Easy to build projects for everyone

Everyday ELECTRONICS

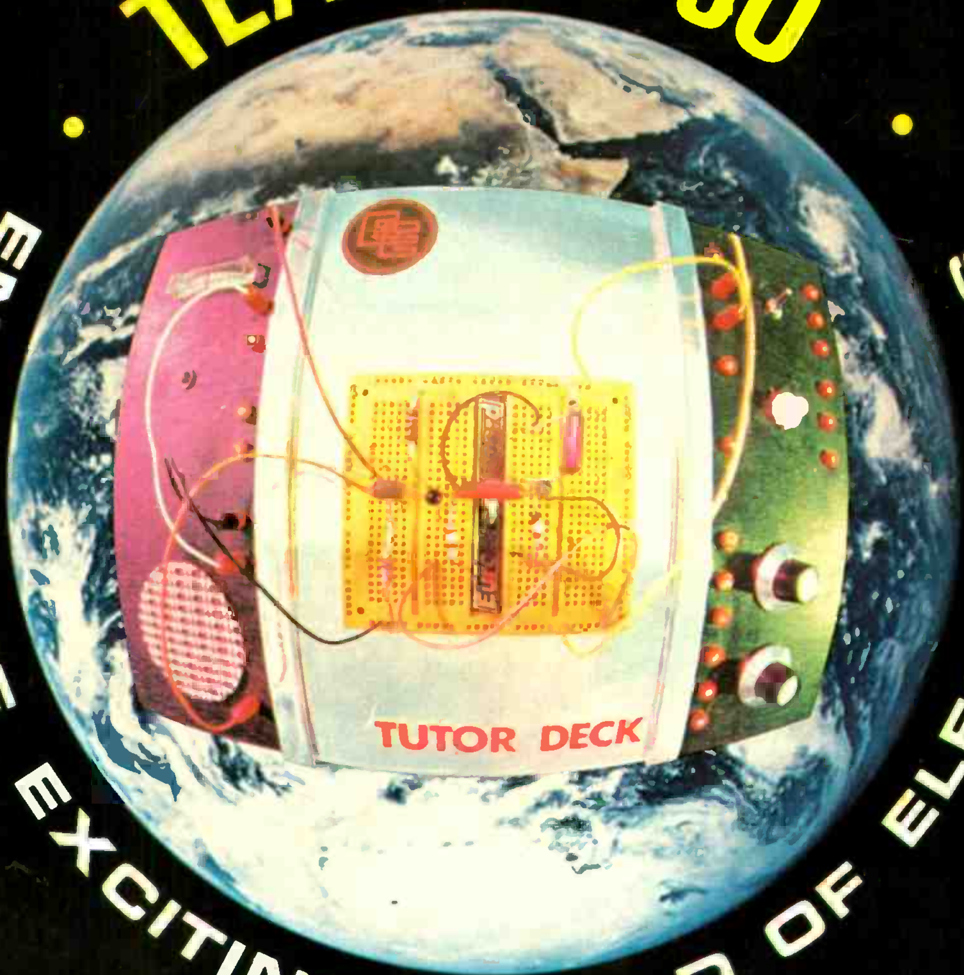
OCT. 79
45p

FREE

CONSTRUCTORS DATA
24 PAGE BOOKLET *IN THIS ISSUE*

FREE

TEACH-IN 80



ENTER THE EXCITING WORLD OF ELECTRONICS

ONE-ARMED BANDIT · HIGH IMPEDANCE VOLTMETER
STEREO SIGNAL INDICATOR · LIGHTS-ON REMINDER

Australia 85c South Africa 85c New Zealand 85c Malaysia $2·75

MAGENTA ELECTRONICS LTD.

E.E. PROJECT KITS

Make us **YOUR No. 1 SUPPLIER OF KITS and COMPONENTS** for E.E. Projects. We supply carefully selected sets of parts to enable you to construct E.E. projects. Project kits include **ALL THE ELECTRONICS AND HARDWARE NEEDED**—we have even included appropriate screws, nuts and I.C. sockets. Each project kit comes complete with its own **FREE COMPONENT IDENTIFICATION SHEET.** We supply—you construct. **PRICES INCLUDE CASES UNLESS OTHERWISE STATED. BATTERIES NOT INCLUDED.** IF YOU DO NOT HAVE THE ISSUE OF E.E. WHICH CONTAINS THE PROJECT—YOU WILL NEED TO ORDER THE INSTRUCTIONS/REPRINT AS AN EXTRA—39p. each.

ELECTRONIC TUNING FORK Aug. 79 £8·21. Suitable microphone & plug £1 61 extra.
WARBLING TIMER. Aug. 79. £5 99
9V POWER SUPPLY Aug. 79. £9 67 inc. pcb.
SWANEE WHISTLER Aug. 79 £2 89
TOUCH ON PILOT LIGHT Aug. 79 £2·92.
QUIZ REFEREE Aug. 79, £5 88.
SOLDERING IRON BIT SAVER. July 79. £7 25.
VOLTAGE SPLITTER. July 79. £3 22.
DOLLS LIGHTS ECONOMISER. July 79. £4 30 no case.
DARKROOM TIMER. July 79. £2 55.
WATER LEVEL INDICATOR. July 79. £4·92.
CONFERENCE TIMER. July 79. £39 21 inc 1 extension unit.
TREMOLO UNIT. June 79. £10 87.
ELECTRONIC CANARY. June 79. £4 50.
LOW COST METAL LOCATOR. June 79. £5·14.
Handle & coil former parts extra £4 75.
METER AMPLIFIER. June 79. £3 64.
QUAD SIMULATOR. June 79. £6 07.
INTRUDER ALARM. May 1979. £15 02. Less Ext. Buzzer & Lamp and Loop Components.
SHORT WAVE CONVERTER. May 79. £14·26 inc. cases.
THERMOSTAT. 'PHOTO' SOLUTIONS. May 79. £14 03. Less socket, tube and grease.
SHAVER INVERTER. April 79. £12 36.
TRANSISTOR TESTER. April 79. £3·50.
TOUCH BLEEPER. April 79. £3 29.
ONE TRANSISTOR RADIO. Mar. 79. with Amplifier & Headset. Less case. £6 43.
TIME DELAY INDICATOR. Mar. 79. £4·49.
VERSATILE POWER SUPPLY. Mar. 79. £8 10.
CHOKE WARNING DEVICE. Apr. 79. £6·66 case 78p.
AUDIO MODULATOR. Feb. 79. £1 58 less case and pins.
LW CONVERTER. Feb. 79. £6·02.
THYRISTOR TESTER. Feb. 79. £3·28.
ADJUSTABLE PSU. Feb. 79. £23·70. Case (horizontal layout) £3·89 extra.
I'M FIRST. Jan. 79. £3·37 less cases.
LIGHTS REMINDER. Jan. 79. £4·58.
CONTINUITY TESTER. Jan. 79. £3·20 less case.
FUZZ BOX. Dec. 78. £4 98.
VEHICLE IMMOBILISER. Inc. PCB. Dec. 78. £4·95
WATER LEVEL ALERT. Nov. 78. £5·30.
"HOT LINE' GAME. Nov. 78. £4·65 less case & rod.
CHASER LIGHT. Sept. 79. £18·95.
AUDIO EFFECTS OSCILLATOR. Nov. 78. £3·03 inc. board.
SUBSCRIBERS TELE TEL METER. Nov. 78. £17 55 case extra £4 13.
FUSE CHECKER. Oct. 78. £1 66.
C.MOS RADIO. Oct. 78. £8 57.
TREASURE HUNTER. Oct. 78. £16 98 less handle & coil former.
GUITAR TONE BOOSTER. Sept. 78. £4·78 inc. p.c.b.
SOUND TO LIGHT. Sept. 78. £6 58.
FILTER. £1.38
SLAVE FLASH. Aug. 78. £2 92 less SK1.
LOGIC PROBE. July 78. £2 52.
IN SITU TRANSISTOR TESTER. June 78. £5 20.
VISUAL CONTINUITY CHECKER. June 78. £3 26 inc. probes.
FLASHMETER. May 78. £12 42 less calc and diffuser.
POCKET TIMER. April 78. £3·10.
WEIRD SOUND EFFECTS GENERATOR. Mar. 78. £4 00.
CHASER LIGHT DISPLAY. Feb. 78. £21 76 inc. p.c.b. case extra £3·90.
AUDIO VISUAL METRONOME. Jan. 78 £4 64.
RAPID DIODE CHECK. Jan. 78. £2·17.
AUTOMATIC PHASE BOX. Dec. 77. £10 58 inc. p.c.b.
VHF RADIO. Nov. 77. £12 60.
ULTRASONIC REMOTE CONTROL. Nov./Dec. 77. £15 13.
TREASURE LOCATOR. Oct. 77. £9·65 case extra. £2 55. Less handle, etc.
ELECTRONIC DICE. March 77. £4 67.
SOIL MOISTURE INDICATOR. June 77. £3 40 inc. probe.
PHONE/DOORBELL REPEATER. July 77. £5 80.
SHORT WAVE RECEIVER. Aug. 77. £12 09 case extra £1·64.
CAR BATTERY STATE INDICATOR. Sept. 78. £1·69 less case Inc. PCB.
R.F. SIGNAL GENERATOR. Sept. 78. £16 83 less case.
TRANSISTOR TESTER. Oct. 77. £6·90 case extra £3·90.
ELECTRONIC TOUCH SWITCH. Jan. 78. £1·59.
ADD-ON CAPACITANCE UNIT. Sept. 77. £4·91.
A.F. SIGNAL GENERATOR. Aug. 78 less dial. £12 10.
QUAGMIRE. July 78. £8 26 less case pins & counters.
CATCH-A-LIGHT. Mar. 78. £7 42.
CAR SYSTEM ALARM. Feb. 78. £5 21.
HEADPHONE ENHANCER. Jan. 79. £2.47.
PASSIVE MIXER. Oct. 78 £2 90.
MIC AMP. Dec. 78. £2 41.
AUDIBLE FLASHER. Dec. 78. £1·19.
VARICAP MW RADIO. Sept. 79. £9·45.

LATEST KITS: S.A.E. OR 'PHONE FOR PRICES

3 BAND SHORT WAVE RADIO

Simple trf design covering 1·2-24MHz. **Covers most amateur bands and short wave broadcast bands.** Five controls-bandset, bandspread, reaction, wavechange and attenuator. Uses an internal 9v battery—very low current consumption. The 3 coils are all mounted on the pcb—selection is by a wavechange switch. Use with headphones or a crystal earpiece. **Kit contains all the components required including the pcb and case.** Instructions are included with this kit. Headphones are not included—we recommend our high impedance mono headphones.

KIT £18·97 **HEADPHONES EXTRA £3·28.**

ELECTRONICS CATALOGUE

MAGENTA'S CATALOGUE HAS BEEN CAREFULLY DESIGNED FOR E.E. READERS. PRODUCT DATA AND ILLUSTRATIONS MAKE THE MAGENTA CATALOGUE AN INDISPENSABLE GUIDE FOR THE CONSTRUCTOR. CATALOGUE INCLUDES CIRCUIT IDEAS FOR YOU TO BUILD. NO MINIMUM ORDER—ALL PRODUCTS ARE STOCK LINES. FIRST CLASS DELIVERY OF FIRST CLASS COMPONENTS. SEND FOR YOUR COPY AND SEE HOW EASY IT IS TO USE THE MAGENTA CATALOGUE! WRITE TODAY ENCLOSING 4 × 10p STAMPS.

MAGENTA ELECTRONICS LTD.

EK9, 98 CALAIS ROAD, BURTON-ON-TRENT, STAFFS., DE13 0UL. 0283-65435. 9-12, 2-5 MON.-FRI.

OFFICIAL ORDERS FROM SCHOOLS, UNIVERSITIES ETC. WELCOME. MAIL ORDER ONLY.

ALL PRICES INCLUDE 15% VAT AND FIRST CLASS POST. ADD 30p TO ORDERS UNDER £10 ENQUIRIES MUST INCLUDE S.A.E.

MAGENTA gives you **FAST DELIVERY BY FIRST CLASS POST OF QUALITY COMPONENTS & KITS.** All products are stock lines and are new & full specification. We give personal service & quality products to all our customers—**HAVE YOU TRIED US?**

METAL LOCATOR

E.E. JUNE 79.

WE HAVE MADE UP A *COMPLETE* HARDWARE KIT FOR THIS PROJECT, WITH TUBULAR PLASTIC COLLAPSIBLE HANDLE, HAND GRIP, COIL FORMER, AND ALL SCREWS, NUTS, CLIPS, TAPE, FOIL SPACERS etc.

Everything you need for the project **including electronics and case £9·89**
Or separately:
Electronics & Case **£5·14**
Hardware Kit **£4·75**

DOING IT DIGITALLY

Complete kit IN STOCK NOW for FAST DELIVERY by FIRST CLASS POST. All top quality components as specified by EVERYDAY ELECTRONICS. Our kit comes complete with FREE TTL & COMPONENT IDENTIFICATION SHEETS. **£25·25** for the TTL TEST BED. **£4·13** for ADDITIONAL COMPONENTS for first 6 months.

COMPONENTS FOR PARTS 7, 8, 9 & 10. £10·98
includes:— photocells, I.C.'s, Resistors, Capacitors, thermistors, Microphone, speaker, presets, etc.

COMPONENTS FOR PART 11 £2·73

TEACH IN 80

NEW SERIES—ALL COMPONENTS IN STOCK NOW FOR FAST DELIVERY. All top quality components as specified by Everyday Electronics. Out kit comes complete with **FREE COMPONENT IDENTIFICATION SHEET.** Follow this educational series and learn about electronics—Start today! **SEND £22·95** for the **TUTOR DECK** and **ADDITIONAL COMPONENTS** parts 1-6. All orders sent by **FIRST CLASS POST.** Out kit contains all these parts:—

TUTOR DECK: METER, BREADBOARD, TRANSFORMER, LEDS, POTENTIOMETERS, SWITCHES, SPEAKER, PLUGS, SOCKETS, BATTERY CLIPS, WIRE, CABLE, FUSES, FUSE-HOLDERS, KNOBS. **ADDITIONAL COMPONENTS. PARTS 1-6**, RESISTORS, PHOTOCELL, DIODES, CAPACITORS.

IDEAL SOLDERING EQUIPMENT FOR THE TEACH IN AND ELECTRONICS

ANTEX X25 SOLDERING IRON 25W **£4·78**
SOLDERING IRON STAND **£2 03**
SPARE BITS. Small, Standard, Large. **65p** each.
SOLDER. Handy size **75p.**
DESOLDER BRAID **69p**
HOW TO SOLDER BOOKLET **12p**
HEAT SINK TWEEZERS **15p.**
SOLDER BOBBIN **30p**
DESOLDER PUMP **£6·98**

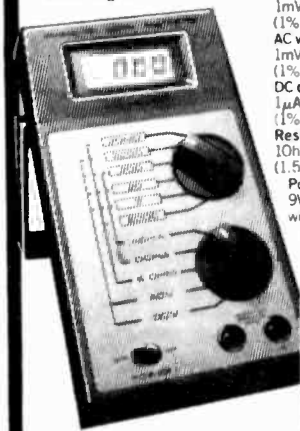
TEACH IN 80

MULTIMETER TYPE 1. 1,000 o.p.v. with probes. 2" × 3½" × 1". £6·78.
MULTIMETER TYPE 2. 20,000 o.p.v. with case and probes. 5" × 3½" × 1¼". £14·25.
ANTEX X25 SOLDERING IRON 25W. Ideal for electronics. £4·98.
SOLDERING IRON STAND. Antex ST3. £2·03.
SPARE BITS. 2 3mm, 3mm, 4·7mm. 65p.
DESOLDER BRAID. 69p.
HEAT SINK TWEEZERS. 15p.
DESOLDER PUMP. Easy to use. £6.98.
F.M. INDOOR AERIAL. 57p.
TELESCOPIC AERIAL. 120 c.m. £2·08.
TELEPHONE PICK-UP COIL. 72p
CRYSTAL MICROPHONE INSERT. 63p.
SPEAKERS MINIATURE. 8 ohm 87p. 64 ohm 98p. 80 ohm £1 .28
PILLOW SPEAKER. 8 ohm £1·08p.
6" ROUND SPEAKER. 8 ohm, 5W. £2 18.
CABINET SPEAKER. 8 ohm, 5W, 5" speaker. Cabinet 10" × 7" × 4". £7·.43
RE-ENTRANT HORN SPEAKER. 8 ohm 5 W. Horn dia. 5½". £5·27.
EARPIECES. Crystal 48p. Magnetic 18p.
STETHOSCOPE ATTACHMENT. Fits our earpieces 69p.
BUZZER. 6V 82p. 12V 85p.
MONO HEADPHONES. 2K. Padded. Superior. Sensitive. £3 28.
STEREO HEADPHONES. 8 ohm. Padded. £4·24.
INTERCOM. 2 Station. Desk. £7·10.
MICROPHONE DYNAMIC. 600 ohm. Cassette type. £1·38.
DENTISTS MIRROR. Adjustable. £2·37.
JEWELLERS EYEGLASS. £1·08p
TRIPLE MAGNIFIER. £1·83.
HAND MAGNIFIER. 3" Lens. £3·28.
SPECTACLE MAGNIFIER. Clips on to spectacle frame. £4·38
ILLUMINATED MAGNIFIERS. 1½" lens £1·09, 3" lens £3·07.
SIGNAL INJECTOR. £5·48.
POCKET TOOL SET. 20 piece. £4·09.
SCREWDRIVER SET. Six piece. £2·18.
Q MAX PUNCH. ⅜" £2 14. ½" £2·39. ⅝" £2·41. ¾" £2·50.
DRILL 12V. Hand or stand use. £11·42. Stand £7·57.
CAPACITANCE SUBSTITUTION BOX. Nine values, 100pF—0·22uF. £3·03.
QUICKTEST. Mains connector. £5 83.
PLUG IN POWER SUPPLY. 6, 7 5-9V d.c. 300mA. £4·05.
SPRINGS—SMALL. 100 Asstd. £1·08.
CROC CLIP TEST LEAD SET. 10 leads with 20 clips. £1·06.
DIMMER SWITCH. 240V. 800W. £4·13.
TRADITIONAL STYLE BELL. 3–8V. 70mm chrome gong. £1.60.
UNDERDOME BELL. 4–10V. Smart. Dia. 70mm. £1 97.
TOWERS INTERNATIONAL TRANSISTOR SELECTOR. New edition. £6·22.
F.M. TUNER CHASSIS. 98-108MHz. 9V d.c. £9·19.
MORSE KEY. High speed. £3·83.
PANEL METERS. 60 × 45mm. Modern style. 50uA, 100uA, 1mA, 1A, 25V d.c. £6·33.
NIGHT LIGHT. Plug type. £1·08.
CONNECTING WIRE PACK. 5 × 5yd. coils. 55p.
VERO SPOT FACE CUTTER. £1·06.
VERO PIN INSERTION TOOL. 0·1" £1·48. 0·15" £1·.45
RESISTOR COLOUR CODE CALCULATOR. 21p.

Top value test equipment from TANDY

LCD DIGITAL MULTIMETER.

Low-cost hand held digital multimeter with a full 3½ digit LCD display. 0.5% basic accuracy, auto polarity operation. 10 Mohm DC input impedance.
Reading to ± 1999.



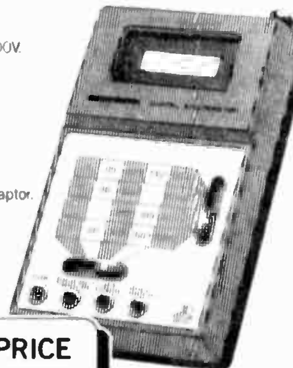
Scales:
DC volts:
1mV to 1000V
(1% ± 1 digit accuracte).
AC volts:
1mV to 500V
(1% ± 2 digits accurate).
DC current:
1μA to 200mA
(1% ± 1 digit accurate).
Resistance:
10hm to 20 MOhms
(1.5% ± 1 digit accurate).
Power source:
9V battery or AC with optional adaptor.
Size:
155 x 75 x 30 mm
22 – 198

PRICE **53.19**

LOW—COST LCD MULTIMETER

A portable, compact sized multimeter with a full 3½ digit LCD display. Auto polarity operation, low battery indicator. 10 MOhm Input impedance.

Scales:
DC volts:
2 – 20 – 200 – 1000V.
AC volts:
200 – 500V.
DC current:
2 – 20 – 200MA.
Resistance:
2 – 20 – 200 – 2000 KOHM.
Power source:
9V battery or AC adaptor.
Size:
37 x 85 x 130 mm.
22 – 197



PRICE **39.93**

COMPONENTS AND PARTS

CAT No	DESCRIPTION	PRICE
276 – 032	LED	4 for 69p
276 – 033	LED	2 for 48p
276 – 034	LED	2 for 59p
276 – 142	Infra-Red Emitter Detector Pair	£1.37
277 – 1003	12V DC Automotive Digital Clock Module	£17.52
276 – 9110	6 pin edge connector for 277 – 1003	40p
276 – 1373	Power Transistor Mounting Hardware	50p
276 – 1363	TO – 220 Heat Sink	60p
276 – 1364	TO – 3 Heat Sink	81p

AC/DC 8 MHz OSCILLOSCOPE

A new approved 8MHz version of last years' winner! The advance design features of this oscilloscope make it an absolute essential for industrial uses on production lines, in laboratories and schools. Ideal for radio and TV servicing, audio testing, etc.

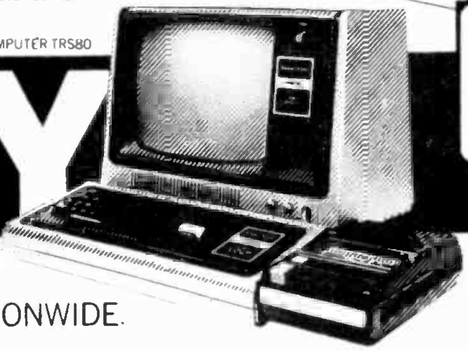
Specifications:
Horizontal axis: Deflection sensitivity better than 250mV/DIV. **Vertical axis:** Deflection sensitivity better than 10mV/DIV (1DIV – 6mm). Bandwidth 0.8MHz. **Input impedance:** 1MOhm parallel capacitance 35pF. **Time base: Sweep range:** 10Hz – 100kHz (4 ranges). Synchronization: Internal (–) **Size:** 200 x 155 x 300 mm. Supply 220/240 V/50Hz. **22 – 9501.**

PRICE **137.36**

You save because we design, manufacture, sell and service.
Tandy have over 7,000 stores and dealerships worldwide. Over 2,500 products are made specifically for or by Tandy at 16 factories around the world. The quality of our products has been achieved by over 60 years of continuous technological advancement.

KNOWN AS RADIO SHACK IN THE U.S.A. MAKERS OF THE WORLD'S BIGGEST SELLING MICROCOMPUTER TRS80

TANDY



The largest electronics retailer in the world.
Offers subject to availability. Instant credit available in most cases.
OVER 170 STORES AND DEALERSHIPS NATIONWIDE.

TANDY DEALER

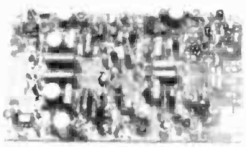
Most items also available at Tandy Dealers. Look for this sign in your area.

Access, Barclaycard and Trustcard welcome.

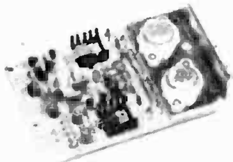
TOTAL AMPLIFICATION FROM CRIMSON ELEKTRIK

——WE NOW OFFER THE WIDEST RANGE OF SOUND PRODUCTS——

STEREO PRE-AMPLIFIER **POWER AMPLIFIER**



CPR



CPR 1—THE ADVANCED PRE-AMPLIFIER

The best pre-amplifier in the U.K. The superiority of the CPR 1 is probably in the disc stage. The overload margin is a superb 40dB, this together with the high slewing rate ensures clean top, even with high output cartridges tracking heavily modulated records. Common-mode distortion is eliminated by an unusual design. R.I.A.A. is accurate to 1dB; signal to noise ratio is 70dB relative to 3·5mV; distortion < 005% at 30dB overload 20kHz.
Following this stage is the flat gain/balance stage to bring tape, tuner, etc., up to power amp. signal levels. Signal to noise ration 85db; slew-rate 3V/uS; T.H.D. 20Hz—20kHz < ·008% at any level. F.E.T. muting. No controls are fitted. There is no provision for tone controls. CPR 1 size is 138 × 80 × 20mm. Supply to be ±15 volts.

MC 1—PRE-PRE-AMPLIFIER

Suitable for nearly all moving-coil cartridges. Sensitivity 70/170uV switchable on the p.c.b. This module brings signals from the now popular low output moving-coil cartridges up to 3·5mV (typical signal required by most pre-amp disc inputs). Can be powered from a 9V battery or from our REG 1 regulator board.

REG 1—POWER SUPPLY

The regulator module, REG 1 provides 15-0-15v to power the CPR 1 and MC 1. It can be used with any of our power amp supplies or our small transformer TR 6. The power amp kit will accommodate it.

POWER AMPLIFIERS

It would be pointless to list in so small a space the number of recording studios, educational and government establishments, etc., who have been using CRIMSON amps satisfactorily for quite some time. We have a reputation for the highest quality at the lowest prices. The power amp is available in five types, they all have the same specification: T.H.D. typically 01% any power 1kHz 8 ohms; T.I.D. insignificant; slew rate limit 25V/uS; signal to noise ratio 110dB; frequency response 10Hz-35kHz, —8dB; stability unconditional; protection—drives any load safely; sensitivity 775mV (250mV or 100mV on request); size 120 × 80 × 25mm.

POWER SUPPLIES

We produce suitable power supplies which use our superb TOROIDAL transformers only 50mm high with a 120—240 primary and single bolt fixing (includes capacitors/bridge rectifier).

POWER AMPLIFIER KIT

The kit includes all metalwork, heatsinks and hardware to house any two of our power amp modules plus a power supply. It is contemporarily styled and its quality is consistent with that of our other products. Comprehensive instructions and full back-up service enables a novice to build it with confidence in a few hours.

PRE-AMPLIFIER KIT

This includes all metalwork, pots, knobs, etc., to make a complete pre-amp with the CPR 1(S) module and the MC 1(S) if required.

ACTIVE CROSSOVERS
XO2 ...... £14·83 XO3 ...... £23·06

POWER AMPLIFIER MODULES
CE 608 60W/8 ohms 35-0 35v £18·33
CE 1004 100W/4 ohms 35-0-35v £21·62
CE 1008 100W/8 ohms 45-0-45v £24·38
CE 1704 170W/4 ohms 45-0-45v £29·12
CE 1708 170W/8 ohms 60-0-60v £31·90

TOROIDAL POWER SUPPLIES
CPS1 for 2 × CE 608 or 1 × CE 1004 £15·55
CPS2 for 2 × CE 1004 or 2/4 × CE 608 .... £17·46
CPS3 for 2 × CE 1008 or 1 × CE 1704 .... £18·54
CPS4 for 1 × CE 1008 .... £16·06
CPS5 for 1 × CE 1708 .... £22·68
CPS6 for 2 × CE 1704 or 2 × CE CE 1708 .... £23·98

HEATSINKS
Light duty, 50mm, 2°C/W ...... £1·35
Medium power, 100mm, 1·4°C/W .... £2·20
Disco/group, 150mm, 1·1°C/W £2·85
Fan, 80mm, state 120 or 240v.... £18·50
Fan mounted on two drilled 100mm heatsinks, 2 × 4°C/W, 65°C max. with two 170W modules .... £29·16

THERMAL CUT-OUT, 70IC.. £1·45

POWER AMP KIT ...... £32·90

PRE-AMPS:
These are available in two versions—one uses standard components, and the other (the S) uses MO resistors where necessary and tantalum capacitors.
CPRI ...... £30·96
CPRIS .... £39·98
MCI ...... £20·81
MCIS...... £32·44
Pre-amp kit £37·24

POWER SUPPLY
REGI ...... £6·75
TR6 ...... £1·92

BRIDGE DRIVER, BDI
Obtain up to 340W using 2 × 170W amps and this module BDI £5·40

CRIMSON ELEKTRIK
1E STAMFORD STREET,
LEICESTER, LE1 6NLL
Tel: (0533) 553508

All prices shown are UK only and include VAT and post. COD 90p extra, £100 limit. Export is no problem, please write for specific quote. Send large SAE or 3 International Reply Coupons for detailed information.

Distributors'—

BADGER SOUND SERVICES LTD.,
46 WOOD STREET,
LYTHAM ST. ANNES,
LANCASHIRE, FY8 1QG

"MINIC TELEPRODUCKTER
BOX 12035; S-750 12
UPPSALA 12, SWEDEN"

What's new from Heathkit?

IM 2212—Auto Ranging DMM

IO 4105—Single Beam 5MHz Oscilloscope

IM 5217—Portable Multimeter

Plus
* GD 1290—VLF Metal Locator
* HX 1681—CW Transmitter
* IR 5201—XY Recorder
* CI 1525—Car Temperature Indicator

These brand new self-assembly kits are designed to the highest specification.

The step-by-step instructions make them easy to build at your leisure in your own home.

And first class quality makes them excellent value for money.

Details of the full Heathkit range are available in the Heathkit catalogue. Send for your copy now.

IM 2215—
Hand-held DMM

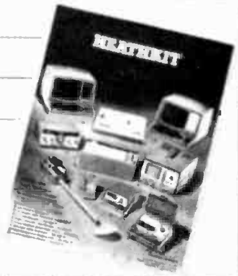
To: Heath (Gloucester) Limited, Dept. (EF10), Bristol Road, Gloucester, GL2 6EE.
Please send a copy of the Heathkit catalogue. I enclose 20p in stamps.

Name ________________

Address ________________

____

____



N.B. If you are already on the Heathkit mailing list you will automatically receive a copy of the latest Heathkit catalogue without having to use this coupon.

Soldering Iron offer FREE

When you receive your catalogue you will get details of this free offer.

There are Heathkit Electronics Centres at 233 Tottenham Court Road, London (01-636 7349) and at Bristol Road, Gloucester (0452 29451).

HEATHKIT

WATFORD ELECTRONICS

35 CARDIFF ROAD, WATFORD, HERTS., ENGLAND
MAIL ORDER, CALLERS WELCOME. Tel. Watford 40588/9

ALL DEVICES BRAND NEW, FULL SPEC. AND FULLY GUARANTEED ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/ P.O.s OR BANKERS DRAFT WITH ORDER. GOVERNMENT AND EDUCATIONAL INSTITUTIONS' OFFICIAL ORDERS ACCEPTED. TRADE AND EXPORT INQUIRY WELCOME. P&P ADD 30p TO ALL ORDERS UNDER £10·00. OVERSEAS ORDERS POSTAGE AT COST. AIR/SURFACE.

VAT Export orders no V.A.T. Applicable to U.K. Customers only. Unless stated otherwise all prices are exclusive of V.A.T. Please add 15% to total cost including P & P.

We stock many more items. It pays to visit us. We are situated behind Watford Football Ground. Nearest Underground/BR Station: Watford High Street. Open Monday to Saturday 9.00 am–6.00 pm. Ample Free Car Parking space available.

POLYESTER CAPACITORS: Axial lead type (Values are in µF)
400V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8, 10m, 15n 9p; 18n 10p; 22n, 33n 11p; 47n, 68n 14p; 100n 17p; 150n, 220n 24p; 330n, 470n 41p; 680n 52p; 1µF 53p.
160V: 39µF, 100n, 150n, 220n 11p; 330n, 470n 19p; 680n, 1µF 22p; 1µ5, 2µ2 23p; 4µ7 36p.
1000V: 10nF, 15n, 20p; 22n 22p; 47n 26p; 100n 38p; 470n 53p; 1µF 175p.

POLYESTER RADIAL LEAD CAPACITORS (250V)
10nF, 15n, 22n, 27n, 5p; 33n, 47n, 68n, 100n 7p; 150n 10p; 220n, 330n 13p; 470n 17p; 680n 19p; 1µF 22p; 1µ5 30p; 2µ2 34p.

FEED THROUGH CAPACITORS
1000pF 350V 8p

ELECTROLYTIC CAPACITORS: Axial lead type (Values are in µF) 500V: 10 40p; 47 85p; 250V: 100 65p; 63V 0·47, 1·0, 1·5, 2·2, 2·5, 3·3, 4·7, 6·8, 8, 10, 15, 22 8p; 47, 32, 50 12p; 63, 100 27p 50V 50, 100, 220 25p; 470 32p; 1000 50p; 40V: 22, 33, 9p; 100 12p; 2200 68p; 3300 68p; 4700 98p; 35V: 10, 33 7p; 330, 470 32p; 1000 49p; 25V: 10, 22, 47 6p; 80, 100, 160 8p; 220, 250 13p; 470, 640 25p; 1000 27p; 1500 30p; 2200 45p; 3300 68p; 4700 85p; 16V: 10, 40, 47, 68 7p; 100, 125 8p; 220, 330 14p; 470 16p; 1000, 1500 20p; 2200 34p; 10V: 100 6p; 640 12p; 1000 14p.
TAG-END TYPE: 450V: 100µF 180p; 70V: 4700 165p; 64V: 3300 130p; 2500 98p; 50V: 3300 105p; 2200 99p; 00V: 15,000 299p; 4700 120p; 4000 92p; 3300 93p; 2500 85p; 2200 85p; 2000 + 2000 120p; 30V: 4700 90p; 25V: 6400 105p; 4700 80p; 3300 80p; 2200 60p.

TANTALUM BEAD CAPACITORS 35V: 0·1µF, 0·22, 0·33, 0·47, 0·68, 1·0, 2·2µF, 3·3, 4·7, 6·8 25V: 1·5, 10 20V: 1·5 16V: 10µF 13p each 47, 100 40p. 10V: 22µF, 33 20p 6V: 47, 68, 100, 30p 3V: 68, 100µF. 20p

MYLAR FILM CAPACITORS
100V: 0·001, 0·002, 0·005, 0·01µF 6p
0·015, 0·02, 0·04, 0·05, 0·056µF 7p
0·1µF, 0·2 9p 50V: 0·47 12p

MINIATURE TYPE TRIMMERS
2-5 6pF, 3-10pF, 10-40pF 22p
5-25pF, 5-45pF, 60pF, 88pF 30p

COMPRESSION TRIMMERS
3-40pF, 10-80pF 30p; 25-190pF 33p
100 500pF 45p 1250pF 50p.

POLYSTYRENE CAPACITORS
10pF to 1nF 8p; 1 5nF to 10nF 10p.

SILVER MICA (Values in pF) 3-3, 4·7, 6·8, 10, 12, 18, 22, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 180 9p each 220, 250, 300, 330, 360, 390, 600, 820 16p each
1000, 1200, 1800, 2000 20p each

CERAMIC CAPACITORS: 50V 0 5pF to 10nF 4p; 22n to 100n 6p.

E.E. INTRUDER ALARM
All parts now available

POTENTIOMETERS: (ROTARY)
Carbon Track. 0·25W Log & 0·5W Linear Value.
500 Ω, 1 K & 2K (Lin. only) Single 27p
5K-2 MΩ single gang 27p
5K-2 MΩ single with DP switch 65p
5K-2 MΩ double gang 78p

SLIDER POTENTIOMETER
0·25W log and linear values 60mm
5K Ω-500K Ω single gang 70p
10K Ω-500K Ω dual gang 80p
Sell Slick Graduated Bezels 25p

PRESET POTENTIOMETERS
Vertical & Horizontal
0-1W 50 Ω–5MΩ Miniature 7p
0-25W 100 Ω–3 MΩ Horiz 10p
0-25W 200 Ω–4·7MΩ Vert 10p

RESISTORS: Carbon Film, High Stability, Low Noise, Miniature Tolerance 5%.

Range	Val.	1-99	100+
¼W 2Ω2–4M7	E24	2p	1p
½W 2Ω2–4M7	E12	2p	1p
1W 2Ω2–10M	E12	5p	4p
2% Metal Film 10Ω–1M	6p		4p
1% Metal Film 51Ω–1M	8p		6p

100+ price applies to Resistors of each value not mixed.

S-Dec 350p T-Dec 400p
U-Dec 'A' 465p U-Dec 'B' 699p

OPTO ELECTRONICS
LEDs plus clips
TIL209 Red 13
TIL211 Grn 17
TIL212 Yellow 18
2" Red 15
2" Yellow Green 18
Square LED 48
ORP12 63
2N5777 45
7 Seg Displays
LS400 255
TIL312 C An 3" 105
TIL313 C Cth 3" 105
TIL321 C An 5" 115
TIL322 C Cth 5" 115
DL704 C Cth 3" 99
DL707 C.A. 3" 99
DL747 C.A. ·6" 180
FND357 120
MAN3540 175
LCD 3½ digit 875
TIL307 675

SWITCHES
TOGGLE 2A 250V
SPST 28p
DPDT 38p
4 pole on/off 54p
SUB-MIN TOGGLE
SP changeover 59p
SPST on/off 54p
DPDT 6 tags 70p
DPDT c/off 79p
DPDT Biased 115p
SLIDE 250V:
1A DPDT 14p
1A DP c/off 15p
½A DPDT 13p
4 pole c/over 24p
PUSH BUTTON
Spring Loaded
SPST on/off 65p
SPDT c/over 70p
DPDT 6 Tag 85p

SUPERBOARD II
Microcomputer. Ready-built and tested. Only £188 ex stock.
Call in at our retail shop for demonstration.

VOLTAGE REGULATORS

1A	TO3 +ve		—ve	
5V	7805	145p	7905	220p
12V	7812	145p	7912	220p
15V	7815	145p	—	
18V	7818	145p	—	

1A	TO220 Plastic Casing			
5V	7805	80p	7905	90p
12V	7812	80p	7912	90p
15V	7815	80p	7915	90p
18V	7818	85p	7918	90p
24V	7824	85p	7924	90p

100mA	TO92 Plastic Casing			
5V	78L05	30p	79L05	65p
6V	78L62	30p	—	
8V	78L82	30p	—	
12V	78L12	30p	79L12	65p
15V	78L15	30p	79L15	65p

CA3085 95	LM323K	625	MVR5		150
LM300H 170	LM325N	240	MVR12		150
LM305H 140	LM326N	240	TAA550		50
LM309K 135	LM327N	270	TBA625B		95
LM317K 350	LM723	39	TDA1412		150

SWITCHES ★ Miniature Non-Locking
Push to Make 15p Push to Break 25p
ROCKER: SPST on/off 10A 250V 23p
ROCKER: Illuminated (white)
Lights when on: 3A 240V 52p
ROTARY: (ADJUSTABLE STOP) 1 pole/ 2-12 way 2p/2-6W, 3p/2-4W, 4p/2-3W. 41p
ROTARY: Mains 250V AC, 4 Amp 45p

DIL SOCKETS ★ (Low Profile – Texas)
8 pin 10p; 14 pin 12p; 16 pin 13p; 18 pin 16p; 20 pin 22p; 24 pin 25p; 28 pin 35p; 40 pin 50p.

JACKSONS VARIABLE CAPACITORS
Dielectric
100/300pF 140p
500pF 165p
6:1 Ball Drive
4511/DAF 115p
Dial Drive 4103
6 1/36:1 650p
Drum 54mm 40p
0-1·365pF 245p
00 2 365pF 275p
0 2 365pF with slow motion
Drive 325p
00 208/176 285p
.. .. with slow motion drive 325p
C804-5pF 10 15
25 50 pF 175p
100, 150pF 250p
'L' 3 x 310pF 495p
00 3 x 25pF 430p

DENCO COILS
'DP' VALVE TYPE
Range 1 to 5 Bl., Rd., Yl. Wht. 86p
6–7 B.Y.R. 75p
1·5 Green 92p
'T' 1 to 5 Bl., Yl., Rd., Wht. 93p
B9A Valve Holder 25p
RDT2 92p
RFC 5 chokes 91p
RFC 7 (19mH) 96p
1 FT 13; 14; 15; 16; 17 86p
1 FT 18/1·6 99p
1 FT 18/465 105p
TOC 1 86p
MW5FR 82p
MW/LW5FR 102p

VEROBOARD

	0·1 (copper clad)	0·15	0·15 (plain)
2½ x 3¾	46p	39p	24p
2½ x 5	55p	50p	31p
3¾ x 3¾	55p	50p	—
3¾ x 5	62p	67p	43p
2½ x 17	169p	135p	92p
3¾ x 17	218p	180p	120p
4¾ x 17	280p	—	183p

Pkt of 35 pins 22p
Spot face cutter 85p
Pin insertion tool 120p

DIODES
AA119 25
AA129 20
BA100 10
BY126 12
BY127 12
CRO33 148
OA9 75
OA47 12
OA70 12
OA79 15
OA81 15
OA85 14
OA90 7
OA91 6
OA95 8
OA200 9
OA202 8
IN914 4
IN916 5
IN4001/2 5
IN4003 6
IN4004/5 6
IN4006/7 7
IN4148 4
IS44 20

We stock a wide selection of Electronic Books and Magazines

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

NOISE
25J 160

BRIDGE RECTIFIERS
(plastic case)
1A/50V 20
1A/100V 22
1A/200V 25
1A/400V 29
1A/600V 34
2A/50V 35
2A/100V 44
2A/200V 46
2A/400V 53
2A/600V 65
4A/100V 72
4A/200V 75
4A/400V 79
4A/600V 105
4A/800V 120
6A/100V 73
6A/200V 78
6A/400V 85
BY164 56
VM18 DIL 40

SCRs Thyristors
0·6A/200V 30p
0·8A/100V 30p
0·8A/200A 35p
3A600V 70
5A300V 35
5A600V 43
8A300V 48
3A500V 58
8A600V 85
12A300V 59
12A500V 92
15A/700V 195p
2N4444 140p
BT106 150
C106D 38
TIC44 25
TIC45 45
3A/100V 18
3A/400V 20
3A/600V 27
3A/1000V 30

TRIACS
3A100V 48
3A200V 49
3A400V 50
8A100V 54
8A400V 64
8A800V 108
12A100V 60
12A400V 70
12A800V 130p
16A100V 95
16A500V 150
25A800V 295
25A1000V 480p
T28000D 120

DIAC
ST2 25

TTL 74
7400 11, 7401 11, 7402 11, 7403 12, 7404 12, 7405 18, 7406 28, 7407 38, 7408 17, 7409 17, 7410 11, 7411 20, 7412 17, 7413 30, 7414 45, 7416 30, 7417 30, 7420 16, 7421 29, 7422 17, 7423 27, 7425 27, 7426 36, 7427 27, 7428 35, 7430 17, 7432 25, 7433 40, 7437 30, 7433 33, 7440 15, 7441 74, 7442 68, 7442 115, 7444 112, 7445 94, 7446 94, 7447 57, 7443 51, 7450 17, 7451 17, 7453 17, 7454 17, 7460 17, 7470 23, 7472 25, 7473 32, 7474 25, 7475 38, 7476 36, 7480 48, 7481 86, 7482 69, 7483 72, 7484 95, 7485 75, 7486 31, 7489 140, 7490 30, 7491 75, 7492 38, 7493 32, 7494 78, 7495 65, 7496 57, 7497 189, 74100 119, 74105 62, 74107 29, 74109 54, 74110 54, 74111 68, 74112 125, 74116 198, 74118 83, 74119 149, 74120 115, 74121 25, 74122 46, 74123 48, 74125 38

74126 57, 74128 74, 74132 73, 74136 65, 74141 56, 74142 209, 74143 314, 74144 314, 74145 65, 74147 175, 74143 109, 74150 99, 74151 64, 74153 64, 74154 96, 74155 53, 74156 80, 74157 67, 74159 185, 74160 82, 74161 92, 74162 92, 74163 92, 74164 105, 74165 105, 74166 140, 74167 200, 74170 185, 74172 625, 74173 120, 74174 87, 74175 87, 74176 75, 74177 78, 74178 153, 74180 85, 74181 165, 74182 88, 74184 135, 74185 135, 74188 275, 74190 95, 74191 95, 74192 98, 74193 98, 74194 98, 74195 98, 74196 93, 74197 80, 74198 150, 7150 175, 75491 92, 75492 92

74LS·
74LS00 11, 74LS01 11, 74LS02 12, 74LS03 12, 74LS04 12, 74LS05 23, 74LS08 22, 74LS09 22, 74LS10 20, 74LS11 22, 74LS12 23, 74LS13 38, 74LS14 75, 74LS15 30, 74LS20 20, 74LS21 22, 74LS22 22, 74LS26 48, 74LS27 48, 74LS28 48, 74LS30 22, 74LS32 27, 74LS33 39, 74LS37 39, 74LS38 39, 74LS40 28, 74LS42 98

74LS47 63, 74LS51 24, 74LS54 28, 74LS55 30, 74LS63 150, 74LS73 46, 74LS74 41, 74LS75 48, 74LS76 40, 74LS78 40, 74LS83 115, 74LS85 118, 74LS86 43, 74LS90 38, 74LS91 104, 74LS92 89, 74LS93 89, 74LS95 116, 74LS96 116, 74LS107 44, 74LS109 55, 74LS112 55, 74LS113 50, 74LS114 50, 74LS123 70, 74LS124 180, 74LS125 60, 74LS126 60, 74LS132 95, 74LS136 55, 74LS138 85, 74LS139 85, 74LS151 96, 74LS153 76, 74LS155 96, 74LS136 96, 74LS157 76, 74LS158 96, 74LS150 128, 74LS161 98, 74LS162 138, 74LS163 102, 74LS154 114, 74LS155 75, 74LS168 155, 74LS169 150, 74LS170 288, 74LS173 105, 74LS174 106, 74LS175 110, 74LS181 398, 74LS183 298, 74LS189 430, 74LS190 140, 74LS191 140, 74LS192 132, 74LS193 130, 74LS194 166, 74LS195 136, 74LS196 100, 74LS197 140, 74LS221 96, 74LS240 236, 74LS241 231, 74LS242 232, 74LS243 232, 74LS244 155, 74LS245 270, 74LS247 190, 74LS251 134, 74LS253 142, 74LS257 110, 74LS258 110, 74LS259 160, 74LS261 450, 74LS266 52, 74LS273 244, 74LS275 250, 74LS279 66, 74LS280 250, 74LS299 468, 74LS323 468, 74LS324 240

74LS365 65, 74LS366 65, 74LS367 65, 74LS368 66, 74LS373 180, 74LS375 160, 74LS374 155, 74LS378 184, 74LS670 248, 74LS673 1050, 74LS674 1450

CMOS
4000 13, 4001 13, 4002 15, 4006 87, 4007 18, 4008 82, 4009 33, 4010 38, 4011 18, 4012 18, 4013 45, 4014 80, 4015 82, 4016 45, 4017 82, 4018 87, 4019 48, 4020 99, 4021 95, 4022 85, 4023 22, 4024 66, 4025 19, 4026 180, 4027 45, 4028 81, 4029 99, 4030 58, 4031 205, 4032 100, 4033 145, 4034 116, 4035 111, 4036 325, 4037 100, 4038 108, 4039 320, 4040 105, 4041 80, 4042 75, 4043 94, 4044 95, 4045 145, 4046 128, 4047 87, 4048 58, 4049 48, 4050 48, 4051 72, 4052 72, 4053 72, 4054 110, 4055 123, 4056 134, 4059 480, 4060 115, 4061 1425, 4062 999, 4063 110, 4066 58, 4067 380, 4068 22, 4069BE 20, 4070 32, 4071 21, 4072 21, 4073 21, 0475 23, 4076 85, 4077 40

4078 21, 4081 20, 4082 21, 4085 74, 4086 73, 4089 150, 4093 85, 4094 190, 4095 105, 4096 105, 4097 372, 4098 110, 4099 145, 4160 109, 4161 109, 4162 109, 4163 109, 4174 110, 4175 99, 4194 108, 4408 720, 4409 720, 4410 720, 4411 958, 4412V 1380, 4415F 795, 4415V 795, 4419 280, 4422 545, 4433 995, 4435 825, 4440 1275, 4450 295, 4451 295, 490F 695, 4490V 525, 4501 19, 4502 120, 4503 69, 4506 51, 4507 55, 4508 298, 4510 99, 4511 150, 4512 98, 4520 108

LINEAR IC's
702 75, 709C 14 pin 35, 710 67, 723 38, 733 125, 741C 8 pin 18, 747C 78, 748C 36, 753 150, 810 159, 8038CC 340, AY-1-0212 580, AY-1-1313 650, AY-1-1320 315, AY-1-5050 190, AY-1-5051 145, AY-1-6721/6 195, AY-3-8500 390, AY-5-1224A 260, AY-5-1230 450, CA3011 82, CA3018 68, CA3020 170, CA3023 170, CA3028A 80, CA3035 240, CA3043 190, CA3046 71, CA3048 210, CA3080E 80, CA3081 190, CA3805 85, CA3809E 210, CA3090AQ 398

CA3123E 200, CA3130 85, CA3140 70, ICL7106E 795, ICL7107 975, ICM7205 1159, ICM7217A 790, ICM7555 89, LD130 452, LM300H 170, LM301A 30, LM308 110, LM318 195, LM324 68, LM339 70, LM348 90, LM379 375, LM380 80, LM381 145, LM381AN 248, LM382 125, LM1458 50, LM3900 60, LM3909N 70, LM3911 125, M253AA 795, MC1304P 260, MC1310 149, MC1312P 195, MC1488 85, MC1489 90, MC1495 350, MC1496 92, MC1710 79, MC3340P 120, MC3360P 120, MC3401 52, MC3403 135, MFC6040 97, MK50362 670, MK50398 635, MM5303 635, MM5307 1275, NE518 210, NE543 210, NE544 185, NE555 22, NE556 660, NE560 325, NE561 395, NE562 410, NE564 425, NE565 120, NE566 160, NE567 170, NE571 420, SAD1024 1350, SN76003 170, SN76013 140, SN76023 140, SN76033 175, SN76477 225, TEAA621 250, TBA120F 70, TBA641 250, TCA965 120, TDA1008 310, TDA1022 575, TDA1024 105, TDA2020 320, TL061 76, TL074 199, TL081 48, TL082 96, TL083 105, TL084 130, UAA170 198, UAA180 198, ZN414 85, ZN424E 130, ZN425E 415, ZN1034 200

