

**PRACTICAL**

# **ELECTRONICS**

**OCTOBER 1980**

**65p**

# **FREE!**

*in this  
issue...*

## **TRANSISTOR IDENTICHART**

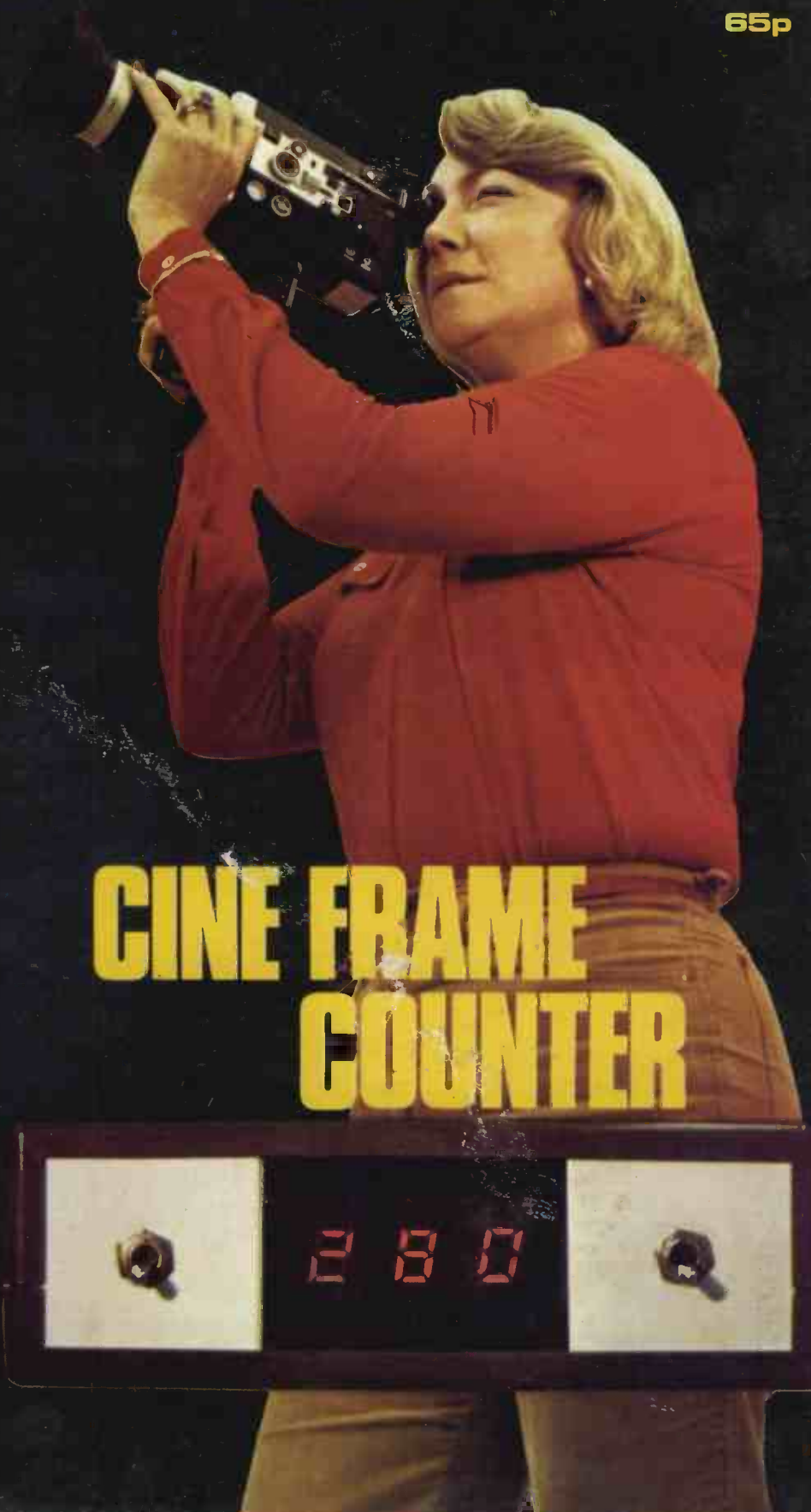
---

## **AUDIO LEAD TESTER**

---

## **SPECIAL Turntable OFFER**

---



## **CINE FRAME COUNTER**



# EUROPE'S FASTEST SELLING ONE BOARD COMPUTER COMPUKIT UK101

★ 6502 based system — best value for money on the market. ★ Powerful 8K Basic — Fastest around ★ Full Qwerty Keyboard ★ 4K RAM Expandable to 8K on board. ★ Power supply and RF Modulator on board. ★ No Extras needed — Plug-in and go. ★ Kansas City Tape Interface on board. ★ Free Sampler Tape including powerful Dissassembler and Monitor with each Kit. ★ If you want to learn about Micros, but didn't know which machine to buy then **this is the machine for you.**

40 pin Expansion Jumper Cable for CompuKit expansion **£8.50 + VAT**

Build, Understand and Program your own Computer for only a small outlay.

**KIT ONLY £179 + VAT  
NO EXTRAS NEEDED**

Available ready assembled, tested & ready to go **£229 + VAT**

### NEW MONITOR FOR COMPUKIT UK101

● In 2K Eprom 2716 ● Allows screen editing ● Saves data on tape ● Flashing cursor ● Text scrolls down **£22.00 + VAT**

### FOR THE COMPUKIT

Assembler/Editor	<b>£14.90</b>
Screen Editor Tape	<b>£5.90</b>

All Prices exclusive VAT

### Game Packs

1. Four Games	<b>£5.00</b>
2. Four Games	<b>£5.00</b>
3. Three Games 8K only	<b>£5.00</b>

Space Invaders	<b>£5.00</b>
Chequers	<b>£3.00</b>
Real Time Clock	<b>£3.00</b>
Case for CompuKit	<b>£29.50</b>

## VISTA V200 SORCERER DUAL DISC DRIVE

Includes two 40 track drive, power supply and CP/M DOS, including basic /E compiler

**£850 plus VAT**

### SPECIAL—ONCE IN A LIFETIME OFFER!

16K **£399**

32K **£449**

48K **£499**

+ VAT

### EXIDY SORCERER

For Personal or Business Use.

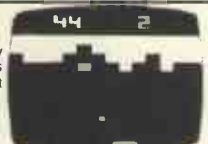
32K or 48K memory. 8K Microsoft Basic in ROM. Dual Cassette I/O, RS232 I/O. Parallel I/O (Centronics). Expansion available through optional extra S100 Motherboard. 69 Key keyboard including 16 key numeric pad.



### NEW TV GAME BREAK OUT

Has got to be one of the world's greatest TV games. You really get hooked. As featured in ETI. Has also 4 other pinball games and lots of options. Good kit for up-grading old amusement games.

**MINI KIT** — PCB, sound & vision modulator, memory chip and de-code chip. Very simple to construct. **£14.90 + VAT**  
**OR** PCB **£2.90** MAIN LSI **£8.50** Both plus VAT



Refurbished ZX80's—fully guaranteed **£69.90**  
(Supply dependant upon stocks). + VAT

We have one of the largest collections of Computer Books under one roof, along with racks of software for the PET and TRS80. **Come and see for yourself.**

### WE ARE NOW STOCKING THE APPLE II EUROPLUS AT REDUCED PRICES



16K **£599**

32K **£649**

48K **£690**

+ VAT

**Getting Started** APPLE II is faster, smaller, and more powerful than its predecessors. And it's more fun to use too because of built-in features like:

● BASIC — The Language that Makes Programming Fun.  
● High-Resolution Graphics (in a 54,000-Point Array) for Finely-Detailed Displays.  
● Sound Capability that Brings Programs to Life.  
● Hand Controls for Games and Other Human-Input Applications.  
● Internal Memory Capacity of 48K Bytes of RAM, 12K Bytes of ROM; for Big-System Performance in a Small Package.  
● Eight Accessory Expansion Slots to let the System Grow With Your Needs.

You don't need to be an expert to enjoy APPLE II. It is a complete, ready-to-run computer. Just connect it to a video display and start using programs (or writing your own) the first day. You'll find that its tutorial manuals help you make it your own personal problem solver.

EXTENDED WARRANTY BY COMPUKARE

We give a full one year's warranty on all our products.

We now have in stock demonstration models of the Atari 800 and Texas 99/4. **Come and see them**



### EXATRON STRINGY FLOPPY FOR TRS80

(Expansion interface not needed)

only **£169 + VAT**

High Speed storage medium that is cheap and reliable. Includes 20 wafers - M/C monitor - BUS EXPN cable. **£169**

### SUPER PET 32K 40/80: EX STOCK £825 PLUS VAT

EXTENDED WARRANTY BY COMPUKARE

### NASCOM 2 DISC DRIVES

Add a powerful, double density, mini floppy disc to your Nascom system.

- Disc Controller Card (includes Nasbus 6 S100 interface)
- Will control 4 Drives.
- CPM operating system.
- Extended Disc Basic Compiler.
- Power supply included

One Disc System — **£499 + VAT**  
Additional Disc Unit — **£299 + VAT**



### NEW REDUCED PRICES

8K **£399**

16K **£499**

32K **£599**

RRP £795 for 32K



### The PEDIGREE PETS

Very popular for home & business use. 8K Microsoft Basic in ROM. 8K Pet 32K & 16K with new improved keyboard. All with green screen.

Cassette Deck **£55 extra** Full range of software available.  
Interface PET IEEE — Centronics Parallel  
Not decoded **£49.00 + VAT** Decoded **£77.00 + VAT**

### SPECIAL SCOOP GET YOURSELF A PRINTER FOR YOUR PET AND SAVE A FORTUNE

only **£349 + VAT**

Full Pet Graphics including cables. Ready to go.

**EX-STOCK.**



"Europe's Largest Discount Personal Computer Store"

Please add VAT to all prices — including delivery. Please make cheques and postal orders payable to **COMP SHOP LTD.**, or phone your order quoting **BARCLAYCARD, ACCESS, DINERS CLUB** or **AMERICAN EXPRESS** number. **CREDIT FACILITIES ARRANGED** — send S.A.E. for application form.  
14 Station Road, New Barnet, Hertfordshire, EN5 1QW Telephone: 01-441 2922 (Sales) 01-449 6596 Telex: 298755 TELCOM G  
OPEN - 10 am - 7 pm — Monday to Saturday  
Close to New Barnet BR Station — Moorgate Line.

★ **NOW in IRELAND** at: 80 Marlborough St., Dublin 1. Tel: Dublin 749933  
★ **COMP SHOP USA**, 1348 East Edinger, Santa Ana, California, Zip Code 92705.  
Telephone: 0101 714 5472526



**NEW SALES SHOP  
311, EDGWARE ROAD,  
LONDON, W2**

# PRACTICAL ELECTRONICS

VOLUME 16 No. 10 OCTOBER 1980

---

## CONSTRUCTIONAL PROJECTS

<b>CINE FRAME COUNTER</b> by <i>Stephen Ibbs</i>	30
Battery Powered Unit with 7-segment display	
<b>LEAD TESTER</b> by <i>Chris Lane</i>	36
Provides rigorous analyses of signal lead	
<b>125W AMPLIFIER</b>	52
High power mono design	
<b>PE TELETEXT Part 3</b> by <i>David Shortland</i>	56
Video Summer Board and P.S.U.	
<b>DISCO DESK Part 2</b> by <i>Ben J. Duncan</i>	62
Card 2 and more circuits	

## GENERAL FEATURES

<b>MICROBUS</b> by <i>D.J.D.</i>	24
Acorn teletext VDU—Nine problems revisited	
<b>SEMICONDUCTOR UPDATE</b> by <i>R. W. Coles</i>	29
LM1871 LM1872 HM6564 TO237 TDA1085A	
<b>INGENUITY UNLIMITED</b>	40
Roulette Wheel—Car Anti-Theft Device—Shoot Game	
<b>THE SHAPE OF SPACECRAFT</b> by <i>C. R. Francis B.Sc., Ph.D.</i>	44
Technical details behind the weird shapes	

## NEWS & COMMENT

<b>EDITORIAL</b>	19
<b>MARKET PLACE</b>	20
New Products	
<b>INDUSTRY NOTEBOOK</b> by <i>Nexus</i>	23
What's happening inside Industry	
<b>SPACEWATCH</b> by <i>Frank W. Hyde</i>	32
Leasat, Landsat 2, Comet Chaser Giotto, and the Solar Maximum Mission	
<b>TURNTABLE OFFER</b>	35
For Disco and general audio applications	
<b>NEWS BRIEFS</b>	55, 68
<b>PATENTS REVIEW</b>	67
Hi-Fi Filming	
<b>POINTS ARISING</b>	67
Micro Prompt	
<b>COUNTDOWN</b>	68
<b>BOOK REVIEW</b>	68
The Personal Computer Book	

OUR NOVEMBER ISSUE WILL BE ON SALE FRIDAY, 10 OCTOBER 1980  
(for details of contents see page 43)

---

© IPC Magazines Limited 1980. Copyright in all drawings, photographs and articles published in PRACTICAL ELECTRONICS is fully protected, and reproduction or imitations in whole or part are expressly forbidden. All reasonable precautions are taken by PRACTICAL ELECTRONICS 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.

# WATFORD ELECTRONICS

33/35, CARDIFF ROAD, WATFORD, HERTS, ENGLAND!  
 MAIL ORDER. CALLERS WELCOME. Tel. Watford 40588/9

ALL DEVICES BRAND NEW. FULL SPEC. AND FULLY GUARANTEED. ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/0-0-0 BANKERS DRAFT WITH ORDER. GOVERNMENT AND EDUCATIONAL INSTITUTIONS OFFICIAL ORDERS ACCEPTED. TELEPHONE ORDERS BY ACCESS NOW ACCEPTED (Minimum order £10.00 please). TRADE AND EXPORT INQUIRY WELCOME. P & P ADD 40p to ALL ORDERS. RETURN £10.00. OVERSEAS ORDERS POSTAGE AT COST.

**VAT** Export orders no VAT. Applicable to U.K. Customers only. Unless stated otherwise, all prices are exclusive of VAT. Please add 15% to the total cost.

We stock many more items. It pays to visit us. We are situated behind Watford Football Ground, nearest Underground/Br. Rail Station: Watford High Street. Open Monday to Saturday 9 a.m.-6 p.m. Ample Free Car Parking space available.

**POLYESTER CAPACITORS:** (Axial Lead Type)  
 400V: 1nF, 1.5n, 2n2, 3n3, 4n7, 6n8, 10n, 15n 9p; 18n 10p; 22n, 33n 11p; 47n, 68n 14p; 100n 17p; 150n, 220n 24p; 330n 47n 41p; 680n 48p; 1uF 64p; 2uF 82p; 4uF 85p.  
 1000V: 10n, 15n, 20n, 22n, 24p; 47n 26p; 100n 42p; 470n 80p; 1uF 175p.

**POLYESTER RADIAL LEAD CAPACITORS:** 250V:  
 10n, 15n, 22n, 27n 5p; 33n, 47n, 68n, 100n, 150n 7p; 200n, 220n, 330n 13p; 470n 17p; 680n 19p; 1uF 22p; 1u5 30p; 2uF 34p.

**ULTRASONIC TRANSDUCERS:**  
 .40KHz 350p pr.

**ELECTROLYTIC CAPACITORS:** (Values are in μF)  
 500V: 10, 50p; 47 78p; 250V: 100 65p; 63V: 0.47, 1.0, 1.5, 2.2, 2.5, 3.3, 4.7, 6.8, 9p; 10, 15, 22, 27, 33, 47, 50 14p; 63, 100, 220p; 50V: 100, 220, 330p; 470, 33p; 1000 60p; 40V: 22, 33p 8p; 100 12p; 220 20p; 330 25p; 470 11p; 35V: 10, 10 3p; 330, 470 32p; 25V: 10, 22, 47, 100 8p; 160, 220, 50 15p; 470 25p; 640, 1000 35p; 1500 40p; 2200 54p; 3300 74p; 4700 92p; 16V: 10, 40, 47 7p; 100, 125 8p; 220, 330 16p; 470 20p; 1000, 1500 30p; 2200 36p.

**TANTALUM BEAD CAPACITORS:**  
 35V: 0.1μF, 0.22, 0.33, 0.47, 0.68, 1.0, 1.5, 2u2, 3u3, 4u7, 25V: 10, 20p; 6u8, 16V: 2u2, 4u7, 10, 20p each.  
 16V: 22u 32p; 47, 100 58p; 220 75p;  
 10V: 15p, 22, 33 28p; 100 40p; 6V: 47p, 68p, 100 32p; 3V: 100 30p.

**MYLAR FILM CAPACITORS:**  
 100V: 0.001, 0.002, 0.005, 0.01μF 6p  
 0.015, 0.02, 0.03, 0.04, 0.05, 0.056μF 7p  
 0.1μF 8p; 50V: 0.47μF 12p.

**CERAMIC CAPACITORS: (50V)**  
 Range: 0.5pF to 1nF 4p  
 15nF, 22nF, 33nF, 47nF 5p  
 100nF/30V, 7p; 220nF/6V 8p

**POLYSTYRENE CAPACITORS:**  
 10pF to 1nF 6p; 1.5nF to 47nF 10p.

**SILVER MICA (pF)**  
 2, 3, 3.4, 4.7, 6.8, 8.2, 10, 12, 18, 22, 27, 33, 39, 47, 50, 56, 68, 75, 82, 95, 100, 120, 150, 180, 200, 220, 270, 300, 360, 380, 470, 600, 800 & 820pF 16p each  
 1000, 1200, 1800, 2000, 4700, 2p each

**TRIMMERS:** miniature  
 2.5pF: 3-10pF 2p  
 3-30pF: 3-50pF 28p  
 5-25pF: 65p/88pF 35p

**COMPRESSION**  
 3-40pF: 10-80pF 30p  
 25-200pF 33p  
 100-500pF 35p  
 400-1250pF 58p

**POTENTIOMETERS:** Carbon Track, 0.25W Log & 0.5W Linear Values.  
 500Ω, 1K & 2K (LIN ONLY) Single 29p  
 5KΩ-2MΩ single gang 29p  
 5KΩ-2MΩ single gang D/P switch 69p  
 5KΩ-2MΩ dual gang stereo 88p  
 1W Wire-wound 50Ω-20K 105p

**SLIDER POTENTIOMETERS:**  
 0.25W Log and linear values: 60mm track 80p  
 5KΩ 500Ω single gang 80p  
 10KΩ 500KΩ dual gang 80p  
 Self-Stick Diagonal Alum. Bezels 33p

**PRESET POTENTIOMETERS:**  
 0.1W 500Ω-2MΩ Mini. Vert. & Horiz. 7p  
 0.25W 100Ω-3.3MΩ Horiz. larger 10p  
 0.25W 250Ω-4.7MΩ Vert. 10p  
 Precision Cermet 1W 100Ω-100K 90p

**RESISTORS—Erie make 5% carbon Miniature, High Stability, Low Noise**  
 RANGE Val. 1-99 100.  
 0.25W 20Ω-4M7 E12 2p 1p  
 0.5W 20Ω-4M7 E24 2p 1p  
 1W 20Ω-10M E12 5p 3p  
 2W Metal Film 100 1M 6p 4p  
 1% 0.5W 5.1Ω-1M E24 8p 6p  
 100 - price applies to Resistors of each type not mixed values

**COMPUTER IC'S:**  
 2102 125  
 2112-2N 125  
 2114-450N 250  
 2114-300N 325  
 2708 445  
 4118 16K 299  
 6502 985  
 6504 745  
 6505 850  
 6550 825  
 6552 828  
 6553 828  
 6551 1050  
 6552 1150  
 6800 600  
 6810 360  
 7450 500  
 7451 680  
 7452 485  
 7453 485  
 7454 485  
 7455 485  
 7456 485  
 7457 485  
 7458 485  
 7459 485  
 7460 485  
 7461 485  
 7462 485  
 7463 485  
 7464 485  
 7465 485  
 7466 485  
 7467 485  
 7468 485  
 7469 485  
 7470 485  
 7471 485  
 7472 485  
 7473 485  
 7474 485  
 7475 485  
 7476 485  
 7477 485  
 7478 485  
 7479 485  
 7480 485  
 7481 485  
 7482 485  
 7483 485  
 7484 485  
 7485 485  
 7486 485  
 7487 485  
 7488 485  
 7489 485  
 7490 485  
 7491 485  
 7492 485  
 7493 485  
 7494 485  
 7495 485  
 7496 485  
 7497 485  
 7498 485  
 7499 485  
 7500 485

**MC1489 7445**  
**MC1441 7446**  
**MC14412 7447**  
**MC1442 7448**  
**MC1443 7449**  
**MC1444 7450**  
**MC1445 7451**  
**MC1446 7452**  
**MC1447 7453**  
**MC1448 7454**  
**MC1449 7455**  
**MC1450 7456**  
**MC1451 7457**  
**MC1452 7458**  
**MC1453 7459**  
**MC1454 7460**  
**MC1455 7461**  
**MC1456 7462**  
**MC1457 7463**  
**MC1458 7464**  
**MC1459 7465**  
**MC1460 7466**  
**MC1461 7467**  
**MC1462 7468**  
**MC1463 7469**  
**MC1464 7470**  
**MC1465 7471**  
**MC1466 7472**  
**MC1467 7473**  
**MC1468 7474**  
**MC1469 7475**  
**MC1470 7476**  
**MC1471 7477**  
**MC1472 7478**  
**MC1473 7479**  
**MC1474 7480**  
**MC1475 7481**  
**MC1476 7482**  
**MC1477 7483**  
**MC1478 7484**  
**MC1479 7485**  
**MC1480 7486**  
**MC1481 7487**  
**MC1482 7488**  
**MC1483 7489**  
**MC1484 7490**  
**MC1485 7491**  
**MC1486 7492**  
**MC1487 7493**  
**MC1488 7494**  
**MC1489 7495**  
**MC1490 7496**  
**MC1491 7497**  
**MC1492 7498**  
**MC1493 7499**  
**MC1494 7500**  
**MC1495 7501**  
**MC1496 7502**  
**MC1497 7503**  
**MC1498 7504**  
**MC1499 7505**  
**MC1500 7506**  
**MC1501 7507**  
**MC1502 7508**  
**MC1503 7509**  
**MC1504 7510**  
**MC1505 7511**  
**MC1506 7512**  
**MC1507 7513**  
**MC1508 7514**  
**MC1509 7515**  
**MC1510 7516**  
**MC1511 7517**  
**MC1512 7518**  
**MC1513 7519**  
**MC1514 7520**  
**MC1515 7521**  
**MC1516 7522**  
**MC1517 7523**  
**MC1518 7524**  
**MC1519 7525**  
**MC1520 7526**  
**MC1521 7527**  
**MC1522 7528**  
**MC1523 7529**  
**MC1524 7530**  
**MC1525 7531**  
**MC1526 7532**  
**MC1527 7533**  
**MC1528 7534**  
**MC1529 7535**  
**MC1530 7536**  
**MC1531 7537**  
**MC1532 7538**  
**MC1533 7539**  
**MC1534 7540**  
**MC1535 7541**  
**MC1536 7542**  
**MC1537 7543**  
**MC1538 7544**  
**MC1539 7545**  
**MC1540 7546**  
**MC1541 7547**  
**MC1542 7548**  
**MC1543 7549**  
**MC1544 7550**  
**MC1545 7551**  
**MC1546 7552**  
**MC1547 7553**  
**MC1548 7554**  
**MC1549 7555**  
**MC1550 7556**  
**MC1551 7557**  
**MC1552 7558**  
**MC1553 7559**  
**MC1554 7560**  
**MC1555 7561**  
**MC1556 7562**  
**MC1557 7563**  
**MC1558 7564**  
**MC1559 7565**  
**MC1560 7566**  
**MC1561 7567**  
**MC1562 7568**  
**MC1563 7569**  
**MC1564 7570**  
**MC1565 7571**  
**MC1566 7572**  
**MC1567 7573**  
**MC1568 7574**  
**MC1569 7575**  
**MC1570 7576**  
**MC1571 7577**  
**MC1572 7578**  
**MC1573 7579**  
**MC1574 7580**  
**MC1575 7581**  
**MC1576 7582**  
**MC1577 7583**  
**MC1578 7584**  
**MC1579 7585**  
**MC1580 7586**  
**MC1581 7587**  
**MC1582 7588**  
**MC1583 7589**  
**MC1584 7590**  
**MC1585 7591**  
**MC1586 7592**  
**MC1587 7593**  
**MC1588 7594**  
**MC1589 7595**  
**MC1590 7596**  
**MC1591 7597**  
**MC1592 7598**  
**MC1593 7599**  
**MC1594 7600**  
**MC1595 7601**  
**MC1596 7602**  
**MC1597 7603**  
**MC1598 7604**  
**MC1599 7605**  
**MC1600 7606**  
**MC1601 7607**  
**MC1602 7608**  
**MC1603 7609**  
**MC1604 7610**  
**MC1605 7611**  
**MC1606 7612**  
**MC1607 7613**  
**MC1608 7614**  
**MC1609 7615**  
**MC1610 7616**  
**MC1611 7617**  
**MC1612 7618**  
**MC1613 7619**  
**MC1614 7620**  
**MC1615 7621**  
**MC1616 7622**  
**MC1617 7623**  
**MC1618 7624**  
**MC1619 7625**  
**MC1620 7626**  
**MC1621 7627**  
**MC1622 7628**  
**MC1623 7629**  
**MC1624 7630**  
**MC1625 7631**  
**MC1626 7632**  
**MC1627 7633**  
**MC1628 7634**  
**MC1629 7635**  
**MC1630 7636**  
**MC1631 7637**  
**MC1632 7638**  
**MC1633 7639**  
**MC1634 7640**  
**MC1635 7641**  
**MC1636 7642**  
**MC1637 7643**  
**MC1638 7644**  
**MC1639 7645**  
**MC1640 7646**  
**MC1641 7647**  
**MC1642 7648**  
**MC1643 7649**  
**MC1644 7650**  
**MC1645 7651**  
**MC1646 7652**  
**MC1647 7653**  
**MC1648 7654**  
**MC1649 7655**  
**MC1650 7656**  
**MC1651 7657**  
**MC1652 7658**  
**MC1653 7659**  
**MC1654 7660**  
**MC1655 7661**  
**MC1656 7662**  
**MC1657 7663**  
**MC1658 7664**  
**MC1659 7665**  
**MC1660 7666**  
**MC1661 7667**  
**MC1662 7668**  
**MC1663 7669**  
**MC1664 7670**  
**MC1665 7671**  
**MC1666 7672**  
**MC1667 7673**  
**MC1668 7674**  
**MC1669 7675**  
**MC1670 7676**  
**MC1671 7677**  
**MC1672 7678**  
**MC1673 7679**  
**MC1674 7680**  
**MC1675 7681**  
**MC1676 7682**  
**MC1677 7683**  
**MC1678 7684**  
**MC1679 7685**  
**MC1680 7686**  
**MC1681 7687**  
**MC1682 7688**  
**MC1683 7689**  
**MC1684 7690**  
**MC1685 7691**  
**MC1686 7692**  
**MC1687 7693**  
**MC1688 7694**  
**MC1689 7695**  
**MC1690 7696**  
**MC1691 7697**  
**MC1692 7698**  
**MC1693 7699**  
**MC1694 7700**  
**MC1695 7701**  
**MC1696 7702**  
**MC1697 7703**  
**MC1698 7704**  
**MC1699 7705**  
**MC1700 7706**  
**MC1701 7707**  
**MC1702 7708**  
**MC1703 7709**  
**MC1704 7710**  
**MC1705 7711**  
**MC1706 7712**  
**MC1707 7713**  
**MC1708 7714**  
**MC1709 7715**  
**MC1710 7716**  
**MC1711 7717**  
**MC1712 7718**  
**MC1713 7719**  
**MC1714 7720**  
**MC1715 7721**  
**MC1716 7722**  
**MC1717 7723**  
**MC1718 7724**  
**MC1719 7725**  
**MC1720 7726**  
**MC1721 7727**  
**MC1722 7728**  
**MC1723 7729**  
**MC1724 7730**  
**MC1725 7731**  
**MC1726 7732**  
**MC1727 7733**  
**MC1728 7734**  
**MC1729 7735**  
**MC1730 7736**  
**MC1731 7737**  
**MC1732 7738**  
**MC1733 7739**  
**MC1734 7740**  
**MC1735 7741**  
**MC1736 7742**  
**MC1737 7743**  
**MC1738 7744**  
**MC1739 7745**  
**MC1740 7746**  
**MC1741 7747**  
**MC1742 7748**  
**MC1743 7749**  
**MC1744 7750**  
**MC1745 7751**  
**MC1746 7752**  
**MC1747 7753**  
**MC1748 7754**  
**MC1749 7755**  
**MC1750 7756**  
**MC1751 7757**  
**MC1752 7758**  
**MC1753 7759**  
**MC1754 7760**  
**MC1755 7761**  
**MC1756 7762**  
**MC1757 7763**  
**MC1758 7764**  
**MC1759 7765**  
**MC1760 7766**  
**MC1761 7767**  
**MC1762 7768**  
**MC1763 7769**  
**MC1764 7770**  
**MC1765 7771**  
**MC1766 7772**  
**MC1767 7773**  
**MC1768 7774**  
**MC1769 7775**  
**MC1770 7776**  
**MC1771 7777**  
**MC1772 7778**  
**MC1773 7779**  
**MC1774 7780**  
**MC1775 7781**  
**MC1776 7782**  
**MC1777 7783**  
**MC1778 7784**  
**MC1779 7785**  
**MC1780 7786**  
**MC1781 7787**  
**MC1782 7788**  
**MC1783 7789**  
**MC1784 7790**  
**MC1785 7791**  
**MC1786 7792**  
**MC1787 7793**  
**MC1788 7794**  
**MC1789 7795**  
**MC1790 7796**  
**MC1791 7797**  
**MC1792 7798**  
**MC1793 7799**  
**MC1794 7800**  
**MC1795 7801**  
**MC1796 7802**  
**MC1797 7803**  
**MC1798 7804**  
**MC1799 7805**  
**MC1800 7806**  
**MC1801 7807**  
**MC1802 7808**  
**MC1803 7809**  
**MC1804 7810**  
**MC1805 7811**  
**MC1806 7812**  
**MC1807 7813**  
**MC1808 7814**  
**MC1809 7815**  
**MC1810 7816**  
**MC1811 7817**  
**MC1812 7818**  
**MC1813 7819**  
**MC1814 7820**  
**MC1815 7821**  
**MC1816 7822**  
**MC1817 7823**  
**MC1818 7824**  
**MC1819 7825**  
**MC1820 7826**  
**MC1821 7827**  
**MC1822 7828**  
**MC1823 7829**  
**MC1824 7830**  
**MC1825 7831**  
**MC1826 7832**  
**MC1827 7833**  
**MC1828 7834**  
**MC1829 7835**  
**MC1830 7836**  
**MC1831 7837**  
**MC1832 7838**  
**MC1833 7839**  
**MC1834 7840**  
**MC1835 7841**  
**MC1836 7842**  
**MC1837 7843**  
**MC1838 7844**  
**MC1839 7845**  
**MC1840 7846**  
**MC1841 7847**  
**MC1842 7848**  
**MC1843 7849**  
**MC1844 7850**  
**MC1845 7851**  
**MC1846 7852**  
**MC1847 7853**  
**MC1848 7854**  
**MC1849 7855**  
**MC1850 7856**  
**MC1851 7857**  
**MC1852 7858**  
**MC1853 7859**  
**MC1854 7860**  
**MC1855 7861**  
**MC1856 7862**  
**MC1857 7863**  
**MC1858 7864**  
**MC1859 7865**  
**MC1860 7866**  
**MC1861 7867**  
**MC1862 7868**  
**MC1863 7869**  
**MC1864 7870**  
**MC1865 7871**  
**MC1866 7872**  
**MC1867 7873**  
**MC1868 7874**  
**MC1869 7875**  
**MC1870 7876**  
**MC1871 7877**  
**MC1872 7878**  
**MC1873 7879**  
**MC1874 7880**  
**MC1875 7881**  
**MC1876 7882**  
**MC1877 7883**  
**MC1878 7884**  
**MC1879 7885**  
**MC1880 7886**  
**MC1881 7887**  
**MC1882 7888**  
**MC1883 7889**  
**MC1884 7890**  
**MC1885 7891**  
**MC1886 7892**  
**MC1887 789**

# WATFORD ELECTRONICS

Continued from opposite side)

## DIODES

AA129	25	1A/50V	20
AAZ15	15	1A/100V	22
BY100	24	1A/200V	25
BY127	12	1A/400V	29
CRO33	158	1A/600V	34
OA9	45	2A/50V	35
OA47	18	2A/100V	44
OA70	12	2A/200V	46
OA79	12	2A/400V	53
OA81	15	4A/100V	72
OA85	15	6A/100V	73
OA90	8	6A/200V	78
OA91	8	6A/400V	85
OA95	8	8Y164	56
OA200	9	VM18 DIL	50
OA202	9		
IN914	4		
IN916	6		
IN400/2	5		
IN400/3	6		
IN400/4/5	6		
IN400/6/7	7		
IN4148	4		
IS44	20		
0-BA30V	28		
0-BA100V	30		
0-BA200V	35		
1A/100V	42		
1A/200V	47		
1A600V	70		
3A/300V	75		
5A600V	43		
8A300V	48		
8A600V	85		
12A300V	89		
12A500V	92		
12A800V	150		
15A700V	195		
BT106	150		
BT116	150		
C106D	38		
MCR101	32		
TC44	22		
TC45	28		
2N4444	140		

## BRIDGE RECTIFIERS

800 3W	75
2" x 2"	75
2 5/8"	88
400 2.5"	88
16 1/2 2.5"	80
800 2.5"	80
80 5W	70
7" x 4"	250
80 3W	160
6" x 4"	

## SPEAKERS

ALUM. BOXES	
3x2x1"	55
2 1/2 x 5 1/2"	75
4x4x1 1/2"	75
4x4x1 1/2"	75
DL707 3" C.Anod	99
DL707 6" An	180
8" Orange C.A.	250
FND357 or 500	120
3" Green C.A.	150
+1.3" Red or Green	150
Bargraph 10 seg. Red	225
Liquid Crystal Display	
3 1/2 digit 875p; 4 digit 975p	
6 Digit LCD	950p

## VERO BOARD

Pitch	0.1	0.15	0.1	0.15
	(copper clad)	(copper clad)	(plain)	(plain)
2 1/2 x 3 1/2"	66p	59p	47p	34p
2 1/2 x 5"	75p	69p	—	39p
3 1/2 x 3 1/2"	75p	—	—	—
3 1/2 x 5"	86p	92p	72p	63p
3 1/2 x 17"	296p	260p	210p	178p
4 1/2 x 17"	387p	—	—	280p

## FERRIC CHLORIDE

1 lb bag Anhydrous	225p + 40p p&p
--------------------	----------------

## EURO BREADBOARD

225p + 40p p&p	£5.20
----------------	-------

## VALVE ETCH RESIST

Pen + Spare tip	90p
-----------------	-----

## BIMBOARDS

SR8P	9.5" x 8.5"
SR8P	6" x 6"
SR8P	6" x 12"

## COPPER CLAD BOARDS

Single sided	90p
Double sided	110p
Glass sided	150p

## SOLDERCON PINS

100 pins-60p	500 pins 275p
--------------	---------------

## OPTO ELECTRONICS

LEDS Plus. Clip	13
TIL209 Red 1 1/2"	18
TIL211 Grn 1 1/2"	18
TIL212 Yellow	22
TIL220 2" Red	15
0.2" Yel, Grn, Amber	18
Rectangular LEDS	
Red, Green and Yellow	30
2N5777 45; OCP71	120
ORP12	63
LD271 Infra Red (emit)	40
TIL32 Infra Red (emit)	58
SFH205 (detector)	70
TIL78 (detector)	70
OPTO isolators	
IL74	48
TIL 111/2 or 117	100
7 Segment Displays	
TIL312 & 313 0.3"	105
TIL321 5" C.An	115
TIL322 5" C.Th	115
DL704 3" C.CtH	99
DL707 3" C.Anod	99
DL707 6" An	180
278H05 5V/5A 595p	250
UA78HG +5 to +24V 5A	150

## VOLTAGE REGULATORS

1A TO3 +ve	—
5V 7805 145p	7905 220p
15V 7812 145p	7912 220p
15V 7815 145p	—
18V 7818 145p	—
1A TO220 Plastic Casing	—
5V 7805 60p	7905 65p
12V 7812 60p	7912 65p
15V 7815 60p	7915 65p
18V 7818 60p	7918 65p
24V 7824 60p	—
100mA TO92 Plastic Casing	—
5V 78L05 30p	79L05 65p
6V 78L12 30p	—
8V 78L12 30p	79L12 65p
15V 78L15 30p	79L15 65p
CA3085 95p	LM323K 625
LM300H 170	LM325N 240
LM305H 140	LM326N 240
LM309K 135	LM327N 270
LM317K 350	LM723 39
78H05 5V/5A 595p	TBA6258 85
UA78HG +5 to +24V 5A	TDA1412 120

## SWITCHES

TOGGLE 2A 250V	32
SPST	32
DPDT	44
4 pole on/off	54
1A DPDT 14	13
1A DPDT C/OFF 15	14
1A DPDT 13	14
4 pole 2-way 24	24
PUSH BUTTON	
Spring loaded red button. Latching	59
SPST on/off 75	SPST on/off 70
SPDT C/over 85	SPDT Biased 88
DPDT 6 tags 70	DPDT C/OFF 79
DPDT Biased 115	DPDT Biased 115
3 pole C/over 150	Push Break 25
ROCKER: 5A, 250V, SPST	30p
ROCKER: (white) 5A 250V SP change-over centre off	52p
ROCKER: Lights red when on. 3A 250V, DPST	85p
ROCKER: (White) 10A/250V DPDT	85p
ROTARY: "Make-A-Switch" Make your own multiway Switch as required. Shafting assembly has adjustable stop. Accommodates up to 6 Wafers Break before make Wafers. Silver contacts. 1 pole/12 way; 2 pole/8 way; 3 pole/4 way; 4 pole/3 way; 6 pole/2 way	59p
Mains DPST Switch to fit Screen & Spacers	40p
Screen & Spacers	6p
ROTARY: (Adjustable Stop Type) 1 pole/2 to 12 way, 2p/2 to 6 way, 3 pole/2 to 4 way, 4 pole/2 to 3 way	43p
ROTARY: Mains 250V AC, 4 Amp	52p

## CRYSTALS

100kHz	323p
455kHz	385p
1.28MHz	392p
1MHz	323p
1.6MHz	395p
1.008MHz	385p
1.80MHz	385p
1.8432MHz	382p
2.4576MHz	362p
3.2768MHz	323p
3.57954M	195p
4MHz	290p
4.032MHz	323p
4.43319M	135p
5.0MHz	355p
5.24288	425p
6.0MHz	392p
6.5536MHz	200p
7.680MHz	323p
8.0833N	362p
8.867MHz	323p
9.375MHz	323p
10MHz	323p
10.7MHz	323p
12MHz	392p
14.31818M	300p
18MHz	323p
18.432M	392p
20MHz	362p
26.69MHz	390p
27.648MHz	350p
38.6667M	250p
48MHz	323p
100MHz	323p

## DIL PLUGS (Headers)

14 pin 35p; 24 pin 85p	16 pin 39p; 40 pin 295p
------------------------	-------------------------

## 'D' CONNECTORS

9 way	85p	110p
15 way	112p	160p
25 way	168p	250p
37 way	250p	360p

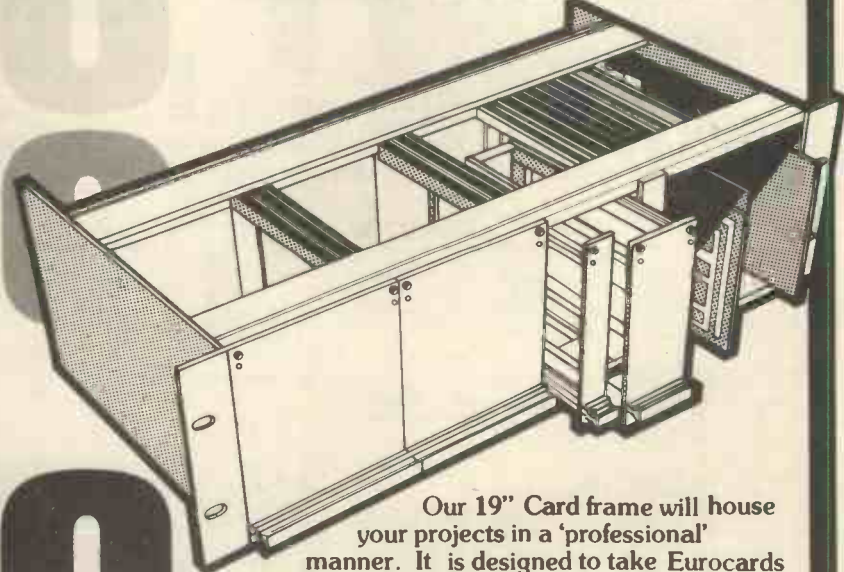
## EDGE CONNECTORS

2x10 way	—	156
2x15 way	—	85p
2x18 way	115p	120p
2x22 way	130p	135p
2x25 way	149p	160p
4 way	85p	—
6 way	98p	—
8 way	210p	—
115p	243p	—

## COMPUTER CORNER

- SUPERBOARD II** Ready-built & tested (requires PSU) **Only: £150**
- PSU 5V/3A** for above incl. UHF Mod. 610 Expansion Board (8K) **£24**
- UK101** Complete Kit incl. instructions **£179**
- Challenger 1P** Cased **£188**
- Plastic Case** for Superboard, fits UK101, NASCOM etc. **£24**
- Space Invaders** for Superboard (4K) **£5**
- PRINTER 800.** Ideal for PET, Apple, TRS80, Superboard etc. **Only: £345**
- VIDEO GENIE** based on TRS80 16K RAM **Only: £325**
- STRINGY FLOPPY** (economy of Cassette, speed of Disc) **Only: £189**
- SOFTY.** Intelligent EPROM Programmer Kit Ready-Built & Tested! PSU for above (Built) **£190**
- TEX UV EPROM Eraser.** Erases up to 32 ICs in 15-30 min. **£33**
- UHF MODULATORS 6MHz** **280p**
- UHF MODULATORS 8MHz** **450p**
- KEYPADS 4 x 4 matrix** **350p**
- Model 756 ASCII Keyboard** **£40**
- 10 x C12 Cassettes** in stockable racks **660p**
- TRANSFORMERS** (mains Prim. 220-240V) 6-0-6V 100mA; 9-0-9V 75mA; 12-0-12V 75mA **98p**
- BVA type: 6V-5A 6V-5A; 9V-4A 9V-4A; 12V-3A 12V-3A; 15V-2.5A 15V-2.5A 215p
- 12VA: 4.5-1.3A 4.5V-1.3A; 6V-1.2, 6V-1.2A 12V-5A 12V-5A **235p (30p p&p)**
- 24VA: 6V-1.5A 6V-1.5A; 9V-1.2A 9V-1.2A; 12V-1A 12V-1A; 15-8A 15-8A; 20V-6A 20V-6A **320p (55p p&p)**
- 50VA: 6V 4A 6V-4A; 9V-2.5A 9V-2.5A; 12V-2A 12V-2A; 15V-1.5A 15V-1.5A; 20V-1.2A 20V-1.2A; 25V-1A 25V-1A; 30V-0.8A 30V-0.8A **365p (60p p&p)**
- 100VA: 12V-4A 12V-4A; 15V-3A 15V-3A; 20V-2.5A 20V-2.5A; 30V-1.5A 30V-1.5A; 40V-1.25A 40V-1.25A; 50V-1A 50V-1A **695p (74p p&p)**
- AUTO (Step Down) TRANSFORMERS:** Prim: 240V Sec: 115V 50/60Hz 50VA: £5.95 (60p); 100VA: £7.40 (70p) 100VA: £9.95 (70p); 250V: £14.75 (85p) (N.B. P&P charge to be added above our normal postal charge.)

# Card Frames



Our 19" Card frame will house your projects in a 'professional' manner. It is designed to take Eurocards or Modules and offers facilities for interconnection through 2-part DIN 41612 or direct edge connectors. A full range of compatible items are available — all selected from the established range of industrial products — boards, accessories, cases etc. Just send 40p. and we'll send you our catalogue by return — it's got the lot!

**VERO ELECTRONICS LTD RETAIL DEPT.**  
Industrial Estate, Chandler's Ford,  
Hampshire SO5 3ZR  
Tel: (04215) 62829



# Marshall's

A. Marshall (London) Ltd., Kingsgate House,  
Kingsgate Place, London NW6 4TA  
Industrial Sales: 01-328 1009

Mail Order: 01-624 8582  
Also retail shops: 325 Edgware Road, London W2.  
40 Cricklewood Broadway, London NW2. 85 West Regent St., Glasgow.  
108A Stokes Croft, Bristol.

## CAPACITORS:

Mullard Ceramic 63v range  
1pF to 10,000pF E 24 range  
all at £0.06 each  
Siemens Ceramic 63v B37448/9  
.01: .022: .033: .047mF @ £0.06  
.068: .1mF @ £0.08: .22mF @  
£0.11

CSF High Voltage Ceramic Discs  
Prices £0.07 to £0.18 Range  
100pF to 10,000pF

Voltage range up to 6Kv.  
See catalogue for details.  
Comprehensive range Siemens  
Layer Polyester Caps: .001 to  
3.3mF  
Prices £0.07 to £0.63.

See catalogue for details.  
Large range of Mullard/Siemens  
Electrolytic Axial/Radial  
Capacitance values 1.0mF to  
10,000mF

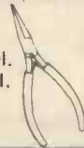
Voltage ranges 25v: 40v: 63v:  
100v:

Prices and types as catalogue  
Also Mullard C280; Siemens  
B32231/4 and B32110. All prices  
net + VAT and postage/packaging.

## TOOLS BAHCO

Side Cutter with Bezel.  
Side Cutter without Bezel.  
End Cutter without Bezel.

Vero Metal Shears.  
Other items as catalogue.



## BOXES & CASES

See catalogue for full range.  
Aluminium boxes 13 sizes.  
Rexine Covered boxes 7 sizes.  
NEW RANGE TMEC CASES  
Send S.A.E. for details & types

Price range. £14.04 to £17.00  
ABS PLASTIC BOXES

3" x 2 1/4" x 1 3/8" Prices as  
3 3/4" x 2 3/4" x 1 3/8" catalogue  
4 1/2" x 3 3/4" x 1 1/2"  
8" x 4 3/4" x 3"

## BAZELLI INSTRUMENT CASES

5 sizes.  
Miscellaneous hardware  
including  
Vero Board: Superstrips:  
Vero Breadboard.  
Vero boxes (see catalogue for  
full range).



Card Frames: Fliptop boxes:  
etc etc.

## 1980 CATALOGUE

U.K.: 65p post paid  
Europe 85p post paid  
Rest of World £1.25  
post paid

Mail order: 01-624 8582



## TTL see catalogue for full range

SN7400N	£0.14	SN7491AN	£0.54
SN7401N	£0.14	SN7492N	£0.31
SN7402N	£0.14	SN7493N	£0.32
SN7403N	£0.14	SN7494N	£0.80
SN7404N	£0.14	SN7495N	£0.55
SN7405N	£0.15	SN7496N	£0.34
SN7406N	£0.34	SN7497N	£1.80
SN7407N	£0.26	SN74100N	£1.10
SN7408N	£0.15	SN74107N	£0.21
SN7409N	£0.18	SN74118N	£0.76
SN7410	£0.15	SN74119N	£1.20
SN7411N	£0.15	SN74121N	£0.25
SN7412N	£0.20	SN74122N	£0.48
SN7413N	£0.28	SN74123N	£0.42
SN7414N	£0.47	SN74124N	£0.53
SN7415N	£0.22	SN74125N	£0.40
SN7416N	£0.22	SN74141N	£0.50
SN7417N	£0.15	SN74142N	£0.54
SN7420N	£0.15	SN74143N	£1.05
SN7423N	£0.18	SN74148N	£1.05
SN7425N	£0.19	SN74150N	£0.79
SN7426N	£0.18	SN74151N	£0.55
SN7427N	£0.19	SN74153N	£0.55
SN7430N	£0.15	SN74154N	£0.90
SN7432N	£0.17	SN74155N	£0.60
SN7437N	£0.21	SN74157N	£0.59
SN7438N	£0.21	SN74160AN	£0.70
SN7440N	£0.15	SN74161AN	£0.70
SN7441AN	£0.52	SN74162AN	£0.70
SN7442N	£0.40	SN74163AN	£0.70
SN7445N	£0.66	SN74164AN	£0.80
SN7446AN	£0.48	SN74165N	£0.80
SN7447AN	£0.48	SN74167N	£1.20
SN7449N	£0.45	SN74174N	£0.80
SN7450N	£0.15	SN74175N	£0.83
SN7451N	£0.15	SN74176N	£0.74
SN7453N	£0.15	SN74177N	£0.73
SN7454N	£0.15	SN74180N	£0.70
SN7460N	£0.15	SN74181N	£1.65
SN7470N	£0.26	SN74182N	£0.83
SN7472N	£0.24	SN74184N	£1.29
SN7473N	£0.25	SN74185AN	£1.10
SN7474N	£0.25	SN74186N	£1.35
SN7475N	£0.31	SN74188AN	£1.84
SN7476N	£0.26	SN74189N	£2.26
SN7478N	£0.39	SN74190N	£0.74
SN7481N	£0.71	SN74191N	£0.79
SN7482N	£0.65	SN74192N	£0.79
SN7483N	£0.60	SN74193N	£0.79
SN7484N	£0.95	SN74196N	£0.74
SN7485N	£0.70	SN74197N	£0.74
SN7486N	£0.25	SN74198N	£1.09
SN7489N	£1.66	SN74199N	£1.09
SN7490AN	£0.33		

## KNOBBS & SWITCHES

Big selection as catalogue  
Also Resistors; Presets; Pots;  
Opto; Semiconductors etc.

## SOLDERING EQUIPMENT

### IRONS-ANTEX

15 watt C15 £3.95

15 watt CX1 £4.20

17 watt CX17 £4.20

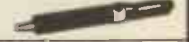
25 watt X25 £4.20

Stand £1.50



### DESOLDERING TOOL

Solder £6.50



## SINCLAIR INSTRUMENTS

### Digital Multimeter

" PDM35 £ 34.50

" DM235 £ 52.50

" DM350 £ 72.50

" DM450 £ 99.00

### Digital Frequency Meter

PFM200 £ 49.80

### Low Power Oscilloscope

SC110 £139.00

## CRIMSON ELEKTRIK HI FI

### MODULES

CE608 Power Amp £18.26

CE1004 " " £21.30

CE1008 " " £23.91

CE1704 " " £30.43

CE1708 " " £30.43

CPS1 Power Unit £16.96

CPS3 " " £20.43

CPS6 " " £26.09

CPR1 Pre Amp £29.57









CPR1S Pre Amp £38.70

All prices + VAT + postage/  
packaging

# NEW! LERNA-KITS!

## ● HIGH QUALITY EDUCATIONAL KITS

- LATEST SOLID STATE TECHNOLOGY – DESIGNED & MADE IN THE U.K.
- DETAILED STAGE BY STAGE BUILDING INSTRUCTIONS
- FREE ADVISORY SERVICE THROUGHOUT THE BUILDING

<p><b>LK1 OSCILLOSCOPE</b> Solid state circuitry; D.C. coupled; 7 cm. dia. tube; Y input 0.3 v/cm to 50 v/cm; X input 1 volt/cm; 1v and 10v. cal. signals; response to 1MHz; Time base ranges to 35.5 per cm. Size 230 x 130 x 190mm. Wt. 2kg. Operates from 110 volt or 220/240 volt A.C. High quality kit complete with carrying case.</p>  <p>£130.00</p>	<p><b>LK2 DIGITAL MULTIMETER</b> Solid state circuitry with large digital display. Ranges are up to 1000v. D.C. and A.C. and current D.C. to 100mA. Resistance ranges 100K ohms. Battery operated Size 185 x 110 x 60mm. Digital display: 37 x 16mm</p>  <p>£40.00</p>	<p><b>LK5 DIGITAL ELECTRONIC TECHNIQUES</b> Experiments carried out on a P.C. board, size 190 x 150mm covering operational amplifiers; integrators; basic logic circuits; NAND, NOR gates; Flip-Flops; Multi- vibrators; clock generator; 4 bit compar- ator feed back; analogue switching; building simple digital meter circuits; Timer. Notes – for full benefit with this kit a C.R.O. is desirable although circuits can be built without one.</p>  <p>£35.00</p>	<p><b>LK6 LOGIC DEMONSTRATION PANEL</b> Basic introduction to computer technology; AND and OR gates; NOR and NAND; Data line selector; Truth tables; AND and INVERT gates; Half and Full Adder; Latches; Flip-Flops; Shift register; Binary coded decimal counter. Over 16 experiments are performed with panel. Battery operated.</p>  <p>£70.00</p>
<p><b>LK3 HOME COMPUTER</b> Ideal simple computer for beginners. Microprocessor has 8 bit data bus and 12 bit address bus. Ready programmed ROM has 4K bits. RAM of 0.5 x 8k bits fully addressable. 8 digit LED display. Hexadecimal read out. Hexadecimal keyboard. Re-set switch and single shot facility. Power supply kit included. Provision for cassette and V.D.U. operation.</p>  <p>£190.00</p>	<p><b>LK4 AUDIO GENERATOR</b> Covers 10Hz to 100kHz in four switched stages. Variable voltage output. Distortion below 0.02% Sine and square wave output. Ideal for Hi-Fi work and as signal tracer.</p>  <p>£40.00</p>	<p><b>LK7 ANALOGUE TEST METER</b> Basic multi range test meter kit with 20,000 ohm/volt sensitivity. Ranges Ranges: D.C. and A.C. volts 0.5, 0.25, 0.100, 0.500, 2.5kV. D.C. 0.5mA, 0.500mA, 0.500µA Resistance 0.50K; 0.5M. Size 150 x 75 x 50mm.</p>  <p>£17.00</p>	<p><b>LK8 SHORT WAVE RECEIVER</b> A simple 3 stage short wave only radio receiver for the amateur. Very good selectivity and sensitivity and will give hours of enjoyment. Simple to construct by people of any age.</p>  <p>£25.00</p>

LERNAKITS, 4 Cleveland Road, Jersey, Channel Islands. (Est. 40 years)

To:— LERNAKITS, 4 Cleveland Road, Jersey, Channel Islands. (Est. 40 years) PE/10/819

Please supply ..... Kit at £ ..... add £2 postage U.K. only. Catalogue available  
£10 postage overseas Air Mail. on receipt 12p stamp.

BLOCK CAPS PLEASE

NAME .....

ADDRESS .....

ALL CREDIT CARDS ACCEPTED

Name of Card .....

No.

Signature .....

(Dispatch is normally within 1 week of receipt of order)

**Aura Sounds** are the first company to successfully market Wersi Organs and Kits in the United Kingdom. Operating from modern Showrooms, we offer a complete, unique evening and weekend telephone support advice. We pride ourselves on our friendly and individual service. We market Wersi products because we feel they are simply the best, both in terms of quality and reliability. These factors, together with a fresh approach, are what have made Wersi one of the leading organ manufacturers in the world today. **AURA SOUNDS AND WERSI – THE WINNING COMBINATION.** Illustrated below are just a few of the wide range of organs in stock.



**The SATURN W3T.**

*The ultimate transportable organ, featuring sophisticated rhythm unit and built-in WERSI Voice. 30 or 61 note Keyboards and 30 pedals.*



**The COSMOS W5S**

*The baby of the range, a great instrument at a great price. There are many optional extras and Cosmos can be easily assembled at home by the average handyman.*



**The HELIOS.** For home or professional use. Available as a transportable model with various options including 25-pedal clavier.



**The GALAXY.**

*The top model of the range with 3 full manuals and a 30 note pedalboard. For looks and sound, the effects are first class.*

**IMPORTANT**

AURA SOUNDS have just been appointed marketing agents for the range of Heath Electronic Kits in the U.K. This exciting range of 'up-market' Kits makes AURA SOUNDS, more than ever before, the company to come to for advice and product choice.

AURA SOUNDS 14-15 Royal Oak Centre, Brighton Road, Purley, Surrey. Telephone 01-668 9733 and at 17 Upper Charter Arcade, Barnsley, West Yorks. Telephone (0226) 5248  
**THE PROFESSIONALS**

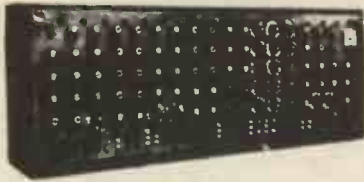
Please send me the 104 page colour WERSI catalogue plus the NEW HEATHKIT BROCHURE & price lists I enclose a cheque/P.O. for £1.00

Name \_\_\_\_\_

Address \_\_\_\_\_

Send to Aura Sounds Ltd. 14/15 Royal Oak Centre, Brighton Road, Purley, Surrey.

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



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

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

# PHONOSONICS

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

## P.E. MINISONIC MK2 SYNTHESIZER

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

Set of basic component kits (excl. KBD R's & tuning pots - see list for options available) and PCBs (incl. layout charts)  
**KIT38-25 £80.12**  
 "Sound Design" booklet **£1.00**

## P.E. 128-NOTE SEQUENCER

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

Set of basic comps, PCBs and charts **KIT76-7 £35.56**  
 Set of text photocopies **£1.36**

## P.E. 16-NOTE SEQUENCER

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

Set of basic comps, PCBs and charts **KIT86-5 £33.60**  
 Set of text photocopies **£1.84**

## P.E. STRING ENSEMBLE

A multivoiced polyphonic string instrument synthesiser.

Set of basic comps, PCBs & charts **KIT77-8 £107.86**

## ELEKTOR ELECTRONIC PIANO

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

5-octave set of basic comps and PCBs (as publ.) **KIT80-9 £148.66**  
 Additional 3-octave extension and basic parts and PCBs (as published) **KIT80-10 £56.36**  
 Set of text photocopies **£1.81**

## ELEKTOR FORMANT SYNTHESIZER

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

Set of basic comps, PCBs (as publ.) **KIT66-14 £255.45**  
 Set of text photocopies **£7.83**

## ELEKTOR DIGITAL REVERB UNIT

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

Main unit basic comps and PCB (as publ.) **KIT78-3 £55.40**  
 Extension unit basic comps and PCB (as publ.) **KIT78-4 £52.77**  
 Text photocopy **86p**

## ELEKTOR ANALOGUE REVERB

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

Main unit basic component set **KIT83-1 £29.49**  
 Additional Delay basic components **KIT83-2 £20.07**  
 PCB (as publ.) to hold both kits **PCB9973 £4.52**  
 Text photocopy **67p**

## ELEKTOR RING MODULATOR

Compatible with the Formant & most other synthesisers.

Set of basic comps & PCB (as publ.) **KIT87-2 £6.84**  
 Text photocopy **38p**

## NEW KITS

### ELEKTOR CHOROSYNTH

A 2 $\frac{1}{2}$ -octave Chorus synthesiser with an amazing variety of sounds ranging from violin to cello and flute to clarinet amongst many others. Experienced constructors can readily extend the octave coverage.

Basic comps, PCBs and charts but excl. sw's **KIT100-B £44.39**  
 Text photocopy **70p**

### ELEKTOR SEWAR

For use with Elektor Analogue Reverb to give greater flexibility to the reverb effects.

Basic comps, PCB (as publ.) **KIT101-1 £22.53**  
 Text photocopy **60p**

### ELEKTOR FUNNY TALKER

Incorporates a ring modulator, chopper & frequency modulator to produce fascinating sounds when used with speech & music signals.

Basic comps, PCB (as publ.) **KIT99-1 £9.60**  
 Text photocopy **40p**

### ELEKTOR FREQUENCY DOUBLER

For use with guitars & other electronic instruments to produce an output one octave higher than the input. Inputs and outputs may be mixed to give greater depth.

Basic comps, PCB (as publ.) **KIT98-1 £5.48**  
 Text photocopy **20p**

### P.E. SPLIT-PHASE TREMOLO

A simple but effective substitute for a rotary cabinet. The output of an internal generator is phase-split and modulated by an input signal from an electronic guitar or other instrument. Output amplitudes, depth & rate are variable. May be fed to one or two amplifiers.

Basic comps, PCB & chart **KIT102-3 £17.58**  
 Text photocopy **65p**

### P.E. MINISONIC WAVEFORM CONVERTER

A simple converter that modifies the Minisonic sawtooth waveform to produce triangle and sine outputs. Ideally one should be used with each Minisonic VCO.

Basic comps, PCB & chart **KIT96-1 £3.98**

### DISCO-CROSS FADER

The cross-fade between 2 decks is switch-initiated and can be preset on the panel for a cross fade rate of between about  $\frac{1}{2}$  sec & 24 secs. Basically a stereo unit but may be used in mono.

Basic comps, PCB & chart **KIT94-1 £11.83**

### P.E. GUITAR MULTIPROCESSOR

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

Set of basic comps, PCBs & charts (excl. SWs) **KIT85-5 £54.56**  
 Set of text photocopies **£2.82**

### P.E. PHASER

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

Basic components, PCB & chart **KIT88-1 £10.89**  
 2-Notch extension, PCB & chart **KIT88-2 £8.36**  
 Text photocopy **88p**

### ELEKTOR PHASING & VIBRATO

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

Set of basic comps, PCB & chart **KIT70-2 £21.67**  
 Text photocopy **87p**

## ELEKTOR RESONANCE FILTER

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

Set of basic comps. & PCB (as publ.) **KIT82-2 £22.45**  
 Text photocopy **57p**

## P.E. GUITAR EFFECTS UNIT

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

Basic comps, PCB & chart **KIT42-3 £10.37**  
 Text photocopy **28p**

## P.E. GUITAR OVERDRIVE

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

Basic components, PCB & chart **KIT56-3 £11.22**  
 Text photocopy **68p**

## P.E. SMOOTH FUZZ

Basic components, PCB & chart **KIT91-1 £6.40**  
 Text photocopy **55p**

## TREMOLO UNIT

A slightly modified version of the simple P.E. unit. Basic components, PCB & chart **KIT54-1 £3.74**

## GUITAR FREQUENCY DOUBLER

A slightly modified and extended version of the P.E. unit. Basic components, PCB & chart **KIT74-1 £5.19**  
 Text photocopy **39p**

## P.E. GUITAR SUSTAIN

Maintains the natural attack whilst extending note duration. Basic components, PCB & chart **KIT75-1 £6.73**  
 Text photocopy **38p**

## P.E. WAH-WAH UNIT

Can be controlled manually or by integral automatic control. Basic components, PCB & chart **KIT51-1 £4.93**

## P.E. AUTO-WAH UNIT

Automatically gives Wah or Swell sounds with each note played. Basic components, PCB & chart **KIT68-1 £9.68**  
 Text photocopy **58p**

## ELEKTOR WAVEFORM CONVERTER

Converts a saw-tooth waveform into sinewave, mark-space sawtooth, regular triangle, or square-wave with variable mark-space. Basic comps, PCB & chart, but excl. sw's **KIT67-1 £9.24**

## P.E. SWITCHED TONE TREBLE BOOST

Provides switched selection of 4 preset tonal responses. Basic components, PCB & chart **KIT89-1 £4.34**  
 Text photocopy **78p**

## P.E. TREBLE BOOST UNIT

A simple treble boost unit with manual control depth. Basic components, PCB & chart **KIT53-1 £2.92**

## P.E. SYNTHESIZER

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

Basic comps, PCBs & charts **KIT23-33 £167.67**  
 Set of text photocopies **£8.21**

### 10% DISCOUNT VOUCHER (PE 83)

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

### ADD: POST & HANDLING

U.K. orders: Keyboards add £2.70 each. Other goods: Under £5 add 50p. under £20 add 75p. over £20 add £1. Recommended insurance against postal mishaps: add 50p for cover up to £50, £1 for £100 cover, etc., pro-rata. Insurance must be added for credit card orders. N.B. Eire, C.I., B.F.P.O. and other countries are subject to higher export postage rates.

### ADD 15% VAT

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

EXPORT ORDERS ARE WELCOME but to avoid delay we advise you to see our list for postage rates. All payments must be cash-with-order, in Sterling by International Money Order or through an English Bank. To obtain list - Europe send 35p, other countries send 75p. Note that we do not offer a C.O.D. service and that our terms are payment in advance.

PHONOSONICS · DEPT PE88 · 22 HIGH STREET · SIDCUP · KENT DA14 6EH

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



# AND OTHER PROJECTS

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

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

OVERSEAS enquiries for list Europe—send 35p; other countries—send 75p.



## KIMBER-ALLEN KEYBOARDS AND CONTACTS

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

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

**CONTACT ASSEMBLIES** (gold-clad wire) — 1 required for each KBD note:  
Type GJ — SPCO 33p ea. Type GB — 2 pr N/O 37½p ea.

### P.E. V.C.F.

A voltage controlled filter extracted from P.E. Minisonic project.  
Basic comps, PCB & chart KIT 65-1 £8.45

### P.E. RING MODULATOR

Extracted from P.E. Minisonic project.  
Basic comps, PCB & chart KIT 59-1 £6.35

### WIND & RAIN EFFECTS UNIT

Slightly modified version of the original P.E. unit.  
Basic comps, PCB & chart KIT 28-1 £4.84  
Text photocopy 28p

### P.E. ENVELOPE SHAPER WITHOUT VCA

Provides full manual control over attack, decay, sustain and release functions, and is for use with an existing VCA.  
Basic comps, PCB & chart KIT 44-1 £5.73  
Text photocopy 49p

### P.E. ENVELOPE SHAPER WITH VCA

Has an integral Voltage Controlled Amplifier, and has full manual control over the A.D.S.R. functions.  
Basic comps, PCB & chart KIT 50-1 £8.03  
Text photocopy 58p

### P.E. TRANSIENT GENERATOR

An ADSR envelope shaper without VCA, and additionally providing Repeat-triggering enabling a synthesiser to be programmed for mandolin or banjo effects.  
Basic comps, PCB & chart KIT 63-2 £7.62  
Text photocopy 58p

### P.E. EXTERNAL-INPUT SYNTHESISER-INTERFACE

Allows external inputs such as guitars, microphone etc., to be processed by synthesiser circuits.  
Basic comps, PCB & chart KIT B1-1 £3.90

### P.E. TUNING FORK

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

### P.E. TUNING INDICATOR

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

### P.E. DYNAMIC RANGE LIMITER

Presets to automatically control sound output levels.  
Basic comps, PCB & chart KIT 62-1 £5.31

### P.E. CONSTANT DISPLAY FREQUENCY COUNTER

A 4-digit counter for 1Hz to 99kHz with 1Hz sampling rate. Readout does not count visibly or flicker due to blanking.

Basic components, PCB & chart KIT 79-4 £31.35  
Text photocopy 78p

### P.E. 6-CHANNEL MIXER

A high specification stereo mixer with variable input impedances.  
Basic components (excl. sw's.) and set of PCBs and charts.

KIT 90-8 £61.25  
Extra 2-channel set with PCB KIT 90-9 £11.62  
Set of Text photocopies £1.50

### STEREO HEADPHONE AMPLIFIER

Extracted from P.E. 6-channel mixer.  
Basic components, PCB & chart KIT 92-1 £5.68

### DIGITAL EXPOSURE UNIT

Controls up to 750 watts in ½ second steps up to 10 minutes, with built-in audio alarm.  
Basic components, PCBs & charts KIT 93-3 £23.27  
Text photocopy £1.20

### P.E. DISCOSTROBE

A 4-channel light show controller giving a choice of sequential, random, or full strobe mode of operation, and with extra audio input.

Basic components, PCB & chart KIT 57-2 £25.12  
Text photocopy 78p

### RHYTHM GENERATORS

Several available, including programmable 16 beat 84000 pattern, 128 beat almost infinite pattern, and pre-programmed 15 pattern using either M252 or M253 rhythm chips. A selection of effects instrument circuits is also available.

### P.E. VOICE OPERATED FADER

For automatically reducing music volume during talkover — particularly useful for discos.  
Basic components, PCB & chart KIT 30-1 £4.37  
Text photocopy 28p

### P.E. DYNAMIC NOISE LIMITER

Very effective stereo circuit for reducing the hiss found in most tape recordings.  
Basic components, PCB & chart KIT 97-1 £8.07  
Text photocopy 75p



PRICES ARE CORRECT AT TIME OF PRESS.  
E. & O. E. DELIVERY SUBJECT TO AVAILABILITY.

PHONOSONICS

# TRAIN FOR SUCCESS

in Radio, Television & Electronics

ICS have helped thousands of ambitious people to move up into higher paid more secure jobs in the field of electronics — now it can be your turn. Whether you are a newcomer to the field or already working in the industry, ICS can provide you with the specialised training so essential to success.

### Personal Tuition and Guaranteed Success

The expert and personal guidance by fully qualified tutors, backed by the ICS guarantee of tuition until successful, is the key to our outstanding record in the technical training field. You study at the time and pace that suits you best and in your own home. In the words of one of our many successful students: "Since starting my course, my salary has trebled and I am expecting a further increase when my course is completed."

### City and Guilds Certificates

Excellent job prospects await those who hold one of these recognised certificates. ICS can coach you for:

Telecommunications Technicians  
Radio, T.V. Electronics Technicians  
Radio Amateurs  
Electrical Installation Work

### Diploma Courses

Colour T.V. Servicing  
CCTV Engineering  
Electronic Engineering & Maintenance  
Computer Engineering and Programming  
Radio, T.V. and Audio, Engineering & Servicing  
Electrical Engineering, Installations & Contracting

### Other Career Courses

A wide range of other technical and professional courses are available including GCE.

FREE BOOK

Post this coupon or 'phone today for free Electronics careers guide.

