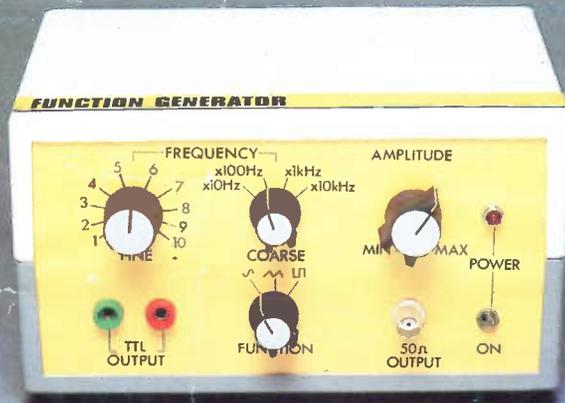


Easy to build projects for everyone

APRIL 83
80p

Everyday ELECTRONICS

TEST GEAR 83 Function Generator



Add-on Amplifier for ZX spectrum



Novelty Egg Timer



CAR RADIO POWER BOOSTER



Flanger Sound Effect

electronize

AUTO-ELECTRONIC PRODUCTS

KITS OR READY BUILT

ELECTRONIC IGNITION



IS YOUR CAR AS GOOD AS IT COULD BE ?

- ★ Is it **EASY TO START** in the cold and the damp? Total Energy Discharge will give the most powerful spark and maintain full output even with a near flat battery.
- ★ Is it **ECONOMICAL** or does it "go off" between services as the ignition performance deteriorates? Total Energy Discharge gives much more output and maintains it from service to service.
- ★ Has it **PEAK PERFORMANCE** or is it flat at high and low revs. where the ignition output is marginal? Total Energy Discharge gives a more powerful spark from idle to the engines max. (even with 8 cylinders).
- ★ Do the **PLUGS and POINTS** always need changing to bring the engine back to its best. Total Energy Discharge eliminates contact arcing and erosion by removing the heavy electrical load. The timing stays "spot on" and the contact condition doesn't affect the performance either. Larger plug gaps can be used, even wet or badly fouled plugs can be fired with this system.

★ Is the **PERFORMANCE SMOOTH**. The more powerful spark of Total Energy Discharge eliminates the 'near misfires' whilst an electronic filter smooths out the effects of contact bounce etc.

Most **NEW CARS** already have **ELECTRONIC IGNITION**. Update **YOUR CAR** with the most powerful system on the market - 3 1/2 times more spark power than inductive systems - 3 1/2 times the spark energy of ordinary capacitive systems, 3 times the spark duration.

Total Energy Discharge also features: **EASY FITTING, STANDARD/ELECTRONIC CHANGEOVER SWITCH, LED STATIC TIMING LIGHT, LOW RADIO INTERFERENCE, CORRECT SPARK POLARITY** and **DESIGNED IN RELIABILITY.**

★ **IN KIT FORM** it provides a top performance system at less than half the price of competing ready built units. The kit includes: pre-drilled fibreglass PCB, pre-wound and varnished ferrite transformer, high quality 2µF discharge capacitor, case, easy to follow instructions, solder and everything needed to build and fit to your car. All you need is a soldering iron and a few basic tools.

FITS ALL NEGATIVE EARTH VEHICLES
6 or 12 volt, with or without ballast.

OPERATES ALL VOLTAGE IMPULSE TACHOMETERS:
(Older current impulse types need an adaptor).

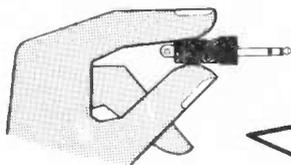
STANDARD CAR KIT £15-90
Assembled and Tested £26-70

PLUS
P. & P.
£1 (U.K.)

TWIN OUTPUT KIT £24-55
For Motor Cycles and Cars with twin ignition systems
Assembled and Tested £36-45

Prices
include
VAT

PROTECT YOUR CAR WITH AN ELECTRONIZE ELECTRONIC ALARM



Don't Wait Until
Its too Late ~
Fit one NOW!

- ★ **2000 COMBINATIONS** provided by an electronic key - a miniature jack plug containing components which must match each individual alarm system. (Not limited to a few hundred keys or a four bit code).
- ★ **60 SECOND ALARM PERIOD** flashes headlights and sounds horn, then resets ready to operate again if needed.
- ★ **10 SECOND ENTRY DELAY** allows owner to dis-arm the system, by inserting the key plug into a dashboard mounted socket, before the alarm sounds. (No holes in external bodywork, fiddly code systems or hidden switches). Re-closing the door will not cancel the alarm, before or after it sounds, the key plug must be used.
- ★ **INSTANT ALARM OPERATION** triggered by accessories or bonnet/boot opening.
- ★ **30 SECOND DELAY** when system is armed allows owner to lock doors etc.

★ **DISABLES IGNITION SYSTEM** when alarm is armed.

★ **IN KIT FORM** it provides a high level of protection at a really low cost. The kit includes everything needed, the case, fibreglass PCB, CMOS IC's, random selection resistors to set the combination, in fact everything down to the last nut and washer plus easy to follow instructions.

FITS ALL 12 VOLT NEGATIVE EARTH VEHICLES.
SUPPLIED COMPLETE WITH ALL NECESSARY LEADS AND CONNECTORS PLUS TWO KEY PLUGS

CAR ALARM KIT £24-95
ASSEMBLED AND TESTED £37-95

PLUS
P. & P.
£1 (U.K.)
Prices
include
VAT



Access and Visa
Welcome. Write or
Phone Quoting Number

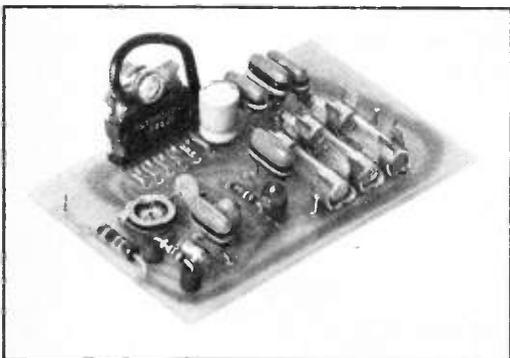
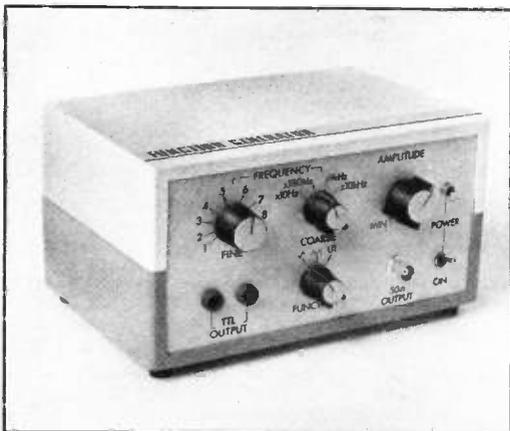
ELECTRONIZE DESIGN

Dept. C · Magnus Rd · Wilnecote
Tamworth · B77 5BY
tel: 0827 281000

Everyday ELECTRONICS

VOL. 12 NO. 4 APRIL 1983

PROJECTS . . . THEORY . . . NEWS . . .
COMMENT . . . POPULAR FEATURES . . .



© IPC Magazines Limited 1983. Copyright in all drawings, photographs and articles published in EVERYDAY ELECTRONICS is fully protected, and reproduction or imitations in whole or in part are expressly forbidden.

PROJECTS

- ZX SPECTRUM AMPLIFIER** by V. Terrell 202
Increase the volume of your Spectrum
- TEST GEAR 83—FUNCTION GENERATOR** 205
Low-distortion sine, square and triangular waveforms by J. R. Barnes
- NOVELTY EGG TIMER** by L. S. Cook 212
A useful item for the kitchen
- FLANGER SOUND EFFECT** by R. A. Penfold 221
A "bucket-brigade" musical effects unit
- NEON NIGHTLIGHT** by D. A. Corder 232
Low cost light for a child's bedroom
- EXPANDED ADD-ON KEYBOARD FOR THE ZX81** 234
Part 2: Construction and setting up by J. M. Stejskal
- CAR RADIO BOOSTER** by C. Lare 242
For increased output from in-car entertainment

SERIES

- THE ELECTRONICS OF INFORMATION TECHNOLOGY** Part 6: Information Storage by T. Ivall 218

FEATURES

- EDITORIAL** 201
Everyday Electronics And Computer Projects
- CIRCUIT EXCHANGE** 216, 232, 237, 238, 241
A forum for readers' ideas
- SHOPTALK** by Dave Barrington 217
Product news and component buying
- JACK PLUG AND FAMILY** by Doug Baker 225
Cartoon
- LETTERS** 226
Your news and views
- PLEASE TAKE NOTE** 226
Beat the Relay
- FOR YOUR ENTERTAINMENT** by Barry Fox 227
Cellular Radio; Recording with Videodiscs
- EVERYDAY NEWS** 228
What's happening in the world of electronics
- RADIO WORLD** by Pat Hawker G3VA 230
Your Personal Humanoid; Vintage Valves; The Young Tutor
- COUNTER INTELLIGENCE** by Paul Young 238
A Retailer Comments
- BOOK REVIEW** 238
- SQUARE ONE** 246
Beginners' Page: Electrolytic Capacitors

Our May 1983 issue will be published on Friday, April 15. See page 231 for details.

Readers Services • Editorial and Advertisement Departments 201

**HOBBY HERALD
HAS ALL THE
LATEST NEWS
FOR THE
ELECTRONICS
HOBBYIST**

When you need to update yourself with all that is available in the "Do-it-yourself" market, then you need the Hobby Herald.

Packed with product information essential to the electronics enthusiast, this new electronics catalogue lists over 60 exciting products ranging from All Purpose Cutters to Verobloc, the solderless breadboard. All products are available throughout the U.K. from over 200 stockists.

HOBBY HERALD

Alternatively ordering products through the Herald is simplicity itself, and you can pay by either cheque, Barclaycard or Access. So make sure you get your copy of Hobby Herald by ringing

(04215) 62829.



BICC-Vero Electronics Ltd.,
Industrial Estate,
Chandlers Ford, Hampshire,
SO5 3ZR.

BICC vero

TWO FABULOUS OFFERS FROM

ALCON

SUPER 20
20k Ω /V a.c. & d.c.

**A SUPER
PROTECTED
UNIVERSAL
MULTIMETER**

Undestructible, with automatic protection on all ranges but 10A.

ONLY £33.50

inc. VAT, P&P, complete with carrying case, leads and instructions.

This special offer is a wonderful opportunity to acquire an essential piece of test gear with a saving of nearly £20.00.

Accuracy: d.c. ranges and Ω 2% a.c. 3% (of f.s.d.)
39 ranges: d.c. V 100mV, 1.0V, 3.0V, 10V, 30V, 100V, 300V, 1000V.
d.c. I 50 μ A, 100 μ A, 300 μ A, 1.0mA, 3mA, 10mA, 30mA, 100mA, 1A, 10A
a.c. V 10V, 30V, 100V, 300V, 1000V.
a.c. I 3mA, 10mA, 30mA, 100mA, 1.0A, 10A.
 Ω 0-5.0k Ω , 0-50k Ω , 0-500k Ω , 5M Ω , 50M Ω .
dB from -10 to +61 in 5 ranges.

Dimensions: 105 x 130 x 40mm.



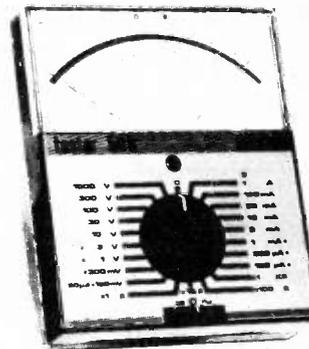
TESTER 50 39 ranges

50k Ω V a.c. and d.c.
With protective diodes and quick-acting 1.25A fuse.

**THE
PROFESSIONAL
SOLUTION
TO GENERAL
MEASUREMENT
PROBLEMS**

ONLY £36.30

incl. VAT, P&P, complete with carrying case, leads and instructions. Goods normally by return of post.



The best instrument for the workshop, school, toolbox, TV shop and anywhere accurate measurement is needed quickly and simply.

Accuracy: d.c. ranges and Ω 2% a.c. 3% (off.s.d.)
39 ranges: d.c. V 150mV, 1V, 3V, 10V, 30V, 100V, 300V, 1000V;
d.c. I 20 μ A, 100 μ A, 300 μ A, 1.0mA, 3mA, 10mA, 30mA, 100mA, 1A, 3A.
a.c. V 10V, 30V, 100V, 300V, 1000V;
a.c. I 3mA, 10mA, 30mA, 100mA, 1A, 3A.
Ohms 5k Ω , 50k Ω , 500k Ω , 5M Ω , 50M Ω .
dB from -10 to +61 in 5 ranges.

Dimensions: 105 x 130 x 40mm.

For details of these and the many other instruments in the Alcon range, including multimeters, components measuring, automotive and electronic instruments, please write or telephone:

ALCON Instruments Ltd.

19 MULBERRY WALK LONDON SW3 6DZ TEL: 01-352 1897 TELEX: 918867

CRICKLEWOOD ELECTRONICS LTD.

40 Cricklewood Broadway, London NW2 3ET. Tel. 01-452 0161. Tlx. 914977.

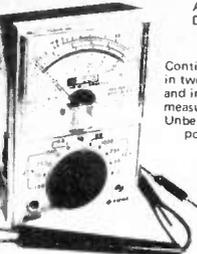
Here's a selection from our vast stocks. Full price list free on request. Orders by phone quoting credit card no. or by mail order. Callers welcome. All products first grade franchised source. All in-stock items despatched same day. Official orders welcome from Govt. Dept's, schools, etc. Please add 60p p&p + 15% VAT. Overseas orders no VAT but allow £2.00 min. p&p. Quantity discounts negotiable.

TRY US NOW - WE'VE GOT WHAT YOU NEED.

RESISTORS	2 2 100 11p	Single sided	2N2905 28p	40411 28s	BC547A 14p
CARBON FILM	2 2 350 30p	100 x 120 1.55	2N2906A 29p	40412 90p	BC547B 14p
5% H.I. STAR	3 3 25 10p	100 x 220 1.00	2N2906 25p	40673 83p	BC548 12p
LOW NOISE	4 7 16 8p	203 x 114 1.95	2N2907 26p	40672 89p	BC548A 13p
100 to 10MΩ	4 7 25 9p	233 x 220 3.99	2N2907A 26p	40872 89p	BC548C 15p
W4 E24 2p	4 7 40 11p	100 - 160 1.65	2N2920 3.47	AC125 35p	BC549 13p
W4 E24 2p	4 7 40 11p	100 - 220 2.15	2N2923 20p	AC126 35p	BC549B 14p
1W E12 6p	4 7 40 11p	233 x 220 4.55	2N2924 25p	AC127 35p	BC549C 13p
2W E12 12p	4 7 40 11p	Developer for	2N2925 15p	AC128 25p	BC550 30p
METAL FILM	10 40 12p	add do not use	2N3053 27p	AC141K 28p	BC551 15p
ULTRA STABLE	10 100 16p	Gold. Hydr. 14p	2N3055 60p	AC142A 28p	BC552 15p
4 EXTRA		add 800mΩ 2.50	2N3058 12p	AC151 50p	BC552B 16p
LOW NOISE	10 100 16p		2N3250 12p	AC152 45p	BC554 15p
100 to 1MΩ	22 40 14p	WIRE & CABLE	2N3250 12p	AC153 55p	BC558B 15p
2% E24 5p	22 63 16p	Prices per Metre	2N3439 80p	AC176 27p	BC558C 17p
1% E24 6p	22 100 21p	Solid Conctring	2N3440 80p	AC176K 37p	BC559 15p
	22 100 21p	Sp. Sp. Sp.	2N3441 1.25	AC187 25p	BC559B 16p
	47 40 17p	Mains/Sp. Speaker	2N3442 1.26	AC188 25p	BC559C 16p
	47 40 17p	Developer for	2N3443 1.26	AC188 25p	BC560 33p
	47 63 26p	1/2W 1amp 14p	2N3444 6.09	AC188K 40p	BC560C 34p
	47 100 28p	1/2W 2amp 14p	2N3445 4.09	AC188K 40p	BC560 34p
	100 25 16p	3 Core 2.5amp 31p	2N3446 5.72	AC188 25p	BC560 34p
	100 40 22p	3 Core 6amp 31p	2N3447 6.56	AC188 25p	BC560 34p
	100 63 25p	3 Core 13amp 56p	2N3448 6.56	AC188 25p	BC560 34p
	220 10 30p	Screened Cable	2N3449 6.56	AC188 25p	BC560 34p
	220 10 30p	Single 14p	2N3450 6.56	AC188 25p	BC560 34p
	220 10 30p	Steeple 27p	2N3451 1.06	AC188 25p	BC560 34p
	220 10 30p	Mini Single 12p	2N3452 1.06	AC188 25p	BC560 34p
	220 10 30p	Mini Stereo 15p	2N3453 1.06	AC188 25p	BC560 34p
	220 10 30p	4 Core 4 Screens 44p	2N3454 1.06	AC188 25p	BC560 34p
	220 10 30p	4 Core 1 Screen 44p	2N3455 1.06	AC188 25p	BC560 34p
	220 10 30p	8 Core 61p	2N3456 1.06	AC188 25p	BC560 34p
	220 10 30p	12 Core 81p	2N3457 1.06	AC188 25p	BC560 34p
	220 10 30p	18 Core 101p	2N3458 1.06	AC188 25p	BC560 34p
	220 10 30p	24 Core 121p	2N3459 1.06	AC188 25p	BC560 34p
	220 10 30p	30 Core 141p	2N3460 1.06	AC188 25p	BC560 34p
	220 10 30p	36 Core 161p	2N3461 1.06	AC188 25p	BC560 34p
	220 10 30p	42 Core 181p	2N3462 1.06	AC188 25p	BC560 34p
	220 10 30p	48 Core 201p	2N3463 1.06	AC188 25p	BC560 34p
	220 10 30p	54 Core 221p	2N3464 1.06	AC188 25p	BC560 34p
	220 10 30p	60 Core 241p	2N3465 1.06	AC188 25p	BC560 34p
	220 10 30p	66 Core 261p	2N3466 1.06	AC188 25p	BC560 34p
	220 10 30p	72 Core 281p	2N3467 1.06	AC188 25p	BC560 34p
	220 10 30p	78 Core 301p	2N3468 1.06	AC188 25p	BC560 34p
	220 10 30p	84 Core 321p	2N3469 1.06	AC188 25p	BC560 34p
	220 10 30p	90 Core 341p	2N3470 1.06	AC188 25p	BC560 34p
	220 10 30p	96 Core 361p	2N3471 1.06	AC188 25p	BC560 34p
	220 10 30p	102 Core 381p	2N3472 1.06	AC188 25p	BC560 34p
	220 10 30p	108 Core 401p	2N3473 1.06	AC188 25p	BC560 34p
	220 10 30p	114 Core 421p	2N3474 1.06	AC188 25p	BC560 34p
	220 10 30p	120 Core 441p	2N3475 1.06	AC188 25p	BC560 34p
	220 10 30p	126 Core 461p	2N3476 1.06	AC188 25p	BC560 34p
	220 10 30p	132 Core 481p	2N3477 1.06	AC188 25p	BC560 34p
	220 10 30p	138 Core 501p	2N3478 1.06	AC188 25p	BC560 34p
	220 10 30p	144 Core 521p	2N3479 1.06	AC188 25p	BC560 34p
	220 10 30p	150 Core 541p	2N3480 1.06	AC188 25p	BC560 34p
	220 10 30p	156 Core 561p	2N3481 1.06	AC188 25p	BC560 34p
	220 10 30p	162 Core 581p	2N3482 1.06	AC188 25p	BC560 34p
	220 10 30p	168 Core 601p	2N3483 1.06	AC188 25p	BC560 34p
	220 10 30p	174 Core 621p	2N3484 1.06	AC188 25p	BC560 34p
	220 10 30p	180 Core 641p	2N3485 1.06	AC188 25p	BC560 34p
	220 10 30p	186 Core 661p	2N3486 1.06	AC188 25p	BC560 34p
	220 10 30p	192 Core 681p	2N3487 1.06	AC188 25p	BC560 34p
	220 10 30p	198 Core 701p	2N3488 1.06	AC188 25p	BC560 34p
	220 10 30p	204 Core 721p	2N3489 1.06	AC188 25p	BC560 34p
	220 10 30p	210 Core 741p	2N3490 1.06	AC188 25p	BC560 34p
	220 10 30p	216 Core 761p	2N3491 1.06	AC188 25p	BC560 34p
	220 10 30p	222 Core 781p	2N3492 1.06	AC188 25p	BC560 34p
	220 10 30p	228 Core 801p	2N3493 1.06	AC188 25p	BC560 34p
	220 10 30p	234 Core 821p	2N3494 1.06	AC188 25p	BC560 34p
	220 10 30p	240 Core 841p	2N3495 1.06	AC188 25p	BC560 34p
	220 10 30p	246 Core 861p	2N3496 1.06	AC188 25p	BC560 34p
	220 10 30p	252 Core 881p	2N3497 1.06	AC188 25p	BC560 34p
	220 10 30p	258 Core 901p	2N3498 1.06	AC188 25p	BC560 34p
	220 10 30p	264 Core 921p	2N3499 1.06	AC188 25p	BC560 34p
	220 10 30p	270 Core 941p	2N3500 1.06	AC188 25p	BC560 34p
	220 10 30p	276 Core 961p	2N3501 1.06	AC188 25p	BC560 34p
	220 10 30p	282 Core 981p	2N3502 1.06	AC188 25p	BC560 34p
	220 10 30p	288 Core 1001p	2N3503 1.06	AC188 25p	BC560 34p
	220 10 30p	294 Core 1021p	2N3504 1.06	AC188 25p	BC560 34p
	220 10 30p	300 Core 1041p	2N3505 1.06	AC188 25p	BC560 34p
	220 10 30p	306 Core 1061p	2N3506 1.06	AC188 25p	BC560 34p
	220 10 30p	312 Core 1081p	2N3507 1.06	AC188 25p	BC560 34p
	220 10 30p	318 Core 1101p	2N3508 1.06	AC188 25p	BC560 34p
	220 10 30p	324 Core 1121p	2N3509 1.06	AC188 25p	BC560 34p
	220 10 30p	330 Core 1141p	2N3510 1.06	AC188 25p	BC560 34p
	220 10 30p	336 Core 1161p	2N3511 1.06	AC188 25p	BC560 34p
	220 10 30p	342 Core 1181p	2N3512 1.06	AC188 25p	BC560 34p
	220 10 30p	348 Core 1201p	2N3513 1.06	AC188 25p	BC560 34p
	220 10 30p	354 Core 1221p	2N3514 1.06	AC188 25p	BC560 34p
	220 10 30p	360 Core 1241p	2N3515 1.06	AC188 25p	BC560 34p
	220 10 30p	366 Core 1261p	2N3516 1.06	AC188 25p	BC560 34p
	220 10 30p	372 Core 1281p	2N3517 1.06	AC188 25p	BC560 34p
	220 10 30p	378 Core 1301p	2N3518 1.06	AC188 25p	BC560 34p
	220 10 30p	384 Core 1321p	2N3519 1.06	AC188 25p	BC560 34p
	220 10 30p	390 Core 1341p	2N3520 1.06	AC188 25p	BC560 34p
	220 10 30p	396 Core 1361p	2N3521 1.06	AC188 25p	BC560 34p
	220 10 30p	402 Core 1381p	2N3522 1.06	AC188 25p	BC560 34p
	220 10 30p	408 Core 1401p	2N3523 1.06	AC188 25p	BC560 34p
	220 10 30p	414 Core 1421p	2N3524 1.06	AC188 25p	BC560 34p
	220 10 30p	420 Core 1441p	2N3525 1.06	AC188 25p	BC560 34p
	220 10 30p	426 Core 1461p	2N3526 1.06	AC188 25p	BC560 34p
	220 10 30p	432 Core 1481p	2N3527 1.06	AC188 25p	BC560 34p
	220 10 30p	438 Core 1501p	2N3528 1.06	AC188 25p	BC560 34p
	220 10 30p	444 Core 1521p	2N3529 1.06	AC188 25p	BC560 34p
	220 10 30p	450 Core 1541p	2N3530 1.06	AC188 25p	BC560 34p
	220 10 30p	456 Core 1561p	2N3531 1.06	AC188 25p	BC560 34p
	220 10 30p	462 Core 1581p	2N3532 1.06	AC188 25p	BC560 34p
	220 10 30p	468 Core 1601p	2N3533 1.06	AC188 25p	BC560 34p
	220 10 30p	474 Core 1621p	2N3534 1.06	AC188 25p	BC560 34p
	220 10 30p	480 Core 1641p	2N3535 1.06	AC188 25p	BC560 34p
	220 10 30p	486 Core 1661p	2N3536 1.06	AC188 25p	BC560 34p
	220 10 30p	492 Core 1681p	2N3537 1.06	AC188 25p	BC560 34p
	220 10 30p	498 Core 1701p	2N3538 1.06	AC188 25p	BC560 34p
	220 10 30p	504 Core 1721p	2N3539 1.06	AC188 25p	BC560 34p
	220 10 30p	510 Core 1741p	2N3540 1.06	AC188 25p	BC560 34p
	220 10 30p	516 Core 1761p	2N3541 1.06	AC188 25p	BC560 34p
	220 10 30p	522 Core 1781p	2N3542 1.06	AC188 25p	BC560 34p
	220 10 30p	528 Core 1801p	2N3543 1.06	AC188 25p	BC560 34p
	220 10 30p	534 Core 1821p	2N3544 1.06	AC188 25p	BC560 34p
	220 10 30p	540 Core 1841p	2N3545 1.06	AC188 25p	BC560 34p
	220 10 30p	546 Core 1861p	2N3546 1.06	AC188 25p	BC560 34p
	220 10 30p	552 Core 1881p	2N3547 1.06	AC188 25p	BC560 34p
	220 10 30p	558 Core 1901p	2N3548 1.06	AC188 25p	BC560 34p
	220 10 30p	564 Core 1921p	2N3549 1.06	AC188 25p	BC560 34p
	220 10 30p	570 Core 1941p	2N3550 1.06	AC188 25p	BC560 34p
	220 10 30p	576 Core 1961p	2N3551 1.06	AC188 25p	BC560 34p
	220 10 30p	582 Core 1981p	2N3552 1.06	AC188 25p	BC560 34p
	220 10 30p	588 Core 2001p	2N3553 1.06	AC188 25p	BC560 34p
	220 10 30p	594 Core 2021p	2N3554 1.06	AC188 25p	BC560 34p
	220 10 30p	600 Core 2041p	2N3555 1.06	AC188 25p	BC560 34p
	220 10 30p	606 Core 2061p	2N3556 1.06	AC188 25p	BC560 34p
	220 10 30p	612 Core 2081p	2N3557 1.06	AC188 25p	BC560 34p
	220 10 30p	618 Core 2101p	2N3558 1.06	AC188 25p	BC560 34p
	220 10 30p	624 Core 2121p	2N3559 1.06	AC188 25p	BC560 34p
	220 10 30p	630 Core 2141p	2N35		

MINI-MULTI TESTER Deluxe pocket size precision moving coil instrument. Jewelled bearings - 2000 o.p.v. mirrored scale. 11 instant range measures:

DC volts 10, 50, 250, 1000.
AC volts 10, 50, 250, 1000.
DC amps 0 - 100 mA.

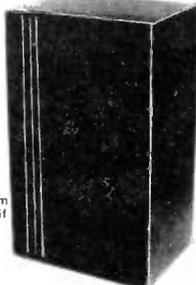


Continuity and resistance 0 - 1 meg ohms in two ranges. Complete with test prods and instruction book showing how to measure capacity and inductance as well. Unbelievable value at only **£6.75 + 60p** post and insurance.

FREE Amps range kit to 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 **£2.50**.

SUPER HI-FI SPEAKER CABINETS

Made from an expensive Hi-Fi outfit - will suit any décor. Resonance free. Cut-outs for 6 1/2" woofer and 2 1/2" tweeter. The front material is Dacron. The completed unit is most pleasing. Supplied in pairs, price **£6.90** per pair (this is probably less than the original cost of one cabinet) carriage **£3.00** the pair.



GOODMANS SPEAKERS

6 1/2" 8 ohm 25 watt **£4.50**, 2 1/2" 8 ohm tweeter. **£2.50**. No extra for postage if ordered with cabinets. Xover **£1.50**.
DITTO but for 8" speaker and 8" tweeter. **£7.50 + £3.50**.



VENNER TIME SWITCH

Mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only **£2.95**. These are without case but we can supply a plastic base **£1.75** or metal case **£2.95**. Also available is adaptor kit to convert this into a normal 24 hr. time switch but with the added advantage of up to 12 on/off per 24 hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is **£2.30**.

THERMOSTAT ASSORTMENT

10 different thermostats. 7 bi-metal types and 3 liquid types. There are the current states which will open the switch to protect devices against overload, short circuits, etc., or when fitted say in front of the element of a blow heater, the heat would trip the stat if the blower fuses, appliance stabs, one for high temperatures, others adjustable over a range of temperatures which could include 0 - 100°C. There is also a thermostatic pod which can be immersed, an oven stat, a calibrated boiler stat, finally an ice stat which, fitted to our waterproof heater element, up in the loft would protect your pipes from freezing. Separately, these thermostats could cost around **£15.00** however, you can have the parcel for **£2.50**.

50 THINGS YOU CAN MAKE

Things you can make include Multi range meter, Low ohms tester, A.C. amps meter, Alarm clock, Soldering iron minder, Two way telephone, Memory jogger, Live line tester, Continuity checker, etc. etc., and you will still have hundreds of parts for future projects. Our 10Kg parcel contains not less than 1,000 items - panel meters, timers, thermal trips, relays, switches, motors, drills, taps, and dies, tools, thermostats, coils, condensers, resistors, neons, earphone/microphones, nicad charger, power unit, multi-turn pots and data on the 50 projects.

YOURS FOR ONLY £11.50 plus £3.00 post.

EXTRACTOR FANS

Mains operated - ex-computer.
Woods extractor 4" x 4" Muffin 115v.
5" - **£5.75**, Post **£1.25** **£4.50**, Post **75p**.
6" - **£6.95**, Post **£1.25** 4" x 4" Muffin 230v.
5" Plannair extractor **£5.75**, Post **75p**.
£6.50, Post **£1.25**.



ROTARY WATER SWITCHES

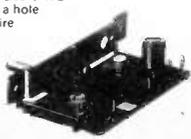
5 amp silver plated contacts. 1/2" shaft, 1" dia. wafer.
Single wafer types, 29p each, as follows:
1 pole 12 way 2 pole 6 way 3 pole 4 way
4 pole 3 way 6 pole 2 way 4 pole 3 way
Two wafer type, 59p each, as follows:
2 pole 12 way 4 pole 5 way 4 pole 6 way
6 pole 2 way 8 pole 3 way 12 pole 2 way
3 wafer types 99p each,
9 pole 4 way 6 pole 5 way 6 pole 6 way
12p 3 way 18p 2 way

EXTRA POWERFUL 12v MOTOR

Made to work battery lawnmower, this probably develops up to 1/2 h.p., so it could be used to power a go-kart or to drive a compressor, etc. etc. **£6.90 + £1.50** post.
(This is easily reversible with our reversing switch - Price **£1.15**).

MINI MONO AMP

on p.c.b., size 4" x 2" approx. Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amplifier. Brand new, perfect condition, offered at the very low price of **£1.15** each, or 10 for **£10.00**.



POPULAR PROVEN PROJECTS

MULTI-CHANNEL or ROBOT CONTROLLER

This is two kits. The 8 channel transmitter kit and the 8 channel receiver kit. Each kit comes with diagrams and notes, but no circuit boards, the component layout being left to you. The data shows how to drive, reverse and steer two or more motors. With spare channels to perform other functions. Price **£9.50** for both kits.

3 CHANNEL SOUND TO LIGHT KIT

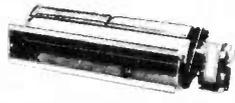


Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are by 1/4" sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Special price is **£14.95** in kit form or **£25.00** assembled and tested. Case & metal Chassis No. Fully punched and prepared.

WHY BE COLD - Build a tangential blower heater.

TANGENTIAL BLOW HEATER

2.5 Kw quiet, efficient instant heating from 230/240 volt mains. Kit consists of blower as illustrated, 2.5 Kw element, control switch and data all for **£4.95**, post **£1.50**.



CAR STARTER AND CHARGER KIT

In an emergency you can start car off mains or bring your battery up to full charge in a couple of hours. The kit comprises: 250 watt mains transformer, 40 amp bridge rectifier, start/charge switch and full instructions. You can assemble this in the evening, box it up or leave it on the shelf in the garage, whichever suits you best. Price **£12.50 + £3.00** post.

TRANSMITTER SURVEILLANCE

Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox - all electronic parts and circuit. **£2.30**. (not licencable in the U.K.).

RADIO MIKE

Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. **£8.90** complete kit. (not licencable in the U.K.).

FM RECEIVER

Made up and working, complete with scale and pointer needs only headphones, ideal for use with our surveillance transmitter or radio mike. **£5.85**, or kit of parts **£3.95**.

3 - 30v VARIABLE VOLTAGE POWER UNIT

With 1 amp DC output, for use on the bench, students, inventors, service engineers, etc. Automatic short circuit and overload protection. In case with a volt meter on the front panel. Complete kit **£13.80**.

INTERRUPTED BEAM

This kit enables you to make a switch that will trigger when a steady beam of infra red or ordinary light is broken. Main components relay, photo transistor, resistors and capacitors, etc. Circuit diagram but no case. Price **£2.30**.

IONISER KIT

Refresh your home, office, shop, work room, etc. with a negative ION generator. Makes you feel better and work harder - complete mains operated kit, case included. **£11.95** plus **£2.00** post.

RADIO STETHOSCOPE

Easy to fault find - start at the aerial and work towards the speaker - when signal stops you have found the fault. Complete kit **£4.95**.

INVISIBLE AND SILENT SENTINEL

Ultra-sonic beam when broken could warn you of visitor - two kits - transmitter & receiver. To operate light or bell. **£9.50**.

BURGLAR ALARM

Complete kit includes 6" extral arm bell, mains power unit, control box with keyswitch, 10 window/door switches, 100 yards of wire. With instructions. **£29.50**.

12v MOTOR BY SMITHS

Made for use in cars, these are series wound and they become more powerful as load increases. Size 3 1/2" long by 3" dia. These have a good length of 1/2" spindle - price **£3.45**.
Ditto, but double ended **£4.25**.
Ditto, but permanent magnet, **£3.75**.



WATERPROOF HEATING WIRE

60 ohms per yard, this is a heating element wound on a fibre glass coil and then covered with p.v.c. Dozens of uses - around water pipes, under grow boxes in gloves and socks. 23p a metre.

J. BULL (Electrical) Ltd.

(Dept. EE), 34 - 36 AMERICA LANE, HAYWARDS HEATH, SUSSEX RH16 3QU. Established 30 YEARS

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £10 add 60p service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted day or night. Haywards Heath (0444) 454563. Bulk orders: write for quote. Delivery by return. Shop open 9.00 - 5.30, mon to Fri, not Saturday.

SCHOOLS-LABS-STORES- WORKSHOPS-FACTORIES-

Your chance to re-stock at less than cost prices!!!

WIRES & CABLES

3 core and screened power flex cable:
3 cores each 50.025 (equiv. 2.5mm) per metre **.40**
3 cores each 30.025 (equiv. 1.5mm) per metre **.20**
3 cores each 24.02 (equiv. 1mm) per metre **.30**
Armoured cable 1.5mm, 3 core **.40**
Extension lead, 3 cores .5mm pvc covered/100 M **£9.50**
Extension lead, twin .5mm rubber covered/1000 metres **£60.00**
Iron flex. Woven cotton covered, rubber insulated 2 core 100 metre **£12.50**
FIGURE 8 FLEX, heavy duty .75mm, 600 metre **£19.00**
Figure 8 Flex per 100 metres **£3.00**

PROJECT CASES - CABINETS - BOXES

Black plastic boxes, 2 7/8 x 4 1/8 x 3" deep **.50**
Ditto 3 5/8 x 2 3/4 x 1 3/4" deep **.40**
Ditto 3 7/8 x 2 3/4 x 1" deep **.30**
Plated metal box 7 1/2 x 4 1/2 x 1 1/2" deep **£1.00**
Dark grey half boxes. May be joined to make three different depth boxes: 4 5/8 x 2 5/8 x 3/4" deep **.20**
4 5/8 x 2 5/8 x 1" deep **.25**
White plastic box ideal for touch switch, transmitter, etc. through top is square hole, 3 1/2 x 3 1/2" **.50**
Loudspeaker cabinet for 6 1/2" speaker **.95**
PORTABLE RADIO CASE - 5" speaker, size approx 6 1/2 x 3 1/2 x 2" deep **£1.00**

RELAYS & RELAY BASES

Standard open relays 3 x 8 amp c/o contacts:
6 volt dc coil **.50** 110 volt ac coil **.50**
24 volt dc coil **.50** 230 volt ac coil **.90**
1 x 8 amp changeover, 230 volt AC coil **.60**
Enclosed plug in round base relays - 3 changeover contacts:
50 volt coil (ex-fruit machine) **.40**
110 volt coil 2 changeover **.50**
12 volt coil 3 changeover **.80**
8 pin bases. Bases for 2 changeover relay **.20**
11 pin bases. Bases for 3 changeover relay **.25**
Miniature relays: 12 volt 2 changeover **.75**
28 volt **.50**
48 volt **.50**

POWER SUPPLY UNITS

In car, 12 volt for using 6 volt equipment **£1.25**
Mains to 24 volt Mullard, Stereo **£1.90**
Mains to 12 volt, 800mA **£1.50**
Mains to 50 volt 25cps for telephone ringing **£2.00**

TRANSISTORS

Photo transistors, Mullard seconds 75% working, 100 for **£5.00**
Full wave rectifier .440v 2 amp **.50**
g.p. 50V Silicon diodes **.02**
Silicon transistor, 107, 109 etc. **.03**
Germanium transistors **.05**
Surface barrier transistors **.25**

PANEL METRES & INSTRUMENTS

Volt meter 0 - 200 volts, 2 1/2" round **£1.50**
Milli amp meter, 500 ma 2 1/2" round **£1.00**
- amp meter, not wire scaled, 0 - 9 amps **£1.20**
Ammeter, 2 1/2" round, centre zero, 500ma **£1.00**
Charger panel meters, 1 1/2" dia, scaled 3 amp **.35**
Panel meter, 1 5/8" square, scaled Vu **.60**
Panel meter, Amstrad, 40mm sq, centre zero, scaled 1, 2, 3 **.50**
Edgeways panel, 3" x 0 - 25 ma, ex-GPO **£1.00**

AMPLIFIERS

1/2 watt, Japanese made with v.c. **£1.50**
1 watt, Mullard Module 1172 **£1.00**
4 watt, Mini-amp with v.c. **£1.00**
Pre-amp, Mullard ref. 9001 module **.80**

BULBS & LAMPS

Torch bulbs, 3.5 MES, Box of 25 **.35**
Pilot light bulbs 6.2v .3A 11mm box of 50 **£1.00**
6.2v .3A 14mm box of 10 **.30**
12v .5A 16mm box of 10 **.50**
Car bulbs: 18 watt SBC **.12**
SBC Lamp holders **.15**

MAINS TRANSFORMERS

6 volt 1 amp **.50** 35 volt 2 amp **£2.00**
6.3 volt 2 amp **£1.00** 38 volt 2 1/2 amp **£2.50**
12 volt 1/2 amp **.75** 26 volt 10 amp **£4.00**
12 volt 4 amp **£2.00** 50 volt 2 amp **£2.00**
12 volt 1 amp **£1.00** 12 - 0 - 12, 2 amp **£2.50**
8.5 - 0 - 8.5 amp **£1.50** 12 - 0 - 12, 1 amp **£2.00**
18 volt 1 amp **£1.50** 100W auto 115v o/p **£2.00**
25 volt 1 1/2 amp **£1.50**

MOTORS - MAINS & BATTERY

3 - 6 volt battery motor, very small **.15**
3 - 12 volt battery motor, very low current **.20**
Mains motor with gear box 5 rev minute **£2.25**
80 rev per minute **£3.00**
110 rev minute **£2.00**
200 rev minute **£1.50**
Mains motor, double ended fan motor **£1.20**
Ditto single ended fan motor **£1.00**
Fan blade for above **.50**
Mains motor, double ended, very powerful 1 1/2" stack **£1.50**
Mains instrument motors 1 rev 24 hours **£1.50**
1 rev 1 hour **£1.50**
with gear box: 16 rev minute **£1.50**
4 rev minute **£1.50**
2 rev minute **£1.50**
1 rev minute **£1.50**
Motor clockwork, set up to 1 hour **.38**
Motor, clockwork set up to 1 hour with ringer **.75**
Mains motor 1/2 h.p., 1425 revs, ex-computer **£4.25**
Vent opening motor with end stop switches **£12.50**
12 volt motors, Smiths, single ended 1/2" spindle **£1.50**
12 volt motors, Smiths, double ended 1/2" spindle **£2.00**
12 volt motors, P magnet type, single ended **£1.75**
1 1/2 h.p. motor 3450 rpm 100 volt, 50Hz. New **£5.00**

SPECIAL TERMS. For items in this column. Order no less than 10 of any item. Then add VAT at 15%, and 20% for carriage in the case of transformers and electric motors. All other items in this column are free post & packing.

Rapid Electronics

MAIL ORDERS:
Unit 3, Hill Farm Industrial Estate,
Boxted, Colchester, Essex CO4 5RD.
TELEPHONE ORDERS:
Colchester (0206) 36412.

ACCESS AND
BARCLAYCARD
WELCOME

CAPACITORS

Polyester, radial leads. 250v. C280 type. 0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1 - 1p; 0.15, 0.22 - 9p; 0.33, 0.47 - 13p; 0.68 - 20p; 1u - 23p.

Electrolytic, radial/or axial leads. 10/16/3V, 1/63V, 2/23/4V, 4/73/3V, 0.47/5V, 2/22/25V, 47/25V - 8p; 100/25V - 9p; 220/25V - 14p; 470/25V - 22p; 1000/25V - 30p; 2200/25V - 50p.

Tag end power supply electrolytics: 2200/40V - 110p; 4700/40V - 160p; 2200/63V - 140p; 4700/63V - 230p.

Polyester, miniature Siemens PCB: 1n, 2n, 3n, 4n, 5n, 6n, 10n, 15n, 22n, 33n, 47n, 68n, 80n, 90n, 100n, 150n, 11p, 220n, 13p, 330n, 20p, 470n, 26p, 680n, 29p, 1u, 33u, 2u, 50u.

Fantalum bead: 0.1, 0.22, 0.33, 0.47, 1.0 @ 35V - 12p, 2.2, 4.7, 10 @ 25V - 20p; 15/16V - 30p; 22/16V - 27p; 33/16V - 45p; 47/16V - 27p; 47/16V - 70p; 68/16V - 40p; 100/10V - 90p.

Cer. disc. 22p, 0.01u, 50v, 3p each. Mullard miniature ceramic plate: 1.80F to 100pF 6p each.

Polyethylene, 5% tol: 100-1000p, 60p; 150-4700, 8p; 500-0.1u, 1p each. Trimmers, Mullard 80B series: 2-10 pF, 22-2.22pF, 30p; 5.5-65pF, 35p.

RESISTORS

1/4W 5% Carbon film E12 series 4.7 ohm - 1M, 2p each.
1/4W 5% Carbon film E24 series 4.7 ohm to 4M7, 2p each.
1/4W 1% metal film E24 series 10 ohm - 1M, 6p each.

SOCKETS

Low profile wire wrap: 8 pin 6p, 14 pin 8p, 16 pin 9p, 20 pin 12p, 22 pin 13p, 22 pin 16p, 22 pin 16p, 24 pin 18p, 24 pin 20p, 40 pin 20p, 40 pin 20p. Solderless pins 60P/100.

POTENTIOMETERS

Rotary, Carbon track Log or Lin 1K - 2M2, Single 32p, Stereo 85p. Single wiper 80p. Slip. 60mm travel single Log or Lin 5K - 500K 63p each. Preset submin. hor. 100 ohms - 1M 7p each. Carbon precision multiturn, 0.75W 3k - 100 ohms to 100K - 88p each.

REGULATORS

78L05 30 78L05 65
78L12 30 78L12 65
78L15 30 78L15 65
7805 35 7805 60
7812 35 7812 40
7815 35 7815 40
LM309K 130 LM723 35
LM317K 270 LM338K 475
LM317 120 78H05 5A
LM323K 350 5V 550

SOLDERING IRONS

Antex CS 17W Soldering iron 460 2.3 and 4.7mm bits to suit. 65
CS 17W iron: 450, element: 210 65
Antex XS 25W iron: 480 3.3 and 4.7mm bits to suit. 65
Solder pump desoldering tool, 480
Spair nozzle for above. 70
10 PCBs 22v solder. 100

PCB MATERIALS

Affix transfer sheets - please state type (e.g. DIL pads etc.). 45
Dialo etch resist, pen. 100
Fibre glass board 3.75"x8" 80
Ferric chloride 250ml bottle. 100

COMPONENT KITS

An ideal opportunity for the beginner or the experienced constructor to obtain a wide range of components at greatly reduced prices. 1/4W 5% Resistor kit. Contains 10 of each value from 4.7 ohms to 1M (total of 85 resistors). 480
Ceramic Cap. kit. 5 of each value - 22p to 0.01u (135 caps) 370
Polyester Cap. kit. 5 of each value from 0.01 to 1uF (65 caps) 575
Preset kit. Contains 5 of each value from 100 ohms to 1M (total of 265 presets) 425
Nut and Bolt kit (total 300 items): 180p
50 6BA 1/4" bolts 50 6BA washers 50 6BA nuts
25 6BA 1/4" bolts 25 6BA 1/4" bolts 50 6BA washers 50 6BA nuts

TOOLS

Small trimming tool 22
Small pocket screwdriver 16
Large pocket screwdriver 13
6 piece precision screwdriver set in plastic case 170
Low cost side cutters 160
High quality side cutters 650
Low cost pliers 160
High quality pliers 650
Wire strippers 120
Exp. reliant drill 695
Expo Titan drill 1025
Drill stand 1200
Reduced shock drill bits for above 0.8mm, 1mm, 1.4mm 60

OPTO

3mm red 7 5mm red 7
3mm green 10 5mm green 10
3mm yellow 10 5mm yellow 10
Clips to suit - 3p each.
Rectangular TIL32 40
Red 12 TIL78 40
Green 17 TIL111 40
Yellow 17 ORP12 85
TIL38 40 TIL60 90
Z5N577 45 Dual colour 60
Seven segment displays: Com anode
DL704 0.3" 95 DL707 0.3" 95
FND500 FND507 95
0.5" 100 0.5" 100
TIL319 0.3" 115 TIL3120 0.3" 115
TIL3220 0.5" 115 TIL321 0.5" 115
LCD: 3 1/2 digit 580p, 4 digit 620p.

TRIACS

400V 8A 65
400V 16A 95
400V 4A 50 BR100 25

SWITCHES

Submin toggle: SPST 50p, SPDT 60p, DPDT 65p. Miniature toggle: SPST 50p, SPDT centre off 90p, DPDT 90p, DPDT centre off 100p. Standard toggle: SPST 30p, DPDT 40p. Miniature DPDT slide 12p. Push to make 12p. Push to break 22p. Rotary type adjustable stop. 1P12W, 2P6W, 3P4W all 55p each. DIL switches: 4SPST 80p 6 SPST 80p. BSPST 100p.

VERO

VEROBLOC 350
Size 1 matrix:
2.5 x 1 22
2.5 x 3.75 75
2.5 x 5 75
3.75 x 5 95
VQ board 160
Veropacs per 100:
Double sided 60
Spot face cutter 105
Pin insertion tool 162
Wiring pen and spool 310
Spares spool 75p Combs 6

DIODES

BY127 12 1N4001 3
0A47 10 1N4002 5
0A90 8 1N4006 7
0A91 7 1N4007 7
0A200 8 1N5401 12
0A202 8 1N5404 16
1N514 4 1N5406 17
1N4148 2 400mW zen 6

CABLES

20 metre pack single core connecting cable ten different colours. 65p
Speaker screened 10p/m
Standard screened 16p/m
Twin screened 24p/m
2.5A 3 core mains 23p/m
10 way rainbow ribbon 65p/m
20 way rainbow ribbon 120p/m

TRANSFORMERS

Miniature mains: 606V, 909V, 1201V all @ 100mA 100p each. PCB mounting. Miniature: 3VA 0-6, 0-6 @ 0.25A, 0-9, 0-9 @ 0.15A, 0-12, 0-12 @ 0.12A 200p each. High quality. Solid bobbin construction. 6VA 0-6, 0-6 @ 0.5A, 0-9, 0-9 @ 0.3A, 0-12, 0-12 @ 0.25A 270p each. 12VA 0-6, 0-6 @ 0.5A, 0-9, 0-9 @ 0.4A, 0-12, 0-12 @ 0.3A 220p each. 6VA 0-6, 0-6 @ 1A, 0-9, 0-9 @ 0.8A, 0-12, 0-12 @ 0.5A, 0-15, 0-15 @ 0.4A 295p (plus 60p carriage). 25VA 0-6, 0-6 @ 1.5A, 0-9, 0-9 @ 1.2A, 0-12, 0-12 @ 1A, 0-15, 0-15 @ 0.8A 330p each (plus 60p carriage). 50VA 0-12, 0-12 @ 2A, 0-15, 0-15 @ 1.5A, 440p each (plus 75p carriage).

HARDWARE

PP3 battery clips 6
Red or black crocodile clips 6
Black point center knob 15
P4 Ultrasonic transducers 350
6V Electronic buzzer 60
12V Electronic buzzer 65
P2B220 Piezo transducer 70
6mm 64 ohm speaker 70
6mm 8 ohm speaker 70
20mm panel fuseholder 25

CONNECTORS

DIN Plug Skt Jack Plug Skt 2 pin 9p 9p 2.5mm 10p 10p 5 pin 12p 10p 3.5mm 5p 9p 5 pin 13p 11p Standard 16p 20p Phono 10p 12p Stereo 24p 25p UHF (CB) Connectors: PL259 Plug 40p. Reducer 14p. SO239 square chassis skt 38p. SO239 round chassis skt 40p. SO239S round chassis skt 40p. IEC 3 pin 250V/6A. Plug chassis mounting 38p. Socket free hanging 60p. Socket with 2m lead 120p

BOXES

Plastic with lid & screws 3x2x1 70
4x3x2 100
4x4x2 120
7x4x2 160 6x4x3 150

SCRs

C106D 30
400V 8A 70
400V 12A 95

BRIDGE RECTIFIERS

2A 200V 40
3A 400V 45
6A 100V 80
6A 400V 95
1A 50V 20 VM18 DIL 50A
1A 400V 35 200V 1.9A

NEW CATALOGUE • NEW CATALOGUE!!!!!!!
Our latest catalogue has just been released containing over 2000 stock lines all at extremely competitive prices backed by Rapid's return of post service. Stocks include Denco coils, tools, Verocases, data sheets etc. etc. Send 5p for your copy now (sent free of charge with all orders over £10).