TRANSISTORS
AC125 20, AC126 20, AC127 20, AC128 20, AC141 24, AC142K 38, AC176 24, AC188 24, ACY17 35, ACY18 40, ACY19 40, ACY20 40, ACY21 35, ACY22 40, ACY28 40, ACY39 78, AD140 70, AD149 70, AD161 42, AD162 42, AF114 40, AF115 40, AF116 40, AF117 40, AF139 35, AF178 70, AF180 70, AF186 50, AF239 42, BC107 11, BC107B 11, BC108 11, BC108B 11, BC108C 12, BC109 11, BC109B 12, BC109C 12, BC117 20, BC119 23, BC137 20, BC140 35, BC142 30, BC143 30, BC147 8, BC148 8, BC149 8, BC153 27, BC154 27, BC157 10, BC158 11, BC159 11, BC160 42, BC167A 11, BC168C 12, BC169C 12, BC170 18

BC171 11, BC172 11, BC177 18, BC178 16, BC179 18, BC182 9, BC182L 11, BC183 9, BC183L 11, BC184 9, BC184L 11, BC187 28, BC212 10, BC212L 11, BC213 10, BC213L 12, BC214 12, BC214L 13, BC307B 20, BC328 15, BC338 15, BC441 36, BC461 36, BC547 25, BC548 13, BC549 13, BC557 15, BC558 20, BC559 20, BCY70 18, BCY71 20, BCY72 20, BD131 45, BD132 45, BD133 43, BD135 38, BD136 37, BD137 36, BD138 50, BD139 40, BD140 36, BD145 198, BD222 75, BD659A 65, BD696A 65, BDY17 195, BDY60 110, BDY61 165, BF115 34, BF154 29, BF156 29, BF167 30, BF173 24, BF177 24, BF178 25

BF179 30, BF180 35, BF194 12, BF195 12, BF196 12, BF197 14, BF198 18, BF200 30, BF224A 18, BF244 30, BF256 60, BF257 30, BF258 30, BF259 30, BF594 40, BF595 38, BFR39 25, BFR40 28, BFR41 28, BFR79 28, BFR80 28, BFR81 28, BFX29 28, BFX81 45, BFX84 26, BFX85 28, BFX86 28, BFX87 28, BFX88 28, BFY50 20, BFY51 20, BFY52 20, BFY71 20, BRY39 39, BSX20 18, BSY65 30, BSY95A 18, BU105 140, BU205 190, BU208 225, MJ491 160, MJ2955 120, MJE340 54, MJE370 58, MJE371 60, MJE2955 99, MJE3055 70, MPF102 66, MPF103 38, MPF104 36, MPF105 40, MPF106 40, MPSA05 25, MPSA06 25, MPSA12 42, MPSA55 25, MPSA56 25

MPSU06 56, MPSU56 60, OC26 170, OC28 150, OC35 130, OC36 130, OC41 48, OC42 48, OC43 55, OC44 31, OC45 28, OC46 28, OC70 28, OC71 28, OC72 42, OC76 36, OC77 76, OC81 50, OC82 50, OC83 48, OC84 44, OC140 110, OC170 85, OC171 75, OC202 95, TIP29 43, TIP29C 60, TIP30 47, TIP30C 65, TIP31 50, TIP31A 52, TIP31B 58, TIP31C 66, TIP32A 58, TIP32C 75, TIP33A 85, TIP33C 105, TIP34A 85, TIP34C 110, TIP35A 185, TIP35C 220, TIP36C 255, TIP41A 63, TIP41B 73, TIP42A 72, TIP42B 82, TIP2955 65, TIP3053 65, TIS43 34, TIS44 45, TIS90 20, TIS91 24, ZTX107 12, ZTX108 12, ZTX109 14, ZTX300 13, ZTX301 15

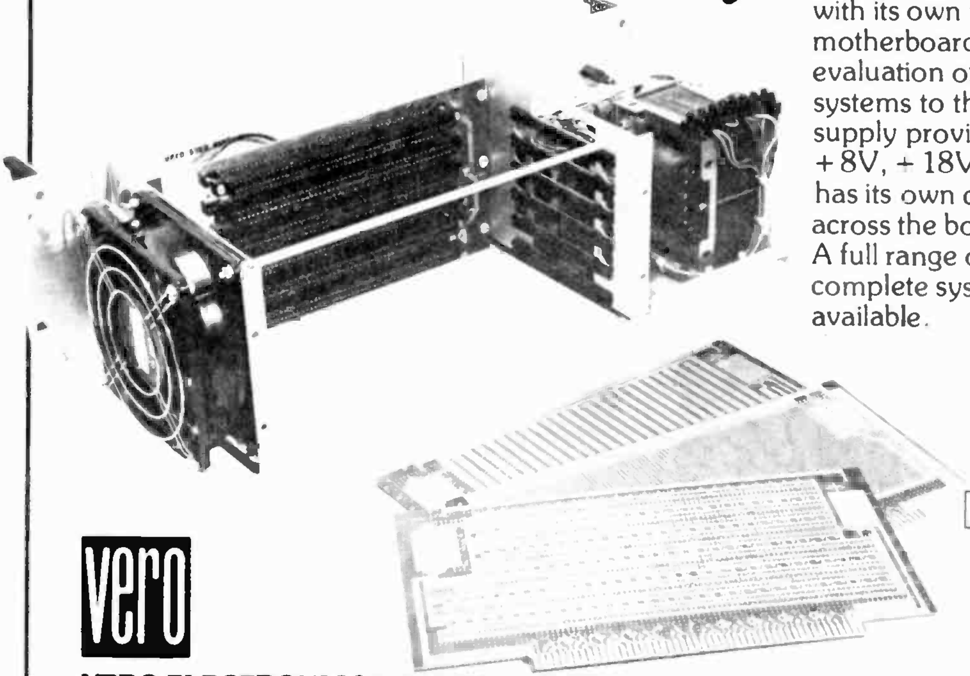
ZTX302 20, ZTX303 25, ZTX304 24, ZTX314 24, ZTX326 40, ZTX341 20, ZTX500 15, ZTX501 15, ZTX502 19, ZTX503 15, ZTX504 25, ZTX531 25, ZTX550 25, 2N526 58, 2N696 36, 2N697 25, 2N698 44, 2N699 54, 2N706 19, 2N708 19, 2N918 40, 2N930 18, 2N961 61, 2N1131 22, 2N1132 35, 2N1302 35, 2N1303 50, 2N1304 50, 2N1305 50, 2N1671B 215, 2N2160 350, 2N2219A 22, 2N2220A 25, 2N2222 20, 2N2369 15, 2N2476 125, 2N2484 25, 2N2646 48, 2N2894 30, 2N2904 22, 2N2905A 22, 2N2906 22, 2N2926G 10, 2N3053 20, 2N3054 55, 2N3055 48, 2N3121 40, 2N3133 43, 2N3135 33, 2N3250 20, 2N3442 140, 2N3663 26, 2N3702 11, 2N3703 11, 2N3704 14, 2N3705 11, 2N3706 11

2N3707 11, 2N3708 11, 2N3709 11, 2N3710 16, 2N3711 12, 2N3713 215, 2N3771 233, 2N3772 195, 2N3773 283, 2N3819 22, 2N3820 45, 2N3882 130, 2N3823 95, 2N3866 90, 2N3903 20, 2N3904 18, 2N3905 18, 2N3906 17, 2N4037 52, 2N4058 17, 2N4061 17, 2N4859 65, 2N5135 42, 2N5136 42, 2N5138 20, 2N5179 60, 2N5180 80, 2N5191 70, 2N5305 40, 2N5457 32, 2N5458 32, 2N5459 32, 2N5485 35, 2N5777 45, 2N6027 40, 3N128 112, 3N140 112, 40311 60, 40313 125, 40316 86, 40317 52, 40324 85, 40326 52, 40327 62, 40348 105, 40360 43, 40361 45, 40407 52, 40411 295, 40412 65, 40467 95, 40576 190, 40594 70, 40673 68

Matched pair add 20p per pair

S100-the British way

The Vero S100 Sub Rack is a 19" rack mountable development kit, complete with its own power supply and backplane motherboard, for the construction and evaluation of microprocessor based systems to the S100 format. The power supply provides three voltage levels — +8V, +18V and -18V. The Sub Rack has its own cooling fan providing airflow across the boards and the power supply. A full range of allied items to enable a complete system to be constructed are available.

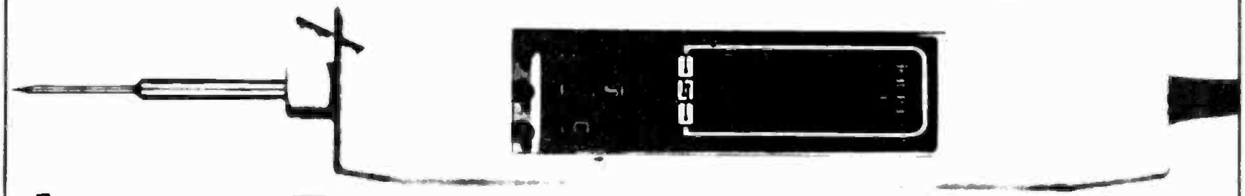


ORDER CODE	ITEM DESCRIPTION
188-2341H	S100 Sub Rack
06-0095L	S100 Dip Board
06-2337L	S100 High Density Board
06-2338F	S100 Square Pad Board
15-1630K	Compatible Connector (Solderlug)
15-1632L	Compatible Connector (Miniwrap)
09-2340H	S100 Extender Board
48-8345K	Mk. II D Series Case
75-2867G	Keyboard Console
79-1729L	Verowire Wiring Kit

vero

VERO ELECTRONICS LTD RETAIL DEPT.
Industrial Estate, Chandler's Ford,
Hampshire SO5 3ZR
Tel: (04215) 2956

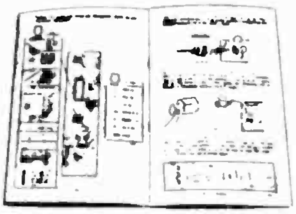
Guess who builds this great



Logic Probe...YOU! for only £11.92

With this easy-to-build Logic Probe Kit from CSC and just a few hours of easy assembly—thanks to our very descriptive step-by-step manual—you have a full performance logic probe.

With it, the logic level in a digital circuit is indicated by light from the Hi or Lo LED; pulses as narrow as 300 nanoseconds are stretched into blinks of the Pulse LED, triggered from either leading edge. You'll be able to probe deeper into logic with the LPK-1, one of the better tools from CSC.



Complete, easy-to-follow instructions help make this a one-night project.

CONTINENTAL SPECIALTIES CORPORATION

CSC

EUROPE, AFRICA, MID EAST: CSC UK LTD. Dept. 4Z
Shire Hill Industrial Estate Units 1 and 2
Saffron Walden, Essex CB 11 3AQ
Telephone: SAFFRON WALDEN (0799) 21682
TLX 817477

CONTINENTAL SPECIALITIES CORPORATION. DEPT. 4Z
Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex.

Name ____________________

Address ____________________

Inc P&P and 15% VAT
LPK-1 £14.86

I enclose cheque/
PO for £ ____________

FREE Catalogue
tick box ☐

Phone your order with Access, Barclaycard or American Express Card No. ____________ Expiry date ____________

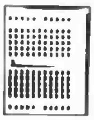
Send your orders to:-
DEPT. EE10, PO BOX 6, WARE, HERTS. Tel: 0920-3182
Visit our NEW shop: 3 BALDOCK ST., WARE, HERTS. Telex: 81786

EXPERIMENTOR BREADBOARDS FROM CSC

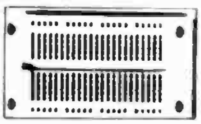
No soldering modular breadboards, simply plug components in and out of letter number identified nickel-silver contact holes. Start small and simply snap-lock boards together to build breadboard of any size.

All EXP Breadboards have two bus-bars as an integral part of the board, if you need more than 2 buses simply snap on 4 more bus-bars with the aid of an EXP.4B.

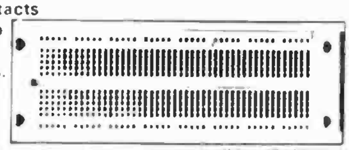
EXP.325. The ideal breadboard for 1 chip circuits. Accepts 8, 14, 16 and up to 22 pin IC's **ONLY £1·70**



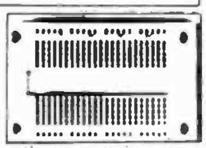
EXP.350. £3·73
270 contact points with two 20-point bus-bars.



EXP.300. 550 contacts with two 40-point bus-bars. **£6·13**



EXP.650 for Micro-processors. **£3·83**



EXP.4B. More bus-bars. **£2·45**

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

DIODES

Type	Price	Type	Price	Type	Price	Type	Price
AA110	£0·09	BY100	£0·25	BYZ11	£0·52	OA90	£0·11
AA120	£0·09	BY101	£0·25	BYZ12	£0·46	OA91	£0·11
AA129	£0·09	BY105	£0·25	BYZ13	£	OA95	£0·11
AAY30	£0·10	BY114	£0·25	BYZ16	£0·47	OA182	£0·15
AAZ13	£0·17	BY124	£0·25	BYZ17	£0·41	OA200	£0·09
BA100	£0·11	BY126	£0·17	BYZ18	£0·41	OA202	£0·09
BA102	£0·37	BY127	£0·18	BYZ19	£0·41	SD10	£0·07
BA148	£0·17	BY128	£0·18	OA5	£0·69	SD19	£0·07
BA154	£0·14	BY130	£0·19	OA10	£0·40	IN34	£0·08
BA155	£0·16	BY133	£0.24	OA47	£0·09	IN34A	£0·08
BA173	£0·17	BY164	£0·58	OA70	£0·09	IN914	£0·07
BB104	£0·17	BY176	£0·86	OA79	£0·11	IN916	£0·07
BAX13	£0·08	BY206	£0·34	OA81	£0·11	IN4148	£0·07
BAX16	£0·09	BYZ10	£0.51	OA85	£0·11	IS44	£0·06
						IS920	£0·07

CASES AND BOXES

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

No.	Length	Width	Height	Price
155	8in	5½in	2in	£1·72
156	11in	6in	3in	£2·92
157	6in	4½in	1½in	£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	2½in	1½in	£0·85
160	4in	4in	1½in	£0·85
161	4in	2½in	1½in	£0·85
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	£1·82
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	2½in	12in	3½in	8in	£5·45
168	2½in	7¼in	4in	16in	4½in	11in	£8·21

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	£4·14
171	140mm	75mm	205mm	£4·62
172	140mm	110mm	205mm	£6·00

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 **£7·79**

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**

CARBON RESISTOR PAKS

These paks contain a range of Carbon Resistors assorted into the following groups

16213	60 mixed 1 8w 100ohms-920ohms	£0·69
16214	60 mixed 1/8w 1Kohms-82Kohms	£0·69
16215	60 mixed 1/8w 10Kohms-83Kohms	£0·69
16216	60 mixed 1/8w 100Kohms-820Kohms	£0·69
16217	40 mixed 1/2w 100ohms-820ohms	£0·69
16218	40 mixed 1/2w 1Kohms-82Kohms	£0·69
16219	40 mixed 1/2w 10Kohms-82Kohms	£0·69
16220	40 mixed 1/2w 100Kohms-820Kohms	£0·69

CERAMIC PAKS

16160	24 3 of each value 22pf 27pf 33pf 39pf 47pf 68pf	£0·69
16161	24 3 of each value 100pf 120pf 150pf 180pf 220pf 270pf 330pf	£0·69
16162	24 3 of each value 470pf 560pf 680pf 1000pf 1500pf 2200pf 3300pf	£0·69
16163	24 3 of each value 4700pf 6800pf 01uf 015uf 022uf 033uf 047uf	£0·69

ELECTROLYTIC PAKS

16201	values from 47mfd – 10mfd	£0·69
16202	values from 10mfd – 100mfd	£0·69
16203	values from 100mfd – 680mfd	£0·69

COMPONENT PAKS

[illegible]	[illegible] ...tors mixed value approx (count by [illegible]	£0·69
[illegible]	[illegible] mixed value approx (count by [illegible]	£0·69
[illegible]	[illegible] 2w resistors mixed values	£0·69
16168	5 [illegible] assorted ferrite rods	£0·69
16169	2 tuning gangs MW LW VHF	£0·69
16170	1 pack wire 50 metres asssorted colours single strand	£0·69
16171	10 reed switches	£0·69
16172	3 micro switches	£0·69
16173	15 assorted pots	£0·69
16175	30 paper condensers mixed values	£0·69
16176	20 electrolytics trans types	£0·69
16177	1 pack assorted hardware – nuts, bolts gromets etc	£0·69

BOOKS BY BABANI

BP6	Engineers & Machinists Ref. Tables	40p
BP14	2nd book Transistor Equivs & Subs	£1·10
BP22	79 Electronic Novelty Circuits	75p
BP24	52 Projects Using IC741 (or Equiv)	75p
BP26	Radio Antenna Book Long Distance Reception & Transmission	85p
BP27	Giant Chart of Radio Electronic Semiconductor & Logic Symbols	60p
BP32	Build Metal & Treasure Locatore	85p
BP34	Practical Repair/Renovation C/TV	95p
BP35	Handbook of IC Audio Preamplifier & Power Amplifier Construction	95p
BP36	50 Cicts use Germ/Sil/Zener Diodes	75p
BP37	50 Projects Using Relays/SCR/Triacs	£1·10
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	75p
BP43	How to make Walki Talkies	£1·25
BP44	IC 555 Timer Projects	£1·45
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	85p
BP202	Handbook of Integrated Circuits Equivalents & Substitutes	75p
BP205	1st Book Hi-Fi Speaker Enclosures	75p
BP213	Circuits for Model Railways	85p
BP215	Shortwave Circuits & Gear for Experiments & Radio Hams	85p
BP216	Electronic Gadgets & Games	85p
BP217	Solid State Power Supply Handbook	85p
BP221	28 Tested Transistor Projects	95p
BP222	Short-wave Receivers for Beginners	95p
BP223	50 Projects using IC CA3130	95p
BP224	50 CMOS IC Projects	95p
BP225	A Practical intro to Digital IC s	95p
BP226	Build Advanced Short-wave Receivers	£1·20
BP227	Beginners Guide to Building Electronic Projects	£1·25

REGULATORS

Positive	Price
uA7805 TO220	£0·85
uA7812 TO220	£0·85
uA7815 TO220	£0·85
uA7824 TO220	£0·85
uA7818 TO220	£0·85
Negative	
uA7905 TO220	£0·92
uA7912 TO220	£0·92
uA7915 TO220	£0·92
uA7924 TO220	£0·92
uA7818 TO220	£0·92
72723 14 pin DN	£0·52
uA723C TO99	£0·52
LM309K TO3	£1·72

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

CASSETTES

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

TRIACS

2 amp TO5 case

volts	No	Price
100	TR12A/100	£0·36
200	TR12A 200	£0·59
400	TR12A/400	£0·82

6 amp

volts	No	Price
100	TR16A 100	£0·59
200	TR16A/200	£0·70
400	TR16A/400	£0·88

10 amp

volts	No	Price
100	TR110A/100	£0·88
200	TR110A/200	£1·06
400	TR110A/400	£1·29

10 amp

volts	No	Price
400	TR110A 400P	£1·29

DIACS
BR100 £0·23 032 £0·23

ZENER DIODES

400 mw (BzyBB) 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**

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**

JUST QUOTE YOUR ACCESS OR BARCLAYCARD NO.

BARCLAYCARD VISA

BI-PAK SEMICONDUCTORS,

TRANSISTORS

Type	Price
AC126	£0.21
AC127	£0.21
AC128	£0.18
AC128K	£0.30
AC132	£0.23
AC134	£0.23
AC137	£0.23
AC141	£0.25
AC141K	£0.35
AC142	£0.23
AC176	£0.21
AC176K	£0.30
AC178	£0.29
AC179	£0.29
AC180	£0.23
AC180K	£0.32
AC181	£0.23
AC181K	£0.32
AC187	£0.21
AC187K	£0.32
AC188	£0.21
AC188K	£0.32
AD140	£0.69
AD142	£0.98
AD143	£0.86
AD149	£0.69
AD161	£0.40
AD162	£0.40
AD161/162MP	£0.81
AF124	£0.35
AF125	£0.35
AF126	£0.35
AF127	£0.37
AF139	£0.40
AF186	£0.58
AF239	£0.47
AL102	£1.38
AL103	£1.36
AU104	£1.61
AU110	£1.61
AU113	£1.61
BC107A	£0.09
BC107B	£0.10
BC107C	£0.12
BC108A	£0.09
BC108B	£0.11
BC108C	£0.12
BC109A	£0.09
BC109B	£0.10
BC109C	£0.12
BC147	£0.08

Type	Price
BC148	£0.08
BC149	£0.08
BC157	£0.12
BC158	£0.12
BC159	£0.12
BC167	£0.14
BC168	£0.14
BC169	£0.10
BC169C	£0.12
BC170	£0.10
BC171	£0.10
BC172	£0.10
BC173	£0.10
BC177	£0.18
BC178	£0.18
BC179	£0.18
BC180	£0.29
BC181	£0.10
BC182L	£0.10
BC183	£0.10
BC183L	£0.10
BC184	£0.10
BC207	£0.13
BC208	£0.13
BC209	£0.14
BC212	£0.10
BC212L	£0.10
BC213	£0.10
BC213L	£0.10
BC214	£0.10
BC214L	£0.10
BC227	£0.18
BC238	£0.10
BC251	£0.17
BC251A	£0.18
BC301	£0.32
BC302	£0.33
BC303	£0.32
BC304	£0.44
BC327	£0.18
BC328	£0.17
BC337	£0.17
BC338	£0.17
BC440	£0.35
BC441	£0.35
BC460	£0.44
BC461	£0.44
BC477	£0.23
BC478	£0.23
BC479	£0.23
BC547	£0.12
BC548	£0.12

Type	Price
BC549	£0.12
BC550	£0.16
BC556	£0.16
BC557	£0.15
BC558	£0.14
BC559	£0.16
BD115	£0.58
BD116	£0.92
BD121	£0.75
BD124	£0.81
BD131	£0.40
BD132	£0.40
BD133	£0.46
BD135	£0.44
BD136	£0.40
BD137	£0.40
BD138	£0.41
BD139	£0.41
BD140	£0.41
BD155	£0.92
BD175	£0.69
BD176	£0.69
BD177	£0.78
BD178	£0.78
BD179	£0.86
BD203	£0.92
BD204	£0.92
BDY20	£0.92
BF457	£0.43
BF458	£0.43
BF459	£0.44
BF594	£0.35
BF596	£0.32
BFR39	£0.28
BFR40	£0.29
BFR79	£0.32
BFR80	£0.32
BFX29	£0.25
BFX30	£0.35
BFX84	£0.25
BFX85	£0.28
BFX86	£0.29
BFX87	£0.25
BFX88	£0.25
BFY50	£0.18
BFY51	£0.18
BFY52	£0.18
BIP19	£0.44
BIP20	£0.44
BIP19/20MP	£0.92
BRY39	£0.51

Type	Price
BU105	£1.84
BU105/02	£2.24
BU204	£1.61
BU205	£1.61
BU208/02	£2.58
MJE2955	£1.04
MJE3055	£0.69
MJE3440	£0.60
MPF102	£0.32
MPF104	£0.40
MPF105	£0.40
MPSA05	£0.23
MPSA06	£0.23
MPSA55	£0.23
MPSA56	£0.23
OC22	£1.73
OC23	£1.73
OC24	£1.55
OC25	£1.15
OC26	£1.15
OC28	£0.92
OC29	£1.09
OC35	£1.03
OC36	£1.03
OC70	£0.27
OC71	£0.17
TIC44	£0.33
TIC45	£0.40
TIP29A	£0.46
TIP29B	£0.48
TIP29C	£0.51
TIP30A	£0.46
TIP30B	£0.48
TIP30C	£0.50
TIP31A	£0.46
TIP31B	£0.48
TIP31C	£0.50
TIP32A	£0.46
TIP32B	£0.48
TIP32C	£0.50
TIP41A	£0.50
TIP41B	£0.52
TIP41C	£0.55
TIP42A	£0.50
TIP42B	£0.52
TIP42C	£0.55
TIP2955	£0.69
TIS43	£0.25
TIS90	£0.20
UT46	£0.23
ZTX107	£0.11

Type	Price
ZTX108	£0.11
ZTX109	£0.11
ZTX300	£0.13
ZTX500	£0.14
2N1613	£0.23
2N1711	£0.23
2N1889	£0.51
2N1890	£0.51
2N1893	£0.35
2N2147	£0.86
2N2148	£0.81
2N2160	£1.15
2N2192	£0.44
2N2193	£0.44
2N2194	£0.44
2N2217	£0.25
2N2218	£0.25
2N2218A	£0.23
2N2219	£0.23
2N2219A	£0.25
2N2904	£0.23
2N2904A	£0.24
2N2905	£0.20
2N2905A	£0.23
2N2906	£0.18
2N2906A	£0.21
2N2907	£0.23
2N2907A	£0.25
2N2926G	£0.10
2N2926Y	£0.09
2N2926O	£0.09
2N2926R	£0.09
2N2926B	£0.09
2N3053	£0.18
2N3054	£0.46
2N3055	£0.46
2N3614	£1.15
2N3615	£1.21
2N3616	£1.21
2N3646	£0.10
2N3702	£0.09
2N3703	£0.09
2N3704	£0.08
2N3705	£0.08
2N3706	£0.09
2N3707	£0.09
2N3708	£0.08
2N3709	£0.08
2N3710	£0.08
2N3711	£0.08
2N3819	£0.21
2N3820	£0.40

THYRISTORS

1 amp	TO 5 Case
Volts No	Price
50 THY1A/500	£0.29
100 THY1A/100	£0.32
200 THY1A/200	£0.36
400 THY1A/400	£0.43
600 THY1A/600	£0.51
800 THY1A/800	£0.66

3 amp	TO 66 Case
Volts No	Price
50 THY3A/50	£0.32
100 THY3A/100	£0.34
200 THY3A/200	£0.37
400 THY3A/400	£0.48
600 THY3A/600	£0.57
800 THY3A/800	£0.74

5 amp	TO 66 Case
Volts No	Price
50 THY5A/50	£0.41
100 THY5A/100	£0.51
200 THY5A/200	£0.57
400 THY5A/400	£0.65
600 THY5A/600	£0.79
800 THY5A/800	£0.93

7 amp	TO 48 Case
Volts No	Price
50 THY7A/50	£0.55
100 THY7A/100	£0.58
200 THY7A/200	£0.65
400 THY7A/400	£0.71
600 THY7A/600	£0.89
800 THY7A/800	£1.05

10 amp	TO 48 Case
Volts No	Price
50 THY10A/50	£0.58
100 THY10A/100	£0.65
200 THY10A/200	£0.71
400 THY10A/400	£0.80
600 THY10A/600	£1.13
800 THY10A/800	£1.40

16 amp	TO 48 Case
Volts No	Price
50 THY16A/50	£0.62
100 THY16A/100	£0.66
200 THY16A/200	£0.71
400 THY16A/400	£0.88
600 THY16A/600	£1.03
800 THY16A/800	£1.59

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
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
60 Amp	
IS70/50 50V	£0.86
IS70/100 100V	£0.96
IS70/200 200V	£1.38
IS70/400 400V	£2.01
IS70/600 600V	£2.58
IS70/800 800V	£2.87
IS70/1000 1000V	£3.45

OPTOELECTRONICS

LED'S (diffused)

O no.	Type	Price
1501	Size 125mm RED	£0.11
1502	Size 125mm GREEN	£0.21
1503	Size 125mm YELLOW	£0.21
1504	Size 2mm RED	£0.11
1505	Size 2mm GREEN	£0.21
1506	Size 2mm YELLOW	£0.21
1509	Size 2mm CLEAR	£0.12
SUPER 'Hi-Brite' Type		
1521	Size 3mm (125) RED	£0.11
1522	Size 5mm (2) RED	£0.11
1514	DRP12 Light dependant 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	£0.20

DISPLAYS

DL703 RED 7 segment D P left (30" height) common anode single digit O/NO 1523 **£0.80**

DL707 RED 7 segment D.P left (0 3" height) common anode single digit O/ND 1510 **£0.92**

DL527 RED 7 segment D.P left (0 50" height) common anode Two digit reflector O/NO 1524 **£1.95**

DL727 RED **7 segment D.P. right (510" height** common anode Two-digit light pipe O/NO 1521 **£2.53**

DL747 RED **7 segment D.P. left (630" height)** common anode Single-digit light pipe O/NO 1511 **£1.72**

OPTO-ISOLATORS

Isolation Breakdown – Voltage 1500 – continuous fwd current 100mA

CIL74 Single-channel 6 pin DIP standard type – optically coupled pair with infra red LED emitter and NPN silicon photo transistor O/NO 1497 **£0.57**

CILD74 Multi-channel 8 pin DIP two isolated channels O/NO: 1498 **£1.15**

CILQ74 Multi-channel 16 pin DIP four isolated channels D/ND: 1499 **£2.53**

2nd GRADE LED PAK

A pack of 10 standard sizes and colours which fail to perform to their very rigid specification, but which are ideal for amateurs who do not require the full spec. O/NO 1507 **£1 04**

74 SERIES TTL ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
7400	£0.10	7427	£0.27	7472	£0.23	74105	£0.43	74163	£0.71
7401	£0.12	7428	£0.29	7473	£0.28	74107	£0.27	74164	£0.78
7402	£0.12	7430	£0.12	7474	£0.28	74110	£0.41	74165	£0.78
7403	£0.12	7432	£0.25	7475	£0.33	74111	£0.66	74166	£0.89
7404	£0.12	7433	£0.34	7476	£0.28	74118	£0.92	74174	£0.74
7405	£0.12	7437	£0.25	7480	£0.50	74119	£1.35	74175	£0.71
7406	£0.25	7438	£0.24	7481	£0.97	74121	£0.27	74176	£0.66
7407	£0.25	7440	£0.13	7482	£0.78	74122	£0.44	74177	£0.66
7408	£0.14	7441	£0.57	7483	£0.66	74123	£0.46	74180	£1.72
7409	£0.14	7442	£0.46	7484	£1.01	74136	£0.59	74181	£0.66
7410	£0.12	7443	£0.80	7485	£0.78	74141	£0.63	74182	£0.80
7411	£0.19	7444	£0.80	7486	£0.25	74145	£0.63	74184	£0.80
7412	£0.17	7445	£0.74	7489	£1.95	74150	£0.78	74190	£0.78
7413	£0.27	7446	£0.69	7490	£0.36	74151	£0.65	74191	£0.71
7414	£0.57	7447	£0.55	7491	£0.73	74153	£0.56	74192	£0.69
7416	£0.26	7448	£0.64	7492	£0.40	74154	£0.94	74193	£0.66
7417	£0.26	7450	£0.12	7493	£0.34	74155	£0.57	74194	£0.71
7420	£0.12	7451	£0.12	7494	£0.86	74156	£0.57	74195	£0.69
7421	£0.23	7453	£0.12	7495	£0.57	74157	£0.57	74196	£1.20
7422	£0.18	7454	£0.12	7496	£0.57	74160	£0.66	74197	£1.20
7423	£0.24	7460	£0.12	74100	£0.97	74161	£0.71	74198	£2.12
7425	£0.21	7470	£0.28	74104	£0.44	74162	£0.71	74199	£2.12
7426	£0.26								

CMOS ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0.16	CD4015	£0.87	CD4026	£1.38	CD4043	£1.01	CD4070	£0.19
CD4001	£0.17	CD4016	£0.48	CD4027	£0.57	CD4044	£0.94	CD4071	£0.19
CD4002	£0.18	CD4017	£0.86	CD4028	£0.78	CD4045	£1.61	CD4072	£0.19
CD4006	£1.05	CD4018	£0.97	CD4029	£0.97	CD4046	£1.49	CD4081	£0.19
CD4007	£0.19	CD4019	£0.48	CD4030	£0.55	CD4047	£1.00	CD4082	£0.20
CD4008	£1.05	CD4020	£1.03	CD4031	£2.30	CD4049	£0.48	CD4510	£1.13
CD4009	£0.51	CD4021	£0.94	CD4035	£1.15	CD4050	£0.48	CD4511	£1.09
CD4010	£0.55	CD4022	£0.94	CD4037	£1.09	CD4054	£1.26	CD4516	£1.15
CD4011	£0.17	CD4023	£0.17	CD4040	£1.01	CD4055	£1.15	CD4518	£1.15
CD4012	£0.18	CD4024	£0.74	CD4041	£0.87	CD4056	£1.55	CD4520	£1.15
CD4013	£0.48	CD4025	£0.17	CD4042	£0.82	CD4069	£0.19	CD4014	£0.92

LINEAR ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CA3011	£0.92	CA3130	£1.06	MC1350	£1.38	UA710C	£0.48	SN76115	£2.18
CA3014	£1.55	CA3140	£0.80	MC1352	£1.61	72710	£0.34	SN76660	£0.86
CA3018	£0.74	LM301	£0.33	MC1469	£3.39	UA711C	£0.36	SL414A	£2.24
CA3020	£1.95	LM304	£1.84	MC1496	£1.03	72711	£0.36	TAA550B	£0.80
CA3028	£0.92	LM308	£1.15	NE536	£3.05	UA723C	£0.52	TAA621A	£2.30
CA3035	£1.61	LM309	£1.72	NE550	£1.09	72723	£0.52	TAA621B	£2.87
CA3036	£1.15	LM320 5V	£1.72	NE555	£0.27	UA741C	£0.27	TAA661	£1.72
CA3042	£1.72	LM320-12V	£1.72	NE556	£0.69	72741	£0.27	TAD100	£1.49
CA3043	£2.12	LM320-15V	£1.72	NE565	£1.38	741P	£0.23	TBA540	£2.41
CA3046	£0.80	LM320-24V	£1.72	NE566	£1.38	UA7447C	£0.69	TBA810S	£0.86
CA3052	£1.84	LM380	£0.97	NE567	£1.95	72747	£0.69	TBA810	£1.12
CA3054	£1.26	LM381	£1.66	UA702C	£0.52	UA748	£0.40	TBA820	£0.80
CA3075	£1.72	LM3900	£0.66	72702	£0.52	72748	£0.40	TBA9200	£2.87
CA3081	£1.72	MC1303L	£0.97	UA703	£0.52	748P	£0.40	TCA270S	£2.30
CA3089	£2.30	MC1304	£2.18	UA709	£0.28	SN76013N	£2.01	TBA800	£0.92
CA3090	£4.14	MC1310	£1.09	72709	£0.52	SN76023	£2.01		
CA3123	£2.18	MC1312	£2.18	709P	£0.28	SN76110	£1.72		

AUDIO MODULES

Amplifiers

AL20	5 watt amplifier module	£3.73
AL30A	7-10 watt amplifier module	£4.35
AL60	15-25 watt amplifier module	£5.39
AL80	35 watt amplifier module	£8.44
AL120	50 watt amplifier module	£13.74
AL250	125 watt amplifier module	£19.24
Pre-amplifiers		
PA12	Stereo pre-amplifier module	£8.94
PA100	Stereo pre-amplifier module	£18.45
PA200	Stereo pre-amplifier module	£19.07
Power Supplies		
PS12	Power supply (24 volts DC)	£1.72
SPM80	Stabilised power supply (33V)	£5.06
SPM120/45	Stabilised power supply (45V)	£6.67
SPM120/55	Stabilised power supply (55V)	£6.67
SPM120/65	Stabilised power supply (65V)	£6.67
SG30	Power supply for equaliser	£4.37
Miscellaneous		
MPA30	Stereo magnetic cartridge pre-amp	£4.42
S450	Stereo tuner	£26.72
Stereo 30	Complete 7 watt stereo amplifier board	£22.66
BP124	Siren alarm module 5 watts	£4.02
GE100MKII	10 channel mono graphic equaliser	£23.00

SOCKETS

1611	8 pin DIL	£0.09
1612	14 pin DIL	£0.11
1613	16 pin DIL	£0.12
1720	18 pin DIL	£0.18
1721	20 pin DIL	£0.20
1722	22 pin DIL	£0.22
1614	24 pin DIL	£0.24
1615	28 pin DIL	£0.26
1723	40 pin DIL	£0.34
1616	TO18 transistor	£0.13
1617	TO3 transistor	£0.37
16117	TO5 transistor	£0.13
1726	14 pin DIL Wire wrap gold plated Cambion	£0.25

G.P. SWITCHING TRANSISTORS

TO18 sim to 2N706/8 BSY27/28/95A ALL usable devices no open & shorts ALSO available in PNP sim to 2N290/BCY70
20 for **57p** – 50 for **£1.15** – 100 for **£2.07** – 500 for **£9.20** – 1,000 for **£16.10** – when ordering state NPN/PNP

SILICON DIODES G.P.

300mW 40PIV (min) sub min FULLY TESTED ideal for Organ builders.
30 for **57p** – 100 for **£1.72** – 500 for **£5.75** – 1,000 for **£10.35**.

METAL FOIL CAPACITOR PAK

Containing 50 metal foil capacitor – like Mullard C280 series – mixed values ranging for 01uf-2 2uf. Complete with identification sheet O/NO 16204 **£1.38**.

JUMBO PAK SEMICONDUCTOR

16222 – Transistors Germ and Silicon Rectifiers-Diodes-Triacs-Thyristors-ICs and Zeners ALL NEW & CODED. Approx 100 pieces offering the amateur a fantastic bargain PAK and an enormous saving **£2.58**.

ALL PRICES INCLUDE VAT. ADD 35p POST PER ORDER

Projects... Theory...

and Popular Features...

The poor old British public must be punch drunk from the ceaseless bombardment of silicon chips it is receiving from the news media. One day this strangely named little device is going to be the saviour of all mankind; the next, it has turned into a frightening villain hell-bent on depriving most of us of our jobs.

The truth is probably less awesome than either of these extremes. On balance the onward march of high technology must be to the advantage of all. There is nothing mystic about this. It's just economics. This wonderful capability of great computing power within extremely small physical confines—which is really what is implied when the term "silicon chip" is bandied about—must be deployed in vast quantities to be commercially viable, and to recover the large outlay incurred during its development. Expanding markets are essential. This means customers sufficiently affluent to purchase the mass produced articles or services that arise from the economic use of this high technology.

It is also reassuring to remember that this high technology can be cut down to size. The most powerful computer is only a conglomerate of electronic circuits. These basic circuits are universally known and perform in a well understood and predictable manner.

Such basic circuits or "building blocks" can be made up from discrete, or separate, parts such as transistors, diodes, resistors and capacitors—the most commonplace of all electronic components. Or they may be manufactured as a single package, within one tiny slice of silicon, as an integrated circuit. The ultimate size of an integrated circuit knows no bounds, as witness the single-chip computer which has become commonplace.

If you understand the principle of the basic semiconductor devices, the diode and the transistor, you hold the key to the more advanced circuits. For it is all a matter of degree.

The rudiments of electronics are not difficult to master, even by those with no technical training. In short, electronics is an ideal subject for private study practically anywhere.

But study must be methodical if it is to bring results and this is where our new beginners series *Teach In 80* provides the answer. We warmly welcome all newcomers who embark on this course of instruction. Soon you will discover what an exciting world you are entering and you can anticipate hours of pleasure in building projects as a practical extension to your study of first principles in *Teach In 80*.

Our November Issue will be published on Friday, October 19. ***See page 657 for details.***

Readers' Enquiries

We cannot undertake to answer readers' letters requesting modifications, designs or information on commercial equipment or subjects not published by us. All letters requiring a personal reply should be accompanied by a stamped self-addressed envelope.

We cannot undertake to engage in discussions on the telephone.

Component Supplies

Readers should note that we do not supply electronic components for building the projects featured in EVERYDAY ELECTRONICS, but these requirements can be met by our advertisers.

ELECTRONICS

VOL. 8 NO. 10 OCTOBER 1979

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

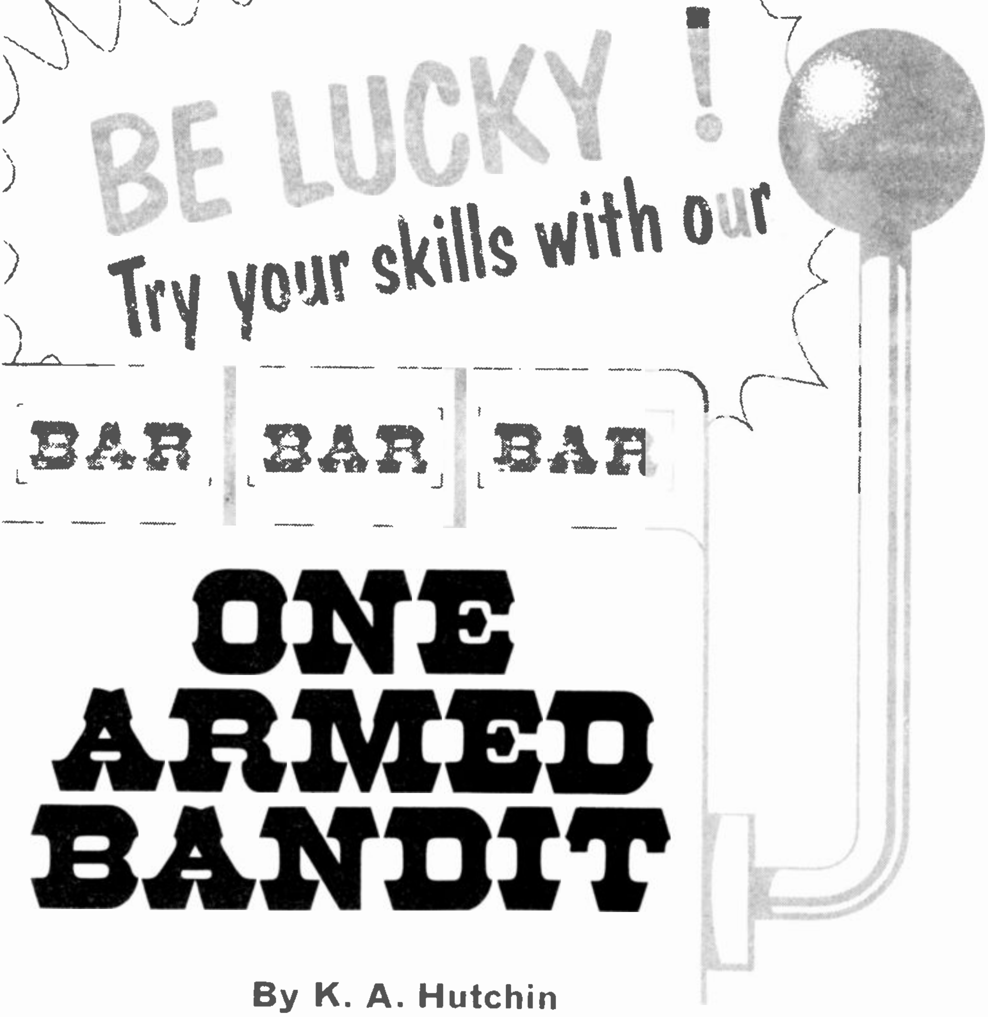
★ ***FREE WITH THIS ISSUE—CONSTRUCTORS' DATA*** *(24 page booklet)*

Back Issues
Certain back issues* of EVERYDAY ELECTRONICS are available worldwide price 70p inclusive of postage and packing per copy. Enquiries with remittance should be sent to Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. In the event of non-availability remittances will be returned.
* *Not available:* October 1978 to July 1979.

Binders
Binders to hold one volume (12 issues) are available from the above address for £3·75 (home and overseas) inclusive of postage and packing. Please state which Volume.

Subscriptions
Annual subscription for delivery direct to any address in the UK: £8·50, overseas: £9·50. Cheques should be made payable to IPC Magazines Ltd., and sent to Room 2613 Kings Reach Tower, Stamford Street, London SE1 9LS.

BE LUCKY! Try your skills with our



ONE ARMED BANDIT

By K. A. Hutchin

THE One Armed Bandit was designed for entertainment purposes, and therefore, no cash intake, or payout, was included. It has proved to be a popular attraction at a number of fêtes, mainly to younger children, who find it easy and fun to use. It can easily be seen when a winning combination occurs, and the possibility of one or more holds after a win makes it more exciting.

The author's family were using the unit one evening, one person acting as banker, collecting and paying out the money, whilst the other played as a punter. Mum was down to her last penny, when three "Bars" came up, and the unit then held for three goes.

The unit can be run from a battery or from the mains, via a suitable battery eliminator. The circuit consumes an average of 150mA at 9V.

CIRCUIT DIAGRAM

The complete circuit diagram of the One Armed Bandit is shown in Fig. 1. The circuit uses a combination of different i.c. families: TTL (IC2, 3, 4, 5, 6, 13), CMOS (IC8, 10, 12) and linear devices (IC1, 7, 9, 11).

The TTL i.c.s. require a 5V supply which is derived from the 9V supply by a simple Zener stabiliser, R1 and D1. This supply is also used for the linear devices. Although the CMOS devices could be powered by 5V, a higher voltage is required to cause the l.e.d.s to illuminate sufficiently to be seen; 9V was found to be adequate.

Transistors TR1, 2 and 3 are used for interfacing TTL to CMOS since the latter require input swings to pass through one- and two-thirds their supply voltage to trigger them. The transistors accomplish this.

DIODE REELS

There are three "reels" simulated by diodes D6 to D12, D13 to D19 and D20 to D26. Each reel has associated with it an astable multivibrator (eg. IC7) feeding a decade counter divider (IC8) via an interfacing transistor TR1. Only one of the seven used outputs is on at any one time, stepping sequentially on the receipt of each pulse from IC7. The eighth output is wired to the reset pin so that the output sequence runs from 0 to 7 and repeats for as long as pulses are received.

Pulses are fed from IC7 via G13a and these are transmitted to IC8 provided the level at pin 5 is logic 1 (high). This level is decided by the preceding logic sections. Thus any "reel" may be "held" stationary or caused to stop by causing the level at pin 5 (9 or 12) to go low. This logic circuitry is controlled by IC1 and can be set by switches S2 to S4.

LOGIC CIRCUITRY

IC1 is wired as an astable multivibrator having a time period ($1/f$) of approximately six seconds. This is the "reel spin" time.

When the unit is switched on, the flip-flop composed of gates G4b and G4c sets so that the output at pin 6, and hence the input to each "spin enable" gate G3b, G3c, G3d, is at logic 1 (high). The outputs are therefore low irrespective of the level at the other input. This prevents pulses from IC7 reaching IC8.

When the START button is pressed, flip-flop G4b/G4c resets and its output becomes low causing a high level at G13a pin 5, allowing IC8 to count.

After about six seconds, IC1 output (pin 3) falls which causes the flip-flop G4b/G4c to change state, placing a logic 1 at pin 3 (G36) producing a low output which halts the count in IC8. The "reel" comes to rest. Since the input to G3a pin 12 is now high, the astable multivibrator (IC1) output has no effect. The hold flip-flops are automatically reset by the negative going pulse from G4a when the reels stop spinning.

The changing levels of flip-flop G4b/G4c act as a pulse source for counter IC2 which provides the random hold facility. When the output at pin 9 is high (indicated by D2 illuminating) the three hold flip-flops can each be set by depressing the appropriate switch which sets a logic "1" on the inputs to gates G3b, G3c, or G3d. The result is a low output from any of these gates which prevents the appropriate astable from feeding

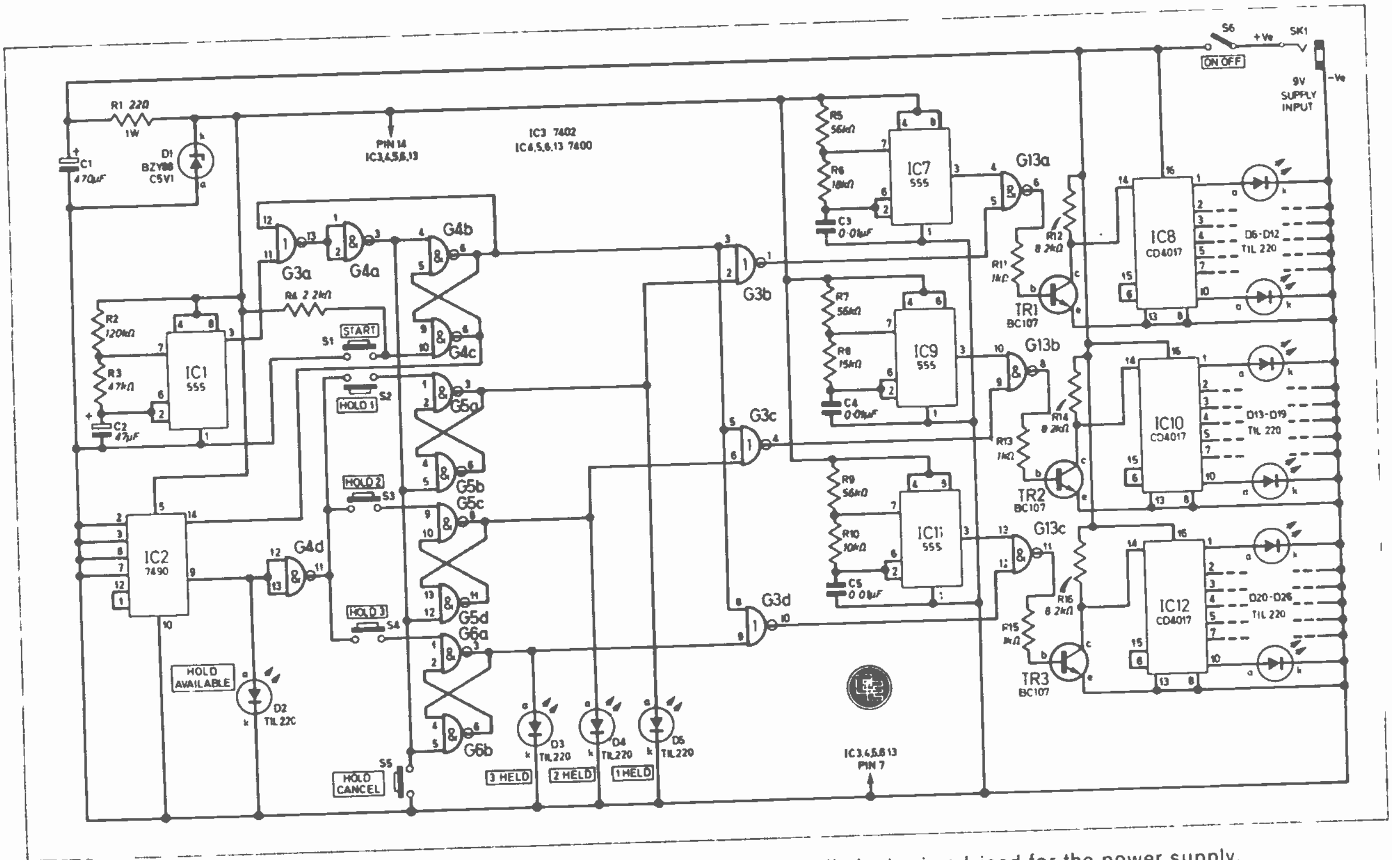


Fig. 1. The circuit diagram of the One Armed Bandit. A battery eliminator is advised for the power supply.

the counter. The l.e.d. position is thus "held" stationary.

