RADIO... ELECTRONICS... INSTRUMENTS... AUDIO...

# practical WIRELESS

55p

Australia 85c
New Zealand 95c
South Africa 90c
Malaysia $2.75

DEC 1979

**extra RADIO DATA**
**8 page supplement**

★ **Special Xmas Watch Offer**


## Radio Control
**series begins**

# practical WIRELESS

DECEMBER 1979
VOLUME 55
NUMBER 12
ISSUE 874

BRITAINS LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR

**Published by IPC Magazines Ltd., Westover House, West Quay Rd., POOLE, Dorset BH15 1JG**


### QUERIES

While we will always try to assist readers in difficulties with a *Practical Wireless* project, we cannot offer advice on modifications to our designs, nor on commercial radio, TV or electronic equipment. Please address your letters to the Editor, *Practical Wireless*, at the above address, giving a clear description of the problem and enclosing a stamped self-addressed envelope. Only one project per letter please.

Components are usually available from advertisers. A source will be suggested for difficult items.

### SUBSCRIPTIONS

Subscriptions are available to both home and overseas addresses at £10.60 per annum, from **"Practical Wireless" Subscription Department, Oakfield House, Perrymount Road, Haywards Heath, West Sussex RH16 3DH.**

### BACK NUMBERS AND BINDERS

Limited stocks of some recent issues of *PW* are available at 80p each, including post and packing to addresses at home and overseas.

Binders are available (Price £3.75 to UK addresses and overseas, including post and packing) each accommodating one volume of *PW*. Please state the year and volume number for which the binder is required.

Send your orders to **Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF.**

All prices include VAT where appropriate. Please make cheques, postal orders, etc., payable to IPC Magazines Limited.

### COPYRIGHT



All reasonable precautions are taken by *Practical Wireless* 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 are those current as we go to press.

## ☐ NEWS & VIEWS


22 **Editorial:** Capacity for Confusion
22 **PW Personality:** Joe Bishop
27 **Obituaries:** John Scott-Taggart. Stanley Robert Mullard
28 **Radio Special Product Report**
FMD-7 FM Detector Module, Burns Electronics
31 **EDXC:** News of European DX Council projects
32 **Hotlines** . . . . . . . . . . *Ginsberg*
Recent developments in electronics
36 **Kindly Note**
VHF DF Loop Aerial, October 1979
49 **Production Lines** . . . . . . . . . . *Alan Martin*
Information on the latest products


## ☐ FOR OUR CONSTRUCTORS


24 **Aerials for 160m—2** . . . . . . . . . . *J. R. Green*
Designs for Top-Band operation
33 **Semiconductor Tester** . . . . . . . . . . *J. Scott Paterson*
Check transistors, diodes, etc, on an oscilloscope screen
37 **Model Radio Control—1** . . . . . *J. Burchell & W. S. Poel*
A comparison of various systems, plus constructional details of the receiver
64 **Field Telephone System** . . . . . . *E. A. Parr & J. Wallace*
A versatile intercom based on 741 op. amps.


## ☐ GENERAL INTEREST


34 **CB-UK—The Facts and the Future**
More thoughts on this controversial subject
52 **Hi-Fi Glossary—3** . . . . . . . . . . *G. J. King*
All you wanted to know about Hi-Fi Jargon
59 **IC of the Month** . . . . . . . . . . *Brian Dance*
The TL497 switching regulator
66 **On the Air**
Amateur Bands . . . . . . . . . . *Eric Dowdeswell*
Medium Wave DX . . . . . . . . . . *Charles Molloy*
Short-Wave Broadcasts . . . . . . . . . . *Charles Molloy*
VHF Bands . . . . . . . . . . *Ron Ham*


## ☆ SPECIAL OFFER


57 **Zentron LCD Time-Zone Watch**


## ○ EXTRA


78 **Index to Volume 55**
Contents of our issues dated January–December 1979


**Our January 1980 issue will be published in early December**

# All these advantages...

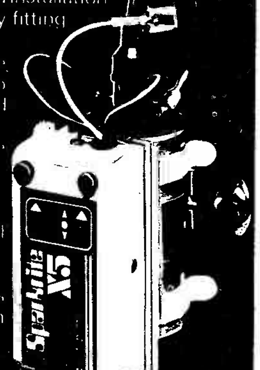
- Instant all-weather starting
- Smoother running
- Continual peak performance
- Longer battery & plug life
- Improved fuel consumption
- Improved acceleration/top speed
- Extended energy storage

## ..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 12 v 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. PW1279
82 Bath Street, Walsall, WS1 3DE. Phone: (0922) 614791

Name ____________________
Address ____________________

Phone your order with Access or Barclaycard

| Inc. V.A.T. and P.P. | QUANTITY REQ'D. |
|---|---|
| X5 KIT £16·95 | |
| ACCESS OR BARCLAY CARD No. | |

I enclose cheque/PO's for £ ________

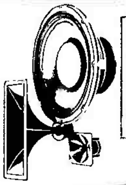
Cheque No.

Send SAE if brochure only required.

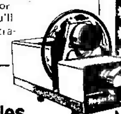
# Now, complete your system!


**Citronic MM313 Mixer**
Ideal for the DIY enthusiast building up a complete disco system 4/6 ch mono. inc. LED indicators, connections via phono sockets at rear. Bargain price, including PSU £89.70.

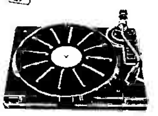
**The ultimate range of speakers**
We carry a good selection of high quality chassis for the DIY speaker constructor: 12" or 15" Bass speakers and Dual Concentrics. Exponential horns from £13.80, or our fabulous Piezo Horns which handle a 5K–20K frequency range in any PA system up to 100W (No X over required) and cost only £6.32 each.



**Projectors** Come and see our specially selected projectors from £50.60 (Squire Multi-fect 150) to £83.37 (Tutor IIE DDU) plus the widest array of projector attachment and effects that you'll ever see on continuous demonstration.



**Ropelights** Great effect at discos. 7 metres long. Multiway connectors. 4 channel. £46.00 (inc.pack of spare bulbs)



**Turntables**
Our unsurpassed Disco experience has enabled us to select the best turntables for your requirements. For example the new BSR P200 belt drive. ONLY £28.75.

**Bulgin Octal plugs and sockets** There's always hundreds of Bulgin Octal multiway plugs and sockets in stock at Roger Squire's. Each pin rated 6A. Perfect for your Sound to Light System. P552 SOCKET £0.69 P551 PLUG £1.72

**Many disco accessories**
All Roger Squire's shops have a service department which carries large stocks of DISCO SPARES & ACCESSORIES

Multiway Cables
4 core (6A) 63p/metre
5 core (6A) 78p/metre
6 core (6A) 92p/metre

ALL SHOPS OPEN TUE-SAT.
LATE NIGHT WED.
(UP TO 8 PM)

**PERSONAL CALLERS ONLY**

## Roger Squire's Disco Centres

LONDON 176 Junction Road, N19. 50yds Tufnell Park Tube Station. Tel: 01 272 7474

BRISTOL 125 Church Road, Redfield (Near St. George) 1 mile from end of M32 Tel: 0272 550550

MANCHESTER 251 Deansgate 3. 15 mins from City Centre Tel: 061 831 7676

GLASGOW 1 Queen Margaret Road (off Queen Margaret Drive) Kelvinside 20. just behind the BBC. Tel: 041 946 3303

# J. BIRKETT

*(Partners: J. H. Birkett. J. L. Birkett)*

Radio Component Suppliers

**25 The Strait, Lincoln. LN2 1JF**

**WIRE ENDED TRANSMIT/RECEIVE PIN DIODES** with data 1MHz to VHF @ **40p**, UHF Type @ **60p**.
**VHF/UHF FETS** 800MHz Type BF 256C at 4 for **75p**.
**300 TO 75 OHM BALUM TRANSFORMERS** @ **20p** each.
**POWER TRANSISTORS** 2N 3055 @ **55p**, 2N 3773 @ **£1.60**, 2N 5039 60MHz, 140 Watt, 20 Amp, 120 Volt @ **£1.60**, 2N 6354 80 Watt, 10 Amp, 150 Volt, 80MHz @ **£1.60**, 2N 6496 80 Watt, 15 Amp, 150 Volt, 60MHz @ **£1.60**, BDY 57 150 Watt, 30 Amp, 160 Volt @ **£1.60**.
**12 WAY CERAMIC TAG STRIPS** @ **15p** each.
**1000pf 6 K.v.w. DISC CERAMICS** @ 6 for **20p**.
**10 Amp SCR's** 100 PIV @ **25p**, 400 PIV @ **50p**, 800 PIV @ **60p**.
**R.F. TRANSISTORS** AF 239 @ **50p**, 2N 918 @ **25p**, 2N 5179 @ **50p**, 2N 5180 @ **50p**, BFY 90 @ **50p**, BF 362 @ **25p**, MPS 6514 @ **10p**.
**2 METRE CRYSTALS** 10X Type 8010KHz @ **40p** each.
**WIRE ENDED DIODES** 50 PIV 2½ Amp @ 6 for **25p**.
**VERNITRON FM4 10.7MHz FILTERS** @ **50p**, 3 for **£1**.
**DUAL GATE MOS FETS** like 40673 @ **33p**, 4 for **£1.10**.
**COIL FORMERS** 3/16 Dia. with core at 6 for **25p**.
**VHF TUBULAR TRIMMERS** 6pf, 8pf, Both **10p**, 18pf @ **15p**.
**MINIATURE VARIABLE CAPACITORS** 25×25×25pf @ **75p**.
**MULLARD FERRITE BEADS** FX 1115 @ **15p** doz.
**VHF STRIPLINE LOW NOISE FETS** 2N 4417 with data @ **£2.20**.
**DAY TRIMMERS** 2 to 9pf, 5 to 35pf, 6 to 45pf, 0 to 125pf, 8 to 140pf, All at **15p** each.
**TV S.A.W. FILTERS** untested. 3 for **40p**.
**MOULDED TRACK 1K LINEAR POTENTIOMETERS** @ **20p** each.
**2GHz STRIPLINE NPN TRANSISTORS** @ **£1** each.
**6GHz STRIPLINE NPN LOW NOISE TRANSISTORS** with data @ **£3**.
**BUTTERFLY PRE-SET VARIABLES** Spindles easily extended. 25×25pf @ **50p**, 38×38pf @ **60p**, 38×38pf. Wide spaced @ **65p**.
**100 MULLARD C 280 CAPACITORS** assorted for **60p**.
**100 TUBULAR CERAMIC CAPACITORS** assorted @ **60p**.
**100 DISC CERAMICS CAPACITORS** assorted @ **60p**.
**R.F. POWER TRANSISTORS** R5174 13 volt 10 watt 175MHz @ **£2.50**.
**SOLDER-IN FEED THRU's** 6.8pf, 300pf, 1000pf. All **20p** doz.
**144MHz 10X CRYSTALS** 8010KHz x 18 = 144.180MHz @ **40p**.
**FM TUNER FRONT END** 80 to 108MHz suitable for Conversion to 2 metres with details @ **£3**, 10.7MHz Module for above @ **£4**, 250mW Audio Amplifier @ **£2.50**.
**ALLOY DIE CASE BOXES** 6"x3. 3/16"x2" @ **£1.15**, 3 for **£2.85**.
**6"x3/8" FERRITE RODS** @ **30p** each.
**MYLAR CAPACITORS** 50V.W. .01uf or .1uf Both **20p** doz.
**ASSORTED CRYSTALS** 30 10XAJ @ **£1**, 20. FT 241A @ **£1.10**, 20. FT 243 @ **£1.50**, 25 10X @ **£1.50**.
**FERRITE BEADS** FX 1115 at **15p** doz.
**F.M. I.C's** CA 3089E @ **£1.20**, TAA 661 @ **60p**.
**ERIE RED CAP SUB-MINIATURE CERAMIC CAPACITORS** @ **5p** each.
**WIRE ENDED GLASS CRYSTALS** 28KHz, 28.5KHz, 29.75KHz All **50p** each.
Please add 20p for post and packing on U.K. orders under £2. Overseas postage charged at cost.

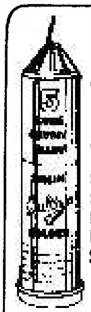
ERSIN Multicore 5 CORE SOLDER

# Handy size Reels & Dispensers

## OF THE WORLD'S FINEST CORED SOLDER TO DO A PROFESSIONAL JOB AT HOME

Ersin Multicore Solder contains 5 cores of non-corrosive flux that instantly cleans heavily oxidised surfaces and makes fast, reliable soldering easy. No extra flux is required.

### SAVBIT handy solder dispenser



Contains 2.3 metres approx. of 1.22 mm Ersin Multicore Savbit Solder. Savbit increases life of copper bits by 10 times.
**Size 5 78p**

For soldering fine joints

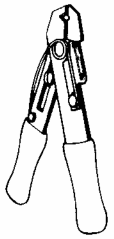
Two more dispensers to simplify those smaller jobs. PC115 provides 6.4 metres approx. of 0.71 mm solder for fine wires, small components and printed circuits.
**PC115 92p**
Or size 19A for kit wiring or radio and TV repairs. 2.1 metres approx. of 1.22 mm solder.
**Size 19A 83p**

### handy size reels of SAVBIT, 40/60, 60/40 & ALU-SOL solder alloys

These latest Multicore solder reels are ideal for the toolbox. Popular specifications cover all general and electrical applications, plus a major advance in soldering aluminium. Ask for a free copy of 'Hints on Soldering' containing clear instructions to make every job easy.

| Ref. | Alloy | Diam. mm. | Length metres approx. | Use | Price |
|---|---|---|---|---|---|
| Size 3 | 40/60 Tin/Lead | 1.6 | 10.0 | For economical general purpose repairs and electrical joints. | £3.22 |
| Size 4 | ALU-SOL | 1.6 | 8.5 | For aluminium repairs. Also solders aluminium to copper, brass etc. | £3.22 |
| Size 10 | 60/40 Tin/Lead | 0.7 | 39.6 | For fine wires, small components and printed circuits. | £3.22 |
| Size 12 | SAVBIT | 1.2 | 13.7 | For radio, TV and similar work. Increases copper-bit life tenfold. | £3.22 |

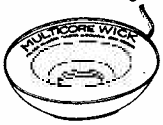
### WIRE STRIPPER & CUTTER



Easily adjustable for most sizes of flex and cable. Fitted with extra strong spring for automatic opening. Easy grip handles and handle locking device.
Ref 9
**£2.21 inc. VAT.**

### MULTICORE WICK

for solder removal and desoldering.



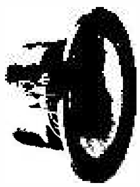

Absorbs solder instantly from tags, printed circuits etc. Only needs 40-50 Watts soldering iron. Quick and easy to use. Non-corrosive.

**Size AB10 £1.29**

Sole UK Sales Concessionaires
**Bib Hi-Fi Accessories Limited,**
Kelsey House, Wood Lane End, Hemel Hempstead, Herts. HP2 4RQ

Prices shown are recommended retail inc. VAT. From Electrical and Hardware Shops. In difficulty send direct plus 20p P&P. Prices and specifications subject to change without notice.

---



# Wilmslow Audio

## THE firm for speakers!

**SEND 15P STAMP FOR THE WORLD'S BEST CATALOGUE OF SPEAKERS, DRIVE UNITS, KITS, CROSSOVERS ETC. AND DISCOUNT PRICE LIST.**

AUDAX ● AUDIOMASTER ● BAKER ● BOWERS & WILKINS ● CASTLE ● CELESTION ● CHARTWELL COLES ● DALESFORD ● DECCA ● EMI ● EAGLE ● ELAC ● FANE ● GAUSS ● GOODMANS ● I.M.F. ● ISOPHON ● JR ● JORDAN WATTS ● KEF ● LEAK ● LOWTHER MCKENZIE ● MONITOR AUDIO ● PEERLESS ● RADFORD ● RAM ● RICHARD ALLAN ● SEAS ● SHACKMAN ● STAG ● TANGENT ● TANNOY ● VIDEOTONE ● WHARFEDALE ● YAMAHA

**WILMSLOW AUDIO** (Dept. P.W.)

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

**Discount Hi-Fi Etc. at 5 Swan Street**

**Speakers, Mail Order & Export 0625 529599 Hi-Fi 0625 526213**

---

# MICROSYSTEMS'80

## A Conference and Exhibition to help you come to terms with the Second Industrial Revolution

at the **WEMBLEY CONFERENCE CENTRE**
**JANUARY 30 - FEBRUARY 1** from 10 am each day

CONFERENCE SESSIONS enable you to share the experience of experts in the microtechnology field.

A BUYERS' FORUM helps you to establish effective criteria for selection of goods and services.

A PROFESSIONAL DEVELOPMENT SEMINAR introduces managers to the use of microprocessors in business and industry.

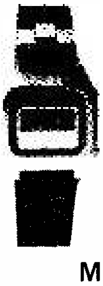
AN EXHIBITION where you can talk personally with the suppliers of microtechnology products and services.

Admission to the exhibition is free. You may book in on the spot for conference sessions, or obtain further details of fees and a booking form from:

MICROSYSTEMS CONFERENCE Room 821, Dorset House, Stamford Street, London, SE1 9LU.


MAPLIN
ELECTRONIC SUPPLIES
PRINTED CIRCUIT DRILLS
Miniature 12V DC drills designed for drilling pcb's.
Small drill: Order as BW03D Price £6.75
Large drill: Order as BW02C Price £10.63
ANTI-STATIC MAT & GUN
Turntable mat removes static from discs while they are playing.
Order as LX18L Price £2.95
Gun removes static charge from discs. After use dust no longer clings and may be easily brushed off.
Order as LX04E Price £4.99
AMP KITS
Complete kits of parts with full instructions to make hi-fi amplifiers with excellent specifications.
8W amp kit: Order as LW36P Price £3.83
50W amp kit: Order as LW35Q Price £13.73
150W amp kit: Order as LW32K Price £14.89
HEADPHONES
High quality stereo headphone with large padded headband and slider volume controls.
Order as WF14Q Price £7.99
CONDUCTIVE PAINT
Repair pcb's, car demisters, etc., with this silver paint. Phial contains 3gm.
Order as FY72P Price £2.59
McKENZIE POWER SPEAKERS
High quality, high power speakers.
12in. 50W 8Ω Order as XQ79L Price £18.79
12in. 50W 16Ω Order as XQ80B Price £18.79
12in. 80W 8Ω Order as XQ81C Price £26.92
12in. 80W 16Ω Order as XQ82D Price £26.92
15in. 150W 8Ω Order as XQ83E Price £57.80
15in. 150W 16Ω Order as XQ84F Price £57.80
MINIATURE VICE
Small modellers vice in tough plastic with metal faced jaws. Clamps to bench. Jaws width 41mm, maximim opening 30mm.
Order as FY53H Price £2.78
20,000 OHM/VOLT MULTIMETER
A 20,000 ohms per volt multimeter at an incredibly low price. DC volts 5, 25, 125, 500, 2,500; AC volts 10, 50, 250, 1,000; DC amps 0 to 0.05mA, 0 to 250mA; Resistance 0 to 50k, 0 to 5M ohms; Decibels −20 to +22dB. Complete with test leads, battery and instruction leaflet.
Order as YB83E Price £13.70
ELECTRET MICROPHONES
Super quality genuine electret microphones operating on 1.5V battery (HP7 type) supplied.
Cassette type with miniature jack plugs.
Order as YB33L Price £3.84
Omnidirectional low-cost with standard jack plug.
Order as YB34M Price £3.75
Unidirectional 600Ω with standard jack plug.
Order as YB35Q Price £9.75
Unidirectional 600Ω/50kΩ dual with standard jack plug (pictured).
Order as WF34M Price £16.77
WIRING TOOLS
Miniature box-jointed wiring pliers with insulated handles and return spring.
Order as BR69A Price £4.52
Miniature box-jointed side-cutters with insulated handles, return spring and precision cutting edges.
Order as BR70M Price £4.45
End-action wire strippers, fully adjustable, insulated handles.
Order as BR76H Price £5.85
CLOCK MODULE
18 30
Module requires only transformer and two push switches to operate 4-digit, 0.7in red LED display. Alarm and radio outputs. Battery back-up when mains fail. Sleep and snooze timer. Seconds display. Just add speaker for alarm tone. Full details on page 267 of our catalogue.
Order as XL14Q Price £8.41
MEGAPHONE
High quality megaphone with differential microphone. Requires eight HP11 batteries (not supplied). Shoulder strap for portable operation.
Order as XQ72P Price £47.61
SWR POWER METER
SWR meter and transmitted power meter in one handy instrument. Frequency range 3.5 to 150MHz. Impedance: 50Ω.
Order as YB02C Price £19.69
CAR AERIAL BOOSTER
High gain car aerial booster for long, medium, short and VHF bands. Negative earth cars only. Very easy to fit − just plugs in plus one wire to +12V. We have measured gains of 20dB at 90MHz!
Order as XX37S Price £5.95
TEACH YOURSELF ELECTRONICS
There is no better way of learning basic electronics than by practical experience and this set of books is undoubtedly the very best basic course for doing just that. Set of five Basic Electronics books.
Order as XX10L Price £7.89
MULTIMETER & TRANSISTOR TESTER
Superb high sensitivity multimeter and transistor tester in one. Sensitivity 100,000 ohms per volt DC. Ranges DC volts 0.5, 2.5, 10, 50, 250, 1,000; AC volts 5, 10, 50, 250, 1,000; DC current 0.01, 0.025, 0.5, 5, 50, 500mA, 10A; AC current 10A; Resistance 5k, 50k, 5M, 50M ohms; Decibels −10dB to +62dB. Complete with test leads, three leads for transistor tester batteries and instruction leaflet.
Order as YB87U Price £39.30
TURNTABLES
Autochanger complete with stereo ceramic cartridge and circuit to make a complete low-cost record player ideal for the young pop fan.
Order as XQ00A Price £16.30
Single-play rim-drive turntable with stereo ceramic cartridge.
Order as XB23A Price £24.79
Single-play belt-drive turntable 'S'-shaped tone arm.
Order as XB25C Price £30.63
TRANSISTOR TESTER
Accurate transistor tester measures dynamic gain, identifies unknown transistors, also ideal for matching transistors into pairs.
Order as LH05F Price £12.28
SWR & FIELD STRENGTH METER
SWR meter and relative field strength meter for transmitter antenna alignment. Accuracy: ±5%.
Order as YB03D Price £11.89
All prices include VAT and postage and packing, but if total under £4 please add 30p handling charge. Prices guaranteed until January 11th 1980. Export customers deduct 13% and export postage will be charged extra at cost.
Please use order code.
All items in stock at time of going to press.
FOR FULL CATALOGUE DETAILS SEE BACK COVER.
MAPLIN ELECTRONIC SUPPLIES LIMITED
All mail to PO 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.

## QUARTZ LCD 5 Function



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

**£6.65**

Guaranteed same day despatch.
Very slim, only 6mm thick.

M1

## SOLAR QUARTZ LCD 5 Function

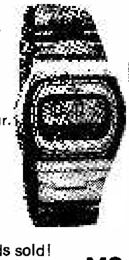
Genuine solar panel with battery back-up. Hours, mins., secs., day, date. Fully adjustable bracelet. Back-light. Only 7mm thick.

**£8.65**

Guaranteed same day despatch.

M2

## QUARTZ LCD 11 Function SLIM CHRONO



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

**£10.65** Thousands sold!
Guaranteed same day despatch.

M3

## QUARTZ LCD ALARM 7 Function

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

**£12.65**

Guaranteed same day dispatch.

M4

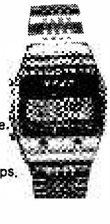
## MULTI ALARM 6 Digits 10 Functions

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

**£18.65**

M5

## FRONT-BUTTON Alarm Chrono Dual Time



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

**£22.65**

Guaranteed same day dispatch

M6

## SOLAR QUARTZ LCD Chronograph with Alarm Dual Time Zone Facility

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

**£27.95**

M7

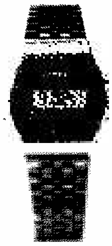
## ALARM CHRONO with 9 world time zones

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

**£29.65**

M8

## SOLAR QUARTZ LCD Chronograph



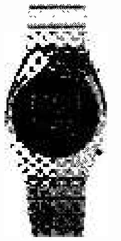
Powered from solar panel with battery back-up. 6 digit, 11 functions. Hours, mins., secs., day, date, day of week. 1/100th, 1/10th, secs., 10X secs., mins. Split and lap modes. Back-light, auto calendar. Only 8mm thick. Stainless steel bracelet and back. Adjustable bracelet. Metac Price

**£13.65**

Guaranteed same day despatch.

M9

## QUARTZ LCD Ladies Day Watch



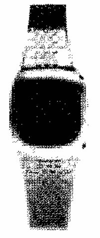
Only 25 × 20mm and 6mm thick. Hours, minutes, seconds, day, date, backlight and auto calendar. Elegant metal bracelet in silver or gold fully adjustable to suit very slim wrists. State colour preference.

**£9.95**

Guaranteed same day despatch.

M15

## QUARTZ LCD Ladies Fashion Watch



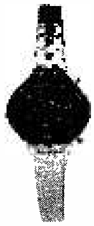
Elegant bracelet in bronze/gold finish or silver colour. Hours, mins, secs, day, date, backlight and auto calendar. Adjustable for the slimmest of wrists. State colour preference.

**£14.95**

Guaranteed same day despatch

M17

## QUARTZ LCD Ladies Cocktail Watch



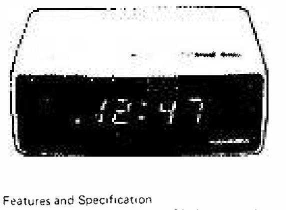
Highly functional watch which also suits those special occasions. Beautifully designed with a very thin bracelet which retains strength as well as elegance. Hours, mins, secs, day, date, backlight and autocalendar. Bracelet fully adjustable to suit slim wrists. State gold or silver finish.

**£19.95**

Guaranteed same day despatch

M18

## HANIMEX Electronic LED Alarm Clock



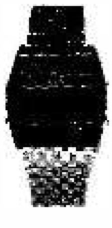
Features and Specification
Hour minute display Large LED display with p.m. and alarm on indicator '24 Hours alarm with on/off control Display flashing for power loss indication Repeatable 9 minute snooze Display bright/dim modes control. Size 5.15" x 3.93" x 2.36" (131mm x 11mm x 60mm) Weight 1.43 lbs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

**£10.20** Thousands sold!
Mains operated.

Guaranteed same day despatch.

M13

## EXECUTIVE ALARM WATCH

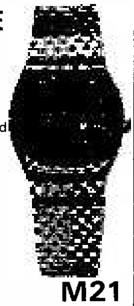


6 Functions plus Alarm: Conference signal. 5 minute snooze alarm. Conference signal sounds 4 secs., before main alarm to give advance warning and an option to cancel. Snooze sounds 5 mins., after main alarm and is always preceeded by the conference signal.

**£14.95**

M60

## MACY QUARTZ ANALOGUE



Automatic Calendar Day and Date infinite bracelet. This mans watch has elegance as well as the robust appearance provided by a watch with traditional features. Accuracy is provided by a quartz crystal powered by a long life miniature battery.

**£24.95**

M21

Metac price breakthrough for an Alarm Chronograph with Dual Time only

**£18.95**

**OUTSTANDING FEATURES**

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

Guaranteed same day dispatch.

M16

**HOW TO ORDER**
Payment can be made by sending cheque, postal order, Barclay, Access or American Express card numbers. Write your name, address and order details clearly, enclose 40 pence per single item for post and packing or the amount stated in the advert. All products carry 1 year written guarantee and full money-back 10 day reassurance. Battery fitting and electronic calibration service is available to customers at any Metac shop. All prices include VAT currently at 15%.

**Metac Wholesale:**
Trade enquiries – send for a complete list of prices for all the goods advertised plus many more not shown also minimum order details.
Telephone orders: Credit card customers can telephone orders direct to Daventry (03272) 76545 or Edgware Rd. 01-723 4753 24 hours a day.

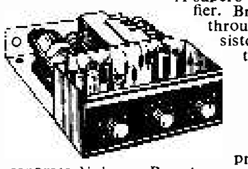
Service Enquiries 03272-77659
CALLERS WELCOME Shops open 9-30am-6.00

# Metac ELECTRONICS & TIME CENTRES

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

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

## SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel. input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V.
PRICE **£18·40,** P. & P. £1·20.

## HARVERSONIC MODEL P.A. TWO ZERO

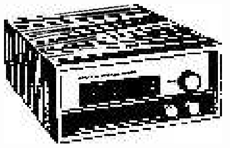
An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram, etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp.). Input 1, 15mV into 47k. Input 2, 15mV into 47k (suitable for use with mic. or guitar etc.). Input 3, 200mV into 1 meg. suitable for gram, tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 30 watts music power. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240 volts. Size approx. 12¼in wide × 5in high × 7¼in deep.
Special introductory price **£29·00** + £2·50 carriage and packing.

### "POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER

Size 11¾" × 14 11/16" × 1 7/16" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details.
Only **£8·80** each + p. & p. (one 90p, two £1·10).
Now available in 8" round version. 10 watts RMS 60Hz 20KHz **£6·30.**
P. & P. (one 65p, two 75p).

**STEREO MAGNETIC PRE-AMP.** Sens. 3mV in for 100mV out. 15 to 35V neg. earth. Equ. ± 1dB from 20Hz to 20KHz. Input impedance 47K. Size 1⅝" × 2⅞" × 5⅜"H. **£3·20** + 20p P. & P.

## MAINS OPERATED SOLID STATE AM/FM STEREO TUNER



200/240V Mains operated Solid State FM AM Stereo Tuner. Covering M.W. A.M. 540-1605 KHz VHF/FM 88-108 MHz.
Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600m/v RMS into 20K. Simulated Teak finish cabinet. Will match almost any amplifier. Size 8¼"w × 4"h × 9¼"d approx.
LIMITED NUMBER ONLY at **£29·00** + £1·50 P. & P.

### 10/14 WATT HI-FI AMPLIFIER KIT

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet **50p** + SAE (Free with parts). **All parts sold separately.** ONLY **£18·40,** P. & P. £1·40. Also available ready built and tested **£22·50,** P. & P. £1·40.

**STEREO DECODER MK.II**
SIZE 1½" × 2.5/16" × ½" ready built. Pre-aligned and tested for 10-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions supplied. **£7·00** plus 20p P. & P. Stereo beacon light if required **40p** extra.

## SPECIAL OFFER

Slightly shop soiled radios by well-known manufacturer for AC Mains or battery use. MW and FM bands. Dynamic M/coil speakers. telescopic aerial and internal ferrite aerial. Earpiece socket for personal listening. Finished in attractive simulated leatherette. Size 7" H × 9½" W × 4" D approx. Fully guaranteed.
Bargain price of only **£10·25** + £1·30 p. & p.

Mullard LP1159 RF-IF module 470kHz **£2·50** + P. & P. 20p. Full specification and connection details supplied.
Pye VHF FM Tuner Head covering 88-108MHz 10·7 MHz I.F. output. 7-8V + earth. Supplied pre-aligned, with full circuit diagram with precision-geared F.M. gang and 323PF + 323PF A.M. Tuning gang only **£3·40** + P. & P. 35p.

**VYNAIR & REXINE SPEAKERS & CABINET FABRICS** app. 54 in. wide. Our price **£2·30** yd. length. P. & P. **50p** per yd. (min. 1 yd.). S.A.E. for samples.

## HARVERSONIC SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integral pre-amp with Bass. Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response: ± 3dB 12-30,000 Hz Sensitivity: better than 80mV into 1M Ω: Full power bandwidth: ± 3dB 12-15,000 Hz. Bass boost approx. to ± 12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.
Overall Size 12"w. × 8"d. × 2¾"h.
Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

| | |
|---|---|
| AMPLIFIER KIT .. .. .. | **£14·95** P. & P. 80p |
| (Magnetic input components 33p extra) | |
| POWER PACK KIT .. | **£6·20** P. & P. 95p |
| CABINET .. .. .. | **£6·20** P. & P. 95p |

**SPECIAL OFFER—only £25·80 if all 3 items** ordered at one time plus £1·25 p. & p.
Full after sales service
Also avail. ready built and tested **£32·20,** P. & P. £1·50.

### HARVERSONIC STEREO 44

A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets & 5 pin din tape rec./play socket are mounted on the printed circuit panel, size approx. 9⅛" × 2¼" × 1" max. depth. Supplied brand new & tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically) at only **£10·40** plus 50p P. & P. Mains transformer with an output of 17v a/c at 500m/a can be supplied at **£2·15** + 40p P. & P. if required. Full connection details supplied.

All prices and specifications correct at time of press and subject to alteration without notice.

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. SEND SAE WITH ALL ENQUIRIES.

# HARVERSON SURPLUS CO. LTD.
**(Dept. P.W.) 170 MERTON HIGH ST., LONDON, S.W.19.** **Tel.: 01-540 3985**
*A few minutes from South Wimbledon Tube Station.* ***Open 9.30–5.30 Mon. to Fri. 9.30–5 Sat. Closed Wed.***

# VALVES

| | |
|---|---|
| A1065 | 1.40 |
| A2293 | 8.50 |
| A2900 | 8.00 |
| AR8 | 0.70 |
| ARP3 | 0.70 |
| ATP4 | 0.60 |
| B12H | 3.35 |
| CY31 | 1.20 |
| DAF96 | 0.70 |
| DET22 | 21.95 |
| DF96 | 0.70 |
| DK96 | 1.05 |
| DH76 | 1.00 |
| DL92 | 0.60 |
| DY86/87 | 0.65 |
| DY802 | 0.65 |
| E55L | 13.80 |
| E88CC/01 | 1.60 |
| E180CC | 1.60 |
| E180F | 6.80 |
| E182CC | 3.95 |
| EA76 | 2.25 |
| EABC80 | 0.60 |
| EB91 | 0.65 |
| EBC33 | 1.15 |
| EBF80 | 0.60 |
| EBF83 | 0.60 |
| EBF89 | 0.80 |
| EC52 | 0.50 |
| ECC81 | 0.65 |
| ECC82 | 0.60 |
| ECC83 | 0.65 |
| ECC84 | 0.55 |
| ECC85 | 0.60 |
| ECC86 | 1.40 |
| ECC88 | 0.75 |
| ECC189 | 0.95 |
| ECF80 | 0.60 |
| ECF82 | 0.55 |
| ECF801 | 0.90 |
| ECH34 | 1.15 |
| ECH35 | 1.70 |
| ECH42 | 0.95 |
| ECH81 | 0.60 |
| ECH84 | 1.20 |
| ECL80 | 0.70 |
| ECL82 | 0.65 |
| ECL83 | 1.40 |
| ECL85 | 0.75 |
| ECL86 | 0.75 |
| EF37A | 1.70 |
| EF39 | 3.30 |
| EF40 | 0.80 |
| EF41 | 0.85 |
| EF80 | 0.50 |
| EF83 | 1.70 |
| EF85 | 0.55 |
| EF86 | 1.40 |
| EF91 | 1.30 |
| EF92 | 0.85 |
| EF95 | 0.95 |
| EF183 | 0.85 |
| EF184 | 1.85 |
| EF804 | 2.30 |
| EFL200 | 0.95 |
| EH90 | 0.80 |
| EL32 | 1.10 |
| EL34 | 1.75 |
| EL37 | 3.45 |
| EL38 | 4.60 |
| EL41 | 0.95 |
| EL81 | 1.20 |
| EL82 | 0.70 |
| EL84 | 0.90 |
| EL86 | 1.05 |
| EL90 | 1.50 |
| EL91 | 3.25 |
| EL95 | 0.80 |
| EL504 | 1.85 |
| EL802 | 1.70 |
| EL822 | 7.50 |
| EM31 | 0.85 |
| EM80 | 0.70 |
| EM81 | 0.70 |
| EM84 | 0.50 |
| EM87 | 1.15 |
| EY51 | 0.55 |
| EY81 | 0.55 |
| EY86/87 | 0.65 |
| EY88 | 0.65 |
| EZ80 | 0.55 |
| EZ81 | 0.10 |
| GY501 | 1.05 |
| GZ32 | 0.75 |
| GZ33 | 3.95 |
| GZ34 | 2.30 |
| GZ37 | 2.80 |
| KT66 | 5.75 |
| KT88 | 7.20 |
| MH4 | 1.15 |
| ML6 | 1.15 |
| N78 | 10.45 |
| OA2 | 0.65 |
| OB2 | 0.70 |
| PABC80 | 0.60 |
| PC85 | 0.60 |
| PC86 | 0.95 |
| PC88 | 0.85 |
| PC900 | 1.45 |
| PCC84 | 0.75 |
| PCC89 | 0.65 |
| PCC189 | 0.75 |
| PCF80 | 0.95 |
| PCF82 | 0.50 |
| PCF84 | 0.75 |
| PCF86 | 0.80 |
| PCF200 | 1.05 |
| PCF201 | 1.05 |
| PCF801 | 1.05 |
| PCF802 | 0.75 |
| PCF805 | 2.10 |
| PCF806 | 0.95 |
| PCF808 | 2.05 |
| PCH200 | 0.95 |
| PCL81 | 0.70 |
| PCL82 | 0.75 |
| PCL84 | 0.80 |
| PCL86 | 0.80 |
| PCL805/85 | 0.85 |
| PD500 | 4.35 |
| PFL200 | 2.80 |
| PL36 | 0.95 |
| PL81 | 0.85 |
| PL82 | 0.60 |
| PL83 | 0.60 |
| PL84 | 0.75 |
| PL504 | 1.60 |
| PL508 | 1.50 |
| PL509 | 3.65 |
| PL802 | 3.15 |
| PLL80 | 3.45 |
| PY33 | 0.70 |
| PY80 | 0.70 |
| PY81/800 | 0.70 |
| PY82 | 0.60 |
| PY83 | 0.60 |
| PY88 | 0.80 |
| PY500 | 1.55 |
| PY809 | 6.45 |
| PY801 | 0.70 |
| QQV03/10 | 2.85 |
| QQV03/12 | 2.85 |
| QQV06/40A | 16.10 |
| QV03-12 | 2.80 |
| SCL/400 | 4.50 |
| SCL/600 | 4.50 |
| SP61 | 0.95 |
| TT21 | 11.80 |
| U25 | 1.15 |
| U26 | 1.00 |
| U27 | 1.15 |
| U191 | 0.85 |
| U281 | 0.65 |
| U301 | 0.65 |
| U600 | 11.50 |
| U801 | 0.90 |
| UABC80 | 0.90 |
| UAF42 | 0.85 |
| UBF80 | 0.70 |
| UBF89 | 0.60 |
| UBL1 | 1.15 |
| UBL21 | 2.50 |
| UCC84 | 0.75 |
| UCC85 | 0.80 |
| UCF80 | 0.90 |
| UCH81 | 0.70 |
| UCL82 | 0.85 |
| UF41 | 0.90 |
| UF80 | 0.60 |
| UF85 | 0.70 |
| UL41 | 0.85 |
| UL84 | 0.85 |
| UM80 | 0.70 |
| UM84 | 0.70 |
| UY82 | 0.65 |
| UY85 | 0.60 |
| VR105/30 | 2.15 |
| VR150/30 | 1.45 |
| X66 | 1.05 |
| X61M | 1.70 |
| Z800U | 3.45 |
| Z801U | 4.00 |
| Z900T | 2.55 |
| 1A3 | 0.70 |
| 1L4 | 0.50 |
| 1R5 | 0.65 |
| 1S4 | 0.45 |
| 1S5 | 0.45 |
| 1T4 | 0.45 |
| 1U4 | 0.80 |
| 1X2B | 1.30 |
| 2D21 | 0.80 |
| 2K25 | 12.40 |
| 2X2 | 0.90 |
| 3A4 | 0.70 |
| 3D6 | 0.50 |
| 3D21 | 23.00 |
| 3E29 | 6.60 |
| 3S4 | 0.60 |
| 5B/254M | 8.80 |
| 5B/255M | 8.80 |
| 5B/258M | 8.80 |
| 5R4GY | 1.30 |
| 5U4G | 1.10 |
| 5V4G | 0.80 |
| 5Y3GT | 0.80 |
| 5Z3 | 1.15 |
| 5Z4G | 0.85 |
| 5Z4GT | 0.90 |
| 6AB7 | 0.70 |
| 6AC7 | 0.70 |
| 6AH6 | 1.15 |
| AK5 | 0.65 |
| 6AK8 | 0.60 |
| AL5 | 0.50 |
| 6AL5W | 0.80 |
| 6AM5 | 1.85 |
| 6AM6 | 0.75 |
| 6AN8 | 3.60 |
| 6AQ5 | 0.90 |
| 6AQ5W | 1.45 |
| 6AS6 | 0.90 |
| 6AT6 | 0.85 |
| 6AU6 | 0.65 |
| 6AV6 | 0.60 |
| 6AX4GT | 0.95 |
| 6AX5GT | 1.15 |
| 6B7 | 0.85 |
| 6BA6 | 0.50 |
| 6BE6 | 0.60 |
| 6BG6G | 1.15 |
| 6BJ6 | 1.25 |
| 6BQ7A | 0.70 |
| 6BR7 | 2.70 |
| 6BW6 | 3.20 |
| 6BW7 | 1.15 |
| 6C4 | 0.70 |
| 6C6 | 0.70 |
| 6CH6 | 7.50 |
| 6CL6 | 1.70 |
| 6CY5 | 1.15 |
| 6D6 | 0.85 |
| 6EA8 | 3.20 |
| 6F6GB | 0.85 |
| 6F8G | 0.85 |
| 6F12 | 0.90 |
| 6F14 | 0.90 |
| 6F15 | 1.30 |
| 6F17 | 1.15 |
| 6F24 | 4.75 |
| 6F33 | 4.75 |
| 6H6 | 1.90 |
| 6J4 | 1.60 |
| 6J4WA | 2.00 |
| 6J5GT | 1.35 |
| 6J6 | 0.85 |
| 6J7 | 0.90 |
| 6J7G | 0.60 |
| 6K7 | 0.80 |
| 6K7G | 0.50 |
| 6K8GT | 0.65 |
| 6L6M | 2.15 |
| 6L6GT | 1.75 |
| 6L7G | 0.75 |
| 6L18 | 0.70 |
| 6LD20 | |
| 6Q7G | 0.95 |
| 6SA7 | 0.65 |
| 6SG7 | 0.90 |
| 6SJ7 | 0.80 |
| 6SJ7GT | 0.60 |
| 6SK7 | 1.05 |
| 6SL7GT | 0.85 |
| 66SN7GT | 0.85 |
| 6SQ7 | 0.85 |
| 6V6GT | 0.95 |
| 6X4 | 0.70 |
| 6X5GT | 0.65 |
| 6Y6G | 1.10 |
| 6Z4 | 0.75 |
| 6-30L2 | 2.05 |
| 7B7 | 0.90 |
| 7V4 | 0.90 |
| 9D2 | 0.70 |
| 9D6 | 0.85 |
| 10C2 | 0.70 |
| 10F18 | 0.70 |
| 10P13 | 0.70 |
| 11E2 | 12.40 |
| 12A6 | 0.70 |
| 12AT6 | 0.55 |
| 12AT7 | 0.65 |
| 12AU7 | 0.60 |
| 12AV6 | 0.80 |
| 12AX7 | 0.65 |
| 12BA6 | 0.60 |
| 12BE6 | 1.25 |
| 12BH7 | 1.10 |
| 12C8 | 0.65 |
| 12E1 | 4.95 |
| 12J5GT | 0.55 |
| 12K7GT | 0.70 |
| 12K8GT | 0.80 |
| 12Q7GT | 0.65 |
| 12SC7 | 0.65 |
| 12SH7 | 0.85 |
| 12SJ7 | 0.65 |
| 12SQ7 | 0.85 |
| 12Y4 | 0.55 |
| 13D6 | 0.70 |
| 14S7 | 1.15 |
| 19AQ5 | 0.90 |
| 19G3 | 11.50 |
| 19G6 | 6.90 |
| 19H5 | 19.55 |
| 20D1 | 0.75 |
| 20F2 | 0.75 |
| 20E1 | 1.30 |
| 20P1 | 0.65 |
| 20P3 | 0.80 |
| 20P4 | 1.30 |

**V.A.T. INCLUDED**

**POSTAGE:** £1-£2 20p; £2-£3 30p; £3-£5 40p; £5-£10 60p; over £10 free, minimum order £1.

A lot of these valves are imported and prices vary for each delivery, so we reserve the right to change prices for new stock when unavoidable.

**VALVES AND TRANSISTORS**
Telephone enquiries for valves, transistors, etc.: retail 749 3934, trade and export 743 0899.

## COLOMOR
**(ELECTRONICS) LTD.** 907353/London
**170 Goldhawk Rd., London W.12**
**Tel. 01-743 0899**
**Open Monday to Friday 9-12.30, 1.30-5.30 p.m.**

# STEPHENS-JAMES LIMITED

*COMMUNICATION ENGINEERS*
47 WARRINGTON ROAD, LEIGH WN7 3EA
ENGLAND
Telephone (0942) 676790

Everything for the Short Wave Listener.
We stock receivers and listening aids by most of the world's leading manufacturers. Full range of VHF receivers—transceivers. Mobile equipment pre-selectors—filters—antennas. Stabilised power supplies from 2 to 20 Amp. Antenna switches—converters. Aluminium masts—clamps. Antenna rotators.

**Yaesu**
FRG7-FRG7000

**Drake**
SSR-1 • SPR4 • R4C •

**Secondhand Equipment**
Our secondhand equipment stock changes daily. Send S.A.E. for latest price list. Part exchanges welcome.
Access-Barclaycard and H.P. facilities.

**TRIO**
R-300-R820S

**Lowe SRX30 Receiver**

**Antenna Multituners**
Designed and manufactured by ourselves. Over 1000 sold in over 50 countries.

Mk2 covers 550 Khz 30Mhz **£25·56**
Prices include VAT and postage.

# PRACTICAL WIRELESS T.V. SOUND TUNER

**(Nov. 75 article by A. C. Ainslie)** ***Copy of original article supplied on request***

IF Sub-Assembly (G8) **£7·82.** P&P 85p.
Mullard ELC1043 V'cap UHF Tuner **£6·33.** P&P 40p.
3-way Station Control Unit **£1·38.** P&P 30p.
6-way Station Control Unit (Special Offer) **£1·15.** P&P 35p.
Power Supply Prtd Circuit Board **£1·15.** P&P 35p.
Res, Caps, Semiconds, etc. for above **£6·67.** P&P 45p.
Mains Transformer for above **£2·88.** P&P 35p.
P&P all items 95p.
*(Price of goods and P&P includes 15% VAT)*
**Callers welcome at shop premises.**

## MANOR SUPPLIES
**172 WEST END LANE, LONDON NW6**
***(Near W. Hampstead Tube Stn.)*** **Tel. 01-794 8751**

NEW LOW PRICES · ALL EX-STOCK

**REAL-STATE-OF-THE-ART**

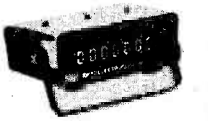
**NEW AC/DC/BATTERY PORTABLE FREQUENCY COUNTER FROM OPTOELECTRONICS USA**

Model OPTO 7000

**7 DIGITS 10Hz to 600MHz**

ONLY £141.45 inc. (was £168)
(£120 + £3 p&p + VAT £18.45)

Complete with built-in NiCads, charging circuits & rear panel switch for 1Hz resolution.



Size only 1¾"H × 4¼"W × 5¼"D.
The miniature go anywhere counter that gives you more range, visibility accuracy and versatility than any comparable unit at anywhere near as low price.

★ TCXO time base 0·8PPM/°C (0·0001% accuracy) less than 2PPM per year aging ★ Deluxe gold and black anodised aluminium case ★ H1Z and 50 ohm imputs ★ 1 sec and 1/10 sec gate times ★ Built in prescaler and preamps standard ★ Auto decimal ★ BNC connectors ★ No direct connect required for RF pick up ★ State of the art LS1 circuitry ★ Sensitivity 10mV to 60MHz 25mV to 150MHz 50mV to 450MHz (less than 75mV guaranteed) ★ Power requirement 7·5V AC/DC – less than 250mA.

**ELENCO PRECISION DMM 1200B**

ONLY £66.70 inc.
(£55 + £3 p&p + VAT £8.70)
(for a limited period only)

The most versatile DMM we have ever offered at lowest ever price!

★ 3½ digit jumbo LED (0·56") display ★ 0·05% basic accuracy ★ Measures AC/DC voltages from 100 microvolt to 1000 volts. AC/DC current from 1 microamp to 2 amp and resistance from 0·01 ohm to 20 Megohm ★ Fully overload protected to 1000 volts.

★ High input impedance to 10 Megohm ★ Mains (with adaptors not supplied) or battery (both disposable and Nicads) operation ★ Uses 1% precision resistors not unstable trimpots ★ Hi Lo power ohms. Hi for diodes, Lo for resistors in circuit (on how many DMM's costing less than £100 do you find this feature!)

**ELENCO POWER SUPPLY MODEL XP–90**

**13·8V · 8 amps Regulated only £63.25 inc.**

Elenco Precision Power Supplies let you operate your mobile or marine or mobile two way radio, CB, tape player AM/FM car radio, or other mobile equipment right in your own home. Elenco provides the exact output voltage no matter what current you use. No loss of power when you transmit due to dropping voltage. Fool proof current protection minimizes surge current that may damage your expensive equipment, works 1000 times faster than any fuse, automatic self resetting. Special circuit protects equipment, user and itself!

SPECIFICATIONS:-

| | |
|---|---|
| Input Voltage | 240V AC |
| Output Voltage | 13·8V DC |
| Output Current | 8 amps |
| Load Regulation | ·15V |
| Line Regulation | ·15V |
| Ripple Max. RMS | ·01V |
| Current Protection | 8A Limit |
| Short Protection | 1A Fold back |
| Crowbar Protection | Yes |
| Output Impedance | ·025 ohms |

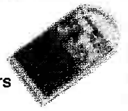
**BE THE HIT AT PARTIES!**

**YAP BOX – 3 Discreet Sounds**

ONLY £9.95 inc.

- Laser Gun
- Siren
- Ray Gun

Plus many others



Use on car PA system, bicycle horn, or protection against would be attackers.

Invent your own sound effects, make believe you're the police or fireman.
GREAT FOR KIDS OF ALL AGES.

**Maclin-Zand Electronics Ltd.**
**38 Mount Pleasant, London WC1 0AP**
**Tel: 01-837 1165**

PW12

Please send me..............................................

.................................@.................................

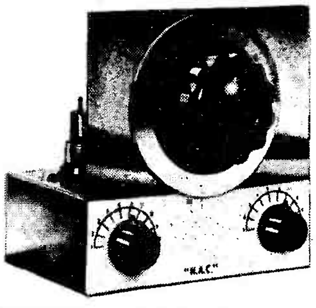
Name..............................................................

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

.......................................................................

# H.A.C. SHORT-WAVE KITS

**WORLD-WIDE RECEPTION**




'H.A.C.' well known by amateur constructors for its Short Wave receivers, now offers a complete range of kits and accessories to suit the novice and the expert.

£12·00 INCLUSIVE—the ever popular and easy to construct DX receiver Mark III; containing all genuine short wave components, drilled chassis, valve, accessories and full instructions.

NEW T TWIN TRANSISTOR RECEIVER, selective, sensitive and with fantastic reception, yet needing only a single PP3 battery, at £14·50 this receiver is outstanding value, and will give you hours of interest and entertainment.

Lastly the K and K plus (illustrated above) for the more advanced constructor. This receiver has recently been re-designed for even better reception. All orders despatched within 7 days. Send stamped and addressed envelope now for free descriptive catalogue of kits and accessories.

**SORRY, NO CATALOGUES WITHOUT S.A.E.**

**"H.A.C." SHORT-WAVE PRODUCTS**
**P.O. Box No. 16, 10 Windmill Lane**
**Lewes Road, East Grinstead, West Sussex RH19 3SZ**

# OSMABET LTD

We make transformers amongst other things.

**LOW VOLTAGE TRANSFORMERS: Prim 240V ac.**
6·3V 1·5A **£3·00;** 3A **£4·15;** 6A CT **£7·90;** 12V 1·5A **£3·75;** 3A CT **£7·90;** 6A CT **£9·75;** 15V 0·5A **£3·00;** 18V 1·5A CT **£7·90;** 24V 1·5A CT **£7·90;** 3A CT **£9·75;** 5A CT **£18·00;** 8A CT **£29·25;** 12A CT **£37·50;** 40V 3A CT **£13·50.**

**TWIN SEC TRANSFORMERS: Prim 240V ac.**
6V 0·6A – 6V 0·6A; 9V 0·4A – 9V 0·4A; 12V 0·3A – 12V 0·3A; 20V 0·15A – 20V 0·15A; all at **£4·15** each; 15V 0·75A – 15V 0·75A **£6·40;** 15V 1·5A – 15V 1·5A **£8·25;** 18V 1A – 18V 1A **£7·90;** 18V 1·5A – 18V 1·5A **£9·75;** 20V 1·5A – 20V 1·5A **£9·75;** 12V 4A – 12V 4A **£12·00;** 25V 2A – 25V 2A **£12·00.**

**MIDGET RECTIFIER TRANSFORMERS: Prim 240V ac.**
6-0-6V 1·5A or 9-0-9V 1A **£3·40** each; 12-0-12V 1A or 20-0-20V 0·75A **£4·15** each; 9-0-9V 0·3A or 12V-0-12V 0·25A or 20V-0-20V 0·15A **£3·00** each.

**LT TRANSFORMERS TAPPED SEC: Prim 240V ac.**
0-10-12-14-16-18V 2A **£7·50;** 4A **£9·40;** 0-12-15-20-24-30V 2A **£8·25;** 4A **£12·00;** 0-20-30-60V 1A **£9·00;** 2A **£12·00;** 0-40-50-60-80-100-110V 1A **£12·00.**

**AUTO TRANSFORMERS 110/240V ac.**
30 watt to 4000 watt ex stock, lists.

**MAINS TRANSFORMERS, SPECIAL OFFER: Prim 240V ac.**
250-0-250V 60 Ma, 6·3V 1A **£2·50;** 250V 100Ma, 6·3V 2A **£3·50;** 9V 3A **£2·50;** 25V 300 Ma **90p.**

**LOUDSPEAKERS**
2¼in, 2½in, 2¾in, 8 ohm, 3in 35Ω, 3½in 3, 8, 16 or 80Ω all **£1·50** each; 8×5in, C/M, 4, 8 or 25Ω, **£3·50** each. Many other types available.

**"INSTANT" BULK CASSETTE/TAPE ERASER**
Instant erasure of cassettes, and any diameter of tape spools, demangnetises tape heads, 200/240V ac, leaflet **£7·50.**

**EDGWISE LEVEL METER FSD 200/μA**
Size 19×18×20mm 800Ω **£1·50.**

**CHARGING METERS 1½in diameter**
2A or 3A **£1·25** each; 5A or 10A **£1·50** each.

**SYNCHRONOUS GEARED MOTORS, 240V ac.**
Brand new, built in gear box, 1 r.p.h. **£1·25** each.

**O/P TRANSFORMERS FOR VALVE AMPLIFIERS**
P.P..sec tapped 3-8-15Ω A-A 6KΩ. 30W **£17·50;** A-A 3KΩ 50W **£26·00;** 100W (EL31, KT88 etc) **£35·00.**

**G.E.C. MANUAL OF POWER AMPLIFIERS**
Covers valve amplifiers 30W to 400W **£1·25.**

**MULTIWAY SCREENED CABLE, PVC COVERED**
36 way **£1·00;** 25 way **75p;** 14 way **50p;** 6 way **25p;** 4 way **20p;** 2 way **10p;** 1 way **8p;** 4 way individually screened **30p;** fig 8 twin stereo do screened **15p,** metre.

**CONDENSERS**
Electrolytic 400 @ 400V **75p;** 2000/30V **30p;** 2200/40V **40p;** 8 – 8mfd 450V **40p;** Paper tubular, W/E, 4/160V; 6/160V **30p** each. 2mfd 150V **25p.**

**CARRIAGE EXTRA ON ALL ORDERS**
**ALL PRICES INCLUDE V.A.T.**

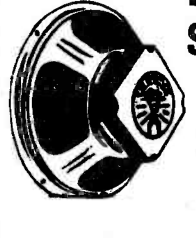
**Callers by appointment only. S.A.E. Enquiries, Lists.**

**46, Kenilworth Road, Edgware, Middsx. HA8 8YG. Tel: 01-958 9314**

# Sonic

HI-FI DISCOUNT CENTRES

# DISCOUNT SPEAKERS



**Imp 8 or 15 as app. Guarantees:**
**TITAN 5 years**
**FANE LIFETIME**
**OTHERS 1 year**
**ALL PRICES INC. VAT**

Prices correct at 20.7.79

## GENERAL PURPOSE

| | Rec. Ret. Price | Sonic Price |
|---|---|---|
| 5" FANE 501 | — | £4.95 |
| 8" AF MODEL 80 | — | £5.95 |
| 8" AF MODEL 83 | — | £6.95 |
| 8" FANE 808T DUAL CONE | — | £3.95 |
| 10" ELAC 10RM 10 WATTS | — | £2.50 |

## HI-FI KITS

| | | |
|---|---|---|
| AF FRI 8" + TWEETER | — | £14.95 pr |
| FANE MODE ONE 8" + TWEETER | — | £19.99 pr |
| WHARFEDALE DENTON KIT | £42.41 pr | £30.95 pr |
| WHARFEDALE SHELTON KIT | £54.32 pr | £38.95 pr |
| WHARFEDALE LINTON KIT | £75.53 pr | £52.95 pr |
| WHARFEDALE GLENDALE KIT | £92.78 pr | £65.95 pr |

## GROUP/DISCO TYPES

| | | |
|---|---|---|
| 12" TITAN T12/50R | £20.20 | £16.95 |
| 12" TITAN T12/100A | £39.95 | £26.95 |
| 12" CELESTION G12H 30W | £22.48 | £14.95 |
| 12" CELESTION G12/50 50W | £19.68 | £12.95 |
| 12" GOODMANS PD | — | £22.95 |
| 12" GOODMANS PG | — | £21.95 |
| 12" FANE SPECIALIST P.A.85 | £33.81 | £23.95 |
| 12" FANE SPECIALIST DISCO 80/2 | £34.88 | £24.95 |
| 12" FANE SPECIALIST DISCO 100/2 | £37.01 | £25.95 |
| 12" FANE SPECIALIST GUITAR 80L | £33.81 | £23.95 |
| 12" FANE SPECIALIST GUITAR 80B/2 | £34.88 | £24.95 |
| 12" FANE CRESCENDO 80 | £53.20 | £36.95 |
| 12" FANE CRESCENDO 80LT | £57.24 | £39.95 |
| 12" FANE CRESCENDO 12E | £74.50 | £51.95 |
| 15" TITAN T15/70 70W | £36.95 | £24.95 |
| 15" TITAN T15/85 | £42.95 | £28.95 |
| 15" TITAN T15/100 100W | £47.95 | £35.95 |
| 15" FANE SPECIALIST BASS 100 | £51.07 | £35.95 |
| 15" FANE CRES. COLOSSUS 15E 200W | £129.88 | £89.95 |
| 18" GOODMANS 18P | — | £46.95 |
| 18" TITAN T18/100 100W | £59.95 | £46.95 |
| 18" CELESTION G18/200 std. | £68.88 | £48.95 |
| 18" FANE CRESCENDO 18E | £122.42 | £85.95 |
| 18" FANE CRES. COLOSSUS 18E 200W | £138.40 | £96.95 |

## HORN UNITS

| | | |
|---|---|---|
| CELESTION MH1000 25W | £20.95 | £14.95 |
| FANE J44 | £8.47 | £5.95 |
| FANE J73 | £13.79 | £8.95 |
| FANE J104 | £20.18 | £13.95 |

## CROSSOVERS (FOR ABOVE)

| | | |
|---|---|---|
| FANE HPX1R OR HPX2R | £4.21 | £2.95 |

Mail Orders/Export enquiries to above. Add £1 carr. on Hi-Fi spkrs. or kits. Otherwise add £1·25 (12" Spkr). £1·50 (15") £2·50 (18")

**SPECIAL OFFER!**
**COLLARO RECORD DECKS**

* 'S' Shaped Arm * Auto or Manual
* 11" Turntable * Ideal for Disco
**£15.95 ea. or 2 for £30.**
Carr. £1.00 ea.

