY-3 series of Top Octave Synthesisers became necessary instead but readers' letters have highlighted a problem here. General Instrument Microelectronics make the AY-1-0212, which is easy to obtain, but buying their AY-3-0214 (and 0215/0216) is next to impossible. Clearly Philips will not sell many sets of TDA1008s if the matching TOS is unavailable: perhaps this company could persuade is stockists to hold the AY-3 series on their shelves, or better still produce their own TOS to match the TDA1008. All this could revolve round the expediency problem mentioned previously.

LEFT BEHIND?

Many beginners' instruments feature one-finger chords which may be pulsed through a lower manual gate fed from a rhythm unit. Fortunately, this facility can be cancelled as one-finger chords impose serious musical restraints and teach you very little. I agree that for the raw beginner they help in getting him off the ground but, assuming he is keen to progress, he will soon find the limited number of chords inadequate. For example, the 120 bass accordeon actually has 48 chords and 24 bass/counter-bass notes (the remaining buttons being duplicates) which is far in excess of the average organ or chord organ. Having to work out a chord in full demands more thought than finding a single button or key but the result will be superior and it doesn't take long to remember the more commonly used chords.

Without applying special attack/decay characteristics, the electronic keyboard will sound as long as a note is held. Playing a piano score is therefore inappropriate as the piano has its own characteristics. If Chord Symbols are printed on the score, the left hand (and pedal, if appropriate) parts can be assembled from these.

CHORD SYMBOLS

The brief details that follow may help in finding chords from scratch, but first it is necessary to be able to play a *major* scale in any key: the various key signatures can be found in most piano beginner's books. Take the key of C, for example: counting from the keynote (C), D is the second note, F the fourth and G the fifth. These are intervals which, for this purpose, we can call 2, 4 and 5 in this or any other major scale. To form any of the chords below, count the interval shown (flattening or sharpening by a semitone if b or # indicated)

Typical Symbol	Chord	Intervals			
C	Major	1	3	5	
Cm	Minor	1	3b	5	
C7	Dominant Seventh	1	3	5	7b
Cdim	Diminished	1	3b	5b	6
C+	Augmened	1	3	5#	
Cm7	Minor Seventh	1	3b	5	7b
Cm6	Minor Sixth	1	3b	5	6
Cmaj7	Major Seventh	1	3	5	7

The actual notes found can be re-arranged in any order (by inversion) but it is best to try to fit these into a fairly small left hand compass—say from E below middle C to G above it. This will allow the left hand to remain in one area, the fingers making the changes: at 8′ pitch using this small keyboard area prevents chords from sounding muddy or competing with the melody line. Needless to say, the harmony found from the Chord Symbols can be used to expand the right hand melody into block chords. Though these hints may seem out of place in P.E., I do know of the difficulties that both purchasers and constructors encounter with piano scores. You can have fun with a simple 'Buskers Book' showing only melody and Chord Symbols, expanding as explained above. For a pedal part, simply use the keynote (1) and perhaps alternate on the fifth.

WORTH IT

Yes—it takes a little concentration, but if the reader has bought an expensive instrument it will pay to exploit its capabilities to the full: specifically arranged music is not always available. Light music is often written in keys that suit transposing instruments (Bb and Eb wind instruments), so the number of chords involved in music of this type tends to be fairly limited.

The reader who has had the tenacity to design and build his own instrument should not stop at that point! Learning to play is simply an extension of the project. Or is it? I find it sad that many constructors never learn to play the instrument that has taken so long to perfect.

2 WIRE TRAIN CONTROLLER

J. MILNE

PART 2

THIS final part deals with construction of the oscillator and amplifier board, power supply and receiver. Testing and setting up is also covered.

CONSTRUCTION

The signal levels in the osc./amplifier circuit are high, and significant interference is unlikely between the channels. A suitable circuit board, and the component layout is shown in Fig. 13.

First fix into position the eleven links. These are all low current, so 26 s.w.g. p.v.c. covered is suitable.

Fix into place the 45 resistors, 13 preset potentiometers, and 34 capacitors, noting the polarity of C52.

The voltage regulator IC20 has a heat sink identical to that used for IC13 on the logic board and is fitted in a similar way.

Next fit the transistors, TR2, to TR9, noting that the f.e.t.s are not all fitted the same way round.

D.i.l. sockets are optional for IC14 to IC18, but should not be used for IC19. On this device, the three centre pins on each side form the heat path to the circuit board and should be soldered directly to it. Finally, fix into place the four diodes.

TESTING

Connect the board positive and negative terminals to a variable power supply. Slowly increase the voltage, checking the regulator output voltage to ensure it stabilises at about 12V, when the input voltage exceeds 14V. With the input voltage at 18V, the current supply should be about 35mA.

Check the 6V rail voltage, at C52 positive connection, and that pin 6 on IC14 to IC18 are at the same voltage. The output, pin 8 on IC19, should be at half supply voltage, that is about 9V.

For the next stage, attach temporary connections to the four logic circuit inputs, the 6V rail, and negative rail. Connect an a.c. millivoltmeter or similar instrument to IC18 output, pin 6. Check that all the frequency adjusting potentiometers are at mid travel. With the d.c. test supply on, connect all the inputs to the 6V rail and check that IC18 output voltage is low, that is, not exceeding about 20mV r.m.s. Disconnect each input in turn and connect it to the negative rail. This allows the output from one of the oscillators to be amplified by IC18. Adjust the appropriate oscillator amplitude control potentiometer (VR13 to VR16) so that IC18 output voltage is 1·5V when the oscillator voltage should be about 1·0V.

After adjusting the fourth oscillator voltage, check IC19 output, at pin 8, and adjust VR17 to give about 800mV. All the above a.c. voltages are r.m.s. values.

POWER SUPPLIES

The rail supply transformer T1 should have a generous rating. This is necessary because of the high instantaneous current, when all the locomotives are moving in the same direction. This effect is more noticeable when they are all being moved at low speed, and all the triacs are switching on for the same short period in the supply cycle. This causes an appreciable instantaneous drop in the rail voltage, resulting in unwanted speed variations. The 55VA transformer used in both of the prototype controllers appears adequate for a small layout, where it is not possible to run the four locomotives simultaneously. The transformer secondary voltage should not exceed 20V, or the rating of components in the receivers will be exceeded.

There is some latitude in the choice of the power supply transformer T2. The circuits require a maximum current of 300mA, at 16V to 20V, the absolute limits being 14V and 22V. The transformer secondary winding can be 12V or 14V, and rated for 500mA minimum.

I tried for a long time to get a reliable square wave representation of the supply voltage, using the rail supply transformer as the source. However, mainly because of locomotive motor noise, and a small but significant phaseshift in the secondary voltage between the loaded, and unloaded states, this failed miserably. The use of a separate transformer overcame this problem. The transformer T3 has a load of about 20mA, and the secondary voltage can be from 18V to 24V, which should be rated for at least 30mA.

A choke L1, in series with the rail supply transformer, limits the loss of control signals. In the original version I used a redundant loudspeaker crossover choke, which worked quite well. To make a suitable choke, wind 120 turns of 24 s.w.g. enamelled copper wire on to a 2 in. length of ferrite rod, $\frac{3}{8}$ in. or $\frac{1}{2}$ in. diameter. Wind in three layers over the centre inch of the rod, and secure firmly into place with adhesive p.v.c. tape. With independent control of the locomotives, collisions and derailments become very common until you