Pressing S5 sets the outputs of all three hold flip-flops to logic "0" which allows the counters to count once the START button is pushed.

Random stray pulses cause the "held" flip-flops to set and prevent a reel from spinning unless cancelled by S5.

The three astables formed by IC7, 9, 11, operate at frequencies 770Hz, 780Hz and 820Hz respectively.

CIRCUIT BOARD

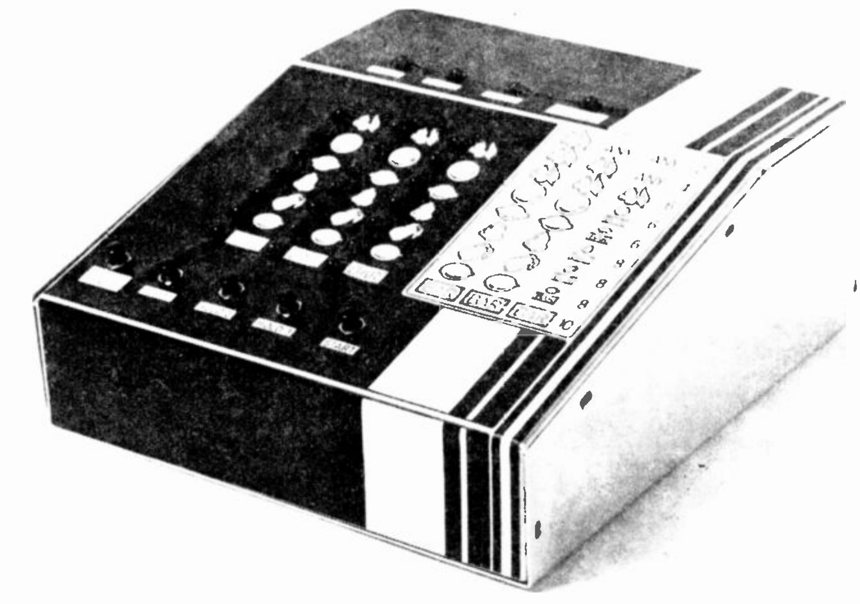
The prototype circuit was constructed on a single piece of stripboard that has 64 holes x 38 punched strips plus four unpunched strips which are used for mounting purposes.

For clarity, the topside view of the component board is shown in two stages, Fig. 2 showing components and tinned copper link wires (none crossing) with the second topside layout Fig. 4 showing the rest of the links to be made using p.v.c. covered wiring.

Begin by making the breaks on the underside and drilling the fixing holes as shown in Fig 2. Mount all the i.c.s, sockets only for IC8, 10, 12, followed by the "bare" link wires, resistors and finally capacitors. Do not insert the i.c.s in their sockets just yet.

With reference to Fig. 4, make the remaining links on the board. Use of wire with different insulation colours will help avoid mistakes and make checking easier. It is a good idea to tick off these connections as they are made.

The completed and labelled prototype.



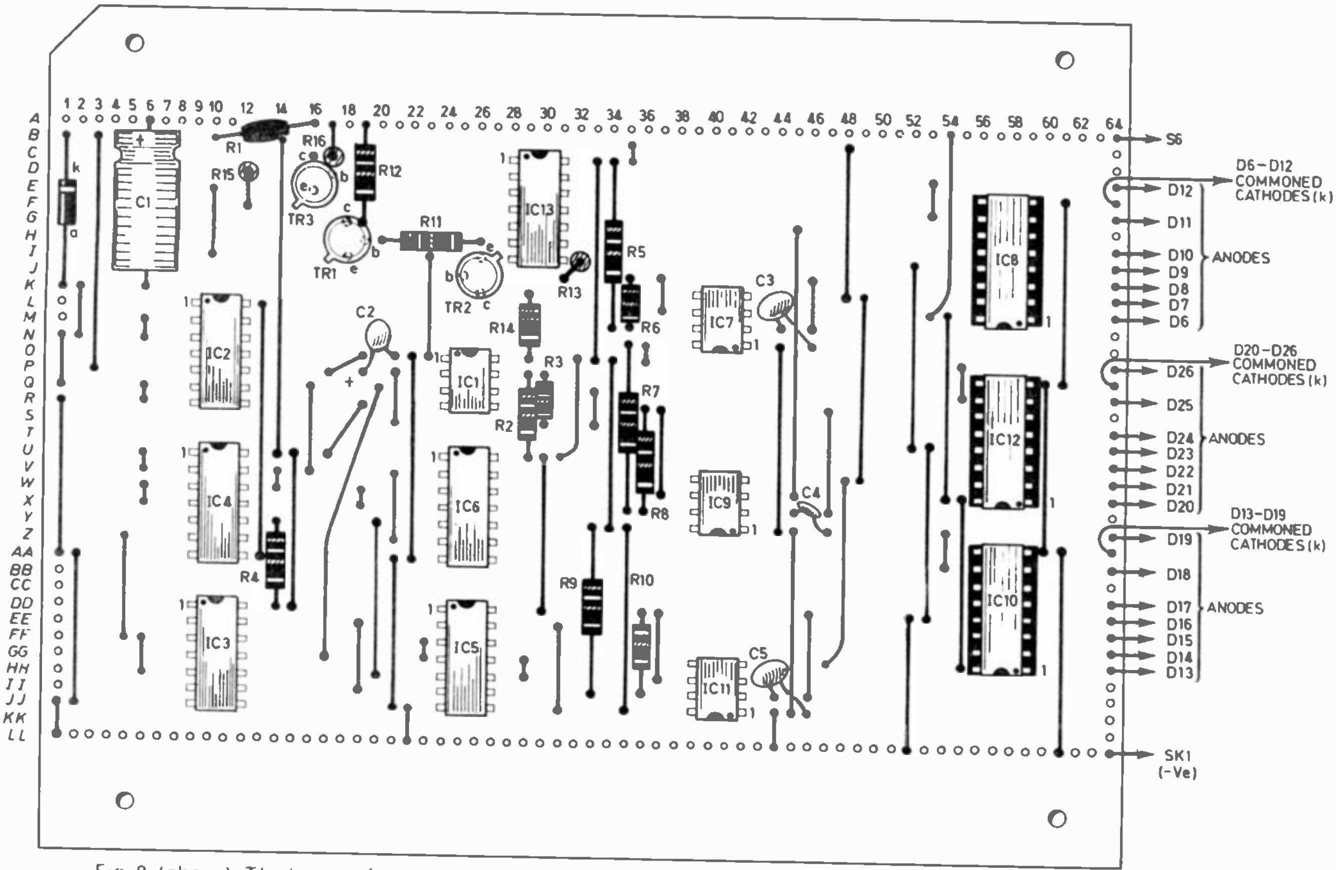
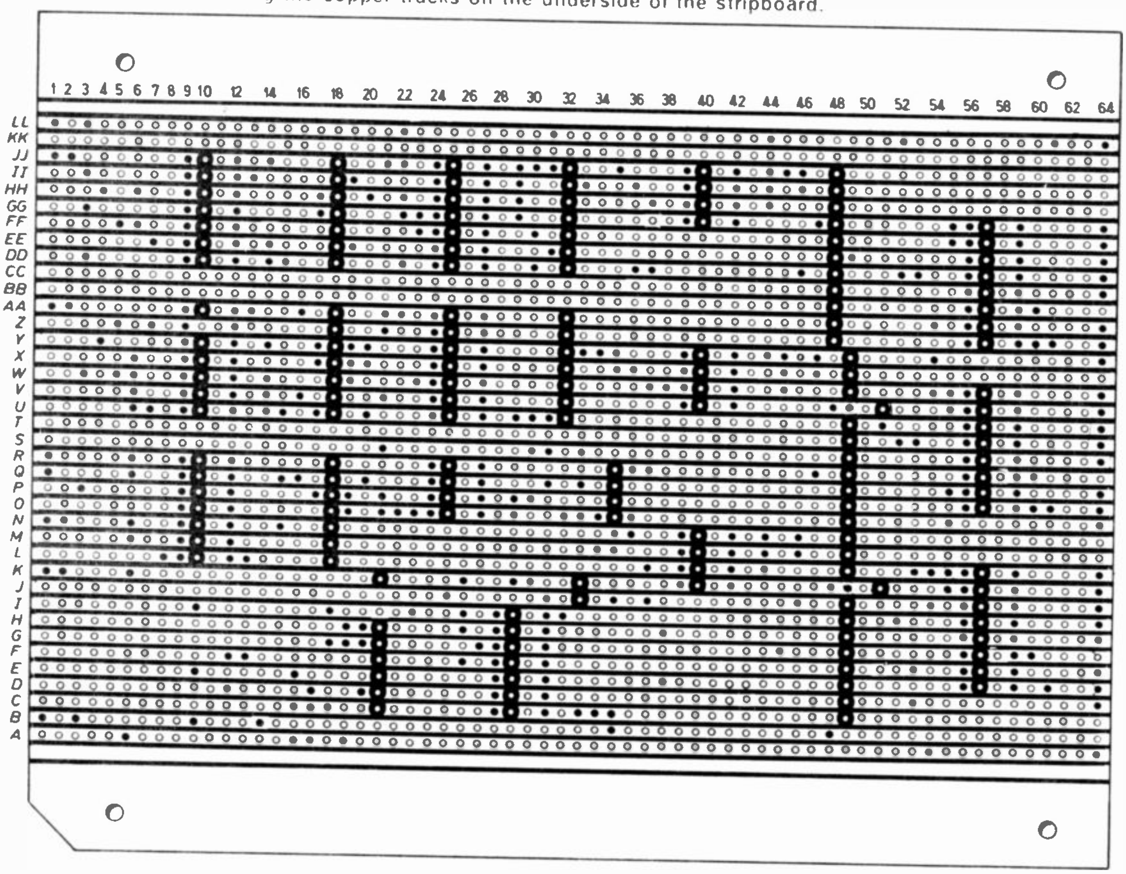
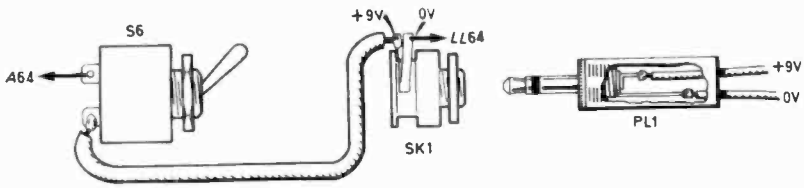


Fig. 2. (above). The layout of the components and the "bare" wire links on the topside of the board; (below) the breaks to be made along the copper tracks on the underside of the stripboard.





COMPONENTS approximate cost £13 excluding case

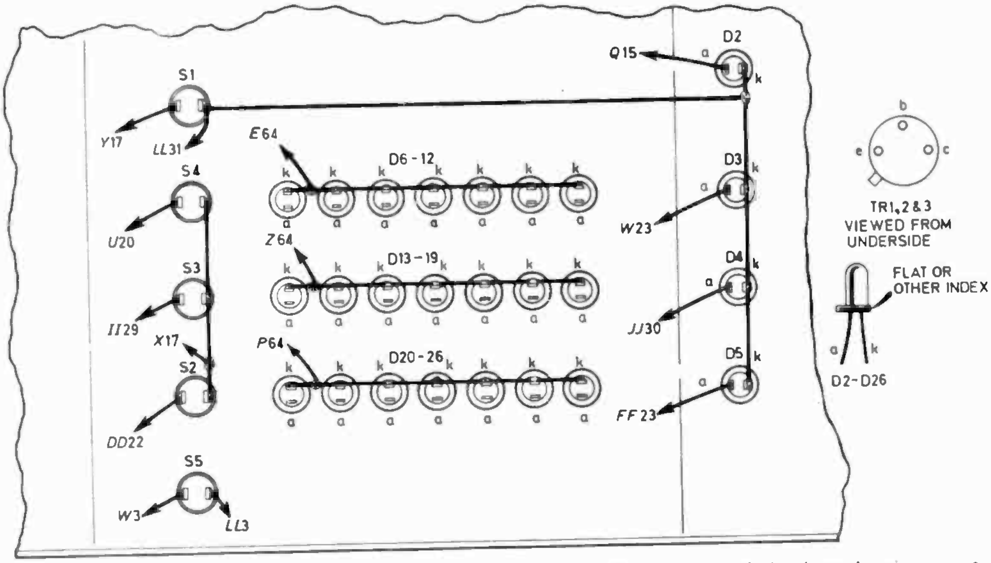
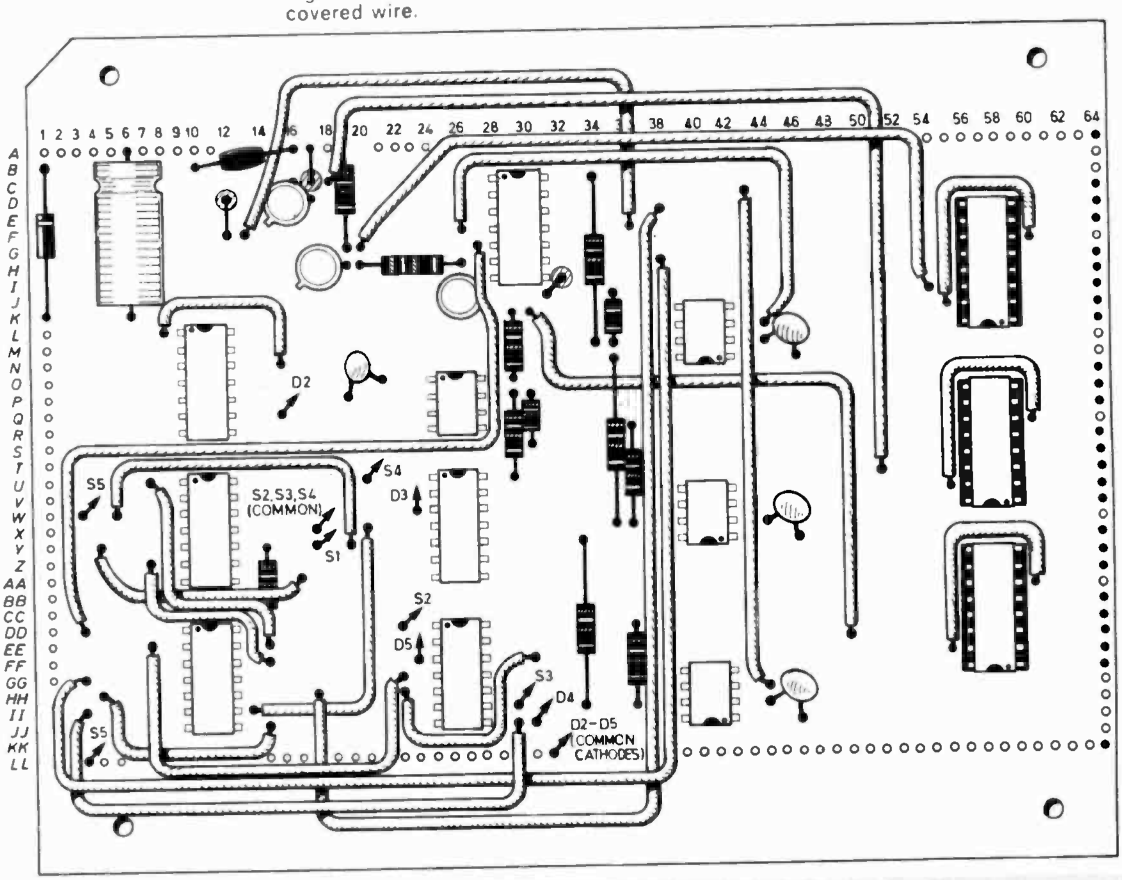
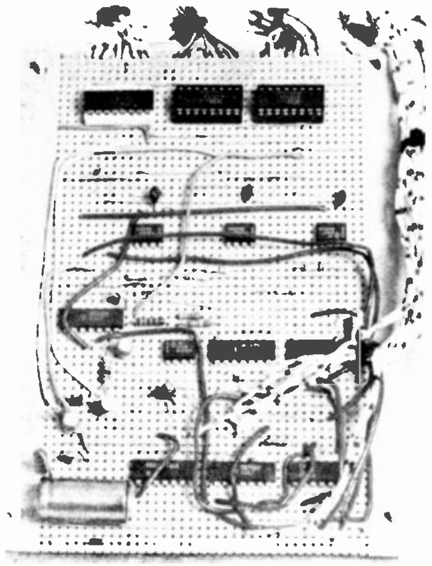


Fig. 3. (right). Underside view of the l.e.d.s and switches in position on the top panel showing interwiring details; (above) wiring of the on-off switch and power inlet socket located on the back panel of the unit. The order of connection to the individual diodes in each of the three columns is unimportant.

Fig. 4. Shows the interconnections to be made on the topside of the board using p.v.c. covered wire.





The finished prototype board sited in its case.

ASSEMBLY PROCEDURE

The prototype used a two-part aluminium sloping front box with base size 238 x 217mm and maximum height of 90mm, the base and two sides forming one section. The upper section holds all the l.e.d.s and switches, the integral back panel holding the on/off switch and power-in jack socket, Fig. 3.

Prepare the case to accept these components and secure in position. Carry out all the interwiring between these components including the common connection to the cathodes of the l.e.d.s.

Sufficient lengths of insulated wiring should next be connected to the board to reach the other components, and the board then secured to the case lower section (see photograph). In the prototype the board was supported by four bolts with two nuts acting as spacers to raise the board above the metal base. Place the two sections close together and wire up according to Figs. 3 and 4 to complete the unit.

TESTING

Although the unit can be powered by a PP9 9V battery, a 9V battery eliminator capable of supply 150mA is recommended. This should be terminated in a plug to suit SK1.

Do not insert the CMOS i.c.s in their sockets at this stage.

Connect a suitable supply, and switch on. Push the START button, wait for approximately 10 seconds and then push again. After a further 10 seconds, the HOLD AVAILABLE l.e.d. should light up. If it does, push the three HOLD buttons, and check that the correct HELD l.e.d. illuminates each time. Now press the HOLD CANCEL, and all the HELD l.e.d.s should extinguish.

If the HOLD AVAILABLE l.e.d. does not light, check the connections to the board, and also check to see if there is a small voltage across the l.e.d., or that the l.e.d. has not been wired in reverse. If this is not the case, check the operation of the flip-flop formed from gates G4b/G4c.

The output from G4c pin 8 should go to a high when the start button is pressed and revert to a low when the 555 ends its timing period. If this is working correctly, the fault lies with the 7490.

If the HOLD AVAILABLE l.e.d. lights but none of the held l.e.d.s light on pressing the appropriate buttons, check the operation of G4d, and the appropriate flip-flop.

Assuming all the circuitry to be working as described, the operation of the three oscillators, and their associated gates, should be checked. This is best accomplished by the use of a logic probe or an oscillator. A simple logic probe can be made from an l.e.d. wired

COMPONENTS

Resistors

R1	22Ω 1W	R6	18kΩ	R11	1kΩ
R2	120kΩ	R7	56kΩ	R12	8·2kΩ
R3	47kΩ	R8	15kΩ	R13	1kΩ
R4	2·2kΩ	R9	56kΩ	R14	8·2kΩ
R5	56kΩ	R10	10kΩ	R15	1kΩ
				R16	8·2kΩ

All ¼W carbon ± 5% except where stated otherwise

Capacitors

C1 470μF 10V elec.
C2 47μF 6V elect. or tantalum
C3,4,5 0·01μF disc ceramic (3 off)

Semiconductors

IC1,7,9,11 555 timer i.c. (4 off)
IC2 7490 TTL decade counter
IC3 7402 TTL Quad 2-input NOR gates
IC4,5,6,13 7400 TTL Quad 2-input NAND gates (4 off)
IC8,10,12 CD4017 CMOS decade counter/divider (3 off)
TR1,2,3 BC107 *npn* silicon (3 off)
D1 BZY88C5V1 5·1V 400mW Zener diode
D2–D26 0·2 inch or similar red l.e.d.s with mounting clips (25 off)

Miscellaneous

S1 on/off toggle
S2,3,4,5 miniature push-to-make, release-to-break push button switch (4 off)
SK1 3·5mm jack socket (with plug to suit)
Stripboard: 0·1 inch matrix 46 strips × 68 holes; p.v.c. covered connecting wire 7/0·2mm, assortment of covering colours; tinned copper wire (links); 16-pin d.i.l. sockets (3 off); 6BA fixings (4 sets); sloping front-panel case (see text); rubber feet for case (4 off).

See Shop Talk page 630

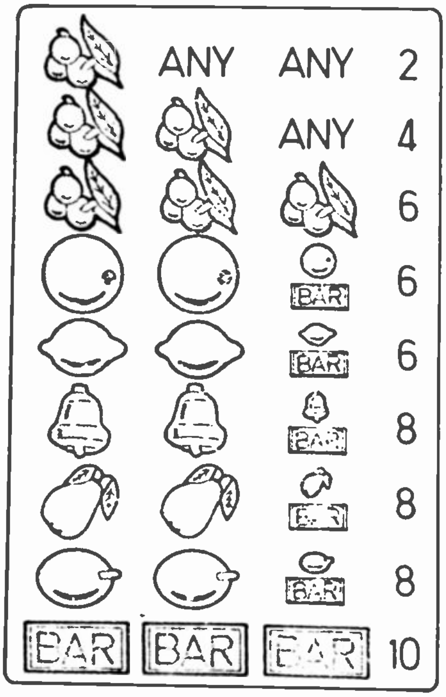
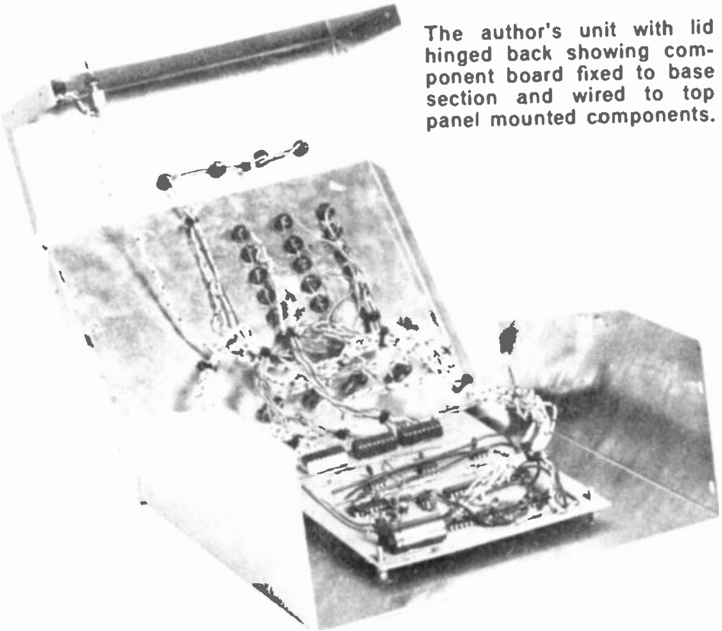


Fig. 5. This "winning line label" can be photocopied, cut out or traced and then coloured and pasted to the unit.



The author's unit with lid hinged back showing component board fixed to base section and wired to top panel mounted components.

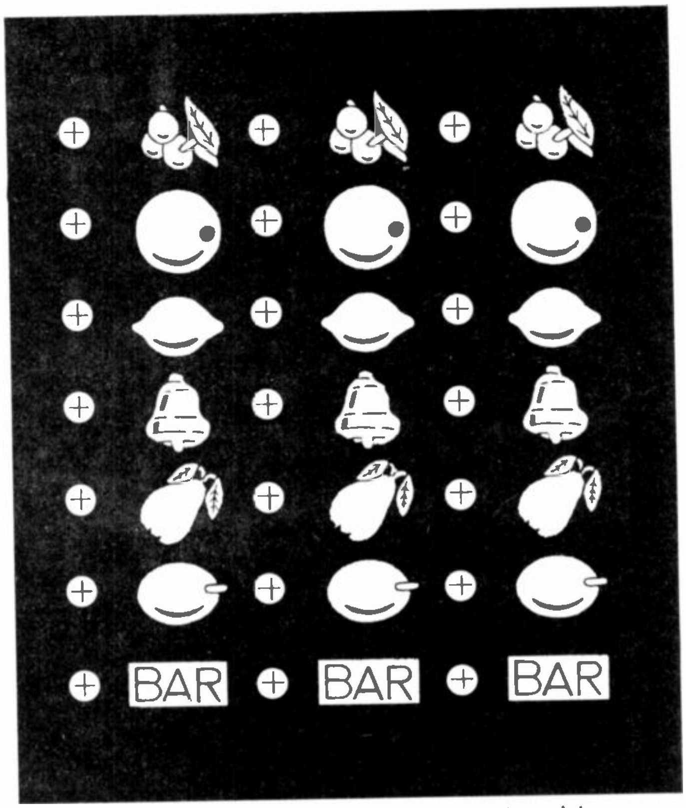


Fig. 6. A label to be photocopied, cut out or traced to identify the l.e.d.s on the top panel. This is reproduced full size and is also intended for use as a template for marking the l.e.d. matrix.

in series with a 1 kilohm resistor.

The output from any of the gates G13a, b or c should be high until the START button is pressed, whereupon an oscillating output should be observed, indicated on a probe by reduced illumination for the duration of the spin.

If all these checks are satisfactory, the CMOS chips may be inserted and the reel display checked. One l.e.d. on each reel should be illuminated when the unit is switched on; all of the l.e.d.s should light up when the START button is pressed, and when the spin stops, only one l.e.d. in each reel should remain on.

If all is satisfactory the unit can be marked with self-adhesive labels, or Letraset, and the labels in Figs. 5 and 6 to provide endless hours of enjoyment and amusement. Rubber feet fitted to the case will afford protection to the surface supporting the unit as well as enhancing the appearance.

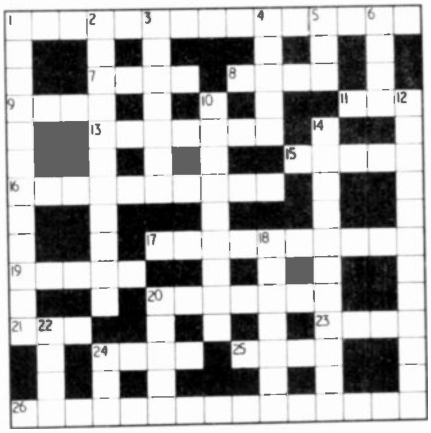
EE CROSSWORD No 20 BY D. P. NEWTON

ACROSS

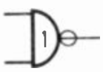
1 In other words, ten to two (7, 2, 6).
7 Certain.
8 Incorrect first and second anode voltages gives such a lack of distinction.
9 To cut a tape.
11 Georg Simon, as he's latterly known.
13 When there's a band on the wireless, give up.
15 Adding a bit to the live line makes it weak.
16 Ohmic impedance.
17 Flip an' wags about and gives lift (Anag.) (1, 6, 4).
19 A formal audio output from

, g less.

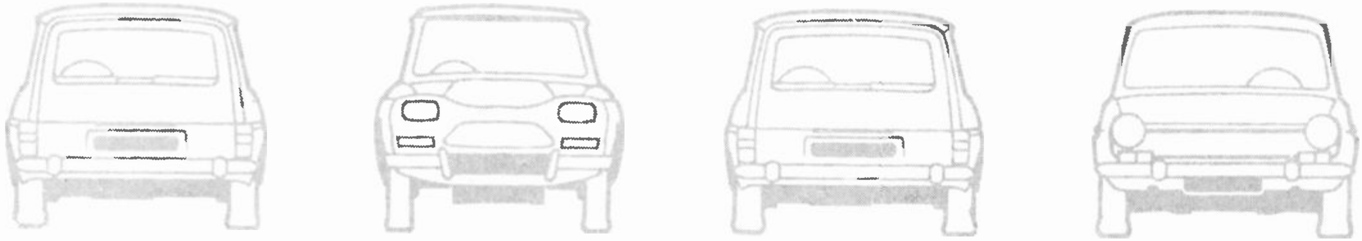
20 A triboelectric cloth to dodge the issue.
21 Selenium cell supplier.
23 Once IBM almost gets the goat.
24 Beast's base.
25 Loosely connected family.
26 Applying a voltage in a contrary manner (7, 8).



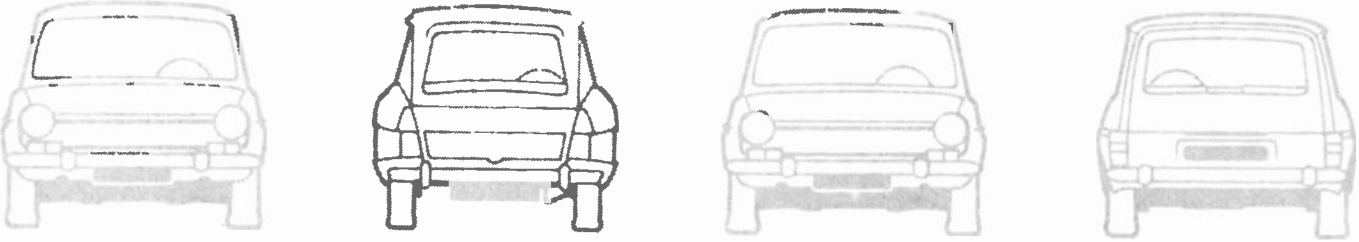
DOWN

1 Dynamic commutative devices (1, 1, 10).
2 Lack of balance in a circuit?
3 Keeping one up front.
4 Coax mismatch eliminator.
5 
6 Radio short spots two from each.
10 The input and output are this when the gain from the non-inverting input is unity.
12 Simultaneous transmission of several messages.
14 Ferrous field detectors (4, 7).
18 Part of the brain's wiring harness?
20 Failures in the monostable.
22 Powerful encouragement from a surge.
24 Static value of the forward current transfer ratio.

Solution on page 666



LIGHTS-ON REMINDER



By T. R. de Vaux-Balbirnie

If you leave your car lights switched on there are always those who will take real delight in letting you know—usually when the battery is almost "flat". They will good-naturedly meet you, armed with jump leads, tow ropes and the like, making you feel a fool.

The author has been in this situation more than once so he decided to make an electronic device for the winter months in an effort to prevent it happening again.

There have been several circuits to achieve this purpose already published but, as far as the author is aware, none has been simpler than that to be described. It is fully automatic, requiring no setting or unsetting by the user. It uses few components and may be easily constructed by a beginner.

CIRCUIT FUNCTIONS

The circuit operates in the following way. With the ignition switched "on" the lights may be operated in the normal course of driving. Only if the ignition is switched "off" with the sidelights still "on" is the circuit actuated and a loud warning note is produced from a miniature loudspeaker.

When the lights are switched "off" the alarm is silenced. The lights may be freely operated with the ignition switched "off". If the lights are switched "off" *before* the ignition, again, no alarm is given.

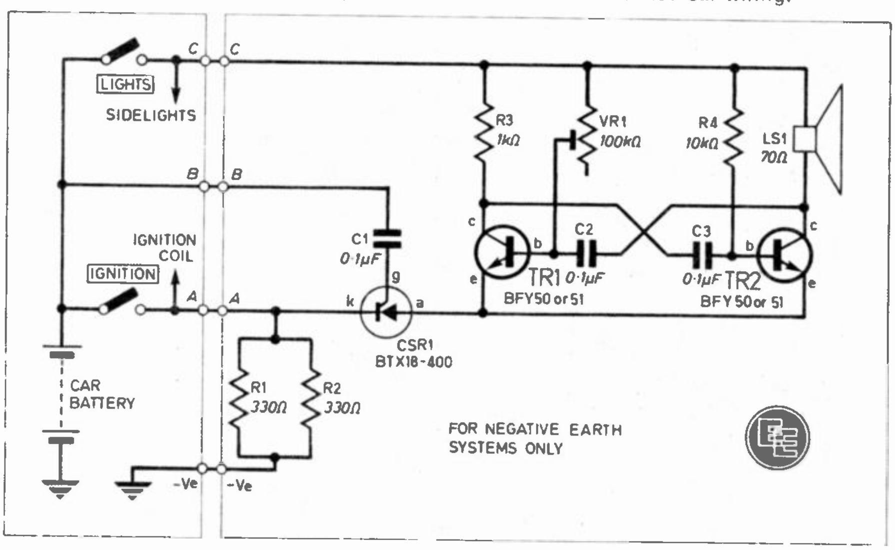
If the operator wishes to leave his lights "on", for example for parking or testing the technique is simple. The lights are switched "off", then the ignition, and finally the lights "on" again. Alternatively, the ignition may be switched "off" first then the lights off and on again (alarm will sound for an instant).

NEGATIVE EARTH ONLY

At this point it must be stated that the circuit is only suitable for vehicles fitted with the "negative earth" system. Most modern cars are of this type but, in case of doubt, the constructor should check by looking at the battery leads. The *negative* terminal should be the one which connects straight to the metal bodywork of the car.

Likewise it should be noted that some cars have their lighting circuits controlled through the ignition switch. The author has in mind certain Italian models, but there may be others. This could easily upset the operation of the circuit. Before construction begins, therefore, a check should be made by switching the lights "on" and ensuring that they stay on steadily

Fig. 1. Circuit of the Lights-On Reminder and associated car wiring.



when the ignition is switched "on" and "off".

If there is any interruption it is better not to construct the circuit. If the lights flick "off" then "on" again a warning tone would only be given during the brief time that the lights were "off".

CIRCUIT DESCRIPTION

The circuit (Fig. 1) consists of two distinct parts. The first is a thyristor (often called a controlled silicon rectifier) and the second a multivibrator which is made up of two transistors and associated components. Under the right conditions the thyristor will "fire" allowing current to flow through the mulivibrator section. The multivibrator is an oscillator and, with the values of components given, will produce an audible tone from the loudspeaker. Provision is made for altering the pitch of the note for the best effect with the preset potentiometer VR1.

If the circuit is studied it will be seen that connections are made to it from the car ignition and lighting circuits. These are labelled *A* and *C* respectively. These connect to either side of the thyristor, CSR1, via the multivibrator section.

THYRISTOR OPERATION

If the ignition and lighting circuits are both "on" or "off" nothing can happen as both sides of CSR1 will be either at 12 volts or 0 and current will not flow between two points at the same voltage.

If the ignition is "on" but the lights are "off", again, no current can flow as this would be in the wrong sense for CSR1. In this respect CSR1 behaves as an ordinary diode—when reverse-biased current cannot flow.

If the lights are "on" but the ignition "off" then *C* will be positive and *A* negative so the sense of the current is correct for CSR1.

If CSR1 were an ordinary diode then current would flow, but it differs from a diode in that it will only conduct if it has received a small positive pulse to its gate (g). In the absence of this pulse CSR1 will remain "off". Once "triggered" CSR1 will remain conducting until its main anode-cathode current is interrupted—the gate loses all control over it.

TRIGGER PULSE

In this project, the trigger pulse is provided by the charging of a low-value capacitor C1. If C1 is already discharged then it will be ready to receive charge and CSR1 will be triggered. If C1 is already charged then no pulse will be given.

When the ignition is switched "on" the terminals of C1 are effectively short circuited through the gate-cathode of CSR1 so it is discharged and so ready to charge. A triggering pulse will be given. therefore, the moment the ignition is switched "off"—when *A* becomes negative. When the lights are then switched "off" CSR1 stops conducting as explained earlier.

If the ignition is already "off" then C1 will be charged—its terminals are effectively across the supply via the gate-cathode of CSR1. No triggering pulse can be given when the lights are switched on and off.

MULTIVIBRATOR

The rest of the circuit consists of the multivibrator based on TR1 and TR2 and this drives a miniature loudspeaker LS1. It was not thought necessary to provide a volume control; it was assumed that the warning should be as loud as possible. It was thought desirable, however, to provide a means by which the pitch of the note could be altered. The preset variable potentiometer VR1 achieves this.

CONSTRUCTION starts here

CIRCUIT BOARD

Construction is very straightforward and for the prototype was based on a piece of 0·1in pitch stripboard 31 holes by 12 strips.

The strips must be cut in the places indicated—a small twist-drill may be used if the special tool is not available. Even a carefully used knife blade will do. During the soldering stage care must be taken to avoid "bridging" adjacent copper strips.

A small case, either of metal or plastic will be needed to house the unit. More care is needed in the case of a metal container to avoid short circuits. A tobacco tin was

COMPONENTS

See **Shop Talk** page 630

Resistors
- R1, 2 330Ω (2 off)
- R3 1kΩ
- R4 10kΩ
- All ¼W carbon ± 10%

Potentiometer
- VR1 100kΩ miniature preset horizontal mounting

Capacitors
- C1-3 0·1μF moulded polyester 25V (or higher) (3 off)

Semiconductors
- TR1, 2 BFY51 or BFY50 *npn* silicon transistor (2 off)
- CSR1 BTX18-400 1A thyristor

Miscellaneous
- LS1 Miniature loudspeaker approx 2½in. dia., 70Ω coil

Stripboard 0·1in. pitch, 31 holes by 12 strips. Miniature 5A terminal block, 4-way. BA nuts and bolts. Case. Connecting wire. Auto-type wire. Connectors.

COMPONENTS approximate cost £3.20

LIGHTS-ON REMINDER

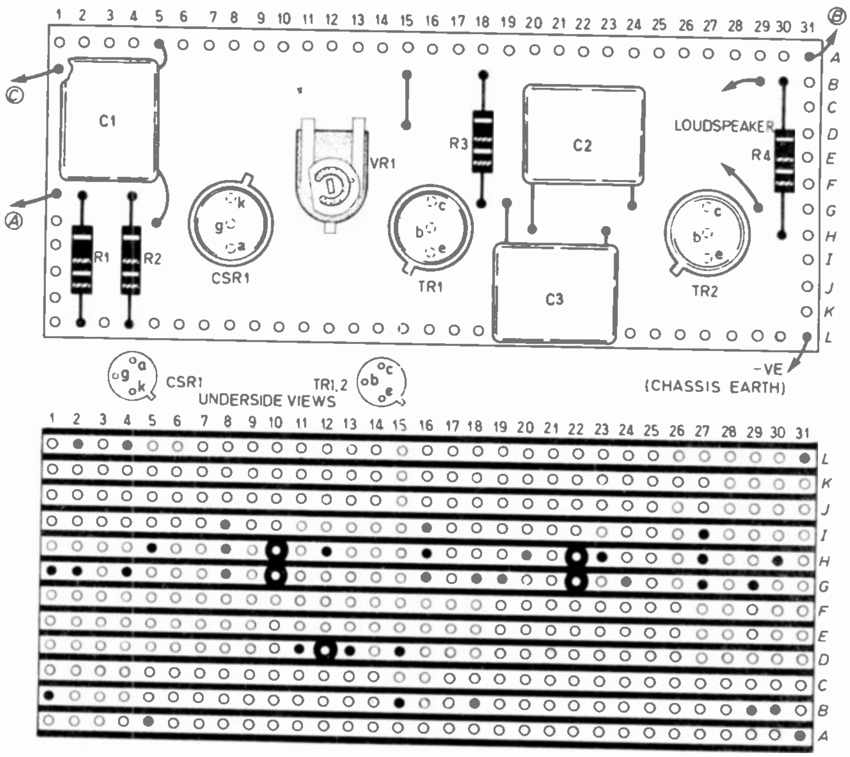
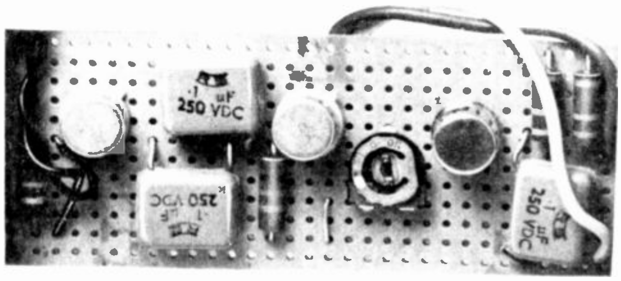


Fig. 2. Top and underside views of the circuit board.



The completed circuit board ready for wiring to the loudspeaker and terminal block.

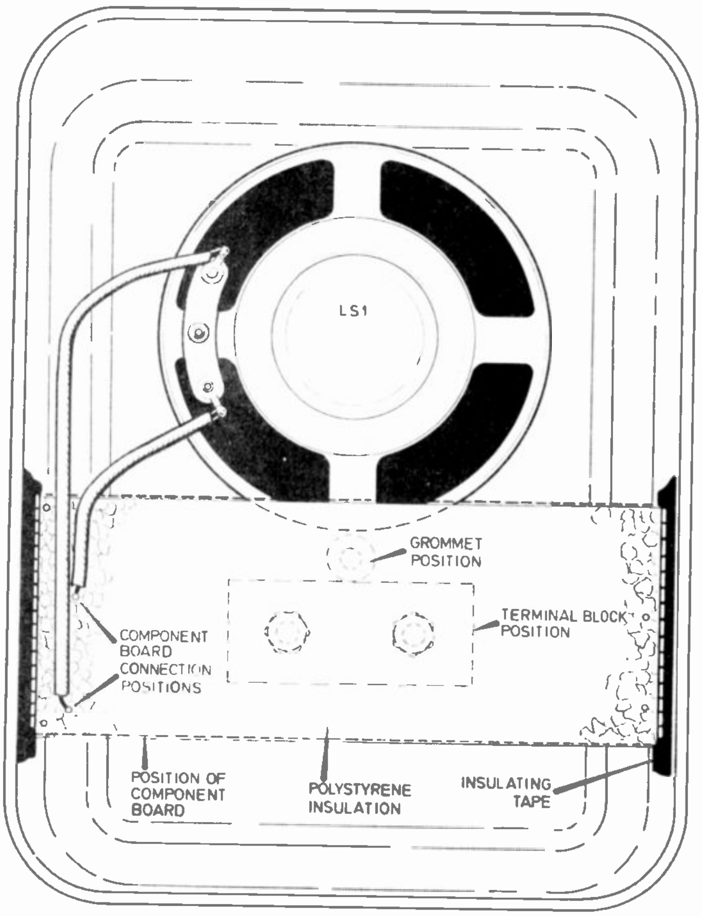


Fig. 3. The complete assembled circuit.

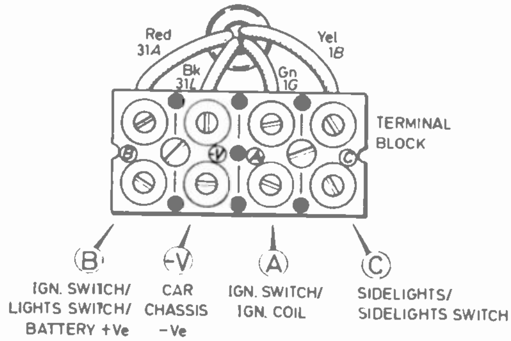
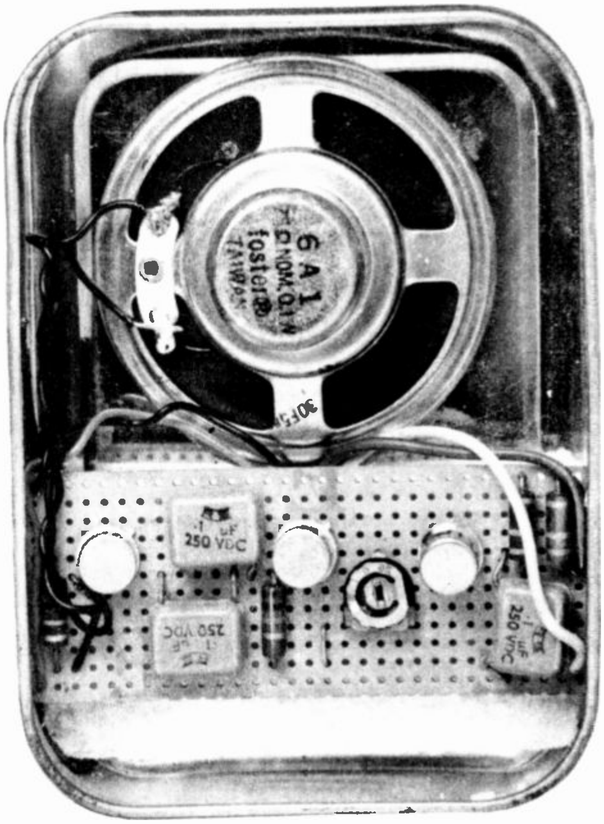


Fig. 4. Details of wiring to the terminal block which is mounted on the front of the case.



The finished unit showing positioning of circuit board on a block of polystyrene for insulation.

used for the prototype. Insulating strips were provided where the stripboard touched the sides, and a piece of polystyrene was sandwiched between the stripboard and the tin to completely isolate the "live" parts.

EARTHING ARRANGEMENTS

A separate "earth" connection was provided but it is possible to use the tin itself so that when it is attached in position to the metalwork of the car the earth will be complete.

A good plan is to fix the lid of the box in position and the box containing the electronics snapped on to it. This has the advantage that the unit may be removed easily at any time. Do not rely here on a good connection being automatically produced between the two halves of the tin. An additional bonding lead should be fitted, secured at one end with screw and nut to facilitate removal.

The external connections *A*, *B*, *C* and "*earth*", if used, are brought to a piece of miniature terminal block mounted on the front of the case. If a metal case has been used it is essential to run the wires from the circuit panel through a grommet. A hole is cut in the case slightly smaller than the loudspeaker, and Epoxy resin adhesive used to attach this unit. Such adhesive must be used sparingly just around the rim.

INSTALLATION

The easiest way to make the connections *A*, *B* and *C* to the car will be at the car fuses. Using a small 12-volt bulb with one side "earthed" a fuse is found which is only "live" when the ignition is switched "on". This will be connection "*A*".

In the same way, a fuse is found which is "live" all the time. This gives connection "*B*". Finally, a fuse is found which is only "live" when the sidelights are "on". This provides connection "*C*".

On some cars the lights are not protected by a fuse. In such cases it will be necessary to connect to a sidelight wire or to the lighting switch. To be safe, it would be wise to include a line fuse holder here (of the type used for car radios) with a low-value fuse in it.

When making the connections to the fuses it is important to use the "dead" sides, that is "dead" when the fuse is removed. If the other side of the fuse is used then the benefit of the fuse will be lost. This point may be checked with the 12-volt bulb.

GOOD CONNECTIONS ESSENTIAL

It is essential to make proper connections. Breaking leads, making a twisted connection, then taping it all up is most unsatisfactory. Such a connection is likely to fail in service when the wire is under vibration. Worse still, a short circuit may be caused to the body of the car.

Proper connectors are easily bought from a car accessory shop. In cases where all available terminals have been used to a given fuse, "piggyback" connectors can be bought which turn one terminal into two. Single-strand wire must never be used for the external connections—only proper auto type wire. This has thick insulation which will withstand hard use.

EARTH CIRCUIT

The "earth" connection, where used, should be run to an existing earth point or a small hole drilled and an eyelet used secured with a self-tapping screw.

At this point the purpose of R1 and R2 will be mentioned. These were included in the prototype to give a definite path to earth from "*A*". It is quite likely that such a path will exist anyway via accessories which are "on" when the ignition is "on". For example, warning lights. (The ignition coil will only serve when the points are closed.)

Constructors may wish to see whether the circuit will work without R1 and R2 but in cases of doubt they should be fitted. Without R1 and R2, of course, no "earth" connection to the circuit is necessary.

It will be noted that R1 and R2 are a pair of equal resistors in parallel. This gives a value of 165 ohms. If a single ½ watt resistor were used it could become rather too warm in use. If a single resistor is used it should be of the 1 watt type. The author considered that many constructors build up a small stock of ½ watt resistors though not of 1 watt so the parallel arrangement was thought best.

FINAL ADJUSTMENTS

Before fitting the unit to the car, VR1 should be set to about mid-position. The circuit should be checked by proving that an audible tone is produced when the lights are left "on" after turning the ignition "off". If all is well, the pitch of the note may be varied by altering the setting of VR1. This must not be adjusted too near its zero resistance position (with the slider not too near C) as excessive base current to the transistors might damage them.

After final checking and adjusting, the unit may be forgotten until one day—perhaps in the not too-distant future—it will bravely signal your thoughtlessness!

By Dave Barrington

Case for Components

It is a very rare occasion when we are able to pass on some information that will benefit our advertisers and, we hope, eventually prove beneficial to our readers. But this month we have received two snippets of news that should interest both parties.

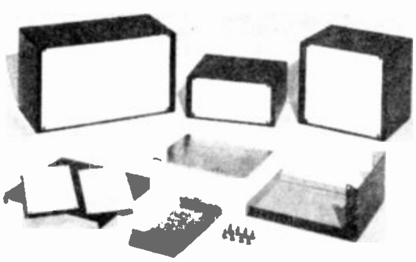
Looking for retail outlets for their new "Pack Flat" range of instrument case are Perancea Ltd. These cases come, as their name implies, in flat packs for easy storage and postage.

The main feature of these cases, which seems to be a novel idea, is that they require only eight screws (four in the front and four in the back panel) to hold them together. This is made possible by the arrangement of folds in the side panels and top and bottom plates. The side panel "folds" are sprung and interlock with the top and bottom plates to form a rigid construction.

We particularly like the idea of a separate aluminium chassis on which components and/or circuit boards can be mounted. The chassis also held by the fixing screws so avoiding any unsightly fastening on the exterior of the case.

Available in eight stock sizes, from the SPIB (180 · 152 · 80mm) to the SP8B (307 × 152 × 156mm) we are unable to quote a recommended retail price, but for further information write to Perancea Ltd., Department EE, 131 First Avenue, Bush Hill Park, Enfield, EN1 1BP.

Range of Perancea Pack Flat Cases



There was a time when Japanese products were widely advertised and one of the cheapest quality items, particularly transistors, on the market. Now, due no doubt to the strength of the Yen, Japanese components are becoming increasingly uneconomical for advertisers to import and stocks are fast disappearing from their shelves. This obviously leads to problems when trying to find replacements when components breakdown.

Recognising this fact, Australia's largest component suppliers to the hobbyist, Dick Smith Electronics Pty Ltd., has just established a purchasing-cum-trading office in Hong Kong. The aim of the office is to supply equivalent quality products from Hong Kong, Taiwan and Korea at, they claim, better prices. In fact, its their boast that they will even quote for one-off items.

They issue an excellent 104-page Jumbo Catalogue which is certainly worth the trouble of writing for at S4·00 (U.S.) airmail. The address to write to is Dick Smith Electronics (HK) Ltd., Dept EE, 29-39 Ashley Road, Kowloon, Hong Kong. Advertisers should ask for wholesale price lists.