Also for personal shoppers only

**AMPS, T'TABLES, JINGLE MACHINES, DISCO CONSOLES, LIGHTING, CABINETS, CREDIT TERMS AVAILABLE** orders over **£20**

BARCLAYCARD VISA

**GREENTHORPE MILLS**
**GREENTHORPE**
**LEEDS LS13 4LQ**

# 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/P.O.s OR 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 30p TO ALL ORDERS UNDER £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, 1n5, 2n2, 3n3, 4n7, 6n8, 10n, 15n, **9p**; 18n **10p**; 22n, 33n **11p**; 47n, 68n **14p**; 100n **17p**; 150n, 220n **24p**; 330n, 470n **41p**; 680n **48p**; 1μF **64p**; 2.2μ **82p**.
**160V:** 10nF, 12n, 39n, 100n, 150n, 220n **11p**; 330n, 470n **19p**; 680n, 1μF **22p**; 2.2μF **32p**; 4.7μF **36p**.
**1000V:** 10n, 15n **20p**; 22n **22p**; 47n **26p**; 100n **38p**; 470n **53p**; 1μF **175p**.

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

**ULTRASONIC TRANSDUCERS** **350p** per pair

**ELECTROLYTIC CAPACITORS:** Axial lead type (Values are in μF). **500V:** 10 **40p**; 47 **68p**; **250V:** 100 **65p**; **63V:** 0.47, 1.0, 1.5, 2.2, 2.5, 3.3, 4.7, 6.8, 8, 10, 15, 22 **8p**; 32, 47, 50 **12p**; 63, 100, **27p**; **50V:** 1.0 **7p**; 50, 100, 220 **25p**; 470 **32p**; 1000 **50p**; **40V:** 22, 33μF **8p**; 100 **12p**; 2200, 3300 **85p**; 4700 **98p**; **35V:** 10, 33 **7p**; 330, 470 **32p**; 1000 **50p**; **25V:** 10, 22, 47 **6p**; 80, 100, 160 **8p**; 220, 250 **13p**; 470, 640 **25p**; 1000 **27p**; 1500 **30p**; 2200 **45p**; 3300 **62p**; 4700 **74p**; **16V:** 10, 40, 47, 68 **7p**; 100, 125 **8p**; 220, 330 **14p**; 470 **16p**; 1000, 1500 **20p**; 2200 **34p**; **10V:** 100 **6p**; 640 **12p**; 1000 **14p**.
**TAG-END TYPE: 450V:** 100μF **180p**; **70V:** 4700 **165p**; **64V:** 3300 **130p**; 2500 **98p**; **50V:** 3300 **105p**; 2200 **99p**; **40V:** 15,000 **399p**; 4700 **120p**; 4000 **92p**; 3300 **93p**; 2500 **85p**; 2200 **85p**; 2000+2000 **120p**; **30V:** 4700 **90p**; **25V:** 6400 **105p**; 4700 **85p**; 3300 **80p**; 2200 **60p**.

**TANTALUM BEAD CAPACITORS**
**35V:** 0.1μF, 0.22, 0.33, 0.47, 0.68, 1.0, 2.2μF, 3.3, 4.7, 6.8. **25V:** 1.5, 10. **20V:** 1.5μ. **16V:** 10μF **13p** each.
**16V:** 15μ, 22 **25p**; 47, 100, 220 **40p**. **10V:** 15μ, 22, 33 **20p**; 100 **35p**; **6V:** 47μ, 68, 100 **30p**; **3V:** 100 **20p**.

**POTENTIOMETERS** (AB or EGEN)
Carbon Track, 0.25W Log & 0.5W Linear Values. Rotary Type.

| | |
|---|---|
| 470Ω, 680Ω 1K, 2K (Lin only) Single | **27p** |
| 5KΩ to 2MΩ Single gang | **27p** |
| 5KΩ to 2MΩ Single with D/P switch | **65p** |
| 5KΩ to 2MΩ Dual gang | **78p** |

**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, 0.2 **10p**. **50V:** 0.47μF **12p**

**SLIDER POTENTIOMETERS**
0.25W log and linear values 60mm track

| | |
|---|---|
| 5KΩ 500KΩ Single gang | **70p** |
| 10KΩ 500KΩ Dual gang | **80p** |
| Self-Stick graduated Alum. Bezels | **25p** |

**CERAMIC CAPACITORS 50V**
Range: 0.5pF to 10nF **4p**
15nF, 22nF, 33nF, 47nF **5p** 100nF **6p**

**PRESET POTENTIOMETERS**

| | | |
|---|---|---|
| 0.1W 50Ω-2.2M Mini. Vert. & Horiz. | | **7p** |
| 0.25W 100Ω-3.3MΩ Horiz. | larger | **10p** |
| 0.25W 250Ω-4.7MΩ Vert. | | **10p** |

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

**RESISTORS**–5% carbon, High Stab. Miniature, Low Noise

| | Range | Val. | 1-99 | 100+ |
|---|---|---|---|---|
| ¼ | 2Ω2-4M7 | E24 | 2p | 1p |
| 0.5W | 2Ω2-4M7 | E12 | 2p | 1p |
| 1W | 2Ω2-10M | E12 | 5p | 3p |
| *2% Metal Film* | *10Ω-1M* | | 6p | 4p |
| 1% 0.5W | 51Ω-1M | E24 | 10p | 8p |

N.B. 100+ price applies to Resistors of each type not mixed values.

**VEROBOARD**

| | 0.1 (copper | Pitch 0.15 clad) | 0.1 (plain) | 0.15 |
|---|---|---|---|---|
| 2½"×3¾" | 49p | 39p | 31p | 24p |
| 2½"×5" | 55p | 50p | — | 31p |
| 3¾"×3¾" | 55p | 50p | — | — |
| 3¾"×5" | 62p | 67p | 50p | 43p |
| 3¾"×17" | 218p | 180p | 141p | 120 |
| 4¾"×17" | 280p | — | — | 183p |

| | | | |
|---|---|---|---|
| Pkt of 36 pins | 20p | VQ Board | 90p |
| Spot face cutter | 85p | DIP Board | 268p |
| Pin insertion tool | 120p | 'S' Board | 1270p |

**COPPER CLAD BOARDS**

| Fibre Glass | Single-sided | Double-sided | SRBP 9" × 8.5" |
|---|---|---|---|
| 6"×6" | 75p | 90p | 80p |
| 6"×12" | 130p | 175p | |

**FERRIC CHLORIDE**
1lb **95p**+35p p&p

**DALO ETCH RESIST PEN**
+6p **75p**

**SOLDERCON PINS**
100 pins **50p**;
500 pins **£2.00**

**VEROWIRING PEN**
+spool **325p**

**DIL SOCKETS**

| | Low profile | Wire wrap |
|---|---|---|
| 8 pin | 10p | 25p |
| 14 pin | 12p | 35p |
| 16 pin | 13p | 46p |
| 18 pin | 16p | 52p |
| 20 pin | 22p | 65p |
| 22 pin | 25p | 70p |
| 24 pin | 36p | 78p |
| 28 pin | 39p | 85p |
| 36 pin | — | 105p |
| 40 pin | 50p | 109p |

**EDGE CONNECTORS**

| | ·1 | ·15 |
|---|---|---|
| 2×10 way | — | 85p |
| 2×15 way | — | 99p |
| 2×18 way | 115p | 120p |
| 2×22 way | 130p | 135p |
| 2×25 way | 149p | 160p |
| 2×30 way | 170p | — |
| 2×36 way | 194p | — |
| 2×40 way | 210p | — |
| 2×43 way | 232p | — |

**DENCO COILS**
Dual Purpose 'DP'
VALVE TYPE
Ranges: 1-5 Bl. Yl. Rd. Wht. **92p**
6-7 B, Y, R **82p**
1-5 Green **100p**
'T'-type (Transistor Tuning).
Ranges: 1-5 Bl. Yl. Rd. Wht. **105p**

| | |
|---|---|
| B9A Valve Base | 25p |
| RDT2 | 98p |
| RFC 5 chokes | 104p |
| RFC 7(19mH) | 104p |
| 1FT 13/14/15/16 17 | 110p |
| 1FT 18/1.6 | 102p |
| 1FT 18/465 | 114p |
| TOC1 | 92p |
| MW 5FR | 88p |
| MW/LW 5FR | 112p |

**JACKSONS VARIABLE CAPS.**

| | |
|---|---|
| Dielectric | |
| 100/300pF | 140p |
| 500pF | 165p |
| 6:1 Ball Drive 4511/DAF | 115p |
| Dial Drive 4103 6:1/36:1 | 650p |
| Drum 54mm | 30p |
| 0-1-365pF | 245p |
| 00 2 365pF | 275p |
| 00-2-500pF | 525p |
| 0 2 365pF with slow motion Drive | 326p |
| 00 208/176 | 285p |
| „ „ with slow motion drive | 325p |
| C804-5pF; 10; 15; 25; 50pF | 175p |
| 100, 150pF | 235p |
| 'L' 3×310pF | 495p |
| 00-3×25pF | 430p |

**TRANSISTORS**

| | p | | p | | p | | p | | p |
|---|---|---|---|---|---|---|---|---|---|
| AC125 | 20 | BC441 | 36 | MJ491 | 160 | ZTX304 | 24 | 2N3906 | 17 |
| AC126 | 20 | BC461 | 36 | MJ2955 | 105 | ZTX314 | 24 | 2N4037 | 52 |
| AC127 | 20 | BC477 | 25 | MJE340 | 54 | ZTX326 | 40 | 2N4058 | 17 |
| AC128 | 20 | BC547 | 12 | MJE370 | 58 | ZTX341 | 20 | 2N4061 | 17 |
| AC141 | 24 | BC548 | 12 | MJE371 | 60 | ZTX500 | 15 | 2N4062 | 17 |
| AC142 | 24 | BC549C | 13 | MJE2955 | 105 | ZTX501 | 15 | 2N4427 | 75 |
| AC176 | 24 | BC557 | 15 | MJE3055 | 70 | ZTX502 | 19 | 2N5172 | 25 |
| ACY17 | 40 | BC558 | 20 | MPF102 | 66 | ZTX503 | 15 | 2N5179 | 60 |
| ACY18 | 40 | BC559 | 20 | MPF103 | 36 | ZTX504 | 25 | 2N5191 | 70 |
| ACY19 | 40 | BCY70 | 18 | MPF104 | 36 | ZTX531 | 25 | 2N5305 | 40 |
| ACY20 | 40 | BCY71 | 20 | MPF105 | 36 | ZTX550 | 25 | 2N5457 | 32 |
| ACY21 | 35 | BCY72 | 20 | MPF106 | 40 | 40311 | 60 | 2N5458 | 32 |
| ACY22 | 40 | BD131 | 45 | MPSA05 | 25 | 40313 | 125 | 2N5459 | 32 |
| ACY28 | 40 | BD132 | 45 | MPSA06 | 25 | 40315 | 55 | 2N5485 | 35 |
| ACY39 | 78 | BD133 | 43 | MPSA12 | 42 | 40316 | 85 | 2N5642 | 750 |
| AD149 | 70 | BD135 | 38 | MPSA55 | 25 | 40362 | 48 | 2N5777 | 45 |
| AD161 | 42 | BD136 | 36 | MPSA56 | 25 | 40408 | 70 | 2N6027 | 40 |
| AD162 | 42 | BD137 | 36 | MPSU06 | 56 | 40411 | 295 | 3N128 | 112 |
| AF114 | 50 | BD138 | 50 | MPSU56 | 60 | 40467 | 95 | 3N140 | 112 |
| AF115 | 50 | BD139 | 40 | OC26 | 170 | 40594 | 90 | **Matched Pair 20p extra** | |
| AF116 | 50 | BD140 | 36 | OC28 | 150 | 40595 | 98 | | |
| AF117 | 50 | BD144 | 198 | OC35 | 130 | 40603 | 65 | | |
| AF118 | 65 | BD145 | 198 | OC36 | 130 | 40594 | 90 | | |
| AF139 | 35 | BD205 | 110 | OC41 | 48 | 40595 | 98 | | |
| AF178 | 70 | BD378 | 65 | OC42 | 48 | 40603 | 65 | | |
| BC107 | 10 | BD434 | 42 | OC43 | 55 | 40673 | 68 | | |
| BC107B | 12 | BD517 | 65 | OC44 | 31 | 2N697 | 25 | | |
| BC108 | 10 | BD695A | 65 | OC45 | 28 | 2N698 | 44 | | |
| BC108B | 12 | BD696A | 65 | OC70 | 28 | 2N699 | 54 | | |
| BC108C | 12 | BDY56 | 156 | OC71 | 28 | 2N706A | 18 | | |
| BC109 | 10 | BF115 | 34 | OC72 | 45 | 2N708 | 19 | | |
| BC109B | 12 | BF167 | 30 | OC74 | 55 | 2N918 | 40 | | |
| BC109C | 12 | BF180 | 35 | OC76 | 36 | 2N1131 | 22 | | |
| BC140 | 35 | BF194 | 12 | OC81 | 50 | 2N1132 | 22 | | |
| BC142 | 30 | BF195 | 12 | OC82 | 50 | 2N1303 | 50 | | |
| BC143 | 30 | BF196 | 12 | OC83 | 48 | 2N1304 | 50 | | |
| BC147 | 8 | BF197 | 14 | OC84 | 44 | 2N1305 | 28 | | |
| BC147B | 10 | BF198 | 18 | OC140 | 110 | 2N1670 | 150 | | |
| BC148 | 8 | BF199 | 18 | OC170 | 85 | 2N1671B | 215 | | |
| BC148B | 10 | BF200 | 32 | OC171 | 75 | 2N2219A | 22 | | |
| BC148C | 10 | BF244 | 29 | OC200 | 85 | 2N2220A | 26 | | |
| BC149 | 8 | BF244B | 30 | TIP29 | 43 | 2N2221A | 23 | | |
| BC149C | 10 | BF256 | 60 | TIP29B | 56 | 2N2222A | 20 | | |
| BC153 | 27 | BF257 | 30 | TIP29C | 60 | 2N2369A | 15 | | |
| BC154 | 27 | BF258 | 30 | TIP30 | 47 | 2N2646 | 48 | | |
| BC157 | 10 | BF259 | 30 | TIP30B | 64 | 2N2784 | 55 | | |
| BC158 | 11 | BF274 | 18 | TIP30C | 65 | 2N2904 | 22 | | |
| BC159 | 11 | BF336 | 35 | TIP31A | 52 | 2N2905A | 22 | | |
| BC160 | 42 | BF594 | 40 | TIP31C | 65 | 2N2906 | 22 | | |
| BC167A | 11 | BF595 | 38 | TIP32A | 58 | 2N2907A | 22 | | |
| BC168C | 12 | BFR39 | 25 | TIP32C | 75 | 2N2926G | 10 | | |
| BC169C | 14 | BFR40 | 25 | TIP33A | 85 | 2N3053 | 20 | | |
| BC170 | 18 | BFR41 | 28 | TIP33C | 105 | 2N3054 | 55 | | |
| BC172 | 11 | BFR79 | 28 | TIP34A | 85 | 2N3055 | 48 | | |
| BC173 | 12 | BFR80 | 28 | TIP34C | 110 | 2N3442 | 146 | | |
| BC177 | 18 | BFR81 | 28 | TIP35A | 185 | 2N3663 | 26 | | |
| BC178 | 16 | BFR98 | 105 | TIP35C | 220 | 2N3702 | 11 | | |
| BC179 | 18 | BFX29 | 28 | TIP36A | 220 | 2N3703 | 11 | | |
| BC181 | 20 | BFX84 | 26 | TIP36C | 255 | 2N3704 | 11 | | |
| BC182 | 9 | BFX85 | 28 | TIP41A | 66 | 2N3705 | 11 | | |
| BC183 | 9 | BFX86 | 28 | TIP41B | 73 | 2N3706 | 11 | | |
| BC184 | 9 | BFX87 | 28 | TIP42B | 82 | 2N3707 | 11 | | |
| BC182L | 11 | BFX88 | 28 | TIP2955 | 65 | 2N3708 | 11 | | |
| BC183L | 11 | BFY50 | 20 | TIP3055 | 65 | 2N3709 | 11 | | |
| BC184L | 11 | BFY51 | 20 | TIS43 | 34 | 2N3710 | 16 | | |
| BC187 | 28 | BFY52 | 20 | TIS44 | 45 | 2N3711 | 12 | | |
| BC212 | 10 | BFY56 | 45 | TIS45 | 45 | 2N3822 | 130 | | |
| BC212L | 11 | BFY64 | 40 | TIS88A | 00 | 2N3771 | 233 | | |
| BC213 | 10 | BFY71 | 20 | TIS90 | 20 | 2N3772 | 195 | | |
| BC213L | 12 | BFY81 | 90 | TIS91 | 24 | 2N3773 | 288 | | |
| BC214 | 10 | BSX20 | 18 | ZTX107 | 12 | 2N3819 | 22 | | |
| BC214L | 13 | BSY95A | 18 | ZTX108 | 12 | 2N3820 | 45 | | |
| BC307B | 20 | BSZ26 | 75 | ZTX109 | 14 | 2N3823 | 95 | | |
| BC308B | 20 | BU105 | 140 | ZTX300 | 13 | 2N3866 | 90 | | |
| BC327 | 15 | BU205 | 190 | ZTX301 | 15 | 2N3903 | 20 | | |
| BC328 | 15 | BU208 | 225 | ZTX302 | 20 | 2N3904 | 18 | | |
| BC338 | 12 | MD8001 | 158 | ZTX303 | 25 | 2N3905 | 18 | | |

**74LS**

| | | | | | |
|---|---|---|---|---|---|
| LS00 | 11 | LS123 | 70 | 74LS398 | 276 |
| LS01 | 11 | LS124 | 180 | 74LS399 | 230 |
| LS02 | 12 | LS125 | 60 | 74LS447 | 144 |
| LS03 | 12 | LS126 | 60 | 74LS490 | 180 |
| LS04 | 12 | LS132 | 95 | 74LS668 | 182 |
| LS05 | 23 | LS136 | 55 | 74LS670 | 248 |
| LS08 | 22 | LS138 | 85 | 74LS673 | 1050 |
| LS09 | 22 | LS139 | 85 | 74LS674 | 1450 |
| LS10 | 20 | LS151 | 96 | | |
| LS11 | 22 | LS153 | 76 | | |
| LS12 | 23 | LS155 | 96 | | |
| LS13 | 38 | LS157 | 76 | | |
| LS14 | 75 | LS158 | 96 | | |
| LS15 | 30 | LS160 | 128 | | |
| LS20 | 20 | LS161 | 98 | | |
| LS21 | 22 | LS162 | 138 | | |
| LS22 | 22 | LS163 | 102 | | |
| LS26 | 48 | LS164 | 114 | | |
| LS27 | 28 | LS165 | 75 | | |
| LS28 | 48 | LS166 | 226 | | |
| LS30 | 22 | LS168 | 155 | | |
| LS32 | 27 | LS169 | 150 | | |
| LS33 | 39 | LS170 | 288 | | |
| LS37 | 39 | LS173 | 105 | | |
| LS38 | 39 | LS174 | 106 | | |
| LS40 | 28 | LS175 | 110 | | |
| LS42 | 98 | LS181 | 398 | | |
| LS47 | 63 | LS183 | 298 | | |
| LS51 | 24 | LS189 | | | |
| LS54 | 28 | LS189 | 430 | | |
| LS55 | 30 | LS191 | 140 | | |
| LS73 | 46 | LS192 | 132 | | |
| LS74 | 41 | LS193 | 130 | | |
| LS75 | 48 | LS194 | 166 | | |
| LS76 | 40 | LS195 | 136 | | |
| LS78 | 40 | LS196 | 100 | | |
| LS83 | 115 | LS197 | 140 | | |
| LS85 | 118 | LS199 | | | |
| LS86 | 43 | LS200 | 348 | | |
| LS90 | 38 | LS221 | 96 | | |
| LS91 | 104 | LS240 | 236 | | |
| LS92 | 89 | LS243 | 232 | | |
| LS93 | 89 | LS244 | 155 | | |
| LS95 | 116 | LS245 | 270 | | |
| LS96 | 116 | LS251 | 134 | | |
| LS107 | 44 | LS253 | 142 | | |
| LS109 | 55 | LS257 | 110 | | |
| LS112 | 55 | LS258 | 110 | | |
| LS113 | 50 | LS259 | 160 | | |
| LS114 | 50 | LS261 | 450 | | |
| LS122 | 70 | LS266 | 52 | | |
| | | LS273 | 244 | | |
| | | LS279 | 66 | | |
| | | LS280 | 250 | | |
| | | LS283 | 192 | | |
| | | LS290 | 128 | | |
| | | LS293 | 128 | | |
| | | LS295 | 185 | | |
| | | LS298 | 68 | | |
| | | LS299 | 468 | | |
| | | LS323 | 468 | | |
| | | LS365 | 65 | | |
| | | LS366 | 65 | | |
| | | LS367 | 65 | | |
| | | LS368 | 66 | | |
| | | LS373 | 180 | | |
| | | LS375 | 160 | | |
| | | LS374 | 155 | | |
| | | LS377 | 212 | | |
| | | LS378 | 184 | | |
| | | LS379 | 215 | | |
| | | LS384 | 86 | | |
| | | LS390 | 230 | | |
| | | LS393 | 230 | | |
| | | LS395 | 218 | | |

**VOLTAGE REGULATORS**

| | |
|---|---|
| 1A +ve 5V, 12V, 15, 18, 24V | 75p |
| 1A –ve | 85p |
| 100mA +ve 5V, 6, 8, 12, 15V | 30p |
| 100mA –ve | 65p |
| LM309K | 135p |
| LM317K | 350p |
| LM323K | 635p |
| LM723 | 38p |

**BRIDGE RECTIFIERS**

| | |
|---|---|
| 1A/50V | 20 |
| 1A/100V | 22 |
| 1A/400V | 29 |
| 1A/600V | 34 |
| 2A/50V | 35 |
| 2A/100V | 44 |
| 2A/200V | 48 |
| 2A/400V | 53 |
| 2A/600V | 65 |
| 4A/100V | 72 |
| 4A/400V | 79 |
| 4A/600V | 105 |
| 4A/800V | 120 |
| 6A/100V | 73 |
| 6A/400V | 90 |
| BY164 | 58 |
| VM18 DIL | 48 |

**SCRs THYRISTORS**

| | |
|---|---|
| 0.8/200V | 35 |
| 5A/100V | 32 |
| 5A/400V | 39 |
| 5A/600V | 43 |
| 8A/300V | 48 |
| 8A/600V | 85 |
| 12A/300V | 59 |
| 12A/800V | 150 |
| 15/700V | 195 |
| BT106 | 150 |
| C106D | 38 |
| TIC44 | 22 |
| 2N4444 | 140 |

**TRIACS**

| | |
|---|---|
| 3A/100V | 48 |
| 3A/400V | 50 |
| 8A/100V | 54 |
| 8A/400V | 64 |
| 8A/800V | 108 |
| 12A/100V | 60 |
| 12A/400V | 70 |
| 12A/800V | 130 |
| 16A/100V | 95 |
| 16A/400V | 105 |
| 25A/400V | 160 |
| 25A/800V | 250 |
| T2800D | 120 |

**DIAC**
ST2 20

**LINEAR IC's**

| | | | | | |
|---|---|---|---|---|---|
| 702 | 75 | LM10 | 450 | RC4136D | 120 |
| 709C 8 pin | 35 | LM301A | 30 | SAD1024 | 1350 |
| 709 14 pin | 38 | LM308T | 110 | SAS560 | 195 |
| 710* | 67 | LM311H | 120 | SAS570 | 195 |
| 723 14 pin | 39 | LM318H | 205 | SG3402 | 295 |
| 741 8 pin | 18 | LM324A | 68 | SN76003N | 170 |
| 747C 14 pin | 78 | LM339 | 70 | SN76013N | 140 |
| 748C 8 pin | 36 | LM348 | 90 | SN76013ND | 130 |
| 753 8 pin | 150 | LM349 | 125 | SN76018 | 148 |
| 810 | 159 | LM373 | 290 | SN76023N | 140 |
| AY-1-0212 | 580 | LM379 | 375 | SN76023ND | 130 |
| AY-1-1313A | 660 | LM380 | 80 | SN76033N | 175 |
| AY-1-1320 | 315 | LM381N | 145 | SN76115N | 215 |
| AY-1-5050 | 190 | LM381AN | 248 | SN76131 | 110 |
| AY-1-5051 | 145 | LM382 | 125 | SN76227N | 115 |
| AY-1-6721/6 | 195 | LM733 | 125 | SN76477 | 225 |
| AY-3-1015 | 560 | LM1458 | 50 | SN76660 | 90 |
| AY-3-8500 | 390 | LM3900 | 60 | SP8629 | 450 |
| AY-5-1013 | 450 | LM3909N | 70 | TAA621AX1 | 250 |
| AY-5-1224A | 260 | LM3911 | 125 | TAA661A | 155 |
| AY-5-1230 | 450 | LM3914 | 220 | TAA960 | 320 |
| AY-5-1315 | 560 | LM13600 | 125 | TAD100 | 159 |
| AY-5-1317A | 630 | M252AA | 750 | TBA120S | 70 |
| AY-5-3500 | 510 | M253AA | 795 | TBA540 | 220 |
| AY-5-3507A | 450 | MC1204 | | TBA550Q | 330 |
| AY-5-4007D | 638 | MC1303 | 88 | TBA990Q | 270 |
| AY-5-8100 | 735 | MC1304P | 260 | TBA641-A12/ | |
| CA3011 | 100 | MC1310P | 150 | BX1 or 8X11 | 250 |
| CA3014 | 137 | MC1312PQ | 195 | TBA651 | 180 |
| CA3018 | 68 | MC1495 | 350 | TBA800 | 90 |
| CA3020 | 170 | MC1496L | 92 | TBA810S | 95 |
| CA3023 | 170 | MC1596 | | TBA820 | 70 |
| CA3028A | 80 | MC1710 | 79 | TBA920Q | 260 |
| CA3035 | 240 | MC3302 | | TCA965 | 120 |
| CA3036 | 110 | MC3340P | 120 | TDA1004 | 290 |
| CA3043 | 190 | MC3360P | 120 | TDA1008 | 310 |
| CA3045 | 140 | MC3401 | 52 | TDA1022 | 575 |
| CA3046 | 71 | MC3403 | 135 | TDA1024 | 105 |
| CA3048 | 210 | MFC6040 | 97 | TDA2020 | 320 |
| CA3075 | 175 | MK50253 | 650 | TL061C | 76 |
| CA3080E | 70 | MK50362 | 650 | TL062CP | 125 |
| CA3081 | 190 | MK50398 | 635 | TL064CN | 199 |
| CA3089E | 210 | MM5303 | 635 | TL072CP | 125 |
| CA3090AQ | 398 | MM5307 | 1275 | TL074CN | 199 |
| CA3123 | 200 | MM57160 | 620 | TL081CP | 48 |
| CA3130 | 85 | MSM5526 | 850 | TL082CP | 96 |
| CA3140 | 70 | NE518 | 210 | TL083CP | 105 |
| ICL7106 | 795 | NE543K | 210 | TL084CP | 130 |
| ICL7107 | 975 | NE544 | 185 | UAA170 | 198 |
| ICL8038CC | 340 | NE555 | 22 | UAA180 | 198 |
| ICM7205 | 1150 | NE556DB | 60 | ZN414 | 90 |
| ICM7215 | 1025 | NE560 | 325 | ZN424E | 130 |
| ICM7216A | 2250 | NE561 | 395 | ZN425E | 415 |
| ICM7216B | 1950 | NE562B | 410 | ZN1034 | 200 |
| ICM7216C | 1950 | NE564 | 425 | | |
| ICM7217A | 790 | NE565A | 120 | | |
| ICM7555 | 89 | NE566 | 160 | | |
| LD130 | 452 | NE567V | 170 | | |
| LF365 | 98 | NE570 | 395 | | |
| | | NE571 | 420 | | |

**COMPUTER IC'S**

| | |
|---|---|
| 2102-2 | 225 |
| 2111 | 195 |
| 2112-2N | 250 |

| | |
|---|---|
| 2114 | 550 |
| 2513 | 650 |
| 2708 | 775 |
| 27L08 | 995 |
| 2716 | 2550 |
| 4116 16K | 1025 |
| 4027 | 325 |
| 4047 | 750 |
| 74S00 | 60 |
| 74S04 | 73 |
| 74S132 | 00 |
| 74S138 | 250 |
| 74S158 | 00 |
| 74S188 | 185 |
| 74S189 | 158 |
| 74S194 | 00 |
| 74S195 | 00 |
| 74S241 | 195 |
| 74S262 | 895 |
| 74S287 | 325 |
| 74S470 | 325 |
| 74S472 | 1150 |
| 74S475 | 825 |
| 81LS95 | 125 |
| 81LS96 | 125 |
| 81LS97 | 137 |
| AY-5-2376 | 920 |
| CP1610 | 920 |
| MC1488 | 85 |
| MC1489 | 90 |
| MK4027 4K | 325 |
| MK4118 | 2099 |
| Z80 CPU2.5 | 990 |
| Z80 4M | 1099 |
| Z80 P10 | 660 |
| Z80 CTC | 595 |

**VDU IC'S**

| | |
|---|---|
| AY-3-1015 | 550 |
| AY-5-1013 | 450 |
| SFF96364E | 1050 |
| SFC71301 | 820 |
| SFS80102 | 205 |
| SN74265 | 63 |
| SN74LS163 | 118 |
| SN74S262 | 895 |
| SN75450 | 120 |
| SN75451 | 70 |
| SN75452 | 70 |
| SN75454 | 225 |
| TMS6011 | 355 |

**TTL 74**
**(TEXAS)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7400 | 11 | 03 | 12 | 95 | 65 | 190 | 95 |
| 7401 | 11 | 04 | 12 | 96 | 57 | 191 | 95 |
| 7402 | 11 | 05 | 18 | 97 | 189 | 192 | 98 |
| | | 06 | 28 | 100 | 119 | 193 | 98 |
| | | 07 | 38 | 104 | 62 | 194 | 98 |
| | | 08 | 17 | 105 | 62 | 195 | 98 |
| | | 09 | 17 | 107 | 29 | 196 | 93 |
| | | 10 | 11 | 109 | 54 | 197 | 80 |
| | | 11 | 20 | 110 | 54 | 198 | 150 |
| | | 12 | 17 | 111 | 68 | 199 | 150 |
| | | 13 | 30 | 112 | 125 | 221 | 132 |
| | | 14 | 45 | 116 | 198 | 246 | 204 |
| | | 16 | 30 | 118 | 83 | 247 | 204 |
| | | 17 | 30 | 119 | 149 | 248 | 240 |
| | | 20 | 16 | 120 | 115 | 249 | 204 |
| | | 21 | 29 | 121 | 25 | 251 | 125 |
| | | 22 | 17 | 122 | 46 | 265 | 63 |
| | | 23 | 27 | 123 | 48 | 273 | 320 |
| | | 25 | 27 | 125 | 38 | 278 | 220 |
| | | 26 | 36 | 126 | 57 | 279 | 119 |
| | | 27 | 27 | 128 | 74 | 298 | 185 |
| | | 28 | 35 | 132 | 73 | 75108 | 60 |
| | | 30 | 17 | 136 | 65 | 75150 | 175 |
| | | 32 | 25 | 141 | 56 | 75491 | 92 |
| | | 33 | 40 | 142 | 209 | 75492 | 92 |
| | | 37 | 30 | 143 | 314 | 75450 | 120 |
| | | 38 | 33 | 144 | 314 | 75451 | 70 |
| | | 40 | 15 | 145 | 65 | 75454 | 225 |
| | | 41 | 74 | 147 | 175 | | |
| | | 42 | 68 | 148 | 109 | | |
| | | 43 | 115 | 150 | 99 | | |
| | | 44 | 112 | 151 | 64 | | |
| | | 45 | 94 | 153 | 64 | | |
| | | 46 | 94 | 154 | 96 | | |
| | | 47 | 57 | 155 | 53 | | |
| | | 48 | 56 | 156 | 60 | | |
| | | 50 | 17 | 157 | 65 | | |
| | | 51 | 17 | 159 | 185 | | |
| | | 53 | 17 | 160 | 82 | | |
| | | 54 | 17 | 161 | 92 | | |
| | | 60 | 17 | 162 | 92 | | |
| | | 70 | 28 | 163 | 92 | | |
| | | 72 | 28 | 164 | 105 | | |
| | | 73 | 32 | 165 | 105 | | |
| | | 74 | 25 | 166 | 140 | | |
| | | 75 | 38 | 167 | 200 | | |
| | | 76 | 36 | 170 | 185 | | |
| | | 80 | 48 | 172 | 625 | | |
| | | 81 | 86 | 173 | 120 | | |
| | | 82 | 69 | 174 | 87 | | |
| | | 83 | 72 | 175 | 87 | | |
| | | 84 | 95 | 176 | 75 | | |
| | | 85 | 75 | 177 | 78 | | |
| | | 86 | 31 | 178 | 153 | | |
| | | 89 | 140 | 180 | 85 | | |
| | | 90 | 30 | 181 | 165 | | |
| | | 91 | 75 | 182 | 88 | | |
| | | 92 | 38 | 184 | 135 | | |
| | | 93 | 32 | 185 | 135 | | |
| | | 94 | 78 | 188 | 275 | | |

**CMOS***

| | | | | | |
|---|---|---|---|---|---|
| 4000 | 13 | 4033 | 145 | 4175 | 99 |
| 4001 | 13 | 4034 | 116 | 4194 | 108 |
| 4002 | 15 | 4035 | 111 | 4408 | 720 |
| 4006 | 87 | 4036 | 335 | 4409 | 720 |
| 4007 | 18 | 4037 | 100 | 4410 | 720 |
| 4008 | 82 | 4038 | 108 | 4411 | 958 |
| 4009 | 38 | 4039 | 320 | 4412V | 1380 |
| 4010 | 38 | 4040 | 105 | 4415F | 795 |
| 4011 | 15 | 4041 | 80 | 4415V | 795 |
| 4012 | 18 | 4042 | 75 | 4419 | 280 |
| 4013 | 42 | 4043 | 94 | 4422 | 545 |
| 4014 | 80 | 4044 | 95 | 4433 | 996 |
| 4015 | 82 | 4045 | 145 | 4435 | 825 |
| 4016 | 45 | 4046 | 128 | 4440 | 1275 |
| 4017 | 82 | 4047 | 87 | 4450 | 295 |
| 4018 | 87 | 4048 | 58 | 4451 | 295 |
| 4019 | 48 | 4049 | 48 | 4452 | |
| 4020 | 95 | 4050 | 48 | 4490F | 695 |
| 4021 | 95 | 4051 | 72 | 4490V | 525 |
| 4022 | 85 | 4052 | 73 | 4501 | 19 |
| 4023 | 22 | 4053 | 72 | 4502 | 120 |
| 4024 | 66 | 4054 | 110 | 4503 | 69 |
| 4025 | 19 | 4055 | 128 | 4506 | 51 |
| 4026 | 180 | 4056 | 135 | 4507 | 55 |
| 4027 | 45 | 4057 | 1950 | 4508 | 298 |
| 4028 | 81 | 4059 | 480 | 4510 | 99 |
| 4029 | 99 | 4060 | 115 | 4511 | 150 |
| 4030 | 58 | 4061 | 1425 | 4512 | 98 |
| 4031 | 205 | 4062 | 995 | 4513 | 206 |
| 4032 | 100 | 4063 | 110 | 4514 | 265 |
| | | 4066 | 58 | 4515 | 299 |
| | | 4067 | 380 | 4516 | 120 |
| | | 4068 | 22 | 4517 | 382 |
| | | 4069 | 20 | 4518 | 102 |
| | | 4070 | 32 | 4519 | 55 |
| | | 4071 | 21 | 4520 | 108 |
| | | 4072 | 21 | 4521 | 228 |
| | | 4073 | 21 | 4522 | 149 |
| | | 4075 | 23 | 4526 | 149 |
| | | 4076 | 85 | 4527 | 152 |
| | | 4077 | 40 | 4528 | 99 |
| | | 4078 | 21 | 4529 | 145 |
| | | 4081 | 20 | 4530 | 85 |
| | | 4082 | 21 | 4531 | 135 |
| | | 4085 | 74 | 4532 | 115 |
| | | 4086 | 73 | 4534 | 575 |
| | | 4089 | 150 | 4536 | 365 |
| | | 4093 | 78 | 4538 | 142 |
| | | 4094 | 190 | 4539 | 105 |
| | | 4095 | 105 | 4541 | 135 |
| | | 4096 | 105 | 4543 | 155 |
| | | 4097 | 372 | 4549 | 375 |
| | | 4098 | 110 | 4550 | 398 |
| | | 4099 | 145 | 4554 | 150 |
| | | 4160 | 109 | 4556 | 72 |
| | | 4161 | 109 | 4557 | 451 |
| | | 4162 | 109 | 4558 | 105 |
| | | 4163 | 109 | | |
| | | 4174 | 110 | | |

**DIODES**

| | |
|---|---|
| AA119 | 18 |
| BY100 | 24 |
| BY127 | 12 |
| CR033 | 148 |
| OA9 | 75 |
| OA70 | 12 |
| OA79 | 12 |
| OA81 | 15 |
| OA85 | 14 |
| OA90 | 7 |
| OA91 | 7 |
| OA95 | 8 |
| OA200 | 9 |
| OA202 | 8 |
| 1N914 | 4 |
| 1N916 | 5 |
| 1N4001/2 | 5 |
| 1N4003/4 | 5 |
| 1N4005/6 | 6 |
| 1N4007 | 7 |
| 1N4148 | 4 |
| 3A/100V | 18 |
| 3A/400V | 20 |
| 3A/600V | 27 |
| 3A/1000V | 30 |

**NOISE DIODE**
Z5J 180

**ZENERS**
2V7 to 33V 400mW **8p**
3V3 to 33V 1.3W **15p**

**VARICAPS**

| | |
|---|---|
| MVAM115 | 140 |
| BA102 | 25 |
| BB104 | 40 |
| BB105B | 40 |
| BB106 | 40 |

**SUPER-BOARD II**
Micro-computer now only
**£188.00**
**For demo call in at our shop**

# THE CHOICE IS YOURS!

YAESU

## YAESU MUSEN
## General Coverage Communications Receiver FRG-7

**£182.75** PLUS VAT

● **0.5-29.9MHz Coverage with 10kHz Readout**
The FRG-7 is a precision-built all-purpose communications receiver, featuring all solid state construction for long life and high performance. Utilizing the Wadley Loop drift cancellation system, in conjunction with a triple conversion superheterodyne circuit, the FRG-7 boasts high sensitivity along with excellent stability. It provides broadcast listeners with such features as a 3-position tone selector, an RF attenuator, and an automatic noise suppression circuit. For many years of satisfying reception, the FRG-7 is the receiver for you.

## YAESU MUSEN
## Digital Display Communications Receiver with CPU Digital Clock & Timer FRG-7000

**£327** PLUS VAT

● 0.25 Thru 29.9MHz Coverage with 1kHz Readout
Computer technology and convenience features are brought together in the FRG-7000, a digital-display general coverage receiver for the discriminating SWL. The digital clock and timer, controlled by a CPU (Central Processing Unit) chip, will read ut both local and GMT time, and will control peripheral station equipment such as a tape recorder. Improved SSB selectivity, ease of operation, and rugged construction are yours with the new FRG-7000 from YAESU.

**FULL DETAILS OF THESE EXCITING RECEIVERS FROM THE NUMBER ONE IMPORTER – PLUS EX-STOCK FREE SECURICOR DELIVERY!**

**(36 pence in stamps brings Illustrated Brochure and our Credit Voucher value £3.60) – A 10 to 1 Winning Offer!**

G3FIK

**AMATEUR ELECTRONICS UK**
508-514 ALUM ROCK ROAD
BIRMINGHAM 8
Tel: 021-327-1497/6313
Telex: 337045

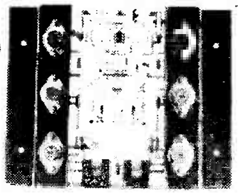
---

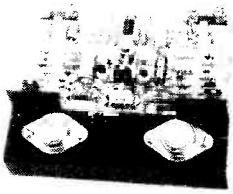
# TUAC

**TRANSISTOR UNIVERSAL AMPLIFICATION CO. LTD.**
**PHONE 01-672 3137/672 9080**
**MANUFACTURERS OF QUALITY AMPLIFICATION AND LIGHTING CONTROL SYSTEMS**

## NEW FROM TUAC

TD500





TD150

**7" × 9" × 1¾" ULTRA QUALITY HIGH POWER 5" × 5" × 2"**
**New D.C. Coupled Design**
**AMPLIFIERS**

**Featuring**—Electronic Short Open and Thermal Overload Protection.
**Brief Spec.**—Input Sensitivity 0·775 v. R.M.S. (O.D.B.) at 25K Ohms
Frequency Response 20 Hz – 20 KHz. T.H.D. at full power 0·1%
Hum and Noise—100 dB Relative full output.

**T.D. 500** 300W into 2 Ohms. 220W into 4 Ohms. 140W into 8 Ohms. .......... **£47.95**
Power supply P.S 300 .......... **£31.95**

**T.D.150** 150W into 4 Ohms. 100W into 8 Ohms. .......... **£27.95**
Power supply P.S. 150 .......... **£21.00**

**T.D. 150** 60 Version 60W into 8 Ohms. 40W into 15 Ohms. .......... **£21.00**
Power supply P.S 60 .......... **£16.50**
Note—P.S. 300 will drive 2 T.D. 150 amplifiers
All output ratings are R.M.S. continuous sine wave output.

**TO ORDER BY POST**
Make cheques/P.O.s payable to TUAC LTD., or quote Access/Barclay Card No. (We accept holders phone orders 01-672 9080.)
*Post to* –
**TUAC LTD., 119 CHARLMONT ROAD, LONDON SW17 9AB.**
Send stamp for our free 28 page catalogue of LIGHTING & AMPLIFIER MODULES. etc

---

# MAGNUM

at

BREAD BOARD 1979

Meet us on **Stand C3** where our NEW CATALOGUE will be on distribution, itemising:

**MAGNUM AUDIO MODULES**
**MAGNUM ENERGY CONSERVATION MODULES**
**FUTABA VF DISPLAYS** combined with
**OKI L.S.I.**
**DELPAK KEYBOARDS**
**DELPAK POWER SUPPLIES**

It you can't make the exhibition but would like a copy of our **New Catalogue,** send large S.A.E. to:

**MAGNUM AUDIO Ltd.**
**DEPT. PW12, 13 HAZELBURY CRESCENT, LUTON, LU1 1DF.**
**TEL: 0582 28887**

**ENGINEERS**

# FREE


**YOURSELF FOR A**

# BETTER JOB WITH MORE PAY!

Do you want promotion, a better job, higher pay? "New opportunities" shows you how to get them through a low-cost, Home Study Course. There are no books to buy and you can pay as you learn.

This easy to follow GUIDE TO SUCCESS should be read by every ambitious engineer. Send for this helpful 44-page free book NOW! No obligation, nobody will call on you. It could be the best thing you ever did.

## CHOOSE A BRAND NEW FUTURE HERE

**CUT OUT THIS COUPON**

Tick or state subject of interest.
Post to address below.

**ELECTRICAL & ELECTRONICS**
- Practical Radio & Electronics (with KIT) ☐
- Electronic Engineering Certificate ☐
- General Elect. Eng. Certificate ☐
- C. & G. Elect. Installations ☐
- Elect. Install. & Work ☐
- C. & G. Elect. Technicians ☐

**RADIO & TELECOM-MUNICATIONS**
- Colour TV Servicing ☐
- C. & G. Telecoms. Technician's Cert. ☐
- C. & G. Radio, TV & Electronics Mech. Cert. ☐
- Radio & TV Engineering Course ☐

- Radio, Servicing & Repairs ☐
- Radio Amateur's Exam. ☐

**AUTO & AERO**
- Motor Mechanics ☐
- C. & G. Motor V. Mechanics ☐
- General Auto Engineering ☐
- A.M.I.M.I. ☐
- Air Registration Board Certs. ☐
- M.A.A./I.M.I. Dip. ☐

**CONSTRUC-TIONAL**
- Heating, Ventilating & Air Conditioning ☐
- Architectural Draughtsmanship & Design ☐
- L.I.O.B. ☐
- Carpentry & Joinery ☐
- Plumbing Technology ☐
- General Building ☐

- Painting & Decorating ☐

**MECHANICAL**
- A.M.S.E. (Mech.) ☐
- General Mech. Eng. ☐
- Inst. Engineers & Technicians ☐
- Maintenance Engineering ☐
- Welding ☐

**MANAGEMENT & PRODUCTION**
- Computer Programming ☐
- Inst. of Cost & Managements Accts. ☐

**DRAUGHTS-MANSHIP & DESIGN**
- General Draughtsmanship ☐
- A.M.I.E.D. ☐
- Electrical Draughtsmanship ☐

POST NOW

**G.C.E.**
**—58 'O' & 'A' Level Subjects**
**—over 10,000 Group Passes!**

## Aldermaston College

**Dept. TPW 24, Reading RG7 4PF**

**also at our London Advisory Office, 4 Fore Street Avenue, London EC2Y 9DT. Tel. 628 2721.**

NAME (Block Capitals)

ADDRESS ...................................................................

...................................................................

............................................................ Postcode...............

Other subjects of interest............................................ Age...........

*Accredited by C.A.C.C. Member of A.B.C.C.*

**HOME OF BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY**

# TUNE IN!

## Build the World Famous CHROMA-CHIME

**Give your friends a warm welcome**

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

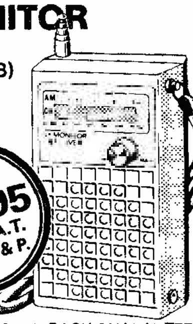
- Handsome purpose built ABS cabinet
- Easy to build and install
- Uses Texas Instruments TMS1000 microcomputer
- Absolutely all parts supplied including I.C. socket
- Ready drilled and legended PCB included
- Comprehensive kit manual with full circuit details
- No previous microcomputer experience necessary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

**ONLY £9.95 + 75p p&p UK ONLY**

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

**TMS 1000N** – MP0027A Microcomputer chip available separately if required. Full 24 tune spec device supplied with data sheet and fully guaranteed New low price only **£4.95** inc. p&p

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



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

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

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

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

PW1279

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

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

Signature ____________

# CHROMATRONICS

# BI-PAK SEMICONDUCTORS,

## TRANSISTORS

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

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

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

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

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

## 74 SERIES TTL ICs

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

## CMOS ICs

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

## LINEAR ICs

| Type | Price | Type | Price | Type | Price | Type | Price | Type | Price |
|---|---|---|---|---|---|---|---|---|---|
| CA3011 | £0.92 | CA3130 | £1.06 | MC1350 | £1.38 | UA710C | £0.46 | SN76115 | £2.18 |
| CA3014 | £1.55 | CA3140 | £0.80 | MC1352 | £1.61 | 72710 | £0.34 | SN76660 | £0.86 |
| CA3018 | £0.74 | LM301 | £0.33 | MC1469 | £3.39 | UA711C | £0.36 | SL414A | £2.24 |
| CA3020 | £1.95 | LM304 | £1.84 | MC1496 | £1.03 | 72711 | £0.36 | TAA550B | £0.40 |
| CA3028 | £0.92 | LM308 | £1.15 | NE536 | £3.05 | UA723C | £0.52 | TAA621A | £2.30 |
| CA3035 | £1.61 | LM309 | £1.72 | NE550 | £1.09 | 72723 | £0.52 | TAA621B | £2.87 |
| CA3036 | £1.15 | LM320-5V | £1.72 | NE555 | £0.27 | UA741C | £0.27 | TAA661 | £1.72 |
| CA3042 | £1.72 | LM320-12V | £1.72 | NE556 | £0.69 | 72741 | £0.27 | TAD100 | £1.49 |
| CA3043 | £2.12 | LM320-15V | £1.72 | NE565 | £1.38 | 741P | £0.23 | TBA540 | £2.41 |
| CA3046 | £0.80 | LM320-24V | £1.72 | NE566 | £1.38 | UA7447C | £0.69 | TBA810S | £0.86 |
| CA3052 | £1.84 | LM380 | £0.97 | NE567 | £1.95 | 72747 | £0.69 | TBA810 | £1.12 |
| CA3054 | £1.26 | LM381 | £1.66 | UA702C | £0.52 | UA748 | £0.40 | TBA820 | £0.80 |
| CA3075 | £1.72 | LM3900 | £0.66 | 72702 | £0.52 | 72748 | £0.40 | TBA9200 | £2.87 |
| CA3081 | £1.72 | MC1303L | £0.97 | UA703 | £0.28 | 748P | £0.40 | TCA270S | £2.30 |
| CA3089 | £2.30 | MC1304 | £2.18 | UA709 | £0.28 | SN76013N | £2.01 | TBA800 | £0.92 |
| CA3090 | £4.14 | MC1310 | £1.09 | 72709 | £0.52 | SN76023 | £2.01 | | |
| CA3123 | £2.18 | MC1312 | £2.18 | 709P | £0.28 | SN76110 | £1.72 | | |

## THYRISTORS

| 1 amp | TO 5 Case |
|---|---|
| Volts No: | Price |
| 50 THY1A/500 | £0.29 |
| 100 THY1A/100 | £0.32 |
| 200 THY1A/200 | £0.36 |
| 400 THY1A/400 | £0.43 |
| 600 THY1A/600 | £0.51 |
| 800 THY1A/800 | £0.66 |
| **3 amp** | **TO 66 Case** |
| Volts No: | Price |
| 50 THY3A/50 | £0.32 |
| 100 THY3A/100 | £0.34 |
| 200 THY3A/200 | £0.37 |
| 400 THY3A/400 | £0.48 |
| 600 THY3A/600 | £0.57 |
| 800 THY3A/800 | £0.74 |
| **5 amp** | **TO 66 Case** |
| Volts No: | Price |
| 50 THY5A/50 | £0.41 |
| 100 THY5A/100 | £0.51 |
| 200 THY5A/200 | £0.57 |
| 400 THY5A/400 | £0.65 |
| 600 THY5A/600 | £0.79 |
| 800 THY5A/800 | £0.93 |
| **7 amp** | **TO 48 Case** |
| Volts No: | Price |
| 50 THY7A/50 | £0.55 |
| 100 THY7A/100 | £0.58 |
| 200 THY7A/200 | £0.65 |
| 400 THY7A/400 | £0.71 |
| 600 THY7A/600 | £0.89 |
| 800 THY7A/800 | £1.05 |
| **10 amp** | **TO 48 Case** |
| Volts No: | Price |
| 50 THY10A/50 | £0.58 |
| 100 THY10A/100 | £0.65 |
| 200 THY10A/200 | £0.71 |
| 400 THY10A/400 | £0.80 |
| 600 THY10A/600 | £1.13 |
| 800 THY10A/800 | £1.40 |
| **16 amp** | **TO 48 Case** |
| Volts No: | Price |
| 50 THY16A/50 | £0.62 |
| 100 THY16A/100 | £0.66 |
| 200 THY16A/200 | £0.71 |
| 400 THY16A/400 | £0.88 |
| 600 THY16A/600 | £1.03 |
| 800 THY16A/800 | £1.59 |

## SILICON RECTIFIERS

| | |
|---|---|
| **200mA** | |
| IS920 50V | £0.07 |
| IS921 100V | £0.08 |
| IS922 150V | £0.09 |
| IS923 200V | £0.10 |
| IS924 300V | £0.11 |
| **1 Amp** | |
| IN4001 50V | £0.05 |
| IN4002 100V | £0.05 |
| IN4003 200V | £0.07 |
| IN4004 400V | £0.08 |
| IN4005 600V | £0.09 |
| IN4006 800V | £0.10 |
| IN4007 1000V | £0.11 |
| **1.5 Amp** | |
| IS015 50V | £0.10 |
| IS020 100V | £0.11 |
| IS021 200V | £0.12 |
| IS023 400V | £0.14 |
| IS025 600V | £0.16 |
| IS027 800V | £0.18 |
| IS029 1000V | £0.23 |
| IS031 1200V | £0.28 |
| **3 Amp** | |
| IN5400 50V | £0.16 |
| IN5401 100V | £0.17 |
| IN5402 200V | £0.18 |
| IN5404 400V | £0.19 |
| IN5406 600V | £0.24 |
| IN5407 800V | £0.28 |
| IN5408 1000V | £0.34 |
| **10 Amp** | |
| IS10/50 50V | £0.21 |
| IS10/100 100V | £0.24 |
| IS10/200 200V | £0.26 |
| IS10/400 400V | £0.40 |
| IS10/600 600V | £0.48 |
| IS10/800 800V | £0.58 |
| IS10/1000 1000V | £0.69 |
| IS10/1200 1200V | £0.79 |
| **30 Amp** | |
| IS30/50 50V | £0.64 |
| IS30/100 100V | £0.79 |
| IS30/200 200V | £1.06 |
| IS30/400 400V | £1.43 |
| IS30/600 600V | £2.02 |
| IS30/800 800V | £2.23 |
| IS30/1000 1000V | £2.65 |
| IS30/1200 1200V | £3.31 |
| **60 Amp** | |
| IS70/50 50V | £0.86 |
| IS70/100 100V | £0.96 |
| IS70/200 200V | £1.38 |
| IS70/400 400V | £2.01 |
| IS70/600 600V | £2.58 |
| IS70/800 800V | £2.87 |
| IS70/1000 1000V | £3.45 |

## OPTOELECTRONICS

**LED'S (diffused)**

| O/no. | Type | Price |
|---|---|---|
| 1501 | Size ·125mm RED | £0.11 |
| 1502 | Size ·125mm GREEN | £0.21 |
| 1503 | Size ·125mm YELLOW | £0.21 |
| 1504 | Size ·2mm RED | £0.11 |
| 1505 | Size ·2mm GREEN | £0.21 |
| 1506 | Size ·2mm YELLOW | £0.21 |
| 1509 | Size ·2mm CLEAR | £0.12 |

**SUPER 'Hi-Brite' Type**

| | | |
|---|---|---|
| 1521 | Size ·3mm (·125) RED | £0.11 |
| 1522 | Size ·5mm (·2) RED | £0.11 |
| 1514 | ORP12 Light dependant resistor | £0.63 |
| 1520 | OCP71 Photo transistor | £0.40 |

**LED CLIPS**

| | |
|---|---|
| 1508/·125 pack of 5 ·125 clips | £0.17 |
| 1508/·2 pack of 5 ·2 clips | £0.20 |

## DISPLAYS

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

DL707 RED 7 segment D.P. left (0·3" height) common anode single digit O/NO: 1510 **£0.92**

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

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

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

## OPTO-ISOLATORS

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

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

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

**CILQ74** Multi-channel 16 pin DIP four isolated channels O/NO: 1499 **£2.53**

**2nd GRADE LEO PAK**

A pack of 10 standard sizes and colours which fail to perform to their very rigid specification, but which are ideal for amateurs who do not require the full spec. O/NO: 1507 **£1.04**

## AUDIO MODULES

**Amplifiers**

| | | |
|---|---|---|
| AL20 | 5 watt amplifier module | £3.73 |
| AL30A | 7-10 watt amplifier module | £4.35 |
| AL60 | 15-25 watt amplifier module | £5.39 |
| AL80 | 35 watt amplifier module | £8.44 |
| AL120 | 50 watt amplifier module | £13.74 |
| AL250 | 125 watt amplifier module | £19.24 |

**Pre-amplifiers**

| | | |
|---|---|---|
| PA12 | Stereo pre-amplifier module | £8.94 |
| PA100 | Stereo pre-amplifier module | £18.45 |
| PA200 | Stereo pre-amplifier module | £19.07 |

**Power Supplies**

| | | |
|---|---|---|
| PS12 | Power supply (24 volts DC) | £1.72 |
| SPM80 | Stabilised power supply (33V) | £5.06 |
| SPM120/45 | Stabilised power supply (45V) | £6.67 |
| SPM120/55 | Stabilised power supply (55V) | £6.67 |
| SPM120/65 | Stabilised power supply (65V) | £6.67 |
| SG30 | Power supply for equaliser | £4.37 |

**Miscellaneous**

| | | |
|---|---|---|
| MPA30 | Stereo magnetic cartridge pre-amp | £4.42 |
| S.450 | Stereo tuner | £26.72 |
| Stereo 30 | Complete 7 watt stereo amplifier board | £22.66 |
| BP124 | Siren alarm module 5 watts | £4.02 |
| GE100MKII | 10 channel mono graphic equaliser | £23.00 |

## SOCKETS

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

## G.P. SWITCHING TRANSISTORS

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

## SILICON DIODES G.P.

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

## METAL FOIL CAPACITOR PAK

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

## JUMBO PAK SEMICONDUCTOR

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

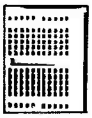
**ALL PRICES INCLUDE VAT. ADD 35p POST PER ORDER**

***Send your orders to:-***
**DEPT. PW12, PO BOX 6, WARE, HERTS. Tel: 0920-3182**
***Visit our NEW shop:* 3 BALDOCK ST., WARE, HERTS. Telex: 817861**

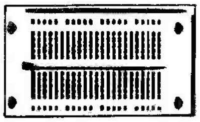
## EXPERIMENTOR BREADBOARDS FROM CSC

No soldering modular breadboards, simply plug components in and out of letter number identified nickel-silver contact holes. Start small and simply snap-lock boards together to build breadboard of any size.
All EXP Breadboards have two bus-bars as an integral part of the board, if you need more than 2 buses simply snap on 4 more bus-bars with the aid of an EXP.4B.