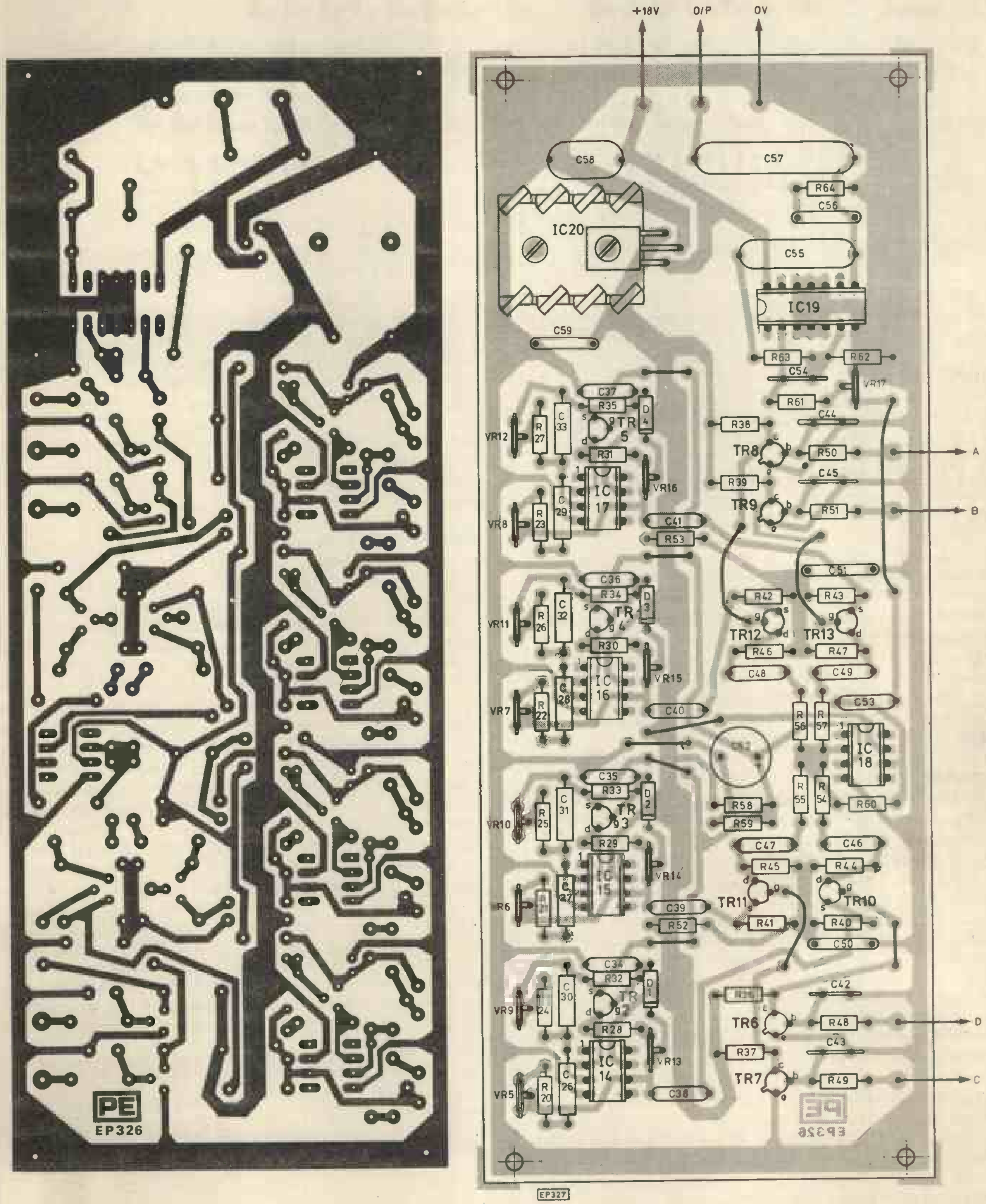
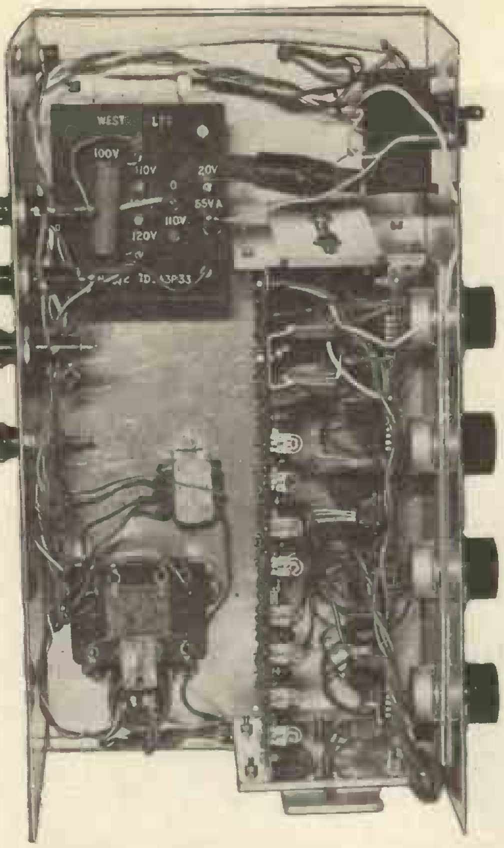
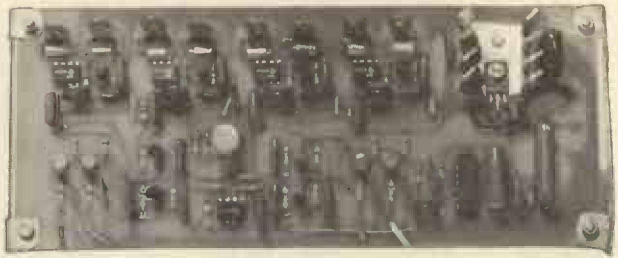
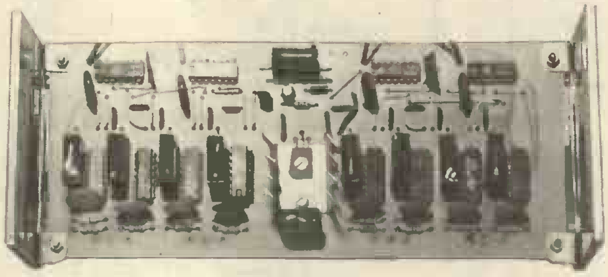


Fig. 13. Oscillator and amplifier p.c.b. and component layout. The lettered inputs are connected to the logic board





Oscillator and amplifier board



Logic board

become used to the controls. It is essential that the rail supply transformer is protected from the effects of these occurrences, but the use of a fuse could become quite expensive. Again, in the original version, I used an old 1A d.c. rail cutout, with a 0·47 resistor connected across the coil to uprate it. In this version an R.S. 2A miniature circuit breaker is used. This is a thermally operated device, and is therefore insensitive to the current peaks that occur in normal use.

It is useful to have some indication that the rail supply is on, and that the circuit breaker has not tripped. This can most easily be provided by a lamp, connected to the rail supply terminals, and is therefore normally illuminated. I used an R.S. 6V subminiature indicator, with a series resistor to drop the voltage at the lamp to about 3V, as it does not need to be very bright.

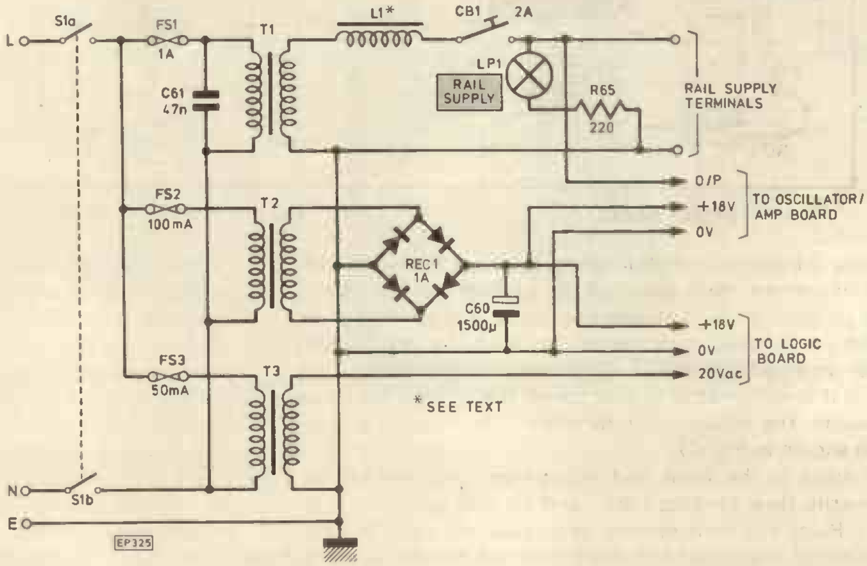
The circuit diagram for the power supplies and interconnections is shown in Fig. 14.

CONSTRUCTION

The physical layout of the boards and power supplies, is not critical, except that the choke L1 should be kept clear of the metal work (Fig. 16).