Disco catalogue

With the ever increasing popularity of Discos on the entertainment scene, Roger Squire Ltd. have just released a new catalogue featuring over 1000 new disco products.

The catalogue covers such items as replacement cartridges, styli, decks and a range of lighting effects units.

The catalogue is available free of charge from Roger Squire Ltd., Freepost, Dept EE, Barnet Trading Estate, Park Road, Barnet, EN5 5SA.

Components catalogue

Another new catalogue received this month is the Marshall's 1979/80 Components catalogue.

This latest 60 page edition contains many new items including an expanded range of i.c.s and microprocessors. Twin reply paid order forms are printed in the catalogue to ease ordering.

To coincide with the publication of the new catalogue, Marshall's are launching their "budget" credit card scheme in conjunction with RETRA. They claim they are the first UK electronic component retailer to offer such a scheme.

The catalogue costs 50p from any branch or 65p, post paid, from Marshall's, Dept EE, Kingsgate House, Kingsgate Place, London, NW6 4TA.

Late news

We have just received news that Precision Instrument Laboratories have been appointed sole London Distributors for Continental Specialities Corporation range of products.

One of the reasons given for winning this franchise is the excellent large showroom premises in the Old Kent Road. Items on display will include, breadboard systems, logic probes and chips, function generators and frequency counters. PIL will also be offering the CSC range through their newly introduced Mail Order System.

Further information and a catalogue is available from Precision Instrument Laboratories, 727 Old Kent Road, London SE15

CONSTRUCTIONAL PROJECTS

Try as we may we cannot find any components that will cause buying problems this month.

The *Lights-on Reminder* project calls for a 70 ohm 2 inch diameter loudspeaker. However, this can be any high impedance type ranging from approximately 50 to 80 ohms. The most common type listed in catalogues seems to be 64 ohms.

The prototype unit for the *One Armed Bandit* used "Standard (0·2in)" red, yellow and green l.e.d.s. but a small saving can be made by using the common TIL209 red l.e.d.s throughout. Of course, if 209's are used then smaller diameter holes must be drilled in the chassis.

Complete kits of parts for the *EE Tutor Deck* are available from the firms listed below.

SUPPLIERS OF KITS FOR TEACH-IN 80

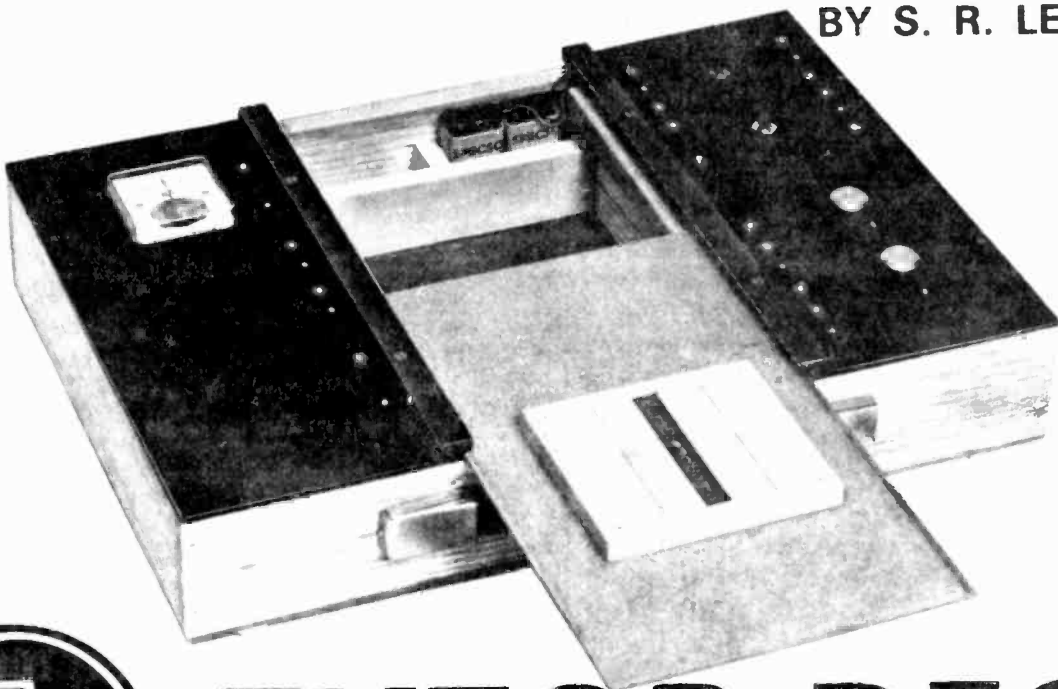
LIST "A"—All electronic components for construction of Tutor Deck as specified on page 634.

LIST "B"—Electronic components needed for Teach-In experiments during first 6 parts of the Series as illustrated on page 640.

Greenweld, 443 Millbrook Road, Southampton, SO1 0HX	Lists A & B	£21·50
Home Radio (Components) Limited, 234 London Road, Mitcham, Surrey, CR4 3HD	List A	£15·80
	List B	£3·20
	Lists A & B	£18·50
A. Marshall (London) Limited, Kingsgate House, Kingsgate Place, London NW6 4TA	List A	£21·50
	List B	£3·75

NOTE: All prices quoted are inclusive of VAT, postage and packing.

BY S. R. LEWIS B.Sc.



TUTOR DECK
for the TEACH-IN 80 series

IN ORDER to follow the experiments in the *Teach-In 80* series, it is recommended that the experimental Tutor Deck described here is constructed. The following instructions describe the construction of the deck referred to in the series but the design can be adapted to suit requirements of the user.

GENERAL DESCRIPTION

The Tutor Deck consists of all the commonly used components secured to two fixed top panels connected to 1mm sockets for easy access. Plugs with 7/0·2mm stranded p.v.c covered wire are used to connect these components to the breadboard on which any ancillary components are placed, see Fig. 1.

There is a centre section in the deck reached by sliding back a centre panel, in which all the non-fixed components for use in experiments may be stored along with some small tools. This compartment is further divided to hold the batteries which form the d.c. power source enabling them to be easily replaced when they are exhausted.

A mains transformer is used to derive the alternating current (a.c.) used in some of the experiments and this is kept in a sealed compartment so as to keep risks to a minimum. Read the instructions carefully on wiring the transformer and if in doubt ask someone with experience to assist.

WOODWORK

The basic structure of the deck consists of a rectangular box formed from hardboard for the

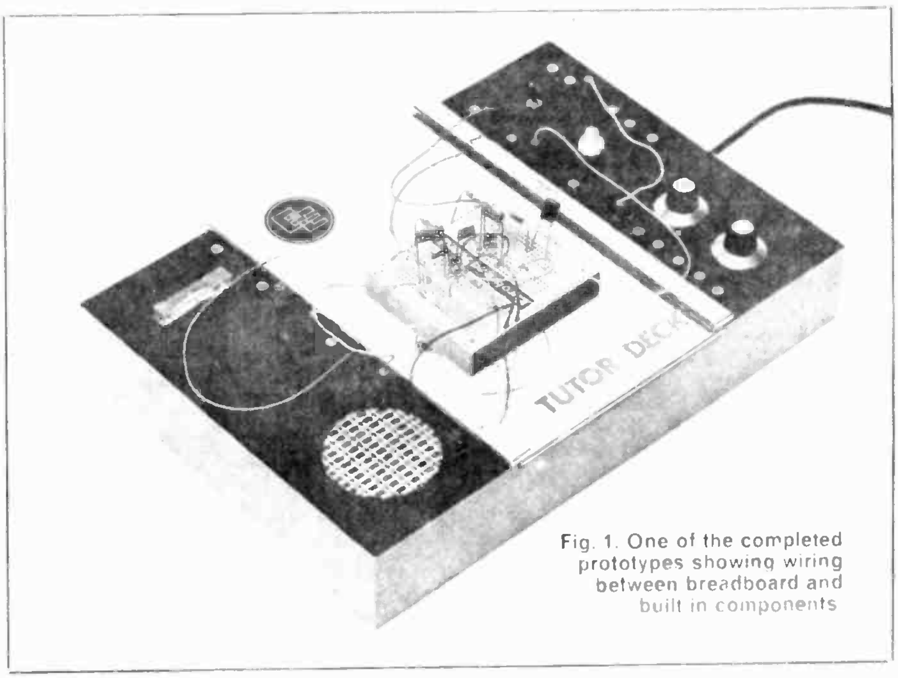


Fig. 1. One of the completed prototypes showing wiring between breadboard and built in components

TUTOR DECK
for the TEACH-IN 80 series

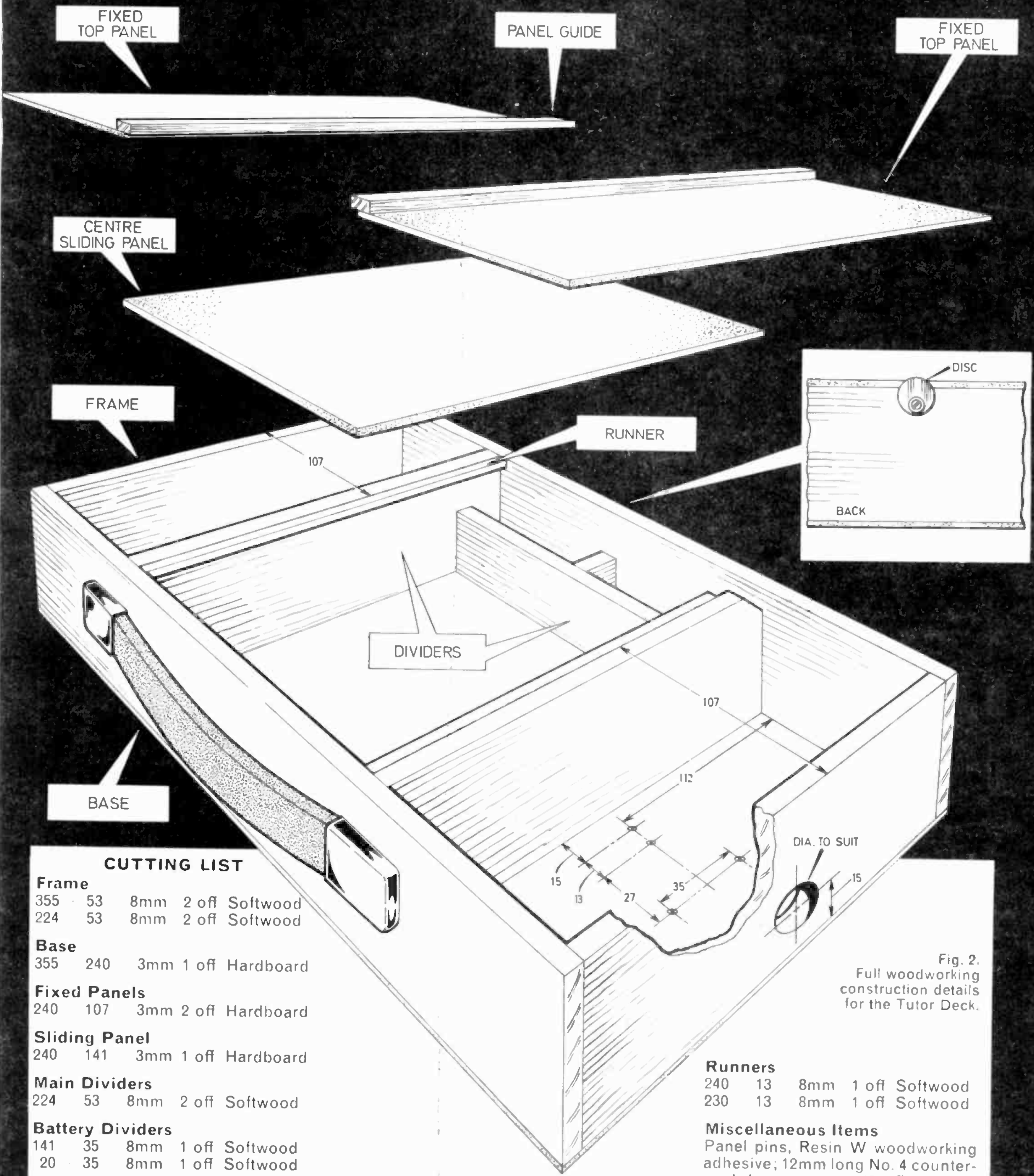


Fig. 2. Full woodworking construction details for the Tutor Deck.

CUTTING LIST

Frame				
355	53	8mm	2 off	Softwood
224	53	8mm	2 off	Softwood
Base				
355	240	3mm	1 off	Hardboard
Fixed Panels				
240	107	3mm	2 off	Hardboard
Sliding Panel				
240	141	3mm	1 off	Hardboard
Main Dividers				
224	53	8mm	2 off	Softwood
Battery Dividers				
141	35	8mm	1 off	Softwood
20	35	8mm	1 off	Softwood
Guides				
240	12	5mm	2 off	Ramin
Runners				
240	13	8mm	1 off	Softwood
230	13	8mm	1 off	Softwood

Miscellaneous Items
Panel pins, Resin W woodworking adhesive; 12mm long No. 4 countersunk brass screws (8 off); rubber feet (8 off); strap-handle and fixings.

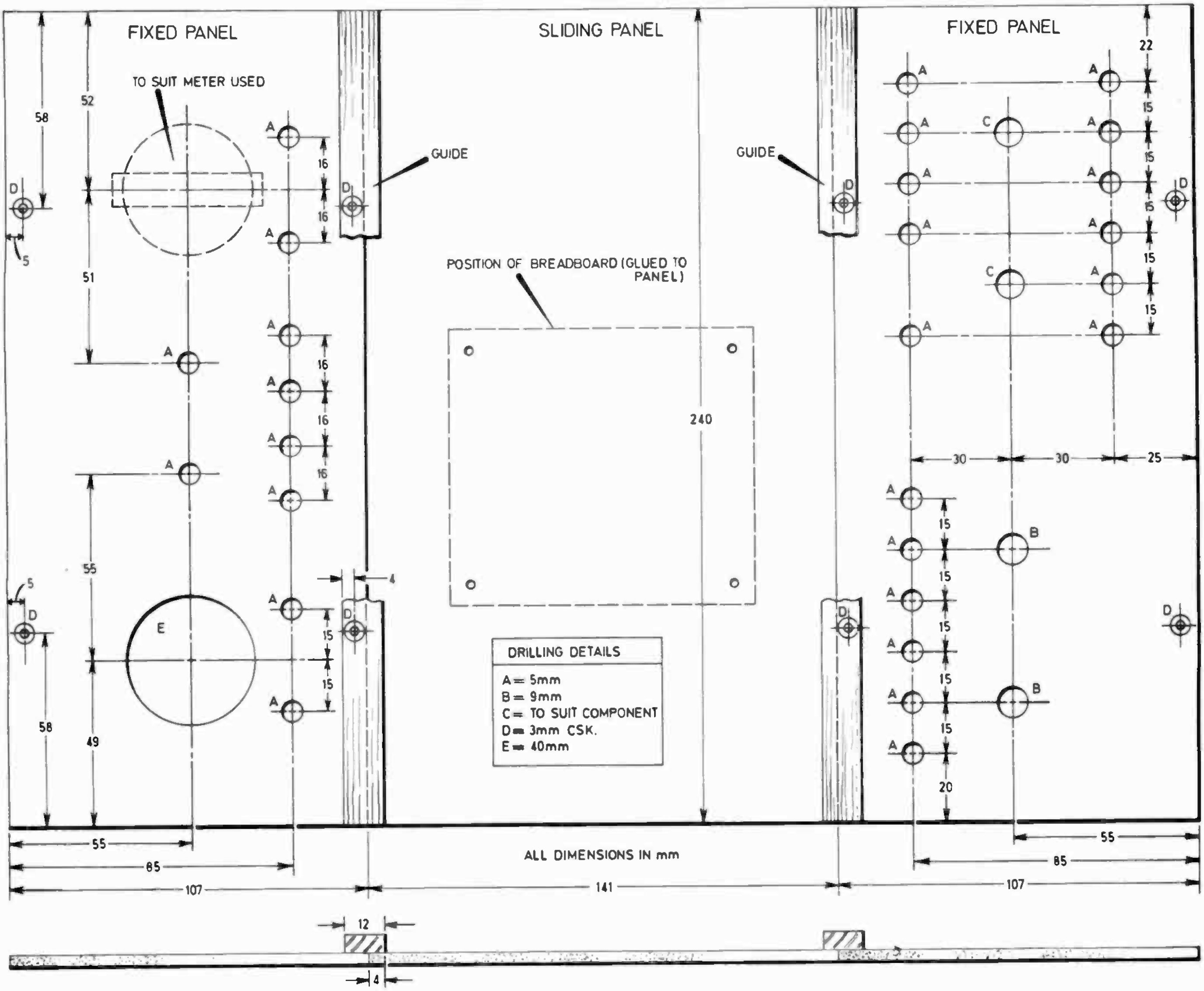


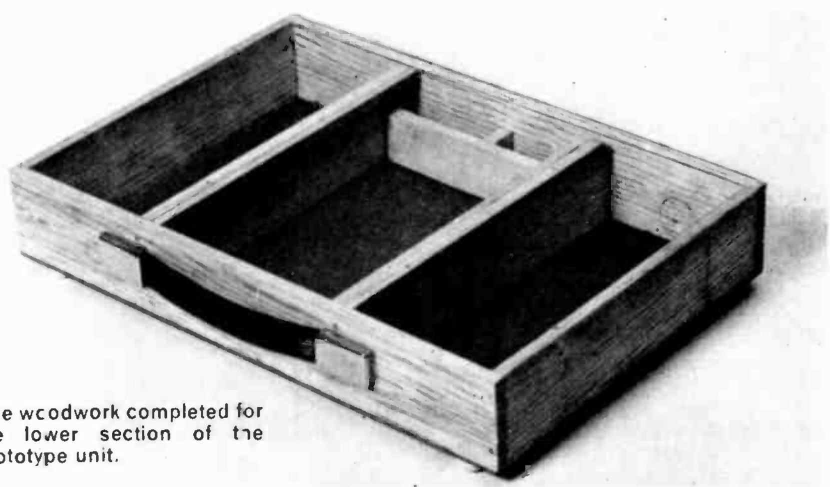
Fig. 3. Dimensions and drilling details of the three top panels in situ. Hole dimensions for some components, i.e. switches and meter may need to be altered to suit component supplied.

top and bottom and softwood for the sides and dividing sections. The centre sliding section holds the breadboard and covers the battery and storage compartment, see Fig. 2.

First cut to size all the pieces as detailed in the cutting list. Drill a hole in one of the shorter frame members to accommodate the mains inlet "plug". Pin and glue the two longer frame members to the base panel. Resin W woodworking adhesive is advised. Next pin and glue the remaining frame members to form an open box.

The two runners should next be fitted to the main dividers and these then pinned and glued in position in the box. The siting of these dividers is critical since they are used as fixing bases for the top panels. Note the diagonal cut-out on one divider to allow the battery leads to reach the centre compartment. Finally glue the two small sections to form the battery compartment to substantially complete the woodworking.

The two fixed panels should now be drilled according to Fig. 3 and the guides glued in place. Carefully drill the panel fixing holes to allow clearance of the screws.



The woodwork completed for the lower section of the prototype unit.

METER CUT-OUT

The hole size for the meter will vary according to the style of meter obtained so the measurements in Fig. 3 should only be regarded as a guide unless an identical meter is used. The easiest way to cut a rectangular hole is to first drill a few holes in the middle of the rectangle and then use a chisel to achieve the required shape.

In the prototype, the top panels were temporarily fitted in their correct positions using Sellotape and the panel fixing holes used as guides for the smaller holes to be drilled in the box ends and dividers to accommodate the fixing screws. Countersink the upper holes for flush screw fitting.

Secure the panels to the box and check that the centre sliding panel moves freely between the guides.

An adjustable stop to prevent this panel from dropping out when the deck is being carried is made from a small disc of aluminium with an offset fixing hole held in place on the rear of the box by a roundhead screw and washer as shown in the inset in Fig. 2.

If all is satisfactory, the top panels (and the remainder of the box) should be painted/varnished before fixing the components (handle and rubber feet—rear and bottom).

CIRCUIT AND WIRING

The "circuit diagram" of the Tutor Deck components is shown in Fig. 4 together with the layout on the top panels.

The positions of these components on the top panels, interwiring and wiring of the mains transformer is shown in Fig. 5. Fix all the components using the fixing

A typical kit of components required to construct the Tutor Deck. Designated List A. (A) Three-pole mains floating socket and panel mounting plug; (B) potentiometers with indexed knobs; (C) three-core mains cable; (D) p.v.c. covered stranded wire; (E) 1mm sockets (black); (F) 1mm plugs (black); (G) Eurobreadboard; (H) light emitting diodes and fixing clips; (I) two versions of s.p.d.t. toggle switches; (J) 1mm sockets (red); (K) 1mm plugs (red); (L) 20mm fuses and chassis fixing fuseholders; (M) miniature mains transformer; (N) monetary action push switch; (O) two versions of $\pm 100\mu A$ meter; (P) PP3 battery connections; (Q) miniature loudspeaker.

COMPONENTS

LIST A

Potentiometers
VR1 1kΩ carbon lin.
VR2 100kΩ carbon lin.

Diodes
D1, D2 0·2 inch red light emitting diodes including fixing bush/clip (2 off)

Sockets
SK1 to SK25 1mm nut-fixing sockets 16 red, 9 black (25 off)
SK26 3-pole mains floating socket

Plugs
PL1 to PL25 1mm plugs 16 red, 9 black (25 off)
PL26 3-pole mains panel mounting plug (to suit SK26)

Switches
S1 s.p.d.t. toggle
S2 momentary action push-to-make, release to-break

Meter
ME1 100-0-100μA to 250-0-250μA moving coil meter

Loudspeaker
LS1 miniature moving coil speaker, impedance 40 to 80 ohms

Transformer
T1 mains primary/20-0-20V 30mA secondary (R.S. 196-280)

Fuses
FS1, FS2 100mA 20mm fuse with chassis mounting holders (2 off)

Batteries
B1, B2 9V type PP3 (2 off)

Miscellaneous
5 metres p.v.c. covered stranded wire, 7/0·2mm, selection of insulation colours; 1A mains cable approx. 2 metres; knobs, with index spot or line (2 off); battery connectors to suit B1, B2 (2 pairs); 6BA fixings (4 sets) Eurobreadboard

For suppliers of complete kits see page 630

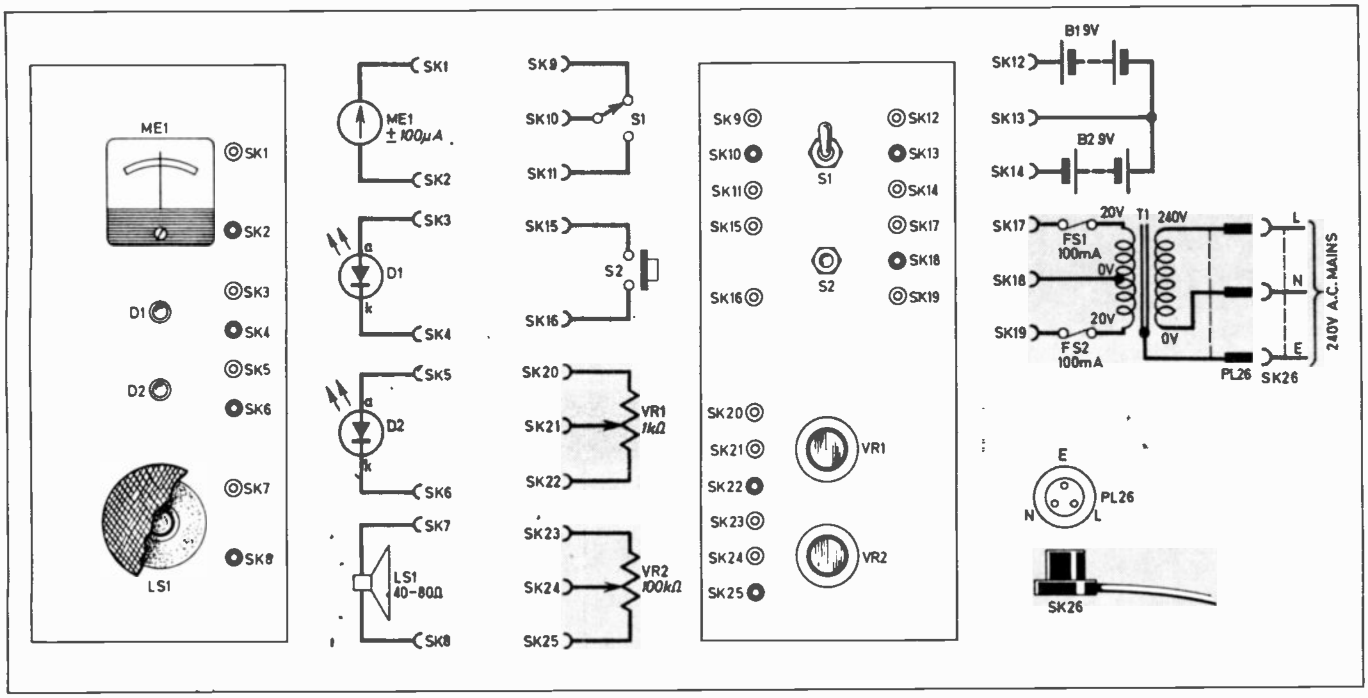


Fig. 4. The circuit diagram of the Tutor Deck showing connection points on the top panels.

nuts/clips provided in the case of the potentiometers, sockets, l.e.d.s and switches and small metal clips in the case of the speaker—if provided. Alternatively the speaker will need to be glued in place.

The meter fixing will vary as to the type. If there are no obvious fixing holes then it may be necessary to make a small bracket out of metal to hold the meter in place. Alternatively it can be glued in place. Next wire up all the components as shown in Fig. 5.

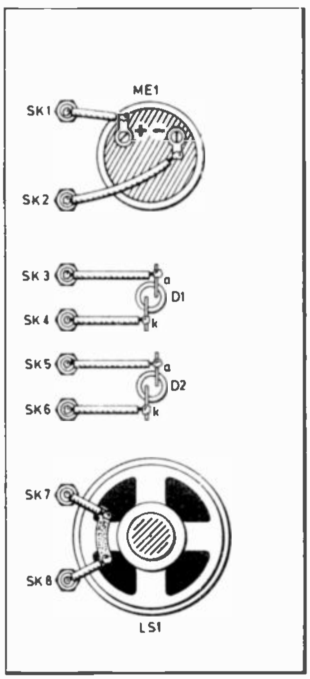
Note carefully how the transformer is wired to the 1mm sockets. It is the secondaries (marked 20V 0 20V) which go to the sockets (via FS1 and FS2). The primary marked 0, 240V goes to mains input chassis mounting plug.

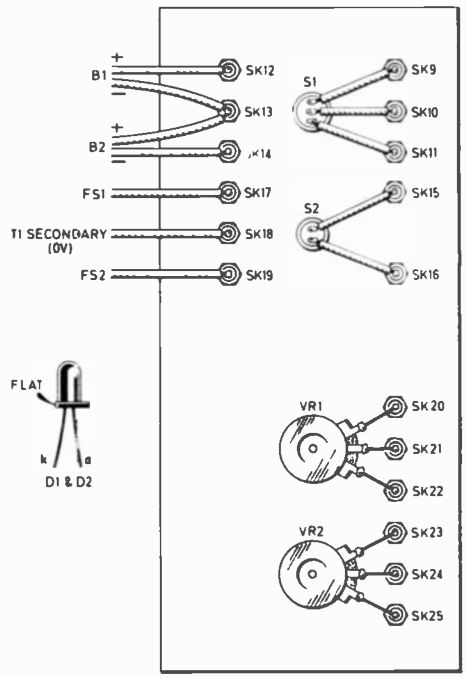
BREADBOARD FIXING

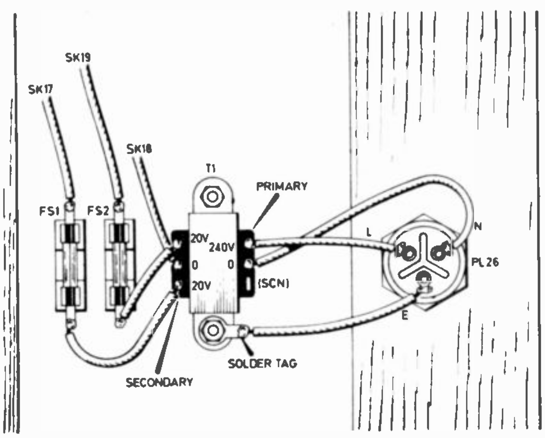
The breadboard is fitted to the centre sliding section. Countersunk bolts pushed up through the board into the breadboard with the nuts at the top can be employed. Make sure the heads of the bolts are flush with the board or the panel will not slide in. Alternatively, a neater appearance will be obtained if the breadboard is glued in place.

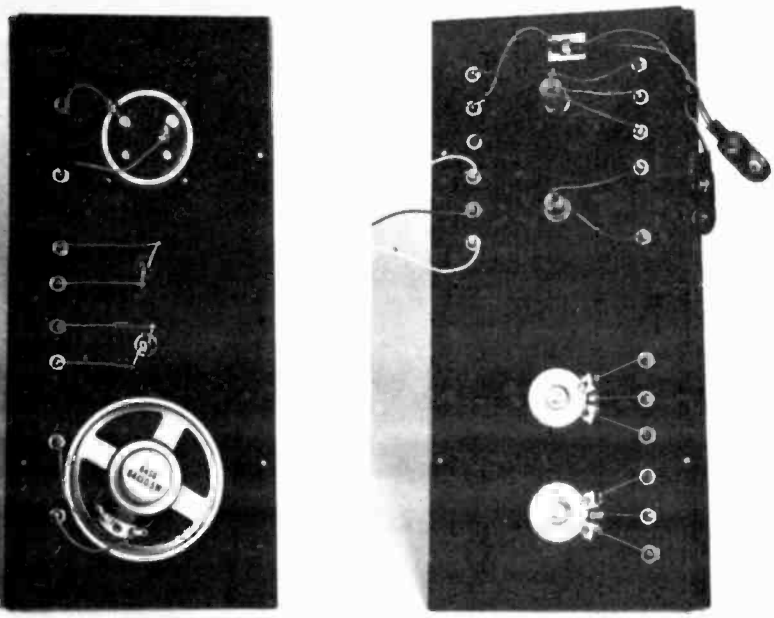
Double-sided Sellotape or self-adhesive pads can be used. These will allow the breadboard to be removed at a later date, if required, without damaging the protective rubber backing. Some readers may wish to leave the breadboard free and be able to store it in the compartment be-

Fig. 5. (right) The wiring on the underside of the top panels. Pay special attention to the polarity of the l.e.d.s and meter; (below) shows the wiring up to the mains inlet plug to the transformer. Extreme care and attention should be paid to this operation as a wrong connection could prove dangerous and disastrous. The position of the transformer on the base panel is critical to avoid any contact with top panel components.

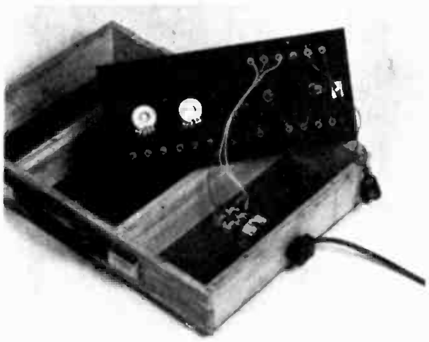




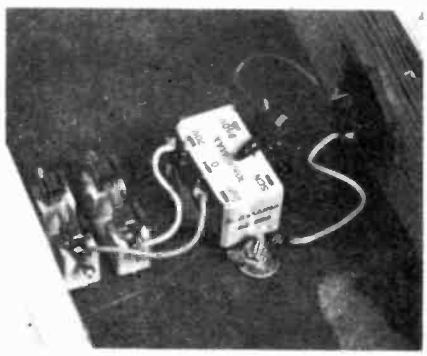




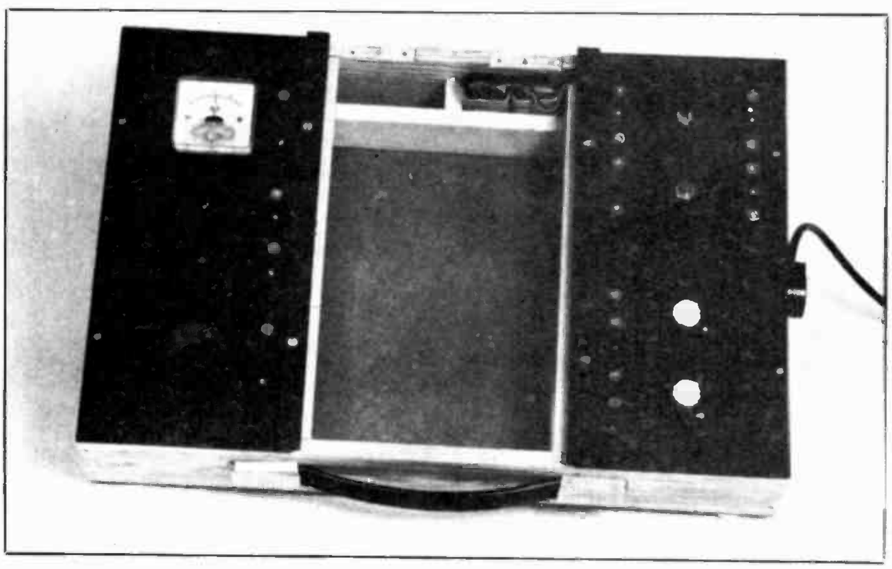
Shows the wiring on the underside of the prototype top panels.



The right hand top panel wired up to the base mounted transformer and fuses.



Wiring to and from the transformer in the prototype Tutor Deck.



The completed EE Tutor Deck with centre panel removed showing storage and battery components.

neath at the end of their experiments. The rubber backing is slip-resistant.

CONNECTING LEADS

The next task is to make the connecting leads. There are 25 sockets on the Tutor Deck and in the event that all will be in use, 25 connecting leads fitted with a plug at one end should be constructed.

P.V.C. stranded wire is recommended as this is more flexible than the solid core type and less likely to fracture with frequent use. Lengths of about 200mm should suit all needs.

A short length (3mm) of the insulation should be removed from one end and the strands neatly twisted together. This requires "tinning"—heating the wire and allowing the solder to flow on to the wires to effectively form a solid core. This is then soldered to the plug.

The other end of the wire should be stripped—about 5mm—twisted and tinned in the same way. This can then easily be pushed into the "sockets" on the breadboard.

A selection of colours should be used, possibly red and black for connection to polarised components, e.g., the meter, l.e.d.s, d.c. power supplies — the negative (−9V) lead preferably being a third colour.

For the a.c. connections, same colour for each 20V outlet and a different colour for the 0V outlet.

Use of as many other "coloured" leads would allow instant recognition of lead function during experiments.

Besides these "plugged" leads a number of different shorter lengths are required to be used for interconnections on the breadboard itself. These need to be stripped about 5mm at each end, twisted and tinned as before.

For neatness and convenience all the leads can be placed in a polythene bag and kept along with a selection of tools and the mains cable (when not required) in the Tutor Deck storage compartment.

It only remains to label the functions on the top panels. Letraset or a similar rub-down lettering is suitable, and can be applied directly to the painted hardboard. ⌘

See next page for the start of Teach-In 80.

Part 1

By S. R. Lewis, B.Sc.

ENTER THE EXCITING WORLD OF ELECTRONICS

TEACH-IN 80

THE NEWCOMER to electronics is faced with a truly bewildering array of interesting devies which, with little or no knowledge of the subject, must remain nothing more than useless pieces of hardware.

In this series it is hoped to give some insight into the basic principles of electronics with particular regard to the uses of components in practical circuits. To this end a special Tutor Deck is used to construct circuits and it is recommended that the building of this deck be carried out as soon as possible so that the practical examples in the series can be copied and learnt from.

ELECTRONICS AND THE CONSTRUCTOR

To understand fully the new semiconductor technologies which have enabled industry to set its sights on million-transistor integrated circuits by the mid-nineteen eighties. it is necessary to have a deep understanding of the physical basis of matter.

The semiconductor designer needs to know intimately the workings of the atom and to do this he must have an excellent grasp of highly complex physics and mathematics.

We, as constructors, only wish to make use of the devices he has designed and, though a thorough understanding of semiconductor principles is required if one wants to get the most out of a device, there are certain guidelines which enable us to understand and build perfectly good, though maybe not optimum, circuits.

It is the purpose of this series to introduce such guidelines.

THE ELECTRON

Fundamental to the whole of electronics is the tiny fragment of the atom which we call the **electron**. The electron, being an extremely small entity, is difficult to describe in terms of physical quantities which we are familiar with in everyday life.

Terms like *mass*, *size* and even *position* are really not precise terms when it comes to describing atomic particles. Indeed, scientists today are still searching for new and better ways of visualising the electron.

However, certain attributes of the electron have enabled it to be defined as having a mass so small that 1,840 of them would be needed to equal the weight of even the lightest atom, hydrogen. *How then can anything so small be so powerful?*

The answer to this can be split into two halves. First, individual electrons are rather insignificant; it is only when vast numbers of them move in unison that exciting things happen. Secondly, it is not the mass of the electron that gives it its usefulness but its strange property which we call **electric charge.**

Electrons each possess a tiny quantity of negative electricity. Atoms are normally electrically neutral because the charge on the electrons is exactly balanced by the positive charge in its central core which is called the **nucleus.** The particles in the nucleus with positive charge are called **protons** but these are heavy particles whose energy is not so simple to harness as that of the electron.

The force which holds the electrons in an atom varies according to the position of the electron with respect to the nucleus and the type of atom which is being considered.

In some elements all the electrons are firmly bound to the nucleus but certain elements have electrons that seem to wander freely from atom to atom. In still other atoms the electrons are sometimes firmly held but can be made to move freely by certain forces. We shall see the significance of these variations later on.

All atoms contain electrons; indeed, it is the electrons which determine the *chemical* as well as *electrical* properties of matter.

ELECTRIC CHARGE

When two charges are brought near to each other they are found to either repel each other, if the charges are the same, or attract each other if they are opposite. This effect can be described by imagining a field of force existing in the vicinity of the charge. We call this field of force the **electric field.** It is the interaction of the electric charge with the electric field that gives the electron its complicated properties.

In electronics, we are not just interested in electrons at rest but much more so in electrons in motion.

In a solid whose temperature is above absolute zero, each electron is in continuous random motion; each electron moves around at vast speeds, colliding with other atoms as it goes (Fig. 1.1a). In this state it is impossible to see any overall change in the distribution of electrons—any particular volume has the same number of electrons as any other.

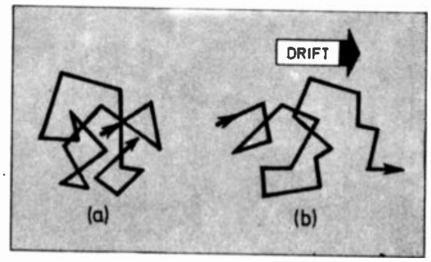


Fig. 1.1 (a) With no electric field electrons move around randomly with no net motion in any particular direction. (b) If a field is applied a slow drift is seen against the field.

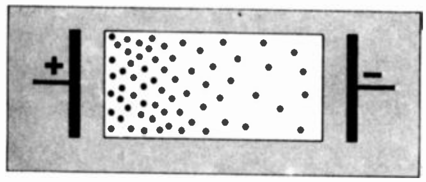


Fig. 1.2 Placing an electric field across a solid produces an uneven distribution of electrons as they try to neutralise the field.

When an electric field is applied across the solid the random motion goes on but there is a general drift in the direction against the field (Fig. 1.1b). The velocity of the electrons is very high as they career about but the drift velocity is quite low.

The motion of the electrons continues until they have redistributed themselves so that the field they create exactly balances the external field. Now, if we look at the solid, we see more electrons in one part than in another (Fig. 1.2).

If the solid is connected to a source of **electromotive force (e.m.f.)**, that is a generator of some sort which can absorb or supply charge for maintaining the internal electric field, then there is a continuous flow of charge circulating around the circuit. The flow of charge we call **electric current** (Fig. 1.3).

What has just been described is the simplest electric circuit: a piece of wire (the solid) placed across the terminals of a battery (the source of e.m.f.).

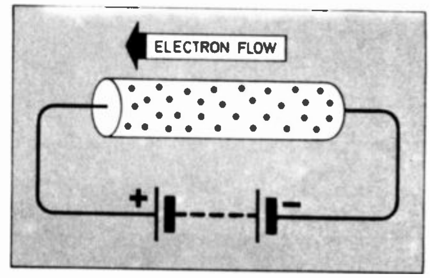


Fig. 1.3 Connection of a source of electromotive force (e.m.f.) across a conductor produces a steady flow of electrons. "The simplest electric circuit".

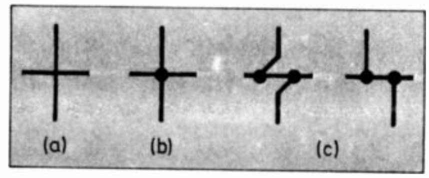


Fig. 1.4 (a) Circuit symbol for two lines crossing with no join. (b) two wires joined, direct cross-over—sometimes used but NOT recommended. (c) two wires joined —either of these "staggered" arrangements are preferred.

CIRCUIT SYMBOLS

To visualise the physical components in an electric circuit it is usual to use a symbolic representation of components.

A circuit diagram tends to represent real components as ideal components. For instance, connecting wire is represented by a solid line which we take to represent zero **resistance** to current flow. Batteries are represented simply as sources of e.m.f., the other properties such as resistance are ignored.

Remember that a circuit diagram of a given real circuit is simply an approximate representation of real components. Its usefulness lies in the fact that it enables us to make calculations about circuit performance which are perfectly good provided we realise that real components are not ideal. Of course, the circuit diagram can be elaborated upon so that real components are represented as many ideal components, but in simple circuits we need not be bothered by this.

Let us look at a few symbols used in circuit diagrams. Connecting wire, as stated above, is shown as a solid line. Where wires cross without any connection we just show two lines crossing each other. An electrical joint is represented by a black dot on the junction (Fig. 1.4).

A battery is represented by a series of identical cells—here the symbol reflects the physical con-

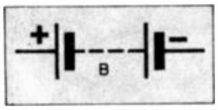


Fig. 1.5 The circuit symbol for a battery.

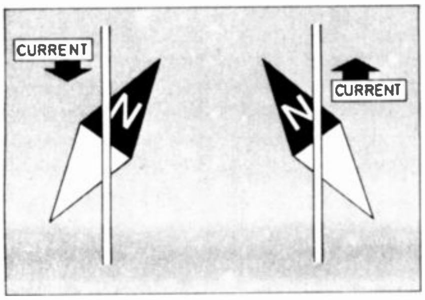


Fig. 1.6 A compass needle will be deflected by the magnetic field produced when current flows in a wire. The direction of the deflection depends on the direction of the current.

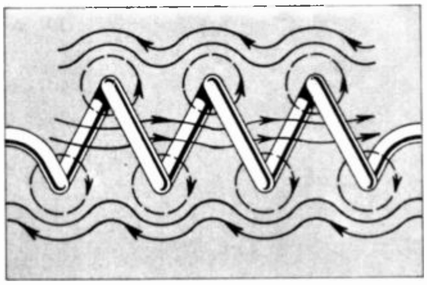
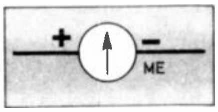


Fig. 1.7 The magnetic fields around the turns in a coil tend to add together.



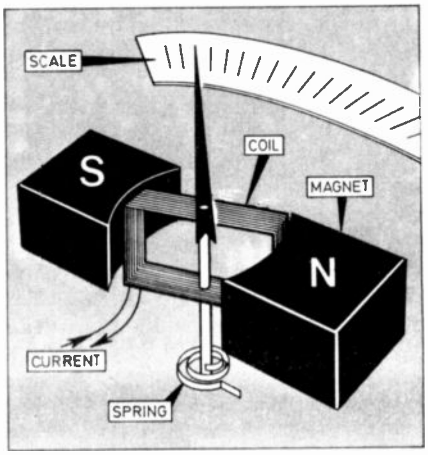


Fig. 1.8 A simple moving coil meter. The magnets produce a force on the coil when a current flows. The circuit symbol is shown alongside.

struction of the battery. The longer thinner line of the cell represents the **positive** (+) terminal and the shorter, thicker one the **negative** (−) (Fig. 1.5).

The labelling of the supply lines on a circuit diagram is something that can easily confuse a beginner. Two circuit diagrams may be encountered, both of which show a single 9V battery as the power supply but in one the lines are marked 0V and +9V, and in the other they are marked 0V and −9V.

The root of the confusion lies in the fact that if we take the positive terminal of a battery as a reference point and call it 0V then all voltages in a circuit diagram will be negative with respect to this reference.

If we call the negative terminal 0V then all voltages will be positive. Both notations occur because some circuit diagrams are easier to follow with all voltages positive whilst others become clearer with negative voltages. Both notations are equally valid.

Throughout the series extensive use will be made of circuit diagrams and as new components are introduced, their circuit symbols will be given.

UNITS

Quantity of charge is measured in units called **coulombs (C)**. The charge on a single electron is very small indeed, it requiring over ten million, million, million (10^{19}) to make one coulomb. However, there are vast numbers of electrons in matter—in metals there are about ten thousand million, million, million (10^{22}) **conduction electrons** in each cubic centimetre.

Current is defined as the rate of flow of charge. It is measured in **amperes (A or amp)**, one amp being when charge flows at a rate of one coulomb per second.

In electronics, as opposed to electrical engineering, the ampere (or "amp," as it is usually referred to in speech) is often too large a unit to handle comfortably. We thus use sub-multiples of the amp: thousandths of an amp (**milliamps** or **mA**) and millionths of an amp (**microamps** or **μA**). So, rather than saying that there are three thousandths of an amp we can say three milliamps (3mA).

Electromotive force is measured in **volts (V)**. Volts are quite handy-sized units—batteries tend to be 1·5V, 3V, 4·5V, 6V, 9V and so on. But in electronic circuits often we come across thousandths of a volt (**mV**) and millionths (**μV**). We will come across the unit volt in connection with another electronic quantity, **potential difference (p.d.)** but, since this is closely connected with e.m.f. there is no reason to be confused.

When electrons flow they transfer energy. We call the rate at which energy is transferred the **power**—this being calculated by multiplying the current flow by the e.m.f. The units of power are called **watts (W)**.

MEASUREMENTS

To understand the working of a circuit we need to be able to monitor the current flowing in each section of the circuit. There is no way of actually counting the electrons as they pass a particular point, so some indirect way of measuring is used.

To measure current, use is made of another force field created by the flow of electrons. This differs markedly from the electric field described earlier and it introduces a new term: **magnetic field.**

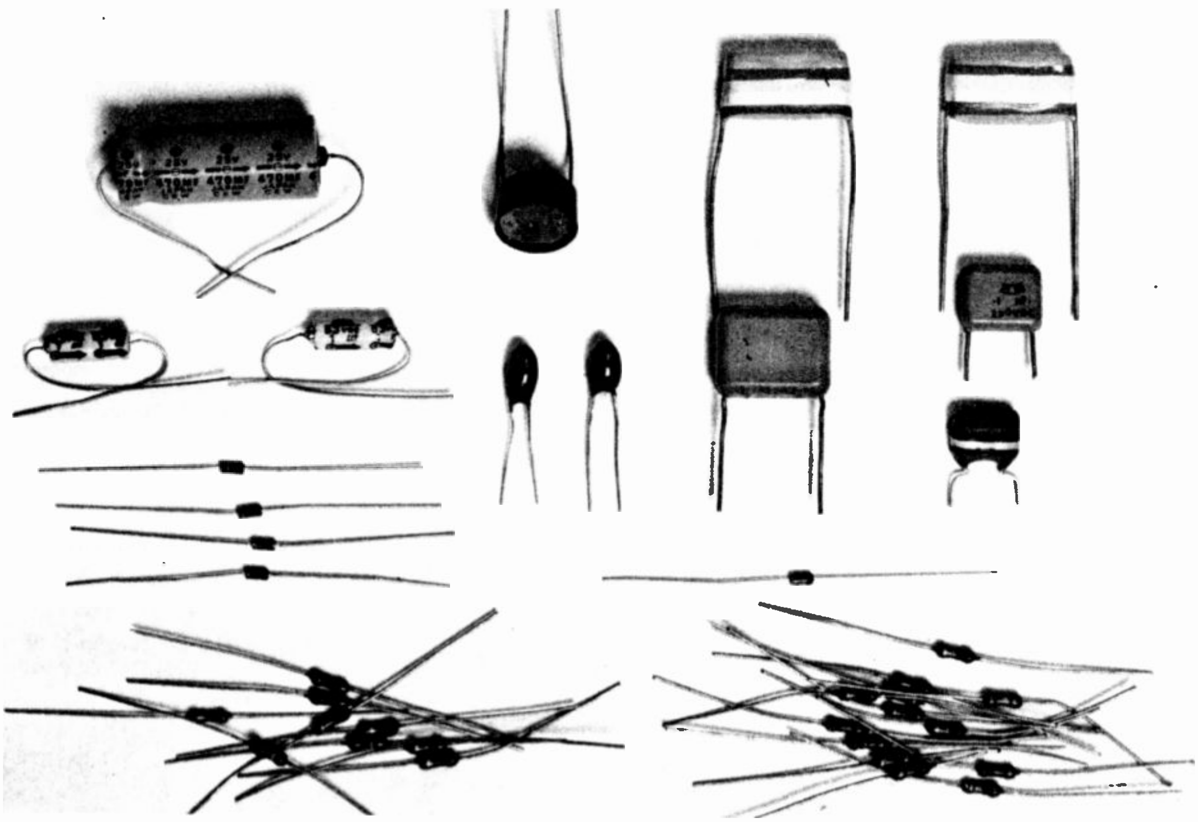
The earliest types of meter made use of compass needles which were in fact thin metal strips which had been magnetised by rubbing them with naturally occurring magnets. When a wire carrying current is placed over the compass needle a deflection from the natural direction of the needle is observed. If the direction of the current is reversed, then the deflection is in the opposite direction (Fig. 1.6).

Modern **"moving coil" meters** make use of the magnetic field created when a current flows but they are made far more sensitive by using coils of wire rather than a single wire.