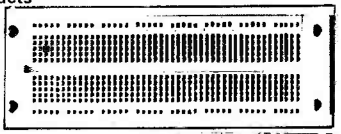
**EXP.325.** The ideal breadboard for 1 chip circuits.
Accepts 8, 14, 16 and up to 22 pin IC's.
**ONLY £1·70**



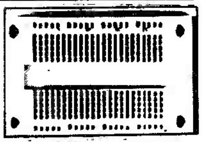
**EXP.350. £3·73**
270 contact points with two 20-point bus-bars.



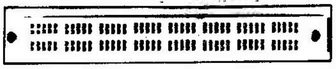
**EXP.300.**
550 contacts with two 40-point bus-bars.
**£6·13**



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



**EXP.4B.**
More bus-bars.
**£2·45**



ALL EXP.300 Breadboards mix and match with 600 series.

## ANTEX IRONS

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

## DIODES

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

## CASES AND BOXES

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

| No. | Length | Width | Height | Price |
|---|---|---|---|---|
| 155 | 8in | 5½in | 2in | **£1·72** |
| 156 | 11in | 6in | 3in | **£2·92** |
| 157 | 6in | 4¾in | 1¾in | **£1·79** |
| 158 | 9in | 5¼in | 2½in | **£2·43** |

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

| No. | Length | Width | Height | Price |
|---|---|---|---|---|
| 159 | 5¼in | 2¼in | 1½in | **£0·85** |
| 160 | 4in | 4in | 1½in | **£0·85** |
| 161 | 4in | 2¼in | 1½in | **£0·85** |
| 162 | 5¼in | 4in | 1½in | **£0·97** |
| 163 | 4in | 2½in | 2in | **£0·87** |
| 164 | 3in | 2in | 1in | **£0·80** |
| 165 | 7in | 5in | 2½in | **£1·43** |
| 166 | 8in | 6in | 3in | **£1·82** |
| 167 | 6in | 4in | 2in | **£1·18** |

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

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 169 | 2⅛in | 5⅜in | 2¾in | 12in | 3½in | 8in | **£5·45** |
| 168 | 2⅝in | 7¼in | 4in | 16in | 4½in | 11in | **£8·21** |

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

| No. | Length | Width | Height | Price |
|---|---|---|---|---|
| 170 | 140mm | 40mm | 205mm | **£4·14** |
| 171 | 140mm | 75mm | 205mm | **£4·62** |
| 172 | 140mm | 110mm | 205mm | **£6·00** |

## SPECIAL OFFERS

**MINIDRILL** 12v hand held battery-operated mini drill. 7,500 r.p.m. Collet chuck. Ideal for drilling printed circuits or model making. No.1402. **£7·79**

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

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

## CARBON RESISTOR PAKS

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

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

## CERAMIC PAKS

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

## ELECTROLYTIC PAKS

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

## COMPONENT PAKS

| | | |
|---|---|---|
| 16164 | 200 resistors mixed value approx (count by weight) | **£0·69** |
| 16165 | 150 capacitors mixed value approx (count by weight) | **£0·69** |
| 16167 | 80 1/2w resistors mixed values | **£0·69** |
| 16168 | 5 pieces assorted ferrite rods | **£0·69** |
| 16169 | 2 tuning gangs MW LW VHF | **£0·69** |
| 16170 | 1 pack wire 50 metres assorted colours single strand | **£0·69** |
| 16171 | 10 reed switches | **£0·69** |
| 16172 | 3 micro switches | **£0·69** |
| 16173 | 15 assorted pots | **£0·69** |
| 16175 | 30 paper condensers – mixed values | **£0·69** |
| 16176 | 20 electrolytics trans. types | **£0·69** |
| 16177 | 1 pack assorted hardware – nuts, bolts gromets etc | **£0·69** |

## BOOKS BY BABANI

| | | |
|---|---|---|
| BP6 | Engineers & Machinists Ref. Tables | **40p**† |
| BP14 | 2nd book Transistor Equivs & Subs | **£1·10**† |
| BP22 | 79 Electronic Novelty Circuits | **75p**† |
| BP24 | 52 Projects Using IC741 (or Equiv) | **75p**† |
| BP26 | Radio Antenna Book Long Distance Reception & Transmission | **85p**† |
| BP27 | Giant Chart of Radio Electronic Semiconductor & Logic Symbols | **60p**† |
| BP32 | Build Metal & Treasure Locatore | **85p**† |
| BP34 | Practical Repair/Renovation C/TV | **95p**† |
| BP35 | Handbook of IC Audio Preamplifier & Power Amplifier Construction | **95p**† |
| BP36 | 50 Cicts use Germ/Sil/Zener Diodes | **75p**† |
| BP37 | 50 Projects Using Relays/SCR/Triacs | **£1·10**† |
| BP39 | 50 Field Effect Trans Projects | **£1·25**† |
| BP40 | Digital IC Equivs & Pin Connection | **£2·50**† |
| BP41 | Linear IC Equivs & Pin Connection | **£2·75**† |
| BP42 | 50 Simple LED Circuits | **75p**† |
| BP43 | How to make Walki-Talkies | **£1·25**† |
| BP44 | IC 555 Timer Projects | **£1·45**† |
| BP45 | Projects on Opto-electronics | **£1·25**† |
| BP46 | Radio Circuits Using IC's | **£1·35**† |
| BP47 | Mobile Discotheque Handbook | **£1·35**† |
| BP48 | Electronics Projects for Beginners | **£1·35**† |
| BP49 | Popular Electronic Projects | **£1·45**† |
| BP50 | IC LM3900 Projects | **£1·35**† |
| BP55 | Radio Stations Guide | **£1·45**† |
| BP160 | Coil Design & Construction Manual | **85p**† |
| BP202 | Handbook of Integrated Circuits Equivalents & Substitutes | **75p**† |
| BP205 | 1st Book Hi-Fi Speaker Enclosures | **75p**† |
| BP213 | Circuits for Model Railways | **85p**† |
| BP215 | Shortwave Circuits & Gear for Experiments & Radio Hams | **85p**† |
| BP216 | Electronic Gadgets & Games | **85p**† |
| BP217 | Solid State Power Supply Handbook | **85p**† |
| BP221 | 28 Tested Transistor Projects | **95p**† |
| BP222 | Short-wave Receivers for Beginners | **95p**† |
| BP223 | 50 Projects using IC CA3130 | **95p**† |
| BP224 | 50 CMOS IC Projects | **95p**† |
| BP225 | A Practical intro to Digital IC's | **95p**† |
| BP226 | Build Advanced Short-wave Receivers | **£1·20**† |
| BP227 | Beginners Guide to Building Electronic Projects | **£1·25**† |

## REGULATORS

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

## BRIDGE RECTIFIERS

**SILICON 1 amp**

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

**SILICON 2 amp**

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

**SILICON 10 amp**

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

**SILICON 25 amp**

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

## CASSETTES

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

## TRIACS

**2 amp TO5 case**

| volts | No. | Price |
|---|---|---|
| 100 | TR12A/100 | **£0·36** |
| 200 | TR12A/200 | **£0·59** |
| 400 | TR12A/400 | **£0·82** |

**6 amp**

| volts | | |
|---|---|---|
| 100 | TR16A/100 | **£0·59** |
| 200 | TR16A/200 | **£0·70** |
| 400 | TR16A/400 | **£0·88** |

**10 amp**

| volts | | |
|---|---|---|
| 100 | TR110A/100 | **£0·88** |
| 200 | TR110A/200 | **£1·06** |
| 400 | TR110A/400 | **£1·29** |

**10 amp**

| volts | | |
|---|---|---|
| 400 | TR110A/400P | **£1·29** |

**DIACS**
BR100 **£0·23** 032 **£0·23**

## ZENER DIODES

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

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

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

## METAL FOIL CAPACITOR PAKS

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

***JUST QUOTE YOUR ACCESS OR BARCLAYCARD NO.***

BARCLAYCARD VISA

# Capacity for Confusion

THERE are some electronic components that seem to present few problems in identifying their type and value. The resistor, for instance, since it moved on from its original form of a hexagonal carbon rod with the value stamped on and a screw terminal at each end (in those days it was a resist*ance*), has just one universally accepted code, based on colour. Admittedly, those of us who were around at the time had to make the mind-blowing transition from the **B**ody **E**nd **D**ot (**BED**) system (remember the fun of identifying a $2{\cdot}2\mathrm{k}\Omega$?) to the Rings system, but at least the basic code has remained the same. And there are mnemonics to help us remember the code: **B**ye **B**ye **R**osie, **O**ff **Y**ou **G**o, **B**irmingham **V**ia **G**reat **W**estern (we're really into the nostalgia bit this month) and others, mostly unprintable!

Capacitors, or condensers for the old hands, have always given difficulty. They originally had the values printed or stamped on, but then someone had the idea of using a colour code. Unfortunately, it didn't stop there, and by the early 1950s reference books were quoting no less than seven different systems of marking capacitors by means of coloured dots. Mullard added yet another system for their C280 "mint humbug" polyester capacitors. Meanwhile, silvered mica, polystyrene and some other varieties continued to have values printed on.

Then came a new problem—capacitors were getting too small to carry all the coloured dots or bands required, so it was back to printed values again, using microscopic lettering. Things had got a lot easier since the old days when, admittedly, "0·00005 MFD" could take up rather a lot of space. With the widespread familiarity with picofarads and nanofarads, a simple unified system could be devised. But did the manufacturers take the opportunity to adopt a common system? Not on your life!

Instead, each seems to have dreamed up his own pet scheme. We now have capacitors marked in pF, tens of pF, nF, decimals of nF, and even a weird system using a numerical version of the colour code so that, for example, a 1nF is marked 102 (A "1", a "0" and two "0"s=1000pF). Add to this an assortment of other letters which presumably convey tolerance, temperature coefficient, working voltage and the like (maybe even the colour of the operator's socks), and is it any wonder that suppliers and users alike are confused, and equipment manufacturers are driven to devising their own crib sheets to translate the various codes for their own and their customers' benefit?

Incidentally, what does that Russian character which looks like a backward "N" signify on a capacitor? My dictionary tells me it's pronounced eeeeeeee . . .

PERSONALITY

**Joe Bishop—Technical Sub-Editor**
After spending the first sixteen years of his life on the same square mile of ground receiving a public school education, Joe reacted by joining first the Merchant Navy and then the Royal Corps of Signals in which he pursued a successful career for over ten years.

As the Irish say, Joe has "something of the travelling man" about him and there followed a period of some years working for a major telecommunications manufacturer as an Installation and Commissioning Engineer, specialising in tropospheric scatter, microwave and television broadcast equipment. From snorkel-diving in the Red Sea in July to antenna construction in the North Sea in midwinter, Joe did it all and enjoyed it all before coming finally to earth in his Dorset cottage.

Hobbies have generally been "those consistent with the available amenities" at a number of locations at home and overseas. Now that he has settled down, Joe intends to follow his first loves—good books, writing, concert-going, walking, sailing and "real ale".

# NEWS... NEWS... NEWS...

## R.A.I.B.C.

The Radio Amateur Invalid and Blind Club is currently celebrating its Silver Jubilee.

The Club is formed of invalid and blind members interested in amateur radio; their local representatives who undertake to help by visits, repairs and advice; and supporter members whose financial contributions enable help to be given. The sole condition of membership, in any of the above categories, is an annual subscription of £1 minimum for "Radial" the club newsletter which is issued every six weeks.

Would readers who are interested in joining this very worthy club, please contact: *Mrs F. E. Woolley, Hon Sec, R.A.I.B.C., 9 Rannoch Court, Adelaide Road, Surbiton, Surrey KT6 4TE.*

## New Catalogues

Toolrange Limited, the Reading based company who specialise in selling tools and production aids to the electronics market, have just issued their latest 104 page colour catalogue. The new catalogue contains over 2000 lines from some 80 manufacturers.

To obtain your copy of the catalogue apply to: *Toolrange Ltd., Upton Road, Reading RG3 4JA. Tel: (0734) 29446 or 22245.*

Available from Technocentre, a free, convenient pocket-sized electronics construction guide. Comprising nearly 200 coloured photographs and illustrations, circuit symbols and practical tips on mounting and soldering, make this handy-sized guide of particular interest to beginners, students, etc.

Send s.a.e. to: *Technocentre, 54 Adcott Road, Acklam, Middlesbrough TS5 7ES.*

Suhner have just produced a new edition of their Crimp Technique brochure. As well as giving comprehensive information about their connector crimping system for r.f. cables, the brochure has been updated to include Suhner's range of crimpable connectors. The brochure also gives details about tools, accessories, connectors and suitable cables as well as examining the physical and mathematical concepts behind the process of crimping.

Copies of the catalogue are available free of charge from: *Suhner Electronics Ltd., Telford Road, Bicester, Oxon OX6 OLA. Tel: (08692) 44676.*

## Breadboard '79

A larger "Breadboard", with more to see and do, is promised by the organisers, Trident International Exhibitions Ltd., at the *Royal Horticultural Halls, Elverton. Street, Westminster SW1* from Tuesday, 4 December to Saturday, 8 December inclusive.

Breadboard '78 attracted over 10,000 visitors and, once again, U.K. and overseas manufacturers and suppliers of components, tools and test equipment have been quick to take advantage of participating in this particular show.

Over 90 exhibition stands will feature micro-computer systems, analysers, logic test accessories, hi-fi amplifier kits, modulators, etc., as well as a varied range of exciting construction kits and TV games.

Competitions and demonstrations will take place during the show when visitors can participate, among other things, in constructing their own lie detectors and working radios.

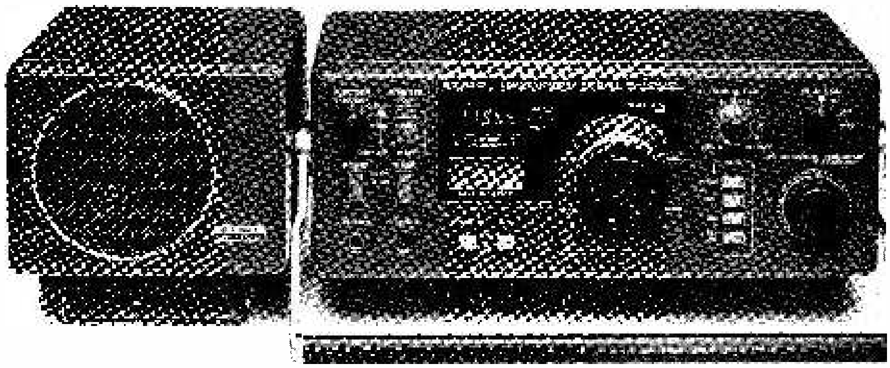
For further information contact: *Trident International Exhibitions Ltd., 21 Plymouth Road, Tavistock, Devon PL19 8AU. Tel: (0822) 4671.*

## Business News

Drake Transformers has acquired all the transformer interests of Lascar Electronics. The change coincides with the recent move by Lascar into portable instrumentation. Both parties express themselves as well pleased with the move. Peter Rowling, Drake MD explains: "Although long established as a high-quality manufacturer of OEM transformers, this acquisition gives us the opportunity to introduce a standard range of 'off the shelf' transformers. All Lascar services will continue, and we intend to ensure that no customers are inconvenienced by the changeover."

Details of the Drake standard range and services can be obtained from: *Drake Transformers, Kennel Lane, Billericay, Essex. Tel: (02774) 51155.*

## Latest from Trio



Lowe Electronics inform us that they now have the latest communications receiver from Trio in stock.

The R-1000 is a high class general coverage receiver covering 30 bands between 200kHz and 30MHz with a p.l.l. synthesiser that incorporates all of Trio's sophisticated electronic technology developed over recent years.

Both digital display readout (1kHz resolution) and analogue display (10kHz resolution) are provided for easy and accurate tuning.

The R-1000 also includes a quartz digital clock with timer, three i.f. filters, r.f. attenuation and tone control, etc., to ensure the best receiving conditions for each mode.

Due consideration has been given to innovative design and compactness, making the R-1000 an excellent station receiver for amateur radio operators, professionals, broadcast and short wave listeners, etc.

The R-1000 costs approximately £300 retail and as soon as we are able *Practical Wireless* will produce a "Radio Special Product Review" on the R-1000.

Further details from: *Lowe Electronics Ltd., 119 Cavendish Road, Matlock, Derbyshire DE4 3HE. Tel: (0629) 2817.*

# AERIALS for 160 Metres

## PART 2

J.R. GREEN G3WVR

Vertical aerials for low-frequency ground-wave propagation have been a topic of keen interest to the author for many years. In particular, due to their sheer impractical size, the question of optimum loading is paramount in their design.

## Theory

To avoid making the theoretical argument unnecessarily complicated, the basis of this section rests on two simple formulae which provide a good approximation to more complex methods:

$$\text{Aerial Efficiency} = \frac{R_{RAD}}{R_{RAD} + R_{DC} + R_G} \quad \ldots\ldots\ldots\ldots (1)$$

where $R_{RAD}$ = The radiation resistance of the aerial (dependent on useful length and height);
$R_{DC}$ = The ohmic d.c. resistance in all wire, coils, and radials;
$R_G$ = Ground losses, i.e., Earth resistance.

Near Field Strength $E$ (mV/metre)

$$= \frac{377 \times I_a \times h_e}{\lambda \times D} \quad \ldots\ldots\ldots\ldots (2)$$

where $I_a$ = Aerial current at the base of the aerial (amps);
$h_e$ = Effective height of the aerial;
$\lambda$ = Wavelength;
$D$ = Distance from aerial (kilometres).

Equation (2) is taken from the ITT *Reference Data for Radio Engineers*. Note that $h_e$ and $\lambda$ must be in the same units.

## Effective Height

The Effective Height ($h_e$) of a grounded vertical aerial is equal to the height of a vertical wire producing the same vertically polarised field as the actual aerial, provided that the vertical wire carries a current that is constant along its entire length and of the same value as the current at the base of the actual aerial. For the more mathematically minded, $I_a \times h_e$ is the value of the integrated sinusoidal current in the actual aerial of physical height $h$.

The diagram Fig. 6 shows clearly how this definition makes sense, the areas "A" and "B" being equal for the correct value of $h_e$. Typically, $h_e$ would range from $0{\cdot}5h$ for a very short vertical aerial, such as a base-loaded whip, to $0{\cdot}66h$ for a quarter-wave vertical.

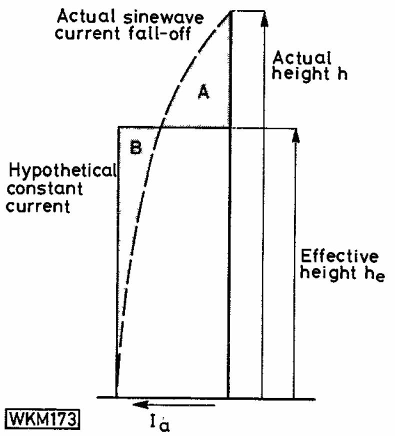



**Fig. 6: Relationship of Actual Height and Effective Height of a λ/4 vertical aerial. Areas "A" and "B" are equal**

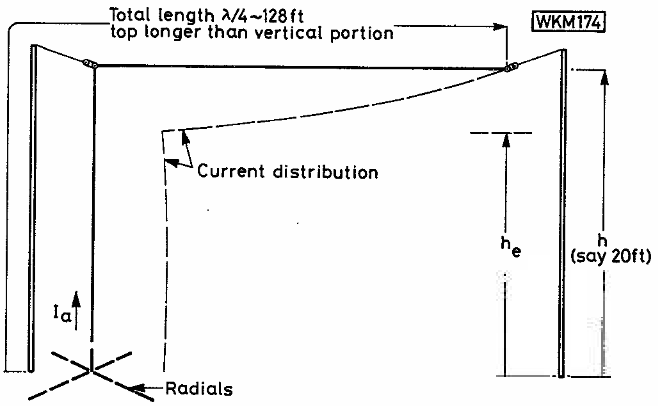



**Fig. 7: Current distribution and Actual and Effective Height relationship for an Inverted "L" aerial**

## Practical Implications

On the basis of theory, we may assume that:

1. From Equation (1), we require a large $R_{RAD}$ (which means a large aerial, and a small $R_{DC}$ (which means thick, heavy wire) and a small $R_G$ (which means a field full of radials).
2. From Equation (2), both $I_a$ and $h_e$ should be as large as possible.

These implications are not really very "practical" at all, but we can at least examine them to make the best use of what facilities are available. Let us first consider a commonly used amateur aerial, the Inverted "L". The diagram Fig. 7 shows a typical inverted "L" whose top section is much longer than the vertical section, and hence the current distribution is almost constant along the vertical portion. This gives an effective height $h_e$ which is nearly equal to the actual height, i.e., about 18ft, which is very poor compared with, say, a $\lambda/4$ vertical, whose effective height would be $128 \times 0{\cdot}66 = 84$ft, but better than a 20ft short vertical, whose $h_e$ would be only 10ft.

As regards radiation resistance, the inverted "L" is fairly good (i.e., high) because of its $\lambda/4$ length, but poor in respect that most of its radiation is horizontally polarised and very high-angle due to its low height.

The vertically-polarised radiation could be reduced by top loading in a non-radiating way. This will reduce the radiation resistance, thereby increasing $I_a$ in the vertical portion, and a greater vertically-polarised field strength will result, although the actual aerial efficiency is lower.

For the standard inverted "L", we might have

$$R_{RAD} = 30\Omega, \quad R_{DC} = 5\Omega, \quad R_G = 20\Omega$$

giving:

$$\text{Efficiency} = \frac{30\Omega}{30\Omega + 5\Omega + 20\Omega} = 55\%$$

and an effective height of 18ft.

The first step towards increasing $I_a$ without worsening $h_e$ is to use "T" top loading, as shown in Fig. 8. Note that the current distribution splits at the top of the vertical radiator and, to a first approximation, cancels out. This eliminates horizontally-polarised radiation and reduces the radiation resistance, increasing $I_a$ and actually increasing the vertically-polarised field strength.

Note that the efficiency might now be, say:

$$\frac{20\Omega}{20\Omega + 20\Omega + 5\Omega} = 45\%$$

but the higher value of $I_a$ still has the desired effect.

## LC Top Loading

The aerial may now be made more compact by using a smaller top composed of multiple wires to increase the capacitance, plus a top-loading inductor to bring the system to resonance, as shown in Fig. 9.

A large capacitance $C$ is preferable, since then less inductance $L$ is required and hence there is less loss ($R_{DC}$) in the $L$, and a wider bandwidth in the resonant frequency due to the lower $Q$ of the system.

The top section should be symmetrical if possible, in order to cancel horizontally-polarised radiation. Since the actual vertical portion will be small compared with a quarter wavelength, the $LC$ resonant frequency on its own will be only slightly higher than the overall aerial resonance, which is reduced by the extra radiator inductance.

Hence, it has been shown that top loading, although nominally not improving overall antenna efficiency, can usefully channel "wasted" horizontally-polarised radiation into improved vertically-polarised radiation, although I daresay that many users of inverted "L" aerials do not consider the horizontal component to be wasted!

## Improving Aerial Efficiency

By improving the efficiency we could, of course, improve the radiated field strength still further, since all we have done so far is to make the radiated energy all vertically-polarised. We must now consider the d.c. and ground losses.

The d.c. resistance losses are usually the least of our problems, since they are generally very low. However, the

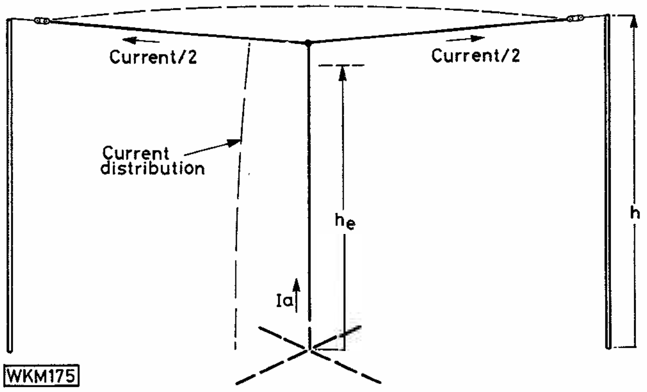



**Fig. 8: Current and height relationship for a "T" aerial**

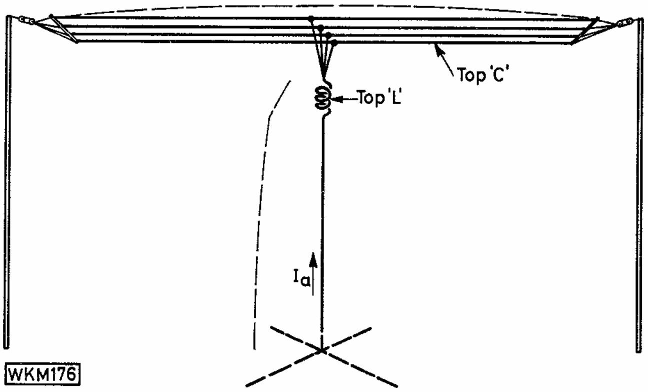



**Fig. 9: A "T" aerial with multiple top span giving added capacitance loading, and top loading inductance**

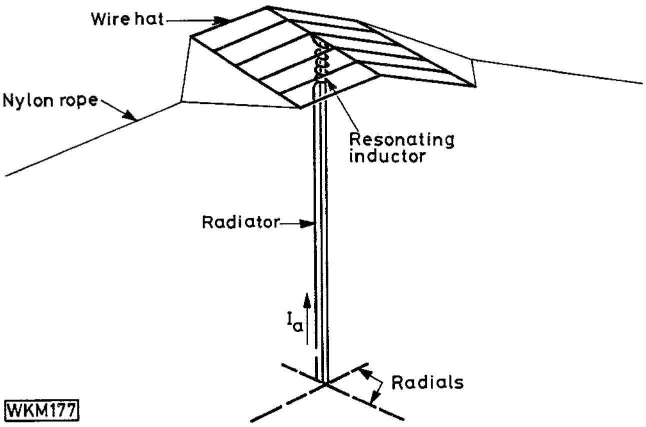



**Fig. 10: Top-hat loading for a single guyed mast aerial. For maximum efficiency, the guy ropes should be led down at the shallowest possible angle, so that the top hat encloses the minimum amount of the vertical radiating element**

use of a large capacity hat of reasonably thick wires plus an inductor wound from the thickest available wire (consistent with weight constraints) is advised, with the actual radiator constructed from coaxial cable braid, or aluminium tubing salvaged from Band I TV aerials or Band II f.m. aerial booms.

In view of the weight involved, the system may be adapted to a single guyed mast as shown in Fig. 10. The ground

## Comparison of an "Ideal" and a Practical Aerial

| **Ideal λ/4 Vertical** | **Practical Vertical** |
|---|---|
| Actual height ($h$) 128ft | Actual height ($h$) 38-40ft |
| Effective height ($h_e$) 84ft | Effective height ($h_e$) 35ft |
| $R_{RAD} = 37\Omega$ | $R_{RAD} = 10\Omega$ |
| $R_{DC} = 0\Omega$ | $R_{DC} = 2\Omega$ approx. |
| $R_G = 0\Omega$ | $R_G = 10\Omega$ approx. |
| Efficiency = 100% | Efficiency = say 45% |

**Aerial current for 7W r.f. input to aerial system**
(i.e., 10W d.c. input to transmitter p.a.)

| Ideal | Practical |
|---|---|
| $W = I^2 R_{total}$ | $W = I^2 R_{total}$ |
| $I_a = \sqrt{\dfrac{W}{R_{total}}}$ | $I_a = \sqrt{\dfrac{W}{R_{total}}}$ |
| $= \sqrt{\dfrac{7}{37}}$ | $= \sqrt{\dfrac{7}{22}}$ |
| $= 0{\cdot}435\text{A}$ | $= 0{\cdot}565\text{A}$ |

Note that $I_a$ is higher for the top-loaded vertical since $R_{total}$ is lower. This helps to compensate for its reduced efficiency

**Field strength at a distance $D$ of 1km**

| Ideal | Practical |
|---|---|
| $E = \dfrac{377 \times I_a \times h_e}{\lambda D}$ | $E = \dfrac{377 \times I_a \times h_e}{\lambda D}$ |
| $I_a = 0{\cdot}435\text{A}$ | $I_a = 0{\cdot}565\text{A}$ |
| $h_e = \dfrac{2}{3} \times \dfrac{\lambda}{4}$ | $h_e = \dfrac{35}{128} \times \dfrac{\lambda}{4}$ |
| $E = \dfrac{377 \times 0{\cdot}435 \times 0{\cdot}67 \times \lambda}{\lambda \times 1 \times 4}$ | $E = \dfrac{377 \times 0{\cdot}565 \times 35 \times \lambda}{\lambda \times 1 \times 128 \times 4}$ |
| $= \dfrac{377 \times 0{\cdot}435 \times 0{\cdot}67}{4}$ | $= \dfrac{377 \times 0{\cdot}565 \times 35}{512}$ |
| = 27mV/metre at 1km | = 14·6mV/metre at 1km |
| This is the "ideal" best possible figure | This is a "practical" realisable figure |

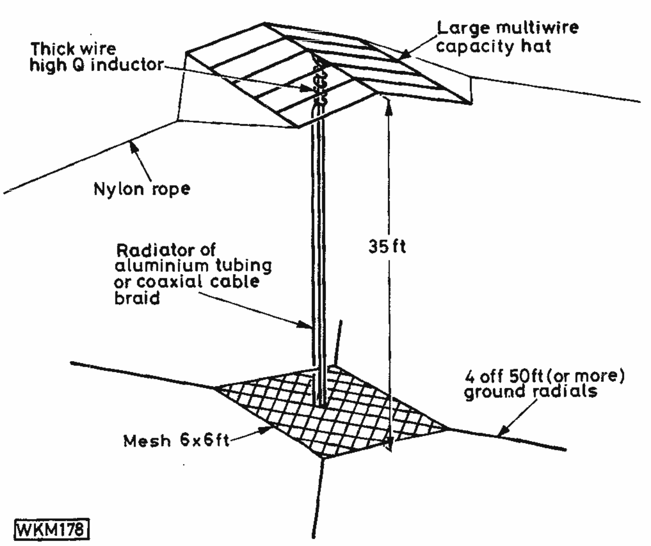



**Fig. 11: More practical details of the author's top-loaded vertical aerial and the associated ground-plane** ◀

losses, however, usually present the major headache in terms of aerial efficiency, because not many amateurs have a convenient field in which to bury the recommended 200 or so λ/2 radials which a medium wave broadcast station, for example, would use with its aerial.

A very ancient radio data book studied by the author some years ago suggested that 4 radials, instead of 200, would reduce the field strength to around half of the theoretical maximum, and a commonsense deduction suggested also that the radials need be no longer than the actual physical height of the radiator.

Experiment has shown that four 50ft radials offer quite a good ground, certainly much better than an earth stake, and if these cannot radiate in all directions from the aerial

*continued on page 56* ▶▶▶

## Wing Commander John Scott-Taggart OBE MC

## Born 27 May 1897

One of the best-known pioneers of radio, John Scott-Taggart died at the end of July 1979. He was recognised as one of the founding fathers of the wireless valve era and a powerful force in initiating broadcasting and establishing a large audience for it in its early days. As author of many textbooks and articles, as well as papers read before learned societies, he both popularised radio and made serious contributions to its development. His first article appeared in *Wireless World* in December 1914.

He joined the army at 17 and served in France from the first battle of the Somme, later becoming Instructor in Wireless to the 1st Army. In 1917 he began his thirteen articles in *Wireless World* which educated the public and technicians in the revolutionary effect on radio of the valve.

In 1918, as wireless officer of the 55th Division, he was Mentioned in Despatches and later won the Military Cross. Also in 1918, he obtained the first of some thirty patents; some of these were of the greatest importance and were sold to leading companies in the radio and cable industries.

After the first world war he joined Ediswan and subsequently Radio Communication Co. As Head of the Patent Dept of that company and of Mullard he was chiefly responsible for the successful defence of a patent action brought by Marconi's and thus prevented a valve monopoly.

In 1921 John Scott-Taggart published a standard textbook entitled *Thermionic Tubes in Radio Telegraphy and Telephony*. In 1922 he founded Radio Press Ltd and successively launched five radio periodicals which contributed very greatly to establishing an audience for the BBC. His set design ST100 alone was built to the extent of 100 000 by amateurs.

In the winter of 1926/27 he sold his publishing interests to Amalgamated Press Ltd, and became chief wireless patent consultant to several world-famous companies. He was called to the Bar in 1928. At this period of his life he qualified as an amateur pilot.

From 1932, Amalgamated Press employed him for five years as chief designer and contributor on a free-lance basis. His annual set designs ST300 to ST900 were built in hundreds of thousands. In 1935 he was elected Fellow of the Institute of Radio Engineers, and he was also a fellow of the Institute of Electrical Engineers, the Institution of Mechanical Engineers and of the Institute of Physics.

In May 1939, foreseeing events, he obtained a commission in the RAFVR, going to France on the second day of the war. Returning later to England, he was chosen to take a course in radar. In late 1939 he went to France to command a radar station. He left just before Dunkirk, having been Mentioned in Despatches for gallant and distinguished service.

On return to England he commanded a Battle of Britain radar station and subsequently became responsible for all radar training (ground and air) in the RAF, and then for the installation and maintenance of all the CH (Chain Home) radar stations in the UK—the chief radar defence system in this country—and several coastal stations serving the Royal Navy. He obtained his third Mention in Despatches.

After the war, John Scott-Taggart joined the Admiralty Signal and Radar Establishment (later named Admiralty Surface Weapons Establishment) as a technical civil servant, retiring in 1959. He wrote many technical manuals for the Royal Navy.

After retirement, John Scott-Taggart actively pursued his interest in art matters, both as collector and author of books. In 1962 the President of Italy appointed him a Knight Officer of the Italian Order of Merit for services to art. In the New Year Honours List in 1975 he was appointed OBE for services to radio engineering.

## Stanley Robert Mullard MBE (MIL)

## Born 1 November 1883

Stanley Robert Mullard, one of the pioneers of the UK radio industry, died in a Sussex nursing home on September 1, at the age of 95.

He was born on 1 November 1883 and, after attending a local school and the Borough Polytechnic, joined a firm of electric lamp manufacturers. He continued his studies at the Northampton Institute (now the City University) and became a student member or the Institution of Electrical Engineers in 1903. His employers appointed him a director of the company when he was only 24.

Later he joined the Ediswan Company. In 1915, while working in the lamp research laboratory, he developed the "Pointolite" arc lamp which was used in projection apparatus for over 40 years.

At the start of the first world war Mullard enlisted in the Engineers' Battalion of the Royal Naval Reserve, but continued his work with Ediswan at the Admiralty's request. His interests now extended to radio valves. His wide knowledge of glass technology and vacuum techniques enabled him to make valuable contributions to the fast-growing use of valves in military radio equipment.

In 1916 he was commissioned as a lieutenant in the Royal Naval Volunteer Reserve, posted to the Royal Naval Air Service and put in charge of a special valve laboratory at Imperial College, London. He also attended meetings at the HM Signal School, Portsmouth, to assist with the design and production of high-power transmitting valves. It was largely due to his participation thet the manufacture of silica types became practicable and by the end of 1919 there was a pressing demand for them for Naval purposes.

It was on the strength of an order for 250 valves that he was able to raise capital required to form the Mullard Radio Valve Company in September 1920. Although this company was started primarily to make high-power transmitting valves, it quickly became involved with the production of smaller types. Public interest in "wireless" was quickening. Many ex-army signallers obtained licences to operate low-power transmitters and were also building their own receivers. Public broadcasting had not yet commenced, but it was possible to pick up private and commercial transmissions from Hilversum, Paris and Berlin.

The start of a public service brought a great demand for reliable valves and, appreciating the enormous potential, Mullard turned over part of his limited manufacturing facilities to the production of small receiving types. They were sold under the trade name ORA, signifying the valve's three main functions: to Oscillate, Rectify and Amplify. Output quickly rose to thousands a week. Demand soon out-stripped manufacturing capacity and larger premises were acquired. These, too, became inadequate when the BBC opened its London transmitter, 2LO, and in 1923 Mullard moved again, this time to Nightingale Lane, Balham. By the end of 1924 production had reached $2\frac{1}{2}$-million a year and by demonstrating that reliable valves could be made cheaply Mullard helped materially to lay the foundations of the British radio industry.

By this time the commercial side of Mullard's activities had become important and he established a second company, the Mullard Wireless Service Co., to handle marketing and distribution. From its London headquarters it published a magazine, *Radio for the Million*, which made an immediate impact. It appeared quarterly for the next two years and sold in millions of copies.

In 1927, with the continuing increase in valve demand, production was moved to a still larger factory at Mitcham, Surrey. This remains one of the company's manufacturing plants, turning out more sophisticated components, but still handling the production and repair of high-power silica valves.

Impending developments in valve technology began to call for research facilities beyond the scope of a company so young as Mullard's. This demand led to the establishment in 1924 of close links with N.V. Philips of Holland and over the next few years Philips acquired all the shares of the company.

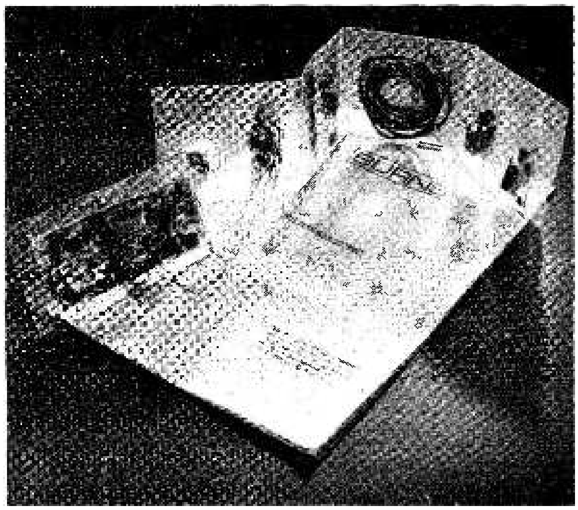
In 1929 Mullard resigned as managing director, but continued as a director, actively interesting himself in the company's affairs until its golden jubilee celebrations in 1970.

Stanley Mullard lived to see the small venture he founded grow to an organisation employing more than 11 000 people and occupying a leading place in the world's electronics industry.

RADIO SPECIAL PRODUCT REPORT

# BURNS

# FMD~7 FM DETECTOR MODULE



The FMD-7 is an f.m. detector designed orginally for the FRG-7/FRG-7000 series of receivers, but it may be used with any receiver that has an intermediate frequency of 455kHz. The module contains a buffer stage to isolate any s.s.b./a.m./c.w. filters in the receiver from those in the FMD-7, two ceramic filters to give adjacent channel selectivity, a multi-function integrated circuit type MC3357P providing high gain, signal limiting, quadrature f.m. detection and squelch, plus output audio filtering and a low power d.c. regulator. Facilities are provided for an external tuning meter and a squelch disable switch.

## ★ specification

**Sensitivity:** 20dB S/N ratio for an input of 10µV at 455kHz deviated ±3kHz at 1kHz
**Limiting Threshold:** 10µV
**Limiting Characteristic:** ±1dB change in output level for 20µV–100mV input
**Maximum Deviation:** ±5·5kHz for 10% distortion
**Selectivity:** –6dB at ±10kHz from 455kHz
–56dB at ±25kHz from 455kHz
**Audio Frequency Response:** –3dB at 300 and 3000Hz relative to 1kHz
**Squelch:** S/N ratio operated. May be preset to fully open at 15dB S/N
**Audio Frequency Output Level:** 900mV peak to peak for ±5kHz deviation
**Power Supplies:**
8–16V d.c. at 6–12mA at pin N (main)
8–16V d.c. at 1–3mA at pin C (buffer)
**Temperature Range:** 0° to +70°C
**Dimensions:** Printed circuit board 51 × 112mm (2 × 4·4in)

### *Assembly*

All parts for the module come packed in stout polythene envelopes. The kit is complete, right down to mounting hardware and wire—all you need is solder and the necessary tools. The printed circuit board is single-sided, epoxy-glass and has all the component locations and references silk-screen printed in white. The only drawback found is that most of the references are covered up once the components have been inserted, making it difficult to locate an item if subsequent fault-finding should be required. It would be a good idea to print the layout in the handbook as well.

Assembly of the module took just on two hours, and no major snags were encountered. Those that were, resulting from a few errors in p.c.b. drilling, were easily overcome. I think that it would have been easier to insert the terminal pins before fitting the remainder of the components, rather than afterwards.

### *Installation*

The review module was installed in an FRG-7, and this proved to be far more time-consuming than assembly, taking some three-and-a-half hours altogether. Fitting details are given in the handbook for the FRG-7, FRG-7000, Lowe SRX-30 and Drake SSR-1, plus general guidance on other receivers, including valved types, for which a special power supply module is available, if necessary.

Most of the installation time was spent in positively identifying the components and links which have to be removed from the host receiver before the module can be connected. Even after years of experience in carrying out mods on professional equipment, I still approach the first one of a new type somewhat heart-in-mouth, and cross-check about three times before cutting or removing anything!

*continued on page 36* ▶▶▶

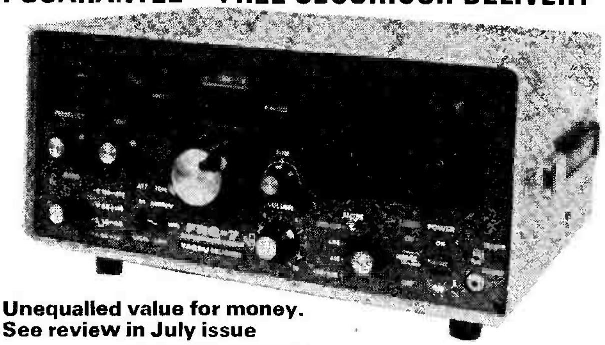
# YAESU MUSEN

## U.K. MAIN DISTRIBUTOR

### TWO YEAR GUARANTEE – FREE SECURICOR DELIVERY

**Deluxe Communications Receiver.**
**See review in the November issue**

## FRG7000 £375 ex-stock (inc. VAT)



**Unequalled value for money.**
**See review in July issue**

## FRG7 £215 ex-stock (inc. VAT)

In addition to offering an enormous range of major communications equipment, masts and antennas SMC are proud to be your single stop source for all those necessary but often hard to get accessories, some of which we list below.

Why not call us for details of our range. 30p in stamps brings a 24 page stock/price list, catalogues etc. Personal callers are welcome at any branch. Mail orders – c.w.o. please. Telephone orders – quote your access or visa card number. Hire purchase – speedily and discretely transacted.

### COAX PLUGS UHF (Post and Packing £0.20) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| PL259 | Standard UHF plug | £0.48 | S0239 | Free angle UR43 | £0.88 |
| UG175/U | Reducer UR43 | £0.12 | PL258 | Back-back, female | £0.79 |
| UG175/U | Reducer UR70 | £0.12 | PL274 | Back-back, chassis | £0.93 |
| PL259R | "Reduced" plug to UR43 | £0.58 | | Back-back, male | £1.20 |
| PL259SL | "Solderless" UR67 | £0.55 | M359 | Angle (1m + 1f) | £0.93 |
| PL259SS | "Solderless UR43 | £0.55 | | "T" (3 females) | £1.48 |
| PL259P | Push-on plug | £0.69 | M358 | "T" (2 fem. 1 male) | £1.20 |
| PL259E | Elbow plug UR43 | £0.83 | | 4-way (3 fem. 1 male) | £1.85 |
| | Panel mount PL259 | £0.93 | | SD239/Car + phono | £0.60 |
| S0239F | 4 hole socket | £0.42 | | S0239/2·5mm Jack | £0.69 |
| S0239T | 2 hole socket | £0.42 | | S0239/3·5mm Jack | £0.69 |
| S0239NI | Socket "nut" inside | £0.51 | 255/U | S0239/BNC male | £1.53 |
| S0239NO | Socket "nut" out | £0.51 | 273/U | S0239/BNC fem. | £1.53 |

### COAX PLUGS BNC (Post £0.20) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| UG38 | Plug. Stnd UR43 | £0.54 | UG491 | Double male | £0.93 |
| UG959 | Plug, Large UR67 | £2.66 | UG274 | "T" 2 female, 1 male | £1.44 |
| UG291 | Socket, 4 hole stnd | £0.56 | | "T" 3 female | £1.74 |
| UG1094 | Socket. Nut fixing | £0.56 | UG306 | Elbow adaptor | £1.62 |
| UG89 | Socket. Free, UR43 | £0.72 | 255/U | BNC male/S0239 | £1.53 |
| UG914 | Double female | £0.93 | 273/U | BNC female/PL259 | £1.53 |

### LIGHTNING ARRESTORS COAXIAL (Post £0.30) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| SM566 | Spark, S0239/PL259 | £2.55 | NSK7S | Gas, S0239/S0239 | £7.50 |
| SM567 | Spark. S0239/S0239 | £2.55 | LA1 | Gas, Bulkhead | £39.50 |

### WIRE & BRAIDS (Post and Packing extra) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| 7/029H | Cu Hard Drawn | yd £0.15 | 14 SWG | Cu Hard Drawn | yd £0.13 |
| 7/036H | Cu Hard Drawn | yd £0.18 | BRAID | Cu/Terylene, $\frac{1}{8}$" | yd £0.14 |
| 7/044H | Cu Hard Drawn | yd £0.24 | 7/029S | Cu Soft Drawn | yd £0.13 |

### CABLES RF FEEDERS (Carriege extra) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| RG58U | 50Ω 0·2" Stranded | yd £0.21 | 307EP | 75Ω "Economy" | yd £0.13 |
| UR43 | 50Ω 0·2" Solid | yd £0.19 | UR70 | 75Ω 0·255" Stranded | yd £0.21 |
| UR76 | 50Ω 0·2" Stranded | yd £0.19 | UR39 | 75Ω 0·306" Medium | yd £0.30 |
| UR67 | 50Ω 0·405" Heavy | yd £0.47 | UR57 | 75Ω 0·405" Heavy | yd £0.56 |
| RG213 | 50Ω 0·405" Heavy | yd £0.47 | 302 | 75Ω Flat twin | yd £0.11 |
| 306 | 300Ω Ribbon | yd £0.13 | 3X21 | 240Ω Oval twin | yd £0.09 |

### AERIAL INSULATORS (Post Extra) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| SMCP1 | 3" Polyprop. ribbed | £0.37 | EGG1 | $1\frac{1}{2}$" Egg porcelain | £0.33 |
| SMCP2 | $8\frac{1}{2}$" polyprop. ribbed | £1.85 | IP3 | 3" Porcelain ribbed | £0.48 |

### WIGHTRAPS AERIAL TRAPS (Post £0.40) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| WTS | Standard – White | £5.85 | WHTB | "Space Sever", 3·5MHz | |
| WTHP | High Power – Blue | £8.25 | | resonance, for 1·8MHz | £7.50 |

### BALUNS 3-30MHz (Post £0.50) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| BN86 | 1:1, "U" bolt mount | £13.50 | W2AU1 | 1:1. c/w spark gap | £9.50 |
| HIQ | 1:1, "Hang up" | £8.70 | W2AU4 | 4:1. c/w spark gap | £9.50 |

### MASTING (Carriage extra) + VAT 15% (N.B. Max 20', Max BRS 13')

| | | | | | |
|---|---|---|---|---|---|
| $1\frac{1}{4}$" od | Aluminium 16g | ft £0.42 | 2" | Al. Thick wall 1.29/64" | £1.05 |
| $1\frac{1}{2}$" od | Aluminium 16g | ft £0.46 | 2" | Steel Galv. 1.29/64" | £0.82 |

### MAST BANDS & PLATES (Carriage £0.40) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| SMP3 | 3 hole guy plate 2" | £0.85 | SMB43 | 3 hook band | £1.15 |
| SMP4 | 4 hole guy plate 2" | £1.55 | SMB151 | 4 hook band 2" | £1.65 |

### ROPES – WIRES (Post and Packing extra) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| 3mm | HT steel, 0·63T. | yd £0.18 | X150 | Rustproof, $\frac{1}{8}$" D. | 490' £16.30 |
| 4mm | HT steel. 1·5T. | yd £0.24 | 7X18g | Galvanised | 100' £4.40 |

### ROPES – TERYLENE (Post and Packing extra) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| $\frac{3}{8}$" | BS150 lbs (circ.) | yd £0.07 | $\frac{3}{4}$" | BS1250 lbs (circ.) | yd £0.14 |
| $\frac{1}{2}$" | BS650 lbs (circ.) | yd £0.10 | 1" | BS2450 lbs (circ.) | yd £0.27 |

### CABLE GRIPS (Post and Packing £0.30) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| 3/16" | Bulldog, galv. | £0.19 | HD9 | Plated brass line clamp | |
| $\frac{1}{4}$" | Bulldog, galv. | £0.16 | | for copper wire | £0.44 |

### SHACKLES (Post and Packing £0.30) + VAT 15% N.B: Pin sizes given.

| | | | | | |
|---|---|---|---|---|---|
| $\frac{1}{4}$" | D galvanised | £0.24 | $\frac{3}{8}$" | D galvanised | £0.33 |
| 5/16" | D galvanised | £0.28 | 7/16" | D galvanised | £0.42 |

### THIMBLES (Post and Packing £0.20) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| F1235 | $1\frac{1}{4}$" Nylon. for terylene | £0.14 | $1\frac{1}{2}$" | Galv. for steel | £0.13 |
| F985 | $1\frac{1}{2}$" Nylon. for terylene | £0.16 | $1\frac{3}{4}$" | Galv. for steel | £0.15 |

### RIGGING SCREWS TURNBUCKLES (P&P £0.30) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| | 4" × 3/16" pressed | £0.75 | | 6" × $\frac{3}{8}$" | £2.85 |
| TPR933 | $4\frac{1}{2}$" × 5/16" | £1.65 | | Miscellaneous | P.O.A. |

### GUY STAKES (Carriage £1.00) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| GS18 | 18" Angle galv. | £2.55 | GS36 | 36" "T" section, Heavy | |
| GS27 | 27" "T" gelvanised | £3.75 | | Duty. Galvanised | £7.75 |

### STAND OFF BRACKETS (P&P £1.75, Sec. £2.80) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| W12 | 12" bracket | pair £6.50 | W21 | 21" bracket | pair £9.50 |
| W18 | 18" bracket | pair £8.75 | W24 | 24" bracket | pair £11.50 |
| W18HD | 18" Heavy Duty | pair £11.75 | W24HD | 24"6 Heavy Duty | pair £14.25 |

### RAWLBOLTS (Post and Packing £0.40) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| | $\frac{1}{4}$" rawlbolt | £0.24 | | $\frac{3}{8}$" rawlbolt | £0.42 |
| D2 | 5/16" rawlbolt | £0.29 | | 5/16" rawlbolt | £1.45 |

### MAST TO BOOM CLAMPS (Post and Packing £0.70) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| SMC53 | 1-2" mast. 1" boom | £1.10 | JBL73 | 1-2" mast, $1\frac{1}{4}$" boom H.D. | £1.50 |
| SMC63 | 1-2" mast. 1-$1\frac{1}{4}$" boom | £1.25 | CP1 | 2" × 2". 6" × 6" plate | £2.30 |

### MISCELLANEOUS HARDWARE (P&P extra) + VAT 15%

| | | | | | |
|---|---|---|---|---|---|
| SMC59/15 | 2" mast sleeve 15" long | £4.20 | ER4 | Earth rod 4' c/w clamp | £4.25 |
| SH2 | Snap hook $2\frac{1}{2}$" | £0.68 | UB2 | U bolts 2" × $\frac{3}{8}$" | £0.32 |
| MC1 | Mast cap cast alloy 2" | £1.85 | | Pulley 1" | £0.48 |
| MBP | Mast Base Plate 2" | £3.40 | | Pulley $1\frac{1}{2}$" | £0.68 |

## SOUTH MIDLANDS COMMUNICATIONS LIMITED

S. M. HOUSE, OSBOURNE ROAD, TOTTON, SOUTHAMPTON, SO4 4DN, ENGLAND
Tel: Totton (0703) 867333, Telex: 477351 SMCOMM G, Telegram: "Aerial" Southampton

**S.M.C. (Jack Tweedy) LTD**
Roger Baines, G3YBO
79 Chatsworth Road,
Chesterfield, Derbyshire
Chesterfield (0246) 34982
9–6: Tuesday–Saturday

**NORTHERN (Leeds) BRANCH**
Colin Thomas, G3PSM
257 Otley Road,
Leeds 16, Yorkshire.
Leeds (0532) 782326
9–5: Mon–Wed & Fri–Sat.

**S.M.C. (Jack Tweedy) LTD**
Jack Tweedy, G3ZY
150 Hornecastle Road,
Woodhall Spa, Lincolnshire
Woodhall Spa (0626) 52793
9–5: Tuesday–Sat (+ appointments)

Buy it with Access

BARCLAYCARD VISA

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| G3ZUL | Brian | Stourbridge | (03843) 5917 | GW3TMP | Howarth | Pontybodkin | (035287) 846/324 | GM8GEC | Jack | Edinburgh | (031665) 2420 |
| GW4GSW | Alan | Swansea | (0792) 24140 | GI3KDR | John | Bangor | (0247) 55162 | GI3WWY | Mervyn | Tandragee | (0762) 84056 |

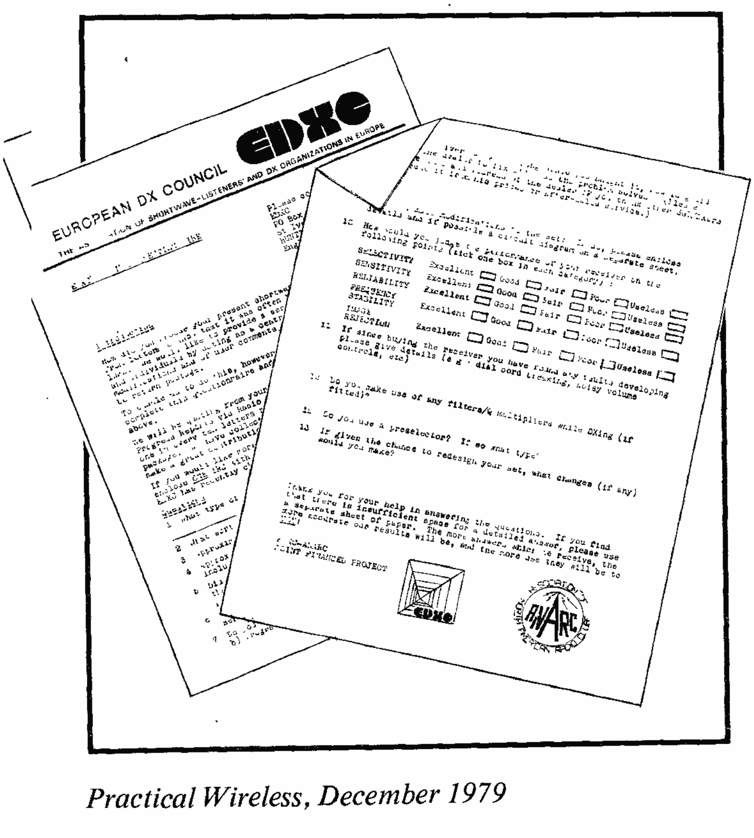
The European DX Council was formed 13 years ago in Copenhagen by a group of DXers and Short-wave Listeners who felt that co-operation between DX Clubs in various countries in Europe could be of mutual advantage. Since then it has succeeded in linking together over 20 clubs within Europe, and organising an annual conference where DXers can have an opportunity to meet fellow listeners and also broadcasters.

Since April 1979, the headquarters of the council has moved from Bochum in West Germany, to St Ives, Huntingdon, in England, from where all projects are now centrally organised. Clubs outside Europe are eligible for observer status with the EDXC, and the organisation also co-operates closely with its North American counterpart, the Association of North American Radio Clubs (ANARC). EDXC is currently undertaking a number of research projects.

## Receiver Information Bank

The Receiver Information Bank is probably the most ambitious project ever undertaken by the EDXC and aims to serve the individual DXer or short-wave listener. In August 1979 a questionnaire was sent out to all registered DX clubs in the world, with the request that it be reprinted in their club bulletins. By this means EDXC has managed to reach a potential of around 40 000 DX magazine readers. In addition, an extensive publicity campaign in a variety of languages was launched to run concurrently in the DX programmes of various s.w. radio stations. These short "spots" warned listeners to look out for the questionnaires and to fill them in. Non-DX Club members were invited to write in to the central address in Huntingdon for a copy of the questionnaire. Response from these requests for help has been very encouraging.

The questionnaire is designed to appeal both to the technical and non-technical SWL. It is interesting to note that non-technical listeners often are not using their receiver properly due to poor instruction booklets, while the more technically minded report persistent or common faults with particular models.




A close dialogue has been established between the EDXC and 15 radio manufacturers, and it is planned to pass on the results of the survey to the designers of the various sets for their attention. In addition, using outlets in DX programmes on Austrian Radio, Radio Nederland, AWR Sines, and BBC (Finnish Section), the EDXC plans to report on new models and compare the various sets on the s.w. market.

EDXC is primarily concerned with broadcast band listening. It does not cover amateur band or utility DXing.

Results will be sorted by a computer into various files. Each file will deal with a particular set and contain (1) A manufacturer's brochure; (2) A circuit diagram; (3) Details of any modifications that are possible; (4) Extracts from reviews; (5) User comments on reliability, servicing, and "usability". It is expected that such files will be available in early 1980 and will cost the price of return postage. Comparative tests on sets in the same price category will be undertaken later.

For a copy of the questionnaire, drop a line to: *EDXC, P.O. Box 4, St Ives, Huntingdon, England PE17 4FE,* enclosing a stamp if possible. EDXC is a volunteer organisation.

## QSL Survey

In August a multiple choice questionnaire was sent out to 57 s.w. radio stations, all of whom have a foreign service. Its purpose was to establish whether or not reception reports are still of use to them, now that many stations rely on technical monitors who are paid for their work. The results of this survey will be made known as soon as possible.

## EDXC-HAP Co-operation

In future, EDXC will act as the central mailing address for the Handicapped Aid Programme—UK organisation in order to simplify the address. In addition, all the stamps on mail to EDXC are being saved for HAP-UK to raise money and the EDXC publicises any projects that HAP-UK organise. John Rose remains as HAP-UK chairman.●

# HOTLINES

**A REVIEW OF RECENT DEVELOPMENTS**
*In general, the author does not have any more information on products than appears in the article.*

## Throw-away Computers

Comedians commonly use throw-away lines, but now electronics has turned to throw-away computers. The new concept is the brain child of a computer manufacturer who is intent on marketing a computer that is designed to have faulty parts thrown away.

The machine (a 16-bit model) is made up of plug-in boards each carrying a separate function. Each board measures roughly 210 × 160mm and has light-emitting diodes on its outer edge, wired in as go no-go indicators. Every time the machine is switched on, a self-diagnostic routine is initiated which tests all circuitry on each of the boards. Any fault that's located causes the no-go diode on the appropriate board to light. The board is then unplugged and thrown away. A new board is plugged in and the system is again fully operational. New boards are reckoned to cost around $200.