MICRO 2114L-2 75
2716 205
2532 340
2712 212
2710 200
6116-3P 150s 365
4164 440

780A CPU 290
280A P10 260
280A CTC 260
280A S1A 900
780A DMA 1150
280A DART 500
81LS95 85

81LS96 85
81LS97 85
1488 55
1489 55
1.8432M 200
2.0M 225
2.0M 140
3.579M 95
12M 170
14M 200

555CMOS 80
555CMOS 150
7662 85
7661 15
748 36
9400C 350
AY-3-1270 720
AY-3-8912 370
AY-3-8912 540
CA304A 60
CA3080 65
CA3089 90
CA3090A 375
CA3130 305
CA3140E 35
CA3161E 100
CA3189 290
CA3240E 110

LM339 45
LM338 50
LM337 170
LM380 65
LM381 120
LM382 120
LM384 130
LM386 65
LM387 120
LM389 100
LM392 100
LM393 100
LM709 25
LM711 60
LM723 140
LM733 75
LM741 28
LM747 60
LM1488 40
LM292 18
LM3900 48
LM3352 125

NE566 140
NE567 100
NE570 370
NE571 100
RC4135 55
CA4558 60
SL480 170
SL490 250
TL76018 150
SN76477 380
SRP829 250
TLA81205 70
TBA800 75
TBA81 95
TBA820 70
TBA950 220
TDA1008 320
TDA1022 490
TDA1024 125
NE555 18
NE556 45
NE565 110
TL064 96
TL071 30
TL072 50
TL074 25
TL081 25
TL082 45
TL084 95
TL085 95
TL094 120
ULN2003 85
ULN2004 90
XR2205 290
ZNA14 100
ZNA23 135
ZNA24 135
ZNA25E 350
ZNA26E 330
ZNA27E 650
ZNA28E 480
ZNA29 285
ZNA30E 200

CMOS 4016 20
4017 30
4018 45
4019 25
4020 42
4021 10
4022 45
4023 16
4024 30
4025 12
4026 35
4027 10
4028 40
4029 45
4030 14
4031 40
4032 125

4034 140
4035 249
4036 280
4037 430
4038 40
4039 42
4040 80
4041 125
4042 38
4043 40
4044 40
4045 40
4046 40
4047 225
4048 13
4049 65
4050 40
4051 42
4052 48
4053 48

4054 78
4055 80
4056 430
4057 48
4058 45
4059 125
4060 18
4061 48
4062 45
4063 110
4064 45
4065 110
4066 45
4067 45
4068 45
4069 290
4070 13
4071 40
4072 13
4073 13
4074 13
4075 13
4076 13
4077 14
4078 14
4079 14
4080 14
4081 12
4082 12
4083 48
4084 45
4085 45
4086 50
4087 45
4088 125
4089 45
4090 45
4091 45
4092 45
4093 45
4094 45
4095 45
4096 45
4097 45
4098 45
4099 45
4100 45
4101 45
4102 45
4103 45
4104 45
4105 45
4106 45
4107 45
4108 45
4109 45
4110 45
4111 45
4112 45
4113 45
4114 45
4115 45
4116 45
4117 45
4118 45
4119 45
4120 45
4121 45
4122 45
4123 45
4124 45
4125 45
4126 45
4127 45
4128 45
4129 45
4130 45
4131 45
4132 45
4133 45
4134 45
4135 45
4136 45
4137 45
4138 45
4139 45
4140 45
4141 45
4142 45
4143 45
4144 45
4145 45
4146 45
4147 45
4148 45
4149 45
4150 45
4151 45
4152 45
4153 45
4154 45
4155 45
4156 45
4157 45
4158 45
4159 45
4160 45
4161 45
4162 45
4163 45
4164 45
4165 45
4166 45
4167 45
4168 45
4169 45
4170 45
4171 45
4172 45
4173 45
4174 45
4175 45
4176 45
4177 45
4178 45
4179 45
4180 45
4181 45
4182 45
4183 45
4184 45
4185 45
4186 45
4187 45
4188 45
4189 45
4190 45
4191 45
4192 45
4193 45
4194 45
4195 45
4196 45
4197 45
4198 45
4199 45
4200 45

LINEAR 555CMOS 80
555CMOS 150
7662 85
7661 15
748 36
9400C 350
AY-3-1270 720
AY-3-8912 370
AY-3-8912 540
CA304A 60
CA3080 65
CA3089 90
CA3090A 375
CA3130 305
CA3140E 35
CA3161E 100
CA3189 290
CA3240E 110

LM339 45
LM338 50
LM337 170
LM380 65
LM381 120
LM382 120
LM384 130
LM386 65
LM387 120
LM389 100
LM392 100
LM393 100
LM709 25
LM711 60
LM723 140
LM733 75
LM741 28
LM747 60
LM1488 40
LM292 18
LM3900 48
LM3352 125

NE566 140
NE567 100
NE570 370
NE571 100
RC4135 55
CA4558 60
SL480 170
SL490 250
TL76018 150
SN76477 380
SRP829 250
TLA81205 70
TBA800 75
TBA81 95
TBA820 70
TBA950 220
TDA1008 320
TDA1022 490
TDA1024 125
NE555 18
NE556 45
NE565 110
TL064 96
TL071 30
TL072 50
TL074 25
TL081 25
TL082 45
TL084 95
TL085 95
TL094 120
ULN2003 85
ULN2004 90
XR2205 290
ZNA14 100
ZNA23 135
ZNA24 135
ZNA25E 350
ZNA26E 330
ZNA27E 650
ZNA28E 480
ZNA29 285
ZNA30E 200

LS TTL LS20 12
LS21 12
LS22 12
LS23 12
LS24 12
LS25 12
LS26 12
LS27 12
LS28 12
LS29 12
LS30 12
LS31 12
LS32 12
LS33 12
LS34 12
LS35 12
LS36 12
LS37 12
LS38 12
LS39 12
LS40 12
LS41 12
LS42 12
LS43 12
LS44 12
LS45 12
LS46 12
LS47 12
LS48 12
LS49 12
LS50 12
LS51 12
LS52 12
LS53 12
LS54 12
LS55 12
LS56 12
LS57 12
LS58 12
LS59 12
LS60 12
LS61 12
LS62 12
LS63 12
LS64 12
LS65 12
LS66 12
LS67 12
LS68 12
LS69 12
LS70 12
LS71 12
LS72 12
LS73 12
LS74 12
LS75 12
LS76 12
LS77 12
LS78 12
LS79 12
LS80 12
LS81 12
LS82 12
LS83 12
LS84 12
LS85 12
LS86 12
LS87 12
LS88 12
LS89 12
LS90 12
LS91 12
LS92 12
LS93 12
LS94 12
LS95 12
LS96 12
LS97 12
LS98 12
LS99 12
LS100 12

LS75 20
LS76 17
LS78 12
LS79 35
LS83 35
LS86 16
LS89 26
LS92 35
LS93 25
LS94 150
LS95 38
LS96 95
LS107 40
LS109 21
LS110 14
LS111 21
LS112 33
LS113 21
LS114 22
LS115 29
LS123 35

LS123 34
LS124 34
LS125 24
LS126 25
LS127 35
LS128 35
LS129 35
LS130 35
LS131 35
LS132 35
LS133 35
LS134 35
LS135 35
LS136 35
LS137 35
LS138 35
LS139 35
LS140 35
LS141 35
LS142 35
LS143 35
LS144 35
LS145 35
LS146 35
LS147 35
LS148 35
LS149 35
LS150 35
LS151 35
LS152 35
LS153 35
LS154 35
LS155 35
LS156 35
LS157 35
LS158 35
LS159 35
LS160 35
LS161 35
LS162 35
LS163 35
LS164 35
LS165 35
LS166 35
LS167 35
LS168 35
LS169 35
LS170 35
LS171 35
LS172 35
LS173 35
LS174 35
LS175 35
LS176 35
LS177 35
LS178 35
LS179 35
LS180 35
LS181 35
LS182 35
LS183 35
LS184 35
LS185 35
LS186 35
LS187 35
LS188 35
LS189 35
LS190 35
LS191 35
LS192 35
LS193 35
LS194 35
LS195 35
LS196 35
LS197 35
LS198 35
LS199 35
LS200 35
LS201 35
LS202 35
LS203 35
LS204 35
LS205 35
LS206 35
LS207 35
LS208 35
LS209 35
LS210 35
LS211 35
LS212 35
LS213 35
LS214 35
LS215 35
LS216 35
LS217 35
LS218 35
LS219 35
LS220 35
LS221 35
LS222 35
LS223 35
LS224 35
LS225 35
LS226 35
LS227 35
LS228 35
LS229 35
LS230 35
LS231 35
LS232 35
LS233 35
LS234 35
LS235 35
LS236 35
LS237 35
LS238 35
LS239 35
LS240 35
LS241 35
LS242 35
LS243 35
LS244 35
LS245 35
LS246 35
LS247 35
LS248 35
LS249 35
LS250 35
LS251 35
LS252 35
LS253 35
LS254 35
LS255 35
LS256 35
LS257 35
LS258 35
LS259 35
LS260 35
LS261 35
LS262 35
LS263 35
LS264 35
LS265 35
LS266 35
LS267 35
LS268 35
LS269 35
LS270 35
LS271 35
LS272 35
LS273 35
LS274 35
LS275 35
LS276 35
LS277 35
LS278 35
LS279 35
LS280 35
LS281 35
LS282 35
LS283 35
LS284 35
LS285 35
LS286 35
LS287 35
LS288 35
LS289 35
LS29

BI-PAK BARGAINS



5T21 SCREWDRIVER SET
6 precision screwdrivers in hinged plastic case. Sizes — 0.8 1.4 2.2 4 2.9 and 3.8mm. **£1.75**

5T31 NUT DRIVER SET
5 precision nut drivers in hinged plastic case. With turning rod. Sizes — 3 3.5 4 4.5 and 5mm. **£1.75**

5T41 TOOL SET
5 precision instruments in hinged plastic case. Crosspoint (Phillips) screwdrivers — H 0 and H 1 Hex key wrenches — 1.5 2 and 2.5mm. **£1.75**

5T51 WRENCH SET
5 precision wrenches in hinged plastic case. Sizes — 4 4.5 5 5.5 and 6mm. **£1.75**

BUY ALL FOUR SETS: 5T21-5T51 and get HEX KEY SET **FREE**
HEX KEY SET ON RING
Sizes 1.5 2 2.5 3 4 5 5.5 and 6mm
Made of hardened steel
HX/1 **£1.25**



"IRRESISTABLE RESISTOR BARGAINS"

Pak No.	Qty*	Description	Price
SX10	400	Mixed 'All Type' Resistors	£1
SX11	400	Pre-formed 1/4-watt Carbon Resistors	£1
SX12	200	1/4 watt Carbon Resistors	£1
SX13	200	1/4 watt Carbon Resistors	£1
SX14	150	1/4 watt Resistors 22 ohm 2m2 Mixed	£1
SX15	100	1 and 2 watt Resistors 22 ohm 2m2 Mixed	£1

Paks SX12-15 contain a range of Carbon Film Resistors of assorted values from 22 ohms to 2.2 meg. Save pounds on these resistor paks and have a full range to cover your projects.
*Quantities approximate, count by weight

GUARANTEED TO SAVE YOU MONEY

SX27A	60	Assorted Polystyrene Bead Capacitors Type 9500 Series PPD	£1.00
SX28A	50	Assorted Silver Mica Caps 5.6pF-150pF	£1.00
SX29A	50	Assorted Silver Mica Caps 180pF-4700pF	£1.00
SX30A	50	High Voltage Disc Ceramics 750V min up to 8KV. Assorted useful values	£1.00
SX31A	50	Wirewound 9 watt (arg) Resistors. Assorted values 1 ohm-12K	£1.00

AUTO SCREWDRIVER/DRILL
Automatic spiral ratchet. Complete with 2 screwdriver blades, 5 & 65mm. 1 screwdriver cross point No. 1 & three drills — 2, 2.8 and 3.65mm — A MUST FOR ALL HOBBY-BUILDERS & CONSTRUCTORS. Order No. ASD/1 **£3.50** each

"CAPABLE CAPACITOR PAKS"

Pak No.	Qty*	Description	Price
SX16	250	Capacitors Mixed Types	£1
SX17	200	Ceramic Capacitors Miniature Mixed	£1
SX18	100	Mixed Ceramics 1p1-56pF	£1
SX19	100	Mixed Ceramics 600pF-0.5mF	£1
SX20	100	Assorted Polyester/Polystyrene Capacitors	£1
SX21	60	Mixed C280 type capacitors metal foil	£1
SX22	100	Electrolytics, all sorts	£1
SX23	50	Quality Electrolytics	£1

*Quantities approximate, count by weight

BARGAINS

SX91	20	x Large 2" RED LED	£1
SX42	20	small 125 Red LED's	£1
SX43	10	Rectangular Green LED's 2	£1
SX46	30	Assorted Zener Diodes 250mw-2 watt mixed voltages. all coded. New	£1
SX47	4	Black instrument knobs—winged with pointer 1/4" Standard screw. Fit size 29 x 20mm	50p
SX49	20	Assorted Slide Knobs. Black/Chrome, etc	£1
SX80	12	Neons and Filament Lamps. Low voltage and mains — various types and colours — some panel mounting	£1

BRAND NEW LCD DISPLAY MULTITESTER.

RE 188m
LCD 10 MEGOHM INPUT IMPEDANCE
"3 1/2" digit "16 ranges plus iNFE test facility for PNP and NPN transistors "Auto zero auto polarity "Single-handed pushbutton operation "Over range indication "12.5mm (1/2-inch) large LCD readout "Diode check "Fused circuit protection "Test leads battery and instructions included
Max indication 1999 or — 1999
Polarity indication Negative only
Positive readings appear without + sign
Input impedance 10 Megohms
Zero adjust Automatic
Sampling time 250 milliseconds
Temperature range — 5°C to 50°C
Power Supply 1 x PP3 or equivalent 9V battery
Consumption 20mW
Size 155 x 88 x 31mm
RANGES
DC Voltage 0-200mV
0-2-20-200-1000V Acc 0.8%
AC Voltage 0-200-1000V
Acc 1.2% DC Current 0-200uA
0-2-20-200mA 0-10A Acc 1.2%
Resistance 0-2-20-200K ohms
0-2 Megohms Acc 1%
BI-PAK VERY LOWEST POSS PRICE
£35.00 each



LEATHER CASE FOR RE 188m £2.50 EACH

SIREN ALARM MODULE

American Police type screamer powered from any 12 volt supply into 4 or 8 ohm speaker. Ideal for car burglar alarm, freezer breakdown and other security purposes. 5 watt, 12v max.

£3.85
Order No. BP124.



The Third and Fourth Hand...

... you always need but have never got 'untill now
This helpful unit with Rod mounted horizontally on Heavy Base. Crocodile clips attached to rod ends. Six ball & socket joints give infinite variation and positions through 360° also available attached to Rod a 2 1/2" diam magnifier giving 2.5 x magnification. Helping hand unit available with or without magnifier. Our Price with magnifier as illustrated ORDER NO. T402 **£5.50**
Without magnifier ORDER NO. 1400 **£4.75**



BI-PAK SOLDER-DESOLDER KIT

Kit comprises ORDER NO. SX80
1 High Quality 40 watt General Purpose Lightweight Soldering Iron 240v mains incl 3/16" (4.7mm) bit
1 Quality Desoldering pump: High Suction with automatic ejection. Knurled anti-corrosive casing and teflon nozzle
1 5 metres of De-soldering braid on plastic dispenser
2 yds (1.83m) Resin Cored Solder on Card
1 Heat Shunt tool Tweezer Type
Total Retail Value over **£12.00**
OUR SPECIAL KIT PRICE **£8.95**



BI-PAK PCB ETCHANT AND DRILL KIT

Complete PCB Kit comprises
1 Expo Mini Drill 10 000RPM 12v DC incl 3 collets & 1 x 1mm Twist bit
1 Sheet PCB Transfers 210mm x 150mm
1 Etch Resist Pen
1 1/2lb pack FERRIC CHLORIDE crystals
3 sheets copper clad board
2 sheets Fibreglass copper clad board
Full instructions for making your own PCB boards.
Retail Value over **£15.00**
OUR BI-PAK SPECIAL KIT PRICE **£9.75**
ORDER NO. SX81



PROGRAMMABLE UNIJUNCTION TRANSISTOR

"PUT" case TO106 plastic MEU22 Similar to 2N6027/6028 PNP Silicon
Price: 1-9 10-49 50-99 100+ Normal Retail
Each: 20p 18p 15p 13p Price £0.35 each

SX33A	6 small (min) (SDST/SPDT Toggle Switches 240v 5amp	£1.00
SX35A	6 small (min) Rocker Switches 240v 5amp	£1.00
SX32A	12 Assorted Jack & Phone plugs, sockets and adaptors, 2.5m, 3.5mm and standard sizes	£1.00
SX71	50 "RC108" 'Fallouts' Manufacture: s out of spec on volts or gain You test.	£1.00
SX72	A mixed bundle of Copper clad Board Fibreglass and paper. Single and double sided. A fantastic bargain	£1.00

SINGLE SIDED FIBREGLASS BOARD

Order No.	Pieces	Size	Sq. Ins.	Price
FB1	4	9 x 2 1/2"	100	£1.50
FB2	3	11 x 3"	100	£1.50
FB3	4	13 x 3"	156	£2.00

DOUBLE SIDED FIBREGLASS BOARD

FB4	2	14 x 4"	110	£2.00
-----	---	---------	-----	-------

SILICON POWER TRANSISTORS — T03

NPN like 2N3055 — but not full spec
100 watts 50V min.
10 for £1.50 — Very Good Value
100s of uses — no duds
Order No. SX90

REGULATED VARIABLE Stabilised POWER SUPPLY

Variable from 2-30 volts and 0-2 Amps. Kit includes —
1 — VPS30 Module, 1 — 25 volt 2 amp transformer, 1 — 0-50v 2" Panel Meter, 1 — 0-2 amp 2" Panel Meter, 1 — 470 ohm wirewound potentiometer, 1 — 4K7 ohm wirewound potentiometer, Wiring Diagram included. Order No. VPS30 KIT **£20**

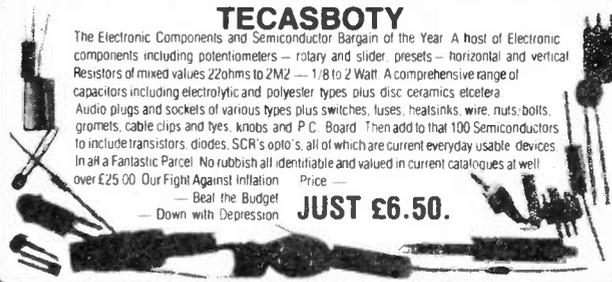
MINIATURE FM TRANSMITTER

Freq: 95-106MHz. Range: 1/2 mile
Size: 45 x 20mm, Add: 9v batt.
Not licenced in U.K.
Ideal for: 007-M15-FBI-CIA-KGB etc **ONLY £5.50**

TECASBOTY

The Electronic Components and Semiconductor Bargain of the Year. A host of Electronic components including potentiometers — rotary and slider, presets — horizontal and vertical Resistors of mixed values 220ohms to 2M2 — 1/8 to 2 Watt. A comprehensive range of capacitors including electrolytic and polyester types plus disc ceramics etcetera. Audio plugs and sockets of various types plus switches, levers, heatsinks, wire, nuts, bolts, gromets, cable clips and ties, knobs and P.C. Board. Then add to that 100 Semiconductor components including transistors, diodes, SCR's opto's, all of which are current everyday usable devices. In all a Fantastic Parcel. No rubbish all identifiable and valued in current catalogues at well over £25.00. Our Fight Against Inflation

Price —
— Beat the Budget
— Down with Depression
JUST £6.50.



SX38 100 Silicon NPN Transistors—all perfect Coded mixed types with data and eqvt sheet. No rejects. Real value. **£3.00**

SX39 100 Silicon PNP Transistors—all perfect. Coded mixed types with data and eqvt. sheet. No rejects. Fantastic value. **£3.00**

2N3055 The best known Power Transistors in the World — 2N3055 NPN 115w.
Our BI-PAK Special Offer Price:
10 off 50 off 100 off
£3.50 £16.00 £30.00

B0312 COMPLIMENTARY PNP POWER TRANSISTORS: TO 2N3055
Equivalent M12955 — B0312 — T03
SPECIAL PRICE £0.70 each
10 off **£6.50**



MORE BARGAINS!

SX51	60 metres PVC covered Hook-up wire single and stranded. Mixed colours	£1
SX58	25 Assorted TTL Gates 7400 Series: 7401-7460	£1
SX59	10 Assorted Flip Flops and MSI TTL	£1
SX60	20 Assorted Slider Potentiometers	£1
SX62	40 Assorted Pre-Sets Hor/Vert etc	£1
SX79	10 Rec Switches — glass type 3 Micro Switches — with lever	£1

BI-PAK

Send your orders to Dept EE4 BI-PAK, PO BOX 6 WARE HERTS
SHOP AT 2 BALDRECK ST, WARE HERTS
TERMS: CASH WITH ORDER, SAME DAY DESPATCH ACCESS
BARCLAYCARD ALSO ACCEPTED TEL (0920) 3182, GIRO 388 7006
ADD 15% VAT and 75p PER ORDER POSTAGE AND PACKING



Use your credit card. Ring us on Ware 3182 NOW and get your order even faster. Goods normally sent 2nd Class Mail.
Remember, you must add VAT at 15% to your order.
Total Postage add 75p per total order.

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. Kits include ALL THE ELECTRONICS AND HARDWARE NEEDED. Printed circuit boards (fully etched, drilled and roller tinned) or Veroboard are, of course, included as specified in the original article, we even include nuts, screws and I.C. sockets. PRICES INCLUDE CASES unless otherwise stated. BATTERIES ARE NOT INCLUDED. COMPONENT SHEET INCLUDED. If you do not have the issue of E.E. which includes the project—you will need to order the instruction reprint at an extra 45p each. Reprints available separately 45p each + p. & p. 45p.

- | | |
|--|---|
| DOUBLE DICE Jan. 83. £10-82 | SIMPLE TRANSISTOR & DIODE TESTERS. Mar. 81. Ohm meter version £2-02. Led version £2-73 |
| ELECTRONIC V/I METER Dec. 82. £11-38 | MINI SIREN. Mar. 81. £8-04. |
| ZX TAPE CONTROL Nov. 82. £6-48 | LED DICE. Mar. 81. £8-44. |
| PHOTO FINISH Nov. 82. £5-98 | LED FLASHER. Mar. 81. £4-28. |
| SINE WAVE GEN Oct. 82. £14-65 | MODULATED TONE DOORBELL. Mar. 81. £8-64. |
| G. P. PRE-AMP Oct. 82. £5-64 | BENCH POWER SUPPLY. Mar. 81. £53-47. |
| LIGHTS ON ALERT Oct. 82. £4-25 | THREE CHANNEL STEREO MIXER. Feb. 81. £18-69. |
| CONTINUITY CHECKER Sept. 82. £4-97 | SIGNAL TRACER. Feb. 81. £8-17 less probe. |
| SOUND SPLITTER Sept. 82. £15-77 | Ni-Cd BATTERY CHARGER. Feb. 81. £13-61. |
| SOUND RECOMBINER Sept. 82. £3-70 | ULTRASONIC INTRUDER DETECTOR. Jan. 81 less case. £53-47. |
| SCREEN WASH DELAY Sept. 82. £4-48 | 2 NOTE DOOR CHIME. Dec. 80. £18-32. |
| INSTRUMENT PRE AMP Aug. 82. £7-02 | LIVE WIRE GAME. Dec. 80. £11-78. |
| TWO TONE DOORBELL ALARM Aug. 82, less case and bell transformer. £8-82 | GUITAR PRACTICE AMPLIFIER. Nov. 80. £12-82 less case. Standard case £3-88. High quality case £8-33. |
| CS ROGER BLEEPER Aug. 82. £8-47 | SOUND TO LIGHT. Nov. 80. 3 channel. £21-34. |
| BRAKE LIGHT RELAY July 82. £4-30 | TRANSISTOR TESTER. Nov. 80. £11-63 inc. test leads. |
| 2-WAY INTERCOM July 82. £4-11 | AUDIO EFFECTS UNIT FOR WEIRD SOUNDS. Oct. 80. £13-11. |
| ELECTRONIC PITCH PIPE July 82. £4-91 | BICYCLE ALARM. Oct. 80. £10-35 less mounting brackets. |
| REFLEX TESTER July 82. £7-07 | IRON HEAT CONTROL. Oct. 80. £5-86. |
| SEAT BELT REMINDER June 82. £3-73 | TTL LOGIC PROBE. Sept. 80. £5-18. |
| EGG TIMER June 82. £4-95 | ZENER DIODE TESTER. June 80. £8-66. |
| TWO TONE TRAIN HORN WITH REMOTE TRIGGER OPTION May 82. £11-26 | 4 STATION RADIO. May 80. £16-29 less case. |
| CAR LED VOLTMETER less case. May 82. £2-89 | LIGHTS WARNING SYSTEM. May 80. £4-68. |
| LIGHTNING CHESS BUZZER. May 82. £6-20 | BATTERY VOLTAGE MONITOR. May 80. £5-16. |
| V.C.O. SOUND EFFECTS UNIT Apr. 82. £11-56 | CABLE & PIPE LOCATOR. Mar. 80. £4-11 less coil former. |
| CAMERA OR FLASH GUN TRIGGER Mar. 82. £12-41 less tripod bushes. | KITCHEN TIMER. Mar. 80. £14-65. |
| POCKET TIMER. Mar. 82. £3-71 | STEREO HEADPHONE AMPLIFIER. Mar. 80. £16-15. |
| GUITAR TUNER Mar. 82. £15-63 | MICRO MUSIC BOX. Feb. 80. £16-26. Grey Case £3-90 extra. |
| CAR OVERHEATING ALARM. Feb. 82. £9-81 | SIMPLE SHORT WAVE RECEIVER. Feb. 80. £25-88. Headphones £2-98. |
| SIMPLE STABILISED POWER SUPPLY. Jan. 82. £24-58 | SLIDE/TAPE SYNCHRONISER. Feb. 80. £12-38. |
| MINI EGG TIMER. Jan. 82. £3-94 | MORSE PRACTICE OSCILLATOR. Feb. 80. £4-82. |
| SIREN MODULE. Jan. 82. less speaker. £5-57. | SPRING LINE REVERS. UNIT. Jan. 80. £25-88. |
| MODEL TRAIN CHUFFER. Jan. 82. £8-27 | UNIBOARD BURGLAR ALARM. Dec. 79. £8-03. |
| SQUARE SIX. Dec. 81. £4-70 | BABy ALARM. Nov. 79. £9-60. |
| GUITAR AMP. Dec. 81. £3-76 | CHASER LIGHTS. Sept. 79. £23-40. |
| REACTION METER. Dec. 81. £17-55. | SIMPLE TRANSISTOR TESTER. Sept. 79. £7-38. |
| ELECTRONIC IGNITION. Nov. 81. £25-98. | DARKROOM TIMER. July 79. £2-89. |
| SIMPLE INFRA RED REMOTE CONTROL. Nov. 81. £18-98. | ELECTRONIC CANARY. June 79. £5-88. |
| PRESSURE MAT TRIGGER ALARM. Nov. 81. £8-27 less mats. | MICROCHIME DOORBELL. Feb. 79. £15-65. |
| EXPERIMENTER CRYSTAL SET. Nov. 81. Less aerial. £5-99. | THYRISTOR TESTER. Feb. 79. £3-78. |
| Headphones. £2-98 extra. | FUSE CHECKER. Oct. 78. £2-31. |
| CAPACITANCE METER. Oct. 81. £23-51. | SOUND TO LIGHT. Sept. 78. £8-42. |
| SUSTAIN UNIT. Oct. 81. £12-76. | CAR BATTERY STATE INDICATOR. Sept. 78. Less case. £2-09. |
| 'POPULAR DESIGNS'. Oct. 81. | R.F. SIGNAL GENERATOR. Sept. 78. £2-72. |
| TAPE NOISE LIMITER. £4-57. | IN SITU TRANSISTOR TESTER. June 78. £6-77. |
| HEADS AND TAILS GAME. £2-52. | WEIRD SOUND EFFECTS GENERATOR. Mar. 78. £5-59. |
| CONTINUITY TESTER. £3-95. | AUDIO VISUAL METRONOME. Jan. 78. £5-98. |
| PHOTO FLASH SLAVE. £3-46. | ELECTRONIC TOUCH SWITCH. Jan. 78. £2-73 less case. |
| FUZZ BOX. £7-78. | RAPID DIODE CHECK. Jan. 78. £2-74. |
| OPTO ALARM. £6-78. | PHONE/DOORBELL REPEATER. July 77. £7-46. |
| SOIL MOISTURE UNIT. £5-81. | ELECTRONIC DICE. Mar. 77. £5-68. |
| ICE ALARM. £7-89. | |
| 0-12V POWER SUPPLY. Sept. 81. £17-98 | |
| CMOS CAR SECURITY ALARM. Sept. 81. £9-08 | |
| CMOS DIE. Sept. 81. £7-98 | |
| LED SANDGLASS. Aug. 81. £8-53. | |
| CMOS METRONOME. Aug. 81. £8-23. | |
| COMBINATION LOCK. July 81. Less case. £19-58. | |
| BURGLAR ALARM SYSTEM. June 81. Less bell, loc & Mic. £40-98 | |
| TAPE AUTO START. June 81. £12-79. | |
| LIGHTS REMINDER AND IGNITION LOCATOR E.E. May 81. £5-66 | |
| SOIL MOISTURE INDICATOR E.E. May 81. £4-09. | |
| GUITAR HEADPHONE AMPLIFIER E.E. May 81. £4-23. | |
| PHONE BELL REPEATER/BABY ALARM E.E. May 81. £5-66. | |
| INTERCOM. April 81. £22-23. | |
| SPEECH PROCESSOR Feb. 83 £10-66 | |
| PUSH BIKE ALARM Feb. 83 £11-32 | |
| MOTOR BIKE ALARM Feb. 83 £14-46 | |

SOLDERING/TOOLS

- | | |
|--|--------|
| ANTEX X5 SOLDERING IRON 25W | £5-48 |
| SOLDERING IRON STAND | £1-98 |
| SPARE BITS. Small, standard, large, 65p each. For X5 + X25 | |
| SOLDER. Handy size | 99p |
| SOLDER CARTON | £1-84 |
| DESOLDER BRAID | 69p |
| HEAT SINK TWEEZERS | 29p |
| DESOLDER PUMP | £6-48 |
| HOW TO SOLDER LEAFLET | 12p |
| LOW COST CUTTERS | £1-69 |
| LOW COST LONG NOSE PLIERS | £1-68 |
| WIRE STRIPPERS & CUTTERS | £2-69 |
| PRECISION PETITE 12V P.C.B. Drill | £11-67 |
| Drill Stand | £7-98 |
| Grinding stone | 50p. |
| Grinding wheel | 50p. |
| Saw blade 85p. Brass wire brush 50p. Burr 50p. | |
| VERO SPOT FACE CUTTER | £1-49 |
| PIN INSERTION TOOL | £1-98 |
| VEROPINS (pk of 100) 0-1" | 52p |
| MULTIMETER TYPE 1 (1,000 opv) | £5-48 |
| SET. 10 leads with 20 clips | 99p |
| RESISTOR COLOUR CODE CALCULATOR | 21p |
| CONNECTING WIRE PACK TYPE ED. 11 colours | 49p |



MULTIMETER TYPE 2. (YN360TR) 20K o.p.v. with transistor tester. £14-75

- | | |
|--------------------------------------|-------|
| ILLUMINATED MAGNIFIERS | |
| Small 2" dia. (5x mag.) | £1-14 |
| Large 3" dia. (4x mag.) | £2-48 |
| CAST IRON VICE | £2-98 |
| SCREWDRIVER SET | £1-98 |
| POCKET TOOL SET | £3-98 |
| DENTISTS INSPECTION MIRROR | £2-85 |
| JEWELLERS EYEGLASS | £1-50 |
| PLASTIC TWEEZERS | 69p |
| PAIR OF PROBES WITH LEADS (cc) | 77p |

TEACH IN 82

All top quality components as specified by E.E. FREE COMPONENT IDENTIFICATION SHEET. Follow this educational series and learn about electronics. List 1 & 2 £27-98. List 3 £5-98.

SPECIAL PRICE FOR ALL 3 TOGETHER £33-48. WOODEN CASE & HARDWARE KIT £11-98.

(includes wood, formica, glue, screws, etc. cut to size. 12 part series - reprints 45p per part or £4-98 the set.

INTRODUCING ELECTRONICS 6 part series E.E. Oct. 82-Mar. 83. No soldering. Connections via screw terminal blocks. Very clear drawings showing how to connect components. Covers the basis of electronics. Components (less batteries) parts 1-5 £6-98. Reprints 45p each extra.

BOOKS

- | | |
|---|-------|
| SEMICONDUCTOR DATA BOOK Newnes | £5-90 |
| ELECTRONIC PROJECTS FOR HOME SECURITY | £3-35 |
| ELECT. PROJECTS IN PHOTOGRAPHY | £3-35 |
| 110 ELECT. ALARM PROJECTS | £3-35 |
| MODEL RAILWAY PROJECTS | £1-95 |
| BASIC ELECTRONICS. Theory and practice | £7-98 |
| BEGINNERS GUIDE TO BUILDING ELECT. PROJECTS | £1-50 |

ADVENTURES WITH MICROELECTRONICS

Similar to 'Electronics' below. Uses I.C.s. Includes dice, electronic organ, doorbell, reaction timer, radio etc. Based on Bim-board 1 bread board. Adventures with Microelectronics £2-55 Component pack £29-64 less battery.

ADVENTURES WITH ELECTRONICS

by Tom Duncan

An easy to follow book suitable for all ages. Ideal for beginners. No soldering, uses an S-Dec breadboard. Gives clear instructions with lots of pictures. 16 projects—including three radios, siren, metronome, organ, intercom, timer, etc. Helps you learn about electronic components and how circuits work. Component pack includes an S-Dec breadboard and all the components for the projects. Adventures with Electronics £2-40. Component pack £18-98 less battery.

HELPING HANDS JIG £6-30

Heavy base. Six ball and socket joints allow infinite variation of clips through 360°. Has 2 1/2" diameter (2.5 magnifier attached), used and recommended by our staff. Speakers min 8ohm 87p 64ohm 89p Crystal earpiece 65p Mono headphones £2-98 Telephone pick up coil 72p



- | | |
|---------------------------|-------|
| Min. buzzers 6V | 50p |
| 12V | 65p |
| Magnetic earpiece | 15p |
| Stereo headphones | £4-35 |
| Euro breadboard | £6-40 |
| S. Dec. breadboard | £3-98 |
| Bimboard breadboard | £6-98 |
| Verobloc breadboard | £4-20 |

30 SOLDERLESS BREADBOARD PROJECTS

Book 1 by R. A. Penfold. Includes fuzx box, radio, metronomes, timers, transistor checker, switches etc. Introduction gives basic information on components including resistors, capacitors, I.C.s, transistors, photocells etc. Ideal for beginners as well as those with some experience. Complete kit including verobloc, book and components (less batteries) £24-75 Less book £22-50, less verobloc £20-25. Book only £2-25.

MORE KITS AND COMPONENTS IN OUR LISTS

FREE PRICE LIST Price list included with orders or send us (9 x 4) CONTAINS LOTS MORE KITS, PCBs & COMPONENTS

ELECTRONICS CATALOGUE

Illustrations, product descriptions, circuits all included. Up-to-date price list enclosed. All products are stock lines for fast delivery. Send 80p in stamps or add 80p to order.

MORE E.E. KITS PLUS H.E. and E.T.I. PROJECT KITS IN THE PRICE LIST.

MAGENTA gives you FAST DELIVERY 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?

MAGENTA ELECTRONICS LTD. EJ49, 135 HUNTER ST. BURTON-ON-TRENT, STAFFS., DE14 2ST. 0283 65435. MON.-FRI. 9-5. MAIL ORDER ONLY. ADD 45p P. & P. TO ALL ORDERS. PRICES INC. VAT



Normal despatch by return of post. OFFICIAL ORDERS WELCOME. OVERSEAS. Payment must be in sterling. IRISH REPUBLIC and B.P.O. UK PRICES. EUROPE. UK PRICES plus 10%. ELSEWHERE: Write for quote.

Everyday ELECTRONICS

VOL. 12 No. 4 APRIL 1983

Editor

F. E. BENNETT

Assistant Editor

B. W. TERRELL B.Sc.

Production and News Editor

D. G. BARRINGTON

Projects Editor

G. P. HODGSON

Technical Sub-Editor

R. A. HOOPER

Art Editor

R. F. PALMER

Assistant Art Editor

P. A. LOATES

Technical Illustrator

D. J. GOODING Tech. (CEI)

Secretary

JACQUELINE DOIDGE

Editorial Offices

KING'S REACH TOWER
STAMFORD STREET
LONDON SE1 9LS
Phone: 01-261 6873

Advertisement Manager

R. SMITH
Phone: 01-261 6671

Representative

R. WILLETT
Phone: 01-261 6865

Classified Supervisor

B. BLAKE
Phone: 01-261 5897

Make-Up and Copy Department

Phone: 01-261 6615

Advertisement Offices

KING'S REACH TOWER
STAMFORD STREET
LONDON SE1 9LS

EVERYDAY ELECTRONICS AND COMPUTER PROJECTS

NEXT month EVERYDAY ELECTRONICS takes on a new look. Apart from introducing a change of type style, our title will be amplified to make clear our commitment to serve the interest of microcomputer users. As a constructors' magazine our overall policy is unaltered—our central purpose is (as always) to put electronics to effective use in any way possible, and to serve any and all interests wherever practical.

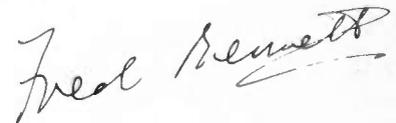
But the increasing importance of computing means that, quite naturally, we will be giving increasing attention to this area and we feel it right to make this clear to personal computer users in general.

Some idea of the scope for the electronics circuit designer and builder in the field of personal computers has been demonstrated in the pages of EE over the last twelve months. But this is only the beginning and an exciting and rewarding area for the project builder is now really opening up as microcomputers multiply in type and the numbers in use increase at a phenomenal rate.

Day by day more EE readers are becoming personal computer users. They will quickly and naturally seize the opportunities to enhance the usefulness of their machines by building for themselves add-on units that would be expensive to buy ready made—always supposing that similar units *are* available as commercial products.

There is, of course, the vast number of microcomputer users who have no technical knowledge nor practical experience in building electronic circuits. This is where EE will offer a special service with its easy to follow features dealing with theoretical matters and all practical aspects of circuit construction.

We do, however, stress that this new emphasis on the computer area will not be at the expense of other interests served by EE. The answer to this apparent conundrum is extra pages of editorial matter in every issue. For this enlarged and enhanced EVERYDAY ELECTRONICS we shall be asking our readers for another 5p. A modest increment in the circumstances, we believe our readers will agree. For details of the contents and the free gift that comes with the May issue please turn to page 231. You won't want to miss it, so why not place a firm order with your local newsagent now.



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.

All reasonable precautions are taken to ensure that the advice and data given to readers are reliable. We cannot, however, guarantee it and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press.

Back Issues

Certain back issues of EVERYDAY ELECTRONICS are available worldwide price £1.00 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.

Binders

Binders to hold one volume (12 issues) are available from the above address for £4.60 inclusive of postage and packing worldwide. Please state which Volume.

Subscriptions

Annual subscription for delivery direct to any address in the UK: £12.00. Overseas: £13.00. Cheques should be made payable to IPC Magazines Ltd., and sent to Room 2613, King's Reach Tower, Stamford Street, London SE1 9LS.

ZX SPECTRUM AMPLIFIER

BY V. TERRELL



THE BEEP command is used to produce sound from the Spectrum. Unfortunately the level of this sound is extremely low. In fact, even in a quiet room notes above and below middle-C can be difficult to hear. It was therefore thought necessary that if use of the BEEP command was to be fully realised the sound level had to be increased. This was accomplished by the amplifier described here. Apart from being considerably louder the quality of the sound was enriched.

FEEDBACK

Fig. 1 shows the tape circuitry of the Spectrum. The sound originates from the ULA chip, and as can be seen, is fed to

both EAR and MIC sockets. Initially when tested the tones at the MIC socket sounded smoother than those at the EAR socket, and so the MIC "output" was used to feed the amplifier. Because the Spectrum EAR and MIC sockets are interconnected, when making a program SAVE, feedback can occur with certain types of cassette recorder. The reason being that whilst recording, the MIC signal also appears amplified at the EAR socket, this is then fed via the computer MIC and EAR sockets back to the cassette's MIC input thus forming a loop. Page 21 of the Spectrum Introduction Booklet suggests pulling the earplug out every time a SAVE is made. To overcome this problem with some cassette recorders, a switch to interrupt

the EAR lead between player and computer has been incorporated in the design of the amplifier. Of course this switch can be omitted and a link wire fitted, if your recorder is able to SAVE properly with both leads in.

CIRCUIT DIAGRAM

The complete circuit diagram for the ZX Spectrum Amplifier is shown in Fig. 2. The integrated circuit amplifier IC1 requires few external components to produce a $\frac{1}{4}$ -watt amplifier. (The gain of the i.c. can be increased if required by placing suitable components between pin 1 and 8, this however was not necessary because of the high level of signal available at the MIC socket.) The gain of the i.c. without feedback is set at about $\times 20$.

In series with the volume on/off control VR1 is R1, to limit the signal fed to the amplifier by a factor of 10 to prevent overloading. Decoupling capacitor C1 prevents high frequency oscillations and should be fitted as close as possible to pin 6 of the i.c. Capacitor C2 and resistor R2 in series at the output, form what is known as a Sobel network to stabilise the output stage. Coupling capacitor C3 connects the output of the amplifier loudspeaker, LS1.

The SAVE/LOAD switch S1 when open breaks the EAR connection from computer to cassette, to prevent feedback when saving, as discussed earlier. S1 is closed for loading. The fact that R1 and VR1 are across the MIC socket SK1, in no way affects the saving of programs because of the high value of R1.

The quiescent current, that is, the current drawn by the i.c. with no signal applied, is very low, so the battery should last a reasonable length of time.

PRINTED CIRCUIT BOARD

All components with the exception of LS1 and the four jack sockets are mounted on a small printed circuit board size 95×32 mm. The full size master pattern to be etched on this board is shown in Fig. 3. The black areas represent the copper tracks to remain after etching.

Fig. 1. Circuit diagram for the tape circuitry of the ZX Spectrum.

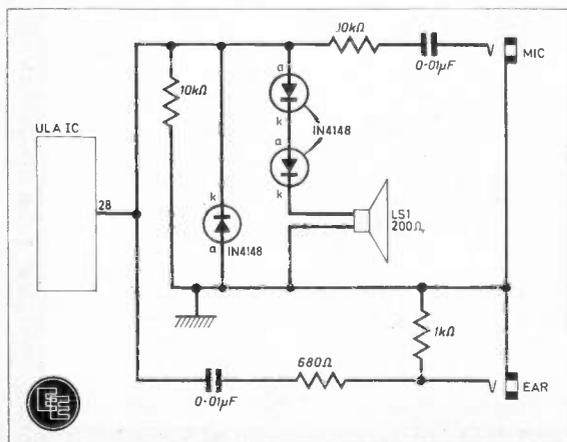
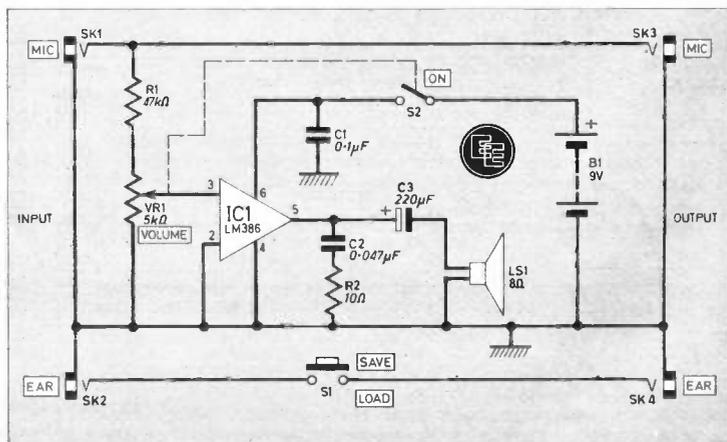


Fig. 2. The complete circuit diagram for the ZX Spectrum Amplifier.





COMPONENTS

Resistors

R1 47k Ω R2 10 Ω
Both $\frac{1}{4}$ watt carbon $\pm 5\%$

Capacitors

C1 0.1 μ F monolithic or disc ceramic
C2 0.047 μ F polyester type C280
C3 220 μ F 16V elect. radial leads

Semiconductors

IC1 LM386 400mW audio amplifier 8-pin d.i.l.

Miscellaneous

S1 Push-on, push-off latching p.c.b. mounting
VR1/S2 5k Ω carbon edge-wise control with s.p.s.t. switch
SK1-4 3.5mm chassis mounting jack socket (4 off)
LS1 8 ohm loudspeaker approx. 90mm diameter
B1 9-volt PP3 Printed circuit board single-sided, size 95 x 32mm; aluminium for case 18 s.w.g.; threaded spacers and screws 6BA; speaker grille cloth; rubber feet (4 off); jack plugs 3.5 (4 off); 8-pin d.i.l. socket (1 off); PP3 battery clip; 0.1 inch Veropins (12 off); screened cable approx. 30cm; solder, glue.

Approx. cost **£7**
Guidance only

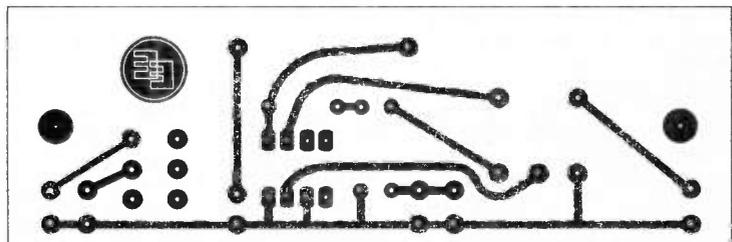
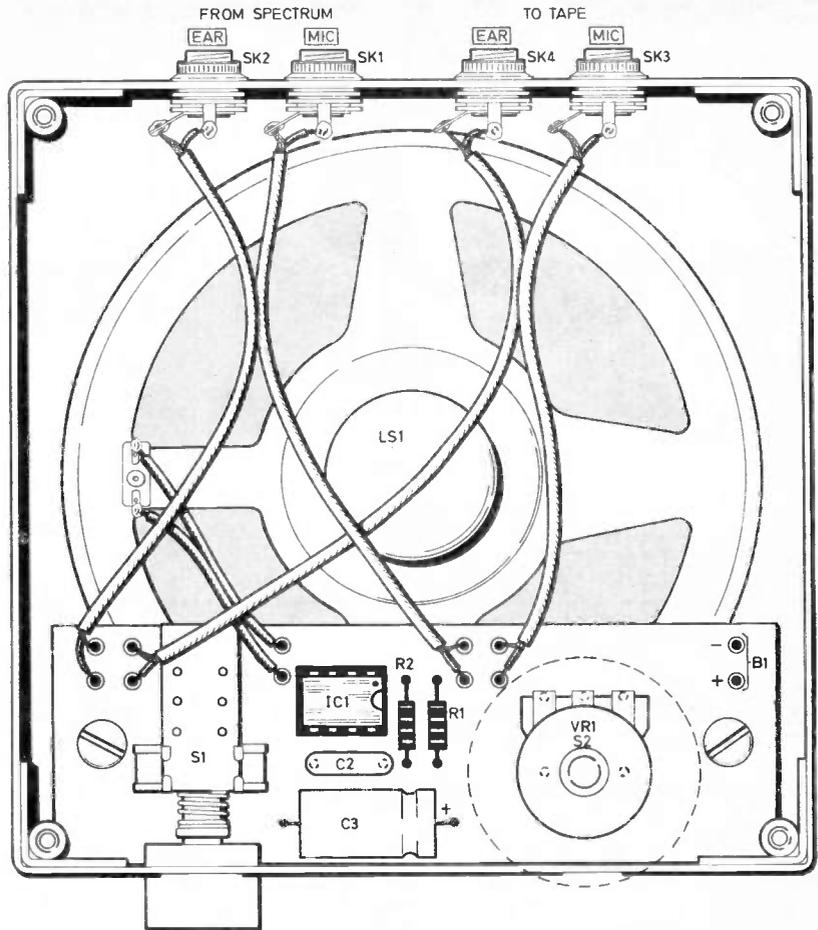
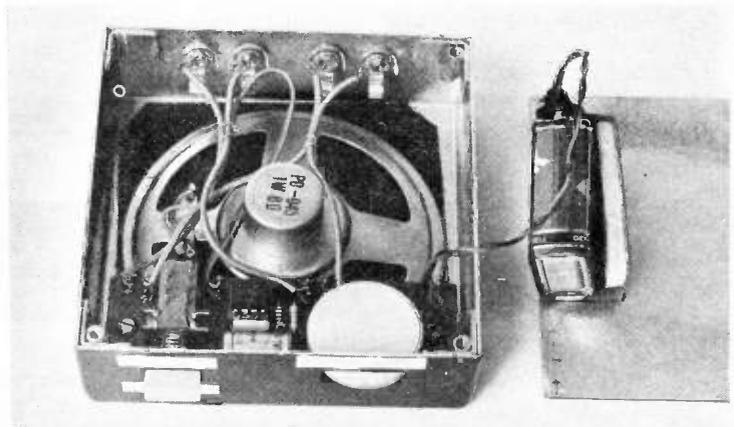


Fig. 3. Full size printed circuit board master, component layout and interwiring details for the ZX Spectrum Amplifier.



Fig. 4. Capacitor C1 mounted on the track-side of the board as close as possible to the pins of IC1.



Completed amplifier showing the battery in position on the lid.

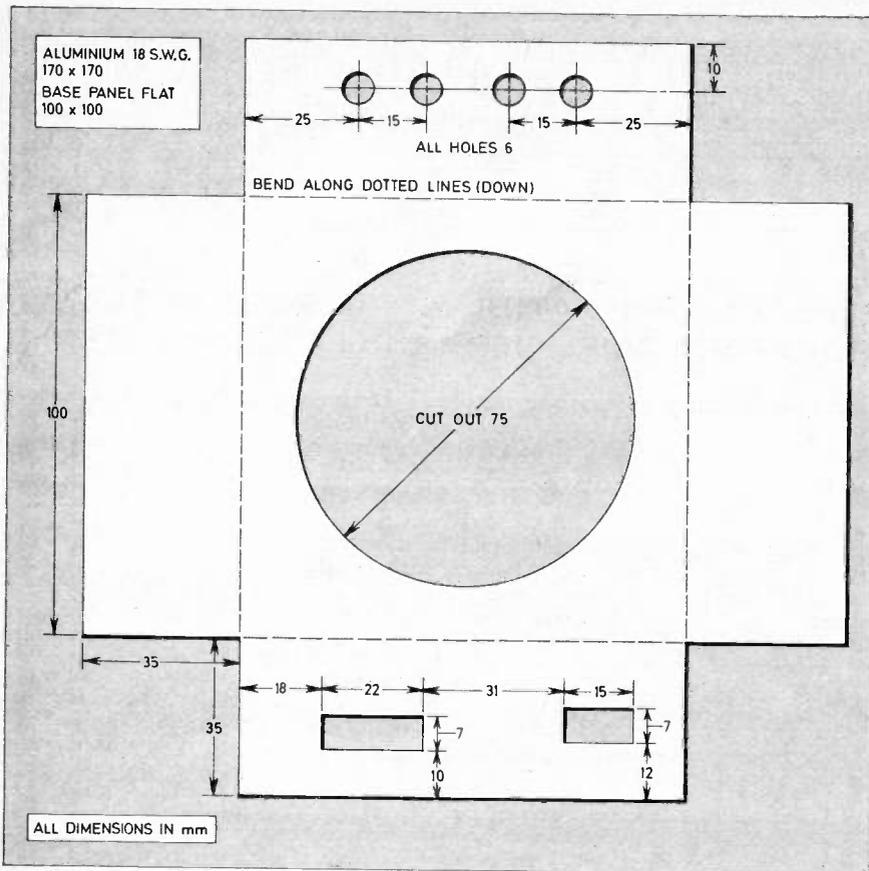


Fig. 5. Drilling and bending details for the suggested aluminium case.