The securing arrangement used for the boards incolves a little metal work, but it allows any component on the boards to be changed easily. The dimensions for the metal fittings are shown in Fig. 17. If it is not intended to tap the holes, as shown in the end plates, thinner material can be used. The circuit boards are joined together, component side inward, at their ends, using the end brackets and end plates, as in Fig. 15. Bend the tabs on the end brackets at right angles and fit to the boards with the tabs on the component side. The boards can then be fitted to the end plates, with the logic board supply connections opposite the oscillator board

Fig. 14. Power supply board and output connections



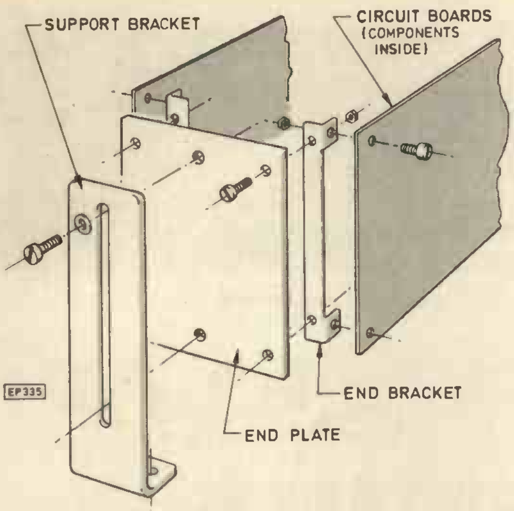


Fig. 15. Method of mounting circuit boards

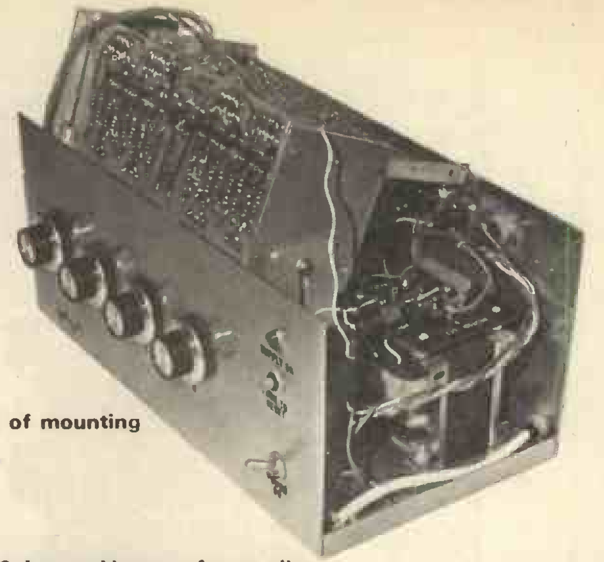
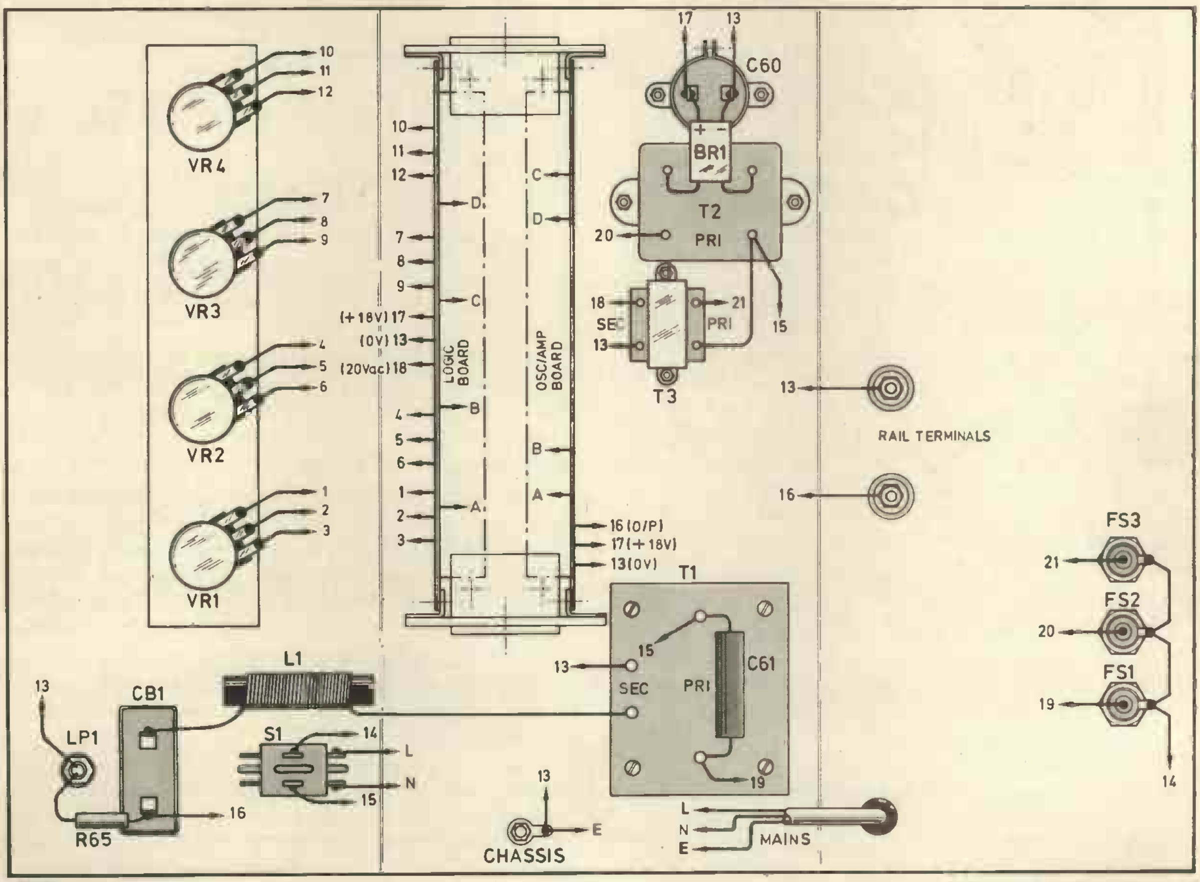


Fig. 16. Internal layout of controller



EP333 **FRONT PANEL** **BASE** **REAR PANEL**

frequency adjusting potentiometers. To save having to drill extra holes in the front panel of the cabinet, for the speed control potentiometer anti-rotation pegs, a mounting plate is fitted inside the front panel, secured by the potentiometer screwed bushes. The potentiometers should be fitted so that when rotated to mid travel, the spindle flat faces downwards. The construction details for the mounting plate are also shown in Fig. 17.

Drill holes in the front and rear panels required for the components (see photographs), and fit into position temporarily. Place the transformers, circuit boards, and C60 into their required positions, and mark the base for the securing screw holes. Also mark the position for the chassis earthing tag screw, and for the rubber feet, if required. Remove all the components and drill the holes. This is now the best time to clean up the chassis, paint or lacquer it, and letter the front and rear panels.

Fix about five inches of flexible wire to each of the speed control potentiometer terminals, and fit to the front panel, together with the mounting plate. When they are in position, check that the spindle flats do face downwards at mid travel. Fix into position the transformers, C60, the rail supply terminals, fuse holders, indicator lamp, circuit breaker, main switch, and the circuit board support brackets. Fit the circuit