Name \_\_\_\_\_

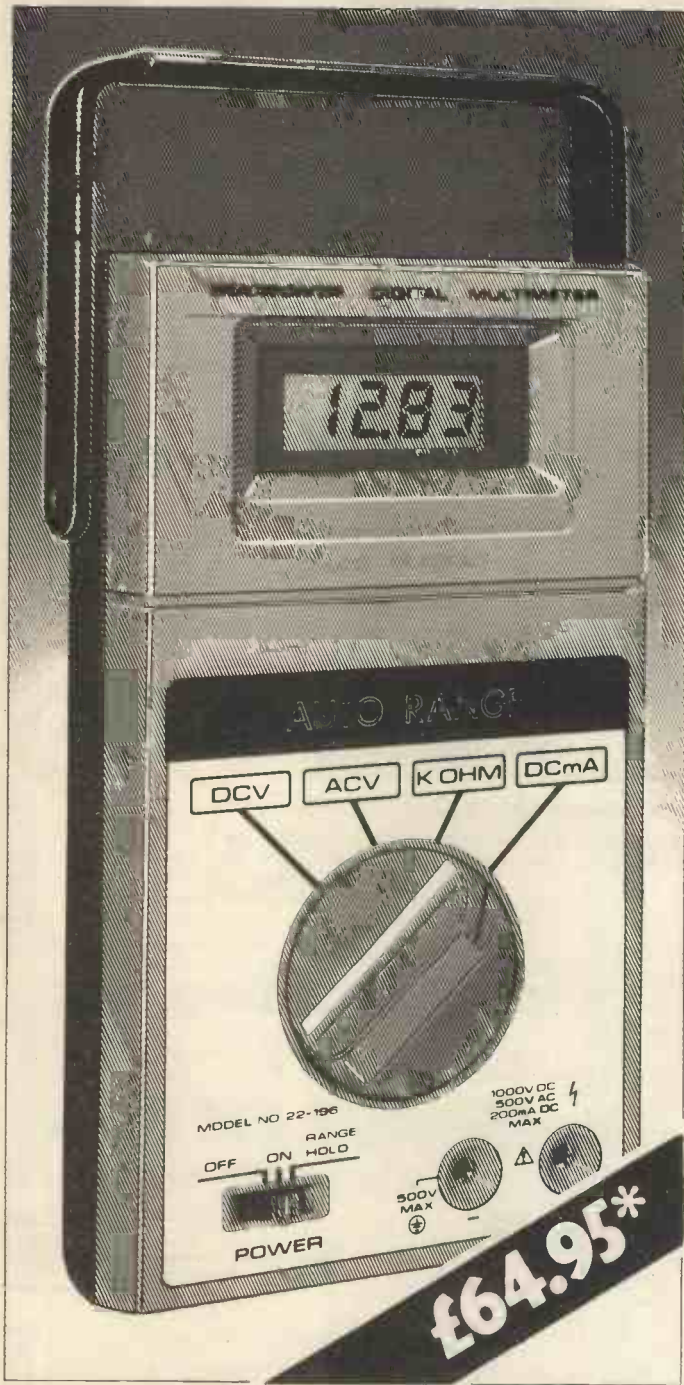
Address \_\_\_\_\_

Age \_\_\_\_\_



To ICS, Dept Z273, Intertext House,  
London SW8 4UJ  
or telephone 01-622 9911 (all hours)

# Pure ind



**£64.95\***

**Micronta Auto Range Multimeter** Gives you correct polarity, range and measurement — every time. Single function switch lets you choose DC 4 ranges; AC 4 ranges; DC current resistance. 4 ranges. LCD readout. Exclusive range hold facility. 22-196



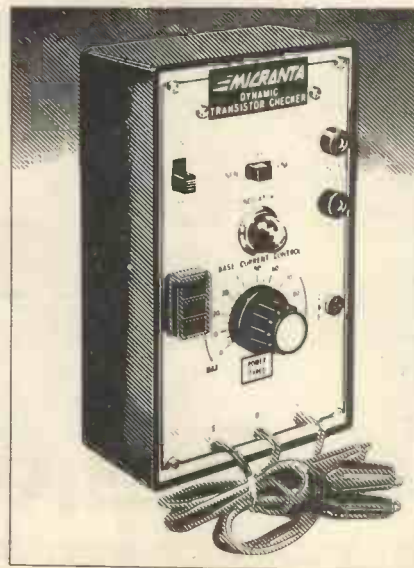
**£6.95\***

**Micronta 1000 Ohms/Volt Multitester** Very compact at 89 x 59 x 32 mm. Easy to read colour meter, pin jacks for all 8 ranges. Reads AC V, DC current and ohms. Mirrored scale. 20-027



**£9.95\***

**Micronta Transistorized Signal Tracer** Spot circuit troubles, check RF, IF and audio signals from aerial to speaker on all audio equipment. It has built in 5 cm speaker with volume control. 50 x 143 x 38 mm. 22-010



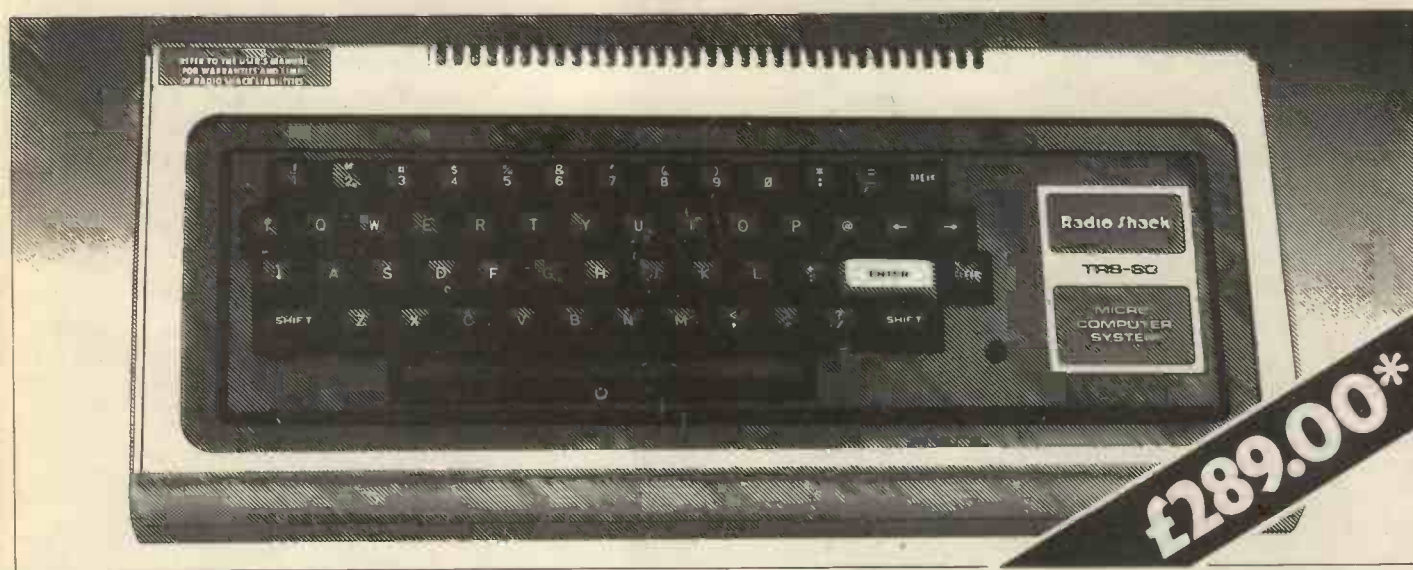
**£9.95\***

**Micronta Dynamic Transistor Checker** Shows current gain and electrode open and short circuit. Tests low medium or high power PNP or NPN types. Go/no-go tests from 5-50 mA on power types. "Quick-check" sockets. 22-024

# Wigence.

Realistic Direct Entry Programmable Scanning Receiver Hear real-life drama on six exciting bands. With direct access to all frequencies, you can punch in actual frequencies for monitoring, storing in the computer's memory or just exploring. Big fluorescent display. Phase locked loop security. 20-9111

TRS-80 Model I C.P.U.'s Ready to run from your TV monitor. Plug in and start computing. Contains 4096 bytes of user memory and can be expanded to 16K. 26-9051



- |   |   |   |   |  |
|---|---|---|---|--|
| <p><b>ACCRINGTON</b><br/>37 Union Street<br/><b>ALDRIDGE</b><br/>15 Central Area Development<br/><b>BARNSELY</b><br/>56 Market Street<br/><b>BASINGSTOKE</b><br/>22 London Street<br/><b>BIRKENHEAD</b><br/>Kwik Save Centre, Prenton<br/><b>BRADFORD COMPUTER CENTRE</b><br/>2/4, Forster Square</p> <p><b>BIRMINGHAM AREA</b><br/><b>BULL RING</b><br/>528 Bridge Link<br/>Shopping Centre<br/><b>CAPE HILL</b><br/>44-46, Cape Hill<br/><b>CITY CENTRE</b><br/>57-58 Dale End<br/><b>CORPORATION STREET</b><br/>80, Corporation Street<br/><b>EDGEBASTON COMPUTER CENTRE</b><br/>Edgibaston Shopping Centre<br/><b>ERDINGTON</b><br/>218 High Street<br/><b>HALESOWEN</b><br/>5/7 Queensway<br/><b>NORTHFIELD</b><br/>749 Bristol Road South</p> <p><b>PERRY BARR</b><br/>20 Lynton Square<br/><b>SHELDON</b><br/>2268 Coventry Road<br/><b>SMAETHHURGE</b><br/>44-46 Cape Hill<br/><b>WARD END</b><br/>887 Washwood Heath Road<br/><b>WEDNESBURY</b><br/>Bilston Road</p> <p><b>BOLTON</b><br/>5 Nelson Square<br/><b>BOSCOMBE</b><br/>548 Christchurch Road<br/><b>BOURNEMOUTH</b><br/>132/4 Commercial Road<br/><b>BRADFORD</b><br/>9 Petergate<br/><b>BRIGHTON</b><br/>70 London Road</p> <p><b>BRISTOL AREA</b><br/><b>BISHOPSTON</b><br/>13 Gloucester Road<br/><b>BRISTOL COMPUTER CENTRE</b><br/>130/4 Commercial Road<br/>Colston Centre<br/><b>CLIFTON</b><br/>140 Whiteslades Road<br/><b>DOWNEND</b><br/>5 Badminton Road<br/><b>KNOWLE</b><br/>Broadwalk Shopping Centre<br/><b>YATE</b><br/>1 North Parade</p> | <p><b>BROMSGROVE</b><br/>6-8 St. John Street<br/><b>BROWN-HILLS</b><br/>60 High Street<br/><b>BURY (Lanes)</b><br/>91 The Rock<br/><b>CARDIFF</b><br/>9 Wood Street<br/><b>CHELTENHAM</b><br/>31, Cambray Place<br/><b>CHESTER</b><br/>Kwik Save Centre<br/><b>COVENTRY</b><br/>Sealand Road<br/><b>CREWLEY</b><br/>4 Hales Street<br/><b>DARLINGTON</b><br/>12 Market Street<br/><b>DERBY</b><br/>15/16 Prestigate<br/><b>DERBY</b><br/>33 Victoria Street<br/><b>DONCASTER</b><br/>32/34 Kingsgate<br/><b>DUDLEY</b><br/>Trindle Road Roundabout<br/><b>CASTLEBURN</b><br/>Langley Shopping Centre<br/><b>EXETER</b><br/>13 Park Street<br/><b>GRIMSBY</b><br/>Riverhead Centre<br/><b>HARROGATE</b><br/>The Colonades<br/><b>Pochester Road</b><br/>34, Oxford Street</p> <p><b>HUDDERSFIELD</b><br/>Packhorse Shopping Centre<br/><b>HULL</b><br/>Status City, Clough Road<br/><b>LEAMINGTON SPA</b><br/>83 Warwick Street<br/><b>LEEDS</b><br/>72 Merrion Centre<br/><b>LEEDS</b><br/>3 Eastgate<br/><b>LEICESTER</b><br/>Market Street<br/><b>LETCHEWORTH</b><br/>25 Commerce Way<br/><b>LINCOLN</b><br/>High Street</p> <p><b>LIVERPOOL AREA</b><br/><b>ALLERTON</b><br/>90 Allerton Road<br/><b>BOOTLE</b><br/>New Strand Precinct<br/><b>OLD SWAN</b><br/>648 Prescott Road<br/><b>ST. JOHNS PRECINCT</b><br/>168 Market Way</p> <p><b>LONDON AREA</b><br/><b>BARKING</b><br/>8/10 North Street<br/><b>BAYSWATER</b><br/>The Colonades<br/><b>Pochester Road</b><br/>1/2, Seacool Lane</p> | <p><b>BECKENHAM</b><br/>144 High Street<br/><b>CATFORD</b><br/>23 Cartford Broadway<br/><b>CHESTER</b><br/>92 Turners Hill<br/><b>CHINGFORD</b><br/>3 Hall Lane<br/><b>CLAPHAM</b><br/>84 Clapham High Street<br/><b>COLLIER ROW</b><br/>27 Collier Row<br/><b>CROUCH END</b><br/>42 The Broadway<br/><b>DAGENHAM</b><br/>297 Heathway<br/><b>EDWARDS</b><br/>128 Burnt Oak<br/><b>EDMONTON</b><br/>23, North Mall<br/><b>ENFIELD</b><br/>10 Colman Parade<br/><b>HAMME SMITH</b><br/>142/4 King Street<br/><b>HENDON</b><br/>24 Sentinel Square<br/><b>DRIPPINGTON</b><br/>5 The Walrus<br/><b>PALMERS GREEN</b><br/>379 Green Lanes<br/><b>ROMFORD</b><br/>27 Collier Row Road<br/><b>SEACOLEY LANE</b><br/>1/2, Seacool Lane</p> <p><b>STREATHAM</b><br/>254 Streatham High Road<br/><b>TOTTENHAM</b><br/>450 High Road<br/><b>WALTHAMSTOW</b><br/>123 High Street<br/><b>WANDSWORTH</b><br/>239 Walworth Road<br/><b>WELLING</b><br/>107/9 High Street<br/><b>WIMBLEDON</b><br/>124/6 The Broadway</p> <p><b>LUTON</b><br/>157 Dunstable Road</p> <p><b>MANCHESTER AREA</b><br/><b>ARNDALE</b><br/>Unit 71, Arndale Centre<br/><b>BRAMHALL</b><br/>14/15 The Centre<br/><b>CHADDERTON</b><br/>67 High Street<br/><b>CHEADLE</b><br/>67 High Street<br/><b>DEANSGATE COMPUTER CENTRE</b><br/>36, Market Place<br/><b>HYDE</b><br/>4-8 The Mall<br/><b>RADCLIFFE</b><br/>25 Blackburn Street<br/><b>SALE</b><br/>The Mall</p> | <p><b>CITY CENTRE</b><br/>Arndale Centre<br/><b>STRETFORD</b><br/>Arndale Centre</p> <p><b>NEWBURY</b><br/>14 Bartholomew Street<br/><b>NORTHAMPTON</b><br/>Weston Favel Shopping Centre</p> <p><b>NOTTINGHAM AREA</b><br/><b>ARNOLD</b><br/>126/8 Front Street<br/><b>BEESTON</b><br/>30 The Square<br/><b>HUNREATHON</b><br/>1 Church Street<br/><b>OXFORD</b><br/>9/10 St. Clements<br/><b>PAIGATON</b><br/>35 Hyde Road<br/><b>PLYMOUTH</b><br/>64 Royal Parade<br/><b>PORT TALBOT</b><br/>Aberafan Centre<br/><b>READING</b><br/>18 The Butts Shopping Centre<br/><b>RUGBY</b><br/>25 Church Street<br/><b>RUNCORN</b><br/>120 Runcorn Shopping City<br/><b>SCUNTHORPE</b><br/>140 High Street</p> | <p><b>SHREWSBURY</b><br/>20 Shop Latch<br/><b>SITTINGBOURNE</b><br/>20 The Forum Shopping Centre<br/><b>SLOUGH</b><br/>293 High Street<br/><b>SOUTHAMPTON</b><br/>East St. Centre<br/><b>STAFFORD</b><br/>6 Sheridan Shopping Centre<br/><b>ST. HELENS</b><br/>Fingerpost Centre<br/><b>STOKE-ON-TRENT</b><br/>Hanley 16 Charles Street<br/><b>SUNDERLAND</b><br/>4 Fawcett Street<br/><b>SURREY</b><br/>206 High Street<br/><b>SUTTON (Surrey)</b><br/>206 High Street<br/><b>TORQUAY</b><br/>134 Union Street</p> <p><b>TYNE AND WEAR AREA</b><br/><b>NEWCASTLE</b><br/>23 Newgate Centre<br/><b>SHEFFIELD</b><br/>19-20, Hillsborough Shopping Centre<br/><b>SHIELDS ROAD</b><br/>184/6 Shields Road<br/><b>WASHINGTON NEW TOWN</b><br/>Galleries<br/><b>SHOPPING CENTRE</b><br/><b>WAKEFIELD</b><br/>Kirkgate Shopping Centre<br/><b>WALSLEY</b><br/>74 Bradford Street<br/><b>WORCESTER</b><br/>8 St. Nicholas Street<br/><b>WORKSOP</b><br/>7/9 Bridge Place<br/><b>YORK</b><br/>5 Church Street</p> |
|---|---|---|---|--|

\* All prices include VAT.

IT'S POSSIBLE, ONLY AT Tandy  
Better Equipment. Lower Prices. No Middlemen!

Offers subject to availability. Instant credit available in most cases.  
Prices may vary in individual stores.  
Access, Barclaycard and Trustcard welcome.  
Most items also available at Tandy Dealers. Look for this sign in your area.

**TANDY**  
DEALER

# All these advantages...

- Instant all-weather starting
- Smoother running
- Continual peak performance
- Longer battery & plug life
- Improved fuel consumption
- Improved acceleration/top speed
- Extended energy storage

## ..in kit form

SPARKRITE X5 is a high performance, top quality inductive discharge electronic ignition system designed for the electronics D.I.Y. world. It has been tried, tested and proven to be utterly reliable. Assembly only takes 1-2 hours and installation even less due to the patented 'clip on' easy fitting.

The superb technical design of the Sparkrite circuit eliminates problems of the contact breaker. There is no misfire due to contact breaker bounce which is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high R.P.M. Contact breaker burn is eliminated by reducing the current by 95% of the norm.

There is also a unique extended dwell circuit which allows the coil a longer period of time to store its energy before discharging to the plugs. The unit includes built in static timing light systems function light and security changeover switch. Will work all rev counters.

**Fits all 12v negative-earth vehicles with coil/distributor ignition up to 8 cylinders.**

**THE KIT COMPRISES EVERYTHING NEEDED**

Die pressed case. Ready drilled aluminium extruded base and heat sink, coil mounting clips and accessories. All kit components are guaranteed for a period of 2 years from date of purchase. Fully illustrated assembly and installation instructions are included.



Roger Clark the world famous rally driver says "Sparkrite electronic ignition systems are the best you can buy."

# Sparkrite

HIGH PERFORMANCE  
ELECTRONIC IGNITION

Electronics Design Associates, Dept. PE1179, 82 Bath St., Walsall, WS1 3DE

Electronics Design Associates, Dept. PE 10/80  
82 Bath Street, Walsall, WS1 3DE. Phone: (0922) 614791

Name \_\_\_\_\_  
Address \_\_\_\_\_

Phone your order with Access or Barclaycard	I enclose cheque/PO's for
inc. V.A.T. and P.P.	QUANTITY REQ'D.
<b>X5KIT £16.95</b>	£ _____
ACCESS OR BARCLAY CARD No. _____	Cheque No. _____
	Send SAE if brochure only required



# MUSICAL MICRO 24 TUNE DOOR BELL



## BUILD THE WORLD FAMOUS CHROMA-CHIME

Give your friends a warm welcome. Yes, think how delighted and amazed they will be to hear the musical Chroma-Chime play when they press your button!

The Chroma-Chime uses a microcomputer to play 24 well-known tunes. The kit is simplicity itself for ease of construction. Absolutely everything needed is supplied, including:

- ★ Resistors, Capacitors, Diodes, Transistors, I.C. Socket and all hardware
- ★ Texas Instruments TMS 1000 microcomputer
- ★ Comprehensive kit manual with full circuit details
- ★ Ready drilled and legended PCB included

**ONLY  
£11.95  
+ 75p p&p  
UK ONLY**

Plays 24 well-known tunes including:

Star Spangled Banner, William Tell Overture, Greensleeves, Rule Britannia, Colonel Bogey, Oh come all ye faithful, plus many other popular tunes.

- ★ No previous microcomputer experience necessary
- ★ All programming retained is on chip ROM
- ★ Fully guaranteed
- ★ Ideal present any time

### TMS 1000N



MP0027A Micro-computer chip available separately if required. Full 24 tune spec device fully guaranteed.

This unique chip can be used not only for electronic door chimes but for other projects requiring musical output.

Car Horns Musical Boxes Alarms  
Amusement Machines Public Address etc  
New low price only  
**£4.95** p&p

ALL CHROMATRONICS PRODUCTS SUPPLIED WITH MONEY BACK GUARANTEE  
PLEASE ALLOW 7-21 DAYS FOR DELIVERY  
CHROMATRONICS, RIVER WAY, HARLOW, ESSEX.

Please send me:  
TO: CHROMATRONICS, RIVER WAY, HARLOW, ESSEX.  
Telephone (0279) 418611  
NAME \_\_\_\_\_ PE/10/80  
ADDRESS \_\_\_\_\_

I enclose cheque/PO value £ \_\_\_\_\_  
or debit my ACCESS/BARCLAYCARD account no. \_\_\_\_\_  
\_\_\_\_\_

Signature \_\_\_\_\_  
**CHROMATRONICS**

# PRIME COMPONENTS LOW PRICES

All our micro chips are at micro prices. Don't be fooled by low prices. We do not offer for sale sub-spec or rebranded devices. All our parts are guaranteed new, first quality, factory prime, full spec devices. It is also our policy to offer you the best of new devices that become available and these are featured regularly. Prices are exclusive of p&p and VAT - please refer to "Ordering Information" before ordering. Official orders from Schools, Colleges, Universities and Gov. Authorities accepted.

DTL	
930	55p
936	65p
937	55p
944	65p
946	55p
947	55p
962	55p
9099	90p

7400	
7400	11p
7401	12p
7402	12p
7403	13p
7404	17p
7409	18p
7410	16p
7412	18p
7413	18p
7420	16p
7430	18p
7432	25p
7440	16p
7442	68p
7448	75p
7473	32p
7474	32p
7475	40p
7476	40p
7477	35p
7482	50p
7493	50p
7496	45p
74121	35p
74123	45p
74154	90p
74157	55p
74122	45p
74125	50p
74195	100p
74196	100p
74197	100p
74290	120p
74365	90p
74366	90p

74LS	
74LS00	18p
74LS01	12p
74LS04	11p
74LS08	20p
74LS10	19p
74LS11	30p
74LS12	30p
74LS14	60p
74LS15	39p
74LS20	19p
74LS30	19p
74LS32	25p
74LS40	28p
74LS42	56p
74LS47	79p
74LS48	85p
74LS49	85p
74LS73	30p
74LS74	30p
74LS75	35p
74LS86	39p
74LS90	40p
74LS107	40p
74LS123	69p
74LS125	50p
74LS132	69p
74LS138	69p
74LS151	75p
74LS153	75p
74LS155	65p
74LS161	79p
74LS163	90p
74LS164	90p
74LS168	190p
74LS174	99p
74LS175	99p
74LS196	87p
74LS221	117p
74LS244	175p
74LS245	325p
74LS251	120p
74LS257	110p
74LS290	95p
74LS293	120p
74LS366	57p
74LS374	170p
74LS375	140p
74LS377	188p
74LS393	135p
74LS490	140p
74LS870	260p

CMOS	
4001	19p
4002	19p
4006	75p
4007	19p
4008	80p
4009	35p
4010	45p
4011	24p
4012	24p
4013	38p
4014	70p
4015	75p
4016	35p
4017	80p
4018	75p
4019	42p
4020	88p
4021	100p
4022	88p
4023	22p
4024	20p
4025	13p
4026	13p
4027	45p

MEMORIES	
2114	300 NS 275p
4116	200 NS 30p
4116	150 NS 395p
4315	(4kx1) 35p
	RAM 450 NS 995p
6514	(1k x 4) CMOS
	RAM 450 NS 795p

EPROMS	
1702A	450p
2708	450 NS 425p
2716	5V 450 NS 850p
2532	32k 450 NS
	2995p

UARTS	
AY-5-1013A	325p
AY-3-1015D	398p
IM6402 IPL	425p

CHARACTER GENERATOR	
RO-3-2513 UC	450p

KEYBOARD ENCODER	
AY-5-2376	795p

FLOPPY DISK CONTROLLERS	
FD1771 B-01	215p
S/D Inverted Bus	2995p
FD1791 B-01	28p
D/D Inverted Bus	4995p
FD1792 B-01	20p
S/D Inverted Bus	3495p

BIPOLAR PROMS	
93448	512x8 40 NS
93453	1kx4 40 NS
93451	1kx8 45 NS
93511	2kx8 50 NS

SUPPORT DEVICES	
6520	495p
6522	795p
6532	895p
6531	1095p
6810	375p
6821	425p
6850	425p
6862	425p
8212	1125p
8214	450p
8224	395p
8228	395p
8251	495p
8252	495p
8255	495p
8257	1050p
8259	1325p
7979	79p
Z80 P10	595p
Z80 P11	595p
Z80 P10	695p
Z80 CTC	695p
Z80 DMA	1995p
Z80 DMA	2495p
Z80 S10/0	2995p
Z80 S10/1	2995p
Z80 S10/1	3495p
Z80 S10/2	2995p
Z80 S10/2	3495p

INTERFACE LINEAR	
MC1488	90p
MC1489	90p
DM8123	125p
75150	125p
75154	125p
75192	195p
75322	250p
75324	325p
75325	325p
75361	325p
75365	295p
75451	50p
5491/2	75p
8126	175p
8128	175p
8195	175p
8197	175p

DISPLAYS	
FND500	80p
FND510	80p
FND567	125p
DL704	85p
DL707	85p
MV57164	225p

ISOLATORS	
ILD74	120p
ILQ74	325p
MCT6	90p
TLL111	75p

LOW PROFILE SOCKETS BY TEXAS	
8 pin	7p 18p 15p 24p 22p
14 pin	9p 20p 18p 28p 25p
16 pin	10p 22p 22p 40p 28p

CPU'S	
6802	795p
6804	795p
6805	795p
6800	695p
6802	995p
8080A	525p
8085A	1095p
Z80	795p
Z80A	995p
Z8001	12500p
Z8002	9500p
WD9000B	19900p

VOLTAGE REGULATORS	
7805/7812	55p
7905/7912	65p
78H05CC	575p
78HGKC	625p

BIPOLAR PROMS	
93448	512x8 40 NS
93453	1kx4 40 NS
93451	1kx8 45 NS
93511	2kx8 50 NS

SOFTWARE	
SCL	19.95, 2708 - £14.95, 2716 - £24.95

TUNES SYNTHESIZER	
AY-1350	495p

The AY-1350 is a MOS microcomputer synthesizer of preprogrammed tunes for applications in toys, music boxes and door chimes. The standard device has a set of 25 different popular and classical tunes. In addition there are 3 chimes making a total of 28 tunes.

- FEATURES**
- Minimal external components.
  - Automatic switch-off signal at end of tune for power saving.
  - Envelope control to give organ or piano quality.
  - Sequential tune mode.
  - 4 door capability when used as door chime.
  - Operation with tunes in external PROM if required (2708).
  - Single supply (+5V) operation.
  - Tunes include: STAR WARS, BEETHOVEN'S 9TH AND 5TH, JINGLE BELLS, YANKEE DOODLE, STAR SPANGLED BANNER, CLEMENTINE, GOD SAVE THE QUEEN, O SOLE MIO, WESTMINSTER CHIMES, and DESCENDING OCTAVE CHIME plus many more! with detailed specs and instructions.

SE 01 Sound Effects Kit	
SE 01	195p

The SE-01 is a complete kit that contains all the parts to build a programmable effects generator. Designed around the new Texas Instruments SN 76477 Sound Chip, the board provides banks of MINI DIP switches and pots to program the various combinations of the SLP Oscillator, VCO, Noise, One Shot, and Envelope Controls. A Quad Op Amp IC is used to implement an Adjustable Pulse Generator, Level Comparator and Multiplex Oscillator for even more versatility. The 31" x 31" PCB board features a prototype area to allow for your added circuitry. Easily programmed to duplicate Explosion, Phaser, Guns, Steam Trains, or almost any infinite number of other sounds. The unit has a multiple of applications. The low price includes all arts, assembly manual, programming charts, and detailed 76477 chip specifications. It runs on a 9V battery (not included). On board 100mV amp will drive a small speaker directly, or the unit can be connected to your stereo with incredible results! (Speaker not included).

COMPLETE KIT ONLY £14.99	
P&P 6p + VAT	

UNIVERSAL SCR	
C106D	400V/5A Sale 30p

AY-3-8910	
AY-3-8910	795p

## THE NEW GI COMPUTER SOUND CHIP

The amazing AY-3-8910 is a fantastically powerful sound and music generator, perfect for use with any 8-bit micro processor. Contains 3 tone channels, noise generator, 3 channels of amplitude controls, 16-bit envelope period control, 2 parallel I/O, 3D/A converters plus much more. All in 40 pin DIP. Super easy to interface to the S-100 or other Busses. ONLY £8.50 + VAT, including FREE reprint of BYTE '79 article! Also, add £2.25 for 60-page data manual.

"Perhaps the next famous composer will not direct a 150-piece orchestra but, rather, a trio of microcomputers controlling a bank of AY-3-8910s." - BYTE July '79.

**NEW**

# SPECIAL OFFER!

**4K CMOS RAM (1K x 4) 450 NS  
ONLY £6.95 (8 for £45).**

The TC 5514P from Toshiba, CMOS equivalent of the 21144

- Low Power Dissipation 100W/BIT (TYP.) 3.0V (STAND BY) 100W/BIT (TYP.) 5.0V (OPERATING)
- Data Retention Voltage 2V to 5.5V
- Single 5V Power Supply
- 18 PIN Plastic Package
- Full Static Operation
- Three State Output
- Input/Output TTI Compatible
- Fast Access Time 450NS.

Toshiba's TC5514P (industry type 6514) is a full static read write memory organised as 1024 words by 4 bits

## 74C

74C20	30p
74C76	60p
74C85	145p
74C97	125p
74C98	125p
74C107	100p
74C160	110p
74C181	145p
74C182	145p
74C163	145p
74C192	175p
74C193	175p
74C194	175p
74C195	175p
74C903	45p

## STEREO!

### \$100 SOUND COMPUTER BOARD!

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY-3-8910 NMOS Computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE etc.

#### KIT FEATURES

- Two GI sound computer IC's (AY-3-8910)
- Four parallel I/O ports on Board.
- Uses on Board audio Amps or your STEREO.
- On Board proto typing area.
- All sockets, parts and hardware are included.
- PC Board is soldermasked, silk screened with gold contacts.
- Easy, quick and fun to build, with full instructions.
- Uses Programmed I/O for maximum system flexibility.
- Both BASIC and ASSEMBLY language programming examples are included.

**COMPLETE KIT . . . Only £59.96** includes 60 page data manual.  
**BARE BOARD . . . Only £25.00** includes 60 page data manual.  
AY-3-8910 chip special price with purchase of BARE BOARD (2 chips) £15.

#### SOFTWARE

SCL is now available! Our Sound Command language makes writing Sound Effects programs a SNAP! SCL is available on all includes routines for Register-Examine-Modify, Memory-Examine-Modify and Play-Memory. SCL is scalable on CP/M compatible diskette or 2708/2716. Diskette - £19.95, 2708 - £14.95, 2716 - £24.95. Diskette includes the source. EPROM'S are ORG at E000H.

## BOOKS

Please order books by reference no. and title, and add 50p post & packing for each book ordered.

21168	Active Filter Cookbook	£10.95
21440	Aviation Electronics 3rd Ed.	£6.78
21558	Audio IC Op Amp Applications 2nd Ed.	£5.98
21524	The Cheap Video Cookbook	£4.50
21396	CMOS Cookbook	£7.75
21539	Design of Active Filters with Experiments	£5.95
21537	Design of Op Amp Circuits with Experiments	£5.95
21545	The Design of Phased-Locked Loop Circuits with Experiments	£6.75
21686	Design of VMOs Circuits with Experiments NEW!	£5.95
21618	Electronic Telephone Projects	£4.95
21127	How to Read Schematic Diagrams 3rd Ed.	£4.25
21613	How to Use Integrated Circuits Logic Elements 3rd Ed.	£4.50
21527	IC Converter Cookbook	£10.50
21695	IC OpAmp Cookbook 2nd Ed.	£11.25
21416	IC Timer Cookbook	£8.50
21801	Instrumentation: Transducers and Applications	£8.95
21452	Learn Electronics Through Troubleshooting 2nd Ed.	£5.25
21594	LC Circuits	£4.46
21542	Logic and Memory Experiments Using TTL Integrated Circuits - Book 1	£7.50
21543	Logic and Memory Experiments Using TTL Integrated Circuits - Book 2	£7.50
21668	Linear IC Principles, Experiments and Projects 2nd Ed.	£7.50
21612	Oscilloscope Applications & Experiments	£6.75
21635	99 Practical Electronics Projects 2nd Ed.	£3.75
21599	Practical Low-Cost IC Projects 2nd Ed.	£3.50
21557	Practical RF Communication Data for Engineers and Technicians	£6.75
21482	Regulated Power Supplies 2nd Ed.	£7.50
21419	Security Electronics 2nd Ed.	£4.50
21821	Solar Heating	£5.25
21036	TTL Cookbook	£7.25
21103	Troubleshooting with the Oscilloscope 3rd Ed.	£4.60
21313	TTL Typewriter Cookbook	£7.50
21339	Video Security Systems	£5.25
21521	Video Tape Recorders	£7.50

3 1/2-DIGIT LIQUID CRYSTAL DISPLAY with 'low bat' indicator.	
1188B	£6.45

- High Contrast Ratio
- Wide Viewing Angle
- 0.5-Inch Digit Height
- ULTRA low Power Consumption LCD 106

## LED BAR GRAPH AND ANALOG METER DRIVER

New from National LM3914. Drives 10 LED directly for making bar graphs, audio power meters, analog meters, LED Oscillators, etc. Units can be stacked for more LEDs. A super versatile and truly remarkable IC. Special price.

12 page data	Only £2.25
Matching red bar display MV57164	£2.25
Data	£2.25

**THE NEW ULN-2232A INTEGRATED MOTION DETECTOR**  
The most SOPHISTICATED MOTION DETECTOR available!

- Long Range Operation
- 100mV Audio Output
- Visible or Infra-red Response
- 14-pin Dual In-Line Clear Plastic Package
- Automatic Timed Reset
- 120Hz Rejection
- Two Sound Patterns

Combining TTL and Bipolar circuitry, the ULN-2232A Motion Detector is a complex optoelectronic IC which includes an on-chip photodiode, high-gain logarithmic and linear amps, extensive digital circuitry for sound generation and timing, and high-current output drivers. Add on five small capacitors, a speaker and power source and you turn this state-of-the-art device into a complete Motion Detector sensitive to small changes in light level as a function of time. DETAILED DEVICE DESCRIPTION AND APPLICATIONS INFORMATION INCLUDED WITH EVERY ULN-2232A. ONLY £7.60!!

## MUSIC FOR YOUR EARS

Bulle's Electronic Music Maker TM Kit has a single

## Base 2 MODEL 800MST 80 COLUMN HIGH PERFORMANCE IMPACT PRINTER



ONLY  
£359 + VAT

- suitable for most Micros.

JUST LOOK AT THESE STANDARD FEATURES:-

- \* RS-232, 20mA, IEEE 488 and Centronics I/O
- \* 15 Baud rates to 9,600
- \* 60 lines per minute - Bidirectional
- \* 6 print densities 60, 72, 80, 96, 120 or 132 Chr/line
- \* Self test switch
- \* 96 Chrs. ASC II Standard
- \* Auxilliary User Defined Ch. set
- \* Tractor and fast paper feed/graphics
- \* 2k Buffer
- \* Accepts 8 1/2" max. paper pressure feed and 9 1/2" max. paper tractor feed.

## Compukit UK101 DISC DRIVES

with up to 32k RAM expansion



free games disc

\* 9 Digit extended Basic  
\* Plugs straight into 8k Compukit requires no hardware mods. (5v.5A required for 610)  
610 Expansion (8k) ONLY £159 + VAT  
Disc Drive with DOS ONLY £285 + VAT

EXATRON TRS80

## Stringy Floppy

COMBINES ECONOMY OF CASSETTE WITH SPEED & RELIABILITY OF DISC (TRS80 expansion interface not needed)

16k loads in approx. 24 secs. - Wafers to 75ft (48k approx.)



ONLY  
£149 + VAT  
PSU  
£5.50 +VAT

Coming soon  
Apple & Pet  
version

Stringy Floppy with 10 Wafers (Tapes)  
BUS EX. 2 for 1. Machine Lang. Monitor

## Ohio Superboard II & Challenger IP

- the no fuss start to Micro's.



NEW  
48 X 32  
SCREEN

All 50Hz  
operation

\* Ready Built \* 8k Microsoft in ROM, 6 digit floating point basic plus full features.

- SUPERBOARD II .. . . . £159 + VAT
- SUPERBOARD II (48x32). . . . £199 + VAT
- POWER SUPPLY 5v.3A. . . . £27 + VAT
- CASE .. . . . £27 + VAT
- CHALLENGER 1P .. . . . £209 + VAT
- CHALLENGER 1P (48x32) . . . £249 + VAT (Superboard is used in Challenger)

VERBATIM 5 1/4" Discs £1.85 each (min. 10) + VAT    STATIC RAM 2114 1-12 £3.00 each + VAT 13+ £2.50 each + VAT

# Mighty Micro

Please add V.A.T. at 15%. Carriage extra, will advise at time of order. Official orders welcome.  
61 NEW MARKET SQUARE, BASINGSTOKE, HANTS. RG21 1HWP Tel: 0256 56417

Buy in confidence. If on receipt of your order the goods do not meet with your satisfaction, return within 7 days for full refund. Credit facilities arranged.



TRAIN AT HOME

# Be an ELECTRONIC ENGINEER

Do something PRACTICAL about your future. Firms all over Britain are crying out for qualified people. With the right training, you could take your pick of these jobs.

Now, the British Institute of Engineering Technology will train you in your spare time to be an Electrical Engineer.

You risk nothing! We promise to get you through your chosen course—or, refund your fee!

So, join the thousands who have built a new future through home study Engineering courses.

- Courses in
- C & G Elect. Technicians
  - C & G Elect. Installations
  - Telecomms. Technicians Exams
  - Television Servicing
  - Radio Maint. & Repairs (BIET)
  - Pract. Radio & Electronics
- Plus over 60 other home study courses.

POST COUPON FOR FREE 44 PAGE GUIDE

## BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

Aldermaston Court, Dept TPE07, Reading RG7 4PF.

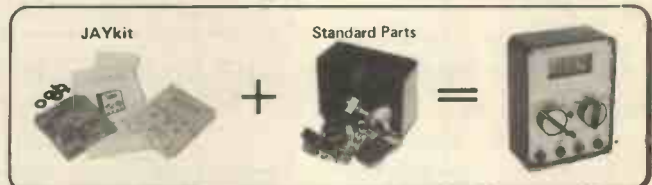
NAME (Block capitals please) \_\_\_\_\_

ADDRESS \_\_\_\_\_

POSTCODE \_\_\_\_\_

Other Subjects \_\_\_\_\_ AGE \_\_\_\_\_

Accredited by CACC Member of ABCC



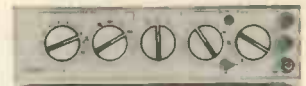
DM-2



DIGITAL MULTIMETER

- \* DC Volts . . . . . 1mV to 1000V
- \* AC Volts . . . . . 1V to 500V
- \* DC Current . . . . . 0.1mA to 0.2A
- \* Resistance . . . . . 1Ω to 20MΩ
- \* 3 1/2 digit LCD
- \* Auto Low Battery indication
- \* Auto Polarity & Zero
- \* 1% accuracy (DC volts)
- \* Designed around Intersil 7106 IC
- \* Total cost around £30 (incl. case)

FG-1a



FUNCTION GENERATOR

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

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

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

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

Name \_\_\_\_\_

Address \_\_\_\_\_

Please send:

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

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

# JAYkits

#### BOOKS BY BABANI

BOOK NO	DESCRIPTION	£ p
BP6	Engineers & Mechanists Ref. Tables	0.50
BP14	2nd Book Transistor Equivs & Subs	1.10
BP24	52 Projects Using IC741 (for equiv)	0.95
BP26	Radio Antenna Book Long Distance Reception & Transmission	1.00
BP27	Giant Chart of Radio Electronic Semiconductor & Logic Symbols	0.80
BP32	Build Metal & Treasure Locators	1.00
BP34	Practical Repair & Renovation of Colour TVs	1.25
BP35	Handbook of IC Audio Pre-amplifier	1.25
BP36	50 Ccts use Germ/Sil/Zener Diodes	0.75
BP37	50 Projects using Relays /SCRs/Triacs	1.25
BP39	50 Field Effect Trans Projects	1.25
BP40	Digital IC Equivs & Pin Connection	2.50
BP41	Linear IC Equivs & Pin Connection	2.75
BP43	How to make Walkie Talkies	1.80
BP44	ICCS55 Projects (Revised & Enlarged Edition)	1.75
BP45	Projects on Opto-electronics	1.25
BP46	Radio Circuits using ICs	1.35
BP47	Mobile Discotheque Handbook	1.35
BP48	Electronics Projects for Beginners	1.35
BP49	Popular Electronic Projects	1.45
BP50	K LM3900 Projects	1.35
BP51	Electronic Music & Creative Tape Recording	1.25
BP52	Long Distance Television Reception (TV DX) For the Enthusiast	1.45
BP53	Practical Electronic Calculations & Formulae	2.25
BP55	Radio Stations Guide	1.45
BP56	Electronic Security Devices	1.45
BP57	How to Build Your Own Solid State Oscilloscope	1.50
BP58	50 Circuits using 7400 Series ICs	1.35
BP59	Second Book of CMOS IC Projects	1.50
BP60	Practical Construction of Pre-amps/Tone Controls/Filters & Atn	1.45
BP61	Beginners Guide to Digital Techniques	0.95
BP62	Elements of Electronics — Book I	2.25
BP63	Elements of Electronics — Book II	2.25
BP64	Elements of Electronics — Book III	2.25
BP65	Single IC Projects	1.50
BP66	Beginners Guide to Microprocessors & Computing	1.75
BP67	Counter driver & numeral display projects	1.75
BP68	Choosing & Using your Hi-Fi	1.85
BP69	Electronic Games	1.75
BP70	Transistor Radio Fault-Finding Chart	0.50
BP160	Col Design & Construction Manual	0.75
BP202	Handbook of Integrated Circuits Equivs & Substitutes	1.00
BP211	First Book of Diode Characteristics & Equivalents & Substitutes	1.25
BP213	Electronic Circuits for Model Railways	1.00
BP215	Shortwave Circuits & Gear for Experimenters & Radio Hams	0.85
BP221	28 Tested Transistor Projects	1.25
BP224	50 CMOS IC Projects	0.95
BP226	Build Advanced Short wave receivers	1.20
BP227	Beginners Guide to Building Electronic Projects	1.25
RCC	Resistor Colour Code	0.20

#### BRACKETS

Right-angle mounting brackets. Ideal for mounting, PCB, panels et cetera into boxes and cases.

**18SWG** — Mild steel — short face has slotted hole 6.5cm x 3.7cm long  
 face has 3.7cm diam. hole

**O/NO.1726** Height 15cm, length 15cm, width 10cm £0.06

**O/NO.1727** Height 25cm, length 15cm, width 10cm £0.07

#### SWITCHES

Description	No.	Price
DPDT miniature slide	1973	£0.16
DPDT standard slide	1974	£0.17
Toggle switch SPST 1 1/2 amp 250V ac	1975	£0.38
Toggle switch DPDT 1 amp 250V ac	1976	£0.48
Rotary on/off mains switch	1977	£0.58
Push switch — Push to make	1978	£0.16
Push switch — Push to break	1979	£0.21

Rocker Switch	Colour	No.	Price
A range of rocker	RED	1980	£0.35
switches SPST — moulded	BLACK	1981	£0.35
in high insulation	WHITE	1982	£0.35
material available in a	BLUE	1983	£0.35
choice of colours ideal	YELLOW	1984	£0.35
for small apparatus	LUMINOUS	1985	£0.35

Description	No.	Price
Miniature SPST toggle 2 amp 250V ac	1958	£0.81
Miniature SPST toggle 2 amp 250V ac	1959	£0.86
Miniature DPDT toggle 2 amp 250V ac	1960	£0.92
Miniature DPDT toggle centre off 2 amp 250V ac	1961	£1.09
Push-button SPST 2 amp 250V ac	1962	£1.04
Push-button SPST 2 amp 250V ac	1963	£1.09
Push-button DPDT 2 amp 250V ac	1964	£1.38

**MIDGET WAFER SWITCHES**  
 Single bank wafer type — suitable for switching at 250V ac 100mA or 150V dc in non-inductive loads. Make-before-break contacts. These switches have a spindle 0.25 in dia and 30 indexing.

Description	No.	Price
1 pole 12 way	1965	£0.55
2 pole 6 way	1966	£0.55
3 pole 4 way	1967	£0.55
4 pole 3 way	1968	£0.55

Micro Switches	No.	Price
Plastic button gives simple 1 pole change over action Rating 10 amp 250V ac	1970	£0.29

#### ANTEX IRONS

No.	Description	Price
1943	15 watt iron element ceramic fitted with 3/32" bit	£8.12
1947	Replacement element for 1943 iron	£2.33
1944	Iron coated bit 3/32" for 1943 iron	£0.58
1945	Iron coated bit 1/4" for 1943 iron	£0.58
1946	Iron coated bit 3/16" for 1943 iron	£0.58
1948	General purpose 18 watt iron fitted with iron coated bit	£5.12
1952	Replacement element for 1948 iron	£2.22
1949	Iron coated bit 3/32" for 1948 iron	£0.58
1958	Iron coated bit 1/4" for 1948 iron	£0.58
1951	Iron coated bit 3/16" for 1948 iron	£0.58
1931	Highly popular x 26.25 watt quality iron ceramic shafts to provide near perfect insulation breakdown voltage of 1500 volts AC and a leakage current of only 3-5uA and another shaft of stainless steel to ensure strength	£5.12
1935	Replacement element for 1931 iron	£2.00
1932	Iron coated bit 1/4" for 1931 iron	£0.58
1933	Iron coated bit 3/16" for 1931 iron	£0.58
1934	Iron coated bit 3/32" for 1931 iron	£0.58
1953	SK1 kit contains 15 watt iron with a 3/16" bit plus two spare solder, heat-sink and a booklet 'How to solder', in presentation display box	£7.28

#### VEROBOARD

No.	Description	Price
2201	2.5" x 5" .1 Copper	£0.71
2201	2.5" x 3.75" .1 Copper	£0.61
2203	2.5" x 17" .1 Copper	£2.14
2205	3.75" x 3.75" .1 Copper	£0.71
2206	3.75" x 17" .1 Copper	£2.76
2207	4.75" x 17.9" .1 Copper	£3.51
2208	2.5" x 1" .58 plate	£0.85
2204	3.75" x 5" .1 Copper	£0.79
2210	2.5" x 5" .15 Copper	£0.64
2211	2.5" x 2.5" .15 Copper	£0.63
2212	3.75" x 17" .15 Copper	£2.90
2213	3.75" x 5" .15 Copper	£0.98
2217	3.75" x 17.9" .1 Plain	£1.79
2218	3.75" x 2.9" .1 Plain	£0.44
2219	5" x 3.75" .1 Plain	£0.58
2220	5" x 5" .15 Plain	£0.37
2225	5" x 3.75" .15 Plain	£0.56

#### BIB HI-FI ACCESSORIES

No.	Description	Price
806	J Compact tape head cleaning kit	£1.22
810	23 Tape Editing kit	£2.65
811	24 Cassette Tape editing and joining kit	£2.76
813	79A Salvage cassette	£0.51
814	31 Record Head cleaning tape	£0.71
817	36A Sargol & Stylus cleaning kit	£0.46
818	41 Hi-Fi Cartridge tape head cleaner	£1.24
819	42 Groove Kleen auto metal record cleaner	£2.65
826	52A Cassette storage tray (holds 10)	£0.92
827	53 Hi-Fi stereo test cassette	£3.17
829	60 Chrome finish Groove Kleen (plastic)	£2.12
834	69 Anti-static Hi-Fi cleaning liquid	£0.35
838	78 Cassette hand tape winder	£1.50

#### WIRE CONNECTORS

Entirely new range of connectors for Discrete wire. Uniquely designed Wirenet is soldered to the P.C. Board. A pre-stripped wire is inserted into the connector and easily locked by pressing the housing down. The wire is alternatively removed by lifting the housing. Tin alloy plated contacts ensure good gold performance.

Housing consists of Thermo plastic polyster.

1728	Single connector in red/black or white	£0.12 inc VAT
1729	Three-way connector black ONLY	£0.23 inc VAT
1730	Four-way connector black ONLY	£0.28 inc VAT

#### FUSE HOLDERS AND FUSES

Description	No.	Price
20mm x 5mm chassis mounting	506	£0.18
1 1/4in x 1/4in chassis mounting	507	£0.14
1 1/4in car inline type	508	£0.18
Panel mounting 20mm	509	£0.23
Panel mounting 1 1/4in	510	£0.37

QUICK BLOW 20mm					
Type	No.	Type	No.	Type	No.
150mA	611	7p	615	6p	619
250mA	612	8p	1 5A	616	7p
550mA	613	8p	2A	617	6p
800mA	614	8p	2 5A	618	7p

ANTI-SURGE 20mm					
Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2 5A	628
250mA	623	2A	626	3 15A	629
500mA	624	1 6A	627	5A	630

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

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

#### NUTS AND BOLTS

BA BOLTS — packs of BA threaded cadmium plated screws slotted cheese head. Supplied in multiples of 50					
Type	No.	Type	No.	Type	No.
1in OBA	839	1 1/2in 4BA	846	2in 4BA	853
1 1/2in OBA	840	2in 4BA	847	2 1/2in 4BA	854
1in 2BA	842	1 1/2in 6BA	848	2in 6BA	855
1 1/2in 2BA	843	2in 6BA	849	2 1/2in 6BA	856
1in 2BA	844	2in 6BA	850	2 1/2in 6BA	851

BA NUTS — packs of cadmium plated full nuts in multiples of 50					
Type	No.	Type	No.	Type	No.
OBA	855	4BA	857	6BA	859
2BA	856	6BA	858	8BA	860

RA WASHERS — flat cadmium plated plain stamped washers supplied in multiples of 50					
Type	No.	Type	No.	Type	No.
OBA	861	4BA	863	6BA	865
2BA	862	6BA	864	8BA	866

SOLDER TAGS — Hot tinned supplied in multiples of 50					
Type	No.	Type	No.	Type	No.
OBA	851	4BA	853	6BA	855
2BA	852	6BA	854	8BA	856

#### AUDIO LEADS

No.	Type	Price
107	FM indoor Ribbon Aerial	£0.69
113	3 5mm Jack plug to 3 5mm Jack plug Length 1 5m	£0.86
114	5 pin DIN plug to 3 5mm Jack connected to pins 3 & 5 Length 1 5m	£0.98
115	5 pin DIN plug to 3 5mm Jack connected to pins 1 & 4 Length 1 5m	£0.98
116	Car aerial extension Screened insulated lead Fitted plug and socket	£1.44
117	AC mains connecting lead for cassette recorders and radios 2 metres	£0.78
118	5 pin DIN phono plug to stereo headphone Jack socket	£1.21
119	2+2 pin DIN plugs to stereo Jack socket with attenuation network for stereo headphones Length 0 2m	£1.04
120	Car stereo connector Variable geometry plug to fit most car cassettes 8-track cartridge and combination units Supplied with inlined fuse power lead and instructions	£0.69
123	6m Coded Guitar Lead Mono Jack plug to Mono Jack plug Black	£1.73
124	3 pin DIN plug to 3 pin DIN plug Length 1 5m	£0.86
125	5 pin DIN plug to 5 pin DIN plug Length 1 5m	£0.86
126	5 pin DIN plug to Tinned open end Length 1 5m	£0.86
127	5 pin DIN plug to 4 Phono Plugs All colour coded Length 1 5m	£1.50
128	5 pin DIN plug to 5 pin DIN socket Length 1 5m	£0.92
129	5 pin DIN plug to 5 pin DIN plug mirror image Length 1 5m	£1.21
130	2 pin DIN plug to 2 pin DIN inline socket Length 5m	£0.78
131	5 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5 Length 1 5m	£0.95
132	2 pin DIN plug to 2 pin DIN socket Length 10m	£1.13
133	5 pin DIN plug to 2 Phono plugs Connected pins 3 & 5 Length 1 5m	£0.86
134	5 pin DIN plug to 2 Phono sockets Connected pins 3 & 5 Length 23cm	£0.78
135	5 pin DIN socket to 2 Phono plugs Connected pins 3 & 5 Length 23cm	£0.78
136	Coded stereo headphone extension lead Black Length 6m	£2.01
178	AC mains lead for calculators/etc	£0.52

#### TRANSFORMERS

MINIATURE MAINS Primary 240V				Price
No.	Type	Secondary	Rating	
2021	MT280	0.6V 100mA	1/2 amp	£1.04
2022	MT280	9V-0.9V 75mA	2 amp	£1.04
2023	MT280	12V-0.12V 100mA	2 amp	£1.29

MINIATURE MAINS Primary 240V with two independent secondary windings				Price
No.	Type	Secondary	Rating	
2024	MT280	0.6V 0.6V RMS	1/2 amp	£1.84
2025	MT150	0.12V 0.12V RMS	1/2 amp	£1.84

1 AMP MAINS Primary 240V				Price
No.	Type	Secondary	Rating	
2026	MT280	6V-0.6V 1 amp	1 amp	£2.88 P & P 45p
2027	MT280	9V-0.9V 1 amp	2 amp	£2.30 P & P 45p
2028	MT280	12V-0.12V 1 amp	2 amp	£2.99 P & P 55p
2029	MT280	15V-0.15V 1 amp	2 amp	£3.16 P & P 65p
2030	MT280	30V-0.30V 1 amp	2 amp	£3.97 P & P 85p

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

No.	Rating	Price	P & P
2031	1/2 amp	£3.91	86p
2032	1 amp	£5.06	86p
2033	2 amp	£6.27	111p

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

£1.50 P & P 86p

#### CASES AND BOXES

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

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

**ALUMINIUM BOXES.** Made from bright anodized construction each box complete with half-inch deep lid and screws

No.	Length	Width	Height	Price
159	3 1/2in	2 1/4in	1 1/2in	£

**BAKER 50 WATT AMPLIFIER** £69 Post £2



Superior quality ideal for Halls/PA systems. Disco's and Groups. Two inputs with Mixer Volume Controls. Master Bass, Treble and Gain Controls. 50 watts RMS. Three loudspeaker outlets 4, 8, 16 ohm AC 240V (120V available). White wording on black cabinet.

**BAKER 150 Watt AMPLIFIER 4 Inputs** £89  
**DRILL SPEED CONTROLLER/LIGHT DIMMER KIT.** Easy to build kit. Controls up to 480 watts AC mains. Post 50p **£3.25**

**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 ganged to make multi-way stereo mixers. **£2.95**

**R.C.S. SOUND TO LIGHT DISPLAY MK 2**

Complete kit of parts with R.C.S. printed circuit. Three channels. Up to 1,000 watts each. Will operate from 200MV to 100 watts signal source. Suitable for home Hi-Fi and all Disco Amplifiers. Cabinet extra £4.50. Post 50p **£18**

**200 Watt Rear Reflecting White Light Bulbs.** Ideal for Disco Lights. Edison Screw 75p each or 6 for £4. or 12 for £7.50.

250-0-250V 70mA, 6-5V, 2A	£3.45
250-0-250V 80mA, 6-3V 3-5A, 6-3V 1A	£4.60
300-0-300V 200mA, 6-3V 3A + 6-3V 2A + 6-3V 2A	£12.00
300-0-300V 120mA, 2x6-1.5V A.C.T. 5V 2A	£10.00
220V 45mA, 6-3V 2A	£2.50

**GENERAL PURPOSE LOW VOLTAGE.**

Tapped outputs available

2 amp 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 25 and 30V	£6.00
1 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£6.00
2 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£9.50
3 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£12.50
5 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£16.00
6V, 500mA	£2.00
6-0-6V, 100mA	£1.50
12V, 100mA	£1.30
12V, 20V, 40V, 60V, 1 amp	£4.00
12V, 750mA	£1.75
10V, 10V 2 amp	£3.00
10V, 10V 40V, 2 amp	£3.50
30V, 5 amp and 17V-0-17V	£3.25
2 amp, 20V, 1 amp	£3.00
0-5, 8, 10, 16V, 3 amp	£2.50
20-0-20V, 1 amp	£3.50
9V, 3 amp	£3.50
30V-0-30V, 2 amp	£8.00
15-0-15V 2 amp	£3.75
2 of 18V, 6 amp each	£11.00
30V, 2 amp	£3.50
12-0-12V, 2 amp	£3.50
30V, 1 amp	£3.30
9V, 3 amp	£1.50

**AUTO TRANSFORMERS 115V to 240V 500W** £10.00

**CHARGER TRANSFORMERS - CHARGER RECTIFIERS**

6-12V-3a	£4.00	6-12V-2a	£1.00
6-12V-4a	£6.50	6-12V-4a	£2.00

**R.C.S. LOUDSPEAKER BARGAINS**

3 ohm 6x4in. £1.50. 7x4in. £1.50. 8x5in. £2.50. 6in. £2.20. 8in. £2.60. 10in. £3.50. 12in. £4.50.

8 ohm 2in. £1.50. 3in. £1.50. 5in. £2.20. 8in. £2.60. 10in. £3.50. 12in. £4.50. 16 ohm 6 x 4in. £1.50. 7 x 4in. £1.50. 5in. £1.50. 8in. £3.10m. £3.50. 12in. £4.50. 10 x 6in. £3.50.

**R.C.S. LOW VOLTAGE STABILISED POWER PACK KITS 90-100 mA** Post 50p **£2.95**

All parts and instructions with Zener diode 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.

**PP BATTERY ELIMINATOR. BRITISH MADE**

**THE "INSTANT" BULK TAPE ERASER**

Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/249V. Leaflet S.A.E. **£7.50** Post 50p

**HEAD DEMAGNETISER PROBE £5.00**

**A.C. ELECTRIC MOTORS POST 50p.**

2 Pole, 240V. -2 Amp. Spindle - 1.43 x 0-212in. £1.75. 2 pole, 240V. -1.5 Amp. Double spindle - 1.75 x 0-16in. Each £1.50. 2 Pole, 120V. -5 Amp. Spindle - 0-75 x 0-2in. Two in series-240V. 75p each. Brush Motor. From a Food Mixer 240V. - 3 Amp. High Speed and Powerful Spindle - 0-5 x 0-25in. £2.95

**BLANK ALUMINIUM CHASSIS.** 18 s.w.g. 2 1/2in. sides. 6 x 4in. 95p; 8 x 6in. £1.40; 10 x 7in. £1.55; 14 x 9in. £1.90; 16 x 6in. £1.85; 12 x 3in. £1.20; 16 x 10in. £2.20; 12 x 8in. £1.70.

**ALUMINIUM PANELS.** 18 s.w.g. 6 x 4in. 24p; 8 x 6in. 38p; 10 x 7in. 54p; 12 x 5in. 44p; 12 x 8in. 70p; 16 x 6in. 70p; 14 x 9in. 94p; 12 x 12in. £1; 16 x 10in. £1.16.

**ALUMINIUM ANGLE BRACKETS** 6 x 1/2 x 3in. 25p.

**ALUMINIUM BOXES, MANY SIZES IN STOCK**

4 x 2 x 2in. £1.00; 5 x 2 x 1 1/2in. £0.80; 6 x 4 x 2in. £1.30; 8 x 6 x 3in. £2.10; 12 x 5 x 3in. £2.30; 6 x 4 x 3in. £1.60; 10 x 7 x 3in. £2.50.

**HIGH VOLTAGE ELECTROLYTICS**

8/800V	£1.20	50/500V	£1.20	50+50/500V	£1.80
16/500V	£1.75	220/450V	£95p	40+80/500V	£5.00
32/500V	£75p			16+32+32/500V	£2

**DE LUXE BSR HI-FI AUTOCHANGER**

Plays 12in., 10in., or 7in records Auto or Manual. A high quality unit backed by BSR reliability with 12 months guarantee. A.C. 200/250V. Size 13 1/2 x 11 1/2in. Above motor board 3in. Below motor board 2 1/2in. With CERAMIC STEREO CARTRIDGE. Post on All Decks £2.

**BSR Single Player P207 cueing device.** ceramic cartridge. £15

Garrard Single Player 6-200 metal turntable, cueing device, aluminium arm, Stereo cartridge. £22

**BSR, P182 Snake arm, flared Aluminium Turntable ADC QLM30 Magnetic Cartridge.** £30

**B.S.R. Auto Changer, 11in. Turntable. Budget price, £17-50**

Stereo ceramic, reliable unit. 3-speed. RSC Disco Deck 3 speed stereo **£9-95 or £18 pair**

Rapid Mail Order 50p minimum. Callers Welcome. Access - Visa. Lists 20p. Closed Wed.

**Radio Components Specialists**  
 337, WHITEHORSE ROAD  
 CROYDON, SURREY, U.K. TEL: 01-684 1665.

**SCS COMPONENTS** Halifax Road, Keighley, West Yorkshire BD21 5HR

All our products are guaranteed high quality components from leading Semiconductor Manufacturers.

<b>CMOS</b>	4065	1.23	<b>LINEAR</b>			<b>POWER</b>			
4000	.19	4056	1.23	CA555CG	.20	2N 2102	.60	2N 4036	.65
4001	.26	4059	4.45	CA741CG	.38	2N 3053	.31	2N 5038	3.01
4002	.22	4060	1.10			2N 3055	.39	2N 5240	1.83
4006	.86	4063	1.05	<b>DIODES</b>		2N 3439	.61	2N 5294	.42
4007	.26	4066	.48	IN4001	.05	2N 3440	.43	2N 6296	.35
4008	.78	4067	3.60	IN4002	.05	2N 3442	.99	2N 5320	.51
4009	.40	4068	.22	IN4003	.06	2N 3553	1.58	2N 6756	.91
4011	.26	4070	.33	IN4004	.06	2N 3773	1.70	2N 5838	1.40
4012	.22	4071	.24	IN4005	.06				
4013	.40	4072	.24	IN4006	.07	<b>Miniature Toggle</b>			
4014	.78	4073	.24	IN4007	.07	E2012 - 3 amp SPDT			.59
4015	.78	4075	.21	IN4148	.04	E2022 - 3 amp DPDT			.74
4016	.40	4076	.93			<b>Slide Switches</b>			
4017	.74	4077	.30	<b>ZENERS</b>		SM1-1 - 1 amp SP on/off			.23
4018	.78	4078	.22	BZY88 3.3V to 30V		SM2-2 - 1 amp DPST			.31
4019	.40	4081	.22	400mW	.07 each	SM2-3 - 1 amp DPOT			.81
4020	.92	4082	.22			<b>LED's</b>			
4021	.98	4085	.75	<b>RESISTORS</b>		MAN3640 - 7.6mm Orange			1.70
4022	.87	4086	.75	5% carbon film resistors. High stability, low noise 1W E24 range of values 1R-1M. .07 for 5 pieces 1 value only.		MAN4640			1.90
4023	.22	4089	1.40			MAN6660 - 14.2mm Orange			2.00
4024	.66	4093	.68	<b>TRANSISTORS</b>		MV50 - 2.3mm Red			.14
4025	.20	4094	1.70	ZTX107	.09	MV52 - 2.3mm Green			.21
4026	1.56	4095	.95	ZTX108	.09	MV53 - 2.3mm Yellow			.20
4027	.40	4096	.95	ZTX109	.09	MV5021 - 4.7mm Red			.15
4028	.72	4097	3.18	ZTX300	.10	MV5054/1 - 5mm Red			.17
4029	1.04	4098	1.05	ZTX310	.10	MV5054/2 - 5mm Red			.10
4030	.45	4099	1.25	ZTX320	.11	MV5054/3 - 5mm Red			.13
4031	2.08	4502	.97	ZTX450	.12	MV50748 - 3mm Red			.44
4032	1.10	4508	2.35	ZTX500	.12	MV52124 - Rectangular Green			.13
4033	1.37	4510	.87	ZTX502	.12	MV53124 - Rectangular Yellow			.44
4034	1.99	4511	.87	ZTX504	.12	MV51724 - Rectangular Red			.44
4035	.92	4512	.85	ZTX750	.20				
4037	.96	4514	2.21	<b>DIL SOCKETS</b>					
4038	1.03	4515	2.21	8P	.09				
4040	.98	4516	.97	14P	.11				
4041	.77	4517	3.55	16P	.13				
4042	.69	4518	.97	18P	.15				
4043	.84	4520	.97	20P	.17				
4044	.84	4527	1.37	22P	.18	Plastic box 7.5mm x 5mm x 1.5mm			£2.00
4045	1.27	4532	1.07	24P	.20	Mixed bag of one dozen assorted heat sinks including DIL flat pack and TO3			£1.00
4046	1.09	4556	5.99	26P	.20				
4047	.82	4585	1.02	28P	.25				
4048	.50	40106	.65	40P	.35				
4049	.40	40160	.74						
4050	.45	40161	.74						
4051	.70	40162	.74						
4052	.70	40163	.74						
4053	.70	40174	.74						
4054	1.05	40194	.93						

Cash/Cheques/P.O.'s with order. P & P add 30p to all orders. Add 15% VAT to total order. All items ex. stock - orders by return post.

**NEW COMPONENTS**

Pack No.		
A10	10 PP3 battery leads.	50p
A30	10 Red or black crocodile clips.	45p
A60	10 Red or black phono plugs.	80p
A61	10 single phono sockets.	70p
A70	10 2.5mm unscrewned jack plugs.	80p
A72	10 3.5mm unscrewned jack plugs.	80p
A73	10 3.5mm chassis sockets.	80p
A74	10 Standard mono jack plugs.	130p
A75	10 Standard switched jack sockets.	170p
A84	10 5 pin 180° DIN plugs.	120p
A85	10 5 pin 180° DIN chassis sockets.	100p
C10	5 Standard toggle switches SPST.	130p
C20	10 Miniature DPOT slide switches.	190p
C30	10 Miniature push to make switches.	130p
C31	10 Miniature push to break switches.	170p
C40	Pair of ultrasonic transducers.	350p
C50	20 Texas 8 pin sockets.	170p
C51	20 Texas 14 pin sockets.	200p
C52	20 Texas 16 pin sockets.	220p
E10	Resistor kit 10 each value 470 to 1M. 1W type.	
Total of 650 resistors. 480p		
1W 5% carbon resistors. 18p per 20.		
Multiples of 20 per value only.		
E33	10 4.7u 63v radial electrolytics.	50p
E34	10 10u 25v radial electrolytics.	50p
E37	10 100u 25v radial electrolytics.	75p
E44	10 1u 35v tantalum capacitors.	100p
E50	10 0.01u Mullard C280 polyester.	50p
E54	10 0.1 Mullard C280 polyester.	50p
F11	10 BC108 transistors.	90p
F15	10 BC184L transistors.	90p
F17	10 BC214L transistors.	90p
F25	10 2N3702 transistors.	80p
F26	10 2N3704 transistors.	80p
F27	10 2N3819 transistors.	190p
F29	10 2N3905 transistors.	90p
F41	4 2N3055 transistors.	200p
F46	5 7805 1A 5V regulators.	300p
H10	20 1N4002 rectifier diodes.	75p
H50	20 OA91 signal diodes.	110p
H60	100 1N4148 signal diodes.	180p
H70	5 C106D 4A 400V thyristors.	200p
H75	5 TIC2480 16A 400V triacs.	520p
J10	20 0.2in red LEDs.	70p
J15	50 0.2in red LEDs.	400p
J20	100 0.2in red LEDs.	750p
J30	20 0.2in green LEDs.	280p
J50	20 0.2in yellow LEDs.	280p
J80	4 FND500 displays.	350p
K10	5 741 operational amps.	8 pin. 90p
K25	5 LM301A operational amps.	8 pin. 140p
K30	1 LM324 operational amplifiers.	50p
K80	5 CA3140 operational amps.	225p
K60	5 NE555 timers.	110p
M10	8 2114LP memories.	2800p
N5	1 Dalo printed circuit board pen.	80p

All prices include VAT. Please add 50p carriage on all orders below £10. Send SAE for our detailed list. Mail order only.

**RAPID ELECTRONICS**  
 Hillcroft House, Station Road, Eynsford, Kent.

**ELECTRONICS/ BUILD & LEARN**

by R. A. Penfold price: **£3.40**

**DIGITAL TECHNIQUES & SYSTEMS**  
 by D. C. Green price: **£5.50**

**ELECTRONIC FAULT DIAGNOSIS**  
 by I. R. Sinclair Price: **£3.50**

**ELECTRONIC DESIGNER'S H/B**  
 by K. Hemingway Price: **£13.50**

**HANDBOOK OF ELECTRONICS CALCULATIONS FOR ENGINEERS & TECHNICIANS**  
 by M. Kaufman Price: **£14.70**

**H/B OF MICROCIRCUIT DESIGN & APPLICATION**  
 by D. F. Stout Price: **£19.20**

**UNDERSTANDING MICROPROCESSORS**  
 by Texas Inc. Price: **£4.00**

**INTRODUCTION TO MICROCOMPUTER PROGRAMMING**  
 by P. C. Sanderson Price: **£4.50**

**THE COMPLETE MICROCOMPUTER SYSTEMS H/B**  
 by E. L. Safford Price: **£8.25**

**TOWERS' INTERNATIONAL TRANSISTOR SELECTOR**  
 by T. D. Towers 1980 Price: **£10.50**

**\*ALL PRICES INCLUDE POSTAGE\***

**THE MODERN BOOK CO.**

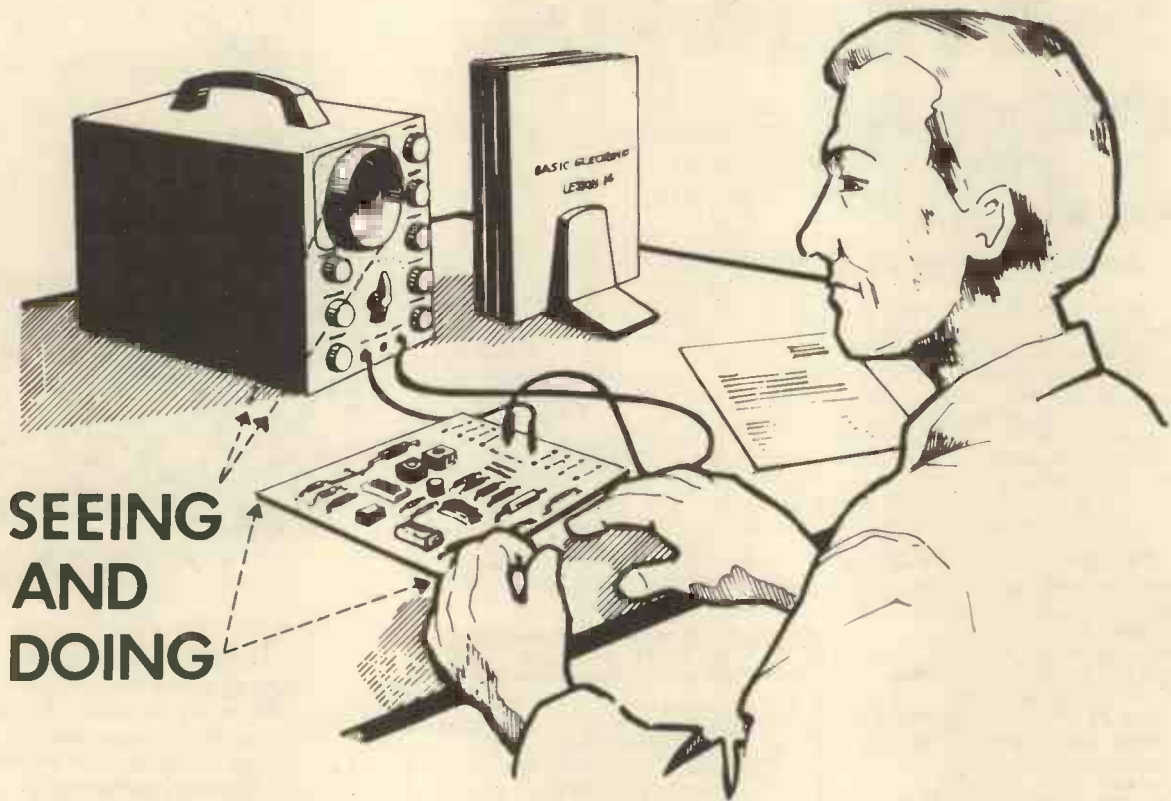
BRITAIN'S LARGEST STOCKIST of British and American Technical Books

**19-21 PRAED STREET LONDON W2 1NP**

Phone 01-402 9176  
 Closed Saturday 1 p.m.



# Master Electronics the new Practical way.



## Conquer the 'Chip' – Easy-Fast-Exciting !

AND MASTER ALL THE NEW TECHNIQUES  
IN MODERN ELECTRONICS.

- Build an Oscilloscope.
- Carry out over 40 full experiments including work on Digital Electronic Circuits.
- Recognition of Electronic Components.
- Understand and draw Circuit Diagrams.
- Experience with handling Solid State Circuits and "Chips".
- Testing and Servicing of Radio, T.V., Hi-Fi and all types of modern computerised equipment.

Colour Brochure – without any obligation. Post to :-

PE/10/812

**BRN**

**BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL**  
4 Cleveland Road, Jersey, Channel Islands.

Name .....

Address .....

.....

.....

BLOCK CAPS PLEASE

# Britain's first com computer kit.

## The Sinclair ZX80.

# £79.95

Price breakdown  
ZX80 and manual: £69.52  
VAT: £10.43  
Post and packing FREE

Please note: many kit makers quote VAT-exclusive prices.

You've seen the reviews... you've heard the excitement... now make the kit!