Begin by inserting and soldering in place the i.c. socket (recommended), followed by the smallest components and ending up at the largest, S1, see Fig. 3. Veropins are used to connect flying leads to the board. This allows the board to be fitted in its case with other case mounted components and then interwired.

Note that C1 is soldered directly to the underside of the board beneath the i.c. This was found to be the best position to locate this component. See Fig. 4.

CASE DETAILS

The prototype case was constructed from 18 s.w.g. aluminium, details are shown in Fig. 5. The overall size of the

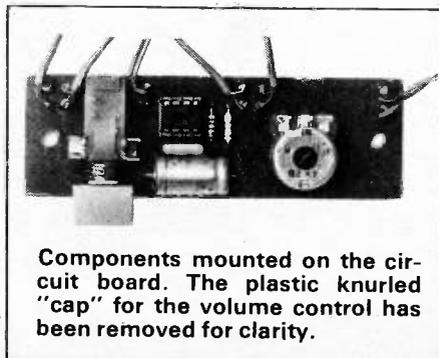
case is determined by the size of the speaker, it is recommended that the speaker used should not be less than 75mm diameter. All holes are made prior to bending.

The size and position of the slots for S1 and VR1 should be adhered to because they relate to the relative positions on the printed circuit board, S1, and the knob fitted to VR1. Once the slots are made, the p.c.b. can be offered up to locate the correct position for the board fixing pillars, these can be glued with Araldite and left to set. The other threaded fixing pillars are glued to the corners of the box to allow the base panel to sit just inside.

The prototype case was sprayed with a coat of primer followed by several coats



Completed amplifier plugged into the ZX Spectrum.



Components mounted on the circuit board. The plastic knurled "cap" for the volume control has been removed for clarity.

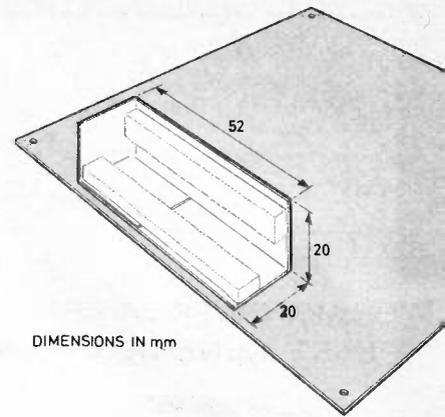


Fig. 6. Details of the battery compartment. Foam strips are used to hold the battery in position.

of black gloss. A piece of speaker grille cloth was then glued in place with Bostic clear. When dry, the speaker can then be glued to the cloth, and allowed to dry before securing the p.c.b. and sockets into the case. Finally, the four self-adhesive rubber feet are fixed to the base plate and the case labelled as required.

ASSEMBLY

When the case and p.c.b. are ready, the final stages of assembly may be carried out. Fit the board in place followed by the four sockets on the rear of the case. Wire up using screened cable. Solder the speaker leads and battery leads in place to complete the unit wiring.

A small flimsy bracket, to position and retain the battery in the case, was constructed from cardboard and self-adhesive foam. Details are provided in Fig. 6. The unit may now be tested.

With the on/off switch in the "off" position check that the i.c. is correctly orientated. Insert the battery and switch on. A faint click should be heard. If a test meter is available check the voltage at pin 5 of the i.c. this should read 4.5 volts, half the battery voltage. The supply current without any input should read approximately 3mA.

FINAL TESTING

To enable the unit and the cassette recorder to be connected up, an extra lead set will be required. This can either be completely made up, or by using the existing leads supplied with the Spectrum, and cut in half with four 3.5mm plugs soldered, one to each end, to the ends.

Connect up Spectrum to amplifier and set up the BEEP command to give a range of notes to check the amplifier.

Next LOAD and SAVE a few programs to check all is functioning. To cue programs already on tape, S1 is switched to the LOAD position, the amplifier turned up and the cassette played in the normal way. This method eliminates the need to keep pulling the cassette earplug whenever you want to cue the tape, the EAR socket doesn't become intermittent and the cassette volume control can be left unaltered. □

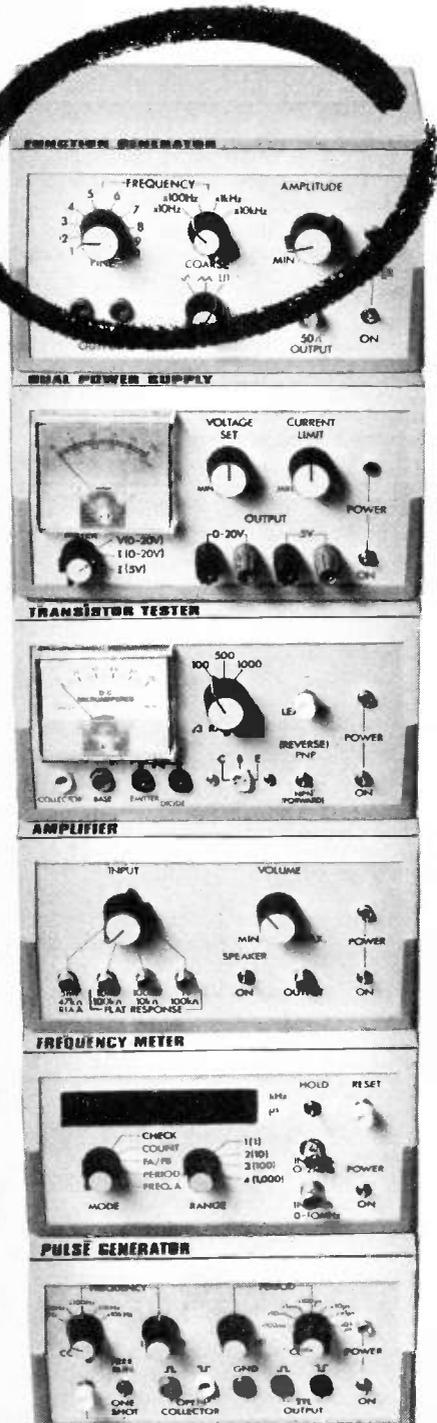
TEST GEAR 83 FUNCTION GENERATOR

UNIT TWO

BY J. R. W. BARNES

THE TEST GEAR 83 SERIES CONSISTS OF:

DUAL POWER SUPPLY ● FUNCTION GENERATOR ● TRANSISTOR TESTER
PULSE GENERATOR ● LABORATORY AMPLIFIER ● FREQUENCY METER



AUDIO signal generators are used in a wide range of applications, other than the most obvious one of checking amplifiers. For example, they can be used for testing sound circuits in television receivers or employed in more general use as a signal source to check that individual parts of an electronic system are functioning correctly.

Another typical application would be to determine the frequency response of a filter circuit.

GENERAL REQUIREMENTS

The general requirements of a signal generator are as follows:

Frequency Range. The normal range offered is 10Hz to 100kHz, with more expensive instruments offering frequencies up to 1MHz. For most home applications however, these higher frequencies are unnecessary.

Accuracy and Stability. These two parameters have an enormous effect on the cost of an instrument. However, calibration accuracies of better than 10 per cent are seldom required. The exact frequency can be determined with either a 'scope or a digital frequency meter, if required. The actual frequency scale on the instrument can be either linear or logarithmic, a linear scale is preferred since it is easier to set the frequency.

Output Impedance. The output impedance, if specified as constant, is usually 50 or 600 ohms. This is to enable the output of the generator to match the impedance of the coaxial cable, and the impedance of a twisted pair transmission line, respectively.

This prevents the signal from being reflected back at the ends of the cable, much in the same way as a wave travels down a "Slinky" coil then, when it hits the end, part of the energy is absorbed and part is reflected.

It is desirable to have a low output impedance, since when the load impedance is equal to the source impedance, the output voltage is reduced by a factor of two.

Output Voltage. For general purpose work with amplifiers, 1V r.m.s. is adequate. To determine the functional properties of an electronic system, a larger output is better. Some method of adjusting the output amplitude is usually provided. This may simply be a potentiometer or an accurate attenuator.

Waveforms. different types of waveforms are available; including squarewaves, pulses, sawtooth (ramp) and sinewaves. The difference here is between the signal sources which generate the waves and those that synthesise them. There are two common ways of making a sinewave, it can either be generated in an oscillator such as a Wien bridge type, or it can be made by rounding the peaks off a triangular wave.

This latter technique is widely used in function generators as it is easier to first make a triangular wave then convert it to a sinewave, than try to generate a triangular wave from a sinewave.

Sinewaves which are generated have a lower distortion content than can be obtained by electronic shaping. For accurate distortion measurements on an amplifier, a generated wave is therefore essential. Squarewave tests are frequently carried out as a check of amplifier perfor-

SPECIFICATION

Frequency range:	Continuously variable from 10Hz to 100kHz in four linear ranges	Output impedance:	47Ω measured at 1kHz (variable output)
Range switch:	x 10Hz (10Hz to 100Hz) x 100Hz (100Hz to 1kHz) x 1kHz (1kHz to 10kHz) x 10kHz (10kHz to 100kHz)	Output impedance:	100Ω (fixed TTL compatible output)
Waveforms:	Sinewave, triangle (saw-tooth) and squarewave. Separate TTL compatible squarewave	Total harmonic distortion:	0.5% for the sinewave (measured at 1kHz)
		Rise time:	0.5μs (variable output squarewave into 50Ω)
		Rise time:	35ns (fixed TTL squarewave output into 100Ω)



CIRCUIT DESCRIPTION

The complete circuit diagram of the Function Generator is shown in Fig. 1. The circuit is built around the waveform generator, IC1. The coarse frequency range is switched by S1 and the capacitors C1 to C5, and the fine frequency is controlled by the current drawn out of pin 7. The frequency (f) is given by

$$f = \frac{320 \times I_1}{C_1}$$

In order to give the frequency control a linear scale, it is essential that I_1 is directly proportional to the dial position. This is accomplished with the aid of IC1. Zener diode D1 is used as a voltage reference and a portion of this, determined by preset VR1 and FREQUENCY control potentiometer VR2, is buffered by IC1 used as a voltage follower.

The voltage difference between the output of the op-amp and pin 7 of IC2 results in the timing current I_1 flowing through R3. Preset VR1 is used to set the minimum frequency and the maximum frequency is fixed and determined by R3.

Switch S2 is used to select the output waveform. The resistors R5 and R7 ensure that the peak-to-peak amplitude of all the waveforms is the same. The amplitude of the triangular and squarewaves must however be set by adjusting VR3.

The output of the waveform generator is amplified by IC3. This is used in the non-inverting mode. Complementary symmetrical emitter followers, TR2 and TR3 provide current gain. Fixed biasing for the output transistors is provided by the forward biased silicon diodes, D3 and D4.

The feedback for the amplifier is by resistors R11 and R12, these set the gain to about 5.6. The output amplitude is controlled by VR4.

The TTL output is taken from the emitter follower TR1, the collector voltage is clamped by the Zener diode D2 to 5.6V. Diode D10 protects the transistor from the reverse base-emitter voltage during negative excursions of pin 11 of IC2.

It should be stressed that the performance of the TTL output is heavily dependant on the switching characteristics of TR1, and constructors should not substitute another type unless they are sure they have similar high frequency behaviour.

POWER SUPPLY

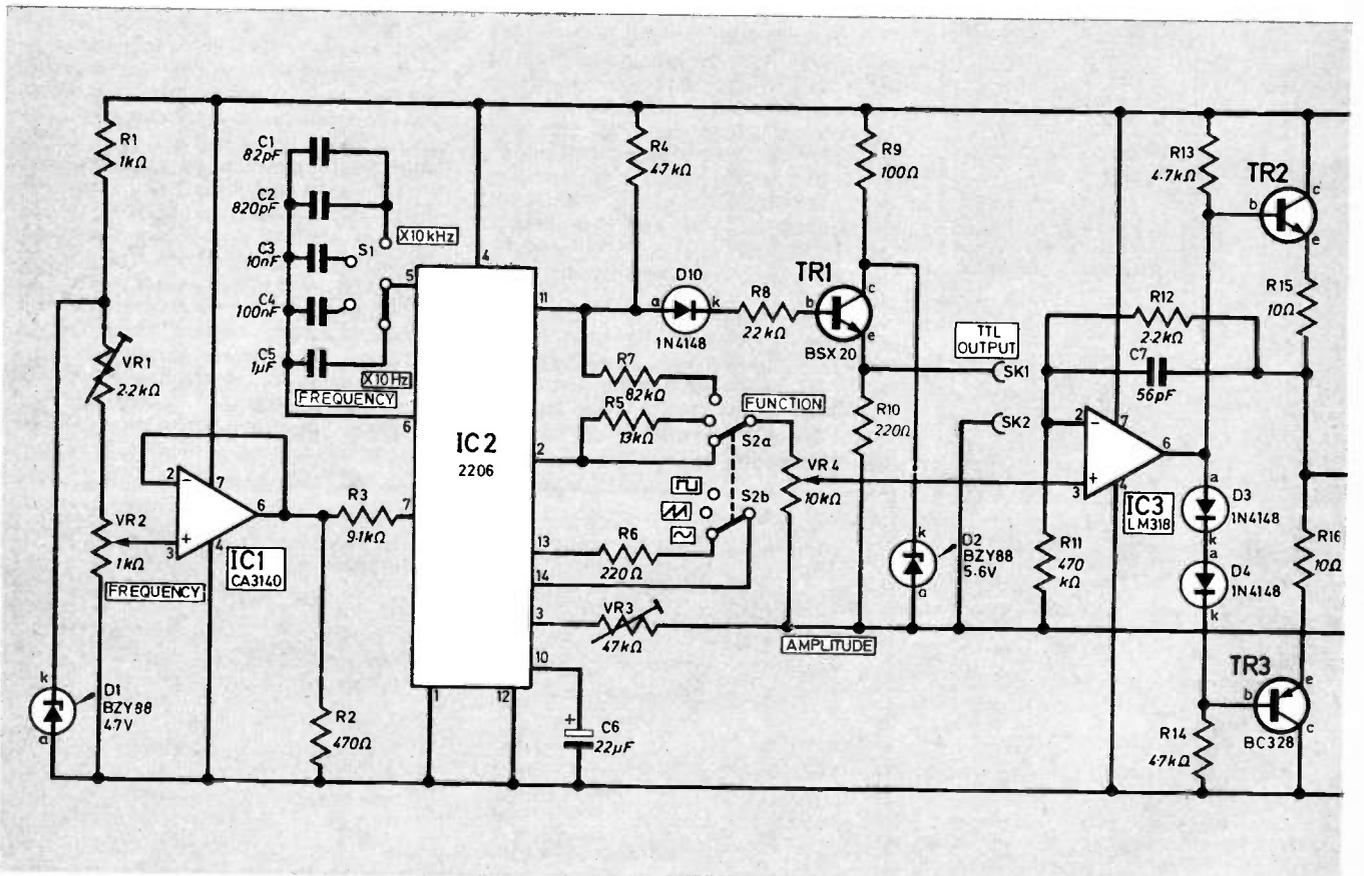
The power supply is very conventional, the two i.c. voltage regulators, IC4 and IC5 are used to provide positive and negative 12-volt rails. A centre-tapped transformer T1, and bridge rectifier together with smoothing capacitors, provide a source of d.c. for the regulators.

mance. The rise time of the output wave indicates the high frequency performance.

The Function Generator described here is of the synthesis type. The heart of the circuit is a 2206 waveform generator i.c. The unit provides two simultaneous outputs, a 5V squarewave TTL compatible output and an adjustable amplitude output with sine, triangular and squarewave outputs. The TTL output may be used for logic experiments, but it is also convenient for synchronising an oscilloscope or driving a frequency meter.

The main output has a 50 ohm output impedance and is capable of producing up to 6V into a 50 ohm load and 12V into a high impedance. The full specifications are given on page 205.

Fig. 1. Complete circuit diagram for the Function Generator. The power supply/voltage regulator section is shown on the opposite page.



CIRCUIT BOARDS

The generator circuit is built on a printed circuit board 100 × 160mm. The layout of the copper tracks is shown in Fig. 2. It should be noted that the tracks which apparently go nowhere, form an essential interleaved ground plane which is necessary to maintain waveform purity. The component layout is also shown.

It will assist wiring later if Veropins are inserted in the board for the flying leads. Once they have been soldered in place, continue construction with the components. The order of construction is unimportant but the normal practice of links, i.e. sockets, resistors, capacitors, and finally the diodes and transistors can be used. Care should be taken to ensure the correct polarity of the diodes and electrolytic capacitors.

The power supply p.c.b., shown in Fig. 3, can be assembled. Again check the polarities of the diodes and capacitors. It is a good idea at this stage to test the

See
**Shop
Talk**
page 217

Resistors

R1	1kΩ
R2,11	470Ω (2 off)
R3	9.1kΩ ±2%
R4,13,14	4.7kΩ (3 off)
R5	13kΩ
R6,10	220Ω (2 off)
R7	82kΩ
R8	22kΩ
R9	100Ω
R12	2.2kΩ
R15,16	10Ω (2 off)
R17	47Ω
R18	680Ω

All ¼W carbon ±5% unless otherwise stated

Potentiometers

VR1	2.2kΩ miniature preset
VR2	1kΩ linear control
VR3	47kΩ miniature preset
VR4	10kΩ linear control

Capacitors

C1	820pF polystyrene
C2	82pF ceramic
C3	10nF Siemens
C4,10,11	100nF Siemens (3 off)
C5	1µF Siemens
C6,8,9	22µF 40V elect. (3 off)
C7	56pF ceramic
C12,13	470µF 63V elect. (2 off)

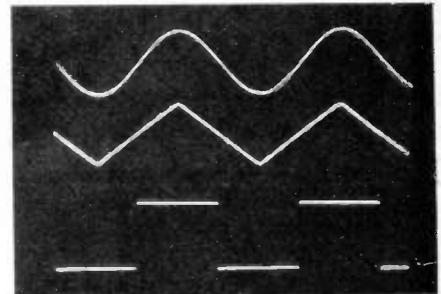
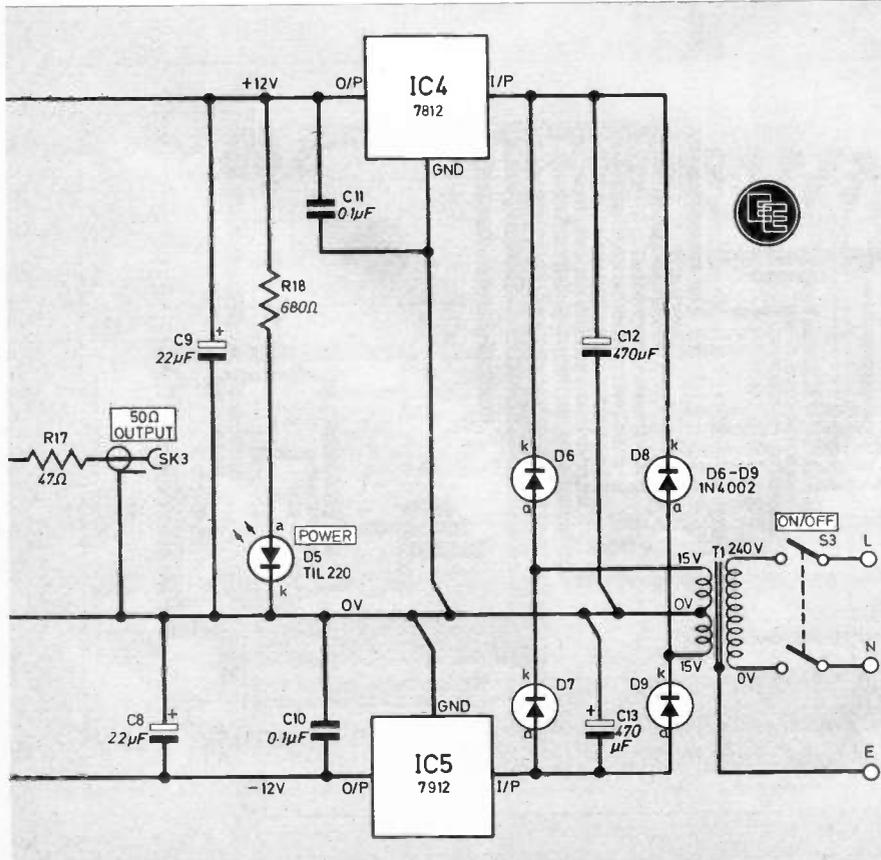
Semiconductors

D1	BZY88 C4V7 Zener
D2	BZY88 C5V6 Zener
D3,4,10	1N4148 silicon (3 off)
D5	TIL220 0.2in red l.e.d.
D6-9	1N4002 silicon (4 off)
TR1	BSX20 silicon npn
TR2	BC338 silicon npn
TR3	BC328 silicon pnp
IC1	CA3140 MOSFET op-amp
IC2	XR2206 waveform generator
IC3	LM318 op-amp
IC4	7812 +12V, 1A regulator
IC5	7912 -12V, 1A regulator

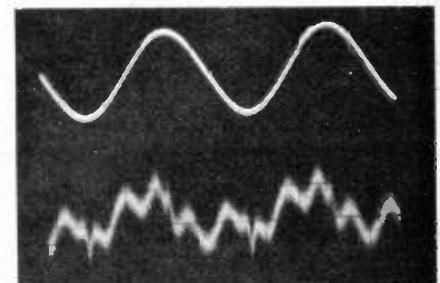
Miscellaneous

S1	3-pole, 4-way midget rotary
S2	4-pole, 3-way midget rotary
S3	d.p.d.t. miniature mains toggle
SK1	4mm banana socket red
SK2	4mm banana socket green
SK3	50Ω b.n.c. socket
T1	6VA p.c.b. mounting mains transformer with 0-15V, 0-15V secondaries (rated at 200mA)

Verocase type 202-21036C; single-sided p.c.b. size 150 × 65mm and 150 × 100mm; l.e.d. holder; control knob (4 off); Veropins; 7/0.2mm wire; mains cable; grommet; P-clip; 8-pin d.i.l. holder (2 off); 16-pin d.i.l. holder; Mounting hardware (M3 or 6BA).



Oscilloscope of the waveforms obtained from the Function Generator.



Total harmonic distortion (THD) factor at 1kHz of the prototype unit showing a 0.5 per cent distortion.

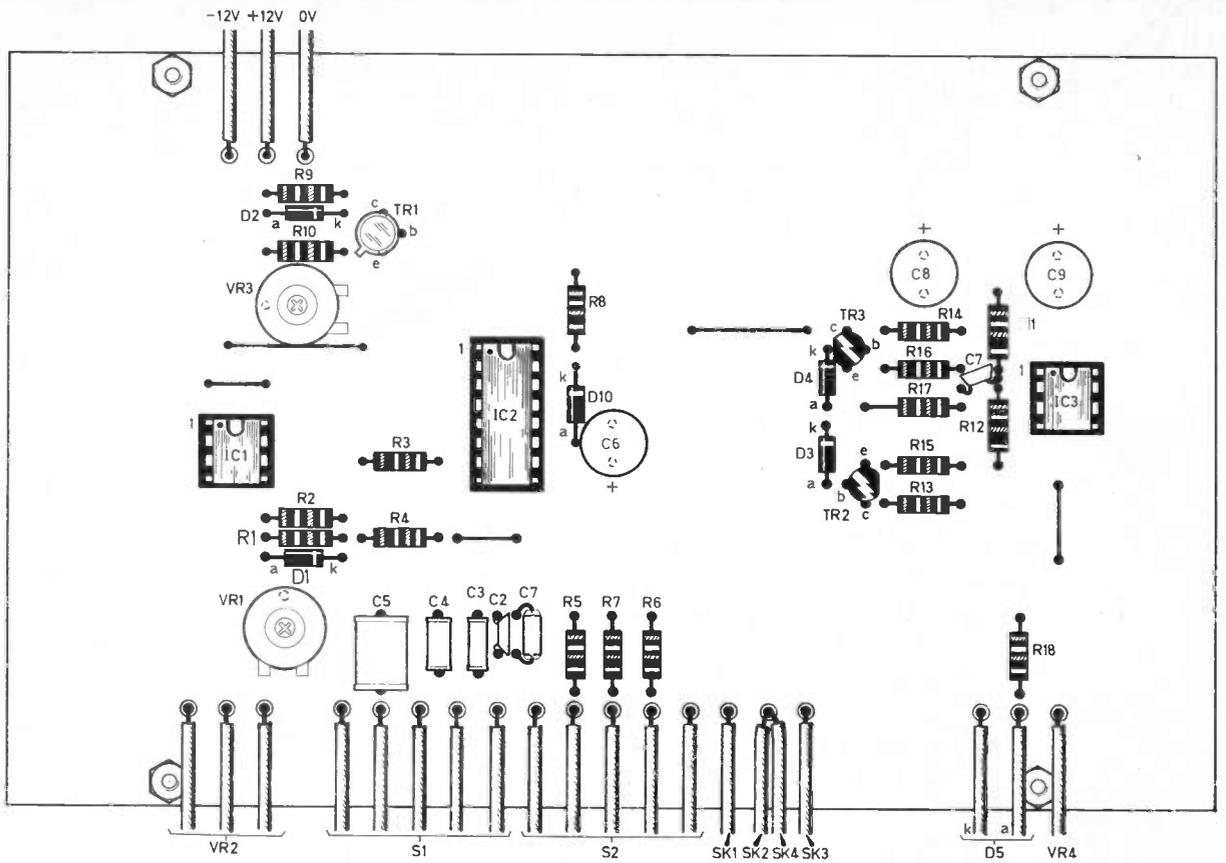
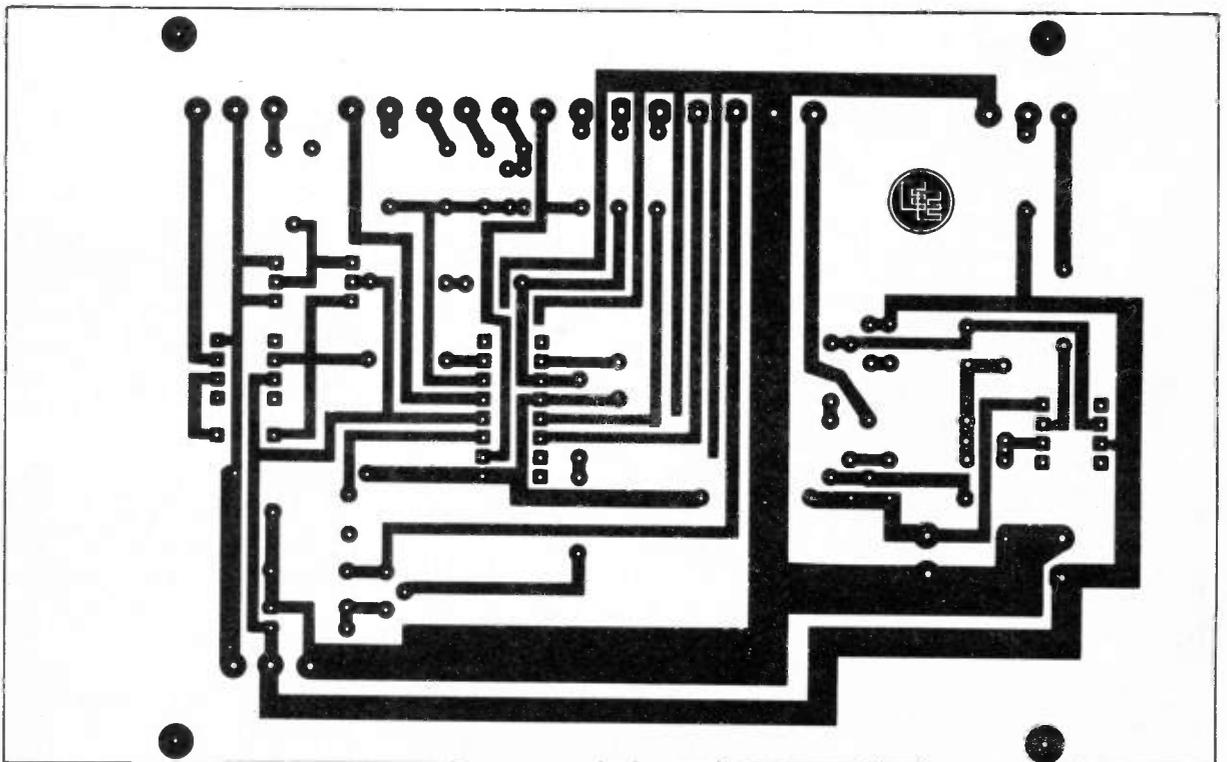


Fig. 2. Component layout (above) and full size printed circuit board master (below) for the waveform generator board (p.c.b.2).



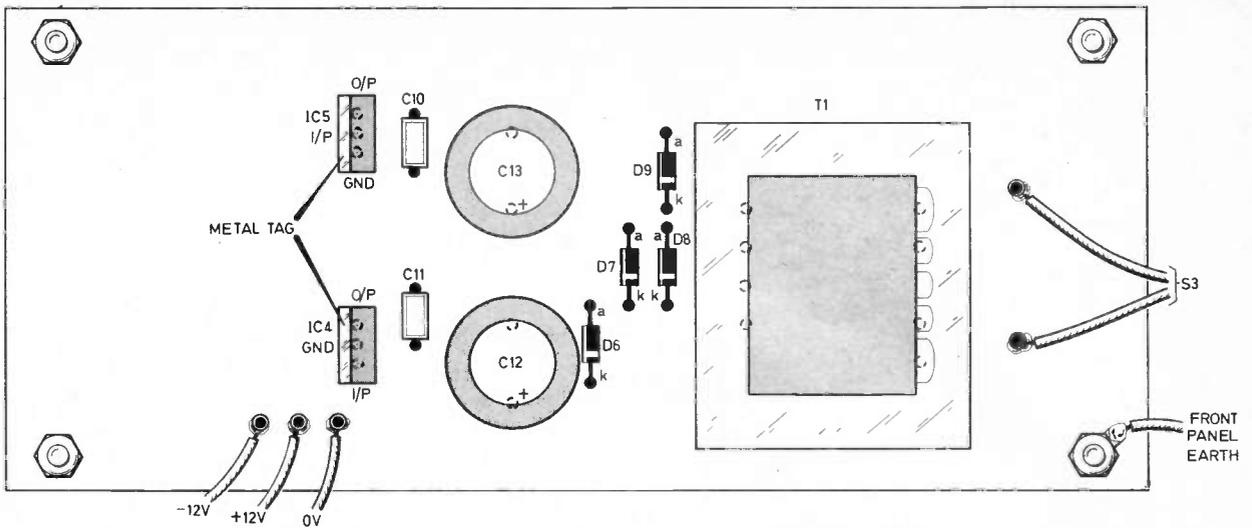


Fig. 3. Component layout (above) and full size printed circuit board master (below) for the power supply board (p.c.b.1).

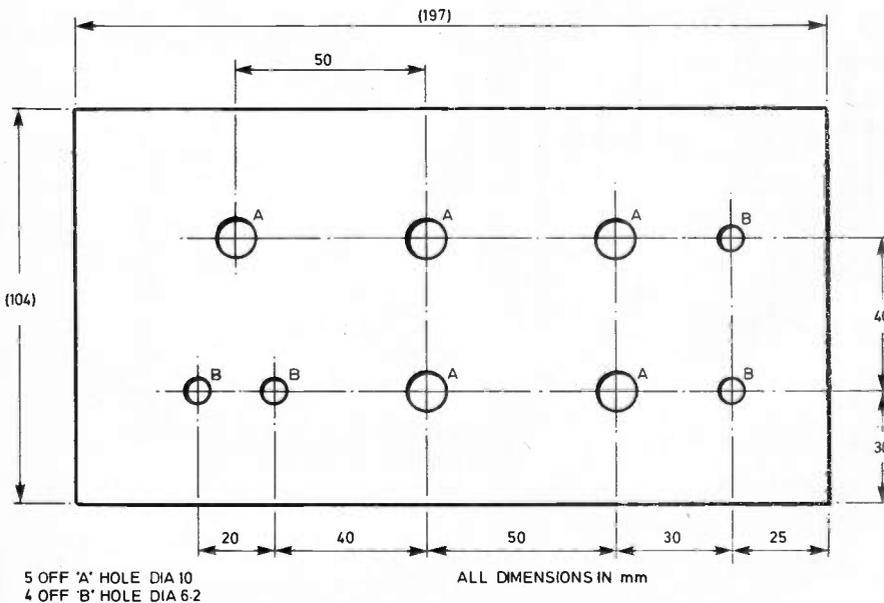
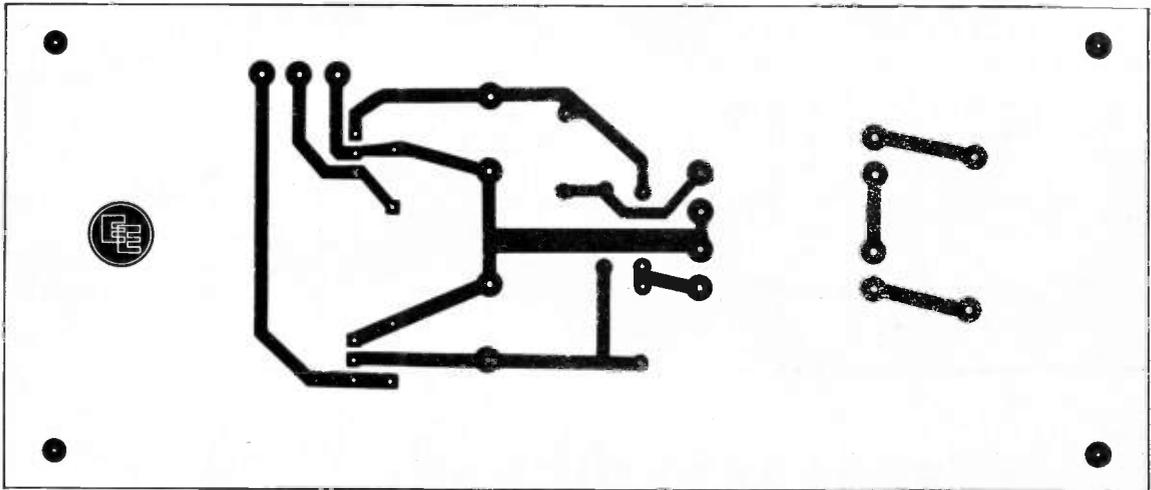
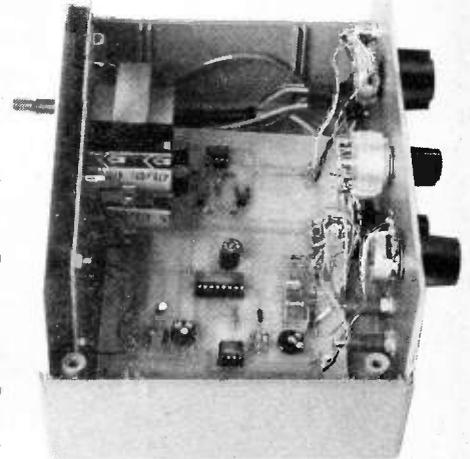


Fig. 4. Drilling details for the aluminium front panel.



Positioning of the waveform generator board (p.c.b.2) and the power supply board (p.c.b.1) inside the case of the completed unit.

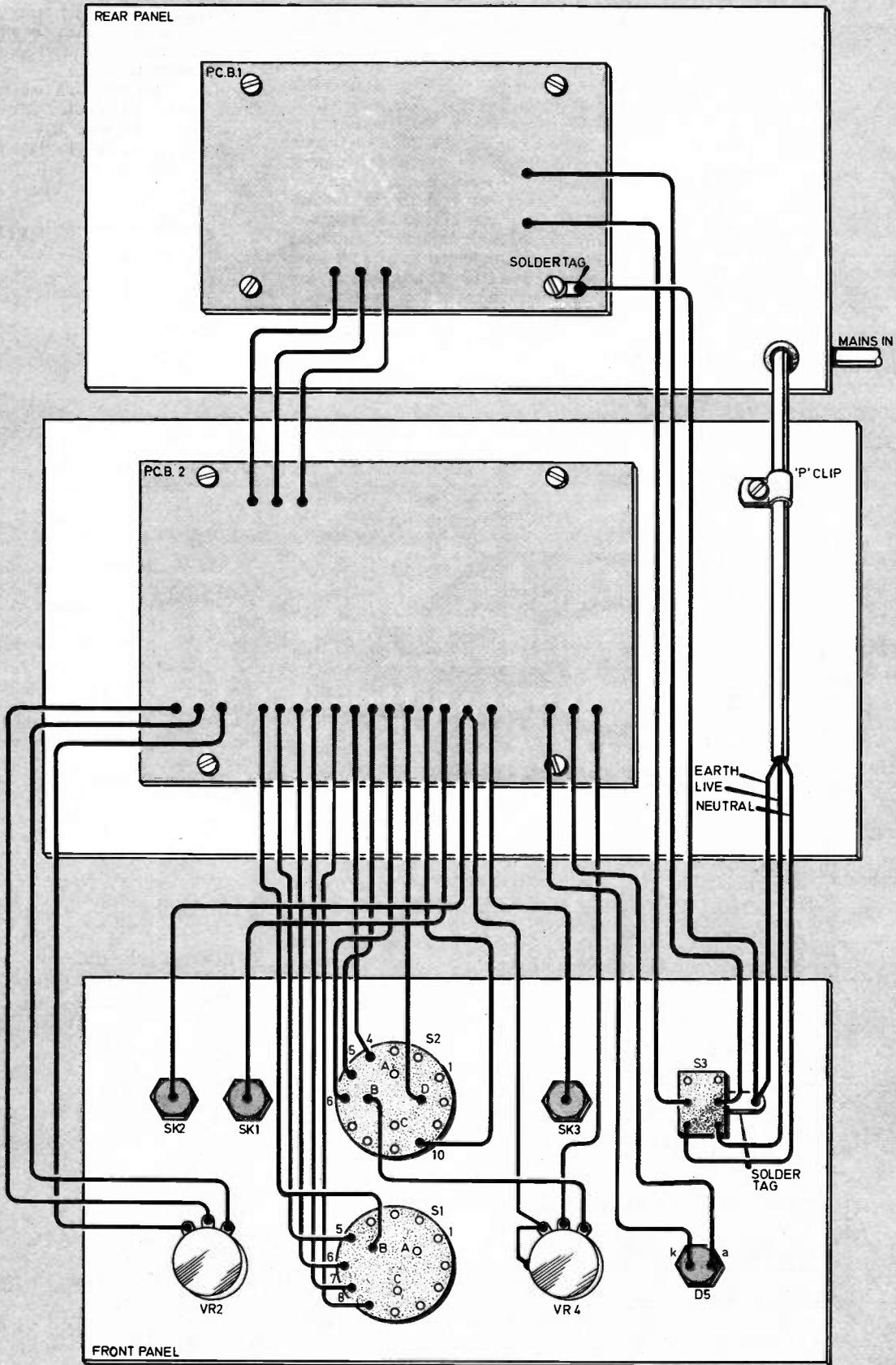


Fig. 5. Interwiring details for the front, base and rear panels.

power supply before connecting it to the main board. Carefully connect a mains input to the board and measure the d.c. outputs; they should be $\pm 12V$.

When the supply is working, the final assembly can be completed. Solder 150mm lengths of stranded wire to the Veropins and it will help if several different colours are used.

CASE

The Function Generator is housed in a Verocase type 202-21036C. The main circuit board is situated in the bottom half of the case, the moulded pillars in the base are used together with the self-tapping screws supplied. The second p.c.b. containing the power supply section is bolted to the rear panel using 8mm long spacers and M3 screws.

The drilling details for the front panel are shown in Fig. 4. The diameter of some of the holes may need to be adjusted to suit the actual components used.

The generator p.c.b. is screwed to the pillars in the base of the case using self-tapping screws. With the front panel in place the other ends of the flying leads can be attached. In general, the wires should be kept short and the wiring should be similar to that of the prototype, this being necessary to avoid interaction and crosstalk. Interwiring details are given in Fig. 5.

The output socket on the prototype was a b.n.c. type and while these are commonly used on commercial instruments, they are rather expensive and can be replaced by the cheaper phono type.

TESTING AND CALIBRATION

Having checked the wiring for mistakes, set both presets (VR1 and VR3) to their mid positions. Connect a loudspeaker to the output of the Function Generator, then turn the unit on. A tone should be heard from the loudspeaker. Check the functions of the controls; the AMPLITUDE control should alter the loudness and the FREQUENCY controls the

The completed wiring to the board and front panel mounted components prior to inserting inside the top and bottom sections of the case.

tone (only the lower end of the highest frequency range is audible).

The calibration procedure depends very much on the equipment available. An oscilloscope is really essential for accurate calibration.

Amplitude. The amplitude of the sine and triangular waves is adjusted by VR3. Set the output of the unit, with S2, to squarewave position and measure the output amplitude. The preset is then adjusted to give the same peak-to-peak amplitude as the squarewave.

This test can also be done with a multimeter. Set the meter to read about 5V a.c. and the Function Generator frequency to the centre of the lowest range. Measure the amplitude of the squarewave output with the AMPLITUDE control turned fully up, then switch to the triangular wave output and adjust VR3 to give a reading of half the original reading.

Frequency. There is no facility to adjust each range, only one control which sets the minimum frequency. Although individual calibrated scales can be made for each range, this was not thought to be essential.

There are two methods of setting the minimum frequency. The first is to use an accurate oscilloscope and measure the output against the timebase.

However, for those without access to any test equipment, copy the scale as shown in Fig. 6 and position this scale behind the frequency control potentiometer. Fasten a suitable knob to the spindle so the stops line up with those on the scale. Adjust the knob to read about 4.4 and set the FREQUENCY range switch to 100 to 1kHz (that is 440Hz).

During test card transmissions on BBC2, a 440Hz signal is broadcast for a period of four minutes on the hour. With the speaker again connected to the output of the Function Generator, it can be tuned by ear to the 440Hz signal from the TV set.

The unit can, of course, be calibrated with a digital frequency meter (perhaps a local technical college could help).

IN USE

The Function Generator will provide all the low frequency signal an enthusiast will require. To obtain maximum benefit from it, an oscilloscope is required. The reverse is also true in that an oscilloscope is of greater use with a signal generator.

Bandwidth test can however be carried out using an audio frequency a.c. voltmeter. The unit can be used as a signal injector, couple the signal to the circuit under test with a 0.1 μ F capacitor, as the Function Generator output is d.c. coupled.

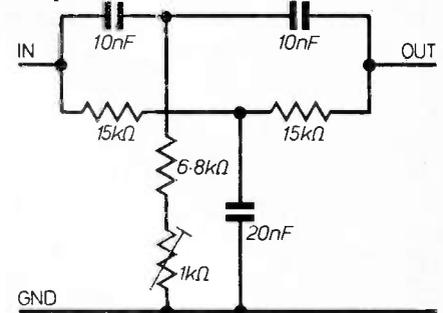


Fig. 6. Circuit diagram for a notch filter used in THD measurements.

MEASUREMENT OF THD

The notch filter shown in Fig. 7 was constructed using carefully selected components. The centre frequency of the filter is around 1kHz. By careful adjustment of the oscillator frequency and fine trimming of the filter using the 1 kilohm preset, the minimum output was observed on a scope. The r.m.s. value of the input and output of the filter were then measured, using a true r.m.s. multimeter (100kHz bandwidth).

The total harmonic distortion (THD) is given by:

$$THD = \frac{\text{output}}{\text{input}} \times \frac{100}{1} \%$$

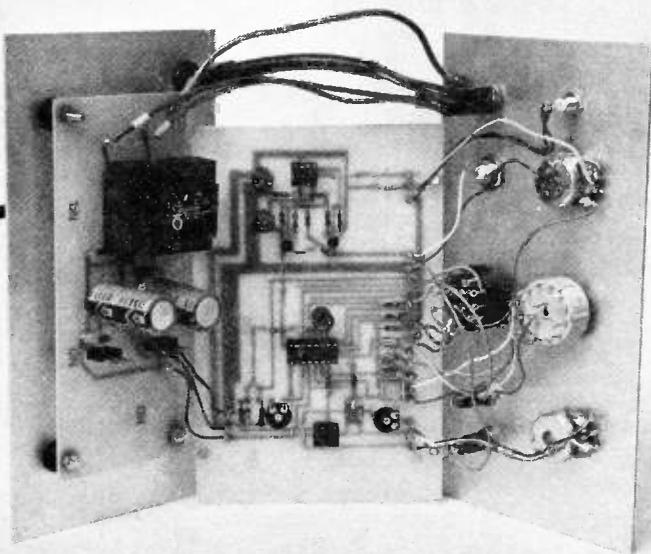
For the example shown in the oscillogram, the measurements of input and output were as follows:

$$\begin{aligned} \text{Upper trace (output)} &= 21\text{mV r.m.s.} \\ \text{Lower trace (input)} &= 4\text{V r.m.s.} \end{aligned}$$

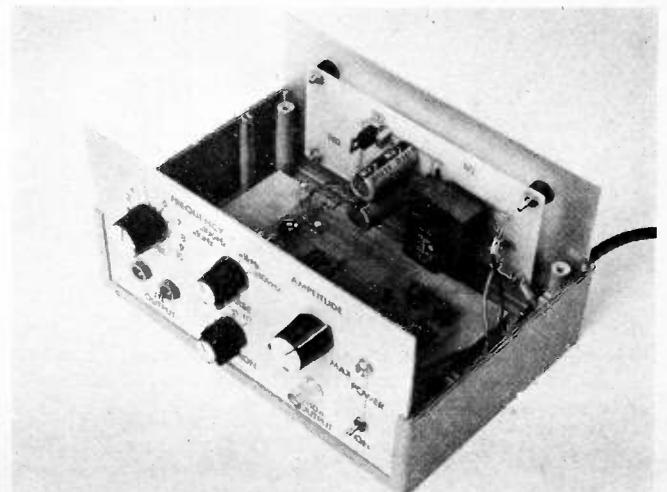
Therefore

$$THD = \frac{21 \times 10^{-3}}{4} \times \frac{100}{1} \% = 0.5\%$$

These measurements were taken from the prototype Function Generator using a dual beam oscilloscope. □



Power supply board mounted on "bushes" on the rear panel.





Novelty Egg Timer

BY L. S. COOK

MODERN electronics provide a means of creating devices which, although now taken for granted, would not have been so simple in the days of the thermionic valve. An obvious example is the omnipresent "timer", which appears in numerous guises in countless applications.

Yet another is featured here, as one intended to assist in that commonplace culinary activity of boiling an egg!

DISCRETE COMPONENTS

Perhaps "modern electronics" is not an accurate description for the timing section of this design, for it comprises discrete

components only and therefore the "middle ages of electronics" would seem more appropriate! However, this gives the constructor the satisfaction of actually building the Timer and not merely plugging in an i.c.

One i.c. is utilised in the circuit, in the alarm section, which produces both an audible and visual indication that the timing period has expired.

When sounding, the alarm section draws a current of about 3mA (from a 9V supply) and during the timing period, the circuit requires only 20µA. Thus the humble PP3 9V battery will be quite adequate.

The timing period is continuously variable from one to eight minutes on a virtually linear scale.

CIRCUIT DESCRIPTION

The timing element of the circuit depends on two basic principles: the charging of a capacitor through a resistor; and the voltage required between the base and emitter of a transistor to allow it to conduct.

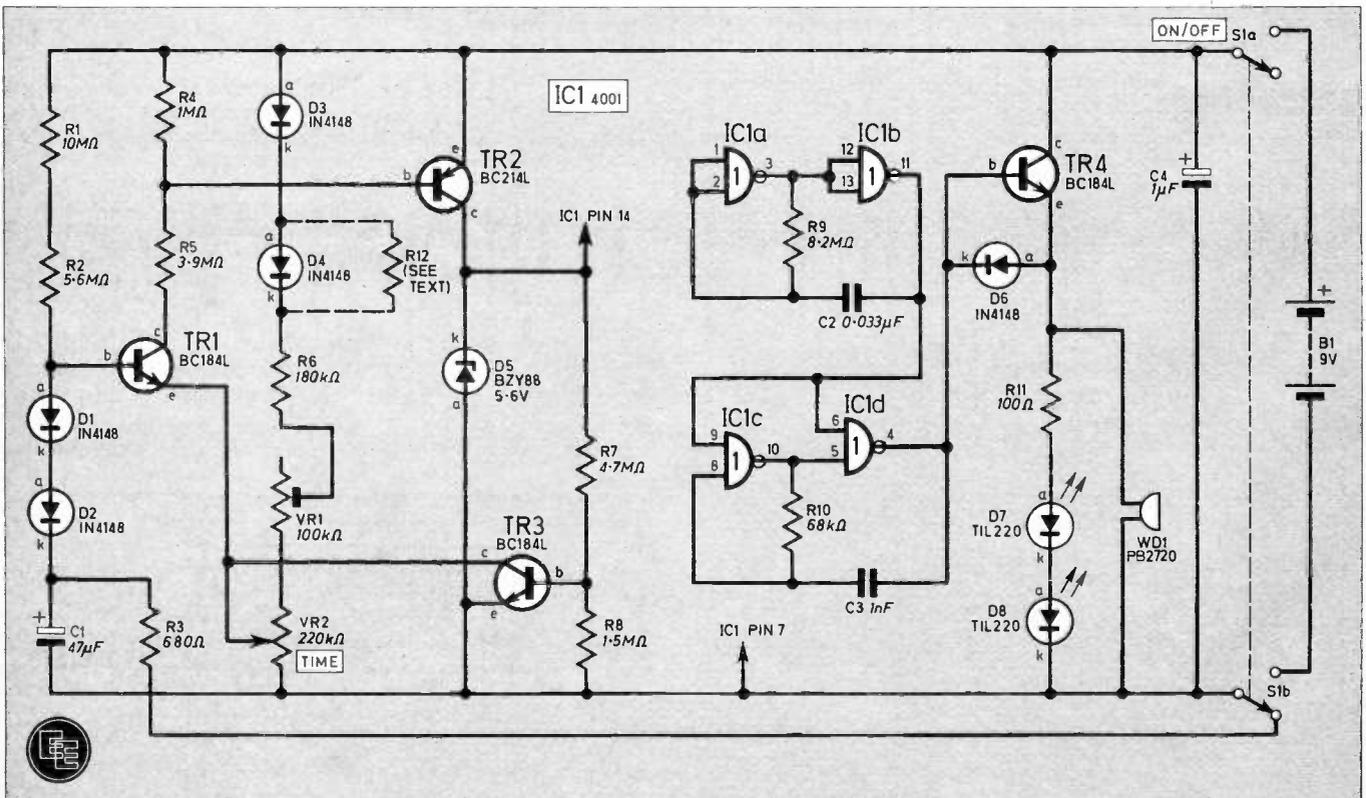
Referring to the circuit diagram in Fig. 1, the transistor in question is TR1 and the resistance and capacitance are R1 + R2 and C1, respectively. High stability resistors are strongly recommended for this application and a tantalum bead capacitor for C1 is essential for its low leakage and relatively stable properties.

When the supply is connected via S1, C1 charges through R1 + R2. Once the potential at the base of TR1 is about 0.5V above that at its emitter (this can be adjusted with VR2), this transistor starts to conduct. However, initially, the current flowing is very small and the rate of increase is too low to be of use, so TR2 amplifies the collector current.