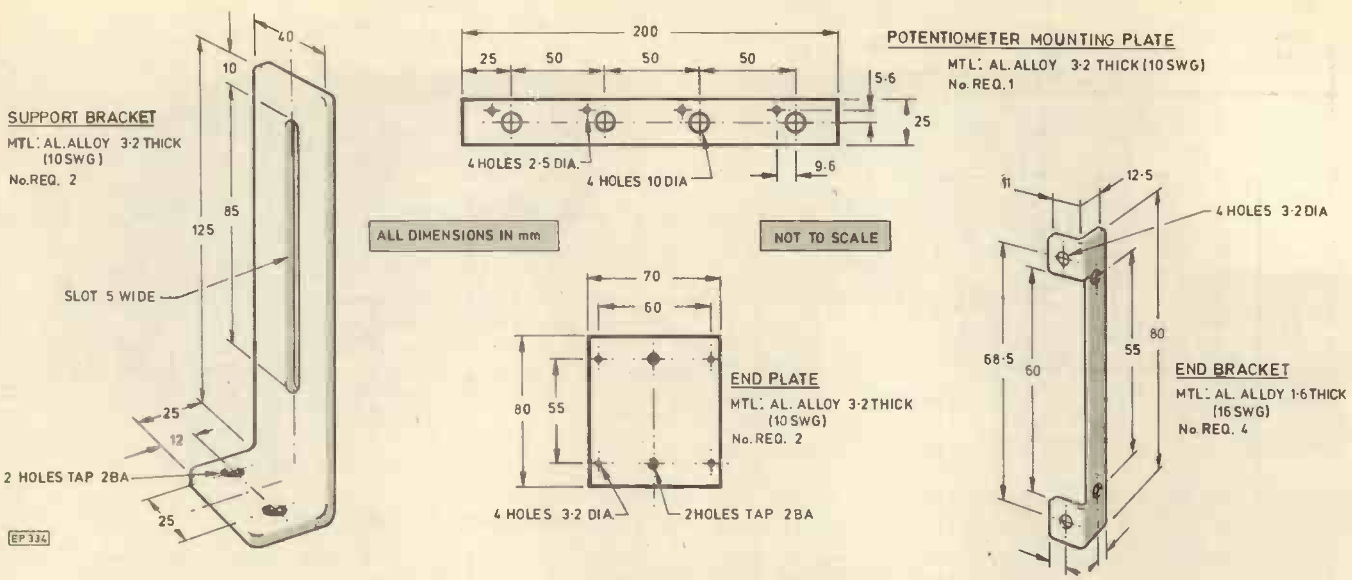


Fig. 17. Bending, cutting and drilling details for brackets and plates

board assembly to the support brackets, using the bottom screws only. The logic board is the nearest to the front panel, and should have its supply connections at the top. Lift the assembly so that the screws are at the top of the bracket slots, and secure. Remove the bottom screws securing the oscillator amplifier board end bracket to the end plates. Slacken the top screws and pivot the board 90° upwards, towards the rear of the chassis, and secure in position. Slacken the support bracket, end plate screws, and pivot the whole assembly about 30° towards the rear of the chassis. It should now be easy to work on the copper side of both boards.

Connect to the logic board the 12 leads from the speed control potentiometers. Connect the 4 leads between the two boards, using flexible wire. Connect the positive and negative supply leads to both boards, and to C60. Connect transformer T3 20V terminal to the logic board connection. Connect the oscillator amplifier board output to the rail side terminal of the circuit breaker. The hole for the mains supply lead should have a grommet fitted before running in the cable. Screw into place the chassis earthing tags and connect the mains supply earth lead to it.

Connect the supply line and neutral leads to the terminals on the main switch S1. From the other side of switch S1, the neutral is connected to one side of each of the transformer primaries, and the line, to the three fuse holders. Connect the output side of the fuse holders to the transformer primary terminals, as shown in Fig. 16, and T13. Capacitor C61 is connected directly to the primary terminals of transformer T1. Run connections from the chassis earthing tag E to C60 negative terminal, transformer T3 secondary 0V terminal, and T1 secondary 0V terminal.

Connect the choke L1 directly between transformer T1 20V terminal and the input terminal on the circiit breaker. Connect R65 to the circuit breaker rail side terminal, and to one of the indicator lamp connections. The other lamp connection can be taken to transformer T1 0V terminal. The rail supply terminals are connected to the circuit breaker, and to transformer T1 0V terminal. The bridge rectifier is connected directly to transformer T2 secondary terminals, and the terminals on C60.

TESTING

Remove the fuse FS1, switch on, and check that the voltage at C60 is between 16V and 20V. Without an oscilloscope, this is the only useful check that can be carried out at this stage.

With an oscilloscope connected to the rail supply terminals, rotate all the speed control potentiometers to their mid positions, and check for zero output. Rotate each of the potentiometers in turn, in both directions, and look for the required pulses of control frequency. Replace fuse FS1, and repeat, looking for the control pulses superimposed on the supply frequency waveform.

To make the final adjustments, the receiver units are required, so this will be covered later.

RECEIVER

The circuit diagram for the receiver is shown in Fig. 19. Connections from the wheel pick up are taken to a choke L1 and a potential divider, R1, R2, at the tuned amplifier input. L1 limits the loss of control signal, but allows supply frequency current to pass to the motor and to the amplifier power supply.

The input stage amplifier IC1 is tuned to its control frequency by a parallel tee circuit in the negative feedback loop.

This resonant circuit exhibits a very high impedance at a specific frequency.

With the circuit connected in the feedback loop, as in Fig. 18, the feedback resistor R6 is effectively shorted out, except at frequencies approaching resonance. At resonance, the amplifier gain is at a maximum and controlled by the ratio of R6 to R3. This type of tuned amplifier was chosen because of its stability and the simple way the frequency is set. It will be noticed from the component list that the components used in the tuned circuit are not exact theoretical values, but the use of the nearest preferred value still gives adequate discrimination between the channels, as was shown in Fig. 3.

RECTIFIED OUTPUT

The output of the tuned amplifier stage is rectified by D5 and D6, reducing the voltage on C8. This voltage is then connected to the second stage, IC2, which is a high input impedance voltage level switch. The circuits work in a very noisy electrical environment, and to reduce the effect of interference the values of C7, C8, and R10 were chosen to