Fig. 1.7 shows how the current through each turn of the coil increases the magnetic field. The stationary magnet causes the coil to produce a twisting force about its pivot which is resisted by a fine spring. The greater the current the greater the twisting force and hence the greater the movement of the needle across the scale (Fig. 1.8).

A meter is really converting electrical energy into mechanical movement and thus it must absorb some power. The amount of power the meter takes depends on the type but it should always be remembered that meters affect the currents in a circuit although, hopefully, the effect is negligible.

Modern **digital meters** are more subtle in the way they make their measurements. In them there is a



The components required for the experiments in the first 6 parts of Teach-In 80. These have been designated List B. The non-polarised capacitors (shown top right hand corner) show alternative types, namely metallised polyester type C280 and moulded cased metallised polyester.

stable, accurately set voltage reference. An ingenious circuit compares the effect of the voltage to be measured with that of the reference voltage.

Other ways of measuring current are available nowadays. One particularly clever one uses a tiny chip of silicon which produces a voltage proportional to the magnetic field through it. Since magnetic field is proportional to current, the probe is simply placed on the wire and current read off.

SOURCES OF ELECTRICAL ENERGY

An electric circuit can be summarised as a source (or many sources) of electrical energy connected with one or more absorbers or dissipators of electrical energy.

Ideally, sources of energy would supply current at a constant voltage no matter how great the current flow was. However, actual sources are far from ideal and the limitations which this implies should be realised.

Chemical

A chemical cell which can produce electric energy is extremely useful as it can be easily transported, is relatively cheap and needs virtually no attention. The common **battery** is simply a set of such cells connected together to give a useful voltage.

If a PP3 type 9V battery is cut open and examined it will be seen to have six cells. Each one in fact has a voltage of only 1·5V; they are connected in such a way as to add all the individual voltages together. A PP3 can only supply few tens of milliamps. If one tries to draw a greater current then the voltage falls off rapidly.

A car battery can supply far more current because of its much greater physical size. It is also reversible in that it can convert electrical energy back into chemical energy. This process we call charging.

The *voltage* of a cell is determined by the materials from which it is made—not by its physical size. Only the *power* it can supply depends on its physical size.

Mechanical

Virtually all our homes are fed with a ready source of electrical energy which we call the mains supply. The major proportion of the electrical energy distributed

COMPONENTS NEEDED FOR EXPERIMENTS UP TO PARTS 6 (LIST B)

Resistors

1 off	10 ohm
2 off	680 ohm
10 off	1 kilohm
4 off	10 kilohm
2 off	33 kilohm
2 off	100 kilohm
1 off	1 megohm
All ¼W carbon ± 20%	
1 off	ORP12 light dependent resistor

Capacitors

2 off	0·1μF polyester film	Mullard type C280, ITT type PMT/2R, or similar
2 off	0·47μF polyester film	
2 off	1μF 25V electrolytic, axial lead (63V would suit)	
1 off	470μF 25V electrolytic, axial lead	
2 off	33μF 10V tantalum bead	

Diodes

4 off	1N4148 or similar silicon diodes
1 off	5·1V 400mW Zener diode

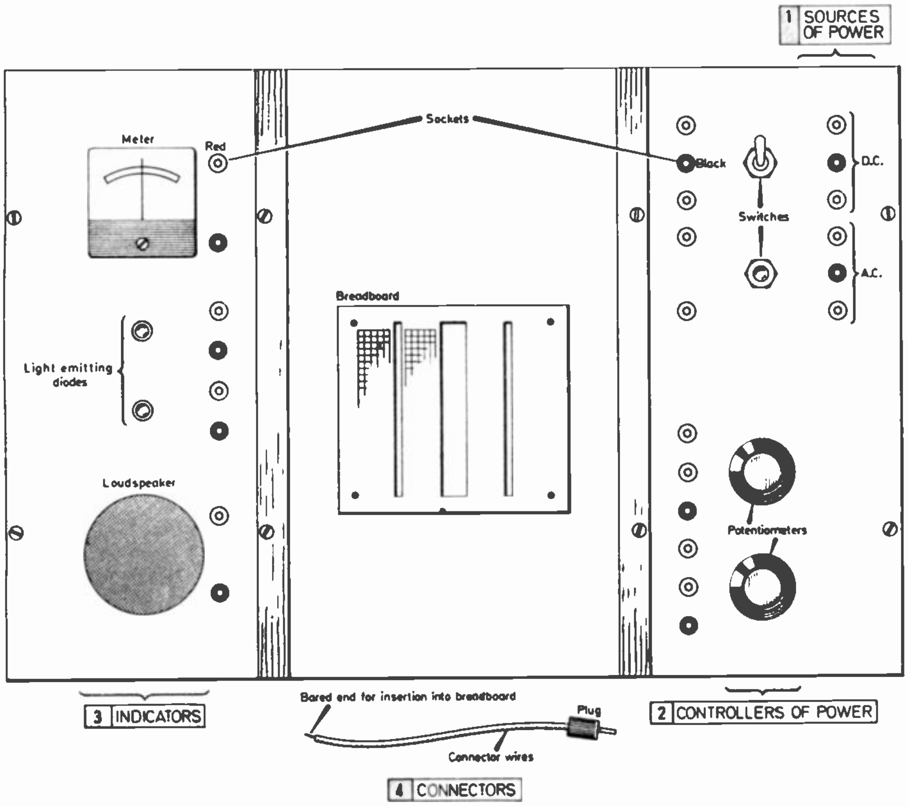


Fig. 1.9 The three types of component on the Tutor Deck.

about the country is produced by machines which convert mechanical energy (produced in its turn from heat) into electrical energy.

Vast rotating machines called **generators** are used and they produce a special kind of voltage—one that changes direction a hundred times a second. When this type of voltage produces a current in a load we call it **alternating current**, or **a.c.** for short. One often sees the slightly confusing phrase **a.c. voltage**. This strictly should be alternating voltage but **a.c. voltage** and **d.c. voltage** (d.c. being direct current, that is a current that flows continually in one direction) are in such wide use that the meaning is quite clear.

Light

It is possible to convert light directly into electricity without any intermediate stages. We call the devices that do this **solar cells** and, in these days of dwindling fuel supplies, these devices are destined to become much more widely used.

Heat

Heat energy can also be converted directly into electrical energy without the need to go through the wasteful step of first converting it into mechanical energy.

When two different metals are placed in contact with each other an e.m.f. is produced. If the junction is heated then the e.m.f. goes up. In fact, to make use of this e.m.f. we need another junction which is usually held at a low temperature in order to eliminate the e.m.f.s produced where the metals used join with the rest of the circuit, which is usually copper.

The device described is a **thermocouple** and when a large number of junctions are connected together a device known as a **thermopile** is formed. As yet, this type of device has not been used as a source of power, probably because of its cost.

THE TUTOR DECK

Looking at the Tutor Deck it will be seen that there are basically three types of components.

(1) **sources of power**, both d.c. and a.c.

(2) **controllers of power** and

(3) **indicators** (Fig. 1.9).

In fact, virtually all electronic components can be classified in one of these categories, although some may be in more than one.

PART 1 QUESTIONS

1.1. Electrons are:
- a) Tiny pieces of metal
- b) Part of an atom
- c) Part of the nucleus?

1.2. The following atoms contain electrons:
- a) Copper
- b) Uranium
- c) Silicon
- d) All of these
- e) None of these?

1.3. Electric current is:
- a) Electrons moving randomly
- b) Electrons flowing in a straight line
- c) Electrons moving randomly but drifting in a given direction?

1.4. Current is measured in:
- a) Coulombs
- b) Amperes
- c) Volts?

1.5. The voltage of a battery depends on:
- a) Its size
- b) The materials from which it is made
- c) How many cells it contains?

A fourth important circuit element is, of course, the **connector**. On the Tutor Deck the connections are made with wires which plug into the breadboard. These go through 1mm plugs and sockets into wires which are soldered to the actual components inside the deck.

Again, this illustrates the types of connection found in all pieces of electronic equipment—**solder joints** where components are never (or very rarely) to be removed and **plug and socket joints** where either components need to be frequently interchanged or where access to certain parts of the equipment would be otherwise impossible.

In Part 2 we will look at ways of controlling the flow of electrons and in particular at various types of resistor.

HIGH IMPEDANCE VOLTMETER

By R. A. PENFOLD

IT is perhaps not generally realised, particularly among newcomers to electronics, that d.c. voltage measurements made using an ordinary multimeter can provide erroneous readings under certain circumstances. The most common cause of such erroneous readings is due to circuit loading. This is where the voltage to be measured is significantly altered when the multimeter is connected into circuit.

Thus, although the multimeter correctly indicates the test voltage, this reading is nevertheless a false one as it is only produced while the multimeter is connected to the circuit under test.

CAUSE OF ERRONEOUS READINGS

This effect is only produced when a high impedance circuit is being checked, and the manner in which it occurs is illustrated in Fig. 1. This shows the circuit diagram of a typical high input impedance emitter follower buffer amplifier.

Circuits of this type are usually designed so that the impedance of resistor *R*a is roughly equal to the combined parallel impedance of resistor *R*b and the input impedance of the transistor. By a simple potential divider action about half the supply potential appears at *TR*a base, or about 4·5 volts in this example.

If a standard 20 kilohm/V multimeter switched to the 5 volt range were to be used to measure the voltage at *TR*a base it would give a reading of about 1 volt instead of 4·5 volts. This is because the multimeter would consist basically of a 50 microampere meter connected in series with a resistor having a value which would give a total meter-resistor series resistance of 100 kilohms.

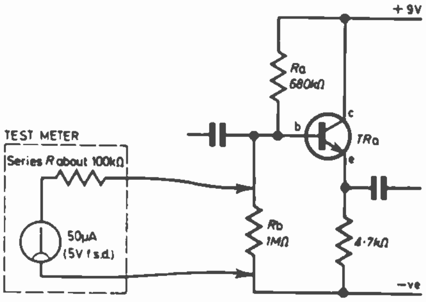


Fig. 1. A testmeter does not always provide reliable readings, as demonstrated here.

The total circuit resistance has to be 100 kilohms as it can be shown from Ohm's Law that 5V will then be required in order to force 50μA through the circuit, and thus produce full-scale deflection of the meter ($I \times R = V$, $0{\cdot}00005\text{A} \times 100{,}000 \text{ ohms} = 5\text{V}$). In other words the multimeter has a sensitivity of 20 kilohm/V, as 20 kilohm of resistance is needed for each f.s.d. volt.

When the test meter is connected to the amplifier circuit its resistance of 100 kilohms is shunted across *R*b and the input impedance of *TR*a. *R*a was formerly feeding a combined parallel resistance of about 680 kilohms, but this is now reduced to about 87 kilohms by the presence of the multimeter circuit. By a simple potential divider action only about 1 volt is now produced at the base of *TR*a. The test meter then correctly, but misleadingly, produces a reading of about 1 volt.

ELECTRONIC VOLTMETER

This problem can be overcome by using an electronic voltmeter when making measurements such as this. An electronic voltmeter has an amplifier added ahead of the meter movement in order to boost the input impedance to a very high level. The input impedance of the unit is then too high to be of significance even when testing high impedance circuits.

The electronic voltmeter described in this article has an input impedance of a little over 11 megohms and it provides six d.c. measuring ranges. These are 0 to 250mV, 1V, 2·5V, 10V, 25V and 100V. This corresponds to sensitivities of between 44 megohms/V and 110 kilohms/V (approximately), which compares very favourably with the 20 kilohms/V of a standard multimeter. It should certainly be sufficiently sensitive for all voltage measurements the amateur is likely to encounter.

The voltmeter can also be used for a.c. measurements, but note that the f.s.d. values are doubled when the unit is switched to the a.c. mode (i.e. the a.c. ranges are

500mV, 2V, 5V, 20V, 50V and 200V). The unit is only suitable for use at audio frequencies.

THE CIRCUIT

The circuit diagram of the high impedance voltmeter is shown in Fig. 2. This breaks down into three main sections, the central one being the amplifier stage. This uses operational amplifier IC1 as a unity gain non-inverting amplifier.

In this configuration the input signal is applied to the non-inverting (+) input and the inverting (−) input is coupled to the output so as to provide a 100 per cent negative feedback loop. This gives the circuit a voltage gain of unity, so that whatever the input voltage is, the output voltage is identical to it.

However, the output is at a low impedance and is capable of driving a simple voltmeter circuit. The input impedance of the amplifier is extremely high, the actual figure being typically 1·5 Tohms (1·5 million megohms).

R16, VR1, and ME1 form the last stage of the unit, which is a conventional voltmeter circuit. VR1 is adjusted to produce a f.s.d. sensitivity of 250mV, and this provides the circuit as a whole with a basic sensitivity of 250mV.

In order to extend the voltage range of the unit a six-position step-type attenuator is added at the input, and this is formed by R1 to R14. S2 is the range switch, which selects the appropriate attenuator output.

A.C./D.C. SWITCHING

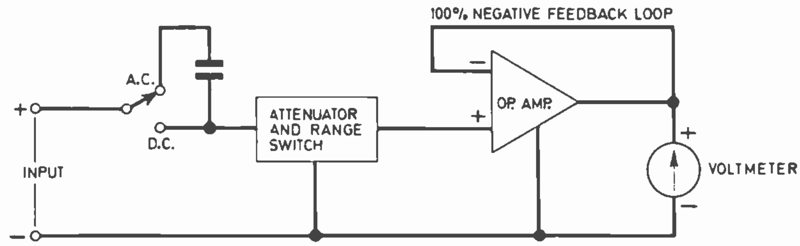
S1a is used to provide a.c./d.c. switching. In the d.c. mode the positive input socket SK1 is connected direct to the input of the attenuator. In the a.c. mode the input is applied to the attenuator via C1 which blocks d.c. signals but permits a.c. signals to pass.

Positive-going half cycles will take the input and output of the IC1 positive, and will cause a deflection of the meter.

Negative-going half cycles will take the input of the amplifier negative of the earth line, but obviously the output cannot do so as this circuit has only a positive supply, and not the usual (for op-amps) dual-balanced positive and negative supplies. Thus the circuit provides rectification. However, it is only half wave rectification, and so the f.s.d. sensitivity of the circuit is twice as high as it is in the d.c mode.

Readers who are familiar with op-amp i.c.s such as the 741C may wonder how this circuit is capable of operating using only a single supply voltage. The reason is

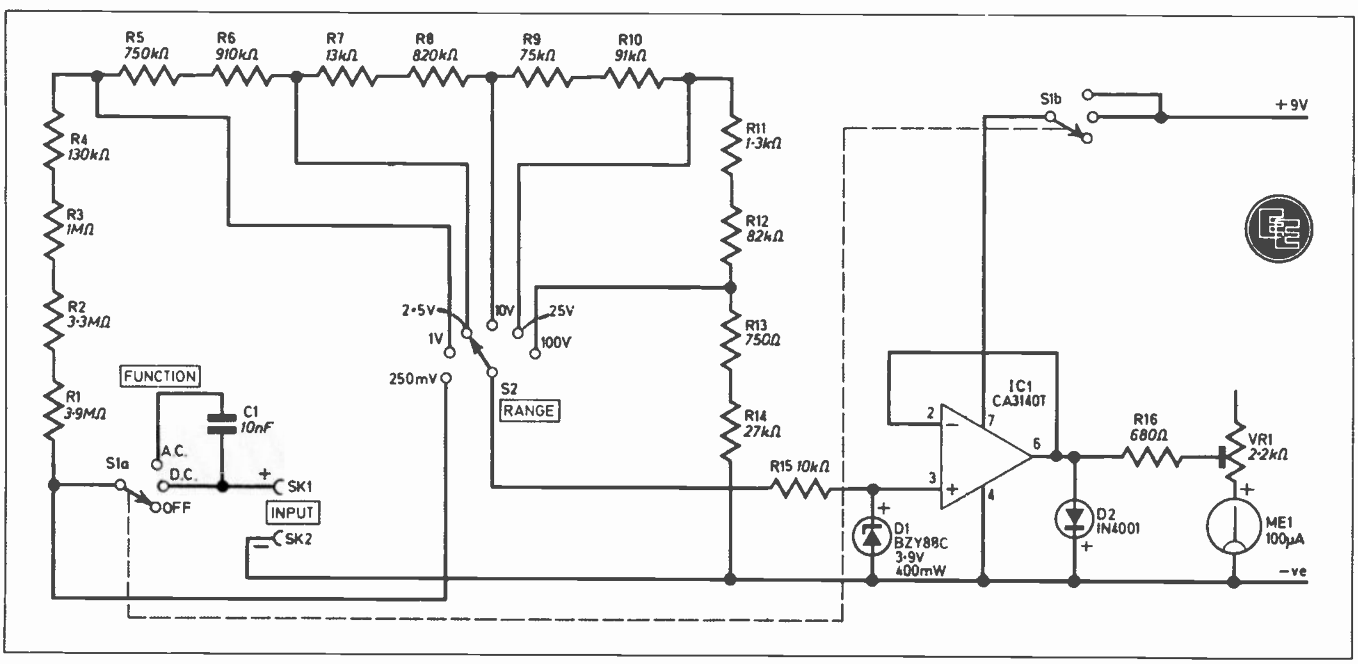
HOW IT WORKS



An operational amplifier i.c. forms the basis of the circuit. This is connected with 100 percent negative feedback so it provides no voltage gain, but its input impedance is so high that no significant input current flows. The unit therefore places very little load on the circuit under test. The output of the unit is fed to an ordinary voltmeter circuit. An attenuator added ahead of the amplifier provides the unit with six measuring ranges.

For a.c. measurements a d.c. blocking capacitor is switched in series with the input. As the circuit only responds to positive input half cycles it provides half-wave rectification, and so no separate rectifier is required.

Fig. 2. The circuit diagram of the High Impedance Voltmeter.



HIGH IMPEDANCE VOLTMETER

Front panel layout and annotation of panel mounted components.

COMPONENTS

Resistors

- R1 3·9MΩ 5%
- R2 3·3MΩ 5%
- R3 1MΩ 5%
- R4 130kΩ 5%
- R5 750kΩ 2%
- R6 910kΩ 2%
- R7 13kΩ 5%
- R8 820kΩ 2%
- R9 75kΩ 2%
- R10 91kΩ 5%
- R11 1·3kΩ 5%
- R12 82kΩ 2%
- R13 750Ω 5%
- R14 27kΩ 2%
- R15 10kΩ 5% or 10%
- R16 680Ω 5% or 10%

All ¼ or ½ watt, tolerance as indicated, or better

See **Shop Talk** page 630

Potentiometers

VR1 2·2kΩ sub-miniature horizontal preset

Capacitor

C1 10nF plastic foil

Semiconductors

- IC1 CA3140T CMOS operational amplifier
- D1 Zener diode BZ88C3V9 (3·9 volt 400mW)
- D2 Rectifier diode 1N4001

Switches

- S1 3-way 4-pole rotary type (only two poles used)
- S2 6-way 2-pole rotary type (only one pole used)

Miscellaneous

ME1 100μA moving coil meter. Sloping front case or similar housing about 160 × 60 × 95mm. 60 × 45mm. Two control knobs. Two 2mm wander sockets, test prods, etc. 0·1in. matrix stripboard (16 holes × 11 strips). PP3 battery and connector to suit. Wire, solder, etc.

COMPONENTS approximate cost £10

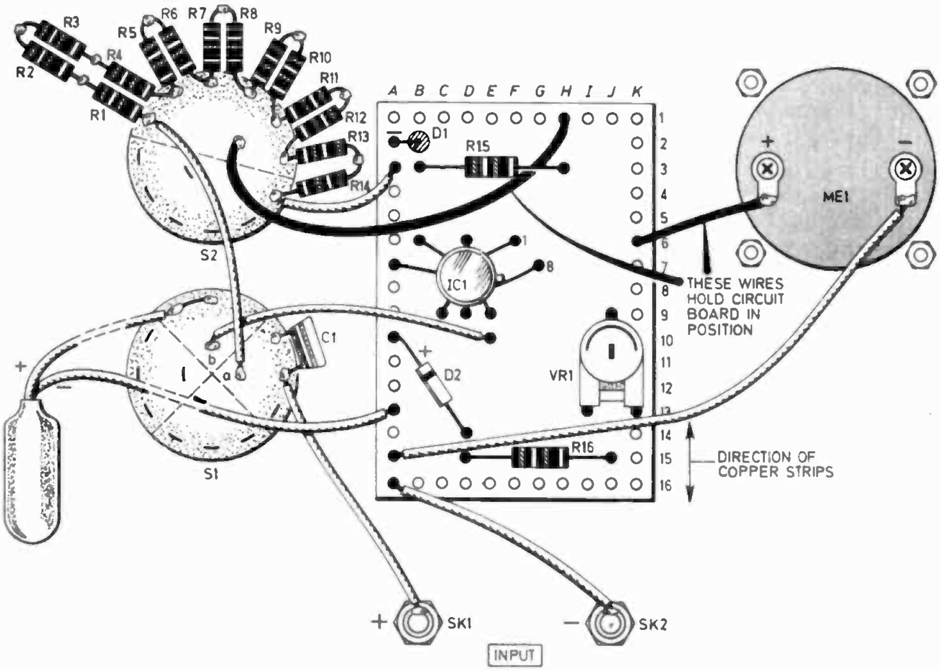
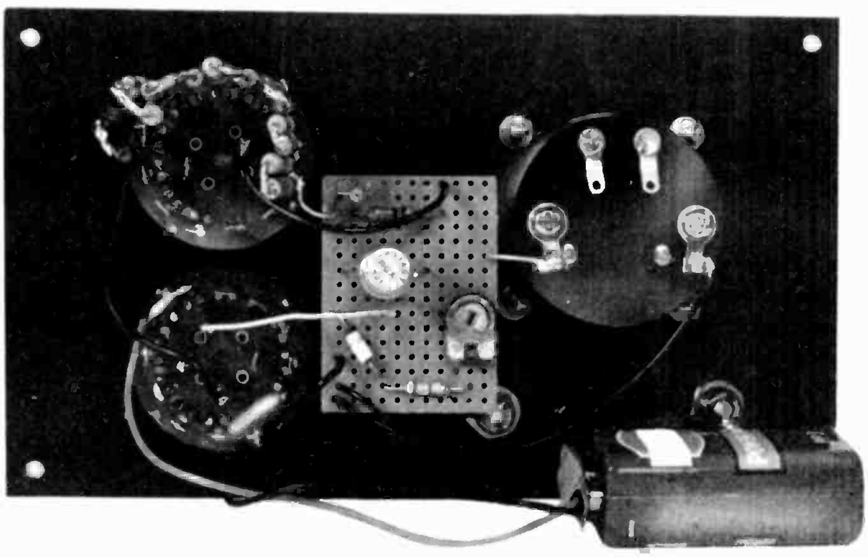


Fig. 3. Constructional details of the High Impedance Voltmeter.

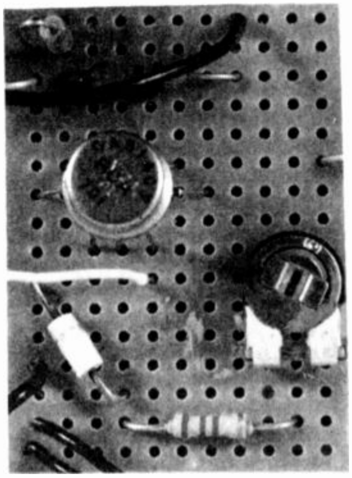


Interwiring and component board positioning details. The range resistors are mounted directly on the switch.

simply that the CA3140T i.c. has a p-channel MOSFET input stage which enables it to operate with its inputs at voltages as low as the negative supply rail.

Ordinary op-amps having bipolar input stages cannot operate correctly with the inputs at voltages of less than about 2V. Also, the outputs of most op-amps will not go to within about 2V of the negative supply rail.

The output of the CA3140T will swing to within a few millivolts of the negative supply rail, so there is no significant voltage across the meter with no input signal. Apart from obviating the need for a negative supply, this also means that no electrical zero-set control for the meter is needed.



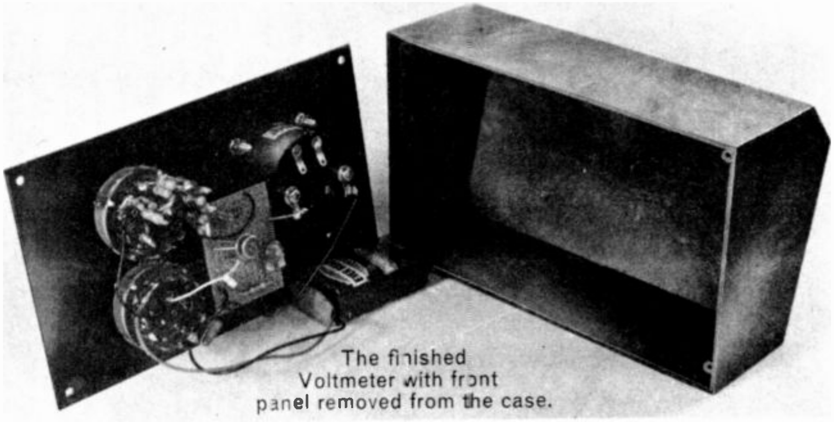
The completed circuit board.

OVERLOAD PROTECTION

In order to protect the i.c. against accidental input voltage overloading, a simple Zener clip-clipping circuit has been added at the non-inverting input. This consists of R15 and D1, which clip the input at 3·9V in the event of a serious overload.

This circuit also protects the unit against overloads of incorrect polarity, as in such an event D1 acts as an ordinary forward-biased silicon diode, and clips the input voltage at about −0·6V.

The meter is protected against severe overloading by D2, which limits the output voltage of the i.c. to about 0·5V. This limits the current through the meter to about double its f.s.d. value, and this is not sufficient to damage the meter, even if sustained for some time.



The finished Voltmeter with front panel removed from the case.

CONSTRUCTION starts here

CASE

A plastics box measuring 160×60×85mm and having a sloping aluminium front panel is used as the housing for the prototype Voltmeter. The general arrangement of the unit can be seen from the photographs. The meter requires a large 38mm diameter cutout, and this can be cut using a fretsaw or a miniature round file. The input sockets are ordinary wander types.

WIRING

Some of the components are mounted on a 0·1in matrix stripboard which has 16 holes by 11 copper strips. The other components are wired up on the two switches. All the wiring is shown in Fig. 3.

The leadout wires of R1 to R14 must be cut fairly short if these components are to fit neatly into the available space. This makes it important that they are soldered into place quickly and efficiently, as otherwise they could be adversely affected by the heat from the soldering iron. It is advisable to clean the ends of the leadouts and tin them with solder prior to making a connection.

Construction of the component panel is commenced by carefully cutting out a panel of the correct size using a small hacksaw. Any rough edges are then filed flat. (There are no breaks in any of the copper strips and no mounting holes are drilled in the panel.) The six components are then soldered into position.

The remaining wiring can then be completed, with the leads which connect the panel to the wiper of S2 and the positive meter terminal being left until last. These leads are made from thick, single-strand wire (a couple of pieces cut from the attenuator resistors will do) and they should be as short as possible. They will then provide the component panel with a firm mounting.

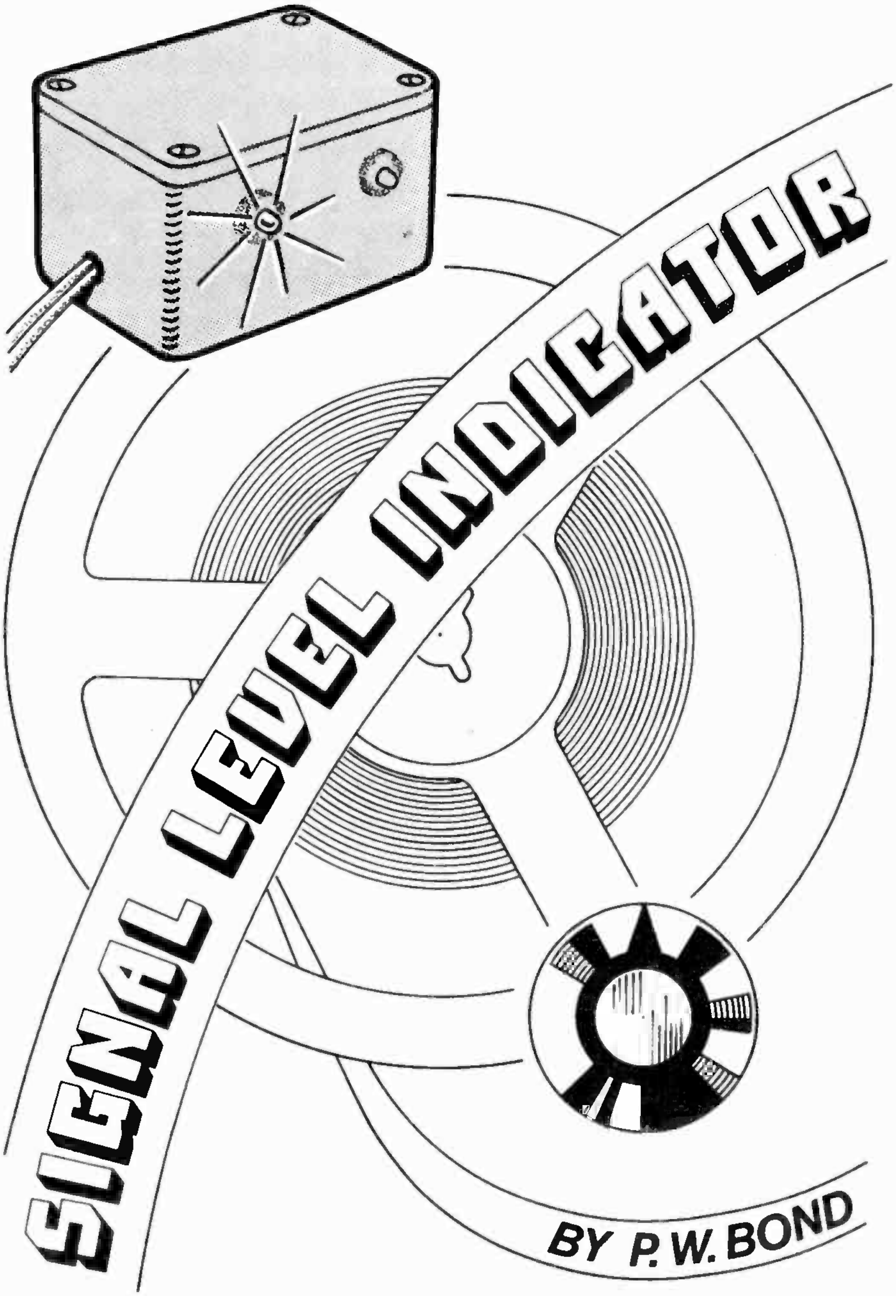
Current consumption of the unit is only about 2·5mA and so a PP3 battery can be used as the power source, and will have a long life.

ADJUSTMENT

Switch the unit to the 250mV range, short the test prods together, and then switch the unit on. A small positive deflection of the meter might then be noticed, although at worst this should be hardly perceptible. In the event that a small meter deflection is produced, this can be offset by mechanically zeroing the meter.

In order to calibrate the unit it is necessary to have a suitable calibration voltage. This could, for example, be a 9V battery, the exact voltage of which has been checked using a multimeter. With the high impedance voltmeter switched to the 10V range and the battery connected to the test prods, VR1 would then be adjusted for the appropriate voltage reading on the unit.

If desired, the front of the meter can be unclipped and the scale plate removed so that additional scales can be added. However, this is not essential as it is quite easy to convert meter readings into the voltages they represent. ⌑



SIGNAL LEVEL INDICATOR

BY P. W. BOND

WHEN making recordings on cassettes or spool tape it is necessary to control carefully the recording level so that distortion does not occur or, on the other hand, the signal does not get lost in the hiss of unmagnetised tape. This project describes a cheap unit which helps the process of recording by providing a visual indication of the level of the signal source.

AUTO OR MANUAL CONTROL

Many domestic tape and cassette recorders have only two heads, as opposed to three on professional and semi-professional machines. One head is used to erase the tape and the other is a combined record and replay head.

Where the combined head is used the only way of ensuring that distortion does not occur is to monitor and adjust the recording level control. The adjustment of the recording source level can be done in one of two ways.

COMPONENTS approximate cost £3.00 excluding case

First, a simple manual volume control can be used which requires the operator to adjust the level to produce a satisfactory recording. Secondly, a system which requires no adjustment is automatic volume control or a.v.c.

AUTOMATIC VOLUME CONTROL

The a.v.c. method has its advantages and disadvantages. For recording an interview or outdoor sounds into a microphone a.v.c. is ideal. The electronic circuit in the a.v.c. changes the recorded signal loudness in response to the level of the signal from the microphone.

When the a.v.c. is used with a recording of music though, the compressing effect causes the sound to be jumpy and with classical music this effect is irritating.

To take full advantage of cheap electronics the present trend is for recorder manufacturers to use both systems. The choice is then left to the user, but for optimum results when recording music it is best to use the manual control.

MANUAL CONTROL

To get good results the manufacturer will recommend that the signal is to be kept to limits as indicated on some form of meter. In many instances this meter is inaccurate or too small and is therefore pretty useless for people with poor eyesight. Whilst a larger indicator such as a VU (Volume Unit) meter would be ideal, it could still be difficult to see unless lit from behind. And what is more, there may not be sufficient room to fit one on the machine.

The unit described here enables the correct recording level to illuminate a light emitting diode *dimly*. If the signal is too low then the l.e.d. will not light-up at all, and if the level is such that a distorted recording will be made then the l.e.d. glows *brightly*.

The l.e.d. is physically quite small and could be incorporated into a tape deck if the associated circuit board can be accommodated. The author's prototype was to be used with an open reel recorder and the unit was built into a cassette case with the power supply being derived from the tape recorder. There are many variations on the design and the actual boxing it not critical, but remember that if the unit is to be battery operated then there must be enough room for the PP3 battery.

STEREO OR MONO VERSIONS

Since there are a number of stereo cassette and open reel tape decks on the market it seemed a good idea to build a *stereo* signal indicator and this is described in the article. However, since the signal indicator was designed initially for a mono tape recorder and some readers may wish to construct the mono only version this is easily accomplished. The stripboard is divided and only the section indicated needs to be built for mono use.

negative half cycles of the input waveform cause TR1 to conduct less collector current. The collector voltage of TR1 thus rises and allows C2 to charge and TR2 to conduct.

With very large signals applied to the input from the signal source, TR1 is allowed to switch off completely and the voltage at its collector will be allowed to rise to the supply rail voltage. C2 is allowed to charge to the supply rail voltage but in practice it only attains a value of about 2·5 volts and this causes the l.e.d. to glow at its brightest.

SLOW DECAY

If the signal returns to a low level, the collector voltage of TR1 falls to 0·1 volt again. However, D2 prevents C2 from discharging rapidly and the voltage at the base of TR2 decays fairly slowly. The l.e.d. thus dims and so indicates that the signal level returns to normal.

The slow decay feature was incorporated to prevent the l.e.d. from flickering—this could be an annoyance to the person making the recording.

VR1 is pre-adjusted so that only high level source signals which would produce a distorted recording produce a very brightly lit l.e.d. More is said regarding the setting of the signal indicator in the last part of this article.

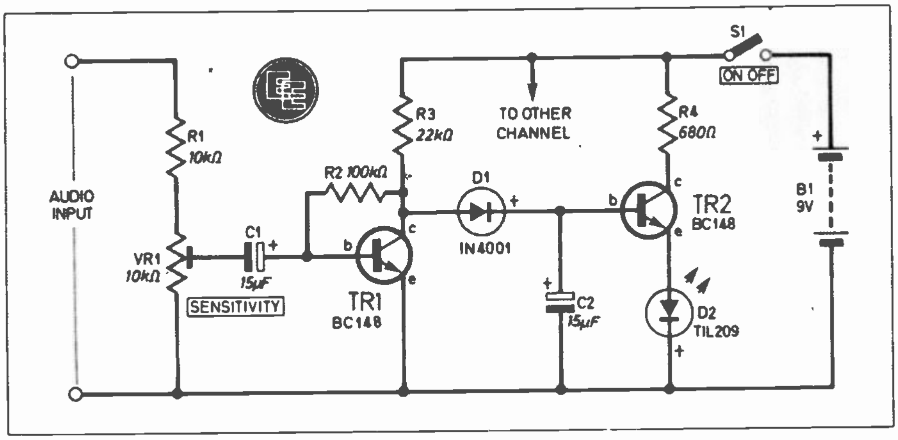


Fig. 1. Circuit of the Signal Level Indicator—mono version.

CONSTRUCTION starts here

CONSTRUCTION

The original unit was a mono signal indicator and was used in a mono recorder. However, there is so much stereo equipment in use these days that it seemed more useful to have a stereo signal indicator. It is the stereo signal indicator that is described here.

CIRCUIT DESCRIPTION

Referring to Fig. 1, this shows the circuit for one channel. For a stereo version, this circuitry is duplicated, save for the battery B1 and the switch S1 which are common to both channels.

The signal indicator unit is connected to a low impedance monitor point on the tape deck, and a socket is often provided for this purpose. Alternatively, the headphone socket could be used.

The input signal is applied to the input of the circuit and the level is adjusted by R1 and VR1; the latter acts as a preset sensitivity control. Under quiescent, no-signal conditions, the transistor TR1 is biased to be conducting and the collector voltage is only about 0·1 volt. Consequently TR2 is held non-conducting and the l.e.d. D2 is not lit.

When the signal is applied to the unit, the amplitude of the

The completed stereo version of the Signal Level Indicator. The screened audio input leads have been wired to a stereo jack plug.

SIGNAL LEVEL INDICATOR

COMPONENTS

Resistors
R1 10kΩ
R2 100kΩ
R3 22kΩ
R4 680Ω
All ¼W carbon ± 5%

Potentiometer
VR1 10kΩ lin. preset (horizontal mounting)

Capacitors
C1 15μF Tantalum
C2 15μF Tantalum
Both 10 volt wkg.

See Shop Talk page 630

Semiconductors
TR1 BC148 *npn* silicon transistor
TR2 BC148 *npn* silicon transistor
D1 1N4001 diode
D2 TIL209 Red light emitting diode (with Bezel)
Note that for a stereo indicator two of each of the above components will be required.

Miscellaneous
B1 PP3 9V battery
S1 Single-pole switch (miniature SPST)
Stripboard, 17 holes × 19 strips. Case, 80mm × 40mm × 60mm approx. Screened lead, plug & socket as necessary. PP3 Battery connector. Wire.

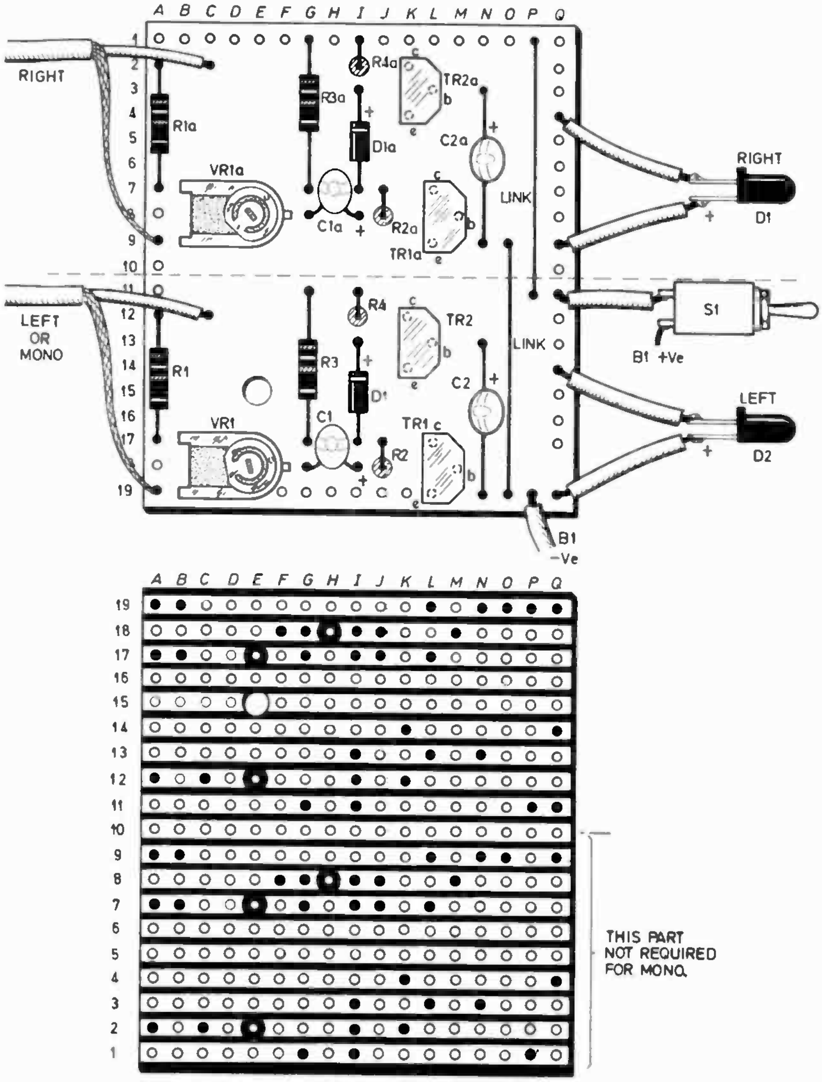


Fig. 2. The stripboard with components in position and view of underside showing breaks in the strips.

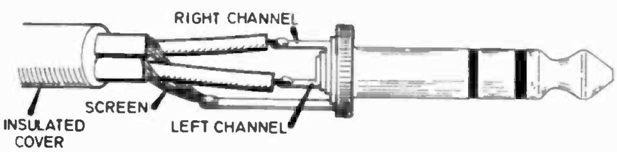
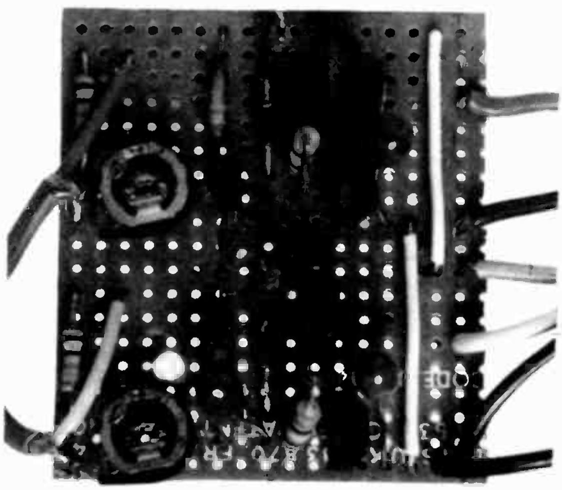


Fig. 3. Jack plug connections.



Completed circuit board for the stereo version.

The unit was built into a small plastics case and connection to the tape equipment was made with two screened leads, with a jack plug.

Two complete signal indicator circuits (Fig. 2) are built side by side on a piece of stripboard only 19 strips by 17 holes, and this left ample space for a PP3 battery inside the case. The use of 0·1 inch matrix stripboard enabled the BC148 transistors to be mounted properly. The BC148 is almost the same as a BC108 in its basic parameters but it has a plastic case which does affect the package dissipation which can be tolerated. In this project though, this is not important, and it is a few pence cheaper than the BC108.

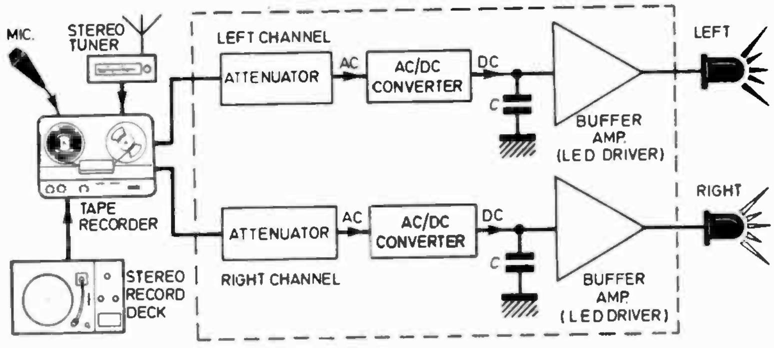
LOCKFIT TRANSISTOR

When the BC148 was designed, it was to be functionally identical to the BC108 but with a special lead. This comprises a flat metal leadout wire so shaped that if it was pushed through the appropriate hole, the lead would lock into place and so support the transistor. The base, emitter and collector are arranged in a triangle like the BC108, but each lead has the self support property known as "Lockfit." When the transistors are mounted, the leads should be carefully pushed into the holes in the stripboard so that the leadout wire end just protrudes on the copper side of the board.

MOUNTING RESISTORS

In order to conserve space on the board, there are certain resistors which are mounted vertically and this entails bending the leads back through 180 degrees. In some cases if the lead is bent too close to the body of the resistor, the connection to the composition inside the resistor can undergo damage. This applies to all cases where resistors are mounted in this way. The risk of damage is avoided if the lead is bent about 3mm away from the body of the component.

The stripboard is drilled in accordance with the diagram in Fig. 2 and the breaks in the strip are indicated on the same figure. For a mono signal indicator the lower half of the stripboard need only be used, which has a mounting hole for securing the unit to the case or equipment.



HOW IT WORKS

The signal from the source to be recorded is monitored by the Signal Level Indicator and a visual indication of very loud signals, liable to produce distortion, is given by a light emitting diode. When the l.e.d. lights brightly, the operator must adjust the controls of the tape deck and reduce the signal from the microphone, tuner or record deck until the l.e.d. dims.

The input signals are fed to the indicator where their level is adjusted by a potential divider which forms a kind of attenuator. The signals are then presented to the input of an a.c./d.c. converter. This changes the alternating currents of the signal to a proportional voltage which has only one polarity.

This unidirectional voltage is used to charge a capacitor *C*. Connected to the capacitor is a buffer amplifier which monitors the voltage across the capacitor, and produces a current which is sufficient to illuminate the light emitting diode. The brightness of the l.e.d. is controlled by the amplitude of the signals coming from the input to the tape deck.

The signal may reduce to a quiet level due to adjustment by the operator, or simply the source signal itself reduces in level naturally. The charge on the capacitor then dies away slowly and the l.e.d. dims proportionately.

The block diagram shows a two-channel version of the Signal Level Indicator. A mono version can be built simply by omitting one channel.

LIGHT EMITTING DIODES

The wiring connections are shown in Fig. 2. Note that the l.e.d.s have a polarity and must be wired the correct way or they will never emit any light. The l.e.d.s should be supplied with a bezel and this is used to support the device in position on the case, front panel or whatever. In this project the l.e.d.s have to be mounted on the side of the case to allow the lid to be easily removed for the gain adjustments to be made. The l.e.d.s are the TIL 209 type and the cathode (marked "+" on the diagrams) is identified by a notch or flat on the body, or other distinguishing mark.

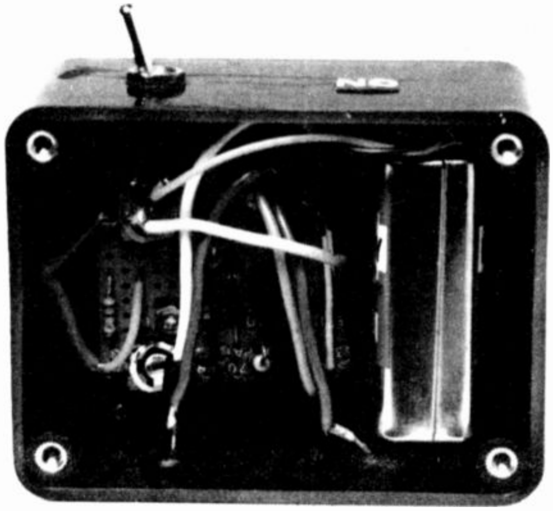
OBSERVE POLARITIES

The transistors and diodes have their polarities indicated on the wiring diagram. Small tantalum bead capacitors have been used. These have a polarity too, and this must be observed when wiring into position.

Some types of this component have colour codes, and no written identification is put onto the body of the component. A coloured spot on the body of the capacitor indicates the multiplication factor of the colour codes. Assuming that the value supplied is correct the anode is the lead which is on the right, when the spot on the component is nearest the viewer.

The l.e.d. leads can be colour coded and the choice of colour is left to the constructor but a simple colour code is *R*ed for *R*ight and *L*emon for *L*eft. This code could be the same as the input leads.

The battery was secured with double-sided adhesive tape since it is a very light component. Once the diodes and other components have been checked for polarity the unit can be tested. This procedure is described in the following section of the article.



The completed Signal Level Indicator (stereo version) with the top panel removed. Care must be taken when positioning the circuit board to avoid damaging the light emitting diode leads. The position of the battery is also shown.

Once testing is complete and the unit is aligned as described, the circuit board can be secured with an insulated washer and a 6BA nut and bolt.

TESTING AND SETTING UP

The left- and right-inputs are connected to the monitor points on the tape deck, as suggested in the description earlier. The leads should be preferably taken to a socket or plug (Fig. 3) or, if the unit is to be permanent, they may be hard-wired.

When the unit is connected to the tape deck the microphone or chosen source should be connected to the recorder input. A trial recording should be made and the monitor unit preset potentiometers should be adjusted so that the very loud passages of source material cause the l.e.d.s to glow brightly.

On average undistorted passages the l.e.d.s should have a dim but fluctuating glow. On very low signals and hence very quiet passages the l.e.d.s should hardly glow if at all. This indicates that the recorded signal will have a poor signal-to-noise ratio. In everyday language this means that the hiss or hum will appear to be quite loud in relation to the recorded sound.

Once the adjustment has been made the lid can be replaced and the unit need never be re-aligned with the same tape deck. The unit will allow persons who are not so technically minded to make good quality recordings. Remember—*Red means distortion* and demands that the record volume control needs turning back until the l.e.d. dims.

OTHER APPLICATIONS

The Signal Indicator could be used by the radio enthusiast as a signal strength indicator in a receiver. In the transmitter at the modulator, the unit can give a simple display of the level from the microphone amplifier and so prevent distortion.

In the disco, the unit could show the levels of the audio signal from the mixer console to the power amplifiers and thereby prevent overload distortion and possible damage to the power amplifier, and loudspeakers. ⌘

BRIGHT IDEAS

SCALES FROM SCRATCH

The appearance of many projects can be marred by the messy execution of panel legends and markings. As a Graphic Designer, the writer has used many lettering systems and methods, in the search for a perfect finish to various projects that are often examined by friends, for looks more than for effectiveness. In most cases, the most suitable method available for unique scales and markings turns out to be the use of 'Scraper Board.'