This turns on TR3 which pulls down the potential at the emitter of TR1, thus accelerating the "switch-on" of TR1. With the whole cycle, about 5.6V (stabilised by Zener diode D5) rapidly appears at the collector of TR2.

Before TR1 conducts, R4 and R8 ground the bases of TR2 and TR3, respectively, to reduce the leakage current through these transistors which could

Fig. 1. Complete circuit diagram of the Novelty Egg Timer.



otherwise have a noticeable effect at the low currents involved.

DIODES

Diodes D1 to D4 are included to help make the circuit independent of supply voltage. It can be shown that this is achieved if the voltage drop across each of these pairs of diodes is equal to the junction potential of TR1. Two diodes are required in each position in this case since at the low currents involved, the drop across just one diode is considerably lower than that at the base-emitter junction of a transistor.

Owing to slight variations in characteristics between components even of the same type, it is possible that the voltage drop across D3 and D4 is too great; resistor R12 would reduce this and could be included if it is found that the timing varies with supply voltage.

D1 and D2 also prevent C1 from discharging through TR1 when it starts to conduct.

In order to produce a near linear scale on the dial, a logarithmic law potentiometer is required for VR2 to follow the rate at which C1 charges. VR1 is included for calibrating the Timer.

The voltage now established at the collector of TR2 supplies power to IC1, a CMOS 4001 quad 2-input NOR gate. This enables the square-wave oscillator consisting of IC1a, IC1b, R9 and C2. At a frequency of between 1Hz and 2Hz, this intermittently enables a second oscillator, formed by IC1c, IC1d, R10 and C3. The frequency of the second oscillator has been chosen to cause the transducer, WD1, to resonate with sufficient loudness.

The two l.e.d.s D7 and D8 (the "eyes") and WD1 are connected in the emitter

COMPONENTS

Approx. cost
Guidance only **£4.50**

See
**Shop
Talk**
page 217

Resistors

R1	10M Ω
R2	5.6M Ω
R3	680 Ω
R4	1M Ω
R5	3.9M Ω
R6	180k Ω
R7	4.7M Ω
R8	1.5M Ω
R9	8.2M Ω
R10	68k Ω
R11	100 Ω
R12	see text
All $\frac{1}{4}$ W carbon film $\pm 5\%$	

Capacitors

C1	47 μ F 6V tantalum bead
C2	0.033 μ F polyester (C280)
C3	1nF ceramic disc
C4	1 μ F 35V tantalum bead

Semiconductors

D1-4,6	1N4148 silicon (5 off)
D5	BZY88 C5V6 5.6V Zener
D7,8	TIL220 5mm red l.e.d. (2 off)
TR1,3,4	BC184L <i>nnp</i> silicon (3 off)
TR2	BC214L <i>pnp</i> silicon
IC1	4001B CMOS quad 2-input NOR gate

Miscellaneous

VR1	100k Ω miniature horizontal preset
VR2	220k Ω logarithmic control
S1	d.p.d.t. sub-miniature slide switch 19mm between fixing centres
WD1	PB2720 piezo electric transducer
B1	PP3 9V battery
0.1in matrix stripboard, 10 strips by 24 holes; PP3 battery clip; 14-pin d.i.l. holder; 7/0.2mm wire (assorted colours); rigid wire (for links).	

Case materials

2mm dia. galvanised steel wire (approx. 2.7m long); aluminium mesh, 250 x 150mm (as used to repair rust holes in car bodies); two-part resin filler such as Plastic Padding or Isopon (*not* the smallest size); 13mm thick balsa wood (often sold in bundles of off-cuts); plastic screw cap (35-40mm dia.); thin plastic sheet; foam rubber; glue; paint; assorted fixings.

circuit of TR4, so the current taken by IC1 is kept low and the wastage through D5 at higher supply voltages (such as with a fresh battery) is minimised. D6 provides the discharge path required by WD1 at the bottom end of the square-wave and C4 provides decoupling.

C1 is discharged through R3 when S1 is switched off ready to start the next timing cycle.

CIRCUIT BOARD

Most of the components are mounted on a readily available piece of stripboard, 10 strips by 24 holes, on a 0.1in matrix. Owing to the necessary compactness, five wire links are required on the *trackside* of the board and many components are mounted upright.

When shaping the leads of the vertically mounted components, grip the leads

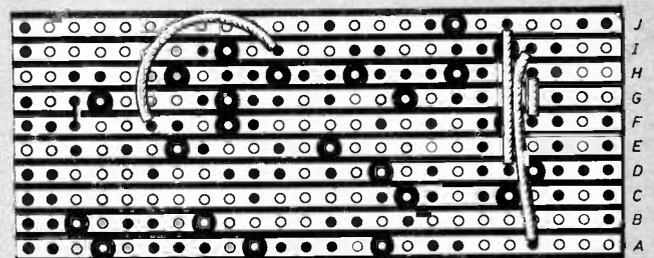
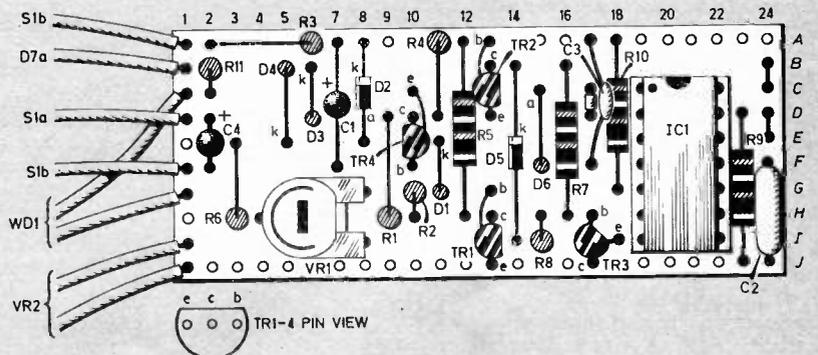
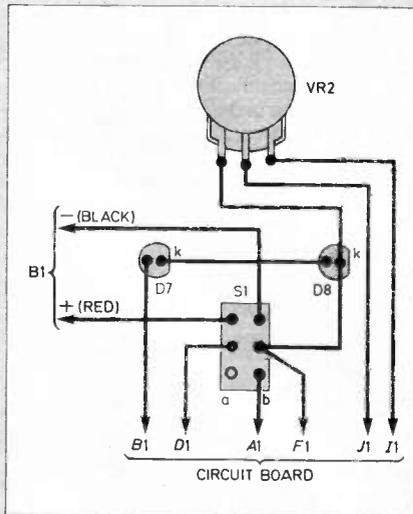
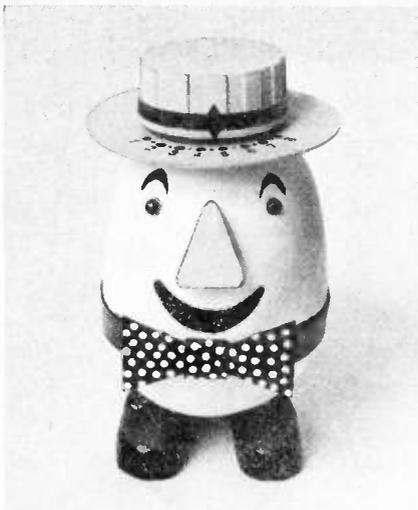


Fig. 2. Stripboard layout and underside view of the Egg Timer circuit board. Note the links on the underside. Inset shows the wiring to components mounted in the casing.



firmly with a pair of long-nosed pliers close to the component body and bend the free end to the appropriate angle.

Commence by making the 23 breaks on the underside of the board as shown in Fig. 2, using a special track-break tool or a small drill bit. Then solder the links on to the track (solder) side using insulating wire.

The other half of Fig. 2 also shows the top (component) side of the board. Solder in the i.c. holder, VR1, and the three wire links using insulated wire for the link under C3.

The remainder of the components can now be assembled, leaving the semiconductors until last to avoid the risk of possible damage.

It may be found that the value of R10 given does not provide the ideal frequency for the transducer WD1 (again, variations occur in components of the same type), so this resistor should be soldered in with its leads at full length. This is a good method of connecting any select-on-test components as it makes replacement far easier later on.

The resistor can be firmly soldered in once the optimum value has been ascertained.

CHECKING

Check very carefully the positions of all components, remembering the orientation of all diodes and polarised capacitors. Ensure that there are no fragments of copper or blobs of solder shorting the adjacent tracks. Attach flying leads, approximately 150mm long, to all appropriate points.

At this stage it is worthwhile testing the circuit, so connect the switch S1, potentiometer VR2, l.e.d.s D7 and D8 (one l.e.d. is sufficient for testing purposes), transducer WD1 and a battery connector. These components will need to be disconnected again before assembling into the case.

Set the switch to the "off" position. The preset VR1 (on the circuit board) is then adjusted so that its resistance plus that of R6 is equal to the full-track (max-

imum) resistance of VR2. The relevant measurements can be made with the components "in circuit" using the resistance range of a conventional multimeter with the negative (black) probe at the "top" end (in relation to the circuit diagram).

This adjustment is not critical; it slightly improves the linearity of the scale. If a suitable meter is unavailable, simply estimate the approximate setting of VR1.

Insert IC1, a fresh battery and set VR2 to about 100 degrees from a fully clockwise position and switch on. The alarm should be triggered after four to five minutes, but this must be timed reasonably accurately.

Switch off, then repeat the test on exactly the same setting of VR2, but with a 6V source. A difference of several seconds can be tolerated but if the discrepancy is too great, the additional resistor R12 may improve matters and a value of 470 kilohms can be taken as a starting point.

THE CASING

Before commencing, it is advisable to fully understand what is involved, as it is a lengthy operation requiring much patience. The method is outlined here with most details given in Fig. 3.

The measurements should only be used as a guide since it is virtually impossible to obtain the same results a second time. Also component sizes may vary slightly.

The case is built in two sections to permit access to the inside. Galvanised steel wire, 2mm in diameter, is used to form a framework for supporting an aluminium mesh to be covered with a two-part resin filler (such as Plastic Padding).

The feet and nose are cut and shaped from balsa wood, the crown of the hat is a screw cap from a discarded container (or a large control knob) and the brim of the hat and the bow-tie are cut from thin plastic sheet.

WIRE FRAME

To make the loops in the wire, and to tighten the supporting struts on the framework, a pair of strong (electricians) pliers are used. It is helpful to form the loops for the l.e.d.s (eyes) before the wire is coiled, their centres to be about 360mm and 390mm from the top end of the wire.

Ensure that the l.e.d.s fit, and also, after shaping the frame, check that the potentiometer, the switch, and the transducer will fit in the correct positions in order to make the "face".

Add the three aluminium mesh pieces, which are placed between the vertical struts, and secure by folding them over at the top and bottom. The mesh is slightly malleable but some creases are inevitable and these must be well flattened.

The bottom half is fashioned in the same way ensuring that it mates up with the top piece.

The resin filler is usually supplied with a separate hardener and as it hardens very rapidly when mixed, use only a small quantity at a time. When coating the mesh, press the filler paste firmly into the spaces and remember to leave holes for the l.e.d.s and the switch tang.

When sufficiently hardened (after about 20 minutes), sand smooth with a coarse grade silicon carbide paper ("wet and dry"); any cracks or irregularities appearing can be refilled later. File smooth any wire that protrudes above the profile of the egg shape and clean up the holes for the switch and l.e.d.s.

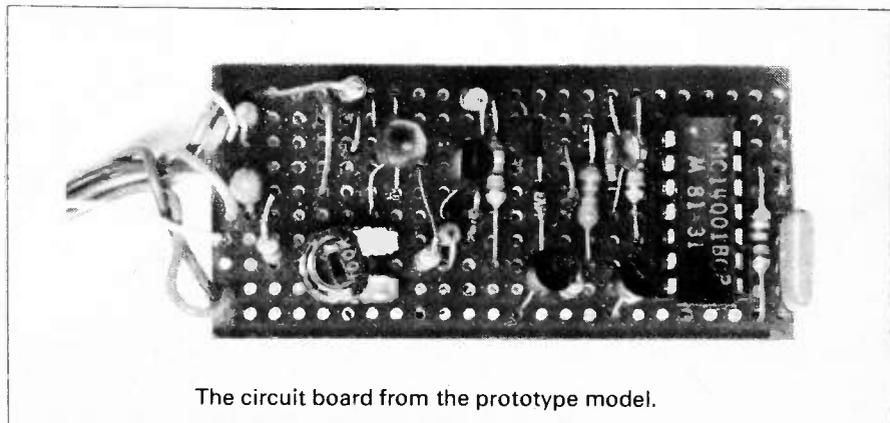
Make two additional mounting holes for the slide switch at either end of the elongated "nose" hole and a further two mounting holes for the transducer. A neat sound hole is also required in the mouth position.

ASSEMBLY

Secure the slide switch in position with two small screws, sinking the screw heads below the surface. Either small self-tapping screws (counter-sunk heads) or screws with suitable nuts can be satisfactorily used here.

Add the transducer in the same manner but note that this component will not lay flat against the inside of the body due to the curvature of the "egg" shape. Insert the two l.e.d.s and preform their leads carefully with pliers if necessary.

The feet are made from 13mm thick balsa wood blocks as shown in Fig. 5 and shaped to fit the contour of the base section of the egg. A hole about 7mm in diameter is required between the feet to allow for the fixing screw of the two halves. Attach the feet with glue and two small screws in each.



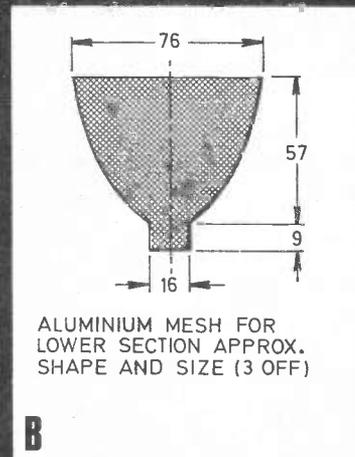
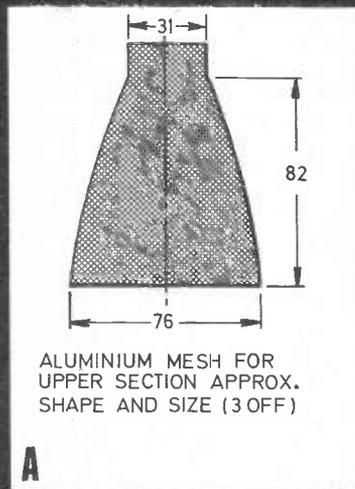
The circuit board from the prototype model.

Novelty Egg Timer

PLASTIC CAP WITH Balsa BLOCK GLUED INSIDE WITH RECTANGULAR HOLE AT CENTRE

POINTER BAND GLUED ON

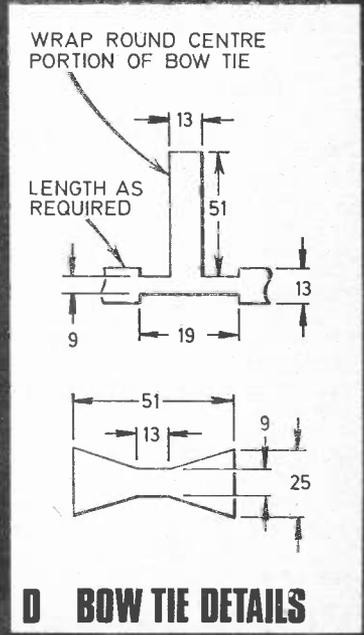
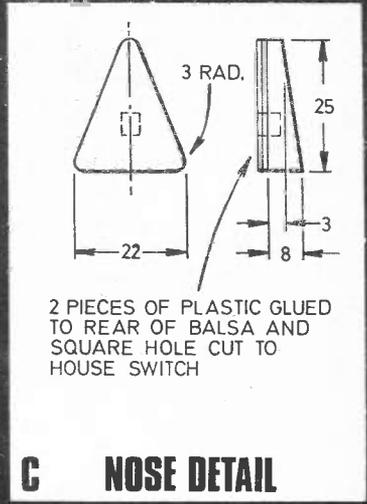
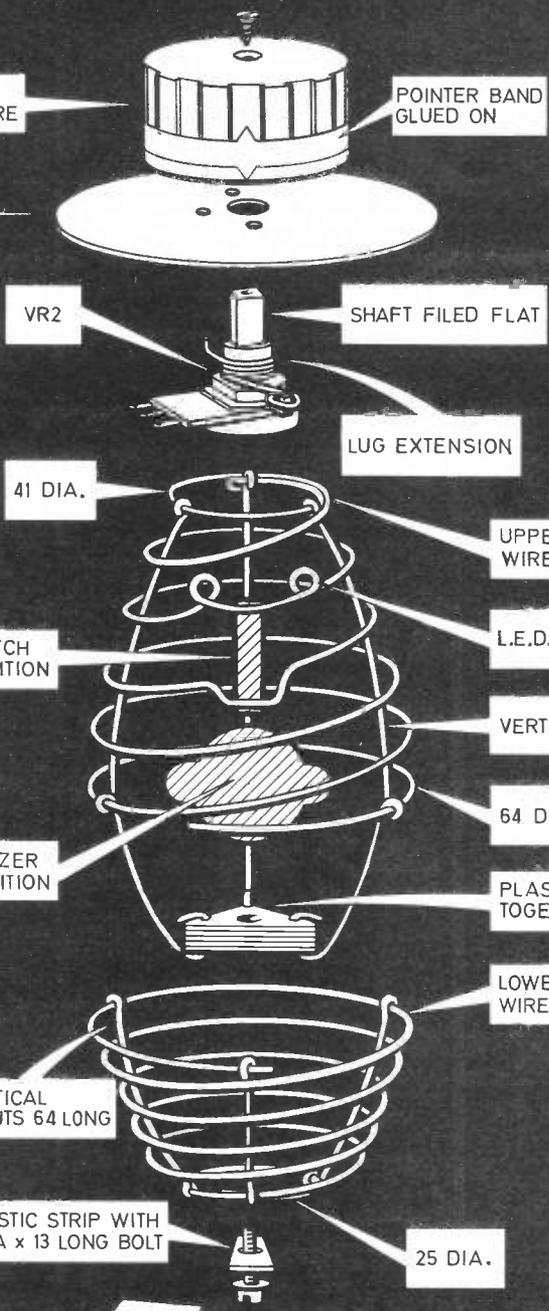
PLASTIC DISC 76 DIA.



Balsa BLOCK 64 x 25 x 13 GLUED TO 25 x 19 x 13 BLOCK TO FORM FEET

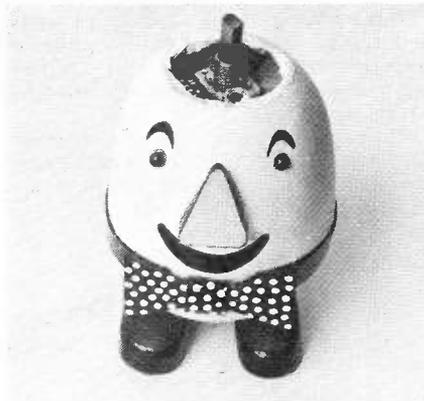
ALL DIMENSIONS IN mm

FIG.3 EXPLODED VIEW SHOWING CONSTRUCTION BEFORE CASING





Novelty Egg Timer with the hat crown removed showing the mounting of VR2.



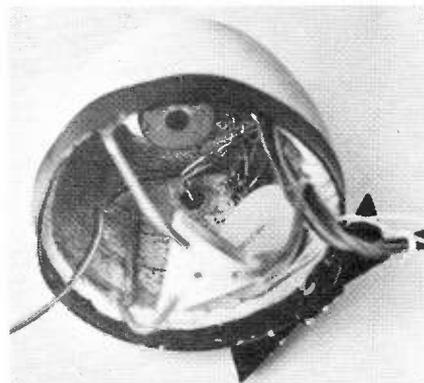
Two screws remove the brim and free the potentiometer.



The two halves of the case can be clearly seen, the bottom half showing the wire frame. Photograph (right) shows a close-up of the wiring inside the top half of the case.

The final layer of filler can now be applied to cover the sunken screw heads, fill the gaps around the joints of the feet and any other irregularities. If desired, the whole body can be covered with a thin coat of filler and then gently dabbed with a damp sponge to achieve an egg-shell texture. When dry, the whole body can be given a coat of paint.

The nose is fashioned from another piece of balsa wood and glued to the tang of the switch. The bow-tie is cut from a



thin plastic sheet and glued to the top half of the body so that it overlaps the lower section. This conceals the joint.

POTENTIOMETER

The brim of the hat holds the control potentiometer, VR2, in place. It is made from a piece of thin plastic (or strong card), 75mm diameter. A 10mm diameter hole is cut in the centre to hold VR2, and the brim is then fixed to the top section

with two screws into the loops formed by the wire.

The crown of the hat is made from an old screw-cap from a plastic container. A large block of balsa wood is glued into the crown and a hole is drilled in the centre of this to attach it to the spindle of VR2.

The final wiring can now be completed, keeping all wires about the same length to make it possible to withdraw the board from the body.

A piece of foam rubber (not the conducting type) is wrapped around the circuit board and the battery, and these are inserted into the top section. More foam rubber can be added for additional support.

CALIBRATION

With WD1 in place, the optimum value for R10 can be found. Values in the range 56 to 82 kilohms can be tried. When the resistor producing the best (loudest) effect is found, it can be soldered permanently in place.

Turning the hat fully clockwise will enable the alarm to sound immediately on switch-on.

To calibrate the Timer, make a temporary mark on the crown of the hat. Note the times obtained on several different settings and make light pencil marks on the brim to correspond to the mark on the crown. This can be done onto a piece of tracing paper placed on the brim to prevent damaging the paint.

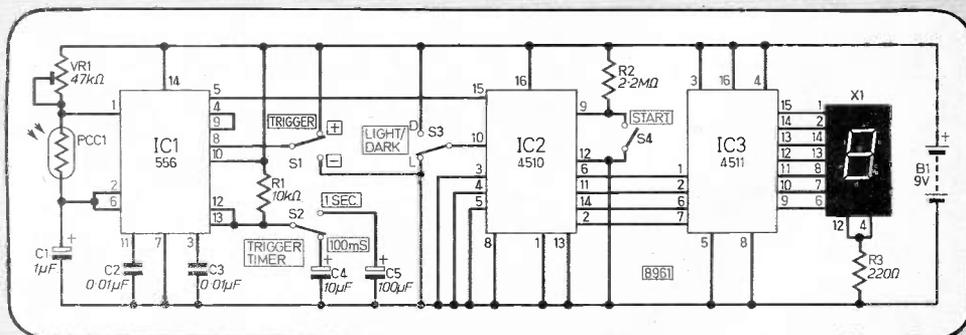
When sufficient marks have been made to cover the range one to eight minutes, mark the positions of whole and half minutes. This may require a certain amount of estimation—remember that the scale is not exactly linear. These positions can be checked with a watch or clock with a second hand.

Shift the marks so that they appear at the front and make them permanent using Letraset type dry-print transfers. A hat band with a pointer completes the Novelty Egg Timer. □

CIRCUIT EXCHANGE

DIGITAL DARKNESS/LIGHT MEASURER

THIS circuit consists of the dual monostable/astable multivibrator chip 556 wired up as an astable multivibrator which works for 1 second or 0.1 second (selected by S2). The b.c.d. counter 4510B counts how many times the multivibrator vibrates in 1 second or 0.1 second, as controlled by VR1, and the 4511B decodes this counting on to the l.e.d. display X1.

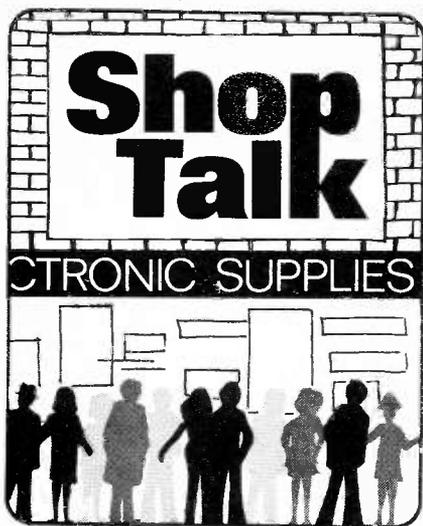


To operate, select how many seconds you want (1 or 0.1), select whether you want it to perform as a light measurer or a darkness measurer, release the start switch until a "0" appears on the display and then turn it back on again, and then pull the trigger switch from negative to positive. You can also adjust the preset

resistor VR1 until the unit is working satisfactorily.

Philip Dalton,
Barkton,
Cheshire.

MORE ON PAGE 232



By Dave Barrington

Self-Feed Soldering Iron

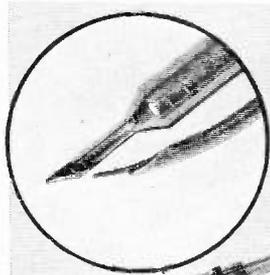
As one of the most common causes of poor soldering can often be tracked down to bad technique and to the person not feeding the soldering iron and solder simultaneously to the intended joint. Even though the proposed connection has been thoroughly cleaned, feeding the solder to the iron tip and then applying the iron to the join runs the risk of a poor or "dry" joint. Unless, of course, the components have been pre-tinned first the solder will not "flow" using this method.

We appreciate that adopting the correct procedure sometimes means wishing for a "third hand", where ever possible the solder and iron tip should always be applied simultaneously to the work piece.

A self-feed soldering iron would certainly help overcome these problems and possibly pay for the additional outlay in terms of time-saving and bad soldering.

One such iron has just been brought to our attention and is being marketed by Gardner Precision Engineering, and, as far as we are aware, is the only type at present offered for sale.

The soldering iron handle is transparent and the flux-cored solder is "visually" housed in the handle and fed down a stainless steel tube to the iron bit. The solder is dispensed by operating a knurled wheel with the index finger of the hand holding the iron.



The new self-feed soldering iron from Gardner Precision Engineering.

The soldering iron is rated at 18 watts and comes complete with 4 metres of solder. Replacement of the solder is carried out by removing a spring clip and inserting a refill.

The cost of the iron is £14.95 and further details can be obtained from Gardner Precision Engineering, Dept EE, North Road, Woking, Surrey GU21 5DS.

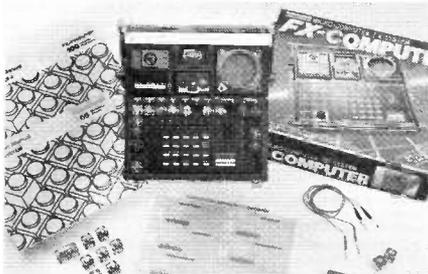
Computer Kit

We have just received the new FX Computer Kit and first impressions are that it appears an ideal "training tool" for an introduction to electronics and computing.

The kit consists of two instruction manuals containing details of computer and electronic projects, keyboard module, component "bricks" or cubes, and a moulded case which acts as the experimenters "test bed".

There are 100 programs/65 electronic projects provided with the FX Computer Kit (cost £69.95 plus £3 for p&p) and is available from Electroni-Kit Ltd., Dept EE, 388 St John Street, London EC1V 4NN.

We shall be publishing a full report in our May issue.



The FX Computer Kit from Electroni-Kit.

CONSTRUCTIONAL PROJECTS

ZX Spectrum Amplifier

The case used in the prototype model of the ZX Spectrum Amplifier was made from a sheet of 18 s.w.g. aluminium. However, there are numerous plastics cases stocked by advertisers that could be used provided the chosen speaker fits inside.

One of the general "potting" cases would be suitable and a black version would match nicely with the Spectrum. If a plastics case is used remember to "common" the sockets as shown in the circuit with a length of wire "trapped" between the case and the metal body of each socket.

The 400mW audio amplifier, LM386, is listed by Cricklewood, Greenweld, Rapid, and TK Electronics.

The push-on, push-off latching p.c.b. type switch is stocked by several advertisers, including Maplin, Greenweld and Tandy. The volume on/off switch is one of the types commonly used in radios and usually sold as "thumbwheel" potentiometers, incorporating on/off switch.

The volume control, with integral switch, used in the authors model was obtained from Maplin and was purchased with a "press-on" plastic knob. These are listed as Edge Controls under their Resistor section—order No. BW06G. The large "thumbwheels" should be ordered as: BW10L (Edge Knob Large Grey).

If one of the common "radio" potentiometers are used, it may be necessary to re-position the circuit board to enable the control knob to protrude through the side of the case.

Test Gear '83—Function Generator

Most of the semiconductor devices listed for the *Function Generator*, Unit Two of our Test Gear '83 series, should be available from most semiconductor stockists.

However, the waveform generator type XR2206 appears to be only available from Technomatic Ltd., Dept EE, 17 Burnley Road, London NW10 1ED. They also stock the complete list of semiconductors

The Siemens capacitors are stocked by Electrovalue.

Car Radio Power Booster

The 20W dual power amplifier type TDA2004 used in the *Car Radio Power Booster* is available from most of our semiconductor advertisers and should not cause too many purchasing problems.

When building this project be sure to connect the "earth" lead to the heatsink of IC1 as outlined in the article. Also, be sure to check the power ratings of your car speaker system.

Flanger Sound Effect

All components for the *Flanger Sound Effect* are available from Maplin Electronic Supplies. The semiconductor devices are also stocked by Cricklewood, Rapid, Watford and Technomatic.

When purchasing the push-button toggle switch, S1, be sure to specify the heavy duty "foot-operated" type as these are especially robust and more suited to the "heavy" treatment that this unit is likely to be subjected to.

Novelty Egg Timer

The resin filler for the "body" of the *Novelty Egg Timer* should be available from most motor spares shops or from most branches of Halfords. It may be possible to use one of the "Potato Man" kits from toy shops for making the figure.

The piezo alarm transducer is now stocked by most advertisers.

Expanded Add-on Keyboard for the ZX81

The keyboard and additional key switches and "tops" for the *Expanded Add-on Keyboard for the ZX81* are available from Redditch Electronics, Dept EE, 21 Ferny Hill Avenue, Redditch, Worcs B97 4RU.

BY T.E. IVALL C.Eng., M.I.E.R.E.

WHEN we store a piece of information such as a telephone number, we record it in some place where it can be easily referred to and read. And to allow us to find it easily when we want it, we identify and label the **storage location** in some way.

These simple requirements for notebooks, files, card indexes and the like apply equally to the electronic storage of information in IT systems.

ANALOGUE AND DIGITAL STORES

First we should remind ourselves that there are two fundamentally different forms of electronic storage: analogue and digital. They work on equivalent principles to the analogue and digital methods of representation discussed in the December 1982 issue.

With analogue storage, an electrical quantity is made proportional to some physical quantity in the outside world. One familiar example is in the diode detector used in a.m. radio receivers, Fig. 6.1.

Here the capacitor *C* stores a charge which, through the action of the diode and the capacitor-resistor time constant, varies in proportion to the amplitude of the audio signal modulating the incoming r.f. carrier. Obviously this is a very temporary storage—from one r.f. half-cycle to the next.

USE OF TWO-STATE DEVICES

Digital stores, on the other hand, hold separate numbers or other characters, in the form of discrete electrical symbols. In most IT systems, in fact, they store the binary digits of the already encoded digital information.

As we saw in the previous article, any information can be represented in two-state form by a variety of devices, and this principle applies equally to digital storage. The most common two-state storage devices are based on current flows, electric charges and magnetisation.

For example, to store an alphanumeric character encoded as a group of 8 binary digits (bits) we could use a row of 8 binary capacitors as shown in Fig. 6.2. Each capacitor is either charged, to represent "1", or uncharged, to represent "0". As distinct from the analogue capacitor store in Fig. 6.1, the actual value of the "1" charge is of no significance: it only has

to be distinguishable from the "0" uncharged condition.

The same row of capacitors could be made to hold different patterns of charge/no charge, by suitable electronic switching, and so store a variety of 8-bit characters. This principle is, in fact, used in one type of integrated circuit memory which allows its stored contents to be repeatedly changed—the **dynamic random access memory (DRAM)**.

CONCEPT OF BIT CELL

Each capacitor in Fig. 6.2 can be considered as a cell for storing a single binary digit, 1 or 0. This concept of the "bit cell" applies, in fact, to all digital stores. For example, a row of on/off switches acting as bit cells (see Fig. 2.2, December issue) can store binary information put in by hand.

An electronic circuit widely used as a bit cell is the bi-stable or flip-flop. As shown schematically in Fig. 6.3, one stable state constitutes the storage of a 1

bit while the other stable state constitutes storage of a 0 bit.

Here the binary information is stored as sustained current flows and non-flows through the semiconductor devices forming the flip-flop. The principle is used in i.c. semiconductor memories such as the **static random access memory (SRAM)**.

MATRIX ORGANISATION

To organise the capacitor of flip-flop bit cells into a complete workable store requires a good deal of electronic circuitry. Semiconductor i.c. memories are organised on the matrix principle shown simplified in Fig. 6.4. This type of array is convenient for manufacture, economical in connections and suited to the bus systems (February article) used in digital computers.

The location of each bit cell—its **address**—is identified by the connecting conductors which intersect at that cell. For example, the bit cell shown in black is at the intersection of row conductor *B* and column conductor 3.

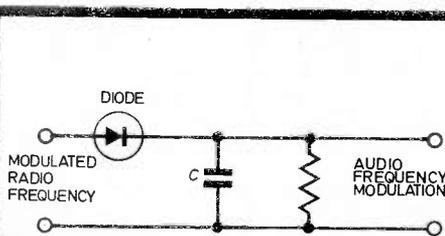


Fig. 6.1. The capacitor *C* in this diode detector circuit is an example of an analogue store. The charge it holds varies in proportion to the amplitude of the signal modulating the incoming r.f. carrier.

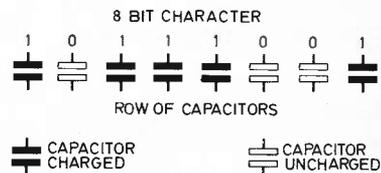


Fig. 6.2. Row of capacitors providing bit cells to store a group of binary digits. Each charged capacitor represents a 1 bit stored and each uncharged capacitor a 0 bit stored.

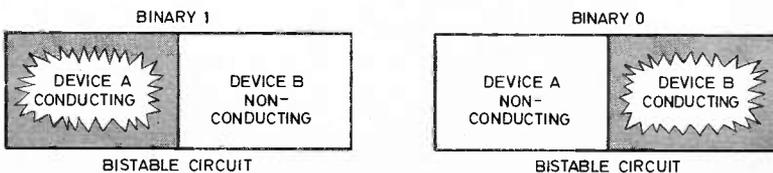


Fig. 6.3. A bit cell can be formed by a bi-stable or flip-flop circuit made from two interconnected semiconductor devices, A and B. Binary information is stored by current flow being maintained in either one half (A) or the other half (B) of the bi-stable (one half "on" and the other "off").

The matrix arrangement provides a means of calling-up, or "addressing", a whole group of bit cells—for example: 8 cells for an 8-bit character. In addition there are connections to carry the bits to be written-in or read-out, to command the whole store to either write or read, to bring the store into operation or hold it out of action and, of course, to supply power.

As an example, a small semiconductor memory has 32 rows and 32 columns of conductors, giving access to $32 \times 32 = 1024$ bit cells*. Since $1024 = 2^{10}$ this memory can be addressed from 10 pins on the i.c. package.

MAGNETIC STORES

This matrix organisation is also used in magnetic core memories. Here the bit cells are small ferrite rings which are switched electromagnetically between two opposite-polarity saturated states of magnetisation to constitute storage of 1s or 0s. Magnetism is, of course, a most useful form of information storage and is exploited most commonly in disc and tape stores.

The physical principle employed is similar to that of the ordinary tape-recorder, in that a moving medium is magnetised by an electromagnet fed by electrical signals—but with an important

* Incidentally, this explains why i.c. semiconductor memories do not have storage capacities in nice round decimal numbers like 1000 or 10,000 bits. Note that whereas 1000 is represented by the symbol k (abbreviation for kilo-), 1024 bits is abbreviated to K. So a 64K memory, for example, has a capacity of 65,536 bits.

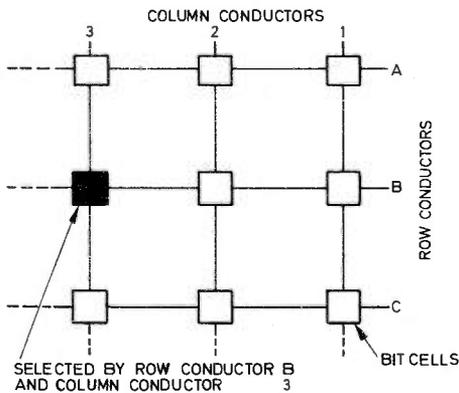


Fig. 6.4. Matrix organisation of semiconductor i.c. memories. Any bit cell can be "called up" or addressed, for writing a digit into it or reading a digit out of it, by means of the pair of connecting conductors, row and column, which intersect at that cell.

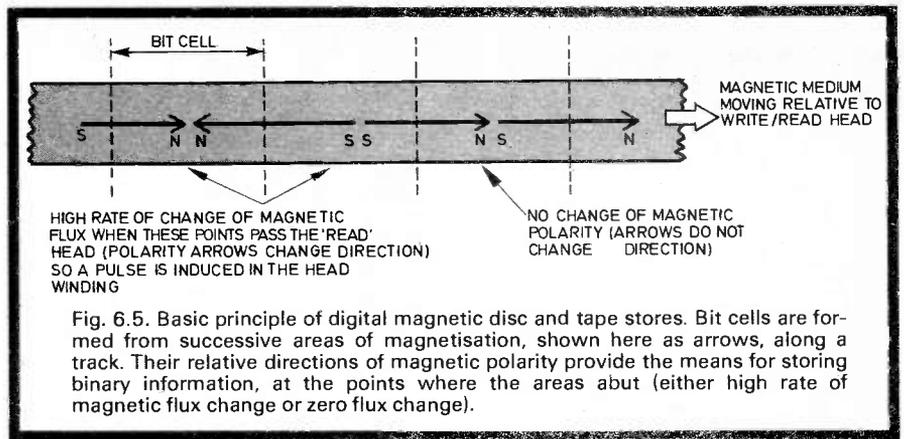


Fig. 6.5. Basic principle of digital magnetic disc and tape stores. Bit cells are formed from successive areas of magnetisation, shown here as arrows, along a track. Their relative directions of magnetic polarity provide the means for storing binary information, at the points where the areas abut (either high rate of magnetic flux change or zero flux change).

difference. A tape-recorder for audio or video signals stores *analogue* information, whereas the corresponding tape store for IT systems holds *digital* information.

In disc or tape stores the bit cells are areas of magnetisation with different polarities formed along a track in the moving medium. There are, of course, two possible directions of magnetic polarity along a track, *N-S* and *S-N*, and these are used to constitute the binary digits 1 and 0 as shown in Fig. 6.5. Usually the same electromagnet, or magnetic head, is used for both writing and reading.

USE OF FLUX CHANGES

Each bit cell is located at the point shown in Fig. 6.5, where one area of magnetisation abuts the next one. If the

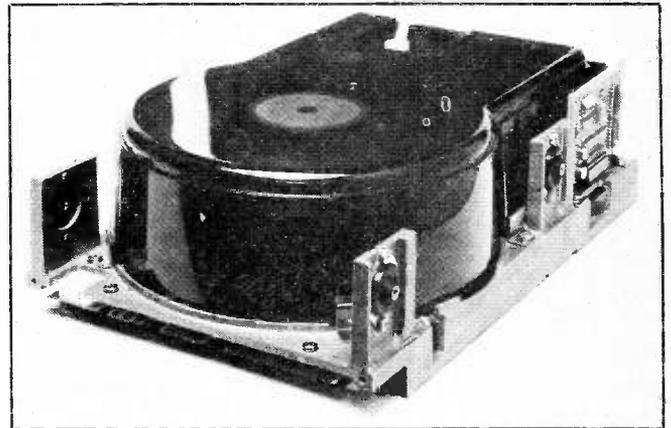
two adjoining areas have opposite directions of polarity a high rate of change of magnetic flux is created when this point in the medium moves past the head and so induces a pulse in it on read-out. This pulse could represent a 1 bit.

When two adjoining areas of magnetisation have the same direction of polarity there is no such change of flux and consequently no pulse from the reading head. This condition could represent a 0 bit.

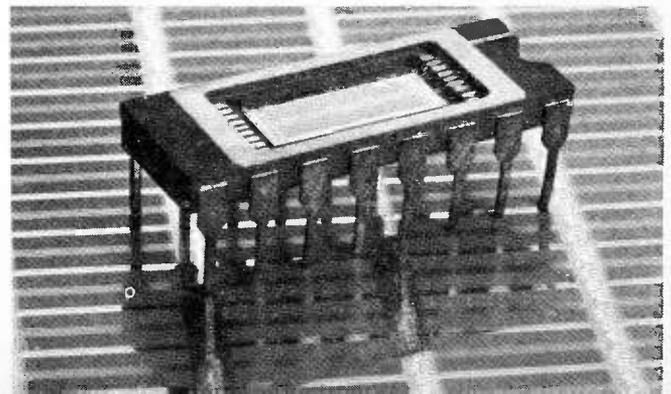
ELECTRONIC LOGIC—THE INFORMATION OF STATES

IT systems also use electrical quantities to represent a different kind of information from that discussed so far. Here the electrical symbols stand for *states* or conditions in the outside world rather than physical quantities—for example,

This magnetic disc store from Thorn EMI Datatech has a storage capacity of 11 megabytes.



Semiconductor i.c. memory made by Siemens is a dynamic RAM with a storage capacity of 64K (65,536 bits).



the "on" state or "off" state of an electric motor rather than its speed, torque or any other such quantity. This is the province of **electronic logic**.

Nevertheless, among the various states which electronic logic can be used to manipulate are the two states of binary notation. So in this respect it can handle, indirectly, any physical quantity that might be encoded in binary form. This happens in the logic circuits of digital computers.

But fundamentally electronic logic is a mechanisation of the formal deductive logic taught as an academic subject—with its premises, true and false statements, valid and invalid arguments and so on. Historically it is one end of a long line starting perhaps with Aristotle, passing through the mediaeval scholars with their syllogisms, through symbolic logic and George Boole's logical algebra to the present age of computers.

LOGIC OF LIFT CONTROL

The best way to understand this side of information technology is by a concrete example. Let's suppose we want to control the electric passenger lift shown in Fig. 6.6. For safety reasons we want to make sure that the lift motor will start running only when a button in the lift is pressed *and* the lift doors are closed. A sensing switch detects when the doors are in fact closed.

Possible states of the button, the door sensing switch and the motor, are shown in Fig. 6.6, with a graphical symbol to represent each of these states. To clarify exactly what our control device, Fig. 6.7, is required to do, we can use these symbols to tabulate all the possible combinations of states of the button and switch, and, beside them on the right, put the symbols for the corresponding required states of the lift motor. See Table 6.1 below:

Table 6.1

a	○	◇	□
b	●	◇	□
c	○	◆	□
d	●	◆	■

In condition *a* both the button and the switch are not operated, and, of course, the lift motor must not be running. In *b* the button is pressed but the door switch is not actuated, so again the lift motor must not be running. In *c* the door switch is actuated but the button is not pressed, so once more the motor must not be running.

In *d*, however, both the button and the door switch are operated, so the motor should be running.

TRUTH TABLE

This logical breakdown of the required action of the control system is a **truth table**, like the truth tables used in deduc-

tive logic. The same table, in fact, could be written in terms of the *T* (true) and *F* (false) letter symbols commonly used in deductive logic, as we are concerned here with control devices which can have only two states—on and off.

For example, if at a given moment the statement "the button is pressed" is true (*T*), the contradictory statement "the button is not pressed" must be false (*F*), since the button cannot be pressed and not-pressed at the same time. So, to describe the two conditions of the button in this symbolism we really only need one statement, "the button is pressed", which can be labelled either *T* or *F*. Similarly for the states of the door switch and the lift motor.

Using this scheme the Truth Table 6.2 (below) would be:

"Truth" Table 6.2

	●	◆	■
a	F	F	F
b	T	F	F
c	F	T	F
d	T	T	T

where the first column refers to the button, the second to the door switch and the third to the lift motor.

It happens that this second table is the general truth table for a *conjunction* in deductive logic. As the name indicates, a conjunction is an expression consisting of two statements linked by the concept "and". For example, "(the button is pressed) **and** (the door switch is not actuated)" in our control problem. The truth table displays all combinations of true and false statements (here describing states) that are possible with a conjunction.

USING AN 'AND' GATE

We see, then, that the lift control requirements set out in the first table are satisfied by the truth table of the "and" truth-functional operator, as this is called in logic. So we need an electronic device that operates according to these conditions in this truth table.

In fact, this is provided by a device acting similarly to the electronic gate shown in Fig. 2.8(a) of the December 1982 article. This gate is, in effect, a coincidence detector—it produces an output signal when, and only when, two identical input signals are presented to it simultaneously.

A device of this kind working to the rules of the conjunction truth table is an AND logic gate. Its application to the lift control problem is shown schematically in Fig. 6.8—which is virtually the same as the "requirements" diagram Fig. 6.7.

Electronic logic gates used to be available as separate components but now, because of increasingly complex applications, they are usually grouped and packaged in various ways in integrated circuits. Their logic states, as shown in Fig. 6.8, are represented by

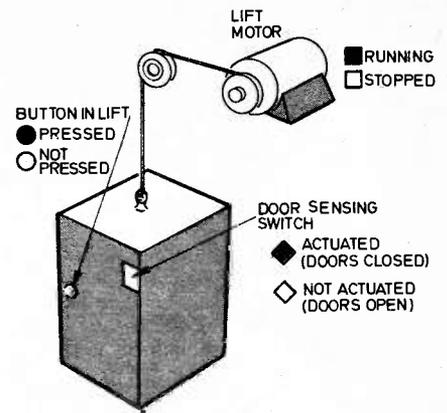


Fig. 6.6. Switching control requirement for this lift illustrates various "states"—information of the kind that electronic logic handles.

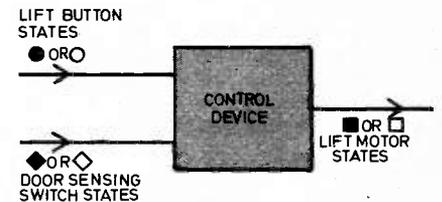


Fig. 6.7. Schematic of the logical system needed to control the lift motor from the button and the door sensing switch. The graphical symbols stand for the various states shown in Fig. 6.6.

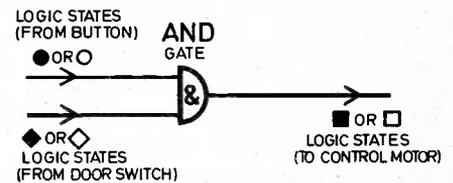


Fig. 6.8. The device which ensures the required control action for the lift in Fig. 6.6 is an AND logic gate. Compare this with the "requirements" diagram Fig. 6.7.

electrical symbols, for example, a high voltage signifying *T* in the Truth Table 6.2 and a lower voltage signifying *F* in the Truth Table 6.2.

As an illustration, consider the truth-function *b* in Truth Table 6.2. One input of the Fig. 6.8 AND gate receives a high voltage, signifying *T* ("button pressed" is true) and the other input receives a low voltage, signifying *F* ("door switch actuated" is false). As a result the AND gate output issues a low voltage signifying *F* ("lift motor running" is false) and this can be used to ensure that the lift motor is in the "stopped" or off state.

Other truth-functional operators and their truth tables can be mechanised in similar ways, producing electronic logic gates for negation (NOT), disjunction (OR) and the combinations of: negation with conjunction (NAND); and negation with disjunction (NOR). Two NAND gates can be interconnected to form the bi-stable circuit in Fig. 6.3, while two further NAND gates would convert this into a gated bi-stable or latch.

To be continued

Flanger

sound effect

BY R A PENFOLD

ALTHOUGH flanging is probably not one of the best known musical effects, it is undoubtedly one of the most interesting, and flangers seem to be rapidly gaining in popularity. It is a complex effect which is similar in some respects to the well known phasing effect.

One method of producing the phasing effect is to have a delay line that has a delay time which is automatically varied, and the delayed and undelayed signals

are then mixed. At some frequencies the two signals will be in-phase and will combine to produce "peaks" in the frequency response, and at other frequencies the two signals will be out-of-phase and cancel each other to produce "troughs" in the frequency response.

By varying the delay time the peaks and troughs are moved up and down the audio spectrum to produce the phasing effect.

FLANGING

The block diagram (Fig. 1) shows how this basic arrangement is modified to produce the flanging effect. All that has changed is that the mixer has been placed at the input of the delay line rather than at the output.

The two low-pass filters and the clock oscillator form part of the delay line. The clock oscillator controls the delay time, and by varying the frequency of this oscillator, the sweep oscillator gives the required variations in delay time.

By placing the mixer at the input of the delay line, a regenerative action is introduced into the system, and this has the effect of boosting the peaks in the frequency response.

A feedback control enables the intensity of the effect to be controlled, and this can be set to produce very large peaks in the frequency response and a very strong effect.

Although there is little difference between a delay line phaser unit and the Flanger, the flanging effect is more obvious when used with a complex signal.

DELAY LINES

The type of analogue delay line used in this application is the Charge Coupled Device (CCD) or "Bucket Brigade" delay lines as they are often called. These devices consist of a series of capacitors and electronic switches, with the input signal periodically applied to the first capacitor in the chain.

Before the capacitor takes each input sample, its charge voltage is passed on to the next capacitor in the series, then as the input is sampled, this charge is further passed on to the next stage in the series. Both these charges are again passed on before a further input sample is taken, and the existing charges are similarly passed along the chain. This action of passing on existing charges, then sampling the input while passing on existing charges is illustrated in Fig. 2.

Most CCD delay lines have between 512 and 4096 delaying stages, and the TDA1022 (IC2) used in this design is a 512 stage type. It is not possible to obtain an output direct from stage 512 of the device for two reasons. One is simply that, like every delaying stage in the line, the circuit alternates between carrying a charge and being discharged.

This occurs because each stage cannot simultaneously pass on its charge and take the charge from the previous stage, and the resultant "gaps" in the delaying stages are shown in Fig. 2. To overcome

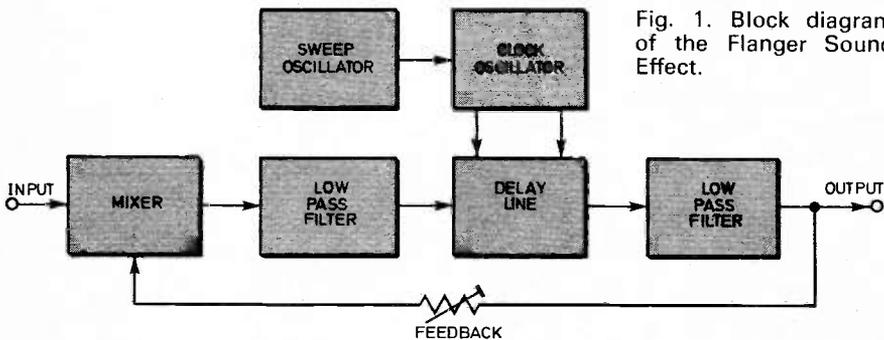


Fig. 1. Block diagram of the Flanger Sound Effect.