If this trend catches on, I can see piles of boards stacked up 100's deep in Lisle Street—just like T1154 and T1155's used to be in the old days.

## Printers Again

Electronic printers are becoming big business, and the latest one could prove extremely useful in both amateur and professional field. Called the VP-850 it uses c.r.t. signals (in a scope etc) directly to drive the print head matrix. Thus whatever is displayed on the screen would be printed out on a roll of electrosensitive paper in the printer.

In operation, the printer takes the analogue signals direct from the c.r.t. gun and samples each raster line 1350 times until it has stored 24 complete raster lines in its RAM. The data, which has now been converted to digital data, is fed to activate the printing head. Costs around $1200 were rumoured in the US.

## Cheapies

Just when I thought that electronic calculators couldn't get any cheaper, I find I'm deluding myself. In absolute cheapness the local store selling a four function machine for less than £4·00 is approaching the limit. But for sheer value the battle appears to be far from over.

Newest and "bestest" to arrive is the Slimline TI-35. In addition to doing so many things (I just couldn't list them all; it's a 54 function calculator!) it also offers keys for finding mean and/or standard deviation for samples and population data. And there's a factorial key. The price of this 54 function machine is to be around $25. Eventually, the batteries will cost more than the calculator!

## Speaking chips

There's chips and there's chips, but the latest one to hail from Japan is going to take a lot of beating. So new it hasn't got a reference number, this one is a speech synthesiser—all on one chip. This miniature marvel codes and decodes human speech by analysing it into sound source parameters (this corresponds to the human vocal chords) and into filtering parameters (corresponding to the roof of the mouth). Onto a piece of silicon measuring less than 3·7mm square, the manufacturers have managed to get 3500 gates, a 2240-bit ROM, and a 350-bit RAM. Wonder how many you could get in the boot of a Mini?

## Scribble

If you dislike licking gum on envelopes every time you post a letter, then your aversion may be in for some assistance. It could come under the intriguing title of "Scrib". This comprises a very novel typewriter that also has a few other tricks it can perform—like word processing, storage or letters and articles (or whatever) on magnetic tape and the ability to transmit your treasured words over the telephone at around 30 characters a second. The self-contained Scrib has its own video screen so that you can see just what you are typing, letter at a time. You can erase or alter as you go along.

Another useful little dodge provided by electronics is that Scrib will display the "old" text you are working on plus the new, updated version with your amendments too. It does this by splitting the screen image into two parts—a sort of schizophrenic c.r.t.! A mini-printer gives you hard copy and Scrib will also keep an accurate record of the number of characters you type in. A cassette magnetic tape is used for storage. No price is mentioned, and although Scrib may weigh heavily on the cheque book, it's only a mere 8·5kg to carry around.

## Der Zug am Gleis . . .

With computer-generated voices being featured in the news these days, it's nice to look around and pick an application or three. A useful one that comes to mind is the German railway station that uses a computer to give out train information to callers. The idea is that the person needing the information rings a special number. They are then asked the identification of the destination station and the desired times of departure. In response, the computer will speak giving the best train around that time.

Perhaps British Rail could use the idea, the computer being used to pick an excuse for late arrival from a long list. Perhaps a suitable program might be:

```
10 LET BR =
   EXCUSE(INTL + 100*RND(0))
20 PRINT "BR"
30 NEXT BR
40 GOTO 10
```

## Solar cells

News has just filtered through that researchers are busy developing a photoelectrochemical solar cell (try saying it quickly!). This rare creature not only obligingly changes sunshine into electric power, it also stores energy while it's doing it. Most solar cells employ comparatively expensive photocrystalline materials, or single crystal ones. This new cell uses the less expensive cadmium selenide and it has three photo anodes. One of these anodes is used to store electrical energy while the sun is shining. Connecting it with a common anode enables it to be persuaded to give an energy after darkness. The efficiencies so far are very low, typically a few per cent. However, the researchers are hopeful, and so am I.

Ginsberg

# SEMICONDUCTOR TESTER For OSCILLOSCOPE DISPLAY

J. SCOTT PATERSON

This simple add-on unit uses two a.c. voltages in quadrature (90° out of phase) which are fed to the semiconductor under test. The condition of the device is displayed on an oscilloscope used in X-Y mode. With no device connected, the Lissajous figure produced is a circle. With a transistor connected, both voltages are half-wave rectified, the transistors being treated as back-to-back diodes, and this results in one quarter of a circle being displayed (Fig. 3). If there is any leakage, the shape will be shrunk in one direction so that either the X or Y voltage is reduced. Horizontal shrinking is due to base-emitter leakage, vertical shrinking due to base-collector leakage, so that the "corners" of the quarter-circle represent the base, emitter and collector connections.

If only a vertical line results (a radius of the original circle) there is a base-collector short; a horizontal line indicates a base-emitter short. Should the line be at 45° then there is a collector-emitter short, and when both junctions are shorted only a dot is shown.

In Fig. 1, we show the patterns produced by good devices; the figures for the various faults can be worked out by connecting resistors between terminals to simulate leakage, by connecting terminals together for shorts and by not connecting terminals together for shorts and by not connecting terminals for open circuits.

WAD464

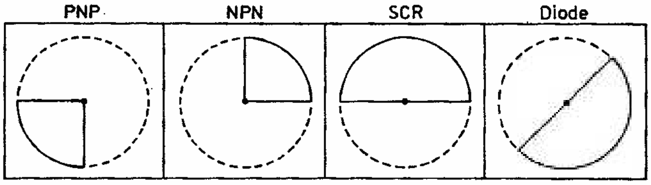



**Fig. 1: The various displays produced on the c.r.t. for good devices**

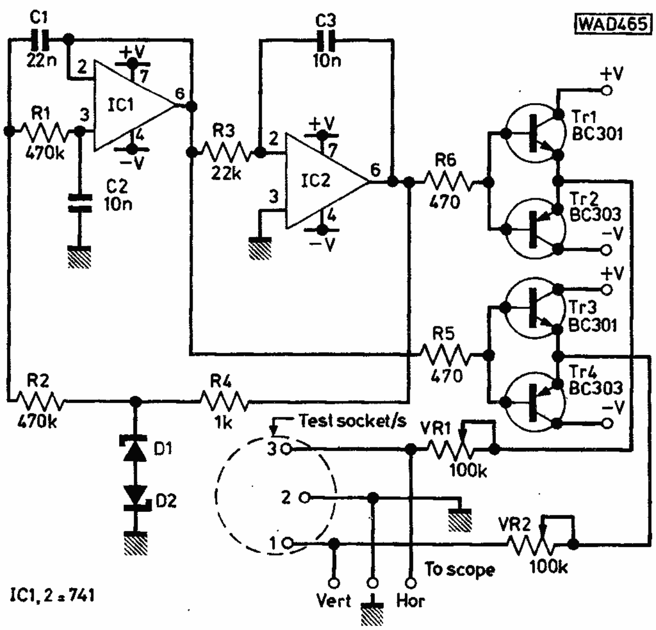



**Fig. 2: Circuit diagram of the semiconductor tester. The leads marked Vert and Hor are connected to the scope Y and X amplifier inputs respectively**

## Circuit Diagram

Operational amplifier IC1 is a low-pass filter, and together with IC2, an integrator, forms a sinusoidal oscillator with quadrature outputs, the amplitude of which are controlled by the two back-to-back Zener diodes. If good temperature stability is required, the two Zeners can be replaced by two diode-connected *npn* transistors (collector to base) with reverse breakdown voltages similar to the original Zener voltages.

**Table 1: Connection chart for different devices**

| Terminal | 1 | 2 | 3 |
|---|---|---|---|
| Transistor | Emitter | Base | Collector |
| Diode | Anode | — | Cathode |
| SCR | Cathode | Gate | Anode |

## ★ components

| | | |
|---|---|---|
| **Resistors** | | |
| *¼W 5%* | | |
| 470Ω | 2 | R5, 6 |
| 1kΩ | 1 | R4 |
| 22kΩ | 1 | R3 |
| 470kΩ | 2 | R1, 2 |
| **Potentiometers** | | |
| 100kΩ | 2 | VR1, 2 |
| **Capacitors** | | |
| *Polyester* | | |
| 10nF | 2 | C2, 3 |
| 22nF | 1 | C1 |
| **Semiconductors** | | |
| *Diodes* | | |
| Zener 8·2V | 2 | D1, D2 |
| *Transistors* | | |
| BC301 | 2 | Tr1, 3 |
| BC303 | 2 | Tr2, 4 |
| *Integrated circuits* | | |
| 741 | 2 | IC1, 2 |
| **Miscellaneous** | | |
| Test socket, Veroboard, Plastics case. | | |

continued on page 56▶▶▶

# CITIZENS BAND UK

## THE FACTS & THE FUTURE

By the time this issue of *PW* appears on the bookstalls, it is quite likely that a government announcement will have been made regarding a Citizens' Band Radio Service in the UK. If so, then what is said here may, in some ways, be less relevant than it was when written. It seems right, however, to give one of our vehemently pro-CB readers the right to reply on behalf of all those who thought the article *CB — an Unbiased Review* in our September issue was in fact strongly biased against CB. I should add, however, that some readers thought it fair, and some even thought it pro-CB! Opinion is a very varied thing.

**Sir:** Would you kindly allow me space in *PW* as you did J. D. Pearson G3KOC in order that I may answer that most Biased-of-Unbiased reviews on CB that I have ever read.

It is my opinion G3KOC that if you honestly consider that your article was unbiased then you are suffering from "Key Clicks" in the tuned circuits of the brain. What frequency are these "clicks"? 27MHz.

"Do we need CB?" If so "Why?" Let me put a filter on your spurious emissions.

1. If one doctor in 1000 arrived at a person's side in time to save his life as a result of CB — WE NEED IT.
2. If one Ambulance man, Nurse, Police Officer, Pedestrian or Motorist did the same. That's five more reasons why WE NEED IT!
3. If any of the people mentioned heard a Small Boat in distress — WE NEED IT.
4. If Muggers were caught as a result of CB, if Bombers and Terrorists were caught — WE NEED IT.
5. If old people in distress received help. If a disabled driver is able to get help, when broken down and incapable of walking to a telephone. If every lonely, elderly, crippled, blind, bedridden person will be able to call up a "good buddy" who can bring some cheer and purpose in their life — WE NEED IT.
6. If Bank robbers, or any other criminal escaping by vehicle were very soon caught as a result of a CB trace, if a multiple motorway pile up was avoided — WE NEED IT.
7. If a few CB'ers choose to move to greater heights and join the RSGB and the Hams — WE NEED IT

What we don't need are the very few Hams, who think because they have passed the RAE, the airwaves should only be for them. There are quite a few Hams who only know just enough to pass the examination. They then go out, pay a few hundred pounds for a set and a matching aerial and never take the cover off the set. When it goes wrong, they return it to the manufacturers. In other words, they are no better than a CB'er. Most of all, we can do without people like you. Professionals calling themselves Hams, who consider themselves "God's Keepers" to the TX Channels. The conversations on the Ham Bands drive me mad. Everyone does not wish to talk or listen to dB's, p.a. output or how many elements the latest Yagi has.

You and your fellow "knockers" of CB should be giving it the go-ahead and encouraging MPs to do so. Why? Because you should be overjoyed at the thought of how many more people will be brought into the fold, to enjoy radio as you and I do. After all, does it matter what form their enjoyment takes?

Think very hard, some Hams don't like v.h.f., some dislike h.f., others don't like either and go on slow scan TV, Telex or Moon-bounce. People like me collect ex-WD sets and monitor all the marine frequencies and by the way more than once I've been responsible for people receiving help at sea, once in Sardinia and another time off the NE coast of Canada.

There is also another type like me — 30 years into radio at sea, Coast-guard and Ham, who knows quite a lot but not all by any means, but who simply falls apart at the thought of an examination. Have you the right to deny me the means of speech? The answer G3KOC is NO, you do not have that right. 73s.

*A. Dorsett BRS39730*
*Alton, Hants*

# CB UK

In the past few months, CB has received a great deal of exposure in the press. A lot of the points, both for and against, have been repeated over and over again; and — if the newspaper reports are to be believed — a lot of drivel and half-truths have been spouted by many people, including licensed radio amateurs, CB fans, Members of Parliament, even the Home Office! There seem to be misconceptions about just what a CB service is for, what regulations it operates under in other countries, what the causes and effects of radio interference are and how it can be overcome, and many other aspects. Even some of our rival electronics publications have been unable to get all the technical facts right. We will try to clear up some of these points.

(a) CB radio is intended as a means of communication between mobiles, or between mobile and fixed stations, for messages about the licensee's private or business affairs. Since messages on business matters are expressly prohibited in the amateur service, an amateur licence is **NOT** a viable alternative. In any case, many potential CB users are not interested in radio technology. The argument that people from all walks of life can and do pass the RAE is irrelevant.

(b) CB radio is **NOT** intended as a hobby in itself. The regulations of the various countries differ in the way in which they express this. Among the most forthright are the Canadian General Radio Service Regulations, which prohibit: "Communication used in itself as a diversionary or recreational activity". If you want to experiment with radio communication then licensed amateur radio is a means available to you. Maybe there should be a Novice class to introduce beginners to the hobby, but that is a separate argument.

(c) CB radio in other countries is not as free and unfettered as some people seem to think. In the USA, for instance, only type-approved CB transmitters may be used; transmitters must not be modified in any way; linear amplifiers are prohibited (possession of a linear is considered to be sufficient evidence that it has been used); all internal repairs and adjustments to CB transmitters must be carried out by, or under the direct supervision of, a person holding a first- or second-class commercial radiotelephone operator licence. Violations of provisions of the FCC Rules or the Communications Act are punishable by fines up to $10 000 and/or up to one year's imprisonment.

The argument advanced that many of the US CB Rules are not enforced really reflects no credit on the CB fraternity there, but only goes to support the arguments put forward by opponents of the service.

(d) The interference problem will not be magically solved overnight by putting CB on a different channel, since *all* radio transmitters are capable of causing interference, particularly at close range. The reduction of interference depends upon good design, correct adjustment and adequate maintenance of transmitters, and good design of receivers (and audio equipment), and upon the sensible allocation of frequencies to various services.

(e) The argument advanced for the adoption of 27MHz CB on the ground that it would allow travellers within the EEC countries to maintain communication throughout their journey is not valid. Although there is a CEPT Specification for 27MHz CB, few of the European countries adhere to it. In fact, if an Italian takes his CB into Germany, it is quite likely to be confiscated and destroyed, because it does not comply with the German regulations.

(f) The commandeering of sections of the r.f. spectrum, in the way that some UK CB fans are trying to do on 27MHz, is not really a blow for freedom: quite the reverse. After all, if you steal something from someone, you cannot really complain if someone else then steals it from you. That way lies chaos, and I'm sure CBers will be quick to complain if they get an allocation and someone else interferes with that!

(g) The problems of interference to radio-controlled models are dismissed by many CBers, but the fact remains that the potential for loss to the modeller, and injury to bystanders, is considerable in the case of aircraft models. In the UK, 26·96–27·28MHz is allocated to radio control, and this band includes 28 of the 40 channels allotted to CB in the US, in other words 70 per cent of the total allocation.

There are reputed to be around 72 000 model control licences currently in force in the UK, and very few models indeed are using the alternative u.h.f. band, as yet.

It has been argued that a CB user finding a radio-controlled model operating on the channel that he has selected will quickly change to another channel. Since most CBers are supposedly non-technical, how will he recognise the strange sounds he might hear as being caused by a radio-control transmitter? In any event, by the time he has recognised that the channel is occupied by a r.c. user it will be too late — the model will most likely have gone out of control with possibly fatal consequences.

## The Future

The recent announcement of the reorganisation of the Post Office, and the opening up of some aspects of the telecommunications services to ouside competition, gives an opportunity for a re-think on the licensing and control of radio and the like, and also of the form that CB might take.

The present system of notifying sales of TV sets to the TVLRO could be extended to such things as radio control systems, metal detectors, and CB transceivers (if legalised!). Licence application forms could be included with each equipment sold, and licences made available over Post Office counters. This could even be extended to amateur licences. After all, the Post Office already issue vehicle licences on presentation of the relevant documents and fee. If buying or renewing a licence were made easier, it might even persuade some of the present unlicensed metal detector and radio control fans to do the decent thing.

Licences for any portable or mobile equipment could, with advantage, be produced in a form like a credit card or driving licence. Maybe even made to be attached to the

# CB UK

set. And while they're about it, they could make the metal detector licence valid for any type-approved design, and save the aggravation of getting a new licence when buying a new detector.

On the subject of CB, there is much to be said for adopting a system flexible enough to allow it to be used at the level of technology and expense desired by the individual. With modern microprocessor circuitry, it would be comparatively simple to extend the service to offer the options of data handling, selective calling, or linking in to the public telephone system. This would allow the current exorbitantly-expensive GPO Mobile Radiophone system to be done away with.

This scale of service would involve a countrywide network of repeaters, but these could easily be sited along motorways and main roads. The repeater system would, even for the lowest level of service — the simple hand-held — offer the advantages of more reliable communication, plus lower transmitter power, and therefore lower battery drain.

Perhaps it's a little 1984'ish, but it would be easy to arrange for an auto-identification signal to be built into each transmitter, to allow a computer to check if you had paid your licence and, if not, refuse to provide you with service, except possibly for emergencies! Remember, 1984 is not all that far off now.

★ ★ ★ ★

We are indebted to readers who have contributed information and ideas to this article. Perhaps, finally, we should try to sum up *PW's* viewpoint on the subject of CB in the UK:

**1. We believe that there is a need for a portable/mobile radio communication service for the general public, at a reasonable cost. This should be entirely separate from the amateur service and should not involve the user in passing any sort of exam.**

**2. This service should be on a frequency band other than 27MHz, which is unsuitable for reliable short-range communications by reason of propagation characteristics, and is already allocated to other services. The band and modulation system chosen should be the best available from the point of view of reduction of interference and should allow for the optional use of special facilities.**

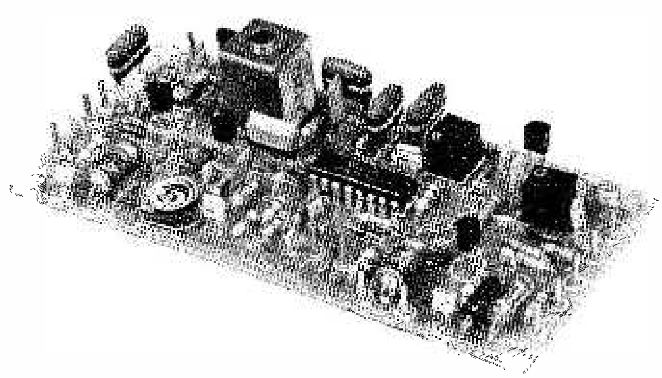
**3. Transmitters used should be type-approved, and the use of linear amplifiers prohibited.**

**4. The service should be capable of being effectively licensed and controlled with a minimum of bureaucracy.**

## FMD–7 FM DETECTOR

▶▶▶ *continued from page 28*

There was one mistake in the installation instructions for the FRG-7, but this was pretty obvious and should not cause any problems.



Switching the module into use ideally requires another position on the MODE switch. This is possible on the FRG-7/7000 if you are prepared to sacrifice the AM/ANL facility, and use this for NBFM. Otherwise, you will need to fit an additional switch somewhere on the receiver. Instructions are given for both methods.

### Results

Once one problem, caused by overlooking a correction slip in the handbook, had been overcome, the module worked perfectly. Tuning, which involves adjustment of the quadrature coil for maximum audio output, takes but a moment, and the only other adjustments required are one preset potentiometer for squelch threshold, and one to make the audio output level roughly equal to that on other modes. Audio quality is good and sensitivity entirely adequate.

Apart from those points about the handbook mentioned already, it includes a full technical description, detailed assembly instructions, test procedures, and fault-finding procedures including comprehensive d.c. and a.c. checks. A full component list and the circuit diagram complete the information.

### Price

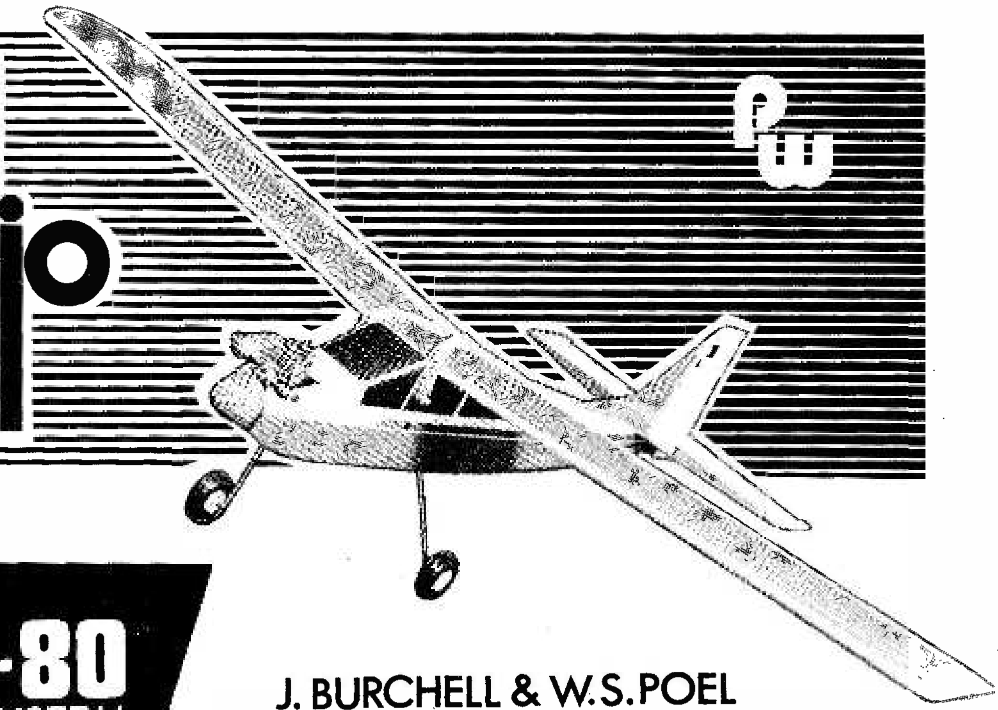
**The FMD-7 was supplied by Burns Electronics, 43a Chipstead Valley Road, Coulsdon, Surrey CR3 2RB. Telephone 01-668 7766. The price in kit form is £21.42, or the module is available ready-built for £26.68. Both prices include UK carriage and insurance and VAT.** ●

## KINDLY NOTE!

VHF DF Loop Aerial. October 1979
The length of each limb of the loop should be 443mm, not 380mm as shown in Fig. 2.

# Model Radio Control

## Part 1



## THE PW FM-80 SYSTEM

J. BURCHELL & W.S. POEL

Historically, radio control has evolved through all manner of what now seems to be the most appalling anachronisms, the first types using valves. But after a long and reasonably happy association with the transistor circuitry, the recent emergence of suitable i.c.s, first in the encoder/decoder circuit, and now in the actual radio sections too, has led to considerable advances in the sophistication and reliability of these systems.

### Reliability

The most sophisticated system in the world is of little use if the whole system fails at a crucial moment. The plane flies never to be seen again, or the boat ends up marooned in the middle of the pond, frantically harassed by a bemused duck.

### Predictability

Early systems were based on straight switching, where the control device slammed from one extreme to another. Or, if motor driven, operated either too slowly or erratically to be of much use in delicate control operations. The use of servo units gives a positional feedback to the control medium, so that a movement of the control stick is directly related to the actual movement observed in the model. In the toy market at present, there are several cheap imported radio controlled cars — and these are nearly all non-proportional control, relying on crude switching functions for forwards/backwards and left/right/centre control. The radio links themselves are extremely dubious, since the cheap receiver techniques employ a super-regenerative technique that itself emits a rather grubby spectrum of noise and hash both on and around the control frequency, and on many harmonically related frequencies. Several examples seen have been excellent at jamming u.h.f. as far as TV frequencies.

### Interference

The question of interference on the 27MHz band allocated to radio control is one of the burning issues for present day modellers, since estimates of some 400 000 radio control devices (including unlicensed users), point to a severe congestion of the few frequencies available.

Freedom from interference and from adjacent channel operators is, primarily, a function of the type of receiver circuit in the equipment. The avoidance of unnecessary power levels in the transmitter is good practice too—but since the aeromodeller is more prone to interference, by virtue of the height of the receiving antenna when airborne, it is understandable that they will wish to use the maximum permitted 1·5W of r.f. to ensure best range. Certainly, on the ground, and on the water, a power of 25–100mW will control any reasonable system just about as far as the eye can follow the manoeuvres of the model. Operation out of eyeshot is not necessarily of much use, since the feedback between the eye and the model under control is the crux of r.c.

The avoidance of interference is one of the prime preoccupations of the serious 27MHz user, and with so much illegal CB equipment in the UK, let alone the 'legal interference' from Europe, and even the USA, this preoccupation is readily understood. However, CB is either a.m. or s.s.b. and since this can scramble an a.m. radio control system on the fringe areas of operation, the use of narrow deviation f.m. is rapidly beginning to gain popularity, due to the a.m. rejection facilities afforded by this mode. The f.m. carrier is also transmitted continuously, and not switched on and off like so many of the a.m. approaches, which means there are no pauses in the data stream to allow the receiver to accept any other signals on the channel (see Figure 1).

The limiting action of f.m. means that the problems associated with good a.g.c. need not apply, since the r.f. and i.f. amplification can be class C, limiting the signal and rejecting a.m. Good limiting with a low input signal means that the recovered carrier information remains constant over a wide range of input signals, which, in the a.m. system requires carefully designed a.g.c. action to achieve.

Thus f.m. can significantly improve the rejection of co-channel signals (those on the same frequency but from some distance away), but for good adjacent channel rejection—such as from other modellers using the same area but on different frequencies—the problem becomes one of i.f. selectivity in the receiver.

The classic a.m. channel spacing for r.c. has been 50kHz, resulting in six channels. However, since the capture effect of f.m. combined with modern ceramic filters can dramatically improve receiver selectivity, 10kHz spacing is possible, greatly increasing the number of possible channels. However, unless you are very certain of your own equipment *and* that of the other users in the vicinity, always put as many kHz between yourself and the other operators as possible, since whilst your receiver may be fine, their transmitters may be slightly off-channel, or, if a.m. the splatter caused may spread well outside their basic channel.

Technically, 27MHz is not ideal, since under the correct conditions, usually associated with sunspot activity, the band has ranges of 6000 miles plus, with hardly any power at the transmitter. This makes life both unpredictable and precarious for 27MHz users. The actual wavelength is 11 metres, so aerials fall into the category of, 'electrically short' (less than $\frac{1}{4}$ wave), which introduces complicated variables into their design. In fact, receiver aerials usually end up as being strictly high impedance capacitive types, tacked on the end of the first tuned circuit—which is in itself not really too bad a compromise, but apart from electrostatic susceptibility (even to the extent of being bothered by rubbing control surfaces), such aerials mean that the conscientious designer really needs to trim each aerial coil to suit the aerial conditions to ensure optimum performance at all times. These types of aerials are not to be confused with good old transmission line impedance of

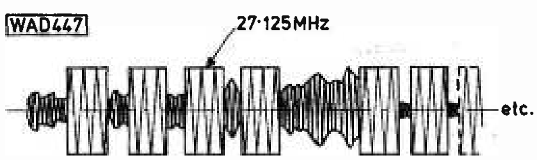
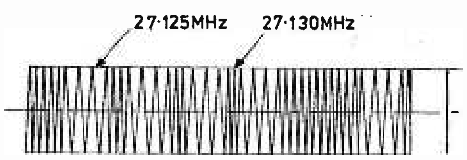



**Fig. 1(a): The waveform above shows a typical a.m. transmission while below is the same information transmitted as an f.m. signal**



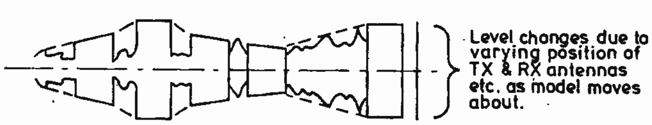
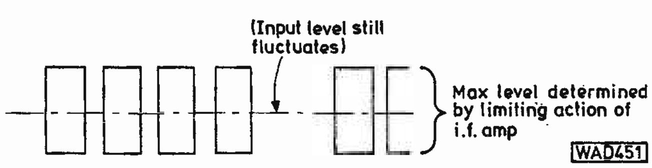




**Fig. 1(b): The level changes with model movement for an a.m. system (above) while for the equivalent f.m. system the level is constant**



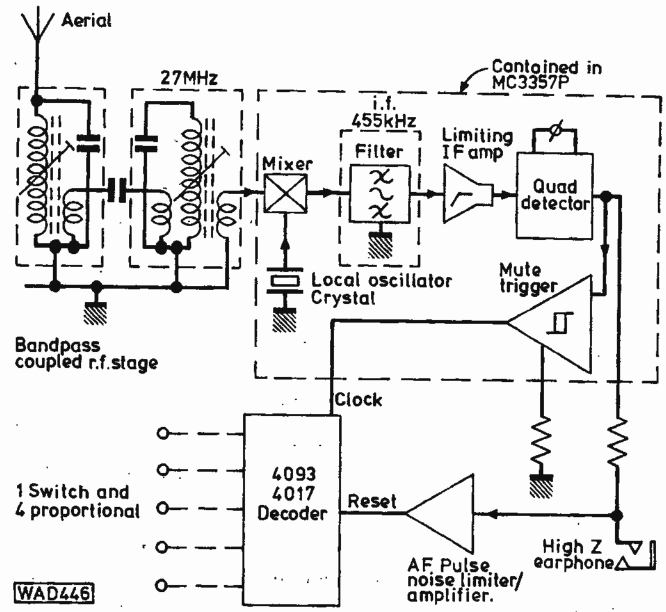




**Fig. 2: The design approach chosen for the PW FM-80 f.m. receiver**

50Ω, and they must not be fed down coaxial cable, since that merely 'looks' like a big capacitor across the tuned circuit, with little hope of getting the circuit to peak.

At the transmitter, power transfer cannot be achieved the same way, and even if you tried, the r.f. voltages developed across such high impedances can lead to r.f. burns. The aerial is thus loaded with a coil at the base, or in the middle. Loading reduces the impedance to the desired level.

An ideal frequency for radio control would be the 144–146MHz amateur radio band (assuming co-channel interference were to be avoided), but it is unlikely to be permitted in this country. The 19in-long, 2 metre band quarter wave antenna is ideal, and the technology available today could permit the construction of suitable miniature receivers to the same dimensions as present 27MHz types. 459MHz u.h.f. is outside the scope of most constructors, since everything from signal generators to strip line technology are just that little bit outside the grasp of the keen amateur. The stability demanded of the crystals used means that they cost about 5 times as much too!

Armed with the aims and objects of a comprehensive r.c. system, we can consider how best to apply currently available technologies to solve the problems. A summary of the features sought, and alternative approaches available are listed in Table 1.

## Receiver Design

The approach to the receiver design is shown in Figure 2. A couple of added features are apparent, since it is a very useful thing to have some means of actually listening to the receiver in operation. This is particularly so with f.m. where the Tx crystal is a fundamental cut, and the range of frequency pulling is quite substantial when compared to the usual 3rd overtone types used for a.m. Basically, this makes life a bit difficult for the home constructor, since it is almost impossible for a setup with 3rd O/T crystals to be more than the i.f. bandwidth off tune. This is not so with f.m. and being able to listen-in means that you can pull in the crystal trim by ear, if you do not

**Table 1**

| Receiver Feature | Approaches commonly used | Conclusions |
|---|---|---|
| Small size | Universally semi-conductor, though surprisingly few using i.c.s. at the moment. Recent i.c.s. from Motorola and Plessey seem to offer real advantages for f.m. applications | use MC3357P |
| Low Power, flexible supply voltages | This factor tends to rule out the use of j.f.e.t. and m.o.s.f.e.t. techniques, since r.c. has grown up with 4·8V being the recognized supply. But at low currents, bipolar stages can suffer from cross modulation very easily. Again, the technique used in the MC3357 scores, since the input configuration is a fully balanced mixer stage, possessing superior performance to a simple transistor r.f. stage of mixer. It also happens to work down to 3V and less, with some 2mA current drain! | use MC3357 |
| Good selectivity | The r.f. tuned circuits should be at least a double tuned pair—but space prevents anything very much more sophisticated. Keeping r.f. gain down will assist here. The main i.f. filter should be a good class ceramic unit, bearing in mind the criteria mentioned earlier. The cost to performance ratio will reflect the final application of the equipment. Since the receiver is basically going to be cheap, it is not really too much to expect that the enthusiast will be prepared to make separate receivers for separate applications. | use miniature ceramic or mechanical filters |

have access to a digital frequency meter. All that is needed is a high impedance crystal earpiece—which is tapped in via a crystal earpiece jackplug socket. This also provides a safety check to hear what's going on, on the channel you propose to use. The mute function may be considered pointless by some, since most commercial systems do not appear to offer this feature yet, possibly because a reliable circuit takes up too much space if not fully integrated as in the MC3357P. The final circuit for the receiver is shown in Figure 3 and whilst this may not be the smallest receiver in the world, it is certainly a manageable size for the home constructor—and particularly those who are being tempted into radio control for the first time.

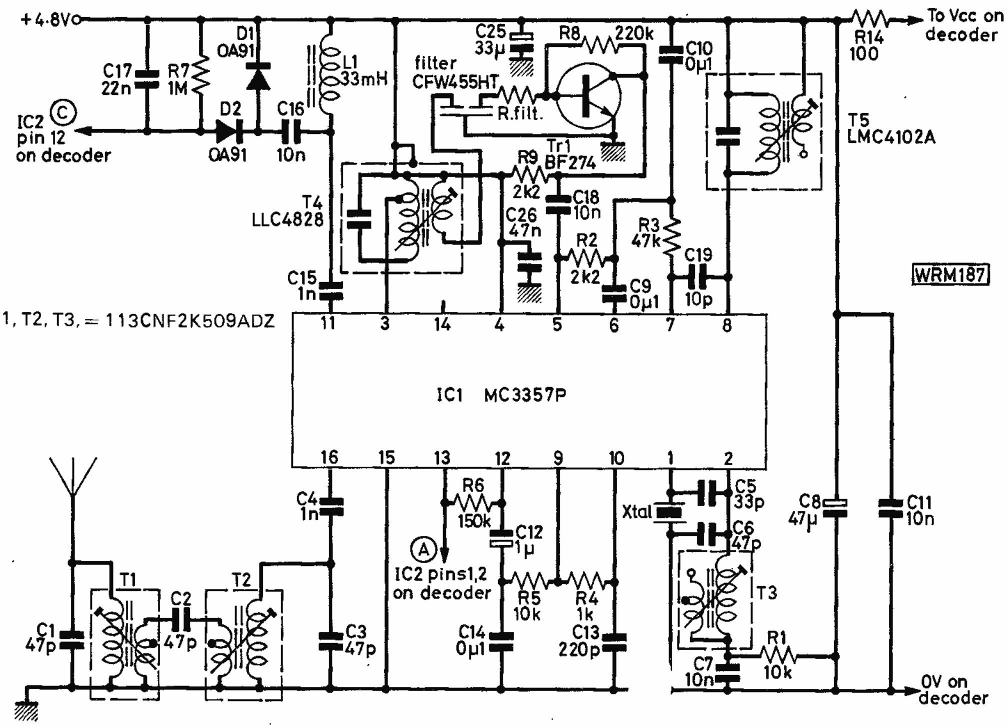
## The Receiver Circuit

Starting at the front end, the wire aerial is fed into the top of the input half of a bandpass coupled pair. Top coupling, and proximity (mutual inductive) coupling is frequently used in r.c. but both these tend to suffer from problems which deserve a brief word of explanation. Both methods nearly always tend to overcouple the circuits, providing too wide a response, and the classic 'double hump'. Top capacity coupling can also be a reasonably good way of allowing v.h.f. and static type interference through, since L1 and L2 look like fairly amiable chokes at 175MHz, permitting passage of some of the very strong v.h.f. carriers likely to be 'seen' by a model aircraft at 100 feet or so. This can lead to blocking of the mixer, despite the fact it has excellent overload capability anyway, with the subsequent demise of the whole system.

So the technique adopted, after some experimentation, was the lower impedance coupling, using the coil secondary to provide a much lower impedance point, and thence requiring use of a higher value coupling capacitor. The overall r.f. response is thus greatly enhanced, and quite excellent close to the desired frequency. Despite this, the use of 455kHz means that the i.f. image rejection is still only 18dB or so down, but that is only improved by going to a higher i.f., and using crystal filters which may not stand up to the rigours of model vibrations.

The actual responses of the r.f. input stage are shown in Figure 4. The h.f. response of this input arrangement is ideal, and the v.h.f. feedthrough is only beginning to get obtrusive as the frequency reaches levels that are outside the receiver frequency response, which tails off at about 60MHz. The plot was taken with a spectrum analyser and high impedance (10MΩ) r.f. probe with a 900MHz response, and so is a reasonable approximation. One very important point for the r.c. enthusiast to bear in mind is the fact that the usual airborne aerial of 15-16 inches (or less) is getting to look suspiciously like a quarterwave antenna for either the commercial 175MHz band, or worse—the Band III TV transmitters. Further work on these types of electrically short aerials is being carried out to investigate methods of making them less attractive to unwanted r.f. of this type. This aspect also means that the use of a really wideband f.e.t. at the input stage is not a good idea, since the response of such a stage will not be bandwidth-limited, and, if the input is wideband then the aerial is certainly going to tend towards its natural resonance, unless suitably loaded. The circuit used can be shown to provide reliable control with an input p.d. of 4µV by rearranging the input circuit to match the 50Ω generator source. This is quite enough for most applications, and too much for some—so further gain in front of the major selectivity of the set is not considered necessary. Remember that the aerial may be thought of as an extension of C1, and so T1 must be trimmed to suit each aerial—and also the aerial when in situ, since the high

**Fig. 3: The circuit diagram of the FM-80 f.m. radio control receiver. This circuit gives excellent performance yet remains simple to build. C25 should be 47μ**




impedance of such an aerial is liable to be influenced by the proximity of metal parts of the installations.

From the input stage, which is a fully balanced mixer, fed from the oscillator and the input signal, the signal passes to the i.f. after mixing. The crystal oscillator used here is worthy of note, since the original function of the MC3357 required a fundamental mode Colpitts circuit to be used here—performing the function of the second conversion in f.m. receivers, from 10·7MHz to 455kHz. However, the circuit needs to run on the 27MHz third harmonic, and since the fundamental of a third overtone crystal is not exactly one third of the 3rd overtone frequency, even the unsatisfactory expedient of running the crystal at its fundamental, and trusting to there being sufficient third harmonic content is not viable. Approaches such as trying to force the crystal onto its third overtone in all manner of 27HMz tuned circuitry around the oscillator pins at 1 and 2 were tried, and found wanting. Unreliable starting was the main problem—and since the Colpitts circuit works well enough when the crystal is replaced by an LC tuned circuit, trying to force the crystal with LC arrangements only provided a free running oscillator that was loosely locked to the crystal. The answer is to prevent operation at 9MHz, and this is the function of the parallel tuned trap formed by C6 and T3. Since pin 2 of the i.c. represents the emitter of the Colpitts configuration, this approach presents an impossibly high impedance at 9MHz, and so the next most likely mode—the 3rd overtone is automatically selected. The 10kΩ resistor R1 is used to further encourage the circuit into life, shunting the internal 100kΩ emitter resistor to provide more urge. To perform the same trick, but at the fifth overtone, the tuned circuit at pin 2 needs to be a more complex double trap, but it still works!

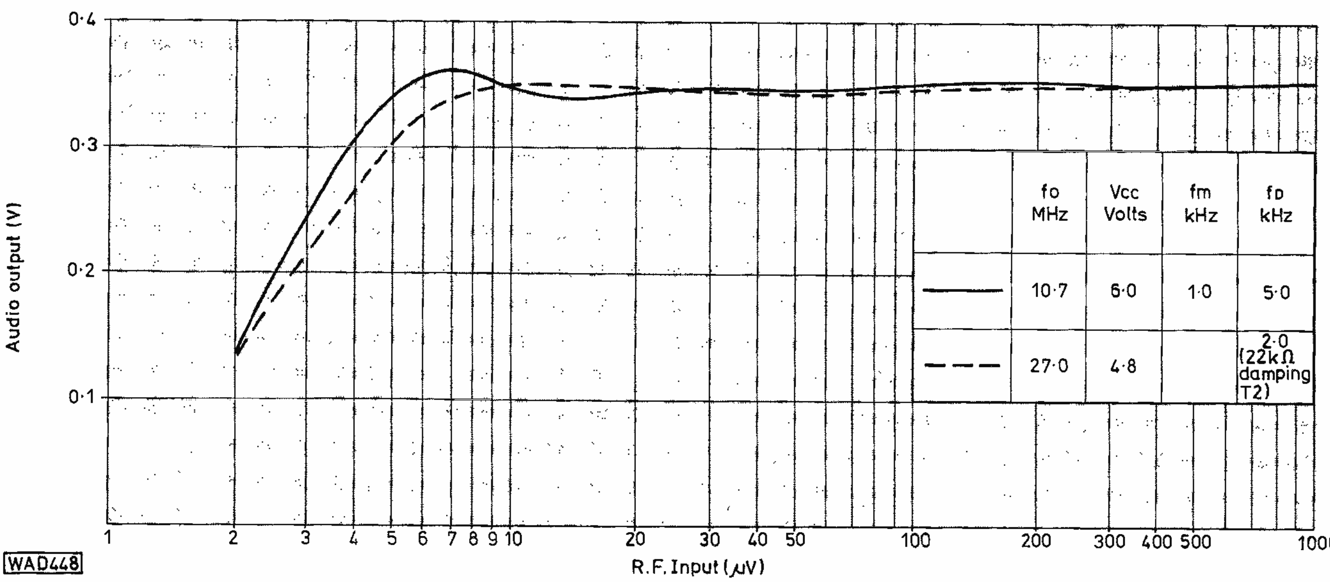



**Fig. 4: The response curves for the r.f. input stage of the receiver**

T4 provides i.f. output matching to the subsequent filter stage. Various possibilities exist here ranging from the very low cost CFM2 filter, which still provides better overall selectivity than the comparable four i.f.t. circuit, to the more expensive ladder filter ceramics, such as the Murata and NTK series CFX and SLF-D series, where the adjacent channel disappears to some 80 or 90dB down. The CFM2 described is not a ceramic filter, but a miniature mechanical filter, and as such, the inter-electrode capacitance causing some of the problems associated with ceramic ladder filters, is far less. Overall stopband is thus better, and combinations of the CFM2 and ceramic ladder filters may be used to good effect, although a higher insertion loss results.

Pin 5 of the i.c. is the entry point for the i.f. and limiter, and although the basic circuit is capable of 4μV operation with the decoder described, there may be certain applications where a bit more is considered desirable. As mentioned earlier, the temptation to place gain at the front end of the circuit should be resisted at all costs, as this tends to amplify not only the 27MHz, but much else besides. The place to put the gain is in the i.f. after the filter stage has limited the bandwidth. The circuit used is very simple, and is in fact the same as many audio amplifier circuits, contributing some extra 12-15dB of noticeable gain.

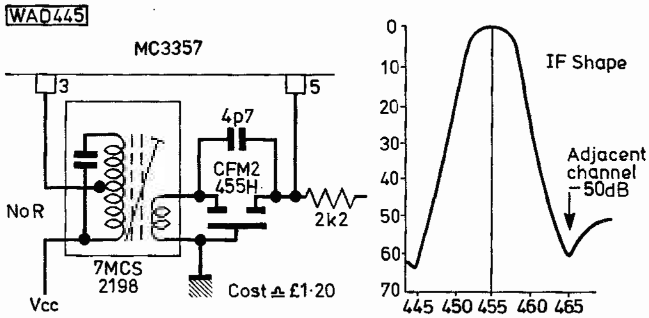
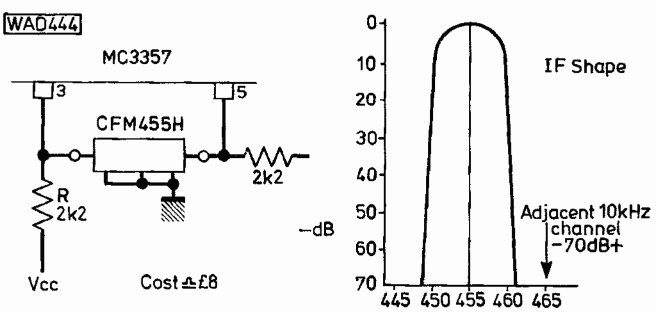



**Fig. 5: Two different filter design approaches for the receiver. The filter chosen for the FM-80 system is the Murata CFW455HT**




The MC3357 amplifier, limiter and detector stage are all biased externally via R2 and R3, and since these resistors basically represent different ends of a very high gain amplifier chain, the junction must be very effectively decoupled to ground with a capacitor that possesses ideal r.f. performance. The types used also need to be about 0·1μF to be effective at all the frequencies involved, and so C9 and C10 are monolithic ceramic plate types, which also happen to be the smallest variety of 0·1μF capacitor anyway. The detector is the usual quadrature phase-shifted system fed from pin 7 via only 10pF, resulting in very little detector loading, and a very steep slope to the detector characteristic at this point.

It is from here that the advocates of the f.m. system tend to mumble quietly to themselves about noise performance. With all that gain before the detector, a no-signal condition results in white noise within the bandwidth of the i.f. system that crashes from rail to rail, i.e. a fully limited output, presenting very nice edges for edge triggered decoders to 'see' and clock from.

When the signal disappears, the residual noise can send the servos into fits of apoplexy, although pure white noise is usually too 'fast' for the decoder, which sits in a condition of reset. The really embarrassing point is the transition from full control to no control, since the partial control area can allow just enough of the desired control information to pass through the decoder, but can also let through noise at the same time. In a.m. systems, the transition from control to partial control is a far more orderly affair, since the noise in no-signal conditions is rarely enough to create spurious operation of the decoder.

The ideal decoder will only permit the passage of correct width control information and immediately reset when it sees the noise. Most present circuits wait until the decoder has buzzed through all channels to the end before holding the reset condition, leaving a trail of jarred servos in its wake.

Original thoughts were that the built-in mute should be used. Indeed a means of signal mute was tried and found to work using the communications noise mute function. However, this took up a lot of space, as well as the rather handy trigger amplifier in the i.c. itself. Handy, because this amplifier provides the ideal means by which the data train may be reconstituted. The amplifier can produce a perfect squarewave from a moderately dishevelled array of data pulses, and so makes a big contribution to noise immunity. However, this still does not entirely get around the problem above—since noise can still foul the decoder, and so a noise mute of another variety is used, with a coil and capacitor combination and a diode 'pump' detector. This mute is almost a linear function of the noise input, relying on the finite reset level of the decoder i.c. for its trigger action. This also means that the mute may be applied in such a way that the reset can occur at any point in the data train, providing instant shutdown, rather than waiting for the decoder logic to rush about randomly until it resets itself.

Thus the transition occurs without major servo jerking and jittering, and may be likened in many respects to the behaviour of an a.m. system at threshold levels.

## The Decoder

The data system used in radio control is a stream of pulses whose width is varied from 1 to 2 milliseconds by the control medium at the transmitter.

In order that the first pulse of a series, or frame, may be recognised by the decoder, a reference or reset pulse is transmitted at the end of each stream of data. This reset pulse is made to be 2 or 3 times the length of the data channel pulse (see Figure 7) and so may be detected by a process which is basically integration with an RC time constant. Thus perhaps the generic term 'digital' is a slight

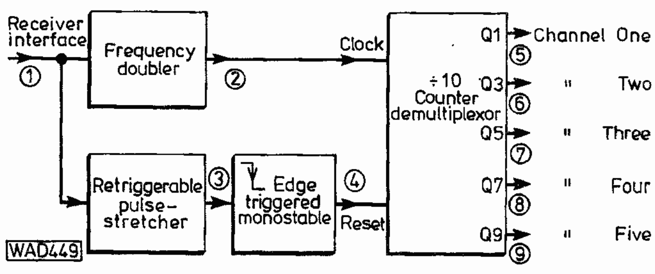
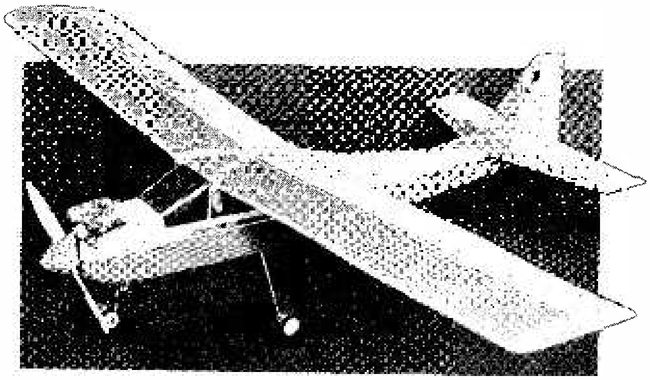



**Fig. 6: Block diagram of the decoder**



**The prototype FM–80 system was installed in a Mini-Escort trainer model aircraft built from a kit made by Galaxy Models and powered by a Flash 15 glow-plug motor supplied by Neway Models. A later part of this series will deal in greater detail with the models and installation**

misnomer, as the system is more accurately a linear function of the channel pulse width, which provides the necessary control information to operate the standard servo mechanism decoders and other control media. To be truly digital, a data stream of fixed pulse width would have to be transmitted in the form of a digital word (binary), and then decoded into positional information directly. The process would require a large number of 'bits' to be accurate, since the present technique offers potentially infinite resolution of control over the range of the servo output. However, pure digital control would not need positional feedback in the classic servo fashion, since a word could be directly translated to a positional function. Thus such a system would only need an update when a control position had changed, as opposed to the usual system of p.w.m. where an absent pulse can cause problems, and so is being continually refreshed. Fully digital control of several channels would require a much longer serial frame length to accommodate all the bits, and the loss of a single bit would cause a system "glitch" that may not be refreshed for almost a second. Thus the present system of control is the ideal compromise, since channel information is updated at a rate of 50-60Hz, within the scope of the relatively narrow r.f. bandwidth available.

The decoder employed is slightly unusual in many respects, since the incoming pulse train is first doubled in the 4093, where leading edges of the data output correspond to the leading and trailing edges of the input signal.

This doubled pulse train then clocks a 4017 Johnson counter, whose alternate outputs correspond to the originally encoded data train. The reset pulse is fed to the retriggerable pulse stretcher, and then used to reset the 4017 to accept the start of a new frame. As long as there is an input to the pulse stretcher, the output remains high, since the input voltage does not reach the threshold. However, after a period determined by the time constant of the stretcher, usually 2 to 3 ms after the trailing edge of an input signal, the output goes low and resets the 4017.

The pulse doubler is built around the first two gates of the 4093, taking advantage of the Schmitt action to provide noise immunity and a perfect clock for the 4017.

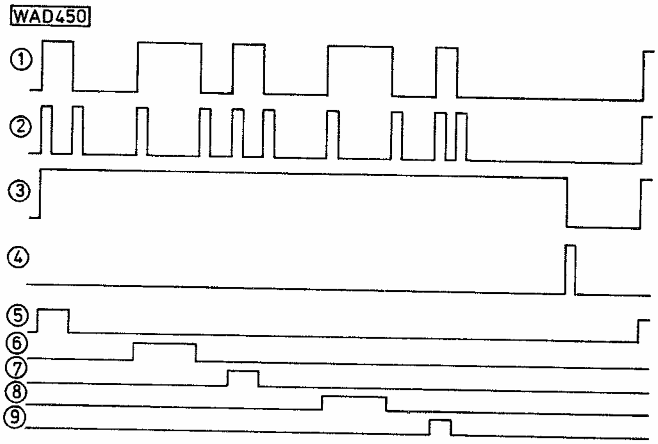



**Fig. 7: Waveforms at various points in the decoder**

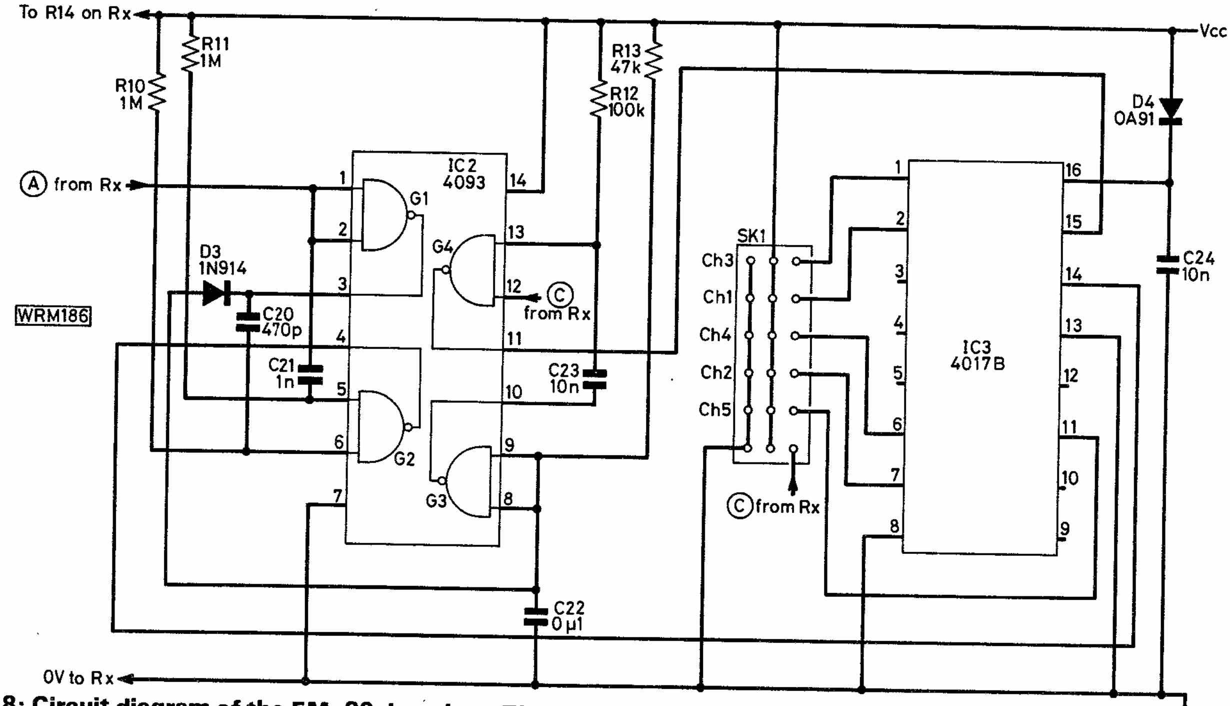



**Fig. 8: Circuit diagram of the FM–80 decoder. The output socket is shown wired in a suitable manner for the majority of servos available but if servos of a different design to those to be described later are used then the socket connections must be checked**

# GALAXY MODELS

SPECIALIST MODEL SHOPS

IPSWICH · NORWICH · THETFORD

FORFAR · ALTRINCHAM

## CLOUD MODEL AND FLASH SUPERDEAL

Escort + Flash 35 R/C £32.95

Mini Escort + Flash 15 R/C ............ £24.95

Mini Escort (A/W) Flash 15 R/C ............ £27.25

All Engines inc. Silencers

### ★ ESCORT

54" simple beginner's Radio Trainer for 2–3 functions radios and .19 to .36 motors using rudder and elevator or rudder, elevator and throttle. Kit contains superb illustrated step by step plan with separate building instructions, all ply and balsa parts machine cut, preformed U/Cart, plus accessory pack containing tank, motor mount, horns, hinges, push rods and clevises, etc. £16.25

**SUITABLE ACCESSSORIES**

3 2½ Wheels ........ £1.80
3m Film Covering ........ £3.15
Wheel Collets ........ 65p
Fuel Pipe (2 ft) ........ 34p
Spinner 2¼" ........ 65p
2 volt Sealed Accumulator ........ £5.55
5 Min Epoxy ........ £1.12

### ★ MINI ESCORT

44" 2–3 function Sport or Trainer model for .09 motors. Also available 4 function aileron wing version for .15 motors. Kit contains all parts machine cut, veneered foam wings, motor mount, tank, preformed U/Cart, horns, hinges, push rods, clevises, plan and instruction booklet.

Standard Mini-Escort ... £14.95
Aileron Mini-Escort ... £17.25

**SUITABLE ACCESSORIES**

3 2¼" Wheels ........ £1.65
2½m Film Covering ........ £2.68
1¾" Spinner ........ 50p
5 Min Epoxy ........ £1.12
Wing Joining Kit ........ £1.05

HOBBYCARD · QUADBOND · BARCLAYCARD · ACCESS

**MAIL ORDER**

Please add £1.00 post/packing on Escorts. Accessories if ordered with kits are post free. Barclaycard, Access and Hobbycard customers, phone card number for immediate attention. Overseas orders sent airmail at cost — please add reasonable amount. Any excess will be credited. 24 hour despatch on all goods unless otherwise notified.

**R/C SERVICE CENTRE**

Derek Hughes runs our fully equipped Service Centre at the Ipswich branch. We are officially appointed Service Agents for Skyleader and Sanwa and have Full spares backing for Futaba and most other makes. Send Direct to Derek for expert individual attention

UNBEATABLE OFFERS & SERVICE

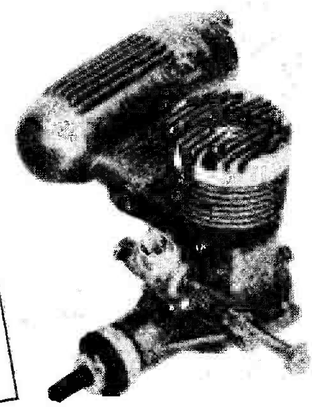
---

# FLASH SPORTS MOTORS

- Easy Starting
- Reliable
- Economical
- Low Cost Spares
- Partial Crash Insurance
- Spares Available

Flash 15 Stunt ...... £11.95
Flash 15R/C .......... £13.95
Flash 20 Stunt .................*
Flash 20 R/C ....................*
Flash 35 Stunt ...... £16.95
Flash 35R/C .......... £18.95

- Due soon
- All prices inclusive of silencers



PARTIAL CRASH INSURANCE

Any Flash engine however badly crash damaged, will be completely rebuilt at a cost not exceding 60% of a new engine.

IMPORTED AND DISTRIBUTED BY:
NEWAY MODELS, THE WALNUTS, THE STREET, RICKINGHALL, DISS, NORFOLK.
TEL: BOTESDALE 714.