This is the ZX80. 'Personal Computer World' gave it 5 stars for 'excellent value.' Benchmark tests say it's faster than all previous personal computers. And the response from kit enthusiasts has been tremendous.

To help you appreciate its value, the price is shown above with and without VAT. This is so you can compare the ZX80 with competitive kits that don't appear with inclusive prices.

### 'Excellent value' indeed!

For just £79.95 (including VAT and p&p) you get everything you need to build a personal computer at home... PCB, with IC sockets for all ICs; case; leads for direct connection to a cassette recorder and television (black and white or colour); everything!

Yet the ZX80 really is a complete, powerful, full-facility computer, matching or surpassing other personal computers at several times the price.

The ZX80 is programmed in BASIC, and you can use it to do quite literally anything from playing chess to managing a business.

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

#### Your ZX80 kit contains...

- Printed circuit board, with IC sockets for all ICs.
- Complete components set, including all ICs—all manufactured by selected world-leading suppliers.
- New rugged Sinclair keyboard, touch-sensitive, wipe-clean.
- Ready-moulded case.
- Leads and plugs for connection to domestic TV and cassette recorder. (Programs can be SAVED and LOADED on to a portable cassette recorder.)
- FREE course in BASIC programming and user manual.

#### Optional extras

- Mains adaptor of 600 mA at 9 V DC nominal unregulated (available separately—see coupon).
- Additional memory expansion boards allowing up to 16K bytes RAM. (Extra RAM chips also available—see coupon).

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

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

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

The unique Sinclair BASIC interpreter offers remarkable programming advantages:

- Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability—takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input-to-request a line of text when necessary. Strings do not need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up to 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions. USR causes jump to a user's machine language sub-routine.
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

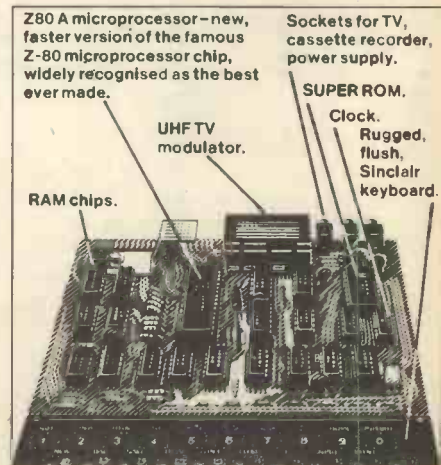
### Fewer chips, compact design, volume production—more power per pound!

The ZX80 owes its remarkable low price to its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer—typically storing 100 lines of BASIC. (Key words occupy only a single byte.)

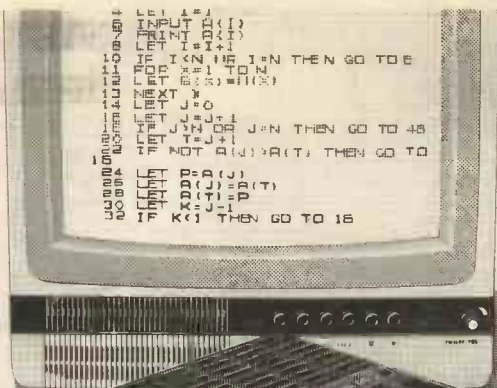
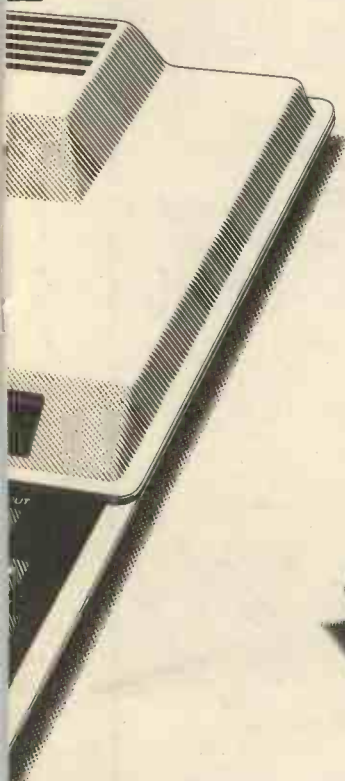
The display shows 32 characters by 24 lines.

And Benchmark tests show that the ZX80 is faster than all other personal computers.

No other personal computer offers this unique combination of high capability and low price.



# plete



## ZX80 software – now available!

See advertisements in Personal Computer World, Electronics Today International, and other journals.

New dedicated software – developed independently of Science of Cambridge – reflects the enormous interest in the ZX80. More software available soon – from leading consultancies and software houses.

### The Sinclair teach-yourself BASIC manual.

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

### The Sinclair ZX80. Kit: £79.95. Assembled: £99.95. Complete!

The ZX80 kit costs a mere £79.95. Can't wait to have a ZX80 up and running? No problem! It's also available, ready assembled and complete with mains adaptor, for only £99.95.

Demand for the ZX80 is very high: use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. We'll acknowledge each order by return, and tell you exactly when your ZX80 will be delivered. If you choose not to wait, you can cancel your order immediately, and your money will be refunded at once. Again, of course, you may return your ZX80 as received within 14 days for a full refund. We want you to be satisfied beyond all doubt – and we have no doubt that you will be.

**sinclair**  
**ZX80**  
Science of Cambridge Ltd  
6 Kings Parade, Cambridge, Cambs., CB2 1SN.  
Tel: 0223 311488.

### ORDER FORM

To: Science of Cambridge Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN. Remember: all prices shown include VAT, postage and packing. No hidden extras. Please send me:

Quantity	Item	Item price £	Total £
	Sinclair ZX80 Personal Computer kit(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	£79.95	
	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual and mains adaptor.	£99.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	8.95	
	Memory Expansion Board(s) (each one takes up to 3K bytes).	12.00	
	RAM Memory chips – standard 1K bytes capacity	16.00	
	Sinclair ZX80 Manual(s) (manual free with every ZX80 kit or ready-made computer).	5.00	

NB. Your Sinclair ZX80 may qualify as a business expense.

**TOTAL** £

I enclose a cheque/postal order payable to Science of Cambridge Ltd for £ \_\_\_\_\_

Please print

Name: Mr/Mrs/Miss \_\_\_\_\_

Address \_\_\_\_\_

PE/10/80

# NEW

## PRACTICAL ELECTRONICS PROJECT 125 WATT POWER AMP KIT

### SPECIFICATIONS

Max. Output power 125 watt RMS  
 Operating voltage (DC) 50-80 Max.  
 Loads 4-16 ohms  
 Frequency response Measured at 100 watts 25Hz-20kHz  
 Sensitivity for 100 watts 400mV @ 47K  
 Typical T.H.D. @ 50 watts 4 ohms load 0.1 %  
 Dimensions 205 x 90 and 190 x 36 mm

The P.E. power amp kit is a module for high power applications—disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, the

output stage uses four 115 watt transistors normally only two would be used, result, a high powered rugged unit. The PC Board is backprinted, etched and ready to drill for ease of construction, and the aluminium chassis is preformed and ready to use, supplied with all parts and circuit diagrams.

**£9.50** plus £1.00 p&p

125 watt power amp kit

### ACCESSORIES

Suitable L.S. coupling electrolytic

**£1.00** plus 20p p&p

Suitable Mains Power Supply Unit

sufficient for one power amp

**£7.50** plus £2.75 p&p

ACCESSORIES available only when purchasing packs.



AS FEATURED IN PRACTICAL ELECTRONICS OCTOBER ISSUE

## DIY STEREO BARGAIN PACKS FEATURING FAMOUS BUILT MULLARD PREAMP MODULES

### MULLARD STEREO PREAMP MODULES AND TWO 12 WATT POWER AMP KITS.



In easy to build form P.C.B.s backprinted, etched and drilled ready to use.

### BUILD A 12 WATTS PER CHANNEL STEREO AMPLIFIER ACCESSORIES AND L.S. KIT EXTRA (not available separately)

**£6.00**

DIY PACK 1 2 x power amp kits LP1182/ preamp module, suitable for ceramic and auxiliary inputs.

**£6.00** plus £1.10 p&p

DIY PACK 2 2 x power amp kits LP1184 preamp module suitable for magnetic ceramic and auxiliary inputs.

**£8.50** plus £1.15 p&p

DIY SPEAKER KIT Two 8" x 5" approx. 4 ohm bass.

**£3.50** plus £1.70 p&p



DIY ACCESSORIES Mains transformer smoothing capacitor rectifier 4 x slider controls, for base, treble and volume.

**£3.00** plus £1.60 p&p

ACCESSORIES: Available only at time of purchase of Bargain Packs

### 12 + 12 WATT AMPLIFIER KIT

NOTE: for use with 4 to 8 ohms speakers.

With up-to-the-minute features. To complete you just supply screws, connecting wire and solder. Features include din input sockets for ceramic cartridge, microphone, tape or tuner. Outputs—tape, speakers and headphones. By the press of a button it transforms into a 24 watt mono disco amplifier with twin deck mixing. The kit incorporates a Mullard LP1183 pre-amp module, plus 2 power amplifier assembly kits and mains power supply. Also featured 4 slider level controls, rotary bass and treble controls and 6 push button switches. Silver finish fascia panel with matching knobs. Easy to assemble teak simulate cabinet and ready made metal work. For further information instructions are available price 50p. Free with kit. Size 9 1/4" x 8 3/4" x 4" approx.

**£13.95**

NOTE: for use with 4 to 8 ohms speakers.

plus £2.55 p&p

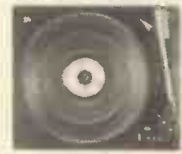
BSR chassis record player deck with manual set down and return, complete with stereo ceramic cartridge. £8.50 plus £2.75 p&p when purchased with amplifier available separately £10.50 plus £2.75 p&p.



TWO WAY SPEAKER KIT. 2 Phillips 8" approx speakers £4.75 per stereo pair plus £1.50 p&p when purchased with amplifier available separately £6.75 plus £1.50 p&p.

ALSO AVAILABLE Stereo magnetic pre-amp conversion kit all components including P.C.B. to convert your ceramic input on the 12 + 12 amp to magnetic. £2.00 when purchased with kit featured above. £4.00 separately inc. p&p.

BSR 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 use.



**£12.25** OUR PRICE plus £2.75 p&p

Size approx 13" x 11"

### PHILLIPS RECORD PLAYER DECK GC037

Size approx 15 1/4" x 12 1/4"



Hi Fi record player deck, 2 speed, damped cueing, auto shut-off, belt drive with floating sub chassis to minimise acoustic feedback. Complete with GP401 stereo magnetic cartridge—LIMITED STOCK. UNBEATABLE OFFER AT

**£27.50** complete plus £2.75 p&p

OFFER! SAVE MONEY by purchasing 12 + 12 amp kit, BSR record deck and speaker kit together for only

**£25.50** p&p £4.50.

### PRACTICAL ELECTRONICS CAR RADIO KIT

(Constructors pack 7)

**£10.50**

plus £1.75 p&p



- \* Easy to build \* 5 push button tuning
- \* Modern styling design \* All new unused components
- \* 6 watt output \* Ready etched & punched P.C.B.
- \* Incorporates suppression circuits \* Now with tape input socket

All the electronic components to build the radio, you supply only the wire and solder as featured in the Practical Electronics March issue. Features: Pre-set tuning with five push button options, black illuminated tuning scale, with matching rotary control knobs, one, combining on/off volume and tone-control, the other for manual tuning, each set on wood simulated fascia. The P.E. Traveler has a 6 watts output, neg ground and incorporates an integrated circuit output stage, a Mullard IF module LP1181 ceramic filter type, pre-aligned and assembled and a Bird pre-aligned push button tuning unit. The radio fits easily in or under dashboards.

Complete with instructions.

#### CONSTRUCTORS PACK 7A

Suitable stainless steel fully retractable locking aerial and speaker (approx. 6" x 4") is available as a kit complete

**£1.95** per pack, p&p £1.00

Pack 7A may only be purchased at the same time as Pack 7.

NOTE: Constructor's pack 7A sold complete with radio kit

**£15.20** including p&p.

FEATURED PROJECT IN PRACTICAL ELECTRONICS.



### 30 + 30 WATT STEREO AMPLIFIER BUILT AND TESTED

Viscount IV unit in teak simulate cabinet silver finished rotary controls and pushbuttons with matching fascia, red mains indicator and stereo jack socket. Functions switch for mic magnetic and crystal pickups, tape and auxiliary. Rear panel features fuse holder, DIN speaker and input socket 30 + 30 watts. RMS 60 + 60 watts peak for use with 4 to 8 ohm speakers. Size 14 1/4" x 10" approx.

READY TO PLAY **£32.90** plus £3.30 p&p



323 EDGWARE ROAD, LONDON W2 21B HIGH STREET, ACTON W3 6NG

ACTON: Mail Order only. No callers ALL PRICES INCLUDE VAT AT 15% All items subject to availability. Price correct at and subject to change without notice.

For further information send for our instruction booklet

NOTE: 20p stamped addressed envelope.

Persons under 16 years not served without parent's authorisation.

### BARGAIN OFFER!!



### ARISTON PICK UP

Ariston pick-up arm manufactured in Japan. Complete with headshell.

**£11.95**

Listed price over £30.00

OUR PRICE plus £2.50 p&p

### 100 WATT MONO DISCO AMPLIFIER

Brushed aluminium fascia and rotary controls. Size approx 14" x 4" x 10". Five vertical slide controls, master volume, tape level, mic level, deck level, PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level controls (PRL) lets YOU hear next disc before fading it in. VU meter monitors output level.

**£76.00**

plus £4.00 p&p

### 50 WATT MONO DISCO AMPLIFIER

Size approx 13 1/4" x 5 1/4" x 6 3/4". 60 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.



**£30.60**

plus £3.20 p&p

## CB—OPEN CHANNEL

AT LAST we have the Government's proposals on CB and we are pleased to see that they propose to allow the use of this facility in the UK. But wait, what are they really giving us? A very short range system for which equipment will be expensive, a system which we believe will be of little use or value to anyone—users or manufacturers.

Some manufacturers have indicated that they consider the use of a 928MHz system would be so small that it would not be worth producing equipment. What use is a range of about 10 miles maximum—considerably less in cities—when the equipment will be very expensive.

We believe the Government is simply paying lip service to public pressure for a system. They may have been misled by the Home Office who have always been against any service and who must realise that, if instigated, these proposals will mean little or no extra work for them or anyone else. Alternatively, they may have misguidedly taken a lead from West Germany. The Government there has recently announced the proposed introduction of a 900MHz service in the

future, but West Germany already has 27MHz CB and the 900MHz service will be an addition to that, which is a different kettle of fish.

The Government is now planning to clamp down on illegal use of 27MHz—there have been a number of convictions and proposed laws to ban the advertising and sale of any 27MHz systems will at least ensure that transceivers are no longer openly available in this country. This is a move with which we approve, anything that can be done to prevent further illegal use of this frequency is sensible, but the Government—having said it is in favour of Open Channel (as they call it)—must now make proposals for a usable alternative. They must provide a system which will meet the needs of the general public, not a system that is designed to silence the voice of the CB associations without giving anything away.

We suggest that they think again, that they seek some more informed, less biased, opinion and that they try to act in the public interest and not just appear to do this.

Of course, some may say that any service is better than none. We do not concur, if 928MHz is introduced it will

be virtually useless to the general public and will prevent any usable service ever being introduced—as indeed it may well be intended to do. The Government have stated that only a small increase in the Home Office staff will be needed to control the service—even with all the civil service red tape—so perhaps they do realise it will be of little use.

We do not want to follow the Australians, with all the problems they have found with 27MHz, but we feel that this useless sop will only tend to encourage illegal use of 27MHz.

Let's stop pussyfooting around and get a viable system off the ground. A system that will ensure a good service and not encourage the cowboys.

It's not too late (hopefully); in a reply to a written question from Mr. Patrick Wall MP, Mr. William Whitelaw made the following statement "... I intend to publish a discussion document on Open Channel within the next few weeks, and I shall take the public reaction to this into account in reaching final decisions." Incidentally it would appear that "the next few weeks" in Government terms is in fact 13 weeks so things could move slowly.

*Mike Kenward*

## EDITOR

Mike Kenward

Gordon Godbold ASSISTANT EDITOR

Mike Abbott TECHNICAL EDITOR

David Shortland PROJECTS EDITOR

Jasper Scott PRODUCTION EDITOR

Jack Pountney ART EDITOR

Keith Woodruff ASSISTANT ART EDITOR

John Pickering SEN. TECH. ILLUSTRATOR

Isabelle Greenaway TECH. ILLUSTRATOR

Colette McKenzie SECRETARY

### Editorial Offices:

Practical Electronics,  
Westover House,  
West Quay Road, Poole,  
Dorset BH15 1JG  
Phone: Editorial Poole 71191

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

### Advertising Offices:

Practical Electronics Advertisements,  
King's Reach Tower,  
King's Reach, Stamford Street, SE1 9LS  
Telex: 915748 MAGDIV-G

**Make Up/Copy Dept.: 01-261 6601**

## ADVERTISEMENT MANAGER

D. W. B. Tilleard

SECRETARY Christine Pocknell

} 01-261 6676

AD. SALES EXEC. Alfred Tonge 01-261 6819

CLASSIFIED MANAGER Colin Brown 01-261 5762

### Technical Queries

We are unable to offer any advice on the use or purchase of commercial equipment or the incorporation or modification of designs published in Practical Electronics.

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

Components are usually available from advertisers; where we anticipate supply difficulties a source will be suggested.

### Back Numbers

Copies of most of our recent issues are available from: Post Sales Department (Practical Electronics), IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF, at 75p each including Inland/Overseas p&p.

### Binders

Binders for PE are available from the same address as back numbers at £4.30 each to UK or overseas addresses, including

postage and packing, and VAT where appropriate. Orders should state the year and volume required.

### Subscriptions

Copies of PE are available by post, inland or overseas, for £10.60 per 12 issues, from: Practical Electronics, Subscription Department, Oakfield House, Perrymount Road, Haywards Heath, West Sussex RH16 3DH. Cheques and postal orders should be made payable to IPC Magazines Limited.

# Market Place

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

by  
**David Shortland**

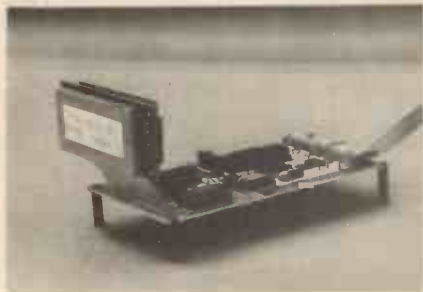
and  
**Jasper Scott**

## VERSATILE DISPLAY

For those occasions when a VDU is overkill, and yet illuminating fixed legends is insufficient, Amber Controls have come up with an intelligent 2-line alpha-numeric display subsystem.

The liquid crystal 32 character display is microprocessor controlled, and its 5x7 dot matrix elements enable full ASCII upper and lower case. A further 5x1 matrix facilitates the use of a cursor.

Surplus programming capacity has allowed editing, split screen use and several modes of interfacing to be included.



An attractive feature of the Visual Display Module is its ability to display factory programmed messages, and even graphics, on receipt of the ASCII "ESC" code, followed by A to Z.

Optical isolation of the serial input and output allows TTL, 20mA current loop or V24 connection. There is also a strobed parallel input for direct keyboard interface.

Ease of interface having been assured electronically speaking by the use of a micro<sup>8</sup>, the

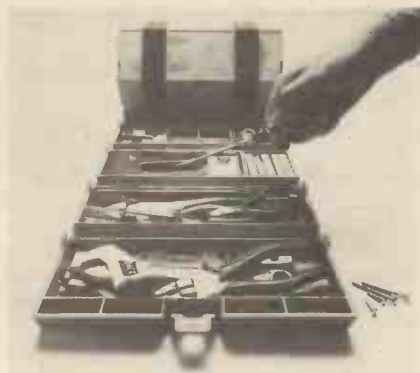
designers went on to make mechanical integration into a system simple too, by linking the display to the p.c.b. with a flexible cable. Power consumption is less than 2 watts.

Details: Amber Controls Ltd., Central Way, Walworth Ind. Estate, Andover, Hants. (0264 65951).

## NEAT AND TIDY

Here at last is an answer to the prayers of many constructors who are looking for a compact yet spacious means of storing tools and components—the Rolykit, from the Dutch Hagemeyer group.

Looking at the ingenious yet somehow obvious design of the Rolykit, it is surprising that something similar was not invented long ago.



When closed, it can be shaken, even thrown in the air and then opened to reveal everything still neatly in its place, conveniently laid out and ready for work. Some of the compartments are large enough to accommodate

pliers, cutters, and reels of wire, while others are divided into smaller units, ideal for components.

The Rolykit comes in two sizes priced at around £12 and £15, and should be available from leading retail outlets and chain stores.

## SPACE-AGE STATION

The new version of the Antex TCSU1 soldering station, meets the latest requirements for temperature-controlled soldering of delicate circuits and semi-conductors. The station is moulded in one of the toughest and most durable moulding materials available.

A significant addition is the anti-static earth connection to protect MOS devices from the damage, often unnoticed until too late, caused by static electricity. By inserting the jack with the special earthing cable in the socket at the side of the unit, a connection can be made to a specially made "earth" to eliminate any static electricity charges.



The soldering station is supplied with either the miniature CTC 40 watt iron or the XTC 50 watt model. Both models are fitted with 5-conductor silicone burn-free cable and 5 pin DIN sockets to connect with the 24 volt supply from the station. Thermocouples, fitted at the front of the irons, sense the temperature which is kept at a pre-set level anywhere between 65 and 420°C with an accuracy of 2 per cent. A range of 3 long-lasting bits, heavily coated with iron, is included with each iron for micro, miniature or ordinary soldering work. These bits slide easily on or off the stainless steel shafts of the irons; screws which may cause oxidation or "freezing" of bits to shafts and damage to the irons, have been carefully avoided.

Avoided also are such evils as magnetic fields, arcing transients or spikes; switching is done electronically at zero voltage.

The separate sponge tray which is supplied with each station, can be taken to a tap; this avoids spilling of water over the station.

The price for the TCSU1 (including either the CTC40 or the XTC50) is £38 plus VAT. Further information is available from: Antex Ltd., Mayflower House, Plymouth, Devon (0752 67377).

## KEYBOARD CASE

A robust ABS case for self-contained alpha-numeric keyboards is now available from West Hyde Developments Ltd.

Known as the Princess Keyboard, the enclosure is vacuum formed in two halves which are clipped and then screwed together for rigidity in final assembly. The ABS plastic is



easy to drill, punch and clean and the base incorporates a series of ribs for simple mounting of many proprietary keyboard assemblies.

The price for the Princess Keyboard is £10.75, and it is available direct from:

West Hyde Developments Ltd., Unit 8, Park Street Industrial Estate, Aylesbury, Bucks. HP20 1ET.

## ELCB

The two main problems associated with conventional fuses is that they are too slow to protect equipment from serious damage and that they offer little protection against serious electrical shock since their ratings and slow operation may allow fatal currents to flow.

The earth leakage circuit breaker overcomes these problems by sensing any small earth leakage current flowing in a circuit or any equipment connected to it. This is achieved by comparing the currents in the live and neutral conductors and detecting any small imbalances. Because of its high sensitivity the ELCB can isolate the circuit or equipment before any serious damage can result.

A comprehensive range of ELCBs have now been introduced by B & R Relays. Called the HO6 Mainsafe series, they feature a wide range of ratings from 25 to 80 amps, with trip

ratings from 30mA up to 500mA. This new range together with the existing HO4 13 Amp portable ELCB gives B & R full coverage of all ELCB applications.

The wide range of models available make it possible to protect an installation in a simple cost effective manner. For instance, overall house or building protection can be provided by fitting say a 63 or 80 Amp HO6 Mainsafe to give a 100 to 300mA trip sensitivity—sufficient to guard against fire or equipment damage. If further protection against electrocution is required, a more sensitive HO6 Mainsafe with, say, a 30mA sensitivity can be fitted to give protection on specific circuits or socket outlets. Alternatively, individual socket or appliance protection, eg. in a garage or damp location can be obtained using the HO4 13 Amp portable ELCB into which the appliance is plugged via a standard 13 Amp socket.

For further information contact B&R Relays Limited Templefields, Harlow, Essex CM20 2BG.

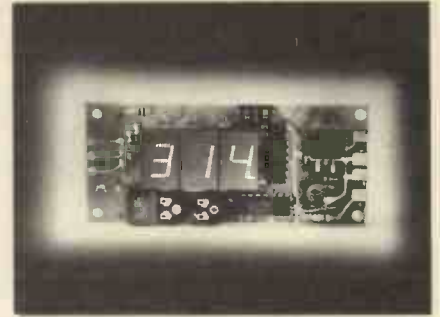
## INTRODUCING RISCAMP

A new component shop supplying a wide range of components, test equipment and books to the hobbyist has been opened by Riscamp Ltd. The hours of opening are 9.00 a.m. to 5.00 p.m. Monday to Saturday, closed all day on Wednesdays.

Coinciding with the opening of their shop, Riscamp have introduced a low cost digital voltmeter known as the DVM 314. This module features a full 3-digit display with 10.9mm digits, and has a display sensitivity of

-99mV to +999mV with an accuracy of 0.1 per cent  $\pm 1$  digit. A single d.c. supply of between 7-12V capable of providing 220mA max. is required to power the unit, thus allowing the module to be operated by either a battery such as the PP9 or a suitable mains operated power supply.

The basic IV maximum reading may be easily extended by the use of simple resistive attenuators with the required decimal point being selected by grounding the appropriate pad on the module.



Measuring 41 x 95 x 10mm the unit is supplied with a full instruction sheet which includes suggested values for resistive attenuators, together with instructions for measuring a.c. voltage, current, resistance, and temperature.

Priced at £11.95 plus VAT, the DVM 314 is available to personal callers or by mail order from Riscamp's new shop at the following address: Riscamp Ltd., 21 Duke Street, Princes Risborough, Bucks. (084 44 6326).

## SERVICE CASE

A new combined tool case and component cabinet has just been introduced by Link-Hampson.

The outer case is made of black simulated leather with a moulded carrying handle. Extra strength is given to the case by incorporating reinforcing side straps. The external dimensions of the case are 380mm x 317mm x 203mm.



A lift up top gives access to a tool carrying tray whilst the component storage drawers are accessible by folding down the front panel.

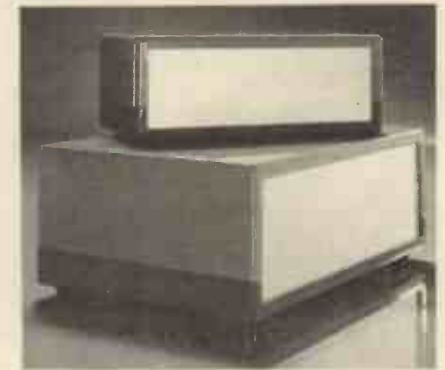
The price of the case, model 2501E, is £29.95 ex. VAT and p&p.

Link-Hampson Ltd., 5 Bone Lane, Newbury, Berkshire (0635 44796).

## VERO CASES

To complement their existing range of grey cases Vero have introduced two models in two-tone brown.

The first type model 75/1713F (154 x 85 x 60mm) has a unique clip together design which requires no fixing screws. The front and rear panels are retained in position when the two halves are assembled.



The second type model 75/1714A (205 x 140 x 75mm) is the usual two section case held together by four screws. Front and rear panels are included as well as fixing points for horizontally mounted p.c.b.s.

The cases are priced at £3.58 (model 75/1713F) and £2.45 (model 75/1714A) excluding VAT and p&p.

Vero Electronics Limited, Industrial Estate, Chandlers Ford, Eastleigh, Hants.



*It's faster and more thorough than classroom learning: you pace yourself and answer questions on each new aspect as you go. This gives rare satisfaction - you know that you are really learning and without mindless drudgery. With a good self-instruction course you become your own best teacher.*

## Understand Digital Electronics

In the years ahead digital electronics will play an increasing part in your life. Calculators and digital watches mushroomed in the 1970's - soon we will have digital car instrumentation, cash cards, TV messages from friends and electronic mail.

After completing these books you will have broadened your career prospects and increased your knowledge of the fast-changing world around you.

### DIGITAL COMPUTER LOGIC AND ELECTRONICS £7.00

This course is designed as an introduction to digital electronics and is written at a pace that suits the raw beginner. No mathematical knowledge is assumed other than the use of simple arithmetic and decimals and no electronic knowledge is expected at all. The course moves painstakingly through all the basic concepts of digital electronics in a simple and concise fashion; questions and answers on every page make sure that the points are understood.

Everyone can learn from it - students, engineers, hobbyists, housewives, scientists. Its four A4 volumes consist of:

**Book 1** Binary, octal and decimal number systems; conversion between number systems; conversion of fractions; octal-decimal conversion tables.

**Book 2** AND, OR gates; inverters; NOR and NAND gates; truth tables; Introduction to Boolean algebra.

**Book 3** Positive ECL; De Morgans Laws; designing logic circuits using NOR gates; dual-input gates.

**Book 4** Introduction to pulse driven circuits; R-S and J-K flip flops; binary counters; shift registers; half-adders.

### DESIGN OF DIGITAL SYSTEMS £12.50

This course takes the reader to real proficiency. Written in a similar question and answer style to Digital Computer Logic and Electronics, this course moves at a much faster pace and goes into the subject in greater depth. Ideally suited for scientists or engineers wanting to know more about digital electronics, its six A4 volumes lead step by step through number systems and Boolean algebra to memories, counters and arithmetic circuits and finally to an understanding of calculator and computer design.

**Book 1** Octal, hexadecimal and binary number systems; conversion between number systems; representation of negative numbers; complementary systems; binary multiplication and division.

**Book 2** OR and AND functions; logic gates; NOT, exclusive-OR, NAND, NOR and exclusive-NOR functions; multiple input gates; truth tables; De Morgans Laws; canonical forms; logic conventions; karnaugh mapping; three state and wired logic.

**Book 3** Half adders and full adders; subtractors; serial and parallel adders; processors and arithmetic logic units (ALUs); multiplication and division systems.

**Book 4** Flip flops; shift registers; asynchronous and synchronous counters; ring, Johnson and exclusive-OR feedback counters; random access memories (RAMs) and read only memories (ROMs).

**Book 5** Structure of calculators; keyboard encoding; decoding display data; register systems; control unit; program ROM; address decoding; instruction sets; instruction decoding; control programme structure.

**Book 6** Central processing unit (CPU); memory organization; character representation; program storage; address modes; input/output systems; program interrupts; interrupt priorities; programming; assemblers; computers; executive programs; operating systems and time sharing.

## Flow Charts and Algorithms

are the essential logical procedures used in all computer programming and mastering them is the key to success here as well as being a priceless tool in all administrative areas - presenting safety regulations, government legislation, office procedures etc.

### THE ALGORITHM WRITER'S GUIDE £4.00

explains how to define questions, put them in the best order and draw the flow chart, with numerous examples.

### GUARANTEE No risk to you.

If you are not completely satisfied, your money will be refunded upon return of the books in good condition.

**CAMBRIDGE LEARNING LIMITED, UNIT RIVERMILL SITE, FREEPOST, ST. IVES, HUNTINGDON, CAMBS., PE17 4BR, ENGLAND. TELEPHONE: ST. IVES (0480) 67446**

All prices include worldwide postage (airmail is extra - please ask for prepayment invoice).

Please allow 28 days for delivery in U.K.

## Microcomputers are coming - ride the wave! Learn to program.

Millions of jobs are threatened but millions more will be created. Learn BASIC - the language of the small computer and the most easy-to-learn computer language in widespread use. Teach yourself with a course which takes you from complete ignorance step-by-step to real proficiency with a unique style of graded hints. In 60 straightforward lessons you will learn the five essentials of programming: problem definition, flowcharting, coding the program, debugging, clear documentation. Harder problems are provided with a series of hints so you never sit glassy-eyed with your mind a blank. You soon learn to tackle really tough tasks such as programs for graphs, cost estimates, compound interest and computer games.



### COMPUTER PROGRAMMING IN BASIC

£9.00

**Book 1** Computers and what they do well; READ, DATA, PRINT, powers, brackets, variable names; LET; errors; coding simple programs.

**Book 2** High and low level languages; flowcharting; functions; REM and documentation; INPUT, IF...THEN, GO TO; limitations of computers, problem definition.

**Book 3** Compilers and interpreters; loops, FOR...NEXT, RESTORE; debugging; arrays; bubble sorting; TAB.

**Book 4** Advanced BASIC; subroutines; string variables; files; complex programming; examples; glossary.

### THE BASIC HANDBOOK £11.50

This best-selling American title usefully supplements our BASIC course with an alphabetical guide to the many variations that occur in BASIC terminology. The dozens of BASIC 'dialects' in use today mean programmers often need to translate instructions so that they can be RUN on their system. The BASIC Handbook is clear, easy to use and should save hours of your time and computer time. A must for all users of BASIC throughout the world.

### A.N.S. COBOL £4.40

The indispensable guide to the world's No. 1 business language. After 25 hours with this course, one beginner took a consulting job, documenting oil company programs and did invaluable work from the first day. Need we say more?

## ORDER FORM

Please send me the following books:-

..... Digital Computer Logic & Electronics @ £7.00

..... Design of Digital Systems @ £12.50

..... Algorithm Writer's Guide @ £4.00

..... Computer Programming in BASIC @ £9.00

..... BASIC Handbook @ £11.50

..... ANS COBOL @ £4.40

..... Your Booklist (Free)

I enclose a \*cheque/PO payable to Cambridge Learning Ltd.

for £..... (\*delete where applicable)

Please charge my:

\* Access/American Express/Barclaycard/Diners Club/Eurocard/Visa/  
Mastercharge/Trustcard

Credit Card No.....

Signature .....

Telephone orders from credit card holders accepted on 0480 67446 (Ansafone).

Overseas customers (incl. Eire) should send a bank draft in sterling drawn on a London bank, or quote credit card number.

Name .....

Address .....

Cambridge Learning Limited, Unit 25, Rivermill Site, FREEPOST, St. Ives, Huntingdon, Cambs PE17 4BR, England. (Registered in England, No. 1328762)





# INDUSTRY NOTEBOOK

By Nexus



## Recession

The in-word this year is recession. We hear it morning, noon and night, presented generally in terms of utter disaster and catastrophe. Such pessimism is entirely misplaced. Surely we should be optimistic because the recession has precipitated a shake-out in industry that is long overdue by a good 20 years, perhaps even longer. Everyone knew that it had to come and that when it did the process would be painful. And in the older industries, more painful than most.

But when we look at the young industries, of which electronics is the most striking example, quite a different picture emerges. GEC's recently announced results show the group cracking through the £3 billion turnover 'barrier' despite unfavourable trading conditions further complicated by industrial disputes. About one third of the total business is now in electronics, automation and telecommunications which showed a 21 percent increase in turnover and a 33 percent increase in pre-tax profit. And you only have to look at the advertisements in the national and trade press to see that GEC's main worry is how to recruit enough engineers.

The strength of the pound sterling is supposed to be 'killing' exports. GEC's exports were up to £805 million. Killing means extinction, quite different from the actuality that the high value of the pound merely makes exporting more difficult and that the converse of a weak pound would make every import of raw materials more expensive. A case of swings and roundabouts.

I have picked out GEC as an example only because their year-end results are the most recent to hand. But the same applies to the lesser giants of the professional electronics industry, such as Racal Group, Plessey and ICL, and smaller groups such as Unitech and companies like Farnell.

If we believe that a measure of performance is seen in the gross returns to shareholders in dividends and capital gains in the past ten years, and the profits must have come from somewhere, it is instructive to examine a recent league table of the 50 top business performers in the UK published in 'Management Today' last June. Racal emerges as the clear winner with a percentage gain of 2,008 percent. Electrocomponents was fourth, Farnell sixth, ICL eleventh and Unitech thirteenth. In these terms, Plessey, GEC and Ferranti are nowhere in the top 50, only steady successful plodders rather than get-up-and-goers.

To show how misleading the media can be in spreading gloom we only have to look at the headline 'Racal Disappoint with £63 million'. That was last year's profits as reported by a business editor. It is so easy to overlook the fact that only a decade ago Racal's total group turnover was only £17.1 million and this was the group's 25th consecutive year of record turnover and profit growth.

The other side of the coin must not be overlooked. Decca and EMI, both failing in performance and now under new management with Racal and Thorn respectively, should start prospering again. Plessey now revitalised, only achieved this through shedding dead wood with painful and massive redundancies. Nasty but necessary medicine.

Well, there are ups and downs in all businesses, some winners, some losers, and in a world recession it is tough going for everyone.

As far as electronics is concerned there is certainly no need for despair except in one single aspect. It is not the sort of industry which creates mass employment. In fact the industry needs relatively less labour per unit of income year after year. Printed and integrated circuits have transformed the manufacturing side of the business. On the other hand the enormous increase of usage has generated a demand for an increasing army of installation and maintenance engineers.

One of the paradoxes of the present situation is the number of complaints of overtime being cut in factories. Whatever happened to the sustained campaign for shorter hours and longer holidays?

## The Chip Scene

As I write there is still no decision on INMOS, an ominous sign reflecting lack of enthusiasm for, if not imminent abandonment of, Government (i.e. taxpayers) support. But at least one aspect of the tangled saga of the chips has been resolved. The GEC-Fairchild joint project has been abandoned through lack of agreement with Fairchild's new owners, Schlumberger. GEC has now acquired the original Fairchild share in the new factory at Neston, Cheshire. But instead of making chips the Newton plant will produce the Sting Ray lightweight anti-submarine torpedo for which Marconi Space and Defence Systems have an initial £200 million con-

tract for final development and first production.

Sting Ray is potentially one of the UK's brightest export projects. It is perhaps as much as five years ahead of the competition, certainly three years, and has built-in 'intelligence' in both the search and terminal homing phases of operation. Sales are expected to exceed £1 billion in the years ahead.

## Energy

Before recession snatched the headlines from the chip the fashionable topic was energy. The problem hasn't gone away, only faded into the background in headline appeal. And so, almost ignored, was the world's largest ever commercial contract for solar energy won by Lucas Energy Systems Ltd in the British-based Lucas engineering group. Under the contract 2,550 solar-power units are being built to power a radio-telephone network linking hundreds of villages in the mountains and equatorial forests in the interior of Columbia. Together the power units will generate a peak power of 100kW from solar energy to charge batteries to a total of 2,400kWh.

But that's not the end of the good news. It is fashionable today, at least in the UK, to regard with scorn, if not outright contempt, the EEC. And yet the European Commission has recently voted £530 million to energy research, some 50 percent increase in funding and now comparing well with similar programmes in the United States, the Soviet Union and Japan.

A substantial sum will be spent on fusion research, the cornerstone of which is the Joint European Torus (JET) which is under construction in the UK at Culham and due to be completed and ready for the first vital experiments in 1983.

Those still fearful of the consequences of nuclear energy should be reassured by big spending on reactor safety projects, and in protecting the environment. And enthusiasts for alternative energy systems should be pleased with a doubling of research funds in solar energy to £14 million with an element of technical support for third-world countries who, in any case, in their sunnier climates are likely to be the main beneficiaries.

I note too, that Gulf and Western Industries in New York has a prototype Volkswagen 'Golf' modified for electric traction with a range of 155 miles at 55m.p.h., and it goes further at lower speeds. The zinc chloride battery is one third of the weight of a lead-acid battery of the same capacity. G & W hope to be in production with electric traction units by the mid-80s.

## Monopolies

Debate will be at furious level on the even very limited weakening of monopoly power in posts and telegraphs in the UK. But optimists like myself believe that the threat of modest competition will have a galvanising effect on efficiency—and that can't be bad.

# MICRO-BUS

Compiled by DJD.

Appearing ever/ two months, Micro-Bus presents ideas, applications, and programs for the most popular microprocessors; ones that you are unlikely to find in the manufacturers' data books. The most original ideas often come from readers working on their own systems, and payment will be made for any contribution featured.

**T**HIS month's Micro-Bus examines the Acorn Teletext VDU, an unusual memory-mapped VDU with the ability to display Prestel and Teletext pictures. The VDU card can be used with the low-cost System One microcomputer, and several programs are presented to demonstrate the use of the VDU with the System One for graphics.

## BLOCK DIAGRAM

A block diagram of the Acorn Teletext VDU is shown in Fig. 2. It consists of three main parts: the VDU memory, the controller chip, and the teletext character generator. The VDU displays the contents of the 1K of memory, which is switched between the VDU and the processor for half of each memory cycle; in other words, access to the VDU is transparent so that the processor can read from or write to the screen memory without affecting the display. The VDU is normally configured for a format of 25 lines of 40 characters, thus using 1000 bytes of the 1024 RAM locations. This format includes an extra line over the teletext format, which is 24 x 40. The memory is normally addressed as locations #0400 to #07FF.

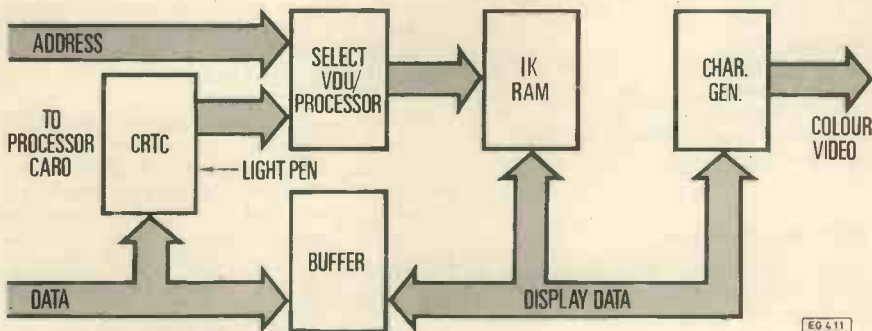


Fig. 2. Block diagram of the teletext VDU card; it interfaces to the computer's address and data lines

## SCREEN FORMAT

The format of characters on the screen is controlled by the 6845 CRT controller chip, and the format can, to a certain extent, be reprogrammed simply by altering constants stored in the 6845's registers. The 6845 is addressed as two memory locations; an address register and a data register. In fact the 6845



Fig. 1. The Acorn Teletext VDU card

contains a total of 18 registers; the number loaded into the address register determines which of the other registers is selected as the data register. A drawback of using the CRTC is that it must be programmed before any display will be obtained. The routine of Fig. 3 illustrates how to do this using the 6502 micro. The routine writes the sixteen values from a table after the program to registers #00 to #0F respectively, and sets the display up in 25 x 40 format with a flashing-underline cursor.

```

;      SET UP CRTC REGISTERS
;      ON TELETEXT VDU.
;
;      CRTC  = $0800      ADDRESS
;      CRTB  = $0801      DATA
;      RESTR = $FF04      IN MONITOR
;
0000          = $0980
0980 AO OF   SETCRT LEV  $0F      NO. OF REGS
0982 9C 00 08 LOOPS  STY  CRTA     SELECT REG
0985 B9 91 09 LEA   CRTTAB,Y   GET VALUE
0988 8D 01 08 STA   CRTB
098B 88      DEY
098C 10 F4   BPL   LOOPS
098E 4C 04 FF JMP   RESTR    BACK.
;
0991 3F      CRTTAB .BYTE $3F,$28,$33,$05
0995 1E      .BYTE $1E,$02,$19,$1B
0999 00      .BYTE $00,$09,$68,$09
099D 04      .BYTE $04,$00,$07,$FF
;      .END
    
```

Fig. 3. Program for the 6502 micro sets up the VDU card for a 25 x 40 display, and a flashing-underline cursor

Registers #00 to #09 determine the screen format. For example, to obtain a format of 16 rows of 32 characters set register #01 (number of characters per line) to #20, and register #06 (number of lines) to #10. The display can be turned off completely, without affecting the contents of the display memory, by setting register #06 to #00.

Registers #0C and #0D contain the high and low bytes respectively of the screen start address. The start address can be changed to alter the mapping of memory to the screen; for example, incrementing it by 40, the number of locations per line, will scroll the display.

The CRTC also provides a cursor, which can be flashing or static, and whose shape can be programmed. The type of cursor is determined by registers #0A and #0B. For the normal flashing underline cursor register #0A has the value #68; or cursors can be obtained by altering this register as follows:

Function:	Value:
Cursor off	#1F
Static block	#00
Slow flashing block	#60
Fast flashing block	#40

The position of the cursor on the screen is determined by registers #0E and #0F, which contain the high and low bytes of the cursor address.

The CRTC also provides a light-pen strobe input; a logic-level transition on this input will cause the address of the cell currently being displayed to be stored in the light-pen address registers, #10 and #11.

## TELETEXT CONTROLLER.

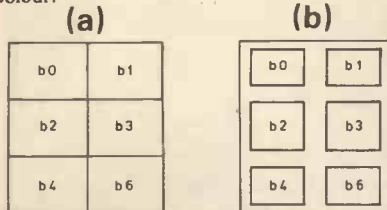
The character generation and display is performed by the SAA5050 Teletext Character Generator, which in addition to being able to display the usual and lower-case character set, has many attractive features such as: double-height characters; the ability to flash characters; display of characters in six colours or white against a background of any colour, black, or white; and display of two different types of graphics. Furthermore, most of these options can be used in combination.

Most memory-mapped VDUs use spare bits in the display memory to select special options for each character; for example, the top bit of the character could be used to determine whether the character is displayed static or flashing. In the teletext VDU there are too many different options to enable them to be specified in this way for each character, so a rather cunning method is used instead. Certain control codes, when present in a line, change the state of subsequent characters on that VDU line. Thus a line will normally be steady, but if a 'flash' code is put on the VDU, all the remaining characters on that line will flash. It is even possible to make one word in a line flash by preceding the word with a 'flash' code, and following it by a 'steady' code.

The Teletext method of selecting special functions has one drawback: the control code will appear on the VDU as a blank cell, corresponding to the background colour; so, for example, it is not possible to display a line of contiguous characters all in different colours; there has to be a blank between each character.

## GRAPHICS

To provide the facility for plotting graphs and histograms the character cell is divided into six picture elements, or "pixels", each of which can be either set to a colour, or cleared to the background colour. The state of each cell is determined by one bit of the code, as shown in Fig. 4. For the graphics symbols, bit 5 is always set. To display codes as graphics, rather than characters, they are preceded by a code specifying graphics and the required colour.



EG 4.10

**Fig. 4. Diagrams showing how the teletext graphics symbols are constructed for: (a) contiguous graphics, and (b) separated graphics**

The usual graphics mode is called 'contiguous graphics', but there is also an option called 'separated graphics' in which the pixels are separated by a thin border; see Fig. 4 (b).

If the whole VDU screen is to be used for graphics the first character of each line should be a 'graphics colour' code; the overall resolution is thus 78 x 75. A routine to clear the display and set it up for white graphics is shown in Fig. 5.

```

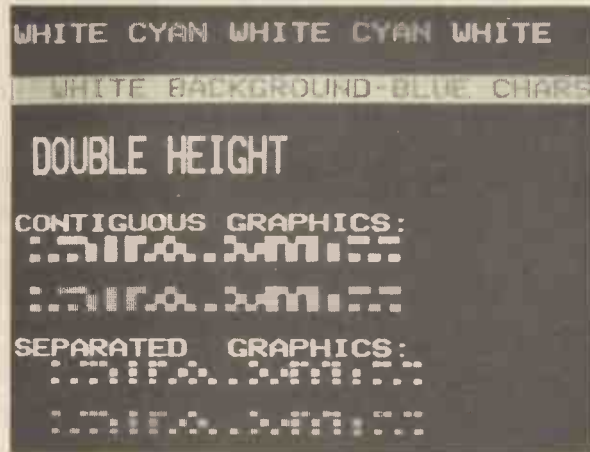
:
: CLEAR SCREEN FOR GRAPHICS
: TELETEXT VDU.
:
: ADDS =#0023          CELL POINTER
: RESTRT =#$F04        IN MONITOR
:
,0000                  ,=#0E80
OE80 AO 00            CLEARS LDY EO
OE82 A9 20            LDA E820
OE84 99 00 04        CLEAR STA $400,Y      SPACE
OE87 99 00 05        STA $500,Y      DO 256 BYTE
OE8A 99 00 06        STA $600,Y      BLOCKS.
OE8D 99 00 07        STA $700,Y
OE90 C8              INY
OE91 D0 F1           BNE CLEAR
OE93 84 23           STY ADDS      ZERO
OE95 A9 04           LDA E804      SET ADDS TO
OE97 85 24           STA ADDS+1   SCREEN START
OE99 D8             CLD
OE9A A2 18           LDX E818     25 LINES
OE9C A9 17           SET  LDA E817   GRAPHICS WHITE
OE9E 91 23           STA (ADDS),Y  START OF LINE
OEAO A9 28           LDA E828     40 CHARS/LINE
OEAZ 18             CLC
OEA3 65 23           ADC ADDS
OEA5 85 23           STA ADDS
OEA7 90 02           BCC NOCY   CARRY?
OEA9 E6 24           INC ADDS+1
OEAB CA            DEK
OEAC 10 EE          NOCY
OEAE 4C 04 FF       JMP RESTRT  DO ALL 25 LINES
:                    STOP.
:                    .END
  
```

**Fig. 5. Routine to clear the display, and initialise the display memory for graphics**

## EXAMPLES

Some examples of displays generated by the Teletext VDU are shown in Fig. 6. The top line demonstrates the use of colour. The default colour at the start of each line is white; to display the word CYAN in the colour cyan it is preceded by an "alpha cyan" code, and it is followed by an "alpha white" code to return to white characters.

The second line illustrates the use of a different background colour. The background colour can be set to the current colour with the "new background" code; since the default colour at the start of a line is white, a "new background" code at the start of a line will give a white background. It is followed by an "alpha blue" code to cause the subsequent characters to appear in blue, which is dark against the white background. The background is returned to black after the text with a "black background" code.



**Fig. 6. Examples of the types of display possible with the teletext VDU**

## GRAPH PLOTTING

The following two programs illustrate how the Acorn Teletext VDU can be used for simple graph-plotting. The routines were devised

```

:
: PLOT POINT AT (XC,YC)
: ON TELETEXT VDU.
:
: XC =#0020          X COORDINATE
: YC =#0021          Y COORDINATE
: ADDS =#0023       CELL ADDRESS
:
:                    *=#0200
:                    CLD
:                    PLOT      INC YC      CALCULATE WHICH
:                    LDA E807   LINE...
:                    STA ADDS+1
:                    LDA E8C1   LDA E8C1
:                    STA ADDS   BOTTOM LEFT
:                    LDY YC      LDY YC
:                    YCALC      LDX E2      DIVIDE BY 3
:                    LOOP      STY YC
:                    DEY
:                    BEQ XCALC   DONE Y?
:                    DEK
:                    BPL LOOP    BPL LOOP
:                    ADDS      ADDS+1     MOVE UP BY
:                    LDA E8C1   ONE LINE.
:                    SEC        SBC E40   CHARS/LINE
:                    STA ADDS
:                    BCS YCALC   BCS YCALC
:                    DEC ADDS+1   CARRY
:                    BCC YCALC   BCC YCALC
:                    CLC        I.E. ALWAYS
:                    ROR XC      DIVIDE BY 2
:                    BCC EVEN   BCC EVEN
:                    LDA YC      Y REMAINDER
:                    BNE NZERA   NZERA
:                    LDA E802   LDA E802
:                    BNE CONT   BNE CONT
:                    NZERA     CMP E801
:                    BNE NONEA   BNE NONEA
:                    LDA E840   LDA E840
:                    STA YC     STA YC
:                    LDA ADDS   LDA ADDS
:                    CLC        CLC
:                    ADC XC      ADC XC
:                    STA ADDS   STA ADDS
:                    BCC DONE   BCC DONE
:                    INC ADDS+1  INC ADDS+1
:                    LDY EO     LDY EO
:                    LDA YC     LDA YC
:                    AND (ADDS),Y AND (ADDS),Y
:                    BNE RETN   BNE RETN
:                    LDA (ADDS),Y LDA (ADDS),Y
:                    CLC        CLC
:                    ADC YC     ADC YC
:                    STA (ADDS),Y STA (ADDS),Y
:                    RETN      RTS
:                    EVEN     LDA YC
:                    BNE NZERB   BNE NZERB
:                    LDA E801   LDA E801
:                    BNE CONT   BNE CONT
:                    NZERB     CMP E801
:                    BNE NONEB   BNE NONEB
:                    LDA E804   LDA E804
:                    BNE CONT   BNE CONT
:                    LDA E810   LDA E810
:                    BNE CONT   BNE CONT
:                    .END
  
```

**Fig. 7. Routine for the 6502 micro to plot a point at specified coordinates on the teletext VDU**

by Peter Mayne of London, who uses the VDU with an Acorn System One micro-computer.

The PLOT routine, in Fig. 7, plots a point, or pixel, on the display at the coordinates specified in the locations XC and YC. The coordinates (0,0) correspond to the bottom left-hand corner of the display, and (77,74) to the top right. Note that XC and YC are modified by the PLOT routine.

The program works by finding, in ADDS, the address of the location that contains the required pixel, and determines a number to

add to that location to set the required pixel. Since there are three pixels per cell in the Y direction, the routine must divide the value of YC by three to find which line contains the required location.

The GRAPH program, Fig. 8, demonstrates how the PLOT routine can be used to plot a graph of an equation. As it stands, the program plots  $Y = \frac{1}{2}X + 16$  for values of X from 0 to 63. The program also draws axes, and finally labels the graph with the equation; see Fig. 9. A delay is included to slow down the plotting.

```

      PLOT A GRAPH
      XC      = $0020      X COORDINATE
      YC      = $0021      Y COORDINATE
      XVAL    = $0040
      PLOT    = $0200      PLOT POINT
      RESTRT  = $FF04      IN MONITOR
      WAIT    = $FECD      DELAY

0000      . = $0300
0300 A2 00  GRAPH LDX  EO      FOR EACH
0302 86 20  DRAW  STX  XC      VALUE OF X..
0304 A9 00      LDA  EO
0306 85 21      STA  YC
0308 86 40      STX  XVAL
030A 20 00 02  JSR  PLOT      X AXIS
030D A6 40      LDX  XVAL
030F 86 21      STX  YC
0311 A9 00      LDA  EO
0313 85 20      STA  XC
0315 86 40      STX  XVAL
0317 20 00 02  JSR  PLOT      Y AXIS
031A A6 40      LDX  XVAL
031C 86 20      STX  XC
031E 8A      TXA
031F 8A      LSR  A      GET X VALUE
0320 18      CLC      DIVIDE BY 2
0321 69 10      ADC  E16      ADD 16
0323 85 21      STA  YC      GIVES Y
0325 86 40      STX  XVAL
0327 20 00 02  JSR  PLOT      PLOT POINT
032A A6 40      LDX  XVAL
032C A0 20      LDY  E20      DELAY
032E 20 CD FE SLOW JSR  WAIT
0331 88      DEY
0332 10 FA      BPL  SLOW
0334 E8      INX      NEXT X..
0335 ED 40      CPX  E$40      ALL DONE?
0337 D0 C9      BNE  DRAW
0339 A2 58      AXES  LDW  F'X      LABEL AXES
033B 8E 01 04   STX  $401
033E E8      INX      GET 'Y'
033F 8E E3 07   STX  $7E3
0342 A2 07      LDW  E7      PUT TITLE
0344 BD 50 03   TITLE LDA  CHARS,X
0347 9D 21 06   STA  $621,X
034A CA      DEX
034B 10 F7      BPL  TITLE
034D 4C 04 FF   JMP  RESTRT      STOP.

0350 07      CHARS .BYTE $7      ALPHA WHITE
0351 59 3D 5C   .BYTE 'Y='
0354 58 2B 31   .BYTE 'X+1'
0357 36      .BYTE '6'
      .END
  
```

Fig. 8. Program for the 6502 micro to plot a graph on the teletext VDU

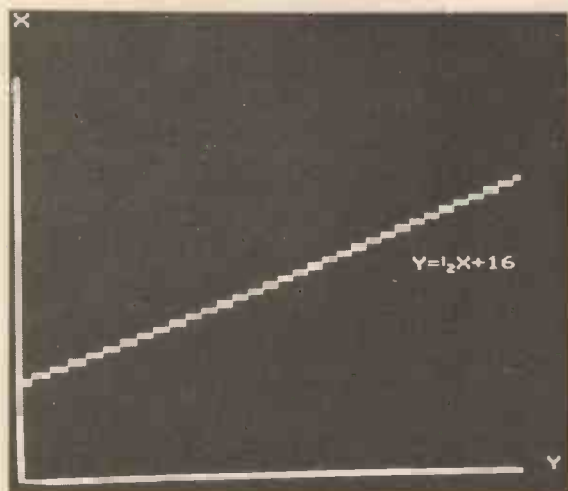


Fig. 9. Graph produced by the program of Fig. 8

Before running the program, the routines of Fig. 3 and Fig. 5 should be loaded and executed at #0980 and #0E80 respectively to initialise the CRTC and clear the screen for graphics.

## NINE PROBLEMS REVISITED

One of the problems posed in the April Micro-Bus asked for a way to reverse the bits in a byte, on the 6800 micro, in under 10 cycles. A solution in hardware was proposed, but *John Diamond* of Coventry has solved the problem using only software by providing a look-up table in which each byte gives the reverse of that byte's position in the table. The six-byte routine to reverse a byte, shown in Fig. 10, then takes only 9 cycles. It uses self-modifying code to avoid having to use the index register, thus saving several cycles. A further cycle can be saved by using zero-page memory.

The listing of Fig. 10 also includes an initialisation routine to generate the 256-byte look-up table. Other functions could be implemented simply by providing a different table.

Another of the problems was to write a programme to find the highest prime factor of a number using a rudimentary machine-code called MINIL. The solution was given without explanation, and readers were asked to provide one. *J. Rennie* of Somerset wrote:

"Your challenge to provide an explanation of the MINIL program . . . proved to be quite

irresistible, and I found the task most interesting. The program is based on a fairly simple algorithm (see flowchart of Fig. 11). Let N denote the number whose highest prime factor is to be found. Thus  $N = (P_0 \times P_1 \times \dots \times P_n)$ , where  $P_0$  to  $P_n$  are the n prime factors of N. The algorithm finds the highest factor of N, working down from  $N - 1$ , which is  $(P_0 \times P_1 \times \dots \times P_{n-1})$ . This new number is then denoted N, and the process is repeated to give the new factor  $(P_0 \times P_1 \times \dots \times P_{n-2})$ . This is repeated until only  $P_0$  is left. No more factors can be found and  $P_0$ , the highest prime factor of the original number, can be output.

"In the original MINIL program registers D and A hold the current values of N and X respectively, while steps 4-10 find the factors of N. The two loops NOT and NEW are identical to loops 1 and 2 of the flowchart."

A similar explanation of the program was received from *Doug Letts* of London. Readers interested in the MINIL language may like to try writing programs which find the greatest common divisor of two numbers, the integer part of a number's square root, and the factorial of a number. But be warned: one of these problems is impossible, and the other two are not simple!

```

      * REVERSE ACC. A INTO ACC. B
      *
E0E3      CONTRL EQU  £E0E3
0200      TABLE EQU £0200

0100      * MAIN PROGRAM
      ORG £0100
0100 B7 01 05 START STA A START+5 5 CYCLES
0103 F6 02 00      LDA B TABLE 4 CYCLES

      * END OF REVERSING ROUTINE
      *
      * INITIALISATION ROUTINE
      *
0180      ORG £0180
0180 CE 02 00      LDX £TABLE
0183 4F      CLR  A
0184 36      LOOP  PSH  A
0185 C6 80      LDA  B ££80      THESE SIX BYTES
0187 48      REVRSE ASL  A      REVERSE A INTO B
0188 56      ROR  B      IN 66 CYCLES
0189 24 FC      BCC  REVRSE
018B E7 00      STA  B .0,X
018D 32      PUL  A
018E 08      INX
018F 4C      INC  A
0190 26 F2      BNE  LOOP
0192 7E E0 E3   JMP  CONTRL
      END
  
```

Fig. 10. Routine to reverse the bits in a byte on the 6800 micro, together with a program to generate the table used by the routine

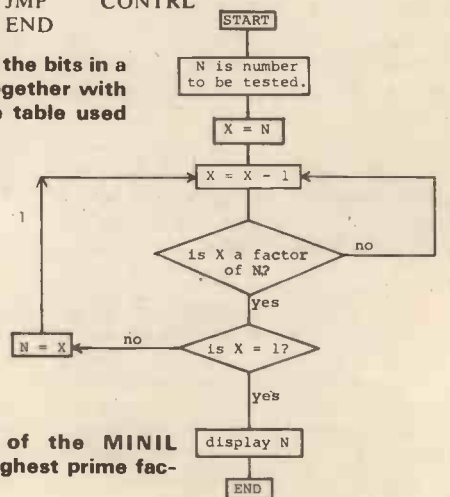


Fig. 11. Flowchart of the MINIL program to find the highest prime factor of a number

The NEW

# VIDEOTONE

YOU CANNOT BUY CHEAPER - YOU CAN ONLY GET LESS FOR YOUR MONEY!

## Introduces DIRECT SELLING - the Ultimate Discount!!!



### LOUDSPEAKERS

The complete fully reviewed range of Videotone Speakers which dominate within their class. Now at lowest ever prices.

D 100	£38
Minimax 11	£44
GB3	£50
GB2	£60
GBS	£207
D 93	£40

DISCOUNT SELLING PRICE  
**£50.00**



### ELECTRONICS

This new range of Electronics from Videotone redefines the words quality and value for money to a new high.

30 watt amp MC Input SA4130	£75.00
Stereo Tuner ST4120	£68.00
Cassette full features SC3200	£98.00
50 Watt amplifier WA7700	£77.00
20 Watt amplifier LA2020	£58.00

DISCOUNT SELLING PRICE  
**£68.00**

DISCOUNT SELLING PRICE  
**£75.00**



### CORAL CARTRIDGES

Fast becoming one of the top names

#### MOVING COIL

UK's No. 1 Cartridge

MC 81	£48.87
777EX	£35
777E	£25

#### MOVING MAGNET

555SX	£7.28
555E	£14.22
666E	£32.48



#### HEAD AMP

H300	£51.75
T100	£24.75

#### HEADSHELLS

S100	£6
S101	£7
S200	£4



### MICROPHONES

MU 105-22	£29.30
MU 105-12	£22.25
MU 25 C	£17.39

### TURNTABLES

Sansui SR222 Mk2	£69.00
JVC LA 11	£64.00
JVC SLQ 3	£140.00

## A MESSAGE FROM VIDEOTONE

Dear Customer

You will find that the products advertised on this page are the best possible value for money. They are only low in price because we have eliminated large amounts of selling costs that other brands have to suffer. These savings are passed directly on to you. We have full brochures on any specific item you may be interested in and a competent realistic staff of engineers at our London Showrooms to help you in your choice. Our consumer protection packages are comprehensive and we offer every form of financing you may require. We carry out our own servicing and are dedicated to giving Value for Money. We are confident our products are unbeatable. You may purchase with confidence because our Engineers have specially selected them from competitive sources throughout the world and we import them directly ourselves. Remember, you have 21 days trial period on all products. That is the measure of our confidence.

Videotone

SEND FOR OUR LATEST FREE BROCHURE AND DETAIL LIST OF LOCAL SALES OUTLETS IN THE U.K.

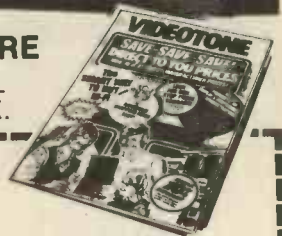
VIDEOTONE  
98 CROFTON PARK ROAD,  
CROFTON PARK, LONDON SE4  
Tel: 01-690 8511/2

Please send me your Direct Selling Brochure and list of sales outlets.

Name \_\_\_\_\_

Address \_\_\_\_\_

PE/10/80



ALL PRODUCTS ON DISPLAY & CONTINUOUS DEMONSTRATIONS

ALL PRICES INCLUDE VAT

# TRANSFORMERS + VAT 15%

### 30 VOLT RANGE

Pri 220/240 Voltages available 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30V or 12V-0-12V or 15V-0-15V.

Ref	Amps	Price	P & P
112	0.5	2.90	0.90
79	1.0	3.93	1.10
3	2.0	6.35	1.10
20	3.0	7.39	1.31
21	4.0	8.79	1.31
51	5.0	10.58	1.52
117	6.0	12.29	1.67
88	8.0	16.45	1.89
89	10.0	18.89	1.89
90	12.0	21.09	2.24
91	15.0	24.18	2.39
92	20.0	32.40	O.A.

## CONTINUOUS RATINGS

All voltages given are at full load

### 60 VOLT RANGE

Pri 220/240V Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 or 24-0-24V or 30V-0-30V.

Ref	Amps	Price	P & P
124	0.5	4.27	1.10
126	1.0	6.50	1.10
127	2.0	8.36	1.31
125	3.0	12.10	1.31
123	4.0	13.77	2.12
40	5.0	17.42	1.89
120	6.0	19.87	2.12
121	8.0	27.92	O.A.
122	10.0	32.51	O.A.
189	12.0	37.47	O.A.

### 50 VOLT RANGE

Pri 220/240V Voltages available 5, 7, 8, 10, 13, 15, 17, 20, 33, 40 or 20V-0-20V or 25V-0-25V.

Ref	Amps	Price	P & P
102	0.5	3.75	0.90
103	1.0	4.87	1.10
104	2.0	7.88	1.31
105	3.0	9.42	1.52
106	4.0	12.82	1.73
107	6.0	16.37	1.89
118	8.0	22.29	2.39
119	10.0	27.48	O.A.
109	12.0	32.88	O.A.

### MAINS ISOLATORS (SCREENED)

PM 120/240 Sec 120/240V CT

Ref	V A	Price	P & P
*07	20	4.84	0.91
149	60	7.37	1.10
150	100	8.38	1.31
151	200	12.28	1.31
152	250	14.61	1.73
153	350	18.07	2.12
154	500	22.52	2.47
155	750	32.03	O.A.
156	1000	40.92	O.A.
157	1500	58.52	O.A.
158	2000	67.99	O.A.
159	3000	96.33	O.A.

\*Pri 0-220-240V Sec 115 or 240V. State sec. volts required.

### CASED AUTO TRANSFORMERS

240V cable in 115V USA flat pin outlet.

V A	Price	P & P	Ref
20	6.55	1.03	58W
75	8.50	1.31	64W
150	11.00	1.31	4W
250	12.56	1.67	69W
500	20.13	1.89	67W
1000	30.67	2.65	84W
2000	44.97	C.A.	95W

### 12 OR 24V OR 12-0-12V

Pri 220-240 volts

Amps	12V	24V	Price	P & P
111	0.5	0.25	2.42	0.52
213	1.0	0.5	2.90	0.90
71	2	1	3.88	1.10
18	4	2	4.48	1.10
85	5	2.5	6.16	1.10
70	6	3	6.99	1.10
108	8	4	8.16	1.31
72	10	5	8.93	1.31
116	12	6	9.89	1.52
17	16	8	11.79	1.89
115	20	10	15.38	2.39
187	30	15	19.72	2.39
226	60	30	40.41	O.A.

### AUTO TRANSFORMERS

Voltage for step up or step down

Ref	V A	(Watts)	£	P & P
113	15	0-115-210-240	2.73	0.81
34	75	0-115-210-240	4.41	1.10
4	150	0-115-200-220-240	5.70	1.10
67	500	0-115-200-220-240	12.09	1.91
84	1000	0-115-200-220-240	20.64	2.39
93	1500	0-115-200-220-240	25.61	O.A.
95	2000	0-115-200-220-240	38.31	O.A.
73	3000	0-115-200-220-240	65.13	O.A.
805	4000	0-10-115-200-220-240-84-55	10.45	O.A.
575	5000	0-10-115-200-220-240-98	45	O.A.

### CONNECTORS

Thorn, Cannon, Plessey, Bendix, Greenpar now available.

Soldering Iron - 25W to BS spec. £1.75 + 30p P&P + VAT.  
Solder Gun - 100W include bulb for spot on vision and joints £7.50 + P&P 70p + VAT.  
De-solder Pump - Spring loaded with quick action button release for one handed working. Large £5.10 P&P 35p + VAT. Small £4.75 P&P 30p + VAT.  
Replacement tips. Small 65p + VAT. Large 86p + VAT.

### BRIDGE RECTIFIER

Ref	Amps	Price	P & P
100V	2.5A	£2.80	
200V	4A	£2.82	
200V	4A	£5.75	
400V	4A	£9.98	
400V	6A	£1.44	
500V	PM7A6 12A	£3.75	

P & P 17p VAT 15%

### 20,000 ohm/V Multimeter

mirror, Scale ranges AC/DC to 1000V DC current to 250ma. Resistance to 3 M Ohms 5"x3 1/2" £14.36. P & P, £1.00. VAT 15%.

### AVO TEST METERS

Model	Price
Model 8 MK5	£100.50
Model 71	£40.80
Model 73	£55.40
Model MM5 minor	£35.95
Model Wire Megger	£22.20
Model TT169 in circuit transistor tester	£42.60
Model EM272 316KΩ per volt	£63.40
Model DA116 digital	£110.90
Model BM7 Megger	£55.40
Model stamp metre to 300A	£59.10

All Avos Meggers and accessories available P&P £1.32 15% VAT

### NEW RANGE TRANSFORMERS

2 windings - 0-36V-48V/36V-0-36V 48V-0-48V 72V or 96V.

Amps	Ref	Price	P & P
0.5	430	4.88	0.76
1.0	431	8.12	0.99
2.0	432	13.35	1.31
3.0	433	16.17	1.40
4.0	434	20.65	2.11
5.0	435	29.30	2.47
6.0	436	36.69	O.A.
8.0	437	40.03	O.A.

### TRANSFORMERS END OF LINE OFFERS

30-Isolator 240V:240V 200VA £4.54 £1.04  
**M616** - 240V: Screen 1) 13-0-13 1A 2) 12V 150ma £1.50 60p  
**M489** - 240V: 1400V • 150ma 6.3V • 4A £5.50 £1.04  
**M708** - 6K to 3Ω matching transformer 5W 90p 40p  
**M679** - 120V x 2; 36V 1.6A £3.00 78p  
**M865** - 100V Line to 4Ω 10 watts £1.75 60p  
**M1020** - 0-240V 12-0-12V - 50ma 75p 41p  
**M1126** - 120/240V: 9-0-9V - 1A £1.75 1/p

**ABS Plastic Boxes:** inset brass nuts, slots to take P.C. cards (boards) flush fitting lid.  
**PBI** - 80mm x 62 x 40 80p  
**PB2** - 100mm x 75 x 40 90p  
**PB3** - 120mm x 100 x 45 £1.04  
**PB4** - 215mm x 130 x 85 £2.88

**Antex Soldering Irons** 15W, 25W £4.58  
**Safety Stand** £1.75 P & P 52p each

**Metal Oxide Resistors** 1/2W 5% £1.00 per 100 a bargain. Use instead of Carbon Film!  
 30p P & P + VAT.  
 390Ω/470Ω/510Ω/560Ω/820Ω/1K/1K1/1K2  
 1K6/1K8/2K/2K4/3K/16K/20K/22K/24K/47K/82K/  
 100K/110K/120K/130K/180K/220K/270K/300K

### U4315 Budget Meter

20Kv/Ω Ranges to 1000V, 2.5A AC/DC 500K Res. In steel case £18.85 P&P £1.32

**SPECIAL OFFER Multimeter (20KΩ/Ω/V with combined audio/L.F. test oscillator at 1KHz, and 465 KHz AC/DC to 1000 volts DC current to 500 mA resistance to 1MΩ size 160x97x40mm £8.50. P&P £1.00. VAT 15%**

**Split Bobbin Type - 0-12-15-20-24-30V.**  
 Ref 009 - 1 Amp £2.98, P & P £1.10  
 Ref 010 - 2 Amp £4.65, P & P £1.10 open frame fixing. Other types available.