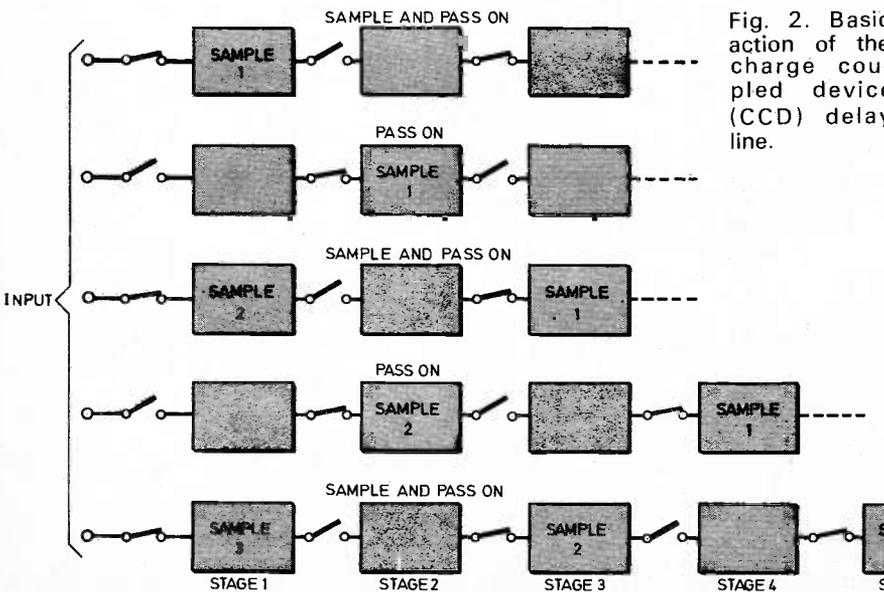
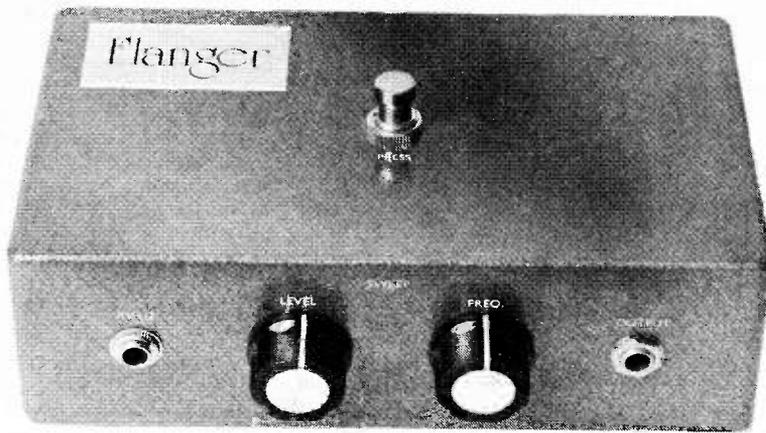


Fig. 2. Basic action of the charge coupled device (CCD) delay line.



kilohms. A controlled amount of feedback is taken from the output via VR1, and R4 gives a voltage gain of about 6dB (about two times) at the input of the mixer stage. A small amount of voltage gain is needed to compensate for losses through the delay line.

LOW-PASS FILTER

TR1 forms a simple low-pass filter having a cut-off frequency of about 12kHz and a nominal attenuation rate of 12dB per octave. This means the circuit has less than the full audio bandwidth of 20kHz, however, a 12kHz bandwidth is adequate in this application.

The point of having a low-pass filter at the input to the delay line is to remove any signals at frequencies close to the clock frequency, and thus prevent a form of distortion known as aliasing distortion. While audio signals should not have any significant components at high enough frequencies to cause aliasing distortion in this instance, it is not uncommon for electronic instruments to produce strong harmonics at frequencies well beyond the upper limit of the audio frequency range.

IC2 is the TDA1022 delay line device, and R9, R10 and R11 plus VR2 are used to provide two bias voltages for this i.c. The first bias voltage can be varied by means of VR2 and is used to bias the input of IC2 to give the optimum overload margin. The other bias voltage is fixed, a little under one volt, and is fed to pin 13 of IC2.

this problem, a 513th stage is added to the output, and the output of this is mixed with the output of stage 512.

Stage 513 then provides an output signal during the periods when stage 512 is unable to do so, and stage 512 provides an output signal when stage 513 cannot. Hence an output is always present.

STEPPED OUTPUT

The second problem is that the output voltage changes in a series of steps. If a high enough sampling rate is used, this can be overcome by using a low-pass filter at the output so that the high frequency component produced as the output jumps from one sample level to another are eliminated, and a smooth, continuous waveform is generated.

In order to obtain satisfactory results,

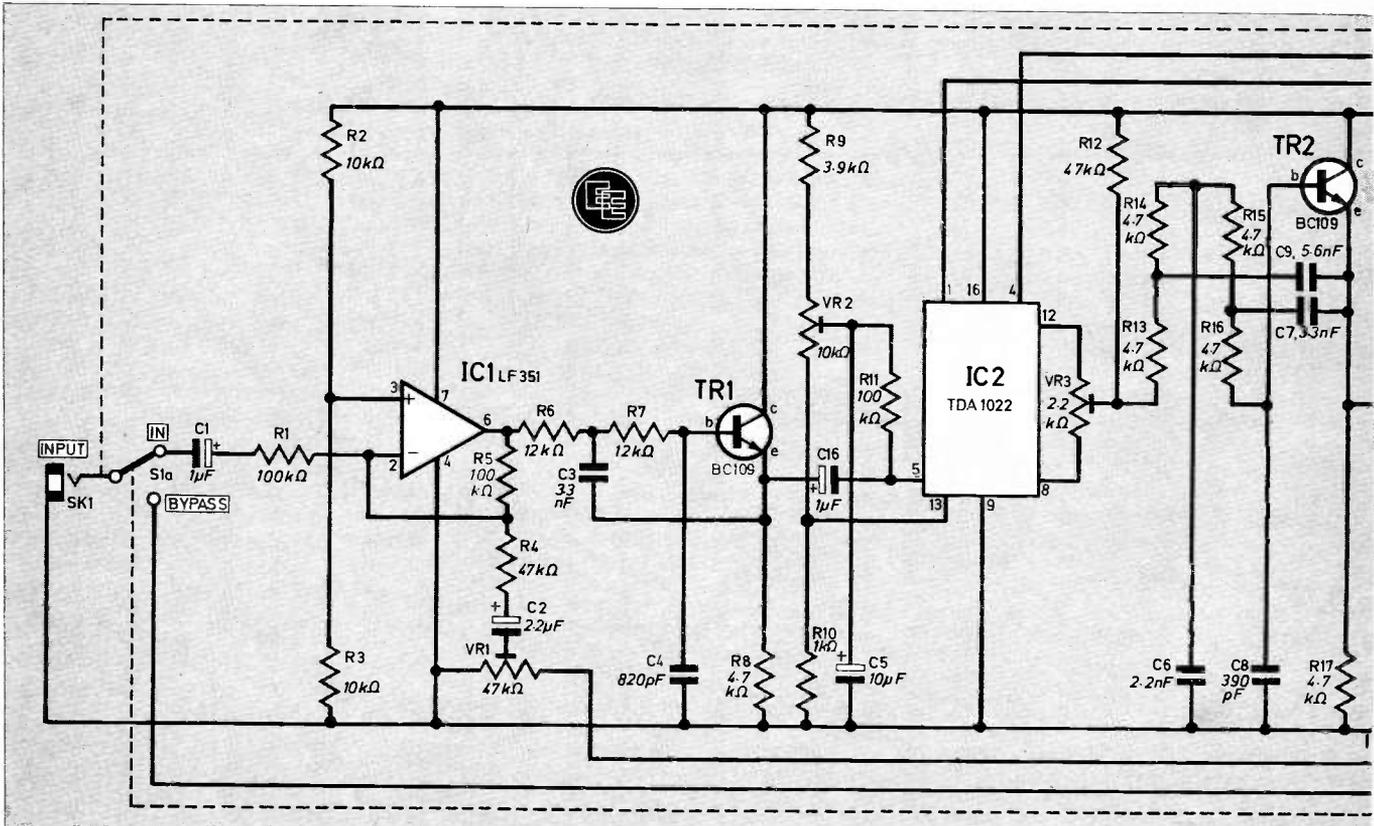
the sample rate should be more than three times the maximum input frequency. The sample rate is controlled by a clock oscillator.

The delay depends upon the number of stages and the clock frequency. Although it might be expected that dividing the number of delay stages by the clock frequency would give the delay time, it must be remembered that samples pass *two* stages down the delay line for each input sample. The delay time is therefore equal to the number of stages divided by *twice* the clock frequency.

CIRCUIT DESCRIPTION

Fig. 3 shows the complete circuit diagram of the Flanger. The input mixer stage, op-amp IC1, gives unity voltage gain and an input impedance of 100

Fig. 3. Complete circuit for the Flanger Sound Effect. The clock oscillator and voltage regulator is shown on the opposite page.



A simple passive mixer, VR3, is used to mix the outputs from stages 512 and 513 of IC2. This is adjusted to balance the outputs and give minimum breakthrough of the clock signal. R12 is the output load resistor for IC2.

The output of IC2 is effectively modulated with the clock signal, and it is necessary to attenuate this high frequency signal as it could have an adverse effect on any equipment the Flanger is coupled to.

A four stage active low-pass filter based on TR2 having a cut off frequency of about 12kHz and a nominal attenuation rate of 24dB per octave is used at the output of the delay line to counteract this.

S1 is used to switch in the Flanger or bypass it as required. Although there is a loss of about 5dB or 6dB through the circuit, the regeneration applied to the circuit effectively cancels out these losses, and there is no apparent change in volume as the flanging effect is switched in and out.

CLOCK OSCILLATOR

The clock oscillator must provide two antiphase clock signals. As can be seen from Fig. 2, the electronic switches in the delay line do not all open and close together, and effectively there are two sets of switches operating in antiphase. It is this that necessitates the two clock signals as the TDA1022 has no internal inverter to give the required out-of-phase operation of the two sets of switches.

The CMOS 4046 phase-locked-loop (IC4) forms the clock generator in this design and is used as a voltage controlled oscillator. One of the phase comparators of IC4 is used as an inverter to generate the two antiphase output signals. The operating frequency of IC4 is determined by the values of C13 and R20, and a control voltage applied to pin 9 can vary the frequency of oscillation over a very wide range.

SWEEP OSCILLATOR

The sweep oscillator uses a CMOS 7555 timer. VR4 controls the sweep oscillator frequency and gives a range of approximately 10Hz at minimum resistance to 0.1Hz at maximum resistance. VR4 is a logarithmic potentiometer as this gives better control at the high frequency end than can be obtained using a linear potentiometer.

The output waveform generated across C12 is roughly triangular, and this gives good subjective results when used as the sweep signal. With the wiper of VR5 at the positive supply rail end, the operating frequency of IC4 is quite high. The peaks and troughs in the frequency response of the circuit are therefore at quite high audio frequencies.

As the wiper of VR5 is brought down towards the other end of its track, the operating frequency of IC4 is swept over an increasingly wide frequency span. The peaks and troughs in the response of the circuit are then swept further across the

audio band. VR5 acts as a simple DEPTH control.

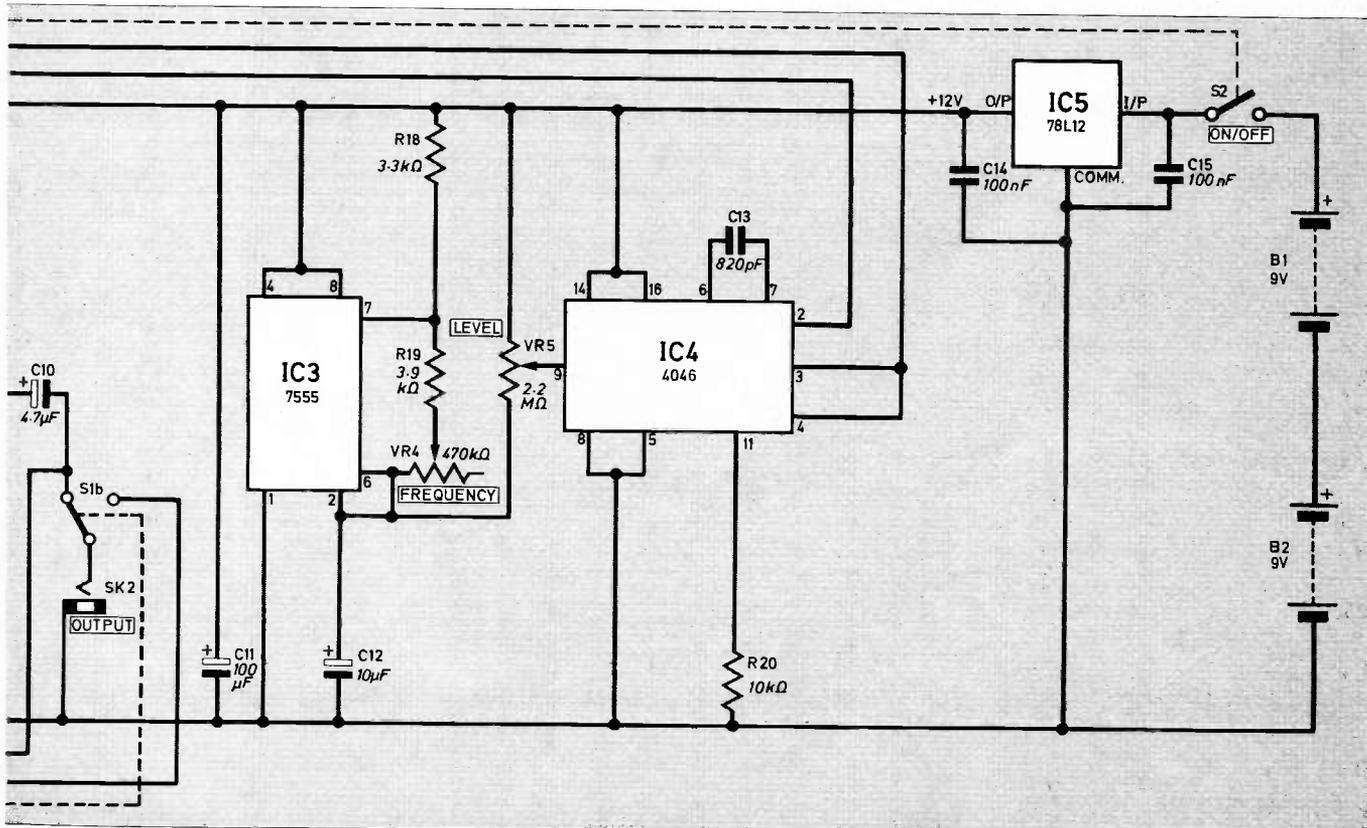
The circuit requires a 12V supply, stabilised to prevent drift in the clock oscillator frequency. Two 9V batteries in series together with a small 12V monolithic voltage regulator (IC5) are used to give a stabilised supply. S2 is the ON/OFF switch and on the prototype this is a set of make contacts on the input socket, SK1.

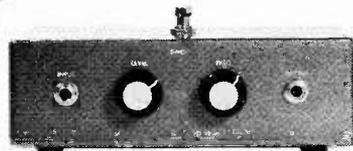


CIRCUIT BOARD

A piece of 0.1in matrix stripboard having 50 holes by 31 strips accommodates all the components except the controls, sockets, and batteries. A board of this size is easily produced by trimming five copper strips from a standard 50 holes by 36 strips board. Details of the component panel are shown in Fig. 4.

Both IC2 and IC4 are MOS devices, and neither are the cheapest of integrated circuits. It is therefore recommended that these should be fitted in 16-pin d.i.l. i.c. sockets, and the normal MOS handling





COMPONENTS

Manger

sound effect

BY R A PENFOLD

COMPONENTS
approximate
cost £23

Resistors

- R1,5,11 100kΩ (3 off)
- R2,3,20 10kΩ (3 off)
- R4,12 47kΩ (2 off)
- R6,7 12kΩ (2 off)
- R8,13-17 4.7kΩ (6 off)
- R9,19 3.9kΩ (2 off)
- R10 1kΩ
- R18 3.3kΩ
- All 1/4W carbon ±5%

Potentiometers

- VR1 47kΩ miniature horizontal preset
- VR2 10kΩ miniature horizontal preset
- VR3 2.2kΩ miniature horizontal preset
- VR4 470kΩ log. carbon
- VR5 2.2MΩ lin. carbon

Capacitors

- C1,16 1μF 63V elect. (2 off)
- C2 2.2μF 63V elect.
- C3,9 3.3nF polystyrene (2 off)
- C4,13 820pF polystyrene or ceramic (2 off)
- C5,12 10μF 25V elect. (2 off)
- C6 2.2nF polystyrene
- C7 5.6nF polystyrene
- C8 390pF polystyrene or ceramic
- C10 4.7μF 63V elect.
- C11 100μF 25V elect.
- C14,15 100nF polyester (2 off)

Semiconductors

- IC1 LF351 f.e.t. op-amp
- IC2 TDA1022 analogue delay line
- IC3 7555 CMOS timer
- IC4 4046B CMOS phase-locked-loop
- IC5 78L12 12V, 100mA voltage regulator
- TR1,2 BC109 silicon npn (2 off)

Miscellaneous

- S1 d.p.d.t. sequential heavy duty push-button
- SK1/S2 6.3mm jack socket with d.p.d.t. switched contacts
- SK2 6.3mm jack socket
- B1,2 9V PP6 batteries (2 off)

Stripboard, 0.1 inch matrix 50 holes by 31 strips; diecast case, 190 x 110 x 60mm; 16-pin d.i.l. i.c. sockets (2 off); control knobs (2 off); Veropins; 6BA screws, nuts, and 6.3mm long spacers; PP6 battery clips (2 off); 7/0.2mm wire.

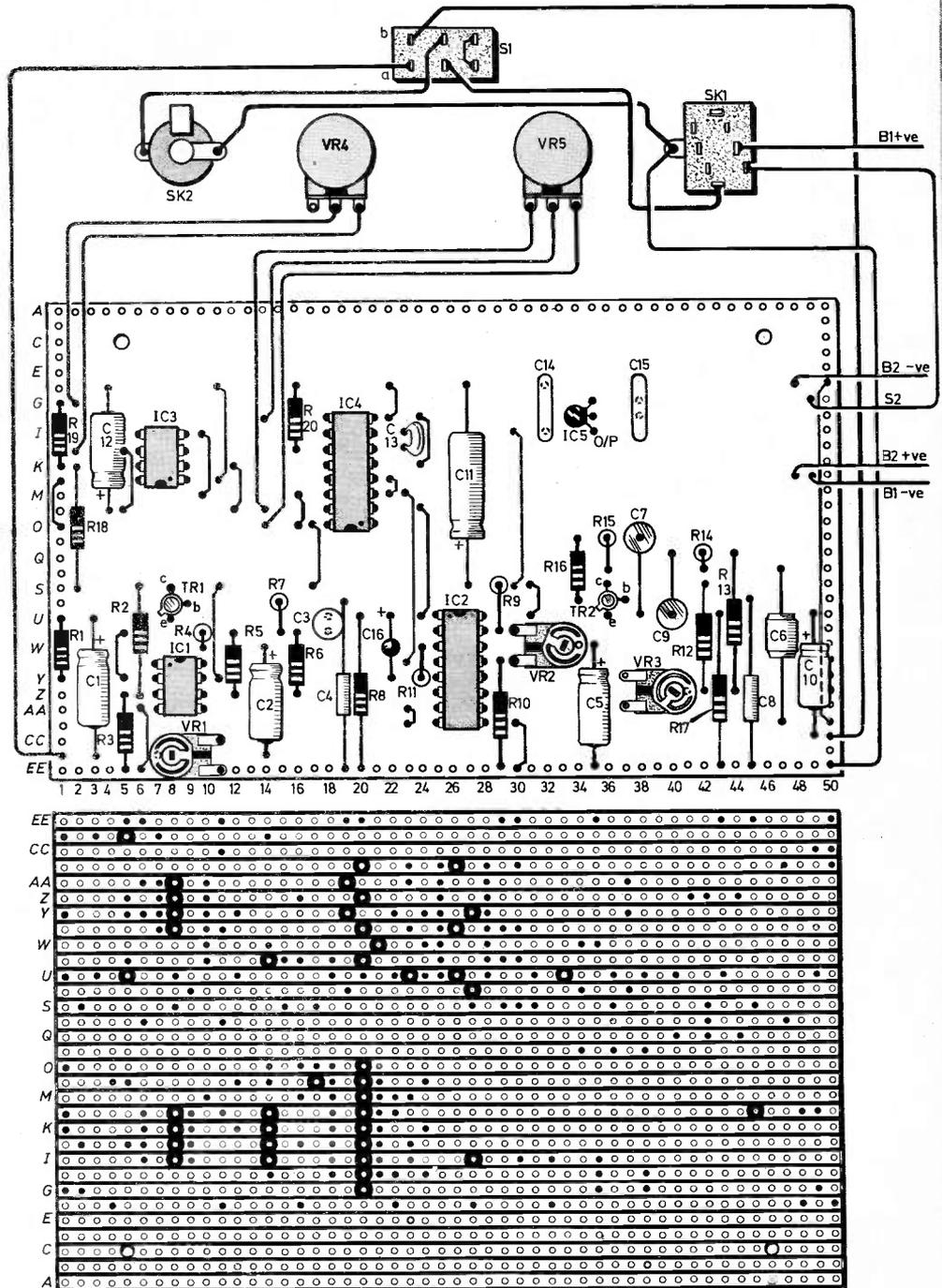


Fig. 4. Component layout, interwiring details and underside of the stripboard showing breaks (41) in the copper strips. The circuit board is mounted on the base of the diecast case and is shown in the photograph on the opposite page.

precautions should be taken. Although IC3 is a MOS device it has built in protection circuitry that eliminates the need for any handling precautions.

The use of pins at points on the board where wire connections will be made to the controls and sockets is advisable. The completed board is mounted to the base panel of the case using 6BA (or M2.5) fixings, including 6.3mm long spacers which prevent solder joints on the underside of the board from short-circuiting through the case.

Check the board thoroughly for mistakes before finally fitting it in place, making sure that none of the link wires or breaks in the copper strips have been omitted, and that there are no accidental short-circuits between copper strips due to solder blobs.

DIECAST BOX

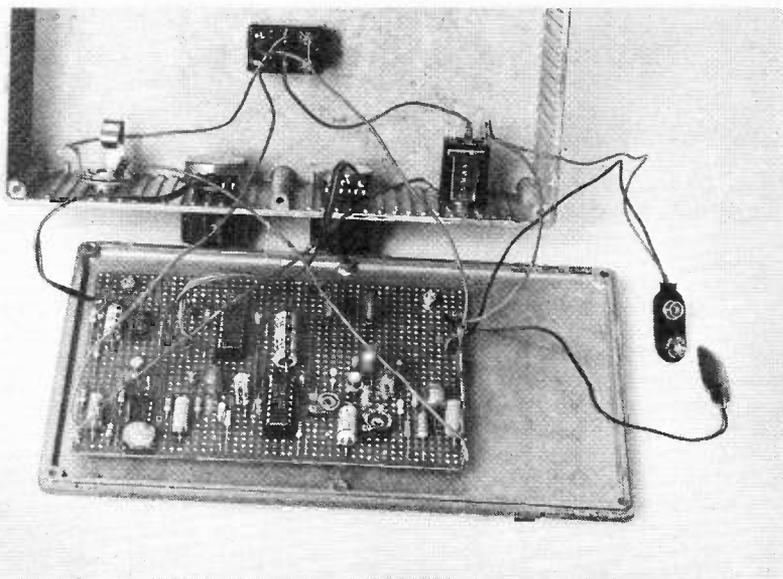
The specified case is a diecast aluminium box having dimensions of about 190 × 110 × 60mm, and this is a little larger than is absolutely necessary. However, it does house all the components without crowding, as well as providing a tough, screened case for the unit. It is used up-side-down so that the removable lid becomes the base panel.

S1 is mounted at the centre of the top panel of the case, and this switch is a heavy duty, sequential operation, push-button type. This enables S1 to be operated by foot if desired. The two potentiometers and the two sockets are mounted along one side of the case.

The final wiring of the unit is also shown in Fig. 4.

ADJUSTMENT

Initially VR1 should be adjusted fully anti-clockwise, and both VR2 and VR3 should be set at about the midway point.



The circuit board mounted in position on the base of the diecast case and side mounted components.

If a signal generator and an oscilloscope are available, VR2 is adjusted to give symmetrical clipping. If suitable test gear is not available, VR2 must be set by ear to produce an output free from obvious distortion.

VR3 is adjusted correctly by monitoring the signal at its wiper terminal with an oscilloscope and finding the setting that gives the minimum breakthrough of the clock signal. There should be no input to the unit when doing this.

A simple alternative is to solder a 100nF capacitor in parallel with C13, so that the clock frequency is reduced to an audio frequency. The breakthrough can then be heard on the output of the unit, and VR3 is adjusted to null this signal. The additional capacitor is then removed.

VR1 is given the setting which is considered to produce the best effect, and the further this is advanced in a clockwise direction the more extreme the effect of the unit. However, if VR1 is advanced too far there will be sufficient feedback to produce oscillation, and VR1 must be kept below this point. This control could be replaced with 47 kilohm linear potentiometer mounted on the front panel if preferred.

The circuit can handle signal levels of a little over 2V r.m.s. without overloading, although using a lot of feedback produces pronounced peaks in the frequency response that reduces this figure somewhat. With an input level of no less than 250mV r.m.s., the circuit will have a signal-to-noise ratio in excess of 60dB. □

JACK PLUG & FAMILY...

BY DOUG BAKER



LETTERS

Bouquet

Sir—I have only just begun a serious study of electronics and I find your magazine and its projects both entertaining and useful, especially those for test instruments, for example, the *Oscilloscope Companion* which I am just constructing at the moment.

I find the information on prices, new products, catalogues and various articles about p.c.b. construction and the very informative *Square One* and *Introducing Electronics* features very commendable additions to an already excellent magazine.

I first obtained several issues of EE from the library and after reading them my mind was made up and I sent away for information about back issues and a subscription, that was how impressed I was! I do recommend this magazine to anyone—whether beginner or professional.

My message to the creators of EVERYDAY ELECTRONICS is that you have a highly commendable magazine with an excellent layout so keep up the fantastic job you're doing!

G. Smail,
Auckland,
New Zealand.

Brick-Bat

Sir—I am the Head of Physics in this school and have been responsible for distributing copies of EVERYDAY ELECTRONICS to my pupils. (We took 24 copies of your December 1982 issue.)

I am however writing to express my concern at the content of the recent issues. I feel that the articles are of far too limited an appeal—the SEDAC prizewinners being the classic examples.

Surely these are not of general interest to your target group. In the past, you published far more articles which were really of general interest and within the reach of relative newcomers to electronics (and their pocket money!).

If this trend continues, I feel that I will no longer feel justified in suggesting to my pupils that they subscribe to EE.

G. T. Jones,
Glan-Y-Mor School,
Pwllheli,
Gwynedd.

A Good Strip

Sir—I would like to add to the "Keep It On Stripboard" campaign, but would also like to comment on the various complaints that you have received from readers in the past.

Many people have sent letters into your office about the p.c.b.s that are included in your magazine for various projects. I myself, hate p.c.b. etching for two reasons: the first is because it is a lengthy and laborious task, and the second is because it is expensive.

So instead, if there is a project that I wish to construct, then I make some sketches on rough paper of stripboard layouts and then pick out the best one. It is then just a matter of construction.

I use this technique because it is easy and only takes approximately a quarter of an hour on average, and because I can get stripboard free.

Proof that this system is simple lies in the fact that I, myself, am only thirteen years old.

Rodney Casbierd,
Cippenham,
Slough.

Meeting Point

Sir—Computer clubs have become extremely popular and new clubs are springing up all over London, bringing people of all ages and fields together with a common interest in computers. These clubs cater for people who simply have an interest in computers and what they can do, or want to get together with similar home computer enthusiasts.

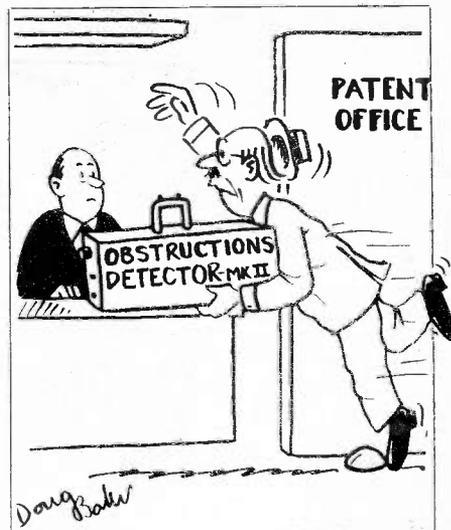
Perhaps you've just acquired a brand new home computer or are thinking of buying one yourself and would like to join one of the many London Clubs. If so and you would like further information write to the Association of London Computer Clubs.

The Secretary,
Association of London Computer Clubs,
North London Hobby Computer Club,
The Polytechnic of North London,
Holloway, London N7 8DB.

Radio Rally

Sir—The 3rd Denby Dale Rally will be held on June 19 at Shelley High School, Skelmanthorpe, Huddersfield.

At the 10th Annual General Meeting, G. Grayson G3YWI was elected chairman, myself as secretary, and M. Littlewood G3OYI as treasurer. New licensees are well represented on the committee.



If any readers would like information on forthcoming Denby Dale (Pie Hall) and District Amateur Radio Society events they should contact the Secretary.

Sec. J. Clegg G3FQH,
8 Hillside,
Leak Hall Lane,
Denby Dale,
Huddersfield HD8 8QZ.

Great Fun

Sir—In my retirement from a full life in mechanical and electrical engineering I have taken up electronics as a hobby. I have taken EVERYDAY ELECTRONICS regularly for nearly three years, and have found it to be full of interest, most instructive from the "Teach-Ins" to projects, some of which I have put together with great fun.

I write to wish you continued success.

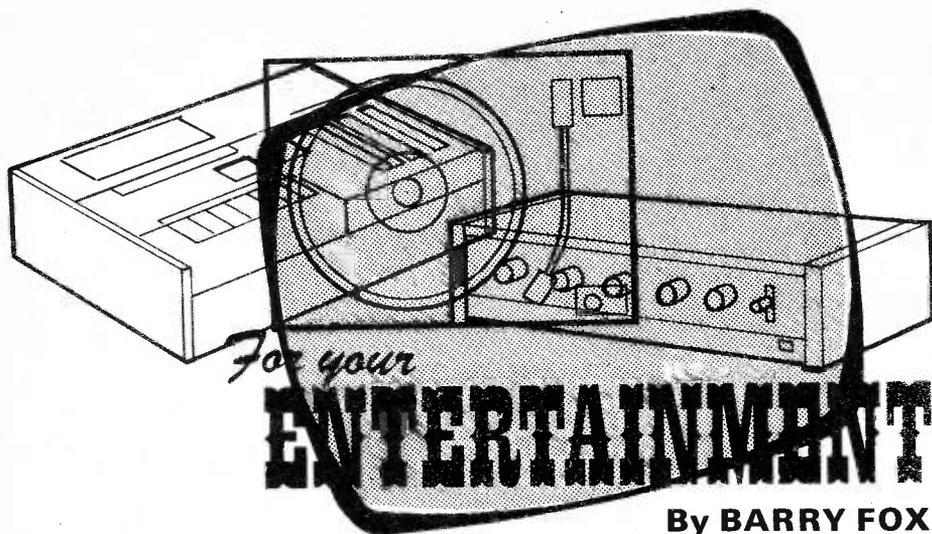
Sir Arnold Lindley,
Shipley,
West Yorkshire.

PLEASE
TAKE NOTE

Beat the Relay (November 1982)

The circuit diagram (Fig. 1, page 736) and the stripboard layout (Fig. 2, page 737) show the electrolytic capacitors C1 and C2 drawn with the wrong polarity.

They should be reversed so that the positive end (+) is connected to the collector (c) of the respective transistor.



Cellular Radio

You will be seeing a lot about cellular radio in print over the next few years. But even if you read everything that's written, you are likely to end up very confused.

The object of cellular radio is to make more room in the crowded airwaves for mobile radio telephones, for instance, car phones. Essentially it's a way of getting a large number of radio operators to share a small number of frequencies.

In June 1982 the Home Office promised 30MHz of the radio spectrum for radio telephone use. In November 1982 the frequency range 854-960MHz was allocated.

To stimulate competition and free enterprise, but not leave British Telecom out in the cold, the Department of Industry decreed that two competing networks should share the allocated spectrum. The DI promised one licence to Sectel, which is a joint venture between Securicor and British Telecom, and threw the other open to private industry.

Five firms applied for a licence to use the other half of the spectrum. The five were: Racal-Millicom, National Radiophone Services (which includes Ferranti) Cellular Radio (which includes Cable and Wireless and Air Call), Metagate of Thanet and Rushbridge of London.

The Department of Industry then set up an advisory panel who in turn employed SRI International to evaluate the bids. But the panel didn't pay any heed to the technology. It adopted what it called "a systems neutral" approach and concentrated on the prospects of jobs in Britain likely to be created by the five bidding companies.

In the end the panel chose Racal, because this British company said it would spend heavily on research and development over the next ten years, make the hardware in Britain and generate 6000 jobs by 1989. This would be in addition to any jobs created by BT.

But there's a small print proviso. Racal will only be able to create these jobs if it can use American technology of its choice and if other European companies follow the British lead, and so create an export market.

The Systems

This is where things start to get confusing. There are at least five different cellular radio systems. Each divides the city up into cells a few miles across, with its own radio transmitter. The mobile phones in the area operate on a range of frequencies which a central computer allocates as they fall free. So waiting time is cut down.

In Norway, Sweden and Denmark they use what is known as the Nordic system. Those countries are most unlikely to switch if a different system is adopted in Britain. In Japan, Nippon Telephone and Telegraph or NTT (the Japanese Post Office) has been using a different system since 1979.

In Germany, Siemens has proposed another approach. But the front-runners for Britain and most of Europe are the Automatic Mobile Phone System or AMPS, developed by AT and T and Bell Labs in America, and the MATS-E system developed by Philips in Germany.

Both these systems transmit the speech signal by f.m., and carry the computer control signals on a different frequency. It's the

Recording with Videodiscs

It's no secret that videodisc sales are *not* booming. People only want to buy a videodisc player after they have bought a video tape-recorder. This is probably because none of the three videodisc systems developed for domestic use (Laservision from Philips, SelectaVision from RCA and VHD from JVC) can record as well as replay. But several research laboratories in Japan have now developed videodisc systems which can record, replay and even erase unwanted recordings. So far record-capable videodiscs have been too expensive for domestic use. But now NHK Laboratories have come up with what could be a budget system. Perhaps this is why some firms have mysteriously lost interest in selling ordinary videodisc systems which can only replay pre-recorded disc programmes.

The NHK system is a mixture of magnetic and optical technology. A glass

manner of handling the control signals that differs. Whereas the American AMPS system has been proved to work, MATS-E is still under development. But it is favoured by some authorities in Europe, if only because it is European.

The fly in the ointment for anyone hoping to be one of the 6000 promised manufacturing jobs, is that Racal wants to use a modification of the American AMPS system developed by its American partner company Millicom. The small print of the Racal promise, which won it the British contract, is that if the company is forced to use another system, such as MATS-E, then the promise of 6000 manufacturing jobs in Britain may no longer hold good. But in true Catch 22 fashion, if AMPS is adopted for Britain, and the rest of Europe goes for MATS-E, there won't be an export market to create manufacturing jobs in Britain!

Ignoring Technology

Under the circumstances it does seem extraordinary that the Department of Industry made a contract decision without even considering the technology. And heaven help any journalist who tries to analyse the competing technologies.

British Telecom and Securicor, its partner in the cellular radio venture, have analysed the five competing technologies. But, because its plans are a trade secret, BT will not say which system it prefers. For the same reason Racal does not want to talk details about the preferred AMPS technology.

When I raised the question of technology at a Department of Industry press conference, I was told by one of the Minister's aides that if I wanted to write about the technology, I should get my information by reading what had already been written in the press. In other words, I should regurgitate other peoples' opinions and errors! Small wonder there has been so much confusion about cellular radio.

disc with a thin coating of gadolinium-cobalt alloy rotates under a fairly low powered laser. The disc is bathed in a magnetic bias field and the laser heats a tiny area of the surface so that its coercivity changes and its magnetic characteristic switches in the bias field.

On replay the disc is spun under a lower powered laser which senses the tiny changes in optical characteristic which follow from the magnetic changes. To erase, the disc is spun under the laser in a reverse bias magnetic field.

Whilst in Japan recently, NHK told me that it would take a couple of years yet before the system is viable for domestic use. But it could well be worth waiting for. For instance, it can be used for recording digital sound.

Home video enthusiasts could also use the disc for editing, by transferring selected passages of a recording from tape onto disc, and then back again onto tape.

Everyday News

... Dateline 29 February 1984

COMPUTER SAVES LONDON

—London saved from floods by swift action of Computer and Officers at London's Thames Barrier ...

THE above message could, in theory, be making headline news in our newspapers next year if the GLC proposals for a special computer back-up to monitor conditions in the Thames estuary—in a further effort to avert any possibility of flooding in central London—is carried out.

The computer will keep a round-the-clock watch on rainfall and river levels, winds and atmospheric pressures, and warn barrier officers when flood gates should be closed.

The system will be used to extend the warning time given and will be accomplished by the computer monitoring and translating information from radar signals on rainfall intensity, from an installation in the Chilterns, and predicting how individual water levels in the tributaries will be effected.

To design the system, the GLC has appointed Wootton Jeffreys & Partners, who will also be responsible for preparing tenders and overseeing installation. Work on the project is expected to commence shortly and be completed by the year end.



Photos courtesy—Richard Costain Group PLC.

CB INTERFERENCE

The problem of operating CB transmitters close to domestic TV, radio and audio has continued to result in many complaints of interference, reports our Radio correspondent, Pat Hawker. During 1982 these averaged nearly 1000 per week, totalling over 46,000. However after peaking at 4952 in March 1982 the numbers have dropped gradually and were down to 2590 in December 1982—but still a higher monthly total than in the "illegal" months of 1981.

How many complaints were due to illegal a.m. and how many to legal f.m. has not yet been released. However, it has been stated in Parliament that in the twelve months to September 1982 there were 2300 prosecutions for illegal operation. It has also been disclosed that British Telecom has questioned whether they should continue to be responsible for tracing interference on behalf of the Home Office.

VIDEOCONFERENCE

Claimed to be the World's largest videoconference, The International Teleconference Symposium will be staged in the Royal Lancaster Hotel, London, in April 1984, and will involve the first ever live link-up between four continents. The participating towns are Philadelphia, Sydney, Tokyo and Toronto.

Delegates in this intercontinental symposium on teleconferencing will be able to see, hear and speak to their partners across the world as if they were in the same room. Both video and audio techniques will be covered.

British Telecom International, the European host to the symposium, have now issued a call for papers. There will also be an exhibition of equipment.

The International Teleconference Symposium is being run under the auspices of Intelsat by BTI in conjunction with Comsat (USA), KDD (Japan), OTC (Australia) and Teleglobe (Canada).

Philips new fibre optics plant at Eindhoven, due for completion this year, is planned to produce 30,000km of fibre annually. Up to 7km in length will be drawn from a single mould compared with only 1.2km on older equipment.

Digital TV goes by Optical Fibre

Digital television signals to the recently approved CCIR Standard have, for the first time, been successfully transmitted by optical fibre link between two BBC television studio centres.

The optical fibre cable was installed in the existing ducts between the BBC studios at Lime Grove and Television Centre, a path of about 800 metres.

Ambit International has been nominated—together with Electroplan and Manhattan Skyline—for the title of All Electronics Show/Electronic Times "Distributor of the Year" Award.



... from the World of Electronics

UK Leads The World

A recent World Survey of Electronic Developments, released by Prestwick Publications of New York, reveals that the most significant breakthroughs in electronics are not just from Japan, or for that matter, from the United States. Europe, for example, holds a commanding lead in the area of circuit design with 41 per cent of the world's total of developments and is tied with Japan in the area of electronic applications with 38 per cent.

The US leads in computer technology with 52 per cent of the developments and in communications and information processing with 46 per cent.

Japan, as expected, leads the world in automation control and robotics with 51 per cent and integrated circuits with 46 per cent.

The Post Office has appointed Mr Charles Read as its first Director of Information Technology.

As a member of the Information Technology Advisory Panel which advises Ministers on IT policy, he chaired the working group which reported to the Prime Minister on Cable TV and related systems.

Fidelity Radio is to design and make British Telecom's first cordless telephones with an initial order worth over £1 million. Mobile user range is 200m from the base unit.

MICROQUEST

Young people with an idea for using microelectronics in industry can win £1000 in a nationwide competition jointly sponsored by Williams & Glyn's Bank and the Department of Industry.

Open to 16 to 19 year olds working in industry or on a Government sponsored training scheme, they are being asked to identify a way in which microelectronics could be used to improve efficiency in their firm and to describe it in less than 100 words.

The best ideas will be selected and those contestants will be invited to submit a detailed 2500 word project explaining how their idea could be implemented. The winners, one from each of the DoI's ten regions, will each receive £250 and will go forward to compete against one another at national level. The final will be held in London in October 1983—the overall winner will receive a prize of £1000, the runner-up £500, and the third placed contestant £250.

The government sponsored Microelectronics Application Project is getting a further £30 million funding to top up the £50 million already spent since 1978.

MAP has created 30,000 training places and offered support to more than 800, mostly small, firms on development projects.

WHERE ARE THE GIRLS?

Forty-two per cent of all people employed in the UK are women. In engineering only one in 500 is a woman. This compares with one in 50 in the USA and 1 in 3 in the USSR in engineering.

Wrong Number

Cordless telephones which meet Home Office performance specifications have been exempted from the need for a Wireless Telegraphy licence by regulations made by the Home Secretary.

However, few of the cordless telephones at present on sale or in use illegally, will be exempt because they do not operate on the appropriate radio frequencies or do not meet other technical requirements.

Nordic MAC

The UK's MAC system for satellite broadcasting has been successfully demonstrated to the Nordic Council of Ministers in Stockholm. This is the first time demonstrations of the system have been given outside the UK.

Ministers and representatives from the Scandinavian broadcasting and telecommunication organisations saw high-quality television pictures, accompanied by multiple-channel sound, transmitted from the IBA Engineering Centre, Winchester via the European Orbital Test Satellite (OTS), stationed 36,000km above the Equator over West Africa.

Demonstrations included direct comparisons with conventional PAL-encoded colour signals.

Edinburgh University is receiving a £2½ million boost to its Microfabrication Facility from grants awarded by the Science and Engineering Research Council.

Tokyo, 1983—Mitsubishi Electric Corporation announced that it plans to manufacture VTRs in its UK factory for sales in the European market.

The initial production of 5000 units per month will be made at the Haddington Works. The company envisages a full-scale production of 10,000 units per month.

Parts for the VHS-type VTRs will be supplied from Japan at the start but as many parts as possible will be bought on the EC market.

Kouji Imakita, Executive Vice President, said: "We believe that planned VTR production in the UK will go some way towards promoting economic cooperation between Japan and EC countries."

Sinclair Developments

After his highly successful and much publicised journey into the stronghold/vaults of the City investors, Clive Sinclair of Sinclair Research has announced a new corporate structure. This consists of an enlarged board of directors and organised operationally into current and advance products divisions.

As chairman and chief executive, Clive Sinclair, retains overall control of all company activities in both areas. He will also personally supervise the advance products division which is concentrating on the development of the company's forthcoming flat-screen Microvision pocket TV, now under pre-production testing at the Timex plant.

It is also researching, at its St Ives and Winchester facilities, future consumer and business applications of the flat-screen and new solid-state technologies.

The current products division, under managing director Nigel Searle, will be responsible for marketing the company's existing personal computer range and the continuing development programme for new personal computers, computer peripherals and software. Entirely new products, once launched, will also be transferred to this division.

Joining Clive Sinclair, Nigel Searle and Chris Fawkes on the board are finance director Bill Matthews, production director Dave Chatten, and newly-appointed research and development directors, Jim Westwood and David Southward.

Kenneth Dick CBE, FCA, chairman of New Court Trust plc and a non-executive director of N. M. Rothschild & Sons Limited, has also been appointed to the board as a non-executive director.

Semiconductor News . . .

The recently announced Innos IMS 1400 16K byte static RAM family in plastic packages is now held in stock by Rapid Recall for immediate delivery.

These devices have, until now, only been available in ceramic packages or leadless chip carriers.

★★★★★

Figures just released by Zilog (UK) show that the sales of their System 8000 family of advanced 16-bit microcomputers have far exceeded original predictions.

In the market-place for only one year, the total number of System 8000s now in use is greater than 500.

★★★★★

Two new hybrid i.c.s for inductive proximity detectors (types OM386 and OM387), which fit inside a Cenelec M8 hollow stud, have been announced by Mullard.

Suitable for positive and negative supply voltages, the output of either i.c. can drive the coil of an electro-magnetic relay. Operating from a 10V to 30V supply the output current is approximately 400mA. The detection range is 1.5mm when used in an M8 tube and is set by an external resistor.

RADIO WORLD

By Pat Hawker, G3VA

Your Personal Humanoid

The consumer electronics industry continues to seek new outlets for its frighteningly large production capacity. Even the boom market in video recorders is unable to absorb the flood of machines now being produced—and sophisticated video games are in a highly competitive situation.

Video games, video discs, home computers, teletext, smoke detectors, microwave ovens, digital audio and now your own robot. Humanoids that can talk, move around, perform simple household tasks are all set to move out of the sci-fi stories and into our homes.

In North America, Androbot Inc., Heath (Zenith Radio), Robotics International and other firms are all reported to have lovable, intelligent little monsters moving along production lines with price tags from about \$1000 upwards, although sales are expected to be modest for the next few years, then building up as more software programs become available. Indeed, early models seem aimed partly at educating humans as to how to stay in control: one manufacturer provides a two-volume, 1200-page course in robotics.

With names like Hero 1, Bob and Genus we are clearly expected to treat the humanoids as companions as they busy themselves vacuum cleaning floors, delivering drinks to guests, looking after home security, teaching any "live" children, exercising their electronic vocal chords or just shuffling around the room. The idea doesn't exactly grab me but then I am still surprised at how many people are buying home computers.

Living History

Both for newcomers and for those for whom electronics is a full-time profession there is nowadays so much technology to learn that few students have much time to spare for learning about the personalities who created all the technology. Yet every device, every component, every circuit had to be developed or discovered by someone or by some team.

The result is that we tend to oversimplify. We say Marconi invented radio communication, Lee De Forest the thermionic amplifier, Baird television, Watson-Watt radar and the transistor by a team at Bell Telephone Laboratories.

Whether or not you accord priority to this short list—and that partly depends on which country you live in—it ignores the really major contributions made by tens if not hundreds of brilliantly innovative engineers, physicists and scientists; many no longer with us but others who are still alive or with colleagues or close relatives still living.

The pioneers of television (Perskyi first used the term "television" in 1900) include many names apart from Baird though I wonder how many will be familiar to readers: Nipkow invented the scanning disc in the 1890s; Rosing and Campbell-

Swinton outlined the principles of electronic television before 1910; V. K. Zworykin conceived the iconoscope in 1923 (although the patent was not issued until 1938 by which time McGee had developed the basically similar Emitron tube in the UK).

Blumlein invented many of the TV circuit techniques; Ballard invented interlacing in 1932; Brown led the RCA team that did so much to bring compatible colour to our screens; Bedford originated "mixed highs" or frequency interleaving for colour.

Bruch in Germany invented PAL; DeHaan in Holland the Plumbicon tube; German engineers pioneered VHF and UHF transmission; Yagi his aerial. One could add many names to this list.

Zworykin, who in later years turned his attention to medical electronics, died only last year; several of those on my list are still happily with us but no longer young. This January, I had the pleasure of meeting the widow of John Logie Baird; a former professional musician and music-teacher, she lives in South Africa with her many lively and vivid recollections of her husband who died in 1946. Her son lives in Canada, her daughter in Scotland.

Mists Of Time

The Royal Television Society has recently appealed to its members to put on record any personal recollections of the early days of television that may otherwise soon be lost in the mists of time.

The four large volumes of BBC history by Asa Briggs tell the formal story, with the lesser known engineering history by E. L. Pawsey. The first volume of Bernard Sendall's history of "Independent Television in Britain" published last Autumn provides an informal and unique insight into the political, commercial and administrative problems that had to be overcome in setting up ITV in the period 1946-62.

There have been many biographies published of John Logie Baird, including one by Michael Hallett who looks after the IBA's "Broadcasting Gallery". There is a useful 40-page monograph on A. A. Campbell Swinton—a remarkable engineer who among many other things was the first president of the Wireless Society of London (now RSGB) and held the amateur (experimental) callsigns 2HK and 2HL—by T. H. Bridgewater whose own career spanned the entire development of broadcast television.

Bridgewater joined the Baird Television Company in 1928 in the days when 30-line mechanical TV was transmitted from Long Acre (2TV) and then became one of the first three BBC television engineers in 1932 when the BBC took over responsibility for the low-definition transmissions. He retired in 1968 as Chief Engineer, Television.

As the engineer largely responsible for the first BBC TV outside-broadcast from France, Tony Bridgewater could claim to be the pioneer of international TV.

But the ranks are thinning. The very first BBC TV engineer, Douglas Birkinshaw, died last October. After working on the 30-line system from 1932 he became engineer-in-charge of Alexandra Palace when that station opened in 1936 using both the Baird 240-line and the Marconi-EMI 405-line systems.

His interest in broadcasting began when he joined Oundle school's wireless society, a group that built one of the experimental stations that broadcast concerts and programmes before the BBC started in 1922.

Vintage Valve

In his new book "Practical Handbook of Valve Radio Repair", Chas E. Miller recalls his adaption some years ago of a famous phrase: "The valves are going out all over Europe, and we shall not see them lit again in our time". He points out that he has been proved wrong, that there has been a resurgence of interest in the collection and restoration of old valve sets.

Indeed, recently I was asked to identify an early Eddystone communications receiver that had been retrieved from a dustbin. It was the 1939 Eddystone ECR model, sold originally for £45, no small price to pay in those days.

Historically it was possibly the very first receiver built in England for amateur radio to include a variable-selectivity, phasing-type crystal filter. It was soon superseded by that firm's wartime model 358. There is little doubt that old valve models in good working condition will become increasingly rare.

A criticism of the book is that it is restricted to standard domestic models and includes few that really deserve to be considered "vintage". But for anyone interested in the development of radio receivers between 1922 and about 1960 when the solid-state revolution began in earnest, this book has much to offer, including some fascinating old advertisements and hundreds of old circuit diagrams.

The Young Tutor

With many of the key-pad, keyboard, push-button, remote-control devices it needs young, agile brains to operate them. For some consumer electronics it is said you are too old at twenty.

There seems to be an increasing number of successful candidates for the Radio Amateurs' Examination at around the minimum age of 14. But it is still unusual to find a schoolboy, who while still under 18 years of age, has successfully tutored 14 enthusiasts—of all ages—through the R.A.E.

John Morris, GU6BG1 of the Guernsey Amateur Radio Society has done this. In December 1982 his latest batch of nine pupils, 14 years of age upwards, passed all the RAE papers that they took. John Morris takes his A-level examination this summer after which he hopes to train as an Air Traffic Control Officer. He is active on 144MHz using home-constructed equipment.

MAY ISSUE

**Special
Offer
Coupon**

Obtain a generous discount when purchasing the circuit boards for these projects.

**FREE
TRANSISTORS**
For use with
these designs
**M.W. Personal Radio
or
Guitar
Headphone Amp**

APPLE II & BBC MICRO USERS

Real-time Clock & Calendar

TWO DESIGNS FOR A HARDWARE CLOCK. BOTH USE A SPECIAL MICROPROCESSOR CLOCK CHIP AND PIA CHIP TO INTERFACE WITH THE COMPUTER. ON BOARD CHARGER AND RECHARGEABLE CELLS FOR BATTERY BACK-UP. CAPABLE OF DISPLAYING DAY-OF-WEEK, HOURS, MINUTES, SECONDS AND TENTHS OF SECOND.