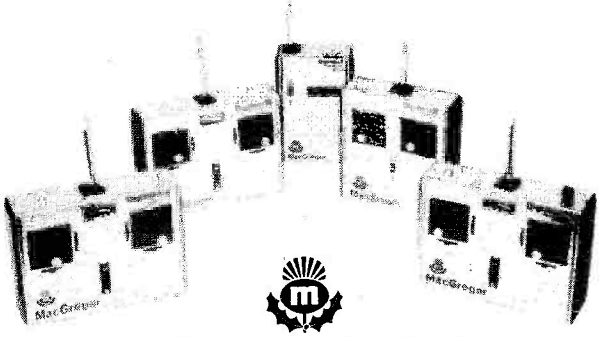
## SEE THEM AT YOUR MODEL SHOP

---

# MacGregor Radio Control

## Servos, Stick Units, Complete Radio Control Systems.

Send stamped, addressed envelope for further information or telephone Slough (0753) 49111 or 42251/2/3



**MacGregor Radio Control**
Canal Estate, Langley, Berkshire SL3 6EQ

---

# BI-PRE-PAK

## NICKEL-CADMIUM BATTERIES AT LESS THAN HALF-PRICE

BY A WORLD-FAMOUS MANUFACTURER IN 5 VALUABLE SIZES

BRAND NEW & GUARANTEED

| Type | Capacity in mAh | Voltage | Charge Rate mA/12 hrs | Size in mm dia.×Thickness | Our price inc. 15% VAT |
|---|---|---|---|---|---|
| NC20 | 200 | 1.24 | 20 | 24.8× 7.4 | 45p |
| NC28 | 280 | 1.24 | 28 | 34.4× 5.3 | 60p |
| NC50 | 500 | 1.24 | 50 | 34.3× 9.5 | 80p |
| NC90 | 900 | 1.24 | 90 | 50.5× 8.3 | £1.20 |
| NC175 | 1750 | 1.24 | 175 | 50.7×14.9 | £1.75 |

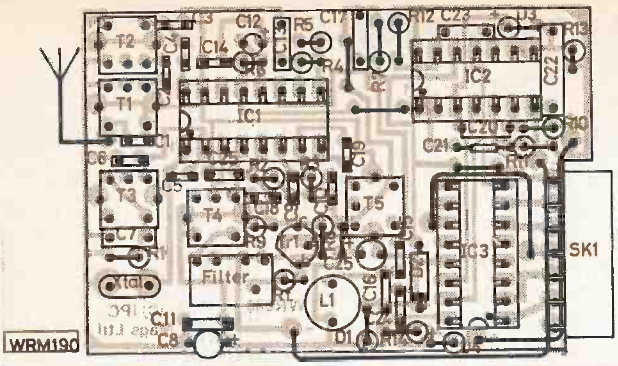
- High capacity for very small size
- Wide temperature operating range
- Low internal resistance
- Very simple charging circuit required
- INDEFINITE SHELF LIFE
- *Ideal for radio control, portable & emergency equipment, instruments etc.*

**TO ORDER**

Please send cash with order. Minimum order £3.00 plus 30p p/p in U.K. Orders over £10 carr. paid U.K. All prices inc. VAT. To pay by ACCESS or BARCLAYCARD simply let us have your account number when ordering.

TRADE ENQUIRIES INVITED

**BI-PRE-PAK LTD.**
(PW2) 222-224 West Road
Westcliff-on-Sea, Essex
SS0 9DF
Telephone 03708 5543



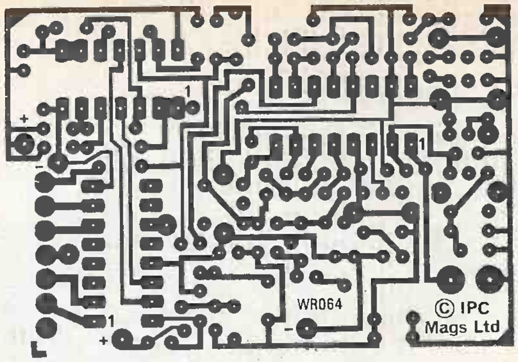




**Fig. 9: The copper track pattern for the printed circuit board used for the complete receiver and decoder is shown full size on the right. The laminate should be $\frac{1}{32}$ inch thick and the p.c.b. is carefully trimmed to fit snugly in the plastics case. The component placement for the p.c.b. is shown above. It should be noted that all components must be as small as possible and fitted flush with the board surface with the exception of the two jacks for the crystal**

## Operation

Gates G1 and G2 form a frequency doubler, where G1 inverts the incoming signal, whilst R10/C20 and R11/C21 differentiate the signal present on their inputs. The output of G2 remains high until the voltage on C10 or C11 has passed the threshold of G2, according to the CR time constant. The retriggerable pulse stretcher is formed from G1, G3, D3 and R13, C22. Whenever the input to G1 is high, the output is low—thereby discharging C22 and keeping the input to G3 low—resulting in a high on the output. When G1 goes low at the end of the last pulse in the data, D3 ceases to conduct, and C22 starts to recharge via R13. After a period related to R13, C22, the output of G3 goes low, unless the capacitor C22 is again discharging by a further data pulse entering G1, when the whole cycle repeats until the reset period is reached. When G3 goes low, the output of G4 goes high—but at the same time, C23 will charge via R12, and after a further period related to R12/C23 product, the output of G4 goes low once again. Desired channel information appears at alternate outputs of the 4017 (frequency doubling makes the intermediate outputs meaningless), Q1, 3, 5, 7 and 9 and the servo control outputs, with Q9 representing the switching channel, which is switched from 1-2ms for functions such as undercarriage retract. The outputs of the CMOS decoder are sufficient to drive all modern servos directly. G4 of the 4093 also includes an input from the linear squelch/noise detector of the receiver output, such that the presence of noise tends to drive the output of the noise detector low, thus creating a reset at any point in the preceding cycle of operations to prevent spurious triggering of the decoder circuit.

## Construction

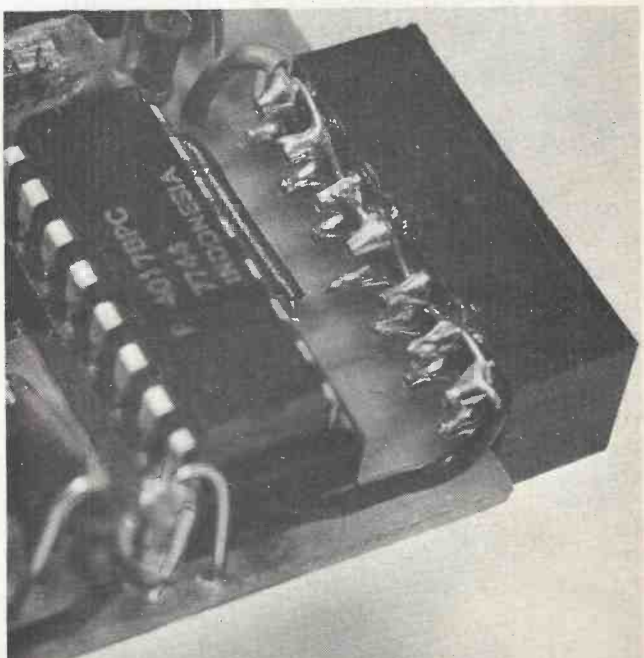
The p.c.b. layout is shown in Figure 9, and by some r.c. standards this may seem large. However, many constructors may be tempted into this as a first exploit in r.c. and so the design is left as manageable, rather than miniaturised. As with any r.f. circuit, all leads should be left cut short as possible—but sockets for the i.c.s are permissible providing you choose ones that will not permit the i.c.s to vibrate out of place.

As many standard parts as possible have been used, since although some purists may like to wind their own coils, and grind their own crystals, most constructors prefer the expedient of using tried and tested components in areas where adjustments and tolerances are not trivial. The outputs are taken via a proprietory SLM servo connector block, which also provides access for the supply. The aerial is connected at the other end of the works—which all fit into a standard SLM receiver box type PT309.

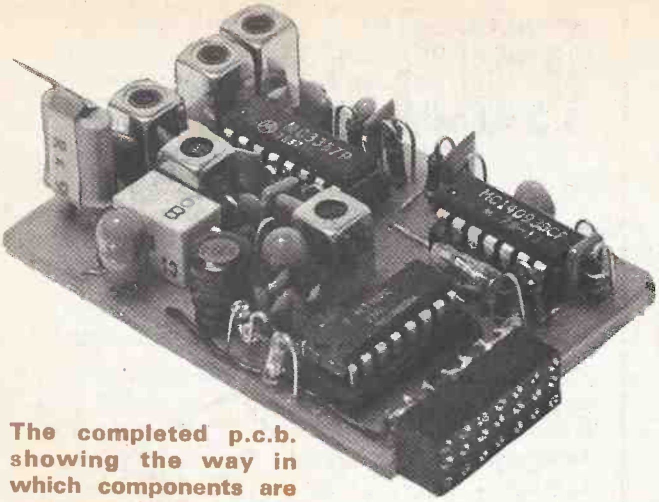
When constructing the receiver p.c.b. use a clean, tinned, hot iron of the miniature 15W variety. Insert the smallest components first finishing up with the i.f. transformers last. The SLM socket is wired up before soldering to the pads on the board. Note that the socket block is mounted vertically on the board edge with the row of output pins soldered to the pads and the other two rows used as supply rails for the servos.

The SLM case will need to be carefully cut as shown in the photo to fit the socket block. A small cut-out can also be made in the lid immediately above the crystal to allow it to be changed without having to undo the box.

All components must be mounted as close to the board as possible without straining the leads and the wires on the copper track side must be cropped as close as possible to the pads. The two Cambion cage jacks used for the crystal holder are fitted to be almost flush with the copper pads.



**Close-up view of the SLM socket block showing the method of mounting and wiring to the p.c.b. The two rows of pins above the board are wired using 22s.w.g. tinned copper wire which also serves to complete the power rails on the p.c.b.**



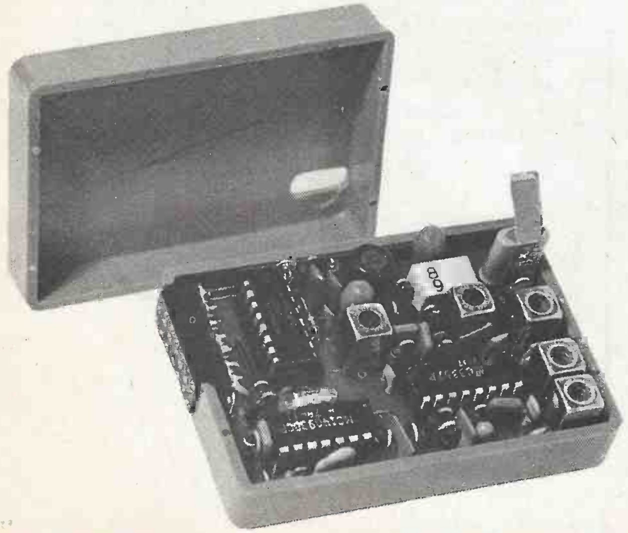
The completed p.c.b. showing the way in which components are mounted on the board

## Testing and alignment

Much of this aspect of the receiver will have to wait until you have completed the encoder/transmitter described next month—but you can perform a preparatory test by applying 4·8V from a current-limited supply, and checking that the current is around 4-6mA. If it is, then you have a good chance of success. If not, check the soldering, the chances of a faulty component are so marginal compared with the incidence of faulty construction as to be discounted.

Assuming the 4·8V supply is providing 4-5mA, then listen to the audio output at the junction of R5 and C14. There should be a characteristic hiss, which changes tone as you dab a finger on the underside by the r.f. and i.f. inputs. Pulling the crystal out should have a marked effect, but if not, adjust the core of T3 until an increase in the noise is noted, indicating this section has started up.

T4 should then be trimmed by NOT MORE THAN A TURN EITHER WAY, to peak the noise apparent in the output. With the i.f. section thus optimised, the detector T5 may be adjusted, again by not more than a single turn, and you should notice a distinct change in the character of the noise. Measuring the d.c. voltage at the junction of R5 and C14 will reveal that it changes its quiescent state be-



The finished p.c.b. mounted into the SLM case. This picture also shows the two cut-outs to be made in the case halves

## ★components

**Resistors**
*¼W 5% carbon film*

| | | |
|---|---|---|
| 100Ω | 1 | R14 |
| 1kΩ | 2 | R4, R filter |
| 2·2kΩ | 2 | R2,9 |
| 10kΩ | 2 | R1,5 |
| 47kΩ | 2 | R3,13 |
| 100kΩ | 1 | R12 |
| 150kΩ | 1 | R6 |
| 220kΩ | 1 | R8 |
| 1MΩ | 3 | R7,10,11 |

**Capacitors**

| | | |
|---|---|---|
| *Ceramic* | | |
| 10pF | 1 | C19 |
| 33pF | 1 | C5 |
| 47pF | 4 | C1,2,3,6 |
| 220pF | 1 | C13 |
| 1nF | 3 | C4,15,21 |
| 10nF | 6 | C7,11,16,18,23,24 |
| 22nF | 1 | C17 |
| 47nF | 1 | C26 |
| 0·1μF (see text) | 4 | C9,10,14,22 |
| *Tantalum* | | |
| 1μF 35V | 1 | C12 |
| 47μF 16V | 2 | C8,25 |
| *Polystyrene* | | |
| 470pF | 1 | C20 |

**Semiconductors**

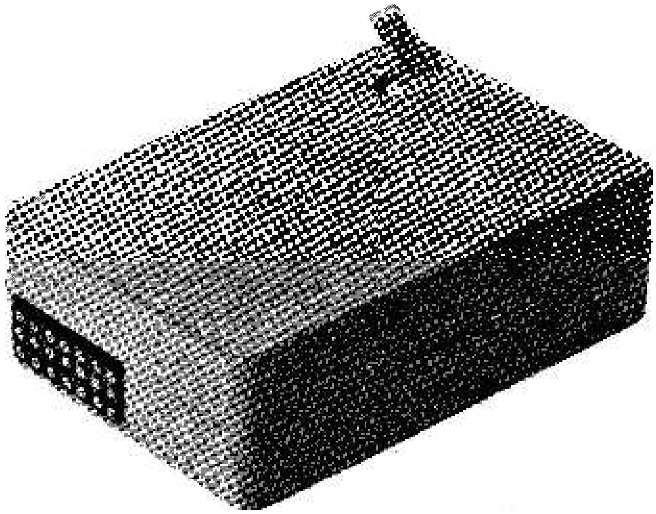
| | | |
|---|---|---|
| *Diodes* | | |
| OA91 | 3 | D1,2,4 |
| 1N914 | 1 | D3 |
| *Transistors* | | |
| BF274 | 1 | Tr1 |
| *Integrated circuits* | | |
| MC3357P | 1 | IC1 |
| 4017B | 1 | IC3 |
| 4093 | 1 | IC2 |

**Inductors**

| | | |
|---|---|---|
| 113CNF2K509ADZ | 3 | T1,2,3 |
| LLC4828 | 1 | T4 |
| LMC4102A | 1 | T5 |
| 33mH | 1 | L1 |
| All by Toko | | |

**Miscellaneous**
Filter CFW455HT (Murata); Crystal (see text), Cambion cage jacks (2); p.c.b. (1); 14 pin d.i.l. socket (1); 16 pin d.i.l. socket (2); 7 channel socket block (SLM); Case PT309 (SLM).

tween extremes of 1 and 3 volts as the detector coil T5 is rotated. This is because the d.c. level follows the characteristic 'S' curve of the f.m. discriminator, with the noise shaped in the i.f. filter providing sufficient 'substance' for the detector to operate. The detector will usually be set at the halfway point between the voltage extremes, corresponding to the crossing point of the detector curve, for symmetrical modulation systems such as speech. But in p.w.m. systems, the information relies on only the two logic levels 0 and 1, and the quiescent point should not be set using an unmodulated carrier from the transmitter/encoder, as this represents one extreme of the detector curve. Accordingly, although an approximation may be made by 'centering on noise', the detector should be adjusted for most consistent results when using a correctly modulated carrier. Thus a sinewave-modulated generator set for about 1-1·5kHz deviation will not give the best results in practice.



The value of R4 may need some adjustment, since this is providing bias for the noise squelch amplifier. Listening to the output of this amplifier at pin 11, using a crystal earpiece may reveal a rather broken sound under no-signal conditions, rather than the usual white noise hiss—and the value of R4 should then be changed for 10kΩ, up to a maximum of about 47kΩ until the output at pin 11 is a constant hiss. The detector setting will have a considerable bearing on the choice of R4, and so you must satisfy yourself that the setting of T5 is accurate before changing R4, as retuning T5 may necessitate a further change in R4, Now check the d.c. voltage at the output of the noise—the signal should be approaching 0V, rising to Vcc as the noise is slowly reduced. During reception of an r.c. transmission, part of the waveform will be detected, and so point C may not be at Vcc, although it should not approach the reset level of the decoder.

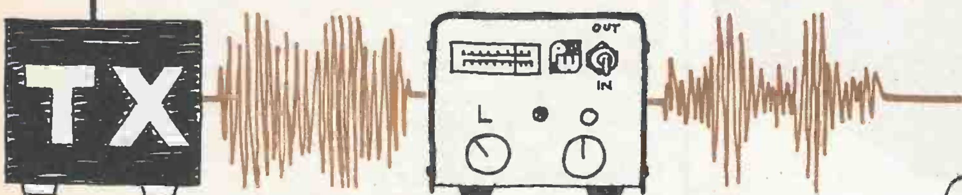
In the development of this circuit, two basic prototype stages were evolved, and over 10 actual receivers of the final design have been made, proving the results achieved. This should give confidence to first-time builders that the design is repeatable so long as the correct components are used.

Part 2 deals with the transmitter and its construction.

**A licence is required to operate radio control equipment. This costs £2.80 for five years. Application forms are available from: The Home Office, Radio Regulatory Dept., Waterloo Bridge House, Waterloo Road, London SE1 8UA**

# NEXT MONTH IN...
# practical WIRELESS

## 'Improve your 'Talk Power'
### With our
## AF SPEECH PROCESSOR




Increase your communications efficiency on a.m., s.s.b. or f.m. without trading in your transmitter or lashing out on a linear. Our a.f. speech processor is simple, neat and inexpensive and is designed by E. A. Rule G3FEW, who also developed the *PW* "Winton" — need we say more?

## Also...

### MTRE RELIABILITY

Achieving reliability depends on adequate circuit design, proper component selection, and good workmanship in assembly. This article looks at the implications for the home constructor and illustrates the points with several practical circuits

## And...

### WIDEBAND RF PRE-AMP

A versatile "gain-block" providing more than 20dB amplification over 200kHz–50MHz, with useful gain extending to 30kHz and 200MHz. Single-transistor design gives good life from a single PP3 battery

# PRODUCTION LINES

alan martin

## Naked d.p.m.

Recently introduced by OMB Electronics, a low cost, low profile frequency meter.

The type 35LCD 3½ digit d.p.m. provides the high accuracy (0·1%) autozeroing and autopolarity, now expected of low cost d.p.m.s, in a low profile package. The front panel occupies only 83 × 31mm of panel space (maximum depth behind panel 43mm).

Power drain is a nominal 1mA from 9V and other supplies up to 24V as well as 120V or 240V a.c. may be accommodated. Other options are available.

The 1-off price is £18·37 plus VAT and 75p P&P from: *OMB Electronics, 30 Riverside, Eynsford, Kent. Tel: (0322) 863567.*


## Nice Pair

Lascar Electronics have recently introduced two new digital multimeters. Both have l.c.d. readouts for clarity and long battery life, and are claimed to be considerably lower cost than imported products of similar specification.

The LMM-100 is suitable for field or bench use, has 25 different ranges, a basic accuracy of 0·1% and is priced at £69.95 plus VAT.


The LMM-200 is a compact hand-held instrument, with 15 different ranges, a basic accuracy of 0·5% and a 200 hour battery life. It is priced at £34.95 plus VAT.

Another ten instruments are to be introduced over the next year and eventually, the range will include frequency counters, counter-timers, thermometers and other general purpose instruments. All with feature l.c.d. readouts.

*Lascar Electronics, Unit 1, Thomasin Road, Burnt Mills Industrial Estate, Basildon, Essex. Tel: (0268) 727383.*

## New Cassette

Agfa-Gevaert have recently introduced a new tape cassette—Agfa Superchrom—and added 6 more minutes of playing time (3 mins each side) to their entire range of C60s and C90s. They are also re-launching the cassette range in new packing designs and colours.

Agfa Superchrom is a new, highly sophisticated dual-layer chrome tape which records at very high levels without distortion. In the company's own laboratory tests, Superchrom registered a t.h.d. of only 1·5%—significantly lower than the 2·2% of a Japanese competitor. At 62dB, the new cassette also has a wider dynamic range than any other cassette—by 2dB, Agfa claim.

Agfa Superchrom is also said to overcome the traditional weakness of chrome tapes in the middle to lower frequencies, having perfect linear response from 333Hz to 10kHz. It has been produced for machines with $CrO_2$ switching, and Agfa assert it has no rival in terms of sophistication and technical performance.

Further details from: *Magnetic Tape Products, Agfa-Gevaert Ltd., 27 Great West Road, Brentford, Middx. Tel: 01-560 2321.*

## ASCII Keyboard

The latest from Star Devices is an ASCII encoded touch keyboard which measures 365 × 203 × 31mm, weighs 454 grams and operates within a temperature range of 0° to 35°C.

The complete "stand-alone" data terminal features 7-bit parallel ASCII encoded output; positive and negative strobe edges; full ASCII set—128 characters—upper and lower case in dual QWERTY layout, individual pads for all control codes; all code outputs will drive 4 t.t.l. loads; l.e.d.s to show ASCII code of selected character; audio feedback with volume/tone control; character output rate continuously adjustable from 0·1 to 1 second; auto repeat and modified 2 key rollover; automatic scan facility—will automatically scan through and output each character in the ASCII set, useful for testing and setting-up systems; operational life in excess of 250 million operations.

Requiring a power supply of 5V d.c. ±0·25V at only 200mA, the keyboard is presented in a low profile case with non-slip feet and wipe-clean polyester touch pad area with back printed characters, which eliminates wear-off.

The assembled, "burnt in" and tested keyboard, manufactured in the UK carries a six month guarantee and costs £37·50 plus VAT.

Further details of optional extras and availability from: *Star Devices Ltd., PO Box 21, Newbury, Berkshire. Tel: (0635) 40405.*

It is now generally accepted that the protection of property is primarily the responsibility of the owner and that he should take appropriate action within the law to minimise his risk.

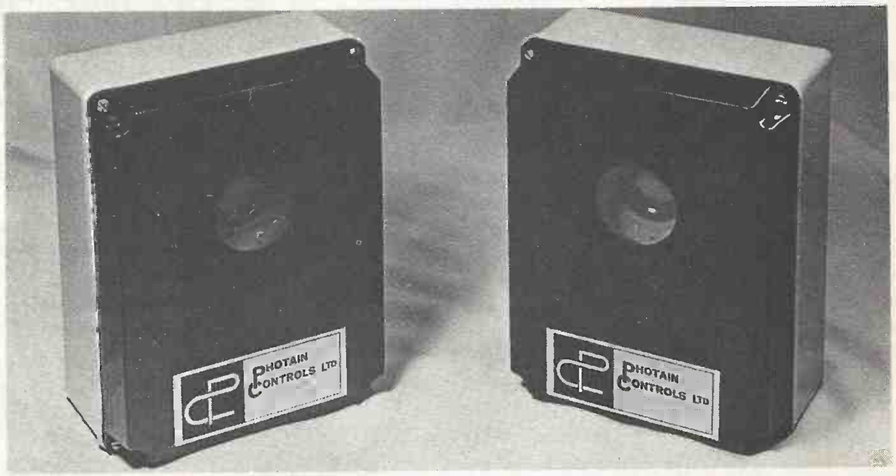
Most alarm systems are based on detecting intruders entering buildings, but now the emphasis will have to change with the object of detecting intruders before entry is attempted thereby enabling the occupier to take appropriate action in good time. Exterior detection of potential intruders presents a number of problems not associated with internal protection and, depending upon the layout of any particular site, it is not always possible to provide complete protection at an economical price. However, any form of prior warning is worthy of consideration and to meet this need Photain Controls Ltd., have designed a new Pulse Modulated Gallium Arsenide Infra-Red Beam Unit, which is contained in a waterproof housing and will provide coverage up to a distance of 50 metres.

The unit comprises two housings, one containing the solid state infra-red emitting device complete with optical system and associated circuitry and the other containing the photocell, optical system, de-modulator circuit and with an output relay. The relay is normally energised and when the beam is interrupted the relay is de-energised changing over the output contacts to perform a switching function. The switching function can be designed to provide a variety of warnings for example:

1. To operate an alarm bell for a period of time (say 5-50 seconds) and then to automatically re-set.
2. To operate an alarm bell continuously until manually re-set by a push button inside the building.
3. To switch on exterior floodlights either for a timed period or until manually re-set.
4. To operate silent alarms inside the premises or remotely to the police.

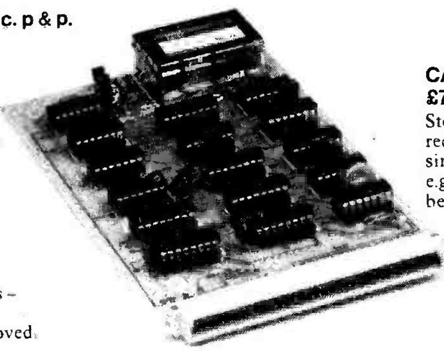
Various units are available, starting with a beam range of 5 metres up to a a beam range of 50 metres. Prices start at £40 plus VAT to £80 plus VAT. The units operate from the mains supply and the output contacts are rated at 5 amps, alternative models are also available operating from a 12V d.c. supply.

Further details from: *Photain Controls Ltd., Unit 18, Hangar No. 3, The Aerodrome, Ford, Nr. Arundel, West Sussex BN18 OBE. Tel: (09064) 21531.*

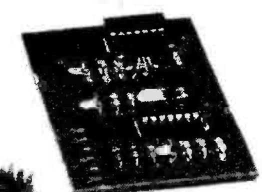


# Now, the complete MK 14 micro-computer system from Science of Cambridge

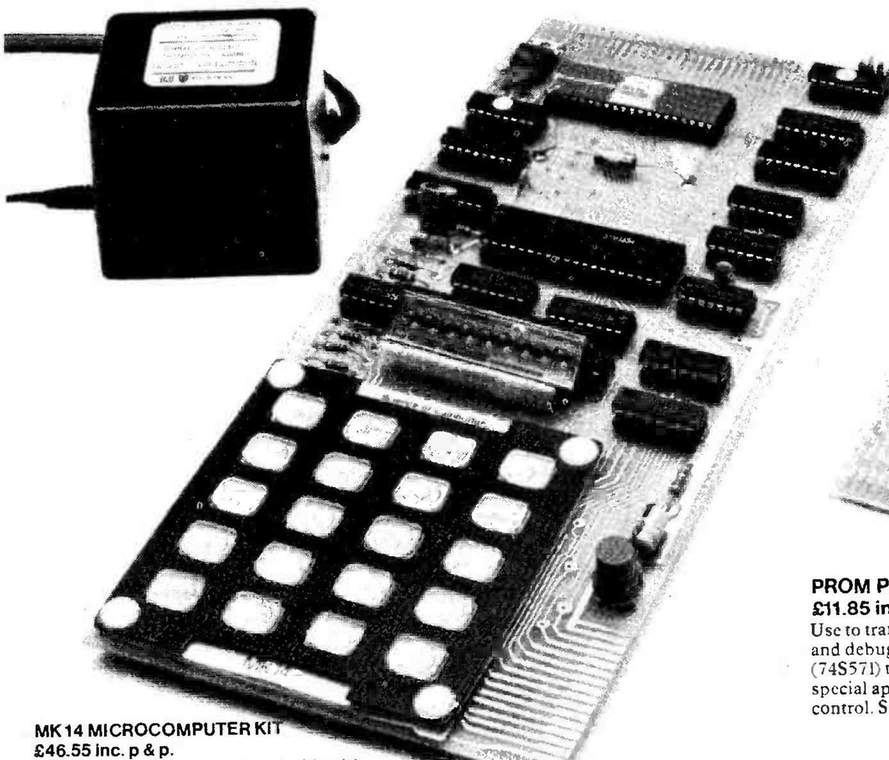
**VDU MODULE. £33.75**
**(£26.85 without character generator) inc. p & p.**
Display up to ½K memory (32 lines x 16 chars, with character generator; or 4096 spot positions in graphics mode) on UHF domestic TV. Eurocard-sized module includes UHF modulator, runs on single 5 V supply. Complete ascii upper-case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



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



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



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

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

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

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

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

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

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

All prices include p and p.

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

Name______________________________

Address (please print)______________________________

______________________________

PW/12

# Science of Cambridge Ltd

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

# HI-FI GLOSSARY

**3**

Gordon J. KING

# D

## DECODER

This is a passive or active circuit which restores the "integrity" of programme material subsequent to *encoding* (see under Encoder). The *multiplex decoder* used in f.m. stereo receivers exemplifies one such application. It is the job of this decoder to reclaim the separate left and right stereo signals from the encoded stereo multiplex information which is modulated on the v.h.f. (very high-frequency) carrier wave (Fig. 10).

In certain types of *noise reduction* circuits, such as Dolby B which is used in domestic cassette decks, the signal is first encoded during recording and then decoded during replay to restore the frequency response integrity while at the same time reducing the noise content. What happens here is that the upper-frequency part of the recording signal is boosted by an amount determined by the signal level. On high-level signals corresponding to a recording level of 200nWb/m (this is called the *Dolby level*) or more, no boost is applied, but as the level reduces so more upper-frequency boost is progressively applied, reaching a maximum of 10dB.

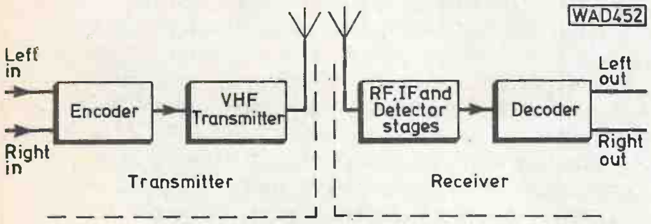



**Fig. 10: Basic principle of f.m. stereo encoding and decoding**

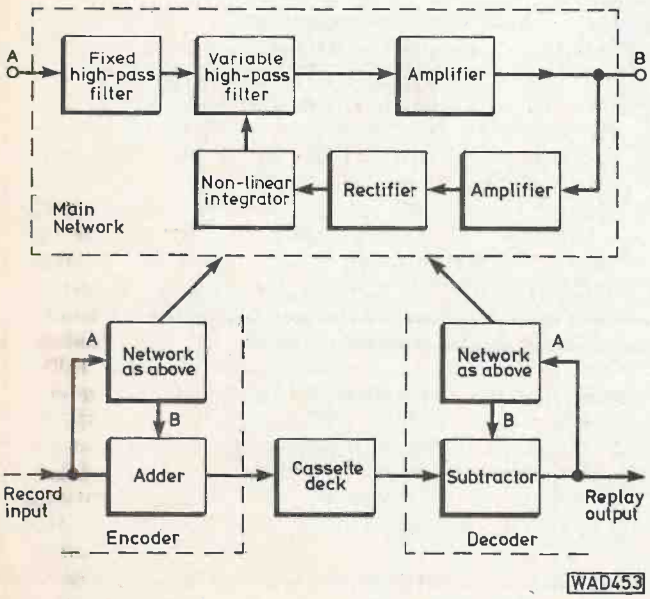



**Fig. 11: Block diagram of Dolby B noise reduction encoding and decoding**

When the encoded signal is replayed, the Dolby decoder comes into operation and introduces upper-frequency attenuation to correspond to the boost applied during recording. The attenuation is thus also determined by the signal level. The net result is not only restored frequency integrity but also a significant improvement in *signal/noise (S/N) ratio* owing to the integrated upper-frequency noise being reduced by an amount corresponding to the decoding attenuation.

The scheme ensures that maximum noise reduction occurs only on low-level signals thereby avoiding impairment to the effective *dynamic range*. The higher level signals automatically mask the noise, anyway. A block diagram of the encode and decode parts of the Dolby B noise reduction system is given in Fig. 11.

It will be appreciated that the encode and decode sections need to track with changing signal level very accurately to avoid frequency response errors when replaying a tape, and for this reason the gains of the two sections need to be normalised with respect to a tape of given sensitivity. Some cassette decks are equipped with a 400Hz oscillator for recording a suitable level tone on the tape used, so that on replay the decoder gain can be adjusted to yield a corresponding output.

## DE-EMPHASIS

For some applications, notably f.m. radio, a fixed amount of upper-frequency boost is introduced at the input. This calls for a fixed amount of treble attenuation at the output for correct frequency integrity, which is generally called de-emphasis (also see under *Pre-emphasis*). Because of this the noise is also reduced. However, because of the fixed pre-emphasis, the average level of input signal needs to be restricted to avoid overloading at the high frequencies. The frequency at which the input treble boost and the output treble attenuation start to take effect is commonly referred to a simple time-constant. The European (including the UK) time-constant for f.m. radio (and TV) is 50µs, which corresponds to a −3dB frequency of $1/2\pi T$ (where T is the time-constant in seconds), or 3184Hz. The time-constant in the USA is 75µs, corresponding to a −3dB (turnover) frequency of 2123Hz.

When Dolby B noise reduction is used on f.m. (in the USA—in the UK this has so far only been experimented with) the time-constant is reduced to 25µs (6369Hz turnover frequency).

If the receiver set for the American standard is used in the UK the treble frequencies are rolled-off prematurely. Conversely, if a receiver set for the European standard is used in America the treble frequencies are boosted.

# HI-FI GLOSSARY

## DIN

These are the initials of the German Industrial Standards organisation, or *Deutscher Industrie Normen*—and not to be confused with the noises produced by dubious so-called hi-fi systems! It commonly refers to the standards for plugs, sockets, equalisation, measurement references and so forth, but also includes the basic requirements for hi-fi under DIN 45-500. Like our own British Standards Institution (BSI), it also defines the standards for numerous items outside the field of hi-fi and electronics.

As DIN 45-500 refers essentially to the basic requirements for hi-fi (though it is being updated) it is not regarded by UK hi-fi devotees as a very strict standard, and many items of hi-fi carrying the DIN 45-500 label often exceed the minimum requirements.

## DROP-OUT

When there is a momentary vanishing of signal from a recording tape this is commonly referred to as a drop-out. It is caused either by a flaw in the magnetic-oxide or metal-particle coating of the tape or a mechanical aberration resulting in the tape momentarily losing contact with the tape head. Some tapes are more prone to drop-out problems than others, which is one reason why cheap, non-proprietary tapes cannot be recommended for use with hi-fi decks. Another reason is that the loose oxide particles of cheap tapes can clog the minute gaps of the heads and impair the upper-frequency response, the output, S/N ratio and the erase ratio.

## DYNAMIC RANGE

One aspect of this is the dB distance between the highest *distortion-limited output* and the noise floor of the reproducing equipment, including the noise of the programme source itself. For example, if the distortion-limited output of a cassette deck with a particular brand of tape is referred to 0dB and 3 per cent distortion and the noise floor is 50dB below this output, then the effective dynamic range would be 50dB.

With acoustic programme material such as "live" music from a concert hall the dynamic range is the difference in *phons* between the strongest and the weakest sounds.

With hi-fi equipment some sort of *noise weighting* is commonly adopted so that the annoyance value of the noise correlates to the measurement. With *CCIR weighting,* for example, a cassette deck with Dolby B noise reduction might return a dynamic range of 65dB at low and middle frequencies with chrome or pseudo chrome tape, a hi-fi f.m. tuner 72dB stereo, and a hi-fi amplifier 75dB at pickup input, the latter referred to an output of 1W, which is thus more accurately the S/N ratio.

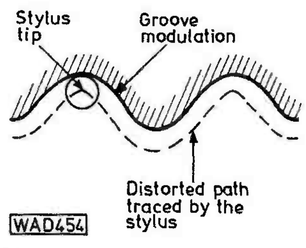



**Fig. 12: Illustration of tracing distortion**

# E

## EIGENTONE

This term refers to sound resonance in a room owing to parallel boundaries. The effect is basically the "bouncing" of the waves to and fro between the parallel surfaces before they decay to a non-disturbing value. When the inter-boundary spacing is a multiple of half the wavelength of the sound the reflections become phase coincident and a *standing wave* resonance is then evoked, so that a listener moving in the sound field will experience successive *nodes* and *antinodes* as he traverses the line of wave incidence.

A primary eigentone corresponds to a sound whose wavelength corresponds to twice the distance between the boundaries. For example, if two parallel surfaces (walls) are spaced by 6m then the room will produce a strong eigentone around 30Hz and possibly "colour" the reproduction. The frequency of a sound can be found from $c/\lambda$ where $c$ is the propagation velocity (close to 344 metres per second at sea level and 20°C) and the wavelength in metres (frequency in Hz). By remembering that an eigentone results from half a wavelength it is possible to calculate the frequency of an eigentone which will develop between any two parallel surfaces.

*Coloration* resulting from eigentones can be reduced by damping the boundary interfaces with acoustic tiles, drapes, etc., but the effect of such damping tends to diminish with decreasing frequency. It has been calculated that, based on unity height, the best dimensions for hi-fi are 1·25 width and 1·6 length for a small room, and 1·6 width and 2·5 length for a large room.

## ELLIPTICAL STYLUS

One aberration of disc replay is the distortion resulting from the tip of the stylus tracing high-frequency, short wavelength groove modulation, as shown in Fig. 12. This is called *tracing distortion* which can only be reduced by decreasing the radius of the stylus tip so that the short wavelength modulation can be better defined.

When this is done with a spherical tip, the tip tends to "bottom" in the groove and decrease the S/N ratio. This is combated by the so-called elliptical stylus which has a small radius for defining the modulation and a larger radius across the groove to avoid bottoming.

## EQUALISATION

For recording or transmission it is often necessary to tailor the programme signal to suit the medium concerned. For example, disc recording calls for a progressively decreasing recording level with reducing frequency to prevent inter-groove collapse on loud bass signals. This

# HI-FI GLOSSARY

is equalised during replay by passing the pickup signal through an amplifier whose gain rises with decreasing frequency.

At the other end of the spectrum it is desirable to give the recording signal a boost *(pre-emphasis)* so that the corresponding degree of attenuation on replay not only restores the frequency integrity but also reduces the noise. As with f.m. radio, time-constants are used to define the turnover frequencies, and with disc records these are 318 and 75μs. In addition, there is a low-frequency turnover of 3180μs (more recently also a subsonic turnover according to IEC 65) to avoid disc ripple effects on replay. These time constants collectively yield *RIAA record equalisation.*

Equalisation is also required for tape recording and replay. When a magnetic tape recorded at a constant input from low to high frequencies is replayed, the output from low to high frequencies rises at the rate of 6dB per octave up to a certain high-frequency where head and tape losses cause the output to start falling. In the replay amplifier, therefore, the gain needs to rise at 6dB per octave with decreasing frequency, while at that frequency where the head and tape losses come into play a suitable upper-frequency boost is also required. The upper-frequency losses are also countered to some degree by the application of treble boost (pre-emphasis) during recording.

The turnover frequencies involved depend on the tape speed and the magnetic properties of the tape. With cassette machines the time-constant is 120μs for basic ferric tape and 70μs for chrome, pseudo chrome, ferro-chrome and metal particle tapes. As with disc replay, there is a further low-frequency time-constant of 3180μs to reduce the effects of mains ripple during replay.

## ENCODER

This is a device which restores the integrity of the programme material during replay when the material has been subjected to encoding during recording or transmission (see under Decoder).

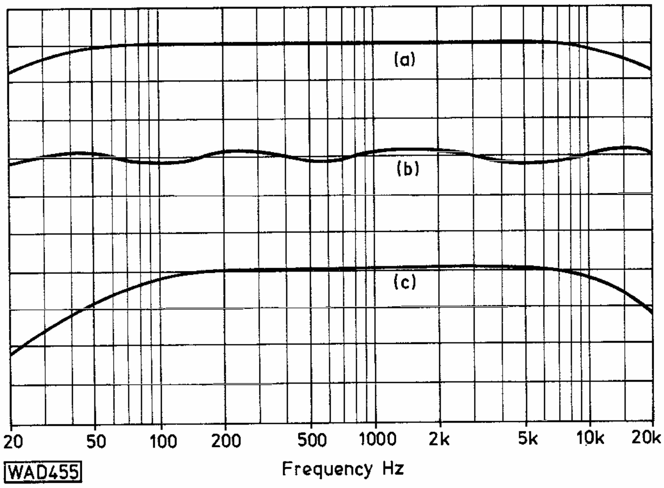



**Fig. 13: Three types of frequency response defined in the text**

# F

## FLUTTER

This term is commonly associated with tape machines and record players and refers to a waver of pitch resulting from spurious fluctuations of speed at periods in excess of about 10Hz. Lower rate fluctuations are referred to as *wow.* Flutter can cause an undesirable "roughness" to the reproduction as the result of intermodulation products. *Wow and flutter* are usually measured together by a suitable instrument, often via a *weighting network* to provide a more valid subjective indication, one standard being DIN peak weighted, often seen in the hi-fi literature.

## FREQUENCY RANGE

This is the range of frequencies over which an item of equipment is operative. Because no defined output limits are included it is not a very meaningful *parameter* and one which should be treated with suspicion when reading the specification of an item of hi-fi equipment.

## FREQUENCY RESPONSE

The frequency *response* is the range of frequencies provided by the equipment within prescribed output (usually dB) limits. The frequency response differs from the *power response* in as much as the former is measured at a low level (well below the full output yield of the equipment), while the latter is measured at or close to the rated output. The frequency response is commonly quoted as that frequency range between low and high terminal frequencies where the output is 3dB below that at 1kHz, as shown in Fig. 13 at (a).

A greater accuracy is provided by referring to the ±1dB undulations within a stated frequency range. Curve (b) in Fig. 13, for example, could be written as ±1dB 20Hz–20kHz. Curve (c) in Fig. 13 could be defined as 60Hz–15kHz −3dB +0·5dB, or as 150Hz–8·5kHz ±0·5dB. The greatest accuracy of all, of course, is provided by the frequency response curve proper being a part of the specification.

## FRINGE AREA

This is the area in advance of the normal *service area* range of a transmitting station, usally an f.m. or TV station. The reliable reception range of a v.h.f. transmitter is a trifle in advance of the line-of-sight distance between the top of the transmitting and receiving aerials, assuming there are no large obstructions in between. This gives the service area distance, which corresponds in miles to $1{\cdot}5\sqrt{h_t}$ **plus** $1{\cdot}5\sqrt{h_r}$, where $h_t$ and $h_r$ are the heights of the transmitting and receiving aerials in feet. For example, if

# HI-FI GLOSSARY

the height of $h_t$ is 1000 feet and the height of $h_r$ 100 feet, then we get 47·43 + 15, or 62·43 miles.

This distance, however, can only be regarded as approximate because it depends on the power of the transmitter and on the prevailing *tropospheric conditions*. The factor 1·5 can increase during a spell of high pressure conditions (e.g., anticyclonic weather) and thus propagate v.h.f. signals more deeply into the fringe area.

# H

## HAAS EFFECT

A sound source is located by a listener by the differences in intensity and time of arrival of the sound waves at his two ears. Imagine two stereo speakers each emitting corresponding sound, of equal intensity but that the sound from one speaker is slightly delayed with respect to that from the other. A listener placed at an equal distance from the two speakers will hear the sound as though emanating from that speaker which is not subjected to the delay. This is called the *precedence effect* or Haas effect. If there is no delay, then the sound will appear to emanate from a point midway between the two speakers when the intensities are equal. If the sound from one speaker is louder than that from the other the sound will appear to come from the speaker of loudest sound.

These two properties of human hearing make it possible for us to enjoy stereo reproduction from a two-channel system; but it is the Haas effect which is the dominating factor, for with a 50ms delay the sound intensity from that speaker needs to be stepped up by some 10dB or more to reverse the apparent balance of sound.

## HALF-POWER BANDWIDTH

If the rated power of an amplifier is, say, 50W, the half-power is 25W, which is 3dB down from 50W. Now, one way of expressing the bandwidth of a power amplifier is to locate the lower and upper frequencies at half power where the distortion is, say, 1% (or, perhaps, a lower value). This is shown diagrammatically in Fig. 14.

## HANGOVER

Not quite the same as the morning after the night before, but just as disconcerting! The effect results from the speaker cone or diaphragm continuing in motion after the passing of a sharp transient. What happens is that the cone or diaphragm overshoots, undershoots, overshoots and so on at diminishing amplitude until all the stored energy has been exhausted. It can result from a very low damping factor (see Part 2) or from "ringing" (e.g., *damped oscillations*) in a filter circuit or part of the amplifier or receiver. The result is that the "edge" is taken from the music definition and the absolute attack of the reproduction is weakened.

## HARMONIC DISTORTION

This results from amplitude non-linearity such that a ratio of increase or decrease of input signal does not result in precisely the same ratio of increase or decrease of output signal. A perfectly linear amplifier would have a straight line transfer (input/output) characteristic as shown by the broken line in Fig. 15. In reality no such amplifier exists. All have a very slightly curved characteristic as shown by the full line in the diagram, which is very much exaggerated, for the curvature of hi-fi amplifiers would not be detectable diagrammatically at this scale.

The mathematical nature of the characteristic determines the order of the distortion produced. A characteristic of even powers produces even-order distortion, such as second-, fourth-, sixth-, etc., harmonic, while a characteristic of odd powers produces odd-order distortion, such as third-, fifth-, seventh-, etc., harmonic. It is generally considered, and agreed by myself, that even-order distortion is more palatable than odd-order distortion, and this applies also to the odd-order (e.g., third-order) *intermodulation distortion* that odd-order non-linearity also evokes.

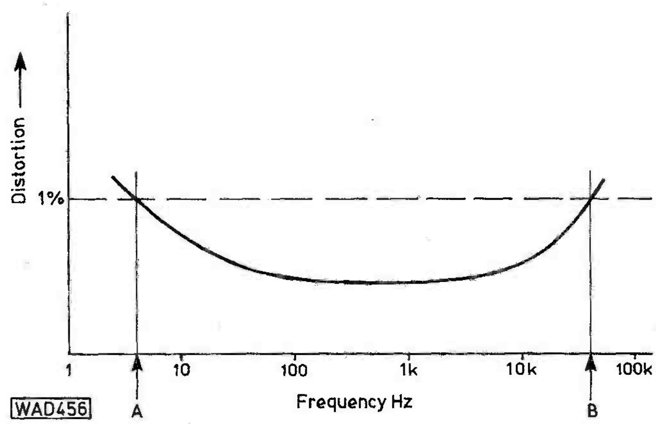



**Fig. 14: Definition of half-power bandwidth**

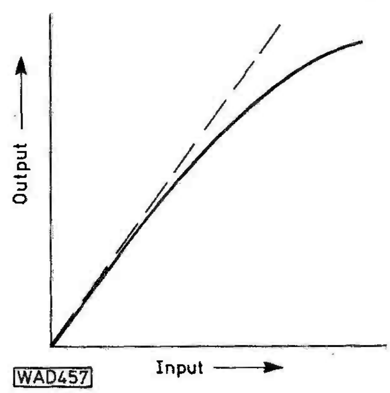



**Fig.15: Transfer characteristic of amplifier. Ideal state shown by the broken-line (perfectly linear), and realistic state (exaggerated) shown by the full-line curve**

# HI-FI GLOSSARY

## HOLE-IN-THE-MIDDLE EFFECT

When the spacing of the two stereo speakers is correctly established in relation to the listening distance from the stereo pair, the sound appears to emanate evenly across the *sound stage* between the two speakers. However, if the two speakers are too far apart or if the phasing between the two is wrong, then there may appear to be an absence of sound coming from the centre of the sound stage. This is sometimes referred to as the hole-in-the-middle effect. If a large room or hall necessitates the use of wide speaker spacing, the hole-in-the-middle can be filled by the use of a third, centre speaker being fed with a correct mix of left and right signals.

## HUM-LOOP

When a hi-fi system is earthed in more than one place, it is possible for minute mains ripple currents to flow round the closed earth loop and appear in series with low-level programme source signals, especially the small signals delivered by the gramophone pickup. When this happens a disconcerting background hum mars the reproduction.

The only solution to this problem lies in disconnecting the earths from all but one item of equipment, which is usually the amplifier. However, extreme care is essential when running certain items of hi-fi without an earth, because under a fault condition this could render the system lethal! Some of the more recent equipment is designed with so-called Class II insulation, which avoids the need for earthing and hence makes it virtually impossible to create a hum-loop condition. However, if in any doubt at all about hi-fi earthing please always consult a reputable hi-fi dealer. It is better to be safe than sorry, particularly since all members of the family are likely to use the hi-fi system.

## Index of Partly Defined Jargon


Antinode
CCIR weighting (also see Part 2)
Coloration
Damped oscillations
Deutscher Industrie Normen
Distortion limited output
Dolby level
Dynamic range
Encoding
Intermodulation distortion
Multiplex decoder
Noise reduction
Phons
Power response
Precedence effect
Pre-emphasis
Service area
Signal/noise (S/N) ratio
Sound stage
Standing wave
Tracing distortion
Tropospheric conditions
Weighting network
Wow and flutter


TO BE CONTINUED

## AERIALS for 160 Metres

▶▶▶ continued from page 26

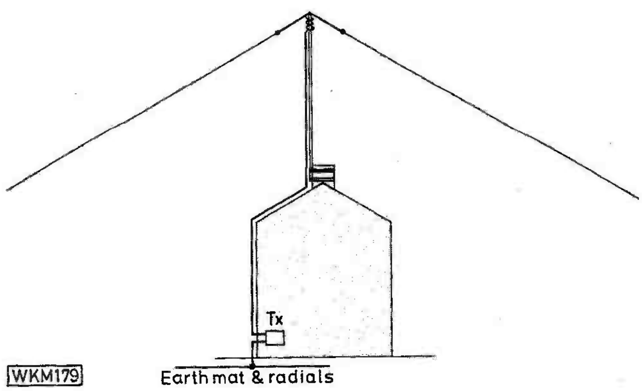



**Fig. 12: If space does not permit a mast in the garden, the aerial of Fig. 11 may be mounted on the house-top**

base, then commonsense suggests that they should run under the aerial's top section, although this may well affect the directivity. In the immediate vicinity of the aerial base, the ground current is highly concentrated and an earth mat of many interconnected wires, or chicken-wire mesh should be used.

To summarise the various recommendations, the author's "practical" 160m top-loaded vertical is shown in Fig. 11. If garden space does not allow the erection of a mast, the aerial may be mounted atop the house, on a chimney stack for instance, as shown in Fig.12. ●

## Semiconductor Tester

▶▶▶ continued from page 33

The two out-of-phase voltages are then passed to two complementary emitter followers which act as current output buffers. Fed through 100kΩ variable resistors, they are connected to the test sockets and also applied to the oscilloscope X and Y amplifiers. Before testing components, VR1 and VR2 are adjusted to give a good circular pattern on the screen.

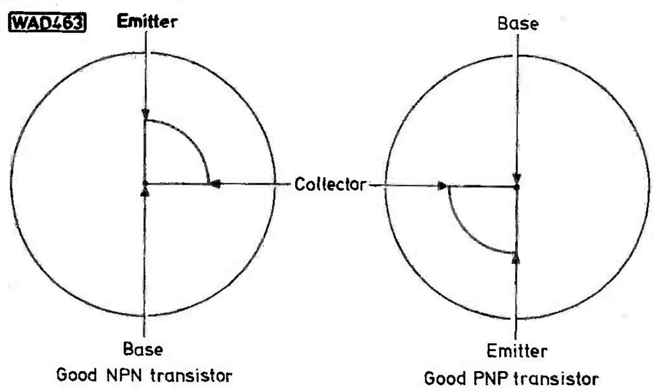



**Fig. 3: The displays for good transistors showing the portions of the display representing the base, emitter and collector connections**

## Construction

Veroboard can be used for the main components, the actual layout not being critical. Power can be derived from two 6V batteries and the completed unit housed in a suitably sized plastics box. Screw terminals can be used to connect the device under test but a specially made socket would be preferable. ●

# SPECIAL OFFER
# ZENTRON LCD
# Time~Zone Watch

Our special offer to *PW* readers this month will appeal particularly to radio amateurs and short wave listeners. Featuring eight predetermined time zones in addition to the basic watch functions, it's a great help in keeping track of time in distant countries.

Not only that—it's also a stop-watch with 1/10 second accuracy; an alarm watch; and a 12-hour down counter.

Having a liquid crystal display, it shows the selected function continuously. No need to put down an armful of books or parcels just to press a button to see what the time is.

The special price of the watch for *PW* readers is £23.95 plus 55p postage and packing, a total of £24.50, including VAT.

Complete the coupon and send it with your remittance to "Practical Wireless", Dept PWL6, Rochester X, Kent ME99 1AA.

THE CLOSING DATE OF THIS OFFER IS 15 FEBRUARY 1980.

## ★ specification

1. **Basic Watch Functions**—Twelve-hour display format with flags displaying hours, minutes, seconds, date, and day of the week. Month displayed only in setting mode. Date controlled by 4-year auto-calendar.
2. **World Time**—Eight predetermined time-zones covering major cities: London, Paris, Cairo, Tokyo, Los Angeles, New York, Rio de Janeiro and Chicago.
3. **Chronograph**—Two stop-watch functions (Add and Lap) of 1/10 second accuracy with running indicators. Start and stop operations checked by sounding of beep-tone. Maximum time 11 hours, 59 minutes, 59·9 seconds.
4. **Down Counter**—Timer of second accuracy, presettable in one-minute steps up to 12 hours. Beep-tone checks start and stop. Alarm tone when time reaches 0 hours, 0 minutes, 0 seconds.
5. **Alarm**—Twenty-four-hour alarm. Presettable to hours and minutes.
6. **Fast Setting**—Automatic slow/fast digit advance feature.
7. **Backlight**—For night viewing.

Single battery operation, UCC393 or equivalent.
32·768kHz quartz crystal control.
Module Size 30mm diameter by 6mm thick.
Viewing area 21·7 × 11mm.
Fully adjustable stainless steel bracelet.

**HOW TO ORDER**

Please complete both parts of the coupon below in BLOCK CAPITALS.

Remittance may be by Access, Barclaycard, Postal Order or Cheque (name and address on back of cheques, please), crossed, and made payable to IPC Magazines Ltd. This offer is open to readers in England, Scotland, Wales, Northern Ireland and Channel Islands only. It is not available in Eire or overseas.

Orders are normally despatched within 28 days but please allow time for carriage. You will be notified if a longer delay may be expected.

If paying by Access or Barclaycard, please do not enclose your credit card with your order.

**To: PRACTICAL WIRELESS**
**Dept PWL6, Rochester X, Kent ME99 1AA**
**Please send me the watch(es) as indicated @ £24.50 each, including P&P.**

**I enclose P.O./Cheque No.**.................. **Value**.............

Number of watches required ☐

**Name** ..........................................................

**Address** ..........................................................

..........................................................

..........................................................

**Tel. No. (Home or Work)** ..........................................

I wish to pay by Access or Barclaycard.

My number is: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

**Cardholder's Address** ..........................................

..........................................................

**Signature** ..........................................................

Number required ☐

**Name** ..........................................................

**Address** ..........................................................

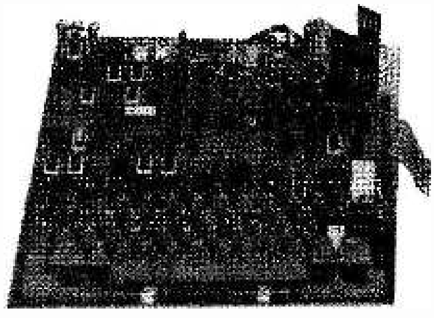
..........................................................

**From: PRACTICAL WIRELESS**
**Dept PWL6, Rochester X, Kent ME99 1AA**

CUT ROUND DOTTED LINE

# COMPUKIT UK101 LOW COST SUPERBOARD IN KIT FORM

SAMPLE TAPE included FREE



**COMPUKIT UK101**

**ELENCO** – 3½ digit D.V.M. as nationally advertised.

ONLY **£55** + V.A.T. + DEL.

**ORDER FROM:–**

## Contour Electronics

23 HIGH STREET,
STANSTEAD ABBOTTS,
WARE, HERTFORDSHIRE

**SEND ONLY £10.00 DEPOSIT TO RESERVE ONE**

An extended monitor on cassette will be supplied free of charge with each kit.

Simple Soldering due to clear and consise instructions compiled by Dr. T. Berk, BSc.PhD

**NO EXTRAS NEEDED JUST HIT 'RETURN' AND GO.**

**Build, understand, and program your own computer for only a small outlay.**

ONLY **£219** + VAT + DEL.
**including RF Modulator & Power supply. Absolutely no extras.**

FOR FURTHER DETAILS
Telephone: Harlow (0279) 415717
or
Ware 870218

**The Compukit UK101 has everything a one board 'superboard' should have.**

★ Uses ultra-powerful 6502 microprocessor.
★ 50Hz Frame refresh for steady clear picture (U.S.A. products with 60Hz frame refresh always results in jittery displays).
★ 48 chars by 16 lines – 1K memory mapped video system providing high speed access to screen display enabling animated games and graphs.
★ Extensive 256 character set which includes full upper and lower case alphanumerics, Greek symbols for mathematical constants and numerous graphic characters enabling you to form almost any shape you desire anywhere on the screen.
★ 8K full Microsoft Basic in ROM compatible with PET, APPLE SORCERER hence taking the headache out of programming by using simple English statements. Much faster than currently available personal computers.
★ Professional 52 Key keyboard in 3 colours – software polled meaning that all debouncing and key decoding done in software.
★ Video output and UHF Highgrade modulator (8Mz Bandwidth) which connects direct to the aerial socket of your T.V. Channel 36 UHF.
★ Fully stabilised 5V power supply including transformer on board.
★ Standard KANSAS city tape interface providing high reliability program storage – use on any standard domestic tape or cassette recorder.
★ 4K user RAM expandable to 8K on board £49 extra.
★ 40 line expansion interface socket on board for attachment of extender card containing 24K RAM and disk controller. (Ohio Scientific compatible).
★ 6502 machine code accessible through powerful 2K machine code monitor on board.
★ High quality thru plated P.C.B. with all I.C.'s mounted on sockets.