**"Educational" Meters (Moving coil)**  
 0-10A, 0-2A, 0-15V, 0-30V.  
 Free standing large scale easily read meters with top screw terminals for quick connections.  
 £4.50 P&P 66p + VAT

### PANEL METERS

43mm x 43mm	82mm	78mm	Price
0.50mA	6.20	0.50mA	6.70
0.500mA	5.95	0.500mA	6.70
0.1mA	5.95	0.1mA	6.70
0.30V	5.95	0.30V	6.70
VU Ind. Panel 48mm x 45mm or 40mm x 40mm 250uA fsd.	2.60		

SV041 Edge VU centre zero fsd £2.80  
 Carriage 76p. VAT 15%

Send 20p stamp for catalogue  
 Prices correct 31/6/80

### 15V Range

**0-C Tap (7.5V-0-7.5V)**

V A	Price	P & P	
171	50mA	2.30	0.52
172	1A	3.28	0.92
173	2A	3.95	0.90
174	3A	4.13	0.99
175	4A	6.30	1.10

**Burglar Alarm** - Ultrasonic 20ft range no. installation costs. Key operated; built in siren (external can be added). Looks like a speaker. £98.00 £2.00 P&P + VAT.

### SCREENED MINIATURES

Ref	mA	Volts	£	P & P		
238	200	3-0-3	2.83	0.63		
212	1A	1A	6-6	0-6	3.14	0.90
13	100	9-0-9	2.35	0.44		
235	300, 330	0-9-0-9	2.19	0.44		
207	500, 500	0-8-9-0-8-9	3.05	0.85		
208	1A	1A	0-8-9-0-8-9	3.88	0.90	
236	200, 200	0-15-0-15	2.19	0.44		
214	300, 300	0-20-0-20	3.08	0.90		
221	700(OC)	20-12-0-12-20	3.75	0.90		
206	1A	1A	0-15-20-0-15-27x26	09	1.10	
203	500, 500	0-15-27-0-15-27x28	49	1.10		
204	1A	1A	0-15-27-0-15-27x28	84	1.10	
239	50	12-0-12	2.88	0.43		
234	500	6	2.19	0.44		

**Barrie Electronics Ltd.**  
 3, THE MINORIES, LONDON EC3N 1BJ  
 TELEPHONE: 01-488 3316/7/8  
 NEAREST TUBE STATIONS: ALDGate & LIVERPOOL 5

# DIGITAL VOLTMETER MODULE



Fully built and tested, **ONLY £11.95 + VAT**

- \* Reads positive and negative voltages with a sensitivity of 0 - +999mV and 0 - -99mV
- \* Requires only single supply between 7 & 12 volts (220mA)
- \* High accuracy ±0.1% + 1 digit
- \* Large bright 0.43" high efficiency displays
- \* 4 readings per second sampling rate
- \* Size only 41 x 95 x 10mm
- \* Supplied with full data & applications information

This brand new, quality module manufactured by Autona Limited (who are one of the U.K's largest module manufacturers) means you can build accurate test equipment, multi-meters, thermometers, etc. easily and at a fraction of the cost of ready-made equipment. Full details are provided showing how to measure A.C. voltage, current, resistance and temperature.

Send your cheque or P.O. (£11.95 + £1.79 V.A.T. + 50pp. & p. = £14.24) now to:-

Dept. P.E.1  
**RISCOMP LIMITED**  
 21 Duke Street  
 Princes Risborough  
 Bucks. HP17 0AT

**BUCKINGHAMSHIRE'S NEW ELECTRONICS CENTRE**  
 8 miles off the M40  
 50 minutes from London  
 Telephone: (084 44) 6326

## PARNDON ELECTRONICS LTD.

44 Paddock Mead, Harlow, Essex, CM18 7RR. Tel: 0279 32700 (Dept. No. 21)

**RESISTORS:** 1/4 Watt Carbon Film E24 range ± 5% tolerance. High quality resistors made under strictly controlled conditions by automatic machines. Bandollered and colour coded.  
 £1.00 per hundred mixed. (Min 50 per value)  
 £8.50 per thousand mixed. (Min 50 per value)  
 Special stock pack. 60 values. 10 off each £5.50

**DIODES:** IN4148 3p each. Min order quantity - 15 items.  
 £1.60 per hundred

**DIL SWITCHES:** Gold plated contact in fully sealed base - solve those programming problems.  
 4 Way 86p each. 6 Way £1.00 each. 8 Way £1.20 each.

**DIL SOCKETS:** High quality, low profile sockets.  
 8 pin - 10p. 14 pin - 13p. 16 pin - 15p. 18 pin - 19p. 20 pin - 25p.  
 22 pin - 29p. 24 pin - 35p. 28 pin - 39p. 40 pin - 57p.

ALL PRICES INCLUDE V.A.T. & POST & PACKING - NO EXTRAS  
 MIN ORDER - U.K. £1.00. OVERSEAS £5 - CASH WITH ORDER PLEASE

**MONOLITH**

QUALITY REEL TO REEL & CASSETTE TAPE HEADS + MECHANISMS

POPULAR UNIVERSAL CASSETTE TAPE HEADS

812-01 Mono Playback	£1.89	C42RP40 Stereo GLASS FERRITE R/P	£11.60
812-02 Mono Record/Playback	£4.02	C42RPS18 Stereo TWIN GAP R/P	£25.21
824-01 Stereo Playback	£3.30	E12-09 Mono/stereo erase	£ 1.85
824-02 Stereo Record/Plbk	£6.66	B22-02 Twin 1/2 track R/P	£ 5.97
824-07 Stereo R/P (Dolby Stm)	£7.87	C44RP40 Quad 1/2 track R/P	£13.17
C42RPH20 Stereo SENDUST R/P	£9.28	C44RPS01 Quad 1/2 track combined R/P + Erase	£26.45
C42RPS01 Stereo combined R/P + Erase	£10.93	C22ES02 Twin half track erase	£ 4.72

SEND FOR OUR FULL CATALOGUE 50p including P. & P.

**MONOLITH**

THE MONOLITH ELECTRONICS CO. LTD.  
 5/1 CHURCH ST. CREWKERNE, SOMERSET, ENGLAND (0460) 74321

PLEASE ENCLOSE 30p P&P WITH ORDER  
 ALL PRICES INCLUDE VAT

# Semiconductor UPDATE...

FEATURING LM1871 LM1872 HM6564 T0237 TDA1085A R.W. Coles

## CONTROL PAIR

We can expect to see large numbers of cheap and capable radio control systems on the market in the near future, thanks to National Semiconductor. I suspect that many of these cheaper systems will fall into the category of "toys", even though these "toys" will be endowed with a digital proportional multi-channel control system which might have cost hundreds of pounds a few years ago!

At the heart of the new systems will be a pair of integrated circuits which between them comprise over 90% of the components required to build a complete 27MHz remote control transmitter and receiver system with two proportional channels and two on-off channels. The transmitter device is the LM1871, and with the addition of a few passive components an aerial, and a battery of between 5 and 16 volts, this diminutive 18 pin device can deliver a radiated signal sufficient to provide a reliable link to the receiver at ranges of at least 100 metres. The transmit frequency would normally be crystal controlled, and the operator controls can be provided by a couple of 500k pots (for the proportional channels) and a couple of toggle or push-button switches (for the on-off channels). The two pots can of course be linked to a joystick mechanism for the control of model aircraft or similar vehicles.

At the receive end another 18 pin device, the LM1872, is used to implement a sensitive and selective single conversion superhet with digital detection and decoding circuits and a powerful a.g.c. system. The LM1872 runs from a 6 volt battery supply and uses a crystal controlled local oscillator and a 455kHz i.f. frequency to obtain a sensitivity of better than 15 microvolts. After decoding, the two proportional channel outputs provide variable width pulse streams for direct input to most control servos. The two on-off channels are latched and their outputs can source or sink up to 200 mA, sufficient to operate motor control relays or other actuating circuits directly.

The basic package offered by the chip set from National is undoubtedly aimed at the high volume market where costs need to be held to just a few pounds per system, but by suitable alterations and additions to the basic circuit it is possible to produce a system with additional proportional channels and with increased transmitter power for greater range. In short these devices

should prove of great interest to serious radio control enthusiasts as well as to those of us looking forward to more fun on Christmas Day!

## MOTHER CHIP

There is a lot of talk about 64K RAM chips at the moment, and many large advertisements in the professional journals proclaiming the imminent arrival of these devices from Texas, Motorola, and others. These new devices will all be NMOS dynamic parts, as this technology is always in the lead as far as capacity and cost per bit are concerned. Other technologies such as NMOS-static and CMOS-static are always one and two generations behind respectively, as evidenced by the current NMOS-static state of the art, a 16K device organised as 2K x 8 and the equivalent in CMOS-static, a 4K device organised 4K x 1 or 1K x 4.

These lower capacities are related directly to the physical size of the basic storage devices on the chips concerned. Dynamic storage cells are very small and simple, the other technologies use bigger and more complex cells and so we have to make do with fewer of them for the same price.

In an attempt to short circuit the CMOS size disadvantage, Harris have come up with a new and quite unique device coded the HM6564. This new offering to those who need both large memory capacity and the well known advantages of CMOS low power technology, effectively leap-frogs two generations by being a 64K CMOS-static device, no less, and released at the same time or even before the 64K NMOS dynamics. An amazing breakthrough in CMOS memory technology? Not really. The HM6564 uses a single ceramic dual in line package with 40 pins, but mounted on the package are no less than 16 separate 4K x 1 chips which in themselves are standard devices usually packaged separately.

To the user, the HM6564 appears as two 8K x 4 arrays each with independent chip enables and write enables. A likely connection configuration would be to link the two blocks to form an 8K x 8 array of static RAM memory with a standby power consumption of only 5mW.

Because of the labour intensive nature of this type of packaging these devices will never be cost competitive with the NMOS dynamics, but for some applications where the small size of such a large parcel of memory can be put to good use, they will

undoubtedly fill a real need.

## COOL CUSTOMER

National have a new package to compete with T05s where the older devices are used close to their maximum power dissipation, as they may be in stereo power amplifiers for example. The new package, coded T0237 is about the same size as any other plastic transistor package except that it sports a heat radiator tab on the top and has its leads preformed to fit the T05 pin circle. The package uses a new patented epoxy plastic and National claim that devices using it can last up to eight times longer than equivalent devices packaged in metal cans, because the transistor chip is kept so much cooler for a given dissipation.

There are already 65 standard transistor types available in the T0237 package, including *pnp* and *nnp* types and some direct replacements for standard T05 devices. Prices are about 40% of the equivalent metal can price.

## MOTOR CONTROLLER

The speed control of series wound a.c. motors is an ideal case for the use of phase-angle control via a triac power switch. Such motors are to be found in power tools, washing machines and fans, and the simplicity of triac speed control has made the technique popular even for low cost appliances.

Speed control can be achieved either open-loop, where no account is taken of load fluctuations, or closed loop where the motor back-EMF is used as feedback to stabilise motor speed even in the face of load changes.

A new circuit from Motorola, the TDA 1085A, is a complete motor control sub-system in a 16 pin package. Able to be used in both open and closed loop controller schemes, the new device needs only a few passive components and a triac to turn it into a cheap and capable speed controller. For applications requiring only a "slow" "medium" and "fast" speed selection there are programming package pins available to minimise external circuitry. Fully variable speed control is possible by means of an external 100k pot. To overcome surge currents due to stalled or stopped motors, the TDA 1085A, features a "soft start" circuit and current limiting.

This could be the answer for that drill speed controller you have always promised yourself!

# CINE FRAME COUNTER



**STEPHEN IBBS**

WHEN MAKING cine films it is often necessary, e.g. for fades, single-frame sequences etc., to be able to count accurately how many frames have been exposed. Most cine cameras nowadays have a set of flash contacts that close once per frame. The project described here uses this fact to produce a three digit frame counter capable of counting from single frame to full speed. The display can be blanked to save battery power but still retaining the count facilities, or can be set to zero by merely turning the power off briefly. The unit is connected to the cine camera by a flash lead and has proved itself to be of immense value.

## HOW IT WORKS

IC1a and b are connected as a monostable multivibrator, (See Fig. 1) the purpose of which is to 'debounce' the flash contact switch S2 inside the cine camera. This is necessary otherwise spurious figures would result. The clock pulses are fed into IC2 which is quite a recently developed i.c. This is the 4553, a 3 digit BCD counter/driver. This chip produces a BCD output, which is fed into IC3, a BCD decoder and 7 segment display driver. The output is fed to all three displays at once, but only one is switched on at any one time because the cathodes are connected back to pins 2, 1, and 15 of IC2. The capacitor between pins 3 and 4 of IC2 control how fast the switching takes place between the digits, and the value of 1n makes the switching so fast that it looks like a continuous display. This technique is called multiplexing and is an ingenious way of saving on interconnecting wires and battery drain.

Normally pin 4 of IC3 is held high by R8, but if S3 is closed, pin 4 is brought low, and this blanks the display, but does *not* affect the counting process. This is a useful way of saving battery power during long count periods.

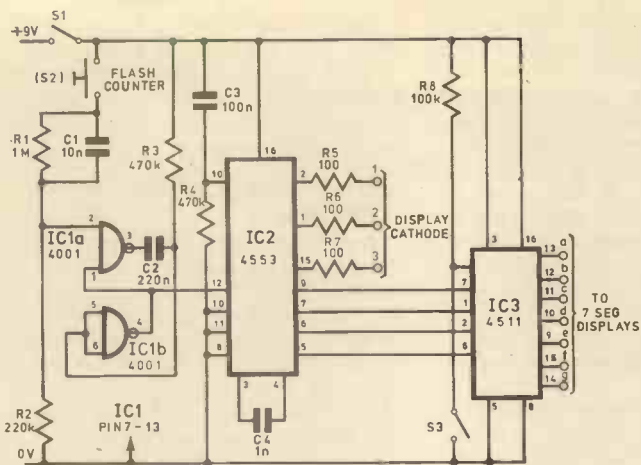
Pin 13 of IC2 is a reset pin which makes the display read 000 when it is high. To make sure that the display reads this at switch-on, a brief reset pulse is fed to this pin via C3. Pin 13 is then brought low by R4, and counting can start. This takes but a fraction of a second.

## CONSTRUCTION

Readers are advised to use a p.c.b., and a recommended design is given in Fig. 2. Check that the i.c.s are mounted the right way round. The awkward part about construction is the mounting and wiring of the 3 digits. The author mounted them in 0.1in. stripboard, breaking tracks where necessary.







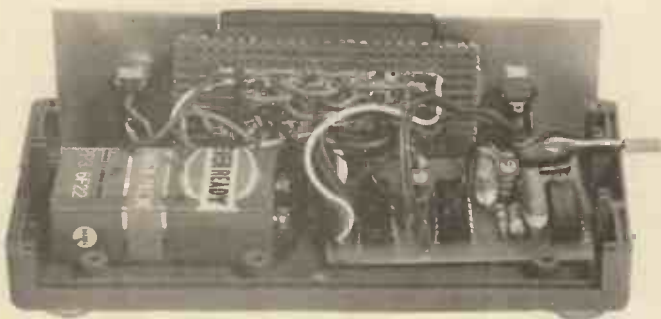
EG407

Fig. 1. Circuit diagram. S2 is the flash contact switch inside the cine camera.

The appropriate pins were then wired together with short lengths of insulated wire. A section of the front panel of the Verobox (aluminium) was cut away, and the display mounted using spacers and epoxy resin. The mounting pillars were removed with a hot wire, and the p.c.b. stuck down with double sided sticky pads. The two switches were mounted either side of the display, and a piece of red perspex placed in front of the display to improve the contrast. Constructors may like to add a push-to-make switch, in parallel with C3, to enable the display to be set to zero without switching the power off. Leads were then run from IC3 to the various digit segments, and the three cathodes, which are not wired together(!) are joined to the appropriate pins 2, 1, 15 of IC2.

A small hole was drilled in the back panel, and a long flash lead was purchased, one end cut off and soldered to the p.c.b. in the S2 position, and the other end is then connected to the cine camera.

If constructors find that they are still getting spurious counts (more than they have shot), it means that they have a "noisy" switch, and C2 needs to be increased slightly, to lengthen the monostable pulse.



## COMPONENTS . . .

### Resistors

R1	1M
R2	220k
R3,R4	470k (2 off)
R5-R7	100 (3 off)
R8	100k

### Capacitors

C1	10n
C2	220n
C3	100n
C4	1n

### Integrated Circuits

IC1	4001
IC2	4553
IC3	4511

### Miscellaneous

S1	SPST min. toggle
S3	SPST min. toggle
Verobox	
	3 off i.e.d. 7 segment CC displays
	P.c.b. or stripboard
	Red perspex
	Battery clip

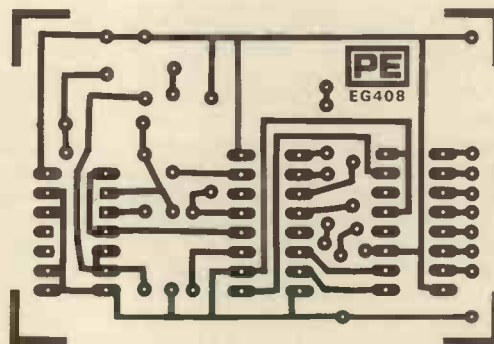
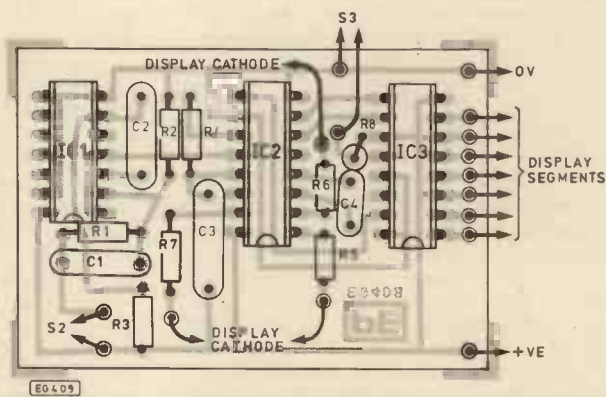


Fig. 2. Printed circuit layout (actual size)



EG409

Fig. 3. Component layout. In the prototype, a piece of stripboard was used to mount the displays behind the front panel window.



# SPACEWATCH

FRANK W. HYDE

## THE LEASAT COMMUNICATIONS SATELLITES

The Leasat Communications Satellites are a new generation tailored to the Shuttle era. They will be part of a new network. The network was primarily aimed at ships and submarines and a major part of the leasing will be taken up by the Defence Department of the United States. This means that it will constitute a part of the defence communications of the Navy, Army and Air force.

Production work is already under way at Hughes Aircraft and the operation of the four control stations together with the control centre will be carried out by Hughes Communications Service. The control centre will be at Los Angeles and the four control stations will be Guam, California, Virginia and Hawaii. The service will be leased for 67 million dollars per annum. Initial launch data provides for the first satellite to be put into orbit in January 1984.

The Leasat design is based on the previous successful vehicles Syncom 4. Hughes were responsible for the cost effective spin-stabilised satellite concept. The design is directed at shuttle launching and this has made it possible to do a number of useful modifications to the shape of the satellite and also make savings of space. The satellite will be increased in diameter to 14 feet. The space on board the shuttle available for the satellite is 15 feet. The net result is that the satellite can be expanded in diameter and shortened in length thereby saving launch costs. At the moment it means that the launch date is dependent on shuttle progress so that already some delays have put the date back to 1984. However the avoidance of the cost of the expendable launch vehicles has enabled the satellite itself to be modified. Major testing has already begun on the ejection system, aerial interference tests and the firing of the satellites propulsion stages. The satellite weighs about 15,000lbs.

The advantage of the new design is that more space is available in the satellite and the propulsion system can be mounted internally. The launch system is called the Frisbee technique because the satellite is thrown clear of the shuttle with the spin motor set for a 2rpm rate. It is released by a spring catch giving a velocity of 1.5 feet/second. The satellite is easily clear of the shuttle and then the spin is increased to 30 rpm. The perigee kick motor is fired at 45 minutes after release. The motor kick lasts one minute. The satellite is then injected into the geosynchronous orbit and the twin apogee liquid fuel thrusters are fired to circularise the orbit. Meanwhile the apogee motor case is jettisoned.

Once the orbit is attained the folded aerals will be deployed. These consist of two helical arrays, one for transmission and one for reception. They have an allocated frequency in the UHF band. There are also aerals for the SHF band. Station keeping will be carried out using a monopropellant system of hydrazine by statagically placed thrusters also built by Hughes.

## LANDSAT 2

Landsat 2 which was retired from service at the beginning of the year has been restored to operational status. Engineers decided that it was the flywheel lubrication that was at fault. After several unsuccessful attempts to reactivate the three axis system the matter was left for several months. However during a communication exercise the flywheel responded, with the possibility of normal operation. By this time though the gas for attitude control had become depleted.

Research had been carried out with a view to using magnetic torque to keep the satellite operational. This has been a successful ploy. The satellite has three magnetic coils, one on each axis. By energising the coils at preselected points in orbit, the accumulated momentum which causes the flywheel to saturate, can be dissipated without the use of the gas.

Landsat 2 is now providing better imaging than before. There is still a problem because the four recorders are out of action. Communication therefore has to be direct to the ground.

## COMET CHASER GIOTTO

The European Space Agency Science Programme Committee made the final decision to go it alone with a mission to intercept Halley's Comet. The point of interception will be just after perihelion, the point when it is nearest to the Sun, when for four hours the spacecraft will collect data. The flyby will take place in 1986 and it is hoped that much more will be known of the nature and composition of cometary bodies.

The Ariane will be used as the launcher and the tracking will be carried out by using the Parkes Radio Telescope in Australia and the Weilheim facility in Germany.

It is of the utmost importance to science that this encounter with Halley's Comet should take place not only because this opportunity will not come again for 75 years or so but also because science needs to know as much as possible about the cometary bodies; What is their make up? and how do they fit into the scheme of the Solar System the

Galaxy and the Universe? During that period of 75 years there will be such tremendous strides in space techniques it is important, as soon as possible to have confirmation or perhaps modification of the present cosmological theories.

## SMM, THE SOLAR MAXIMUM MISSION

In February this year the special spacecraft SMM was launched upon a mission to study a star. That star is the nearest one to the Earth. It is the Sun, pouring down upon the surface of the Earth radiation over the full extent of the electromagnetic spectrum, giving life and destroying life for this is raw nature. Like so many items of study by scientists the more that is discovered the more there remains to be studied and understood. It provides the means for communications and is also the cause of preventing those very communications. It causes the atmosphere to become a destroyer while providing the means of subsistence for the flora and fauna of the Earth.

The spacecraft SMM will endeavour by its programmed activities to examine the radiations, the flares, the second to second changes on the surface and from this, the observers will try to make sense from the data. The Sun is in the act of destroying even itself by flinging vast amounts of its substance away every second. What appeared to the naked eye a signpost of stability is now known to be unstable, varying in size, with a temperature in its interior beyond anything that could be developed by man. Mankind by gradually sifting data and learning how to tame this controller of destiny is able in some measure to turn the situation to advantage. Part of this story is the proposal to collect the energy, beam it down to Earth and light up and warm towns and cities.

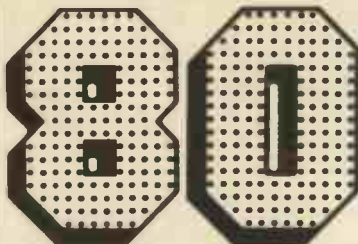
On board SMM there are seven instrument packages each with its own mission task. They are the gamma-ray spectrometer, the hard X-ray imaging spectrometer is an extremely sensitive instrument that can resolve down to 8 minutes of arc and detect X-rays with energies of the order of 3.5 to 30keV. There is also a hard X-ray burst spectrometer to deal with some of the puzzles of the X-ray burst stars. This instrument has a caesium iodide detector which can operate up to 300keV with a duration as short as 10ms.

An X-ray Polychromator which can provide spectra of emission lines at wavelengths between 0.14 and 2.24 nanometres.

An active cavity radiometer with three pyroheliometers will measure the emission of the solar radiation from far infrared to ultraviolet at about 0.1 percent accuracy.

An ultraviolet spectrometer and polarimeter which has a reflecting telescope with a field of view of 4 arc seconds square. The resolution of this instrument is 3 arc seconds. The main purpose of the instrument is to scan the chromosphere and the corona. This is a new instrument not used before.

Finally there is the Coronagraph—polarimeter. It will be possible to take pictures of the corona with a vidicon camera with about 900 by 900 picture elements. This system will work in the wavelength region of 400 to 700 nanometres.



26th Nov — WEDNESDAY — 10am-6pm  
 27th Nov — THURSDAY — 10am-8pm  
 28th Nov — FRIDAY — 10am-6pm  
 29th Nov — SATURDAY — 10am-6pm  
 30th Nov — SUNDAY — 10am-4pm

COMPONENTS DEMONSTRATIONS SPECIAL OFFERS MAGAZINES BOOKS

## Royal Horticultural Halls Elverton Street

Westminster London SW1

November 26-30 1980

### It's all at Breadboard '80

This is **the** exhibition for the electronics enthusiast. From November 26-30 there is only one place in the universe for the electronics enthusiast to be — Breadboard '80, at the Royal Horticultural Hall in London. The majority of leading companies will be exhibiting, including all the top monthly magazines in the field. There will be demonstrations on most stands and many feature special offers that are **EXCLUSIVE** to Breadboard!

All aspects of this fascinating field are catered for, from CB to home computing, so whether you want to buy a soldering iron or a synthesiser — or just keep up to date with your hobby — don't miss Breadboard '80.

Advance Tickets, Modmags Ltd,  
 145 Charing Cross Rd, London WC2H 0EE

**AVOID QUEUES — GET ADVANCE TICKETS**

Send to: Advance Tickets, Modmags Ltd,  
 145 Charing Cross Rd, London WC2H 0EE

Please send: ..... tickets @ £1.50

..... tickets @ £1.00 (Student/Child/OAP)

TO: .....

I enclose P.O./Cheque for £ .....

# Faster than a scope safer than a voltmeter

**LOGIC  
 MONITOR  
 LM-1**



## Instant — simultaneous monitoring of the logic state of all IC nodes

Just clip it over your IC

LM-1 instantly and accurately shows both static and dynamic logic states on a bright 16 LED display.

LM-1 finds its own power.

LM-1 cuts out guesswork, saves time, and eliminates the risk of short circuits.

LM-1 is suitable for all dual-in-line logic ICs LED on = logic state 1 (high), LED off = logic state 0 (low), and each LED is clearly numbered 1 to 16 in the conventional IC pattern.

**ONLY £28.70** (Excluding P&P and VAT)

Total £34.44 including box and instruction manual.

CONTINENTAL SPECIALTIES CORPORATION



C.S.C. (UK) Limited, Dept 5S,  
 Unit 1, Shire Hill Industrial Estate,  
 Saffron Walden, Essex CB11 3AQ.  
 Tel: Saffron Walden (0799) 21682  
 Telex: 817477

C.S.C. (UK) Limited, Dept. 5S, Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.  
 LM-1 £34.44 (incl. P&P and 15% VAT) Qty. Req.  For FREE Catalogue tick box

Name ..... Address .....

I enclose PO/cheque for £..... or debit my  
 Barclaycard, Access, American Express No. ....  
 exp. date .....

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

# THIS WAY YOUR ELECTROVALUE CATALOGUE IS IS ALWAYS UP TO DATE



EVERY THREE MONTHS WE PUBLISH AN UP TO DATE PRICE LIST FOR USE WITH OUR CURRENT CATALOGUE. THESE ARE MAILED FREE VIA OUR COMPUTER TO REGULAR CUSTOMERS. IF YOU WOULD LIKE A FREE COPY JUST WRITE OR PHONE. ALSO FOR CURRENT 120 PAGE CATALOGUE FREE IF YOU SO WISH.

## OUR MINI-SELECTION POINTS THE WAY!

### EXAMPLE ONE — SOLDERING IRONS

Oryx 50	£12.08 net	Antex X25	£4.83 net
Isotip	£25.90 net	Desolder tool SR3A	£7.48 net
Antex C	£4.83 net	500 gm reel solder	£7.59 net

### EXAMPLE TWO — PRINTED CIRCUIT MATERIALS

PCB's 300 x 150 mm		Etch Resist Pen	£1.21
SRBP S/S £1.38	D/S £1.73	Breadboards	
F/Glass S/S £2.19	D/S £2.48	Bimboard 12	£9.23
Positive resist 75cc	£1.67	Eurobreadboard	£5.56 net
Ferric Chloride 500g	£3.45	T-DeC	£5.18

### EXAMPLE THREE — SWITCHES

Chrome toggle		13A time switch adaptors	
Std. SPST 65p	DPDT 89p	Smiths TS 100	£14.43 net
Min. SPDT 66p	DPDT 92p	Wavechange Lorlin, 1P12W, 2P6W, 3P4V, 4P3W	46p each

### EXAMPLE FOUR — CAPACITORS BY SIEMENS

Polyester 7.5mm PCM  
1, 1.5, 2.2, 3.3, 4.7nF, 10, 15, 22, 33, 47nF 8p each, 0.1u 12p, 0.15u 14p, 0.22u 18p, 0.33u 21p, 0.47u 27p, 0.68u 34p, 10mm PCM 1u 37p.  
Electrolytic, axial, (uF/V)  
1/40 15p, 1/100 12p, 2.2/25 15p, 2.2/63 12p, 4.7/16 15p, 4.7/40 12p, 10/25 12p, 10/40 13p, 22/25 13p, 22/40 13p, 22/63 19p, 47/10 13p, 47/25 16p, 47/40 19p, 47/63 20p, up to 1000/16V 32p, then 1000/25V 44p, etc.  
Also full supporting ranges of other ceramic, plastic and electrolytic caps.

### EXAMPLE FIVE — POTENTIOMETERS BY RADIOHM

Single gang lin or log	34p	(Twin types stereo matched)	
Twin gang lin or log	93p	Slider knobs	10p each
Mono slider lin or log	83p	Presets lin, horiz. or vert.	12p
Twin slider lin or log	136p		

### EXAMPLE SIX — RESISTORS

1/2, 3/4W 2.3p 1W 6p  
Wirewound from 23p

WE ARE STOCKISTS  
FOR I.L.P.  
TOROIDAL TRANSFORMERS

### AND AS FOR SEMI CONDUCTORS

1N914	6p	40362	75p	BB103	43p	MPSA63	44p	TIP3055	69p
1N4007	9p	40636	£1.69	BB104	70p	OA47	14p	TIS43	40p
1N4148	5p	40673	99p	BB105	37p	OA90	8p	WO2	35p
1N5402	19p	555	34p	CO16D1	52p	OA202	16p	ZN425E	£4.49
2N1599	£1.01	556	58p	CA140E	46p	OC29	£1.23	ZTX107-9	14p
2N2389A	24p	AC128	36p	E1110	92p	OC36	£1.18	ZTX300	14p
2N3055	81p	AC176	67p	E1210	92p	T2800D	£1.20	ZTX500	16p
2N3702	11p	AD136	£4.25	LM301AN	35p	TIP31A	52p		
2N4443	£1.78	AD149	£1.01	LM324N	67p	TIP32A	52p		
2N4444	£2.28	AD161	40p	LM380N	£1.14	TIP41A	69p		
2N4991	72p	AD162	52p	LM3900N	78p	TIP41C	74p		
2N5457.9	45p	AF127	43p	MJE2955	£1.38	TIP42A	69p		
40HF40	£2.25	AL102	£1.84	MJE3055	£1.00	TIP42C	74p		
40361	49p	BA379	29p	MPSA12	42p	TIP2955	69p		

For full range -  
see Catalogue.

**INFORMATION** - To show everything we supply would take about seven pages of closely packed type in this journal - the range is enormous, including not only opto devices and very advanced sophisticated items, but all the everyday things you need as well down to nuts and washers! IT'S ALL IN CATALOGUE 10 - OUR 120 PAGE CATALOGUE FREE FOR THE ASKING.

**PRICES AND V.A.T.** - All prices quoted here include V.A.T. for U.K. orders. Overseas buyers deduct 13% when ordering.

**POSTAGE** - For orders up to £5.75 value (U.K.) please add 40p for p/p. If over, orders sent post free in U.K. Overseas orders sent at cost (Min. 40p).

**DISCOUNTS** - 5% allowed on non-net items if order value exceeds £11.50, 10% if order value exceeds £29. Quantity discount prices on most components.

**ELECTROVALUE LTD.** DEPT. PE/10, 28 St. Judes Road, Englefield Green, Egham, Surrey TW20 0HB. Phone Egham 33603 (STD 0784 - London 87). Telex 264475 Northern Branch (Personal Shoppers only) 680 Burnage Lane, Burnage, Manchester M19 1NA Phone (061) 432 4945.



# Wilmslow Audio

THE firm for speakers!

SEND 50p FOR THE WORLD'S BEST CATALOGUE OF SPEAKERS, DRIVE UNITS, KITS, CROSSOVERS ETC. AND DISCOUNT PRICE LIST.

- AUDAX ● AUDIOMASTER ● BAKER ●
- BOWER & WILKINS ● CASTLE ● CELESTION ●
- CHARTWELL ● COLES ● DALESFORD ●
- DECCA ● EAGLE ● ELAC ● EMI ● FANE ●
- GAUSS ● GOODMANS ● HARBETH ●
- ISOPHON ● I.M.F. ● JORDAN ● JORDAN
- WATTS ● KEF ● LOWTHER ● MCKENZIE ●
- MISSION ● MONITOR AUDIO ● MOTOROLA ●
- PEERLESS ● RADFORD ● RAM ● ROGERS ●
- RICHARD ALLAN ● SEAS ● SHACKMAN ● STAG ●
- TANNOY ● VIDEOTONE ● WHARFEDALE ●

## WILMSLOW AUDIO (Dept. P.E.)

SWAN WORKS, BANK SQUARE, WILMSLOW, CHESHIRE SK9 1HF

Tel: 0625 529599

FOR MAIL ORDER & EXPORT OF DRIVE UNITS, KITS ETC.

Tel: 0625 526213

(SWIFT OF WILMSLOW) FOR HI-FI & COMPLETE SPEAKERS

## AT BLINKIN' LAST

# COLOURBOARD II

THE NEW 50HZ COLOUR VERSION OF OHIO SCIENTIFIC'S SUPERBOARD II IS HERE AND LIKE A TON OF BRICKS DOWN CRASHES THE PRICE OF STANDARD SUPERBOARD II

50HZ UK BLACK AND WHITE SUPERBOARD II £159.95+15% VAT POST FREE.  
COLOURBOARD II £205 + 15% VAT.

THE UNIQUE SPECIAL OFFER YOU CAN'T RESIST

- \* \* \* \* \*
- \* If bought with superboard or colour board these items are at the reduced prices shown first. Also sold separately at the bracketed prices. Add 15% VAT. Modulator and power supply kit £7.95 (£11). 4K extra ram £20 (£24). Case £23 (£26). Cassette recorder £13 (£15). Colour Conversion Board £45 (£45). Super Print 800MST printer £399 (£399).
- \* \* \* \* \*



### BATTERY ELIMINATOR KIT

100ma radio types with press-stud connectors 4+V £1.49, 6V £1.49, 9V £1.49, 4+4+3V £1.92, 8+6V £1.92, 9+9V £1.92. Stabilized TTL computer supply 5v 2A £7.44, 5v 4A £12.60. Stabilized 8-way types 3/4/6/7/9/12/15/18v 100ma £2.60, 1A £6.50, 2A £9.84. Stabilized variable voltage models 2-18v 100ma £2.60, 1-30v 1A £6.75, 1-30v 2A £12.10. 12v car converter 6/7/9v 1A £1.35.

### SINCLAIR (THANDAR) PRODUCTS

SC110 10MHz oscilloscope (Illustrated) £144.95. PFM200 £51.95, case £2.07, adaptor £4.20, connector kit £13.95. Microvision TV £89, mains adaptor £6.88. PDM35 £34.25, mains adaptor £4.20, case £2.07. DM350 £76.70, DM450 £102.17, DM235 £55.55. Accessories for all 3 models - rechargeable batteries £7.99, mains adaptor/charger £4.20, case £8.90. Enterprise prog calculator £19.95. TG105 pulse generator £87. Bench frequency counter £150.

### BATTERY ELIMINATORS

3-way switched type with 4-way multijack 6/7/9v 300ma £3.14. 100ma radio models with press-stud connectors 9v £3.77, 9+9v £4.99. Fully stabilized model 3/6/7/9v 400ma £6.50. Car converter 12v 3c input, output 3/4/6/7/9/12v 800ma £2.76.

## SWANLEY ELECTRONICS

Dept. PE, 32 Goldsai Rd., Swanley, Kent BR8 8EZ.

Mail order only. Please add 35p postage. Prices include VAT unless stated. Lists 27p post free. Overseas customers deduct 13%. Official credit orders welcome.

# Special RECORD DECK

**Offer**  
**£24**  
**EACH**



**INCLUDING STEREO MAGNETIC CARTRIDGE and V.A.T.**  
**POSTAGE £2.50 for ONE or £3.75 for TWO DECKS**

To tie up with our *Disco Desk* series PE has been able to arrange a special offer on these BSR decks either singly or in pairs. The decks are also excellent for use with general purpose audio systems.

## THE DECK

- ★ BSR P182
- ★ Fitted ADC, QLM 30 Mk III stereo magnetic cartridge
- ★ Automatic cueing for 7, 10 or 12 inch records
- ★ Manual cue lever with viscous damping in both directions
- ★ S shaped pick-up arm with counter balance weight
- ★ 3 speed with idler wheel drive
- ★ Automatic and manual pick-up arm clip
- ★ Dynamically balanced 4 pole motor
- ★ Flared aluminium turntable
- ★ Rumble > -29dB relative to 1000Hz at 1.2 cm/sec
- ★ Wow < 0.03% r.m.s. Flutter < 0.08% r.m.s.
- ★ Ready wired phono output sockets
- ★ 240V 50Hz with 450mm (approx) long double insulated flying mains lead
- ★ Transit screws
- ★ Size approx 290 x 330mm

To: RT-VC, 21B High Street, Acton, London W3 6NG

### Mail order only

Please send me

Deck/s

One deck £24 plus £2.50 p&p (£26.50)

Two decks £48 plus £3.75 p&p (£51.75)

I enclose PO/Cheque No. .... Value .....

Name .....

Address .....

.....

.....

Please allow 28 days for delivery

**OFFER CLOSSES FRIDAY NOVEMBER 14 1980**

.....

Name .....

Address .....

.....

.....

To: RT-VC, 21B High Street, Acton, London W3 6NG

Please complete both parts of the coupon in BLOCK CAPITALS

# LEAD TESTER

**I.C. LARE** B.Sc. M.Sc.

## For mono jack and Cannon connectors

**M**ANY of the problems which occur in PA systems, be they for group or disco use, are the direct result of lead failure. It is worth remembering that a typical small group rig will need upwards of 40 signal leads and the probability of failure of at least one is fairly high. This is not surprising when it is considered that these leads suffer from repeated coiling, stretching, bending and beer. A faulty lead somewhere in the system can be very hard to find, particularly in the semi-darkness with time running out and so a lead tester must be considered as part of any PA setup. Regrettably, many lead testers available fail to check the lead properly, or do not stand up to life on the road, breaking down at the most vital moment.

The design presented here is for a tester that is easy to use, robust, and performs a rigorous test of the lead.

### DESIGN PHILOSOPHY

In formulating a successful design the following conditions were drawn up.

- Nearly all stage leads are either mono jack or balanced line with Cannon connectors. Other leads are sometimes used, but these tend to be rather diverse, and it is not possible to design an absolute tester for every combination. Accordingly, the tester was designed for jack and Cannon only.
- The tester must be simple to operate. Once the lead is plugged in pressing a single button must initiate a complete test sequence.
- Many testers check each core of the lead for open circuit, and then for shorts between signal cores and earth. This is acceptable for mono jack leads but fails when Cannon leads are tested. In such a lead a short between earth and a signal core will cause increased hum and some loss of signal, since the lead is then unbalanced—Fig 1. This will be found by a standard tester, but it will not find a short between the two signal cores which gives rise to total lead failure. The tester must therefore check each core, including the earth for open circuits, and also check for a short between any combination of cores.
- The lead status should be clearly displayed, and the type of failure indicated. The display must be readable in poor light.
- The tester must be self contained, robust and reliable.



### THE CIRCUIT

The lead status is displayed on seven l.e.d.s, one green indicating that the lead has passed, the other six red ones corresponding to the possible failure modes. The circuit is designed around CMOS logic; this being compact and not requiring much supply current. It does however have one disadvantage since drive transistors are required for the l.e.d.s. TTL logic, although not requiring the transistors would present an unreasonable load on the battery.

The circuit is shown in Fig. 2. It consists of four D-type flip flops through which a '1' is clocked and used to check each

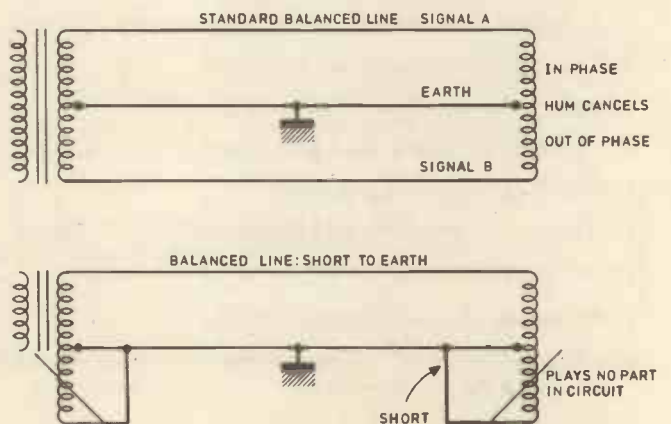


Fig. 1. Non-fatal short on line

lead core in turn. The three core test circuits are identical. If the core is intact both inputs to the Exclusive-OR remain the same and no output is generated. An open circuit will cause the EX-OR output to go high, lighting the relevant l.e.d. The diode across the EX-OR only enables the transistor drive when the associated flip flop is high to prevent spurious open circuit indications if a short circuit is present. Diodes D2-4 prevent a level clash if a short exists. The cores are pulled down by the 100k resistors. This value is high enough to allow faults involving the semi-conducting layer found in microphone cable to be detected.

Any short circuits will be detected by the AND gate connected to each pair of cores. Again, the relevant l.e.d. will light up in the event of a failure. If no failures are detected the fourth flip flop will be clocked lighting the 'O.K.' l.e.d.

When an l.e.d. lights the base of TR8 is pulled down, and the inhibit line goes high, stopping the clock. This means that the status of the lead is displayed until the test button is released. The clock is inverted to ensure that the inhibit will only generate a high to low transition, thus not affecting the flip flop states.

The flip flops are initially set and reset by IC1d which holds the relevant inputs high for a brief period after test is

pressed. Diode D1 allows the capacitor to discharge quickly after test is released.

If a mono jack plug is to be tested switch S1 bypasses IC3a so that core B is not tested.

### CONSTRUCTION

The tester was built into a die-cast aluminium box, measuring approximately 150 x 80 x 50mm. The parts are fairly tightly packed, and it is suggested that care is taken if a different box is used. Two printed circuit boards were used, the main one holding all the i.c.s and associated components, the other the display l.e.d.s and driver transistors. The details of the p.c.b.s are shown together. It is not possible to use sockets for the i.c.s because of the greater depth of the board.

The main board is fixed into the bottom of the box with three 6 BA bolts, a nut serving to separate the board from the base of the box. The battery pack fits in the missing section of the p.c.b. and was held in place with a single angle bracket.

The l.e.d. display is arranged as a circle with the three cores drawn as spokes. An l.e.d. is placed on the circle between the spokes and on each intersection to correspond to

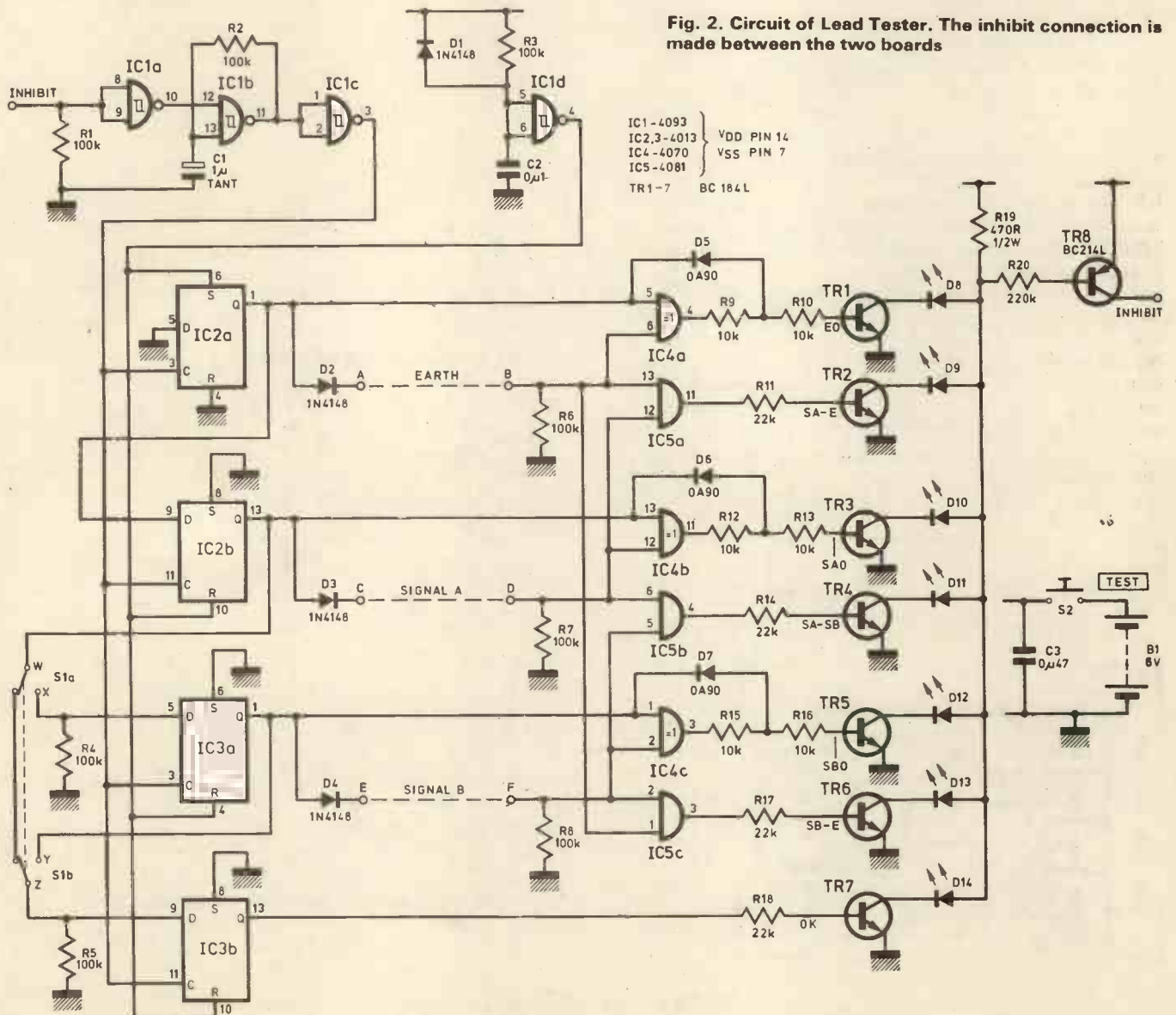
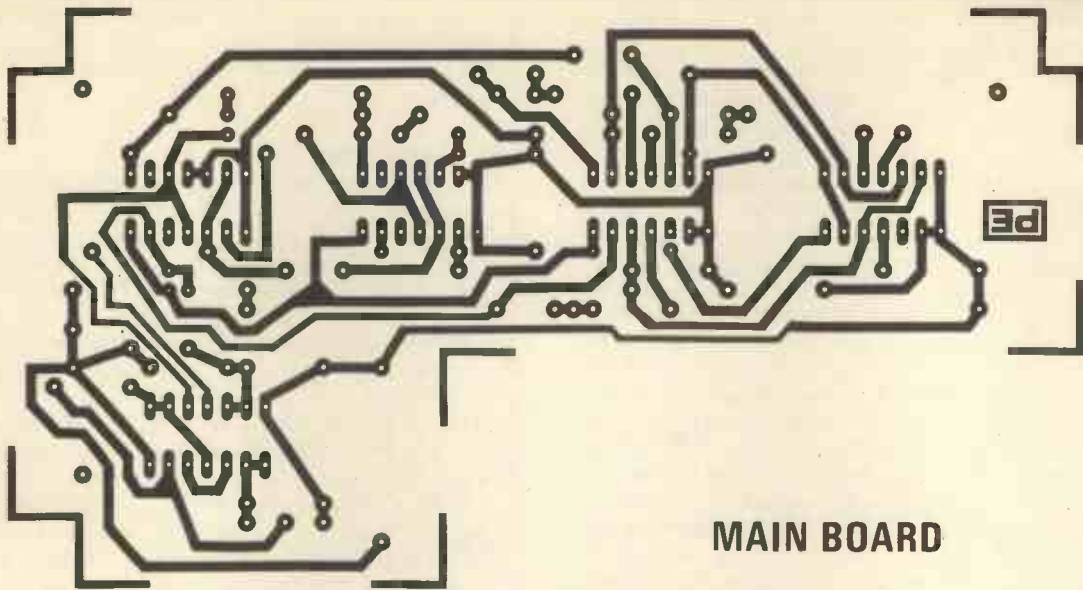
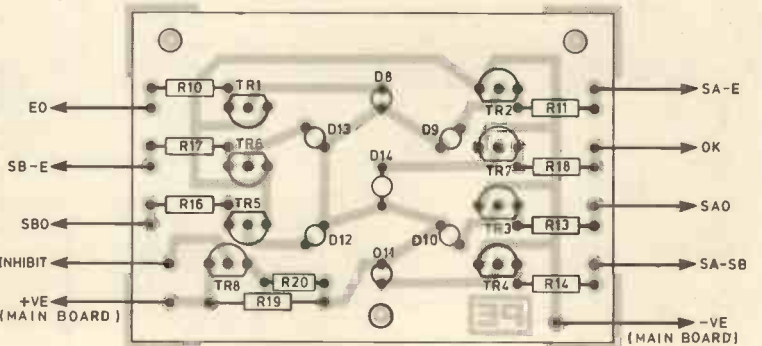
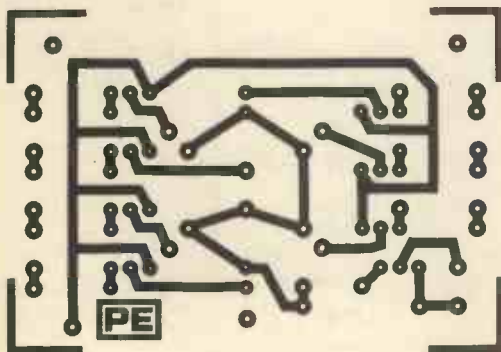
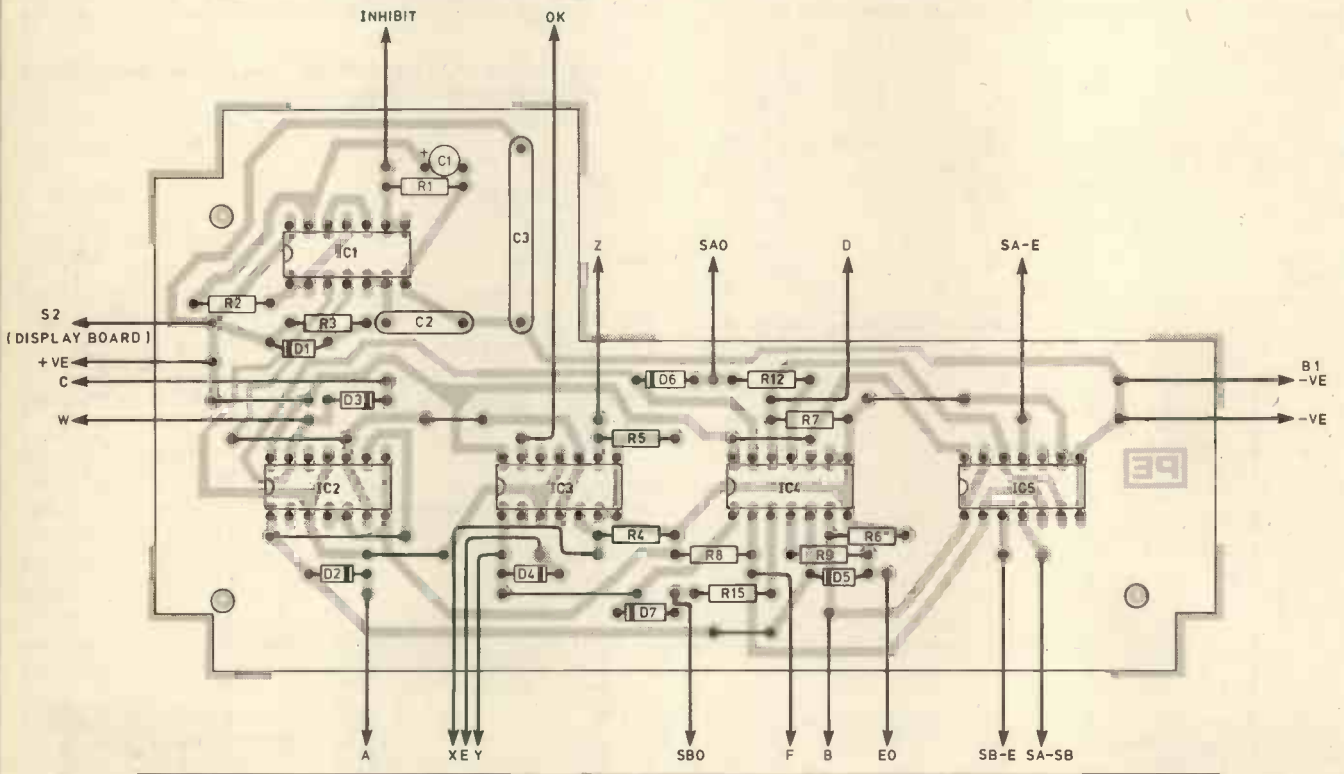


Fig. 2. Circuit of Lead Tester. The inhibit connection is made between the two boards



**MAIN BOARD**



**DISPLAY BOARD**



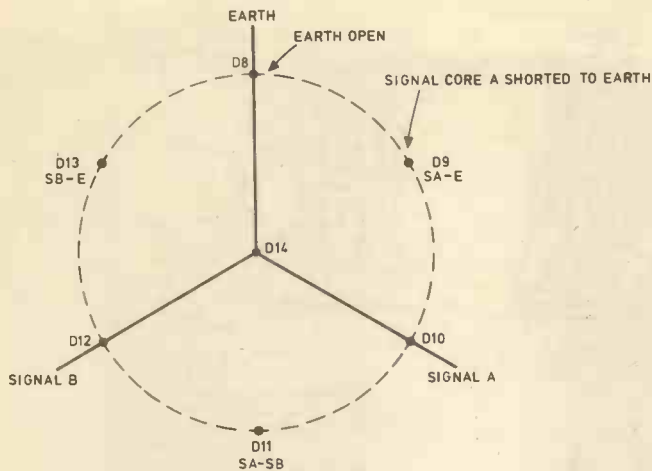


Fig. 3. Physical layout of l.e.d.s. The six on the circumference are red and the centre one green. The circle diameter should be 1in

## COMPONENTS

### Resistors

R1-8	100k
R11, 14, 17, 18	22k
R9, 10, 12, 13, 15, 16	10k
R19	470R ½ watt
R20	220k
<i>All ½ watt carbon unless indicated</i>	

### Capacitors

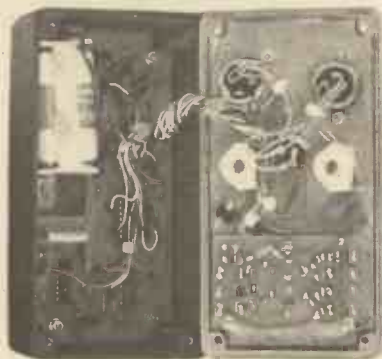
C1	1µF tant
C2	0.1µF polyester C280
C3	0.47µF polyester C280

### Semiconductors

D1-4	1N4148
D5-7	OA90 or OA91
D8-13	Red 2.9mm
D14	Green 2.9mm
TR1-7	BC184L
TR8	BC214L
IC1	4093
IC2, 3	4013
IC4	4070
IC5	4081

### MISCELLANEOUS

Die cast box, approx 150 x 80 x 50mm. Battery holder for four HP7 in cube layout. Battery clip. Miniature double pole double throw switch. Miniature push button. Jack sockets. Male cannon chassis plug. Female cannon chassis socket. P.c.b. pins. 6 BA pillars, 0.375in and 6 BA nuts and bolts.



Interior layout showing how main and display boards are mounted

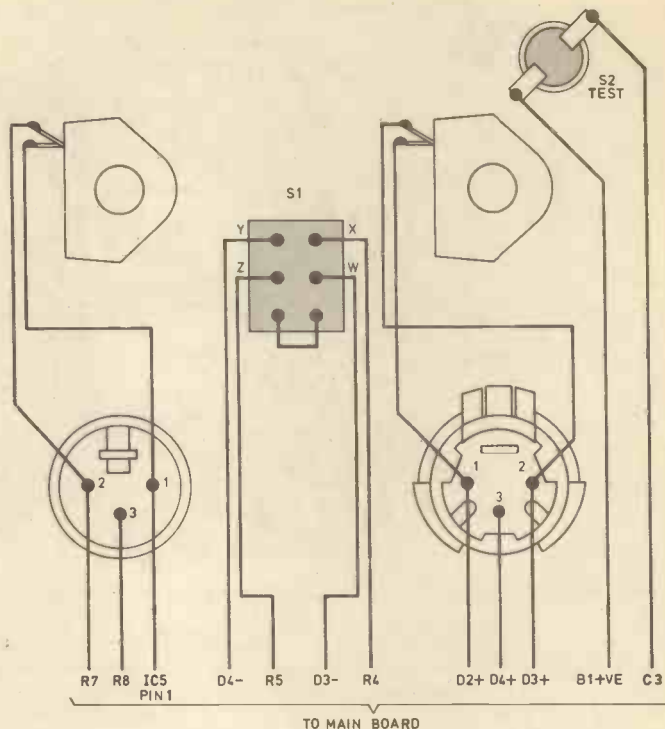


Fig. 4. Wiring from front panel components to main board

short and open circuits. (Fig. 3). The green 'O.K.' l.e.d. is placed at the centre of the circle. The best way to drill the holes for these is to mark the centre position of the circle with a centre punch, and use a pair of compasses to draw a 1in circle. The top and bottom positions can then be punched in, and the remaining positions found by using the compasses as dividers. A 7/64in drill is exactly right for the 2.9mm l.e.d.s. used.

The display p.c.b. is mounted on the top plate with three 6 BA pillars. These are fixed to the top panel with countersunk screws, the holes being filled and smoothed before spray painting the panel. White Letraset is used to complete the panel. The 'Test' button is placed for a right handed user, so the tester can be held in the left hand, and the thumb used to press the button.

The 'Earth' test is connected to the body of the jack socket and pin 1 of the Cannons. Signal A is connected to the jack tip and pin 2, whereas the signal B is only connected to pin 3. It does not matter which Cannon is connected to which end of the test circuit.

### TESTING

Testing of the unit should present no problems. If any are encountered it is useful to slow the clock down by adding a 47µ capacitor across C1. Removing the inhibit line should light all the open circuit l.e.d.s. in turn followed by the 'O.K.' l.e.d. A set of crocodile clip leads is convenient for checking that each combination generates the correct fail condition.

### USING THE TESTER

The tester is simple to use and the fascia legending is self-explanatory. No battery check is provided as such, simply pressing 'Test' with no lead connected lights the 'Earth' open l.e.d. providing such a check. Note that a lead that fails might give an 'O.K.' reading after it has been moved about. This is because a fault clearing will allow the test to continue. This is quite deliberate and useful for suspected intermittent leads.





## CAR ANTI-THEFT DEVICE

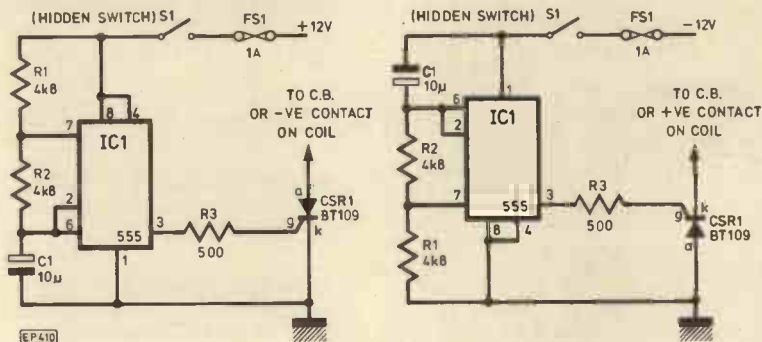
THE locks on most old cars are so worn that virtually any key will open and start them, making them easy prey for joyriders or thieves.

My solution to this is the circuit shown right. With the hidden switch in the 'on' position it is possible to start the car but any attempt to drive the car off results in a series of 'kangeroo' hops, forcing any prospective thief to abandon the car within a few yards. The figure left is for negative earth and the right for positive earth.

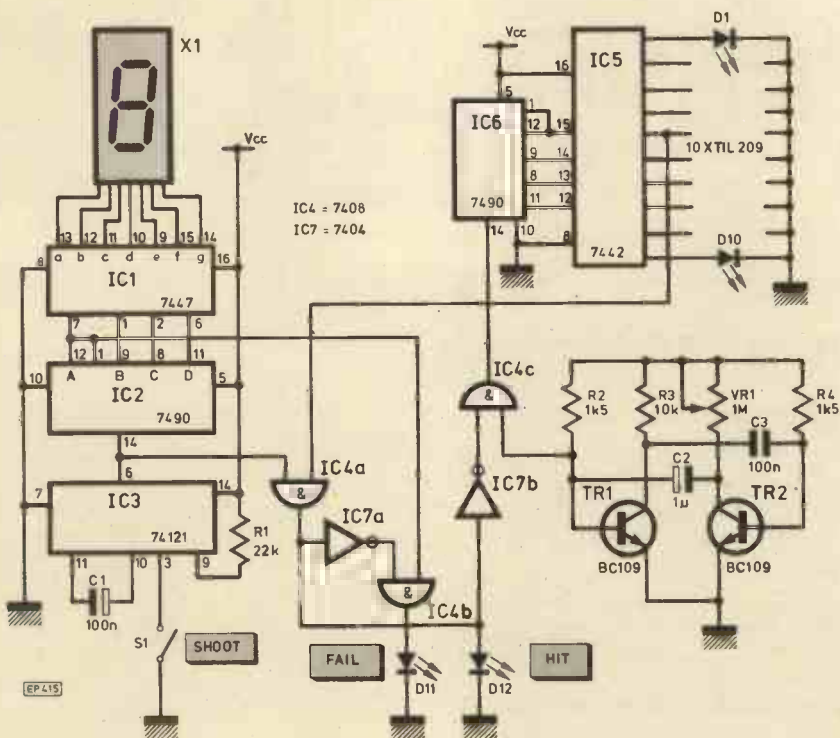
The device operates by shorting the contact breaker points for approximately 70ms in every 100ms.

The circuit consists of a 555 timer connected as an oscillator running at approximately 10Hz with its output triggering thyristor CSR1 via R3, so that it conducts when the points are open effectively short circuiting them and disabling the ignition.

Alastair Mutch.  
Aberdeen.



## SHOOT GAME



IN this circuit the transistors and their accompanying resistors and capacitors form a pulse generator (clock) whose frequency can be controlled by adjusting VR1. The output feeds a dual input 'AND' gate the output of which is high only when both inputs are high. The other input of this gate is initially high so that the output is high only when a clock pulse is generated. Therefore the 7490 received a series of pulses which are counted and a running total supplied in binary, this is converted by the 7442 into a decimal format and this is displayed by the l.e.d.s D1-10. Since only one l.e.d. can be on at any time this means that the light will appear to move across the array of l.e.d.s. The contestant has to try and press the switch at exactly the same instant as the centre l.e.d. is illuminated.

Upon pressing the switch a pulse is sent to the 74121 which sends out a fixed length pulse irrespective of the length of the input pulse. The length of the output pulse is determined by C1 and R1. The output of the 74121 feeds the input of a second 'AND' gate whose output is high when the switch and l.e.d. D5 are on together its output stops the counter and illuminates D12 indicating a hit. The output of the 74121 also feeds a binary counter which counts how many times the switch has been pressed and displays this value on the seven segment display.

After eight presses of the switch and no hits the D11 l.e.d. is illuminated indicating a fail. The circuit can be reset by temporarily disconnecting the power by a suitable switch.

D. Johnson.  
Worsley.  
Lancs.



# NEXT MONTH

# FREE

## IC TIMER NOMOGRAPH CHART



# SECURITY SENTINEL

Secure your property with our security sentinel system which will protect up to six rooms. The system includes such features as entry/exit delays, auto siren reset, a two wire tamperproof alarm loop, fully automatic system status check and a battery back up facility.

# GAMES TIMER

In many games, a timer adds tension, particularly this timer, because it has a "booby" delay which can strike on any player's turn giving him only a few seconds to make his move.



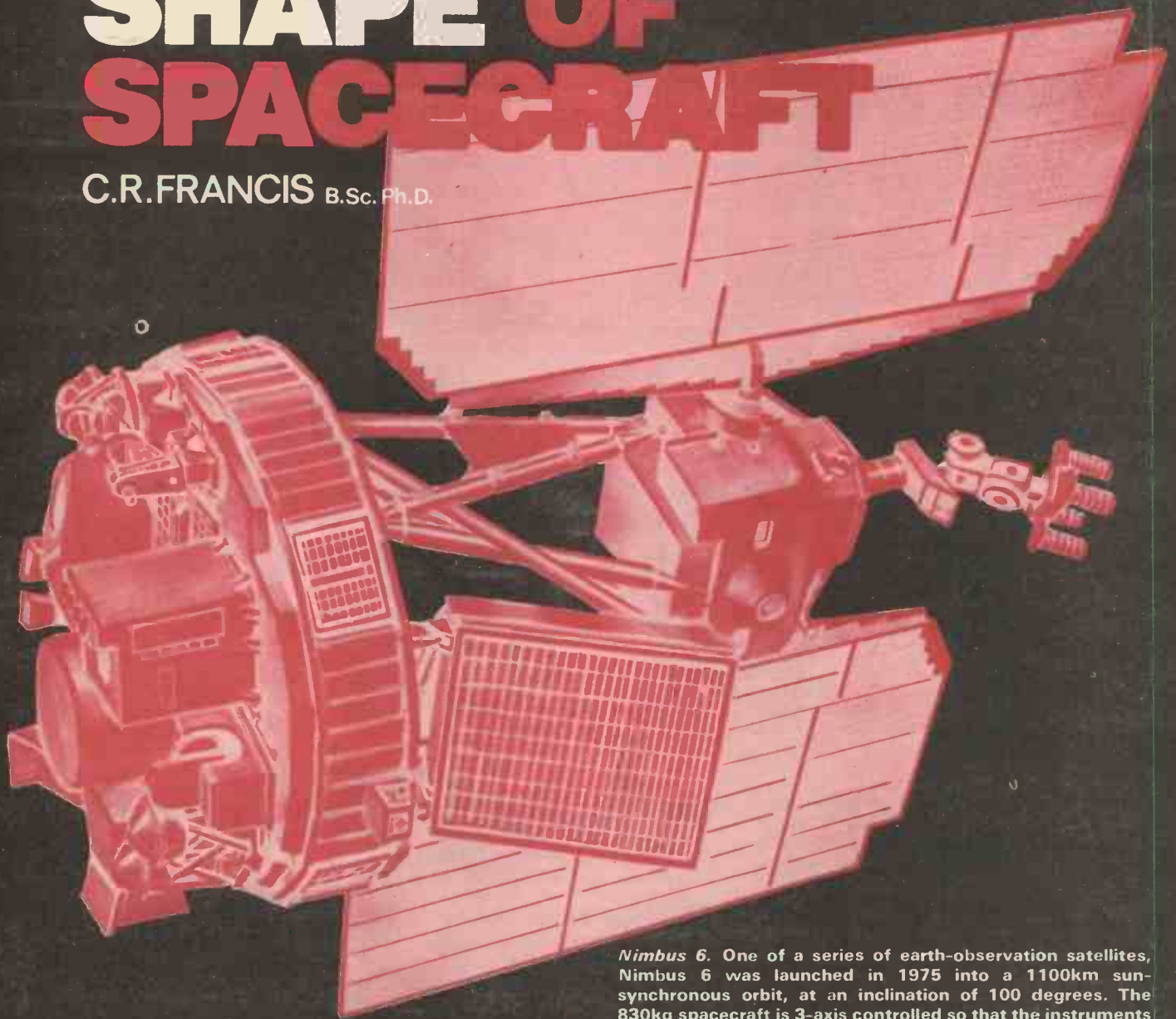
**SPEECH SYNTHESIS**—Theory and hardware. PART 1

# PRACTICAL ELECTRONICS

OUR NOVEMBER ISSUE WILL BE ON SALE FRIDAY 10 OCTOBER 1980

# THE SHAPE OF SPACECRAFT

C.R. FRANCIS B.Sc. Ph.D.



**I**N THE years that have passed since the launch of the first Sputnik in 1957, the heavens have gradually become populated with our machines. There are many thousands of man-made objects orbiting around the earth, a few dozen in independent orbits around the sun, and a few in trajectories which will take them out of the solar system forever. There are also scores of space vehicles lying on the surface of the moon and the planets, and many have re-entered the earth's atmosphere. The variation in shape, size and purpose of these objects is enormous. Even if we restrict ourselves to un-manned, non-landing spacecraft, and we ignore discarded jetsam such as clamps and ties, the variation is still very large.

**Nimbus 6.** One of a series of earth-observation satellites, Nimbus 6 was launched in 1975 into a 1100km sun-synchronous orbit, at an inclination of 100 degrees. The 830kg spacecraft is 3-axis controlled so that the instruments may remain earth-pointing. The attitude control system and the solar arrays are mounted as a separate unit linked to the payload assembly by an interconnecting truss. Thermal control louvres can be seen around the sensory ring. (By courtesy of General Electric)

The earliest spacecraft were of necessity very small and experimental, but nowadays it is not unusual for satellites to weigh several tons or to form parts of complex operational systems. Perhaps the best example of this is to be found in communications satellites: these are now a part of our everyday lives and many are operated and owned by commercial concerns. Experimental techniques have now largely been replaced by established design procedures.



**TD-1A.** A structural model of the 472kg TD-1A spacecraft in position prior to space simulation tests. TD-1A was launched in 1972 into a 540km orbit, inclination 98 degrees, and was an ultra-violet astronomy satellite. It was 3-axis controlled and had a box-type structure. The only deployed appendages were the solar arrays which were flat panels.  
(By courtesy of European Space Agency)

The designers of spacecraft are constrained by many factors different from those encountered by more earth-bound engineers. We shall be looking at the effects of these factors on the spacecraft subsystems in more detail later, but let's take environmental effects as an obvious example. While terrestrial environmental considerations may include the weather, dust, humidity and possibly even unauthorised tampering, the spacecraft designer is much more concerned by the influence of vacuum, radiation, micrometeoroids and the weightlessness of free-fall.

To the layman then the external appearance of spacecraft may seem diverse and puzzling. There have been spheres large and small, from Vanguard, not much bigger than a grapefruit to the 100 foot diameter Echo balloons. Other spacecraft resemble boxes; TD-1A is illustrated and the OGO series are also examples of this type. Drum-shaped spacecraft are common. Geos, Intelsat and Tiros for example, and there are other strange and exotic shapes.

Why must spacecraft have these different shapes? There are obviously many factors—the purpose of the satellite, its payload, is the principle driving force and this is expressed through demands on the satellite subsystems.

## MISSIONS

On the whole, satellites exist to carry a payload into space (as always, there are exceptions, the British satellite X4, for example, was simply a technology demonstration exercise, with no payload as such). This is the ultimate driver of satellite characteristics. The payload may consist of a single item, or may comprise a collection of instruments, experiments and so on. The categories into which these payloads may be placed are numerous; Table 1 lists many of the types of mission.

Payloads make demands on the spacecraft. Their properties and requirements which may need to be satisfied are: mass, volume, shape, power, telecommands/control, telemetry, timing and synchronisation, instrument orientation, attitude measurement, attitude control, orbit control and thermal control.