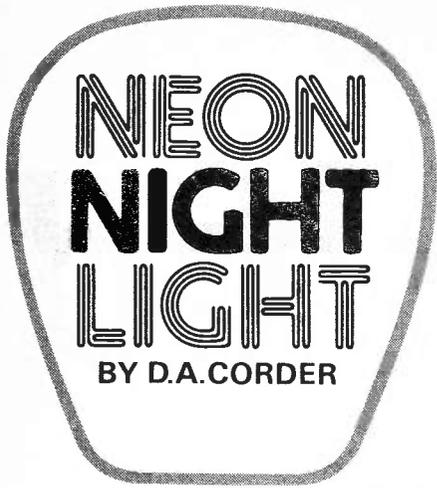
LABORATORY AMPLIFIER

Part 3 of Test Gear 83. A high quality unit, 500mW output into integral speaker. Three "flat" inputs, one RIAA equalised input.

TRAIN CONTROLLER

This unit will provide simulated inertia, momentum and braking. Designed around a voltage controlled oscillator, it will complement any good train set.

**Everyday
ELECTRONICS**



PLUG ASSEMBLY

A standard flat-pin 13A plug is used to house the components, and the positioning and wiring is shown in Fig. 2. One end of the resistor R1 is connected to the L terminal of the plug, with the remaining end being soldered to one of the two neon connections. A short length of wire is then used to connect the remaining neon connection to the N terminal of the plug.

To avoid possibilities of short circuits, all leads should be insulated with plastic sleeving or insulating tape.

A rectangular section is then cut from the plug lid and this is made by drilling two holes and removing the remaining plastic with a file. When drilling the holes make sure that the distance between them is less than the length of the neon filament. This will prevent the neon connections being exposed. A small piece of transparent material may then be stuck over the rectangular section to protect the neon.

The next step is to remove the flexible cord securing grip and block the mains cable inlet hole with a wooden or cork plug which should be cemented in.

IN USE

Remember that even though the E terminal of the plug is not being used, the terminal must not be removed as the plug socket will not operate without the E pin.

When all connections inside the plug have been checked, a 2A fuse can be fitted and the unit is ready for use. □

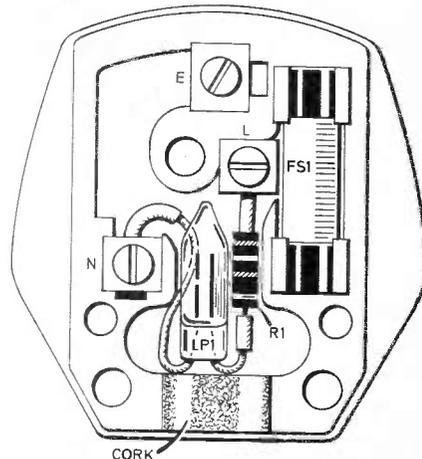


Fig. 2. Diagram showing layout of components and wiring.

THIS project is a homemade alternative to the commercially made glow-lights. Its main advantages are the reduction in cost and its simplicity. Although the neon does not produce much light it is enough to dimly illuminate objects within a close proximity. The Neon Nightlight also has the advantage that it will only consume small amounts of power.

The room inside a 13A plug is very limited and this should be taken into account when buying the plug. If in doubt take the neon filament to the shop with you.

CIRCUIT AND OPERATION

The circuit diagram for the Neon Nightlight is shown in Fig. 1. The neon LP1 receives a current through the limiting resistor R1. The resistor R1 is placed in the circuit to prevent the neon burning out, and should have a value of around 220kΩ.

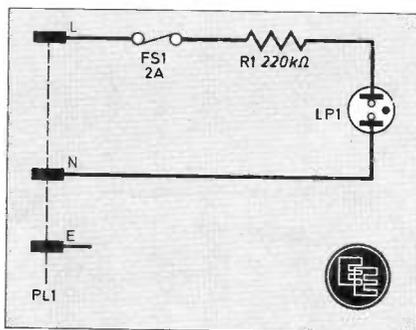


Fig. 1. Complete wiring diagram of Neon Nightlight.

COMPONENTS

R1 220kΩ
 1/4W carbon ±10%
 FS1 2A or 3A fuse
 LP1 wire-ended neon
 PL1 flat-pin 13A mains plug
 1mm plastics sleeving or insulating tape; cork; clear plastics.

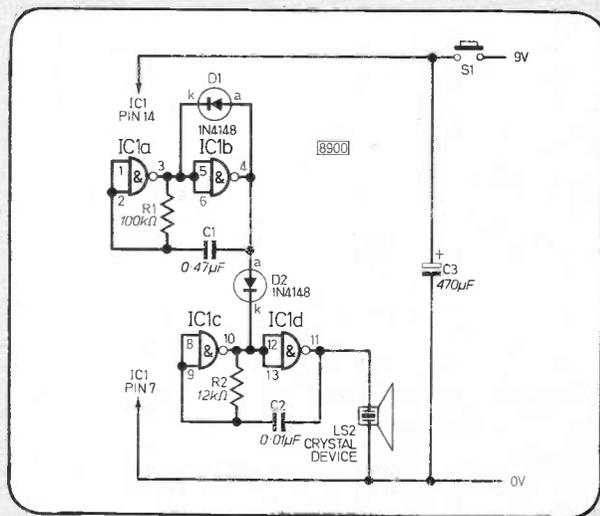
Approx. cost
 Guidance only
 See page 217 **£1.50**

CIRCUIT EXCHANGE

WARBLING OSCILLATOR

THIS Warbling Oscillator is designed around a 4011 CMOS i.c. The four gates of IC1 are connected to form two oscillators. The higher frequency of the oscillator formed by gates IC1c and IC1d is pulsed at a lower frequency by D1. D2 causes the output to warble. When S1 is released the output fades slowly due to C3 discharging. No values are critical except LS1 which must be a crystal transducer. I used a device from a doctor's radio paging bleeper.

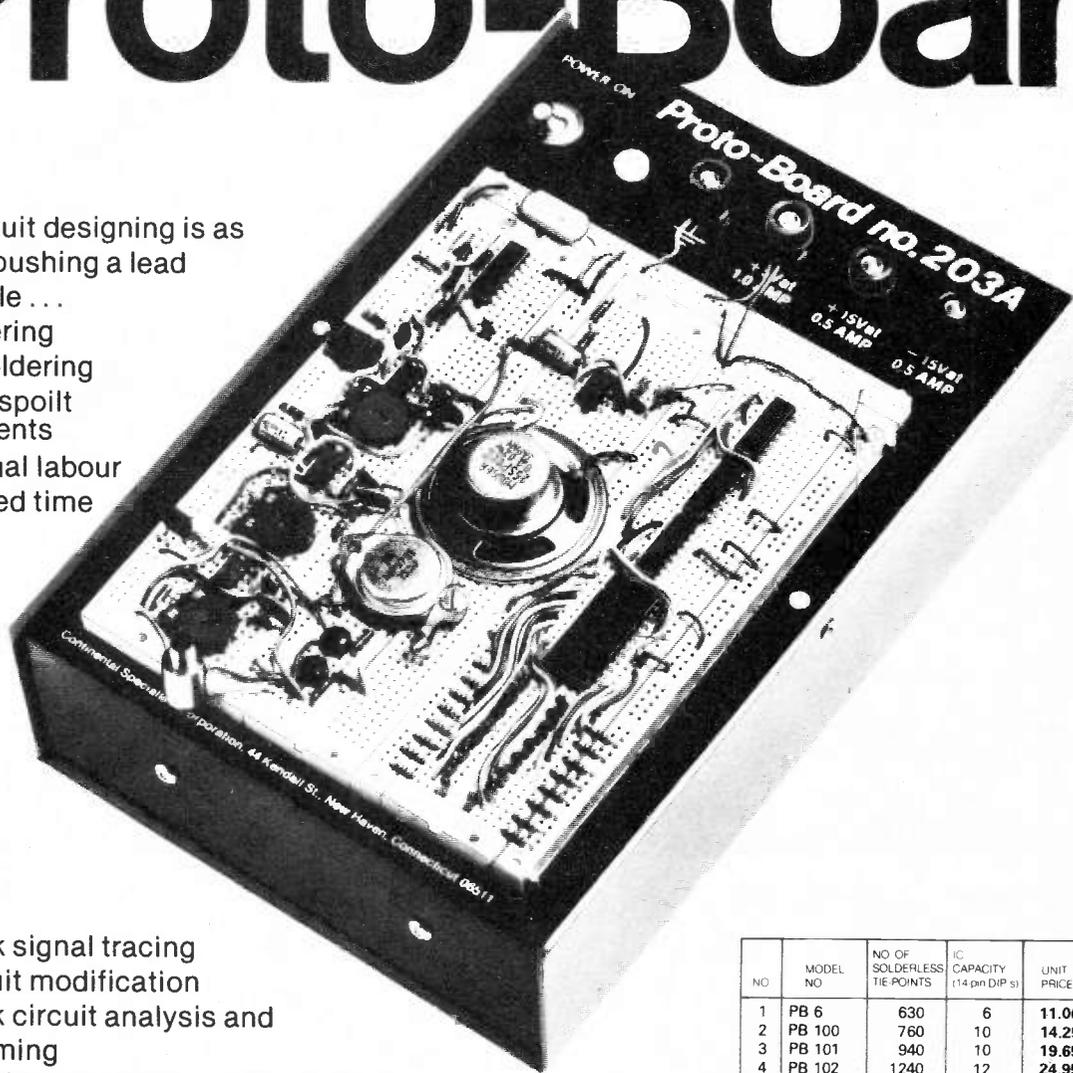
David Cross,
 Gidea Park,
 Essex.



MORE ON PAGE 237

The Proto-Board®

Now circuit designing is as easy as pushing a lead into a hole ...
 No soldering
 No de-soldering
 No heat-spoilt components
 No manual labour
 No wasted time



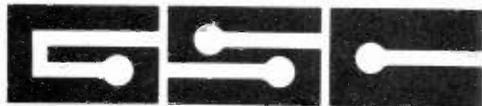
For quick signal tracing and circuit modification
 For quick circuit analysis and diagramming
 With or without built-in regulated power supplies
 Use with virtually all parts — most plug in directly, in seconds.
 Ideal for design, prototype and hobby

NO	MODEL NO	NO OF SOLDERLESS TIE POINTS	IC CAPACITY (14 pin DIP s)	UNIT PRICE	PRICE INC P&P 15% VAT	OTHER FEATURES
1	PB 6	630	6	11.00	12.36	Kit
2	PB 100	760	10	14.25	15.52	Kit
3	PB 101	940	10	19.65	22.31	
4	PB 102	1240	12	24.95	30.41	
5	PB 103	2250	24	40.95	46.57	
6	PB 104	3060	32	51.45	58.07	
7	PE 203	2250	24	74.50	83.95	5V @ 1A
8	PB 203A	2250	24	76.00	72.45	5V ± 15V
9	PB 203AK	2250	24	105.00	83.95	5V ± 15V
10	PB 203AK	2250	24	85.00	83.95	& Kit

Tomorrow's tools for today's problems

Goods despatched within 48 hours.

GLOBAL SPECIALTIES CORPORATION



G.S.C. (UK) Limited, Dept. 4U
 Unit 1, Shire Hill Industrial Estate,
 Saffron Walden, Essex. CB11 3AQ.
 Telephone: Saffron Walden (0799) 21682
 Telex: 817477

G.S.C. (UK) Limited, Dept 4U, Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.

1 Qty Req 2 Qty Req 3 Qty Req 4 Qty Req 5 Qty Req 6 Qty Req 7 Qty Req 8 Qty Req 9 Qty Req

Name _____ Address _____

I enclose Cheque/P.O. for £ _____ or debit my Barclaycard, Access, American Express card no. _____ exp. date _____

FOR IMMEDIATE ACTION — The G.S.C. 24 hour 5 day a week service
 Telephone (0799) 21682 and give us your Barclaycard, Access, catalogue
 American Express number and your order will be in the post immediately tick box

EXPANDED ADD-ON KEYBOARD *for the ZX81*



PART TWO

BY J. M. STEJSKAL

LAST month in Part 1 we dealt with the theory of the design. We now show how to build and test the unit.

used by the author to receive the two supply lines. An l.e.d. and series resistor (180 ohms) were fitted across these fingers also to act as a power on indicator for the extended keyboard circuitry.

CIRCUIT BOARDS

The circuitry was constructed on four separate circuit boards and fitted by means of home-made brackets to the main keyboard p.c.b. The plans shown here are for the original prototype, not very elegant admits the designer, but nevertheless quite efficient. No doubt some constructors will design a single p.c.b. to accommodate all circuitry.

The circuitry requires a +5V power supply. On the prototype this was picked up from the ZX81 internal supply as was the 0V line. These were connected to the edge connector receiving KBD0 to KBD4 and A8 to A11 from the ZX81 to connect to the main circuit board. On the Redditch keyboard there are two spare positions on the rear finger set. They were

VEROSTRIP

The two circuit boards to be fitted to either end of the main keyboard are shown in Fig. 4 and photographs. These are lengths of Verostrip. This board already has a line of "breaks" in the copper strips running through the centre of the board length. Start by fitting and soldering the keyswitches to previously cut and drilled lengths for the two boards. All other connections to be made on the underside (copperside) of the board.

Assemble each board and fit the necessary linking wires between tracks using, in most cases, p.v.c. covered wire. Do not fit any off-board wiring or components at this stage. Next bolt both boards (A and B) to the main keyboard using a technique of drilled supports as shown in Fig. 4 or some other method you prefer.

In the prototype, board C was made from a piece of fibre glass board with the key switches glued to one side with their leads protruding through holes suitably drilled in the board. One half of a length of Verostrip could be used instead, but will not be as strong as the fibre glass strip. A dedicated fibre glass p.c.b. would be the best choice. The board is bolted to the main p.c.b. using 25mm long threaded spacers acting as both nuts and mounting feet.

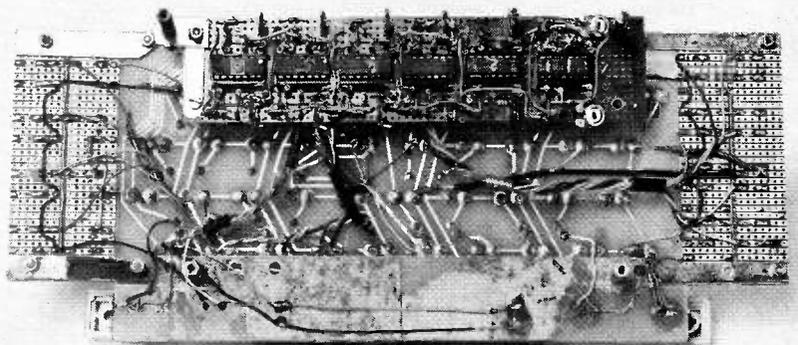
With A, B and C boards secured in place, the wiring and components interconnecting them to the main keyboard may now be soldered in place.

INTEGRATED CIRCUITS

The fourth board (D) is a piece of Verostrip and this holds the logic gates and their associated components for the remainder of the key switches, S11 to S22.

The component layout around each of the six i.c.s is identical. This layout is shown in Fig. 5 which also gives details of the breaks to be made along the copper strips on the underside as well as the existing breaks on the Verostrip.

Underside view of completed prototype Expanded Keyboard.



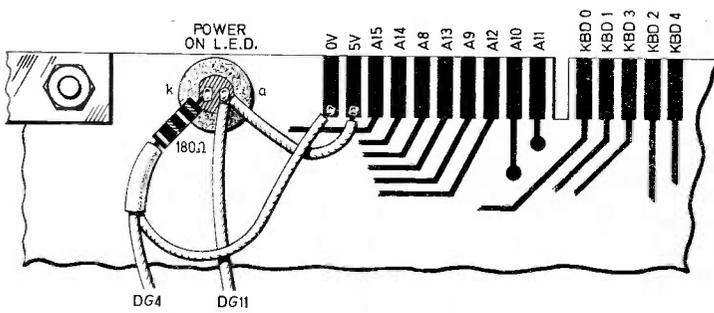
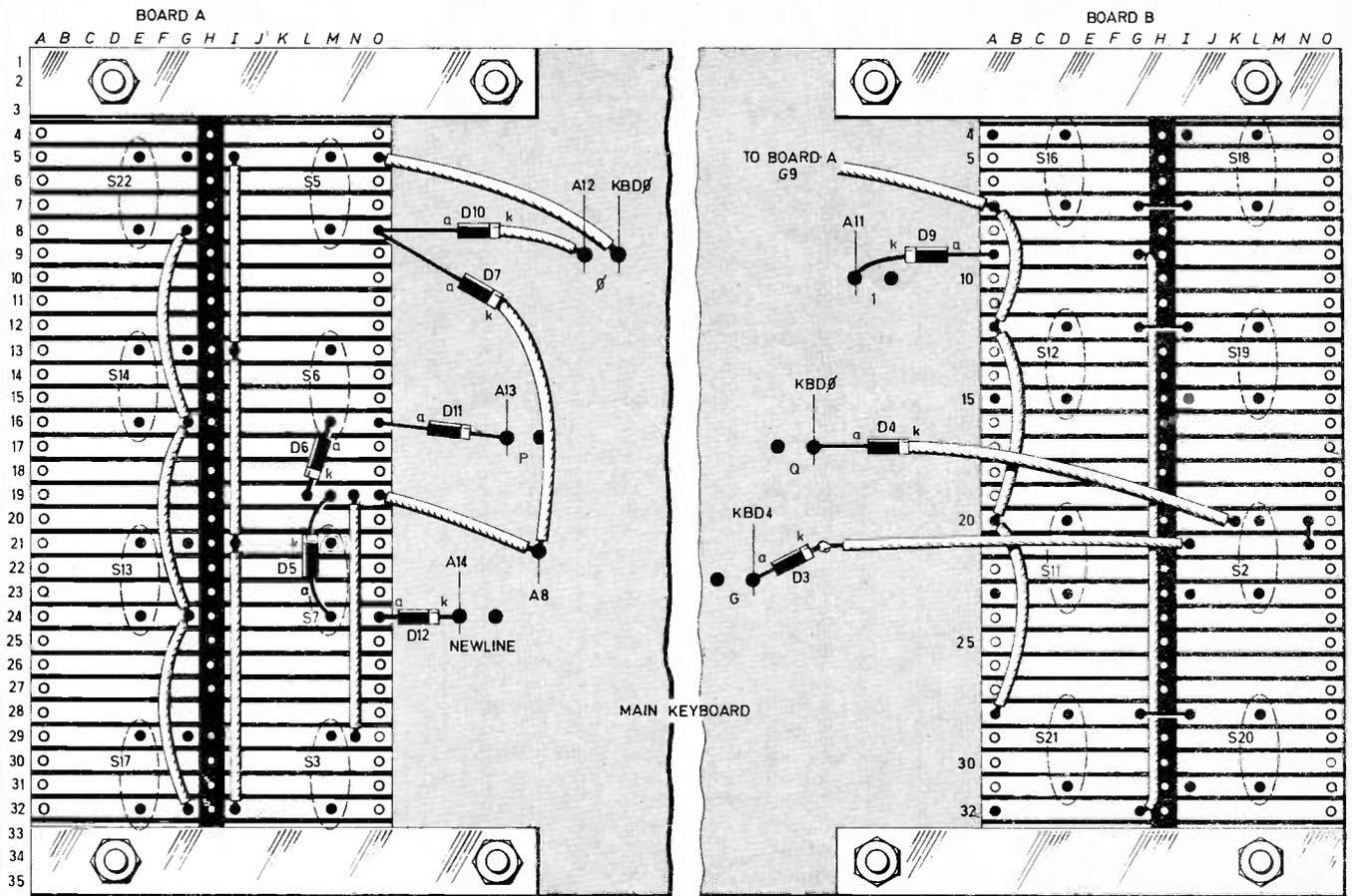


Fig. 4a (upper). Layout of the keyboard switches on the two extreme boards, A and B, and interwiring to each other and the main keyboard p.c.b. with fixing details.

Fig. 4b (left). Labelling of the input finger set on the underside rear of the main keyboard p.c.b.

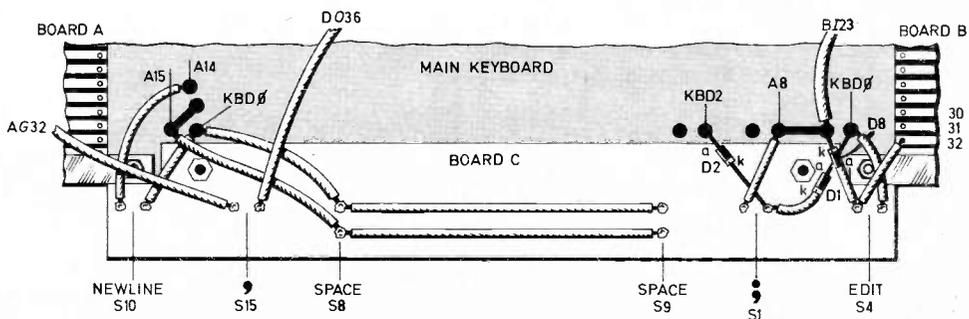


Fig. 4c (below). Board C with key-switch positions and interwiring to the main board and boards A, B and D.

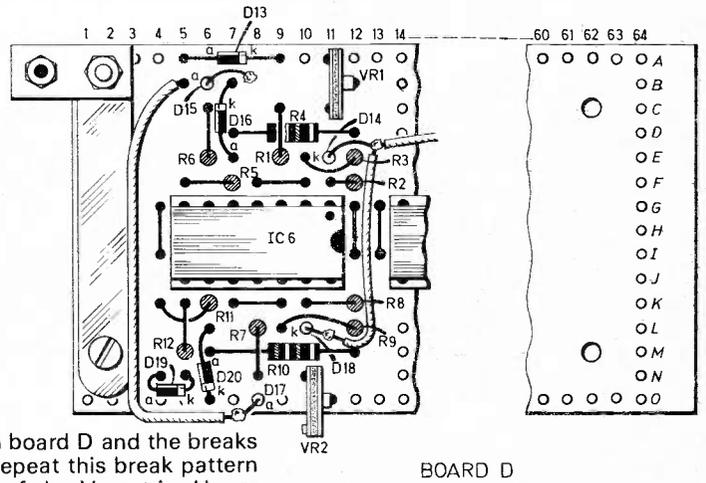
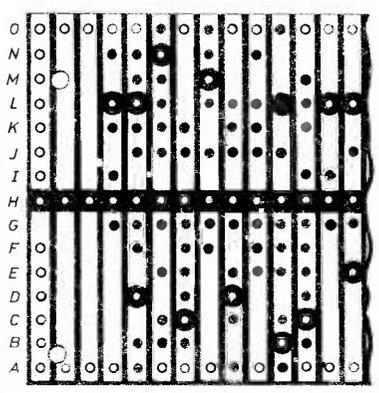
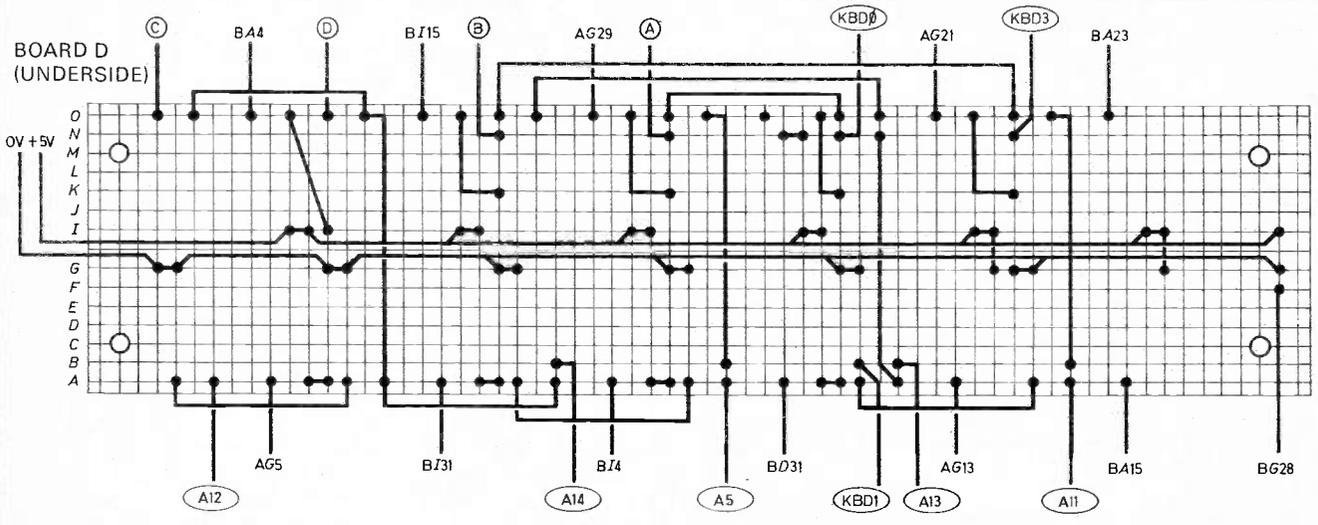
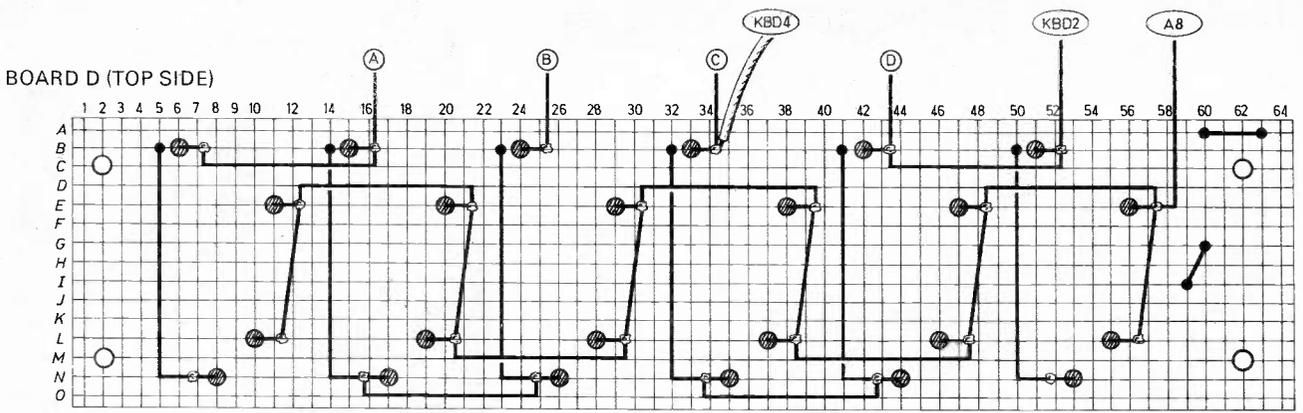
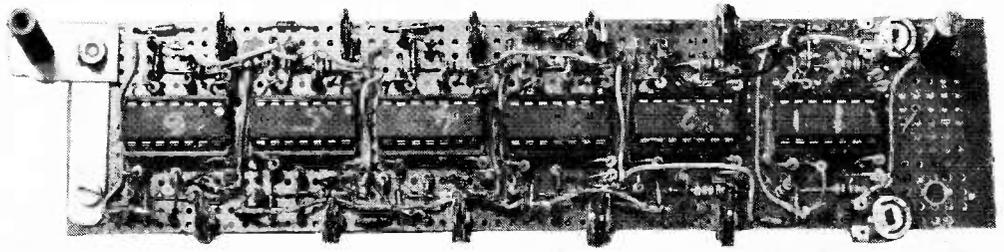
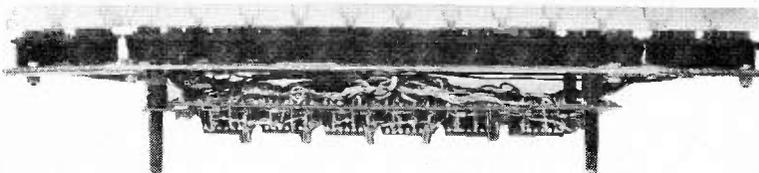


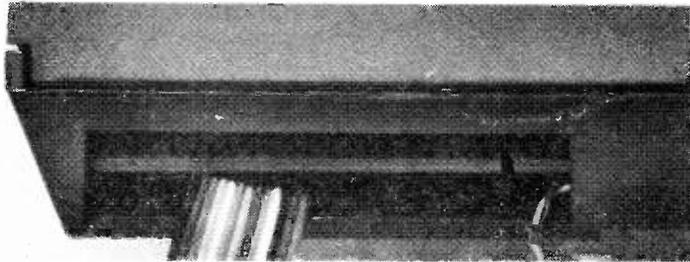
Fig. 5. The layout of one complete section on board D and the breaks to be made in the strips on the underside. Repeat this break pattern and layout (6 sections) along whole length of the Verostrip. Upper two drawings give interstage wiring on top and underside of board D. Use p.v.c. covered wire for all interconnections other than very short links.



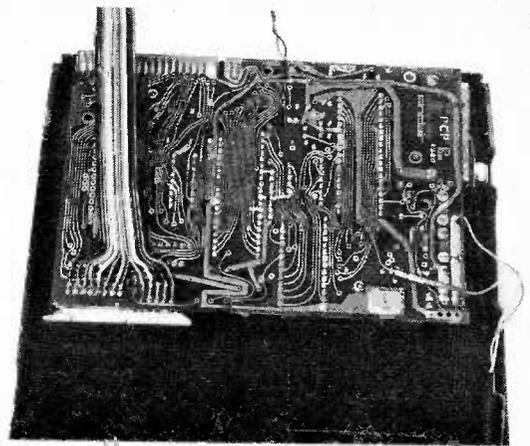
Close up plan view of board D topside.



Edge view of completed prototype fitted with stand-off pillars.



Ribbon cable exits ZX81 at expansion slot bus.



Connection to the ZX81 p.c.b.

Repeat this break pattern around each i.c. location along the board. This board is fitted to the main board using stand-off pillars and brackets. Drill the fixing holes for mounting these first. All i.c.s are fitted in sockets. This allows easy replacement at any time should this prove necessary.

Begin assembly of board D by soldering all the sockets to the prepared board followed by the link wires, resistors and diodes. Pay special attention to diode polarities. The cathode end (k) is marked with a band. With all the components assembled, the topside and underside interwiring may be carried out now. Thoroughly check this board before proceeding.

Dealing with an i.c. gate pair at a time, wire board D to the other boards, checking the operation of each i.c. as it is connected.

Make the connecting wires sufficiently long so that, after soldering to their correct destinations, they can be neatly bound and, when any adjustment, servicing or replacement becomes necessary,

the complete i.c. strip can be detached and placed in front of the keyboard in the normal, upright position without having to disconnect anything.

SETTING UP

The six presets VR1 to VR6 need to be adjusted to give the required results. Consider the TO switch and its associated circuitry.

If the resistance of VR1 is too small either nothing happens when S11 is pressed or only a slight flicker on the screen will result. Increase VR1 resistance until the desired character (TO) appears, then increase slightly more and leave it there. A further increase will produce the unshifted character, in this case, 4.

The correct setting of VR1 ensures a stable operation of the "shift first" rule. It is possible to start the adjustment of VR1 with either the minimum or maximum resistance in the circuit, so position of each preset wiper is unimportant at switch on.

Should difficulty be experienced in producing the shifted character, then reduce the value of R5 position resistor to the next preferred value.

If R5 is too high, nothing shows apart from a screen flicker when the key is pressed. Neither a letter, number or a shifted character would appear (similar to low VR1). Reduce the value of R5 to 2.7kΩ, 2.2kΩ or 1.8kΩ (a resistance as low as 1.5 kilohms still works but the results may not be reliable). If several gates use the same A-line, reduce R5 in one or more circuits to 1.8kΩ. These tests and adjustments can be done at any time during construction, but the final setting of all presets and the final value of R5 position resistors can only be determined when all i.c.s are connected and working.

Although the resistors R2 and R3 are shown as 22kΩ, it may be necessary that, with some i.c.s, their value may have to be altered: R2 to 15kΩ, R3 to 10kΩ. As a general rule 22kΩ represents the most reliable value in almost every case. □

CIRCUIT EXCHANGE

TAMPERING DETECTOR

MOST caravans plug into the car supply to provide lighting and power to other electrical systems. Anyone trying to steal the car would have to remove the plug to drive away.

The circuit described here registers whether or not the plug has been removed.

With voltage applied to the caravan plug, one contact of RLA1 is "live". When the reset button of S1 is pressed, the relay coil RLA is energised and the normal open contacts of RLA1 engage, making the relay stay energised, even

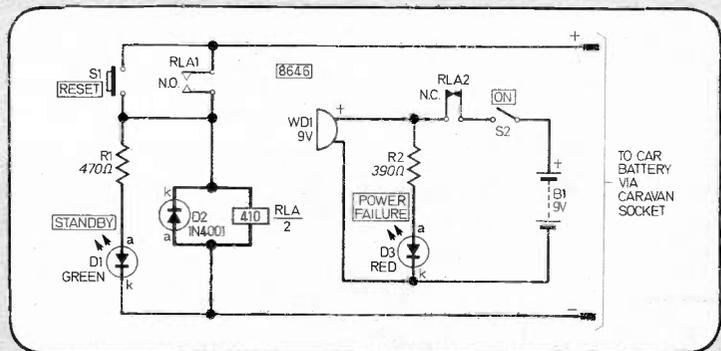
when the button is released. Diode D1 will light, indicating that power is applied.

When power is removed, by disconnection of the power plug, RLA1 opens and RLA2 closes making (when S2 is closed) WD1 sound and D3 light. Re-inserting the power plug back in its socket will not

stop the buzzer from sounding until S1 is pressed again.

S2 switches off the unit when you want to drive away from the caravan without sounding the alarm!

Alex Clark,
Lichfield, Staffs.



MORE ON PAGE 238

COUNTER INTELLIGENCE

By PAUL YOUNG

Selective Problem

Two major problems face the component retailer today. The first being that the low unit price of discrete components, which in many cases has remained static over a number of years, makes it difficult to keep up with overheads that have escalated alarmingly.

The second is the proliferation of semiconductor devices. Looking through a catalogue of a well-known manufacturer recently, I found the total came to a staggering 32,000!!

To overcome the first, the retailer has been forced to diversify into the sale of items with a larger unit price such as radio, television, video recorders, and even computers. Therefore, you must not be surprised at his lack of enthusiasm for discussing what value resistor you should buy on a busy Saturday when the customer behind you is waving a fistful of tenners.

The second, he can only hope to solve by selective buying. This makes life very difficult, because he is torn between the desire to give good service, while at the same time knowing it is essential for his economic survival to only purchase those devices that will readily sell.

Well Done!

It is a human trait that we rejoice when David beats Goliath. A case that bears on our own hobby occurred recently.

The splash down of the nuclear fuel core, off the coast of Brazil, was another success and is the third time the school has beaten Russian and American scientists in announcing the news.

"We just had to rely on reports and radar data because the satellite's batteries went flat," said Mr. Geoffrey Perry, science teacher.

The boys of Kettering school aided by their Science master and using their own home built electronic equipment, reported a Russian satellite falling to Earth. By their own skill they had beaten all the world's radio astronomers including the boffins of NASA with their wealth of priceless sophisticated tracking equipment.

We can only say, "Well done". It shows what the amateur enthusiast is capable of achieving.

Changed Character

My delight at poking fun at computers is well known to most readers. I am now a changed character and with good reason. Those of you who have been following the excellent BBC series, "Making the Most of the Micro" cannot have failed to have been touched by the experience of Richard Gomm that was shown at the start of the series.

Richard Gomm has a fine brain, an agile mind, a sense of humour and unbelievable

courage. He suffers from Cerebral Palsy. Speech is difficult and the only part of his body he can move and to some extent control, is his head. He is endeavouring to write a thesis, and thanks to the computer he will be able to do it.

He grips a long spatula with his teeth and taps out the words on the keyboard letter by letter. This appears on the computer screen and he is able to correct it, before committing it to paper.

I found this spectacle deeply moving and decided that with this one use alone, the computer had more than justified its existence.

Electric Ambition

I have an ambition, before I depart this vale of tears, to own an electric car. Until now I have always thought that although technically feasible it would not happen in my lifetime, because if someone invented one, he or she would find it easier to sell to the oil Barons than trying to develop it and market it. It would then disappear.

However, I read recently that, that wizard supreme of electronics Clive Sinclair is now interested in the project and as his computers come off an assembly line at the rate of one every four seconds, I may be lucky yet.

BOOK REVIEWS

THE GRAMOPHONE GUIDE TO HI-FI

Author John Borwick
Price £12.50
Size 240 x 160mm. 256 pages. Hardback
Publisher David & Charles
ISBN 0 7513 8231 4

FROM the musical note struck in the very first chapter it is clear this is a book for people who love music written by a fellow devotee of the musical art. This note is sustained throughout, with a final emphasis in the appendix giving suggestions for a basic record collection. Mr Borwick is audio editor of *Gramophone* and a well-known broadcaster and lecturer in sound and recording topics.

The body of the work is concerned with the practical means to achieve the end—to recreate in the home as faithfully as possible the original sound from the concert hall. A history of sound recording is followed by basic physics of sound and music. Then the component parts of a complete audio system are described, with separate chapters each dealing with the record player, tape deck, tuner, amplifier and loudspeakers. The current state of the art in all these departments is well covered.

There is helpful advice on how to read specifications to aid the non-technical person when studying manufacturers' adverts and brochures, in preparation of the intending purchaser's first explorations of the hi-fi showrooms. As the author makes clear, the final assessment and decision on what to buy must rest largely on the customer's ears. But having read and digested the contents of John Borwick's book the task of selecting equipment and organising and looking after a hi-fi system can be approached with confidence.

F.E.B.

CIRCUIT EXCHANGE

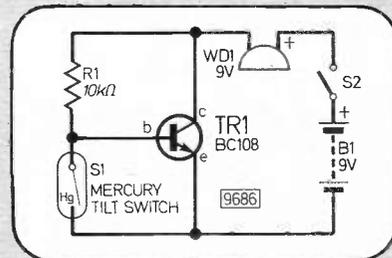
TILT ALARM

My idea is for a simple alarm circuit that activates when the sensor S1 is tilted from the vertical, the alarm stopping when repositioned.

The sensor S1 is a s.p.s.t. mercury switch, the contacts normally closed when the switch is held in the upright position. The transistor TR1 switches the buzzer off as soon as the sensor is returned to its upright position.

The mercury switch is available from Tandy stores. The complete unit can be built in a matchbox and used as an alarm or simple spirit level.

D. Cockburn, Middleton, Manchester.



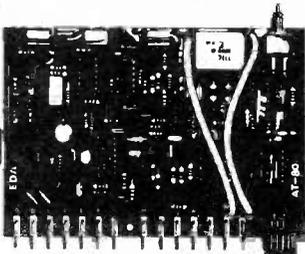
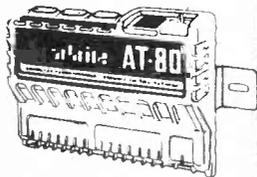
MORE ON PAGE 241

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

Sparkrite

BRANDEADING ELECTRONICS

NOW AVAILABLE IN KIT FORM



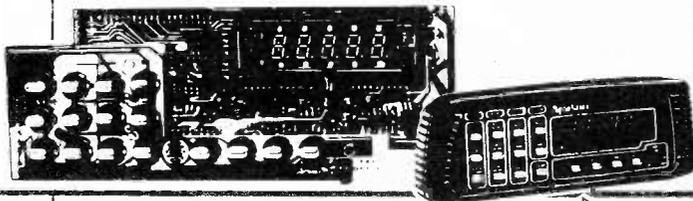
AT-80

Electronic Car Security System

- Arms doors, boot, bonnet and has security loop to protect fog/spot lamps, radio/tape, CB equipment
- Programmable personal code entry system
- Armed and disarmed from outside vehicle using a special magnetic key fob against a windscreen sensor pad adhered to the inside of the screen
- Fits all 12V neg earth vehicles
- Over 250 components to assemble

VOYAGER Car Drive Computer

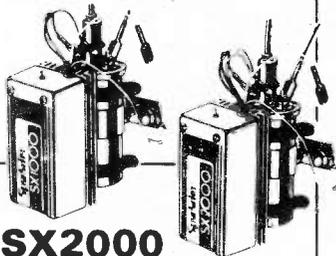
- A most sophisticated accessory
 - Utilises a single chip mask programmed microprocessor incorporating a unique programme designed by EDA Sparkrite Ltd.
 - Affords 12 functions centred on Fuel, Speed, Distance and Time
 - Visual and Audible alarms warning of Excess Speed, Frost/Ice, Lights-left-on
 - Facility to operate LOG and TRIP functions independently or synchronously
 - Large 10mm high 400ft-L fluorescent display with auto intensity
 - Unique speed and fuel transducers giving a programmed accuracy of + or - 1%
 - Large LOG & TRIP memories 2,000 miles, 180 gallons, 100 hours
 - Full Imperial and Metric calibrations
 - Over 300 components to assemble
- A real challenge for the electronics enthusiast!



SX1000

Electronic Ignition

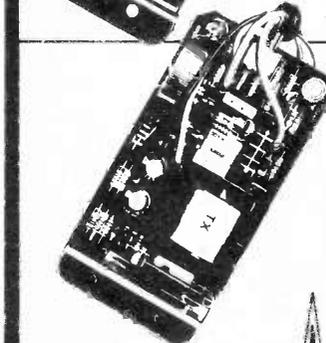
- Inductive Discharge
- Extended coil energy storage circuit
- Contact breaker driven
- Three position changeover switch
- Over 65 components to assemble
- Patented clip-to-coil fitting
- Fits all 12v neg. earth vehicles



TX1002

Electronic Ignition

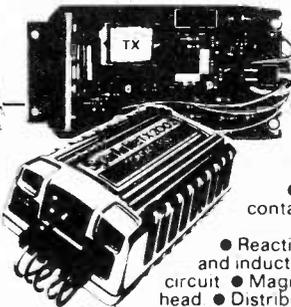
- Contactless or contact triggered
- Extended coil energy storage circuit
- Inductive Discharge
- Three position changeover switch
- Distributor triggerhead adaptors included
- Die cast weatherproof case
- Clip-to-coil or remote mounting facility
- Fits majority of 4 & 6 cyl. 12V. neg. earth vehicles
- Over 145 components to assemble.



SX2000

Electronic Ignition

- The brandleading system on the market today
- Unique Reactive Discharge
- Combined Inductive and Capacitive Discharge
- Contact breaker driven
- Three position changeover switch
- Over 130 components to assemble
- Patented clip-to-coil fitting
- Fits all 12v neg. earth vehicles



TX2002

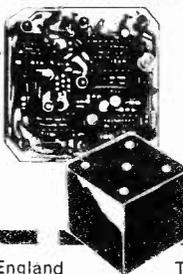
Electronic Ignition

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

All SPARKRITE products and designs are fully covered by one or more World Patents

SPECIAL OFFER

"FREE" MAGIDICE KIT WITH ALL ORDERS OVER £45.00



MAGIDICE

Electronic Dice

- Not an auto item but great fun for the family
- Total random selection
- Triggered by waving of hand over dice
- Bleeps and flashes during a 4 second tumble sequence
- Throw displayed for 10 seconds
- Auto display of last throw 1 second on 5
- Muting and Off switch on base
- Hours of continuous use from PP7 battery
- Over 100 components to assemble

Sparkrite, 82 Bath Street, Walsall, West Midlands.

SPARKRITE 82 Bath Street, Walsall, West Midlands, WS1 3DE England

Tel: (0922) 614791 Allow 28 days for delivery

	SELF ASSEMBLY KIT
SX 1000	£12.95
SX 2000	£19.95
TX 1002	£22.95
TX 2002	£32.95
AT 80	£32.95
VOYAGER	£64.95
MAGIDICE	£9.95

NAME _____ EE4
ADDRESS _____

I ENCLOSE CHEQUE(S)/POSTAL ORDERS FOR

£ _____ KIT REF. _____

CHEQUE NO. _____

PHONE YOUR ORDER WITH
SEND ONLY SAE IF BROCHURE IS REQUIRED



PRICES INC. VAT. POSTAGE & PACKING

CUT OUT THE COUPON NOW!

BRANDEADING BRITISH ELECTRONICS

T.V. SOUND TUNER BUILT AND TESTED



£22.95 + £2.00 p&p.

In the cut-throat world of consumer electronics, one of the questions designers apparently ponder over is "Will anyone notice if we save money by chopping this out?" In the domestic TV set, one of the first casualties seems to be the sound quality. Small speakers and no tone controls are common and all this is really quite sad, as the TV companies do their best to transmit the highest quality sound. Given this background a compact and independent TV tuner that connects direct to your Hi-Fi is a must for quality reproduction. The unit is mains operated. This TV SOUND TUNER offers full UHF coverage with 5 pre-selected tuning controls. It can also be used in conjunction with your video recorder. Dimensions: 11 1/2" x 8 1/2" x 3 3/4".

E.T.I. kit version of above without chassis, case and hardware. £12.95 plus £1.50 p&p.

PRACTICAL ELECTRONICS STEREO CASSETTE RECORDER KIT



£32.95 + £2.75 p&p.

• NOISE REDUCTION SYSTEM • AUTO STOP • TAPE COUNTER • SWITCHABLE E.O. • INDEPENDENT LEVEL CONTROLS • TWIN V.U. METER • WOW & FLUTTER 0.1% • RECORD/PLAYBACK I.C. WITH ELECTRONIC SWITCHING • FULLY VARIABLE RECORDING BIAS FOR ACCURATE MATCHING OF ALL TAPES.

Kit includes tape transport mechanism, ready punched and back printed quality circuit board and all electronic parts, i.e. semiconductors, resistors capacitors, hardware top cover, printed scale and mains transformer. You only supply solder and hook-up wire.

Featured in April issue P.E. Reprint 50p. Free with kit. Self assembly simulated wood cabinet - £4.50 + £1.50 p&p.

SPECIAL OFFER!
£31.00 plus £2.75 p&p
Complete with case.

BSR RECORD DECK

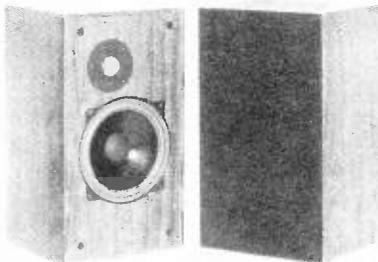
Manual single play record deck with auto return and cueing lever. Fitted with stereo ceramic cartridge 2 speeds with 45 rpm spindle adaptor ideally suited for home or disco.



13" x 11" approx. **£12.95** + £1.75 p&p.

SPECIAL OFFER! Replacement stereo cassette tape heads - £1.80 ea. Mono £1.50 ea. Erase 70p ea. Add 50p p&p to order.

Special Offer! AUDAX 45 WATT TWO WAY SPEAKERS **£36.95 a pair** Plus £7.00 p&p



Originally made to sell for over £70. Unit comprises 8" bass/mid range and 4" soft dome tweeter and a 6 element crossover. Mirror image. Finished in rosewood. Size: 470mm high x 264mm wide x 225mm deep. Empty cabinets available separately if required. **£9.95 pair** + £4.75 p&p.

All mail to:

21A HIGH STREET, ACTON W3 6NG.

Note: Goods despatched to U.K. postal addresses only. All items subject to availability. Prices correct at 30/10/82 and subject to change without notice. Please allow 7 working days from receipt of order for despatch. RTVC Limited reserve the right to up-

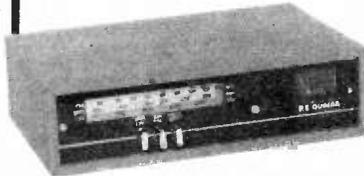
PERSONAL LS AMP KIT

Amplifier for your personal stereo cassette player as featured in January issue of Everyday Electronics. Turn your personal stereo into a mains powered home unit.



Parts: Stereo power amp PCB with all components, **£3.50** + 75p p&p. Power supply unit, **£1.95** + £1.50 p&p. Pair of 4 1/2" elliptical speakers, **£1.50** the pair, + £1.00 p&p. Input & output sockets & plugs, **£1.50**. Recommended case (for the power supply and amp only), **£2.95** + 80p p&p. P&P inclusive price of **£1.75** for two or more articles.

P.E. STEREO TUNER KIT



This easy to build 3 band stereo AM/FM tuner kit is designed in conjunction with Practical Electronics (July '81 issue). For ease of construction and alignment it incorporates three Mullard modules and an I.C. IF. System.

FEATURES: VHF, MW, LW Bands, interstation muting and AFC on VHF. Tuning meter. Two back printed PCB's. Ready made chassis and scale. Aerial: AM - ferrite rod, FM - 75 or 300 ohms. Stabilised power supply with 'C' core mains transformer. All components supplied are to P.E. strict specification. Front scale size: 10 1/2" x 2 1/2" approx. Complete with diagram and instructions.

£17.95
Plus £2.50 p&p.

Self assembly simulated wood cabinet sleeve to suit tuner only. Finish size: 11 1/2" x 8 1/2" x 3 3/4". **£3.50** Plus £1.50 p&p.

SPEAKER KIT

2 WAY 10 WATT

8" bass/mid range and 3 1/2" tweeter. Complete with screws, wire, crossover components and cabinet. All wood pre-cut - no cutting required. Finish - chipboard covered wood simulate. size 14 1/2" x 8 3/4" x 4". **PAIR for ONLY**

£12.50 plus £1.75 p&p.



MONO MIXER AMP

Ideal for Church halls & Club houses.

£45.00
+ £2.00 p&p.

50 WATT Six individually mixed inputs for two pickups (Car. or mag.), two moving coil microphones and two auxiliary for tape tuner, organs, etc. Eight slider controls - six for level and two for master bass and treble, four extra treble controls for mic. and aux. inputs. Size: 13 1/2" x 6 1/2" x 3 3/4" app. Power output 50 watts R.M.S. (cont.) for use with 4 to 8 ohm speakers. Attractive black vinyl case with matching fascia and knobs. Ready to use.



Matching AKG Microphone to suit (with speech and music filter). Complete with lead. **ONLY £9.95 plus 75p p&p.**

Telephone or mail orders by ACCESS welcome.



Everyday Electronics, April 1983

CIRCUIT EXCHANGE

This is the spot where readers pass on to fellow enthusiasts useful and interesting circuits they have themselves devised.

Payment is made for all circuits published in this feature.

Contributions should be accompanied by a letter stating that the circuit idea offered is wholly or in significant part the original work of the sender and that it has not been offered for publication elsewhere.

DOOR ALARM WITH L.E.D. INDICATOR

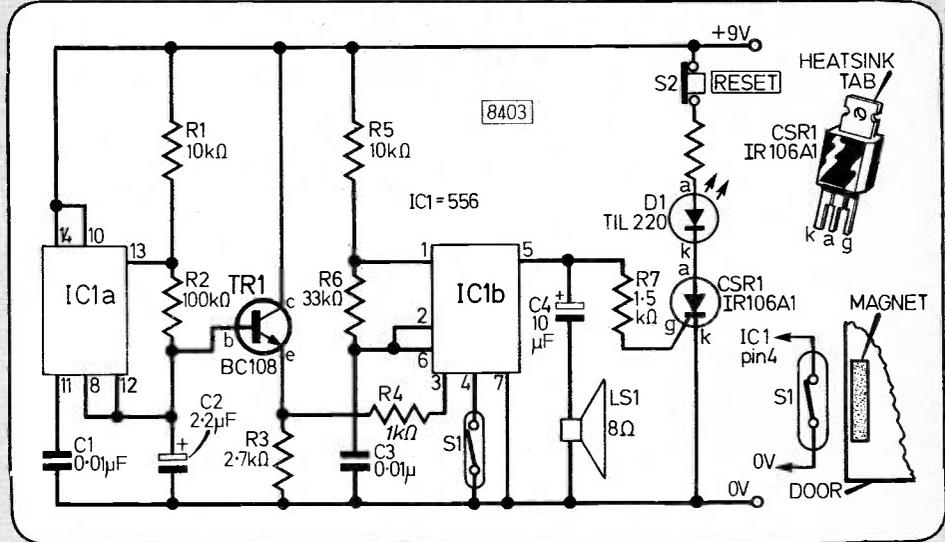
This circuit gives out an "American" siren sound when the reed switch S1 is de-activated and also operates a light emitting diode (l.e.d.).