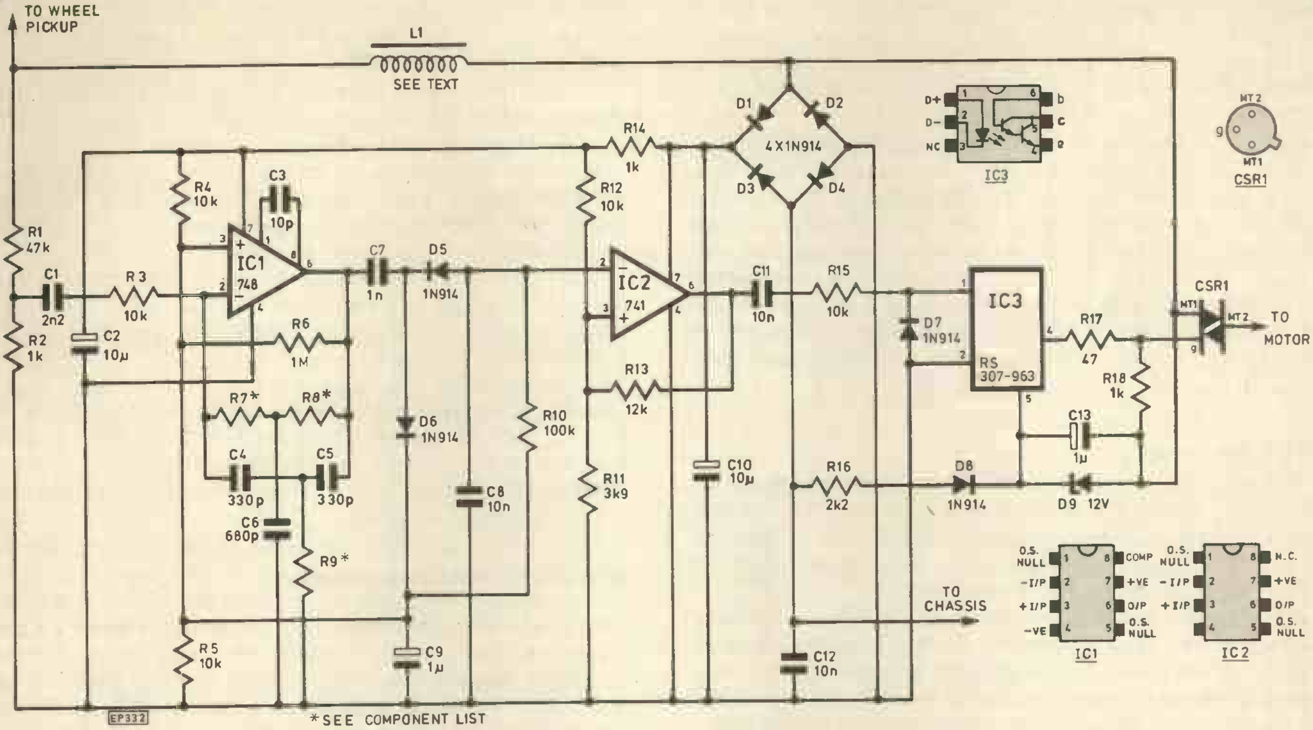


Fig. 18. Receiver circuit

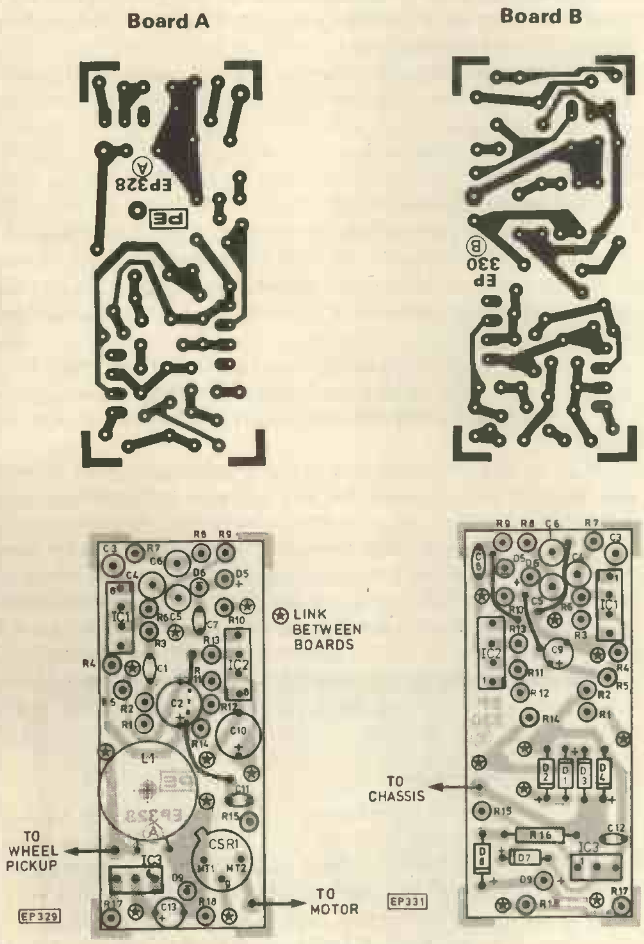


Fig. 19. Receiver p.c.b.s and layouts

Receiver assembly

Receiver easily fits a small truck or tender

cause a delay of about 1·5ms between receiving the control signal and the output of IC2 triggering from the low to the high state.

The output of IC2 is connected to an l.e.d. in the optical isolator IC3, through C11 and R15. D7 protects the l.e.d. from excessive reverse voltage.

C13 is charged to 12V by the connection through R16, and D8, and D1 limits the voltage. The optical isolator l.e.d. will be illuminated briefly when the output of IC2 changes from the low to the high state. Its optically coupled Darlington transistor will then conduct and partially discharge C13 into the gate of the triac. The triac will switch on, and will continue to conduct until its load current falls below the minimum holding value. This normally occurs at zero voltage, or soon after, depending on motor speed and back e.m.f.

CONSTRUCTION

The major problem in this part of the circuit has been one of how to squeeze a quart into a pint pot. The method described here produces a receiver block, 51mm + 23mm + 12mm, which can be hidden away in a tender or goods wagon, if not inside the locomotive itself.

Two circuit boards are used, fixed face to face, like a sandwich, with the components as the filling. The boards, and the arrangement of components is shown in Fig.19. It should be noted that in the positions for resistors R7, R8 and R9 the holes are slotted out to the edge of the board, with a small file, to allow these resistors to be changed relatively easily.

The choke L1 has been difficult. Its target inductance is 1 to 2mH; it should conduct the motor peak load current of over 1A without saturating; it should be relatively unaffected by metal close by, and it should be very small. The compromise solution has been to use a pot core with a very large air gap.

CHOKE ASSEMBLY

In the original unit the now obsolete FX1011 was used, but the current FX2236 has been used in the same way, with similar results. The outer rim of the cores is carefully broken away using small side cutters, a small piece at a time as they are very brittle, and any rough edges cleaned up with a piece of abrasive paper. The two halves are then stuck together and held with a screw until set. A piece of 6BA screwed pillar can be filed to fit the centre hole of the pot core, and cut to the length of the hole in the pair, that is, about 9mm. This is then Araldited into position at the same time as the two halves are joined. After the adhesive has set, wind 120 turns of 34s.w.g. enamelled copper wire directly on to the ferrite and secure in place with a strip of adhesive p.v.c. tape.

On board A, fix into position the choke L1, either using adhesive or a screw through the board. It should be noted that there is no space between the top of the pot core and the components on board B for the head of a screw through the centre hole. Fix into position the link shown in Fig. 19, using 26s.w.g. p.v.c. covered wire, or similar. Also fit C1, C2, C7, C10, C11 and C13, fixing as close to the board as possible, and vertical to it. Locate and fix the triac CSR1, leaving a gap of about 1mm between the base of the case and the board.

On board B, fix the three links, following the paths shown in Fig. 19. Locate and fix R16, C8, C9, D1, D2, D3, D4, D7 and D8. On both boards, all the components have very short leads, so soldering should be carried out as quickly as possible to prevent damage. The diodes, in particular, should be checked with a test meter after soldering, to ensure they have survived.

MATING THE BOARDS

Fit the two boards together, face to face, checking that there is clearance between the capacitors, and adjusting their position slightly if necessary.

It should be possible to fit the boards over each other, with the tops of the mylar capacitors touching the other board. Also check that the top of C7 does not foul the links on board B.

Lay board A, copper side down, on a piece of expanded polystyrene, about one inch thick. Cut 9 pieces of single core insulated copper wire, about 30mm long, and strip the insulation off 10mm, at each end. Push these, one at a time through the holes marked in Fig. 19 for vertical links, and into the polystyrene. Shorten the leads to about 15mm on R1, R2, R3, R4, R5, R6, R10, R11, R12, R13, R14, R15, R17 and R18, and insert into the board. Repeat with C3, C4, C5 and C6, with the outer foil uppermost. Fit D5, D6 and D1, checking the polarity.

On IC1, IC2, and the optoisolator, carefully straighten the pins. Measure the distance across the pin shoulders, and if this exceeds 11mm, carefully file back. Fit IC1, IC2, and the optoisolator into position, noting the positions for pins 8 and 6 respectively.

All the holes in the board should now be filled, except those for R7, R8, R9 and the external connections. Before going any further, check that all the components are in their correct positions, as it is almost impossible to change them later.

The next stage is to drop board B, component side down, over all the loose ends protruding from board A. This operation requires time and patience for all the leads to end up in the right holes. When all is correct, push the boards tightly together, when the tops of the mylar capacitors should contact the opposite board. Adjust the positions of the vertical components so they are about mid way between the boards, solder, and clip off the surplus leads. Turn the boards over and repeat on the other side.

At this stage it is possible to carry out a quick check to see that all is well. Using a 30V d.c. test supply, connect the positive lead to board B chassis connection, and the negative to board A wheel pick up connection, when the current should be about 14mA. Reverse the connections and the current should now be about 7mA. The following voltages can also be checked, with respect to the negative rail, on the boards. C10 29V; C2 24V; IC1 pin 6 12V; IC2 pin 6 2V.

If all appears satisfactory, fit the required values of R7, R8, and R9 by slotting them into the end of the boards and soldering.

To check the amplifier response, if required, connect the test supply as before, either way round. Inject a test signal of about 10mV at R1, R2 junction, when IC1 output should peak at 1V at the tuned frequency and drop rapidly each

Rear panel showing fuses and rail terminals

side. Also check the d.c. voltage at IC2 output, which should switch to the high state when the test signal exceeds about 12mV at the tuned frequency, and fall back to the low state when the injected signal is reduced to about 3mV. All the a.c. voltages referred to are r.m.s. values.

CONNECTIONS

On the locomotive motor, one brush is connected to the motor chassis, and the other connected either to a wheel pick up or to a separate wheeled unit. The latter connection should be broken, and a lead taken from the "live" brush, to board A motor connection, and the one from the pick up to the wheel pickup connection also on board A. The r.f. suppressor capacitor, connected to the live brush, should be left in position.

A lead should also be run from a good connection on the motor chassis, to the chassis connection on board B. All the connecting leads should be very flexible, particularly if they are to run between two wheeled units. If the receiver is housed in a separate truck, the coupling should be modified so that it cannot easily become disconnected and throw the load on to the leads.

FINAL ADJUSTMENTS

Before connecting the transmitter to the rails make sure that there are no r.f. suppressor capacitors on the rail circuit or in the connector. Connect the transmitter to the rails, place the first locomotive on the track, and switch on. Rotate the appropriate speed control potentiometer to a high speed position, and adjust the pair of frequency setting potentiometers (VR5 and VR9 etc) until the locomotive starts to move, keeping them in approximately similar positions. Reduce the speed setting and trim the potentiometers again. Bring the locomotive to a point on the track, close at hand, and reduce the speed setting until there is no movement, but a faint buzz is emitted from the motor, and then make the final adjustments. Repeat this operation with the other three locomotives.