British Scraper Board can be purchased in packets from art shops and most stationers, and is available in a range of sizes from 150×100mm to 610×480mm, in black and white. Pack number five, for example, which costs about 50p, contains three sheets of black scraper board, one white, each 150×100mm, and a cutting tool. Full instructions are given in every packet, but the basic idea is that you scribe through the black coated surface of the board, with the tool provided, or with a craft knife or similar, to reveal white beneath.

For starters, use the tool, in a pen holder, fixed to a school type compass for the arcs needed for marking scales round rotary potentiometers. A steel straight edge can be used for other lines. The basic outline required can first be drawn lightly with pencil. Mistakes can be touched over with felt pen or brushed Indian Ink. Lettering is best executed with white Letraset, and the final touch is to give the panel a coat of spray-on varnish, to withstand rough usage.

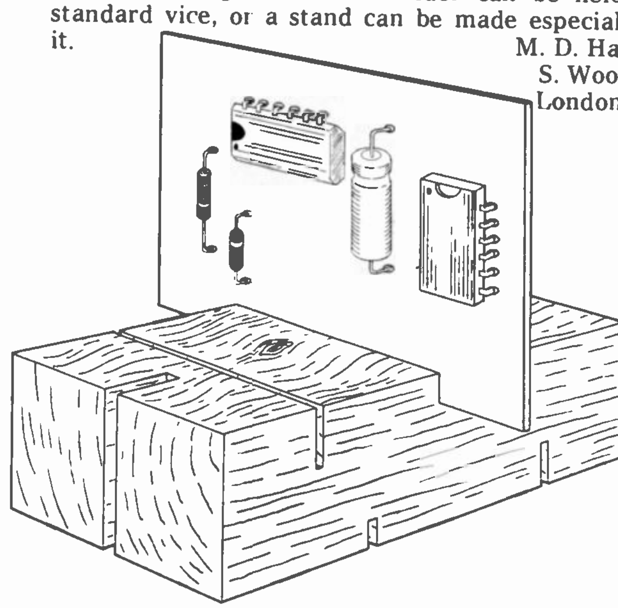
The white Scraper Board can also be coloured with ink, brushed evenly, in any colour to suit the project box.

K. Croft,
Broadstairs, Kent.

PCB HOLDER

I have evolved a very simple but effective way of holding circuit boards while soldering. It consists of a piece of wood with slots of varying widths for different thickness of board, the drawing shows the general arrangement. The holder can be held in a vice, or a stand can be made especially for it.

M. D. Harrison
S. Woodford,
London. E.18



Everyday News

MAKING BUBBLES

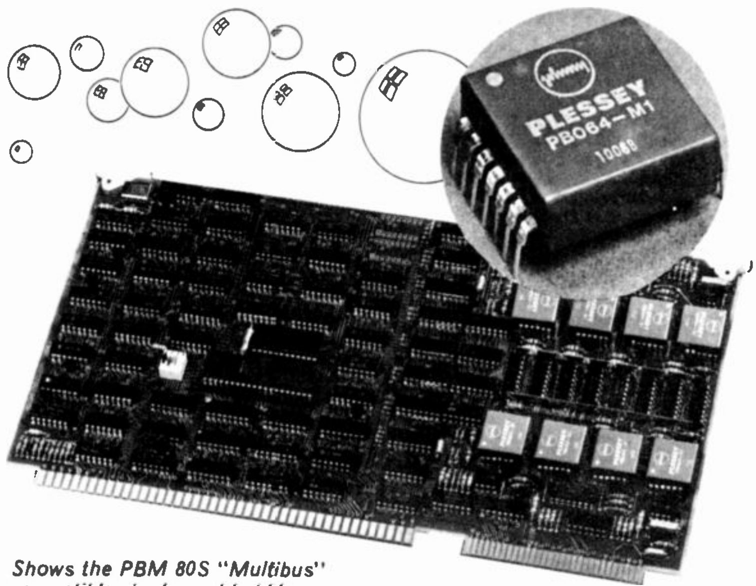
The electronics industry and the technical media has long been telling us that the next leap forward in technology will be the expansion of the capabilities of magnetic bubble memories.

Its heartening to see that Plessey are to the forefront of this new development and are already producing a 64K bit bubble memory in a 14-pin package. In fact their single-board memory systems are capable of up to 2M bytes.

A major advantage of the magnetic bubble system is, it is claimed, that solid state technology (against tape or disc) offers greater ruggedness and reliability with high storage density. An immediate demand is seen in telecommunications, data terminals, aerospace and defence.

The PBM80S memory is a "Multibus" compatible ½M bit card with eight on-board 64K bit devices. The unit offers a 100K byte per second data rate when operated as a program loader or backing store.

The PBM80M bubble memory card is expandable up to 2M bytes. An average access time of 7m sec gives the 2M bit card a substantial speed advantage over disc and tape memories when interfaced to the "Multibus" via a controller. Up to eight memory cards can be bussed from one controller.



Shows the PBM 80S "Multibus" compatible single card bubble memory system. The costs are £1,350 (PBM80S) and £3,000 (PBM80M).

SURPRISE PURCHASE

Surprise news this month is that Binatone International Ltd, have purchased the interests of Sinclair Radionics Ltd. The deal gives Binatone full rights to the Microvision miniature television and Sinclair's range of pocket calculators.

Trading under the name of Sinclair Electronics, the Instrument Division is continuing operations and is based in St. Ives, Huntingdon.

The "wallet-sized" 4in flat screen TV project is continuing and discussions are being held with third parties, with a view to its long-term development being taken up in partnership with an existing, undisclosed, company in the industry. This development work is supported by the NRDC.

Girls Look to Engineering

After hearing that nearly 800 sixth-form girls applied to attend a one-week teach-in on engineering as a career, held at Loughborough College, for which there were only 30 vacancies, GEC-Marconi has sponsored a similar course at Essex University.

One day was devoted to visits to company factories in the Essex area.

CB SOON?

Citizens Band (CB) radio could come to the UK in a few years. The new Government has conceded there is no objection in principle, only on technicalities on frequencies, types of set permitted, and administration.

The CB Association, a pressure group in favour of "freedom of the air" estimates that nearly 100,000 sets are currently in illegal use on the 27MHz band. If CB is allowed in the UK it seems fairly certain that in-built station identification will be compulsory to deter bad language and other abuses which have given CB a bad image in other countries.

The Conservative MP, Mr Patrick Wall, is leading a committe of backbench MPs in a new bid to persuade the government to authorise Citizen's Band (CB) radio in UK.

The Home Office, however, is likely to stick to its view that CB would be difficult to control and would lead to widespread abuse.

The president of IBM, John R. Opel, forecast recently that by the end of the 1980s the packing density of transsistors, logic and memory would be a hundred times greater than in today's devices and the cost per function would fall by a factor of twenty.

TRAFFIC NEWS

Car radio is big business in Germany with 2·3 million sets sold in the domestic market last year.

The top price models have decoders which detect official traffic announcements and provide an automatic override of either radio reception or cassette playback and put the set back on normal volume level if it has been turned low.

German drivers regard their sets as a driving information system as well as for en-route entertainment.

Drive to MPUs

Ford cars in the 1980s will incorporate MPUs for fuel management to comply with exhaust emission regulations and to increase fuel economy.

Intel has won big contracts for the system components. But Motorola, Fairchild, Signetics, Texas Instruments and National Semiconductors are all in the race to supply car manufacturers throughout the world with energy saving electronics.

The Japanese are also competing and have produced an electronic control for fuel injection systems as well as for normal carburettors.

An Electronic Dash

The day of the universal electronic dashboard in our cars is drawing nearer. General Instrument Microelectronics have a prototype system to perform all the functions, speedo, odometer, trip meter, fuel level, oil pressure, rev counter, all on one microcomputer chip.

The whole lot of the electronics, say GIM, can be mounted on a double-sided PCB only 2½ inches square.

According to ITT, 65 per cent of its 16-inch colour TVs marketed as a portable second set end up as a household main set. Reason seems to be that the small screen is still big enough to give fine picture definition while the compact size of the set suits small rooms.

BICC Bids for Vero

Home constructors will be interested to hear that circuit board manufacturers Vero Electronics Ltd is in negotiation for acquisition by cable and electrical engineering giant BICC. Both companies, at the time of going to press, were looking to a favourable outcome of the talks.

—ANALYSIS

THE ENERGY EQUATION

Suddenly, everyone is doing sums. The motorist his petrol bill, the householder his winter fuel costs, the manufacturer his genuine as distinct from imagined power needs, county councils, central governments, the whole world is at it.

A Middle East war followed a few years later by a political revolution in one country, and our way of life is distorted, if nothing worse. But this is no tragedy—only a challenge to meet change, and civilisations have been challenging and mostly triumphing over change since the days of antiquity.

Nobody is doing sums more diligently at present than the electronics industry, expecting to profit from new demands. It is not long ago that atomic energy enthusiasts were despairing that the future was in doubt because, despite early promise, cost per kilowatt/hour produced was still more expensive than that from coal or oil-fired conventional generating stations. Today, atomic energy is the cheapest and opposed now on environmental rather then economic grounds.

Similarly, the crackpot ideas like solar cells and wave power, not to mention the long-discarded old-fashioned windmill, are now emerging as possible solutions, not only practical but relatively economic, too. The windmill, incidentally, died only because of the availability of cheap rural electricity in the first half of this century.

Electronics will play a huge part in energy adaptation in the years ahead, in conservation, in power generation and in energy management. In the home, office and factory, electronic sensors and timers for more efficient air conditioning, in the car MPUs and electronic ignition for more miles per gallon.

The drive is now on, principally in the United States but also in Europe, to produce solar cells which will produce electricity at a cost fully competitive with conventional power. Semiconductor manufacturers are spearheading the attack, getting conversion efficiency up and manufacturing costs down. As oil prices rise so the gap narrows. And narrows again as solar cell technology improves as, indeed, it is doing month by month.

Of course solar energy either from solar panels or solar cells is not always convenient, being intermittent and in need of a storage system. Even the most optimistic proponents of solar energy talk only of a 10 per cent or so contribution to our total energy needs. But well worth considering when a 5 per cent shortfall in oil is regarded as a world crisis!

So far universally unacknowledged is the enormous contribution electronics has already made to energy conservation. Imagine the waste in megawatts of extra heat dissipated if the countless millions of TV and radios now in use were all still using thermionic valves. Not to mention computers. The famous ENIAC of 1946 used 18,000 valves consuming 100 kilowatts of power and had a processing capability less than a 1979 mini while being far more temperamental.

Meantime, while the electronic industry and readers of EE come up with new ideas, I can only suggest that everyone follows my own example on the energy problem—save it!

Brian G. Peck

INMOS REPRIEVE

The controversial INMOS project to mass produce l.s.i. circuits in the UK is not to be axed under Government spending cut-backs.

Sir Keith Joseph, Industry Secretary, stated that a contractual commitment has been made through the NEB for £25 million and the future of INMOS would be reviewed at the appropriate time.

CABLE BOOM

Cable TV offering interference-free multiple-choice programmes and films is booming in the United States.

One company, Cox Cable Communications Inc, has ordered 4,000 miles of cable to be sure of meeting immediate and near-future demand. The first few hundred miles are scheduled for a system in Oklahoma City.

CRYSTAL GAZING

A crystal gazing scientist at Sperry Univac, Earl C. Joseph, forecast a density of 10,000 million gates in a single component as achievable by 1990. It would be a six-inch wafer component rather than present techniques where a smaller wafer is diced into individual chips.

An intermediate step would be a 3,000 million gate device which could be in production by 1985. There would remain a problem of how to programme and use such a powerful device.

Prestel Problems

The Post Office Prestel programme is on time with its extension plans to have the service available to 60 per cent of the population by the mid-1980s.

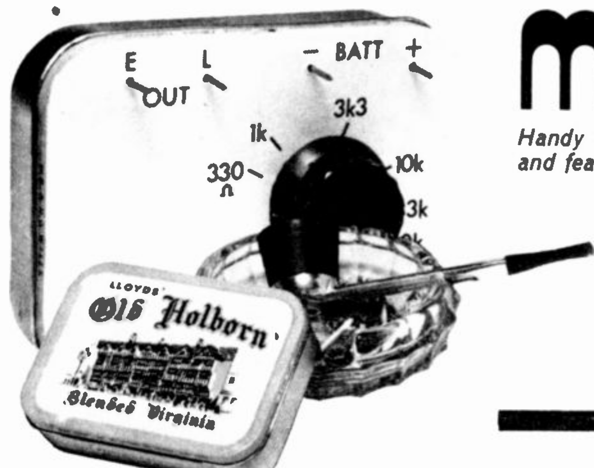
A big media promotion project planned for the autumn will be postponed to spring next year as there is no point in publicising the service while receivers are in short supply. Reasons for the shortfall in Prestel-equipped TVs is industrial trouble last winter and continued component shortages say the set manufacturers.

Hand-Held Computer

The new Hewlett-Packard HP-41-C programmable calculator has so many facilities, including substantial built-in memory, that it is already being hailed as the world's first hand-held computer.

The basic instrument is expected to have a UK price of under £200 with peripheral extra options such as a printer, magnetic card reader and electronic "wand" for reading printed-bar codes. Additional ROM can also be added.

More than 3,000 programs are available from H-P's User Program Library.



MINI~MODULES

By George Hylton

Handy "Beginner" projects based on simple circuits and featuring a variety of building methods.

12 UNIVERSAL OSCILLATOR

THIS month's Mini Module is the last of the series. It is rather different from the earlier ones. They were mostly circuits designed for a specific purpose such as testing transistors or handling audio signals. The Universal Oscillator, on the other hand, though it does do one standard task is really a handy box of tricks for the experimenter who will invent his own ways of cashing in on its capabilities.

I've had one on my own workbench for years and I've used it for all these jobs: as a "poor man's Q-meter" to assess the goodness of a tuned *LC* circuit; in conjunction with a frequency meter to measure inductance and capacitance; as a selective amplifier; as an aid to matching capacitors and resistors; and as a crude signal generator.

A VERSATILE CIRCUIT

These are only a few of the possible uses of this simple but versatile circuit. What it really does is to make other circuits oscillate. That is, if you connect it to almost any other circuit, from a simple capacitor or resistor up to a complete active circuit such as an amplifier, the complete circuit can be set oscillating and in a controlled way.

If the circuit which is made to oscillate is a parallel combination of inductance and capacitance—an *LC* tuned circuit—it is possible to make a measurement of one of its basic properties.

A parallel-tuned circuit has an impedance which rises to a maximum at its resonant (tuned) frequency. At this frequency the circuit behaves as if it were a resistance, the so-called dynamic resistance. Knowing the dynamic resistance enables the experimenter to estimate the gain when the *LC* circuit is used as the load impedance of a tuned amplifier and other useful things.

If you also know the frequency and the value of *L* or *C* you can then calculate the *Q*, because the dynamic resistance is just *Q* times the impedance of *L* or *C* at the tuned frequency.

For example, if the dynamic resistance as read off the Universal Oscillator's easily-calibrated control is 1,000 ohms and the reactance of *C* is 100 ohms then *Q* is 10.

What's more you don't have to fiddle about to set the right frequency. The circuit automatically oscillates at the resonant frequency. All the user has to do is set the regeneration control so that the circuit just oscillates: the value of its dynamic resistance can then be read off. This is child's play compared with fiddling about with bridges or signal generators to do the same job.

COMPONENTS

Resistors
- R1 1MΩ
- R2 See text
- R3 1MΩ
- R4 10kΩ
- All ¼W carbon film ±5%

Potentiometer
- VR1 47kΩ or 50kΩ carbon track, log. law

Capacitors
- C1-3 100nF (0·1μF) metallised polyester (e.g. Mullard C280 series) (3 off)

Semiconductors
- TR1 BC107, BC108 or BC109
- TR2 BC214
- (If possible both transistors should be of the same gain group, e.g BC108B and BC214B)

Miscellaneous

Two-ounce rectangular tobacco tin or other small metal case. White card for covering panel etc. Veroboard, 0·15in. matrix, 9 strips of 11 holes. Wood strips (e.g. ½in. square moulding). Glue, 1in. panel pins (6) for leadouts. Crystal earphone for testing. Pointer knob for VR1.

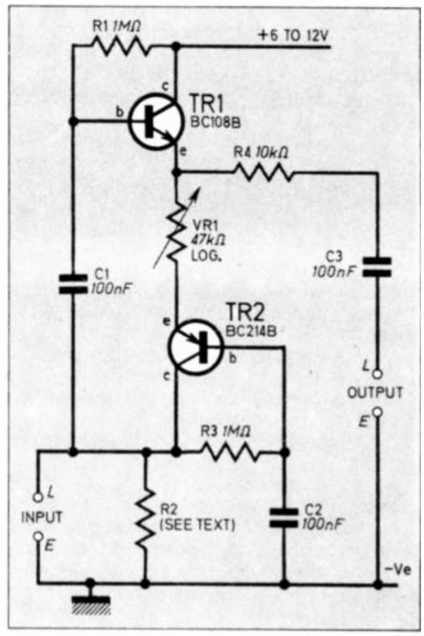


Fig. 1. Universal Oscillator circuit.

PRACTICAL CIRCUIT

So much for theory. The circuit (Fig.1) consists of a common-collector stage TR1 driving a common-base stage TR2 via the regeneration control—the "throttle", if you like—VR1.

The output of TR2 is coupled back to TR1 via C1 to complete the positive feedback loop. If the impedance connected to the input terminals is more than a few hundred ohms the circuit oscillates at some settings of VR1—in fact at any setting where VR1 is appreciably less than the external impedance. Thus if a 1 kilohm resistor is connected across the input the circuit oscillates when VR1 is appreciably less than 1 kilohm.

By selecting an appropriate value of R2 (as described later) the circuit can also be made to oscillate even when nothing is connected to its input. It then acts as a low-frequency pulse generator.

CONSTRUCTION

I used a small piece of 0·15-inch matrix Veroboard as a base (Fig. 2). It has nine strips of 11 holes and no breaks in the copper are needed. But any of the other circuit board bases described in this series will do.

A metal case for screening is advisable. It seemed fitting, for this poor man's Q-meter, to use a recycled case in the shape of a rectangular two-ounce tobacco tin.

After drilling ³⁄₈ inch holes in the lid for the terminal lead-outs, strips of wood were glued behind the lid to cover the holes and act as insulating supports for the lead-outs, which are just 1 inch steel panel pins pushed through pilot holes and if necessary secured with glue.

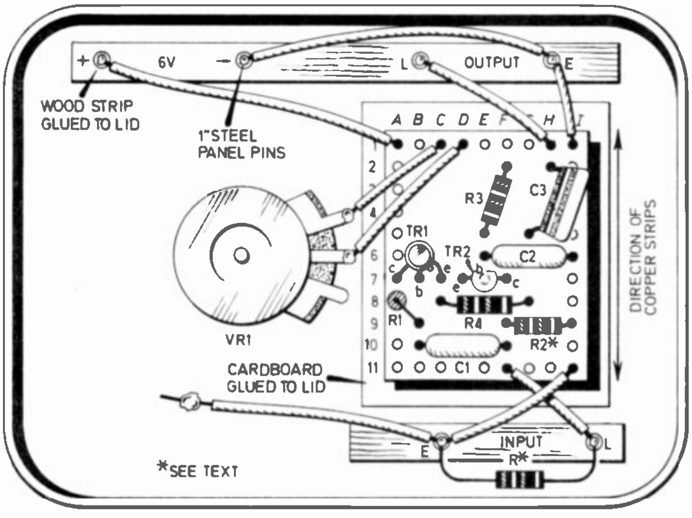


Fig. 2. Assembly of the universal oscillator components upon the lid of a tobacco tin. Note that wire from "input E" pin is soldered to case.

The circuit board is adequately secured by the interconnecting leads. A piece of cardboard is glued to the lid immediately below the circuit board to insulate from the metal lid.

Covering the top of the lid with white card provides for scale markings etc. A piece of cardboard is glued to the inside of the tin for insulating purposes.

SETTING UP

Because of the wide tolerance (usually ±30 per cent) on log. law carbon potentiometers (VR1) it is best to select R2 by trial and error. If R2 is too high, pulse oscillation occurs at all settings of VR1. If too low, oscillation stops long before VR1 has reached maximum resistance (knob fully clockwise) and this in effect wastes part of VR1 track.

The aim is therefore to select R2 so that it just kills pulse oscillation when VR1 is turned almost fully clockwise. This enables almost the whole of VR1 track to be calibrated, giving the most open scale.

After completing and checking the circuit connect a crystal earphone to the output (or feed the output to an amplifier with loudspeaker so you can hear the circuit pulse-oscillating).

Set VR1 fully clockwise. Connect 10 kilohm or thereabouts across the input and switch on. Nothing will happen, but if you now turn VR1 slowly anticlockwise a point will be reached where oscillation starts (a whistle or buzz) and it will continue, with variation in pitch, as the potentiometer is turned down towards zero.

Having checked the working of the circuit in this way remove the 10 kilohm and try resistances in the range 33 kilohm to 60 kilohm until you find a value which allows oscillation to persist except when VR1 is almost fully clockwise. The selected resistor can be soldered in place either on the baseboard or behind the panel to the INPUT lead-outs.

Alternately you can begin by incorporating R2 = 68 kilohm permanently on the baseboard then (if necessary) trim it to size by means of a second resistance across the input terminals. (I did this in the prototype and the trimming resistance came out as 150 kilohm, but with a 30 per cent tolerance anything from 60 kilohm upwards is theoretically possible.)

CALIBRATION

You are now ready to calibrate VR1. Connect carbon resistances (5 per cent tolerance is quite good enough) across the INPUT and adjust VR1 each time until the circuit just begins to oscillate. Mark the setting with the value of resistance in use at the time.

A reasonable number of initial calibration points is obtained using test resistances of: 330 ohms, 1 kilohm, 3·3 kilohm, 10 kilohm, 33 kilohm, 100 kilohm and 330 kilohm.

With some samples of TR1 and TR2 you may be able to obtain oscillation with a test resistance of 100 ohms, giving an extra calibration point at the low end. There is no point in calibrating beyond 330 kilohm at the high end as the markings will be too close together to be of any use.

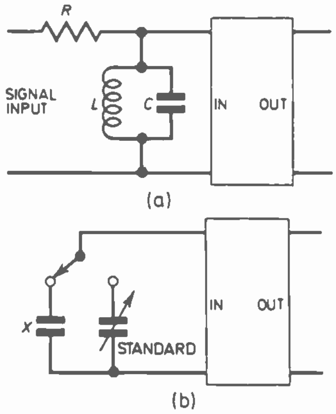


Fig. 3. (a) Selective amplification. (b) Capacitance comparison.

USING THE "UNIVOSC"

Measuring dynamic resistance has already been mentioned. Connect the *LC* circuit to the input, set to the just-oscillating point and read off the dynamic resistance from the scale of VR1. For *LC* circuits tuned above the audio range you'll need a receiver, h.f. voltmeter or oscilloscope to detect the onset of oscillation.

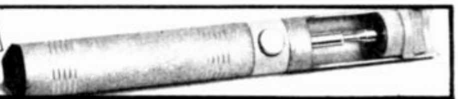
The circuit will oscillate at up to around 20MHz but its measuring ability gets progressively worse as the frequency increases so it should be regarded as unreliable above say a couple of MHz.

The Univosc is really a controllable negative resistance circuit and as such can be used in a number of ways. Fig.3a shows how to connect it as a selective amplifier tuned by *L* and *C*. *R* should be at least as high as the dynamic resistance of *L*, *C* for good selectivity. Setting just short of oscillation increases both selectivity and gain.

Fig.3b shows how to compare an unknown capacitance with a standard, using a voltmeter, oscilloscope, or best of all a frequency meter as an indicator (equal readings for equal capacitances).

Resistances (if non-inductive) can also be compared but inductors behave as tuned circuits because of stray capacitance and this should be swamped by connecting a large capacitance across the input as well. (Use 1000pF for h.f. inductors and 10nF for l.f. ones.)

THE NEW

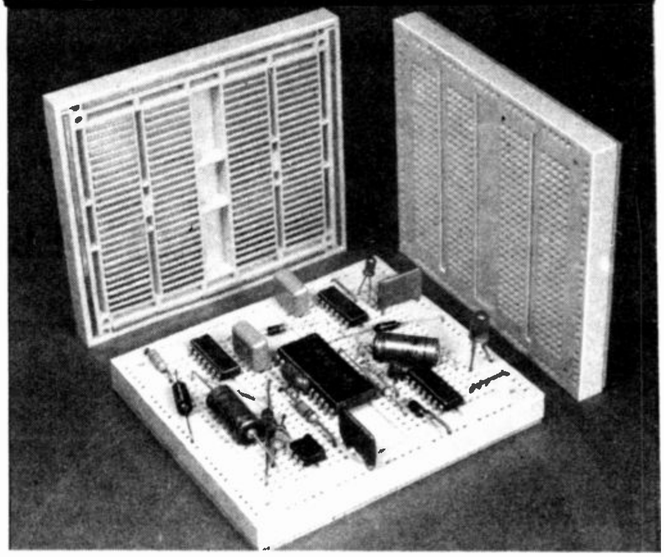


EUROSOLDERSUCKER

This 195mm long, all metal, high suction, desoldering tool with replaceable Teflon tip enables removal of molten solder from all sizes of pcb pads. Primed and released by thumb, it incorporates an anti recoil system and built in safety guard. Only **£7.25** inc. VAT & P.P.

THE UNIQUE

EUROBREADBOARD



Logically laid out to accept both 0.3" and 0.6" pitch DIL packages as well as Capacitors, Resistors, LED's, Transistors and components with leads up to .85mm dia.

500 individual connections in the central breadboarding area, spaced to accept all sizes of DIL package without running out of connection points, plus 4 Integral Power Bus Strips around all edges for minimum inter-connection lengths.

All connection rows and columns are now numbered or lettered enabling exact location indexing.

Double-sided nickel silver contacts for long life (10K insertions) and low contact resistance (< 10m. ohms).

Easily removable, non-slip rubber backing allows damaged contacts to be rapidly replaced.

No other breadboard has as many individual connections, offers all these features and costs only **£6.20** each or **£11.70** for 2 – inclusive of VAT and P.P.

Snip out and Post

David George Sales, r/o 74 Crayford High St., Crayford, Kent DA1 4EF

EE 10/79

David George Sales
r/o 74 Crayford High Street,
Crayford, Kent, DA1 4EF.

Please send me 1 EuroSolderSucker @ **£7.25** ☐
or 1 EuroBreadBoard @ **£6.20** ☐
or 2 EuroBreadBoards @ **£11.70** ☐
Please Tick

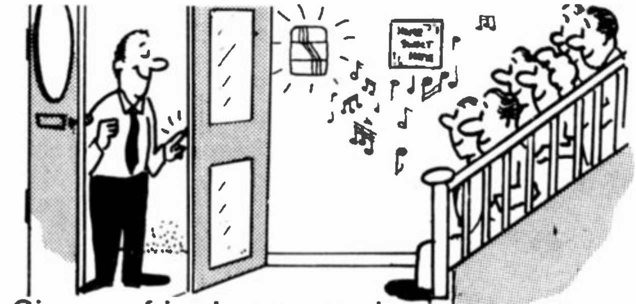
All prices are applicable from July 1st 1979 and include VAT + P.P. but add 15% for overseas orders.

Name . . . .
Company . . . .
Address . . . .
. . . .
. . . .
Tel. No. . . . .

Please make cheque/P.O.'s payable to David George Sales

TUNE IN!

Build the World Famous
CHROMA~CHIME



Give your friends a warm welcome

This kit has been carefully prepared so that practically anyone capable of neat soldering will have complete success in building it. The kit manual contains step by step constructional details together with a fault finding guide, circuit description, installation details and operational instructions all well illustrated with numerous figures and diagrams.

- Handsome purpose built ABS cabinet
- Easy to build and install
- Uses Texas Instruments TMS1000 microcomputer
- Absolutely all parts supplied including I.C. socket
- Ready drilled and legended PCB included
- Comprehensive kit manual with full circuit details
- No previous microcomputer experience necessary
- All programming permanently retained is on chip ROM
- Can be built in about 3 hours!
- Runs off 2 PP3 type batteries.
- Fully Guaranteed

ONLY **£9.95** + 75p p&p UK ONLY

* *Save pounds on normal retail price by building yourself.*

TMS 1000N - MP0027A Micro-computer chip available separately if required. Full 24 tune spec device supplied with data sheet and fully guaranteed.

New low price only **£4.95** inc. p&p

R/C MODELLERS - LISTEN FOR THE C.B. MENACE
GET A 27MHZ MONITOR

- ★ **Audibly confirm your channel's clear.**
- ★ **Tunes over whole 27mhz model band. (CB)**
- ★ **Receives normal broadcast AM/FM bands as well.**
- ★ **Sensitive with telescopic aerial.**
- ★ **Totally portable.**
- ★ **Runs on standard batteries.**

This neat three band Superhet receiver not only provides an invaluable service, checking your channel and TX, but gives normal broadcast reception when you need it as well. Costing less than a decent Servo, you'll find it cheap and reassuring insurance!

ONLY **£17.95** INC. V.A.T. AND P. & P.

ALL CHROMATRONICS PRODUCTS SUPPLIED WITH MONEY BACK GUARANTEE
PLEASE ALLOW 7-21 DAYS FOR DELIVERY

E.E. 10 79

Please send me:
TO: CHROMATRONICS, RIVER WAY, HARLOW, ESSEX.
NAME ______________________
ADDRESS ______________________
____
____

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

Signature ______________________

CHROMATRONICS

Next Month

A COMPLETE RADIO CONTROL SYSTEM FOR CARS, BOATS & AIRCRAFT

An advanced design catering for up to 7 channels.
A versatile linear ramp encoder and other technical features make this system ideal for novice and expert operators alike.
This series will cover all design and constructional aspects of the transmitter, receiver and ancillary units.

Synthesisers Explained Part 1

TWO-TRANSISTOR RADIO TUNER

SINE SQUARE & TRIANGULAR WAVE GENERATOR

BABY ALARM

Everyday ELECTRONICS

NOVEMBER
ISSUE ON SALE
FRIDAY, OCTOBER 19
Price 45p

RUMMAGING AROUND

with Keith Cadbury

A PLUG FOR SAFETY

You will not have been an electronics hobbyist for long when friends and relatives start to (a) off-load all their old radios and record-players etc., in your direction and (b) ask you to mend various electrical appliances.

If you have looked at the mains plugs on some of these items you will have been appalled at the wiring of the plugs. Slip-shod, hazy, crazy, higgledy-piggledy, etc., etc., many descriptions of the wiring come to mind, but whatever else, *all DANGEROUS*.

Quite intelligent people, some of them, yet quite incapable of wiring a plug correctly. They realise the dangers of escaping gas, because they have seen photographs of the resulting explosions (and anyway, you can *smell* gas). But they equate poor electrical connections with poor plumbing, "I must get that dripping tap/buzzing plug seen to, next month, or the month after . . .".

No amount of jumping up and down, apoplexy, etc., on your part, will make them realise the dangers of such a lackadaisical attitude towards electricity. Short of forcibly ramming their fingers into a ten amp two pin socket (there are still some in use, believe it or not!), they do not learn, until it is too late, alas.

If the radio or what have you was a good present, or the people concerned are dear to you, a constant gentle reminder might not go amiss.

The Electrical Association For Women market an Irish linen tea towel, which shows the colours of old and new types of cable colour coding, and square-pin and round-pin plug connections. It also shows how to prepare the cable-ends for insertion into both pillar- and clamp-type terminals.

With such a tea-towel in the offending household, the chances are more in favour of a mains plug being wired correctly. In my experience, women are not the big offenders here—they are more likely to ask someone else to wire a plug if they are not sure about it. The greatest offenders are *men*, who when asked to wire plugs, have no idea how, but feel to admit such a thing would be an affront to their masculinity, so they "do their best!"

The price of the E.A.W. Tea Towel (headed *Can You Wire A Plug?*) is £1·03, postage and packing included, (make cheques or PO payable to E.A.W. Publications Ltd.) and the address is: Electrical Association for Women, 25 Foubert's Place, London W1V 2AL.

Since I decided, six months after my first project was completed, that electronics was from now on my number one hobby I have been collecting components from old radios and recorders given to me and from cheap component packs.

Storage of the components thus accrued became more and more of a problem. Plastic storage drawers would be ideal, but too expensive for the likes of me, so word was sent round the grapevine of the small town in which I live: "Keith wants all old household matchboxes!"

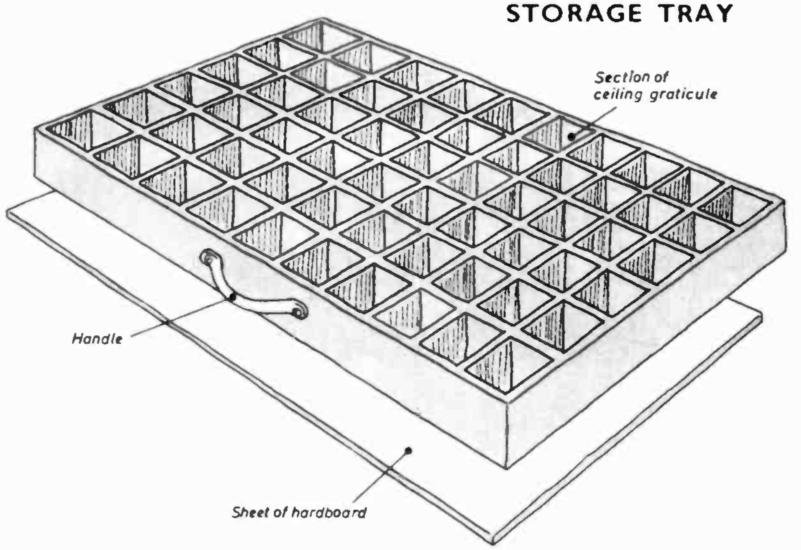
Unfortunately, many other uses for old matchboxes have already been found, and most housewives already seem to be committed to supplying various handymen, modellers, etc. My frantic appeals have so far only produced about forty boxes, and a lot more storage receptacles than that are needed, to file all the collected components.

Other containers used at present include thirty-five two-litre ice-cream cartons, from a never-ending supply: my own family of millions of guzzling children! Components collected in small numbers, e.g., transistors of T018 size, are stored in small matchboxes, Sellotaped together in blocks three wide and six high.

The big problem was to find suitable storage for resistors, about fifty separate compartments were needed. The solution came to me suddenly, as I was sitting in a friend's office. His office is one of those modern open-plan types, that the inhabitants partition off with judicious arrangement of office cabinets and cupboards.

An electrician was changing a strip light tube, and managed to knock one of the ceiling graticule things down, which broke two corners off when it hit the ground, and my feet. My friend thought I was mad when I asked if I could have the missile that had nearly been the subject of a claim from his Public Liability insurance policy.

STORAGE TRAY

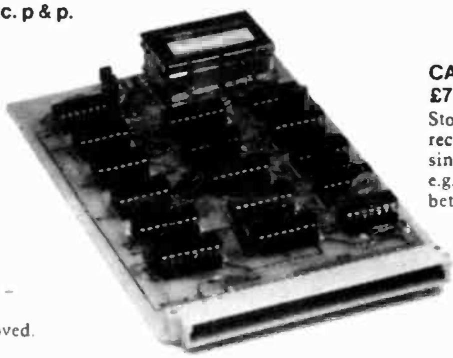


Back in the workshop, the piece of "ceiling" was cut down to a portion six squares by ten. The cutting proved easy, as it was moulded out of material similar to chipboard. When cut it was smeared with "Thixofix" glue over the edges of one side, and then tacked to a sheet of hardboard, see diagram.

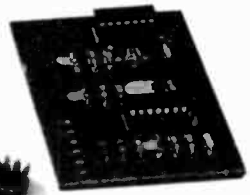
The tray of sixty compartments, each about 50mm square and 30mm deep, is now a drawer under my workbench that houses all my low wattage resistors. Cost: about 25p and a sore foot!

Now, the complete MK 14 micro-computer system from Science of Cambridge

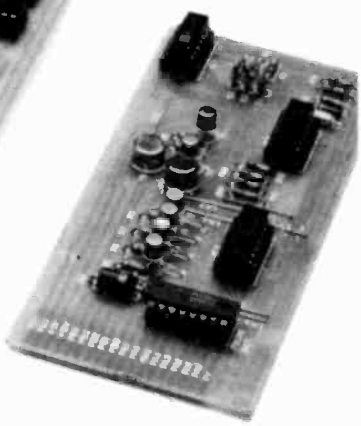
VDU MODULE. £33.75
(£26.85 without character generator) inc. p & p.
Display up to ½K memory (32 lines x 16 chars, with character generator; or 4096 spot positions in graphics mode) on UHF domestic TV. Eurocard-sized module includes UHF modulator, runs on single 5 V supply. Complete ascii upper-case character set can be mixed with graphics.



CASSETTE INTERFACE MODULE.
£7.25, inc. p & p.
Store and retrieve programs on any cassette recorder. Use for serial transmission down single line at up to 110 baud (teletype speed), e.g. over telephone line, and to communicate between two or more MK 14s.



POWER SUPPLY. £6.10 inc. p & p.
Delivers 8 V at 600 mA from 220/240 V mains – sufficient to drive all modules shown here simultaneously. Sealed plastic case, BS-approved.



PROM PROGRAMMER.
£11.85 inc. p & p.
Use to transfer your own program developed and debugged on the MK 14 RAM to PROM (74S571) to replace SC10S monitor for special applications, e.g. model railway control. Software allows editing and verifying.

MK 14 MICROCOMPUTER KIT
£46.55 inc. p & p.
Widely-reviewed microcomputer kit with hexadecimal keyboard, display, 8 x 512-byte PROM, 256-byte RAM, and optional 16-lines I/O plus further 128 bytes of RAM.

Supplied with free manual to cover operations of all types – from games to basic maths to electronics design. Manual contains programs plus instructions for creating valuable personal programs. Also a superb education and training aid – an ideal introduction to computer technology.

Designed for fast, easy assembly; supplied with step-by-step instructions.

Science of Cambridge Ltd

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

To order, complete coupon and post to Science of Cambridge for DELIVERY WITHIN 14 DAYS. Return as received within 14 days for full money refund if not completely satisfied.

To: Science of Cambridge Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN.

Please send me:
- ☐ MK 14 standard kit @ £46.55.
- ☐ Extra RAM @ £4.14 per pair.
- ☐ RAM I/O device @ £8.97.
- ☐ VDU module including character generator @ £33.75.
- ☐ VDU module without character generator @ £26.85.
- ☐ Cassette interface module @ £7.25.
- ☐ PROM programmer @ £11.85.
- ☐ Power supply @ £6.10.
- ☐ Full technical details of the MK 14 System, with order form.

All prices include p and p.

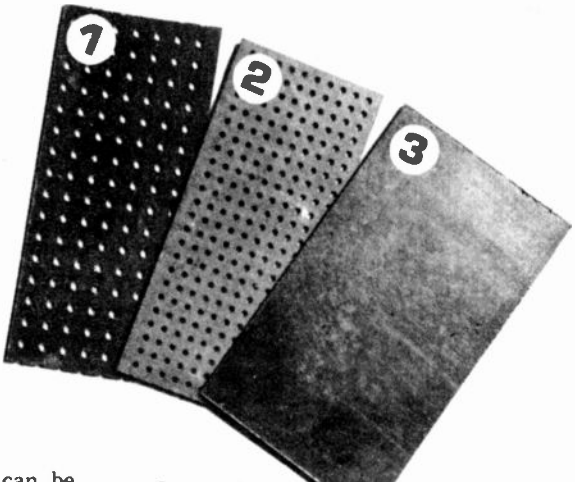
I enclose cheque/MO/PO for £__________ (total).

Name__________________________

Address (please print)__________________________

Delivery within 14 days. EE/10/79

SQUARE ONE FOR BEGINNERS

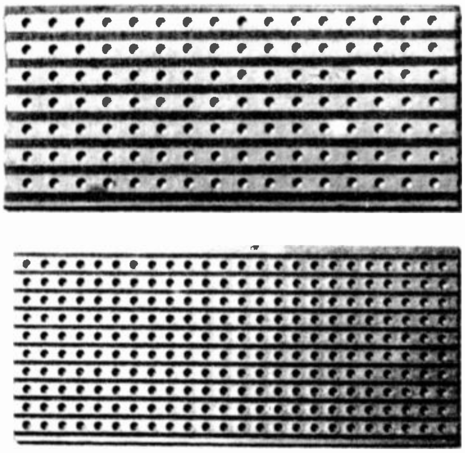


1 Stripboard
2 Plain board
3 Copper-clad board

THE usual method of building up a circuit is to mount the individual components on a piece of "plastics" board. The material in general use for this purpose is actually synthetic-resin-bonded-paper, referred to as s.r.b.p. for short.

This material is a good electrical insulator, it is strong yet easy to cut and drill. Thus it makes an ideal base for electronic circuits.

It is available as plain board, in various sizes and thicknesses. Also, perforated with holes to suit the leads of electronic components. The holes are arranged on either a 0·1 inch or 0·15 inch matrix.



The two types of stripboard used in the majority of the projects in EE.

STRIPBOARD

Both above-mentioned forms of s.r.b.p. have their uses in electronic construction, but the most popular and versatile board is *Veroboard*. This is the proprietary name for a product consisting of a sheet of s.r.b.p. with copper strips bonded to one side of the board. Hence the common name by which it is also known—"Stripboard". It is available with holes punched on 0·1 inch and 0·15 inch matrix. The 0·1 inch type is in more general use.

Stripboard features in EVERYDAY ELECTRONICS constructional projects more than any other form of board. It is easy to use, and breaks can be made in the copper strips as required, by using the special spot-face cutter tool available, or failing that, a twist-drill bit or even a pocket knife blade. The tip of the cutting tool is placed in the appropriate hole and the tool then rotated by hand until a circular area of copper has been removed cleanly from the strip.

The two sections of this strip are now electrically isolated.

Sometimes two or more strips are required to be joined together. This is easily done by soldering link wires from one strip to the other. Such links should always be on the top (plain) surface of the board. Sleeved, insulated, wire should be used for this purpose wherever there is danger of contact with adjacent component leads.

MATRIX CODE

Reference to typical constructional articles in this magazine will show clearly how stripboard is used in practice. The custom of identifying individual strips and holes by numerical and alphabetical codes is very useful and a great assistance to the constructor, especially with the larger size boards used for the more complex projects.

When mounting components develop the habit of carefully checking and double-checking the location of each component on the circuit board against the published component layout diagram before finally soldering into position. It is also a wise additional precaution to cross-check the physical location against the circuit diagram. Apart from preventing possible errors, this habit will lead to a closer understanding of electronic circuits—in both theory and practice.

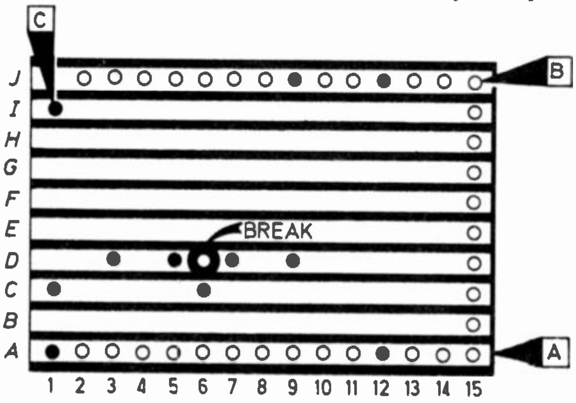
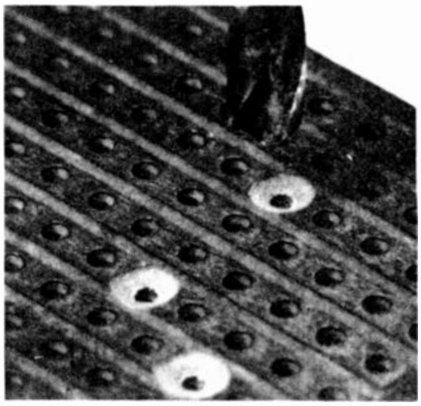
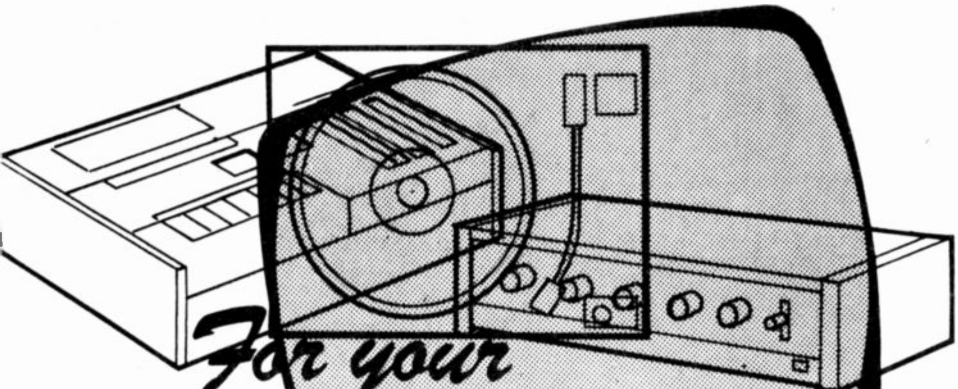


Fig. 1. Method of identifying and using stripboard. (a) copper strip, (b) hole, break in copper, (c) solder joint. The matrix of holes and strips are given letters (strips) and numbers (holes) for easy cross-reference.

Using a twist drill to make breaks in the copper tracks. A special tool can be purchased for this operation.





For your ENTERTAINMENT

By ADRIAN HOPE

Restrictive Dish

The manufacturers of microwave ovens have not surprisingly been quick to reassure the public that there is virtually no risk of radiation leakage from a properly maintained oven.

Microwave sales had plunged after claims were made that some people's eyes had been damaged by leaking radiation. Now, just as the reassurances have been accepted and the public has started to buy microwave ovens again, comes a report from Cheshire which could throw the whole issue back in the melting pot again.

Sir Bernard Lovell is Professor of Radio Astronomy at Manchester University and Director of the Laboratories which run the Jodrell Bank radio telescope. Recently Sir Bernard argued to the Cheshire County Council Planning Committee that they should continue to restrict housing development anywhere near the giant Jodrell Bank telescope.

Why? Because according to Sir Bernard, some microwave ovens leak so much radiation that if they are within even a few miles of the telescope they play havoc with its reception. I wonder what the oven makers will have to say about this?

Power Packs

From Japan comes news of paper-thin batteries; and by paper thin I mean literally paper thin. Matsushita has produced a manganese dioxide dry cell, with zinc for the negative electrode and a very, very thin stainless steel plate as the positive electrode. This is instead of the usual carbon rod. One battery stack of cells still only the size of a stick of chewing gum can operate a liquid crystal display calculator for a thousand hours continuous running.

So far these batteries aren't on sale in the UK but oddly enough you can get something almost the same, effectively free gratis and for nothing. In fact they are currently being unwittingly thrown away by the thousand in the UK!

When you take a picture using the Polaroid SX70 instant film system, the print is pushed out of the camera by a very powerful motor-driven feed system. This motor and all the other camera electronics, are driven by a battery inside the film pack.

The decision to incorporate the battery inside the film pack was taken at an early stage in development of the SX70 system. The main reason was to ensure that users always had fresh batteries for every film shot; another reason was to keep the size of the camera as small as possible.

Ten years ago now Polaroid commissioned ESB Inc. of Philadelphia, who make Ray-o-Vac batteries, to design a battery powerful enough to drive the SX70 electrics, reliable enough to have a good shelf life and compact enough to fit inside the film pack. After all manner of production difficulties Polaroid and ESB finalised a 6 volt, flat, manganese dioxide battery formed from a sandwich of nineteen plastic and metal layers sealed together.

Because the system has to have a substantial safety margin for power, it is almost always the case that the battery which is thrown away with the exhausted SX70 film pack still has plenty of useful life left. Informal tests carried out by Polaroid suggest that every fresh film pack battery has sufficient power to shoot between a hundred and fifty pictures; that is to say ten or fifteen times the power necessary for the ten shot film pack.

To put the unused life to free advantage, all you do is break open the exhausted film pack and pull out the flat battery. One side is printed over with symbols and warnings to discourage anyone from cutting open, stripping down or burning the battery. On this printed side there are two round metal terminal tags, of which the one nearest a symbol denoting a pair of scissors is the positive.

The easiest way to attach a pair of leads to these tags is to over-clamp them with Blue Tac, Plasticine or chewing gum. Surprisingly, this can make a very firm electrical joint. A couple of Polaroid batteries in series, of course, gives 12 volts or a couple in parallel gives more power.

Waste not, want not, used to be a war time motto. But it still makes good sense.

About Time

It shouldn't be long now before some readers will have owned an l.c.d. watch or clock for five years. Well, anyone who has owned or used one for as long as this should take a close look at it. Is the display as clear and easy to read as it was in the beginning —or has it started to fade?

The chances are that your five year old display will be far less easy to read than it was in the beginning. When l.c.d. displays first came on the market they were criticized for poor reliability and this was subsequently put down to poor sealing of the cells.

The signs are that this may well not be the whole story. One of the largest electronic watch companies in the world, Citizen, has now incorporated a very significant disclaimer in its instruction manuals. "The liquid crystal display has a finite life which, under normal conditions of use, is approximately 50,000 hours (about five years)" the manual reads; "Replace the liquid crystal display when it begins to fade".

In other words Citizen, who should know more about the life time of l.c.d. time displays than any other company, is promising no more than five years use. Recently I saw a watch that has been used for four and a half years. Sure enough the l.c.d. readout is now so faint as to be virtually unusable.

Repair Time

Of course, it isn't unreasonable to expect a repair bill for a watch or clock after five years of use, even on top of the routine cost of replacing the batteries. But here's the rub. Consumer electronic products like watches, clocks and calculators, are now changing very fast, very often. So very few firms will be able to keep a whole range of spares available for the five years or more that will be necessary if owners of l.c.d. gadgets are to "replace the liquid crystal display when it begins to fade".

I'll bet that many of the firms today producing gadgets with l.c.d. displays won't even be in the same business in five years time. And even if l.c.d. replacements are available, how much will it cost to have them refitted? And how easy will it be to find someone to take on the job?

QUARTZ LCD 5 Function

Hours, mins, secs., month, date, auto calender, back-light, quality metal bracelet.

£6.65

Guaranteed same day despatch.

Very slim, only 6mm thick.

M1

SOLAR QUARTZ LCD 5 Function

Genuine solar panel with battery back-up. Hours, mins., secs., day, date. Fully adjustable bracelet. Back-light. Only 7mm thick.

£8.65

Guaranteed same day despatch.