A magnet, mounted in a door, is sited beside the reed switch to hold the contacts closed, shorting the reset pin 4 of IC1 to the 0V line so that the siren will not sound. When someone opens the door, the magnet's influence on the switch S1 is removed and the siren sounds.

Once the door has been opened, the light emitting diode, D1 is also activated. It stays on even when the door is closed again because of the action of the thyristor CSR1. The push-to-break switch S2 resets D1 to standby.

The timing circuit is built around a 556 dual timer i.c. IC1a operating as a slow astable and IC1b as a fast astable producing the note.

The switch S2 and the l.e.d. D1 should be concealed outside the door. This is because the siren would go off as you



enter or leave the room. Also, as the light emitting diode D1 remains on, once triggered, you have to be able to reset it

before entering the room and as you leave.

M. Lawson,
Choppington, Northumberland.

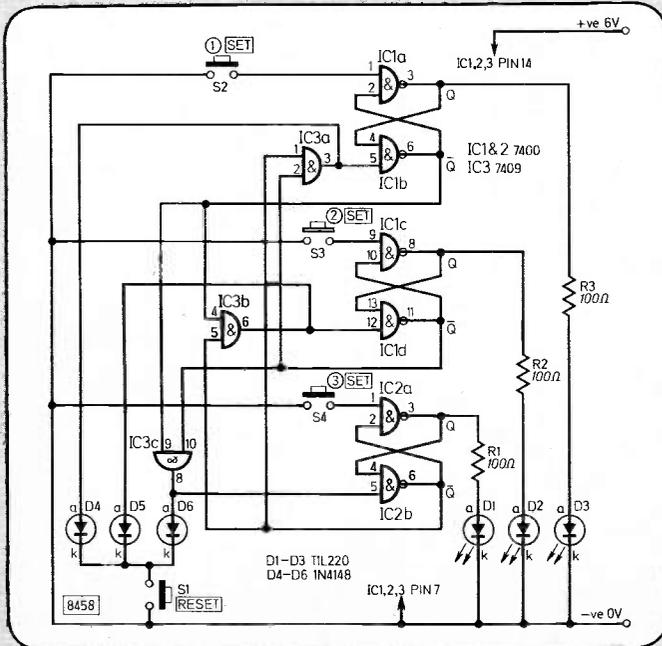
THREE WAY SNAP INDICATOR

This circuit uses three bistable latches. When one latch is set by its switch, the Q output goes high and lights an l.e.d. and the \bar{Q} output puts a low on the inputs of two AND gates connected to the other two latches. Thus causing the outputs of these gates to go low also, resetting the other two latches and stopping them being activated.

So the first button to be pressed latches the appropriate l.e.d. and disables the other latches. If another button is pressed, the relevant l.e.d. will light, but not latch.

To reset the unit, switch S1 is pressed which resets every latch, using the diodes to stop all the reset inputs being permanently shorted as this would prevent the unit operating properly.

Lee Dowthwaite,
Workington,
Cumbria.



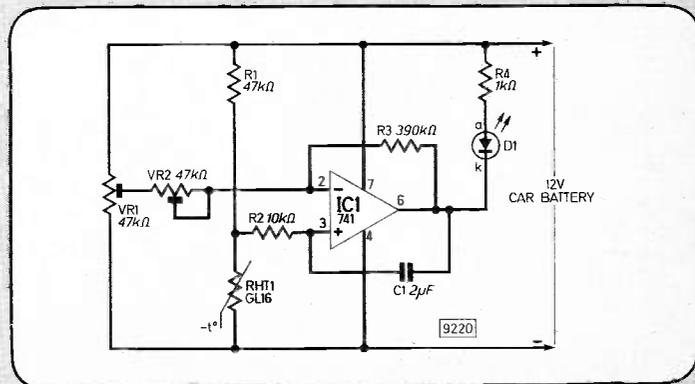
CAR OVERHEATING INDICATOR

This unit gives a timely warning before your car gets overheated. The l.e.d. D1 will flash at a regular rate when the temperature reaches a predetermined value as set by VR1.

When the temperature continues to rise the l.e.d. stops flashing and becomes continuously illuminated. The range of temperature over which it flashes can be set by VR2.

The unit is suitable for both positive and negative earth vehicles without modification. The frequency of flashing of D1 can be altered by changing the value of C1.

J. Sreekumar,
Kaloor, Cochin-17,
India.



Car Radio POWER Booster



BY C. LARE

In general, car radio units do not have an adequate audio output level. This is because they use a simple class *A* or *B* output stage, which, off a 12-volt supply, can only produce 4-5 watts. This level of audio is often not sufficient to be heard above the ambient noise without driving the unit's output stages into severe overload.

BRIDGE MODE

One method of increasing the audio level is to use two standard amplifiers in *bridge mode*. This effectively multiplies the output power by 4 into the same impedance speaker. The maximum power available from a 12-volt supply is around 20 watts into 4 ohms.

This level of power has been found to be perfectly adequate when driving a pair of Pioneer TS107 speakers. Indeed, the value of higher powers must be questioned because it has been found that even gentle use of the bridge power booster masks the engine sound which is unwise if something starts to rattle prior to falling off. It is this method of power boosting which forms the basis of this article.

BRIDGE MODE AMPLIFICATION

Before considering the actual circuit in any detail it is necessary to understand the basics of bridge mode amplification. Consider Fig. 1, which shows the output stage of a typical amplifier. For clarity a class *B* type is assumed, although a class *A* would be just as appropriate. Before the decoupling capacitor the amplifier output sits at 6 volts ($\frac{1}{2}$ supply) without any audio input. The capacitor ensures that this d.c. voltage does not appear across the speaker.

Now, if an audio signal is applied to the amplifier the output will swing around the 6-volt level, and will obviously produce the highest sound levels as it approaches the 12-volt and 0-volt levels since these correspond to the largest deviation from the 6-volt centre line. The output will not actually reach 12 volts or 0 volts because of the voltage drop across the output transistors.

This voltage will be termed $V_{CE\text{ Sat}}$, because it corresponds to the full-on condition of the transistor, or the saturation voltage drop. A typical value of $V_{CE\text{ Sat}}$ is 2 volts, and so the maximum power of a

single-ended amplifier such as the type in Fig. 1, is given by:

$$P_{\text{out}} = \frac{V^2}{R_L}$$

where R_L is the speaker impedance

therefore

$$P_{\text{out}} = \frac{(V_s/2 - V_{CE\text{ Sat}})^2}{R_L}$$

where V_s is the total supply voltage. Using typical values of R_L (4 ohms), V_s (12 volts) and $V_{CE\text{ Sat}}$ (2 volts) the power output is easily calculated as being 4 watts, a figure to be found in most radio specifications.

A bridge mode amplifier uses two amplifiers, with one of the amplifiers connected to give an inverted output. The speaker is connected between the two amplifier outputs (Fig. 2). Obviously, as before, the two amplifiers will sit with a 6-volt output when no signal is applied. Thus, when no signal is present no current flows through the speaker, and as an added bonus therefore, no output decoupling capacitor is required.

If a positive signal is applied to the input the output of the non-inverting amplifier will rise, and the output of the inverting amplifier will fall by the same amount. The voltage across the load then, for any given input, is twice the voltage one would obtain from a single-ended amplifier. It also follows that, if the input voltage falls, the non-inverting amplifier output will fall as the inverting output rises, and the twice voltage condition is preserved.

The result of this is that the peak voltage across the load is no longer

$$\frac{(V_s - V_{CE\text{ Sat}})}{2}$$

but

$$(V_s - 2V_{CE\text{ Sat}})$$

(one $V_{CE\text{ Sat}}$ drop on each amplifier), and so the actual output power is vastly increased as follows:

$$P_{\text{out}} = \frac{(V_s - 2V_{CE\text{ Sat}})^2}{R_L}$$

and using the same values as before gives a power output of 16 watts. This is slightly lower than they hoped for

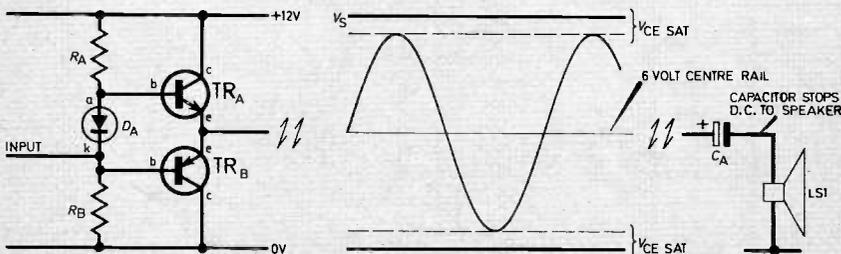


Fig. 1. Diagram showing the output stage of a typical amplifier.

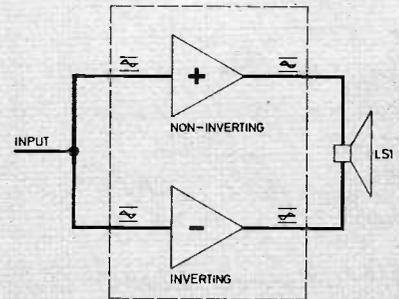


Fig. 2. Wiring diagram of two amplifiers in a bridge mode configuration.

because of the rather generous value of 2 volts assumed for $V_{CE\text{ Sat}}$, and in fact, the prototypes managed 18.9 watts before clipping off 11.8 volts.

DUAL POWER AMPLIFIER

In this project use is made of a dual power amplifier available in a single package. The TDA2004 contains two identical power amplifiers, which may be connected in inverting or non-inverting mode, which makes it ideal for this application. Obviously the two amplifiers may be used separately in standard stereo modes.

The TDA2004 is particularly suitable for mounting in cars because it is an electrically robust device and can stand reverse polarity connections for the time it takes a fuse to blow, excessive temperatures, high voltage spikes and even output short-circuits.

CIRCUIT DESCRIPTION

The circuit for the Car Radio Power Booster is shown in Fig. 3. The first amplifier (pins 1, 2 & 10) is arranged as a non-inverting amplifier. Because of the internal structure of the device a current proportional to the input signal flows out of pin 2 (usually the non-inverting ter-

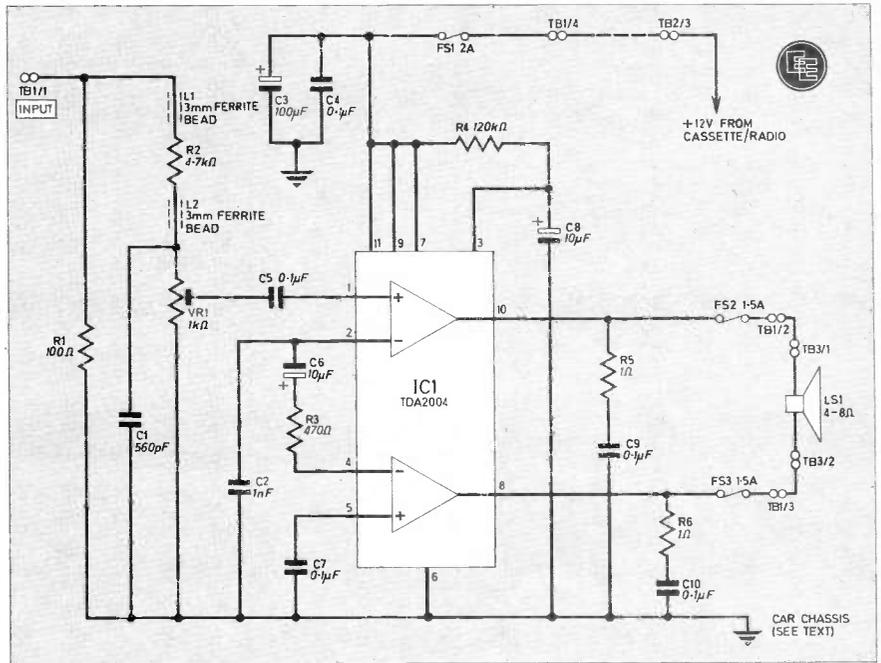


Fig. 3. Complete circuit diagram of the Car Radio Power Booster.

minal), and this is fed to the second amplifier through its inverting terminal.

This amplifier has the non-inverting terminal connected to ground at a.c. frequencies by C6 which ensures stability. This configuration works because the input stage of the TDA2004 is a simple transistor with the base designated non-inverting input and the emitter-inverting input. The collector load is a current source, and so by connecting the two emitters together, change on one emitter as a result of an input moves the other emitter, which gives rise to out-of-phase output signals.

The two inverting inputs are decoupled by C2 to ensure that minute differences in the two amplifier sections do not cause a different nominal output voltage to occur, and hence a constant current flow through the speaker. Two Zobel networks

on the outputs ensure stability by matching the impedance of the speaker to the amplifier over the entire frequency range.

The input is taken directly from the output stage of the radio. The waste power developed is passed into the 100 ohm resistor, R1. The signal is then divided down in level by R2 and VR1, which provides for level adjustment. Two ferrite beads and the 560pF capacitor C1 tend to filter out any interference from ignition, generator, or CB. The signal is then coupled into the TDA2004 via C9, a d.c. blocking capacitor.

The power is supplied via a 2-amp fuse and a 100μF electrolytic capacitor which together with the 0.1μF capacitor tends to decouple the i.c. The input stage of the i.c. is more sensitive to supply variations than the output, and is further decoupled by means of R4 and C8.

COMPONENTS

Resistors

R1	100Ω ½W
R2	4.7kΩ
R3	470Ω
R4	120kΩ
R5	1Ω
R6	1Ω

All ½W carbon ±5% unless otherwise stated

Capacitors

C1	560pF polystyrene
C2	1nF ceramic plate
C3	100μF 16V elect. radial leads
C4	0.1μF polyester (C280)
C5	0.1μF polyester (C280)
C6	10μF 16V tantalum
C7	0.1μF polyester (C280)
C8	10μF 16V tantalum
C9	0.1μF polyester (C280)
C10	0.1μF polyester (C280)

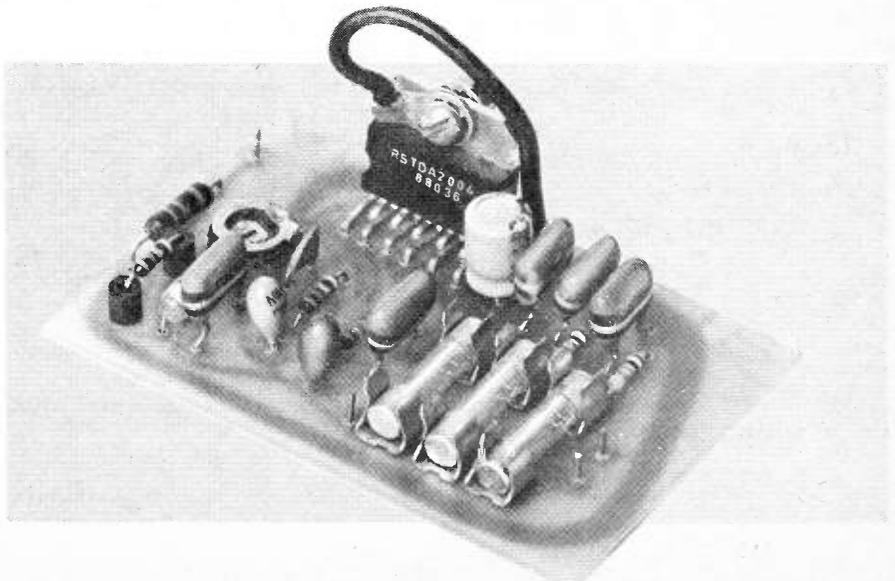
Semiconductors

IC1	TDA2004
-----	---------

Miscellaneous

VR1	1kΩ miniature preset
FS1	2A 20mm fuse
FS2, 3	1.5A 20mm fuse (2 off)
Aluminium case type (AB11), 102 × 64 × 51mm; single-sided p.c.b. 90 × 50mm; 6 fuse clips; 2 ferrite beads; 4BA solder tag; 4BA nut and bolt; heatsink compound.	

Guidance only
Approx. cost **£10**



Car Radio POWER Booster

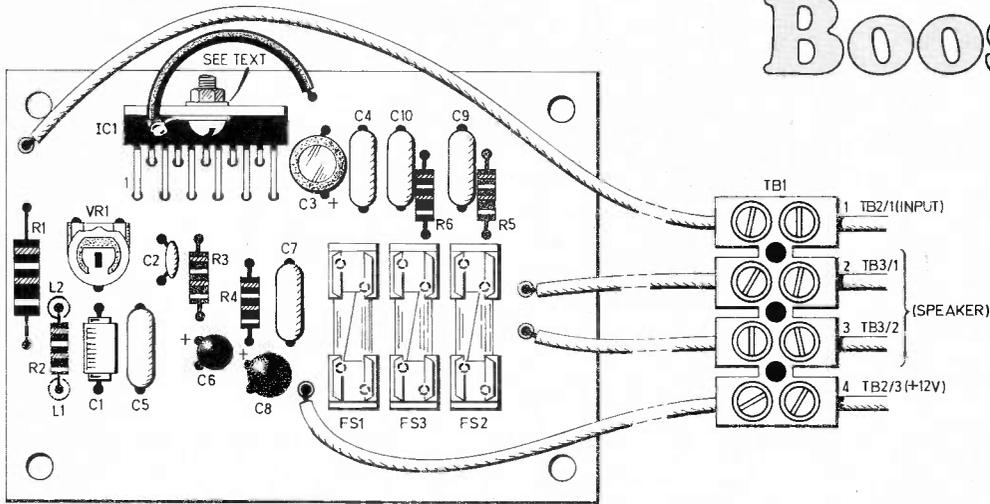
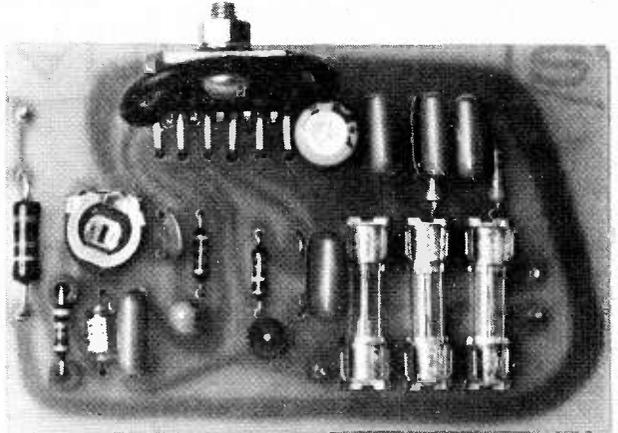
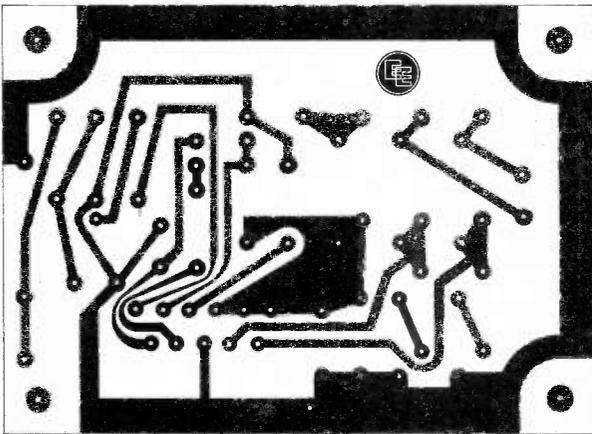


Fig. 4. Component layout, interwiring and full size printed circuit board.



Completed circuit board for mono version.

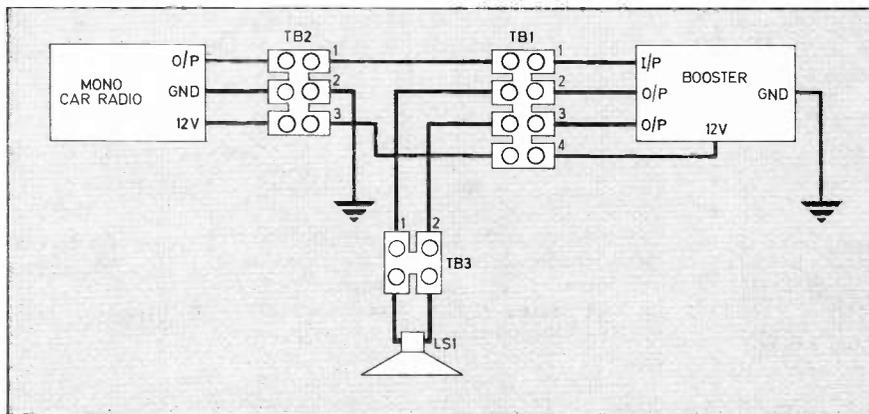


Fig. 5. Complete wiring diagram for a mono audio system.

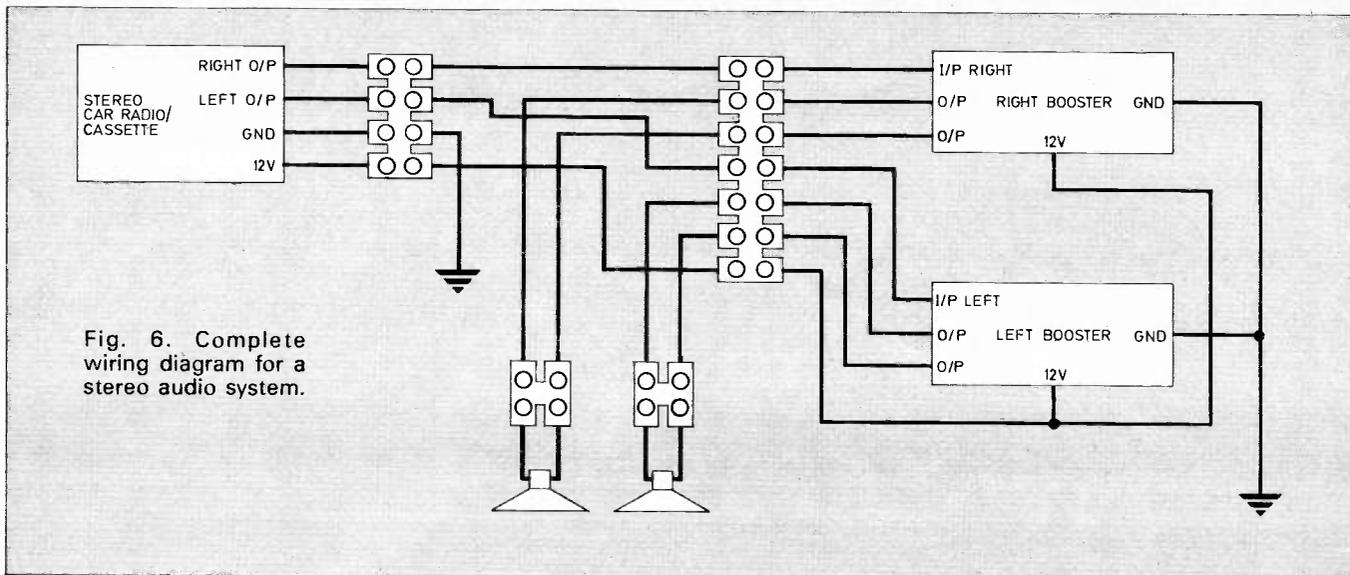


Fig. 6. Complete wiring diagram for a stereo audio system.

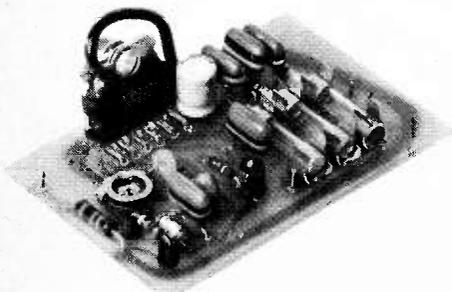


PRINTED CIRCUIT BOARD

Construction of the booster is very simple indeed, and the only care that really needs to be taken is with the polarised capacitors. However, it is strongly suggested that the printed circuit board design is used, otherwise stability problems may well result. Note in particular that the *earthy* side of the input resistor, R1, is taken back to the central earth down a discrete track (Fig. 4).

Inserting the TDA2004 can be tricky, but patience and a small pair of pliers will insert it in the end. Don't forget the ferrite beads. It may well be necessary to bend in the fuse clips to stop them from touching, and this should be checked.

Finally, connect a piece of wire from the ground pin on the board to a 4BA solder tag, which should be bolted to the tag of the i.c.



TESTING

If a current limited supply is not available connect a 10 ohm resistor between the supply and the board. Connect the ground to the low side of the supply, using the solder tag on the i.c. to make the connection. Apply power and check that nothing becomes hot. Measure the standing current which should be between 60mA and 140mA.

Finally, check that both outputs are sitting at about 6 volts. If this is so connect up a 4-ohm speaker and a low impedance input. If the amplifier is to be run from a signal, rather than speaker levels, remove R1 and temporarily short-out the resistor R2.

Turn down the preset on the board and apply power. If all is still well turn up the preset and the output should become audible. If this does not happen check all the connections, particularly that all the legs of the TDA2004 are properly placed and soldered. The amplifier is now ready for installation.

INSTALLATION

The car must be negative earth if the amplifier is to be used as described. The heatsink of the i.c. may be bolted to any convenient bulkhead using the 4BA bolt, or a self-tapping screw, but some heatsink compound should be placed between the heatsink and the car chassis. Check continuity between the chassis and the amplifier ground, making it good if not.

Connect up a 12-volt supply from either the ignition switch or the radio "on" switch and then connect in the speaker. Some radios have two wires feeding the speaker outputs; in this case it will be necessary to establish with the aid of an ohmmeter which is the *earthy* one which is not used. For radios with only one wire where the speaker is returned to chassis there is no problem and the normal speaker feed should be connected into the booster input.

It is suggested that when installing your Car Radio Power Booster, terminal blocks should be used for wiring connections from the radio, booster and speakers. The terminal blocks may then be positioned using double-sided tape. Detailed terminal block wiring is shown in Fig. 5.

The finished booster should be housed in an aluminium box of a suitable size (AB11). Aluminium in particular has good heatsinking qualities. Note that if the audio booster is to be used for a stereo system an additional booster must be constructed. The two boosters can then be connected as shown in Fig. 6, remember that the case should be solidly connected to the car chassis. □

PRACTICAL ELECTRONICS

APRIL 1983

PROJECTS

Digit Talker speech board
Battery Tester
Wiper Delay
Phaser

COMPUTING

Into The Real World,
interfacing micros
Ultimum Romulator board
Microprompt

PLUS

Microfile:
the 6809 microprocessor

ON SALE NOW

SQUARE one FOR BEGINNERS

ELECTROLYTIC capacitors are found in many electronic circuits. In mains power supplies they are virtually indispensable. Elsewhere they are often the most convenient packages of capacitance since they are compact and cheap. But "electrolytics" have limitations which the user needs to keep in mind.

PRINCIPLE

If a sheet of aluminium is suspended in a solution of borax in a metal container (Fig. 1a) and a voltage applied, as shown, several things happen. At first, a relatively large current flows, because the solution is a conductive one (an electrolyte). Chemical action takes place at the aluminium plate, whose surface slowly becomes oxidised.

The oxide is an insulator which in covering the metal restricts the flow of current very severely. The oxide film acquires an electric charge to the battery voltage, and this charge dies away slowly after the battery is removed.

The aluminium plate becomes one plate of a capacitor whose dielectric is the oxide film. The other plate is the electrolyte, which connects to the metal container.

HIGH CAPACITANCE

The oxide layer is very thin: of the order of a ten-thousandth of a millimetre. Thin dielectrics mean high capacitance.

The capacitance can be increased by first etching the surface of the aluminium with acid before making the capacitor. The myriad "etch pits" increased the effective plate area considerably.

In the form described, the capacitor is a "wet" electrolytic. That is, it contains free liquid.

In practice, the positive plate or "anode" is made from aluminium foil and the metal container or "can" is also aluminium. The foil is often laid over with a spongy insulator and rolled up compactly.

The electrolyte is held in by a rubbery seal which often embodies a crude valve for venting gas, which can be created by further chemical action. Applying a voltage of the wrong polarity can make this happen with explosive suddenness!

Other forms are less "wet". The electrolyte is still there, somewhere (it has to be), but is either held in an absorbent material to make a "semi-dry" capacitor or chemically solidified to make a "dry" electrolytic.

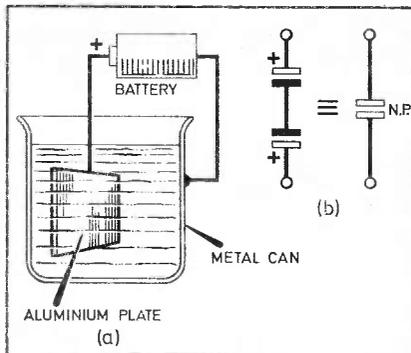
TANTALUM

If the metal tantalum is used instead of aluminium (and with a different electrolyte) the result is a rather superior capacitor, compact, of low residual ("leakage") current, and made to closer tolerances than the aluminium type. But also more expensive!

LIMITATIONS

The obvious limitation is that to preserve the oxide film an electrolytic must always be kept charged by a voltage of the same polarity. Reversing the polarity, or merely leaving the capacitor uncharged for a long time, causes the film to dissolve. Whether the capacitor can then be "re-formed" by applying a voltage marginally above the nominal working voltage depends on how far the damage has gone.

Fig. 1a. Demonstrating the principle and make up of the electrolytic capacitor. (b) Two electrolytics connected "back-to-back" to form a non-polarised capacitor.



If two electrolytics are connected "back-to-back" (Fig. 1b), one of them is always correctly "polarised", whatever the direction of the applied voltage. Non-polarised (N.P.) electrolytics are really like this, inside, and are therefore reversible, though hardly true a.c. devices.

A second limitation is imposed by the "leakage current", that is the small residual current which always flows, however long the "forming voltage" is connected. Tantalums have less leakage than aluminium electrolytics, but the leakage of both types can be reduced dramatically by operating a well-formed capacitor at a much reduced voltage.

If, on the other hand, the voltage is increased above the working voltage there is a very sharp increase in leakage current, and this may damage the capacitor. Voltage ratings must be observed! It is always safe to use a capacitor at less than its rated voltage, never safe to use it above its rating.

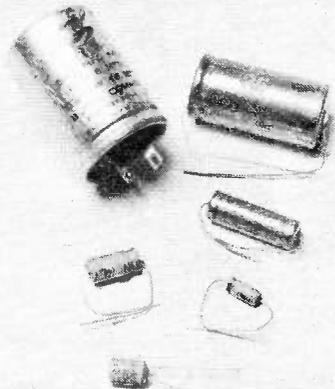
In most circuits in E.E. the highest voltage around is the battery voltage and it is wise to use capacitors rated at a somewhat higher voltage than this, say 16V or 20V for a 9V battery. Remember, however, that higher working voltage usually means a bigger component.

TOLERANCE

Because of the variability of the oxide thickness, aluminium electrolytics generally have very wide tolerances compared with other passive components. In many circuits it is important that the capacitance should not be less than a certain minimum.

This leads to tolerances such as: 1,000 μ F, +100%, -50%, which means that the true capacitance of this nominal 1,000 μ F capacitor could be as high as 2,000 μ F but in any case will not be less than 500 μ F. Tantalum electrolytics usually have more normal tolerances, such as \pm 20%.

A selection of electrolytic capacitors. The tolerance of these capacitors is generally very wide, often +100, -50 per cent and the leakage current, that is the d.c. current flowing between the plates, is also high. Typical uses include smoothing in power supplies and inter-stage coupling in audio amplifiers.



MASTER ELECTRONICS NOW!

The PRACTICAL way!

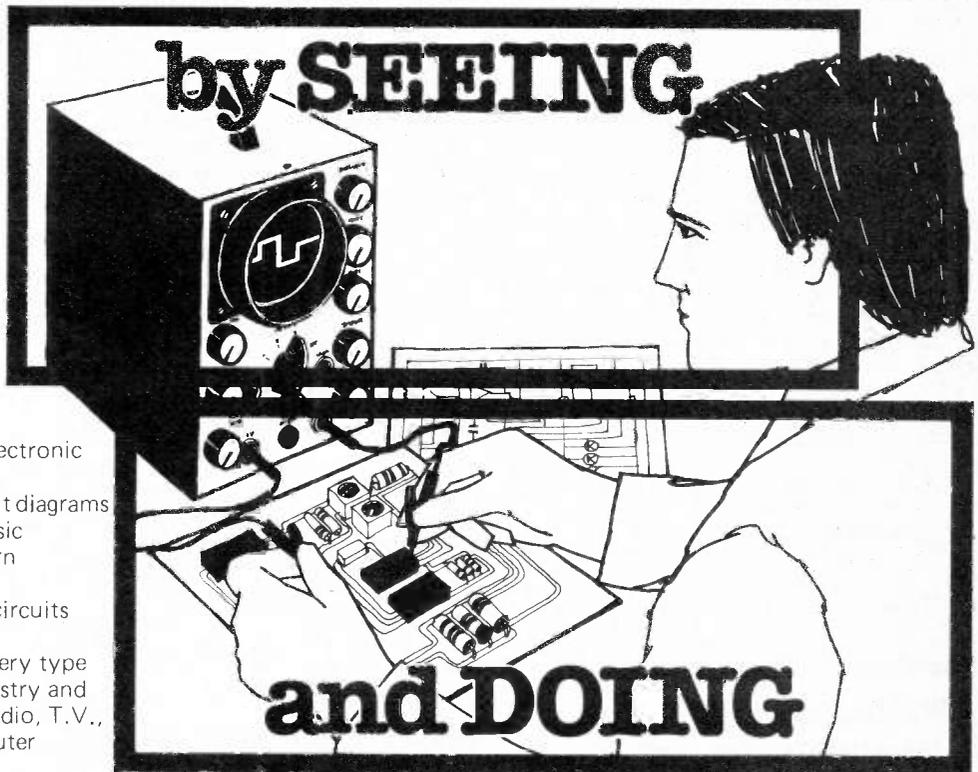
This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

You learn the practical way in easy steps mastering all the essentials of your hobby or to start or further a career in electronics or as a self-employed servicing engineer.

All the training can be carried out in the comfort of your own home and at your own pace. A tutor is available to whom you can write personally at any time, for advice or help during your work. A Certificate is given at the end of every course.

You will do the following:

- Build a modern oscilloscope
- Recognise and handle current electronic components
- Read, draw and understand circuit diagrams
- Carry out 40 experiments on basic electronic circuits used in modern equipment
- Build and use digital electronic circuits and current solid state 'chips'
- Learn how to test and service every type of electronic device used in industry and commerce today. Servicing of radio, T.V., Hi-Fi and microprocessor/computer equipment.



New Job? New Career? New Hobby? Get into **Electronics** Now!

FREE!

COLOUR BROCHURE



POST NOW TO:

Please send your brochure without any obligation to

I am interested in:

- COURSE IN ELECTRONICS as described above
- RADIO AMATEUR LICENCE
- MICROPROCESSORS
- LOGIC COURSE

NAME _____

ADDRESS _____

OTHER SUBJECTS _____

BLOCK CAPS PLEASE

EE4/820

British National Radio & Electronics School Reading, Berks. RG1 1BR.

Sinclair ZX Spectrum

**16K or 48K RAM...
full-size moving-
key keyboard...
colour and sound...
high-resolution
graphics...**

**From only
£125!**



First, there was the world-beating Sinclair ZX80. The first personal computer for under £100.

Then, the ZX81. With up to 16K RAM available, and the ZX Printer. Giving more power and more flexibility. Together, they've sold over 500,000 so far, to make Sinclair world leaders in personal computing. And the ZX81 remains the ideal low-cost introduction to computing.

Now there's the ZX Spectrum! With up to 48K of RAM. A full-size moving-key keyboard. Vivid colour and sound. High-resolution graphics. And a low price that's unrivalled.

Professional power— personal computer price!

The ZX Spectrum incorporates all the proven features of the ZX81. But its new 16K BASIC ROM dramatically increases your computing power.

You have access to a range of 8 colours for foreground, background and border, together with a sound generator and high-resolution graphics.

You have the facility to support separate data files.

You have a choice of storage capacities (governed by the amount of RAM). 16K of RAM (which you can upgrade later to 48K of RAM) or a massive 48K of RAM.

Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.

Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

There's no need to stop there. The ZX Printer—available now—is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232 / network interface board.



Key features of the Sinclair ZX Spectrum

- Full colour—8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound—BEEP command with variable pitch and duration.
- Massive RAM—16K or 48K.
- Full-size moving-key keyboard—all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution—256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set—with upper- and lower-case characters.
- Teletext-compatible—user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE—16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC—incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

um

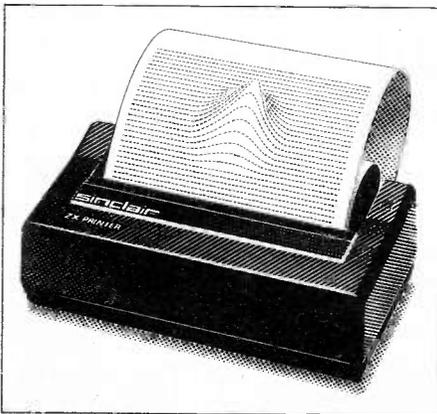


The ZX Printer—available now

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set—including lower-case characters and high-resolution graphics.

A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your ZX Spectrum. A roll of paper (65ft long and 4in wide) is supplied, along with full instructions. Further supplies of paper are available in packs of five rolls.



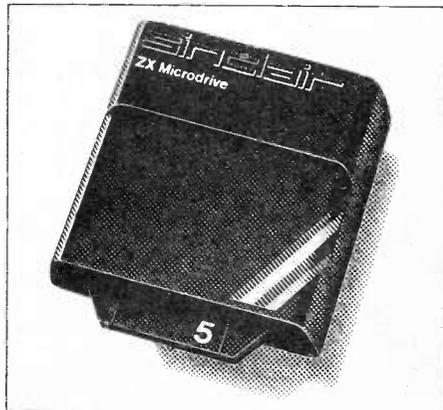
The ZX Microdrive—coming soon

The new Microdrives, designed especially for the ZX Spectrum, are set to change the face of personal computing by providing mass on-line storage.

Each Microdrive can hold up to 100K bytes using a single interchangeable storage medium.

The transfer rate is 16K bytes per second, with an average access time of 3.5 seconds. And you'll be able to connect up to 8 Microdrives to your Spectrum via the ZX Expansion Module.

A remarkable breakthrough at a remarkable price. The Microdrives will be available in the early part of 1983 for around £50.



ZX Spectrum software on cassettes—available now

The Spectrum software library is growing every day. Subjects include games, education, and business/household management. Flight Simulation... Chess... Planetoids... History... Inventions... VU-CALC... VU-3D... Club Record Controller... there is something for everyone. And they all make full use of the Spectrum's colour, sound, and graphics capabilities. You'll receive a detailed catalogue with your Spectrum.

ZX Expansion Module

This module incorporates the three functions of Microdrive controller, local area network, and RS232 interface. Connect it to your Spectrum and you can control up to eight Microdrives, communicate with other computers, and drive a wide range of printers.

The potential is enormous, and the module will be available in the early part of 1983 for around £30.

sinclair

Sinclair Research Ltd, Stanhope Road,
Camberley, Surrey GU15 3PS.
Tel: Camberley (0276) 685311.

How to order your ZX Spectrum

BY PHONE—Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day. BY FREEPOST—use the no-stamp needed coupon below. You can pay by cheque, postal order, Access,

Barclaycard or Trustcard.

EITHER WAY—please allow up to 28 days for delivery. And there's a 14-day money-back option, of course. We want you to be satisfied beyond doubt—and we have no doubt that you will be.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR.

Order

Qty	Item	Code	Item Price £	Total £
	Sinclair ZX Spectrum—16K RAM version	100	125.00	
	Sinclair ZX Spectrum—48K RAM version	101	175.00	
	Sinclair ZX Printer	27	59.95	
	Printer paper (pack of 5 rolls)	16	11.95	
	Postage and packing: orders under £100	28	2.95	
	orders over £100	29	4.95	
				Total £

Please tick if you require a VAT receipt

*I enclose a cheque/postal order payable to Sinclair Research Ltd for £

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable

Signature

PLEASE PRINT

Name: Mr/Mrs/Miss

Address

EVE904

FREEPOST—no stamp needed. Prices apply to UK only. Export prices on application.

CALL IN AND SEE FOR YOURSELF

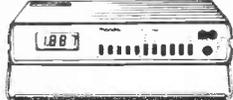
AUDIO ELECTRONICS

ALL PRICES INCLUDE VAT

TEST EQUIPMENT CENTRES ALL MODELS ON DISPLAY OPEN SIX DAYS A WEEK

RETAIL • MAIL ORDER • EXPORT • INDUSTRIAL • EDUCATIONAL

DIGITAL MULTIMETERS (UK C/P Free)



- HAND HELD**
 K0250*13 range 0.2A DC 2 meg ohm £24.95
 K0300*26 range 1A AC/DC 20 meg ohm £34.95
 K055C*28 range 10A AC/DC 20 meg ohm £39.95
 6010+ 22 range 10A AC/DC 20 meg ohm £34.40
 7030+ As 6010 but 0.1% basic. £41.30
 188M 16 range 10A DC 2 meg plus Hfe tester £39.95
 189M 30 range 10A AC/DC 20 meg plus Hfe tester £69.95

- HAND HELD AUTO RANGE**
 OM2350*21 range 10A AC/DC 20 meg ohm (Miniature) £49.95
 H030 16 range 0.2A AC/DC 2 meg ohm £41.95
 H030/B As above plus cont. buzzer £44.50
 H031 22 range 10A AC/DC 2 meg ohms plus cont. buzzer £58.95



- BENCH MODELS** (3 1/2 digit unless stated)
 TM353+ 27 range LCO 2A AC/DC £86.25
 TM355+ 29 range LEO 10A AC/DC £86.25
 TM351+ 29 range LCO 10A AC/DC £113.85
 2001 28 range LCO 10A AC/DC plus 5 range Cap. Meter with case £108.00
 TM451 4 1/2 digit LCO every facility (0.02%) £171.00
 1503a 4 1/2 digit LCO every facility (0.05%) £171.00
 1503Ha 0.03% basic version of above £189.00
 *Optional carry case £2.95 *With free carry case
 *Optional carry case £6.84

EDUCATIONAL DISCOUNTS AVAILABLE FOR ALL STOCKS - PLEASE ENQUIRE

FREQUENCY COUNTERS



- PFM200A** 200 MHz hand held pocket 8 digit LEO £67.50
 8110A 8 digit LEO bench 2 ranges 100 MHz £77.00
 8610B 9 digit LEO bench 2 ranges 600 MHz £113.85
 8000B 9 digit LEO 3 ranges 1 GHz £178.00
 TF040* 8 digit LCO 40 MHz £126.50
 TF200* 8 digit LCO 200 MHz £166.75
 *Optional carry case £6.84
Prescalers - Extended range of most counters
 TP600 800 MHz £43.00
 TP1000 1 GHz £74.00

SIGNAL GENERATORS (220/240v AC)



- FUNCTION** - All sine/square/triangle/TTL, etc.
 TG100 1 Hz - 100 KHz £90.00
 TG102 0.2 Hz - 2 MHz £166.75
PULSE
 TG105 Various facilities 5 Hz - 5 MHz £97.75
AUDIO - Multiband Sine/Square
 LA627 10 Hz to 1 MHz £86.00
 A6202A 20 Hz to 200 KHz £78.00
RF
 SG402 100 KHz to 30 MHz £59.95
 LSG17 100 KHz to 150 MHz £71.00

AUDIO • RF • FUNCTION • PULSE



- OSCILLOSCOPES**
 Full specification any model on request. SAE by post.
'HM' Series HAMEG: 'SC' THANDAR: 'CS' Series TRIO: '3' Series CROTECH
SINGLE TRACE
 3030 15 MHz 5mV. 95mm tube plus component tester C/P £3.00 £172.50
 SC110A* Miniature 10 MHz battery portable Post free £171.00
 HM103 15 MHz 2mV. 6 x 7 display plus component tester C/P £3.00 £177.00
 *Optional carry case £6.84 AC adaptor £6.69 Nicads £12.50
DUAL TRACE (UK C/P £4.00)
 HM203/4 Dual 20 MHz plus component tester £276.00
 CS1566A Dual 20 MHz. All facilities £299.00
 HM204 Dual 20 MHz plus component tester sweep delay £419.75
OPTIONAL PROBE KITS
 X1 £7.95 X10 £9.45
 X1-X10 £10.50 X100 £16.95

STOCKISTS FOR TRIO: HAMEG: CROTECH: SAFFAN SCOPES. MOST MODELS IN STOCK.

ELECTRONIC INSULATION TESTER

YF 501 500 V/0-100m with carry case £63.00

MULTIMETERS (UK C/P 65p)

- Y7206 20K/V. 19 range pocket meter £7.95
SPECIAL PRICE
 C7081 50K/V 21 ranges. Range doubler 10A DC. £15.95
SPECIAL PRICE
 ETC5000/5001 21 ranges. 50K/V. Range doubler. 10A DC. £16.50
 TMK500 23 ranges 30K/V. 12A OC plus cont. buzzer. £23.95
 NH56R 20K/V. 22 range pocket £10.95
 EU102 14 range 2K/V pocket £5.95
 830A 26 range 30K/V. 10A AC/DC overload protection, etc. £23.95
 360TR 23 range 100K/V. Large scale 10A AC/DC plus Hfe. £36.95
 AT1020 18 range 20K/V. Deluxe plus Hfe tester. £17.50
 ST303TR 21 range 20K/V plus Hfe tester. £16.95

VARIABLE POWER SUPPLIES

- PP241 0/12/24V 0/1A. £35.00
 PP243 3 amp version £59.95 (UK C/P £1.00)

DIGITAL THERMOMETER

TH301 LCO -50°C to +75°C with thermocouple £68.43

AC CLAMP METER

ST300 0/300A 0/600 VAC 0/1 Kohm 8 ranges With carry case (UK C/P 65p) £28.50

LOGIC PROBES

LP10 10 MHz £28.50
 LPD76 50 MHz £56.90

HIGH VOLTAGE METER

Direct reading 0/40 KV 20K/Volt. (UK C/P 65p) £18.40

DIGITAL CAPACITANCE

0.1 pf to 2000 mfd LCO 8 ranges OM6013 £57.95 (Carry case £2.95)

TRANSISTOR TESTER

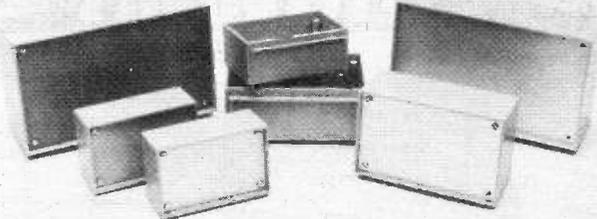
Direct reading PNP-NPN, etc. TC1 (UK C/P 65p) £21.95

AUDIO ELECTRONICS

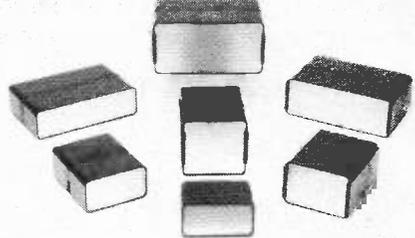
Cubegate Limited
 301 EDGWARE ROAD, LONDON W2 1BN. TEL: 01-724 3564
 ALSO AT MENRYS RADIO.
 404/406 EDGWARE ROAD, LONDON W2

FREE CATALOGUE! SEND LARGE SAE (UK 20p)
 ALL PRICES INCLUDE VAT
 Order by Post with CHEQUES/ACCESSES. VISA or you can telephone your orders. All orders despatched within 3 days unless advised.

PLASTIC CASES



beige cases offer choice of front panels; grey plastic (P), silver plastic (M) and aluminium (A). PCB slots and 10° tilt vertically or desk style.	TYPE	EXTERNAL DIMENSIONS	PRICE EACH		
			P	M	A
	10	85 x 60 x 40	0.99	1.16	1.22
	20	110 x 75 x 50	1.20	1.49	1.72
	30	155 x 95 x 60	2.10	2.51	2.74



BLACK CASES WITH BLACK AND SILVER END PANELS. PCB BOSSES. TOP SCREWS TO BOTTOM.

TYPE	EXT DIMS	EACH	TYPE	EXT DIMS	EACH
110	115 x 74 x 64	2.47	220	220 x 140 x 64	4.81
115	115 x 140 x 64	2.85	221	220 x 140 x 84	6.53
116	115 x 140 x 84	4.52	222	220 x 140 x 114	7.68
117	115 x 140 x 114	5.38			

Mail Order only. All prices include VAT and P&P. Send large SAE for Catalogue of boxes, knobs, power supplies (from 5A to 150A), controllers and more.

Please allow 28 days delivery

elec trains

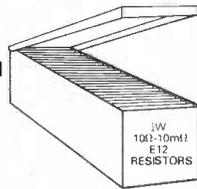
DEPT. EE4, 2 THE WILLOWS, HERSTMONCEUX, East Sussex, BN27 4LE. Tel. 0323 832571.

RESISTOR FILE

Std E12 VALUES 1/4w CARBON FILM 10Ω to 10MΩ

73 PRINTED ENVELOPES EACH CONTAINING 10 FULL SPEC, 5% RESISTORS COVERING THE E12 SERIES FROM 10Ω TO 10MΩ IN A SMART FLIP-TOP FILE FOR YOUR WORK BENCH £8.50

SUPER FILE. AS ABOVE BUT WITH 100 RESISTORS IN EACH ENVELOPE £55.00



CHEQUES & P.O's PAYABLE TO: POPS COMPONENTS. PRICES ARE INCLUSIVE BUT ADD 60p P&P TO EACH ORDER

REFILL ENVELOPES CONTAINING 10 x 1/4w RESISTORS ANY E12 VALUE FROM 10Ω TO 10MEGΩ 15p EACH CONTAINING 100 x 1/4w RESISTORS ANY E12 £1.20 EACH Please allow 28 days delivery.

POPS COMPONENTS CALLERS WELCOME @

38/40 LOWER ADDISCOMBE RD, CROYDON, SURREY CR0 6AA TEL: 688 2950



ENFIELD ELECTRONICS

PRESENT FANTASTIC BARGAINS IN DIGITAL & ANALOGUE MULTIMETERS - UNBEATABLE PRICES!!!

WHEN ORDERING, PLEASE ALLOW 12 DAYS FOR DELIVERY.