Different payloads exhibit great variation in these properties and requirements. We may compare two examples; one

**Table 1.**  
**Types of Space Mission**

Scientific/Experimental	{ Meteorological Earth Resources Environmental Monitoring Spy Satellites
Astronomical	
Communications	
Navigation	
Applications	
Earth Observation	

representative of instruments carried as part of recent earth-observation payloads, the other typical of experiments carried by small scientific satellites in the late 60s and early 70s. The first is the Scanning Multichannel Microwave Radiometer, or SMMR, which has been flown on two American satellites, Seasat-1 and Nimbus 7, which were both launched in 1978. This instrument measures the microwave radiation emitted from the earth at 5 frequencies, in the range 6.6 to 37GHz; the characteristics of the earth's surface and the intervening atmosphere may be deduced from these measurements.

The second instrument is an ELF/VLF receiver which was flown on the British satellite Ariel 4 launched in December 1971. This experiment, which was designed at Sheffield University, also made measurements at 5 frequencies, but this time they were rather lower; ranging from 750Hz to 16kHz. These measurements are used in the study of wave-particle interactions in the magnetosphere. The important characteristics of these instruments are given in Table 2. Although there are great differences between the instruments, they do not, by any means, represent extreme cases.

We have pointed out that, in essence, the payload defines the characteristics of the spacecraft, but often the instruments in a payload are themselves constrained by the spacecraft capabilities. This may occur, for example if the agency responsible for a spacecraft announces the availability of limited space, power and mass, so that instruments or experiments must be designed within these limits.

**Table 2.**  
**Characteristics of two representative payloads**

	SMMR	ELF/VLF Receiver
Mass	52kg	5kg
Size	2 boxes 15cm x 20cm x 33cm + 1 box 15cm x 20cm x 16cm + antenna 80cm diameter	1 box 20cm x 15cm x 15cm + loop antenna 3m diameter
Power	60W	0.35W
Data output	Digital 2000 bits/sec	Analogue, 17 channels sampled once every 27.92 sec. With 10 bit digitisation equivalent to 6 bits/sec
Telecommands/Control	12 commands	No commands  10 control pulses

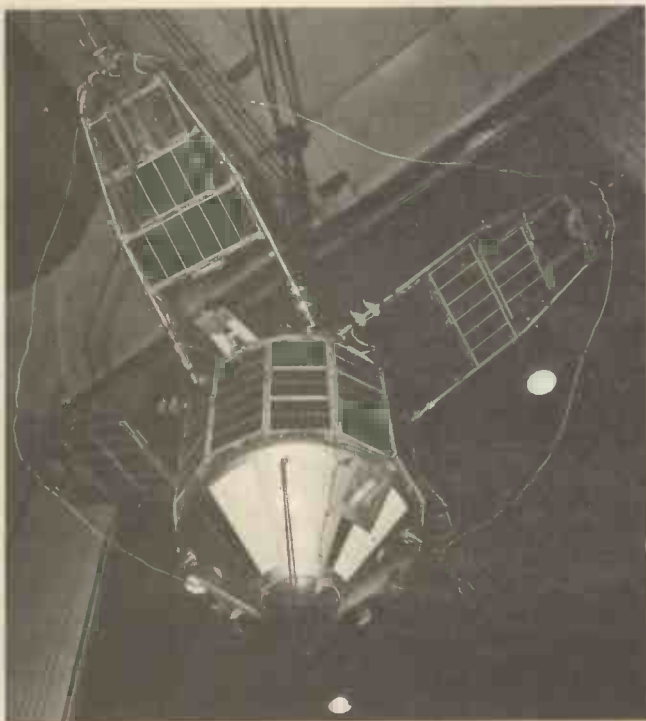
Table 3.

Correspondence between payload characteristics and spacecraft subsystems.

Payload Characteristics	Spacecraft Subsystem
Mass	Structure
Volume	
Shape	
Instrument orientation	
Attitude measurement	Attitude and Orbit Control System
Attitude control	
Orbit control	
Telecommands	Telecommand Telemetry and Control System
Telemetry	
Orbit tracking	
Control and timing	
Synchronisation	
Thermal control	Thermal Control System
Power supply and regulation	Power System

The requirements of the payload are met by the various subsystems of the spacecraft. These include such things as the power system and the thermal control system. The correspondence between requirements and subsystems is given in Table 3. Although it is not, strictly speaking, a subsystem itself, the orbit chosen for a spacecraft is also selected in response to payload requirements, and it has, as we shall see, a profound effect on the entire spacecraft.

**Ariel 4.** Ariel 4 was one of a series of British satellites. It was launched in 1971 into a 550km orbit at 83 degrees inclination. The 100kg satellite was used to study the ionosphere and magnetosphere. It was spin-stabilised with four deployable booms. There were many aerials, including the Sheffield VLF experiment loop aerial attached around the ends of the booms, alongside a magnetorque coil. (By courtesy of British Aerospace)



**Intelsat 4.** Eight Intelsat 4 communications satellites were launched in the period January 1971 to May 1975, for the International Telecommunications Satellite Consortium, into geostationary orbit. Each was able to handle 5000 telephone channels (or 12 TV channels). The 595kg satellites have since been superseded by the Intelsat 4A and Intelsat 5 satellites. Although spin-stabilised the antennas could point continuously at the earth as they were mounted on a despun platform. Note the large area of the solar array required for the communications transmitters. (By courtesy of Hughes Aircraft Company)

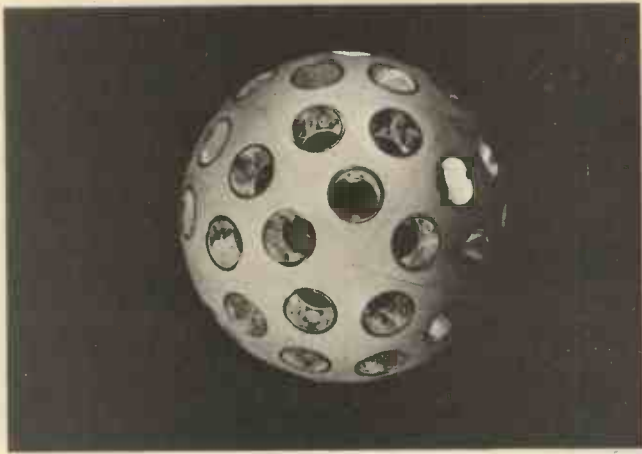
## ORBITS

The orbit is the closed path the satellite traverses through space. Most spacecraft orbit the earth, and the orbit is in general elliptical, with the earth at one focus. In many cases these orbits are approximately circular; orbit insertion errors tend to ensure that few satellites orbit in perfect circles.

There are many special orbits. Perhaps the most widely known of these is the geostationary orbit. In this case the orbital altitude is chosen so that the satellite takes 24 hours to make one revolution; it therefore always remains above the same spot on the earth spinning below. This altitude is 35,850km. This is only strictly true for an orbit in the equatorial plane, for otherwise the spacecraft could move North and South of the equator during each orbit. Geostationary spacecraft are therefore normally stationed in or near the equatorial plane, and must be able to maintain their position there.

Another specialised orbit is the sun-synchronous orbit. Here the spacecraft is in a comparatively low altitude orbit (normally less than about a thousand kilometres) with a near-polar inclination. This inclination is carefully chosen so that the orbital plane precesses, under the influence of the earth's oblateness, at the same rate as the apparent motion of the sun around the earth during the year. In this way the sub-satellite track on the earth is





**Starlette.** The French Starlette satellite was simply a 25cm diameter sphere, weighing 68kg, inset with corner-cube laser reflectors. Laser ranging enabled the orbit to be accurately determined, for geodetic purposes. (By courtesy of CNES)

always at the same local time. This type of orbit is often used for remote sensing satellites, as the observations are more meaningful when made under the same angle of illumination.

We shall see that the circle of orbit often has a great effect on spacecraft design.

#### ATTITUDE AND ORBIT CONTROL SYSTEM

Satellites do exist which need no control of attitude or orbit. The Echo balloons were examples, and so are the laser-ranging satellites Lageos and Starlette. In almost every other case though some control of the attitude, and sometimes the orbit as well, is required. There are, essentially, two ways to stabilise the attitude of a spacecraft. It can either be spun about one axis so that it possesses gyroscopic rigidity, or control can be applied to all three axes so that the spacecraft can point in any desired direction for as long as control is maintained.

The type of control used is fundamental to the design, and it often determines what kind of payload can be carried. A spinning satellite enables angular surveys to be carried out, by astronomical instruments and magnetospheric particle detectors. Three axis control is necessary for many earth-observational instruments.

For a spinning satellite to be stable, the spin axis must be the axis of maximum moment of inertia. These satellites tend to be symmetrical about the spin axis so that they are dynamically balanced, and are often drum shaped. Sometimes part of the spacecraft is attached to a motor rotating at the same speed as the spinning spacecraft, but in the opposite direction so that this part remains stationary. This is called a de-spun platform and the satellite is a dual-spin spacecraft. Examples of this technique are the Intelsat 4 and 4A communications satellites where the despun platform enables the antennas to point at the earth though the rest of the spacecraft is spinning.

Power for the spacecraft is normally provided by arrays of solar cells and it is often sufficient to simply cover the sides of the spacecraft, if spin stabilisation is chosen. As the spacecraft spins, most parts of its surface will face the sun at some time. The three-axis controlled spacecraft by contrast, normally carries its solar cells on flat panels which are movable so that they may follow the sun no matter which way the spacecraft is pointing. Already we see the interaction between subsystems, and the effect of this on overall configuration.

Control of the attitude implies that means are available to

measure the spacecraft attitude. This may be an Inertial Reference Unit, containing gyroscopes to provide an "internal" measurement, or "external" measurements by sun-sensors, earth sensors or star-trackers. Usually a combination of these methods is used.

Attitude control also requires some means of moving the spacecraft about each axis, in a controlled way. Thrusters or gas-jets are the obvious method, but fine control is difficult to achieve. Accurately controlled attitude manoeuvres may be performed by using reaction wheels—these are essentially flywheels attached to electric motors. As the motor accelerates the wheel in one direction, the spacecraft as a whole spins in the opposite one, so that the overall angular momentum is conserved. Momentum wheels are similar devices except that they spin in their undisturbed state, so that they possess gyroscopic rigidity: they are momentum bias devices, and are commonly used on 3-axis stabilised spacecraft. Small torques may also be achieved by using a magnetorquer. This is a loop of wire through which an electric current may be passed, to produce a magnetic field. This then interacts with the Earth's magnetic field and can be used to rotate the spacecraft.

Some spacecraft also need to be able to adjust their orbit. Obvious examples are geostationary spacecraft; to maintain their geostationary condition under the perturbing influence of lunar and solar gravitational effects, substantial orbit control ability is required. This always has to be by means of thrusters—devices



**SMMR.** Scanning Multichannel Microwave Radiometer, flown on the Seasat and Nimbus 7 satellites. The offset paraboloid antenna is 70cm across, and scans 25 degrees each side, driven by the mechanism which is visible. The central microwave horn is a very advanced 5-frequency device, and three calibration horns are also visible. The electronics are housed in the three bays beneath. Note the 12 inch ruler attached to the ground handling support. (By courtesy of Jet Propulsion Laboratories)

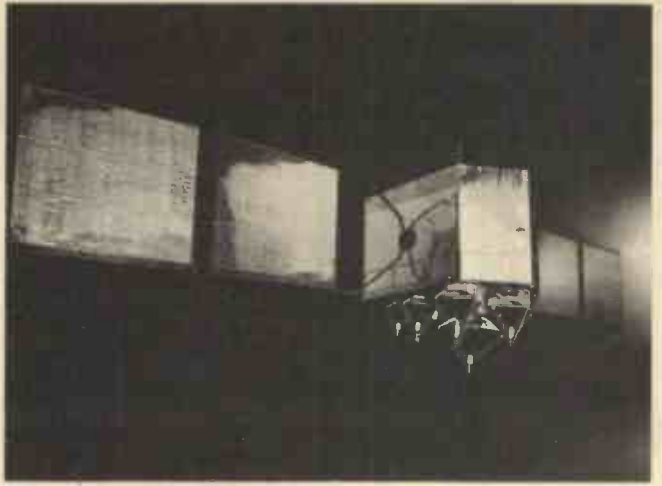
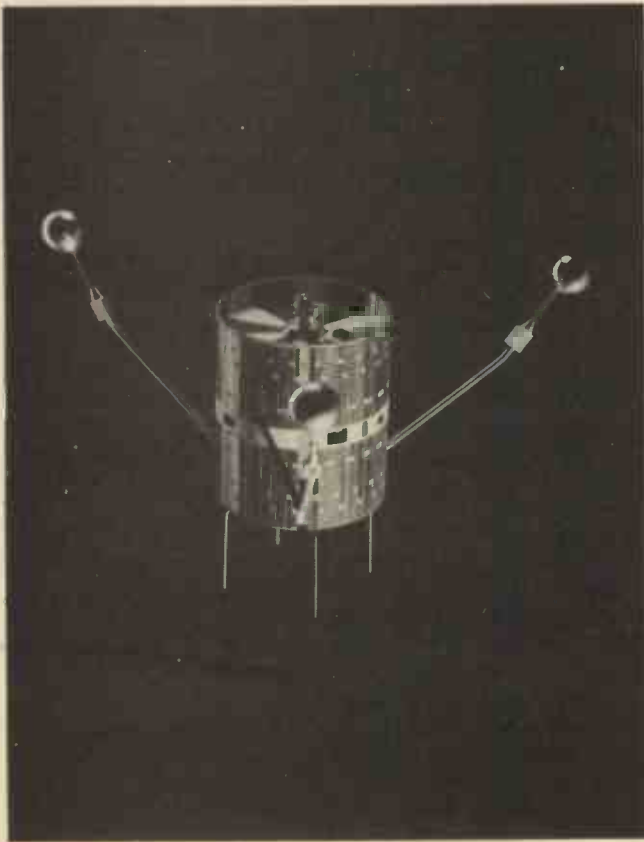
which merely spin the spacecraft cannot change the orbit. To achieve geostationary orbit an apogee boost motor is required. This is normally a fairly large solid fuel rocket engine. Orbital measurements are not carried out by the spacecraft, but are made on the ground. The on-board equipment which enables this to be done falls into the Telemetry, Tracking and Command System.

### POWER SYSTEM

These days the main source of power for spacecraft is the sun. Occasionally some sort of nuclear power source is used, and the earliest spacecraft tended to use batteries, with no means of charging them up—their lifetimes were consequently rather low. The dominant feature of most spacecraft therefore are the arrays of solar cells. We have already seen that spin-stabilised spacecraft often have solar cells all around their surface, as a result of the constantly changing angle of illumination, while three-axis controlled spacecraft have solar panels which follow the sun.

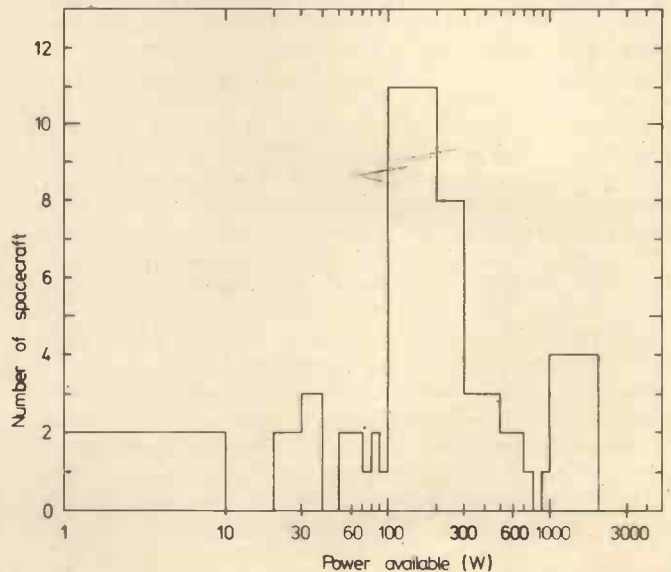
A little thought will quickly show that the number of rotation axes such panels will require depends on the orbit. For example an equatorially orbiting satellite only requires an axis of rotation for its arrays, normal to the plane of the orbit (we can ignore the seasonal variation in the sun's position—at  $23\frac{1}{2}$  degrees each way it is not significant). OTS is such a spacecraft. Similarly a satellite in a sun-synchronous orbit only requires one axis, though the arrays may require to be tilted to this axis, depending on the angle the orbital plane makes to the sun. Sometimes however, two axes are required.

**ESRO 4.** ESRO 4 was launched in 1972 into an elliptical 245 x 1173km orbit, inclination 91 degrees. The 130kg satellite was spin-stabilised, with three deployable booms, and studied the ionosphere. (By courtesy of European Space Agency)



**OTS.** The Orbital Test Satellite is a forerunner to the European Communications Satellite programme. The 444kg, 3-axis controlled spacecraft was placed into geostationary orbit in 1977. This model shows some of the subsystems mentioned in the text. The solar cells are mounted on panels which turn about one axis, normal to the equatorial plane of the orbit to follow the sun as the antennas remain pointed at the earth. These antennas are not for TCC but form part of the payload; an experimental communications relay. The foil-like thermal blanketing and polished reflectors on the satellite's body, which are parts of the thermal control system, are visible; so too are the nozzles of two thrusters. (By courtesy of European Space Agency)

The amount of power required for a spacecraft, and therefore the area devoted to solar cells, varies greatly. Fig. 1 shows a histogram of the solar array power capability for a representative selection of spacecraft of the late sixties and the seventies. The spacecraft range from small scientific satellites to large communications satellites, and include spin-stabilised and 3-axis controlled vehicles. Clearly arrays providing a few hundred watts are the commonest size, and with an efficiency of the order of 10 per cent this implies an area of about  $1\text{m}^2$ .



**Fig. 1.** A histogram of the power generated by the solar arrays of a random selection of 51 unmanned spacecraft

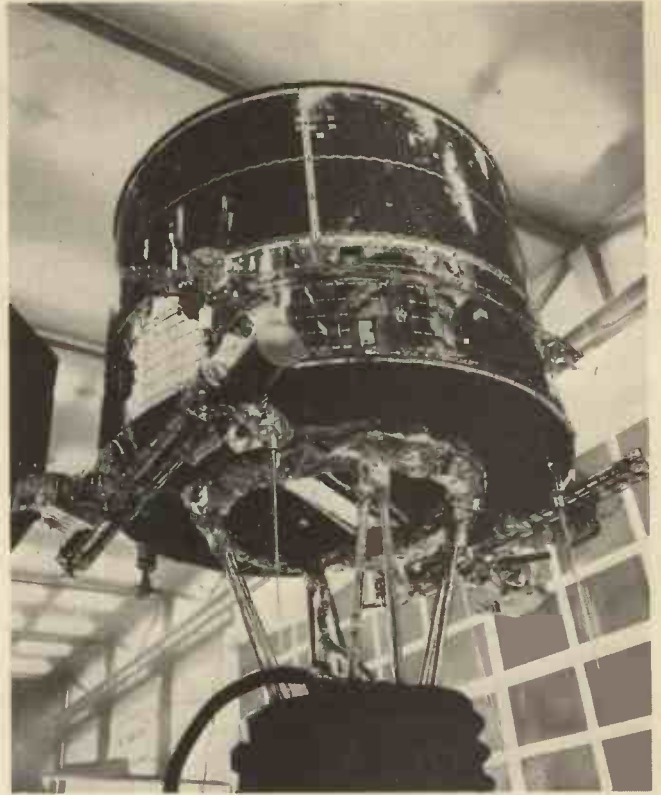


**Geos.** The Geos structure is seen during the installation of the wiring harness. The thrust-tube and platform structure can be clearly seen. The apogee boost motor is placed inside the thrust-tube. (By courtesy of British Aerospace)

Large arrays, delivering in excess of 1kW will become more common in the 1980's. The extreme case of this is the satellite whose sole purpose is to collect solar power, so that it may be beamed to suitable receivers on the earth in the form of microwave radiation. This is the Solar Power Satellite concept, and here the array will generate about 10,000MW; clearly it will have to be very large—several kilometres square (see *Spacewatch* PE August 1980).

Sometimes a nuclear power source is used. American spacecraft use a Radioisotope Thermoelectric Generator, an RTG, where heat generated in a quantity of radioactive isotope is converted to electricity by thermocouples. The isotope need not be capable of sustaining a chain reaction. When the Russian space-vehicle *Cosmos 954* crashed in Canada in 1978 it became clear that here the nuclear energy source was a true reactor, where a critical mass of material which can maintain a chain reaction is used, again to raise heat which can be converted to electricity.

The RTG is characterised by a need to maintain one junction of its thermocouples as cool as possible, and it is therefore covered with radiating surfaces which are normally fins. Such power sources may be used instead of, or in addition to, solar cells. Obviously if nuclear energy replaces solar energy the constraints on configuration due to the solar arrays are removed but new ones are added by the RTG. It must be able to radiate its heat away efficiently, and, on a long mission accumulated radiation damage due to stray radiation from the device must be limited. These factors normally ensure that the RTG must be accommodated on a boom away from the rest of the structure. This of course raises its own problems.



**Geos.** This view of Geos clearly shows the thermal blanketing applied to the satellite. Geos was a magnetospheric research satellite intended to be placed in geostationary orbit, but a launch malfunction in 1977 put the original Geos in an elliptical 38,498 x 213km orbit. A second vehicle, *Geos 2*, was launched in 1978 into the correct orbit. The 574kg satellite (including a 350kg apogee boost motor) is spin stabilised and has many deployable booms. (By courtesy of European Space Agency)

The power system must contain, in addition to its primary energy source, secondary sources (i.e. rechargeable batteries) and regulating and distributing subsystems. A power dump is also required. This equipment does not have a great impact on the structure and configuration of the spacecraft.

#### TELEMETRY, TRACKING AND COMMAND

The name of this system is self-explanatory, and again much of the system is internal equipment; transmitters, receivers, multiplexers, A-to-D converters, tape recorders and so on. The only item which is significantly affected by the configuration is the antenna subsystems. Often spacecraft have a multiplicity of antennas. These include VHF omnidirectional antennas for commands and for low data rate telemetry (though the VHF network is now being phased out), and directional S- and X-band antennas (the latter are not yet common) for high rate telemetry. High resolution imagery from spacecraft may require data transmission rates in excess of 100Mbs<sup>-1</sup>, so the S- or X-band antenna requires high gain, or a high power transmitter! (In spacecraft terms of course. The RF power output is almost always less than 100W.)

For spacecraft in earth orbit, even fairly distant orbits such as the geostationary orbit, telemetry antennas are small and insignificant. (Note that we are here considering that the large antennas of communications satellites are part of the payload.)

However, planetary probes, which must return data from millions of miles away, normally need a large directional antenna, so that transmitter power can be kept low, and the transmitted data-rate as high as possible. The Pioneer and Voyager probes to Jupiter (and beyond) were completely dominated by their high-gain antennas.

### THERMAL CONTROL SYSTEM

In our British climate we are not always aware of the full heating effect of the sun. Yet we have all heard of eggs being fried on bare rocks in desert regions and should therefore be able to appreciate that in space, depending on their surface finish, ex-

posed surfaces can become very hot. Similarly, the coldest night on earth is positively warm compared to the temperature to which a shadowed object in space can fall.

It is the task of the Thermal Control System to regulate the spacecraft temperature to preset limits. These vary from item to item in the equipment inventory, but may be, typically,  $-10^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$ .

Solar heat inputs, and heat produced by onboard equipment, must be balanced against radiation losses to space, and the thermal inertia must be such that the temperature does not drop too far while the spacecraft is in shadow. Although some active devices are used, such as heaters and thermal louvres, much of the Thermal Control System lies in the surface finish of the spacecraft. Combinations of aluminised plastic film, polished metal surfaces and paint are used, to achieve the correct thermal properties.

This system therefore governs the final surface finish of the spacecraft: and explains why space vehicles often look as if they have been wrapped in cooking foil!

### STRUCTURE

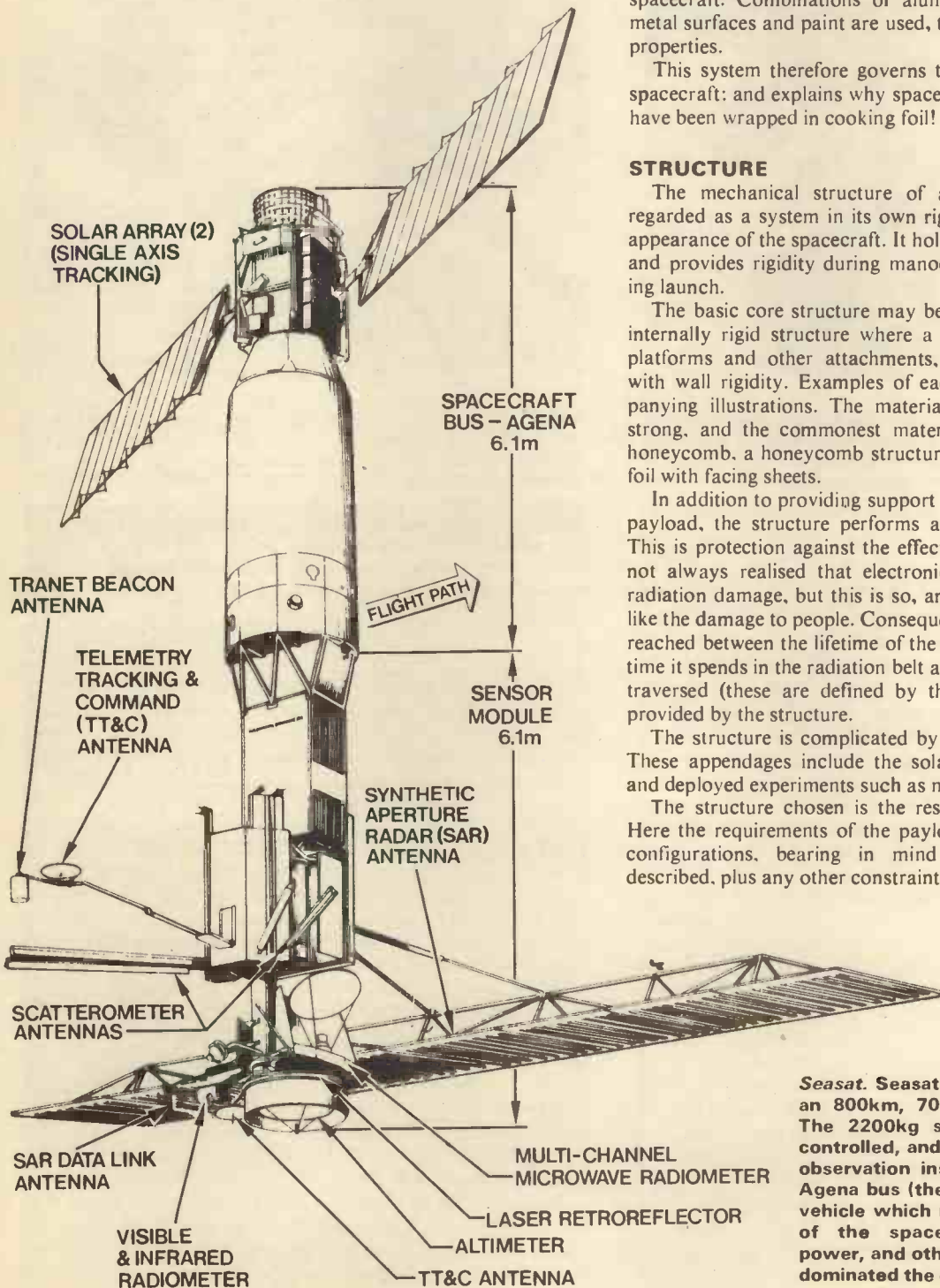
The mechanical structure of a space-vehicle is normally regarded as a system in its own right, and it really governs the appearance of the spacecraft. It holds all the other parts together and provides rigidity during manoeuvres, and particularly during launch.

The basic core structure may be of two types. These are the internally rigid structure where a central thrust tube supports platforms and other attachments, and the box-type structure with wall rigidity. Examples of each are shown in the accompanying illustrations. The materials used are lightweight and strong, and the commonest material for panels is aluminium honeycomb, a honeycomb structure made from thin aluminium foil with facing sheets.

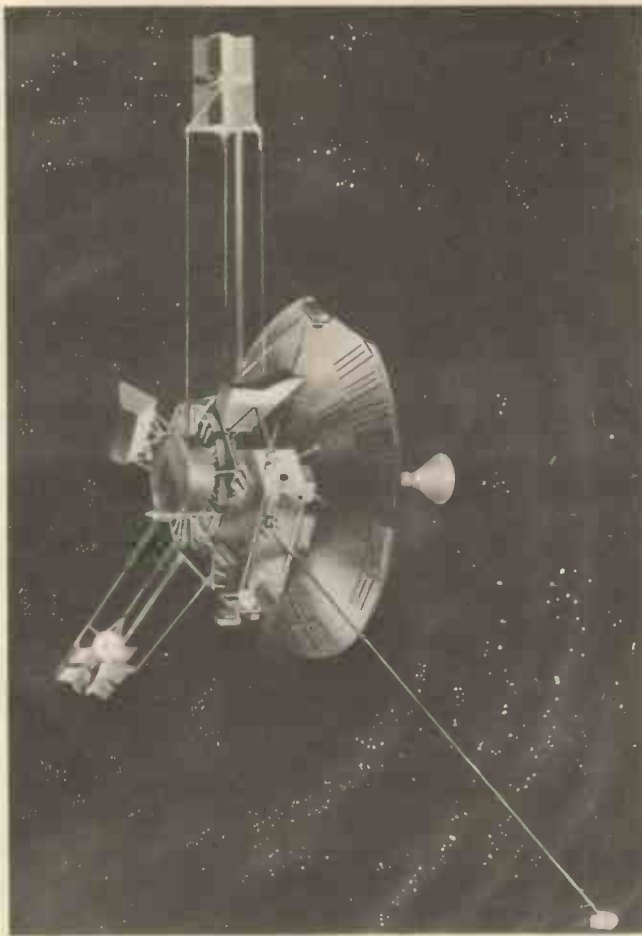
In addition to providing support for the other systems and the payload, the structure performs a further important function. This is protection against the effects of the radiation belts. It is not always realised that electronic devices are susceptible to radiation damage, but this is so, and it is a cumulative process, like the damage to people. Consequently a compromise has to be reached between the lifetime of the spacecraft, the fraction of its time it spends in the radiation belt and which part of the belts are traversed (these are defined by the orbit) and the protection provided by the structure.

The structure is complicated by the addition of appendages. These appendages include the solar arrays, various antennas, and deployed experiments such as magnetometers.

The structure chosen is the result of configuration studies. Here the requirements of the payload are matched to possible configurations, bearing in mind the constraints we have described, plus any other constraints which may exist.



**Seasat.** Seasat was launched in 1978 into an 800km, 70 degrees inclination orbit. The 2200kg spacecraft was three axis controlled, and carried a number of earth-observation instruments. The use of the Agena bus (the upper stage of the launch vehicle which remains as an integral part of the spacecraft, providing AOCs, power, and other functions) has obviously dominated the design



**Pioneer 10/11.** These two spacecraft were precursors to the Voyager missions to the outer planets. Pioneer 11 flew past Saturn in September 1979, following its launch in April 1973 and Jupiter fly-by in 1974. Pioneer 11 was renamed Pioneer Saturn. The spacecraft has a large (2.74m diameter) antenna to maintain contact with Earth and is spin stabilised about the antenna axis. There are no solar cells, power is provided by two radioisotope thermoelectric generators

### LAUNCH

The launch imposes an inflexible set of constraints which every spacecraft must meet. The space inside launch vehicles is limited, and accelerations, vibrations and acoustic noise levels are high.

The available volume and mass which the launch vehicle allows are a strong design driver. Many spacecraft have obviously been designed to fit the cylindrical space within the launcher, and some even include the upper stage of the launcher as part of the spacecraft. Seasat is an example of this type. As a result of the limited space most appendages have to be deployed after launch, and this has given rise to many fascinating deployment mechanisms.

When the Space-Shuttle comes into service, it's primary purpose will be to launch satellites. It's huge cargo-bay will ease many of the launch constraints, though some new ones related to safety will appear.

Although the spacecraft will spend most of its life in a weightless environment, it must be designed for strength along the longitudinal axis to cope with the launch acceleration, and it must be able to stand strong vibrations in all directions.

The illustrations accompanying this article show a diverse range of spacecraft. The reason for some of this diversity should now be clear, though manned spacecraft and many planetary landers may look as inexplicable as ever. These, though, are a different story altogether. ★

## PLEASE NOTE

**Schools, colleges, apprentice training schools etc.,**

## I.C. REMOVAL TOOLS

We are making a special offer on these tools. If you buy 50 or more on a cash with order basis we will only charge you 10p each (normally 30p). This offer is not available to retailers, distributors, companies etc., and the tools **must not be resold on a commercial basis**.

To take advantage of the offer please send a cheque or PO (made payable to IPC Magazines) and an order or letter on official notepaper. We can only supply quantity discount orders to official addresses, not to individuals.

## Codespeed Electronics

P.O. Box 23, 34 Seaford Road, Copnor, Portsmouth, Hants PO3 5BJ

**SOUND EFFECTS PCB** brand new, made for spaceman robot toy. Gives 5 spaceman sounds with flashing LEDs (speaker not supplied). Entertain the kids for only 85p. **FLUORESCENT REJECT CALCULATORS** modern, ten function calculators with full memory. Most repairable but no guarantees, £2.50 each. **ALARM CLOCK CHIP MM5316** digital alarm clock I.C. With data, £2.35 each. **GIANT LED CLOCK DISPLAY** non-multiplexed, common cathode display panel. With data, £3.95 each. **WRISTWATCH LED DISPLAY** tiny, bright displays for led watches. Note display is housed in 'legless flatpack' package and requires fairly fine soldering. Supplied with data, 95p each or 2 for £1.50. **DIGITAL MULTIMETER CHIP** to build an Auto-polarity, 4 1/2 digit multimeter (requires additional circuitry). With data sheet, £3.55. **8 DIGIT CALCULATOR DISPLAY** common cathode, multiplexed, 0.1" digits. With data, 99p each. **PLASTIC POLARIZING FILTER** 0.006" thick plastic film. Any size cut from 1 square inch up to a maximum size of 19 inches x 250 feet. Only 3p per square inch. **SUPER QUALITY JACK SOCKETS** gold plated contacts for high reliability. Mono 25p Stereo 30p each. **CALCULATOR KEYBOARDS** excellent value, 2 for 99p. **LM 555 TIMER I.C.** suitable for most timer applications, and is supplied with applications booklet, 25p each. **CALCULATOR CHIP NORTEC 4204**, four function and constant. With data and diagram, 80p each. **PUSH-BUTTON SWITCHES** with 1 n.o. contact (momentary action). With red button, 15p each. **MINIATURE SLIDER SWITCHES** with 2 pole change-over contacts, 16p each. **STATIC RAMS 2102** memories, with data, only 99p each. **REJECT LED CALCULATORS** some repairable but excellent value for spares. Yields lots of parts. £2.50 each. **LIQUID CRYSTAL CLOCK DISPLAY** nice style display gives black digits on grey background. Could also be used for freq. meters, dvm's etc. With data £5.25. **PROFESSIONAL QUALITY CONTROL KNOBS** rotary knobs satin finish black nylon knobs to fit standard 1/4" D shaped shafts. Coloured snap-in caps also have position indicator line. Cap colours available, black, white, grey, red, green, blue and yellow. Knob and coloured cap 20p (state cap colour required). Skirted rotary knobs As above but has 'flared' nut cover around base of knob, 27p each. (State cap colour required). Slider control knobs fits 5mm or 8mm shafts. Available in black, white, grey, red, green, blue and yellow. 14p each (state colour required). **QUALITY REED SWITCHES** tiny but sensitive reed switches. Ideal for burglar alarms etc. Only 39p each. **RECTANGULAR BAR MAGNETS** small but powerful. Purchased for use with above reed switches, 59p each. **REED RELAYS** 12v d.c. coil, one n.o. contact. Small enough for PCB mounting, 79p each. **POWER RELAYS** 12v d.c. coil. Two change-over contacts, each rated at 10 amps. Contacts solid silver for high reliability. Only £2.65 each. Relay bases for above relays are 35p each. **TRANSISTOR RADIO I.F. TRANSFORMERS** all brand new. May include several types. Ten transformers for 55p. **NYLON CABLE TIES** 25 for 35p (ties are 4" long). **SHRINK TUBE** available in 3 bore sizes. Shrinks by approx 50% when heated. 2.4mm bore 15p per metre, 4.8mm bore 16p per metre, 12.7mm bore 23p per metre. **TEN UNTESTED LED DISPLAYS** Gambler? - try these. Ten 0.1" common cathode displays for 99p. You to test.

**SATISFACTION GUARANTEED ON ALL ITEMS OR FULL CASH REFUND**  
NEW CATALOGUE (No. 8) NOW AVAILABLE - JUST SEND MEDIUM SIZED S.A.E.  
POST AND PACKING PLEASE ADD 40p (OVERSEAS ORDERS ADD £1.00)

**V.A.T.** ADD 15% TO THE TOTAL COST OF YOUR ORDER (INCLUDING POST AND PACKING)

# 125W AMPLIFIER...

**T**HIS 125W module, which has been designed for high power audio applications is a compact single board unit suitable for pop groups, discos, hi-fi, PA systems, etc.

The module, including a loudspeaker coupling electrolytic can be built for under £12.00 (see components list).

## CIRCUIT DESCRIPTION

The complete circuit diagram of the module is shown in Fig. 1. Transistors TR1 and TR2 form a differential input pair, the output of which is d.c. coupled to the pre-driver TR3. Its mid-point voltage is set by the resistors R2 and R3. The level of negative feedback is determined by C3 and R7. Increasing the value of R7 will result in an increase in the negative feedback which improves linearity and distortion. However, C3 should not exceed 50 $\mu$ F otherwise "clamping" will result. The capacitors C4, C7 and C11 ensure high frequency stability.

The collector load of TR3 is "boot strapped" to the mid point via C8. The output from the input stage is connected to a complimentary driver pair via the diode D4. Under normal conditions D4 is forward biased but in the event of a high voltage occurring at the emitters of the power transistors, due to a short circuit at the loudspeaker terminals, the sensing resistors R28, R29, R30 and R31 will trigger the appropriate protection transistors TR5, TR7, TR4 or TR6. The protection circuit reverse biases D4 and clamps the bases of the drivers, TR9, TR10 to the mid point. When the short is removed normal operating conditions are restored.

The bias condition, which sets the quiescent current of the output transistors is determined by the collector-emitter voltage of TR8. This voltage is set by VR1. A stable quiescent current is maintained throughout the working temperature range of the module by transistor TR8 being in ther-

mal contact with the heatsink. Any rise in temperature reduces the collector-emitter voltage of TR8 thus compensating for the current rise in the drivers and output transistors.

The bias path via TR8 which also carries the a.c. signal to TR10 has the junction of R15 and R16 "bootstrapped" to the mid point. The diode D5 ensures maximum drive at high power levels.

The output transistors TR11, TR13, TR12 and TR14 are parallel connected with independent emitter resistors. The diodes D2 and D3 limit the mid point swing to the level of the supply voltage as when an inductive load is connected without D2 and D3 the mid point voltage could become higher or lower than the supply voltage.

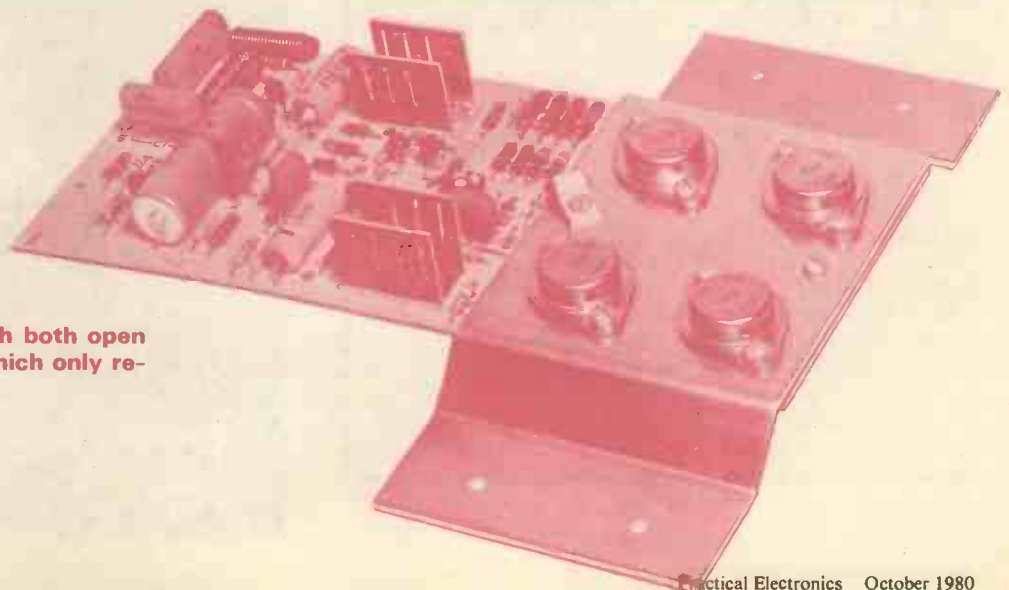
The output is shunted with a Zobel network (C9 and R14) and connects to the speaker via L1 and R8. This arrangement minimises the effect of the speaker's inductance and presents the speaker with as near a d.c. load as possible. The coil L1 also enables electrostatic speakers to

## SPECIFICATION

Output Power	125W r.m.s. (not continuous sine wave) maximum into 4 ohms
Frequency Response	25Hz to 20kHz at 100W
T.H.D. 4 ohm lead	0.1% typical
at $\frac{1}{2}$ power 8 ohm lead	0.07% typical
Signal/noise	78dBs
Sensitivity for 100W	400mV
Input Impedance	47k

Short and open circuit protection.

**A power amplifier module with both open and short circuit protection which only requires a p.s.u. for operation**



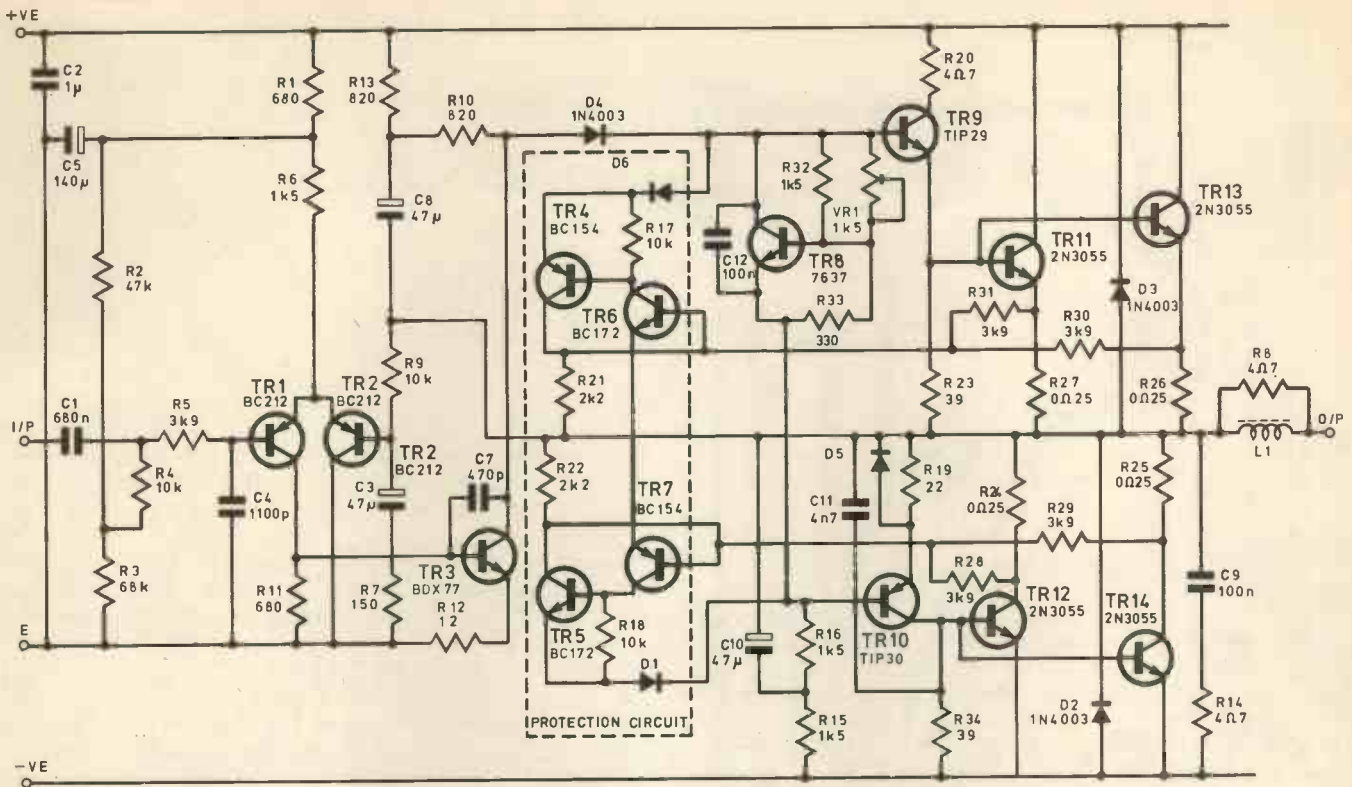


Fig. 1. Circuit diagram of the amplifier

EG406

be used. However, the shunt resistor R8 may require some adjustment but it should not be higher than 15 ohms otherwise severe ringing may occur.

### PREMATURE LIMITING

Premature limiting may occur due to the spread in component values, particularly minor variations in the values of R24, R25, R26 and R27. The symptom of premature limiting is the break-up of sound at high power levels. Should this occur the value of R21 and R22 should be changed from 2k2 to 1k5.

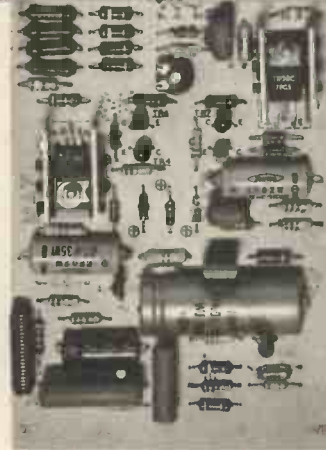
### COUPLING CAPACITOR

The load coupling capacitor which should be connected with the positive lead to the module must be at least 470 $\mu$ F 60V for a 16 $\Omega$  load, 1000 $\mu$ F 60V for an 8 $\Omega$  load and 2200 $\mu$ F 60V for 4 $\Omega$  loads. The voltage rating can be reduced with the supply voltage but should never be less than two thirds of the supply voltage.

An unregulated power supply capable of giving 80V at 2.5A is suitable for use with each module the current rating can be reduced to 0.5A if a 16 $\Omega$  load at 50V is used. Hum generated as a result of supply line ripple will be the controlling factor in the smoothing of the power supply.

### CONSTRUCTION

The p.c.b. which is supplied with the kit requires drilling. All the holes should be drilled first with the exception of the power transistor holes. Particular care should be taken to drill the two heatsink fixing screws accurately. The p.c.b. can then be fixed to the heatsink and using the heatsink as a template all the power transistor holes can then be drilled. Make sure that all the holes are drilled in the centre of the heatsink holes as no insulation bushes are used. The power transistors should be mounted into position using mica



washers and a silicon compound. The rest of the components can now be soldered. Note that TR9 and TR10 both have heatsinks fitted to them.

Carefully check all the soldered joints and using a multi-



Fig. 2. P.c.b. design

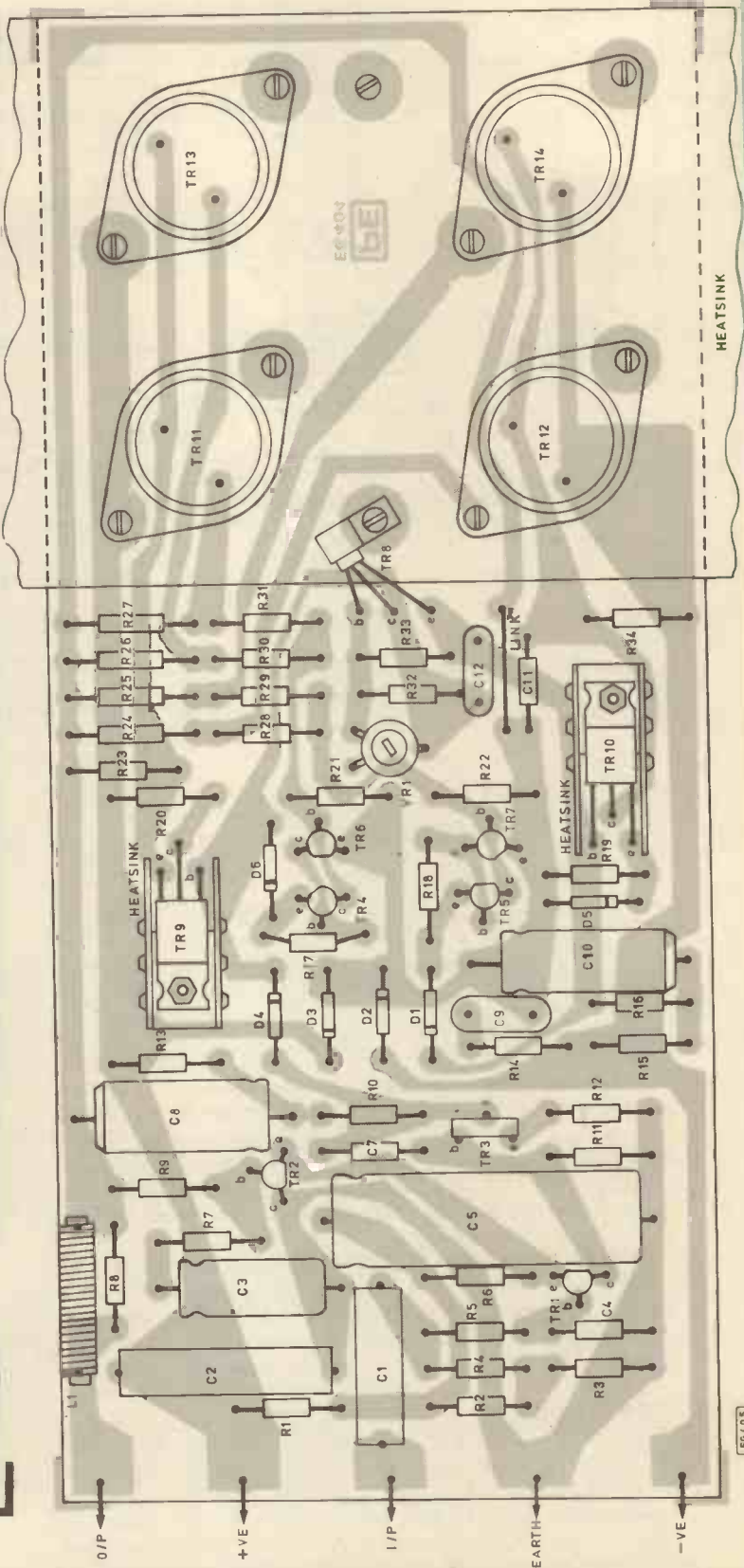


Fig. 3. Component layout for the amplifier  
 Note: C6 is not required



## COMPONENTS . . .

### Resistors

R1, R11	680 (2 off)
R2	47k 5%
R3	68k 5%
R4, R9, R17, R18	10k 5% (4 off)
R5, R28, R29, R30, R31	3k9 5% (5 off)
R6, R15, R16, R32	1k5 (4 off)
R7	150
R8, R14, R20	4Ω 7 (3 off)
R10, R13	820 ½W (2 off)
R12	12
R19	22
R21, R22	2k2 5% (2 off)
R23, R34	39 (2 off)
R24, R25, R26, R27	0Ω 25 (4 off)
R33	330

All transistors ½W 10% carbon except where otherwise stated.

### Potentiometers

VR1	1k5 preset lin
-----	----------------

### Capacitors

C1	680n
C2	1μ

C3	47μ 63V elect
C4	1100p
C5	140μ 70V elect
C7	470p
C8, C10	47μ 35V elect (2 off)
C9, C12	100n (2 off)
C11	4n7

### Semiconductors

D1	Germanium diode
D2, D3, D4	1N4003 (3 off)
D5, D6	Silicon diode (2 off)
TR1, TR2	BC212 (2 off)
TR3	BDX 77
TR4, TR7	BC154 (red spot) (2 off)
TR5, TR6	BC172 (white spot) (2 off)
TR8	7637
TR9	TIP29 (white spot TO220)
TR10	TIP30 (red spot TO220)
TR11, TR12, TR13, TR14	2N3055 (4 off)

### Miscellaneous

P.c.b.
Heatsink
Mica washers (4 off)
Inductor

### Constructor's Note

A complete kit of parts for the amplifier module is available from *Radio and TV Components, 21B High Street, Acton, London W3 6NG*. A suitable power supply unit kit for the amplifier is also available from RT-VC.

meter check there is no continuity between the cases of the output transistors and the heatsink.

The inter wiring should be kept as short as possible with screened leads used for the input connections. Each module should be earthed to a central earthing point only, as should the power supply—ve, mains, earth, etc. The main leads should be capable of carrying a continuous current of 2.5A. Generally speaking, the heavier the earth lead the better and 24/0.2mm conductor is recommended.

### OUTPUT POWER

To obtain the maximum output from the module a power

supply of 80V (the maximum allowable voltage) and a load of 4 ohms must be used. When the module is being operated at full power it should be mounted on an aluminium case or heatsink of at least 16 s.w.g. and with a surface area of 950 sq. cms.

With a 50V supply (minimum voltage) and a load of 16 ohms the output power will be approximately 16W and if an 8 ohm load is used, 32W.

With the module connected to a suitable p.s.u. and loudspeaker, and with no input signal applied, VR1 should be adjusted for a total current reading of 50mA. ★

## News Briefs

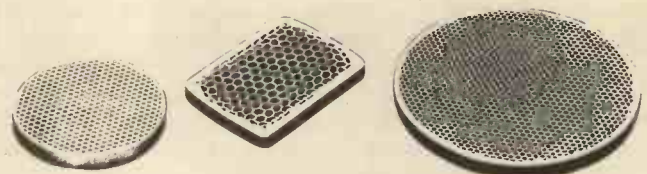
### MAGIC ELEMENT

**A**N ENTIRELY new and intriguing type of heating element with built-in temperature control without the need for any external sensors or cutouts is now available from Salford Electrical Instruments Ltd. Known as PTC Honeycomb heaters, the new elements are available for use from 240V or 110V a.c. mains, and are ideally suited to use in domestic appliances and blown air applications in industry.

The heaters depend for their operation on the thermal properties of doped barium titanate, a semiconductor ceramic whose resistance increase sharply above a certain temperature, known as the switching temperature. The elements are available in round or rectangular shapes, with a "honeycomb" structure of hexagonal holes to ensure easy air flow over as large a surface as possible.

The low initial resistance of the elements means that warm-up is achieved very rapidly after switching on, but once the switching temperature is reached equilibrium occurs, with heat losses from the element balancing the input power. Passing air through the heater results in a new, lower equilibrium temperature, which in turn causes the resistance to drop and hence increases the input power. The result is that the overall temperature of the block remains nearly constant at around the switching temperature, and heating power can be varied merely by controlling the flow of air.

An important feature of the elements is their inherent safety; if the air flow stops for any reason, the current flow into the device becomes self-limiting and the heater remains at the switching temperature. Other advantages include minimal temperature fluctuations, with no "dead spots" within the heater block.



Self-regulating heater elements

# PE TELETEXT

with **INFRA-RED**  
**REMOTE CONTROL**

**David Shortland**

## **PART 3... VIDEO SUMMER BOARD & P.S.U.**

**T**HE circuit diagram of the Video Summer Unit is shown in Fig. 3.1. In addition to the R, G and B signals from the character generator, the TEA1002 requires a number of timing signals. These are all derived from signals available in the teletext decoder. The PAL switch input (pin 12) is a square wave at half line frequency which changes the colour burst phase on alternate lines to provide correct PAL encoding. It is generated by taking the GLR signal and dividing it by two with a binary counter. The counter is negative edge triggered to ensure that the timing of the PAL switch is correct. GLR is also used to generate the Colour Burst Flag (CBF) input to the TEA1002. It is gated with F1 in the 4528 monostable (IC16) to provide a 2.2 $\mu$ s pulse which enables the colour burst encoder in the TEA1002 at the correct time. AHS is used as the composite sync input to the TEA1002 and also to trigger the second monostable of IC16. This generates a 4.5 $\mu$ s pulse which is adjustable to enclose the whole of the colour burst on the TV video signal. This output is then inverted and fed to the burst gate input of IC17. This enables IC17 to frequency lock its 8.8MHz oscillator to the frequency of the incoming burst. The oscillator output is then buffered and connected to the oscillator input of the TEA1002. The Picture On input from the teletext board is used to kill the oscillator whenever TV display is selected since there would otherwise be an ambiguity in the colours of the displayed text. This means that news flashes and subtitles are displayed in black and white only.

Pin 11 on the TEA1002 has a chroma band limiting filter connected to it to reduce the harmonics present in the TEA1002 chroma signals. This considerably improves the quality of the display but necessitates the use of a delay line in the luminance path between pins 6 and 7. A delay of 270ns effectively compensates for the delays introduced by the filter in the chroma path.

Pin 9 on the TEA1002 is used to select two different

colour bar standards. For teletext use, it is grounded to give colours based on the BBC 95 per cent colour bar standard. If it is taken to the 5V supply, colours based on the EBU 75 per cent colour bars are produced which are more suitable for TV games.

The remainder of the circuit consists of a black level clamp which clamps the TV video black level to that of the TEA1002 video output, and an analogue switch to select either the TV video information or the encoded teletext display. The output of the switch is buffered and provide a signal suitable for driving the REMO 200 modulator directly.

The composite video output from the TEA1002 is shifted in d.c. level and reduced in amplitude to give a 1 volt signal on the input to the analogue switch and on one side of the long tailed pair. When the CBF signal is high, current flows in the long tailed pair and the p.n.p. transistor conducts to charge the 1 $\mu$ F clamping capacitor until the two bases of the pair are at the same potential.

The TV signal which is nominally 2.4V peak to peak is reduced in amplitude and buffered to provide a 1V signal at the output of the clamp.

IC19 is an analogue switch and when the blanking signal is low, the Y<sub>0</sub> input is connected to the output giving a TV picture display. If the blanking signal is high as in teletext mode or during boxed information on news flash and subtitle pages, then the Y<sub>1</sub> input is connected to the output giving a text display.

### **CONSTRUCTION**

The Video Summer Circuit, sound amplifier and modulator are all mounted on the p.c.b. shown in Figs. 3.2. and 3.3. The through-board links shown by the square pads in Fig. 3.3. should be soldered first. Before soldering the rest of the components carefully check the links for continuity with a multimeter. It is recommended that i.c. holders are used for

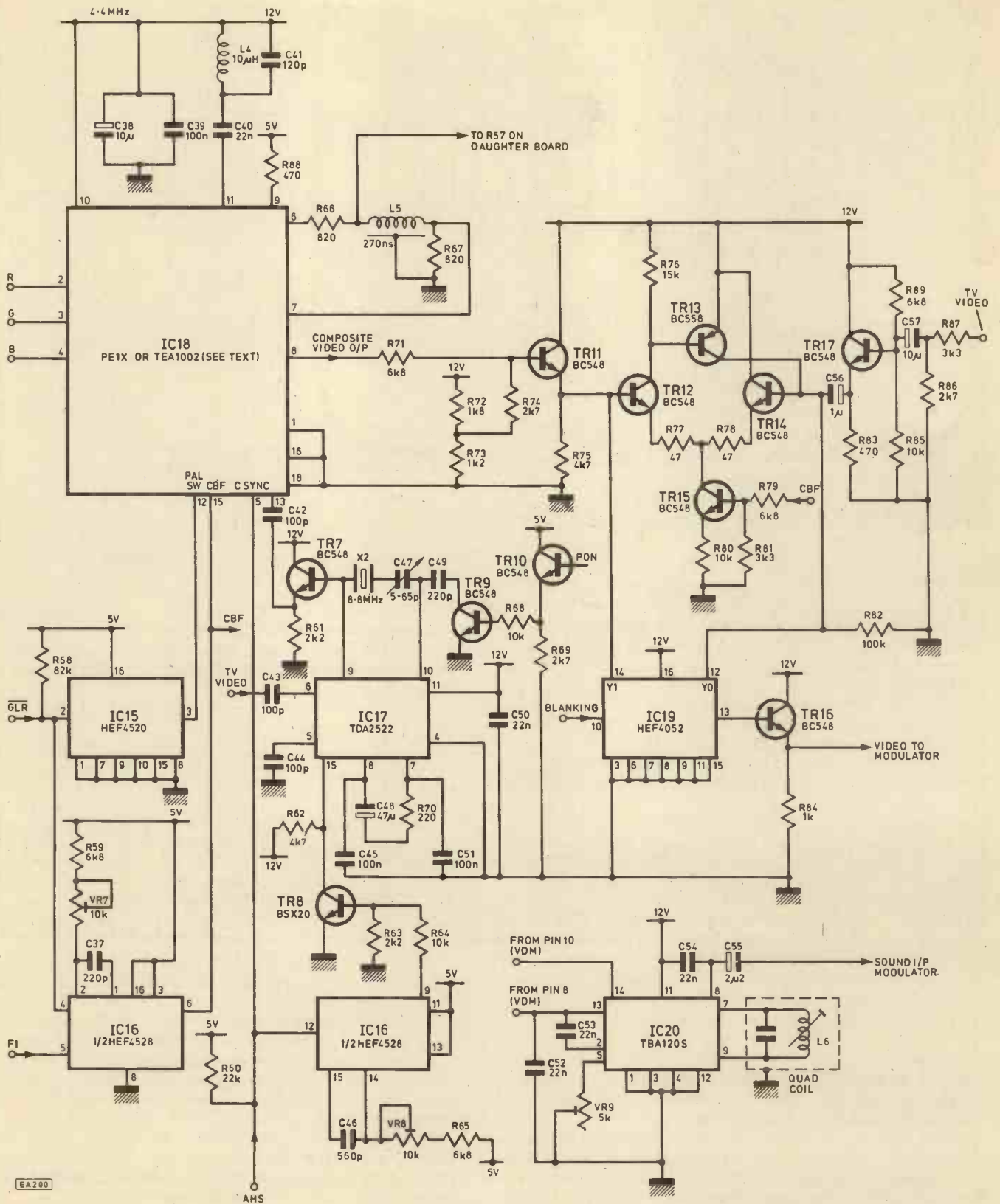


Fig. 3.1. Circuit diagram of the Video Summer Unit

## COMPONENTS . . .

### VIDEO SUMMER BOARD

#### Resistors

R58	82k
R59, R65, R71, R79, R89	6k8 (5 off)
R60	22k
R61, R63	2k2 (2 off)
R62, R75	4k7 (2 off)
R64, R68, R80, R85	10k (4 off)
R66, R67	820 (2 off)
R69, R74, R86	2k7 (3 off)
R70	220
R72	1k8
R73	1k2
R76	15k
R77, R78	47 (2 off)
R81, R87	3k3 (2 off)
R82	100k
R83, R88	470 (2 off)
R84	1k

#### Potentiometers

VR7, VR8	10k (2 off)
VR9	5k

#### Capacitors

C37, C49	220p (2 off)
C38, C57	10 $\mu$ 16V elect (2 off)
C39, C45, C51	100n (2 off)
C40, C50, C52, C53,	
C54	22n (5 off)
C41	120p
C42, C43, C44	100p (3 off)
C46	560p
C47	5-65p
C48	47 $\mu$ 16V elect
C55	2 $\mu$ 2 16V elect
C56	1 $\mu$ 16V elect

#### Semiconductors

TR7, TR9, TR10, TR11	
TR12, TR14, TR15, TR16,	
TR17	BC548 (9 off)
TR8	BSX20

TR13	BC558
IC15	4520
IC16	4528
IC17	TDA 2522
*IC18	PE1X or TEA 1002
IC19	4052
IC20	TBA120S

#### Miscellaneous

p.c.b.  
Holders for i.c.s. (6 off)  
Modulator REMO 200  
X28.8MHz crystal  
L4 inductor 10 $\mu$ H  
L5 delay line 270ns  
L6 Quad coil

\* See text.

### POWER SUPPLY UNIT

#### Capacitors

C58, C59, C63	220n
C60	4700 $\mu$ 25V elect
C61	2200 $\mu$ 25V elect
C62	220 $\mu$ 160V elect

#### Semiconductors

D20, D21	1N4001 (2 off)
D22	BZY88 47V zener
BR1	1 Amp bridge rectifier WO 1
IC21	LM340T-5
IC22	LM340T-12
IC23	LM78L24 CH

#### Miscellaneous

S1 single pole switch  
LP1 neon lamp  
T1 mains transformer (30-0-30, 0-5A; 8-0-8, 0-2A)  
Fuse holder  
Case RB6  
UHF panel mounted sockets (2 off)  
UHF plugs (4 off)

the chips and care should be taken with the orientation of the transistors. Double check the correct types have been used.

#### SETTING UP

All the adjustments on the board can be carried out using an oscilloscope, a standard TV receiver and a source of broadcast video including teletext data.

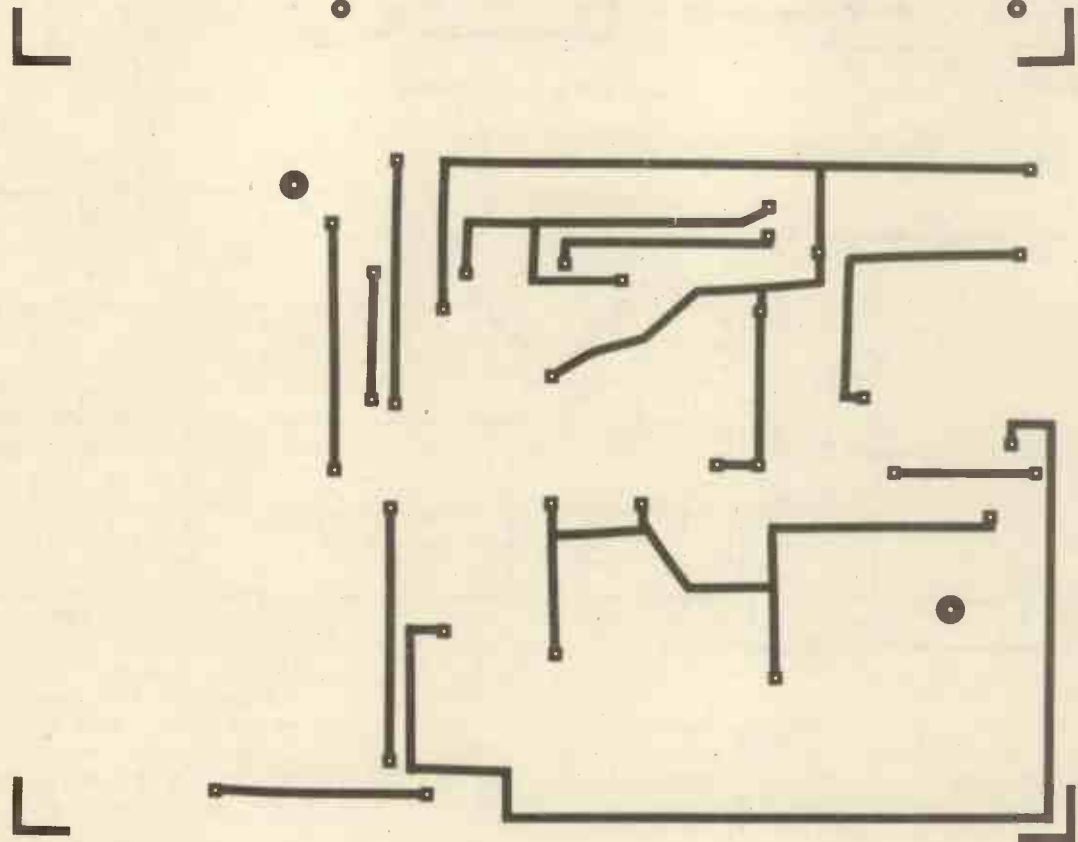
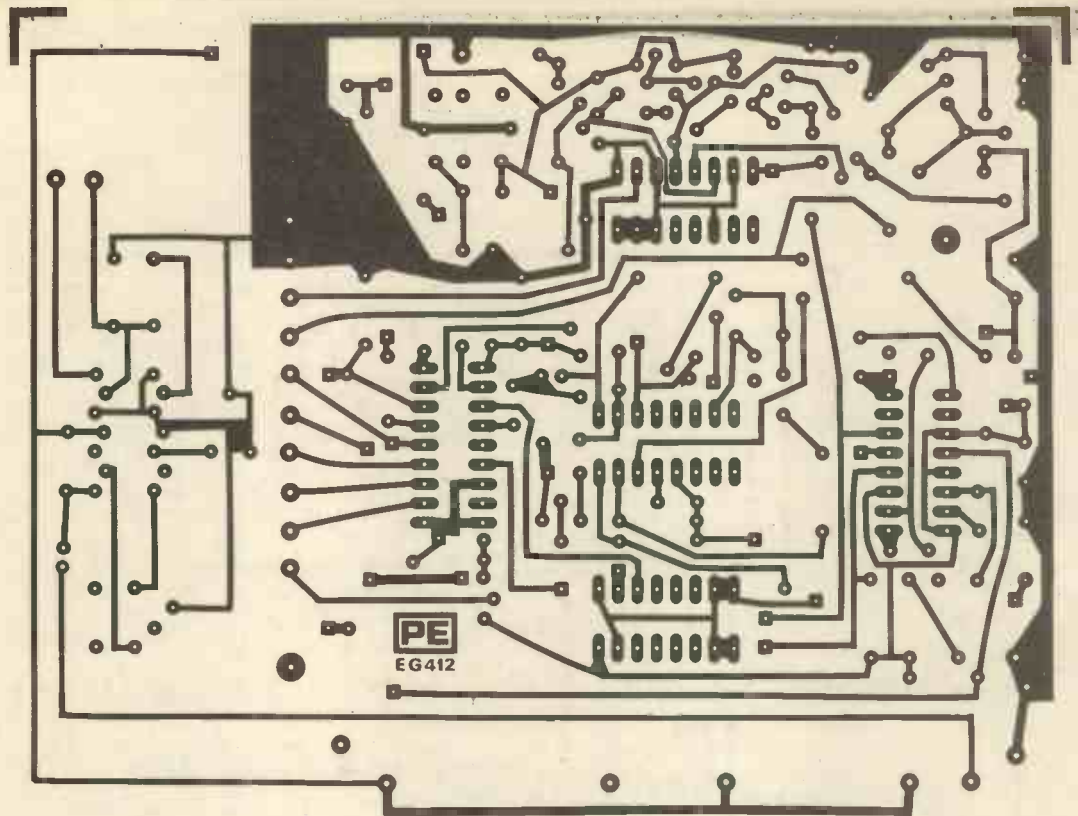
First the CBF pulse on pin 6 of the IC16 should be adjusted to be 2.2 $\mu$ s wide. Then the pulse at pin 15 of the IC17 should be adjusted to just enclose the colour burst on the incoming TV video signal. Check that it is correct for all channels. It is now necessary to adjust the frequency of the reference oscillator (IC17). For this, it is necessary to display both TV video and coloured teletext simultaneously. To do this, select a newsflash or subtitle page which contains

coloured information, then open-circuit the PON input (TR10 base). This allows the reference oscillator in IC17 to continue oscillating to give a colour display of the newsflash. Now short circuit together pins 7 and 8 of IC17 to allow the oscillator to free run, and adjust the crystal trimmer capacitor for the minimum beat of the colours in the displayed text. The oscillator is now correctly tuned, and the shorting link can be removed and PON reconnected.

Finally, the coil in the chroma filter on pin 11 of the TEA1002 should be adjusted for maximum colour burst amplitude at the TEA1002 output. This should correspond to minimum patterning on the teletext display.