The control signal level should be the minimum to give satisfactory control of all the locomotives. There will be slight variations in the gain in the receiver tuned amplifiers, because of component tolerances and stray capacitance, so the signal level should be just high enough to operate the one with the lowest gain. With all four locomotives on the track, set them to a just perceptible creep. Reduce the signal level, by adjusting VR17, until one locomotive stops, then increase it again, until the locomotive starts to move. This should give about the right signal level for control at all speeds, and check the locomotives in both directions.

Please note that in the Components List under "Receiver Board" R8 value resistors are the same as R7 also R9/D is 12k. In Fig. 10, R64 should be 2·7 ohms.

Countdown

Seminex April 14-18. Dept. Physics, Imperial College, London. **H1**
Communication 80 April 14-18. National Exhibition Centre. **I**
Calibration April 15-17. National Microprocessor and Electronics Centre, London. **L1**
Peripherals April 16–17. Bloomsbury Centre, London. This exhibition is not orientated towards the amateur. **Z1**
Welsh Amateur Mobile Rally April 20. Barry Memorial Hall. **C**
Small part Production April 21–25. Bingley Hall, Birmingham.
IFSSEC 80 21–25 April. Olympia. Fire protection and engineering, security and crime prevention, health and safety at work. **X1**
Electronic Test & Measuring Information April 22-24. Wythenshaw Forum, Manchester. **T**
Labware April 22–24. Westminster Exhibition Centre.
International Conference On The Electronic Office April 22-25. London Penta Hotel.
Mach (International Machine Tool) April 22–May 2. NEC.
North Midlands Mobile Rally April 27. Drayton Manor Park, Tamworth, Staffs. Details: Norman Gutteridge, 68 Max Rd., Quinton, Birmingham
Audio Visual April 28–May 1. Conference Centre, Wembley.
All-Electronics Show April 29-May 1. Grosvenor House, London. **E**
The Mersey Micro Show April 30-May 2. Adelphi Hotel, Liverpool. **O**
Compec Europe May 6-8. Centre International Rogier, Brussels. **L**
Remscon (Remote Supervisory & Control) May 6–8. Mount Royal Hotel, London.
RSGB Amateur Radio Exhibition May 9–10. Alexandra Palace, London.
Hevac (heating and air conditioning) May 19–23. NEC.
International Word Processing (Exhibition and Conference) May 20-23, Wembley Conference Centre. **O**
East Suffolk Wireless Revival May 25. Grounds of Ipswich Area Civil Service Sports Association, Straight Rd., Bucklesham. **V1**
Electronic Hotel June 4–5. West Centre Hotel, London. **Z1**
Satellite Communications (Conference) June 18-19. London Press Centre. **O**
Great British Electronics Bazaar *cancelled*
Intel Fair June 24. Wembley Conference Centre, London. **U**
The Energy Show June 24–26. National Exhibition Centre, (NEC), Birmingham. **Z1**
Tempcon July 1-3. Wembley Conference Centre. Exhibition devoted to temperature control & measurement. **T**
Transducer July 1-3. Wembley Conference Centre. **T**
Microsoftware (symposium) July 7-10 University of Sussex. **S1**
The 1980 Microcomputer Show July 10-12. Royal Lancaster Hotel, London. **O**
BAEC Amateur Electronics Exhibition July 12-19. The Esplanade Shelter, Penarth, near Cardiff, S. Glam. **B**
Computer Graphics (exhibition & conference) Aug. 12-14. Metropole, Birmingham. **O**
Harrogate International Festival of Sound Aug. 16-19 (18 & 19 trade). The Exhibition Centre + hotels. **X**
Edtech Aug. 19–21. Holland Park School, London. **C1**
Laboratory Sept. 9–11 Grosvenor Ho., Park Lane, London. **E**
Intron 80 Sept. 9–11. RDS, Dublin. **V**

B British Amateur Electronics Club, 26 Forrest Road, Penarth, S. Glamorgan.
C Barry College of F.E. Radio Society, College of Further Education, Colcot Rd., Barry, S. Glam. CF6 8YJ
E Evan Steadman. ✆ 0799 22612
I Industrial Trade Fairs. ✆ 021-705 6707
L Iliffe Promotions. ✆ 01-261 8437/8
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U Brian Crank Associates, 58 London Rd., Southborough, Kent. ✆ 0892-31812 38414
V SDL Exhibitions, 68 Fitzwilliam Square, Dublin.
X Exhibition & Conference Services, Claremont Ho., Victoria Ave., Harrogate, Yorks. ✆ 0423-62677
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L1 P. Smith, London World Trade Centre, Europe House, London E1 9AA. ✆ 01-488 2400
S1 Society of Electronic & Radio Technicians, 57-61 Newington Causeway, London SE1 6BL. ✆ 01-403 2351
X1 Victor Green Publications Ltd., 106 Hampstead Rd., London, NW1 2LS. ✆ 01-388 7661
Z1 IPC Exhibitions Ltd., 40 Bowling Green Lane, London EC1R 0NE. ✆ 01-837 3636.

Readout...

A selection from our Postbag

Readers requiring a reply to any letter must include a stamped addressed envelope.
Opinions expressed in Readout are not necessarily endorsed by the publishers of Practical Electronics.

AY3 Availability

Sir,—Referring to the letter of B. D. Arnold in P.E. for March '80 I would like to assure him that General Instrument Microelectronics do still manufacture the AY-3-0214/15/16 top octave generators, and while Semiconductor Specialists (the G.I.M. franchised distributor) does not in general service the amateur market, a number of those companies that do, and advertise regularly in P.E., buy products from us. May I suggest that Mr. Arnold (and others interested) write to his favourite supplier and ask for a price and delivery. Demand does create supply!

Incidentally Mr. Arnold is not quite correct in calling the top octave generators the AY3 series since quite a number of G.I.M's devices are called AY–3–XXXX (from UART's to cooker times) and the "3" only indicates the type of IC construction.

Paul Partridge
Product Marketing Manager
Semiconductor Specialists (U.K.) Ltd.

Congratulations

Sir—I would be grateful if you would pass on to Mr. Ben J. Duncan my congratulations on his excellent feature *PA Loudspeaker Systems* in your March issue. The article answers many of the questions raised by the popular music fraternity.

However, may I point out that Mr. Duncan had been over generous in suggesting that a Vitavox 220S/522 multicellular horn has a horizontal dispersion of 150° by 60° vertical. The manufacturers publish the nominal acoustic distribution as 20° per cell indicating 100° × 40° for the model in question.

H. Warren
Consultant in Electro-Acoustics
Luton

Regrettably I have made it appear as if a general statement about multicells referred specifically to the Vitavox horn illustrated in the article. I must admit though that a horizontal dispersion of 150° is a little generous for most multicellular horns and a figure of 100/150° would be more representative. Incidentally, perplexed rock fans with magnifying glasses will be interested to know that the band on the last page of the article are "The Jam". Another point is that the bullet horns shown on the 4kW Muscle Music stack are in fact from HH rather than JBL.—Ben. J. Duncan

Hard or Soft?

Sir,—My attention has been drawn to a letter in Readout, together with a reply from your contributor Nexus, concerning courses available to students wishing to study Microprocessor Systems. It is worth noting that the intending student does not necessarily have to make a decision at the outset whether to enter an electronics biased or a computing biased course. A few colleges, including this one, offer a course which allows students to study in parallel both the hardware and the software aspects of the subject, and, more important, to appreciate the interaction and the trade-offs between them. In our own Microelectronics and Computing course, students during the first year study foundation courses in both electronics and computing. At the end of the first year, they have the option of continuing with the combined scheme or, if they prefer, specialising in either hardware or systems.

Prof. G. Emery,
Department of Computer Science,
University College of Wales,
Aberystwyth.