M2

QUARTZ LCD 11 Function SLIM CHRONO

6 digit, 11 functions. Hours, mins., secs., day, date, day of week. 1/100th, 1/10th, secs., 10X secs., mins., Split and lap modes. Back-light, auto calendar. Only 8mm thick. Stainless steel bracelet and back. Adjustable bracelet. Metac Price

£10.65 Thousands sold!

Guaranteed same day despatch.

M3

QUARTZ LCD ALARM 7 Function

Hours, mins., secs., month, date, day. 6 digits, 3 flags plus continuous display of day and date or seconds. Back-light Only 9mm thick.

£12.65

Guaranteed same day dispatch.

M4

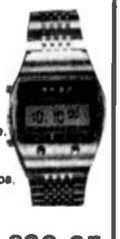
MULTI ALARM 6 Digits 10 Functions

- Hours, mins., secs.
- Months, date, day.
- Basic alarm.
- Memory date alarm.
- Timer alarm with dual.
- Time and 10 country zone.
- Back-light.
- 8mm thick.

£18.65

M5

FRONT-BUTTON Alarm Chrono Dual Time



6 digits, 5 flags, 22 functions. Constant display of hours and mins., plus optional seconds or date display. AM/PM indication, month, date. Continuous display of day. Stop-watch to 12 hours 59·9 secs., in 1/10 second steps. Split and lap timing modes. Dual time zones. Only 8mm thick. Back-light. Fully adjustable open bracelet.

£22.65

Guaranteed same day dispatch

M6

SOLAR QUARTZ LCD Chronograph with Alarm Dual Time Zone Facility

6 digits, 5 flags. 22 functions. Solar panel with battery back-up. 6 basic functions. Stop-watch to 12 hours 59·9 secs., in 1/10 sec., steps. Split and lap timing modes. Dual time zones. Alarm. 9mm thick. Back-light. Fully adjustable bracelet.

£27.95

M7

ALARM CHRONO with 9 world time zones

- 6 digits, 5 flags.
- 6 basic functions.
- 8 further time zones.
- Count-down alarm.
- Stop-watch to 12 hours 59·9 secs. in 1/10 sec. steps.
- Split and timing modes.
- Alarm.
- 9 mm thick.
- Back-light.
- Fully adjustable bracelet.

£29.65

M8

SOLAR QUARTZ LCD Chronograph

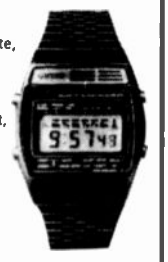
Powered from solar panel with battery back-up. 6 digit, 11 functions. Hours, mins., secs., day, date, day of week. 1/100th, 1/10th, secs., 10X secs., mins. Split and lap modes. Back-light, auto calendar. Only 8mm thick. Stainless steel bracelet and back. Adjustable bracelet. Metac Price

£12.65

Guaranteed same day despatch.

M9

SEIKO Alarm Chrono



LCD, hours, mins., secs., day of week, month, day and date, 24 hour Alarm, 12 hour chronograph, 1/10th secs., and lap time. Back light, stainless steel, HARDLEX glass.

List Price £130.00

METAC PRICE

£105.00

M10

SEIKO MEMORY BANK

Calendar watch M354 Hours, mins., secs. Month, day, date in 12 or 24 hour format all indicated continuously. Monthly calendar display month, year and all dates for any selected month over 80 year period. Memory bank function. Any desired dates up to 11 can be stored in advanced. 2 year battery life. Water resistant.

List Price £130

Metac Price **£105**

M11

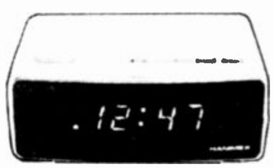
SEIKO-STYLE Dual time-alarm Chronograph

Mineral glass face. Battery hatch for DIY battery replacement. Top quality finish with fully adjustable bracelet.

£35.00

M12

HANIMEX Electronic LED Alarm Clock



Features and Specification

Hour minute display Large LED display with p.m. and alarm on indicator 24 Hours alarm with on off control Display flashing for power loss indication Repeatable 9 minute snooze Display bright dim modes control Size 5.15" x 3.93" x 2.36" (131mm x 11mm x 60mm) Weight 1.43 lb 0.65 kg) AC power 220V

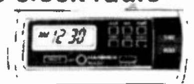
£9.65 Thousands sold!

Mains operated.

Guaranteed same day despatch

M13

HANIMEX portable LCD clock radio



- Time set & alarm controls.
- Snooze & sleep controls.
- Wake to music or alarm.
- AM/PM indicator.
- Battery operated. No plug required.
- Receives all standard AM radio broadcasts.
- Drawstring carrying case included.
- Back-light.
- Batteries supplied free.
- Quartz crystal controlled.

£17.95

M14

QUARTZ LCD Ladies 5 Function

Only 25 x 20mm and 6mm thick. 5 function. Hours, mins., secs., day, date and back light and auto calendar. Elegant metal bracelet in silver or gold. State preference

£9.95

Guaranteed same day despatch.

M15

Price breakthrough only £18.95

OUTSTANDING FEATURES

- DUAL TIME. Local time always visible and you can set and recall any other time zone (such as GMT). Also has a light for night viewing.
- CALENDAR FUNCTIONS include the date and day in each time zone.
- CHRONOGRAPH/STOPWATCH displays up to 12 hours, 59 minutes, and 59.9 seconds.
- On command, stopwatch display freezes to show intermediate (split/lap) time while stopwatch continues to run. Can also switch to and from timekeeping and stopwatch modes without affecting either's operation.
- ALARM can be set to anytime within a 24 hour period. At the designated time, a pleasant, but effective buzzer sounds to remind or awaken you!

Guaranteed same day dispatch.

M16

HOW TO ORDER

Payment can be made by sending cheque, postal order, Barclay, Access or American Express card numbers. Write your name, address and the order details clearly, enclose 30p for post and packing or the amount stated. We do not wait to clear your cheque before sending the goods so this will not delay delivery. All products carry 1 year guarantee and full money back 10 day reassurance. Battery fitting service is available at our shops. All prices include VAT.

Trade enquiries: Send for a complete list of trade prices – minimum order value £100.

Telephone Orders: Credit card customers can telephone orders direct to Daventry or Edgware Rd., 24 hour phone service at both shops. 01 723 4753 03272 76545

CALLERS WELCOME

Shops open 9.30 - 6.00.

Metac ELECTRONICS & TIME CENTRES

North & Midlands
67 High Street, DAVENTRY
Northamptonshire
Telephone: 03272 76545

South of England
327 Edgware Road
LONDON W.2
Telephone: (01) 723 4753

RADIO WORLD

By Pat Hawker, G3VA

WARC 1979

For everyone interested either professionally or as amateurs — as listeners/viewers, in any of the many uses of the radio spectrum for communications, broadcasting, radio astronomy, radio navigation, safety and emergency services and the like, the next two months (specifically from September 24 to about the end of November) must be a time of anxiety and hope and nail-biting. It is during those weeks, several thousands of delegates, representing some 150 countries, will be in Geneva for the World Administrative Radio Conference (WARC) of the International Telecommunication Union (ITU). Nowadays the ITU is a specialised agency of the United Nations, although its history can be traced back almost 115 years when telegraphic communication began to cross frontiers and people realised you cannot have effective communications without international co-operation.

The task of WARC is to look at the full span of the radio spectrum—radio frequencies from a few kilohertz up to hundreds of gigahertz (1 GHz is a 1000MHz) and to decide just which radio services have most need for and claim to each portion of the spectrum. Also whether different services could successfully share the use of the same bands or whether they need to be kept rigidly separated in the three different ITU regions of the world.

WARC, it should be noted, will not allocate particular frequency channels to individual stations but instead will determine which services can use each block or band. It has to make all sorts of value judgements between, for instance, broadcasting and taxi-cab radio, safety at sea and the use of medical and industrial equipment.

Cutting the cake

Some parts of the radio spectrum are suitable for long distances, some are virtually confined to line-of-sight and so can be used many times over provided the stations are sufficiently far apart. Some transmissions, such as television and broad-band multi-channel microwave telecommunications links (terrestrial or satellite) gobble up larger chunks of band width than others. One television channel could be used for about 40 f.m. radio channels; almost 1000 a.m. radio channels; some 2500 radio-telephone circuits or about 25,000 radio-teleprinter channels—and, at least theoretically, hundreds of thousands of morse transmissions.

For some four years, the Home Office, working through many committees, have agreed a set of proposals which have the support of the main users of the radio spectrum. But, of course, the 150 other countries are also putting forward their own proposals—and no two sets of proposals appear to be entirely the same.

What will happen?

There seems a good chance that frequencies allotted for v.h.f./f.m. sound broadcasting in Europe will be extended, possibly to 104 or 108 MHz but there is bound to be great pressure on the v.h.f. band, due to the explosion in the mobile two-way radio field.

The subject of Citizens Band is unlikely to be raised at WARC since this is not an internationally defined radio service (though this would not prevent the Home Office from subsequently making frequencies available for CB).

Probably some parts of the radio spectrum will continue to be allotted much as at present. But between 3—30MHz where much commercial traffic has been transferred to space satellites, there may be extra frequencies given to short-wave broadcasting, and radio amateurs have modest hopes of new bands around 10, 18 and 24MHz (although few European countries except the UK appear to be officially supporting the introduction of these bands).

Only an optimist will expect to emerge from WRAC with their own hopes entirely fulfilled. It will be extremely difficult to achieve agreement between 150 countries and there is a real danger of further regionalization and a proliferation of "footnotes". Footnotes are the means by which counties reserve the right to use frequencies in a manner different to that of the final international Table of Frequency Allocations.

But radio signals do not stop at or recognise political frontiers—and more than ever before there is a need for international co-operation, goodwill and if necessary compromise: otherwise we shall face increasing chaos in radio matters!

Already there are signs of countries jumping the gun, particularly in the field of external broadcasting, where the spectrum is intentionally polluted by jamming. Again, the Russians have ignored the international regulations in operating their network of "Woodpecker" over-the horizon radar stations which continue to cause widespread interference with other services.

Also there are signs that although much military traffic is carried by satellites, there has been no corresponding slackening of defence interest in h.f. circuits, since these might be needed if satellites were deliberately destroyed or jammed.

Morse and the novice

One of the international Radio Regulations that often comes under attack is the requirement that (below 30MHz) radio amateurs must have proficiency in morse (cw) operation. Only in Japan is this requirement waived for some classes of low-power amateur licences.

There appears to be a widespread belief that morse is now an "obsolete" form of communication, too slow and largely discarded except by ships and amateurs. Those who use morse, however, firmly believe that it is still the most effective means of communicating information between people with no common language other than "telegraphese" while equipment and aerials can be simple and low-cost and many hundreds of stations can operate in narrow bands.

Few people actually enjoy learning morse and many give up when they find their progress appears to be slow and uncertain. To a beginner, the Post Office morse test at 12 words per minute seems a distant, unreachable target and he soon discovers that in practise operating speeds are usually appreciably higher than this. One result is that many potential amateurs turn towards the more limited "Citizens Band" concept which has far less to offer to the technically interested.

A number of countries have successfully introduced "novice" licences which enable newcomers to go on the air, and learn while enjoying operating, after reaching about 5 words per minute. Now a group of active cw amateurs ("European CW Association") which represents a number of different clubs has been actively promoting the early introduction of a cw only "novice" licence in the UK.

The Association has recently persuaded the Radio Society of Great Britain to set-up a sub-committee of its Telecommunications Liaison Committee to investigate these proposals with a view to the RSGB making an official approach to the Home Office.

The difficulty still remains of convincing people that morse is worth learning and is still widely used by amateurs for effective international working. Unfortunately only those who use it regularly know this to be the case

CB and amateurs

Amateurs are sometimes accused of being "anti CB". Very occasionally this may be true, but I find that far more often amateurs feel that the "pro-CB" lobby is misleading the politicians and the public about such questions as interference to television and the transmission of anonymous obscenities, etc.

A professional engineer who is also a radio amateur recently wrote forcefully in the IEE journal "Electronics and Power": *"It is easy to make a case for CB radio in the UK, but is an uncertain proposition. Those who stand to gain from it are those who sell equipment and who are looking for new products to exploit now that the "hi-fi" and colour TV markets are virtually saturated."*

LETTERS

Just the ticket

Your contributor Adrian Hope, see *For Your Entertainment* April issue, may be interested to hear that the fare dodging French simply sliced their tickets lengthwise and had two acceptable Metro tickets for the price of one, the magnetic coding was shared between the two halves.

The implied criticism of British Transport for installing magnetic rollers to erase tickets and thus preventing the issue of "season" tickets is surely invalid, coded instructions to route a season ticket around the magnetic rollers would surely be a simple solution.

J. Baker
Llantwit Major

True Situation

Looking back over some old issues I was reading the feature entitled *Your Career In Electronics* by Peter Verwig. In the April 1976 issue, he discussed the career of Ship's Radio Officer. As always, this feature is well researched and most informative. However in view of the existing situation, I would like to comment.

Ever since the end of the Second World War, the British Merchant Navy has been shrinking, both in the number of ships flying the Red Ensign and in the number of men employed. New nations such as Nigeria, India and Pakistan have been building their own ships and employing their own crews. No longer do we carry the commercial cargoes of the World. Even a country like Cyprus has its own ships and its own national crews.

At the present time in the United Kingdom, there are scores, if not hundreds of qualified marine radio officers, waiting and hoping for employment on board British Merchant Ships. In one case recently, a fully qualified man wrote 134 letters to Shipping Companies seeking employment as a Ship's Radio Officer and failed to obtain an offer of employment. Scores of qualified men are on the "dole" and have been looking for work for the past two years.

I would like to further inform you that the present training time for ship's radio officer is about three years and that one has then to spend three years at sea to qualify as a grade 1 radio officer. A further 7 years is required before one can hope to be a senior radio officer.

Nowadays marine radio officers tend to remain longer in the Merchant Navy. This is due to better conditions improved status and very much longer leave. The outlook for employment is poor and it will get worse. There are schemes afoot to combine the duties of radio officer with that of ship's electrician etc. There is even talk of phasing the job out due to the advent of satellite communications.

I think in fairness, the many young men who read your magazine each month, should be informed of the true situation. Also, the many marine radio training schools in the United Kingdom should not mislead young men by advertising long training courses for jobs that may never become available.

Wishing your magazine every success.

P. B. Killeen
Radio Officer
M. V. "*London Enterprise*"

Equal Tempered

I have just finished constructing the *Electronic Tuning Fork* that you featured in August's edition. As a guitarist I find it extremely useful to have a means of adjusting my instrument to concert (equal tempered) tuning.

However I would like to point out that it is impossible to correctly set the oscillator frequencies using the 100 kilohms presets (VR1-6) suggested in the circuit. After some experimenting I solved the problem by mounting a six-way tag board inside the unit and using six 4·7 kilohm presets as fine adjusters.

By putting a 4·7 kilohm preset in series with a 100 kilohm preset I was able to roughly set up a frequency before doing fine adjustments at my leisure. For those building the circuit using "stock components" it may be useful to know that the series resistances for *E, A, D, G, B, E* were approximately 53 kilohm, 40 kilohm, 30 kilohm, 22 kilohm, 17 kilohm and 13 kilohm respectively.

Phil Allen,
Bournemouth

Sound Dip

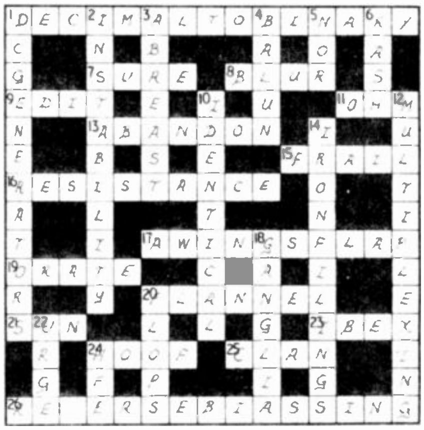
I found Mr Lovett's point on noise exposure in the August issue (' Subjective Response"—Letters Page) very interesting.

The so called "4K dip" is well known in those who have been exposed to heavy industrial noise. It could well be that males who go out to "bring home the bacon" are more at risk of suffering such a dip than a wife who stays at home looking after the house and children.

Perhaps womens liberation and the trend towards sexual equality will produce more women with 4K dips who no longer complain at the sound of loud music.

Adrian Hope
London

Crossword No. 20—Solution



JACK PLUG & FAMILY... BY DOUG BAKER

WORKSHOP MATTERS

By Harry T. Kitchen

Files and filing

Filing, in essence, is the removal of unwanted material, most commonly metal. Material can be removed to present a smooth finish, to reduce it in size, or perhaps to a specific shape, or to increase holes in size in varying shapes.

Let me qualify the opening statement. A file can, if nothing better is available, be used on any material, but the softer the material, the more rapidly the teeth of the file will clog up and reduce its efficiency. Frequent cleaning is therefore necessary if the optimum efficiency of the file is to be realised.

As a general rule, then files are used on the harder metals. But what is a file and how does it work?

Every file contains a number of sharp cutting teeth set at an angle of about 60 degrees. The fewer teeth per square inch, the coarser the file; the converse also applies.

Teeth normally run in two directions that intersect to give the well-known diamond pattern. These are commonly referred to as cross-cut files.

Single-cut files are also available, and these have one set of teeth running in parallel lines.

A file works because, as they are passed over a piece of metal, every tooth removes a portion of that metal. A coarse file will remove larger portions, and will cut deeper into the metal, leaving its impression on it. A fine file will remove significantly smaller portions and will not penetrate the metal as deeply and so will leave a much finer impression.

Apart from the number of teeth, files come in varying shapes and sizes, and it is rewarding to look at these in detail.

Types of filing

Most useful in the electronics workshop are the Hand File and the Flat File. The former is parallel throughout its length, but tapers downwards in thickness towards the end. Both faces are cross-cut; one edge is single-cut, the other is uncut, to provide a "safe" edge to prevent one face being cut into whilst the other is being filed.

The Flat File is parallel for about two-thirds of its length, and then tapers inwards in width and thickness. Both faces are cross-cut, both edges being single-cut, with no safe edge.

Round file

The Round File is of circular cross-section and tapers towards the end. It is used for enlarging round holes and the like. It is cross-cut on the *rough* and *bastard* types over 6 inches long; below 6 inches the *rough* and *bastard* files are single-cut as are the *second-cut* and *smooth* files.

The Half Round is not truly that, only partly so. The flat face is cross-cut, the curved face being single-cut for the second-cut and smooth types.

The Rasp file, sometimes called a Dreadnought, is quite outstanding for the removal of large chunks of metal. Since it is a crude tool, it must be followed by a finer file if finish is important.

File sizes vary from around 4 inches to around 20 inches long. Finishes range from rough; bastard; second-cut; smooth; and dead-smooth, in increasing fineness.

Depending on your purse and interests you will end up with a variety of files; the greater the variety of files, the greater the variety of work you can tackle successfully.

Bending metal

Metal can be bent, crudely, by grasping it in some way and exerting brute force. To bend metal with some pretensions to precision, and in a pre-determined form, requires some form of tools and thought.

Easily the most precise way of bending sheet metal, the form we are most concerned with, is to use a proper bending tool. Mostly easier said than done. With a little thought it is quite possible to bend sheet metal to an acceptable degree of precision using very simple tools.

An essential is a stout vice securely fastened to an equally stout bench, your own or borrowed. Also necessary are two pieces of strong angle iron somewhat longer than the longest sheet of metal that it is anticipated will be bent.

Angle iron clamps

The angle iron is likely to be roughly finished with a Galvanised surface. The roughness must be removed prior to use. In order to do this, clamp the two pieces of angle iron very firmly between the vice, back to back. Level them off as accurately as you can, so that the two upper surfaces appear to be one. Then file them smooth, so that they really do appear to be one. This is important in obtaining accurate bends free from indentations.

Next drill a hole at each end, about one inch in. The size should suit any bolts and nuts you have available (if you have none, a suitable size is ½ inch UNF). Drill the holes carefully, so that the two angle iron pieces are not displaced relative to one another. The size of hole should result in a tight fitting bolt; this ensures repeatability when the angle iron pieces are next reassembled.

The sheet of metal, cut to size and duly marked out, is clamped immovably when the nuts are tightened and the whole assembly is clamped in the vice. We now have a simple but highly effective bending tool.

Marking out the panel

A panel can be simple or complex. If it has many holes it is worth knocking up a sketch, however rudimentary. Errors, on paper, are simply rectified; on the panel rectification may prove difficult or impossible. But there is a snag.

The snag? The drawing must be in reverse, for the panel must be marked out in reverse, or wrong side. Marking out requires the scribing of lines as reference points. If the panel is marked out on the correct side, these lines will be visible, a sign of careless or inexperienced workmanship. And we can't have that. Can we?

"I'll have to modify the car burglar alarm, the car failed the noise test."

DIGITAL RECORDING

BY ADRIAN HOPE

THE idea of digital sound isn't new. It was dreamed up and patented in the late thirties by a British engineer, Alec Reeves, who was at the time working for STC in France. But like television, magnetic recording, and the moving coil microphone, all of which were first patented way back in the 19th century, the idea of digital sound couldn't become a reality until practical technology had caught up with the theory.

This happened in the late 60's when the BBC adopted a digital sound system based on Reeves' ideas for carrying radio signals across the country between transmitters.

So what exactly is digital sound? Sound waves in the air are analogue, as are electrical audio signals. They fluctuate continuously and represent, or are "analogues" to, the original sound. Digital signals move in steps, not smoothly and slowly. To digitise an analogue wave form it has to be chopped up into individual steps. This is called "sampling".

SAMPLING

If the wave is chopped up into large steps then the original wave can never be accurately recreated. So the smoother the steps the higher the fidelity. It is now generally accepted that the minimum sampling rate that is necessary if the waveform is to be accurately re-created is twice the highest frequency present in the original signal.

The BBC's radio transmissions only extend up to 15kHz, so a sampling rate of 32kHz is used when sound is converted into digital form for routing between transmitters. Where wider bandwidth is required, for instance for studio recordings in digital manner, a sampling rate of over 40kHz is necessary. This will give a fidelity bandwidth of over 20kHz.

QUANTISING

Sampling an analogue waveform is only half of the converstion battle. The other half is to "describe" the samples by quantising them. This is usually done in so-called binary code. In some respects binary code represents a modern version of the old morse code. In morse codes the dots and dashes are used to describe letters of the alphabet and in binary code pulses the gaps (where pulses could be) are used to denote ones and zeros to build up a number in mathematical fashion. The more "bits" (ones or zeros) that are used to describe each sample, the more accurate the description and the better the signal-to-noise ratio of the analogue sound eventually retrieved from the digital code.

The BBC use of 13-bit code, that is 13 pulses or pulse absences to describe each of their 32,000 samples per second. Codes for studio quality recording are often 16 bit. In general, the faster the sampling rate used the better the frequency response and the more code bits used per sample, the cleaner the sound.

DIGITAL RECORDING

Sooner or later digital sound recording will arrive in a big way because it has great advantages. First and foremost, perhaps, a digital recording can be copied a virtually infinite number of times without any degradation of quality from one generation copy to the next. But whether digital sound arrives sooner or later depends entirely on how soon or how late the industry can organise itself into standardisation.

To cut a long story short no one can agree on what sampling rates and quantising codes should be used in the recording studio or for domestic recorders Another difficulty is that video recorders are often used to record the pulse stream because this stream is equivalent to a very high frequency signal (1MHz or more) and video recorders can easily handle a signal of this bandwidth. It is for the same reason that video discs make an ideal medium for digital sound.

INCOMPATIBLE

But video recorders and video disc systems are tied to television standards. The frame rate (number of pictures that appear on the screen per second) varies between Europe and the USA and Japan, as does the colour system used and the number of lines from which the picture is made up. It is thus impossible to play an American or Japanese video recording on European equipment. It thus becomes impossible to take a digital recording made on standard video equipment in the USA or Japan and play it on even superficially similar equipment.

This situation governing world TV standards (or more accurately non-standards) is unlikely to change in the foreseeable future, but it should be possible for the digital disc designers to agree a world coding standard independent of TV standards so that a digital sound recording made in the USA or Japan will play back on European equipment and vice-versa. This seems of prime importance. Imagine the situation if the gramophone record bought in one country was unplayable in another.

DIFFERING VIEWS

Philips has now announced its plans for a digital audio disc. This uses the company's laser-based video disc technology but is not tied to television picture standardisation and is thus (hopefully) playable world wide.

However, other companies in the video disc market place have their own ideas over digital audio. The road to standardisation will not be smooth. For instance although the Japanese companies believe that homes of the future should have a single player, capable of handling both video disc and digital audio disc, Philips has argued that homes of the future should have two players, one for video discs and one for digital audio discs. In the meantime some companies such as Decca are making studio or master recordings on digital tape and issuing them on conventionl LP discs.

The lack of agreement over digital (also called PCM, short for Pulse Code Modulation for reasons which should now be clear) is also partly responsible for the upsurge of interest into direct-to-disc recording.

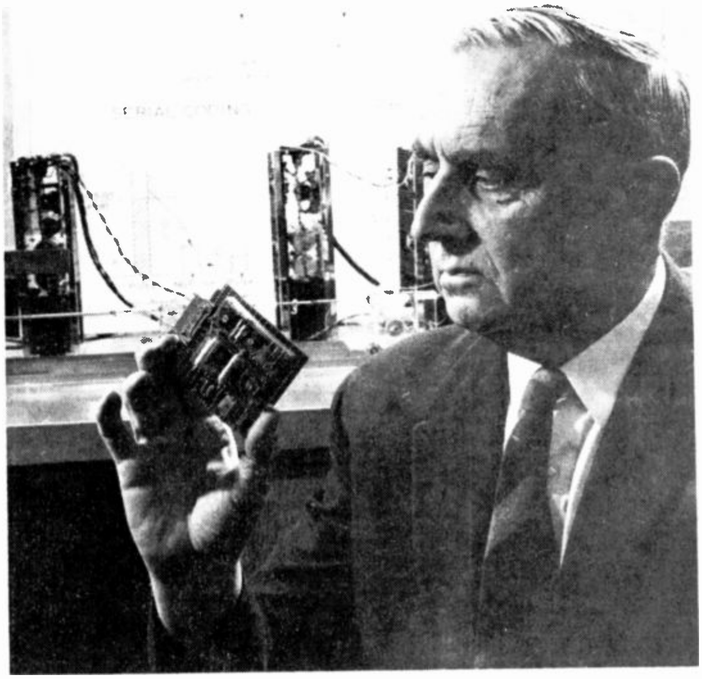
DEVELOPMENT OF RECORDING

When Edison and Bell were first recording sound a hundred years ago they did so by cutting a groove direct into a rotating cylinder. When flat disc records started to compete with the cylinder, thanks mainly to the efforts of Emile Berliner, the groove was also cut directly into the record surface. By the 1930's the cylinder record had disappeared and 78r.p.m. discs were standard.

Until 1939, 78r.p.m. records were made by cutting a groove direct into a 78r.p.m. master disc in the studio. Then the US recording industry changed over to recording 16-inch masters which rotated at 33⅓r.p.m. but had a standard sized groove (rather than a very fine, or microgroove, as on modern 33⅓r.p.m. LP records). The recordings were subsequently dubbed onto 78r.p.m. masters.

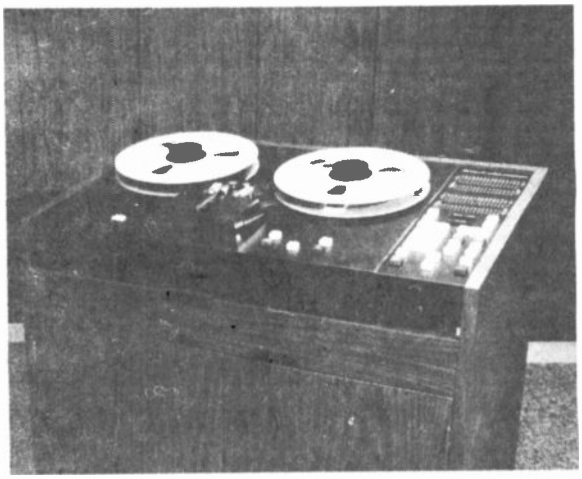
TAPE INTERMEDIARY

The next step in what we know to have been a downhill path in some respects, came soon after the war.



(Above). The late Alec Reeves who dreamed up and patented the idea of digital sound in the late 1930's.

A "digital disc" player from JVC.



(Right). The Digital Audio Mastering System from 3M designed for use in the professional recording studio which can record 32 audio channels on a 1-inch tape.

The industry gave up recording direct onto discs altogether and went over to magnetic tape as an intermediary step.

For years the use of magnetic tape went unchallenged because the distortions introduced (tape has inherently non-linear recording characteristics which must be straightened out by bias and equalisation) went un-noticed The distortions went unnoticed because reproduction equipment was on the whole not good enough to show them up.

But by the early 60's, with the move to microgroove stereo records, the overall standard of available reproduction equipment started to improve by leaps and bounds. By the late 60's domestic hi fi systems could outperform some of the records being played on them. So the distortion introduced by the use of magnetic tape in the recording studio started to show.

RETURN TO DIRECT-CUT

In 1968 two Americans, Doug Sax and Lincoln Mayorga, opened the Mastering Lab in California, a recording studio equipped to eliminate the use of magnetic tape. Sax and Mayorga had found that, especially on piano music, some recordings made in the 30's (while recording studios were still cutting direct onto 78r.p.m. masters) sounded better than recordings made in the 40's (when the studios were using those 16 inch standard groove $33\frac{1}{3}$r.p.m. masters and better also than post war recordings made using magnetic tape.

DIRECT-CUT MICROGROOVES

In their Mastering Lab Sax and Mayorga could cut direct onto $33\frac{1}{3}$-r.p.m. microgroove discs. Their first direct-to-disc recording was "Lincoln Mayorga and Distinguished Colleagues" and it is now unobtainable. The pressing stampers made from the original direct-to-disc master have long since worn out and no more copies can be pressed.

Although this Sax-Mayorga direct cut was by no means the first direct-to-disc microgroove recording (I still have a 1963 direct-cut recording made by the Ziff-Davis Publishing Co. of New York as a special demonstration record for a hi fi magazine) the Mastering Lab disc was the first really to catch the public's enthusiasm. Its clean sound made almost any hi fi system sound better and before long virtually every hi fi firm was using it to demonstrate their equipment in public shows. The public then bought the records so more were produced.

IN VOGUE

Currently there are several hundred direct-cut discs on sale around the world, originating from almost as many small record companies. The cost of a direct-cut is high, due mainly to the limited production run possible.

There is no doubt that some companies have jumped on the direct cut band-wagon hoping to sell musical rubbish under the direct-cut banner. So beware. The British firm Quadramail, which exhibits at most hi fi shows currently has the most comprehensive list of respectable direct cut recordings.

Direct-cuts will last only as long as the current chaos on PCM or digital recording standards persists.

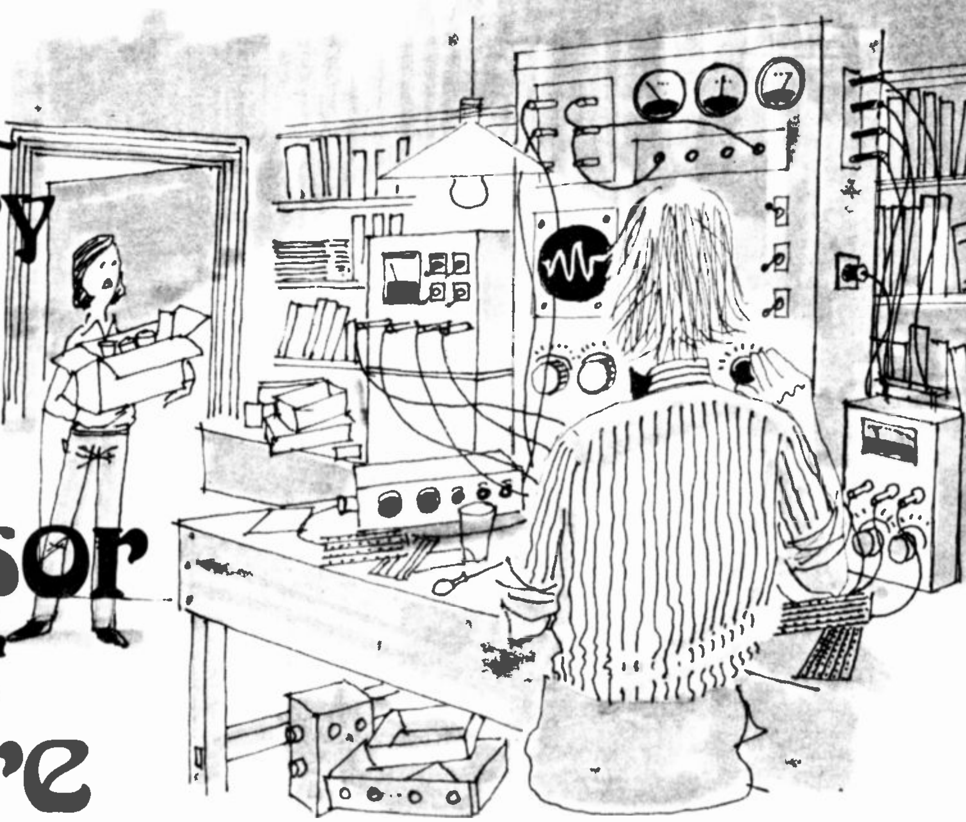
DIGITAL RECORDING WILL TAKE OVER

As soon as the recording industry can standardise itself on a digital code it will become routine for studio recordings to be made digitally on magnetic tape. Digital recording overcomes all the old distortion problems of analogue tape but with the added advantage of facility to edit, albeit using sophisticated electronic equipment. There is of course no possibility of editing a direct-to-disc master.

Decca is only one of many companies now using digital tape and personally I give the direct-cut craze only a year or so. After that digital recording will take over.

Although initially conventional vinyl LP's will be pressed in analogue form from digital tape, as soon as digital sound reproduction equipment is standardised and sold at domestic price levels, we shall see digital discs sold for home use.

The Extra-ordinary Experi-ments of Professor Ernest Eversure



by Anthony John Bassett

TOM and Maurice are forming a Space Age Rock Band with electronic instruments and effects, plus as many unusual gadgets as they can get on stage.

The Prof. is repairing a Spring Line Reverberation Unit for the boys. He examined the unit and drew out a circuit diagram (Fig. 1).

"As you can see", he pointed out to Bob. "This unit contains two integrated circuit amplifiers type 741, one of which IC1 acts as the spring line driver amplifier whilst IC2 is the pickup amplifier, and also carries the "straight through" signal. If these amplifier circuits are faulty the reverberation unit will not function".

The Prof. used a multimeter to check the d.c. voltage conditions on the 741 integrated circuits, and found that, apart from Pin 7 the 18V positive supply, all the other pins read very low, their voltages being at or near 0V.

"Does this mean that both the integrated circuits are faulty, Prof.?" Maurice asked.

"Not necessarily, Maurice. The fault is most likely to be located in the bias circuit, which feeds half of the 18-volt supply voltage to pin 3 of each i.c. If this voltage is not correct, the i.c.s will not function as they should."

The Prof. turned his attention to the bias circuit, which consisted of two 10kΩ resistors (R16, 17) wired in series across the 18 volt supply. A 22μF electrolytic capacitor, C6, was connected from this 9 volt bias point to the 0V line, and this was the cause of the trouble. It had developed a fault, and was allowing the bias to leak away, so that the bias point, instead of being at 9 volts positive, read almost zero on

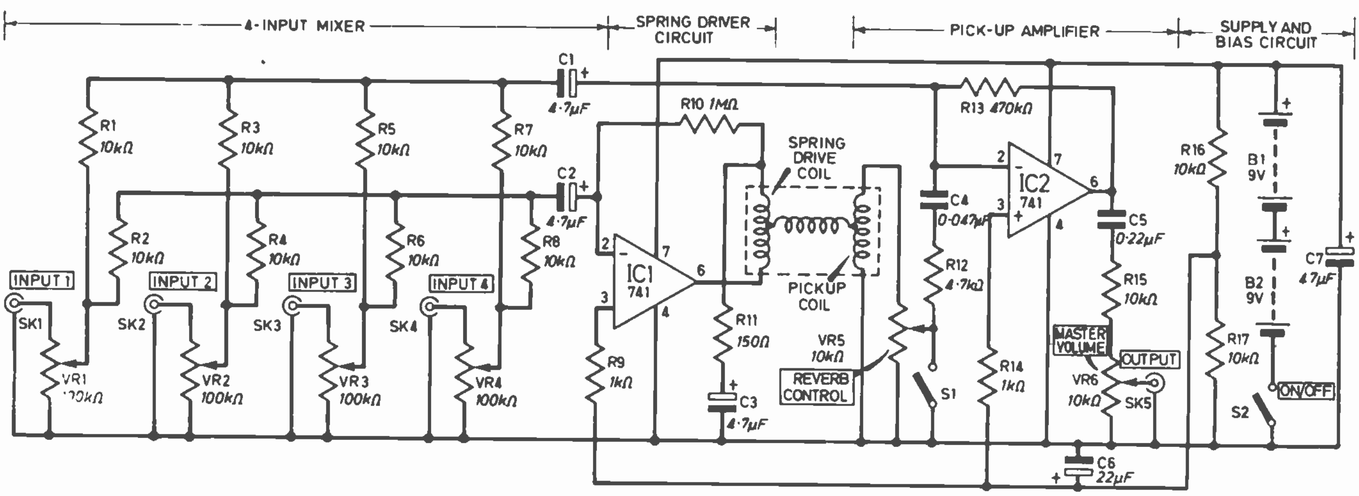


Fig. 1. Circuit diagram for a four input Spring Line Reverberation Unit. The supply bias components are R16, R17 and C6.

the Prof's multimeter.

When the Prof. replaced the electrolytic capacitor with a new one the voltages on the input and the output pins of IC1 and IC2 rose to their correct working point of 9 volts.

UNNECESSARY COMPLICATION

"Prof., it seems to me that this reverberation unit could do without this particular bias circuit", remarked Bob. "We could get the same voltage from one of the batteries. This would save:

1. Three components (2 resistors and 1 capacitor).
2. Battery current which flows in the bias circuit.
3. Risk of breakdown of the bias circuit components.

The unit would become more reliable.

"Prof., why should this bias circuit be necessary?"

"This has been done in order to simplify the on/off switch, Bob. If an individual connection is made to each battery, then a double-pole switch becomes necessary in order to switch off both batteries. In order to use a single-pole switch, which can easily be incorporated in the output jack-socket, the bias circuit has been included. In practice, however, it may be possible in some circuits to omit the bias circuit as you suggest and still use only a single-pole on/off switch.

LOOSE SPRING

This is because the bias current taken at the non-inverting input is so small that it could simply be left connected, without doing any harm to the batteries or the circuit, and only the main battery power supply need then be switched off and on".

Bob connected the output socket of the reverberation unit to the input of an audio amplifier and switched "on". He plugged a microphone into one of the four inputs and turned up the volume control. When he spoke into the microphone, however, his voice came out of the speaker without any noticeable reverberation effect even though the reverberation control was turned up full.

He gently tapped on the frame which carried the reverberation springs and coils, with his finger and as he did so, the sounds of vibrating springs could be clearly heard through the loudspeaker.

"This means that the pickup coil and the pickup amplifier are O.K." Bob remarked, "but it seems there must still be a fault in the spring driver circuit."

Suddenly there came a crackle from the speakers, followed by a 'twanging' sound, and Bob found that when he spoke into the microphone there was now plenty of reverberation effect, as if he were speaking inside a huge cavern.

"I didn't do anything, Prof! Why has it suddenly started to work?" "Yes you did, Bob, you tapped it with your finger. Obviously there is something loose in the Spring Driver part of the circuit. There are not many components in this part of the circuit, so the fault should not be difficult to locate."

The Prof. began to prod the various components of the Spring Driver circuit gently with the end of a plastic trimmer tool, as he did so, the reverberation effect came and went; it did not seem to matter very much which component he touched.

"It seems that the break in the circuit must be very small; microscopic, so that the minute amount of flexing in the board which is produced when I touch any component causes it to touch or part unpredictably. The fault will be more difficult to locate because it comes and goes so unpredictably."

PSYCHIC WORK

"Perhaps, Prof.", Maurice suggested, "This is an opportunity for me to try psychic fault-finding techniques, which have been demonstrated to me by a friend of Lilian, the dowsing Lady we met recently. I have been wanting to try it out for myself ever since.

Lilian's friend is a flower power mystic who earns his living as a computer operator with a large computer company. Like me, he does not know much about electronics, but when the repair technicians are having trouble in locating a difficult fault in a complicated computer circuit, he sometimes helps out.

Even though some of the skilled technicians are furious that someone with so little knowledge should be able to find the source of the trouble much more easily than they can, they reluctantly let him loose on the equipment because it saves them hours of difficult work under the pressure of a firm who want the computer repaired fast."

Maurice rooted in his duffel bag and soon produced a small plastic pendulum similar to the one which Bob and the Prof. had seen Lilian use. He held it over one corner of the circuit board of the reverberation unit, and it soon began to swing along a line, which Maurice marked across the board using a ruler. Now he held it over another corner of the board and soon produced another line; the two lines intersected over one end of the electrolytic capacitor C3.

Maurice gently touched the capacitor, and one of its connecting wires broke loose. "That's the fault" he announced, and indeed when Bob replaced the capacitor, the reverberation unit worked perfectly.

PSYCHIC BRAIN

"How do you explain this psychic fault-finding, Prof?" Bob asked.

"At present, Bob, there is no generally accepted objective explanation. Investigators have found that some phenomena claimed to be psychic have in fact been the results of fraud; but there remain a lot where this has not been a plausible explanation, and scientists are forced to listen unhappily to the tantalisingly mystical subjective explanations given by the 'psychic experts.'

These often involve mysterious factors such as 'energy fields' of a nature undetectable by conventional physical instruments, and invisible 'spirit beings' and many people find these explanations dubious or frightening.

However, brainwave investigations appear to be giving some clues and in psychic healing, for instance, it has been stated that the brainwave pattern of the patient changes, and come to resemble the brainwave pattern of the healer as the healing progresses."

ELECTRONICS and THE LOCH NESS MONSTER

"Obviously in such investigations, electronics is relied upon to provide the apparatus for brainwave monitoring and many other functions, which may help to link psychic phenomena to particular brainwave patterns."

"Prof., at school we were discussing the mystery of the Loch Ness Monster, and it seems that in some circles this is held to be, not a real physical flesh and blood monster, but an elemental psychic phenomena. If it is true that perception of such things is linked to particular brain wave patterns, maybe the use of electronic brainwave equipment could help clear up this mystery?"

"Perhaps you could persuade one of Lilian's talented friends to teleport the Laboratory to Lock Ness for a while, so that we could investigate there! Meanwhile, we've still got a Spring Line Reverberation Unit on the bench."

"I was going to mention next," the Prof. remarked, "that this is a very simple example of a Spring Line Reverberation Unit, and that it is possible to buy or construct more elaborate units

SUSTAIN AND REPEAT

Sustain sound effects can be produced by feeding some of the reverberation signals back to one of the inputs.

Repeat effects can be produced by passing the signal from the pick-up coil through a tremolo unit. If more than one tremolo unit is used, with the outputs through different channels of a stereo or quadrophonic system, the sounds produced become very interesting, and can produce even more effectively the illusion of playing in a much larger hall or room.

To be continued

Once a year around this time, I repeat myself word for word, and I am quite unrepentant about it. The reason is simply that around September and October I know many new readers will join us, and I think one of the most useful functions I can perform, is to give them the best advice I can on buying their components. So, new readers read on, and regular readers, I beg your indulgence.

Buying components

You may be one of the lucky ones and have a little man round the corner who can supply your every need, but the odds against it are a hundred to one. Even in London it is not easy to find component shops, and the provinces are hardly likely to be better served, but do not let this in any way deter you.

Once you have accepted the fact that you are unlikely to get all your requirements from one supplier, and also that you will have to rely mainly on mail order, your troubles are practically over.

Your first purchases should be as many catalogues as you can afford. Study them carefully and then compile a list of all the items you are likely to need: resistors, capacitors, variable capacitors, switches, potentiometers, transistors, integrated circuits, hardware, tools. It's a long list and you are certain to add to it from time to time.

Now take each item and find it in each of the catalogues. You could with advantage code each item by giving it a number from one to five (in relation to each catalogue of course), five denoting a good selection, and one rather poor. You could apply the same test with reference to prices.

The price comparison would be particularly useful if only to show you that if Dealer "As" resistors cost one penny, and Dealer "Bs" cost sixpence, that everything that Dealer "B" sells is not six times as dear as Dealer "A". If this were the case, Dealer "B" would not stay long in business.

Once you have made your list, keep it handy and you will always know from whom to buy any particular item.

Ordering

With reference to ordering, always use the firm's own order form if they provide one, it makes life easier for them and it follows that it is less likely that mistakes will occur. With costs continually rising everything has to be cut to a minimum, and today it is not unusual for a mail order firm to return your order form with your goods while keeping no copy themselves. They will usually tell you that in the event of a query, the paperwork must be returned. I would in your own interest (especially if your handwriting is anything like mine) write your name and address in block capitals.

Finally and I regret having to say it, our postal service, is not as fast as it used to be. Make allowances for this, and if, according to your bank statement, your supplier has cashed your cheque and you are still awaiting your goods, take my word for it, he has not done it so he can lay his hands on your money as quick as possible, but in order to give you positive proof that he has received your order.

Wishing you every success with the best of all hobbies.

IT'S FREE

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—often bargains which sell out before our advertisement can appear—it's an interesting list and it's free—just send S.A.E. Below are a few of the Bargains still available from previous lines.

5000 WATT HEATER KIT
Why not make a standby heater, you never know oil, gas even coal could run out this winter so be prepared and in any case a big heater is a good thing to have for an emergency. We are offering the kit at a very special price until September 30th only. The kit consists of:—two metal bladed tangential blowers, two 2 5 kW mineral filled metal clad heating elements, a three level switch, thermal safety cutout, mains and wiring connector panel, all the necessary tag ended leads and last but not least the wiring and assembly diagram. You have to provide the case material yourself, but our diagram gives all the details—the special off season price is £7 95 + £1 20, carriage £2. Price after September 30th is £11 50 + £1 75 + carriage.

HUMIDITY or the amount of water held in the air—it has a big effect on many things—unless the humidity is right for instance—chicken eggs won't hatch—tomato flowers won't set—cigars aren't fit to smoke—just to name a few, but most important is, we breathe the air, so humidity has a big effect on our health—air thats too dry makes us feel listless and also damages lungs and respiratory passages—too damp can kill us and in fact it does, fog (humidity 100%) is responsible for premature deaths of may people during winter months. Bearing in mind these facts its surprising that so few of us do anything to control humidity. This company sells a humidity controller switch made by Honeywell of U.S.A. price £1 + 15p, this adjustable for varying humidities and it will switch 10 amps at 240v—but its just a switch, and if one of our readers would design a simple to make humidifier, we will reward him and pass his design to any interested readers.

FLUORESCENT CHOKES
Another off season special offer. 80 watt chokes £1 75 + 27p, 65 watt £1 35 + 20p, 40 watt £1 25 + 18p. Prices are based upon an order for minimum of 20 chokes, but are subject to a discount of further 15% if you order 100 chokes. Try to collect but if not then add 25p per choke for carriage. Special Summer offer ends Sept. 31st.

RECORD PLAYER MOTORS
As fitted to Magnavox, B.S.R., Garrard etc. 2 pole motors £1 50 + 22p, post 35p. 4 pole (note these are also fitted to some tape recorders) £2 + 30p post 40p per motor. An interesting point about these motors is that they will replace a motor which is not quite the same, as the part with the winding on can usually be replaced separately

A DOOR SWITCH
Neat tubular pattern for letting into door frame. All you have to do is drill a ¼" dia hole and chisel out for the fixing. This is a changeover switch, so can be used in opening or closing circuits. Price 57p..

CROUZET SKELETON MICRO SWITCH
Crouzet ref. 319/C this a changeover switch with unlimited uses, contacts rated 10 amps stackable and very light weight, snap action. Price 29p.

MINI DECADE THUMB WHEEL SWITCH
Stackable, panel hole size 1½" high and approx ¼" for each switch. Matt black with white figures—gold plated break before make contacts. Price 87p.

ROCKER SWITCH
Double pole 13 amp 250v for hole size 1½" × ¾" white with nickel plated surround. DOT ref. 82/631. Price 41p.

VARIABLE AUTO TRANSFORMERS (Variacs)
We have 12 only 8 amp variacs, these are unused being removed from new Ex Gov. power supplies—these variacs enable normal 230/40 mains to be varied smoothly from 0 volts to 270 volts in one volt steps. The current passing through the variac can be anything up to 8 amps continuous or 12 amps intermittent. These are ideal for dimming lighting or heating, speed control etc and on the work bench for testing unknown transformers etc. The up to date price in the trade catalogue is £50 + vat, but our price is only £34 50 + £3 carriage.

MOTORS FOR VARIACS
Do you have a job which calls for the remote control of variacs—say the raising and lowering of the house lights in a theatre or the control of the air conditioning by thermostats set at different temperatures. If so you may like to know we have motorised cradles to take up to 4 variacs—mains operated, these drive the variacs backwards or forwards and have limit switches at the end of their 320° travel. Price £46 + carriage £5.

LOW TORQUE MICROSWITCH
Can be operated by air flow, coins or other small weights so they have many applications—SPDT silver contacts rated at 250v 5a expected life of 10,000,000 operations. Price 52p.

LIGHT DEPENDENT RESISTOR ORP12
A cadmium sulphide l.d.r. with clear end window—resistance reduces as light increases, dark resistance 1 meg plus, sun light resistance 100—200 ohms. Price 87p.

SUB MINI TRIMMING POTS
Wire leads suit 1 matrix board—top adjusting available in following values: 10 ohms, 10k, 20k, 50k, 100k, 200k, 250k, 500k and 1 meg Price 74p each or 62p if ordered in ten of one value.

MULTI TURN POT
1¼" cermet—20 turn metal cased with three leads for p.c.b.—multi-contact wiper ensures minimum noise and excellent stability—slipping clutch end stop, one value only at present this is 2 kΩ. Price 63p.

SPECIAL CABLES
In addition to the list given in our May/June newsletter we have a few more to add—these have medium duty 7 0076 copper conductors P.V.C. insulated and colour coded, twisted into pairs, each pair braided with a metal screen then all are laid together and covered, black pvc 4 screened pairs 45p, 5 screened pairs 50p, 8 screened pairs 60p, 16 screened pairs 95p. All prices are per foot and subject to VAT and 60p carriage if order under £6.