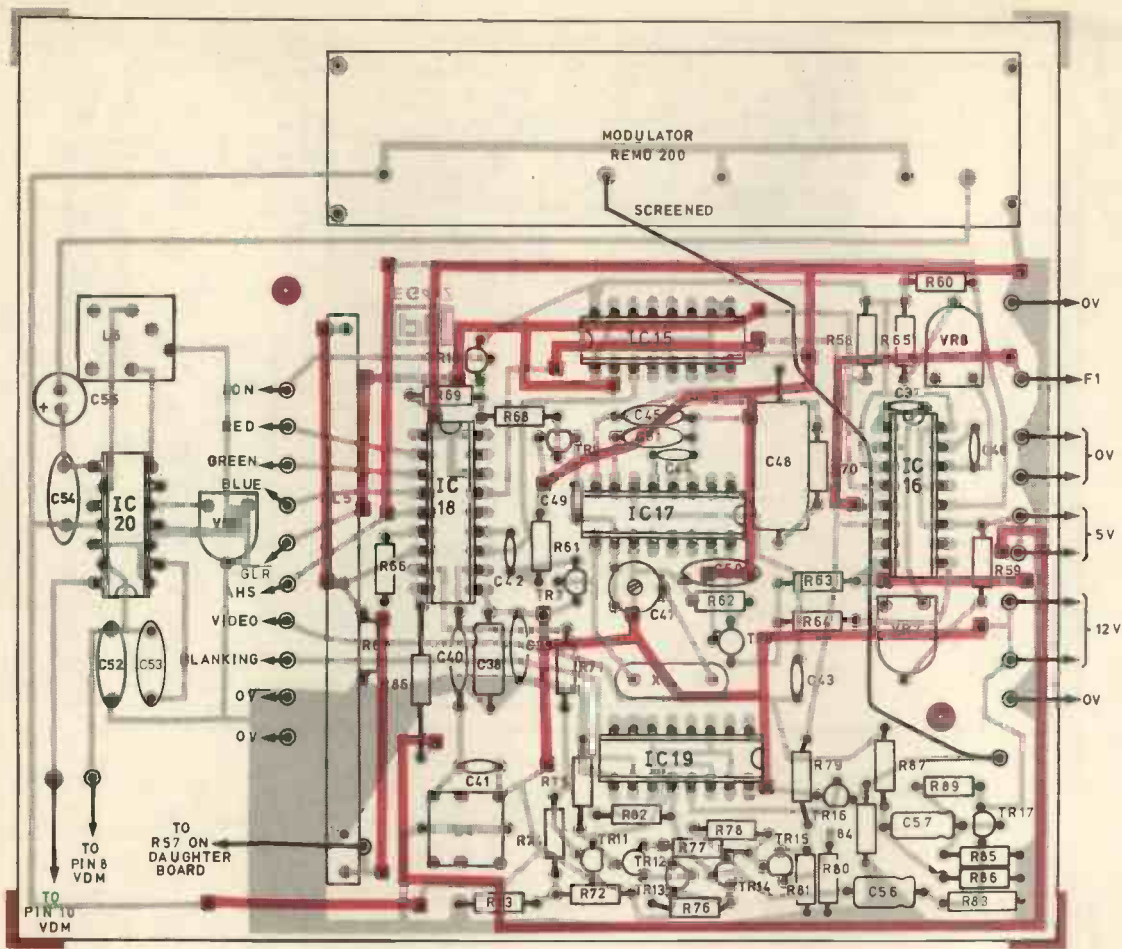
#### PE1X MODIFICATION

Supplies of the TEA1002 are at present very limited. However, the PE1X can be used in place of the TEA1002.



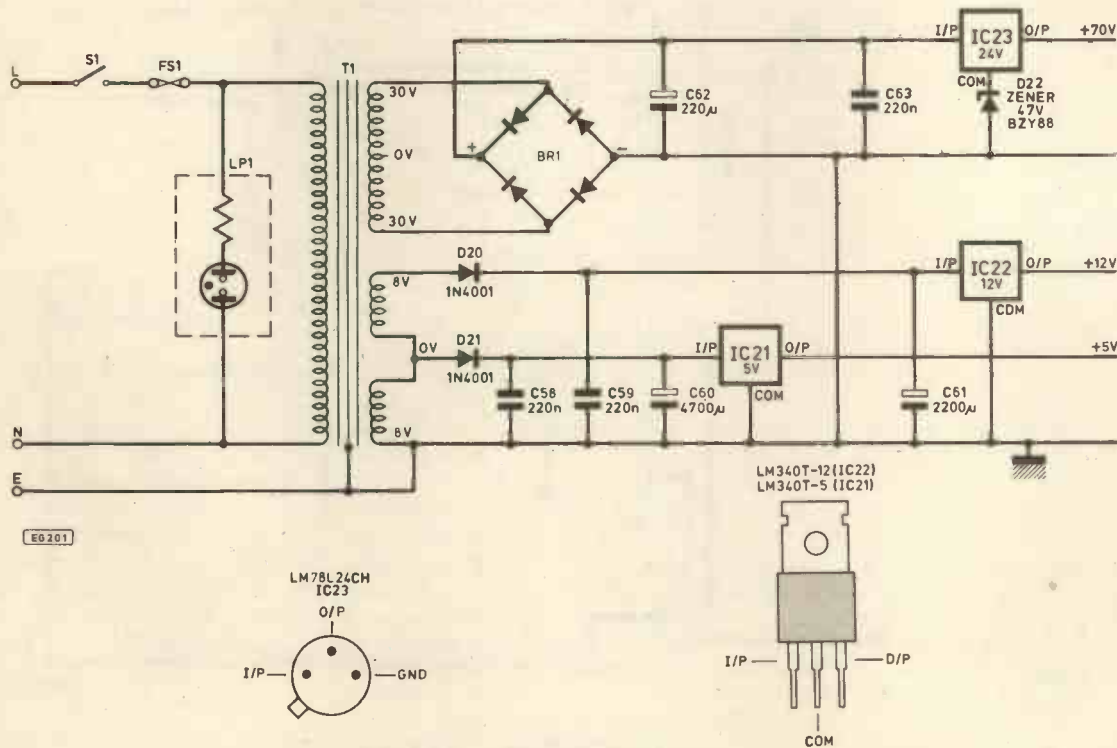
EG 4.13

Fig. 3.2. Video Summer p.c.b. design



E0413 E0414

Fig. 3.3. Component layout



E0201

Fig. 3.4. Circuit diagram of the p.s.u.

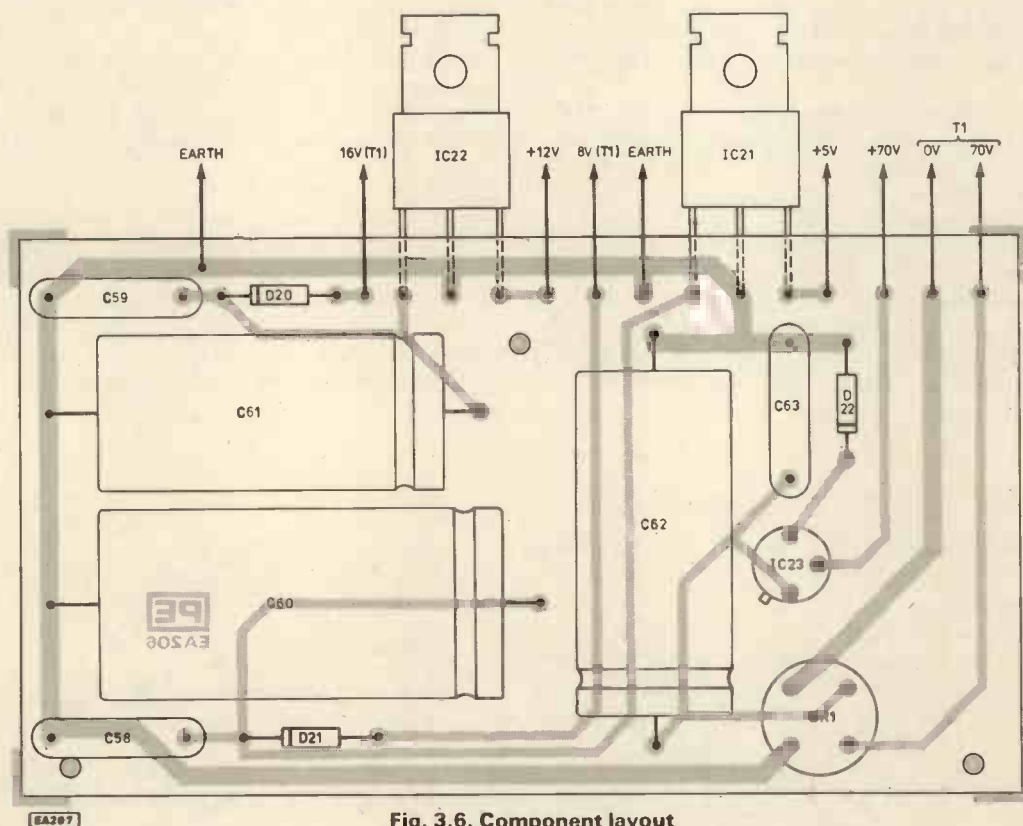
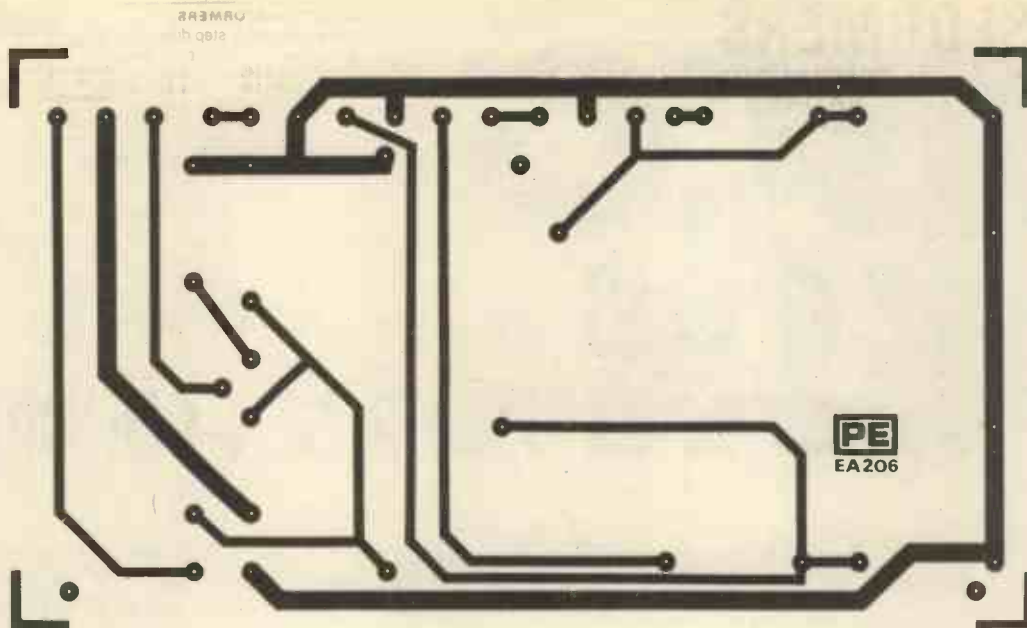


Fig. 3.6. Component layout

The PE1X which is similar to the TEA1002 although it does not have the BBC colour bar option. If the PE1X is used, then additional components are required to simulate the BBC colour bars provided by the TEA1002. This is done by ORing together the R, G and B signals with diodes and using this signal to inject an extra current into the luminance channel at the delay line input. In addition, the PE1X has a  $470\Omega$  series resistor to pin 9.

The circuit diagram and the p.c.b. are shown for PE1X operation. If a TEA1002 is to be used then the series resistor R88 should be removed and pin 9 should be linked to 0V instead of 5V and the diodes D14 to D18 and resistor R57 should be removed from the daughter board.

#### POWER SUPPLY UNIT

The circuit diagram of the p.s.u. is shown in Fig. 3.4. Three output voltages are required by the decoder; +70V for the tuning voltage, with +12V and +5V for the TTL and CMOS.

The p.c.b. design is shown in Fig. 3.5 with the component layout in Fig. 3.6. The two voltage regulators (IC21, IC22) are mounted on the copper side of the board and their leads should be kept as long as possible. The p.c.b. is mounted at the rear of the case with the regulators bolted to the case.

Before connecting the p.s.u. to the system, carefully check the output voltage of each rail.

#### NEXT MONTH: WIRING AND TESTING

# DISCO DESK

## Part 2 BEN DUNCAN

In this part the circuits of cards 2 and 3 and the assembly of the former will be dealt with.

### CARD 2

Fig. 6 includes the panel mounted components and the interwiring that lies between Cards 1 and 2. The panel mounted components, however, will be dealt with in greater detail later.

S1 and S2 are the source switches, S3 is the monitor PFL selector and VR1 is the crossfader. IC1 raises the disc or line input signal to line level and provides RIAA bass boost. A degree of rumble filtering is provided by C11, which causes the gain of the stage to fall below 20Hz. The output of IC1 feeds the tone control stage and also the Sound-to-Light output via a mixer. C17 and C23 control the degree of midrange variation; to reduce the midrange boost and cut, a lower value, typically 2n7 should be substituted. C25 provides d.c. isolation thereby ensuring that the tone controls are quiet in action. Instead, the d.c. bias current flows through R25.

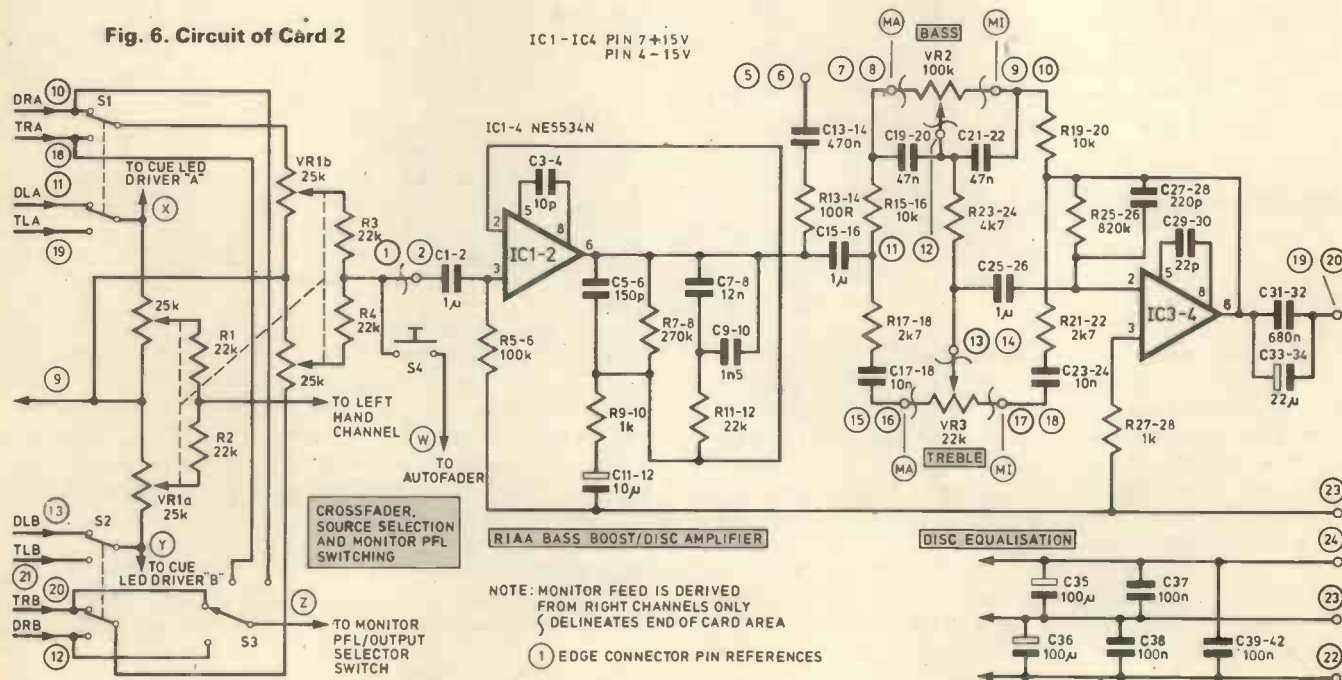
C27 provides lead compensation in order to achieve stability even when the wires leading to the tone controls are quite long. The value given is typical, and generally, for good performance it must be as small as possible. The precise value of C27 can only be determined when the completed unit is tested.

When wiring the board, keep the 'MA', 'CEN' and 'MI' tone control connection wires away from each other, and make the wiring as direct as possible. Again, use 16/0.2 wire for the 0V connection and screened cable for the inputs.

### CARD 3 CIRCUIT

The microphone input stage shown in Fig. 8 is intended for high output unbalanced capacitor microphones with a typical output of 1.5mV/ $\mu$ Bar. A 47V line is needed to power the integral preamplifier in most capacitor microphones, and this voltage appears at the input socket. For this reason, the rarely encountered 4 pin XLR is used to lessen the chance of accidental connection of other circuits or microphones to the 47V supply.

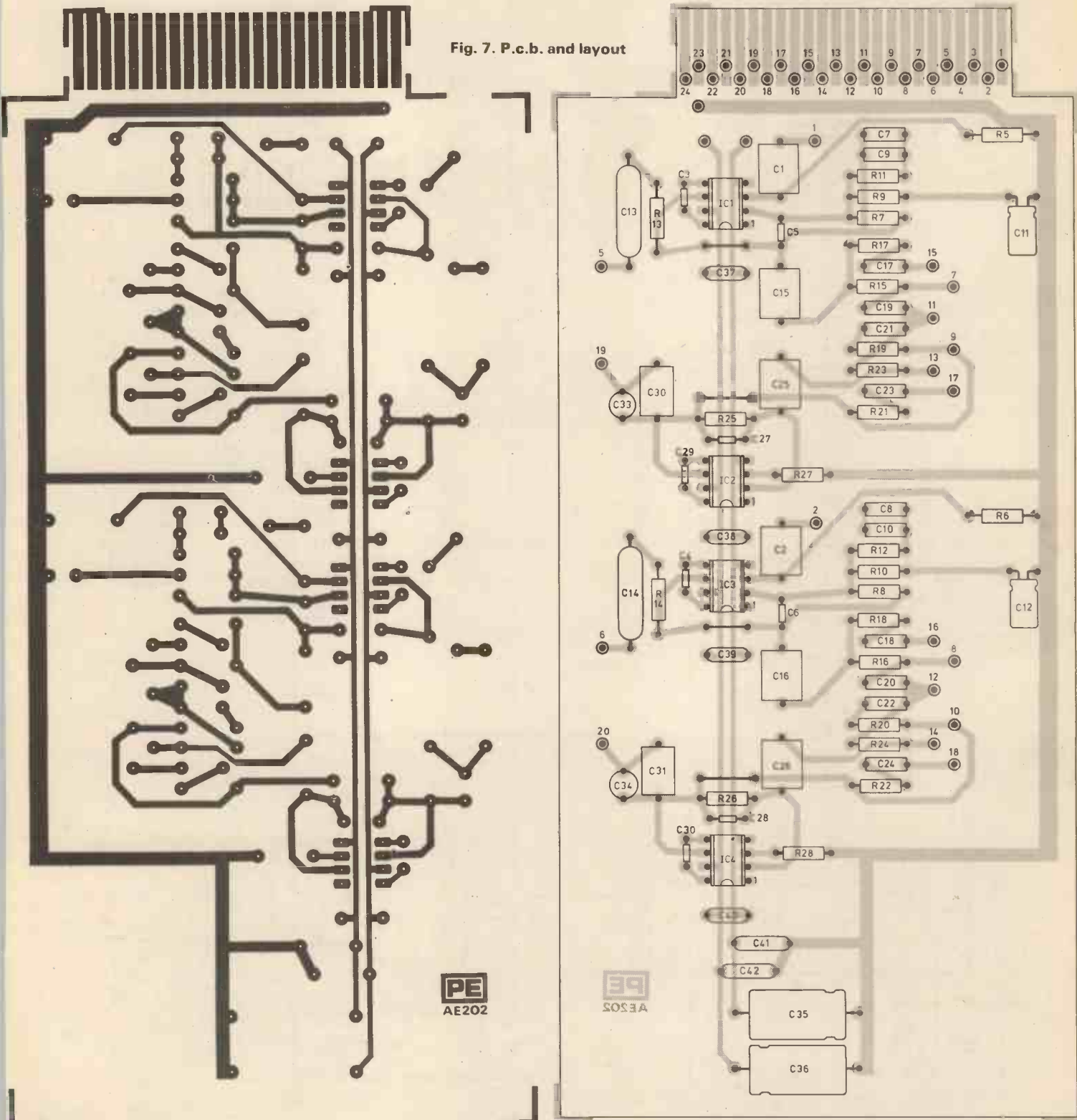
Fig. 6. Circuit of Card 2

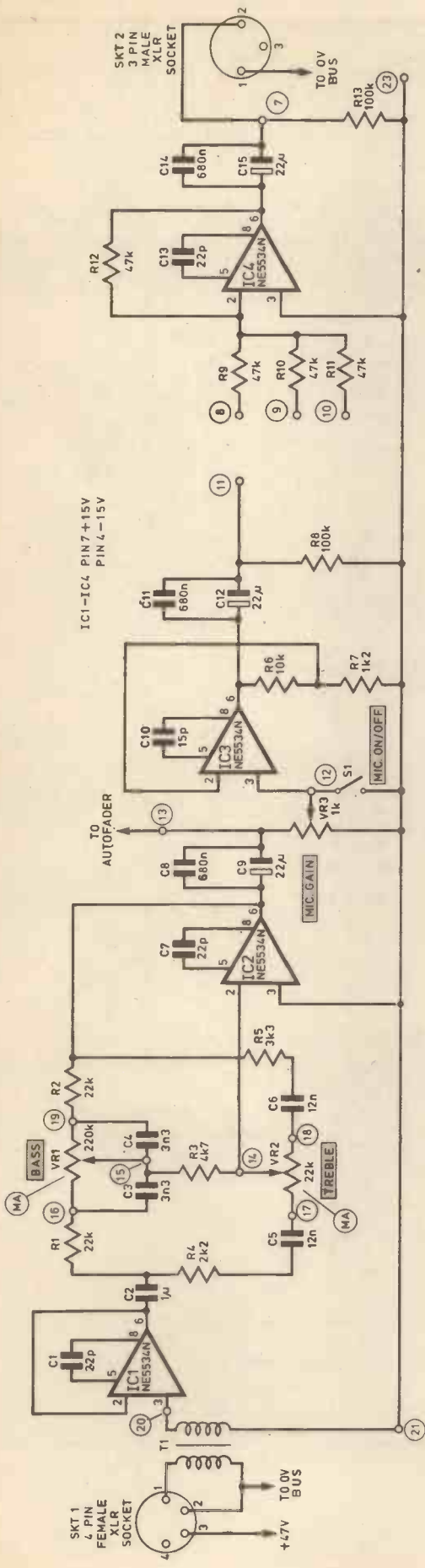




# CARD 2

Fig. 7. P.c.b. and layout

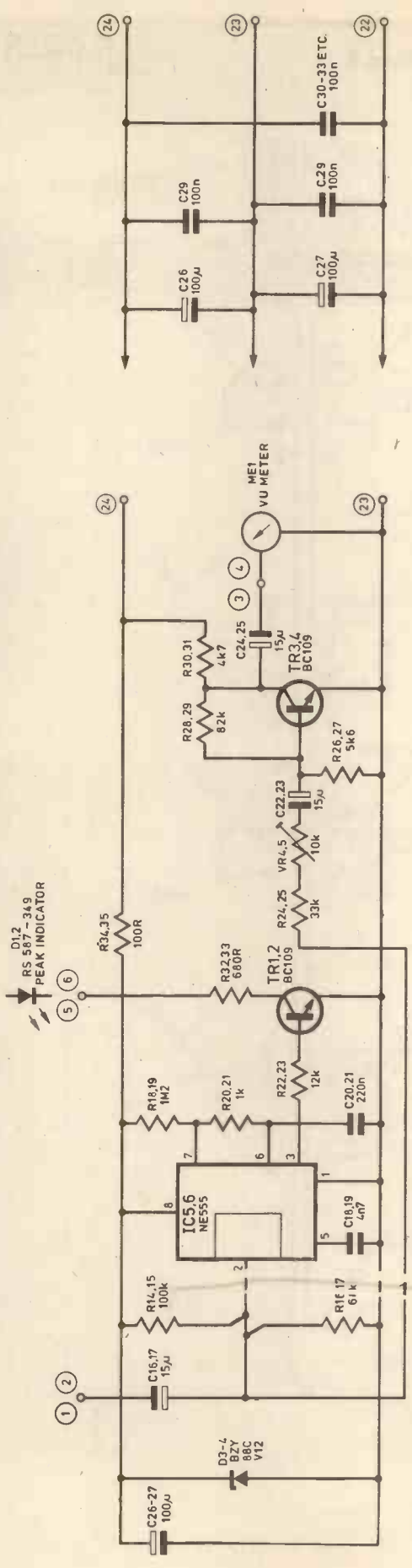




MICROPHONE PRE-AMPLIFIER

MICROPHONE LINE DRIVER

MONO MIXER



PEAK INDICATOR (ONE ONLY SHOWN)

VU DRIVER (ONE ONLY SHOWN)

SUPPLY RAIL DECOUPLING

Fig. 8. Circuit of Card 3

## Card 2

## COMPONENTS

## Card 3

## Resistors

R1—4	22k	} Metal oxide, ½ watt, 2%
R5—6	100k	
R7, 8	270k	
R9, 10	1k	
R11, 12	22k	
R13, 14	100R	
R15, 16	10k	
R17, 18	2k7	
R19, 20	10k	
R21, 22	2k7	
R23, 24	4k7	
R25, 26	820k	
R27, 28	1k	

All ¼ watt, 5% unless otherwise specified

## Potentiometers

- VR1—25k quad slider pot with log/antilog tracks (Rivlin)  
 VR2—100k lin dual slider pot (Maplin type FX80B)  
 VR3—22k lin dual slider pot (Maplin type FX78K)

## Capacitors

C1, 2	1µ polycarbonate
C3, 4	10p ceramic
C5, 6	150p ceramic or polystyrene
C7, 8	12n polycarbonate
C9, 10	1n5 polycarbonate
C11, 12	10µ, 25V PC electrolytic
C13, 14	470n polyester, C280AE series
C15, 16	1µ polycarbonate
C17, 18	10n polycarbonate
C19, 20	47n polycarbonate
C21, 22	47n polycarbonate
C23, 24	10n polycarbonate
C25, 26	1µ polycarbonate
C27, 28	220p ceramic (see text)
C29, 30	22p ceramic
C31, 32	680n polycarbonate
C33, 34	22µ, 25V p.c. electrolytic
C35, 36	100µ, 40V axial electrolytic
C37—42	100n polyester, C280AE series

## Semiconductors

IC1—4 NE5534N

## Miscellaneous

- S1—2 'Min maka switch' with 3-way, 4-pole wafer (RS components, types 327—311 and 327—377)  
 S3 Min. rotary switch, 4-way, 3-pole  
 S4 Pushbutton illuminated switch with red lens and shield (RS 339—358, 339—409, 339—415), one each of these required

4 x 8 pin d.i.l. sockets

Pointer type collet knobs to suit above switches

Crossfader knob (Maplin type RX27E)

P.c.b.—RS type 434-150

4 x 8 pin d.i.l. sockets

Kobs to suit slide pots (Maplin type F)

P.c.b.—RS type 434-150

VU meters—Maplin type RX53H (see text)

S1—Push-button illuminated switch, orange lens and shield (RS 339-358, 339-409, 339-415) see text (one each of the above required)

## Resistors

R1—2	22k
R3	4k7
R4	2k2
R5	3k3
R6	10k
R7	1k2
R8	100k
R9—R12	47k
R13	47k
R14—15	100k
R16—17	68k
R18—19	1M2
R20—21	1k
R22—23	12k
R24—25	33k
R26—27	5k6
R28—29	82k
R30—31	4k7
R32—33	680R 1W
R34—35	100R 1W

All ¼W, 5% carbon unless otherwise stated

## Capacitors

C1	22p ceramic
C2	1µ polycarbonate
C3, 4	3n3 polycarbonate
C5, 6	12n polycarbonate
C7	22p ceramic
C8	680n polycarbonate
C9	22µ, 25V PC electrolytic
C10	15p ceramic
C11	680n polycarbonate
C12	22µ, 25V PC electrolytic
C13	22p ceramic
C14	680n polycarbonate
C15	22µ, 25V PC electrolytic
C16, 17	15µ, 40V electrolytic, axial
C18, 19	4n7 polycarbonate
C20, 21	220n polycarbonate
C22, 23	15µ, 40V, axial electrolytic
C24, 25	15µ, 40V, axial electrolytic
C26, 27,	100µ, 40V, axial electrolytic
C28—33	100n polyester, C280AE series

## Potentiometers

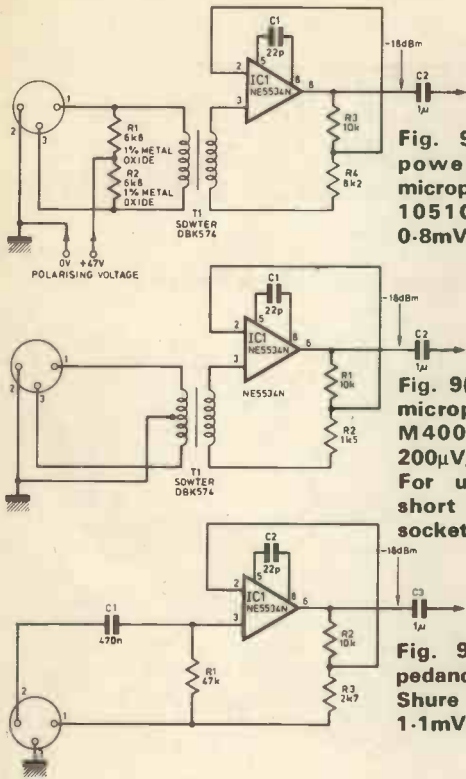
- VR1 220k lin dual slide pot (Maplin type FX81C)  
 VR2 22k lin dual slide pot (Maplin type FX78K)  
 VR3 1k log dual slide pot (Maplin type HB00A)  
 VR4—5 10k enclosed cermet preset (RS components type 186-182)

## Semiconductors

- IC1—4 NE5534N  
 IC5—6 NE555  
 TR1—2 BC109  
 D1—2 Flush panel l.e.d. red (RS type 576-327)  
 D3—4 BZY88C-V12

## Miscellaneous

- SKT1 4 pin female XLR socket (see text)  
 SKT2 3 pin male XLR socket (Maplin type BW92A)  
 T1 Sowter microphone transformer (see text)



**Fig. 9(a). For phantom powered capacitor microphones e.g. Calrec 1051C. Sensitivity 0.8mV/μBar**

**Fig. 9(b). For moving coil microphones e.g. Beyerdynamic M400NC. Sensitivity 200μV/μBar. For unbalanced working short pins 2 and 3 on socket**

**Fig. 9(c). For high impedance microphone e.g. Shure 515SA. Sensitivity 1.1mV/μBar**

Fig. 9 shows alternative input circuit arrangements which will accommodate the vast majority of moving coil and phantom powered capacitor microphones. Phantom powering keeps the polarising voltage out of harm's way and thus the common 3 pin XLR socket can be used. All the circuits shown in Fig. 9 provide similar performance to the input stage in Fig. 8, and the output voltage for the quoted microphone sensitivities is identical.

To achieve a good overload margin, the signal is not brought to line level immediately. Instead, it passes through the equalisation stage (IC2 and associated components) and the gain control (VR3).

The tone control potentiometers are not isolated from the input bias current of IC2, as in Card 2, because they are usually preset before a performance. If this is not the case, then the arrangement shown in Fig. 6 can be applied, i.e., a 1μ isolating capacitor and an 820k resistor to derive the bias current from pin 6 on the op.amp.

IC3 is a line driver, providing amplification to line level and a low output impedance. The microphone signal passes to the send-return switch and socket (shown later) and then to the mono mixer (IC4), together with the stereo lines. R8 and R13 prevent switch clicks, etc., by holding the voltage on the output capacitors at ground potential, regardless of any offset voltages that may be present.

Also on Card 3 are the peak indicator i.e.d. and VU meter drivers. The 555 timer (IC5) is powered from the +15V rail because there are insufficient pins on the edge connector to provide a +12V rail.

This device can readily introduce noise on the supply rail when switching; C26 and R35 are provided to decouple switching noise generated by this device. IC5 operates in the monostable mode; R15 and R17 are set so that a signal in excess of 500mV applied to pin 2 causes triggering. Other signal levels can be accommodated by slight adjustments to the values of these resistors. Once triggered, IC5 turns TR1

## Card 2—Edge connector details

Pin No.	Connection
1	Right input
2	Left input
3	No connection
4	No connection
5	Right output to SLM mixer (8 on card 4)
6	Left output to SLM mixer (7 on card 4)
7	B.MA (R)
8	B.MA (L)
9	B.MI (R)
10	B.MI (L)
11	B.CEN (R)
12	B.CEN (L)
13	T.CEN (R)
14	T.CEN (L)
15	T.MA (R)
16	T.MA (L)
17	T.MI (R)
18	T.MI (L)
19	Right output to volume control
20	Left output to volume control
21	No connection
22	-ve, 15V
23	0V
24	+ve, 15V

Abbreviations for tone control connection:

- CEN—Centre (slider)
- MA—Max boost position
- MI—Min (cut) position
- T—Treble pot
- B—Bass pot

and its associated i.e.d. on until C20 has charged (about 300ms), whence it returns to its stable state. The time delay provided by C20 allows the shortest transient peaks to be seen clearly.

Like the 555 timer, the peak indicator i.e.d.s can introduce noise on the supply rails, but in this case, because they are panel mounted, they can be fed from the auxiliary 12 volt supply. This supply does not feed any audio circuitry, apart from the monitor amplifier, thus noise levels on this rail are largely immaterial.

Professional VU meters have rigidly defined ballistics, frequency response and impedance and are designed to bridge 600 ohm lines directly. Panel space limitations prevented the use of such a meter, and a miniature meter with a VU scale was used. The genuine article is designed such that OVU occurs at +4dBm, but the non-standard OVU=0dBm was considered to be more useful. A VU driver was required to bring the level derived from stereo lines up to +4dBm, and cause OVU deflection in the meter. TR3 provides such amplification and VR4 allows accurate calibration.

Test the circuit as before, connecting all inputs to 0V. Also connect pins 15 and 19 together to bias IC2 in the absence of VR1. To test the peak indicator, connect a i.e.d. to the +15V rail and pin 5. Although only the +15V rail is required to test this circuit, both rails must be connected, otherwise the op-amps will saturate and damage may result. Apply a 1kHz signal to pin 1 on the edge connector and raise the input level until the i.e.d. lights. Trimming of R15 and R17 may be necessary to achieve the desired indication level accurately. The VU driver is tested in a similar manner; in this case, a 776mV r.m.s. input signal should cause an OVU reading.

**Next Month:** More circuits and boards.

# PATENTS REVIEW...

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

## HI-FI FILMING

New British patent application 2 031 690 from Polaroid Corporation of Cambridge, Massachusetts (filed under the New Laws and dating back to September 1978) describes a complex, but interesting microphone system for a home movie camera. The aim is to facilitate direct sound recording with an integrated camera, recorder and microphone system. Home movie cameras which record sound direct onto the magnetic stripe of conventional (but pre-stripped) Super 8 film are already available and the patent application may mean that Polaroid intends to launch a sound version of the Polaroid instant movie system. This is called Polavision and uses a modified form of Super 8 colour film which is automatically developed in a table-top player with a back projection screen. So far Polavision has been only a silent system.

Home movie cameras produce a considerable amount of noise i.e. motor and claw whirr which spreads from 100Hz to 6000Hz with a peak at around 2000 Hz. As this peak is in the centre of the speech frequencies any camera noise recorded on the film soundtrack is a considerable nuisance. Polaroid suggest a microphone system capable of efficiently rejecting sound at a chosen frequency and angle of incidence. Figure 1 shows camera 17 with microphone 13 mounted on a boom and connected to a processing circuit 15. Figure 2 shows a design for circuit 15 which can be tuned to reject a selected sound spectrum in a solid cone angle marked by chain lines 22 in figure 1.

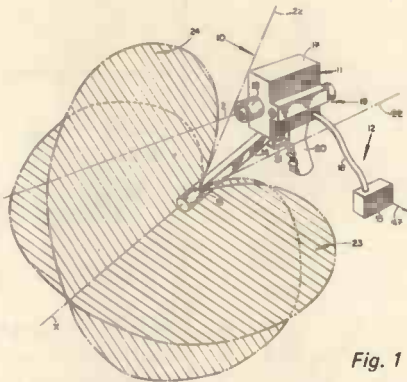


Fig. 1

Microphone 13 is in fact a linear ray of four omni-directional microphone elements M1, M2, M3 and M4, spaced apart (by distances D1, D2). An arriving sound wave thus produces four identical, but mutually phase shifted, output signals. In figure 2 summing channel 40 adds the signals from elements M2, M3 and subtractor 41 differences the signals from M1, M4. The output of subtractor 41 is integrated with respect to time, at 42 and combining means 46 adds the outputs from the sum-

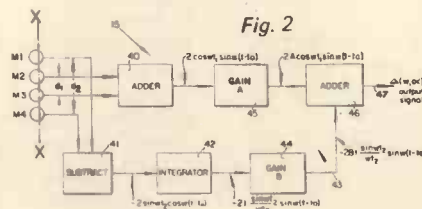


Fig. 2

ming and integrated channels. A gain control 44, 45 in each channel allows adjustment of the relative channel levels. The overall output, which appears on line 47, is recorded and can be reduced to zero at any desired frequency and angle of incidence by

suitable selection of the relative gain at 44, 45 and the spacing D1, D2 between the elements. Extensive formulae are given in the patent to enable necessary calculations to be made.

A three microphone stereo system, with filtering to reduce wind noise, is also described, (Figure 3). A means of adding and subtracting microphone inputs by mechanical rather than electrical means is suggested (Fig. 4). Two microphones 126, 128, are arranged with their diaphragm axis mutually at right angles. When the output of microphone 128 is integrated and added to the output of microphone 126, the response pattern obtained is similar to that obtained with the circuit of Figure 2.

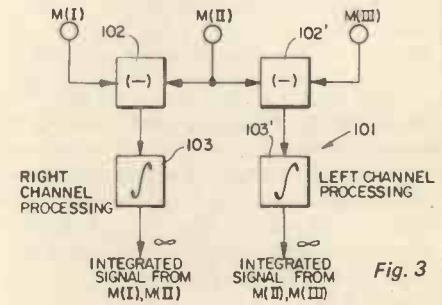


Fig. 3

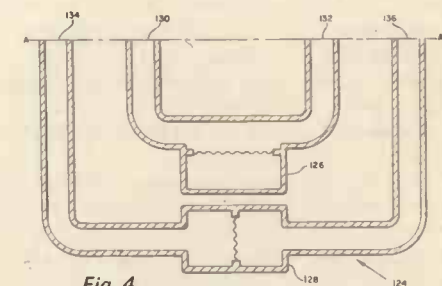


Fig. 4

## POINTS ARISING

### MICROPROMPT (July 1980)

Don't try running this as a program, it will not work. These lines contain corrections to the "LE PASSE-TEMPS" program. Our apologies for these errors.

```

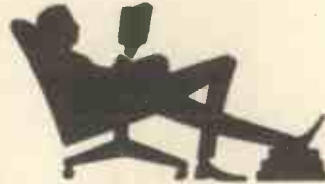
40 DIMS(44), T(11): POKE 530, 1 : PRINT : GOTO 60
80 E = 0 : F = 0 : G = 0 : FOR A = 1 TO 42 : S(A) = 0 :
  NEXT
705 FOR A = 0 TO 11 : T(A) = 0 : NEXT A
730 T(I) = T(I) + S(U)
830 FOR D = 0 TO 3 : T(I) = T(I) + S(N) : N = N + 6 :
  NEXT D : I = I + 1
850 FOR H = 0 TO 1 : D = T(H) : IF D = 4 THEN E = 1
950 FOR A = 1 TO 7 : IF S(A) = 0 THEN 970
980 PRINT TAB (22-LEN (M$)/2) M$ ; CHR$(13) ;
1010 IF MM = 0 THEN 1040
1070 IF G THEN G = 0 : S3 = S3 + 1 : GOTO 50
  
```

# Countdown

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

- EMIX** (Electronic Measuring Instruments Exhibition) Sept. 30, Oct. 1-2. Post House Hotel, Southampton. **I**
- BEX** (Business Equipment Exhibition) Oct. 1-2. The Guildhall, Plymouth. **K**
- EMIX** Oct. 7-8. Centre Hotel, Newcastle. **I**
- Fire Alarms and Emergency Lighting — Some Modern Developments** (IEETE event) Oct. 14. Thompson Arms, Sackville St., Manchester, at 7.15 p.m. **B3**
- D.C. Servo Motors** (IEETE event) Oct. 14. SSEB, 75 Waterloo Street, Glasgow, at 7 p.m. **B3**
- EMIX** Oct 14-15. Guildhall, Cambridge. **I**
- Drive Electric** Oct. 14-17. Wembley Conf. Centre, London. Organiser £ 01-834 2333.
- Mailing Efficiency Exhibition** Oct. 14-17. Cunard International Hotel, London. **Z**
- BEX** Oct. 15-16. Assembly Rooms, Edinburgh. **K**
- Engineering Ireland** Oct. 15-18. Leopardstown Exhibition Centre. **V**
- Testmex** (exhibition and conference) Oct. 28-30. Wembley Conf. Centre. **T**
- Viewdata Exhibition for Professional & Business People** Oct. 29-31. West Centre Hotel, London. **Z1**
- Compec** Nov. 4-6. Olympia. **Z1**
- BEX** Nov. 5-6. Sophia Gardens, Cardiff. **K**
- London Business Equipment Exhibition** Nov. 11-14. Cunard International Hotel, London. **Z**
- Semiconductor International 80** Nov. 25-27. Metropole Convention Centre. **T1**
- BEX 80** Nov. 26-27. Exhibition Centre. Bristol. **K**
- Breadboard** Nov. 26-30. Royal Horticultural Halls, Westminster. **T**
- BEX 81** Feb. 4-5. Pavilion, Bournemouth. **K**
- Microsystems 81** (exhibition and conference) March. 11-13. Wembley Conf. Centre, London. **Z1**
- INSPEX 1981** March. 16-20. NEC, Birmingham. **Z1**
- Seminex 81** (seminars only) March 23-27. Imperial College, London. **H1**
- BEX 81** Mar. 25-26. Metropole, Brighton. **K**
- BEX 81** April 8-9. Centre hotel, Liverpool. **K**
- All Electronics Show 81** April 22-24. Grosvenor Ho., Park Lane, London. **F1**
- Computer Graphics 1981** April 28-30. The Barbican Centre, London. **O**
- BEX 81** April 29-30. Dragonara Hotel, Leeds. **K**
- Entertainment 81** May 9-17 (weekday mornings trade only) NEC, Birmingham. **B2**
- The European Consumer Electronics Show 81** May 10-13. Nuremburg Fair Centre, W. Germany. (Trade) **I**
- BEX Train** May 11-22. Calling at: Cambridge, Norwich, Leicester, Sheffield, Newcastle, Middlesbrough, Hull, Nottingham, Reading and Portsmouth. **K**
- Defence Components Expo 81** May 12-14. Brighton Metropole. **I**
- Semlab 81** June 2-5. Grand Hall, Olympia, London. The international scientific, educational, medical and industrial laboratory exhibition. (Trade) **I**
- Components 81** (Electronic Components Industry Fair) June 9-12. Earls Court, London. This show will alternate yearly with Electronics, now that the IEA amalgamation with Electrex has ceased. **I**
- International Word Processing Exhibition & Conf. 81** June 23-26. Wembley Conf. Centre, London. **Z**
- Solar Energy Exhibition** Aug. 23-28. 1981. Brighton. **M**
- International Business Show 81** Oct. 20-29. NEC, Birmingham. **A2**
- Electronics 82** (Sub-titled International Electronics Control and Instruments Exhibition) May 24-28. 1982. NEC. **I**

- I** Industrial Trade Fairs. £ 021-705 6707
- K** Douglas Temple Studios, 1046 Old Christchurch Road, Bournemouth
- M** Montbuild £ 01-486 1951
- O** Online Conferences £ 0895 39262
- T** Trident International Exhibitions £ 0822 4671
- V** SDL Exhibitions, 68 Fitzwilliam Square, Dublin, Ireland
- H1** Seminex Ltd. £ 0892 39664
- T1** Kiver Communications UK, Millbank House, 171/185 Ewell Road, Surbiton, Surrey. KT6 6AX
- Z1** IPC Exhibitions Ltd., 40 Bowling Green Lane, London EC1R 0NE. £ 01-837 3636
- A2** Hart Browne & Curtis Ltd., 29 Sackville Street, Piccadilly, London W1X 1DR. £ 01-439 8556
- B2** Brintex Exhibitions Ltd., 178-202 Great Portland Street, London W1N 6NH. £ 01-637 2400



## BOOK REVIEWS

### THE PERSONAL COMPUTER BOOK

By Robin Bradbeer

Published by Input Two-Nine and distributed by MCB Publications Ltd., Bradford 499821.

220 pages. 147 x 210 mm. Price £5.25.

ANYONE who has had even the briefest encounter with the world of personal computers and its literature will probably have come across the name Robin Bradbeer. Few would be better placed to put a book of this nature together. A freelance writer on personal computing, senior lecturer at the Polytechnic of North London, and founder of the North London Computer Club, the author has produced an excellent book, packed with photographs and illustrations. This is truly a beginner's book, explaining the whole concept and meaning of the microcomputer revolution in simple terms. It goes on to explain languages, software and hardware, and most important of all—what you can do with a home computer once you have one!

The Personal Computer Book's greatest strength is probably the appendices, which are as follows: (a) Binary Arithmetic; Octal; Hexadecimal; ASCII Code; (b) Bus Standards, (c) Manufacturers and Distributors in the UK, (d) Computer Clubs in the UK, (e) Magazines in English, (f) Bibliography of Selected Computer Books, (g) Glossary, (h) Some Hints on Kit-Build Systems.

Having served as a thorough introduction to the subject of microcomputers, therefore, the work should continue to serve as a most handy source of reference.

## News Briefs

### CLUB NEWS

THE SCOTTISH Amateur Computer Society meet on the first Wednesday of every month in the Claremont Hotel, Claremont Crescent, Edinburgh, at 7.30 pm.

Details of the next meeting, and a copy of the latest newsletter may be obtained from:

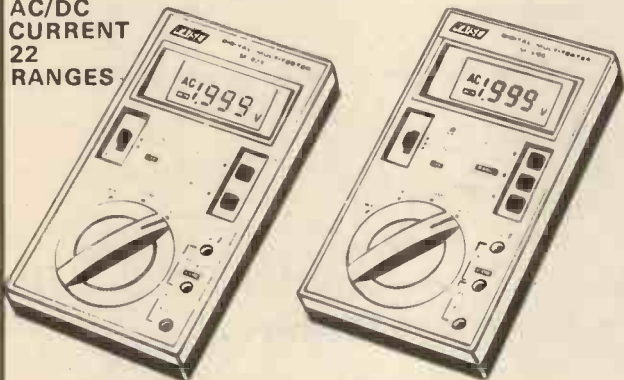
Alastair Macpherson (Secretary)  
6 Curriehill Castle Drive,  
Balerno,  
Edinburgh 14.

# SPECIAL PURCHASE



## OF TOP QUALITY LCD MULTIMETERS

AC/DC  
CURRENT  
22  
RANGES



**6100**

**6200**

### CHOOSE FROM FOUR MODELS

- 3½ digit autoranging (volts/Ohms)
- 200 hours battery life (2 pencils)
- 10 amp AC/DC (6220 & 6100)
- 1000v DC 600v AC
- 200 mA AC/DC (6200 & 6100)
- Range hold facility (6100 & 6110)
- Unit and range sign (6110 & 6220)
- Continuity buzzer (6100 & 6110)

### RESOLUTION

100 µV DC, 1 mV AC  
10 µA AC/DC, 0.1 Ohm  
10 mA on 10A, AC/DC

### ACCURACY 6100/6110

0.5% DC Volts  
1% DC Current  
1.2% AC Current  
0.5% Resistance

### 6200/6220

0.8% DC Volts  
1.3% DC Current  
1.4% AC Current  
0.8% Resistance

### OTHER FEATURES (ALL MODELS)

Low power Ohms range.  
Zero Adjust key.  
Battery Warning.  
In circuit resistance test.  
Size 155 x 85 x 28 mm. 250 g.

6200	£39.95
6220	£49.95
6100	£64.95
6110	£74.95

- All prices include batteries/leads and UK VAT (UK c/p 65p)
- Order by post or telephone with Barclay or Access.

**OR CALL IN AND SEE FOR YOURSELF**

Cubegate Limited OPEN 9-6 SIX DAYS A WEEK

**AUDIO ELECTRONICS**

301 EDGWARE ROAD, LONDON, W2 1BN

TELEPHONE 01-724 3564



**FREE CATALOGUE!**

Send large SAE (175p UK)  
Schools, Companies,  
etc. free on request.

From Mr/Mrs/Miss ..... Ref P.E.

(Block caps please) .....

Please supply .....

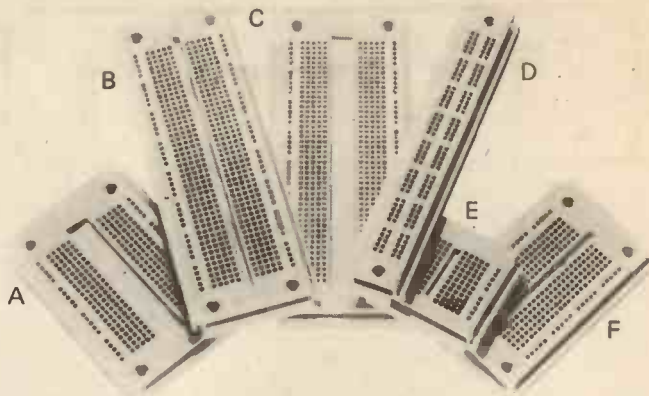
Qty ..... Model(s) .....

I/We enclose (incl. 65p post) .....

Chq/PO Value .....

Or debit Barclay/Access No. ....

# IT'S AS EASY AS A,B,C...



- A EXP 650 For microprocessor chips. £3.60
- B EXP 300 The most widely sold breadboard in the UK; for the serious hobbyist. £5.75
- C EXP 600.6" centre channel makes this the Microprocessor Breadboard. £6.30
- D EXP 4B An extra 4 bus-bars in one unit. £2.30
- E EXP 325 Built in bus-bars accepts 8, 14, 16 and up to 22 pin ICs. £1.60
- F EXP 350 270 contact points, ideal for working with up to 3 x 14 pin DIPS. £3.15
- G PB6 Professional breadboard in easily assembled kit form. £9.20 (Not illustrated.)
- H PB 100 Kit form breadboard recommended for students and educational uses. £11.80 (Not illustrated.)

### & IT'S AS EASY AS 1,2,3 with THE EXPERIMENTER SYSTEM

SCRATCHBOARD  
-BREADBOARD  
-MATCHBOARD

1. EXP 300PC which includes one item. A matchboard pre-drilled PCB - £1.32
2. EXP 302 which includes three items. Three 50 sheet scratchboard workpads - £1.68
3. EXP 303 which includes three items. Two matchboards and an EXP 300 solderless breadboard - £8.60.
4. EXP 304 which includes four items. Two matchboards and EXP 300 breadboard and a scratchboard workpad - £9.30

The above prices do not include P&P and 15% VAT

## TOMORROW'S TOOLS TODAY

CONTINENTAL SPECIALTIES CORPORATION

C.S.C. (UK) Limited, Dept. 5H,  
Unit 1, Shire Hill Industrial Estate,  
Saffron Walden, Essex CB11 3AQ.  
Tel: Saffron Walden (0799) 21682.  
Telex: 817477.



NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

I enclose cheque/PO for £ \_\_\_\_\_  
or debit my Barclaycard, Access, American Express card  
No. \_\_\_\_\_ Exp. date \_\_\_\_\_  
or Tel: (0799) 21682 with your card number and your order will be in the post immediately.

A EXP 650 £5.00	Qty. Reqd.	B EXP 300 £7.76	Qty. Reqd.
C EXP 600 £8.39	Qty. Reqd.	D EXP 4B £3.50	Qty. Reqd.
E EXP 325 £2.70	Qty. Reqd.	F EXP 350 £4.48	Qty. Reqd.
G PB6 £11.73	Qty. Reqd.	H PB 100 £14.72	Qty. Reqd.

### Experimenter System

1 EXP 300 PC £2.38	Qty. Reqd.	2 EXP 302 £2.79	Qty. Reqd.
3 EXP 303 £11.04	Qty. Reqd.	4 EXP 304 £11.85	Qty. Reqd.

Boxed prices include P & P and 15% VAT  
If no dealer in your area contact CSC direct. FREE catalogue tick box

Continental Specialties Corporation (UK) Limited, Dept. 5H,  
Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.

# KEELMOOR Quality..

Keelmoor Ltd is a company which has been established for a long time—we supply the products you have often bought from other companies. Our precision watches and electrical goods are renowned for their superb quality and reliability. We differ from other companies in that we import direct world-wide—that difference is passed on to you at unbeatable prices. You receive the goods faster and we provide a service and no catch guarantee of which we are justly proud. We employ experts world-wide whose job it is to seek out products of the highest quality at the lowest possible prices. Illustrated here is just a tiny selection of our comprehensive range. Just compare these items with those seen elsewhere—we are confident the prices will amaze you. You can save ££££'s.

## GENTS 5 FUNCTION LCD



This is the foundation of our range and is ideal for the man requiring the basic functions of hours, minutes and seconds, with month and date. A backlight is included and the stainless steel strap provided is fully adjusted to suit any size of wrist. Guaranteed for one year, this watch represents fantastic value at only

**£4.95p**

ILLUSTRATED BELOW IS THE LADIES 5 FUNCTION LCD. This watch has the same time and auto calendar functions as the basic gents model described above, together with backlight and adjustable strap to suit the daintiest of wrists. It's compact, pleasing appearance makes it a very practical day watch and it is also often used for boys and girls. Available in black or white face.

These are just a few of our fantastic offers remember. A free colour catalogue is posted with every order.

**£5.95p**



## GENTS LCD ALARM WATCH

This model represents fantastic, incredible value for money. The 6 digit display continuously shows hours, minutes and seconds, or may be changed at will to hours, minutes and date. Its effective alarm is extremely useful and may be set to any time within a 24 hr. period. In addition, there is an alarm indicator, 4 year calendar and snooze repeater.

**£8.95p**

### FULLY GUARANTEED

We must emphasize all these items are fully guaranteed for one year. All electronic goods come complete with demonstration batteries which cannot be guaranteed. New batteries are available for only 60p.

**BARCLAYCARD AND ACCESS CARD WELCOME. SEE COUPON.**

## HERE IS THE AMAZING 12/24 HOUR ALARM/CHRONOGRAPH



Along with the usual time and date displays, this multi-functional timepiece has a 24 hour alarm and a  $\frac{1}{2}$  second stopwatch. The time may be set to operate in 12 or 24 hour mode and the date can be in English or American format. The day of the week is continuously indicated and the stopwatch display may, on command, be frozen to show split/laptime while the stopwatch continues to run. Stopwatch operation does not effect normal time keeping. £12.95 only for this model. Also available with solar energy panel to conserve energy during daylight hours for £14.95

FROM **£12.95p**

From Watches to Clocks, from Calculators to Radios, from Binoculars to Tool Kits – KEELMOOR is the name for the right quality at the right price. Your personal catalogue will tell you more – free with every order.

## LADIES QUARTZ LCD DRESS WATCH

This attractive ladies model with the standard 5 functions of hours, minutes, seconds, month and date has literally sold in tens of thousands. Available in gold or silver colours with 'sugar coated' finish. Please state first and second choice of square, round or oval design.

**£8.95p**

## THE ULTIMATE GENTS LCD CALCULATOR/ALARM WATCH

If you want a watch from the top end of the market this is the one for you. Full calculator functions plus memory and percentage are combined with time and alarm functions to make this item an outstanding buy. Manufactured in Japan at the same factory that produces models for probably the most famous name in the watch business, this device represents sheer quality at an unbelievable price. Comes complete with backlight and button operating tool carried in the strap clasp. We advise you to order quickly whilst stocks last.

**£39.95p**





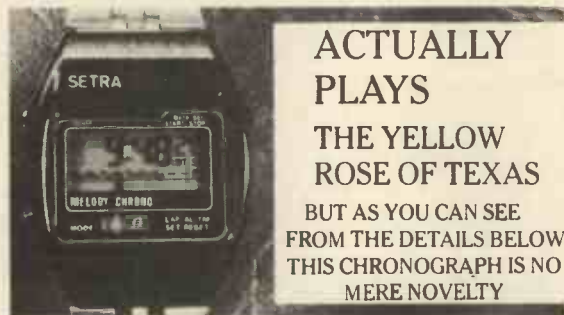
# at Keener Prices

**FREE**

With every order.  
Big colourful  
Keelmoor catalogue  
featuring hundreds of  
products at bargain  
prices.

We don't think you'll find items of this quality anywhere else at the price we offer. Order now, Christmas is round the corner and this is the way to make gift buying easier – and cheaper too.

**WE ARE PROUD TO INTRODUCE THE AMAZING MELODY ALARM CHRONOGRAPH**



**ACTUALLY  
PLAYS  
THE YELLOW  
ROSE OF TEXAS**  
BUT AS YOU CAN SEE  
FROM THE DETAILS BELOW  
THIS CHRONOGRAPH IS NO  
MERE NOVELTY

Today's technology has produced this fine watch which incorporates a musical alarm which plays a complete verse of 'The Yellow Rose of Texas.' Other functions included are as for model number 1.

**£14.95p**

**NEW TO OUR RANGE, WE COMBINE PRECISION AND STYLE IN THIS—THE SUPER SLIM GENTS 5 FUNCTION CHRONOGRAPH**



JUST TO GIVE YOU AN IDEA OF THE ULTRA SLIMNESS OF THESE WATCHES WE HAVE ILLUSTRATED A SIDE VIEW OF THE SUPERSLIM DIGITAL. BELOW, WE HAVE ELABORATED ON SOME OF THE TECHNICALITIES:—

These watches need no special functions to make them stand out in a crowd—their slimness serves that purpose. If you've been put off digital quartz watches in the past because you require an ultra-slim design, now is the time to change. Is equipped with standard 5 functions and backlight.

**£9.95p**

**MAINS DIGITAL ALARM CLOCK**



A very practically sized mains operated digital alarm clock – this item is extremely well finished and looks equally at home by the bedside or in the living room. With snooze/repeater alarm you could not even buy the components to build your own for this price. Available at the amazingly low price of only

**£8.95p**

**AND FINALLY, WHAT MUST BE THE ULTIMATE IN SQUEEZING A QUART INTO A HALF PINT POT! THE INCREDIBLE MINIATURE LCD TRAVEL/ALARM CLOCK**



**£10.95p**

As you can see from the photograph above this device is tiny and yet it continuously displays hours and minutes with auto calendar and night light. Invaluable for the busy traveller or simply for use in the modern home, it comes complete with its own travelling case and can easily be carried in top pocket or the smallest of handbags. It has even got a stand for upright position on table, shelf or sleeping compartment. An unusual gift to yourself or others at only £10.95.

Every order  
dispatched by  
return, and is  
sent by  
recorded  
delivery. That  
is Keelmoor's  
Promise To  
You.

**THE KEELMOOR PROMISE**

Keelmoor have a tremendous reputation to uphold, both in the retail and wholesale trades and so, with every product sold, we automatically give the Keelmoor Promise. This includes:—

- **NO RISK GUARANTEE.** Try any of these items for 15 days and if you are not completely satisfied with the quality and value simply return it for a complete refund.
- **ONE YEAR'S FULL GUARANTEE** on all products
- **BACK UP SERVICE** second to none

**15 DAY TRIAL COUPON.**

To Keelmoor Ltd, 78 Castle Street, Melbourne, Derby DE7 1DY  
Please send me the items indicated in the boxes below. I understand that if I am not completely satisfied, I may return the goods undamaged within 15 days and my money will be refunded in full.

A	B	C	D	E	F	G	H	I	J	Just indicate with a ✓ tick, item required if more than one required tick plus number - Lev 3
<b>TOTAL AMOUNT = £</b>										

NAME Mrs, Miss, Ms, Mr. \_\_\_\_\_  
ADDRESS \_\_\_\_\_

POSTCODE \_\_\_\_\_

I enclose a cheque/P.O. to KEELMOOR LTD  
(Or charge my Access  or BARCLAYCARD  (tick as applicable))

No. \_\_\_\_\_

TOTAL — £

The advertisements to watch for quality precision at the right price.  
All goods dispatched by return.

PE 5

# The new Toolrange catalogue



# still the only catalogue of its kind

The New Toolrange Catalogue is still the only comprehensive single source of electronic tools and production aids.

The product range has almost doubled since last year and now over 2,000 tools, toolkits and service aids are illustrated in full colour.

Products from over 100 top manufacturers are available from stock.

Over 60,000 catalogues are now in circulation. If you don't have one simply write, telephone or telex Toolrange for your free copy.

# Toolrange

Upton Road, Reading, Berks. RG3 4JA  
Telephone: Reading (0734) 22245 Telex: 847917

## — CLEF KITS —

**ELECTRONIC ROTOR**

Two speed organ rotor simulation plus a three phase chorus generator on a single p.c.b. (8" x 5"). Kit includes all components/IC sockets throughout/mains operation and stereo headphones. Driver p.c.b. Easily integrates with existing organ.

COMPONENT KIT — £89

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

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

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

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

**JOANNA 72 & 88 PIANOS**  
Six and 7½ Octave Electronic Pianos with unique Touch Sensitive Action as used in the P.E. JOANNA, which electronically simulates piano key inertia — a feature not available in any other design. Build this widely acclaimed professional instrument, for either domestic or Stage use, from our top quality Component Kits.

**SIX OCTAVES — £207**  
**7½ OCTAVES — £232**

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

**COMPONENT KIT — £169**

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

CLEF PRODUCTS (ELECTRONICS)  
LIMITED

(Dept. PE) 16, Mayfield Road, Bramhall, Cheshire SK7 1JU.  
061-439 3297

<p style="text-align: center; font-weight: bold; font-size: 0.8em;">MULLARD CAPACITORS</p> <p style="font-size: 0.7em;">Special purchase of factory clearance capacitors enables us to offer: C280 Polyesters (Liquoree Allsorts) at £2 for 100 mixed. And Miniature Electrolytics at £1.50 for 100 mixed. Pack of each only £3.</p> <p style="font-size: 0.7em;">These consist of spillages, floor sweepings, cosmetic imperfects etc. As we have no time to sort them they are magnificent value for the constructor.</p>	<p style="text-align: center; font-weight: bold; font-size: 0.8em;">MINIATURE MAINS TRANSFORMERS</p> <p style="font-size: 0.7em;">Top quality. Split bobbin construction will give 4.5V, 0.4. 5V at 250 MA 1½" x 1½" x 1½", all sorts of uses ONLY 90p. 3 for £2.20.</p> <p style="font-size: 0.7em;">2.200 µA 40V Radial 1½" x 2" 60p. 3 for £1.50. 1.000 µA 100V Radial 1½" x 2" ONLY 70p. 3 for £1.50.</p> <p style="font-size: 0.7em;">BD181 78 Watt T.O.3 Power Transistors. 50p ea. 3 for £1. AAF1 Alternator Diodes. Ideal for making Battery Chargers etc. 4 make 50 amp bridge 50p ea. —Ve or +Ve case 2 for ea. £1.50.</p>
<p style="text-align: center; font-weight: bold; font-size: 0.8em;">HUMIDISTATS</p> <p style="font-size: 0.7em;">Don't Let Your Environment Dehydrate You! Buy our Honeywell Humidity Controller. Membrane actuated, very sensitive, ½" shaft. 250V, 3.75A Contacts Ideal for greenhouses, centrally heated homes, offices etc. Build your own humidifiers or alarms. Fraction of original cost 90p ea. 3 for £2.</p>	<p style="text-align: center; font-weight: bold; font-size: 0.8em;">TRANSISTOR PACKS</p> <p style="font-size: 0.7em;">100. Full spec. new and marked. Includes: BC148, BC184L, MED412, BF274, BC154 etc. etc. £4.95</p> <p style="font-size: 0.7em;">200 as above and includes AC128, 2N3055, 8F50, BD131, 8F200 etc. £9.95</p> <p style="font-size: 0.7em;">Buy bulk and save money, these packs are worth at least double</p>
<p style="text-align: center; font-weight: bold; font-size: 0.8em;">20 ASSORTED ZENER DIODES</p> <p style="font-size: 0.7em;">1 watt and 400MW. £1.50</p>	<p style="text-align: center; font-weight: bold; font-size: 0.8em;">P/B SWITCH BANKS</p> <p style="font-size: 0.7em;">These cost a fortune! Ware made for various music centres. Includes independent and interdependent latching types multi pole etc etc. Can be modified. Can't be repaired. 3 Banks for £1</p> <p style="font-size: 0.7em;">Knobs for P/B Switches. Fit 3½ mm sq shaft. 10 for £1. Chrome or Spun Aluminium Finish</p>
<p style="text-align: center; font-weight: bold; font-size: 0.8em;">100 MIXED DIODES</p> <p style="font-size: 0.7em;">Includes: Zener, power, bridge, germanium, silicon etc. All full spec. £4.95</p>	<p style="text-align: center; font-weight: bold; font-size: 0.8em;">BULK BARGAINS STOCK UP FOR SUMMER</p> <p style="font-size: 0.7em;">300 mixed ½ &amp; ¼ watt resistors £1.50 150 mixed 1 &amp; 2 watt resistors £1.50 300 mixed capacitors, modern, most types £3.75 100 mixed ceramic and plate caps £1.20 400 mixed film resistors £2.95 100 mixed polystyrene caps £2.20 25 pots and presets £1.50 25 presets, skeleton etc. £1.20 20 VDRs and thermistors £1.20 100 Hi-wattage resistors wirewound at £2.75 100 electrolytics, nice values £2.20 300 printed circuit resistors £1 300 printed circuit components £1.50</p>
<p style="text-align: center; font-weight: bold; font-size: 0.8em;">2" LEDs</p> <p style="font-size: 0.7em;">0-2" LEDs with 2 piece clips</p>	<p style="text-align: center; font-weight: bold; font-size: 0.8em;">100K MINIATURE THUMBWHEEL SLIDER PDTS</p> <p style="font-size: 0.7em;">Very neat, can be banked side by side. Ideal for v. cap tuning, graphic equalisers etc. 10 for £1</p>
<p style="text-align: center; font-weight: bold; font-size: 0.8em;">ULTRASONIC TRANSDUCERS</p> <p style="font-size: 0.7em;">Transmitter and receiver 40 kHz 14 mm dia. £3-25 pair.</p>	<p style="text-align: center; font-weight: bold; font-size: 0.8em;">MINIATURE LEVEL/BATT. METERS 200µA</p> <p style="font-size: 0.7em;">F.S.D. as fitted to many cassette recorders 80p</p>
<p style="text-align: center; font-weight: bold; font-size: 0.8em;">MINIATURE REED SWITCHES</p> <p style="font-size: 0.7em;">We are the cheapest! 12 for £1.00 100 for £4.20</p>	<p style="text-align: center; font-weight: bold; font-size: 0.8em;">50p P &amp; P on all above items. Cheque or P.D. with order to:</p>
<p style="text-align: center; font-weight: bold; font-size: 0.8em;">G.E.C. UHF TRANSISTOR TV TUNERS</p> <p style="font-size: 0.7em;">Rotary type with slow motion drive, leads and aerial socket. £1.50 3 for £3.50 "for G.E.C. 2010" series etc."</p>	<p style="text-align: center; font-weight: bold; font-size: 0.8em;">SENTINEL SUPPLY, DEPT. P.E.</p> <p style="text-align: center; font-weight: bold; font-size: 0.8em;">149A BROOKMILL RD., DEPTFORD, LONDON, SE8</p>
<p style="text-align: center; font-weight: bold; font-size: 0.8em;">DE LUXE FIBRE GLASS PRINTED CIRCUIT ETCHING KITS</p> <p style="font-size: 0.7em;">Includes 150 sq. ins. copper clad F/G board, 1 lb ferric chloride 1 dale etch resist pen. Abrasive cleaner, Etch tray plus Instructions. Special Price £4.95 1 lb FE. C1. To mil spec. £1.25 5 lb FE. C1. To mil spec. £5.00 150 sq. in. Single sided board £2.00 150 sq. in. Double sided board £3.00</p>	

# CHROMASONIC electronics

56 FORTIS GREEN ROAD MUSWELL HILL LONDON N10 3HN  
TELEPHONE 01-883 3705 01-883 2289

YOUR SOUNDEST CONNECTION IN THE WORLD OF COMPONENTS

## PETS

8N (8K RAM)

**£399**

16N (16K RAM) **£499**

32N (32K RAM) **£599**

**ALL WITH NEW KEYBOARD AND GREEN SCREEN.**

### PERIPHERALS

Service & Assistance available.

Interfaces available are:

X-Y plotters, analogue to digital converter, 16 channel interfaces, bi-directional interfaces, etc.

EXTERNAL CASSETTE DECK SUITABLE FOR ALL PETS **£55**



**NEW LOW PRICE**



## UK101

**£179 in kit form**

**£229 ready built & tested**

**£249 complete in case**

NO EXTRAS REQUIRED

- \* FREE SAMPLER TAPE
- \* FULL QWERTY KEYBOARD
- \* 8K BASIC
- \* RAM EXPANDABLE TO 8K ON BOARD (4K INC)
- \* KANSAS CITY TAPE INTERFACE

\* New monitor allows full editing & cursor control.

**£22**

**INVADER TAPE**  
**£5.00**

**ASSEMBLER EDITOR TAPE**  
**£14.95**

## MEMORY

D. RAMS	£ p.
4027	2.75
4050 (350NS)	2.35
4060 (300NS)	2.39
4116	4.35
S. RAMS	
2102A	1.09
2102A-2	1.09
2112A	2.25
21L02	.98
2114-4045	2.95
4035	1.07
4044-5257	6.93
BULK PURCHASE	
8 x 2114	22.50
8 x 4116	29.95
8 x 21L02	7.00
BULK PURCHASE	
16 x 2114	39.95
16 x 21L02	13.00
32 x 21L02	25.00
64 x 21L02	45.00

## EPROM'S

2708	4.95
2716 (5v)	13.95
2532	39.95

## ROM'S

2513(UC)	5.95
2513(LC)	5.95

## CPU'S

6502	9.50
8080	4.75
9900	25.95
6800	5.90
Z80	8.95

## BUFFERS

81LS95	1.25
81LS96	1.25
81LS97	1.25
81LS98	1.25
SN74365	.52
SN74366	.52
SN74367	.52
SN74368	.52
8T26	1.75
8T28	1.75
8T95	1.57
8T96	1.57
8T97	1.50
8T98	1.57

## BAUD RATE GENS

MC14411	8.75
MM5307	8.75

## UARTS

AY-5-1013	3.45
AY-5-1015	3.98
MM5503	4.75
TMS 6011	3.55

## LATEST STOP PRESS AND PRICE LIST

SEND SAE OR PHONE FOR UP TO DATE **PRICES** OF ALL OUR RANGE OF ITEMS STOCKED

### CASES

Available for UK101, Superboard, NASCOM.  
Approx. dim. 17" x 15"  
435mm x 384mm

**Price £24.50**

Post and packing £1.50

### TAPES

Unique stackable tape storage unit. Interlocking drawers. Drawers each containing 2 x C12 tapes.

10 drawers **£9.50**

5 drawers **£5.25**

Single drawer **£1.10**

### MEMORY EXPANSION KIT

Suitable for UK101, Superboard expansion using 2114's. Each board has 16K RAM capacity.