**FULL CONSTRUCTION DETAILS IN P.E. AUG 1979 EDITION**

**AVAILABLE NOW**

---

**TTLs BY TEXAS**

| | | | |
|---|---|---|---|
| 7400 | 11p | 7497 | 150p |
| 7401 | 12p | 74100 | 130p |
| 7402 | 12p | 74104 | 65p |
| 7403 | 14p | 74105 | 65p |
| 7404 | 14p | 74107 | 34p |
| 7405 | 18p | 74109 | 55p |
| 7406 | 32p | 74110 | 55p |
| 7407 | 32p | 74111 | 70p |
| 7408 | 19p | 74116 | 200p |
| 7409 | 19p | 74118 | 130p |
| 7410 | 15p | 74119 | 210p |
| 7411 | 24p | 74120 | 110p |
| 7412 | 20p | 74121 | 28p |
| 7413 | 30p | 74122 | 48p |
| 7414 | 60p | 74123 | 48p |
| 7416 | 27p | 74125 | 55p |
| 7417 | 27p | 74126 | 60p |
| 7420 | 17p | 74128 | 75p |
| 7421 | 40p | 74132 | 75p |
| 7422 | 22p | 74136 | 60p |
| 7423 | 34p | 74141 | 70p |
| 7425 | 30p | 74142 | 200p |
| 7426 | 40p | 74145 | 90p |
| 7427 | 34p | 74147 | 190p |
| 7428 | 36p | 74148 | 150p |
| 7430 | 17p | 74150 | 100p |
| 7432 | 30p | 74151A | 70p |
| 7433 | 40p | 74153 | 70p |
| 7437 | 35p | 74154 | 100p |
| 7438 | 35p | 74155 | 90p |
| 7440 | 17p | 74156 | 90p |
| 7441 | 70p | 74157 | 70p |
| 7442A | 60p | 74159 | 190p |
| 7443 | 112p | 74160 | 100p |
| 7444 | 112p | 74161 | 100p |
| 7445 | 100p | 74162 | 100p |
| 7446A | 93p | 74163 | 100p |
| 7447A | 70p | 74164 | 100p |
| 7448 | 80p | 74165 | 130p |
| 7450 | 17p | 74166 | 100p |
| 7451 | 17p | 74167 | 200p |
| 7453 | 17p | 74170 | 240p |
| 7454 | 17p | 74172 | 720p |
| 7460 | 17p | 74173 | 120p |
| 7470 | 36p | 74174 | 93p |
| 7472 | 30p | 74175 | 85p |
| 7473 | 34p | 74176 | 90p |
| 7474 | 30p | 74177 | 90p |
| 7475 | 30p | 74178 | 160p |
| 7476 | 35p | 74180 | 90p |
| 7480 | 50p | 74181 | 200p |
| 7481 | 100p | 74182 | 90p |
| 7482 | 84p | 74184A | 150p |
| 7483A | 90p | 74185 | 150p |
| 7484 | 100p | 74186 | 500p |
| 7485 | 110p | 74190 | 100p |
| 7486 | 34p | 74191 | 100p |
| 7489 | 175p | 84192 | 100p |
| 7490A | 30p | 74193 | 100p |
| 7491 | 80p | 74194 | 100p |
| 7492A | 46p | 74195 | 95p |
| 7493A | 30p | 74196 | 95p |
| 7494 | 84p | 74197 | 80p |
| 7495A | 70p | 74198 | 150p |
| 7496 | 65p | 74199 | 150p |

| | |
|---|---|
| 74221 | 160p |
| 74251 | 140p |
| 74259 | 250p |
| 74265 | 90p |
| 74278 | 290p |
| 74279 | 140p |
| 74283 | 190p |
| 74284 | 400p |
| 74285 | 400p |
| 74290 | 150p |
| 74293 | 150p |
| 74294 | 200p |
| 74298 | 200p |
| 74365 | 150p |
| 74366 | 150p |
| 74367 | 150p |
| 74368 | 150p |
| 74390 | 200p |
| 74393 | 200p |
| 74490 | 225p |
| **74 LS SERIES** | |
| 74LS00 | 13p |
| 74LS02 | 18p |
| 74LS04 | 14p |
| 74LS08 | 22p |
| 74LS10 | 20p |
| 74LS13 | 38p |
| 74LS14 | 75p |
| 74LS20 | 22p |
| 74LS22 | 28p |
| 74LS27 | 38p |
| 74LS30 | 22p |
| 74LS47 | 90p |
| 74LS55 | 30p |
| 74LS73 | 50p |
| 74LS74 | 40p |
| 74LS75 | 50p |
| 74LS83 | 110p |
| 74LS85 | 100p |
| 74LS86 | 40p |
| 74LS90 | 60p |
| 74LS93 | 60p |
| 74LS107 | 45p |
| 74LS112 | 100p |
| 74LS123 | 75p |
| 74LS132 | 900p |
| 74LS133 | 60p |
| 74LS138 | 60p |
| 74LS139 | 60p |
| 74LS151 | 100p |
| 74LS153 | 60p |
| 74LS157 | 60p |
| 74LS158 | 120p |
| 74LS160 | 100p |
| 74LS161 | 100p |
| 74LS162 | 140p |
| 74LS163 | 100p |
| 74LS164 | 120p |
| 74LS165 | 80p |
| 74LS173 | 110p |
| 74LS174 | 110p |
| 74LS175 | 110p |
| 74LS181 | 320p |
| 74LS190 | 100p |
| 74LS191 | 100p |

| | |
|---|---|
| 74LS192 | 140p |
| 74LS193 | 140p |
| 74LS195 | 140p |
| 74LS196 | 120p |
| 74LS221 | 100p |
| 74LS240 | 175p |
| 74LS241 | 175p |
| 74LS242 | 175p |
| 74LS243 | 175p |
| 74LS244 | 195p |
| 74LS245 | 250p |
| 74LS251 | 200p |
| 74LS257 | 120p |
| 74LS259 | 175p |
| 74LS298 | 249p |
| 74LS373 | 200p |
| 74LS374 | 195p |
| 81LS95 | 140p |
| 81LS96 | 140p |
| 81LS97 | 140p |
| 81LS98 | 140p |
| 8T28 | 230p |
| 9301 | 160p |
| 9302 | 175p |
| 9308 | 316p |
| 9310 | 275p |
| 9311 | 275p |
| 9312 | 160p |
| 9314 | 165p |
| 9316 | 225p |
| 9322 | 150p |
| 9368 | 200p |
| 9370 | 200p |
| 9374 | 200p |
| 9601 | 100p |
| 9602 | 225p |
| **INTERFACE I.C.s** | |
| MC1488 | 100p |
| MC1489 | 100p |
| 75107 | 160p |
| 75182 | 230p |
| 75450 | 120p |
| 75451/2 | 72p |
| 75491/2 | 96p |
| **C-MOS I.C.s** | |
| 74C00 | 25p |
| 74C02 | 25p |
| 74C04 | 27p |
| 74C08 | 27p |
| 74C10 | 27p |
| 74C14 | 90p |
| 74C20 | 27p |
| 74C30 | 27p |
| 74C32 | 36p |
| 74C42 | 110p |
| 74C48 | 250p |
| 74C73 | 75p |
| 74C74 | 70p |
| 74C85 | 200p |
| 74C86 | 65p |
| 74C90 | 95p |
| 74C95 | 130p |
| 74C107 | 125p |
| 74C150 | 250p |
| 74C151 | 260p |

| | |
|---|---|
| 74C157 | 250p |
| 74C160 | 155p |
| 74C161 | 155p |
| 74C162 | 155p |
| 74C163 | 155p |
| 74C164 | 120p |
| 74C173 | 120p |
| 74C174 | 160p |
| 74C175 | 210p |
| 74C192 | 150p |
| 74C193 | 150p |
| 74C194 | 220p |
| 74C195 | 110p |
| 74C221 | 175p |
| **4000 SERIES** | |
| 4000 | 15p |
| 4001 | 17p |
| 4002 | 17p |
| 4006 | 95p |
| 4007 | 18p |
| 4008 | 80p |
| 4009 | 40p |
| 4010 | 50p |
| 4011 | 17p |
| 4012 | 18p |
| 4013 | 50p |
| 4014 | 84p |
| 4015 | 84p |
| 4016 | 45p |
| 4017 | 80p |
| 4018 | 89p |
| 4019 | 45p |
| 4020 | 100p |
| 4021 | 110p |
| 4022 | 100p |
| 4023 | 22p |
| 4024 | 50p |
| 4025 | 20p |
| 4026 | 130p |
| 4027 | 50p |
| 4028 | 84p |
| 4029 | 100p |
| 4030 | 55p |
| 4031 | 200p |
| 4033 | 180p |
| 4034 | 200p |
| 4035 | 110p |
| 4040 | 100p |
| 4041 | 80p |
| 4042 | 80p |
| 4043 | 90p |
| 4044 | 90p |
| 4046 | 110p |
| 4047 | 100p |
| 4048 | 55p |
| 4049 | 40p |
| 4050 | 45p |
| 4051 | 80p |
| 4052 | 80p |
| 4053 | 80p |
| 4055 | 125p |
| 4056 | 135p |
| 4059 | 600p |
| 4060 | 115p |
| 4063 | 120p |
| 4066 | 55p |

**LINEAR I.C.s**

| | | | |
|---|---|---|---|
| AY1-0212 | 600p | MC1496 | 100p |
| AY1-1313 | 668p | MC3340 | 120p |
| AY1-5050 | 212p | MC3360 | 120p |
| AY5-1224A | 225p | MK50398 | 750p |
| AY5-1315 | 600p | NE531 | 100p |
| AY5-1317 | 750p | NE543K | 225p |
| AY5-1320 | 320p | NE555 | 25p |
| CA5019 | 80p | NE556 | 70p |
| CA3046 | 70p | NE561B | 425p |
| CA3048 | 225p | NE562B | 425p |
| CA3080E | 72p | NE565 | 130p |
| CA3089E | 225p | NE566 | 155p |
| CA3090AQ | 375p | NE567 | 175p |
| CA3130E | 100p | RC4151 | 400p |
| CA3140E | 70p | SN76003N | 175p |
| CA3160E | 75p | SN76013N | 140p |
| FX209 | 750p | SN76013ND | 120p |
| ICL7106 | 925p | SN76023ND | 120p |
| ICL8038 | 340p | SN76033N | 175p |
| LM301A | 36p | SP8515 | 750p |
| LM311 | 190p | TBA641B11 | 225p |
| LM318 | 200p | TBA800 | 90p |
| LM324 | 70p | TBA810 | 100p |
| LM339 | 90p | TBA820 | 90p |
| LM348 | 95p | TCA940 | 175p |
| LM377 | 175p | TDA4500 | 250p |
| LM380 | 75p | TDA1004 | 325p |
| LM381AN | 150p | TDA1008 | 300p |
| LM389N | 140p | TDA1022 | 600p |
| LM709 | 36p | XR2206 | 400p |
| LM710 | 50p | XR2207 | 400p |
| LM733 | 100p | XR2216 | 675p |
| LM741 | 29p | XR2240 | 400p |
| LM747 | 70p | ZN414 | 90p |
| LM748 | 35p | ZN424E | 135p |
| LM3900 | 70p | ZN425E | 400p |
| LM3911 | 130p | ZN1034E | 200p |
| LM4136 | 120p | 95H90 | 800p |
| MC1310P | 150p | | |
| MC1458 | 55p | | |
| MC1495 | 400p | | |

**VOLTAGE REGULATORS**
**Fixed Plastic TO-220**

| **1A** | **+ve** | | **1A** | **–ve** | |
|---|---|---|---|---|---|
| 5V | 7805 | 75p | 5V | 7905 | 90p |
| 12V | 7812 | 75p | 12V | 7912 | 90p |
| 15V | 7815 | 75p | 15V | 7915 | 90p |
| 18V | 7818 | 90p | 18V | 7918 | 90p |
| 24V | 7824 | 90p | 24V | 7924 | 90p |
| **100mA** | **TO-92** | | **100mA** | **TO-92** | |
| 5V | 78L05 | 35p | 5V | 79L05 | 80p |
| 12V | 78L12 | 35p | 12V | 79L12 | 80p |
| 15V | 78L15 | 35p | 15V | 79L15 | 80p |

**OTHER REGULATORS**

| | | | |
|---|---|---|---|
| LM309K | 135p | TBA625B | 120p |
| LM317T | 200p | TL430 | 65p |
| LM323K | 625p | 78HO5KC | 675p |
| LM723 | 37p | 78MGT2C | 140p |

**OPTO-ELECTRONICS**

| | | | | | |
|---|---|---|---|---|---|
| 2N5777 | 45p | ORP12 | 90p | ORP61 | 90p |
| OCP71 | 130p | ORP60 | 90p | TIL78 | 70p |

**TRANSISTORS**

| | | | |
|---|---|---|---|
| AC127/8 | 20p | BFY51/2 | 22p |
| AD149 | 70p | BFY56 | 33p |
| AD161/2 | 45p | BFY90 | 90p |
| BC107/8 | 11p | BRY39 | 45p |
| BC109 | 11p | BSX19/20 | 20p |
| BC147/8 | 9p | BU105 | 190p |
| BC149 | 10p | BU108 | 250p |
| BC157/8 | 10p | BU205 | 220p |
| BC159 | 11p | BU208 | 240p |
| BC169C | 12p | BU406 | 145p |
| BC172 | 12p | MJ2501 | 225p |
| BC177/8 | 17p | MJ2955 | 100p |
| BC179 | 18p | MJ3001 | 225p |
| BC182/3 | 10p | MJE340 | 65p |
| BC184 | 11p | MJE2955 | 100p |
| BC187 | 30p | MJE3055 | 70p |
| BC212/3 | 11p | MPF102 | 45p |
| BC214 | 12p | MPF103/4 | 40p |
| BC461 | 36p | MPF105/6 | 40p |
| BC477/8 | 30p | MPSA06 | 30p |
| BC516/7 | 50p | MPSA12 | 50p |
| BC547B | 16p | MPSA56 | 32p |
| BC549C | 18p | MPSU06 | 63p |
| BC557B | 16p | MPSU56 | 78p |
| BC559C | 18p | OC28 | 130p |
| BCY70 | 18p | OC35 | 130p |
| BCY71/2 | 22p | R2008B | 200p |
| BD131/2 | 50p | R2010B | 200p |
| BDY56 | 200p | TIP29A | 40p |
| BF200 | 32p | TIP29C | 55p |
| BF244B | 35p | TIP30A | 48p |
| BF256B | 70p | TIP30C | 60p |
| BF257/8 | 32p | TIP31A | 58p |
| BF259 | 36p | TIP31C | 62p |
| BFR39 | 27p | TIP32A | 68p |
| BFR40 | 27p | TIP32C | 82p |
| BFR41 | 27p | TIP33A | 90p |
| BFR79 | 27p | TIP33C | 114p |
| BFR80 | 27p | TIP34A | 115p |
| BFR81 | 27p | TIP34C | 160p |
| BFX29 | 30p | TIP35A | 225p |
| BFX30 | 34p | TIP35C | 290p |
| BFX84/5 | 30p | TIP36A | 270p |
| BFX86/7 | 30p | TIP36C | 340p |
| BFX38 | 30p | TIP41A | 65p |
| BFW10 | 90p | | |
| BFY50 | 22p | | |

| | | | |
|---|---|---|---|
| TIP41C | 78p | 2N3866 | 90p |
| TIP42A | 70p | 2N3903/4 | 18p |
| TIP42C | 82p | 2N3905/6 | 20p |
| TIP2955 | 78p | 2N4036 | 65p |
| TIP3055 | 70p | 2N4058/9 | 12p |
| TIS43 | 34p | 2N4060 | 12p |
| TIS93 | 30p | 2N4061/2 | 18p |
| ZTX108 | 12p | 2N4123/4 | 22p |
| ZTX300 | 11p | 2N4125/6 | 22p |
| ZTX500 | 15p | 2N4289 | 20p |
| ZTX502 | 18p | 2N4401/3 | 27p |
| ZTX504 | 30p | 2N4427 | 90p |
| 2N457A | 250p | 2N4871 | 60p |
| 2N696 | 35p | 2N5087 | 27p |
| 2N697 | 25p | 2N5089 | 27p |
| 2N697 | 45p | 2N5172 | 27p |
| 2N706A | 20p | 2N5179 | 27p |
| 2N708A | 20p | 2N5191 | 83p |
| 2N918 | 30p | 2N5194 | 90p |
| 2N930 | 18p | 2N5245 | 40p |
| 2N1131/2 | 20p | 2N5296 | 55p |
| 2N1613 | 25p | 2N5401 | 50p |
| 2N1711 | 25p | 2N5457/8 | 40p |
| 2N2102 | 60p | 2N5459 | 40p |
| 2N2160 | 120p | 2N5460 | 40p |
| 2N2219A | 30p | 2N5485 | 44p |
| 2N2222A | 20p | 2N6027 | 48p |
| 2N2369A | 16p | 2N6247 | 190p |
| 2N2484 | 30p | 2N6254 | 130p |
| 2N2646 | 50p | 2N6290 | 65p |
| 2N2904/5A | 30p | 2N6292 | 65p |
| 2N2906A | 24p | 2N128 | 120p |
| 2N2907A | 30p | 3N140 | 100p |
| 2N2926 | 9p | 3N201 | 110p |
| 2N3053 | 20p | 3N204 | 100p |
| 2N3054 | 65p | 40290 | 250p |
| 2N3055 | 48p | 40360 | 40p |
| 2N3442 | 140p | 40361/2 | 45p |
| 2N3553 | 240p | 40364 | 120p |
| 2N3565 | 30p | 40408 | 70p |
| 2N3643/4 | 48p | 40409 | 65p |
| 2N3702/3 | 12p | 40410 | 65p |
| 2N3704/5 | 12p | 40411 | 300p |
| 2N3706/7 | 12p | 40594 | 97p |
| 2N3708/9 | 12p | 40595 | 105p |
| 2N3773 | 300p | 40603 | 58p |
| 2N3819 | 25p | 40673 | 90p |
| 2N3820 | 50p | 40841 | 90p |
| 2N3823 | 70p | 40871/2 | 90p |

**DIODES**

| | |
|---|---|
| BY127 | 12p |
| OA47 | 9p |
| OA81 | 15p |
| OA85 | 15p |
| OA90 | 9p |
| OA91 | 9p |
| OA95 | 9p |
| OA200 | 9p |
| OA202 | 10p |
| 1N914 | 4p |
| 1N916 | 7p |
| 1N4148 | 4p |
| 1N4001/2 | 5p |
| 1N4003/4 | 6p |
| 1N4005 | 6p |
| 1N4006/7 | 7p |
| 1N5401/3 | 14p |
| 1N5404/7 | 19p |
| **ZENERS** | |
| 2·7V-33V | |
| 400 mW | 9p |
| 1 W | 15p |

**SPECIAL OFFERS**
100+ 741 £16
100+ 555 £20
100+ RCA 2N3055 £36

**BRIDGE RECTIFIERS**

| | |
|---|---|
| 1A 50V | 21p |
| 1A 100V | 22p |
| 1A 400V | 30p |
| 2A 50V | 30p |
| 2A 100V | 35p |
| 2A 400V | 45p |
| 3A 200V | 60p |
| 3A 600V | 72p |
| 4A 100V | 95p |
| 4A 400V | 100p |
| 6A 50V | 90p |
| 6A 100V | 100p |
| 6A 400V | 120p |
| 10A 400V | 200p |
| 25A 400V | 400p |

**RED LEDS**

| | | |
|---|---|---|
| 0.125" | 12p | 50+ 10p |
| 0.2" | 12p | 50+ 10p |

For full lists please send S.A.E. or see our full page advertisements in P.E., E.T.I., Wireless World.

**Please add 30p p&p and VAT at 15%**

**Govt., Colleges, etc. orders accepted.**
**Callers welcome**

**MON-FRI 9.30-5.30**
**SATURDAY 10.30-4.30**

## TECHNOMATIC LTD

**17 BURNLEY ROAD**
**LONDON NW10**
**Tel: (01) 452 1500 Telex: 922800**

# OF THE MONTH 79

Brian DANCE M.Sc

## TEXAS INSTRUMENTS TL497 REGULATOR

The integrated circuit regulator device is now widely used whenever a well regulated, smoothed supply is required which can be made with the absolute minimum of trouble. The most commonly used form of regulator device employs a series pass transistor which controls the continuous current flowing into a load. One of the disadvantages of this type of regulator is that a considerable proportion of the input power can be wasted, especially when the input voltage is much higher than the output voltage.

During the past couple of years or so, another type of regulator has come onto the market which has many advantages, but also some disadvantages. This new device, known as a switching regulator, can operate with very high efficiency so that little power is wasted in the regulator circuit. Therefore, one does not need a large heatsink to keep the regulator device cool (in contrast to the heatsink required with high-current regulators employing series pass transistors). Additional advantages of switching regulator circuits include the fact that one can obtain output voltages which are lower than the input voltage, higher than the input voltage or of the opposite polarity to the input voltage. Also, if the output voltage is lower than the input voltage, the output current can exceed the input current.

In spite of the versatility of the switching regulator circuits which enable such a wide range of outputs to be obtained at high efficiency, one must remember that these devices require more complex circuitry than series pass regulator devices, which often have just input, output and ground connections. Switching regulator circuits require an inductor. This type of regulator operates by switching current to a reservoir capacitor at a high frequency and is therefore liable to generate radio frequency interference.

## Basic circuits

Before we consider the TL497 device in detail, let us first discuss three basic switching regulator circuit configurations which enable (a) an output voltage lower than the input voltage to be obtained with low input current (b) an output voltage greater than the input voltage to be achieved and (c) an output of inverted polarity to be obtained.

**(a) The step-down circuit.** The basic circuit of the step-down switching regulator (also known as the "buck regulator") is shown in Fig. 1(a). The output voltage is always less than the input voltage.

The transistor acts purely as a fast switch. When the transistor is biased to conduction, the voltage across the diode D rises almost to the input voltage. Thus a voltage approximately equal to the difference between the input and output voltages appears across the inductor L and causes a steadily increasing current to flow through this inductor. This increasing current ceases to flow only when the transistor ceases to conduct.

The voltage across the inductor is now reversed and the diode is biased to conduction so that the magnetic energy stored in the inductor can be passed to the reservoir capacitor C. The internal control circuit used to operate the transistor switch is controlled by an oscillator circuit which automatically increases the "on" time of the transistor if the output voltage decreases and increases the "off" time if the output voltage increases.

The output voltage is therefore maintained almost constant. As the energy stored in the inductor is recovered during the "off" time of the transistor, when no current is being taken from the input, the circuit can operate at high efficiency with the output current larger than the input current. This type of circuit can generate a relatively large amount of noise in the input line due to the rapid switching.

**(b) The boost circuit.** The boost regulator circuit of Fig. 1(b) can be used when one requires an output voltage greater than the input voltage. At the instant the transistor is switched to conduction, most of the input voltage appears across the inductor and the diode is reverse biased, since the collector of the transistor is only a little above earth potential.

When the transistor is switched off, the energy stored in the inductor will send a current through the diode to the reservoir capacitor. The internal circuit automatically times the switching operations so that the mean diode current is equal to the load current and therefore the output voltage remains constant.

This type of circuit has the advantage that little noise is generated in the power supply input line, since current can flow into the circuit during both of the transistor switching states. Unfortunately it is not especially easy to filter the

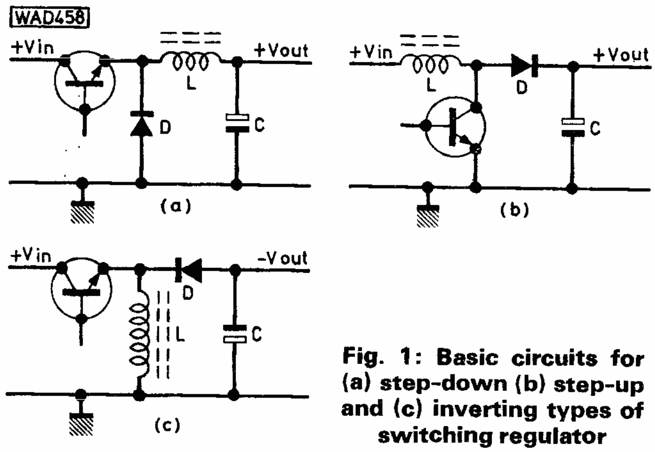



**Fig. 1: Basic circuits for (a) step-down (b) step-up and (c) inverting types of switching regulator**

output voltage so as to render it really smooth without any fluctuations at the switching frequency.

It should be clear that in this type of circuit the input current must exceed the output current, since otherwise there would be an inadequate flow of energy to allow the output voltage to exceed the input voltage.

**(c) The inverter or flyback circuit.** The inverter circuit of Fig. 1(c) provides a negative output voltage from a positive input voltage, the magnitude of the output voltage being either smaller or larger than the input, depending on the circuit design.

Almost the whole of the input voltage appears across the inductor L when the transistor conducts, so energy is stored in L as a magnetic field. When the transistor is switched off, the reverse voltage appearing across the inductor causes the diode to conduct so that the capacitor C becomes charged.

Both the input and output circuits tend to be quite noisy at the switching frequency in this circuit. The output should therefore be well smoothed, not merely by the use of an electrolytic capacitor (which has a high series inductance), but also by a smaller capacitor in parallel with the electrolytic.

The Texas Instruments TL497 device contains the semiconductor devices which are required to make any of the three types of circuits discussed. Output currents of up to 500mA can be obtained from the device itself, but the TL497 can also be used with an external transistor to provide much higher regulated output currents.

The basic internal circuit of the 14-pin TL497 is shown in Fig. 2. The most recent type is the TL 497A which has a Schottky type diode between pins 6 and 7, but either type can be used in the circuits to be discussed. The TL497AC is the economical commercial type.

It is important to note that the absolute maximum permissible input voltage to the TL497 device is 15V, but it is wise to limit the maximum input voltage to a somewhat smaller value, perhaps 12V, but certainly no more than 14V, so as to provide some margin of safety. The absolute maximum output voltage is 35V, but again it is wise to allow some margin of safety.

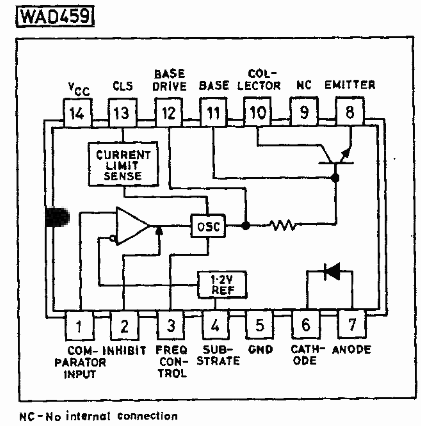
The TL497 contains an internal 1·22V precision reference voltage source. In practical circuits a fraction of the output voltage is tapped off by means of a potential divider circuit and is compared with this reference voltage by the use of the internal comparator. The output of the comparator determines whether the transistor switch is put in the "on" or in the "off" state.

## Step-down circuit

A typical circuit for providing an output of +5V from an input of about +7V to +14V is shown in Fig. 3. The oscillator frequency is determined by the value of the capacitor connected between pin 3 and ground. The value of this capacitor, $C_T$ in Fig. 3, is 150pF and this results in a maximum oscillator frequency of about 60kHz which is suitable for most TL497 circuits.

The output voltage is stabilised at a value which results in the pin 1 potential (one of the inputs to the internal comparator) being equal to the internal 1·22V reference voltage. The output voltage is divided in potential by R1 and R2, so with the values shown in Fig. 3, the pin 1 voltage is near to +1·2V. Obviously there are tolerances in the values of R1, R2 and in the value of the internal reference voltage, but if necessary R1 can be trimmed so that the circuit provides the exact output voltage needed. As the internal reference voltage is about 1·2V (actually 1·08V to 1·32V), it is convenient to choose the value of 1·2 kΩ for R2, since the output voltage is then the sum

**Fig. 2: Internal components in block form of the TL497**




of the values of R1 and R2 in kilohms—to a first approximation.

The use of the current sensing resistor $R_{sc}$ between pins 13 and 14 is optional. If this resistor is omitted, these two pins should be joined directly together. If the resistor is included in the circuit, when the voltage at pin 13 is about 0·07V below that at pin 14, the internal switching transistor is turned off so that no output is obtained. Thus when the value of 1 ohm is employed for this resistor, the output current is limited to approximately 700mA and this will prevent damage to the device if the output is accidentally shorted to ground.

The circuit of Fig. 3 is based on that of Fig. 1(a). It should be clear that the inductance L and the capacitance C are in similar positions to those in Fig. 1(a), whilst the diode D of Fig. 1 is connected internally between pins 6 and 7 of the TL497 in Fig. 3.

In a typical case, the input to the circuit of Fig. 3 could be 12V at 130mA representing a power of 1·56W. The output could be 5V at 200mA which is 1W; thus the overall efficiency would be about 64%. Output ripple in this circuit is typically around 15mV.

Naturally other output voltages may be obtained by suitable choice of R1 and R2. The output voltage is equal to (1 + R1/R2) times the value of the internal reference voltage.

A circuit for stepping up an input voltage of perhaps +5 or +10V to an output of +16·2V is shown in Fig. 4. This is based on the circuit of Fig. 1(b), but the input passes through the resistor $R_{sc}$ before reaching the inductor L, this resistor performing the same function as the similar resistor in Fig. 3. As indicated in Fig. 1(b), the right-hand side of the inductor is connected to the switching transistor

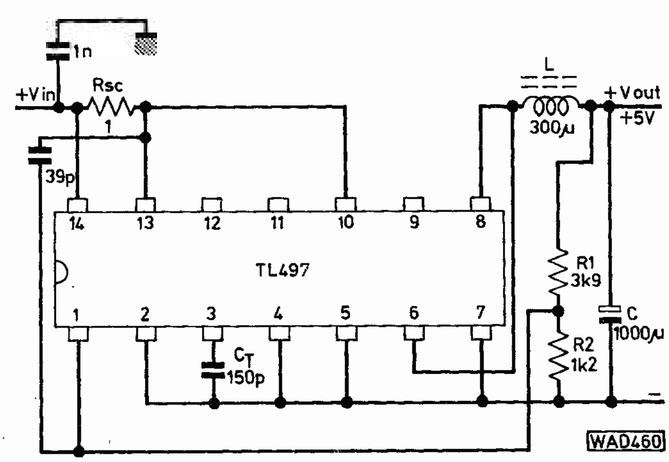



**Fig. 3: A typical step-down TL497 circuit providing a +5V output**

(pin 10 in Fig. 4) and hence through a diode (pin 7 to pin 6) to feed the capacitor C.

As in the case of Fig. 3, the output voltage is equal to (1 + R1/R2) times the value of the internal reference voltage. By selecting a value of 1·2 kΩ for R2, the output voltage is made equal to the sum of the values of R1 and R2 in kilohms.

## Inverter circuit

An inverting regulator circuit for supplying an output of about −5V is shown in Fig. 5. This is based on the circuit of Fig. 1(c) with the addition of the short-circuit limiting resistor $R_{sc}$, as in the previously discussed circuits. In Figs. 3 and 4 the one side of the 1·2V internal voltage reference is grounded at pin 4 so that this reference voltage can be compared with the potential across a resistor, one side of which is grounded. In Fig. 5, however, pin 4 is connected to the output potential and pin 1 to the junction of the two potential dividing resistors so that the positive side of R2 can be connected to the comparator input at pin 1 in order to render the polarities at the comparator inputs correct.

The output voltage from the Fig. 5 circuits is equal to −(1 + R1/R2) times the internal reference voltage.

## General comments

The use of the TL497 device enables switching regulator circuits to be constructed much more simply than if discrete components are used. The basic circuits shown in Figs. 3 to 5 are simple to construct, but circuits using an external power transistor for controlling larger currents must be carefully designed.

The minimum input voltage for the operation of the TL497 is 4·5V. The step-down circuit of Fig. 3 is suitable for providing any output voltage from the +1·2V of the internal reference up to a value of 1V less than the input. The step-up circuit of Fig. 4 can be used to provide an output of not less than 2V above the input voltage up to the maximum of 30V. In the inverting circuit of Fig. 5, the output voltage can range from the negative value of the internal reference source up to −25V.

Texas Instruments have made available specially-designed inductors for use with the TL497 device, these being known as the RI 497. Four types are available, details being shown in Table 1. The 0·5V types are suitable for use in the circuits of Figs. 3 to 5 inclusive, the 5A types being required only when an external transistor is employed to obtain large output currents. These inductors are encapsulated in cases 25·4mm square by 9·53mm in height and incorporate a toroidal ferrite inductor.

Although the use of the specially-designed inductors is strongly to be recommended, any ferrite-cored inductor could be employed provided that the ferrite material does not become magnetically saturated at the maximum current at which it is likely to be used. As an experiment, the writer wound about 70 turns of 28 s.w.g. wire around a standard ferrite rod aerial and found that the TL497 device would operate satisfactorily in two of the three

**Table 1. Data on the coils produced for use with the TL497 device**

| Inductor type | Inductance (μH ±10%) | Resistance (ohm, max.) | Max. Current (A) |
|---|---|---|---|
| RI 497–01 | 75 | 4 | 0·5 |
| RI 497–02 | 150 | 6 | 0·5 |
| RI 497–03 | 75 | 0·1 | 5 |
| RI 497–04 | 150 | 0·15 | 5 |

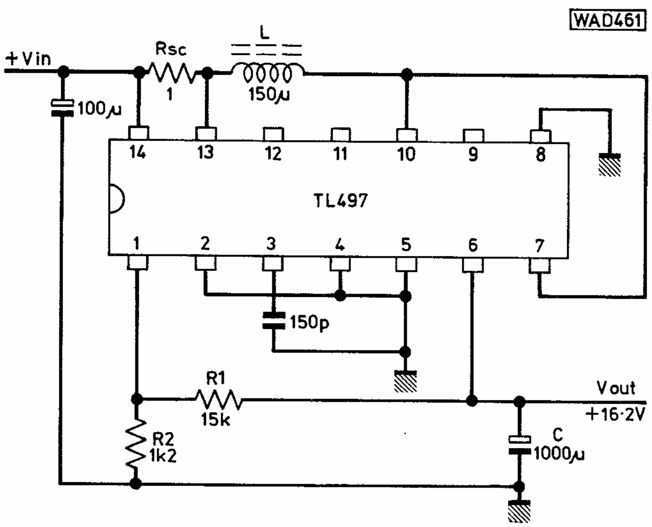



**Fig. 4: A step-up circuit providing an output of +16·2V with the component values shown**

circuits shown. However, the design of switching regulator circuits is not especially easy and it is well worth while using the recommended inductor.

Switching regulator circuits can generate much high frequency noise if a reasonable layout is not adopted. In order to obtain low output voltage ripple, the output filter capacitor (marked C in the circuits of Figs. 3 to 5 inclusive) should be close to the integrated circuit and have

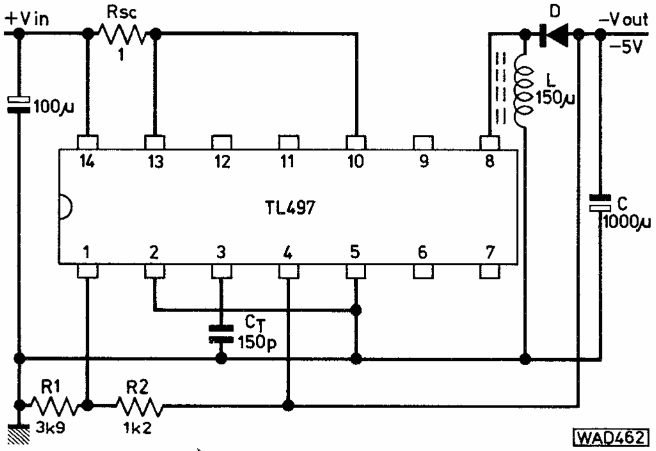
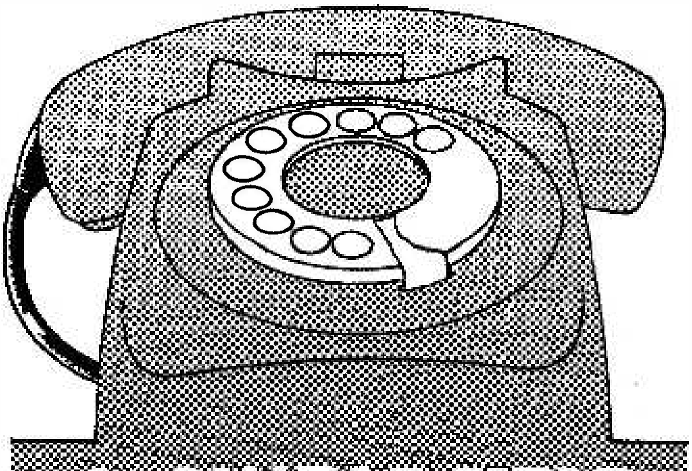



**Fig. 5: An inverting switching regulator circuit providing an output of about −5V**

a short lead to a point on the negative line close to pin 5 of the TL497. A good quality capacitor should be employed. If long power supply leads are used to bring current to the TL497, a larger value of input filter capacitor may possibly be required, but this capacitor should always be close to the integrated circuit. Inadequate filtering of the input and output leads can cause considerable problems with switching regulator circuits.

No capacitor behaves as if it were a pure capacitor without resistance. In switching regulator applications it is very important that the "equivalent series resistance" of the input and output filter capacitors should be reasonably small; this small resistance can be obtained by suitable constructional techniques when making the capacitors, namely by joining the input leads onto the metal foil of the capacitor in many places rather than just at one place. Such capacitors tend to be slightly more expensive than inferior types having a much higher series resistance.

The TL497 i.c. and the RI 497-02 coil are available from Arrow Electronics Ltd., Leader House, Coptfold Road, Brentwood, Essex, CM14 4BN. ●



# A SIMPLE FIELD TELEPHONE SYSTEM

E.A.PARR & J.WALLACE

The authors spend a large amount of their working year on site, commissioning complex electrical equipment. This often involves checking electrical panels several hundred yards from control panels and the work is usually hindered by poor or non-existent communications.

The simple telephone handset system described here was developed to provide versatile instant communications. To meet our requirements, the system must:

1. Be cheap. Despite million-pound budgets for projects, firms usually baulk at a £10 order to RS Components.
2. Be battery-operated with a very long life on a PP3 battery.
3. Comprise, at each end, a telephone handset (or headset with a boom microphone) and an amplifier. The amplifier must be small and light enough to be carried in a pocket.
4. Unlike the usual "baby alarm" circuit, have two-way speech with no press-to-talk buttons.
5. Be a two-wire system, floating to allow use with spare cores in multicore cables shared with high-voltage, heavy-current signals without suffering from interference.
6. Have a call facility which will work with the receiving amplifier turned off.
7. Have a range of approximately 1 km.

These design criteria were met by a simple circuit built around standard Post Office-style handsets and the ubiquitous 741 amplifier.

## Circuit Description

The basic design is shown on Fig. 1. We have two handsets and amplifiers, denoted A and B, connected by a signal pair. Each amplifier is connected to the signal line by a series resistor RSA and RSB. The two earpieces are connected direct onto the lines.

Suppose amplifier A is transmitting, and we have a voltage $V_{OA}$ at the amplifier output. Since the output of amplifier B looks like a low impedance, the voltage on the line will be

$$V_{LA} = V_{OA} \times \frac{\text{(RSB in parallel with two earpieces)}}{\text{(RSB in parallel with two earpieces)} + \text{RSA}}$$

Similarly the voltage on the line from amplifier B will be:

$$V_{LB} = V_{OB} \times \frac{\text{(RSA in parallel with two earpieces)}}{\text{(RSA in parallel with two earpieces)} + \text{RSB}}$$

Since $V_{OB} = V_{OA}$ by design and RSA = RSB by design then $V_{LA} = V_{LB}$ and speech of equal volume will be obtained in both earpieces, and two-way speech is possible. Note that when you speak into your handset, you will hear yourself in your own earpiece. This effect, known as sidetone, is deliberate, as it is disconcerting NOT to hear yourself, and in addition it reduces the natural tendency to shout in noisy locations.

The actual circuit of one handset and amplifier is shown in Fig. 2. The circuit of the other amplifier and handset is, of course, identical. The microphone in a standard PO handset is a carbon transmitter, and needs a bias current. This is provided by R1. In the absence of any data, the value of R1 was determined empirically. IC1 is a conventional 741 op. amp. connected as an inverting amplifier. The amplifier is biased by R2 and R3 to a point mid-way between the supply rails. The signal from the microphone is a.c. coupled to the amplifier and the gain of the amplifier is fixed by R4 and R5. This was deliberately made non-adjustable to ensure that $V_{OA}$ and $V_{OB}$ are equal. If moving-coil microphones are used, R4 and R5 may need to be changed, and R1 may be omitted. At the amplifier output, a signal of approximately 1 volt is produced. The amplifier output is a.c. coupled onto the line via C2. Resistor R6 is the source resistance RS of the amplifier mentioned above.

The earpiece is connected to the line via the volume control VR1. Note that this only affects the received volume, not the transmitted volume. In theory it will affect the volume on both earpieces as the load on the line is changed, but this effect is negligible.

The call facility is provided by S2. This simply applies positive feedback via C3, causing IC1 to oscillate. As a practical observation it is advisable to remove the handset from your ear before pressing the call tone button. If the circuit is used with earphones and a boom microphone, the call facility is best omitted in the interest of preventing induced deafness!

The ON/OFF switch is a two-pole switch. One contact switches the supply, the other causes the earpiece to bypass the volume control so that the call facility can be used when the receiving amplifier is turned off and the volume control is turned right down. When in use, battery consumption is a miserly 1-2 mA.

## Construction and Use

The amplifiers were built on a piece of 0·1 in pitch Veroboard measuring 42 × 42 mm, with the layout shown on Fig. 3. The circuit board, volume control, ON/OFF switch, line connector and battery were mounted into a standard diecast box which is small and light enough to fit into a pocket.

The circuit is so simple it should be straightforward to fault-find on if problems are encountered. An obvious area to start is the voltages on pins 2, 3 and 6 of IC1. These should all be at half battery volts. To aid fault finding and repairs, IC1 should be mounted in a d.i.l. socket.

The connection to the line is made via a jack plug and socket or crocodile clips, as convenient. It is important that neither of the signal lines is connected to the case. There are two reasons for this; the first being safety. In impromptu use it is quite possible that a live wire could be used in error: with a signal wire connected to the case the

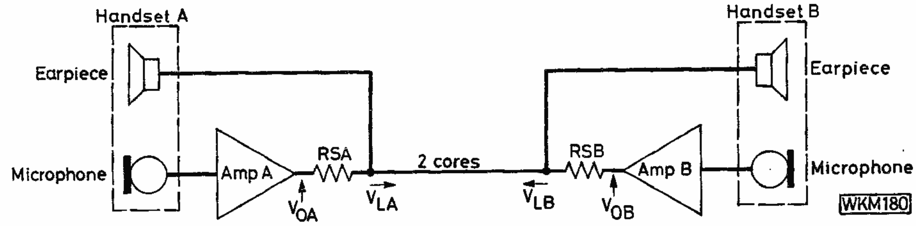



**Fig. 1: Basic principles of two-way operation**

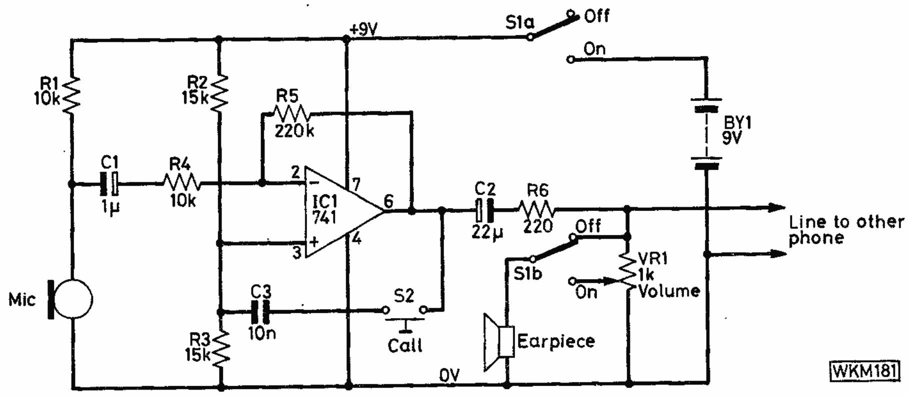



**Fig. 2: Circuit diagram of one telephone**

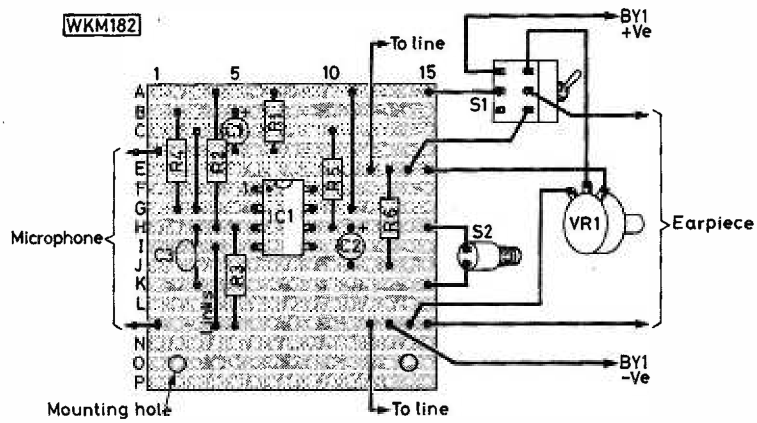



**Fig. 3: Veroboard layout and external connections. The only track cuts required are those beneath IC1**

# ★ components

**THIS LIST COVERS ONE AMPLIFIER AND HANDSET**

**Resistors**

*¼W 5%*

| | | |
|---|---|---|
| 220Ω | 1 | R6 |
| 10kΩ | 2 | R1, 4 |
| 15kΩ | 2 | R2, 3 |
| 220kΩ | 1 | R5 |

**Potentiometers**

| | | |
|---|---|---|
| 1kΩ | 1 | VR1 |

**Integrated Circuits**

| | | |
|---|---|---|
| 741 | 1 | IC1 (8-pin d.i.l. version) |

**Capacitors**

*Disc ceramic*

| | | |
|---|---|---|
| 10nF | 1 | C3 |

*Tantalum bead, 16/35V*

| | | |
|---|---|---|
| 1µF | 1 | C1 |
| 22µF | 1 | C2 |

**Miscellaneous**

S1 Min. toggle d.p.d.t.
S2 Min. push-to-make
Veroboard 0·1 in pitch, 42 × 42mm
8-pin d.i.l. socket (optional but recommended)
Diecast box 114 × 64 × 30mm. PP3 battery and connector. Post Office-style handset and cable (available from surplus shops, etc.). Jack plug and socket, or crocodile clips (see text)

results could be fatal. The second reason is that if the signal wires were crossed, and both cases were on an earthed surface, the signal would be shorted and the phones would not work.

Several pairs of phones have been constructed, and they have proved to be a valuable aid to site work. They have been operated in adverse conditions with high background noise and in the presence of electrical interference and have proved very durable. Apart from the obvious industrial use they were designed for, they are also useful for applications such as sports meetings, amateur dramatics, aerial adjustment, house to shed links etc. The simplicity and low cost makes them an excellent project for an inexperienced constructor. ●

# ON THE AIR

*by Eric Dowdeswell G4AR*

It was a pleasure to read that the European CW Association (*PW* September, Letters) is supporting the idea that I and others have been putting forward from time to time of a Novice-style licence as an introduction to the full amateur licence. This will allow the newcomer a chance to get a good grounding in the construction and operation of equipment to combat the sad lack of experience so prevalent today among newly-licensed amateurs.

It seems to me that everyone nowadays wants to start at the top, with the best of equipment, regardless of the cost. Fine, but where does one go from there? Since the answer is obviously not "on and up" it must be "down and out". Out of one hobby into another, seeking some kind of satisfaction although, of course, the person concerned will never admit this.

Real, lasting satisfaction in a hobby is obtained by working one's way up from the bottom, learning and seeking new information on all aspects of the hobby, making and doing with one's own hands, saving up hard-earned cash to buy another bit of gear, meeting with others to share experiences, generally getting results from one's own efforts.

The acquisition of expensive equipment that is operated without a backing of knowledge and experience will bring only short-lived satisfaction in many cases. How much nicer to know what really goes on inside those black unimaginative boxes. If something goes wrong the best one can do is to change one anonymous-looking module or p.c.b. for another, which is not likely to prove very instructive, only expensive.

With the advent of some form of CB radio service in this country amateurs will need to be doubly sure that they are not wrongly blamed for TV QRM, and a more than skin-deep knowledge of TVI and its cure will be a necessity. The "appliance operator" in this situation will be ill-equipped to deal with TVI.

The introduction of some form of novice licence could mean that *PW* and similar magazines could once again publish constructional articles on low-power transmitters and all the associated equipment and test gear which were so popular in years gone by. There would be a whole new market for kits and components to meet the demands of novice licensees. Readers would find a new interest in studying electronics at its roots with practical applications, instead of having to take so much for granted as they do today.

Merely soldering blank-looking i.c.s. to a p.c.b. is not a very inspiring or instructive pastime and is unlikely to hold the attention for very long. How many readers of this column have assembled such a p.c.b. only to find that it doesn't work and then have not had the slightest idea as to how they should go about finding the trouble? They then pass on to another project having learned precisely nothing in the process.

Whatever the hobby or interest may be, there is only one place to start if the genuine understanding of the subject is the target. At the bottom. The projected novice licence could easily provide the necessary inspiration and incentive, leading on to a new generation of amateurs who would be technicians as well as operators, which, after all, is what our amateur radio service is supposed to be all about. It might even lead to a rewarding career in electronics.

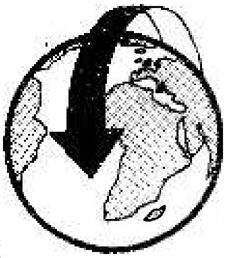
## Clubs Ahoy

Just for a change, let's start with news of the clubs that have sent in info on their activities, like the newly formed **St. Helens and District ARC** which welcomes new members to its Wednesday meetings at the YMCA HQ, 107 Corporation Street, St Helens at 1945, with a preceding Morse code practice session. Paul Gaskell G8PQD, 131 Greenfield Road, St Helens, Lancs, will be pleased to hear from any interested reader or tel 25472 if it's easier.

**Maidenhead and District ARC** wants to get in on the act, and why not, seeing that the ad is free; meetings are on the first Thursday and third Tuesday of each month at 1945 at the Red Cross Centre, The Crescent, Maidenhead, and John Patrick G3TWG, Bedford Lodge, Camden Place, Bourne End, Bucks will be pleased to take your queries by letter or on Bourne End 27275.

Reading the **RAIBC** newsletter *Radial* recently I noted an excellent practice which deserves wider mention, namely the idea of clubs donating sums of money, from small to large, to the RAIBC, obtained by a general collection or from a particular function. Just 10 per cent from a junk sale could be several pounds with no trouble at all. And it all goes to helping handicapped and blind members get a receiver or transmitting gear installed and, believe me, every penny is put to good purpose, there are no "overheads". Contact Frances Woolley G3LWY at 9 Rannoch Court, Adelaide Road, Surbiton, Surrey for more info. Or listen to the RAIBC net with G4IBC on 3750 at 1000 on Tuesdays or 1400 Wednesdays.

**West Kent ARS** has meetings at Adult Education Centre, Monson Road, Tunbridge Wells, Kent at 8pm on



# NEW! ONLY FROM US

The finest-value general-coverage synthesised communications receivers in its class.

FRG-7

**FRG-7**
**£199 inc. VAT**
**and Heliscan aerial**

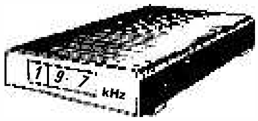
**SPECIAL OFFER**

## The HELISCAN Wall-to-Wall Aerial

A specially developed high-tensile receiving antenna giving superb results. Use it indoors or out — from wall-to-wall, from point-to-point, or even from pillar-to-post!

**INTRODUCTORY PRICE — JUST £15.00 INC. VAT**

NOW AVAILABLE. External digital display giving accurate frequency readout while still retaining the analogue tuning facility. A MUST for the serious FRG-7 owner.

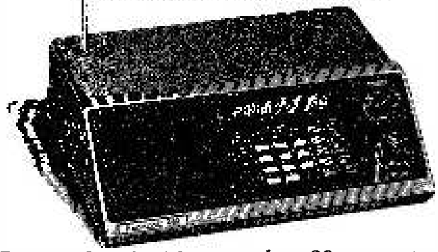


£49 inc. VAT

**AMATEUR RADIO EXCHANGE**
2 Northfield Road, Ealing, London W13 9SY. Tel: 01-579 5311

---

# LISTEN IN ON A MILLION LIVES TONIGHT.



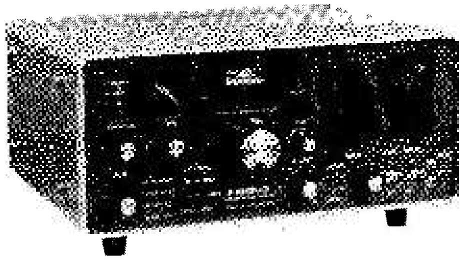
The Bearcat® 250 with more than 30 separate and distinct functions is designed with the professional scanner in mind. Since it's crystalless, programming 50 frequencies in infinite frequency combinations is as easy as pushing a few buttons. With its incredible "non-volatile" memory, the *Bearcat* 250 searches out frequencies, stores them in memory for later retrieval, and even counts transmissions by frequency. It's also a fine quartz crystal clock. The capabilities of the *Bearcat* 250 almost defy imagination. If you want the ultimate scanner available today, this is it.

**Bearcat 250**

**RADIO SHACK LTD**
188 BROADHURST GARDENS, LONDON NW63AY.
TELEPHONE: 01 - 624 7174. TELEX: 23718.

---

## General Coverage Communications Receiver FRG-7



- 0.5-29.9MHz Coverage with 10kHz Readout

The FRG-7 is a precision-built all-purpose communications receiver featuring all solid state construction for long life and high performance. Utilizing the Wadley Loop drift cancellation system, in conjunction with a triple conversion super-heterodyne circuit, the FRG-7 boasts high sensitivity along with excellent stability. It provides broadcast listeners with such features as a 3-position tone selector, an RF attenuator, and an automatic noise suppression circuit. For many years of satisfying reception the FRG-7 is the receiver for you. Free Securicor Delivery **£210.**

**WIDE RANGE OF NEW and USED RECEIVERS and TRANSCEIVERS**

Access — BARCLAYCARD VISA

**Open 7 days a week. Sundays 11-3.00 pm.**

**AMCOMM SERVICES**
194A Northolt Road, South Harrow, Middx.
01-864 1166 01-422 9585

# MAIL ORDER AT BREDHURST ELECTRONICS

**0444 400786 HIGH ST. HANDCROSS SUSSEX**

BARCLAYCARD ● ACCESS INSTANT H.P. ● PART EXCHANGE ALL PRICES INCLUDE VAT — CARRIAGE — INSURANCE

### H.F. RECEIVERS

| | |
|---|---|
| Lowe SRX 30 | £179.00 |
| Yaesu FRG 7 | £215.00 |
| Trio R1000 | £299.00 |
| Yaesu FRG 7000 | £372.00 |
| Trio R 820 | £790.00 |

### ½ METRE FM RECEIVERS

| | |
|---|---|
| Search 9 | £59.00 |
| FDK TM56B + scan | £106.00 |
| Belcom AMR 217B + scan | £120.00 |
| HF 12 Pocket | £79.95 |

### MARINE VHF RECEIVERS

| | |
|---|---|
| Search 9 | £59.00 |
| FDK TM 56B + scan | £115.00 |
| Belcom AMR 217B + scan | £120.00 |
| HF 12 Pocket | £79.95 |
| SR 11 + scan | £87.00 |

### AIR BAND RECEIVERS

| | |
|---|---|
| Lowe AP 12 | £120.00 |
| SCC R517 | £50.00 |
| Waltham W144 | £29.95 |

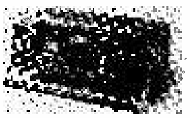
### POPULAR ACCESORIES

| | |
|---|---|
| Jaybeam Antennas | P.O.A. |
| ASP Mobile Antenna | P.O.A. |
| Hygain H.F. Antenna | P.O.A. |
| G. Whip Mobile H.F. Antenna | P.O.A. |
| Microwave Modules | P.O.A. |

### SPECIAL OFFER

| | |
|---|---|
| 12v 3A cont. power supply 5A surge fully protected | £19.50 |

R1000



NEW! NEW! NEW! NEW!

ONLY **£299** inc. VAT & Carriage

The new R1000 general coverage receiver incorporates all the features you would expect on a high quality product from TRIO.

A PLL synthesiser covers 30 switch selected bands up to 30MHz with both digital and analogue tuner for ease of use.

Three IF filters match every mode – wide for 4M with good tonal quality, narrow for DX work and custom designed for SSB communication.

Built in noise blanker to cut pulse type noise.

Simple RF tuning without pre-selector. Band pass filters are automatically switched in on the MHz band switch.

Other features include built in digital clock, large speaker, RF attenuators, tone controls, recording jacks, multiple antenna inputs etc. etc.

Why not try this new receiver? It would look good on any bookshelf and out performs many receivers presently available.

To order any of the above items simply write to the above address or telephone 0444 400786, giving your address or Barclaycard number to ensure same day despatch.

**REMEMBER 0444 400786**

### H.F. TRANSCEIVERS

| | |
|---|---|
| Denton HF 200A | £408.00 |
| Trio TS 120V | £408.00 |
| Yaesu FT 7B | £430.00 |
| Trio TS 120S | £495.00 |
| Trio TS 520S | £542.00 |
| Yaesu FT 101Z | £574.00 |
| Yaesu FT 101ZD | £661.00 |
| Trio TS 180S | £712.00 |
| Trio TS 820S | £832.00 |

### 2 METRE F.M. MOBILES

| | |
|---|---|
| ICOM IC 240 | £193.00 |
| FDK Multi 700E | £229.00 |
| Trio TR 7600 | £247.25 |
| Yaesu FT 227R | £244.00 |
| Trio TR 7625 | £273.70 |
| Yaesu FT 227 RBS | £295.00 |

### 2 METRE F.M. HANDHELDS

| | |
|---|---|
| Yaesu FT 202 R | £99.00 |
| FDK Palm II | £139.00 |
| FDK Palmsizer | £159.00 |
| Yaesu FT 207R | £199.00 |
| Trio TR 2300 | £199.00 |
| AOR AR 240 | £199.00 |

### 2 METRE MULTIMODES

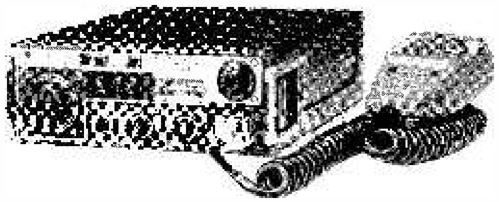
| | |
|---|---|
| ICOM IC 245E | £399.00 |
| FDK Multi 3000 | £519.00 |
| Trio TS 770 | P.O.A. |
| ICOM IC 211E | £549.00 |
| Yaesu FT 225RD | £615.00 |

### 2 METRE SSB

| | |
|---|---|
| Mizuho SB 2M | £165.00 |
| Trio TR 7010 | £193.00 |
| ICOM IC 202S | £199.00 |

---

ICOM



**IF YOU ARE INTERESTED IN**

# AMATEUR RADIO

**AND LIVE IN OR NEAR KENT**

WHY NOT COME AND VISIT US
(or Phone us for a copy of our Catalogue)

WE STOCK

**TRANSCEIVERS POCKET RECEIVERS**
**BOOKS RECEIVERS POWER SUPPLIES**
**ROTATORS AERIALS**

FOR

**AMATEUR, MARINE & PRIVATE MOBILE RADIO**

# THANET ELECTRONICS

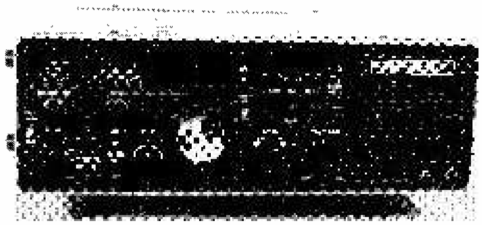
**143 RECULVER ROAD, HERNE BAY, KENT**

**Tel: (02273) 63859 Telex: 965179**

---

# Western

**THE COMMUNICATIONS SPECIALISTS**
**EVERYTHING FOR THE RADIO AMATEUR**



## YAESU FRG-7000 £355

The New Performance Standard in Communications receivers!
A high quality general coverage receiver for the discerning SWL and a worthwhile additon as a second receiver for the transmitting amateur.
How often have you wanted a true general coverage receiver of this calibre but been put off by the price.
The FRG-7000 is a cost-effective answer to your prayers.
★ Full and continuous coverage 250kHz to 29.999MHz ★ Operation on SSB/AM/CW ★ Switched selectivity and fine tune control for maximum efficiency on SSB ★ Accurate digital frequency readout to 1kHz, using advanced CPU techniques ★ Built-in digital clock with facilities for setting two time zones (GMT and local), selected at the flick of a switch ★ CPU controlled timing clock switches receiver on or off at preselected times; also enables control of external unit such as tape recorder ★ Wadley loop circuitry for minimum drift and maximum stability ★ Simple and accurate frequency selection; easy-to-use colour coded bandswitch and preselector.