POWERFUL LOW SPEED MOTOR
230v or 115v mains driven, 45 r.p.m. approx at 50 Mz 60 r.p.m. at 6 Mz. Size is approx 2¾" dia × 2¼" deep ¼" dia shaft ¾" long—mountable from front or rear, this extremely powerful, in fact the writer could not stop it by hand. Price £3 75 + 56p, post 40p

¼ H.P. MOTORS Normal base mounting, ex computors but tested, 230—240v 50 hz good length spindle mostly American make. Price £8 62 each, carriage £2 00.

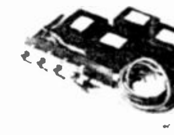
STEREO HEADPHONE LEAD
Black curly 10ft approx. terminations, stereo jackplug one end—miniature two pin plugs on other. Price 57p .

MAINS OPERATED WATER PUMP
Most readers will know that we stock the Jabsco drill pump which was made to work with most portable drills, the price is £2 15, we have coupled this to an 110 rpm motor, mounted them on a metal chassis and offer this as a general purpose pump. It is suitable for most liquids and certainly for water. The pump will lift the liquid up to quite a head Price £10 60, post £1 00.

HEAVY DUTY MAINS RELAY
With three c/o 15 amp contacts—fitted with plastic dust cover, this has push on tags for quick connections. Price £3 26.

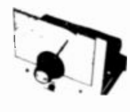
MULLARD UNILEX

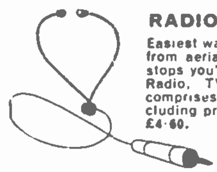
A mains operalad 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone in easy - to - assemble modular form and complete with a pair of speakers this should sell at about £30—but due to a special bulk-buy and as an incentive for you to buy this month we offer the system complete at only £15 including VAT and postage.



SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 10, 25, 29, 31 metre bands. Kit contains chassis front panel and all the parts £2·30—crystal earphone 65p including VAT and postage.





RADIO STETHOSCOPE

Easiest way to fault find, traces, signal from aerial to a speaker, when signal stops you've found the fault. Use it on, Radio, TV, amplifier, anything. Kit comprises transistors and parts including probe tube and twin stetho-set £4·60.

WINDSCREEN WIPER CONTROL

Vary speed of your wiper to suit conditions. All parts end instructions to make £4·25.

DRILL CONTROLLER

Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £3·75.

SOUND TO LIGHT UNIT

Will proved circuit flashes up to 750 watts of lamps. Complete kit includes S.C.P. mains input leads, all parts and very neat plastic case £4 95.

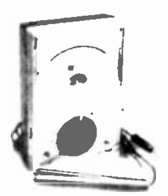
CASSETTE OUTFITS

Complete mechanisms with record/playback and erase heads—all electronics and speaker £9·75 post and VAT paid. *Note* these are all cased up ready to use but case may be slightly uncomplete, cracked or broken.

VARICAP POCKET RECEIVER

CHASER DISPLAY

To quickly receive parts for these and other E.E. projects, send the approximate cost as shown. Any cash adjustment can be made later.



MINI-MULTI TESTER

Amazing. deluxe pocket size precision moving coil instrument jewelled bearings—1000 opv—mirrored scale.
11 instant ranges measure:—
DC volts 10, 50, 250, 1000
AC volts 10, 50, 250, 1000
DC amps 0-1mA and 0-100 mA
Continuity and resistance 0-150K ohms.
Complete with insulated probes, leads, battery, circuit diagram and instructions.

Unbelievable value only £6·50 + 50p post and insurance.

FREE Amps ranges kit enable you to read DC current from 0-10 amps, directly on the 0-10 scale. It's free if you purchase quickly but if you already own a mini tester and would like one send £1 50.

TERMS: Cash with order—but orders under £6 must add 50p to offset packing, etc.

BULK ENQUIRIES INVITED. PHONE: 01-688 1833.

ACCESS & BARCLAYCARD ACCEPTEO

J. BULL (ELECTRICAL) LTD

(Dept. E.E.), 103 TAMWORTH RD., CROYDON CR8 1SG

LATCHING RELAY
This is in fact a double relay, mechanically arranged so that when relay no. 1 closes it will stay closed until no. 2 is closed. Each relay has its own coil (50v dc) and its own c/o contacts, useful in burglar alarm and similar circuits. Price £3·45.

DOUBLE ENDED MOTOR
Mains operated, capacitor run, power estimation at approx. ⅛ h.p., this has spindle coming out each side and should be very suitable for converting into a doubled ended polisher or grinder, holes conveniently placed in the housing make it very easy to stand in the right position and the speed although not high is adequate. We are offering these with capacitor at £4·70, post £1·50.

THREE POSITION ROCKER SWITCH
10 amp changeover with a centre off standard size pushes into hole size approx. 1" × 7/16". Special bargain this month, 10 for £2·30.

WATERPROOF HEATING WIRE
As used for electric blankets etc. This has dozens of other applications—in gloves or socks for people with poor circulation are obvious uses. One unusual use suggested by a customer is a 'grow' bag heater. The wire which consists of an element wound on glass fibre then covered by clear PVC has a resistance of 60 ohms per yard. The price is 23p per metre.

FAST RUNNING OUT
The miniature 24hr timer module, with facility for 32 on offs and 16 amp contacts. If you want one of these send your order this month or you will be too late. Price is £7·71. Extra on off triggers £1·15 per set.

ANOTHER UNREPEATABLE BARGAIN
Which will soon be sold out, is the Sensitive Voltmeter/Relay—fully described in our January newsletter—brand new offered at only about 1/10th of manufacturers price namely £8·93 and post £1. The 4½" 1 mA movement alone is worth more than double this and we give a circuit diagram of the non energy consuming relay/alarm circuit built into the voltmeter's case.

HALF PRICE CABLE OFFERS
Copper clad—made to B.S.I. specification. Prices are only about half the present list prices so be clever buy now while stocks last.

Size	Type	Price 100 metres	Carriage
1·5 mm	Single c.c.	£2·87	£1·00
1·5 mm	Single double insulated	£3·02	£1·50
1·5 mm	Flat twin	£5·17	£1·75
4 mm	Single c.c.	£8·72	£2·50
4 mm	Flat twin	£11·45	£3·00
6 mm	Flat three core	£25·92	£4·00
6 mm	Twin & E.	£25·92	£4·00
10 mm	Twin & E.	£40·25	£6·00
16 mm	Twin & E.	£62·20	£8·00

ELECTRICAL ACCESSORIES SUMMER PRICES
Waterproof cast metal thermostat box £2 87 + 37p post 40p.
Wall mounting Multiswitches metal box with front GEC, single switch 57p, twin switch 60p + 8p. Architrave single 69p. Architrave double 86p.
Quad switch 87p, 6 switch £1·15, 12 switch £1·73.
Switches for above 5 amp sp. 35p, 15 amp sp. 52p.
5 amp 2 way 40p, 2 way and off 58p.
13 amp sockets unswitched brown 34p + 4p, switched brown 59p.
Junction box 23p.
Spurs white 40p, with socket 60p.
16 line connecting box £1·70.
Dim and full switch, 4 pole c/o with centre off 10 amps. £1·15.
Water heater switch 20 amp 250v flush 57p.
5 amp 3 pin switched sockets, 5 for £1·70, unswitched 5 for £1·15
3 Bank rocker switch, interlocked for blow heaters 57p.
Waterproof 5 amp single pole 250v switch 32p.
Flexible conduit 5⅛" and 7" internal dia. 34p per metre.
Garden waterproof flood lamp £6 + 60p.
Mem. switch ref. 1613 52p.
Mem. switch ref. 1600 34p.
Brown surface switch square or round 5 amp 250v 41p.
Immersion Heater 2 kw £3·45, 3 kw £4·60, thermostat £3·45.

THERMOSTAT WITH REMOTE PROBE
This is a Satchwell thermostat using sensor connected to the switch by a 26" length of capillery. Adjustable 30° to 140°F with control knob. Price £2·60.

4 WAY CONNECTOR BLOCKS
Twin grub screw in PVC type, 10 blocks for 69p + 9p.

DC VOLTAGE CHANGING
For operating 12v equipment from 6v car battery etc etc., based on a circuit which appeared in a recent addition of the Wireless World this device fills an urgent need in that it doubles a DC voltage (within the limits of the transistors used). The ones we supply are suitable for operating up to 40 volts so providing the final voltage does not exceed this then you can double any voltage you like (or you can treble it or alter it to suit yourself). The kit comprises—2 selected power transistors, 1⅞" ferrux pot core FX 2242, enamelled copper wire, electrolytic condenser for smoothing and heat sink etc. Price of the kit is £3·45, the case 80p extra.

COMPONENT BOARD Ref. W0998. This is a modern fibre glass board which contains a multitude of very useful parts, most important of which are:- 35 assorted rectifiers including four 3 amp 400v types (made up in a bridge), 8 transistors type BC 107 and 2 type BFY 51, electrolytic condensers, SCR ref. 2N 5062 250uf 100v DC and 100uf 25v DC, and over 100 other parts including variable, fixed and wire wound resistors, electrolytic and other condensers. A real snip at £1·15.

SUPER 2N3055
Transistor RCA 52360, in our experience this does all the 3055 can do but does it better, we have good stock of these price 57p.

SPEAKER CABINETS
Simulated teak finish, nice handy size 11" × 8" × 4½" approx. modern black sponge type front, price £2·36, post £1·50.

IN CAR SPEAKER CABINET
White with black edge very modern looking plastic with threaded studs for mounting speaker complete with back, price £1 75, post 60p.

AC CAPACITORS
For use on fluorescent lighting for power factor correction or as a voltage dropping device, these are very rugged and will stand DC voltages up to three times their RMS voltage. A big perchase enables us to offer these at about one third of the current manufacturers price, all are 300v RMS working or higher and are in aluminium cans with tags or wire ends, following values: 1·25uf 40p, 1·5uf, 52p 3uf 63p, 4uf 74p, 7uf 98p, 8uf 107p, 15uf £1·45p.

COMPUTOR COOLING FANS
The famous Plannair, these are a six bladed 4½" fan rotating at appros. 3000 revs per minute, in a die cast case size approx. 5" square with 4 fixing holes and cable entry box. Not new but any not in perfect working order would be replaced. Price £5·75 + 40p post.

Fluorescent Fittings definitely the time to think of lighting. We are making a special offer of fluorescent fittings to callers, complete with tubes, summer prices are 2 ft. £4·02, 1 metre £4 60, 4 ft £5·46, 5 ft £6·61.

Calculator Key pad Ex broken up calculators these are approx 2½" square and have the normal 10-9 buttons plus on/off, divide, multiply, plus, minus buttons as well few only left of these 88p.

Simply ahead!

HIGH PERFORMANCE MODULAR UNITS BACKED BY NO-QUIBBLE 5 YEAR GUARANTEE

Of all the purpose-built power amplifier modules by I.L.P., the HY50 is understandably the most popular with those wanting to build or up-grade a hi-fi system, run a small high quality P.A. system, amplify a musical instrument (say for practise or small range use) or use it for lab work. Its useful 30 watts RMS output into 8 ohms, its rugged construction and freedom from heatsink worries make HY50 the ideal all-purpose quality power amp—and it is unconditionally guaranteed for five years. Ten of thousands are in use throughout the world

. . . and a spec that means what it says!

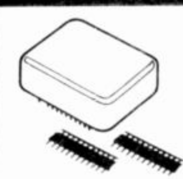
Encapsulated power amp with integral full-rated heatsink. Input—500mV.
Output 30 watts RMS/8 Ω.
Load Impedance—4 to 16 Ω.
Distortion—0·04% from 100mW to 25 watts at 1KHz/8 Ω.
Supply Voltage ±25V. Size 105 × 50 × 25mm.
Inc. V.A.T. and postage in U.K. £8 15

Nothing has been overlooked in the design and manufacture of I.L.P. Modular Units. Heavy duty heatsinks, encapsulated circuitry, no-compromise production standards and true professional finish ensures world leadership for I.L.P. Now we have up-graded output ratings and down-graded prices to bring I.L.P. within easier reach of all who want the best.

New production techniques enable us to reduce prices by an average of 20%, making I.L.P. a better buy than ever.
USE OUR FREE POST SERVICE for sending your orders, requests for information sheets etc. Simply address envelope. No stamps required.

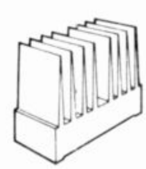
OTHER UNITS IN THE RANGE

OTHER UNITS IN THE RANGE
All prices inc. V.A.T. & Postage in the U.K.



HY5 PRE-AMPLIFIER

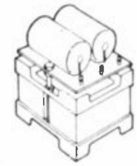
Compatible with all I.L.P. power amps and P.S.U.'s in a single pack, needs external pots and switches. Multi-function equalization. 5 inputs. High overload margin. Active tone controls, 500mV out. Distortion at 1 KHz—0·01%. Two connect easily for stereo. £5·22



THE POWER AMPS

With heatsinks, full load line and thermal protection. Distortion typically 0·05% at 1 KHz.

HY120	60 Watts RMS/8 Ω	114 × 50 × 85mm	£16·42
HY200	120 Watts RMS/8 Ω	114 × 50 × 85mm	£19·92
HY400	240 Watts RMS/4 Ω	114 × 100 × 85mm	£29·89



THE POWER SUPPLY UNITS

(Split line outputs to suit I.L.P. power amps and HY5)

PSU50	for 1 or 2 × HY50	£9·11
PSU70	for 1 or 2 × HY120	£14·70
PSU90	for one HY200	£14·70
PSU180	for one HY400 or 2 × HY200s	£24·80

★ NOW-PRICES DOWN BY 20%

Please supply ....
Total Purchase Price..
I Enclose Cheque ☐ Postal Orders ☐ Money Order ☐
Please debit my Access account/Barclaycard Account number ....
Name ....
Address ....
....
Signature..
FP3/7.. ....
Reg. Bus No. 1032630 Eng.

ILP ELECTRONICS LTD.

FREEPOST 3
Graham Bell House, Roper Close, Canterbury, Kent CT2 7EP
Phone (0227) 54778

SMALL ADS

The prepaid rate for classified advertisements is 18 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £4·40 per single column centimetre (minimum 2·5cm). All cheques, postal orders, etc., to be made payable to Everyday Electronics and crossed "Lloyds Bank Ltd." Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Everyday Electronics, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London SE1 9LS. (Telephone 01-261 5942).

CONDITIONS OF ACCEPTANCE OF CLASSIFIED ADVERTISEMENTS

1. Advertisements are accepted subject to the conditions appearing on our current advertisement rate card and on the express understanding that the Advertiser warrants that the advertisement does not contravene any Act of Parliament nor is it an infringement of the British Code of Advertising Practice.

2. The publishers reserve the right to refuse or withdraw any advertisement.

3. Although every care is taken, the Publishers shall not be liable for clerical or printers' errors or their consequences.

For Sale

NEW BACK ISSUES of "EVERYDAY ELECTRONICS". Available 65p each Post Free, open PO/Cheque returned if not in stock. BELL'S TELEVISION SERVICES 190 Kings Road, Harrogate, Yorkshire. Tel: (0423) 55885.

OFFERS for "Everyday Electronics" from Vol. 1 No. 1 to Vol. 4 No. 11 (Nov. '75) plus Jan. '76. 50 issues in mint condition. Phone: Pete (0823) 432746.

1,000 TRANSISTORS 2N1302 best offer over £150 secures, ring 01-851 2022.

Receivers and Components

TURN YOUR SURPLUS capacitors, transistors, etc., into cash. Contact COLES-HARDING & CO, 103 South Brink, Wisbech, Cambs, 0945 4188. Immediate settlement.

COMPONENTS AT SILLY PRICES! Mixed Resistors: 250 £1·20, 1,000 £3·60. Capacitors: 100 £1, 500 £3·20. Transistors: BC108, BC214, 10 70p, 100 £5·80. Mixed Components, Hardware, Boards, 10lb £3·50. S.A.E. lists. W.V.E., 2 Craigo Farm, Tintern, Gwent.

200 COMPONENTS £4 10. Red L.E.D.s 0·125 90p. Lists 15p. Sole (E. E.), 37 Stanley Street, Ormskirk, Lancs L39 2DH.

ELECTRONIC COMPONENTS. Send SAE for list. Special offers monthly. Radnor Supplies, 23 Arbury Road, Nuneaton, Warks.

SILICON DIODES (1N4148 specification). These high quality components represent remarkable value at 50 for 50p, 150 for £1, 500 for £3, 1,000 for £5. CARBON FILM RESISTORS (5%, ¼, ⅓W), 20 each of 30 different values plus sample 20 of above diodes for £3. Post free from D. Johnston, 12 Balgillo Road, Dundee DD5 3LU.

Situations Vacant

If your hobby is electronics why not consider doing it as a full-time job working in the SE1 area of London? We have a vacancy for a young person with an electronics background (experience or academic) to join our Maintenance team working on some very sophisticated machines. Salary c£3500 p.a.

Interested? then write in confidence to:–

The Laboratory Manager,

Colorama Processing Laboratories Ltd

44/50 Lancaster Street, London, SE1 0RP

Educational

COURSES—RADIO AMATEURS EXAMINATION. City and Guilds. Pass this important examination and obtain your G8 Licence, with an RBC home study course. For details of this, and other courses (GCE, professional examinations etc.), write or phone: THE RAPID RESULTS COLLEGE, Dept. JR1 Tuition House, London SW19 4DS. Tel: 01-947 7272 (Careers Advisory Service) or phone for a prospectus only, ring 01-946 1102 (24hr recording service).

Record Accessories

STYLI, CARTRIDGES FOR MUSIC CENTRES &c. FREE List No. 29. For S.A.E. includes Leads, Mikes, Phones, etc. FELSTEAD ELECTRONICS (EE), LONGLEY LANE, GATLEY, CHEADLE, CHES SK8 4EE.

Books and Publications

INTRODUCTION TO MICROPROCESSORS and Computing. 50 pages of diagrams and explanation to get you started. Price £2·30 plus 45p postage. EDUCATIONAL DATA AND TECHNICAL SERVICES, 59 Station Road, Cogenhoe, Northampton NN7 1LU.

SPECIAL ½ PRICE OFFER!!!

"RIGHT FROM THE START"

The only PRACTICAL Home Study Course for you! Projects and experiments introducing Audio, Radio, Logic and Measurement techniques. A progressive practical MINIMUM MATHS course at a SPECIAL SUMMER OFFER price of only £17·50 covering all necessary components, including printed circuit type solder boards.
The profusely illustrated MANUAL, especially written for the beginner, may also be purchased separately for ONLY £5·00.
Prices include P. & P., etc. C.W.O. to:

MANTEC 7 Dellsome Lane, Welham Green, HATFIELD, HERTS.

Receivers and Components

DISCOVER ELECTRONICS. Build forty easy projects including: Metal Detector; Breathalyser; Radios; Stethoscope; Lie Detector; Touch time-switches; Burglar Alarms, etc. Circuits, plans all for £1·29 including FREE circuit board. Mail only. RIDLEY PHOTO/ELECTRONICS, Box 62, 111 Rockspark Road, Uckfield, Sussex.

NO LICENCE EXAMS NEEDED

To operate this miniature, solid-state Transmitter-Receiver Kit. Only £10–70 plus 25p P. & P.

'Brain-Freeze' 'em with a MINI-STROBE Electronics Kit, pocket-sized 'lightning flashes', vari-speed, for discos and parties. A mere £4·50 plus 25p P. & P. Experiment with a psychedelic DREAM LAB, or pick up faint speech/sounds with the BIG EAR sound-catcher; ready-made multi-function modules. £5 each plus 25p P. & P.

LOTS MORE! Send 25p for lists.

Prices include VAT.

BOFFIN PROJECTS
4 CUNLIFFE ROAD, STONELEIGH
EWELL, SURREY. (E.E.)

P.C.B.s Paxolin 10½" × 4½" 4—£1 30. 12" × 9½" 85p. 16" × 11½" £1·40. D.S. 10" × 8½" 85p. Fibreglass 12" × 7½" £1 60. 14" × 6" £1·56. D.S. 10½" × 7" £1 35. 8" × 7" £1 15. Panel with 40 assorted 74 series I.C.s £1·00. 20 wire ended Neons £1 20. Small 3 Transistor Audio Amps 3—£1·20. 300 Small Components, Trans, Diodes £1·00. 7lbs Assorted Components £3 75. List 15p. refundable. Post 20p. Insurance add 15p.

J.W.B. RADIO
2 Barnfield Crescent, Sale, Cheshire M33 1NL

ORDER FORM PLEASE WRITE IN BLOCK CAPITALS

Please insert the advertisement below in the next available issue of Everyday Electronics for ....

insertions. I enclose Cheque/P.O. for £............................

(Cheques and Postal Orders should be crossed Lloyds Bank Ltd. and made payable to Everyday Electronics)

NAME ....

ADDRESS ....

....

Send to: Classified Advertisement Manager
EVERYDAY ELECTRONICS
GMG, Classified Advertisements Dept., Room 2337,
King's Reach Tower, Stamford Street, London SE1 9LS.
Telephone 01-261 5942
Rate:
18p per word, minimum 12 words. Box No. 60p extra.

Company registered in England. Registered No. 53626. Registered Office: King's Reach Tower, Stamford Street, London SE1 9LS.

Service Sheets

SERVICE SHEETS from 50p and SAE. Catalogue 25p and SAE. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex.

BELL'S TELEVISION SERVICE for service sheets of Radio, TV etc. £1 plus SAE. Colour TV Service Manuals on request. SAE with enquiries to BTS, 190 King's Rd, Harrogate, N. Yorkshire. Tel: 0423 55885.

Miscellaneous

AUDIO OSCILLATOR Sine-Square-RIAA outputs. 15Hz to 200kHz in four ranges. Thermistor stabilised. Assembled PCB ready to use. (V. supply required.) SAE data. £16·30 inclusive. Quantec, 40 Aln Court, Ellington, Morpeth, Northumberland. Morpeth 860101.

DIGITAL WATCH BATTERIES, state type. 60p+10p PP. 2 for £1·20. 4 for £2·40. 6 for £3·40. Discount for larger quantities. F. S. Butler, 511 Fulbridge Road, Peterborough PE4 6SB.

VERY STYLISH BLACK mini-project boxes. Approx 80 x 60 x 20mm. Hinged leather grained lid. Sample 50p. Five £2·00 post paid W. L. Hampson, 221 Hodges St, Wigan.

BUILD 25 PROJECTS with our multi-purpose kits, details supplied. Send £15·00 to Major Oak Services, 33 Lillian Avenue, London W3.

RECHARGEABLE BATTERIES

TRADE ENQUIRIES WELCOME

FULL RANGE AVAILABLE. SAE FOR LISTS. £1 25 for Booklet "Nickel Cadmium Power" plus catalogue. Write or call, Sandwell Plant Ltd, 2 Union Drive, Boldmere, Sutton Coldfield, West Midlands. 021-354 9764. Or see them at TLC 32 Craven Street, Charing Cross, London WC2.

TUNBRIDGE WELLS COMPONENTS, BALLARD'S, 108 Camden Road, Tunbridge Wells, Phone 31803. No lists, enquiries S.A.E.

THE SCIENTIFIC WIRE COMPANY

PO Box 30, London E.4.
Reg. Office, 22 Coningsby Gardens.

ENAMELLED COPPER WIRE

SWG	1 lb	8 oz	4 oz	2 oz
10–19	2 65	1 45	75	60
20–29	2 85	1 65	90	70
30–34	3 05	1 75	1 00	75
35–40	3 40	1 95	1 15	84
41–43	4 55	2 55	1 95	1 30
44–46	5 05	3 05	2 15	1 70
47	8 00	5·00	3 00	1·80
48	15 00	9 00	6 00	3 30

SILVER PLATED COPPER WIRE

14, 16, 18	4 50	2 25	1 44	90
20 & 22	5 00	2 65	1 74	1 06
24 & 26	5 70	3 31	2 00	1 22
28 & 30	6 67	3 86	2 35	1 44

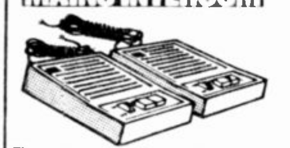
Prices include P & P and VAT.
SAE brings list of copper & resistance Wires.
Dealer enquiries invited.

FOR COMPUTER OPERATORS, TI Programmer. Hexadecimal, octal, decimal calculator/converter for computer programmers. Performs arithmetic in any of three number bases. 15 sets of parentheses for complex problems. Independent memory and constant. Price £44·85 including VAT and P & P Or s.a.e. for details—R & E Marketing, Long Acre, The Ride, Ifold, Billingshurst, Sussex.

AERIAL BOOSTERS

Improves weak VHF radio & television reception.
B45–UHF TV, B11-VHF RADIO. B11 A-2 metres.
For next to the set fitting.
PRICE £5. S.A.E. FOR LEAFLETS.
ELECTRONIC MAILORDER LTD.
62 Bridge Street
Ramsbottom, Bury, Lancs, BLO 9AG.

MAINS INTERCOM



NO BATTERIES NO WIRES

ONLY **£32·99** PER PAIR + VAT £4·95

The modern way of instant 2-way communications. Just plug into power socket. Ready to use. Crystal clear communications from room to room. Range ½-mile on the same mains phase. On/off switch. Volume control. Useful as inter-office intercom, between office and warehouse, in surgery and in homes. P. & P. £1·25.

4-STATION INTERCOM **£27·95** + VAT £4·19

Solve your communication problems with this 4-Station Transistor Intercom system (1 master and 3 Subs) in robust plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs to Master. Ideally suitable for Business, Surgery, Schools, Hospitals and Office. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. A Battery and other accessories. P. & P. £1·25.

NEW! AMERICAN TYPE CRADLE
TELEPHONE AMPLIFIER

£17·95 +VAT £2·69

Latest transistorised Telephone Amplifier with detached plug-in speaker. Placing the receiver on to the cradle activates a switch for immediate two-way conversation without holding the handset. Many people can listen at a time. Increase efficiency in office, shop, workshop. Perfect for "conference" calls: leaves the user's hands free to make notes, consult files. No long waiting, saves time with long-distance calls. On/off switch, volume control, conversation recording model at £19·95 + VAT 15% £2·99 P. & P. 99p.

DOOR ENTRY SYSTEM

No house/business/surgery should be without a DOOR ENTRY SYSTEM in this day and age. The modern way to answer the door in safety to unwanted callers. Talk to the caller and admit him only if satisfied by pressing a remote control button which will open the door electronically. A boon for the invalid, the aged and busy housewife. Supplied complete d.i.y. kit with one internal Telephone, outside Speaker panel, electric door lock release (for Yale type surface latch lock), mains power unit, cable (8-way) 50 ft and wiring diagram. Price £49·95 + VAT £7·50 + P. & P. £1·45. Kit with two Telephones £59·95 + VAT £9·00 + P. & P. £1·65.

10-day price refund guarantee on all items.

WEST LONDON DIRECT SUPPLIES (EE10)
169 KENSINGTON HIGH STREET, LONDON, W8

MAIL ORDER PROTECTION SCHEME

The Publishers of Everyday Electronics are members of the Periodical Publishers Association which gives an undertaking to the Director General of Fair Trading to refund moneys sent by readers in response to mail order advertisements, placed by mail order traders, who fail to supply goods or refund moneys owing to liquidation or bankruptcy. This arrangement does not apply to any failure to supply goods advertised in a catalogue or in a direct mail solicitation.

In the unhappy event of the failure of a mail order trader readers are advised to lodge a claim with Everyday Electronics within three months of the date of the appearance of the advertisement, providing proof of payment. Claims lodged after this period will be considered at the Publisher's discretion. Since all refunds are made by the magazine voluntarily at its own expense, this undertaking enables you to respond to our mail order advertisers with the fullest confidence.

For the purpose of this scheme, mail order advertising is defined as:— 'Direct response advertisements, display or postal bargains where cash had to be sent in advance of goods being delivered. 'Classified and catalogue mail order advertising are excluded.

TECHNICAL TRAINING IN ELECTRONICS AND TELECOMMUNICATIONS

ICS can provide the technical knowledge that is so essential to your success: knowledge that will enable you to take advantage of the many opportunities open to you. Study in your own home, in your own time and at your own pace and if you are studying for an examination ICS guarantee coaching until you are successful.

City and Guilds Certificates:
Telecommunications Technicians
Radio, TV, Electronics Technicians
Technical Communications
Radio Servicing Theory
Radio Amateurs
Electrical Installation Work
MPT Radio Communications Certificate

Diploma Courses:
Colour TV Servicing
Electronic Engineering and Maintenance
Computer Engineering and Programming
Radio, TV, Audio Engineering and Servicing
Electrical Engineering, Installation and Contracting

POST OR PHONE TODAY FOR FREE BOOKLET

ICS **To: International Correspondence Schools**

Dept M268 Intertext House, London
SW8 4UJ or telephone 622 9911

Subject of Interest ....
Name ....
Address ....
.... Tel: .... Age: ....

INDEX TO ADVERTISERS

PLEASE MENTION

EVERYDAY ELECTRONICS

WHEN REPLYING TO ADVERTISEMENTS

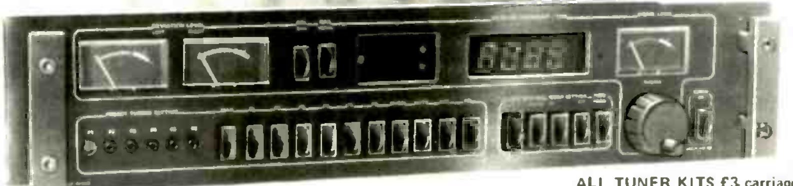
Published approximately the third Friday of each month by IPC Magazines Ltd., Kings Reach Tower, Stamford St., London SE1 9LS. Printed in England by Index Printers Ltd., Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/Sia) Ltd. South Africa—Central News Agency Ltd. Subscriptions: Inland £8.50, Overseas £9.50 per annum payable to IPC Services, Oakfield House, Perrymount Road, Haywards Heath, Sussex. Everyday Electronics is sold subject to the following conditions namely that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on cover, excluding Eire where the selling price is subject to V.A.T., and that it shall not be lent, resold, or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

Tecknowledgey for sale.

The Mark III FM Tuner

DIY Hi-Fi will never seem the same again. Ambit's Mark III tuner system is electrically & visually superior to all others. Some options available, but the illustrated version with reference series modules: £149.00 + £18.62 VAT

With Hyperfi Series modules £185.00 + £23.12



ALL TUNER KITS £3 carriage

Features of the system

* Precision construction & design of all parts
* Time/frequency display
* State of the art performance with facilities for updates, using modular plug in systems.
* Deviation level calibrator for recording
* All usual tuner features

Digital Dorchester All Band Broadcast Tuner: LW/MW/SW/SW/SW/FM stereo

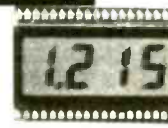
A multiband superhet tuner, constructed using a single IC for RF/IF processing - but with all features you would expect of designs of far greater complexity. The FM section uses a three section (air gang) tuned FET tunerhead, with ceramic IF filters and interstation mute; AM employs a double balanced mixer input stage, with mechanical IF filters - plus a BFO and MOSFET product detector for CW/SSB reception. Styled in a matching unit to the Mark III FM only tuner, employing the same degree of care in mechanical design to enable easy construction. MW/LW reception via a ferrite rod antenna.

Electronics only (PCB and all components thereon)	£33.00 + £4.95 VAT
Complete with digital frequency readout/clock-timer hardware	£99.00 + £14.85 VAT
Complete with MA1023 clock/timer module with dial scale	£66.00 + £9.90 VAT

Hardware packages are available separately if you wish to house your own designs in a professional case structure. Please deduct the cost of electronics from complete prices.

LW/MW/FM LCD Digital Frequency Display - July PW feature

Update your old radio, or build this into a new design. Or use it as a servicing aid - this low power unit with LCD display reads direct frequency in kHz/MHz, or with usual AM/FM IF offsets for received frequency. Low power LCD means no RFI - 15-20mA at 9v even with the divide by 100 prescalar. FM resolution is 100kHz, AM 1kHz. Sensitivities better than 10mV



Complete kit £19.50 + £2.93 VAT, built and tested module £27.00 + £4.05VAT

Ambit stocks and distributes a wide range of frequency counter LSI for all types of DFM - part two of the catalogue contains details of the MSM5523/4/5/6 range, and the versatile MSL2318 divide by ten or hundred prescalar IC. The DFM1 combined counter for AM,FM SW and direct/clock/stopwatch/timers - details available, but SAE please !

PW SANDBANKS PI METAL LOCATOR

Maintaining our professional approach to home constructor kits, we offer the pulse induction 'Sandbanks'. Now with injection molded casing for greatly improved enviromental sealing. £37.00+£5.55vat

VHF MONITOR RX WITH PLESSEY IC

4/9 channel version of the PW design but using standard (fundx9) crystals, and TOYO 8 pole crystal filter with matching transformers. Coil sets from our standard range to cover bands from 40 to 200MHz. Complete module kit £31.25 +£3.90vat .

MICROMARKET

OSTS overflow:

6800P	650p	8212	230p	2102	170p
6820P	600p	8216	195p	2112	340p
6850P	275p	8224	350p	2513	754p
6810	400p	8228	478p	4027	578p
6852	365p	8251	625p	2114	1000p
8080	630p	8255	540p	+15% VAT	

RADIO and AUDIO MODULES : Consistently the most advanced

FOR FM

EF5801-3-4 series: 6 stage varicap tuning, all with oscillator output

5801	Dual gate MOSFET RF stages, bipolar mixer	£17.45 + 2.61VAT
5803	Dual gate RF/mixer stages, amplified LO out	£19.75 + 2.96VAT
5804	'Hyperfi' series, with internal PIM diode agc, and ultra wide range tuning system	£24.95 + 3.74VAT
EF5402	4 stage varicap tuner with TDA1062 and LO output. Uses FET/IC input. PIN agc	£10.75 + 1.61VAT

FOR 30-200MHz

The EF series are available on special order to cover bands (usually approx 20% of the centre frequency) in the range described. Details in our price list.

FOR FM IFs at 10.7MHz

7030	single 6 pole linear phase filter IF with HA1137	£10.95 + 1.64VAT
7130	two 6 pole linear phase filter IF with CA3189E	£16.25 + 2.44VAT
7230	Hyperfi IF, switched bandwidth, AGC IF preamp, linear phase ceramic filters with diode switched narrow filter	£24.95+3.74VAT

DECODERS for MPX (STEREO)

Various types, guaranteed the world's biggest and best ranges

LARSHOLT FM TUNERSETS

7252	MOSFET front end combined with CA3089 IF	£26.50 +3.97VAT
7252	JFET front end, combined with IF and decoder	£26.50 +3.97VAT

FM/AM tuning synthesiser, see details elsewhere in th is advertisement

COMPONENTS FOR RADIO/COMMUNICATIONS/AUDIO/TV etc.

As usual, Ambit brings you the latest and best, a small selection of which is shown in this advertisement. The Ambit catalogues contain information on most of the devices mentioned here - and an order for the new part three will ensure you stay up with latest developments. Data photocopying service described in pricelist info.

RADIO ICs for FM		vat
CA3089E	1.94	29
CA3189E	2.45	37
HA1137W	2.20	33
HA11225	2.20	33
SN76660N	0.75	11
RADIO ICs for AM/FM		
TDA1090	3.35	50
TDA1083	1.95	29
TDA1220	1.40	21
IF AMPLIFIERS		
KB4406	0.50	07
MC1350	1.20	18
see comms ics also		
COMMUNICATIONS		
KB4412	2.55	38
KB4413	2.75	41
SD6000	3.75	56

SL1600 series		
SL1610	1.60	24
SL1611	1.60	24
SL1612	1.60	24
SL1613	1.89	28
SL1620	2.17	33
SL1621	2.17	33
SL1623	2.44	37
SL 624	3.28	49
SL1625	2.17	33
SL1626	2.44	37
SL1630	1.62	24
SL1640	1.89	28
SL1641	1.89	28
SL6640	2.75	41
SL6690	3.20	48
MC3357	3.12	47
MC1496	1.25	19
NE544	1.70	25

Audio preamps		vat
LM381N	1.81	27
LM382N	1.65	25
KB4436	2.53	38
KB4438	2.22	33
TDA1028	3.50	53
TDA1029	3.50	53
TDA1074	3.75	56
Audio power		
TBA820M	0.75	11
TBA810AS	1.09	16
LM380N	1.00	15
ULN2283	1.00	15
TDA2002	1.95	29
HA1370	2.99	45
TDA2020	2.99	45

FETs, MOSFETs, bipolars and various others: see PL

2SJ133/2SJ48 £10.00 + £1.50 pr. various high voltage drivers etc. from correctly matched Hitachi series transistors. (All 120v types)

OSTS: Remember all OSTS stocks are obtained from BS9000 approved sources - your assurance that all devices are very best first quality commercial types. Some LPSN TTL is presently in great demand, so please check by phone before ordering .

TTL:Standard AND LP SchottkY

All prices listed in pence *

	'N'	'LSN'		'N'	'LSN'
7400	13	20	7472	28	
7401	13	20	7473	32	38
7402	14	20	7474	27	38
7403	14	20	7475	38	40
7404	14	24	7476	37	38
7405	18	26	7478		38
7406	38		7480	48	
7409	17	24	7481	86	
7410	15	24	7482	69	
7411	20	24	7485	104	99
7412	17		7486		40
7413	30		7489	205	
7414	51		7490	33	90
7415		24	7491	76	110
7416	30		7492	38	78
7417	30		7493	32	99
7420	16	24	7494	78	
7421	29	24	7495a	65	99
7423	27		7496	58	120
7425	27		7497	185	
7426		27	741XX series		
7427	27	29	74107	32	38
7428	35	32	74109	63	38
7430	17	24	74110	54	54
7432	25	24	74111	68	
7437	40	24	74112		38
7438	33	24	74113		38
7440	17	24	74114		38
7441	74		74116	198	
7442	70	99	74118	83	
7443	115		74120	115	
7444	112		74121	25	
7445	94		74122	46	
7446	94		74123	46	
7447	82	89	74124		137
7448	56	99	74125	38	44
7449		99	74126	57	44
7451	17	24	74128	74	
7453	17		74132	73	78
7454	17	24	74136		40
7455	35	24	74138		60
7460	17		74139		60
7463		124	74141	56	
7470	28				

	'N'	'LSN'		'LSN'
74142	265		74257	108
74143	312		74260	153
74144	312		74273	124
74145	65	97	74283	120
74147	175		74293	95
74148	109	191	74365	49
74150	99		74366	49
74151	64	84	74367	43
74153	64	54	74368	49
74154	96		74373	77
74155	54	110	74374	77
74156	80	110	74377	124
74157	67	55	74379	130
74158		60	74393	140
74159	210			
74160	82	130		
74161		78		
74162		130		
74163	92	78		
74164	104	130		
74165	105			
74167	20			
74169		200		
74170	230	200		
74172	625			
74174	87	120		
74175	87	110		
74176	75			
74177	78			
74181	165	350		
74183		210		
74184	135			
74185	134			
74188	275			
74190		92		
74192	105	180		
74193	105	180		
74194	105			
74196	99	110		
74197		110		
74198	150			
74199	160			
74247		90		
74253		105		

VOLTAGE REGS:

7800 series 1Amp pos	95p
7900 series 1Amp neg	100p
78M series ½Amp pos	90p
78LCP 100mA	35p
78MGT2C variable	175p
79MGT2C variable	175p
/23CN variable IC	65p
NE550	73p
L200 variable V and I	195p

MAINS EMI FILTERS (BS etc approved types)

1 Amp in IEC chassis connector	4.83
6 Amp in IEC	5.83
5 Amp wirein	3.87

(Toroid cores in Cat no. 2)

MISC. Counter/timer, scalar devices............

NE555 30p NE556 78p NE558 180p
LM3909 72p

95H90DC divide by 10/11 to 320MHz	780p
11C90DC divide by 10/11 to 650MHz	1400p
8629 divide by 100 to 175MHz min	420p
MSL2318 divide by 10/100 to 175MHz min	420p
ICM7216BIPI : 8 decade 10MHz DFM counter and full function timer, with direct drive for an LED display (mpx). Uses 10MHz xtal	1982p
ICM7217AIBI ; 4 decade programmable counter with direct LED drive	950p
ICM7207 clock pulse generator	495p
ICM7208 : 7 decade counter display	1495p
ICM7106CP : LCD DVM (3½ digit)	955p
ICM7106CPK : evaluation kit for 7106	24.80
ICM7107CP : LED DVM (3½ digit)	955p
ICM7107CPK : LED DVM kit for 7107	20.65
OKI MSM5523/4 : LED/Fluorescent display driver IC for time/timer/stopwatch/ AM/FM received frequency display and direct counter (use MSL2318 prescalar) inc Crystal	1400p
MSM5525 : AM/FM frequency only couner, for fluorescent displays (6LT06) inc xtal	1100p
MSM5526 : as MSM5525 but for LCD	1100p
4 digit LCD for ICM7106 or MSM5526	1100p
10 LED (2½x5mm) bar graph driver PCB for LOG or LIN (specify). Kit ex leds	300p

IMPORTANT: ALL PRICES SHOWN EXCLUDE VAT - WHICH MUST BE ADDED AT 15% OVERALL.
PLEASE NOTE THE REDUCED CMOS/LPSN TTL RANGES DUE TO CURRENT SUPPLY SHORTAGE

CD4000

4000	17	4522	149
4001	17	4528	102
4002	17	4529	141
4006	109	4532	125
4007	18	4538	150
4008	80	4539	110
4009	58	4543	174
4010	58	4549	399
4011	17	4554	153
4012	17	4558	117
4013	55	4560	218
4014	95	4562	530
4016	52	4566	159
4017	80	4568	281
4018	80	4569	303
4019	60	4572	25
4020	93	4584	63
4021	82	4585	100
4022	90		
4023	17		
4024	76		
4025	17		
4026	180		
4027	55		
4028	72		
4029	100		
4030	58		
4035	120		
4040	83		
4042	85		
4043	85		
4044	80		
4046	130		
4048	60		
4049	55		
4050	55		
4051	65		
4052	65		
4053	65		
4055	135		
4059	563		
4060	115		
4063	109		
4066	53		
4068	25		
4069	20		
4070	20		
4071	20		
4072	20		
4073	20		
4075	20		
4076	90		

LINEARS

CA3130E	84
CA3130T	90
CA3140E	
CA3140T	72
LM301AH	67
LM301AN	30
LM339N	66
LM348N	186
LM3900N	60
709HC	64
709PC	36
710HC	65
710PC	59
723CN	65
741CH	66
741CN	27
747CN	70
748CN	36
NE531N	105

7 SEG DISPLAYS

HP5082 series.......

Red	7650	233p
	7653	233p
Yell	7660	233p
	7663	233p
Grn	7670	233p
	7673	233p
Fairchild FND 500/507		150p

MORE FROM THE GENERAL AMBIT CATALOGUE RANGES:

Varicap tuning diodes for AM/FM/TV :

1-9 v AM tuning (Cr 15:1) from TOKO--			
KV1211 double matched	175p	26p vat	
KV1210 triple matched	245p	37p vat	
KV1215 triple snap-apart	245p	37p vat	
MVAM115 single 15v	105p	16p vat	
MVAM125 single 25v	105p	16p vat	
MVAM2 double 25v	148p	22p vat	
BB204/104 double FM	40p	6p vat	
BA102 single AFC etc	30p	4p vat	
BA121/ITT210 single afc	30p	4p vat	
BB105B single UHF	40p	6p vat	
PIN DIODES, BANDSWITCH types			
BA479 PIN attenuator	35p	5p vat	
TDA1061 Pi-form atten.	95p	14p vat	
BA182 Bandswitch	21p	3p vat	

All RF semiconductors stocked in depth. Please ask for quantity pricing details

MPU controllable digital freq. synthesiser PCB. Preliminary:

Serial data controlled, with the standard swallow count system for maximum speed of operation. Multiple time constant filters, suitable for AM/FM and other communications/generator applications. Not for beginners. Full preliminary data package £1 + SAE. No phone enquiries answered on this system for the time being. Watch this space........ Projected cost of the controller PCB less than £30: comprises the two modulus counter, prog.div., phase detector, multiple TC loop filter/integrators.

TOP GRADE LEDS by AEG: PRICES ARE EXC. VAT (add 15%)

SIZE	Red	Green	Yello	Orang	Quantity discounts for LEDs:
5mm	14p	16p	15p	20p	10 per type - less 10%
3mm	13p	15p	18p	19p	100 per type - less 30%
2½x5	17p	20p	20p	24p	100 mix in 10s - less 25%

FUTABA FLUORESCENT VACUUM DISPLAYS for CLOCKs etc

5LT02	clock display (static drive) with AM/PM flags	£9 + 1.35
5LT03	DFM display for MSM5525 LSI counter	£9.45 + 1.42 vat
6LT06	5 digit DFM display (GI AY58100) mpxed	£9.75 +1.46 vat

TOKO COILS, FILTERs, CHOKES, etc for AM/FM/TV comms-- (please add VAT @15%)

TYPE Size:	5mm	7mm	10mm	
AM IF	55p	33p	30p	Various for ICs, transistor etc.
FM IF	55p	33p	33p	Various for ICs, transistor etc.
SW coils			33p	Two impedance series
OSC coils	55p	33p	33p	For LW/MW/SW
TV vhf/uhf			35p	

Various coils in the range 20kHz to 300MHz - see TOKO catalogue

CERAMIC and MECHANICAL FILTERS (inc MURATA TYPES)

CFT455B/ CFT455C 60p; CFX014 -180p; CFU455C - 85p
CFT470C - 60p; CFU470C -65p
MURATA CFU455H and CFU455F cermic block filters 1.95ea
MURATA CFM455 series ladder filters, D,E,F,G,H bandwidths available now (20,16,12,8,6 kHz) £8.35 ea (metal encapsulated)
SFD455B, SFD470B, SFD472B 85p ea
CFM2 series mechanical elements types A,B,C,D (4-10kHz bandwidth) - 65p ea. (As used in RCME feature)

MULTIPLEX/PILOT TONE FILTERS. FM IF FILTERS (see cat and:)

CFSE10.7/SFE10.7 - stereo FM IF ceramic filters (sim FM4 etc)	50p
CFSB10.7/SFE10.7MJ - mono bandwidth ceramic FM IF filters	50p
SFE10.7ML - ultra linear phase stereo ceramic IF filters	70p
CDA10.7 - 10.7MHz ceramic discriminator (for CA3089 etc)	70p

Current news: A PCB for the Mullard OC tone and volume control system is now available £3 + 0.45 VAT. HMOS PA modules for 60-100W - kit £14 +£2.10VAT, heatsink £4.10+0.61. FM radio control system crystals £3.75 pair inc VAT (Sept on). MK50366N: static drive clock/timer IC £3.78 + 0.57 VAT. 12½kHz channel spacing 8 pole 10.7MHz XTAL filter by TOYO type H4402 £15.50 + £2.32VAT. A further updated pricelist is now available, and we would like to remind you that enquiries can only be answered if accompanied either by an official business letterhead, or an SAE. STOP PRESS: TOKO's new split-apart triple AM tuning diodes are in stock £2.45 + 37p VAT, (KV1215). S BL1 diode DBM 1-500MHz - £4.25+0.64p.

Terms: CWO please. Account facilities for commercial customers OA. Postage 25p per order. Minimum credit invoice for account customers £10.00. Please follow instructions on VAT, which is usually shown as a separate amount. Overseas customers welcome - please allow for postage etc according to desired shipping method. Access facilities for credit purchases.

Catalogues: Ambit. Part 1 45p. Part 2 50p 90p pair. TOKO Euro shortform 20p. Micrometals toroid cores 40p. All inc PP etc. Full data service described in pricelist supplements.

Hours/phone: We are open from 9am -7pm for phone calls. Callers from 10am to 7pm. Administrative enquiries 9am to 4.30pm please (not Saturdays). Saturday service 10am to 6pm.

AMBIT catalogues are guaranteed to contain the most up-to-date and best informed comment on modern developments and advances in the field of radio and audio. There is no competetive publication that even approaches the broad range of parts/information on modern techniques.

ambit ® international 2 Gresham Road, Brentwood, Essex.

MAPLIN

Post this coupon now for your copy of our 1979-80 catalogue price 70p.

Please send me a copy of your 280 page catalogue. I enclose 70p (plus 37p p&p). If I am not completely satisfied I may return the catalogue to you and have my money refunded. If you live outside the U.K. send £1.35 or ten International Reply Coupons.

I enclose £1.07.

NAME ______

ADDRESS ______

E.E.10.79

A 63-key ASCII keyboard with 625-line TV interface, 4-page memory and microprocessor interface. Details in our catalogue.

Our catalogue even includes some popular car accessories at marvellous prices.

A 10-channel stereo graphic equaliser with a quality specification at an unbeatable price when you build it yourself. Full specification in our catalogue.

These are just some of the metal cases we stock. There are dozens of plastic ones to choose from as well. See pages 52 to 57 of our catalogue.

A massive new catalogue from Maplin that's even bigger and better than before. If you ever buy electronic components, this is the one catalogue you must not be without. Over 280 pages – some in full colour – it's a comprehensive guide to electronic components with hundreds of photographs and illustrations and page after page of invaluable data.

Our bi-monthly newsletter contains guaranteed prices, special offers and all the latest news from Maplin.

Mobile amateur radio, TV and FM aerials plus lots of accessories are described in our catalogue.

A digitally controlled stereo synthesiser the 5600S with more facilities than almost anything up to £3,000. Build it yourself for less than £700. Full specification in our catalogue.

A superb range of microphones and accessories at really low prices. Take a look in our catalogue – send the coupon now!

An attractive mains alarm clock with radio switching function and battery back up! Complete kit with case only £18.38 (incl. VAT & p & p) MA1023 module only £8.42 (incl. VAT).

A superb technical bookshop in your home! All you need is our catalogue. Post the coupon now!

A hi-fi stereo tuner with medium and long wave, FM stereo and UHF TV sound! Full construction details in our catalogue.

Add-on bass pedal unit for organs. Has excellent bass guitar stop for guitarists accompaniment. Specification in our catalogue.

MAPLIN

ELECTRONIC SUPPLIES LTD

All mail to:–
P.O. Box 3, Rayleigh, Essex SS6 8LR.
Telephone: Southend (0702) 554155.
Shop: 284 London Road, Westcliff-on-Sea, Essex. (Closed on Monday).
Telephone: Southend (0702) 554000.