Kit contains:

- \* On board power supply
- \* 4K EPROM expansion
- \* Fully buffered for easy expansion via 40 pin socket

\* **8K KIT £99.95**

\* **16K KIT £139.90**

## PRINTERS

**TX-80 £375**

**EPSON TX-80 £375**

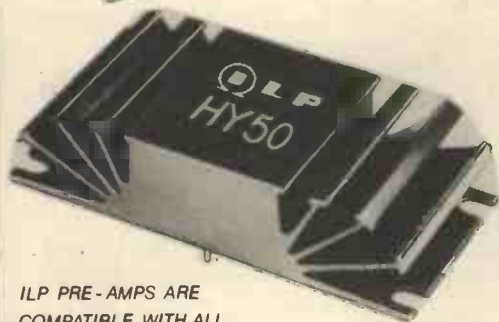
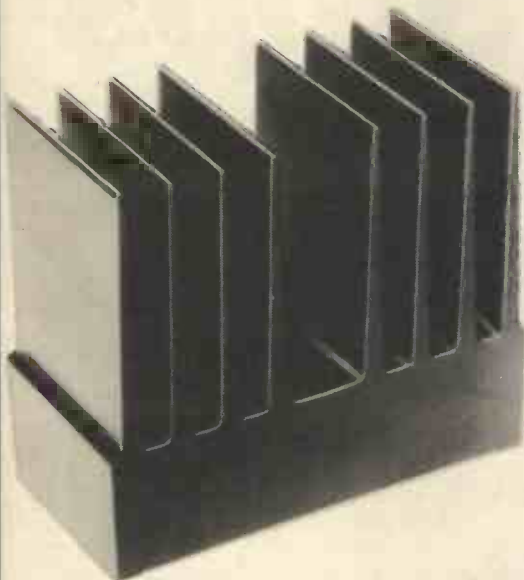
Dot-matrix printer with Pet graphics Interface: Centronics parallel, options: PET, Apple and serial.



**PLEASE ADD VAT 15% TO ALL PRICES. POSTAGE ON COMPUTERS, PRINTERS & CASSETTE DECKS CHARGED AT COST. ALL OTHER ITEMS P&P 30p. PLACE YOUR ORDER USING YOUR ACCESS OR BARCLAYCARD (Min. Tel. order £5.00). TRADE & EXPORT ENQUIRIES WELCOME, CREDIT FACILITIES ARRANGED.**



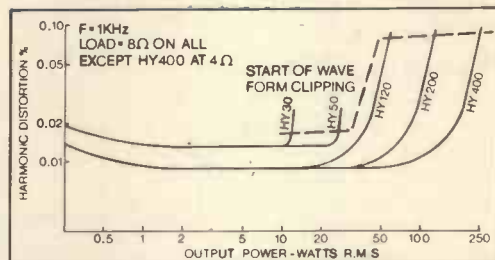
# Simply ahead...



ILP PRE-AMPS ARE  
COMPATIBLE WITH ALL  
ILP POWER AMPS AND PSUs

## POWER AMPLIFIERS

ILP Power Amplifiers are encapsulated within heatsinks designed to meet total heat dissipation needs. They are rugged and made to last a lifetime. Advanced circuitry ensures their suitability for use with the finest loudspeakers, pickups, tuners, etc. using digital or analogue sound sources.



Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 $\Omega$	0.02%	100 dB	-20 -0 +20	105x50x25	155	£6.34 + 95p
HY50	30 W into 8 $\Omega$	0.02%	100 dB	-25 -0 +25	105x50x25	155	£7.24 + £1.09
HY120	60 W into 8 $\Omega$	0.01%	100 dB	-35 -0 +35	114x50x85	575	£15.20 + £2.28
HY200	120 W into 8 $\Omega$	0.01%	100 dB	-45 -0 +45	114x50x85	575	£18.44 + £2.77
HY400	240 W into 4 $\Omega$	0.01%	100 dB	-45 -0 +45	114x100x85	1 15Kg	£27.68 + £4.15

Load impedance - all models 4  $\Omega$  -  $\infty$   
Input sensitivity - all models 500 mV  
Input impedance - all models 100K  $\Omega$   
Frequency response - all models 10Hz - 45 KHz - 3dB.

## POWER SUPPLY UNITS



ILP Power Supply Units with transformers made in our own factory are designed specifically for use with ILP power amplifiers and apart from PSU 30 and 36 which are smaller PSU's - in all the other ILP manufactured PSU's, ILP toroidal transformers are used which are half the size and weight of laminated equivalents. They are also more efficient and have greatly reduced radiation.

PSU 30  $\pm 15V$  at 100mA to drive up to 12 x HY6 or 6 x HY66 £4.50 + £0.68 VAT

THE FOLLOWING WILL ALSO DRIVE ILP PRE-AMPS  
PSU 36 for 1 or 2 HY30's £8.10 + £1.22 VAT

THE FOLLOWING ALSO INCLUDE TOROIDAL TRANSFORMERS

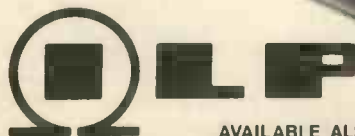
PSU 50 for 1 or 2 HY50's £8.10 + £1.22 VAT

PSU 60 for 1 HY 120 £9.75 + £1.46 VAT

PSU 70 for 1 or 2 HY120's £13.61 + £2.04 VAT

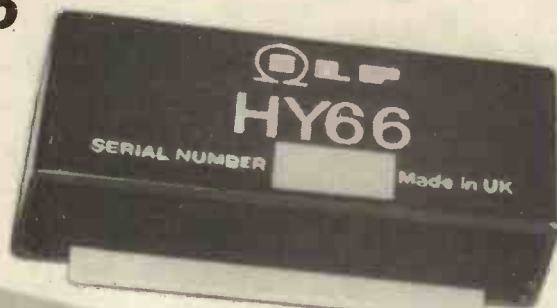
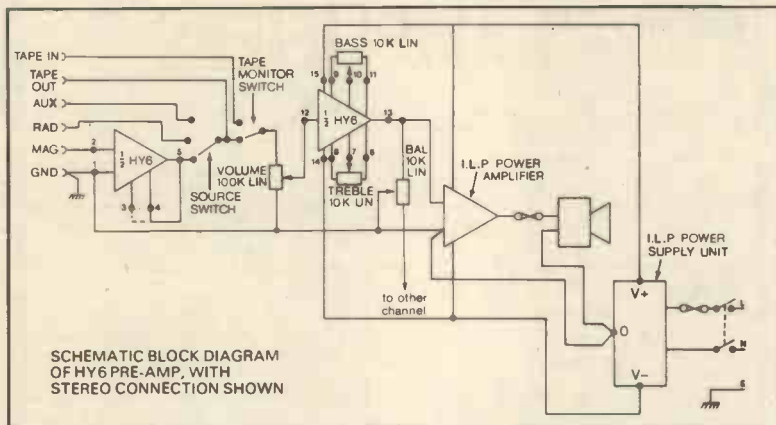
PSU 90 for 1 HY200 £13.61 + £2.04 VAT

PSU 180 for 1 HY400 or 2 x HY200 £23.02 + £3.45 VAT



AVAILABLE ALSO FROM WATFORD ELECTRONICS, MARSHALLS AND CERTAIN OTHER SELECTED STOCKISTS.

# this time with two new pre-amps



## HY6 mono HY66 stereo

When ILP add a new design to their audio-module range, there have to be very special reasons for doing so. You expect even better results. We have achieved this with two new pre-amplifiers – HY6 for mono operation, HY66 for stereo. We have simplified connections, and improved performance figures all round. Our new pre-amps are short-circuit and polarity protected; mounting boards are available to simplify construction.

Sizes – HY6 – 45 x 20 x 40 mm. HY66 90 x 20 x 40 mm. Active Tone Control circuits provide  $\pm 12$ dB cut and boost. Inputs Sensitivity – Mag. P.U. – 3mV; Mic – selectable 1-12mV; All others 100mV; Tape O/P – 100mV; Main O/P – 500mV; Frequency response – D.C. to 100KHz – 3dB.

### HY6 mono

£5.60  
+ VAT 84p

### HY66 stereo

£10.60  
+ VAT £1 59

#### Connectors included

B6 Mounting Board  
78p + 12p VAT

B66 Mounting Board  
99p + 15p VAT

- LOW DISTORTION - Typically 0.005%
- S/N RATIO - Typically 90 dB (Mag. P.U. – 68 dB).
- HIGH OVERLOAD FACTOR – 38 dB on Mag. P.U.
- LATEST DESIGN HIGH QUALITY CONNECTORS.
- REQUIRE ONLY POTS, SWITCHES, PLUGS AND SOCKETS.
- COMPATIBLE WITH ALL ILP POWER AMPS AND PSUs.
- NEEDS ONLY UNREGULATED POWER SUPPLY  $\pm 15$ V to  $\pm 60$ V.

NO QUIBBLE  
5 YEAR GUARANTEE  
7-DAY DESPATCH ON ALL ORDERS  
BRITISH DESIGN AND MANUFACTURE  
FREEPOST SERVICE  
– see below

★ ALL U.K. ORDERS DESPATCHED POST PAID

#### HOW TO ORDER, USING FREEPOST SYSTEM

Simply fill in order coupon with payment or credit card instructions. Post to address as below but do not stamp envelope – we pay postage on all letters sent to us by readers of this journal.



FREEPOST 2 Graham Bell House, Roper Close,  
Canterbury, Kent CT2 7EP.  
Telephone (0227) 54778 Telex 965780

Please supply ..... PE.10.  
..... Total purchase price £.....  
I enclose Cheque  Postal Orders  International Money Order   
Please debit my Access/Barclaycard Account No.....  
NAME.....  
ADDRESS.....  
Signature.....

# STEVENSON

REGULATORS	
78L05	33p
78L12	33p
78L15	33p
7905	85p
7912	85p
7915	85p
TIC246 16A 400V Triac	115p
C106D 4A 400V 50 SCR	45p

SPEAKERS	
64mm 8Ω	110p
64mm 64Ω	110p
70mm 8Ω	140p
70mm 80Ω	170p
56mm 8Ω	100p
Pair of ultrasonic transducers	37p
Magnetic earphone + 3.5mm plug	18p
Crystal earphone + 3.5mm plug	48p


POTENTIOMETERS	
Preset var. or hor.	8p
Rotary 5K-1M Log or Lin	33p
Rotary 5K-1M stereo	110p
Slide 60mm travel 5K-500K log or Lin, single	65p
Suitable knobs for above with coloured caps in red, blue, green, grey, yellow and black. Rotary 16p. Slide 12p each.	

CONNECTORS		
DIN	Chassis Socket	Line Socket
2 pin	9p	8p
3 pin	12p	10p
5 pin 180	13p	11p
JACK	Plug	Scr. plug
2.5mm	10p	16p
3.5mm	11p	18p
std.	17p	30p
Stereo	25p	39p

MISC.	
8mm stranded conn. cable	30p
Min. mains cable per metre	25p
PP3 battery clips	6p
Crocodile clips	6p
AA rechargeable cells	145p
PP3 rechargeable cells	495p
Red or black terminals	30p
3 lead TO18 socket	15p
Red or amber neon indicator	42p
Subminiature SPST toggle	65p
Standard SPST toggle	40p
Miniature slide switches	16p
IP1 2W rotary switches	52p
Push to make switches	16p
TO5 heatsinks	12p
20mm panel fuseholders	22p
ORP12 LDR	70p
3.75 x 5.0 1 veroboard	99p
2.5 x 1.0 1 veroboard	21p
3 x 2 x 1 aluminium box	82p
6 x 4 x 2 aluminium box	99p
Miniature 606, 909 transformer	110p
TIL111 optoisolator	80p
4 self adhesive feet	20p
SRB Soldering iron	430p
Desoldering tool	550p

Our new catalogue is now available. It contains 100 illustrated pages detailing over 3000 line items. Send 50p for your copy! You will receive: • A reply paid envelope. • A Mail Order form to facilitate rapid despatch. • A 50p Discount voucher. All prices include VAT. Please add 50p carriage on all orders below £15.00.

Access & Barclaycard welcome  
Sales office: 01-464 5770.



TRANSISTORS	
AC127	25p
AC128	25p
AD161	40p
AD162	40p
BC107	10p
BC108	10p
BC109	10p
BC147	9p
BC178	16p
BC182	10p
BC182L	10p
BC184	10p
BC184L	10p
BC212	10p
BC212L	10p
BC214	10p
BC214L	10p
BC547	8p
BCY71	18p
BD131	35p
BD132	35p
BD139	35p
BD140	35p
BFX29	25p
BFX84	26p
BFY50	23p
BFY51	23p
MJ2955	98p
TIP29C	60p
DIODES	
1N914	4p
1N4001	4p
1N4006	7p
BZV88 series	8p each.
ZTX108	12p
ZTX109	12p
ZTX300	14p
ZTX500	15p
2N3053	25p
2N3055	55p
2N3702	9p
2N3703	9p
2N3704	9p
2N3819	22p
2N3905	10p
2N5777	50p
1N4148	3p
1N4002	5p
1N5401	14p

CMOS	
4001	25p
4002	25p
4006	95p
4007	25p
4011	30p
4013	45p
4015	85p
4016	48p
4017	50p
4018	90p
4020	110p
4022	100p
4023	25p
4024	60p
4025	25p
4026	150p
4027	50p
4028	90p
4029	110p
4040	110p
4042	85p
4046	110p
4048	60p
4049	50p
4050	50p
4052	80p
4060	120p
4066	63p
4068	25p
4069	25p
4070	25p
4071	25p
4072	25p
4081	30p
4082	30p
4085	85p
4093	80p
4095	110p
4510	90p
4511	100p
4518	90p
4520	110p
4527	165p
4528	100p
4532	125p
4543	170p
4583	80p
4585	115p

LINEAR	
741	18p
747	70p
748	40p
7106	850p
CA3046	70p
CA3080	75p
CA3130	100p
CA3140	60p
LF347	170p
LF351	45p
LF353	90p
LF356	95p
LM301A	30p
LM318	85p
LM324	52p
LM339	55p
LM348	100p
LM377	170p
LM378	230p
LM380	80p
LM381	140p
LM382	120p
LM386	90p
LM387	120p
LM1458	40p
LM1830	180p
LM3900	60p
LM3909	72p
LM3911	120p
LM3914	320p
LM3915	320p
MM57160	650p
NE531	140p
NE555	23p
NE556	60p
NE567	120p
RC4136	100p
SN76477	230p
TBA800	80p
TBA810	110p
TDA1022	630p
TL081	45p
TL082	85p
TL084	125p
XR2206	390p
ZN414	80p
ZN426E	475p

SKTS	
8 pin	9p
14pin	11p
16pin	12p
18pin	16p
20pin	18p
22pin	20p
24pin	22p
28pin	26p
40pin	38p

OPTO	
0.125in	0.2in
Red	TIL209 TIL220 10p
Green	TIL211 TIL221 16p
Yellow	TIL213 TIL223 16p
Clips	3p
DL704	0.3in CC 130p
LDL07	0.3in CA 130p
FND500	0.5in CC 100p

CAPACITORS	
0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1 and 2.2uF @ 35V	12p
4.7, 6.8, 10uF @ 25V	20p
22 @ 16V, 47 @ 6V, 100 @ 3V	26p
POLYESTER (Mullard C280 series)	
0.01, 0.015, 0.022, 0.033, 0.047, 0.1	6p
0.15, 0.22	8p
0.33, 0.47	12p
RADIAL LEAD ELECTROLYTICS	
63V 0.47 1.0 2.2 4.7 10 7p	
	22 33 47 9p
	25V 10 22 33 47 7p
	100 9p
	470 20p
	1000 32p

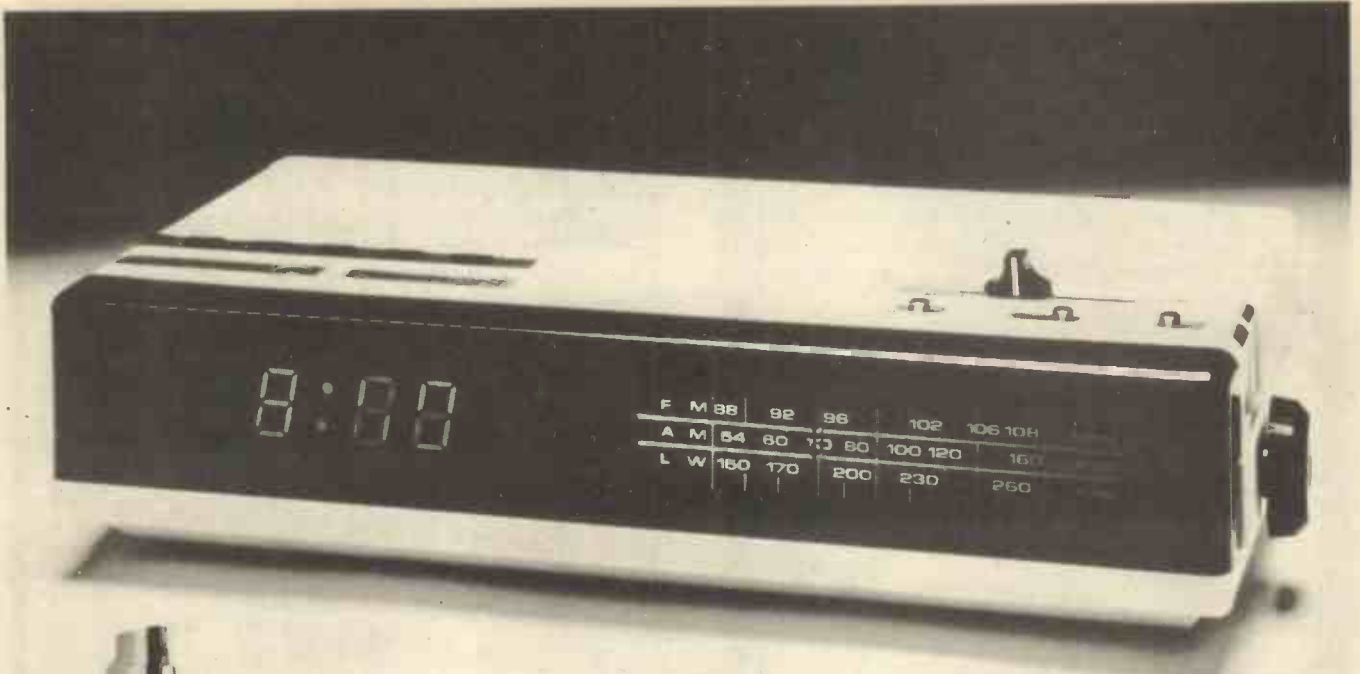
76 College Road, Bromley, Kent BR1 1DE.

## FLADAR TRANSFORMERS

PRIMARY 0-240V 50Hz

SEND FOR OUR TRANSFORMER CATALOGUE PRICE £1.00 WHICH INCLUDES A 50p VOUCHER OFF YOUR FIRST PURCHASE.

Type	Voltage	Current	£	p/p	Type	Voltage	Current	£	p/p
08FE06	6-6	0.5A EACH	1.99	60p	08FE60	15-0-15	0.4A	1.95	60p
12FE06	6-6	1A EACH	2.66	75p	08FE40	9-0-9	1A	2.35	60p
20FE06	6-6	1.6A EACH	3.36	75p	08FE60	15-0-15	0.5A	2.35	60p
50FE06	6-6	3A EACH	4.02	90p	12FE40	9-0-9	1.5A	2.60	75p
60FE06	6-6	4A EACH	5.03	125p	12FE50	12-0-12	1A	2.60	75p
					12FE60	15-0-15	0.8A	2.60	75p
08FE09	9-9	0.3A EACH	1.99	60p	20FE50	9-0-9	2A	3.30	75p
08FE09	9-9	0.5A EACH	2.40	60p	20FE60	12-0-12	1.6A	3.30	75p
12FE09	9-9	0.7A EACH	2.66	75p	20FE70	15-0-15	1.2A	3.30	75p
20FE09	9-9	1A EACH	3.36	75p	20FE80	20-0-20	1A	3.30	75p
50FE09	9-9	2.5A EACH	4.02	90p	20FE100	30-0-30	0.6A	3.30	75p
60FE09	9-9	3A EACH	5.03	125p	50FE50	9-0-9	5A	4.00	90p
					50FE70	15-0-15	3A	4.00	90p
06FE12	12-12	0.2A EACH	1.99	60p	50FE80	20-0-20	2A	4.00	90p
08FE12	12-12	0.3A EACH	2.40	60p	50FE110	30-0-30	1.4A	4.00	90p
20FE12	12-12	0.8A EACH	3.36	75p	60FE70	15-0-15	4A	5.00	125p
50FE12	12-12	1.8A EACH	4.02	90p	60FE80	20-0-20	3A	5.00	125p
60FE12	12-12	2.5A EACH	5.03	125p	60FE100	28-0-28	2.2A	5.00	125p
80FE12	12-12	3A EACH	6.20	125p	60FE110	30-0-30	3A	5.00	125p
06FE15	15-15	0.2A EACH	1.99	60p	80FE40	12-0-12	6A	6.15	125p
08FE15	15-15	0.25A EACH	2.40	60p	80FE50	15-0-15	5A	6.15	125p
12FE15	15-15	0.4A EACH	2.66	75p	80FE60	20-0-20	4A	6.15	125p
20FE15	15-15	0.6A EACH	3.36	75p	80FE80	28-0-28	2.5A	6.15	125p
50FE15	15-15	1.5A EACH	4.02	90p	80FE70	24-0-24	3A	6.15	125p
60FE15	15-15	2A EACH	5.03	125p	80FE90	30-0-30	2.3A	6.15	125p
80FE15	15-15	3A EACH	6.20	125p					
06FE20	20-20	0.15A EACH	1.99	60p	90FE50	15-0-15	5A	6.30	150p
12FE20	20-20	0.25A EACH	2.66	75p	90FE80	28-0-28	3A	6.30	150p
20FE20	20-20	0.5A EACH	3.36	75p	90FE90	30-0-30	3A	6.30	150p
50FE20	20-20	1.2A EACH	4.02	90p	100FE50	15-0-15	4A	6.60	150p
60FE20	20-20	1.5A EACH	5.03	125p	100FE26	26-0-26	3.5A	6.60	150p
80FE20	20-20	2A EACH	6.20	125p	100FE28	28-0-28	3A	6.60	150p
					100FE30	30-0-30	3A	6.60	150p
					100FE36	36-0-36	3A	6.60	150p
					100FE36	36-0-36	3A	6.60	150p
					150FE15	15-0-15	6A	8.20	160p
					150FE28	28-0-28	5A	8.20	160p
					150FE30	30-0-30	4A	8.20	160p
					150FE36	36-0-36	4A	8.20	160p
					150FE42	42-0-42	3A	8.20	160p
					250FE28	28-0-28	8A	9.02	200p
					250FE30	30-0-30	7A	9.02	200p
					250FE42	42-0-42	5A	9.02	200p



# MITRAD

The premier mail order house specialising in quality products and superior after-sales care.



**ZETRON CLOCK RADIO** Full fidelity AM-FM-LW radio with green tube electronic time display. Alarm, settable anywhere in 24 hour period, can also activate radio to provide wake-to-music facility. 60 minute sleep timer with auto shut-off and touch snooze control. Auto brightness control. Power failure indication.

**£16.95 + 85p p&p.**

**SEIKO QUARTZ LCD MEMORY-BANK CALENDAR WATCH**

Displays hour, minute, second, month, day of the week and date in 12 hour indication - or 24 hour at the touch of a button. Button touch also display month and year and dates for

a designated month with Sunday dates flashing. Stores dates in memory up to 11 ahead, flashes 'MEMO' on designated dates. Illuminated time and calendar display. Display flashes when battery nears life end. Stainless steel case and wrist strap (adjustable). In presentation case with instructions.

**£49.95 + 85p p&p.**

**PANTER QUARTZ PEN WATCH**

Five function LCD pen watch showing hours, minutes, seconds, month and date. Computerised four year date memory. Ball point pen. Stainless steel case. Price includes presentation case and full instructions.

**£12.00 inc. p&p.**

To: Mitrad, 68-70 High Street, Kettering, Northants.

Please send me:

Zetron clock radio(s) at £17.80 inc p&p

Seiko Watch(es) at £50.80 inc p&p

Pen Watch(es) at £12.00 inc p&p

**Total value of my order £**

I enclose cheque/PO or debit my Access/Barclaycard



No. \_\_\_\_\_ Signature \_\_\_\_\_

Name \_\_\_\_\_ (block letters please)

Address \_\_\_\_\_

From the collection of 12 month guaranteed leading make products offered through Mitrad's 48 hour distribution system and backed by Mitrad's own service organisation. For complete product range, ring or write for catalogue. Trade price list available for bulk buyers.



MITRAD 68-70 High St.,  
Kettering, Northants.  
Telephone 0536 522024



Credit card holders may telephone (0536) 522024 24 hours a day stating card number for immediate attention. All orders despatched within 48 hours. Delivery subject to availability. Full refund if not completely satisfied. Mitrad. Registered in England No. 1500613. Code: PE.





# AITKEN BROS

35, High Bridge, Newcastle upon Tyne  
Tel: 0632 26729



EXP300



P86 Kit

**EXP300**  
550 contacts with two 50-point BUS bars. Size 152x53mm. £6-95.  
**PROTO-BOARD 6 KIT**  
630 contacts, four 5 way binding posts, accepts up to 6 14 pin DIPs. £10-98.

## CSC LOGIC PROBES LP-2 ECONOMY PROBE

Min. pulse width 300 nanoseconds, 300 KΩ input impedance, tests circuits up to 1.5MHz. Detecting pulse trains or single-shot event in TTL, DTL, HTL, and CMOS circuits. £20-95.

LP-1 Memory Probe £35-65  
LP-3 High Speed Memory Probe £56-75  
CSC catalogue available. Please send S.A.E.

## CALSCOPE SUPER 6 £186-30

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

## CALSCOPE SUPER 10 £251-85

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

## SINCLAIR LOW POWER PORTABLE OSCILLOSCOPE SC110 £159-85

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

**TMK 500 MULTIMETER** 30,000 o.p.v. AC volts 2-5, 10, 25, 100, 250, 500, 1000. DC volts, 0.25, 1, 2-5, 10, 25, 100, 250, 1000. DC current 50μa, 5MA, 50MA, 12 amp. Resistance 0-6K, 60K, 6MEG, 60MEG. Decibels, -20 to +56 db. Buzzer continuity test size, 160 x 110 x 55MM. Batteries & leads included. **PRICE £25-95.**

## CSC EXPERIMENTOR BREADBOARDS

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



**SINCLAIR DM350** £83-95  
**SINCLAIR DM450** £114-95

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

## Sinclair PFM200 frequency meter

Size 157x76x32mm.  
Range 20Hz to 200MHz. Accessories and illustration as for PDM35 below. £57-95.

## SINCLAIR PDM35 DIGITAL POCKET MULTIMETER

DC volts (4 ranges) 1mV to 1000V AC volts 1V to 500V DC current (6 ranges) 1nA to 200MA. Resistance (5 ranges) 1Ω to 20 MEGΩ. **PRICE £39-95 AC Adaptor £4-25 de luxe padded carrying case £1-95 MN 1604 Battery £1-28.** Size 157x76x32mm.

## SINCLAIR DM235 BENCH-PORTABLE DIGITAL MULTIMETER.

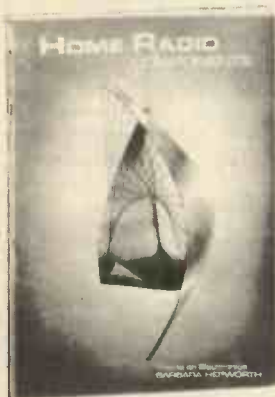
DC volts (4 ranges) 1mV to 1000V AC volts (4 ranges) 1mV to 750V AC & DC current 1μa to 1000MA Resistance (5 ranges) 1Ω to 20 MEG Ω. **PRICE £60-98.** Carrying case **£8-95.** AC adaptor/charger, **£4-25.** Rechargeable Battery Pack. **£8-95.** Size 255 x 148 x 40mm.

## PANEL METERS

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

## DESOLDERING TOOL SUCTION PUMP. £8-45

Education Establishment Orders Accepted.  
PHONE OR SEND YOUR ACCESS OR  
BARCLAYCARD NUMBER  
ALL PRICES INCLUDE POSTAGE AND VAT.



## Top Priority for every constructor- HOME RADIO CATALOGUE

- About 2,000 items clearly listed.
- Profusely illustrated throughout.
- Large A-4 size pages.
- Bargain list, order form and 2 coupons each worth 25p if used as directed, all supplied free.

Price £1, plus 50p for post, packing and insurance.

Send cheque or P.O. for £1.50

HOME RADIO Components LTD  
Dept. PE, P.O. Box 92, 215 London Road,  
Mitcam, Surrey. 01-543 5659

# MONITORS MONITORS MONITORS



Uncased from 3" to 12"  
Cased from 5" to 20"

Semi professional or  
professional available  
from stock.

Monitor PCB's including  
Transformers and Tubes  
also in stock.

Phone or write for  
details.

## CROFTON ELECTRONICS

Crofton Electronics Limited  
35 Grosvenor Road, Twickenham, Middx.  
Tel: 01 891 1513

## THIS MONTH'S SNIP!

*"Let us quote for your hard to get components for PE projects"*

**CLAIREX CL705HL — £4-50 ea.**  
**PMI REF 02 — £4-00 ea.**

**RS ITEMS A SPECIALITY!**

*Send s.a.e. for priced parts list of PE projects  
(max. 4) stating month and project title.*

I enclose 30p\* please send catalogue

name \_\_\_\_\_

address \_\_\_\_\_

\*refundable with future order over £5.00



### NOTICE TO READERS

When replying to Classified Advertisements please ensure:

- That you have clearly stated your requirements.
- That you have enclosed the right remittance.
- That your name and address is written in block capitals, and
- That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

### RECEIVERS AND COMPONENTS

TUNBRIDGE WELLS COMPONENTS, Ballards, 108 Camden Road, Tunbridge Wells. Phone 31803. No Lists. Enquiries S.A.E.

**DICOM** High quality Adjustable mains P.S.U. modules

OUTPUT—2.15V DC at 1A £14.37  
size 150 x 77 x 55mm inc VAT, p&p  
Fitted transformer and heatsink

5 Town Hall Yard, Market Place  
Ashbourne Derbyshire. Tel (03355) 5733

100 DIODES 85p. 50 Transistors 95p. 10 I.C.s 75p. All mixed. Post Paid. Lists 15p. Sole Electronics, (P.E.) 37 Stanley Street, Ormskirk, Lancs. L39 2DH.

**BRAND NEW COMPONENTS BY RETURN**

Electrolytic Capacitors 16V, 25V, 50V.  
0.47, 1.0, 2.2, 4.7 & 10 Mfds. — 5p.  
22 & 47—5p. (50V—6p). 100—7p. (50V—8p).  
220—8p. (50V—10p). 470—11p. (40V—16p).  
1000/15V—15p. 1000/25V—18p. 1000/40V—35p.

Subminiature bead Tantalum electrolytics. — 14p.  
(0.1, 0.22, 0.47, 1.0, 35V, 4.7, 6.3V—20p.  
2.2/35V, 4.7/25V—15p. 10/25V, 15/16V—20p.  
22/16V, 33/10V, 47/6V, 68/3V & 100/3V—30p.  
15/25V, 22/25V, 47/10V—35p. 47/16V—80p.

Subminiature Ceramic Caps. E12 Series 100V.  
2% 10 pf. to 47 pf.—3p. 56 pf. to 330 pf.—4p.  
10% 390 pf. to 4700 pf.—4p.

Vertical Mounting Ceramic Plate Caps. 50V.  
E12 22 pf. to 1000 pf. E6 1500 pf. to 47000 pf.—2p.

Polystyrene E12 Series 63V, Horizontal Mtng.  
10 pf. to 820 pf.—3p. 1000 pf. to 10,000 pf.—4p.

Miniature Polyester 250V Vert. Mtg. E6 Series.  
.01 to .068—4p. .1—5p. .15, .22—5p. .33, .47—10p.  
.68—12p. 1.0—15p. 1.5—22p. 2.2—24p.

Mylar (Polyester) Film 100V. Vertical Mounting.  
.001, .0022, .0047—3p. .01, .022—4p. .04, .05, 0.1—5p.

Miniature Film Resistors Highstab. E12 Ser. 5%.  
0.125W mixed carbon/metal 10Ω to 1MΩ—1p.  
0.25W Carbon 10 to 10MΩ (10% over 1MΩ)—1p.  
E24 Series av. in JW G. Film 10 to 5MΩ (1%).  
0.25W, 0.5W & 1.0W Metal Film 10Ω to 2MΩ—2p.  
1N4148—2p. 1N4002—4p. 1N4006—6p. 1N4007—7p.  
BC107/8/9, BC147/8/9, BC157/8/9, BF194 & 7—10p.  
8 Pin I.C.s. 741 Op. amp.—18p. 555 Timer—24p.  
DIL Holders 8 pin—9p. 14 pin—12p. 16 pin—14p.  
LED's 3 & 5mm. Red—10p. Green & Yellow—14p.  
Grommets for 3mm—13p. p.c.e. holders 5mm—24p.  
20mm. Q.B. Fuses .15, .25, .5, 1, 2, 3 & 5A—3p.  
20mm. Anti Surge 100mA. to 5.0A—5p.  
20mm. Fuseholders P.C. or Chassis Mtg.—5p.  
Solid A1. knobs 15mm.—25p. 25mm.—35p. 30mm.—50p.  
400mV Zener diodes E24 series 2V7 to 33V—8p.  
Prices VAT Inclusive Post 15p. (Free over £5.00).

**THE C. R. SUPPLY CO.**  
127, Chesterfield Rd., Sheffield S8 0RN.

BOURNEMOUTH/POOLE. Electronic components for the hobbyist, and friendly service. Why not pay us a visit. H & H ELECTRICS LTD., 353 Ashley Road, Parkstone, 742643.

TURN YOUR SURPLUS Capacitors, transistors, etc., into cash. Contact COLES-HARDING CO., 103 South Brink, Wisbech, Cambs. 0945-4188. Immediate settlement.

## SMALL ADS

The prepaid rate for classified advertisements is 24 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £8.00 per single column centimetre (minimum 2.5 cms). All cheques, postal orders etc., to be made payable to Practical Electronics and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Practical Electronics, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846).

**CLEARANCE PARCELS:** Transistors, Resistors, Boards, Hardware. 10lbs only £5.80! 1,000 Resistors £4.25, 500 Capacitors £3.75. BC108, BC171, BC204, BC230, 2N5061. CV 7497 Transistors 10 70p, 100 £5.80. 2N3055, 10 for £3.50. S.A.E. Lists: W.V.E. (2), 15 High Street, Lydney, Gloucestershire.

**100 ASSORTED COMPONENTS 115p.** 100 Assorted Resistors 60p. 100 Assorted capacitors 150p. 50 reed switches 200p. 10 mains neons 50p. 10 Micro switches 150p. Add 25p P&P. Durrants, 9 St. Mary's Street, Shrewsbury, Salop.

### YOUR OWN P.C.B.'s & FRONT PANELS EASILY MADE, NO COMPLICATED PROCESSES

Full details S.A.E.

Drafting packs: pcb £1.67; panel £1.97. Processing packs: pcb (3" x 4") £2.10, panel (5" x 6") £2.88. Drills, etchant, pc board and all materials available.

**R. S. QUALITY COMPONENTS  
LYNWOOD ELECTRONICS**  
20, Stourcliffe Avenue,  
Bournemouth, BH6 3PT.

### EDUCATIONAL

**CAREERS** in Marine Electronics. Courses commencing September and January. Further details; the Nautical College, Fleetwood FY7 8JZ. Tel. 03917 79123.

### CITY & GUILDS EXAMS

Study for success with ICS. An ICS homestudy course will ensure that you pass your C. & G. exams. Special courses for: Telecoms. Technicians, Electrical Installations, Radio, TV & Electronics Technicians, Radio Amateurs. Full details from:

**ICS SCHOOL OF ELECTRONICS**  
Dept. Z272 Intertext House, London SW8 4UJ  
Tel. 01-622 9911 (all hours)  
State if under 18

### TECHNICAL TRAINING

Get the training you need to move up into a higher paid job. Take the first step now—write or phone ICS for details of ICS specialist homestudy courses on Radio, TV, Audio Eng. and Servicing, Electronics, Computers; also self-build radio kits. Full details from:

**ICS SCHOOL OF ELECTRONICS**  
Dept. Z272 Intertext House, London SW8 4UJ  
Tel. 01-622 9911 (all hours)  
State if under 18

### COLOUR TV SERVICING

Learn the techniques of servicing Colour TV sets through new homestudy course approved by leading manufacturers. Covers principles, practice and alignment with numerous illustrations and diagrams. Other courses for radio and audio servicing. Full details from:

**ICS SCHOOL OF ELECTRONICS**  
Dept. Z272 Intertext House, London SW8 4UJ  
Tel. 01-622 9911 (all hours)  
State if under 18

### BOOKS AND PUBLICATIONS

**BOOKS, BOOKS, BOOKS.** Large Range of Electronics Books in stock. Send S.A.E. for list. Servio Radio (Dept PE10), 156/8 Merton Road, Wimbledon, SW19 1EG.

**ANY REQUESTED SERVICE SHEET £1 + Large S.A.E.** Full repair data any named TV £5.50 (with circuits, layouts etc. £7). SAE brings newsletter, bargain offers, etc. AUSPEL, 76 Church St, Larkhall, Lanarks ML9 1HE.

## NOTICE TO READERS

Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser to check both prices and availability of goods before ordering from non-current issues of the magazine.

### SERVICE SHEETS

#### G.T. TECHN. INFO. SERVICE 75 Church St, Larkhall, Lanarks ML9 1HE

Any single service sheet £1 + large SAE  
1,000s of sheets/manuals always in stock.  
Sole suppliers of all T.V. Repair Systems  
Giant Diagram Manual for Washing Machines  
Single tubs/twin tubs/auto—only £13.50  
Repair Data any named T.V. £5.50 (with circuits, etc. £7.00). SAE for newsletter, bargain offers etc.  
Phone 0698 883334 after 4pm.

**SERVICE SHEETS** from 50p and S.A.E. Catalogue 25p and S.A.E. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex.

**BELL'S TELEVISION SERVICES** for Service Sheets on Radio, TV, etc £1.00 plus S.A.E. Colour TV Service Manuals on request. S.A.E. with enquiries to B.T.S. 190 Kings Road, Harrogate, N. Yorkshire, Tel: (0423) 55885.

### FOR SALE

**SINCLAIR ZX80 COMPUTER.** Working 100% plus manual, leads, power pack, programmes tape. Owner upgrading £85 ono. Ring Dave 0202/422623 (day) or 02016/77183.

1 in. **VIDICON CGTV CAMERAS** with 19 in. rack CCU's, circuit diagrams, connectors, etc. £45 each. 20 ins. metal cased monochrome monitors £30 each. Sony AV 3650 1/2 in. open reel video machine, 120 volt model, £40. Prices inc. VAT. JMF Video Supplies, 01-445-0452.

MK14, P.S.U. new keyboard, extra RAM, cassette interface. £45. Telephone Sedgley 74804.

**COMPUKIT 101 8K,** built, cased £270 various books included in price. Alloway, 15 Stewards Close, Sutton, Cambs. 0353-778122.

**ZX80 COMPUTER.** Working almost new; £60. 24 Church Walks, Llandudno, Tel. 75105.

**ACORN MICROCOMPUTER.** System one. Manufacturer assembled. Complete with power pack and manual. Perfect, demonstrated, £55. Boud, 23, Cranebrook, Manor Road, Twickenham. 894 4429.

**COMPUKIT UK101** cased and working, cassette works at 600 band. £220. Tel. 01-399 5894.

**NEW BACK ISSUES** of "Practical Electronics" available 80p each Post Free. Open P.O./Cheque returned if not in stock—**BELL'S TELEVISION SERVICES**, 190 Kings Road, Harrogate, N. Yorks. Tel: (0423) 55885.

**MAPLIN Drumsetts** Rhythm generator kit. Plays fifteen different rhythms. Ready built and working. £70. Telephone: Ingrebourne 45704 (Romford).

**100 CLOSE TOLERANCE** metal oxide resistors. Mixed values and wattage (mostly 0.25W). £1.20p inc. P&P. Jackson, 37, Knott Lane, Gee Cross, Hyde, Cheshire. SK 14 5HZ.

**COMPUKIT UK101 4K** Ram, Cased with leads, book etc. £225. Phone 021-350 3894.

**MK 14 MICROCOMPUTER** with Power Supply, Manual, extra RAM, RAM I/O, box and new switches. £40. Tel. South Benfleet 53658.

**HOMEMADE ORGAN** in case. Two keyboards, room for pedals. Two 12 in. Fane speakers, 50 watt amp in working order based on Livingstone "Princes". £100 o.n.o. Telephone 0604 56020.

## SITUATIONS VACANT

### UNIVERSITY OF LONDON GOLDSMITHS' COLLEGE

#### Psychology Department Technician

Applications are invited for the post of Technician in the Psychology Department at either Grade 3 or Grade 1A/1B level, to start as soon as possible.

**Grade 3 Qualifications:** ONC/OND/City & Guilds Intermediate level and/or experience in one or more of the following areas:- General Laboratory Equipment, A/V, test gear, digital/analogue, micro-processor, mini computer, prototype wiring. Day release for relevant studies feasible. Salary: £4,374 x 5 increments to £4,872 p.a. inclusive.

**Grade 1A/1B Suitable** for young person as a trainee technician. Qualifications equivalent to 'O' level standard, with Maths and, preferably a science or engineering subject. The person appointed will be expected to attend relevant day-release course. Salary: £3,711 x 6 increments to £4,119 p.a. inclusive.

Write for further particulars to the Personnel Officer, University of London Goldsmiths' College, New Cross, London, SE14 6NW stating clearly for which post you are applying. Closing date for applications 26th September, 1980.

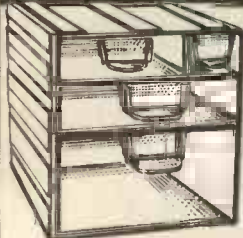
**INDUSTRIAL ELECTRONICS:** Are you an Electronic Test Technician or Service Mechanic? Have you had an apprenticeship followed by at least 5 years recent practical experience with a manufacturing or servicing organisation? If so we can offer you employment as an **INSTRUCTOR**, with good promotion opportunities and pensionable security at Gloucester, Bristol, and Swindon skillcentres. Starting salary £6,000 p.a. rising by two increments to £7,110 p.a. For more information contact Miss A. Curran, M.S.C. T.S.D. 11, Park Place, Clifton, Bristol, Telephone Bristol 20661.

**INDUSTRIAL ELECTRONICS.** Are you an Electronic Wireman/Tester or Prototype Wireman? Have you had an apprenticeship followed by at least 5 years recent practical experience? If so we can offer you employment as an **INSTRUCTOR**, with good promotion opportunities and pensionable security at Bristol, and Swindon skillcentres. Starting salary £6,000 p.a. rising by two increments to £7,110 p.a. For more information contact Miss A. Curran, M.S.C. T.S.D. 11, Park Place, Clifton, Bristol, Telephone Bristol 20661.

## MISCELLANEOUS

### NEAT! TIDY! HANDY!

## INTERLOCKING PLASTIC STORAGE DRAWERS



**AS SUPPLIED:  
TO POST OFFICE  
& GOVT DEPTS**

Newest, neatest system ever devised for storing small parts and components: resistors, capacitors, diodes, transistors, etc. Rigid plastic units

Interlock together in vertical and horizontal combinations. Transparent plastic drawers have label slots. 1D and 2D have space dividers. Build up any size cabinet for wall, bench or table top.

**SINGLE UNITS (1D)** (5in+2½in+2½in) £3.90 DOZEN  
**DOUBLE UNITS (2D)** (5in+4½in+2½in) £6.50 DOZEN  
**TREBLE (3D)** £5.90 for 8.  
**DOUBLE TREBLE 2 drawers**, in one outer case (6D2), £9.50 for 8.

Extra large size (6D1) £7.90 for 8.

#### PLUS QUALITY DISCOUNTS

Orders over £60, less 5%. Packing/Postage/Carriage: Add £1.30 to all orders under £10. Orders £10 and over, please add 10% carriage.

#### QUOTATIONS FOR LARGER QUANTITIES

Please add 15% V.A.T. to total remittance.

All prices correct at time of going to press.

## FLAIRLINE SUPPLIES

(PE10) 124 Cricklewood  
Boulevard, London  
N.W.2. Tel: 01-460  
4844.

**PRINTED CIRCUIT BOARDS.** Glass fibre, tinned and drilled, proto types to batch runs. Quick turn-round, competitive prices. Send S.A.E. for quotations. - R. D. Electronics, 12, Whiteoaks Road, Oadby, Leicester. 0533-716273.

**BURGLAR ALARM EQUIPMENT.** Latest Discount Catalogue out now! Phone C.W.A.S. Alarm 0274 682674.

### GUITAR/PA/ MUSIC AMPLIFIERS

100 watt superb treble/bass overdrive. 12 months guarantee. Unbeatable at £48; 60 watt £40; 200 watt £69; 100 watt twin channel sep. treble/bass per channel £62, 60 watt £54; 200 watt £72; 100 watt four channel sep. treble/bass per channel £80; 200 watt £98; slaves 100 watt £34; 200 watt £56; fuzz boxes, great sound £12, bass fuzz £12.90; overdriver fuzz with treble and bass boosters £20.00; 100 watt combo superb sound overdrive, sturdy construction, castors, unbeatable £98; twin channel £105; bass combo £110; speakers 15in. 100 watt £38; 12in. 100 watt £24; 60 watt £16; microphone Shure Umdyne 8 £25.

Send cheque or P.O. to:

**WILLIAMSON AMPLIFICATION**

62 Thorncliffe Avenue, Dukinfield, Cheshire.  
Tel: 061-308 2064

Readily available Hardware and Accessories for Home Constructors, Dev. Engineers, Modelmakers. Selected range of quality components, Drawing materials for p.c. boards, Reliable resist coated epoxy glass laminate, no unusual chemicals. Printed circuit boards, top quality to personal designs, prompt service. Photography for p.c.h. Solid tungsten carbide drills.

All immediately available.  
Catalogue 15p stamps please to:

## RAMAR CONSTRUCTOR SERVICES,

Masons Rd. Stratford on Avon  
Warwks. CV37, 9NF 0789-4879

**SUPERB INSTRUMENT CASES BY BAZELLI**, manufactured from P.V.C. Faced steel. Hundreds of people and industrial users are choosing the cases they require from our vast range. Competitive prices start at a Low £1.05. Chassis punching facilities at very competitive prices, 400 models to choose from. Suppliers only to Industry & The Trade. BAZELLI (Dept No. 23), St. Wilfrids, Foundry Lane, Halton, Lancaster, LA1 6LT.

### BUILD YOUR OWN PROJECTS!

from our Electronic Construction Kit Data Sheets.

Complete sets of plans now available for:-	
ECK 2 - 8 trans U/S VHF Multiband radio	£2.00
EV 5 - 6 trans MW/LW radio	£1.50
Pocket 5 - 5 trans MW/LW radio	£1.50
Air Converter Unit - range up to 100 miles	£1.75
Edu-Kit Major - 15 super projects	£2.50
SXB 2 - 2 band 8 trans SW radio	£2.00
RK 1 - 8 trans multiband radio	£2.00
RK 3 - 13 trans VHF/AM 9 wavebands	£3.00
Post and packing for each of the above	25p

<b>Global Special Introductory Offers</b>	
Car radio: Five push button MW/LW	£16.40+p.p. £1.75
Car radio: Manual tuning MW/LW, LSP	£9.28+p.p. £1.50
Car Speaker stereo set, 4 ohms 5 watts	£3.95+p.p. £1.60
Electric car aerial	£8.25+p.p. £1.28
Car Cassette Radio: AM/FM/MPX	£31.95+p.p. £2.00
Sharp LCD Calculators: 6 functions & MEM	£6.95+p.p. 85p

Cheques and P.O.'s made payable to  
**GLOBAL ELECTRONIC ENTERPRISES**  
St. John's Works, St. John's, Bedford, Beds.  
Free catalogue sent with order or 45p on request.

**UK 101 SOFTWARE.** Try our original programmes (on cassette) **GRAPHIC PAINT BRUSH-GRAPHIC PLOTTER** etc. Working programmes that will give you ideas of your own. S.A.E. M & B SERVICES, 182a, High Street, Margate, Kent.

Understanding Microprocessors  
with the S.O.C.

## Mk 14

Full programming manual at last!

★ 216 pages for £5.95!

★ programming, number-crunching, DMA, memory expansion, all those missing Mk 14 details!

★ limited edition, by Macmillan Press.

At your local bookshop, or direct from

**Tony Watson, Globe Book Services,  
Little Essex Street, London WC2.**

(Add 35p postage.)

**7 SEGMENT LED's** at low cost 0.3in, RH decimal, common cathode, FND70 series. Base diagram included. £2 plus SAE for three. F. Rose, 33, Wallace Drive, Eaton Bray, Beds.



### RYDER ORGAN SYSTEM

The W.W. classical design for full-size keyboards, including couplers. Expanded range of units now includes chorus, vibrato, combination stop control. AND - a new reverb. Data, p.c. boards, from:

**HIYKON LTD. (P).**

Woodside Croft, Ladybridge Lane,  
Bolton BL1 5ED.

**CLEARING LABORATORY:** scopes, generators, P.S.U.'s, bridges, analysers, meters, recorders, etc. 0403-76236.

## RECHARGEABLE BATTERIES

### TRADE ENQUIRIES WELCOME

FULL RANGE AVAILABLE. SAE FOR LISTS. £1.25 Booklet "Nickel Cadmium Power" plus Catalogue. Write or call: Sandwell Plant Ltd., 2 Union Drive, BOLDMERE, SUTTON COLDFIELD, WEST MIDLANDS, 021-354 9764, or see them at TLC, 32 Craven Street, Charing Cross, London WC2.

**LOGIC ANALYSER/PULSE CATCHER** in kit form £8.75

**TARGET A** variable speed game to test your reactions, in kit form £9.75

**MYLAR FILM CAPACITORS - 100V.**

0.001, 0.0015, 0.0022, 0.0033, 0.0047, 0.0068 - 5p.  
0.01, 0.015, 0.022 - 6p. 0.033, 0.047, 0.068 - 7p.  
0.1 - 8p.

Resistors - High stability carbon film 1½p.

Orders under £5, add 30p. P&P.

Mail Order only.

### HERTS ELECTRONICS

16 Dunlin Road,  
Hemel Hempstead,  
Herts. HP2 6LU.

**ULTRASONIC TRANSDUCERS.** £2.85 per pair + 25p P&P. Dataplus Developments, 81 Cholmeley Road, Reading, Berks.

### Cabinet and Flightcase Fittings

Fretcloths, Coverings, Handles, Castors etc., Jacks and Sockets, Cannons, Bulgins, Reverb Trays, Emilar Compression Drivers, AKG Mics, Celestion Speakers, ASS, Glassfibre Horns.

Send 30p Postal Order for illustrated catalogues to:-

### ADAM HALL (P. E. SUPPLIES)

Unit G, Carlton Court, Granger Road,  
Southend-on-Sea, Essex SS2 5BZ.

### UK101 Hardware:

**Programmable Sound Generator**

Add another dimension to your UK101. We will supply the P.C.B. list of parts. Hardware and Software instructions and Software on tape. All for only £9.50.

### UK101 Software on Tape:

Our most popular programs: 4K Alien Invaders; 8K Home Finance. Our latest program: 8K Asteroid Runner, and our other firm favourites: 4K Snakes and Ladders; 4K Fruit Machine; 4K The My-mY Game; 4K Drawing Machine. £3.00 each or £5.00 for any two including P&P. Cheque or P.O. or just S.A.E. for details to **MaricK Dept. 12, 1 Branksome Close, Paignton, S. Devon TQ3 1EA.**

## DIGITAL WATCH BATTERY REPLACEMENT KIT



These watches all require battery (power cell) replacement at regular intervals. This kit provides the means. We supply eyeglass, non-magnetic tweezers, watch screwdriver, case knife and screwback case opener, also one doz. assort. push pieces, full instructions and battery identification chart. We then supply replacement batteries—you fit them. Begin now. Send **£9.00** for complete kit and get into a fast growing business. Prompt despatch.

**BOLSTER INSTRUMENT CO.**  
(PE17)

11 Percy Avenue, Ashford, Middx. TW15 2PB.

**MORE UK101 SOFTWARE** from the guy who wrote "Le Passe-Temps". 4K logic: Bridge-it. 4K Graphics: Bomb-run, Breakout, Wall-ball, Piranha. 8K: Galactic Hitchhiker (adventure), Startrek. Prices for these and previously advertised games: 4K £1.50; 8K £3.00. Circuit diagrams/Instructions for 4 P.I.A.s 1/2 Meg, 110/300/600 Baud conversions £2.00. All inclusive prices from: Mr. S. Knight, 28, Simonside Walk, Ormesby, Cleveland.

**ELECTRONIC IGNITION.** Manufacturers surplus tested £2.75 each. Phone (01) 643 6111 after 6 p.m.

## PRACTICAL ELECTRONICS P.C.B.'s

Apr. 80 2 Wire Train Controller EP320 £2.93  
May 80 Two Wire Train Controller EP326 £3.02  
EP328/30 £1.20 pair  
Dynamic Semiconductor Tester EG311/2 £1.83 pair  
Jun. 80 MasterTune EP343 £3.80 (Not plated through)  
Greenhouse Temp. Control EP358 £1.90  
Jul. 80 Tape Slide Synch EP353 £1.28  
Sept. 80 DISCO deck EP365 £3.26  
Sound Gen. EC14 £2.53  
Class A amp EG400 £1.84

For full list and current pcb's please send SAE. Pcb's also produced to customers own masters. Trade enquiries welcome. Please write for quote. CWD Please. Postage. - Please add 30p postage and packing to complete order. Europe 65p.

### PROTO DESIGN

14 Downham Road, Ramsden Heath  
Billericay, Essex CM11 1PU  
Telephone 0268-710722

## THE SCIENTIFIC WIRE COMPANY PO Box 30, London E.4

### ENAMELLED COPPER WIRE

SWG	1lb	8oz	4oz	2oz
8 to 29	2.76	1.50	0.80	0.60
30 to 34	3.20	1.80	0.90	0.70
35 to 40	3.40	2.00	1.10	0.80
41 to 43	4.75	2.60	2.00	1.42
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	6.50	3.75	2.20	1.40
----------	------	------	------	------

### TINNED COPPER WIRE

14 to 30	3.85	2.36	1.34	0.90
----------	------	------	------	------

Prices include P&P, VAT and wire Data.

SAE for list. Dealer enquiries welcome.

Reg office 22 Coningsby Gardens.

**PRINTED CIRCUITS.** Make your own simply, cheaply and quickly! Golden Fotolac Light Sensitive Lacquer - now greatly improved and very much faster. Aerosol cans with full instructions. £2.25. Developer 35p. Ferric Chloride 55p. Clear Acetate sheet for master 14p. Copper-clad Fibre-glass Board approx. 1mm thick £1.70 sq. ft. Post/Packing 60p. **WHITE HOUSE ELECTRONICS.** P.O. Box 19, Castle Drive, Penzance, Cornwall.

## EXACT TIME?

**MSF CLOCK** is ALWAYS CORRECT - never gains or loses, self setting at switch-on, 8 digits show Date, Hours, Minutes and Seconds, larger digit Hours and Minutes for easy QUICK-GLANCE time, auto GMT/BST and leap year, also parallel BCD output for computer and audio output to record (with commentary) and show time on playback, receives Rugby 60KHz atomic time signals, built-in antenna, 1000Km range, **ABSOLUTE TIME, £54.80.**

**V.L.F. 7 EXPLORE 10-150KHz, Receiver £13.70.**

Each fun-to-build kit includes all parts, printed circuit, case, postage etc, money back assurance so SEND OFF NOW.

### CAMBRIDGE KITS

45 (FK) Old School Lane, Milton, Cambridge.

## NO LICENCE EXAMS NEEDED

To operate this miniature, solid-state Transmitter-Receiver Kit. Only £12.95 plus 35p P. & P. 'Brain-Freeze'™ em with a MINI-STROBE Electronics Kit, pocket-sized 'lightning flashes', vari-speed, for discos and parties. A mere £5.95 plus 35p P. & P. Experiment with a psychedelic DREAM LAB, or pick up faint speech/sounds with the BIG EAR sound-catcher: ready-made multi-function modules £6.85 each plus 35p P. & P.

**LOTS MORE!** Send 30p for lists. Prices include VAT.

## BOFFIN PROJECTS

4 Cunliffe Road, Stoneleigh  
Ewell, Surrey (P.E.)

**THE BRITISH AMATEUR ELECTRONICS CLUB** for all interested in electronics. Four Newsletters for a year. Library of technical books and magazines. Help for members by experts. U.K. & Eire £4.50, Europe £6. Airmail £7.50—Sterling per year. Details from Hon Sec. J. G. Margetts, 3, Bishopstone Close, Golden Valley, Cheltenham.

**SEEN MY CAT?** 5000 Odds and ends. Mechanical. Electrical. Cat free. Whiston Dept. PRE, New Mills, Stockport.

**NATIONAL Personal Computer Users Association,** 11 Spratling Street, Manston, Ramsgate, Kent (S.A.E. Details).

**MAKE YOUR OWN PRINTED CIRCUITS** Etch Resist Transfers - Starter pack (5 sheets, lines, pads, I.C. pads) £1.60. Large range of single sheets in stock at 34p per sheet.

Master Positive Transparencies from P.C. layouts in magazines by simple photographic process. Full instructions supplied. 2 sheets (20 x 25cm) negative paper and 2 sheets (18 x 24cm) positive film £1.80. Drafting film (30 x 21cm) 22p per sheet.

17p stamp for lists and information. P&P 30p/order

P.K.G. ELECTRONICS

OAK LODGE, TANSLEY, DERBYSHIRE

## J. BIRKETT

(Partners: J. H. Birkett, J. L. Birkett)

Radio Component Suppliers

25 The Strait, Lincoln. LN2 1JF

INTEL P4001 256x8 MASK PROGRAMMABLE ROM AND 4 BIT 1/0 PORT with data • 60p each.

HOUSE CODED TTL I.C.'s 7400, 7410, 74100, 7430, 7453 All at 6 for 50p.

QUAD COMPARATOR LM 339 with data • 50p.

UGA994559 DTL MASTER SLAVE JK or RS FLIP-FLOP • 10p.

SN 7474 DUAL D TYPE EDGE TRIGGERED FLIP-FLOP • 15p.

SN 7486 QUAD EXCLUSIVE OR GATE • 15p.

LM 7524 SENSE AMPLIFIER FOR CORE MEMORIES with data • 35p.

TTL I.C.'s 74H00 • 15p, 74H30 • 15p, 74H50 • 15p, 74H51 • 15p, 74H61 • 15p, 74H106 • 25p, 74S05 • 22p, 74S10 • 22p, 74S51 • 22p, 74S64 • 22p, 74S158 • 60p, 74S194 • 60p.

IM 5600 INTEL 256 BIT (32x8) STATIC ROM • 60p.

9 VOLT ITRON 9 DIGIT SEVEN SEGMENT DISPLAY Type FG 95A • £1.80.

BECKMAN 3 DIGIT SEVEN SEGMENT GAS DISCHARGE ORANGE DISPLAYS Type SP 353 • £1.95.

PLASTIC POWER TRANSISTORS BD 175 • 20p, BD 187 • 20p, BD 589 • 25p, TIP 33 • 30p, BD 207 • 50p.

6 TO 12 VOLT MINIATURE RELAYS Single Pole C.O. 5 Amp Contacts • 60p.

STANDARD TOGGLE SWITCHES Car Type Long Dolly on-off • 35p, CHROME BULGIN 1 Make 1 Break • 30p, ARCO 2 Pole Make • 30p.

MINIATURE LEVER TYPE MICRO SWITCHES 1 Pole C.O. • 20p, 6 for £1.

500 METRE REELS OF PVC CABLE 13 Strands - 019 • £10 Reel.

MULLARD DISC THERMISTORS VA 1034 • 10p, VA 1040 • 10p, VA 1077 • 20p.

ROXBURGH MAINS FILTERS 250 V.A.C. 1.5 Amps Type SDA-013 • £1.15.

FERRITE RINGS size 7/8" Dia. Internal Dia. 3/8" • 35p.

20 WAY LUCAR TAG CONNECTING BLOCKS • 60p, LUCAR CONNECTOR • 2p each.

SILICON STUD RECTIFIERS 1N 3880R 100 PIV 20 Amps • 50p, 1N 1188A 400 PIV 40 Amps • 75p.

FERRITE BEADS FX 1115 • 15p Doz, Long Type 1/2" • 6 for 10p.

SPECIAL 5 NPN DARLINGTON PAIRS in 14 PIN DIL Package HFE 5000, 10 Volt 500mA with connections • 50p.

SILICON PNP TO3 TRANSISTORS 60 Volt 10 Amp 2N 3789 • 55p.

SILICON NPN TO3 TRANSISTORS BDY 57 120 Volt 25 Amp • £1.30, BDY 91 100 Volt 15 Amp • 80p, 2N 5039 120 Volt 20 Amp 60 MHz • £1.15, 2N 6354 150 Volt 10 Amp 80 MHz • £1.15, 2N 6496 150 Volt 15 Amp 60 MHz • £1.

TO3 FINNED HEAT SINKS For Mounting on P.C. Board • 25p.

MAINS TRANSFORMERS 250 Volt Input. Type 1, 24 Volt Tapped at 14 Volt 1 amp • £1.30 (P&P 25p), Type 2, 30-0-30 Volt 500 mA • £1.30 (P&P 25p), Type 6, 16 Volt 2 Amp • £1.60 (P&P 25p), Type 10, 13 Volt 1 Amp • £1.60 (P&P 25p).

SIGNETICS HIGH SPEED TTL PRESETTABLE DECADE COUNTER 829 • 20p.

CRYSTALS Glass Wire Ended 28 KHz or 28.5 KHz Both • 50p each.

PAPER CAPACITORS 10 U.F. 370 V.A.C. Working size 5 1/2 x 2 1/2 x 1 1/2 • £1.50.

ELECTRET MICROPHONE INSERTS with FET Pre-Amp • £1.85.

VERY USEFUL MAINS TRANSFORMER 240 Volt Input, Output 43 Volt 50 mA, 11 Volt 2.5 Amp, 22-0-22 Volt 150 mA, 16 Volt 120 mA, 15 Volt 1.5 Amp, 20 Volt 275 mA • £3.90 (P&P £1.20).

Please add 20p for post and packing on U.K. orders under £2. Overseas orders postage charged at cost.

## CONGRESS AMPLIFIER

We supply all the designer approved parts for this exceptional kit, including high quality printed circuit boards and transformer.

Complete kit, excluding metalwork with 20% discount on parts. **£73.74**

All parts to assemble pre-amp i.e. R's, C's, PCB's, semicon, controls etc, but excluding transformer with 10% discount on parts. **£41.79**

All parts to build main amp board **£20.48**

Mains transformer **£12.82**

Smoothing caps & clips **£8.86**

Front Panel **£3.20**

Chassis (unpainted, pre-punched) **£13.40**

Front panel and chassis not subject to reduction but if ordered together with complete kit available at special price of **£11.50**

*This offer also applies to previous purchasers of complete kits.*

### MAIL ORDER ONLY.

Prices include VAT and p&p

Please send A5 S.A.E. for full price details.

Terms: Cash with order. Cheques etc. should be made payable to:

### CONGRESS ELECTRONICS PROJECT

Allowing 14-21 days after sending order for delivery. Send order to:

Photostat of article available at £1.20.

WICCA SYSTEMS LTD,

24 HILLCREST PARADE, COULSDON, SURREY.

Tel. 01-668 5256

ALL PRICES IN PENCE EACH UNLESS OTHERWISE STATED

C-MOS (SOP REFERED)				LINEAR				SEMICONDUCTORS			
HEF4004	22	HEF4004	103	HEF4512	136	CA3086	84	IN916	5	BC182L	12
HEF4001	22	HEF4001	103	HEF4516	127	CA308E	122	IN4001	5	BC184	11
HEF4002	22	HEF4002	109	HEF4517	476	CA3130E	99	IN4002	8	BC184L	12
HEF4006	119	HEF4006	57	HEF4518	118	CA3140E	48	IN4004	7	BC212	11
HEF4007	22	HEF4007	57	HEF4519	97	CA3189E	783	IN4007	9	BC212L	12
HEF4008	100	HEF4008	87	HEF4520	118	LM301AN	34	IN4148	4	BC214	11
HEF4011	22	HEF4011	90	HEF4521	235	LM339N	78	IN5402	18	BC214L	12
HEF4012	22	HEF4012	90	HEF4528	124	LM390N	108	2N2369	21	BC547	13
HEF4013	57	HEF4013	57	HEF4532	150	LM3818AN	108	2N2646	46	BC548	11
HEF4014	105	HEF4014	475	HEF4534	638	LM3900N	75	2N2926G	13	BC549	12
HEF4015	100	HEF4015	22	HEF4539	138	MC3403P	196	2N3063	18	BC557	15
HEF4016	57	HEF4016	22	HEF4543	122	NE531	131	2N3054	35	BC558	15
HEF4017	100	HEF4017	22	HEF4724	214	NE53ET	259	2N3055	95	BFY70	18
HEF4018	100	HEF4018	22	HEF4007	113	NE555A	28	2N3702	8	BCY71	15
HEF4019	58	HEF4019	23	HEF4009	97	NE566A	96	2N3704	9	BD131	19
HEF4020	112	HEF4020	23	HEF4006	78	NE568N	171	2N3705	10	BD132	39
HEF4021	107	HEF4021	23	HEF4010	149	NE570N	485	2N3773	297	BD139	39
HEF4022	103	HEF4022	130	HEF4019	149	NE871N	505	2N3819	22	BD140	39
HEF4023	22	HEF4023	22	HEF4027	149	RG1218	146	2N3820	39	BF960	333
HEF4024	76	HEF4024	23	HEF4028	23	78A1205	88	2N3904	9	BFX88	29
HEF4025	22	HEF4025	23	HEF4061	23	TDA1022	713	2N4547	39	BFY50	17
HEF4026	744	HEF4026	23	HEF4062	23	TD1034B	239	2N4559	35	BFY51	17
HEF4027	57	HEF4027	57	HEF4065	89	TL081CP	84	40823	86	BRV35	50
HEF4028	89	HEF4028	89	HEF4086	89	UA723CN	42	LC107	14	ESX20	21
HEF4029	113	HEF4029	63	HEF4093	63	UA7805CU	78	LC108	18	LC8860	2850
HEF4030	58	HEF4030	58	HEF4094	218	UA7815CU	78	UA741CT	47	TC931	48
HEF4031	220	HEF4031	206	HEF4104	206	UA7815CU	78	Zener	8	TC109	14
HEF4032	136	HEF4032	116	HEF4105	116	UA7812CU	97	Diodes	8	TC108	19
HEF4033	107	HEF4033	107	HEF4106	107	UA7815CU	78	Diodes	8	TC109C	20
HEF4034	94	HEF4034	94	HEF4508	232	UA7819CS	38	400mW CVT C33	8	TC148	10
HEF4042	83	HEF4042	133	HEF4510	133	UA7812CS	38	BZY88/BZM79	8	TC158	10
HEF4043	100	HEF4043	157	HEF4511	157	UA7815CS	38	+ Voltage	8	BCY77	17
										TS43	36

**GMT SELL P.A. EQPT.** PLEASE SEND SAE FOR DETAILS

CAPACITORS				Polyester Radial Leads				Electrolytic Radial Leads									
Electrolytic Axial				Doped Type, C280/352 Style				-10% to +50% Tol									
Cap	Dims	µF	±%	Order Code	Cap	352	350	Order Code	Cap	350	±%						
µF	V	10	25	40	63	100	150	µF	V	10	25	36	40	50	63	80	100
1.0	16	9	9	9	9	9	9	1.0	16	9	9	9	9	9	9	9	9
1.5	16	9	9	9	9	9	9	1.5	16	9	9	9	9	9	9	9	9
2.2	16	9	9	9	9	9	9	2.2	16	9	9	9	9	9	9	9	9
3.3	16	9	9	9	9	9	9	3.3	16	9	9	9	9	9	9	9	9
4.7	16	9	9	9	9	9	9	4.7	16	9	9	9	9	9	9	9	9
6.8	16	9	9	9	9	9	9	6.8	16	9	9	9	9	9	9	9	9
10	16	9	9	9	9	9	9	10	16	9	9	9	9	9	9	9	9
15	16	9	9	9	9	9	9	15	16	9	9	9	9	9	9	9	9
22	16	9	9	9	9	9	9	22	16	9	9	9	9	9	9	9	9
33	16	9	9	9	9	9	9	33	16	9	9	9	9	9	9	9	9
47	16	9	9	9	9	9	9	47	16	9	9	9	9	9	9	9	9
68	16	9	9	9	9	9	9	68	16	9	9	9	9	9	9	9	9
100	16	9	9	9	9	9	9	100	16	9	9	9	9	9	9	9	9
150	16	9	9	9	9	9	9	150	16	9	9	9	9	9	9	9	9
220	16	9	9	9	9	9	9	220	16	9	9	9	9	9	9	9	9
330	16	9	9	9	9	9	9	330	16	9	9	9	9	9	9	9	9
470	16	9	9	9	9	9	9	470	16	9	9	9	9	9	9	9	9
680	16	9	9	9	9	9	9	680	16	9	9	9	9	9	9	9	9
1000	16	9	9	9	9	9	9	1000	16	9	9	9	9	9	9	9	9
1500	16	9	9	9	9	9	9	1500	16	9	9	9	9	9	9	9	9
2200	16	9	9	9	9	9	9	2200	16	9	9	9	9	9	9	9	9

RESISTORS				Skeleton Presses, Miniature				Order Code			
Carbon Film, Fixed				0.1W, E3 Values, 100R-1M, Lin. Vertical Mounting				Min. Preset V			
0.25W, E24 Values, IRO-10M, 5% Tol.				0.1W, E3 Values, 100R-1M, Lin. Horizontal Mount				+ Value			
2 each				0.2W, E3 Values, 100R-1M, Lin. Vertical Mounting				Std. Preset V			
Rev. RD%				0.3W, E3 Values, 100R-1M, Lin. Horizontal Mount				Std. Preset H			
0.5W, E12 Values, IRO-4M7, 10% Tol.				Potentiometer, Rotary				39			
3 each				0.5W, E3 Values, 1K-2M2, Lin.				Ro. Pot. Lin			
Rev. RD%				0.25W, E3 Values, 1K-2M2, Log.				39			
+ Value				Potentiometer, Slider				45			
Metal Film, Fixed				0.5W, E3 Values, 1K-2M2, Lin.				Std. Pot. Lin			
0.5W, E24 Values, SRH-1M, 2% Tol.				0.25W, E3 Values, 1K-1M0, Log.				S Pot. Lin			
8 each				+ Value				45			
Rev. MR30											
16 each											
Rev. PR52											
+ Value											
Metal Glaze, Fixed											
0.5W, E24 Values, IM-33M, 5% Tol.											
16 each											
Rev. VR37											
+ Value											

**SEND A LARGE S.A.E. FOR OUR 'FLOG LIST' & OTHER INFO.**

MAINS TRANSFORMERS				Plastic Boxes - Boss Industrial Mouldings				Order Code			
Secondary may be connected in series or parallel to give wide voltage range				Mounted Boss and Cross-Fitting Flanged Lid				A85 Box, C/W Brass Bushes, and Lid in Orange			
Primaries 0-220, 240V				A113 WB3 D31				90			
0-8A - Clamp Type Construction				L180 WD D50				131			
235 each				L190 W110 D60				223			
Approx. 16% Regulation F.C. 54, H36, W35				Plastic Boxes with Metal Lids				Recessed Top 8oz			
0-4.5V, 0-4.5V Secondaries				A85 Box, C/W Brass Bushes, in Orange				1mm Aluminium Top Panel Finished Grey			
0.5V, 0.6V				L85 W58 D29				112			
0.12V, 0.12V				L111 W71 D42				150			
0.15V, 0.15V				L181 W98 D53				208			
0.175V, 0.175V				Diode Boxes				Aluminium Box and Lid in Natural Finish			
0.20V, 0.20V				L113 WB3 D31				124			
70VA - Clamp Type Construction				L152 WB2 D50				215			
360 each				L192 W112 D61				336			
Approx. 16% Regulation F.C. 70, H48, W46				SWITCHES				Order Code			
0-4.5V, 0-4.5V Secondaries				Miniature Toggle - Moneywell				67			
0.8V, 0.8V				SPDT				5W 8A1011			
0.12V, 0.12V				SPDT C/O/H				81			
0.15V, 0.15V				SPDT C/O/H				90			
0.175V, 0.175V				SPDT C/O/H				99			
0.20V, 0.20V				SPDT C/O/H				111			
				Miniature Push - C & K				52			
				SP Push To Make, Momentary				5W 8533			
				SP Push To Break, Momentary				5W 8533			

VERO ELECTRONICS PRODUCTS				F.E.T. ELECTRONIC KITS			
2.5" x 8", 1" pitch Veroboard				FULL TELETYPE KIT			
71				Free standing unit - no internal connection to T.V.			
200-21069A				£199.90			
3.75" x 5", 1" pitch Veroboard				TELETYPE DECODER - REMOTE CONTROL KIT			
95				For working into viewing operation			
200-21072D				£133.90			
2.5" x 1", 1" pitch Veroboard (B)				PAL ENCODER MODULATOR KIT			
85				£22.80			
200-21078C				DOOPER RADAR ALARM KIT			
3.75" x 5", 1" pitch Plain Board				£46.80			
135							
200-21084E							
Spot Face Cutter							
107							
200-21013A							
Pin insertion Tool for .040 type pin							
147							
200-21015F							
OS Pm, 040 (100)							
46							
200-21087G							
SS Pm, 040 (100)							
46							
200-21017H							
Veroboard Kit (100, 2-year, 25-comb)							
454/Kit							
200-21341D							
Veroboard Combs (25)							
109/Pack							
200-21340G							
Veroboard Wire (2)							
109/Pack							

**GMT ELECTRONICS, P.O. BOX 290, HAMPTON STREET, BIRMINGHAM B19 3JR**



**2**  
**SUPERB NEW KITS!**  
**£2 OFF SPECIAL OFFER**



**C300/ES200**  
high performance electronic ignition to add power, economy, reliability, sustained smooth peak performance, instant all weather starting, to your car.