Send large SAE for further details of this and other equipment – or use our Answerphone after hours.

**Western Electronics (UK) Ltd**

**HEAD OFFICE (All Mail/Enquiries)**
**FAIRFIELD ESTATE**
**LOUTH, LINCS, LN11 0JH**
**Tel: Louth (0507) 604955/6/7**

ACCESS
VISA
DINERS CLUB
H.P.

9 Nov. with Tom Douglas G3BA speaking on "Radio in PoW Camps", on 23 Nov. there is junk sale and 7 Dec. sees Laurie Crawford expounding on modernising old receivers. Contact is Brian Castle G4DYF, 6 Pinewood Avenue, Sevenoaks, Kent.

**Bury ARS** G3BRS every Tuesday night at Mosses Centre, Cecil Street, with 13 Nov. devoted to a junk sale, and 11 Dec. sees the AGM linked to a wine and cheese party with, I imagine, the ladies getting a word in for a change! A warm welcome awaits visitors to the **Edgware & District RS** at Watling Community Centre, 145 Orange Hill Road, Burnt Oak, on the second and fourth Thursdays at around 8pm. Latest gen on meetings from Howard Drury G4HMD QTHR. The *Edgware Ham News* is a good read combining technical and personal chitchat with member G3SHY designing a CMOS logic keyer and organising a kit for less than £3.

**Northern Heights ARS** has a similar style newsletter plus an excellent fixtures card for the wallet, running right through to next August! That's what I call organisation and other clubs might do worse than think about this idea. At least it shows that the committee is doing it's job! Meetings 8pm promptly at the Bradshaw Tavern, Bradshaw, near Halifax, on Wednesdays with 7 Nov seeing the RSGB's RR in attendance, a junk sale on 14 Nov. and the 28th welcomes Dr Bailey a Bradford University.

## Here and There

Normally from West Wickham, Kent, **John Dainty** has been merrily caravanning around East Anglia and able to "listen without the infernal crackles etc at my QTH" his DXing being aided on this occasion by the vertical multiband aerial described in the RSGB Handbook. **Jim Rowland** in Tetbury, Glos., bought an a.t.u. which did nothing for his DX160, which seemed strange, as I told him. He persevered and eventually found a solder bridge in the wiring which, when demolished, let the a.t.u. do the job it was intended to. Then Jim bought a crystal calibrator by mail order which was supposed to provide signals from 1MHz to 1kHz, but didn't! Supplier took a month to reply but said nothing useful. Jim found a dry solder joint on a Veroboard "standing out like a desert island in a silver sea". Clearing this and all was OK. Needless to say, Jim is very apprehensive now about mail order, and rightly so, since in both cases the equipment could not have been tested properly at any stage which is just not good enough, but Jim has given me the names of the suppliers and these will be borne in mind.

Jim mentions his 130ft Windom "leaping over telephone wires and ducking under electricity cables". I am sure he is exaggerating a bit, or I hope so, because an aerial should never, ever, be allowed to come close to such installations. Over the years a number of amateurs have been killed when an aerial has fallen across power wires, so be warned, don't do it!

**Eric Flack,** 58 Victoria Road West, Hebburn, Tyne & Wear, would like to hear from readers who have been able to improve their DX160s in respect of selectivity, sensitivity and general stability. Ex-RAF wireless op **W. Thompson** is returning to the fold after some 40 years and would like to beg, borrow, or steal a manual for the CR300/1 receiver. Already he is back to 20 w.p.m. so if you can help write to him at 21 Polwarth Drive, Brunton Park, Gosforth, Newcastle-on-Tyne.

**Rod Williams** has got his B40 Owners' Club going, the main problem being lack of spares for these sets. If you know of a source or perhaps of any sets that could be cannibalised please write to Rod at 54 Woodlands Avenue, Talgarth, Brecon, Powys.

## Far and Wide

Strings of VP8s make **Bill Rendell** in Truro wonder what is "going on" down in them there parts! Like VP8SB on Adelaide Is (QSL G3ZMF "we only have one ship a year"), VP8SO on Signy Is., and VP8QI on Argentine Island, the site of the British "Faraday" Antarctic base (QSLs to G4CHD), all on 20m s.s.b. However, warmer climes produced SV1DC DXpedition to Greece's Mount Athos, (QSL Box 161, Athens) on 15m together with VP2ARS (QSLs to DF1EQ), VP2MM on Montserrat and 5T5AY.

Like most readers **Allan Stevens** of Crowthorne, Berks, found 28MHz becoming quite lively and improving all the time, producing YB0WR in Jakarta and P29GC on New Britain Is. in Papua New Guinea, with ZF1J on 21 MHz for good measure. **Peter Hawkes** from Stourbridge, West Mids, moved his DX160 into the end of his garage and so virtually cleared up his TVI problem, except on the Top Band, so that is one answer to the radiation from TV set time-bases. Peter mentions the Hurricane Net on 14 325kHz, run by YLs K4HKL and WA1KKP, which presumably has had plenty to do of late! Peter logged stuff on 10m like SU1CR, AP2KS, YB0WR with 5T5AY, HS1ABD, 3D6BP and 3V8ONU on 15m. 20m provided VP8SO of Signy, with 8P6AH on 40m and VO1BB, ZS6DW (!), K6SVL/VP9 and 8P6KY on 80m, all s.s.b.

**Mike Stollov** G4HWB in Blackley, Manchester also has trouble trying to get his 60ft wire clear of telephone wires but his FRG-7 still found 10m wide open with a marked burst of solar noise on August 26 at 1135. He logged CP5JA/P2, JY5ZM, XT2AW, 5H3KS and 9G1JX. **Arthur White,** near Grantham, Lincs, had trouble with his Trio QR666 and borrowed an Eddystone 888 which he is now loath to return and hopes to buy! Using a 60ft wire and a.t.u. he found VK6NY on 10m, stacks of VKs on 20m, and ZS2MI of Marion Is. who QSLs via ZS6APO or WA2ZN. Our RTTY hero **Dennis Sheppard** (Sheerness, Kent) has not been too active, preferring to concentrate on a stereo amp he is building, but nevertheless logged, or rather got them to log themselves, DJ6UZ and JA1DSI on 10m, JA1BPQ and ZS6AKO on 15m and AH6D (Hawaii), G4BHT/4X4, VE3JCU, VK2EG, YV1EQ, ZS1LM, 3V8ONU and 5N0SID on 20m. Dennis now has 34C confirmed on this mode.

With a trapped dipole in the loft feeding his FRG-7, **Bob Anderson** of Canvey Island (no, it's not a new country!), Essex, logged ZE8JB and 9K2DR on 10m with A2CBT, HP1ACJ, VP2VBK and 7X2HM on 14MHz. **Pete Lucas,** near Newport, Salop, decided not to take his AR88 with him on holiday since he didn't want to have to hire a crane, so was out of touch with the bands for a while. He comments on the American prefixing system which seems to have gone quite mad making our prefix lists look rather sick. Space permitting I will try to sort this out by giving the new prefixes, but in the meantime take nothing for granted but check by listening for the actual QTH. This applies to almost any US and possessions station.

Great to hear that **Dave Coggins** is able to get something up other than a long wire. He has his 66ft as an inverted-V aimed at VK/ZL, feeding an a.t.u. into his DX160 which he is able to compare with a 2-element quad on the 10m band. On 10m it was ST2SA in Khartoum, VP8PU (another one!), YB0ADW, with FO8DT, P29GC and VU2LQA on 15m, 5W1BP (W. Samoa) and 9Y4TFL for 20m and CO2DC and 6W8DY representing 40m, while 80m produced FM7WS and ZS6DW, the latter confirming the reception by Peter Hawkes of this ZS6 mentioned earlier. So 80m is already showing an improvement and hopefully is a forecast of things to come this winter.

# MEDIUM WAVE DX

**by Charles Molloy G8BUS**

The appearance of signals from the Droitwich transmitters on 693kHz, 1053kHz and 1215kHz "at a wide variety of places on the band" are making DXing difficult for reader **Stewart Kinsley** of Coventry. The receiver is a Drake SSR-1 used with a 20ft end-fed aerial.

## Overloading

Overloading is the problem, which is giving rise to spurious responses within the receiver. Stronger signals than the receiver is capable of handling are being fed into the aerial socket, and the cure is to reduce these offending signals by means of an attenuator fitted between the aerial and the receiver.

A simple attenuator can be made using a 1kΩ potentiometer. There are three tags on the "pot". Connect the aerial to the centre tag. Connect either of the outer tags to the receiver aerial socket. Connect the remaining outer tag to the receiver earth socket along with the earth wire if one is used.

When the pot is set to one end of its travel there will be maximum signal. At the other end there will be little or no signal. Start with the pot at maximum signal and slowly rotate the control until the spurious signals disappear but, and this is the snag, you will also have reduced the strength of your DX signals as well. Only use the minimum attenuation necessary to cure the overloading.

It might also be worthwhile to check that the receiver r.f. stage is working properly, as a fault in this part of the receiver or in the mixer stage might give similar results.

In spite of his difficulties, Stewart managed to pull in Malta on 1557kHz, Tenerife on 621, Conakry, Guinea on 1404, Rhodes on 1260 and Batra in Egypt on 819.

## FRG-7 Survey

As promised in the July issue here is a synopsis of a survey made from letters from forty FRG-7 owners. It was compiled by **George Tyler** of Bristol and it starts by saying that the FRG-7 is a fine receiver, well laid out externally and internally with each component marked on the printed board for ease of identification.

Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:

**AMATEUR BANDS** Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey KT21 2TW. Logs by bands, each in alphabetical order.

**MEDIUM and SW BANDS** Charles Molloy G8BUS, 132 Segars Lane, Southport PR8 3JG. Reports for both bands **must** be kept separate.

**VHF BANDS** Ron Ham BRS15744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

No component failure was reported and the manual is considered excellent. The stability is also excellent and the only spurious signal observed was on 21 350kHz. The calibrated dial mechanism gives frequency readout to 10kHz and can easily be read to 5kHz. Selectivity is adequate for a.m. reception but is not for s.s.b. (A selectivity modification kit is available).

Power consumption on internal batteries is high. The receiver is poor for m.w. DXing. The attenuator is of little value unless a very strong signal overloads the receiver. The tone control is useful on both a.m. and s.s.b. The fine tuning knob is too small and the noise limiter has little effect.

High impedance phones give better results for DXing than the low Z types. The Dial Set is useful but the S meter is rather small.

## Comment on the Survey

There are a couple of points I feel compelled to comment on. The first has to do with selectivity.

A receiver with fixed selectivity will have to compromise between a bandwidth wide enough to give good intelligibility, and narrow enough to pick out a wanted station from interference. Wide bandwidth means good quality audio along with poor selectivity. Narrow bandwidth means poor quality audio but good separating ability. Hi-fi and DXing do not go together! It would appear that the FRG-7's bandwidth is too wide hence the modification kit. What will the audio be like after modification? There really ought to be a selectivity switch, with two positions at least, on any communications receiver.

It is a pity that "poor for m.w. DXing" was not expanded. Readers of this column have reported some excellent DX on the FRG-7 and this is the first time I have heard this complaint. I wonder how many of the reporters are experienced m.w. DXers?

Finally, many thanks to George for making this survey available to readers of *PW* and my apologies to him for chopping it down from the original four pages.

## Bats

"I thought you might like to hear of some unusual long wave DX—Bats", writes **Martin Mann** from Cambridge. He fixed a 40kHz transducer at a window and fed it to the aerial input of a receiver. At dusk he heard and recorded several bursts of bat sonar signals which sounded rather fluttery(!) with rapidly sweeping pulse frequency. The range was about 20ft which must make this the shortest distance DX reported to date.

A bat's radar system is based on ultrasonic sound waves, not radio, hence the need for the transducer. Martin has demonstrated how, with a little ingenuity, one can extend DXing into a new and interesting field, however it is *not* long wave DX! Wavelength equals velocity of transmission divided by frequency. The velocity of radio waves is 300 000km per second which gives a wavelength of 7500 metres for a frequency of 40kHz. The velocity of sound waves through air is roughly 330 metres per second which gives a wavelength of 8mm. So bats really use microwave radar and the report from Martin should have gone to Ron Ham!

## Realistic DX160 Receiver

A rather disturbing report comes fom reader **David Hyams** of Finchley who discovered that his newly-acquired DX160 has an internal aerial for use on the medium and long waves. This aerial replaces the aerial tuning coils which are shown as T1 and T2 on the circuit diagram. If this aerial is disconnected then the receiver will not work. As it stands this latest version of the DX160 cannot be used with a m.w. loop. David is trying to get the supplier to restore the receiver to its original unmodified state and unless this can be done then it will be of limited value for m.w. DXing. Obviously the manufacturer has not heard of DXing on the medium waves.

It is easy to test if a receiver has an internal aerial. Unplug any external aerial and tune round the m.w. band. Any signals heard must be picked up by an internal aerial and they will still be heard when a loop is nulling out a station. The overall result therefore is no null. The directional properties of the loop are masked by the pick-up of the internal aerial.

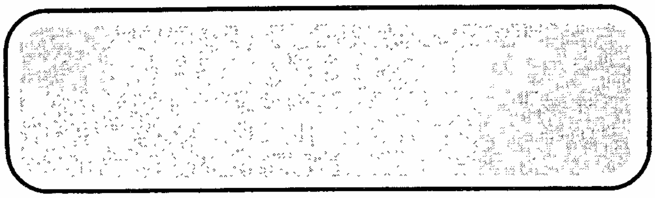
## DX

A "40 inch" loop together with a home-brew receiver were used during the first week in September by **Alan Morton** (Edinburgh) to log the following North Americans: CJYQ St John's Newfoundland on 930kHz at 0330, WBZ Boston on 1030 at 0400, WINS New York City on 1010 at 0415 and CHNS in Halifax, Nova Scotia on 960kHz at 0430.

The maximum of the current sunspot cycle was expected during the autumn and with it a lower than average reception on the North American path. Once the maximum has passed then reception should pick up quickly, so listen around midnight for the stations listed above. Others to look for are CBN St John's on 640, CKVO Clarenville in Newfoundland on 710, CHER in Sydney on 950, WNEW New York City on 1130 and CKEC New Glasgow in Nova Scotia on 1320kHz.

DX signals on the medium waves are subject to slow cyclic fading which lasts over several minutes. A channel may have a reasonable signal on it at one moment, but two or three minutes later nothing can be heard. So tune slowly and come back later to any dead channels.

A short extract from my own log to round off this month. The receiver is a BRT400 used with a "40 inch" loop on 15 September to pull in: Conakry, Guinea on 1404kHz at 2220 SIO 333, Ouagadougou, Upper Volta on 747 at 2225 SIO 232 and CJYQ St John's on 930 at 2230 SIO 333. At first sight the reception of CJYQ at this time appears surprising, but local sunset here was some four hours earlier at 1829 and Newfoundland is $3\frac{1}{2}$ hours behind GMT. In mid-winter, CJYQ has been heard as early as 1930 and it is only European QRM that prevents it being a conspicuous signal during the evening when conditions are good.



# SHORT-WAVE BROADCASTS

***by Charles Molloy G8BUS***

Occasionally a frustrated DXer with a faulty receiver sends me details of his troubles in the hope that, like some modern Sherlock Holmes, I will instantly diagnose the trouble and point to an easy and immediate remedy. That sort of servicing belongs, along with the famous detective, to the world of fiction. A modern receiver is really quite a complex piece of equipment and the chances that a novice would be able to repair it are negligible. He is more likely to be the phantom twiddler who knocks everything out of alignment and in the case of a mains operated receiver he may even receive a nasty shock. It is only on the test bench in the hands of a competent person that the trouble will be sorted out properly.

## Home Made Receivers

The "competent person" need not necessarily be a service engineer. Radio Amateurs have the technical knowledge to deal with receiver problems and there are still a few about who even construct their own gear. Why not do the same? It is great fun and you do not need a technical background to construct a simple receiver. Designs and constructional details are easy to come by, in *Practical Wireless* for example. Not only will you have the satisfaction of using something you have made yourself but you will be able to peak it up, modify it and improve it to meet your own individual requirements. All the time you will become more proficient and knowledgeable and the day will come when you feel bold enough to try your skill on a commercial receiver.

## TRF Receivers

"I cannot afford a communications receiver", writes student **Nick Quin** of Lancing, who built a 3-transistor t.r.f. receiver from a design in *Radio and Electronics Constructor* (oh!). The receiver nominally tunes over the range 1·2 to 24MHz but by altering the position of the tuning coil cores slightly he was able to get up to the 11m band which is from 25 600 to 26 100KHz. The aerial was a 30ft long wire, now increased to 90ft, and the receiver drives a pair of headphones. DX heard included Radio RSA on 25 790kHz at 1410, Radio Australia on 11 800 at 1824, All India Radio on 11 620 at 1805 and the Voice of the Revolution in Iran on the 31m band at 1920. Nick would be very interested to learn of DX heard by anyone else who has built a t.r.f. No need to worry if you are not sure of the exact frequency. Just mention the metre band, but DX only please.

The term t.r.f. means tuned radio frequency and refers to a complete receiver working on this principle. The expression has been used by at least one manufacturer in the United States to refer to a superhet with a tuned r.f. stage, which is rather confusing. In the UK t.r.f. means a simple receiver usually with a reaction control.

## Broadcasting on 10 Metres

My suggestion in the September issue that the IBA Jerusalem broadcasts beyond the upper edge of the 10m amateur band might be a harmonic, has brought some interesting replies. **Paul Hardy,** who lives at Caversham, says that 29 705 is quoted in the IBA schedule, while **Andy Sennitt** of the *World Radio and TV Handbook* confirms that the transmission was really on the fundamental and he suggests that it was intended for reception by Russian radio amateurs. Paul says the frequency was withdrawn in June but **Harold Brodribb** (St Leonards-on-Sea) picked it up again in September SIO 555 at 1415. The Programme, which was in Yiddish (sounds like German), was the same as on 25 605 and 25 640kHz in the 11m band, both of which were being jammed.

## Beyond 10 Metres

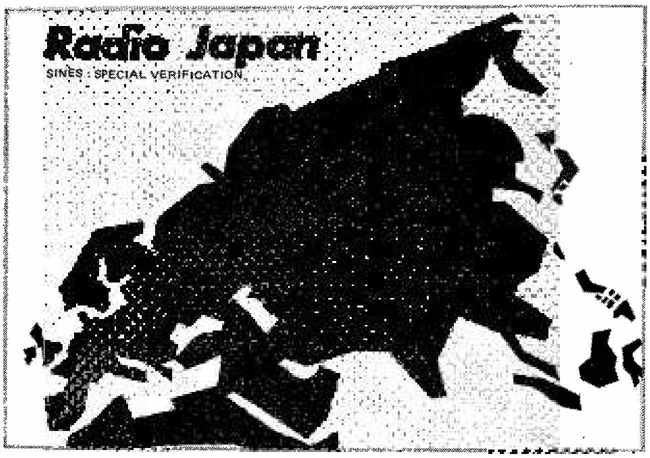
The frequency mentioned is rather interesting as it lies in a sort of no man's land where h.f. ends and v.h.f. begins. The boundary is 30MHz, which was the lower of the two frequencies of the Knickebein beam navigation system used by German bombers during the last war. The other was 31·5MHz and both beams were discovered using a Hallicrafters S27 bought in Webbs Radio in Soho. At that time it was the only v.h.f. communications receiver available. I have an S27, which covers 28 to 143MHz in three bands and far from being an antique, it is still a very useful receiver.

## Hallicrafters

Another Hallicrafters admirer is **Ashley Griffiths** who has acquired an S38E. It is in working order but he would like to know more about it. Replies to 73 Llanmiloe Est, Pendine, Dyfed, S Wales please. From memory I think it is a general coverage receiver without an r.f. stage. There was a commercial version of it called the Echophone which had a rather unusual bandspread control. By means of cord, pulley wheels and a spring, a piece of ferrite material was moved in and out of the air-cored oscillator coil.

Hallicrafters gave names to some of their receivers such as Sky Buddy, Sky Champion, Sky Rider; names that will bring a twinge of nostalgia to older DXers. What a pity modern manufacturers do not do the same. I have heard one currently available receiver referred to as the Frog!

**QSL Cards from Radio Japan**




## Radio Japan

Transmissions of Radio Japan broadcasts over Radio Trans Europe in Portugal will take place again this winter. The frequencies are 17 815 from 0700 to 0730 for the Middle East and on 15 305 from 2200 to 2230 for Europe. Reception reports are welcome and should go to Overseas Dept, Nippon Hoso Kyokai, Tokyo, Japan.

Last winter the European transmission was on the 25m band where tests were conducted for the month of October only. It was possible to pick up the same programme on the 31m band direct from Japan, with a much inferior signal of course. At the time of writing the winter schedule of R Japan is not yet available.

Direct reception of Japan is usually at breakfast time on the 13 and 16m bands. When R Japan first appeared on the short waves before the war it gave a good signal in the evening. Overcrowding and high-power transmitters have made other than single-hop broadcasting unpopular and this has led to the modern practice of using relay stations.

## Readers' Letters

Jakarta in Indonesia has been picked up by **A D Scholefield** (South Shields) on 11 790kHz between 1400 and 1500. **Paul Martin** (Edinburgh) used his Panasonic RF2200 to pull in Radio RSA on 25 790 at 1425 SIO 333 and Radio Japan on 21 610 at 0900 SIO 222. He asks if he can use an aerial tuning unit (a.t.u.) between this receiver and his 70ft long wire. An a.t.u. can be used with any receiver that has an aerial and earth socket.

The problems of getting a QSL from South American stations are highlighted by **Jeremy Boot** (BRS 41156), who speaks both French and Portuguese. He has been quite successful with Brazil, though many stations have not replied despite reports in their own language and IRCs. International Reply Coupons are not valid in some countries and are unwelcome in others. It is better if you can send unused postage stamps of the relevant country if you anticipate problems. They are available from stamp dealers.

## News Items

There are no longer any s.w. transmissions from Syria (*World Radio and TV Handbook Newsletter,* August 1979). Someone asked about Syria a few months ago.

Radio New Zealand frequencies for the period 28 October to 1 March (Spring and Summer!) are as follows, all times being in GMT:

**Pacific Service**

| | |
|---|---|
| 1700—2005 | 11 835 or 17 860kHz |
| 2015—0715 | 17 860 |
| 1700—0525 | 15 345 |
| 1540—0930 | 6105 |

**Australian and NW Pacific Service**

| | |
|---|---|
| 0730—0115 | 11 945 |
| 0945—1115 | 6105 |

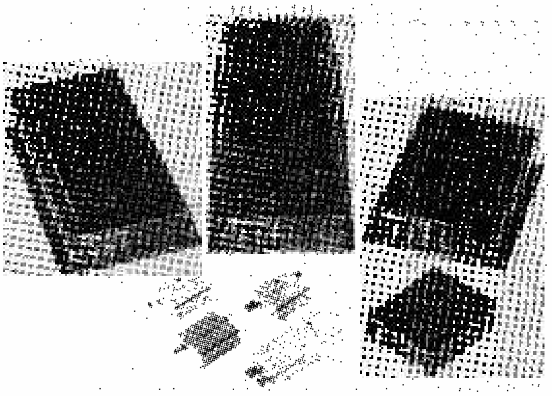
If a QSL card is required then RNZ are now asking for 3 IRCs, according to their latest schedule.

# IF YOU WANT PERFORMANCE –

A.R.R.A.
NATIONAL AMATEUR RADIO EXHIBITION
GRANBY HALLS, LEICESTER
8th, 9th & 10th NOV. 1979

# IT'S GOT TO BE LUNAR

Lunar Electronics, based in San Diego, California, are undoubtedly the leading manufactures of 144MHz and 432Mhz Linear Amplifiers and Preamplifiers. *But* don't take our word for it, ask a LUNAR user. TAKE A LOOK AT THE RANGE.



**LINEAR AMPLIFIERS**

**144MHz**

| | |
|---|---|
| **2M10-80P** | 80 Watt all mode, Linear/Preamp **£120**+VAT |
| **2M30-160P** | 160 Watt all mode, Linear/Preamp **£160**+VAT |
| **2M10-150P** | 150 Watt all mode linear - preamp **£170** + VAT |
| **HF** | HF3-100L2 Linear/Preamp 1·8-30MHz, 200 watt PEP output (100 watt continuous) **£120**+VAT |

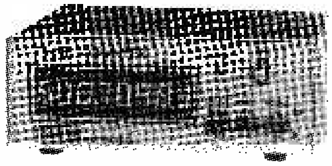
**PREAMPLIFIERS**

| | |
|---|---|
| **28MHz** | |
| **PA28** | 28MHz 1·1 db N.F. **£20**+VAT |
| **144MHz** | |
| **PA144** | Preamp 1·5 db N.F. **£20**+VAT |
| **PAI144** | RF Switching Preamp 1·9 db N.F. **£28**+VAT |
| **432MHz** | |
| | PA432·2. 1·6 db N.F. **£22**+VAT |
| | PAE 432·5. EME USE. 1·0 db N.F. 16 db Gain |

Available either direct from us, the EXCLUSIVE AUTHORISED UK & EUROPEAN DISTRIBUTORS, or from one of our appointed agents: C. B. Electronics, SMC Ltd, Waters & Stanton, Bredhurst Electronics, Crayford Electronics, Amcomm Services, GM3ZBE (Aberdeen) and GM8GEC (Edinburgh): TMP Electronics; See Rad Comm Adverts.

**U.K. Distributors for**
**DAVIS ELECTRONICS FREQUENCY COUNTERS**

## NEW! 600MHz Mini Counter £145 + VAT



General purpose low cost Counter without the sacrifice of basic performance
**"Check the features we have that some other low cost counters don't have"**

● All metal Cabinet ● Sensitivity 10 MV at 150 MHz ● Completely Auto Decimal Point ● 8 Digit 4" LED Display
● 240V or 12V Operation ● Selectable Gate Times (1 Sec & ·1 Sec) ● Push Button Controls ● Built in Preamp
● 12V Input Jack ● Gate Light ● Crystal Time Base (1 ppm).

S.A.E. for full set of Data Sheets, or see our stand at most of the coming Rallies & Exhibitions. Trade & Export enquiries welcome.

## SOTA COMMUNICATIONS SYSTEMS LTD.

**26, CHILDWALL LANE, BOWRING PARK, LIVERPOOL, L14 6TX ENGLAND Tel: 051-480 5770**
**Hours: 9.00 a.m. to 6.00 p.m., Monday to Saturday.**

---

## FIT A DIGITAL DISPLAY TO YOUR FRG7 OR SRX30.

These units come complete, with only three wires to connect. The FDU7 for the Yeasu FRG7 can be fitted in place of the KHz dial, or can be supplied for external use. **(Please state when ordering)**
The FDU3 for the SRX30 is supplied for top of the set use only.
**(Full Fitting Instructions are supplied.)**

**(FDU7) for FRG7 @ £44.77**
**(FDU3) for SRX30 @£44.77**

We also manufacture an R.T.T.Y. Converter.
The MB6R (Receive only) and the MB6R/T (Receive/Transmit).
We supply these units with single or double current loops for connection to teleprinter To Order.
T.T.L./C-MOS Logic Levels and Oscilloscope Outputs are provided. Dimensions (84X304X210).

**(MB6R Double or single current) @ 77.96**
**(MB6R/T Double or single current) @ £83.25**

(All Units are fully Guaranteed, and come complete)
(No extras needed)
(All prices inclusive of postage and V.A.T.)
(Payment by P.O., Cheque or Access)

**B. BROOKES ELECTRONICS, 69 Leicester Street,**
**NORWICH NR2 2DZ, ENGLAND.**
**Tel: 0603-24573.**

---

## NORTHERN COMMUNICATIONS

A new name to you, perhaps, but not in communications. More than 10 years professional experience is now available to you. Whatever your interest, we can help: Why not give us a ring? Most leading makes of equipment and accessories available including,

**YAESU. FDK-Multi SWAN ATLAS DENTRON NAG**
**SEM, J. Beam SINCLAIR**

*We keep a comprehensive range of new and used:*
HF Receivers, Transceivers, VHF convertors, Pre-amps, Antennas, Mobile whips, Power supplies, SUR meters, Rotators, Digital Multimeters and Frequency Counters, Books You name it!

Trade-ins are most Welcome, Access, Barclaycard Finance Available

*Why not ring, or write to:–*
(0274)-814218 *Mon to Sat, & Ansaphone*
(0422)-40792 *Thur, Fri, Sat*

*Why not visit our new Retail Showroom at,*

**303, Claremount Road, Claremount,**
**HALIFAX. West Yorkshire HX3 6AW.**
9.45-5.30 Thur, Fri, Sat or by appointment.

---

LAR

. . . the sign of fine communications

**TRIO EQUIPMENT**

## SRX30 SWL RECEIVER £181.75

(inc. £3.75 Securicor Delivery)

| | | Price inc. VAT £ | Carr £ |
|---|---|---|---|
| **R820** | The ultimate SWL receiver | **790.00** | **3.75** |
| **YG455C** | CW filter 500Hz | **61.50** | **.50** |
| **YG455CN** | CW filter 250Hz | **69.00** | **.50** |
| **SP820** | Speaker | **39.00** | **1.50** |
| **R300** | General coverage receiver | **189.00** | **3.75** |
| **HS5** | Communications headphones, tailored response | **23.50** | **.75** |
| **HS4** | Communications headphones, tailored response | **10.75** | **.75** |
| **VHF AMATEUR RECEIVERS** | | | |
| **SR9** | Tuneable/crystal 2m FM receiver 144-146MHz | **46.00** | **.86** |
| **AMR217B** | Scanner with 8 crystals. The best and most popular Mains/battery | **120.75** | **1.50** |
| | Crystals for above. Each | **2.50** | **.15** |
| **ROTATORS, TUNERS & SWITCHES** | | | |
| **AR40** | (5 core cable required) | **54.63** | **3.75** |
| **FU200** | For lightweight 2m beams | **40.39** | **3.75** |
| **CL22** | SWL Antenna Tuner 1·8 to 30m Hz | **16.10** | **.75** |
| **CX3** | SWL 3-way Antenna Switch | **7.20** | **.50** |
| **DAIWA** | CS201. 2-way Antenna Switch | **11.98** | **.50** |
| **KW SWL** | 3-way Antenna Switch | **14.80** | **.50** |
| **AIR BAND RECEIVERS** | | | |
| **SHARP** | | | |
| **FX-213-AU** | Air Bands Portable Receiver | **16.00** | **1.00** |
| **LOWE AP12** | Crystal Controlled air band portable receiver c/w ni-cad batteries, charger and fitted 12 crystals | **118.45** | **1.00** |
| | Leatherette Case | **2.28** (extra) | **.25** |

All prices include new VAT rate

Buy by post or phone your Barclay Card or Access number.

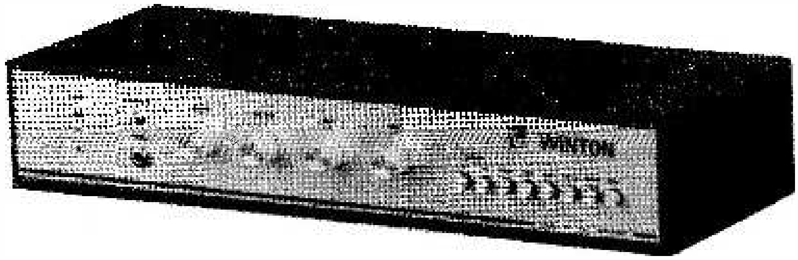
Alternatively, call in for a chat. The shop is just 10 minutes from Leeds City Station, and there's easy parking if you travel by car ★ Instant H.P. for licenced Amateurs ★ Extended Credit Terms Available ★ Send 50p for Catalogue and Price List.

LAR
**LEEDS AMATEUR RADIO**
**27 Cookridge Street,**
**Leeds. W. Yorks. Tel. 452657**

**LOWE TRIO DISTRIBUTOR**

LAR are area distributors for Jay Beams, Antenna Specialists and Hilomast Products.

# NO ALE




NO ALE?, Perish the thought, we mean of course NOEL, you know the season of goodwill & all that. More specifically we have in mind that awful vacuum after the event, you must know the scene only too well. Your waistline has expanded two inches, the games at the office party are by now just guilty memories (and that Amanda seemed such a quiet girl too), you have read the puerile jokes out of the crackers for the tenth time, :sample, "My dog's got no nose", really? how does he smell? "Terrible" ugh . . .
There are so many repeats on the Telly that you are considering sending the Beeb some Alka-Seltzer, and to round off your happiness you are in the Doghouse with the Wife for thumping young Willie because he was trying to shave the cat with the Electric Razor Santa brought you.
Now is the time to slope off to your Den and start to build your WINTON so that when the festivities are over you can really appreciate your record collection and discover just how Hi the Fi really is.
With spring to look forward to, Stravinsky's Rite of Spring will never have sounded so rite (sorry about that), the definition and clarity is quite awesome.
So send us a 10p stamp, and we will send you a bumph sheet that will sober you up a bit, and bring to you the realisation of how ordinary some Amp's are, or better still send a cheque for your kit now to ensure a very Happy New Year.

The Superlative WINTON is available for your convenience packed as follows:

Pack (A) All Capacitors and Fixed Value Resistors, (Inc. 7 Amp ripple Res. Caps.) **£21.93**
Pack (B) Switch Bank, Switches, Potentiometers, Pre-Sets & all Knobs **£15.93**
Pack (C) Printed Circuit Board (Tinned, Drilled, & Overlay Printed) & Pins **£8.28**
Pack (D) Hardware Pack, consisting of precision formed & punched Chassis, Black Epoxy finish Heat Sinks, Teak Veneered Cabinet, all screws, wire, fuseholders, etc., and a super Brushed Silver Aluminium Fascia Panel. **£40.25**
Pack (E) All Semiconductors, (Including HITACHI POWER MOS-FETS) **£31.21**
Pack (F) Special LOW HUM FIELD Toroidal Transformer **£23.55**

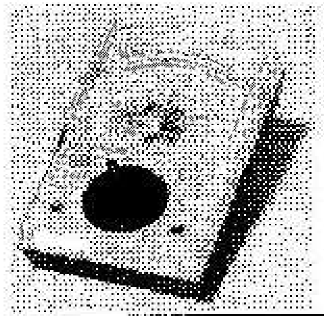
**COMPLETE KIT,** of all parts necessary to build the P.W. WINTON **£133.50**

Order with complete confidence (C.W.O. only please) from:

**T. & T. ELECTRONICS**
**Green Hayes, Surlingham Lane,**
**Rockland St. Mary, Norwich, NR14 7HH.**

**ALL PRICES INCLUSIVE OF V.A.T. & CARRIAGE**

# GOOD QUALITY INEXPENSIVE POCKET SIZE MULTIMETER



## SPECIFICATIONS

- DC VOLTAGE: 0-10, 50, 250, 1000 volts 2000 ohms/volt
- AC VOLTAGE: 0-10, 50, 250, 1000 volts 2000 ohms/volt
- DECIBEL: – 10 to + 22dB
- DC CURRENT: 0-100mA
- OHMMETER: 0-1 0 kilohms, 0-1 megohms, 60 ohms centre scale
- POWER SUPPLY: One 1.5V size "AA" cell ohmeter
- SIZE: 3-5/8", 2-3/8" × 1-1/8"
- WEIGHT: 4oz

**Price: £5.30 inclusive V.A.T. & P & P**

*Cash with order*

TRADE ENQUIRIES INVITED

**ARMON PRODUCTS LIMITED**

COTTERELL HOUSE, 53-63 WEMBLEY HILL ROAD, WEMBLEY, MIDDX. HA9 8BH
TEL: 01-902 4321 TELEX: 923985

# BURNS ELECTRONICS

## FM DETECTOR MODULE FMD-7

Designed for use with the Yaesu FRG-7*/FRG-7000, Lowe SRX-30, Drake SSR-1 or any general purpose receiver with a 455KHz IF, the FMD-7 provides channel selectivity, high gain and limiting, quadrature detection, squelch and audio filtering. A buffer is included to isolate the receiver filters from those in the FMD-7.
The module uses a low power, multi-function, linear integrated circuit for reliability and ease of assembly and is available in kit or made and tested form. Full assembly and test instructions are provided.

Price: KIT **£18.63** + VAT
Made and tested **£23.20** + VAT

*FRG-7 receiver reviewed in July 1979 Practical Wireless.

| | |
|---|---|
| Absorption Wavemeter TC-101 with signal probe | **£36.95** + VAT |
| Crystal Calibrator CC-10 | **£41.90** + VAT |
| Frequency Standard SD-11 | **£138.60** + VAT |

Further details of our range of frequency measuring instruments and communications modules on application – send large SAE.

## APPLICATIONS MANUAL No. 1 – RESONANT CIRCUITS

Theory and applications of resonant circuits covering filters, amplifiers, oscillators, mixers and multipliers. Circuits are given covering frequencies from 85KHz-200MHz together with block diagrams of larger functions – receivers, transmitters etc.

Price **£0.60** post free in UK and zero VAT.

A full range of electronic components, C-MOS, TTL, Hardware, Wires, Connectors etc. are listed in our new Issue 10 Component Catalogue together with many attractive discounts, Price £0.25 post free in UK and zero VAT.
All kit and equipment prices exclude VAT which must be added for UK sales at the rate of 15%. Carriage within the UK is included.

**43a Chipstead Valley Road, Coulsdon, Surrey. CR3 2RB.**
**Tel. 01- 668 7766 (Ansafone)**

***by Ron Ham BRS15744***

Generally speaking, DX, as far as v.h.f. is concerned is relative to where we live and the surrounding terrain. For instance, if the home QTH is situated on high ground then, under normal conditions, our signal catchment area is far greater than that of a station in a valley or behind a hill. All reader's reports are therefore welcome because, whether their particular DX is great or small, or whatever mode is used, it is worth writing about.

## Solar

**Cmdr Henry Hatfield,** Sevenoaks, and I recorded solar noise at 136 and 146MHz respectively on August 22 and September 5, 9 and 14 and individual bursts on August 23, 24 and 31 and September 6 and 7, Fig. 1. **Sam Faulkner,** Burton-on-Trent, heard solar noise between 50 and 60MHz around 1715 on August 29 and **Mike Allmark,** Leeds, heard solar noise in the 2m band at 1518 on the 28th, all no doubt due to the 65 sunspots counted by **Ted Waring,** Bristol, on the 26th.

On September 9, Henry, using his spectrohelioscope, saw the remains of a flare and five sunspot groups, "two quite large", and at 0935 on the 14th he saw a bright loop prominence, about 100 000 miles high on the eastern solar limb. This could well have been the remnants of the event which caused the sudden ionospheric disturbance, at 0735, reported by Louis Prechner in the BBC's *World Radio Club* programme on the 16th.

## Lucky Henry

At 1025 on September 15, Henry watched a bright patch, on the eastern limb of the sun, develop into an arched prominence rising about 50 000 miles above the sun and take 20 minutes to return to the solar surface approximately 100 000 miles away. "It was a beautiful sight", said Henry, who also recorded some radio noise at 136MHz from the event.

## The 10 Metre Band

During the 28 days from August 21 to September 17, I heard signals from the International Beacon Project stations at Bahrain A9XC, on 12 days, Bermuda VP9BA, 2 days, Cyprus 5B4CY, 22 days, and Germany, DL0IGI, 8 days. Periodically, on some days, the signals from 5B4CY were peaking 599 and although Ted Waring's I.B.P. report was similar to mine he did hear the Canadian beacon VE3TEN, on August 24 and 31 and September 8 and 12. During the early morning of August 24 I heard many strong signals from Russian stations and by midday it was obvious that the band was wide open. In fact, some American stations who were coming in like locals, were saying that they were "surprised and delighted" about the good conditions. For example, I received 9-plus signals from both sides of a QSO between W4MB and 4Z4SG.

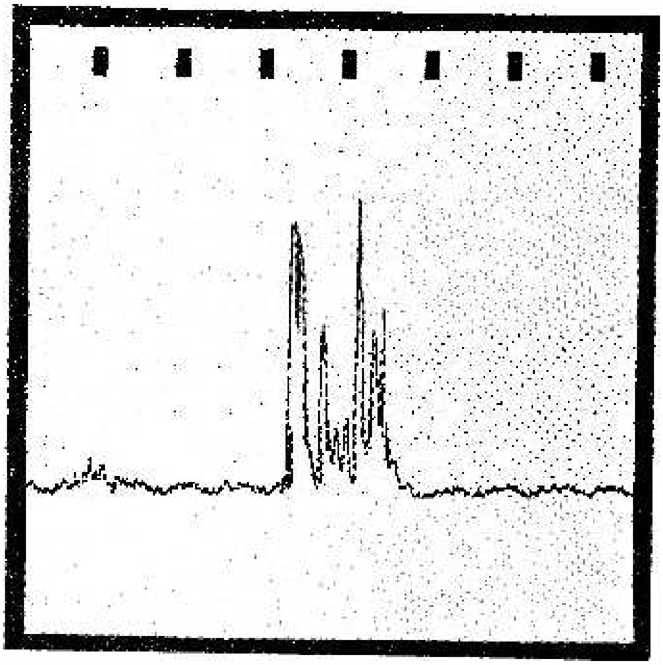


**Fig. 1: A 1·5 minute duration solar burst recorded by the author at 146MHz at midday on 6 September**

Russian signals were again very strong during the early mornings of August 27 and 28 and September 16 and 17 and at midday on the 15th and 17th. Around 1225 on the 17th I heard strong signals from VK3XF, Melbourne and VK5ZK, Adelaide, who both worked GD3EIG on the Isle of Man.

## Satellites

"OSCAR-7B is going strong on sun power only" writes **John Branegan** GM4IHJ, Saline, Fife, on September 2. "Some recent QSOs include VE6KY and VE6TD in Edmonton, Alberta, K3BWD, Haverford, Pennsylvania, VE3TW, St Catherines, Ontario, W0CA, Backus, Minnesota and W8DX, Detroit, Michigan." John has now received QSL cards from stations in DB, DC, G, OH, OK, and W for QSOs through the Russian satellites and on September 2 he worked GD5UG giving him another country through OSCAR-8J.

## Aurora

During the auroral event on August 29, John Branegan heard Tone-A c.w. signals from the 2m beacons in Cornwall GB3CTC and Northern Ireland GB3GI and amateur stations in Belgium, Denmark, France, Holland, Germany, Norway, Sweden and Wales between 1300 and 1900. In addition he had c.w. contacts with stations in EI, G, GM, GW and PA0. "Having c.w. even with 10 watts, makes a tremendous difference", said John who makes full use of his GM4 call. **Roy Bannister** G4GPX, Lancing, heard auroral signals from stations in GI and GM between 1800 and 1900 but could not raise them.

"We had a very good aurora on August 29 from 1519 to 1910", writes Mike Allmark. "Many countries were heard here on 2m and the TV bands went berserk. All G was heard from Cumbria to Cornwall." **Kevin Jackson,** Leeds, said: "The aurora was very intense at Band I frequencies, the strongest noted here in five years." During the event, Kevin saw a clutter of BBC-1 signals from all parts of the UK, some unidentified programmes on

Channels E2 and E4 and a signal in Band III from France-Lille on Channel F8a.

## DX TV

In my August column I used the words: "I feel sure an F2 opening to Scandinavia occurred" when referring to a particular event. Well, my assumption was wrong, and three West Yorkshire readers, Mike Allmark, Kevin Jackson and **Clive Morton** G4CMV, were quick to tell me that it was due to sporadic-E and proved their claim with some most interesting letters. Welcome to the column Gentlemen, and I hope that my error has gained three new contributors.

Mike's interests range from Band I to u.h.f. and he is very experienced in these fields. On Band I he has seen all of Europe via sporadic-E, meteor scatter and some aurora, and USSR and possibly China and Malaysia via F2. Although on Band III he has seen lots of stations via tropo, best DX is Spain. He has received signals from stations in many countries by the meteor scatter mode, and while on u.h.f. his best DX is Poland, TVP on Channel R25, he has also seen pictures from Belgium, Netherlands, Luxembourg and Sweden.

Kevin has been a TV DXer for 5 years and, like Mike, has an impressive record. He is interested in all modes of propagation in addition to monitoring for the odd occurrences of Night-Es, which, as Kevin explains, is "like sporadic-E but at night only and all transmitters are from the auroral zone and only when a geomagnetic storm is in progress". Observations are reported to the IARU co-ordinator. Kevin's receiver, a Bush TV161, is connected to crossed dipoles for Band I, a dipole and 5-element Yagi for Band III, and an MBM 70, Group A and a 10-element, Group B for u.h.f. These aerials are all fixed, beaming south-east, because Kevin lives in a sheltered valley with a clear take-off in that direction. "Even so", writes Kevin, "I see Sweden at u.h.f., off the side of the beam over a 150ft rise in the ground which surrounds me except for the south-east." When Kevin installed the 70-element on u.h.f. he found that he could receive the Dutch TV from Goes on Channel 32 and what's more, he can see it daily, as he can the Belgian station on Channel 43 with his 10-element Yagi directed toward Egem. His best DX on Band I via F2 is Vladivostock, 8353km, Band III, sporadic-E, Italy, 2026km, and u.h.f., tropo, Feldis, Switzerland, 1101km.

It is letters like these from Mike and Kevin that stir the enthusiasm into others who wonder whether or not TV DX is worthwhile. On August 18, Mike Allmar, John Branegan and Sam Faulkner, all received RTVE, Spain, via sporadic-E. Sam also has very strong pictures from Budapest carrying adverts for HUNGEXPO followed by news and cartoons. On the subject of RTVE, I have just received a coloured QSL card, Fig. 2, in response to a photograph and report which I sent to them about their signals.

Sam watched a music programme, with a YL announcer on Channel R1, during the evening of the 19th and a fashion show around 1830 on the 21st. **Ian Rennison,** Horsham, also saw the YL announcer on R1 on the 21st at 1958. Ian has now added a JVC 3070 UKC to his DX TV equipment and is pleased with its performance.

Russian signals were also reported by John Branegan around this time, and Mike reported very strong sporadic-E signals from Austria, Czechoslovakia, Italy, Russia, Spain and Switzerland, during the morning and early evening, on Band I. On August 27, Sam received the 0249 test card at 0900 from TSS, USSR, Fig. 3; at 1400, Ian Rennison, received a strong PM5544 test card from

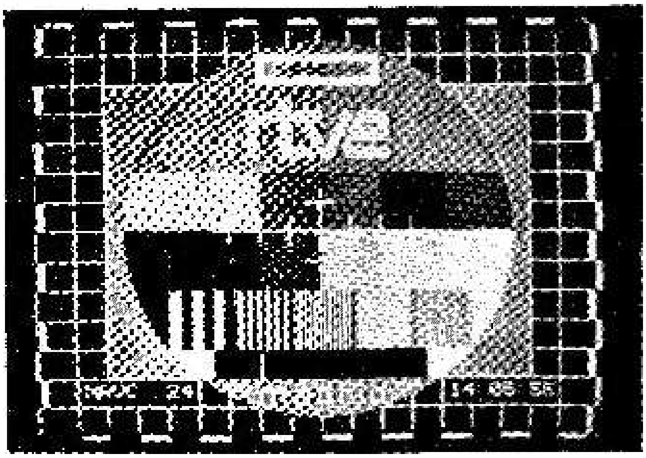


**Fig. 2: The QSL card received by the author from RTVE Spain**

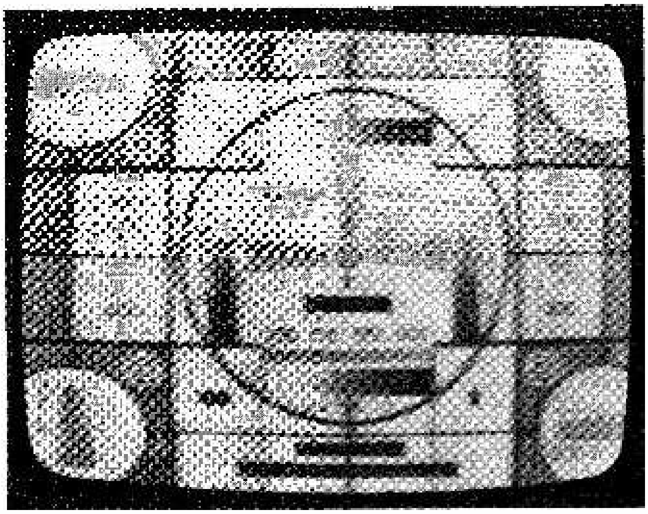


**Fig. 3: The 0249 Test card from TSS, USSR, received by Sam Faulkner on 27 August**

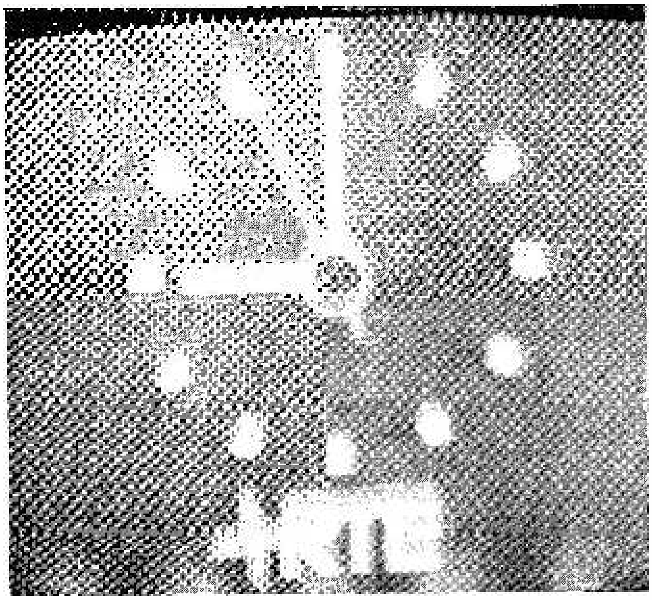


**Fig. 4: The signal from RTE, received by Sam Faulkner on 4 September**

Sweden, and later in the afternoon and early evening John Branegan watched television signals from both Russia and Spain. Both Sam and John received pictures from RTVE, Spain, on September 2 and on the 4th, Sam received pictures from RTE, Eire, Fig. 4, during a tropospheric opening.

During the good tropo conditions on August 29, 30, 31 and September 1 and 5, Mike Allmark received u.h.f. television pictures from stations in Belgium, France, Holland and West Germany. Ian Rennison received pictures from the Netherlands at 0700 on the 5th, and from Russia and Wales on the 7th.

## Tropospheric

**George Grzebieniek** RS 41733, London, who entered the receiving section of the RSGB's 144MHz contest on September 1 and 2, heard F1CB/P, F1KBF/P, ON5FF/P, PE0AY and PE0MAR/P and a couple of GWs. Before the contest he heard signals through the Brighton GB3SR, Cambridge GB3PI and Malvern Hills GB3MH, repeaters. George has been carrying out receiver tests on 23cm with G3FZL and G3IDG, yet another example of co-operation between radio amateurs.

On August 30, **Alan Baker** G4GNX, Newhaven, told me that he heard signals on all repeater channels from R0 through to R9. Conditions on v.h.f. were generally good on September 1, 4, 5, 8, 11, 12 and 16, shown up on each occasion by the strength of the repeater signals. During the opening on the 1st, I heard a 3-way QSO between G3JEP, Exmouth, G4EJV, Worthing and GW3XJA, via the Bristol Channel repeater GB3BC. The GW was using 1 watt to a home-brew Slim Jim aerial.

At 2200 on the 16th, Alan heard signals through the French repeater FZ1THF, R0, and as it faded he worked a station in Kent via the Leicester repeater GB3CF, R0. Later he worked HB9ARI on s.s.b. and heard HB7MMM. Congratulations to **Ken Jeal,** Horsham, who has passed the RAE and now sports the call sign G8SVY.

## Old Receiver

Can anyone help Mr E. G. Thomas of 11 Burrell Ave, Lancing, Sussex, with a manual or service info for a Hallicrafters, S20R, Sky Champion.

HAVE YOU SEEN THE NEW *PW* QSL CARD?