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PERFORMANCE MODULAR UNITS

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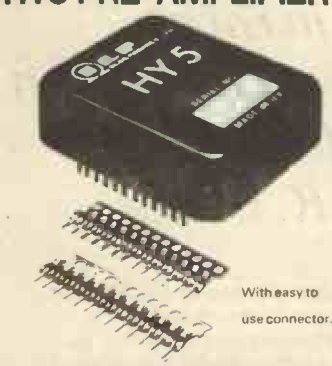

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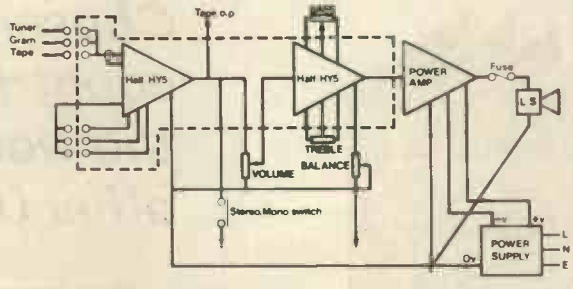

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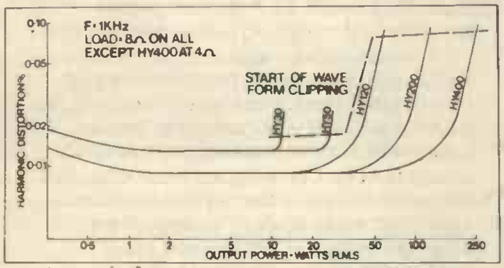

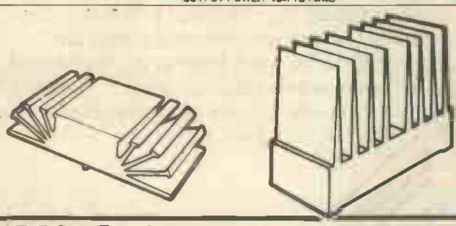

Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
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HY50	30 W into 8 Ω	0.02%	90dB	-25 -0- +25	105x50x25	155	£7.24 + £1.09
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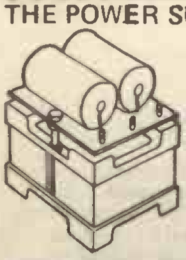

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Ref	Amps	Price	P & P
112	0 5	2·90	0·90
79	1 0	3·93	1·10
3	2 0	6·35	1·10
20	3 0	6·82	1·31
21	4 0	8·79	1·31
51	5 0	10·86	1·52
117	6 0	12·29	1·67
88	8 0	16·45	1·89
89	10 0	18·89	1·89
90	12 0	21·09	2·24
91	15 0	24·18	2·39
92	20·0	32·40	O.A.

50 VOLT RANGE
Pri 220/240V Sec 0-20-25-33-40-50V Voltages available 5, 7, 8, 10, 13, 15, 17, 20, 33, 40 or 20V-0-20V or 25V-0-25V.

Ref	Amps	Price	P & P
102	0 5	3·75	0·90
103	1 0	4·57	1·10
104	2 0	7·88	1·31
105	3·0	9·42	1·52
106	4 0	12·82	1·73
107	6 0	16·37	1·89
118	8 0	22·29	2·39
119	10 0	27·48	O.A.
109	12 0	31·79	O.A.

MAINS ISOLATORS (SCREENED)
PM 120/240 Sec 120/240V CT

Ref	VA	Price	P & P
*07	20	4·84	0·91
149	60	7·37	1·10
150	100	8·38	1·31
151	200	12·28	1·31
152	250	14·61	1 73
153	350	18·07	2·12
154	500	22·52	2·47
155	750	32·03	O.A.
156	1000	40·92	O.A.
157	1500	56·52	O.A.
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All voltages given are at full load

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Ref	Amps	Price	P&P
124	0·5	4·27	1·10
126	1·0	6·50	1·10
127	2·0	8·36	1·31
125	3·0	12·10	1·31
123	4·0	13·77	2·12
40	5·0	17·42	1·89
120	6·0	19·87	2·12
121	8·0	27·92	O.A.
122	10·0	32·51	O.A.
189	12·0	37·47	O.A.

12 OR 24V OR 12-0-12V
Pri 220-240 volts

Ref	Amps 12V	Amps 24V	Price	P&P
111	0 5	0·25	2·42	0·52
213	1·0	0 5	2·90	0·90
71	2	1	3·86	0·90
18	4	2	4·46	1·10
85	5	2·5	6·16	1·10
70	6	3	6·99	1·10
108	8	4	8·16	1·31
72	10	5	8·93	1·31
116	12	6	9·89	1·52
17	16	8	11·79	1·52
115	20	10	15·38	2·39
187	30	15	19·72	2·39
226	60	30	40·41	O.A

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Ref	VA (Watts)		£	P&P
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64	75	0-115-210-240	4·41	1·10
4	150	0-115-200-220-240	5·70	1·10
67	500	0-115-200-220-240	12·09	1·91
84	1000	0-115-200-220-240	20·84	2·39
93	1500	0-115-200-220-240	25·81	0A.
95	2000	0-115-200-220-240	38·31	0A.
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1·0	431	8·12	0·99
2·0	432	13·35	1·31
3·0	433	16·17	1·40
4·0	434	20·65	2·11
5·0	435	29·30	2·47
6·0	436	36·69	O.A.
8·0	437	40·03	O.A.

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13	100	9-0-9	2·35	0·44
235	330, 330	0-9, 0-9	2·19	0·44
207	500, 500	0-8-9, 0-8-9	3·05	0·85
208	1A, 1A	0-8-9, 0-8-9	3·88	0·90
236	200, 200	0-15, 0-15	2·19	0·44
214	300, 300	0-20, 0-20	3·08	0·90
221	700(DC)	20-12-0-12-20	3·75	0·90
206	1A, 1A	0-15-20-0-15-27 ×2	5·09	1·10
203	500, 500	0-15-27-0-15-20 ×2	4·39	1·10
204	1A, 1A	0-15-27-0-15-27 ×2	6·64	1·10
239	50	12-0-12	2·88	0·43
234	500	6	2·19	0·44

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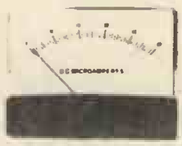

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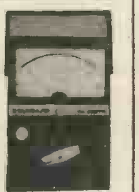

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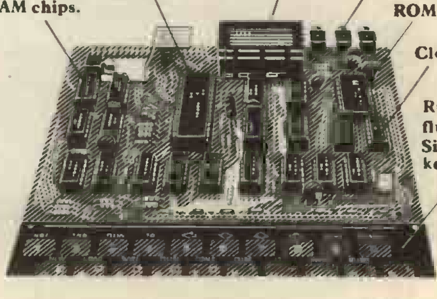

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F/Glass S/S £1.96	D/S £2.13	Bimboard 12£9.23	
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Std. SPDT 65p	DPDT 89p	Smiths TS100	£14.43 net
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1N5402	19p	AD136	£4.25	MJE2955	£1.13	T1P42C	74p
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2N4443	£1.78	AL102	£1.84	OA90	8p	2Tx107.9	14p
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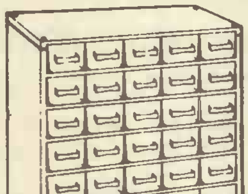

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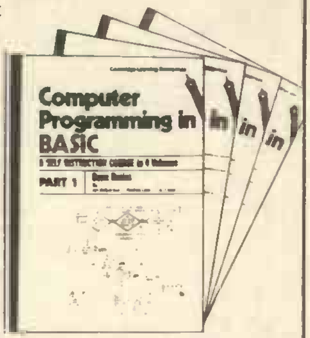

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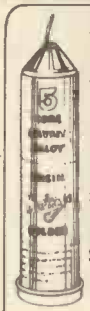

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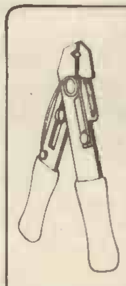

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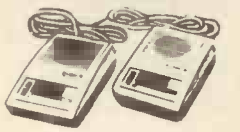

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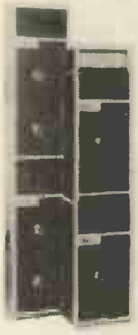

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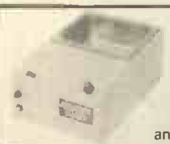

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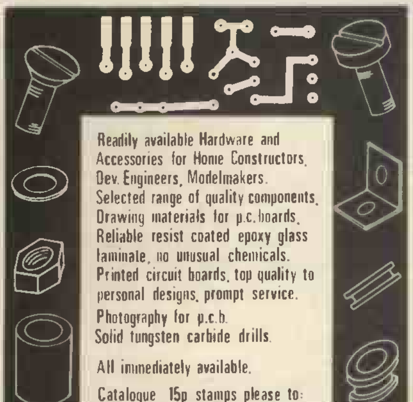