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

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

**C300.** In its ready built form (C3000) it came top of all systems tested by an independent national authority July '79. A high energy capacitive discharge ignition incorporating a high output short circuit proof inverter, top grade Swedish output capacitor, pulse processor circuit, transient overload protection. Fast rise bidirectional output ideal for fuel injection, sports carburation, oily engines. Compatible with most rev. counters. (Low cost adaptors available for rare cases. Application list enclosed with each kit. Note: Vehicles with Smiths/Jaeger rev. counters code RVI on dial will require adaptor type TCI).

**What's in the kits.** Surefire's own precision anodised aluminium extruded case. P.C. mounted selection changeover switch, static timing light. Special selection Motorola semi-conductors. Capacitors, resistors etc. selected after 5 years experience. Glass fibre pcb, solder, complete down to last washer. Fully illustrated comprehensive instructions and full technical back up service.



Suretron Systems (UK) Ltd.  
Bayer Buildings, Lower Bristol Rd, Bath, BA2 3EF  
Dept. PE4  
Tel: Bath (0225) 332317

Name \_\_\_\_\_  
Address \_\_\_\_\_

Phone order with Access Barclaycard VAT and P & Pinc

Item	Price	Quantity	Price
ES200: Neg	£13.95	1	£11.95
C300: Pos	£17.95	1	£15.95
C300: Neg	£17.95	1	£15.95
Tacho Adapt. TCI		1	£3.90

I enclose chq/P.O.'s  
Chq No.

# DOUBLES AS A CLOCK



## when you build this PW 'SHERBORNE' SYNTHESISED AM/FM TUNER

A state-of-the-art design, with microprocessor-controlled coverage of the long and medium-wave broadcast bands, the 49, 41 and 31 metre short-wave broadcast bands and Band II v.h.f., f.m. Manual tuning and automatic scanning modes are incorporated, plus an 8-station memory. And it doubles as a clock!

### Direct Conversion Receiver

An ideal project for the beginner to short-wave listening. The prototype picked up stations from all six continents within hours of being completed!

### Rechargeable Handlamp

A very useful NiCad powered torch for lighting up your darkest moments.

# Practical wireless

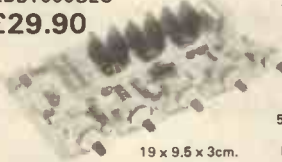
OCTOBER ISSUE OUT NOW 65p

## LIGHTING & AMPLIFIER MODULES FROM L & B

RING 01-689 4138



**LB31000SLC**  
**£29.90**

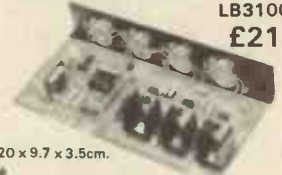


19 x 9.5 x 3cm.

**LB31000SLC SOUND TO LIGHT/CHASER.**  
THE MOST ADVANCED SOUND TO LIGHT MODULE AVAILABLE, WITH AUTOMATIC SWITCHING TO CHASE UPON ABSENCE OF A MUSIC INPUT.

3 Channels, 1000w each. Fully fused  
Very high input Impedance. Electronic filters.  
5HZ to 70KHz bandwidth. Operates from 1/4 to 300w  
sound input. Triac zero voltage triggering.  
Master Vol/Bass/Mid/Treble/Chase speed controls.

**LB31000SL**  
**£21.40**



20 x 9.7 x 3.5cm.

**LB31000SL SOUND TO LIGHT.**  
A SUPERB PERFORMING SYSTEM  
AT AN INCREDIBLY LOW PRICE.  
3 channels, 1000w each. Fully fused.  
Very high input impedance. Operates  
from 1/4 to 300w sound input.  
Third order filters. Zero voltage fired.  
Master/Vol/Bass/Mid/Treble controls.

**£26.50**

**LB81000LC**  
19 x 9.5 x 3cm.

**LB41000LS SEQUENCER**  
LOGIC RANDOM SEQUENCER, WITH TWO  
SPEED CONTROLS OFFERING A WIDE  
RANGE OF EFFECTS.

4 channels, 1000w each. CMOS circuitry.  
Zero voltage fired.

**LB31000LD**



20 x 7.8 x 3.5

**LB81000LC CHASER**  
A FULLY DIGITAL 8 CHANNEL  
CHASER, ALLOWING VARIATION  
OF CHASE SPEED AND CHASE  
RETURN DELAY.

1000w per channel. CMOS circuitry.  
Zero voltage fired. Can be footswitch  
triggered. Additional modules can be  
cascaded to form 16, 24, 32 chan etc.



**LB41000LS**  
20 x 9.2 x 3.5cm. **£17.50**

**LB31000LD and 11000LD DIMMERS.**  
FULL POWER 3 & SINGLE CHANNEL  
LIGHTING DIMMERS FOR USE IN  
CLUBS/PUBS/THEATRES/SCHOOLS, ETC.

1000w per channel. Fully fused phase controlled.  
Full Input and Individual Triac filters.

**LB31000LD £14.70** **LB11000LD £6.70**

**LB31000LD less pots** **£13.50**  
(for use with sliders) (sliders 75p)

**NEW! LBAC01**

3 channel active crossover module with  
18dB boost control, to lift Bass mid or  
treble bands. Available with cross-over  
frequencies of 200 or 300 and 2k or  
3kHz (please specify) - **£17.90**  
**LBPSU1 - 15V supply for LBAC01 -**  
**£6.20**

**POWER AMPS, 250, 150, 100 & 25W RMS.**  
**RUGGED TOUGH DEALING**  
**POWER AMP MODULES.**

Full spec available in our catalogue.

LB250	LB150	LB100	LB25
10Hz TO 20KHz S/N 110dB THD 0.1% 0.5v SENS 775mV versions available	10Hz TO 25KHz S/N 110dB THD 0.1% 0.5v SENS 775mV versions available	10Hz TO 25KHz S/N 110dB THD 0.1% 0.5v SENS 775mV versions available	20Hz TO 60KHz S/N94dB THD 0.07% 0.5v SENS 775mV versions available
<b>£39.50</b>	<b>£26.50</b>	<b>£18.20</b>	<b>£11.20</b>

**ROPELIGHTS NOW AVAILABLE!**  
8 metres in length Red/blue/green/  
yellow. R.R.P. **£45 + 6.75 VAT.**  
Complete control units with  
forward/reverse and automatic  
options from 2/sec to 2/min.  
R.R.P. **£69 + 10.35 VAT.**

### PREAMPS

**LBPA3.** Complete stereo disco preamp  
system. Comprising of L&R deck mixers,  
mic mixer, deck and mic tone stages, mic  
auto fade over decks, PFL, output  
drivers and its own regulators.

**LBPA2.** General purpose 4  
chan. mixer/tone stage.

**LBPA1.** Stereo  
Hi-Fi System

### LBRLD1

Relay delayed speaker  
connecting device,  
placed between  
Amp & Spk.

**£5.70**

**LBPA1 £19.50**  
**LBPA2 £17.20**

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

**LBPA3-M**  
20.4 x 9.5cm.

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



**LB250PS**

Four types of powerful supply units for  
our power amps. Consisting of a varnish-  
impregnated mains transformer and  
rectifier board (fuse protected)

**LB250PS £24.50 (p/p £1.70)**  
**LB150PS £18.00 (p/p £1.40)**  
**LB100PS £14.70 (p/p £1.40)**  
**LB25PS £11.20 (p/p £1.20)**

YOU REQUIRE A BOARD THAT'S MIGHTY COMPETITIVE, RELIABLE,  
MANUFACTURED FROM THE HIGHEST QUALITY COMPONENTS, OF HIGH  
PERFORMANCE, TESTED AND INSPECTED, SUPPLIED WITH CONNECTION AND  
CCT, DGM AND GUARANTEED, IN TWO LETTERS YOU REQUIRE L & B.

All prices shown are inclusive of VAT (15%)  
P/packing 50p in the UK except power supplies (\*)  
Trade and Overseas inquiries welcome.  
For the new Autumn catalogue send 50p

**L & B** 45 WORTLEY ROAD  
WEST CROYDON  
SURREY CR0 3EB  
ELECTRONIC (PE) TEL. 01-689 4138

# Marshall's

A. Marshall (London) Ltd., Kingsgate House,  
Kingsgate Place, London NW6 4TA  
Industrial Sales: 01-328 1009  
Mail Order: 01-624 8582  
Also retail shops: 325 Edgware Road, London W2.  
40 Cricklewood Broadway, London NW2. 85 West Regent St., Glasgow.  
108A Stokes Croft, Bristol.

Build the P.E./Marshall's Teletext Project and convert your standard colour television receiver to receive Teletext and Oracle. We can supply either a complete kit of parts at £200 inclusive of VAT/postage & packing, alternatively kits of parts for the various sub assembly as follows:

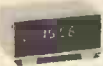
- |  |        |                              |
|--|--------|------------------------------|
| 1. Transmitter                           | £19.00 |                              |
| 2. Receiver                              | £13.00 |                              |
| 3. Decoder (supplied as a complete unit) | £87.00 | All prices inclusive of VAT, |
| 4. Summer Board                          | £27.00 | postage & packing.           |
| 5. Tuner                                 | £60.00 |                              |
| 6. Power Supply                          | £16.00 |                              |
| 7. Hardware and other parts              | £ 9.00 |                              |

We accept American Express: Access: Barclay Card: Diners Card: also our own Marshall's Credit Charge.

Phone your order now to Margaret O'Donnell on 01-624 0805

Get a great deal from  
**Marshall's**

## 24 HOUR CLOCK/APPLIANCE TIMER KIT



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

CT1000K Basic Kit £14.90  
CT1000KB with white box (56/131 x 71mm) £17.40  
Ready Built £22.50

## MINI KITS

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

**MK1 TEMPERATURE CONTROLLER/THERMOSTAT**  
Uses LM3911 IC to sense temperature (80°C max), and triac to switch heater. 1KW £4.00

**MK2 SOLID STATE RELAY**  
Ideal for switching motors, lights, heaters, etc. from logic. Opto-isolated with zero voltage switching. Supplied without triac. Select the required triac from our range. £2.60

**MK3 BAR/DOT DISPLAY**  
Displays an analogue voltage on a linear 10-element LED display as a bar or single dot. Ideal for thermometers, level indicators etc. May be stacked to obtain 20 to 100 element displays. Requires 5-20V supply. £4.75

**MK4 PROPORTIONAL TEMPERATURE CONTROLLER**  
Based on the TDA1024 Zero voltage switch, this kit may be wired to form a "burst fire" power controller or a "proportional temperature" controller enabling the temperature of an enclosure to be maintained to within 0.5°C. 3KW £5.95

**MK5 MAINS TIMER**  
Based on the ZN1034E Timer IC this kit will switch a mains load on (or off) for a preset time from 20 minutes to 35 hours. Longer or shorter periods may be realised by minor component changes. Maximum load 1KW £4.50

## TRIACS



400V Plastic Case (Texas)  
3A 49p  
8A 58p 16A 95p  
12A 85p 25A 130p  
6A with trigger 80p  
8A isolated tab 65p  
Diac 18p

## MINI TRANSFORMERS



Standard mains primaries 240V a.c.  
100mA secondaries  
6-0-6V 80p  
9-0-9V 85p  
12-0-12V 90p

TRADE ENQUIRIES WELCOME

## TK's SPECIAL OFFERS OF THE MONTH

Orders must be received by 31.10.80

AY-5-1224 Clock IC £2.20  
LM3915 Bar/Dot Driver £2.10  
2x DL304 0.3" cc Display £1.35  
2x DL307 0.3" ca Display £1.35  
2x 2N3442 £1.80  
10 of each 0.2" LEDs Red, Green, Yellow £2.90  
TOTAL - 30

## INTEGRATED CIRCUITS

555 Timer 21p  
741 Op. Amp. 19p  
AY-5-1224 Clock £2.60  
AY-5-1230/2 Clock/Timer £4.50  
AY-3-1270 Thermometer £8.20  
ICL7106 DVM (LCD drive) £7.00  
LM377 Dual 2W Amp. £1.45  
LM378S Dual 6W Amp. £3.50  
LM380 2W Audio Amp. 60p  
LM382 Dual low noise Preamp £1.00  
LM386 250mW low voltage Amp. 75p  
LM1830 Fluid Level Detector £1.50  
LM2907 f-v Converter (8 pin) £1.40  
LM2917 f-v Converter (14 pin) £1.60  
LM3909 LED Flasher/Oscillator 60p  
LM3911 Thermometer £1.20  
LM3914 Dot/Bar Driver £2.10  
MM74C911 4 digit display controller £6.50  
MM74C915 7 segment-BCD converter 96p  
MM74C928 4 digit counter with 7 seg. o/p £4.50  
S5668 Touchdimmer £2.50  
SN263 Touchswitch 16-way £4.85  
SN76477 Complex Sound Generator £2.52  
TBA800 5W Audio Amp. 68p  
TBA810AS 7W Audio Amp. 68p  
TDA1024 Zero Voltage Switch £1.20  
TDA2020 20W Audio Amp. £2.85  
ZN1034E Timer £1.80  
All ICs supplied with data sheets.  
Data Sheets only. 10p each device.

## AND NOW A DIMMER THAT MAKES TOUCH DIMMERS OBSOLETE

Two years ago TK Electronics launched a touchdimmer kit, the TD300K, which made knob controlled dimmers obsolete. This was such a great success that many magazines and more retailers soon produced similar designs. SO THAT OTHERS MAY FOLLOW, TK have designed a touch dimmer kit with an Infra Red Remote Control, enabling you to switch and control the brightness of your lights from the comfort of your armchair etc. (as well as manually by touching the frontplate or by using the TDE/K extension kit).

As with all our kits, these units come complete with all components, including RFI suppression, frontplate, a neon to help you find the switch in the dark and a neat box for the transmitter. The plastic frontplate has no metal pads to touch, ensuring complete safety and enabling the plate to be covered with a decorative finish to blend with your room decor.

We have designed the light dimmer unit to fit a standard wall box, the transmitter to fit your hand and the price to fit your pocket.

In two years' time everyone will be selling remote control dimmers but you can have your TDRK300K kit NOW for only £14.30 for the dimmer unit and £4.20 for the transmitter. For the more athletic of you, the TD300K is still available at £6.50 and the TDE/K at £2.00.

DONT FORGET to add 40p P&P and 15% VAT to your total purchase.

## REMOTE CONTROL COMPONENTS

LD271 IR Emitting Diode 36p  
SFH205 Photodiode Detector 95p  
SL480 IC Pulse Amp £1.70  
SL490 32 command encoder/transmitter £2.40  
ML922 10 channel receiver + 3 analogue outputs £4.20  
ML926 16 channel receiver 4 momentary binary o/p £1.40  
ML928 16 channel receiver 4 latched binary o/p £1.40  
ML929 16 channel receiver 4 latched binary o/p £1.40  
Data sheets per device 10p  
These ICs can be used with infra red, ultrasonic or radio links, depending on range, cost and speed of operation.

## RC500K KIT

If you do not require a sophisticated multi-channel remote control, we have developed a simple single-channel on/off infra red transmitter and receiver kit. The transmitter unit comes complete with a hand held box and requires a PP3 (9V) battery. The receiver includes a triac capable of switching up to 500W at 240V a.c. and comprises a pre-amplifier bistable latch and a mains power supply, making the unit completely self-contained. The small size of the receiver enables the unit to be "built into" all kinds of equipment from lamps to tape recorders. Range: approximately 20 ft. £12.50.

ALL COMPONENTS ARE BRAND NEW AND TO SPECIFICATION. ADD VAT AT CURRENT RATE TO ABOVE PRICES. 40p P&P MAIL ORDER - CALLERS WELCOME BY APPOINTMENT



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



# Toroidal Transformers



## CHOICE OF 3 PRIMARY INPUTS

Each of the five ranges shown here is available for 110V, 220 or 240V AC inputs. When ordering, indicate as below the input type required.

For 220V Primary please insert 1 in place of X in type number. Example 120VA 240V 15 + 15V, 4A = 42013

For 240V Primary please insert 2 in place of X in type number.

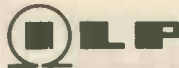
★ Customer design and O.E.M. enquiries welcomed.

## FREEPOST Facility

We pay postage on your enquiries and orders (UK). Simply address your envelope: FREEPOST T2, ILP, at the address below. NO NEED TO PUT A STAMP ON!

## TO ORDER

Send Cheque/Money Order/International Money Order with order, or advise us of your Access or Barclaycard number.



TRANSFORMERS, a division of ILP Electronics Ltd. Graham Bell House, Roper Close, Canterbury CR2 7EP. Phone (0227) 54778. Telex 965780

We use advanced winding technology to make our toroidal transformers. They have only half the weight and height of their laminated equivalents within the range and are appreciably more efficient. Our toroids cost virtually the same as their now outdated laminated equivalents and hum is down to a negligible tenth of what it used to be. Each ILP toroidal transformer is supplied with rigid mounting kit comprising centre bolt, two neoprene and one steel washer.

## NOW IN A RANGE OF 37 SIZES.

TYPE	VA	SECONDARY RMS VOLTS	SECONDARY RMS CURRENT	DIMENSIONS DIA-HT	WEIGHT KG	PRICE
2X010	50	6+6	4.16	70x40mm	0.9	EACH £5.40 +£1.10 P&P +98p VAT
2X011		9+9	2.77			
2X012		12+12	2.08			
2X013		15+15	1.66			
2X014		18+18	1.38			
2X015		22+22	1.13			
2X016		25+25	1.00			
3X010	80	6+6	6.64	90x30mm	1.0	EACH £5.76 +£1.20 P&P +£1.04 VAT
3X011		9+9	4.44			
3X012		12+12	3.33			
3X013		15+15	2.66			
3X014		18+18	2.22			
3X015		22+22	1.81			
3X016		25+25	1.60			
3X028		110V	0.72			
3X029		220V	0.36			
3X030		240V	0.33			
4X010	120	6+6	10.00	90x40mm	1.2	EACH £6.72 +£1.30 P&P +£1.20 VAT
4X011		9+9	6.66			
4X012		12+12	5.00			
4X013		15+15	4.00			
4X014		18+18	3.33			
4X015		22+22	2.72			
4X016		25+25	2.40			
4X028		110V	1.09			
4X029		220V	0.54			
4X030		240V	0.50			
5X016	160	25+25	3.20	110x40mm	1.8	EACH £8.88 +£1.40 P&P +£1.54 VAT
5X017		30+30	2.68			
5X028		110V	1.45			
5X029		220V	0.72			
5X030		240V	0.66			
6X016	300	25+25	6.00	110x50mm	2.6	£12.27 +£2.50 P&P +£2.07 VAT
6X017		30+30	5.00			
6X018		35+35	4.28			
6X026		40+40	3.75			
6X025		45+45	3.33			
6X028		110V	2.72			
6X029		220V	1.36			
6X030		240V	1.25			

## BUILD A SYNTHESISER! NO SPECIAL SKILLS NO SPECIAL EQUIPMENT REQUIRED



Using **Dewtron** (Reg'd)

### PROFESSIONAL MODULES

Over 20 different electronic modules to select what YOU want to build a synthesiser; simple or complex. Start simple and add to it as you can afford. New attractive prices for the long-popular, well-tried range of Dewtron synthesiser and other effects modules. Also "Mister Bassman" Bass Pedal Units. Send 35p for Musical Miracles Catalogue NOW!

### DESIGN ENGINEERING (WOKINGHAM) LTD.

254 RINGWOOD ROAD, FERNDOWN, DORSET BH22 9AR.

**PROGRESSIVE RADIO 31, CHEAPSIDE, LIVERPOOL L2 2DY**  
**SEMICONDUCTORS.** Texas R1038 T03 power trans. 50p, 741 8 pin 22p. NE555 24p. TAG4443 SCR 45p. 723 14 PIN REGS. 35p. AD 161/2 MATCHED PAIRS 70p. 2N5062 SCR 18p. TL209 RED LEDS 10 for 75p. BD238 28p. BD438 28p. MUR131 P.L.T.'s 40V, 200mA, 375mW 15p each. 2N3753 £1.75. Infra Red 0.2" LEDs 30p. Rectangular Red LED's 12p each. CA3020 I.C.'s 40p each.  
**MINIATURE MAINS TRANSFORMERS.** ALL 240VAC PRIMARY. 6-0-6 100mA 9-0-9 75mA. 12-0-12 50mA all 75p each. 12V 200mA 75p. 6V 500mA £1.10p. 0-6V-0-6V 280mA £1.30  
**PULSE TRANSFORMERS.** 1:1 (GPO type) 30p. 1:1 plus 1 min. P.C. mounting 60p.  
**MINIATURE SOLID STATE BUZZER.** 33x17x15mm. output at 3 feet 70db, only 15mA drain, operating range 4-15VDC 75p each.  
**LOUD BUZZER.** 6-12 volts 63p. Rotary Alarm siren, 12VDC. Red plastic body and mounting bracket 68x75mm £4.50p.  
**POCKET MULTIMETER.** MODEL MH55 2,000 ohms per volt. 1,000 volts AC/DC. 100mA DC current. 2 resistance ranges to 1 meg £5.50p.  
**SOLDER SUCKER.** High suction/teflon nozzle. £4.65p.  
**MURATA TRANSISTORS.** 40KHz. REC/SENDER £3.50 pair.  
**MOTORS.** 3V model type 22p. 6V cassette motor £1.20p. Replacement 12VDC 8 track motors 55p. Ex. equip. 5-7 volt cassette motors 70p. Low rev. mains motor 240VAC motor with gearbox 2 1/2 RPM 75p.  
**AMPHENOL COAX CONNECTORS.** Plugs 47p, Sockets 42p, Elbows 90p, Reducers 13p. Back to back sockets 85p. Back to back plugs 85p.  
**HIGH IMPEDANCE HEADPHONES.** mono 2,000 ohms imp. transducer type, adjustable band and padded earpiece £2.75.  
**SPECIAL OFFER STEREO HEADPHONES.** 8 ohms, adjustable, standard stereo plug only £2.95p  
**INTERCOM UNITS** (can be used as baby alarm) supplied with approx. 80' cable, call button, 2 was. £5.25 pair, 3 way £7.25p. **WIRELESS INTERCOM.** 2 units both operate on 240VAC and mains connected. AM frequency 180KHz. £29.95p.  
**MINIATURE TIE PIN MICROPHONE.** Omm. 1K imp., uses deaf aid battery (supplied) £4.95p. **LOW COST CONDENSER MIKE.** Stick type. Omm. 600 ohms, on/off switch, standard jack plug only £2.95p. **EM607 CONDENSER MICROPHONE.** Highly polished metal stick mike, uni directional, 600 ohms 30-18KHz., on/off switch only £7.95p. **OYNAMIC STICK MIKE.** CARIDD, dual imp., 600 ohms or 20K. 70-15KHz., attractive black metal case only £7.75p.  
**PUBLIC ADDRESS HORN SPEAKERS.** Suitable for outdoor use 5" round 8 watts. 8 ohms, adjustable bracket £8.95p. 6" 15 watts 8 ohms adjustable bracket £8.25p.  
**CRIMPING TOOL** for standard terminals also 6 gauge stripper and wire cutter, insulated handles only £2.30.  
*Cash with order please, official orders welcome from schools etc., please add 30p post and packing. VAT inclusive. ALL ORDERS DESPATCHED BY RETURN POST*  
*SAE for latest illustrated stock list.*

## SPECIAL OFFER YOU MUST NOT MISS £127 + VAT

### SAFGAN OFFERS ST-45 SINGLE TRACE OSCILLOSCOPE

AT ONLY £127 + VAT P&P FREE TILL 10th OCT (1980)

10mv/div ... 5MHz ... 4" CRT ... 1 YEAR GUARANTEE ... BRITISH SPECIFICATION

- ★ 10mv/div – 5v/div in 9 cal steps.
- ★ BANDWIDTH greater than 5MHz.
- ★ TIME BASE 1  $\mu$ s/div – 50ms/div in 15 cal steps  
x5 EXPANSION to 200ns/div  
x5 MULTIPLIER to 250ms/div

- ★ TRIGGER LEVEL,  $\pm$ slope, bright line auto
  - ★ SENSITIVITY: 0.5div int, 100mv ext.
  - ★ GRATITUDE BLUE RULLED 8x10 div (6.4x8 cm<sup>2</sup>)
  - ★ SIZE H215mm W165mm D280mm Weight 4kg.
- ACCESSORIES**  
 Probe (X1-Ref-X10) £11.50 + VAT  
 ADAPTOR BNC to 4mm Socket £2.95 + VAT



ST-45

Orders to: SAFGAN ELECTRONICS LTD.,

56 Bishops Wood, St. Johns, Woking, Surrey GU21 3QB.

Tel. Woking 66836

or Woking 69560

OFFICIAL GOVERNMENT AND EDUCATIONAL ORDERS ACCEPTED



# INDEX TO ADVERTISERS

Ace Mailtronix	79
Adam Hall (P.E. Supplies)	81
Aitken Bros	79
Audio Electronics	69
Aura	5
Barrie Electronics	28
BIET	12
Bi-Pak	13
Birkett J.	82
Boffin Projects	82
Bolster Instruments Co.	82
Boss Industrial Mouldings	42
Breadboard Exhibition 1980	33
British National Radio & Electronics School	4, 15
Cambridge Kits	82
Cambridge Learning	22
Chromasonic Electronics	73
Chromatronics	10
Clef Products	72
Codespeed	51
Computer Components (Teleplay)	Cover II
Continental Spec.	33, 69
Crofton Electronics	79
C.R. Supply Co.	80
Design Engineering (Wokingham) Ltd.	86
Dicom Ltd.	80
Doram	78
E.D.A.	10
Electrovalue	34
Fladar	76
Flairline Supplies	81
Global	81
GMT	83
Goldsmith College	81
GT Technical Information Services	80
Herts Elec.	81
Hiykon Ltd.	81
Home Radio	79
I.C.S. Intertext	7, 80
I.L.P. Electronics	74, 75, 86
Interface Components	78
Jayen Developments	12
Keelmoor	70, 71
L&B Electronics	84
Lynwood Electronics	80
Maplin Electronics	Cover IV
Marick	81
Marshall A.	4, 85
The McMillan Press Co.	81
Micro Circuits	11
Mighty Micro	12
Mitrad	77
Modern Book Co	14
Monolith	28
Parndon	28
Phonosonics	6, 7
PKG Electronics	82
Progressive Radio	86
Proto Design	82
Radio Component Specialists	14
Radio & T.V. Components	18
Ramar Constructor Service	81
Rapld Electronics	14
Riscomp Limited	28
Sandwell Plant	81
Saxon Entertainments	76
Safgan	86
Science of Cambridge	16, 17
Scientific Wire Co.	82
Service Trading	Cover III
Semi-Camp Northern	14
Sentinel Supply	72
Stevenson	76
Suretron	83
Swanley Electronics	34
Tandy	8, 9
Tempus	87
T.K. Electronics	85
Technomatic	88
Toolrange	72
Vero Electronics	3
Videotone	27
Watford Electronics	2, 3
Wicca Electronics	82
Williamson Amplification	81
Wilmslow Audio	34

Is  
this

# THE ULTIMATE WATCH

from  
Seiko?

## JET 010 ANALOGUE/DIGITAL ALARM CHRONOGRAPH

A superbly styled analogue watch only 7.5mm thick (approx.) with a multi-functional digital display.

### ANALOGUE DISPLAY

Independent hours and minutes with sweep second hand.

### DIGITAL DISPLAY

**Time:** Independent 6 digit display of hours, minutes and seconds with am/pm indication (12 hour system) or 24 hour readout.

**Calendar:** Alpha day and date with automatic adjustment.

**Alarm:** The 24 hour alarm sounds for 60 seconds. 12 or 24 hour readout with alarm set symbol constantly displayed.

**Chimes:** The hourly signal, with symbol, can be switched on or off.

**Stopwatch:** Measures net times from 1/100 second to 1 hour.

**Dual time, countdown and accumulation function availability.**

Stainless steel case and bracelet. Hardlex glass. Shock and water resistant. Anti-magnetic. Approximately 2 year battery life. Seiko's world-wide 12 month guarantee.

**This state-of-the-art watch is destined to become a classic.**



**ONLY £62.50**



**83QS-41B ALARM CHRONO SPECIAL OFFER £19.95**



## SPECIAL SUMMERTIME OFFERS

Excluding new models illustrated in this advertisement

**A FURTHER ALL OUR NORMAL DISCOUNT PRICES**



**All our normal discount prices for ALARM, ALARM CHRONO and CALCULATOR WATCHES.**

Send 25p for our illustrated catalogue  
**OFFER CLOSES SEPTEMBER 30TH 1980**  
**SUBJECT TO AVAILABILITY**

## SEIKO'S NEW SOLAR ALARM CHRONOGRAPHS



Water resistant case withstands splashing, etc.

**£52.50**

Price includes VAT, P & P. Send your cheque, P.O. or phone your ACCESS or BARCLAYCARD number to:

**Interval countdown alarm timer.**  
**Weekly programmable alarm.**

Comprehensive display of hours, minutes, seconds, day, date and month.

The 24 hour alarm can be programmed to ring on any day or days of the week.

The hourly chimes can be switched on or off.

The interval alarm timer can be set for any period of time up to 16 hours and is repetitive until switched off.

The stopwatch measures net, lap and 1st & 2nd place times from 1/100 second to 20 minutes, then in seconds to 12 hours, the upper display indicating lap times, the lower display total time.

Stainless steel case and bracelet.

Hardlex glass. Approx. 7 year battery life. 6 solar panels.

12 month world-wide guarantee.



**100m WATER RESISTANT.** Suitable for swimming, etc.

**£69.95**

**TEMPUS**

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

<b>FLABBY TEXAS</b>	74180 93p 7400 11p 7401 12p 7402 12p 7403 12p 7404 14p 74504 90p 7405 14p 7406 36p 7407 36p 7408 19p 7409 19p 7410 19p 7411 20p 7412 20p 7413 30p 7414 30p 7415 30p 7416 27p 7417 27p 7420 17p 7421 40p 7422 22p 7423 34p 7424 34p 7425 34p 7426 34p 7427 34p 7428 36p 7430 17p 7431 30p 7432 30p 7433 40p 7434 35p 7435 35p 7440 17p 7441 70p 7442 112p 7443 112p 7444 112p 7445 100p 7446A 93p 7447A 75p 7448 80p 7449 17p 7451 17p 7453 17p 7454 17p 7460 17p 7470 36p 7472 36p 7473 36p 7474 24p 7475 30p 7476 150p 7477 35p 7480 50p 7481 100p 7482 84p 7483A 70p 7484 100p 7485 100p 7486 30p 7489 17p 7490A 36p 7491 80p 7492A 36p 7493A 36p 7494 84p 7495A 70p 7496 65p 7497 180p 74100 130p 74104 85p 74105 65p 74107 34p 74109 55p 74110 55p 74111 70p 74112 200p 74113 130p 74119 110p 74120 110p 74121 28p 74122 48p 74123 48p 74125 65p 74126 60p 74128 75p 74132 75p 74136 75p 74141 60p 74145 60p 74147 190p 74148 150p 74150 100p 74151A 70p 74153 70p 74154 100p 74156 90p 74157 70p 74158 90p 74159 100p 74160 100p 74161 100p 74162 100p 74163 100p 74164 100p 74165 100p 74166 100p 74167 200p 74168 100p 74169 100p 74170 100p 74171 100p 74172 100p 74173 100p 74174 100p 74175 85p 74176 90p 74177 90p 74178 160p	9300 SERIES 4000 18p 4001 25p 4002 25p 4006 95p 4007 25p 4008 25p 4009 40p 4010 50p 4011 50p 4012 18p 4013 50p 4014 94p 4015 84p 4016 45p 4017 80p 4018 89p 4019 45p 4020 100p 4021 110p 4022 100p 4023 25p 4024 50p 4025 20p 4026 130p 4027 50p 4028 84p 4029 100p 4030 55p 4031 200p 4032 180p 4033 200p 4034 240p 4035 110p 4040 100p 4041 80p 4042 80p 4043 80p 4044 90p 4046 110p 4047 100p 4048 55p 4049 40p 4050 49p 4051 80p 4052 80p 4053 80p 4054 150p 4055 125p 4056 160p 4057 160p 4058 115p 4063 120p 4066 55p 4067 450p 4068 22p 4069 22p 4070 30p 4071 22p 4072 22p 4073 22p 4074 22p 4075 22p 4076 22p 4077 22p 4078 22p 4079 22p 4081 25p 4082 22p 4093 80p 4094 175p 4098 120p 4099 130p 4112 100p 4113 100p 4114 100p 4115 110p 4116 100p 4117 100p 4118 120p 4119 120p 4120 120p 4121 180p 4122 180p 4123 180p 4124 180p 4125 180p 4126 180p 4127 180p 4128 180p 4129 180p 4130 180p 4131 180p 4132 180p 4133 180p 4134 180p 4135 180p 4136 180p 4137 180p 4138 180p 4139 180p 4140 180p 4141 180p 4142 180p 4143 180p 4144 180p 4145 180p 4146 180p 4147 180p 4148 180p 4149 180p 4150 180p 4151 180p 4152 180p 4153 180p 4154 180p 4155 180p 4156 180p 4157 180p 4158 180p 4159 180p 4160 180p 4161 180p 4162 180p 4163 180p 4164 180p 4165 180p 4166 180p 4167 180p 4168 180p 4169 180p 4170 180p 4171 180p 4172 180p 4173 180p 4174 180p 4175 180p 4176 180p 4177 180p 4178 180p 4179 180p 4180 180p	93 SERIES 9301 160p 9302 175p 9308 316p 9310 275p 9311 275p 9312 160p 9314 165p 9316 225p 9321 225p 9322 150p 9334 340p	<b>VEROBOARD</b> 0.1 0.15 1 1.5 2 3 3 4 4 5 5 6 6 7 7 8 8 9 9 10 10 11 11 12 12 13 13 14 14 15 15 16 16 17 17 18 18 19 19 20 20 21 21 22 22 23 23 24 24 25 25 26 26 27 27 28 28 29 29 30 30 31 31 32 32 33 33 34 34 35 35 36 36 37 37 38 38 39 39 40 40 41 41 42 42 43 43 44 44 45 45 46 46 47 47 48 48 49 49 50 50 51 51 52 52 53 53 54 54 55 55 56 56 57 57 58 58 59 59 60 60 61 61 62 62 63 63 64 64 65 65 66 66 67 67 68 68 69 69 70 70 71 71 72 72 73 73 74 74 75 75 76 76 77 77 78 78 79 79 80 80 81 81 82 82 83 83 84 84 85 85 86 86 87 87 88 88 89 89 90 90 91 91 92 92 93 93 94 94 95 95 96 96 97 97 98 98 99 99 100	<b>TRANSISTORS</b> AC126 25p AC127/20 25p AC176 25p AC187/8 25p AC188/6 25p AD149 70p AD161/2 45p AU107 25p 8C107/8 11p 8C109 11p 8C117 20p 8C147/8 9p 8C149 10p 8C157/8 10p 8C159 11p 8C169C 25p 8C173 20p 8C177/8 17p 8C179 18p 8C182/3 10p 8C184 11p 8C187 30p 8C121/3 11p 8C214 12p 8C461 36p 8C477/8 30p 8C516/7 20p 8C517 20p 8C518 20p 8C549 18p 8C557 16p 8C595 18p 8C70 20p 8C71/2 22p 8C72 22p 8C73 22p 8C74 22p 8C75 22p 8C76 22p 8C77 22p 8C78 22p 8C79 22p 8C80 22p 8C81 22p 8C82 22p 8C83 22p 8C84 22p 8C85 22p 8C86 22p 8C87 22p 8C88 22p 8C89 22p 8C90 22p 8C91 22p 8C92 22p 8C93 22p 8C94 22p 8C95 22p 8C96 22p 8C97 22p 8C98 22p 8C99 22p 8C100 22p	<b>TRANSISTORS</b> BF880 25p BF881 25p BFK29 30p BFK30 34p BFK31 34p BFK86/7 30p BFK88 30p BFY10 90p BFY50 90p BFY51 12 90p BFY56 33p BFY90 90p BFY93 45p BSX19 20p BU104 225p BU108 225p BU109 25p BU108 25p BU205 200p BU208 200p BU406 145p E830 50p E808 50p J310 50p MJ2501 225p MJ2955 90p MJ3001 225p MJ310 40p MJE255 100p MJE3055 70p MPF102 45p MPF103 44p MPF105 40p MPSA06 30p MPSA12 50p MPSA13 50p MPSA43 50p MPSA50 20p MPSA56 32p MPSA70 40p MPSU06 32p MPSU65 78p OC28 130p OC35 130p R2008 200p R2010 200p R2012 40p R2013 40p R2014 40p R2015 40p R2016 40p R2017 40p R2018 40p R2019 40p R2020 40p R2021 40p R2022 40p R2023 40p R2024 40p R2025 40p R2026 40p R2027 40p R2028 40p R2029 40p R2030 40p R2031 40p R2032 40p R2033 40p R2034 40p R2035 40p R2036 40p R2037 40p R2038 40p R2039 40p R2040 40p R2041 40p R2042 40p R2043 40p R2044 40p R2045 40p R2046 40p R2047 40p R2048 40p R2049 40p R2050 40p R2051 40p R2052 40p R2053 40p R2054 40p R2055 40p R2056 40p R2057 40p R2058 40p R2059 40p R2060 40p R2061 40p R2062 40p R2063 40p R2064 40p R2065 40p R2066 40p R2067 40p R2068 40p R2069 40p R2070 40p R2071 40p R2072 40p R2073 40p R2074 40p R2075 40p R2076 40p R2077 40p R2078 40p R2079 40p R2080 40p R2081 40p R2082 40p R2083 40p R2084 40p R2085 40p R2086 40p R2087 40p R2088 40p R2089 40p R2090 40p R2091 40p R2092 40p R2093 40p R2094 40p R2095 40p R2096 40p R2097 40p R2098 40p R2099 40p R2100 40p R2101 40p R2102 40p R2103 40p R2104 40p R2105 40p R2106 40p R2107 40p R2108 40p R2109 40p R2110 40p R2111 40p R2112 40p R2113 40p R2114 40p R2115 40p R2116 40p R2117 40p R2118 40p R2119 40p R2120 40p R2121 40p R2122 40p R2123 40p R2124 40p R2125 40p R2126 40p R2127 40p R2128 40p R2129 40p R2130 40p R2131 40p R2132 40p R2133 40p R2134 40p R2135 40p R2136 40p R2137 40p R2138 40p R2139 40p R2140 40p R2141 40p R2142 40p R2143 40p R2144 40p R2145 40p R2146 40p R2147 40p R2148 40p R2149 40p R2150 40p R2151 40p R2152 40p R2153 40p R2154 40p R2155 40p R2156 40p R2157 40p R2158 40p R2159 40p R2160 40p R2161 40p R2162 40p R2163 40p R2164 40p R2165 40p R2166 40p R2167 40p R2168 40p R2169 40p R2170 40p R2171 40p R2172 40p R2173 40p R2174 40p R2175 40p R2176 40p R2177 40p R2178 40p R2179 40p R2180 40p R2181 40p R2182 40p R2183 40p R2184 40p R2185 40p R2186 40p R2187 40p R2188 40p R2189 40p R2190 40p R2191 40p R2192 40p R2193 40p R2194 40p R2195 40p R2196 40p R2197 40p R2198 40p R2199 40p R2200 40p R2201 40p R2202 40p R2203 40p R2204 40p R2205 40p R2206 40p R2207 40p R2208 40p R2209 40p R2210 40p R2211 40p R2212 40p R2213 40p R2214 40p R2215 40p R2216 40p R2217 40p R2218 40p R2219 40p R2220 40p R2221 40p R2222 40p R2223 40p R2224 40p R2225 40p R2226 40p R2227 40p R2228 40p R2229 40p R2230 40p R2231 40p R2232 40p R2233 40p R2234 40p R2235 40p R2236 40p R2237 40p R2238 40p R2239 40p R2240 40p R2241 40p R2242 40p R2243 40p R2244 40p R2245 40p R2246 40p R2247 40p R2248 40p R2249 40p R2250 40p R2251 40p R2252 40p R2253 40p R2254 40p R2255 40p R2256 40p R2257 40p R2258 40p R2259 40p R2260 40p R2261 40p R2262 40p R2263 40p R2264 40p R2265 40p R2266 40p R2267 40p R2268 40p R2269 40p R2270 40p R2271 40p R2272 40p R2273 40p R2274 40p R2275 40p R2276 40p R2277 40p R2278 40p R2279 40p R2280 40p R2281 40p R2282 40p R2283 40p R2284 40p R2285 40p R2286 40p R2287 40p R2288 40p R2289 40p R2290 40p R2291 40p R2292 40p R2293 40p R2294 40p R2295 40p R2296 40p R2297 40p R2298 40p R2299 40p R2300 40p R2301 40p R2302 40p R2303 40p R2304 40p R2305 40p R2306 40p R2307 40p R2308 40p R2309 40p R2310 40p R2311 40p R2312 40p R2313 40p R2314 40p R2315 40p R2316 40p R2317 40p R2318 40p R2319 40p R2320 40p R2321 40p R2322 40p R2323 40p R2324 40p R2325 40p R2326 40p R2327 40p R2328 40p R2329 40p R2330 40p R2331 40p R2332 40p R2333 40p R2334 40p R2335 40p R2336 40p R2337 40p R2338 40p R2339 40p R2340 40p R2341 40p R2342 40p R2343 40p R2344 40p R2345 40p R2346 40p R2347 40p R2348 40p R2349 40p R2350 40p R2351 40p R2352 40p R2353 40p R2354 40p R2355 40p R2356 40p R2357 40p R2358 40p R2359 40p R2360 40p R2361 40p R2362 40p R2363 40p R2364 40p R2365 40p R2366 40p R2367 40p R2368 40p R2369 40p R2370 40p R2371 40p R2372 40p R2373 40p R2374 40p R2375 40p R2376 40p R2377 40p R2378 40p R2379 40p R2380 40p R2381 40p R2382 40p R2383 40p R2384 40p R2385 40p R2386 40p R2387 40p R2388 40p R2389 40p R2390 40p R2391 40p R2392 40p R2393 40p R2394 40p R2395 40p R2396 40p R2397 40p R2398 40p R2399 40p R2400 40p R2401 40p R2402 40p R2403 40p R2404 40p R2405 40p R2406 40p R2407 40p R2408 40p R2409 40p R2410 40p R2411 40p R2412 40p R2413 40p R2414 40p R2415 40p R2416 40p R2417 40p R2418 40p R2419 40p R2420 40p R2421 40p R2422 40p R2423 40p R2424 40p R2425 40p R2426 40p R2427 40p R2428 40p R2429 40p R2430 40p R2431 40p R2432 40p R2433 40p R2434 40p R2435 40p R2436 40p R2437 40p R2438 40p R2439 40p R2440 40p R2441 40p R2442 40p R2443 40p R2444 40p R2445 40p R2446 40p R2447 40p R2448 40p R2449 40p R2450 40p R2451 40p R2452 40p R2453 40p R2454 40p R2455 40p R2456 40p R2457 40p R2458 40p R2459 40p R2460 40p R2461 40p R2462 40p R2463 40p R2464 40p R2465 40p R2466 40p R2467 40p R2468 40p R2469 40p R2470 40p R2471 40p R2472 40p R2473 40p R2474 40p R2475 40p R2476 40p R2477 40p R2478 40p R2479 40p R2480 40p R2481 40p R2482 40p R2483 40p R2484 40p R2485 40p R2486 40p R2487 40p R2488 40p R2489 40p R2490 40p R2491 40p R2492 40p R2493 40p R2494 40p R2495 40p R2496 40p R2497 40p R2498 40p R2499 40p R2500 40p R2501 40p R2502 40p R2503 40p R2504 40p R2505 40p R2506 40p R2507 40p R2508 40p R2509 40p R2510 40p R2511 40p R2512 40p R2513 40p R2514 40p R2515 40p R2516 40p R2517 40p R2518 40p R2519 40p R2520 40p R2521 40p R2522 40p R2523 40p R2524 40p R2525 40p R2526 40p R2527 40p R2528 40p R2529 40p R2530 40p R2531 40p R2532 40p R2533 40p R2534 40p R2535 40p R2536 40p R2537 40p R2538 40p R2539 40p R2540 40p R2541 40p R2542 40p R2543 40p R2544 40p R2545 40p R2546 40p R2547 40p R2548 40p R2549 40p R2550 40p R2551 40p R2552 40p R2553 40p R2554 40p R2555 40p R2556 40p R2557 40p R2558 40p R2559 40p R2560 40p R2561 40p R2562 40p R2563 40p R2564 40p R2565 40p R2566 40p R2567 40p R2568 40p R2569 40p R2570 40p R2571 40p R2572 40p R2573 40p R2574 40p R2575 40p R2576 40p R2577 40p R2578 40p R2579 40p R2580 40p R2581 40p R2582 40p R2583 40p R2584 40p R2585 40p R2586 40p R2587 40p R2588 40p R2589 40p R2590 40p R2591 40p R2592 40p R2593 40p R2594 40p R2595 40p R2596 40p R2597 40p R2598 40p R2599 40p R2600 40p R2601 40p R2602 40p R2603 40p R2604 40p R2605 40p R2606 40p R2607 40p R2608 40p R2609 40p R2610 40p R2611 40p R2612 40p R2613 40p R2614 40p R2615 40p R2616 40p R2617 40p R2618 40p R2619 40p R2620 40p R2621 40p R2622 40p R2623 40p R2624 40p R2625 40p R2626 40p R2627 40p R2628 40p R2629 40p R2630 40p R2631 40p R2632 40p R2633 40p R2634 40p R2635 40p R2636 40p R2637 40p R2638 40p R2639 40p R2640 40p R2641 40p R2642 40p R2643 40p R2644 40p R2645 40p R2646 40p R2647 40p R2648 40p R2649 40p R2650 40p R2651 40p R2652 40p R2653 40p R2654 40p R2655 40p R2656 40p R2657 40p R2658 40p R2659 40p R2660 40p R2661 40p R2662 40p R2663 40p R2664 40p R2665 40p R2666 40p R2667 40p R2668 40p R2669 40p R2670 40p R2671 40p R2672 40p R2673 40p R2674 40p R2675 40p R2676 40p R2677 40p R2678 40p R2679 40p R2680 40p R2681 40p R2682 40p R2683 40p R2684 40p R2685 40p R2686 40p R2687 40p R2688 40p R2689 40p R2690
---------------------	---	---	--	---	--	---

# SERVICE TRADING CO

## GEARED MOTORS

### FT3 NEON FLASH TUBE

High Intensity multi turn high voltage, neon glow discharge flash tube. Design for ignition timing etc. **£1.50**, P. & P. **25p** **(£2.01** incl. VAT) 3 for **£3.0**, P. & P. **50p** **(£4.03** incl. VAT & P.).

### WHY PAY MORE?

**MULTI RANGE METER TYPE MF15A** a.c. d.c. volts 10 · 50 · 250 · 500 · 1000. Ma 0-5 · 0-10 · 0-100 Sensitivity 2000V, 20 range, diameter 1.33 by 93 by 46mm including test leads. Price: **£7.00** plus 50p P. & P. **(£8.63** incl. VAT & P.).



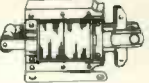
### METERS (New) - 90 mm DIAMETER

A.C. Amp., Type 62T2, 0-1A, 0-5A, 10A, 0-20A, 50A  
A.C. Volt. 0-150V, 0-300V, 0-100A D.C. price **£5.00** + 50p P. & P. **(£6.33** incl. VAT).  
D.C. Amp., type 65C5, 0-2A, 5A, 0-10A, 0-20A, 0-50A, 0-100A  
D.C. Volt. 15V, 30V.  
All types **£3.50** ea. + P. & P. **50p** **(£4.60** incl. VAT), except 0-50A, 0-100A D.C. price **£5.00** + 50p P. & P. **(£6.33** incl. VAT).



### HEAVY DUTY SOLENOID, m.f. by Magnetics Devices

**240V, 2 C** intermittent operation. Approx. 20 lb. pull at 1.25 in. Ex-equip. Tested. Price: **£5.50** + 75p P. & P. **(£7.19** incl. VAT & P.).



### 12V D.C. SOLENOID

12V. D.C. heavy duty Solenoid 4 Kp. pull. Easily removable from plate. All chassis containing 4x24V. D.C. Push Solenoids (14 lb. approx.). 5-fig. Counter, 2 min. photo calls. Sub-min. Micro-switches etc. Ex-equip. London Transport Printer. Price: **£9.00** + **£1.00** p. & p. (total incl. VAT **£11.50**).

12V. D.C. Solenoid approx. 1lb. pull. Price: **£1.40** + p. & p. **30p**. (total incl. VAT **£1.96**). N.M.S.

### SOLENOIDS

**WESTOOL SERIES D6** Model A3 24V. D.C. Price **£1.50** + 50p P. & P. (Total incl. VAT **£2.30**) N.M.S.  
**WESTOOL SERIES D4** Model A4. 24V. D.C. Price **£1.00** + 30p P. & P. (Total incl. VAT **£1.50**) N.M.S.

**AG/GT 24V. D.C. 70 ohm Coil Solenoid.** Push or Pull. Adjustable travel to 3/16 in. Fitted with mounting brackets and spark suppressor. Size: 100 x 65 x 25 mm. Price: 3 for **£2.40** + P. & P. (min 3 off.) **(£3.11** incl. VAT & P.). N.M.S.

### 800 WATT DIMMER SWITCH

Easily fitted. Will control up to 800 W. of all lights except fluorescent at mains voltage. Price: **£3.90** + 50p p. & p. **(£5.06** incl. VAT).



**REED SWITCHES.** Size 28mm x 4mm dia. Price: 10 for **£1.00** + p. & p. **20p**. (total incl. VAT **£1.38**). 100 for **£8.00** + p. & p. **30p**. (total incl. VAT **£9.55**). N.M.S.

### MICRO SWITCHES

Sub. Min. Honeywell Lever m/s type 3115m 906ft. 10 for **£3.50** post paid **(£4.03** incl. VAT). These V3 types.

Button type (Pye) 10 for **£3.00** **(£3.45** incl. VAT)  
Short Lever type 10 for 6pm. rating (Grouzet) **£4.00** **(£4.60** incl. VAT)  
Roller Type (Bonnella) 10 for **£3.50**. **(£4.03** incl. VAT). N.M.S.  
D.P. C/O lever m/s switch mfg. by Cherry Co. USA. Precious metal low resistance contacts. 10 for **£2.25** P. & P. **30p**. Total incl. VAT **£2.93** (min. 10).



### SOLID BHT UNIT

Input 230V ac. Fully isolated output 10mm spark. Approx. 15kV. Built in 10 sec. Timer. Easily modified for 20 sec. 30 sec. to a continuous operation.  
Designed for boiler ignition. Dozens of uses in the field of physics and electronics, eg. supplying neon or argon tubes etc., EHT, sparta or laser xenons, csi lamps, VAN DER GRAAFF generator, loss of vacuum detector, OUDINI coils etc.  
Size: Length 155mm, width 85mm, height 50mm. Weight 530 grammes. Price: **£5.00** + 85 pence post & packing. Total incl. VAT **£6.73**. N.M.S.

### A.E.G. CONTACTOR

Type L56/L11. Coil 240V 50 Rs. Contacts - 3 make: 600V: 20amp. 1 break: 600V: 20 amp. Price: **£5.50** + 50p P. & P. **(£6.90** incl. VAT & P.). N.M.S.

**ARROW-HART MAINS CONTRACTOR.** Cat. No. 130A30. Coil 250V, or 500V. A.C. Contacts. 3 make 50 amp up to 660V. A.C. 20 h.p. at 440V. 3 phase 50 Hz. Price: **£7.75** + p. & p. **£1.00** (incl. VAT, total: **£10.06**). N.M.S.

### SMITH BLOWER

Type FFB. 1706. Small, quiet, smooth running. 240V. A.C. operation. Output approx 45x40cm. Overall size 135 x 165 cm. Flange mounting. Price: **£4.25**. P. & P. **75p**. (Total: **£5.75** incl. P. & P.). N.M.S.

Other types available. S.A.E. for details.

### AIRFLOW DEVELOPMENT LTD.

Centrifugal Blower Unit powered by GEC 230/250V. 2850 r.p.m. motor producing approx. 120 c.f.m. Apertures 65 x 90mm. Overall size 222 x 225 x 195mm. Incl. Starter Capac. Price: **£16.00** + **£2.00** p. & p. (Total incl. VAT **£20.70**) N.M.S.

### 24 volt. D.C. BLOWER UNIT

Precision 24 volt. D.C. O-8 amp Blower that works well on 12V 0-4 amp D.C. Producing 30 cu.ft. min at normal air pressure. **£4.50** P. & P. **75p** (incl. VAT **£6.04**). N.M.S.

### INSULATION TESTERS NEW!

Test to I E E Spec Rugged metal construction suitable for bench or field work constant speed clutch Size L Bin W 4in H 6in weight 6lb, 500V, 500 megohms, **£48**. Post 80p **(£57.27** incl. VAT & P.). 1,000V, 1,000OM, **£55**. Post 80p **(£64.17** incl. VAT & P.). S.A.E. for leaflet.  
**Yet another outstanding offer.**



**IMFD 600V Dablier** wire-ended capacitors. N.M.S. 10 for **£1.50** p&p 50p. **(£2.30** incl. VAT + p&p) (Min 10)

## VARIABLE VOLTAGE TRANSFORMERS

### INPUT 230/240V a.c. 50/60 OUTPUT 0-260V

200 watt (1 amp inc. voltmeter)	£14.50
0.5 KVA (2 amp MAX)	£18.00
1 KVA (5 amp MAX)	£24.00
2 KVA (10 amp MAX)	£39.00
3 KVA (15 amp MAX)	£47.00
5 KVA (25 amp MAX)	£76.00
10 KVA (50 amp MAX)	£168.00
15 KVA (75 amp MAX)	£250.00



### 3-PHASE VARIABLE VOLTAGE TRANSFORMERS

3KVA (max. 15 amp.)	£106-43	All plus Carriage & V.A.T.
6KVA (max. 30 amp.)	£159-37	
10KVA (max. 50 amp.)	£327-43	

### LT TRANSFORMERS

13-0 watt 1 amp £2.50 P. & P. 50p **(£3.45** incl. VAT)  
0-4V/6V-24V/32V at 12 amp £20.35 P. & P. £2.30 **(£26.05** incl. VAT & P.)  
0-6V/12V at 20 amp **£16.20** P. & P. £1.00 **(£19.78** incl. VAT) £1.50 **(£21.33** incl. VAT & P.)  
0-12V at 20 amp or 0-24V at 10 amp **£12.00** P. & P. £1.50 **(£15.93** incl. VAT & P.)  
0-6V/12V at 10 amp **£9.10** P. & P. £1.50 **(£12.19** incl. VAT)  
0-6V/12V/17V/18V/20V at 20 amp **£20.90** P. & P. £2.00 **(£26.34** incl. VAT & P.)  
0-10V/17V/18V at 10 amp **£11.55** P. & P. £1.80 **(£15.35** incl. VAT)  
Other types in stock; phone for enquiries or send see for leaflet.

### HY-LIGHT STROBE KIT MK IV

Latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/240V a.c. operation. Designed for larger rooms, halls, etc. Speed adjustable 1-20 f.p.s. Light output greater than many (so called 4 Joule) strobes. Hy-Light Strobe Kit Mk Iv. **£22.00** + **£1.50** P. & P. (incl. VAT total **£27.03**). Specially designed case and reflector for Hy-Light **£9.00**. Post **£1.50** **(£12.08** incl. VAT & P.). Super Hy-Light Strobe (approx. 16 joules) Price **£33**. P. & P. **£1.50** (incl. VAT total **£39.68**). Suitable case **£1.00** + **£1.50** P. & P. **(£4.30** incl. VAT & P. & P.).

### XENON FLASHGUN TUBES

Range available from stock. S.A.E. for details.

### ULTRA VIOLET BLACK LIGHT FLUORESCENT TUBES

**4ft. 40 Watt** **£8.70** incl. VAT **£10.00** (callers only).  
**2ft. 20 watt** **£6.20**. Post **75p**. **(£7.99** incl. VAT + P.).  
For use in start (on fittings).  
**12in. 8 watt** **£2.80**. Post **35p**. **(£3.62** incl. VAT + P.)  
**9in. 6 watt** **£2.25**. Post **35p**. **(£2.99** incl. VAT + P.)  
**6in. 4 watt** **£2.25**. Post **35p**. **(£2.99** incl. VAT + P.)  
Complete ballast unit, for either 6", 9" or 12" tube 230V AC op. **£4.50**. Post **45p**. **(£5.69** incl. VAT + P.)  
DC op. **£4.50**. Post **45p**. **(£5.49** incl. VAT + P.)  
400 watt UV lamp and ballast complete **£38.00**. Post **£3.50** **(£47.73** incl. VAT + P.). 400 watt UV lamp only **£14.00**. Post **£1.50**. **(£17.83** incl. VAT + P.).

### WIDE RANGE OF DISCO LIGHTING EQUIPMENT

S.A.E. (foolscap) for details.

### PROGRAMME TIMERS

240V A.C. operation. 12 individually adjustable cams. **£7.50** + **75p** P. & P. **(£9.49** incl. VAT). R.T.  
6 adjustable 6 fixed cams. Price **£6.00** + 75p p. & p. **(£7.76** incl. VAT). R. & T.

### Superior Quality Precision Made NEW POWER RHEOSTATS

New ceramic construction, embedded winding heavy duty brush assembly, continuously rated.  
**25 WATT** 10/25/50/100/250/500/1KQ/  
1-5KQ. **£2.80**. Post 20p **(£3.45** incl. VAT & P.)  
**50 WATT** 250Q £2.90. Post 25p **(£3.62** incl. VAT & P.)  
**100 WATT** 1/5/10/25/50/100/250/500/1KQ/1-5KQ/2 5KQ/3.5KQ **£6.90** p. & p. **35p** **(£8.34** incl. VAT).  
Black, Silver, Skirted knob calibrated in Nos. 1-9 1/2 in. dia. brass bush. Ideal for above Rheostats 24p each.



### RELAYS

Wide range of AC and DC relays available from stock. Phone or write in your enquiries. N.M.S.  
Other types available — phone for details. N.M.S.  
**230/240V A.C. Relays:** Arrow 2 c/o 15 amp **£1.50** **(£1.96** incl. VAT & P.).  
T.E.C. open type 3 c/o 10 amp **£1-10** **(£1-50** incl. VAT & P.).

**KMKI Relay.** 230V, A.C. 1 c/o. open type 10 amp contact, m.f. by "Keypswitch" 80p. + 20p. p. & p. **(£1.15** incl. VAT). 5 for **£3-75** postpaid **(£4-32** incl. VAT).

**D.C. Relays:** Open type 9/12V 3 c/o 7 amp **£1.00** **(£1-38** incl. VAT & P.) Sealed 12V 1 c/o 7 amp octal base. **£1.00** **(£1-38** incl. VAT & P.) Sealed 12V 2 c/o 7 amp octal base. **£1.25** **(£1-67** incl. VAT & P.) Sealed 12V 3 c/o 7 amp 11-pin. **£1.35** **(£1-78** incl. VAT & P.) 24V. Sealed 3 c/o 7 amp 11 pin **£1.35** **(£1-78** incl. VAT & P.). (lamps = contact rating). P&P on any Relay 20p.

**Hellermann Deutsch.** Hermetically sealed sub-min. Relay. 12-24V. D.C. 2 c/o. 850 ohm coil. 0.2 pitch. P.C. mounting. L 20mm. W. 10mm. H. 12mm. Fraction of maker's price: **£2.50** postpaid **(£2.88** incl. VAT). N.M.S.

**Diamond H** heavy duty A.C. Relay 230/240V a.c. two C/O contacts 25 amps res at 250 a.c. **£2.50** p&p 50p. **(£3-45** incl. VAT + p&p). Special base 80p. (incl. VAT 58p). N.M.S.

4.5rpm SIGMA motors approx. 35lbs inch  
7rpm KLAXON motors approx. 25lb inch  
28rpm WYNSCALE motors approx. 20lb inch  
71rpm WYNSCALE motor approx. 10lb inch  
Above four motors are designed for 110V. A.C. supplied with auto transformer 240V. A.C. operation. **£9.25** p. & p. 75p. Total incl. VAT **£11.50**. N.M.S.



19 rpm FHP 220/240V. a.c. reversible, torque 14.5kg. Gear ratio 144-1. Brand new including capacitors. m.f. CITENCO. Price: **£14.25** + **£1.25** P. & P. **(£17-83** incl. VAT). N.M.S.



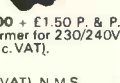
30rpm 230/240V. a.c. 50lb in. m.f. PARVALUX. Price: **£15.00** + **£1.50** P. & P. **(£18-98** incl. VAT). N.M.S.



56 rpm. 240V. a.c. 50lb. in. 50Hz 0.7 amp. Shaft length 35mm. Dia 16mm. Wt. 6kg. 600g m.f. FRACMO. Price: **£15.00** + **£1.50** P. & P. **(£18-98** incl. VAT). N.M.S.



100 rpm. 110V. a.c. 115lb. in. 50Hz. 2.8 amp. single phase split capacitor. Immense power.  
Totally enclosed. In-line gearbox. Length 250mm. Dia. 135mm. Spindle dia. 15.5mm. length 145mm. Tested. Price: **£12.00** + **£1.50** P. & P. **(£15.53** incl. VAT). R. & T. Suitable Transformer for 230/240V operation. Price **£8.00** + 75p P. & P. **(£10.06** incl. VAT).



200 rpm. 35 lbs. in. 115V. 50Hz. Price: **£16.00** + **£1.50** P. & P. **(£20-13** incl. VAT). N.M.S. Suitable Transformer for 230/240V a.c. Price: **£8.00** + **£1.00** P. & P. **(£10-35** incl. VAT). N.M.S.

1 rpm 230/240V. a.c. Synchronous geared motor. m.f. HAYDON. 2 rpm 230/240V. a.c. Synchronous geared motor. m.f. CITIZEN. Either type £3.90 + 30p P. & P. **(£4.85** incl. VAT). Board specification. Price **£9.50**.

230V a.c. FAN ASSEMBLY.  
Powerful continuously rated a.c. motor complete with 5 blade 6in. or 4 blade 5in. aluminium fan. Price: **£3.50**. P. & P. **85p** **(£4.77** incl. VAT & P.).



24V. D.C. GEARED MOTOR  
24V. D.C. 200 rpm 10lbs/in. continuously rated geared motor fly, either Parvalux or Carter. Easily removable from heavy ali. chassis containing 9x24V. D.C. Solenoids, microswitches, friction clutch, precision gearing etc. Ex-equipment London Transport Ticket Printer. Price: **£11.00** + **£2.00** p. & p. (total incl. VAT **£14.95**).

24V. D.C. REVERSIBLE MOTOR  
Parvalux type SD12L, 24 D.C. shunt wound motor, either 133 rpm 65lbs in Gearbox ratio 30:1. Current 6.8 amp. Rating continuous. Will operate on reduced power and speed at 9V D.C. or less. Size Dia. 16mm, Width 150mm, Shaft dia. 16mm. Price: **£15.00** + **£2.00** p. & p. **(£20.70** incl. VAT). N.M.S. or 60 rpm 100lb in rating. Price as above. N.M.S.  
100W Rheostat 1 ohm speed control available **£6.90** **(£7.94** incl. VAT).

ROTARY CARBON VANE VACUUM & COMPRESSOR.  
Direct coupled to 1/3 h.p. 110/115V. A.C. Motor 4.2 amp. 1380 rpm. Motor manu. by A.E.I. or G.E.C. Pump by Williams. Max. Vac. 25" H.G. Max. pressure cont. 10 p.s.i. Inlet 1.5 p.s.i. Max. airflow 3 c.f.m. at "0" H.G. Price: **£30.00** + **£30.00** P. & P. **(£37.95** incl. VAT). N.M.S.  
Suitable transformer for 240V. op. **£10.00** P. & P. **£2.00** **(£13.80** incl. VAT). N.M.S.

COMPRESSOR  
Precision built USA. Horizontally opposed twin head diaphragm type producing 20lbs. approx. P.S.I. per head. 3.5 plus C.F.M. Output virtually pulse free. Powered by 110V A.C. motor size 30x23x15cm. Weight 7 kilos. Price **£25.00** + **£2.00** P. & P. **(Total incl. VAT **£31.05**)**. N.M.S.  
Suitable transformer for 240V op. **£8.00** P. & P. **£1.50** **(£10.93** incl. VAT).



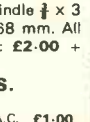
VERY EXCEPTIONAL OFFER  
REDUCTION DRIVE GEAR BOX.  
Ratio 72:1. Input spindle 1/2 x 1/2 in. Output spindle 3/4 x 3 in. long. Overall size approx: 120 x 98 x 68 mm. All metal construction. Ex-equip. tested. Price: **£2.00** + **50p**. (incl. VAT **£2.88**).

A.C. Wkg. TUBULAR CAPACITORS.  
Fraction of makers price. Motor start etc.

1.5 mfd. 440V. A.C.	60p	7.5 mfd. 200V. A.C.	£1.00
2 mfd. 250V. A.C.	60p	10 mfd. 250V. A.C.	£1.00
2.2 mfd. 450V. A.C.	75p	10 mfd. 400V. A.C.	£1.75
3 mfd. 440V. A.C.	£1.00	15 mfd. 250V	£3.00
4.1 mfd. 440V. A.C.	£1.00	(Block)	£1.50
5 mfd. 400V. A.C.	£1.25	19 mfd. 280V. A.C.	£2.00
5.3 mfd. 160V. A.C.	60p	20 mfd. 250V. A.C.	£2.25
5.4 mfd. 280V. A.C.	75p	50 mfd. 370V.	£5.00
6.5 mfd. 280V. A.C.	£1.00	(Block)	

P. & P. up to 2.5 mfd. 25p. 3 mfd tp 20 mfd. 50p. 50 mfd. £1.50. All plus V.A.T. N.M.S.

ERD Time switch 200/250V a.c. 30 amp contact 2 on/2 off every 24 hrs. at manually pre-set time. 36 hour Spring Reserve and day omitting device. Built to highest Electricity Board specification. Price **£9.00**. P. & P. **75p** **(£11.79**). R. & T.



SANGAMO WESTON TIME SWITCH  
Type S251 200/250V. a.c. 2 on/2 off every 24 hours. 20 amps contacts with override switch dia. 4 x 3 price **£8.50** P. & P. 50p incl. VAT **£10.35**. Also available with Solar dial. R. & T.

N.M.S. New Manufacturers Surplus R & T Reconditioned and Tested

# SERVICE TRADING CO

57 BRIDGMAN ROAD CHISWICK LONDON W4 5BB 01 995 1560

Personal callers only Open Saturdays

9 Little Newport Street, London WC2H 7JJ  
Phone 01-437 0576

All Mail Orders Callers

Ample Parking Space  
Showroom open Mon-Fri.

ACCOUNT CUSTOMERS MIN. ORDER £10.00

# MAPLIN

## announce the opening of their new LONDON shop

259-261  
King St.  
Hammersmith  
London W6  
01 748 0926



- \* Excellent metered parking
- \* Close to Hammersmith Underground Station for Piccadilly, District & Metropolitan Lines
- \* Bus no's 260·266·704·27·91 267·290 stop outside



# Opens Tuesday 16th September, 1980

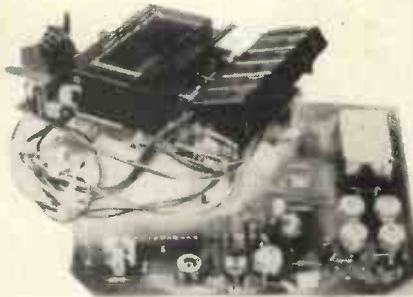
Opening Hours 9.45 am to 5.30 pm Tuesday to Saturday (Closed Monday)

Maplin mail-order –  
Now better than ever!

- \* Up to 8% discount for use with next order
- \* All prices include VAT
- \* Same day service on in-stock lines
- \* Over 95% of our stock lines in stock
- \* Large range of all the most useful components
- \* First class reply paid envelope with every order
- \* Quality components – no rejects – no re-marks
- \* Competitive prices
- \* Your money is safe with a reputable Company

On price, service, stock, quality and security, it makes sense now more than ever to make **Maplin** – your first choice for components every time!

### Stereo Cassette Tape Deck



Utilising the superb JVC deck made for Tandberg and a ready-made pre-aligned, tested and guaranteed module, this cassette deck has a superb sound and a high quality specification. We've got everything you need (except cabinet) including full instruction leaflet for only £39.95. Order as XY36P (Cassette Recorder Kit)

### Space Invaders

Fight the space invaders, be a polaris captain or a spaceship commander. Full colour action on your own TV set and over 450 games to play.

Basic console with Combat cartridge (AC00A) £99.50 + £2.50 carriage

All cartridges available including:

Space Invaders (AC26D)	£29.95	Adventure (AC22Y)	£23.95
Indy 500 (AC24B)	£34.50	Skydiver (AC13P)	£16.95
Chess (8levels) (AC28F)	£34.50	Breakout (AC05F)	£16.95
Golf (9holes) (AC18U)	£16.95	Slot Racers (AC19V)	£16.95
Air Sea Battle (AC01B)	£16.95	Programming (AC27E)	£34.50
Space War (AC02C)	£16.95	Olympics (AC04E)	£16.95
Brain Games (AC16S)	£16.95	Street Racer (AC14Q)	£16.95
Outlaw (AC03D)	£16.95	Keyboards per pair (AC29G)	£11.95

All prices include VAT and carriage except where shown.

Post this coupon now for your copy of our 1979-80 Catalogue price 70p

Please send me a copy of your 280 page catalogue. I enclose 70p (plus 46 p&p). If I am not completely satisfied I may return the catalogue to you and have my money refunded. If you live outside the U.K. send £1.35 or ten International Reply Coupons. I enclose £1.16.

Name \_\_\_\_\_

Address \_\_\_\_\_

PE.10.80

# MAPLIN

Maplin Electronic Supplies Ltd

All mail to:- P.O. Box 3, Rayleigh, Essex SS6 8LR.  
Telephone: Southend (0702) 554155.

Shop: 284 London Road, Westcliff-on-Sea,  
Essex. (Closed on Monday)

Telephone: Southend (0702) 554000.



Catalogue now available in all branches of WHSMITH Price £1.00

by 195 71