KRT 50011
£15.95

Over-load protected by two silicon diodes.
Used Double-Jewelled $\pm 2\%$
Meter with mirror and $\pm 1\%$
temperature stabilized resistor.
DC Volts: 0-125-250mV, 0-1.25-2.5-5-10-25-50-125-250-500-1000V $\pm 3\%$
AC Volts: 0.5-10-25-50-125-250-500-1000V $\pm 4\%$
DC Current: 0.25-50A-0.2-5-5-25-50-250-500mA-0.5-10A $\pm 4\%$
Resistance: 0-2K-20K-200K-0.2M-20M $\pm 3\%$



YN 360TR1
£12.95

DC Volts: 0-1v-5v-2.5v-10v-50v-250v-1000v $\pm 3\%$
AC Volts: 0-10v-50v-250v-1000v $\pm 3\%$
DC Current: 0.50uA-2.5mA-25mA-0.25A $\pm 3\%$
Resistance: min 0.2-2-200-200k ohms $\pm 3\%$
mid 20-200-20k-200k ohms $\pm 3\%$
max 2k-20k-2m-20m ohms $\pm 3\%$
As a transistor tester
Leakage current
0.150uA at X1k range $\pm 5\%$
0-15mA at X10 range $\pm 5\%$
0-150mA at X1 range $\pm 5\%$



KD 25C1
£45.95

DC Volts: 200mV, 2V, 20V, 200V and 1000V $\pm 0.8\%$ of rdg.
AC Volts: 200mV, 2V, 20V, 200V, 700V $\pm 1\%$ of rdg.
DC Current: 200uA, 2mA, 20mA, 200mA $\pm 1.5\%$ of rdg.
1000mA (1A), 10A $\pm 3\%$ of rdg.
AC Current: 200uA, 2mA, 20mA, 200mA $\pm 1.5\%$ of rdg.
1000mA (1A), 10A $\pm 3\%$ of rdg.
Resistance: 200 $\pm 1\%$ of rdg. + 0.3%
2K, 20K, 200K, 2000K (2M) $\pm 1\%$ rdg. $\pm 0.2\%$
200M $\pm 3\%$ of rdg.
Power: One 9 Volt Rectangular Battery

WE ALSO STOCK A LARGE RANGE OF SEMICONDUCTORS



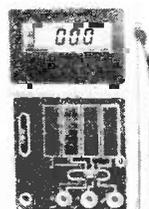
HT 7351
£23.95

DC Volt: 0-0.25-2.5-12.5-125-500-1250
AC Volt:
0-5-25-125-250-500-1250
OHMS: x1, x10, x100, x1000
DC A: 0.50 uA-5mA-50mA-500mA-10A
AC A: 0.5mA-50mA-500mA-10A
Battery: UM-3 (1.5-V) x 1pc. 006p (9-V) x 1pc.
Temp: 0.250°C (OHM x 1 range) -50 to 100 °C (OHM x 100 range)
With Carrying Case



TMK 5001
£19.95

DC Voltages: 0-0.25-1-2.5-10-25-100-250-1,000V at 30,000 ohms per volt
AC Voltages: 0-2.5-10-25-100-250-500-1,000V at 13,000 ohms per volt
DC Currents: 0.05-5-50-500mA, 0-12A
Resistance: 0-2K-20K-2M-20M (20, 200, 20K, 200K at midscale)
Decibels: -20 to +56db (Odb = 1mW, 600 ohms)
Audio Out: Capacitor in series with AC volt ranges
Short Test: Internal buzzer



KD 55C1
£29.95

DC Volts: 0-2V, 0-20V, 0-200V, 0-1000V $\pm 1\%$ of reading
AC Volts: 0-200V, 0-500V $\pm 2\%$ of full scale
DC Current: 0.2mA, 0-20mA, 0-200mA $\pm 1.5\%$ of reading
Resistance: 0-2K, 0-20K, 0-200K, 0-2M $\pm 1.5\%$ of reading



208 Baker Street, Enfield, Middlesex
01-366 1873.

IMPORTANT - Please add
£1.00 p&p + 15% VAT
per item.



EVERYDAY ELECTRONIC COMPONENTS

★ ELECTRONICS ★ COMMUNICATIONS ★ COMPUTING ★ VIDEO ★ AUDIO

You've probably heard about Ambit's computerised service by now. After all it got us nominated as one of the three top distributors in the UK electronics business.

So what?

You might imagine that your humble order for parts for EE projects is beneath the dignity of such an eminent piece of technological sophistication.

Not a bit of it.

If we weren't just as willing - and even better able to handle orders for BC239's at 8p as we are to process orders for £70 NC generator ICs we'd hardly be after your custom here, would we?

★ 3 x £1 DISCOUNT Vouchers as usual

★ PRICE-ON-THE-PAGE



ambit INTERNATIONAL
200 North Service Road,
Brentwood, Essex CM14 4SG
Telephone (Consumer
Sales/Enquiries) 0277-230909
— Telephone (Industrial
Sales/Enquiries) 0277-231616
— Telex 995194 AMBIT G
Data 24hrs (RS232/300baud)
0277-232628 - REWTEL.

• Prices exclude VAT except where otherwise shown.
• Postage and Packing 60p per pre-paid order.
• Orders submitted using Ambit Stock Codes will be processed first. • Orders for in-stock items processed same day
• Hours - (consumer sales) 8am-7pm Mon-Sat. (Industrial) 8am-6pm (Mon-Fri).



XK113 MW RADIO KIT

Based on ZN414 IC, kit includes PCB, wound aerial and crystal earpiece and all components to make a sensitive miniature radio. Size: 5.5 x 2.7 x 2cms. Requires PP3 9V battery. IDEAL FOR BEGINNERS. **£5.00**

NOW available in stock

THE JUPITER ACE MICROCOMPUTER

uses FORTH which executes about 10 times faster and requires less program memory than a comparable program using basic. Features 8K ROM, 3K RAM, built in speaker, 40 key keyboard and a 32 x 24 line flicker-free display on TV. Comes supplied complete with leads, mains adaptor, a comprehensive easy-to-follow manual on Forth programming + FREE cassette containing 5 sample programs. **ONLY £75.00** (+ £2.00 carriage + VAT)

JUPITER ACE SOFTWARE J5 DOT MAN **£3.90**
 J3 SPACE INVADERS **£3.90** J7 ZAP 'EM (ASTEROIDS) DUCK
 J4 SWAMP MONSTERS **£3.90** SHOOT & MINEFIELD (3 programs) **£5.20**

COMPONENT PACKS

- PACK 1 650 Resistors 47 ohm to 10 Mohm — 10 per value **£4.00**
- PACK 2 40 x 16V Electrolytic Capacitors 10µF to 1000µF — 5 per value **£3.25**
- PACK 3 60 Polyester Capacitors 0.01 to 1µF/250V — 5 per value **£5.55**
- PACK 4 45 Sub-miniature Presets 100 ohm to 1 Mohm — 5 per value **£2.90**
- PACK 5 30 Low Profile IC Sockets 8, 14 and 16 — pin — 10 of each **£2.40**
- PACK 6 25 Red LEDs (5mm dia.) **£1.25**

3-NOTE DOOR CHIME

Based on the SAB0600 IC the kit is supplied with all components, including loudspeaker, printed circuit board, a pre-drilled box (95 x 71 x 35mm) and full instructions. Requires only a PP3 9V battery and push-switch to complete. AN IDEAL PROJECT FOR BEGINNERS. Order as XK102 **£5.00**

LCD 3½ DIGIT MULTIMETER

16 ranges including DC voltage (200 mv-1000 v) and AC voltage, DC current (200 mA-10 A) and resistance (0-2 M) + NPN & PNP transistor gain and diode check. Input impedance 10M. Size 155x88x31 mm. Requires PP3 9V battery. Test leads included. **ONLY £29.00**

ELECTRONIC LOCK KIT XK101

This KIT contains a purpose designed lock IC, 10-way keyboard, PCBs and all components to construct a Digital Lock, requiring a 4-key sequence to open and providing over 5000 different combinations. The open sequence may be easily changed by means of a pre-wired plug. Size: 7 x 6 x 3 cms. Supply: 5V to 15V d.c. at 40uA. Output: 750mA max. Hundreds of uses for doors and garages, car anti-theft device, electronic equipment, etc. Will drive most relays direct. Full instructions supplied. **ONLY £10.50**

Electric lock mechanisms for use with latch locks and above kit **£13.50**

DISCO LIGHTING KITS

DL 1000K
 This value-for-money kit features a bi-directional sequence, speed of sequence and frequency of direction change, being variable by means of potentiometers and incorporates a master dimming control. **£14.60**

DLZ100K
 A lower cost version of the above, featuring unidirectional channel sequence with speed variable by means of a pre-set pot. Outputs switched only at mains zero crossing points to reduce radio interference to a minimum. **ONLY £8.00**

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

DL3000K
 This 3 channel sound to light kit features zero voltage switching, automatic level control & built in mic. No connections to speaker or amp required. No knobs to adjust — simply connect to mains supply & lamps. (1Kw/Channel) **Only £11.95**

DVM/ULTRA SENSITIVE THERMOMETER KIT

This new design is based on the ICL7126 (a lower power version of the ICL7106 chip) and a 3½ digit liquid crystal display. This kit will form the basis of a digital multimeter (only a few additional resistors and switches are required—details supplied), or a sensitive digital thermometer (—50°C to +150°C) reading to 0.1°C. The basic kit has a sensitivity of 200mV for a full scale reading, automatic polarity indication and an ultra low power requirement—giving a 2 year typical battery life from a standard 9V PP3 when used 8 hours a day, 7 days a week. **Price £15.50**



Have you got our **FREE ORANGE CATALOGUE** yet? NO?! Send S.A.E. 6" x 9" TODAY!!

It's packed with details of all our KITS plus large range of SEMICONDUCTORS including CMOS, LS TTL, linear, microprocessors and memories; full range of LEDs, capacitors, resistors, hardware, relays, switches etc. We also stock VERO and Antex products as well as books from Texas Instruments, Babani and Elektra.

ALL AT VERY COMPETITIVE PRICES.

ORDERING IS EVEN EASIER — JUST RING THE NUMBER YOU CAN'T FORGET FOR PRICES YOU CAN'T RESIST.

5-6-7 8-9-10

Answering service evngs & weekends

and give us your Access or BarclayCard No. or write enclosing cheque or postal order. Official orders accepted from schools, etc.

FAST SERVICE - TOP QUALITY - LOW LOW PRICES

No circuit is complete without a call to —

TH ELECTRONICS

11 Boston Road
 London W7 3SJ

Add 65p postage & packing + 15% VAT to total Overseas Customers.
 Add £2.50 (Europe), £6.00 (elsewhere) for P&P
 Send S.A.E. for further STOCK DETAILS
 Goods by return subject to availability

OPEN 9am to 5pm (Mon to Fri)
 10am to 4pm (Sat)

ALL PRICES EXCLUDE VAT

Tel: 01-567 8910 ORDERS
 01-579 9794 ENQUIRIES
 01-579 2842 TECHNICAL AFTER 5PM



TECHNICAL TRAINING IN ELECTRONICS, TELEVISION AND AUDIO IN YOUR OWN HOME — AT YOUR PACE

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 the trained man. 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 & Guilds Certificates

Radio Amateurs Basic Electronic Engineering (Joint C&G/ICS)

Certificate Courses

TV and Audio Servicing
Radio & Amplifier Construction
Electronic Engineering* and Maintenance
Computer Engineering* and Programming
Microprocessor Engineering*
TV, Radio and Audio Engineering
Electrical Engineering,* Installation and Contracting *Quality for IET Associate Membership



Approved by CACC



Member of ABCC

POST OR PHONE TODAY FOR FREE BOOKLET

Please send me your FREE School of Electronics Prospectus.

Subject of Interest _____

Name _____

Address _____



Post to: ICS
 Dept F268
 160 Stewarts Road,
 London SW8 4UJ



01-622 9911
 (All Hours)



METERS: 110 x 82 x 35mm
 30µA, 50µA, 100µA. **£6.75.** Post 50p.

METERS: 45 x 50 x 34mm
 50µA, 100µA, 1mA, 5mA, 10mA, 25v, 1A, 2A, 5A 25V. **£3.54.** Post 30p.

METERS: 60 x 47 x 33mm
 50µA, 100µA, 1mA, 5mA, 10mA, 100mA, 1A, 2A, 25v, 50v, 50-0-50µA, 100-0-100µA. **£5.87.**
 VU meters **£5.87.**
 Post on above meters 30p.

Silicone grease 50g £1.32.
 Post 16p.

NI-CAD BATTERY CHARGER
 Led indicators charge-test switch. For PP3, HP7, HP11 & HP2 size batteries.
 Price **£5.85.** Post 94p.

MULTI-METER

7N 360TR
 20,000 ohm/volt
 DC Volts: 0.1, 0.5, 2.5, 10-150-250-1,000v.
 AC Volts: 10-50, 250-1,000
 RESISTANCE RANGES
 X1, X10, X1K, X10K
£15.20
 P.&P. 94p.



TRANSFORMERS

240v Primary

3-0-3v	100mA	£1.10
6-0-6v	100mA	£1.16
6-0-6v	250mA	£1.32
12-0-12v	50mA	£1.14
12-0-12v	100mA	£1.21

Post on above transformers 48p.

9-0-9v	1A	£2.00
12-0-12v	1A	£2.50
15-0-15c	1A	£2.95
6.3v	1½A	£2.00
6-0-6v	1½A	£2.20

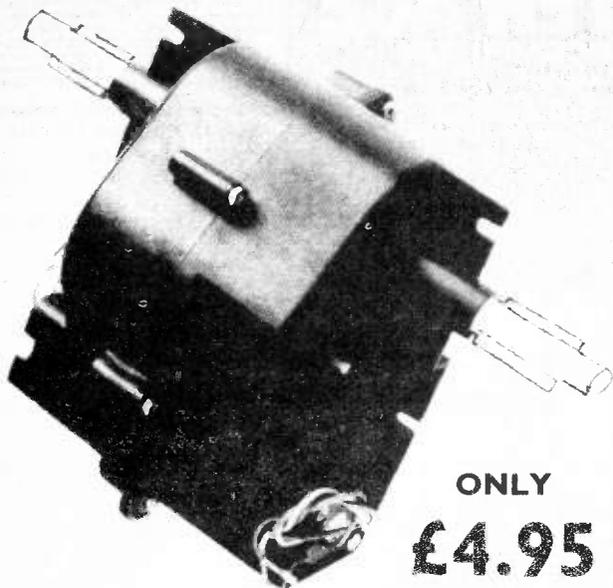
Post on above transformers 94p.

All above prices include V.A.T. Send 80p for fully illustrated catalogue with 1983 price list. S.A.E. with all enquiries. Special prices for quantity quoted on request. For a new price list only send large s.a.e.

All goods despatched within 3 days from receipt of the order.

M. DZIUBAS

158 Bradshawgate, Bolton,
 Lancs. BL2 1BA.



**ONLY
£4.95**

"BIG TRAK" MOTORIZED GEARBOX

These units are as used in the "Big Trak" computerized vehicle, and offer the experimenter in robotics the opportunity to purchase the electro-mechanical parts required in building remote controlled vehicles. The unit comprises:

- (a) 2 x 3V motors, linked by a magnetic clutch, thus enabling turning of the vehicle;
- (b) A gearbox contained within the black ABS housing reducing the final drive speed to approx. 50rpm.

Data is supplied with the unit showing various options on driving the motors, as well as a direction controller circuit, enabling the unit to turn right, left or go straight ahead.

SIMON GAME

... is back again. Another supply of ready built PCB's for this flashing light/pulsating tone computerised game is now with us. Supplied tested and working with speaker & instructions. **£4.95.**

REED RELAYS

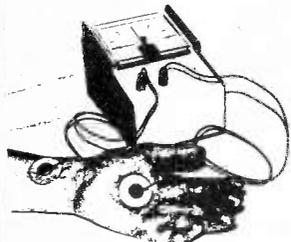
Manufacturers rejects - DIL and other PCB mounting types. SP, DP and 4P - make, break & c/o contacts. Not tested, may be only partially working or o/c etc, so very low price - pack of 10 assorted **£1;** 25 **£2.00;** 100 **£7.00.**

IN4148 - BEST PRICE EVER

Supplied in packs of 100, by Toshiba **£2** per pack; 3 packs **£5.50;** 10 packs **£15;** 25 packs **£32;** 100 packs **£115.**

FERRIC CHLORIDE

New supplies just arrived - 250mg bags of granules, easily dissolved in 500ml of water. Only **£1.15.** Also abrasive polishing block **95p.**



LIE DETECTOR

Not a toy, this precision instrument was originally part of an "Open University" course, used to measure a change in emotional balance, or as a lie detector. Full details of how to use it are given, and a circuit diagram. Supplied complete with probes, leads and conductive jelly. Needs 2 4 1/2V batts. Overall size 155x100x100mm. Only **£9.95** - worth that for the case and meter alone!

AA NI-CADS - 10 for £9.95

Brand new nickel cadmium batteries by GE, standard 1.2V @ 450mA/H. Professional quality with solder tags both ends. **Special price, £1.40 ea;** 10 for **£9.95;** Box of 80 **£65.** **Ni-cad Charger:** Charges up to 4 AA, C or D cells + PP3. Only **£7.95.**

BRAND NEW VEROBLOC KIT!!!

Just published by Babani, Mr. R. A. Penfolds new book, "30 SOLDERLESS BREADBOARD PROJECTS" - this book features 30 different projects for assembly on a Verobloc, and the kit contains all parts necessary to make:

- Audio Amplifiers
- Light & Dark Activated Switches & Alarms
- Timers
- Metronome
- Oscillators & Tone Generators
- Warbling Door Buzzer
- Two-tone Train Horn
- Touch Switch
- Reaction Game
- Sound Activated Switch
- Radio Receivers
- Fuzz Unit ... + lots more!!

The introduction shows all the different components and explains how to use the breadboard. The Verobloc layout is shown for every project together with the circuit diagram and an explanation of how it works. Ideal for beginners in electronics, but also suitable for more advanced students

The complete kit is contained in an attractive plastic case, which can be divided up into 15 compartments in which your components may be stored.

Complete Kit, including book, Verobloc & all parts **£24.95;** Book only **£2.25;** Kit without Verobloc **£20.45.**



**NOW
REDUCED
TO £3.95**

ELECTRO-DIAL

Electrical combination lock-for maximum security-pick proof. 1 million combinations!! Dial is turned to the right to one number, left to a second number, then right again to a third number. Only when this has been completed in the correct sequence will the electrical contacts close. These can be used to operate a relay or solenoid. Overall dia. 65mmx60mm deep. Only **£3.95.**

STABILIZED PSU PANEL

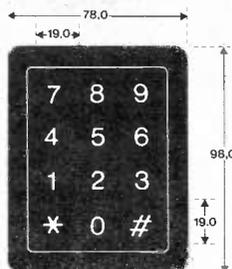
A199 A versatile stabilized power supply with both voltage (0-30V) and current (20mA-2A) fully variable. Many uses inc. bench PSU, Ni-cad charger, gen. purpose testing. Panel ready built, tested and calibrated. **£7.75.** Suitable transformer and pots. **£6.00.** Full data supplied.

GREENWELD

443D MILLBROOK ROAD, SOUTHAMPTON SO1 0HX
All prices include VAT - just add 50p post. Tel. (0703) 772501

FST

3 x 4 KEY PAD



Features

- Sealed low profile construction
- Silver contacts on X-Y matrix
- For front or rear panel mounting
- Under surface printed graphics
- Easy clean and durable front surface
- Blue or red as standard options
- Available with P.C.B. or flexible backing

PLEASE ORDER BY PART NUMBER

Blue Flexible - FST 12\$0251	£6.50
Red Flexible - FST 12\$0252	£6.50
Blue P.C.B. - FST 12\$0351	£6.50
Red P.C.B. - FST 12\$0352	£6.50

Delivery by return - price includes V.A.T., postage & packing.

Send cheque or postal order to:-

CIRCUIT BOARD COMPONENTS

55 MURDOCK ROAD
BEDFORD
MK41 7PL

Telephone (0234) 214219

HOW DARE THEY!

If you see an advertisement in the press, in print, on posters or a cinema commercial which makes you angry, write to us at the address below. (TV and radio commercials are dealt with by the I.B.A.)

The Advertising Standards Authority. ✓
If an advertisement is wrong, we're here to put it right.

ASA Ltd, Brook House, Torrington Place, London WC1E 7HN

AT YOUR SERVICE

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 Department, Everyday Electronics, Room 2612, IPC Magazines Limited, King's Reach Tower, Stamford St., London SE1 9LS. (Telephone 01-261 5942).

Miscellaneous

6 PRECISION SCREWDRIVERS in Hinged Case, sizes 0.8-3.8mm only £1.95; Pen-Watch, slim stainless steel pen combining L.C.D. 5 function watch, uses "Parker" refill only £3.99; L.C.D. clocks 1½" dia. sticks anywhere, sale price £2.50. **TAITS MAIL ORDER**, 31 Lime Grove, Addlestone, Surrey.

SILVER OXIDE BATTERIES

Save pounds on silver oxide and alkaline button cells. Fully guaranteed. e.g.: LR44 for Pentax ME Super camera only 42p each post free. For **FREE EQUIVALENTS CHART** and price list send s.a.e. to:

H. M. WHEELER & CO.,
(Unit 1), 15 Hawthorn Crescent,
Bewdley, Worcs. DY12 2JE.

DIGITAL WATCH REPLACEMENT PARTS. Batteries, displays, backlights, etc. Also reports, publications, charts. SAE for full list. **PROFORDS**, Copners Drive, Holmer Green, Bucks HP15 6SGA.

THE SCIENTIFIC WIRE COMPANY

PO Box 30, London E.4. 01 531 1568

ENAMELLED COPPER WIRE

SWG	1 lb	8 oz	4 oz	2 oz
8 to 34	3.30	1.90	1.00	0.80
35 to 39	3.52	2.10	1.15	0.85
40 to 43	4.87	2.65	2.05	1.46
44 to 47	8.37	5.32	3.19	2.50
48 to 49	15.96	9.58	6.38	3.69

SILVER PLATED COPPER WIRE

14 to 30	7.09	4.20	2.43	1.72
----------	------	------	------	------

TINNED COPPER WIRE

14 to 30	3.97	2.41	1.39	0.94
----------	------	------	------	------

FLUXCORE SOLDER 5.75 3.16 1.73 0.96
Prices include P & P vat. Orders under £2 add 20p. SAE for list of copper and resistance wire. Dealer enquiries welcome.

CONVERT TV into large screen oscilloscope. Easy built unit plugs into TV aerial socket (all external). Circuit & plans £3. J. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

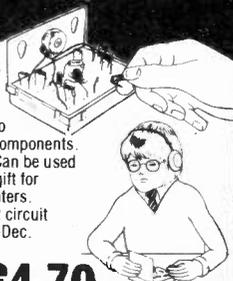
LEARN ELECTRONICS WITHOUT SOLDER

Build electronic circuits without solder on a Roden S-Dec. This has built-in contacts and holes into which you plug your components. Suitable for all ages. Can be used time after time. Ideal gift for students or experimenters. Full instructions and 2 circuit diagrams with each S-Dec.

Send cheque or P.O. to:
Roden Products, Dep.EE
High March, Daventry,
Northants, NN11 4QE.

£4.70

including p & p



Service Sheets

BELL'S TELEVISION SERVICE for service sheets on Radio, TV etc. £1.25 plus SAE. Colour TV Service Manuals on request. SAE with enquiries to BTS, 190 King's Rd., Harrogate, N. Yorkshire. Tel: 0423 55885.

ANY PUBLISHED, FULL-SIZE SERVICE SHEET by return £2 + LSAE. CTV/music centres £3. Repair data with all circuits, layouts, etc, your named TV or Video £8.50. Free 50p mag. All orders, queries—T.I.S. (E.E.), 76 Churches, Larkhall, Lanarkshire.

Courses

CONQUER THE CHIP—master modern electronics the practical way by seeing and doing in your own home. Write for your free colour brochure now to **BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL**, Dept C3, Reading, Berks RG1 1BR.

TALK TO THE WHOLE WORLD

... and discover a new one for yourself. If you're experienced or even a beginner our skilled preparation will enable you to obtain a G.P.O. Licence.



British National Radio & Electronics School, Reading, Berks. RG1 1BR

FREE brochure without obligation from:—

British National Radio & Electronics School
READING, BERKS. RG1 1BR

Name

Address

EE/4/81/

BLOCK CAPS PLEASE

TELEVISION

Servicing—video—construction—developments
The only magazine in Britain that gives the enthusiast and professional engineer alike a comprehensive up-to-date coverage of TV and Video technology.

IN THE APRIL ISSUE

FREQUENCY COUNTER-TIMER

More and more equipment using digital electronics—VCRs, TV games, etc—is entering the home. This calls for extra, more specialised servicing equipment. A frequency counter-timer is particularly helpful when dealing with digital circuits. This one has more features and is better value than most commercially available units, is easy to build and truly portable since it is battery operated. Measures frequencies <1Hz—>1.5GHz with 8 digits of resolution. Basic power consumption <10mA. Wiring kept to a minimum by use of a triplexed LCD display.

GET A COPY TODAY 90p

★ BAKER ★

GROUP P.A. DISCO AMPLIFIERS post £2

50 watt (illustrated) 2 input Mixer Pre-Amp.	£69
150 watt Output, 4 input Mixer Pre-Amp	£99
150 watt Output, Slave 500 mw. Input	£80
150+150w Stereo Slave 500 mw. Inputs	£125
150w P.A. Vocal, 8 inputs, High/Low Mixer	£129
100 watt Valve Model, 4 inputs, Heavy Duty	£125

DRILL SPEED CONTROLLER LIGHT DIMMER KIT. Easy to build kit. Controls up to 480 watts AC mains. £3
DELUXE MODEL Ready Built, 800 watts. £5

STEREO PRE-AMP KIT. All parts to build this pre-amp. 3 inputs for high, medium or low gain per channel, with volume control and P.C. Board. Can be ranged to make multi-way stereo mixers. £3.50. Post 65p.

SOUND TO LIGHT CONTROL KIT MK II

Complete kit of parts, printed circuit. Mains transformer, 3 channels. Up to 1,000 watts each. Will operate from 200MV to 100 watts signal. Suitable for home or Disco. £19 p.p. 95p.

OR COMPLETE READY BUILT IN CABINET £27
 200 Watt Rear Reflecting White Light Bulbs. Ideal for Disco Lights. Edison Screw 75p each or 6 for £4 or 12 for £7.50.

MAINS TRANSFORMERS Primary 240V A.C.		POST
150-0 250V 50mA, 6-3V 3A, 6-3V 1A	£6.00	£2
250-0 350V 250mA, 6-3V 6 Amp C.T.A.	£12.00	£2
220V 50ma, 6V 1A £2.220V 45ma, 6V 2A	£4.00	£1
230V 60ma 6-3V 2A	£4.75	£1

General purpose tapped outputs voltages available.

2 amps 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 25 and 30V	£6.00	£2
1 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£5.00	£2
2 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£10.50	£2
3 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£12.50	£2
5 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£16.00	£2
5-8-10-16V 1a	£2.50	£1
6V 1a	£2.00	£1
6-0-6V 1 1/2a	£3.50	£1
9V 250ma	£1.50	£1
9V 3a	£4.00	£1
9-0-9V 50ma	£1.50	£1
10-0-10V 2a	£4.00	£1
10-30-40V 2a	£4.50	£1
12V 100ma	£1.50	£1
12V 750ma	£2.50	£1
12V 3a	£4.50	£1
12V 2a	£4.00	£1
12-0-12V 2a	£4.50	£1
15-0-15V 2a	£4.50	£1
20V 3a	£4.00	£1
20-0-20V 1a	£4.50	£1
20-40-60V 1a	£4.50	£2
25-0-25V 2a	£4.50	£2
28V 1a Twice	£6.00	£2
30V 1 1/2a	£4.50	£2
30V 3a	£5.50	£2
34-0-34V 6A	£12.00	£2
35V 2a	£4.50	£1

TOROIDAL 30-0-30V 4 Amp +20-0-20V 1 Amp £10.00 £2
CHARGER TRANSFORMERS RECTIFIERS

6-12V 3a	£4.00	£2	6-12V 2a	£1.00	80p
6-12V 4a	£8.50	£2	6-12V 3a	£2.00	80p

LOUDSPEAKER BARGAINS, MANY OTHERS
 3 ohm, 6 x 4in., 6in., 7 x 4in., £2.50, 8 x 6in. 6in. £3.00.
 8in. £4.50, 10in. £5.00, 8 ohm, 2 1/2, 2 1/2in. £2.00.
 3in., 5 x 3in., 5in. £2.50, 3in. £4.50, 10in. £5.00, 12in. £8.00.
 16 ohm, 3 1/2in. 6 x 4in. 5in. £2.50, 8in. £4.50, 10 x 6in. £4.00.
 25ohm, 3 1/2in. 35 ohm, 3in. £2.50. Many others in stock.
 Speaker Covering Material Samples 25p. stamps.

E.C.S. LOW VOLTAGE STABILISED POWER PACK KITS 90-100 mw. Post 75p **£3.95**
 All parts and instructions with Zener (ltd) printed circuit, rectifiers and double wound mains transformer input 200-240 a.c. Output voltages available 6 or 7.5 or 9 or 12V d.c. up to 100mA. State voltage required.

PP BATTERY ELIMINATOR, BRITISH MADE £4.50
 Mains Transformer Rectifier 9 volt 400ma. Post 75p stabilised, with overload cutout. Plastic case size 5 x 5 1/2 x 2 1/2. Suitable Radio/Cassettes. Fully Isolated and Smoothed. DELUXE Switched Model 3-6-7-9V 400ma. £7.50. post £1

THE "INSTANT" BULK TAPE ERASER
 Suitable for cassettes and all sizes of tape reels. A.C. mains 200/240V. Post £9.50
 Ideal all Computer. 95p
 Tapes, Discs, Cassettes.
HEAD DEMAGNETISER PROBE £5.00.

A.C. ELECTRIC MOTORS POST 95p.
 2 Pole, 240V, 0.2 Amp Spindle
 1.43 x 0.212in. £1.75, 2 Pole, 240V, 0.15 Amp Double spindle—1.75 x 0.16in. Each £1.2 Pole, 120V, .5 Amp Spindle—0.75 x 0.2in. Two in series—240V, 50p. each. Brush Motor. From a Food Mixer 240V, .3 Amp High Speed and Powerful Spindle—0.5 x 0.25in. £2.95. Good selection of B.S.R. Motors £4. Garrard Motors £5.

ALUMINIUM CHASSIS 18 s.w.g. Undrilled, 4 sides, riveted corners: 6 x 4 x 2 1/2in. £1.75; 8 x 6 x 2 1/2in. £2.20; 10 x 7 x 2 1/2in. £2.75; 14 x 9 x 2 1/2in. £3.60; 16 x 6 x 2 1/2in. £2.50; 12 x 3 x 2 1/2in. £1.80; 12 x 8 x 2 1/2in. £3.20; 16 x 10 x 2 1/2in. £3.80.

ALL ANGLE BRACKET £4 x 3in. 25p.
ALUMINIUM PANELS 18 s.w.g. 12 x 12in. £1.80; 14 x 9in. £1.75; 6 x 4in. 55p; 12 x 8in. £1.30; 10 x 7in. 96p; 8 x 6in. 90p; 14 x 3in. 72p; 12 x 5in. 90p; 16 x 10in. £2.10; 16 x 6in. £1.30.
ALUMINIUM BOXES, MANY OTHER SIZES IN STOCK.
 4 x 2 1/2 x 2in. £1.00; 3 x 2 x 1in. 80p; 6 x 4 x 2in. £1.60; 8 x 6 x 3in. £2.50; 12 x 5 x 3in. £2.75; 6 x 4 x 3in. £1.80; 10 x 7 x 2 1/2in. £3.

HIGH VOLTAGE ELECTROLYTICS 32+32/350V60p
 8/450V45p 50/450V85p 32+32/500V£1.80
 32/350V45p 220/450V85p 32+32+32/352V 75p
 32/500V85p 8+16/450V75p 16+32+32/500V £2

BSR HI-FI AUTOCHANGER £18
 Stereo Ceramic Cartridge Plays 12in., 10in., or 7in. records Auto or Manual. Quality unit 240V AC Size 13 1/2 x 11 1/2in. POST £2

BSR Single Player P204 cueing device, Ceramic £15 post £2 or with ADC, QLM 30/3 Magnetic cartridge. £20 post £2

BSR P184 QUALITY DECK, BELT DRIVE VARIABLE SPEEDS, 12in Turntable with Strobe Markings. Balanced Arm with Magnetic Cartridge. ADC,QLM 30/3. £47 post £3

BSR P170 Single Player. Slim arm. 240V. AC. Ceramic cartridge. Cueing device. Auto stop. £20 post £2

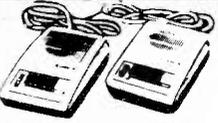
B.S.R. P232. Belt drive, magnetic cartridge, snake arm, cueing device. 12 volt D.C. £23 post £2

B.S.R. Single Player. 9 volt D.C. motor, rim drive, ceramic cartridge. £18 post £2

RADIO COMPONENT SPECIALISTS

337 WHITEHORSE ROAD, Dept 4, CROYDON, SURREY, UK. Tel. 01-684 1665. Same Day Despatch. Lists 25p. Closed Wed.

MAINS INTERCOM



NO BATTERIES NO WIRES ONLY £33.95 PER PAIR + £7.35 VAT & P & P incl.

The modern way of instant 2-way communications. Just plug into power socket. Ready for use. Crystal clear communications from room to room. Range 1/2-mile on the same mains phase. On/off switch. Volume control, with 'buzzer' call and light indicator. Useful as inter-office intercom, between office and warehouse, in surgery and in homes. Also available F.M. 2-channels model £55.95 incl. VAT & P & P.

NEW AMERICAN TYPE CRADLE TELEPHONE AMPLIFIER



£18.95 + £4.65 VAT & P & P incl.

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.

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. Talk two-way 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, multicore cable, 50ft and wiring diagram. Price £65.95 including VAT & P & P. Extra phone £10.95.

PLEASE ALLOW 10-15 DAYS FOR DELIVERY 10-day price refund guarantee on all items Access and Barclay Visa Card welcome. Personal Callers Welcome

WEST LONDON DIRECT SUPPLIES (EE4) 119 THE VALE, AXTON LONDON W3 7RQ Tel. 01-740 9760

MAIL ORDER ADVERTISING

British Code of Advertising Practice

Advertisements in this publication are required to conform to the British Code of Advertising Practice. In respect of mail order advertisements where money is paid in advance, the code requires advertisers to fulfil orders within 28 days, unless a longer delivery period is stated. Where goods are returned undamaged within seven days, the purchaser's money must be refunded. Please retain proof of postage/despatch, as this may be needed.

Mail Order Protection Scheme

If you order goods from Mail Order advertisements in this magazine and pay by post in advance of delivery, EVERYDAY ELECTRONICS will consider you for compensation if the Advertiser should become insolvent or bankrupt, provided:

- (1) You have not received the goods or had your money returned; and
 - (2) You write to the Publisher of EVERYDAY ELECTRONICS summarising the situation not earlier than 28 days from the day you sent your order and not later than two months from that day.
- Please do not wait until the last moment to inform us. When you write, we will tell you how to make your claim and what evidence of payment is required.

We guarantee to meet claims from readers made in accordance with the above procedure as soon as possible after the Advertiser has been declared bankrupt or insolvent.

This guarantee covers only advance payment sent in direct response to an advertisement in this magazine not, for example, payment made in response to catalogues etc, received as a result of answering such advertisements. Classified advertisements are excluded.

INDEX TO ADVERTISERS

Alcon	194
Ambit	251
Audio Electronics	250
Bicc Vero	194
Bi-Pak	198, 199
B.K. Electronics Cover III	
B.N.R. & E.S.	247, 255
Bull J.	196
Cricklewood Electronics	195
Dziubas M.	252
Electrains	250
Electronize Design	Cover III
Enfield Electronics	251
G.S.C.	233
Greenweld Electronics	253
I.C.S. Intertext	252
Kish Ltd.	253
Magenta Electronics 200 Maplin Electronics	Cover IV
Pops Components	250
R & TVC	240
Rapid Electronics	197
R.C.S.	256
Sinclair Products 248,	249
Sparkrite	239
T.K. Electronics	252
West London Direct Supplies	256



MULLARD SPEAKER KITS

Purposefully designed 40 watt R.M.S. and 30 watt R.M.S. 8 ohm speaker systems recently developed by MULLARD'S specialist team in Belgium. Kits comprise Mullard woofer (8" or 5") with foam surround and aluminium voice coil. Mullard 3" high power domed tweeter. B.K.E. built and tested crossover based on Mullard circuit, combining low loss components, glass fibre board and recessed loudspeaker terminals. SUPERB SOUNDS AT LOW COST. Kits supplied in polystyrene packs complete with instructions. 8" 40W system - recommended cabinet size 240 x 216 x 445mm
Price £14.90 each + £2.00 P & P.
5" 30W system - recommended cabinet size 160 x 175 x 295mm
Price £13.90 each + £1.50 P & P.

Designer approved flat pack cabinet kits, including grill fabric. Can be finished with iron on veneer or self adhesive vinyl etc.
8" system cabinet kit £8.00 each + £2.50 P & P.
5" system cabinet kit £7.00 each + £2.00 P & P.

STEREO CASSETTE TAPE DECK MODULE

Comprising of a top mechanism coupled to a record/play back printed board assembly. Supplied as one complete unit for horizontal installation into cabinet or console of own choice. These units are brand new, ready built and tested.

Features: Three digit tape counter. Autostop. Six piano type keys, record, rewind, fast forward, play, stop and eject. Automatic record level control. Main inputs plus secondary inputs for stereo microphones. Input Sensitivity: 100mV to 2V. Input Impedance: 68K. Output level: 400mV to both left and right hand channels. Output Impedance: 10K. Signal to noise ratio: 45dB. Wow and flutter: 0.1%. Power Supply requirements: 18V DC at 300mA. Connections: The left and right hand stereo inputs and outputs are via individual screened leads, all terminated with phono plugs (phono sockets provided). Dimensions: Top panel 5 1/2" x 11 1/2". Clearance required under top panel 2 1/2". Supplied complete with circuit diagram and connecting diagram. Attractive black and silver finish.
Price £26.70 + £2.50 postage and packing.
Supplementary parts for 18V D.C. power supply (transformer, bridge rectifier and smoothing capacitor) £3.50.

LOUDSPEAKERS

15" 100 watt R.M.S. (HI-FI, P.A., DISCO, BASS GUITAR) Die cast chassis, 2" aluminium voice coil, white cone with aluminium centre dome. 8 ohm imp., Res. Freq. 20Hz., Freq. Resp. to 2.5KHz., Sens. 97dB (As photograph). Price: £32.00 + £3 carriage.

12" 100 watt R.M.S. (HI-FI) Die cast chassis. 2" aluminium voice coil. Black cone. 8 ohm imp., Res. Freq. 20Hz., Freq. Resp. to 4.5KHz., Sens. 95dB. (As photograph). Price: £23.50 + £3 carriage.
8" 50 watt R.M.S. (HI-FI, P.A.) 1 1/2" aluminium voice coil. White cone. 8 ohm imp. Res. Freq. 40Hz., Freq. Resp. to 6KHz. Sens. 92dB. Also available with black cone fitted with black metal protective grille. (As photograph). Price: White Cone £8.90, Black cone/grille £9.50 P&P £1.25.

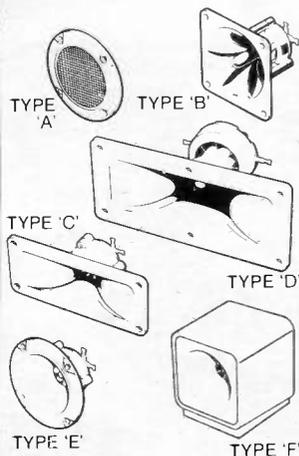
12" 85 watt R.M.S. McKENZIE C1285GP (LEAD GUITAR, KEYBOARD, DISCO) 2" aluminium voice coil, aluminium centre dome, 8 ohm imp., Res. Freq. 45Hz., Freq. Resp. to 6.5KHz., Sens. 98dB. Price: £22.00 + £3 carriage.

12" 85 watt R.M.S. McKENZIE C1285TC (P.A., DISCO) 2" aluminium voice coil. Twin cone. 8 ohm imp., Res. Freq. 45Hz., Freq. Resp. to 14KHz. Price £22 + £3 carriage.

15" 150 watt R.M.S. McKENZIE C15 (BASS GUITAR, P.A.) 3" aluminium voice coil. Die cast chassis. 8 ohm imp., Res. Freq. 40Hz., Freq. Resp. to 4KHz. Price: £47 + £4 carriage.

PIEZO ELECTRIC TWEETERS - MOTOROLA

Join the Piezo revolution. The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover is not required these units can be added to existing speaker systems of up to 100 watts (more if 2 put in series). FREE EXPLANATORY LEAFLETS SUPPLIED WITH EACH TWEETER.



TYPE 'A' (KSN2036A) 3" round with protective wire mesh, ideal for bookshelf and medium sized Hi-fi speakers. Price £3.45 each.

TYPE 'B' (KSN1005A) 3 1/2" super horn. For general purpose speakers, disco and P.A. systems etc. Price £4.35 each.

TYPE 'C' (KSN6016A) 2" - 5" wide dispersion horn. For quality Hi-fi systems and quality discos etc. Price £5.45 each.

TYPE 'D' (KSN1025A) 2" - 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2KHz). Suitable for high quality Hi-fi systems and quality discos. Price £6.90 each.

TYPE 'E' (KSN1038A) 3 3/4" horn tweeter with attractive silver finish trim. Suitable for Hi-fi monitor systems etc. Price £4.35 each.

TYPE 'F' (KSN1057A) Cased version of type 'E'. Free standing satellite tweeter. Perfect add on tweeter for conventional loudspeaker systems. Price £10.75 each.

P&P 20p ea. (or SAE for Piezo leaflets).



OMP 80 LOUDSPEAKER

The very best in quality and value. Ported tuned cabinet in hardwearing black vinyl with protective corners and carry handle. Built and tested, employing 10in British driver and Piezo tweeter. Spec: 80 watts RMS, 8 ohms; 45Hz-20KHz. Size: 20in x 15in x 12in; Weight: 30 pounds.

Price: £49.00 each. £90 per pair
Carriage: £5 each. £7 per pair

1K.WATT SLIDE DIMMER

- Controls loads up to 1KW
- Compact size

4 3/4" x 13" x 2 1/2"

- Easy snap in fixing through panel/cabinet cut out
- Insulated plastic case
- Full wave control using 8amp triac
- Conforms to BS800
- Suitable for both resistance and inductive loads

Innumerable applications in industry, the home, and discos/theatres etc.

Price: £11.70 each + 50p P&P (Any quantity)

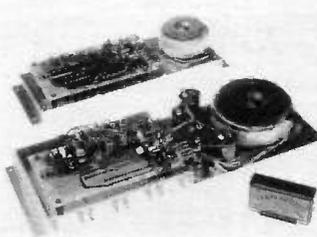
BSR P256 TURNTABLE

P256 turntable chassis • S shaped tone arm • Belt driven • Aluminium platter • Precision calibrated counter balance • Anti-skate (bias device) • Damped cueing lever • 240 volt AC operation (Hz) • Cut-out template supplied • Completely manual arm. This deck has a completely manual arm and is designed primarily for disco and studio use where all the advantages of a manual arm are required.

Price: £28.50 + £2.50 P&P



POWER AMPLIFIER MODULES



KEYBOARDS



MEMBRANE KEYBOARDS manufactured from a tough polycarbonate film mounted on 1mm glass fibre printed circuit board assembly incorporating silver plated contacts.

16 way numeric keyboard Standard keyboard providing 0-9 and A-F functions.

Size: 100mm x 100mm x 2mm. Price: £5.99 + 35p p&p

Alpha Numeric Keyboard Full size 55 key non encoded keyboard with the commonly required functions in a Qwerty array. Matrix output via a 16 pin DIL socket.

Size: 350mm x 100mm x 2mm. Price: £13.99 + 50p p&p



100 WATT R.M.S. AND 300 WATT R.M.S. MODULES

Power Amplifier Modules with integral toroidal transformer power supply, and heat sink. Supplied as one complete built and tested unit. Can be fitted in minutes. An LED Vu meter is available as an optional extra.

SPECIFICATION:

Max Output Power: 110 watts R.M.S. (OMP 100) 310 watts R.M.S. (OMP 300)

Loads: Open and short circuit proof. 4-16 ohms.

Frequency Response: 20Hz - 25KHz + 3dB.

Sensitivity for Max. Output: 500mV at 10K (OMP 100) 1V at 10K (OMP 300)

T.H.D.: Less than 0.1%

Supply: 240V 50Hz

Sizes: OMP 100 360 x 115 x 72mm

OMP 300 460 x 153 x 66mm

Prices: OMP 100 £31.50 each + £2.00 P&P

OMP 300 £89.00 each + £3.00 P&P

Vu Meter £6.50 each + 50p P&P

Matching 3-way loudspeakers and crossover

Build a quality 60watt RMS system 8ohms

Build a quality 60 watt R.M.S. system

★ 10" Woofer 35Hz-4.5KHz

★ 3" Tweeter 2.5KHz-19KHz

★ 5" Mid Range 600Hz-8KHz

★ 3-way crossover 6dB/oct 1.3 and 6KHz
Recommended Cab-size 26" x 13" x 13"

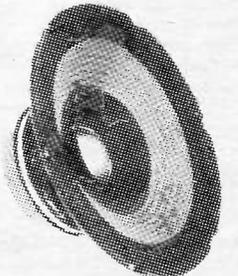
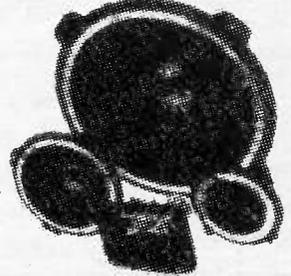
Fitted with attractive cast aluminium fixing es-cutcheons and mesh protective grills which are removable enabling a unique choice of cabinet styling. Can be mounted directly on to baffle with or without conventional speaker fabrics. All three units have aluminium centre domes and rolled foam surround. Crossover combines spring loaded loudspeaker terminals and recessed mounting panel.

Price £22.00 per kit + £2.50 postage and packing. Available separately, prices on request

12" 80 watt R.M.S. loudspeaker.

A superb general purpose twin cone loudspeaker. 50 oz. magnet. 2 aluminium voice coil. Rolled surround Resonant frequency 25Hz. Frequency response to 13KHz. Sensitivity 95dB. Impedance 8ohm. Attractive blue cone with aluminium centre dome.

Price £17.99 each + £3.00 P&P.



B.K. ELECTRONICS

37 Whitehouse Meadows, Eastwood, Leigh-on-Sea, Essex SS9 5TY

★ SAE for current lists. ★ Official orders welcome. ★ All prices include VAT. ★ Mail order only. ★ All items packed (where applicable) in special energy absorbing PU foam. Callers welcome by prior appointment, please phone 0702-527572.

BK ELECTRONICS

Prompt Deliveries
VAT inclusive
prices
Audio Equipment
Test Equipment
by
Thandar
and
Leader



SPEECH SYNTHESISER FOR ZX81 and VIC20

THE MAPLIN TALK-BACK

Now your computer can talk!

- ★ Allophone (extended phoneme) system gives unlimited vocabulary.
- ★ Can be used with unexpanded VIC20 or ZX81 — does not require large areas of memory.
- ★ In VIC20 version, speech output is direct to TV speaker with no additional amplification needed.
- ★ Allows speech to be easily included in programs.

Complete kit only £24.95.

Order As LK00A (VIC20 Talk-Back).

LK01B (ZX81 Talk-Back).

Full construction details in Maplin Projects Book 6.

Price 70p. Order As XA06G (Maplin Mag Vol. 2 No. 6).



KEYBOARD WITH ELECTRONICS FOR ZX81



- ★ Full size, full travel keyboard that's simple to add to your ZX81 (no soldering in ZX81).
- ★ Complete with electronics to make "Shift Lock", "Function" and "Graphics 2" single key selections.
- ★ Powered (with adaptor supplied) from ZX81's own standard power supply.

Full details in Project Book 3 (XA03D) Price 60p.

Complete kit (excl. case) £19.95. Order As LW72P.

Case £4.95. Order As XG17T.

Ready built-in case £29.95. Order As XG22Y.

OTHER KITS FOR ZX81

3-Channel Sounds Generator (Details in Book 5).
Order As LW96E. Price £10.95.

ZX81 Sound On Your TV Set (Details in Book 6).
Order As LK02C. Price £19.95.

ZX81 I/O Port gives two bi-directional 8-bit ports (Details in Book 4).
Order As LW76H. Price £9.25.

ZX81 Extensible will accept 16K RAM and 3 other plug-in modules.

PCB: Order As GB08J. Price £2.32.

Edge Connectors (4 needed): Order As RK35Q. Price £2.39.

HOME SECURITY SYSTEM

Six independent channels - 2 or 4 wire operation. External horn. High degree of protection and long term reliability. Full details in Projects Book 2. (XA02C) Price 60p



MATINEE ORGAN

Easy-to-build, superb specification. Comparable with organs selling for up to £1000. Full construction details in our book (XH55K). Price £2.50. Complete kits available. Electronics (XY91Y) £299.95*. Cabinet (XY93B) £99.50*. Demo cassette (XX43W) £1.99.



* Carriage extra

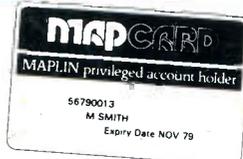
25W STEREO MOSFET AMPLIFIER



- ★ Over 26W/channel into 8Ω at 1kHz both channels driven
- ★ Frequency response 20Hz to 40kHz ± 1dB
- ★ Low distortion, low noise and high reliability power MOSFET output stage.
- ★ Extremely easy to build. Almost everything fits on main pcb, cutting interwiring to just 7 wires (plus toroidal transformer and mains lead terminations).
- ★ Complete kit contains everything you need including pre-drilled and printed chassis and wooden cabinet. Full details in Projects Book 3. Price 60p (XA03D). Complete kit only £55.20 incl. VAT and carriage (LW71N).

BUY IT WITH MAPCARD

Send now for an application form — then buy it with MAPCARD. MAPCARD gives you real spending power — up to 24 times your monthly payments, instantly.



All prices include VAT & carriage. Please add 50p handling charge to orders under £5 total value.

MAPLIN'S FANTASTIC PROJECTS

Full details in our project books. Issues 1 to 5: 60p each. Issue 6: 70p.

In Book 1 (XA01B) 120W rms MOSFET Combo-Amplifier • Universal Timer with 18 program times and 4 outputs • Temperature Gauge • Six Vero Projects.

In Book 2 (XA02C) Home Security System • Train Controller for 14 trains on one circuit • Stopwatch with multiple modes • Miles-per-Gallon Meter.

In Book 3 (XA03D) ZX81 Keyboard with electronics • Stereo 25W MOSFET Amplifier • Doppler Radar Intruder Detector • Remote Control for Train Controller.

In Book 4 (XA04E) Telephone Exchange for 16 extensions • Frequency Counter 10Hz to 600MHz • Ultrasonic Intruder Detector • I/O Port for ZX81 • Car Burglar Alarm • Remote Control for 25W Stereo Amp.

In Book 5 (XA05F) Modem to European standard • 100W 240V AC Inverter • Sounds Generator for ZX81 • Central Heating Controller • Panic Button for Home Security System • Model Train Projects • Timer for External Sounder.

In Book 6 (XA06G) Speech Synthesiser for ZX81 & VIC20. • Module to Bridge two of our MOSFET Amps to make a 350W Amp. • ZX81 Sound on your TV. • Scratch Filter. • Damp Meter.

MAPLIN'S NEW 1983 CATALOGUE

Over 390 pages packed with data and pictures and all completely revised and including over 1000 new items. On sale in all branches of WHSMITH Price £1.25.



Post this coupon now!

Please send me a copy of your 1983 catalogue. I enclose £1.50 (inc 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 £1.90 or 10 International Reply Coupons. Despatched by return of post.

Name

Address

EE/4/83

MAPLIN

MAPLIN ELECTRONIC SUPPLIES LTD.

P.O. Box 3, Rayleigh, Essex SS6 8LR

Telephone: Sales (0702) 552911 General (0702) 554155

Shops at:

Note: Shops closed Mondays

159 King St., Hammersmith, London W6. Telephone: 01-748 0926

284 London Rd., Westcliff-on-Sea, Essex. Telephone: (0702) 554000

Lynton Square, Perry Barr, Birmingham. Telephone: (021) 356 7292