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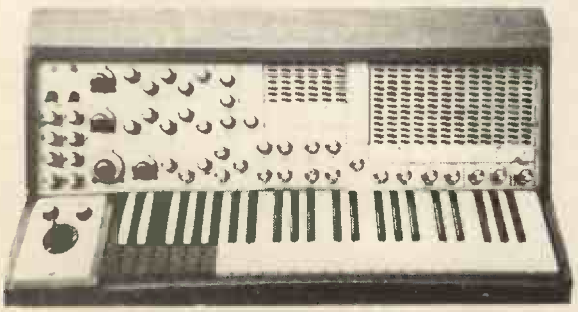

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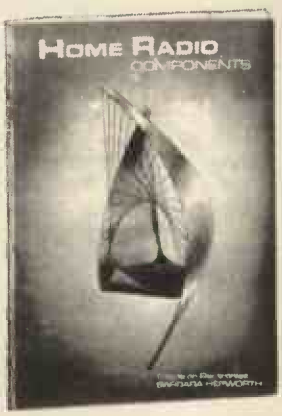

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71301	700p
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74S387	350p
74S471	700p
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93436	650p
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1802	650p
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6800	900p
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2708	675p
2716	£21

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3242	800p
3245	450p
4002	
6820	500p
6821	550p
6850	500p
8250	320p
8212	225p
8216	225p
8224	400p
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8251	700p
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AY-5 2376	£9

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(prim 220 240V)

6 0-6	100mA	88p
9 0 9	75mA	92p
12 0 12	100mA	95p
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0-12 15 20 24 30 1A		340p*
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8 pin	10p	18 pin	22p	24 pin	30p
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16 pin	12	22 pin	27p	40 pin	50p

WIRE WRAP SOCKETS BY TEXAS

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14 pin	50p	20 pin	90p	28 pin	110p
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TOGGLE

SPST	55p
SPDT	58p
DPDT	60p
DPDT (Centre off)	85p
Push to make	15p
break	25p
*SLIDE DPDT	18p
*ROCKER SPST	28p

*WAFER

1P/12W	45p
3P/4W	45p
4P/3W	45p
2P/6W	45p

*CRYSTALS

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1MHz	370p
3.2768M	350p
4MHz	350p
8.867MHz	350p
10.7MHz	350p
18MHz	300p
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CCN 15W	400p
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DIP Breadboard 4.15" x 6.15" 270p (Suitable for 20 x 14 pin or 16 x 16 pin DIL ICs)

DIP Breadboard as above with tracks for 31 way connector 250p

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EDGEBOARD CONNECTORS 0.156" PITCH

2 x 10 way	85p	2 x 22 way	135p
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96364	£11
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18V	7818	60p	7918	65p
24V	7824	60p	7924	65p
100mA	TO-92			
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TIL211 Gr	20p	TIL228 Red	22p
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N.M.S.

0-60 sec. 230V a.c. operation. Incorporating a lapsed time indicator and repeat facilities. A precision motorised timer ideal for process timing, photography, welding, mixing, etc. Price £6. P. & P. 60p. £7·59 inc. VAT & P. & P.

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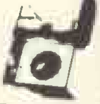

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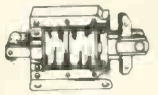

A.C. SOLENOID pye ether type 176/2 240 AC. Approx 1lb at ½ inch, intermittent rating. Price £1 p&p 20p (£1·38 inc VAT + P).

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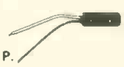

MINIATURE 2-CAM PROGRAMMER
Crouzet 1 rpm. 115V. A.C. Motor operating 2 Roller Micro switches (4 amp). Can be used on 240V. A.C. with either 0·25 mfd 250V Condensor or 5·6K wirewound Resistor 7 watt. (supplied) Price £2·50 + 50p. p. & p. (£3·45 incl. VAT & P.).
N.M.S.

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Type FFB. 1706. Small, quiet, smooth running. 240V. A.C. operation. Output aperture 45x40cm. Overall size 135x165 cm. Flange mounting. Price: £4.25. P.&P. 75p. (Total: £5.75 inc. P. & VAT. N.M.S.
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Precision 24 volt. D.C. 0·8 amp Blower that works well on 12V 0·4 amp D.C. Producing 30 cu.ft. min at normal air pressure. £4.50 P. & P.75p (inc. VAT £6·04). N.M.S.

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IMFD 600V Dubilier
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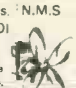

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3KVA (max. 15 amp.)	£106·43
6KVA (max. 30 amp.)	£159·37
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All plus Carriage & V.A.T.

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Complete ballast unit for either 6", 9" or 12" tube 230V AC op £3.50. Post 45p. (£4·54 inc VAT + P). Also available for 12V DC op £3.50. Post 45p. (£4·54 inc VAT + P).
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240V A.C. operation. 12 individually adjustable cams. £7.50 + 75p P. & P. (£9.49 inc. VAT). R.T.

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Black, Silver, Skirted knob calibrated in Nos. 1-9 1½in. dia. brass bush. Ideal for above Rheostats 24p each.

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4½rpm SIGMA motors approx. 35lbs inch
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56 rpm. 240V. a.c. 50lb. in. 50Hz 0·7 amp. Shaft length 35mm. Dia. 16mm. Wt. 6kg. 600g. mf. FRACMO. Price: £15·00 + £1·50 P. & P. (£18·98 inclus. VAT). N.M.S.

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1 rpm 230/240V. a.c. Synchronous geared Motor, mf. HAYDON. 2 rpm 230/240V. a.c. Synchronous geared Motor, mf. CROUZET. Either type £2·90 + 30p. P. & P. (£3·68 inclus. VAT). N.M.S.

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ROTARY CARBON VANE VACUUM & COMPRESSOR.
Direct coupled to 1/3 h.p. 110/115V. A.C. Motor 4.2 amp. 1380 rpm. Motor manuf. by A.E.I. Pump by Williams. Max. Vac. 25" H.G. Max. pressure cont. 10 p.s.i. Int. 15 p.s.i. Max. airflow 3 c.f.m. at "0" H.G. Price: £25.00 + P. & P. (£32.20 inclus. VAT). N.M.S.
Suitable transformer for 240V. op. £10.00 P. & P. £2.00 (£13.80 incl. VAT). N.M.S.

COMPRESSOR
Precision built USA. Horizontally opposed twin head diaphragm type producing 20lbs. approx. P.S.I. per head. 3.5 plus C.F.M. Output virtually pulse free. Powered by 110V A.C. motor size 30x23x15cm. Weight 7 kilos. Price £24 + £2 p. & p. (total incl. VAT £29.90). N.M.S.
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VERY EXCEPTIONAL OFFER REDUCTION DRIVE GEAR BOX.
Ratio 72:1. Input spindle ¼ x ½ in. Output spindle ⅜ x 3 in. long. Overall size approx: 120 x 98 x 68 mm. All metal construction. Ex-equip. tested. Price: £2·00 + 50p. (incl VAT £2.88).

A.C. Wkg. TUBULAR CAPACITORS.
Fraction of makers price. Motor start etc.

1.5 mfd.	440V. A.C.	60p	7.5 mfd.	200V. A.C.	£1·00
2 mfd.	250V. A.C.	60p	10 mfd.	250V. A.C.	£1·00
2 mfd.	450V. A.C.	75p	10 mfd.	400V. A.C.	£1·75
2.2 mfd.	440V. A.C.	75p	14 mfd.	400V. A.C.	£3·00
3 mfd.	440V. A.C.	£1·00	15 mfd.	250V	
4.1 mfd.	440V. A.C.	£1·00	(Block)		£1·50
5 mfd.	400V. A.C.	£1·25	19 mfd.	280V. A.C.	£2·00
5.3 mfd.	160V. A.C.	60p	20 mfd.	250V. A.C.	£2·25
5.4 mfd.	280V. A.C.	75p	50 mfd.	370V. (Block)	£5·00
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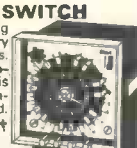
MINIATURE 24-HOUR TIMESWITCH
(German mfr.). 240V. A.C. operation. Spring Reserve. 10 amp contacts, one on-off every 24 hours. Calibrated in two hour steps. Minimum on-off period 6 hours. **Day Omission.** Unusual feature with these Switches is that trips may be removed at will enabling individual days to be programmed as required. Size only 3" x 4". Depth 2½". Price: £6·50 + 50p. p. & p. (£8·05 incl. VAT & P). N.M.S.



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