Then turn to page 47

# INDEX

**PW**

## Volume 55
## JANUARY TO DECEMBER 1979


### *EDITORIAL*

| | | |
|---|---|---|
| A Case for Change? | 20 | Jan |
| Our Role | 20 | Feb |
| Sorry! | 20 | Mar |
| Citizens' Band — Yes or No? | 20 | Apr |
| Problems! | 20 | May |
| CB? | 18 | June |
| Opinion | 20 | July |
| Communications | 20 | Aug |
| Don't Shoot the Pianist | 20 | Sept |
| The Microprocessor in the Home | 18 | Oct |
| The Penalty of Progress | 0 | Nov |
| Capacity for Confusion | 22 | Dec |

### *CONSTRUCTIONAL—Receiving*

| | | | |
|---|---|---|---|
| AM/FM Frequency Readout *by W. S. Poel* | | 22 | July |
| "Dorchester" All-band Tuner *by W. S. Poel* | Part 2 | 22 | Jan |
| | Part 3 | 59 | Feb |
| FM Noise Blanker *by R. A. Penfold* | | 42 | Sept |
| Follow-up to the PW "Gillingham" *by D. S. Coutts* | | 38 | May |
| "Hythe" Marine Band Receiver *by M. Tooley and D. Whitfield* | Part 1 | 41 | Feb |
| | Part 2 | 34 | Mar |
| "Imp" 3-Waveband Receiver *by I. Hickman* | | 40 | May |
| Simple Receiver *by E. Vaughan* | | 44 | Oct |
| VHF Monitor Receiver *by J. M. Bryant* | | 34 | Apr |

### *CONSTRUCTIONAL—General*

| | | | |
|---|---|---|---|
| A Simple Field Telephone System *by E. A. Parr and J. Wallace* | | 64 | Dec |
| Aerials for 160 Metres *by J. R. Green* | Part 1 | 38 | Nov |
| | Part 2 | 24 | Dec |
| Automatic Intercom *by K. Cummins* | Part 1 | 44 | Aug |
| | Part 2 | 34 | Sept |
| Burglar Alarms *by P. J. Wales* | Part 1 | 26 | Sept |
| | Part 2 | 36 | Oct |
| Car Test Probe *by C. J. Beaman* | | 24 | May |
| Economical Loudspeaker Reflex Enclosure *by E. M. Parratt* | | 64 | Jan |
| Editing Home Recorded Cassettes *by B. Barnard* | Part 1 | 47 | Oct |
| | Part 2 | 55 | Nov |
| Experimental Acoustic Delay Line *by M. J. Hughes* | | 68 | Jan |
| Ideas Department | | | |
| Step Tone Generator *by D. Brown* | | 31 | Mar |
| Car Cassette Power Supply *by M. Burrell* | | 32 | Mar |
| Remote Aerial Pre-Amplifier Supply *by P. J. H. Fox* | | 46 | June |
| Workbench Amplifier *by D. L. Jones* | | 28 | July |
| Tachometer/Dwell Meter *by R. J. Jenkins and M. E. Taylor* | | 28 | July |
| TTL "Snap" Indicator *by J. Bloxham* | | 0 | July |
| Jumbo Wall Clock | | 36 | June |
| Logical Noughts and Crosses *by J. D. Mitchell* | Part 1 | 52 | Apr |
| | Part 2 | 26 | June |
| Model Radio Control *by J. Burchell and W. S. Poel* | Part 1 | 37 | Dec |
| MW/LW Loop Aerials *by C. Molloy* | | 49 | Nov |
| "Sandbanks" Metal Detector *by P. J. Wales* | | 47 | Jan |
| "Sandbanks" Metal Detector Follow-up—1 | | 32 | Apr |
| "Sandbanks" Metal Detector Follow-up—2 | | 65 | Aug |
| Selective Sound Operated Switch *by C. R. Harris* | | 38 | July |
| Simple Substitution Boxes *by S. V. Essex* | | 22 | Oct |
| "Soundlite" 3-channel Sound-to-Light Unit *by T. P. Hopkins* | | 25 | Mar |
| Telephone Bell Repeater *by B. Barnard* | | 34 | Aug |
| VHF/UHF Folded Colinear Aerial Array *by F. C. Judd* | | 22 | Apr |
| VHF DF Loop Aerial *by F. C. Judd* | | 50 | Oct |
| "Winton" Stereo Amplifier *by E. A. Rule* | Part 1 | 39 | Mar |
| | Part 2 | 42 | Apr |
| | Part 3 | 51 | May |
| | Part 4 | 57 | June |
| 12V Fluorescent Light | | 22 | Feb |

### *CONSTRUCTIONAL—Test Equipment*

| | | |
|---|---|---|
| Follow-up to the PW "Purbeck" *by R. A. Ganderton* | 55 | Jan |
| Follow-up to the Wide-Range Capacitance Meter *by I. Hickman* | 30 | Feb |
| FM Multitester *by D. Whitfield and M. Tooley* | 62 | Apr |
| Inexpensive AF Electronic Voltmeter *by M. Tooley* | 62 | July |
| In-Line Crystal Calibrator *by M. Tooley* | 49 | May |
| Passive 10:1 Divider Probe *by I. Hickman* | 20 | June |
| Semiconductor Tester *by J. Scott Paterson* | 33 | Dec |
| Wideband Noise Generator *by D. Whitfield* | 49 | Mar |

## CONSTRUCTIONAL—*Transmitting*


Follow-up to the PW "Avon" Transmitter *by P. Preston* ........ 48 Mar
Follow-up to the VMOS Top Band Transmitter *by J. R. Green* ........ 49 Aug
Tone-burst Generator *by P. Hodson* ........ 51 Mar
"Trent" Linear HF Amplifier ........ Part 1 47 June
Part 2 55 Aug
VMOS Top Band Transmitter *by J. R. Green* ........ 44 July


## *IC of the MONTH by B. Dance*


No. 73 LM391–60 Audio Power Driver ........ 48 Feb
No. 74 TDE1607 Interface Device ........ 54 Mar
No. 75 Thomson-CSF SF. F96364 TV Display Driver ........ 29 May
No. 76 Fairchild µA78HG Variable Voltage Regulator ........ 58 June
No. 76 Thomson-CSF TDE2608 Waveform Generator ........ 30 Aug
No. 77 TDB0791 Power Op. Amp ........ 26 Nov
No. 78 TDA 1062 FM Front End ........ 62 Nov
No. 79 TL497 Switching Regulator ........ 59 Dec


## *GENERAL INTEREST*


A Glance into the Past *by C. E. Miller* ........ 43 June
Aerial Design with Scale Models *by F. C. Judd* ........ 26 Aug
BIFET Integrated Circuits *by D. F. Bowers* ........ 51 Aug
Building Disco Cabinets *by T. P. Hopkins* ........ 62 Sept
CB—An Unbiased Review *by J. D. Pearson* ........ 22 Sept
CB-UK—The Facts and the Future ........ 34 Dec
Changes in Broadcast-Band Listening on Short Waves *by J. Marks* ........ Part 1 50 July
Part 2 41 Aug
Digital Audio Amplification *by G. J. King* ........ 26 Feb
Direct Use of Communications Satellites ........ 33 June
EDXC—European DX Council ........ 31 Dec
FM Receivers—Devices and Circuits *by M. J. Darby* ........ Part 1 60 Jan
Part 2 34 Feb
Hi-Fi Glossary *by G. J. King* ........ Part 1 28 Oct
Part 2 40 Nov
Part 3 52 Dec
Hotlines *by Ginsberg* (recent developments in electronics) 28 Jan, [illegible]0 F[illegible], 55 Apr, 56 May, 61 July, 67 Aug, 39 Oct, 48 Nov, 32 Dec
Introduction to Logic [illegible]y *S. A. Money* ........ Part 6 43 Jan
Part 7 52 Feb
Keep in Trim—Using your free gift ........ 21 Oct
Numbers Without Tears *by Dr. G. Brown* ........ 34 July
OK. So What is a Nut Runner? ........ 37 May
Optical Fibre Telecommunications ........ 33 Jan
Radio Special Product Report
Burns FMD–7 FM Detector Module ........ 28 Dec
Lowe SRX–30 Communications Receiver ........ 60 Aug
Swan 100MX SSB Transceiver ........ Part 1 46 Sept
Part 2 57 Oct
Yaesu Musen FRG–7 Communications Receiver ........ 55 July
Yaesu Musen FRG–7000 Communications Receiver ........ 58 Nov
Satellite Communications into the Eighties ........ 23 Aug
Sheer Simplicity *by M. McDonagh* ........ 28 Nov
Simple Audio Filter Design *by S. Skepper* ........ 30 Apr
Special Product Report
CSC Logic Probe Kit ........ 27 July
CSC Mini-Max Counter ........ 31 Sept
Datong AD170 Active Antenna ........ 60 June
Micron PL–7D Model Radio Control Kit ........ 33 Nov
Philips CR Bridge Kit ........ 72 Jan
Radat 3106C Oscilloscope ........ 29 Aug
Sinclair DM235 Digital Multimeter ........ 32 Feb
Telecommunications Accessories Ltd. RW100L VSWR Bridge ........ 48 May
Speech Processing in Amateur Transmitters *by A. J. Nailer* ........ 21 Nov
Stereo Decoders—Devices and Circuits *by M. J. Darby* ........ Part 1 56 Apr
Part 2 59 May
Student Radio *by C. Arundel* ........ 24 June
Teaching Radio to the Blind *by B. Watson* ........ 67 Sept
The Cassette Tape Medium *by G. J. King* Part 1 28 Apr
Part 2 26 May
The Sun's Influence *by R. Ham* ........ 44 Nov
Ultrasonic Remote Control *by M. J. Darby* ........ 38 Aug
VSWR Problems at VHF *by Fred Judd* ........ 33 May
Wireless Went to War *by R. Ham* ........ 39 Apr


## *KINDLY NOTE*

*Points arising from earlier articles*


Bifet Integrated Circuits Aug 1979 ........ 64 Oct
"Burley" Power Supply Nov 1978 ........ 71 Jan
Breadboards Supplement Dec 1978 ........ 56 Mar
Car Radio LW Converter Dec 1978 ........ 56 Mar
Car Test Probe May 1979 ........ 54 June
Changes in Broadcast Band Listening July–Aug 1979 ........ 64 Oct
Digital Door Chimes Dec 1978 ........ 56 Mar
DXer's Audio Filter May 1978 ........ 64 Oct
"Hythe" Marine Band Receiver Feb 1979 ........ 31 Apr
"Hythe" Feb–Mar 1979 ........ 64 Oct
"Ideas Department" Step Tone Generator Mar 1979 ........ 47 May
"Imp" Beginners Receiver May 1979 ........ 52 July
Logical Noughts and Crosses June 1979 ........ 33 Aug
"Purbeck" Oscilloscope Jan 1979 ........ 56 Mar
"Sandbanks" Metal Detector Jan 1979 ........ 56 Mar
"Sandbanks" Follow-Up—2 Aug 1979 ........ 61 Nov
Selective Sound Operated Switch July 1979 ........ 64 Oct
"Soundlite" Mar 1979 ........ 47 May
"Soundlite" Mar 1979 ........ 54 June
Step Tone Generator Mar 1979 ........ 47 May
"Trent" June and Aug 1979 ........ 61 Nov
VHF DF Loop Aerial Oct 1979 ........ 36 Dec
VHF Monitor Receiver Apr 1979 ........ 47 May
VMOS Top Band Transmitter July 1979 ........ 64 Nov
"Wimborne" Music Centre Oct 1978 ........ 31 Apr

## ON THE AIR

Amateur Bands *by A. E. Dowdeswell* 73 Jan, 62 Feb, 60 Mar, 68 Apr, 62 May, 63 June, 66 July, 68 Aug, 58 Sept, 67 Oct, 65 Nov, 66 Dec

MW Broadcast Bands *by C. Molloy* 75 Jan, 63 Feb, 62 Mar, 70 Apr, 65 May, 65 June, 70 July, 71 Aug, 61 Sept, 70 Oct, 69 Nov, 70 Dec

SW Broadcast Bands *by C. Molloy* 76 Jan, 64 Feb, 63 Mar, 71 Apr, 66 May, 68 June, 71 July, 72 Aug, 63 Sept, 71 Oct, 70 Nov, 71 Dec

VHF Bands *by R. Ham* 78 Jan, 67 Feb, 64 Mar, 72 Apr, 69 May, 68 June, 73 July, 77 Aug, 64 Sept, 74 Oct, 73 Nov, 75 Dec

VHF Personalities *by R. Ham*
- Flt. Lt. John Keegan ........ 80 Jan
- The Two Erns ........ 66 Mar
- Guy Stanbury ........ 78 Apr
- The Rennison Brothers ........ 72 June
- John Tye ........ 75 July
- David Wakefield ........ 78 Oct

What do the VHFs have to offer? *by R. Ham* ........ Part 3 75 Apr

## PRODUCTION LINES by Alan Martin

- Adcola Products—Soldering Aids ........ 37 Aug
- Agfa-Gevaert Ltd.—New Cassette ........ 49 Dec
- Albol Electronic & Mechanical—Portable Oscilloscope ........ 33 July
- Alcon Instruments—Capacitance Meter ........ 24 Sept
- Ambit International—DFM Module ........ 54 Nov
- Ambit International—IF Filters ........ 24 Sept
- Ambit International—Mini IFT ........ 66 Jan
- Armon Products—Mini-Meter ........ 24 Sept
- Beckman Instruments—Versatile DMM ........ 25 Sept
- Boss Industrial Mouldings—Mini-Drill ........ 59 Mar
- Carel Components—Drill-Mills ........ 59 Mar
- Carel Components—Cable Stripper ........ 32 July
- Crompton Parkinson—High Power Batteries ........ 58 Feb
- D. J. Pattle—Anodised Aluminium Panels ........ 51 Apr
- Ferranti Electronics—Solar Cell ........ 66 Oct
- FieldTech—Mini-Buzzer ........ 66 Jan
- Fluke International Corporation—New Low Cost DMM ........ 65 Oct
- Hadley Sales Services—Mains Intercom ........ 66 Jan
- Henri Picard & Frere—Blow Torch ........ 66 Oct
- IMOS—Coaxial Switches and Relays ........ 66 Jan
- Jackson Bros—Low-Loss Trimmers ........ 37 Aug
- Lascar Electronics—Low Cost DMM's ........ 49 Dec
- Light Soldering Developments—Lead Bending Tool ........ 47 Feb
- Light Soldering Developments—Transistor Tester ........ 31 Nov
- Manx Electronics—Burglar Alarm ........ 66 Oct
- Mega Electronics—Drill Stand ........ 47 Feb
- OK Machine & Tool—Economy Cutter ........ 24 Sept
- OK Machine & Tool—Wi Wrapper ........ 61 June
- OK Machine & Tool—Battery-Operated Wire Wrapper ........ 59 Mar
- OMB Electronics—Low Cost DPM ........ 49 Dec
- Panorama Antennas—Antennas ........ 31 Nov
- Perancea—New Cases ........ 31 Nov
- Photain Controls Ltd.—Infra-Red Beam Alarm ........ 50 Dec
- Plustronics—Mini TVs ........ 65 Oct
- Sinclair Radionics—New Sinclair DFM ........ 33 July
- Speedograph—Test Clips ........ 25 Sept
- Star Devices Ltd.—ASCII Keyboard ........ 49 Dec
- Tempus—Alarm Watch ........ 58 Feb
- Texas Instruments—Spelling Aid ........ 33 July
- Toolrange—Arbor Press ........ 32 July
- Toolrange—Mini Soldering Station ........ 37 Aug
- Turnkey—Mixer t ........ 66 Jan
- Vero Electronics—Battery Holder ........ 51 Apr
- Vero Electronics—Display Bezel ........ 62 June
- Verospeed—DIP Sockets ........ 59 Mar
- Verospeed—Transformers ........ 32 July
- Videotime Products—Mains Failure Alarm ........ 61 June
- Watford Electronics—A Better 555 ........ 62 June
- West Hyde Developments—Cases Galore ........ 47 Feb
- West Hyde Developments—Classic Case ........ 61 June
- West Hyde Developments—Test Prod Connector ........ 32 July
- West Hyde Developments—Two-part Cases ........ 25 Sept
- Winslow Components Systems—IC Sockets ........ 37 Aug
- 3M UK—Electrostatic Grounding Kit ........ 51 Apr

## SHOW REPORTS

- The Great British Electronics Bazaar ........ 33 Oct

## NEW BOOKS

- A Guide to Amateur Radio *by P. Hawker G3VA* ........ 75 Nov
- Beginner's Guide to Tape Recording *by I. R. Sinclair* ........ 32 Nov
- Electronic Designers Handbook (3rd Edition) *by K. Hemingway* ........ 32 Nov
- Electron —an elementary introduction for beginners *by L. W. Owers* ........ 61 Feb
- Integrated Circuits—How to Make Them Work *by R. H. Warring* ........ 32 Nov
- Learnabout—Making a Transistor Radio *by G. C. Dobbs* ........ 32 Nov
- Learnabout—Simple Electronics *by Rev. George C. Dobbs* ........ 32 Nov
- Master Hi-Fi Loudspeakers and Enclosures *by Dave Berriman* ........ 32 Nov
- Radio Amateurs' Examination Manual *by G. L. Benbow G3HB* ........ 75 Nov
- Radio Repair *by Les Lawry-Johns* ........ 32 Nov
- Telecommunications Systems for Technicians—1 *by G. L. Danielson and R. S. Walker* ........ 32 Nov
- Television Interference Manual (2nd Edition) *by B. Priestley* ........ 32 Nov

### MISCELLANEOUS

Citizens' Band Association—A letter to the Prime Minister *by J. Bryant* .......... 21 Apr
Cover Price Increase .......... 20 Nov

News—News—News .... 21 Jan, 21 Feb, 21 Mar, 24 Apr, 21 May, 19 & 30 June, 21 & 31 July, 21 Aug, 21 & 57 Sept, 19 Oct, 24 Nov, 23 Dec

Obituaries
Wing Commander John Scott-Taggart OBE, MC .......... 27 Dec
Stanley Robert Mullard MBE(Mil) .......... 27 Dec

PW Personality
Dick Ganderton .......... 20 Jan
Alan Martin .......... 20 Feb
Debbie Chapman .......... 20 Mar
Peter Metalli .......... 20 Apr
Peter Preston .......... 20 May
Keith Woodruff .......... 18 June
Charles Molloy .......... 20 July
Eric Dowdeswell .......... 20 Aug
Ron Ham .......... 18 Oct
Fred Judd .......... 20 Nov
Joe Bishop .......... 22 Dec

PW QSL Cards .......... 33 Sept, 56 Oct, 30 Nov, 47 Dec
PW Subscription Form .... 80 Jan, 58 Feb, 32 Mar, 31 June, 60 July, 68 Sept, 60 Oct, 81 Dec
RAE Reprint Coupon .... 58 Jan, 71 Feb, 24 Mar, 78 Apr, 36 May, 70 June, 30 July, 62 Aug, 30 Sept, 55 Oct, 64 Nov
Readers' Letters .......... 65 Jan, 24 Mar, 29 Apr, 32 Sept

### SUPPLEMENT etc

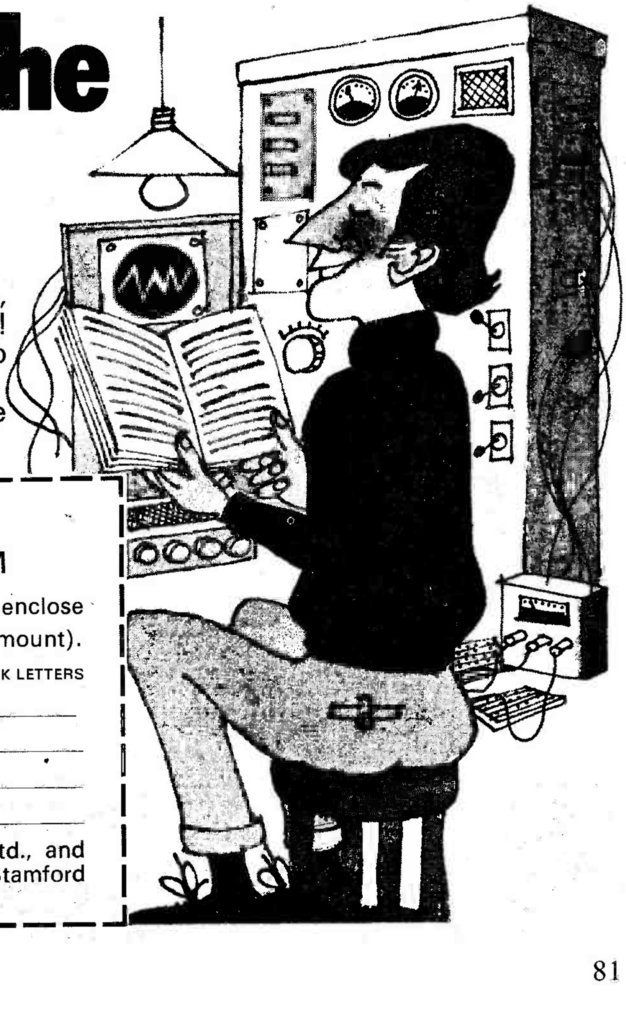
**Special Features**
Metal Detection .......... 35 Jan
Hints and Tips for Constructors .......... Mar
Holiday Radio and TV Guide .......... Sept
Radio Data Supplement .......... Dec

**Gifts**
4BA and 6BA Nut Runner .......... May
Professional Trimming Tool .......... Oct
Aerial Data Chart .......... Nov

**Special Offers**
Commodore 95X3 and 35X1 l.c.d. watches .......... 30 Jan
CSC Logic Probe Kit .......... 50 Aug
Hanimex LC780 Scientific l.c.d. Calculator .......... 34 Oct
Zentron LCD Time-Zone Watch .......... 57 Dec

**Indexes**
Volume 54 May 1977–Dec 1978 .......... Feb
Volume 55 Jan 1977–Dec 1978 .......... 78 Dec


# Every month is the right frequency



When you're building a major project from a PW design, you want to be sure of getting every issue in sequence! Use this order form for a year's supply to be posted to you.
ANNUAL SUBSCRIPTION RATES (including postage and packing) U.K. £10.60. Overseas £10.60.

**practical WIRELESS** SUBSCRIPTION ORDER FORM

Please send me Practical Wireless each month for one year. I enclose a Sterling cheque/international money order for..............................(amount).

PLEASE USE BLOCK LETTERS

NAME Mr/Mrs/Miss______________________________

ADDRESS______________________________

______________________________

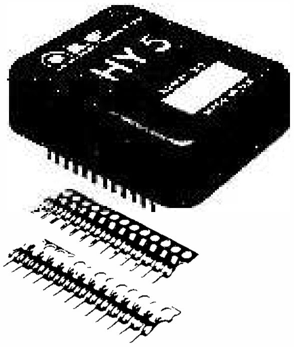
POSTCODE______________________________

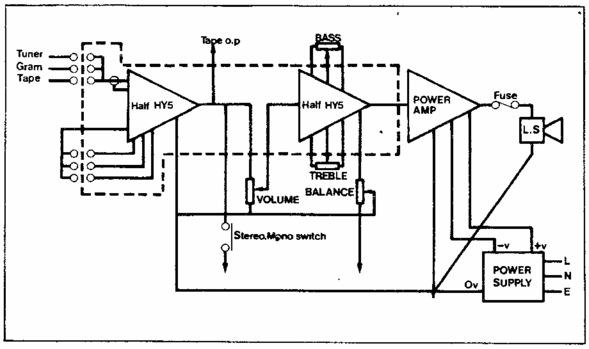
Make your crossed cheque/MO payable to IPC Magazines Ltd., and post to: Practical Wireless, Room 2613, King's Reach Tower, Stamford Street, London SE1 9LS.

# and staying there

# PERFORMANCE MODULAR UNITS

## HY5 PRE-AMPLIFIER

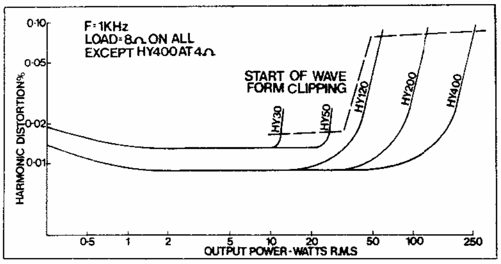


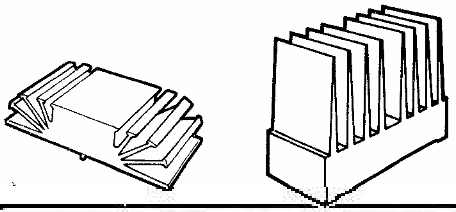




The HY5 pre-amp is compatible with all I.L.P. amplifiers and P.S.U.'s. It is contained within a single pack 50 x 40 x 15 mm. and provides multi-function equalisation for Magnetic/Ceramic/Tuner/Mic and Aux (Tape) inputs, all with high overload margins. Active tone control circuits; 500 mV out. Distortion at 1KHz–0.01%. Special strips are provided for connecting external pots and switching systems as required. Two HY5's connect easily in stereo. With easy to follow instructions.

**£4.64** + 74p VAT

## THE POWER AMPLIFIERS

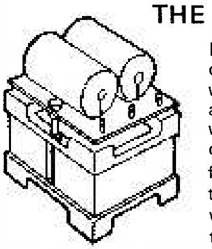


| Model | Output Power R.M.S. | Distortion Typical at 1KHz | Minimum Signal/Noise Ratio | Power Supply Voltage | Size in mm | Weight in gms | Price + V.A.T. |
|---|---|---|---|---|---|---|---|
| HY30 | 15 W into 8 Ω | 0.02% | 80dB | -20 -0- +20 | 105x50x25 | 155 | **£6.34** + 95p |
| HY50 | 30 W into 8 Ω | 0.02% | 90dB | -25 -0- +25 | 105x50x25 | 155 | **£7.24** + £1.09 |
| HY120 | 60 W into 8 Ω | 0.01% | 100dB | -35 -0- +35 | 114x50x85 | 575 | **£15.20** + £2.28 |
| HY200 | 120 W into 8 Ω | 0.01% | 100dB | -45 -0- +45 | 114x50x85 | 575 | **£18.44** + £2.77 |
| HY400 | 240 W into 4 Ω | 0.01% | 100dB | -45 -0- +45 | 114x100x85 | 1.15Kg | **£27.68** + £4.15 |

Load impedance — all models 4 - 16 Ω
Input sensitivity — all models 500 mV
Input impedance — all models 100 KΩ
Frequency response — all models 10Hz - 45KHz - 3dB

## THE POWER SUPPLY UNITS



I.L.P. Power Supply Units are designed specifically for use with our power amplifiers and are in two basic forms — one with circuit panel mounted on conventionally styled transformer the other with toroidal transformer having half the weight and height of its conventional laminated types.

**PSU 36** for 1 or 2 HY30's **£8.10** + £1.22 VAT
**PSU 50** for 1 or 2 HY50's **£8.10** + £1.22 VAT
**PSU 70** with toroidal transformer for 1 or 2 HY120's **£13.61** + £2.04 VAT
**PSU 90** with toroidal transformer for 1 HY200 **£13.61** + £2.04 VAT
**PSU180** with toroidal transformer for 1 HY400 or 2 x HY200 **£23.02** + £3.45 VAT
**PSU 30** ± 15V at 100ma to drive up to five HY5 pre-amps **£4.50** + 68p VAT

NO QUIBBLE 5 YEAR GUARANTEE
7-DAY DESPATCH ON ALL ORDERS
BUILT-IN PROTECTIVE CIRCUITRY
BRITISH DESIGN AND MANUFACTURE
FREEPOST SERVICE — see below

UK DESPATCHED — ALL ORDERS POST PAID

### HOW TO ORDER, USING FREEPOST SYSTEM

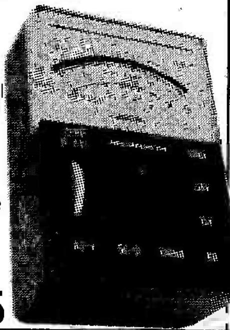
Simply fill in order coupon with payment or credit card instructions. *Post to address as below but do not stamp envelope — we pay postage on all letters sent to us by readers of this journal.*

**ILP ELECTRONICS LTD.**
**FREEPOST 1 Graham Bell House, Roper Close, Canterbury, Kent CT2 7EP.**
**Telephone (0227) 54778 Telex 905780**

Please supply . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . Total purchase price £ . . . . . . . . . . . .
I enclose Cheque ☐ Postal Orders ☐ International Money Order ☐
Please debit my Account/Barclaycard Account No. . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
NAME . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
ADDRESS . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
Signature . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

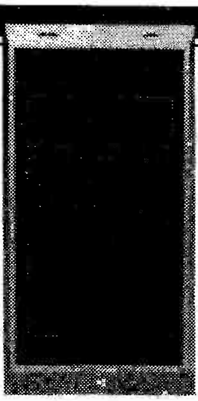
# MORE BIG VALUE FROM YOUR TANDY STORE

## 1000 OHMS/VOLTS AC/DC 8 RANGES



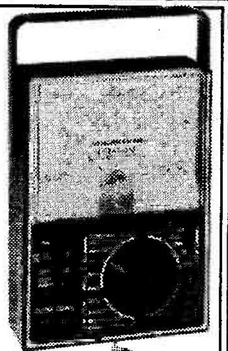
Handy multitester for home and work-shop. Easy-to-read two colour 5cm meter, pin jacks for all 8 ranges. Reads AC and DC volts: 0-15-150-1000 DC current; 0-150 mA. Resistance: 0-100,000 ohms. Accuracy: ± 3% full scale on DC ranges, ± 4% on AC ranges. Complete battery. **22-027.** REG. PRICE **£6.95**

## 6-DIGIT FREQUENCY COUNTER



Counts frequencies from 100 Hz to over 45 MHz with 100 mS gate time. Accuracy is 3 ppm at 25°C or less then ± 30 Mkz on 10 MHz! Overload-protected 1-meg input. Sensitivity, 30 mV up to 30 MHz. Req. 9V battery. **22-351.** REG. PRICE **£79.95**

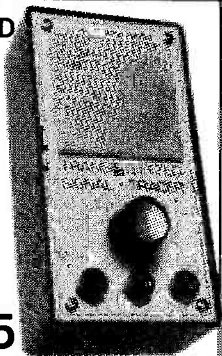
## MULTITESTER



Dual FET imput for accuracy and minimum loading. 11.5cm mirrored scale. DC volts, 0-1-3-10-30-100-300-1000. DC current 0-100 a. 0-3-30-300 milliamp. Resistance 0-30-300-3k-301C-1 megaohm. 0-100-1k-101C-100K-3 megaohms. Req. 9V battery. **22-209.**

REG. PRICE **£29.95**

## TRANSISTORIZED SIGNAL TRACER



Spot circuit troubles and check RF, IF and audio signals from aerial to speaker on all audio equipment. With 9V battery, instructions. **22-010.**

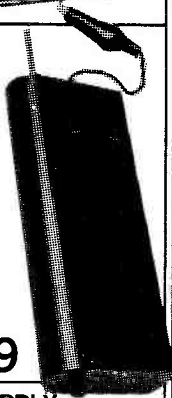
REG. PRICE **£9.95**

## DIGITAL IC LOGIC PROBE

Unique circuitry makes it a combined level detector, pulse detector and pulse stretcher. Hi-LED indicates logic "1". Lo-LED is logic "0". Pulse LED displays pulse transitions to 300 nanoseconds, blinks at 3 Hz for high frequency signals (up to 1.5 MHz). Input impedence: 300K ohms. With 36" power cables. **22-300.**

REG. PRICE **£19.95**

## SIGNAL INJECTOR



For RF, IF, AF circuits. Maximum accuracy. Easy pushbutton operation. Needs two "AA" batteries. **22-4033.**

REG. PRICE **£2.79**

## AC/DC CIRCUIT TESTER

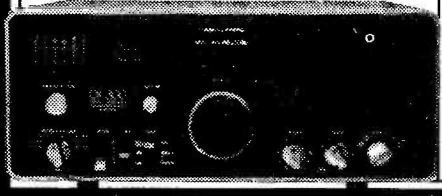
Accuracy in 1-300 volts ranges. Safe in live/dead circuits. Needs two "AA" batteries. **22-4034.**

REG. PRICE **£1.99**

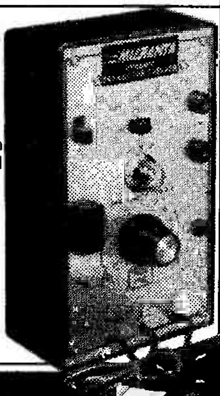
## REALISTIC DX 300

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

REG. PRICE **£229.95**



## DYNAMIC TRANSISTOR CHECKER



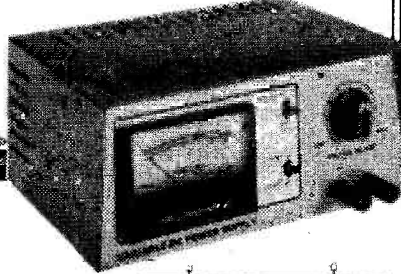
Shows current gain and electrode open and short circuit. Tests low, medium or high power PNP or NPN types. Go/no-Go test from 5-50mA on power types. **22-024.**

REG. PRICE **£9.95**

## VARIABLE POWER SUPPLY

Power project boards. IC's, other low-voltage DC equipment. Load regulation: less than 450mV at 1 amp at 24V DC. Ripple: less then 25mV. Maximum output current: 1.25 amps. Switchable colour-coded meter reads 0-25V. DC and 0-1.25 amps. Three-way binding posts take wires, banana plugs or dual banana plugs with 0.75" centres. For 220/240V AC. **22-9123**

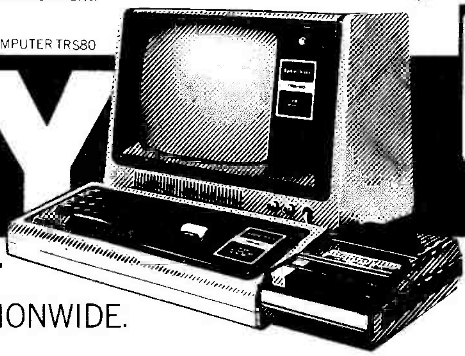
REG. PRICE **£35.95**



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

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

# TANDY



**The largest electronics retailer in the world.**

Offers subject to availability. Instant credit available in most cases.

OVER 170 STORES AND DEALERSHIPS NATIONWIDE.

**TANDY**
DEALER

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

Access, Barclaycard and Trustcard welcome.

Prices may vary at individual stores.

# CHROMASONIC electronics

*your soundest connection in the world of components*

The items shown in this advert are just a small selection taken from our 1979 Catalogue containing everything from Resistors to the latest in Microprocessors. Order your copy today FREE with all orders upon request or S.A.E

Dept PW1, 56 FORTIS GREEN ROAD, MUSWELL HILL, LONDON, N10 3HN

TEL: 01 883 3705 01 883 2289

## VOLTAGE REGULATORS

**Positive**

**78L SERIES 100mA**
5v, 6v, 8v, 12v & 15v. All **32p** each

**78M SERIES 500mA**
5v, 6v, 8v, 12v, 15v, 20v & 24v. All **64p**

**7800 SERIES 1A**
5v, 8v, 12v, 15v, 18v, & 24v. All **89p**

**Negative**

**79M SERIES 500mA**
5v, 6v, 8v, 12v, 15v, 20v & 24v. All **78p**

**7900 SERIES 1A**
5v, 8v, 12v, 15v, 18v & 24v. All **98p**

## VARIABLES

| | |
|---|---|
| μA723 (DIL) | .43 |
| L200 | 1.95 |
| LM304H | 2.55 |
| LM323K | 6.66 |
| LM325N | 2.77 |
| LM326N | 2.77 |
| LM345K | 8.91 |

## ZENERS

BZY88 400MW Range **9p** each
BZX61 1.3 W4TT Range **15p** each

## DENCO COILS

**ROD AERIALS**

| | |
|---|---|
| FRA1 L & MW (300pf) | 1.17 |
| FRA2 L & MW (500pf) | 1.17 |

**I.F. TRANSFORMERS**

| | |
|---|---|
| 1FT 13 465KHz | .87 |
| 1FT 14 465KHz | .87 |
| 1FT 15 10.7MHz | .97 |
| 1FT 16 1.6MHz | .97 |
| 1FT 17 1.6MHz | .97 |
| 1FT 18 465KHz | 1.14 |
| 1FT 18 1.6MHz | 1.14 |

**TRANSISTOR RANGE**
1T, 2T, 3T, 4T, 5T – BLUE, YELLOW, RED AND WHITE – £1.06

**DUAL PURPOSE RANGE**
DP1, DP2, DP3, DP4, DP5, DP6, DP7 – BLUE, YELLOW, GREEN, RED AND WHITE – 97p

## ANTEX SOLDERING IRONS

| | |
|---|---|
| X25 | 4.25 |
| CX | 4.25 |
| CCN | 4.25 |

## DESOLDERING GUN

| | |
|---|---|
| Gun | 6.37 |
| Spare Nozzle | .98 |
| Desolder Braid | .63 |

## QUARTZ CRYSTALS

| | |
|---|---|
| 100KHz | 3.95 |
| 1.0MHz | 3.45 |
| 2.0MHz | 3.45 |
| 2.097152MHz | 3.45 |
| 2.5625MHz | 3.45 |
| 3.27680MHz | 3.45 |
| 4.194304MHz | 3.45 |
| 4.433619MHz | 1.27 |
| 5.0MHz | 3.45 |
| 8.0MHz | 3.45 |
| 10.0MHz | 3.45 |
| 10.7MHz | 3.45 |

## TUNING CAPACITORS

**DILECON**

| | | | |
|---|---|---|---|
| 100pf | 1.94 | 40pf Max | .25 |
| 300pf | 2.29 | 500pf Max | .36 |
| 500pf | 2.52 | | |

(TRIMMERS: 40pf Max .25; 500pf Max .36)

**C804**

| | |
|---|---|
| 5pf, 10pf, 15pf, 25pf | 2.23 |
| 20pf, 50pf | 2.41 |
| 60pf, 75pf, 100pf | 2.77 |

**TYPE '0'**

| | |
|---|---|
| 365pf | 3.46 |
| 365pf + 365pf | 3.97 |
| '00' 208pf + 176pf | 3.67 |

## ELEMENTS AND BITS

| | | |
|---|---|---|
| 1.80 | 50, 51, and 52 | .57 |
| 1.80 | 6/1106 **.53p** 7/1101 | .86 |
| 2.10 | 1100, 1101, 1102, 1103 | .53 |

## REELS OF SOLDER

| | |
|---|---|
| 18 SWG Size 5 | .62 |
| 22 SWG Size PC115 | .74 |
| 18 SWG Size 12 | 2.29 |
| ST3 Soldering Iron Stand | 1.70 |

## RESISTORS

¼Watt HI/STAB 5% 2.7Ω-10M
⅛Watt HI/STAB 5% 10Ω-1M
All **2p** each
100 + £1.75

## PRESETS

| | |
|---|---|
| 0.1 Watt Carbon | .07 |
| 0.5 Watt Cermet | .62 |

## POTENTIOMETERS

| | |
|---|---|
| Log/Lin L/S | .31 |
| Log/Lin W/S | .72 |
| Dual Log Lin L/S | .90 |
| Dual Log Lin W/S | 1.28 |

## SLIDERS

| | |
|---|---|
| Single | .41 |
| Dual | .61 |

## CAPACITORS

Polyester, Polystyrene, Ceramics, Electrolytics, Tantalum Bead, Silver Mica, Mylar. All in stock send for catalogue S.A.E.

## AUDIO AMP KITS

| | |
|---|---|
| 75B 7 Watts | 3.67 |
| 75 × 10 Watts | 4.60 |

## 3½ DIGIT METER KITS

| | |
|---|---|
| 7106 L.C.D. | 26.99 |
| 7107 L.E.D. | 23.99 |

## VEROBOARD

Size inches 0.1 c/clad

| | |
|---|---|
| 2.5 × 1 | .12 |
| 2.5 × 3.75 | .45 |
| 2.5 × 5 | .52 |
| 3.75 × 3.75 | .52 |
| 3.75 × 5.0 | .60 |
| 17 × 2.5 | 1.55 |
| 17 × 3.75 | 2.06 |
| 17.9 × 4.7 | 2.68 |
| Pin insertion tool | .98 |
| Spot face cutter | .84 |
| Veropins per 100 | .42 |

## VERO BOXES

| | |
|---|---|
| 2523E | 8.78 |
| 1798K | 5.09 |
| **G RANGE** | |
| 2672A | 5.88 |
| 2673G | 9.17 |
| 2674B | 12.49 |
| **PLASTIC** | |
| 2514F | 1.99 |
| 2516G | 2.27 |
| 2518H | 2.53 |
| 2520J | 2.87 |
| 2522K | 3.85 |
| **SERIES 2 CASE BOX** | |
| 2037C | 3.93 |
| 2068B | 5.21 |
| 2073K | 7.08 |

## RESISTOR NETWORKS

150Ω, 270Ω, 1K, 4.7K, 10K, 47K, 100K **81p** each

## LINEAR IC's

| | |
|---|---|
| 741 8 Pin | .23 |
| 748 8 Pin | .38 |
| LM301 | .28 |
| LM307 | .51 |
| LM308 | .75 |
| LM324 | .65 |
| LM380 | .85 |
| LM381 | 1.77 |
| LM3900 | .55 |
| MC1310 | 1.26 |
| NE555 | .30 |
| TBA810AS | .99 |
| TCA940 | 1.75 |
| TDA2020 | 3.58 |
| ZN414 | .75 |

## SPECIAL OFFERS

| | |
|---|---|
| 5 × 741 for | 1.00 |
| 4 × 555 for | 1.00 |
| 2 × ZN414 | 1.00 |
| 2 × CA3086 | 1.00 |
| 2 × MC1310 | 1.50 |
| 10 × TIL209 | 1.00 |
| 10 × .2 Red LED | 1.00 |
| 1.TCA730 | 8.50 |
| 1.TCA740 | 8.50 |

## DIN

| Pin | Plug | Socket |
|---|---|---|
| 2 | .15 | .10 |
| 3 | .15 | .10 |
| 4 | .15 | .10 |
| 5 (180°) | .15 | .10 |
| 5 (240°) | .15 | .10 |

## IC SOCKETS

| | |
|---|---|
| **TEXAS DIL** | |
| 14 PIN | .13 |
| 16 PIN | .14 |
| 28 PIN | .32 |
| 40 PIN | .47 |
| **T099** | |
| 10 PIN | .35 |

## TRANSISTORS

| | |
|---|---|
| BC107 | .10 |
| BC108 | .10 |
| BC109 & C | .10 |
| BC147 | .08 |
| BC148 | .08 |
| BC149 | .09 |
| BC157 | .09 |
| BC158 | .09 |
| BC159 | .09 |
| BC182L | .12 |
| BC183L | .12 |
| BC184L | .12 |
| BC212L | .12 |
| BC213L | .12 |
| BC214L | .12 |
| BC327 | .12 |
| BF194 | .10 |
| BF195 | .10 |
| BF196 | .18 |
| BF197 | .10 |
| BFY50 | .23 |
| 2N1711 | .22 |
| 2N2905 | .23 |
| 2N2925 | .10 |
| 2N2926G | .12 |
| 2N3055 | .51 |

We welcome Access

V.A.T. Inclusive prices 15%. Export Customers deduct V.A.T. 3/23.
Postage and Packing 25p. Trade and Export Inquiries most Welcome. Hours 9.00am – 5.00pm.
Now available our ORDER-RING line, just phone your order through with your Access or Barclaycard number and providing the order is received by 3.00pm the components will be despatched the same day (min tel order £5.00).

BARCLAYCARD VISA

---

# A. S. COOPER
## RADIO REPAIRS

11a Kingsholm Road, Gloucester GL1 3AY
Tel: DAY (Glos.) 422259 NIGHT (Glos.) 27223

BARCLAYCARD VISA

## CLEARANCE SALE

Buy it with Access

Capacitors and Trimmers – all Ceramic.
All must go. All at **£1.00** per pack.

☑ No Please tick box and number required.

| | | | | |
|---|---|---|---|---|
| 1 | ☐☐ | Trimmers 0·5 to 5 pf | PC mount | 10 per pack |
| 2 | ☐☐ | Trimmers 2·0 to 2·5 pf | PC mount | 15 per pack |
| 3 | ☐☐ | Trimmers 3·5 to 13 pf | PC mount | 15 per pack |
| 4 | ☐☐ | Trimmers 4·5 to 20 pf | PC mount | 15 per pack |

Next 6 boxes fixed pf values, all 25 per pack.
Circle required pf value.

| | | |
|---|---|---|
| 5 | ☐☐ | 0·5, 2·0, 2·7, 3·3, 3·9, 4·0, 4·7, 6·8, 12·0, 15·0 |
| 6 | ☐☐ | 18, 20, 25, 27, 30, 33, 36, 40, 47, 50 |
| 7 | ☐☐ | 60, 68, 75, 82, 220, 240, 250, 300, 330, 360 |
| 8 | ☐☐ | 400, 560, 620, 750, 820, 2·2k |
| 9 | ☐☐ | 2·5k, 2·7k, 3·0k, 3·5k, 4·0k, 4·7k |
| 10 | ☐☐ | 7pf, 8pf tab type disc |

Packs of 100

| | | |
|---|---|---|
| 11 | ☐☐ | 1k pf leadless disc |

Buy any 10 packs and get one Bumper Pack of mixed values FREE.
Cut out and order today while stocks last.
P & P Orders up to £5 add 30p. Orders £5 to £10 add 50p. Orders over £10 free. UK ONLY.
Overseas enquiries very welcome. SAE with enquiries only.

Name ..........................................................................
Address ......................................................................
...................................................................................
.............................................. Post Code ..............................

---

# ELECTROVALUE

**LEADING DIRECT SUPPLIERS FOR**

**nm**

NASCOM MICROCOMPUTERS

***AND FULL SUPPORTING RANGE OF ITEMS TO ENABLE YOU TO WORK AT PROPER PROFESSIONAL LEVELS***

- ★ *Appointed Nascom stockists*
- ★ *Widest possible range stocked*
- ★ *Information on request*
- ★ *Enquiries from trade, industrial and educational users invited*

***We are also appointed distributors for the fine products of:***

**SIEMENS, ISKRA, RADIOHM, VERO AND MANY OTHER FAMOUS MANUFACTURERS**

**It's a good deal better from**

**ELECTROVALUE LTD**

Be among the very first to receive your

**FREE CATALOGUE 10**
*(Ready shortly)*

by sending your name and address NOW (124 pages – packed with items, illustrations etc.)

● **We pay postage**
in U.K. on orders list value £5 or over. If under, add 27p handling charge.

● **We give discounts**
on C.W.O. orders, except for a few items marked Net or N in our catalogue price list.
**5%** on orders, list value £10 or more
**10%** on orders list value £25 or more.
*Not applicable to Access or Barclaycard orders.*

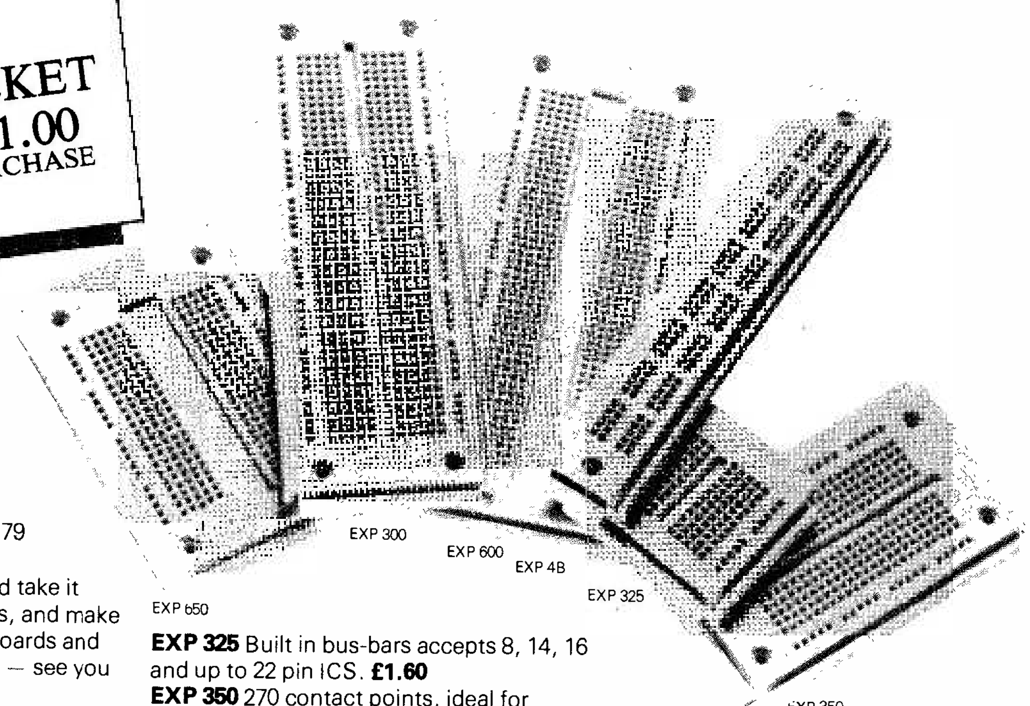
● **We stabilise prices.**
by keeping to our printed price lists which appear but three or four times a year.

● **We guarantee**
all products brand new, clean and to maker's spec. No seconds, no surplus.

**Dept. PW12, 28 St. Judes Road, Englefield Green, Egham, Surrey TW20 0HB.**
Phone: Egham 33603. (London, dial 87 first: STD 0784). Telex 264475.
Northern Branch (Personal shoppers only), 680 Burnage Lane, Burnage, Manchester M19 1NA. Phone (061) 432 4945.

# Britain's Best Breadboard Buy at Breadboard '79

**FREE ENTRY TICKET WORTH £1.00 WITH EVERY PURCHASE**




All over Britain, hobbyists are discovering Britain's Best Breadboard Buys. At the London Breadboard exhibition '79 on Stand Nos. F1, F2 and G1, G2, CSC will be exhibiting their full range of breadboards.

Here is your chance to obtain a special ticket for Breadboard '79 worth £1.00 absolutely FREE.

Cut out the coupon below and take it along to one of our listed dealers, and make a purchase of any of our breadboards and receive your special FREE ticket – see you at Breadboard '79.

Take the coupon to any of these main dealers:

**LONDON**
Rastra Electronics Ltd., 279-281 King Street, Hammersmith, London W6
Cubegate Ltd., Audio Electronics, 301 Edgware Road, London W2 1BN
Technomatic Ltd., 17 Burnley Road, London NW10 1ED
Precision Instrument Labs., Instrument House, 727 Old Kent Road, London SE15

**MANCHESTER**
Shudehill Supply Co., 53 Shudehill, Manchester M4 4AW

**BUCKINGHAMSHIRE**
West Hyde Development, Unit 9, Park Street Industrial Estate, Aylesbury, Bucks HP20 1ET
Best Electronics (Slough) Ltd., Unit 4 Farnburn Ave., Slough, Bucks SL1 4XU

**KENT**
Lawtronics, 13a High Street, Edenbridge, Kent TN8 5AX

**NEWCASTLE**
Aitken Bros., 35 High Bridge, Newcastle upon Tyne

**SCOTLAND**
Marshalls, 85 West Regent Street, Glasgow G2
F. Brown & Co., 45 George IV Bridge, Edinburgh EH1 1E3

**LEEDS**
Leeds Amateur Radio Club, Cookridge Street, Leeds 1

**HERTFORDSHIRE**
BI-PAK, 3 Baldock Street, Ware, Herts.

CONTINENTAL SPECIALTIES CORPORATION

CSC

**CSC UK LTD.** EUROPE, AFRICA, MIDEAST
Shire Hill Industrial Estate Unit 1 Dept. 6CC2
Saffron Walden, Essex CB11 3AQ
Tel: Saffron Walden **(0799) 21682.** Telex: 817477

**EXP 325** Built in bus-bars accepts 8, 14, 16 and up to 22 pin ICS. **£1.60**
**EXP 350** 270 contact points, ideal for working with up to 3 × 14 pin DIPS. **£3.15**
**EXP 650** For microprocessor chips. **£3.60**
**EXP 4B** An extra 4 bus-bars in one unit. **£2.30**
**EXP 300** The most widely sold breadboard in the UK; for the serious hobbyist. **£5.75**
**EXP 600** 6" centre channel makes this the Microprocessor Breadboard. **£6.30**
**PB6** Professional breadboard in easily assembled kit form. **£9.20**
**PB100** Kit form breadboard recommended for students and educational uses. **£11.80**
The above prices do not include P&P and 15% VAT

## The Experimentor System

**4 ways to order Experimentor Systems.**

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

This coupon entitles the holder to a free ticket worth £1.00 to Breadboard '79, with the purchase of any listed breadboards

| | | | |
|---|---|---|---|
| 1.EXP 325 £2.70 | Qnty.Reqd. | 2.EXP 350 £4.48 | Qnty.Reqd. |
| 3.EXP 650 £5.00 | Qnty.Reqd. | 4.EXP 4B £3.50 | Qnty.Reqd. |
| 5.EXP 300 £7.76 | Qnty.Reqd. | 6.EXP 600 £8.39 | Qnty.Reqd. |
| 7.PB6 £11.73 | Qnty.Reqd. | 8.PB 100 £14.72 | Qnty.Reqd. |

**Experimentor System**

| | | | |
|---|---|---|---|
| 1.EXP 300PC £2.38 | Qnty.Reqd. | 2.EXP 302 £2.79 | Qnty.Reqd. |
| 3.EXP 303 £11.04 | Qnty.Reqd. | 4.EXP 304 £11.85 | Qnty.Reqd. |

**Boxed prices include P&P and 15% VAT**

NAME ........................................
ADDRESS ........................................
........................................
........................................

FREE catalogue tick box ☐
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.

If no dealer in your area contact CSC direct.
**Continental Specialties Corporation, (U.K.) Limited, Dept 6CC2,**
Unit 1, Shire Hill Industrial Estate, Saffron Walden, Essex Tel: (0799) 21682

## Receivers and Components

**LARGE RANGE** of specialised components for radio controlled home construction. SAE for lists please. Trio Instruments Limited, (Dept PW,) Dartford Road, Farningham, Kent. DA4 0DZ.

**BRAND NEW COMPONENTS BY RETURN**

**Electrolytic Capacitors 16V, 25V, 50V.** 0·47, 1 0, 2 2, 4·7, & 10 mfds. — **5p.** 22, 47—**5½p.** (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.** 0·1, 0·22, 0·47, 1·0 « 35V 4·7 « 6·3V—**14p.** 2·2/35V, 4·7/25V—**15p.** 10/25V, 15/16V—**15p.** 22/16V, 33/10V, 47/6V, 68/3V & 100/3V—**20p.** 15/25V, 22/25V, 47/10V—**26p.** 47/16V—**36p.**

**Mullard Miniature Ceramic E12 Series 63V 2%.** 10 pf. to 47 pf.—**3p.** 56 pf. to 330 pf.—**4p.**

**Vertical Mounting Ceramic Plate Caps 50V.** E12 22 pf.—1000 pf. E6 1500 pf.—47000 pf.—**2p.**

**Polystyrene E12 Series 63V. Hor. Mounting.** 10 pf. to 820 pf.—**3p.** 1000 pf. to 10000 pf. **4p.**

**Miniature Polyester 250V. Vert. Mtg. E6 Series.** ·01—·068—**4p.** ·1—**5p.** 15, ·22—**6p.** ·33, ·47—**10p.** 68—**12p.** 1·0—**15p.** 1·5—**22p.** 2·2—**24p.**

**Mylar (Polyester) Film 100V. Vertical Mtg.** ·001, ·002, 005—**3½p.** 01, 02—**4½p.** ·04, ·05—**5½p.**

**Miniature Film Resistors Highstab. E12 5%.**
0 125 watt 10 Ω 2M2Ω .......... **1p**
0 250 watt 1 Ω to 10MΩ. (10% over 1M) .......... **1p**
0 500 watt 10 Ω to 2M7Ω .......... **2p**
1 000 watt 10 Ω to 10MΩ .......... **2p**

1N4148—**2p,** 1N4002—**4p,** 1N4006—**6p,** 1N4007—**7p** BC107/8/9, BC147/8/9, BC157/8/9, BF194 & 7—**10p.** 8 Pin Dil i.c's 741's—**18p.** 555's—**24p.**

20mm. fuses 15, ·25, 5, 1 0, 2·0, 3 0 & 5A—**3p.** 20mm. fuseholders P.C. or Chassis Mtg.—**5p.** Post 10p (Free over £4). Prices VAT inclusive.

**THE C. R. SUPPLY CO.**
**127, Chesterfield Road, Sheffield S8 0RN**

**100 MIXED COMPONENTS** £2·75. Sole Electronics, 37 Stanley Street, Ormskirk, Lancs. L39 2DH.

**VALVES**

Radio – T.V. – Industrial – Transmitting

Projector Lamps and Semiconductors

We Dispatch Valves to all parts of the world by return of post, Air or Sea mail, 4000 Types in stock, 1930 to 1976. Obsolete types a speciality. List 50p. Quotatioans S.A.E. Open to callers Monday to Saturday 9.30 to 5.00 closed Wednesday 1.00. We wish to purchase all types of new and boxed Valves, Projector Lamps and Semiconductors.

**COX RADIO (SUSSEX) LTD.**
**Dept. P.W. The Parade, East Wittering, Sussex PO20 8BN**
**West Wittering 2023 (STD Code 024366)**

**TUNBRIDGE WELLS COMPONENTS,** BALLARD'S, 108 Camden Road, Tunbridge Wells, Tel: 31803. No Lists. Enquiries S.A.E.

**AM/CW/SSB COMMUNICATION RECEIVER** and preselector modules. The cheapest way to good amateur and BC DX.
**CRYSTALS** Brand new high-precision. You benefit from very large stocks held for industrial supplies. All normal freq standards, baud rates, MPU, and all magazine projects inc: HC33/U· 1·0, 1·008, 2·5625 MHz, **£3·50.** 1·280 MHz, **£4·15.** HC18/U; 4·0, 5·0, 6·0, 7·0, 8·0, 9·0, 10·0, 10·7, MHz **£3·00.** 12·0, 15·0, 16·0, 18·0, 20·0, 6·9375, 38·6667, MHz, **£3·25.** Selected freqs stocked in Glider, Marine and 27 MHz bands. Any freq made to order in 6 weeks from **£3·90.**
**FILTERS** Your best source for 6 and 8 pole and monolithics for AM, CW, SSB, FM, on 455 kHz, 1·6, 9·0, 10·7, 21·4 MHz, etc.
Prices inc. VAT and UK post. SAE lists.

**P. R. GOLLEDGE ELECTRONICS**
**G3EDW, Merriott, Somerset, TA16 5NS.**
**Tel: 0460 73718**

# SMALL ADS

The prepaid rate for classified advertisements is 22 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £7·50 per single column centimetre (minimum 2·5 cms). All cheques, postal orders etc., to be made payable to Practical Wireless 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 Wireless, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846)

**Publishers Announcement**

Due to increases which may have taken effect since this issue went to press, we strongly advise readers to check with advertisers the prices shown, and availability of goods, before purchasing.

**WAVEFORM GENERATOR.** Square, sine, triangular. Adjustable range 1 to 20 KHz. Built and tested £5.98 p&p 30p. Reynolds (P.R.) 32 Common Approach, Benfleet, Essex.

**VHF TUNERHEAD.** 45-220MHZ, 30MHz IF output, ideal feed HF receiver. £6.00 60p post. 45-220, 440-870MHz tuner £14.00 60p post. Sae data & lists on many items. H. Cocks, Bre Cottage, Staplecross, Robertsbridge, E. Sussex. Tel. 058083-317.

**SOUTHERN VALVE CO.,**
**2nd Floor, 6 Potters Road, New Barnet, Herts.**
**Tel: 01-440 8641**
For current prices & availability, all popular valves stocked. NO CALLERS, SAE Lists. Cash with order — Same Day Postal Despatch.

Valves, Tubes, Aerials etc by LEADING MAKERS. Send SAE Lists or Phone for current prices. Counter or MAIL ORDER. NO COD. Speedy despatch assured. No order under £1.
**Philip Bearman, 6 Potters Road, New Barnet, Herts.**
**Tel: 01-449 1934/5 (1934 Recording Machine).**

**100 7400 SERIES** IC + 100 Diodes 4148 type, marked and unmarked, untested. 100 + 100 £1.50. STE Ltd., Uni-Com Building, Edenbridge, Kent. TN8 6EW.

## Books and Publications

**FREE.** World-famous manufacturers convenient, pocket-sized electronic construction guide (nearly 200 full-colour illustrations). Limited period offer. Send S.A.E. now to TECHNOCENTRE, 54 Adcott Road, Middlesbrough.

**Build your own**

**P.A., GROUP & DISCO SPEAKERS**
by R. F. C. Stephens
Save money with this practical guide. Plans for 17 different designs, line source, I.B., Horn and Reflex types, for 8"-18" drive units. **£3·95** post free ($8 overseas).

**THE INFRA-BASS LOUDSPEAKER**
by G. Holliman
(full constructional details for versions using 15", 12" and 10" drive units.) **£2·95** post free ($6 overseas)

**THE DALESFORD SPEAKER BOOK**
by R. F. C. Stephens
This book is a must for the keen home constructor. Latest technology DIY designs. Plans for I.B., and Reflex designs for 10-100 watts. Also unusual centre-bass system. **£2·20** post free ($5 overseas).

**VAN KAREN PUBLISHING**
**5 SWAN STREET, WILMSLOW, CHESHIRE**

**FULL REPAIR** data any named T.V. £5.30, with circuits, layouts, etc., £7. (AUSW) 76 Church Street, Larkhall, Lanarks ML9 1HE.

## Aerials

**KILL THAT INTERFERENCE**
G2DYM ANTI-T.V.I. TRAP DIPOLES:
S.W.L. Indoor models **£14.50** & **£27.50**
S.W.L. Outdoor models **£30.00** & **£34.50**
Tx-ing models **£36.00, £46.00** & **£54.75**
Lists 10x8in SAE. Aerial Guide **50p.**
Indoor and invisible aerials for S.W.L's **£3.50.**
**G2DYM, Uplowman, Tiverton, Devon.**

**NOTICE TO READERS**

When replying to Classified Advertisements please ensure:

(A) That you have clearly stated your requirements.
(B) That you have enclosed the right remittance.
(C) That your name and address is written in block capitals, and
(D) That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

**COPPER AERIAL WIRE** 14swg hard drawn 70' £3.50. 140' £7.00. inc. VAT. Postage £1.00. T.M.P. Electronic Supplies. Britannia Stores, Leeswood, Nr. Mold, N. Wales.

**AERIAL BOOSTERS**
Improves weak VHF Radio and Television reception.
B45-UHF TV, BII-VHF Radio. B11A-2 metres
For next to the set fitting.
**Price £6.** S.A.E. for Leaflets. ACCESS
ELECTRONIC MAILORDER LTD,
62 Bridge Street,
Ramsbotton, Bury, Lancs, BL0 9AG.

## For Sale

**NEW BACK ISSUES** of "PRACTICAL WIRELESS" available 70p each, post free. Open P.O. Cheque returned if not in stock – BELL'S TELEVISION SERVICE, 190 Kings Road, Harrogate, N. Yorks. Tel: (0423) 55885.

**PRACTICAL WIRELESS** August 1973 to July 1977. Offers Leeds 691655.

**ELECTRONIC** ignition (Capacitor Discharge) manufacturers surplus P.C. Boards, Tested less Box £2.75 each. (01) 643-6111 after 6 p.m.

**MULLARD LP1164** AM/FM I.F. Modules guaranteed unused £1.50. P.P. C.W.O. S.A.E. Lists. Tennex Limited, Stock Road Industrial Estate, Southend, Essex.

**SALE** – Grundig "Satellite 2100", LW, MW, FM and 18 × SW. Guaranteed. £140. Ring X. Kreiss (London) 2403456 Ext. 2671.

**U.S. SIGNAL CORPS** – 27 MHz Transmitter and Receiver with 78 Crystals. £75. Phone Tunbridge Wells 28607.

## Wanted

**WANTED** Cossor Oscillograph Model 1049MK1. Working or not to be used as spare. S. Burns, 15 Glenelg Quadrant, Easterhouse, Glasgow, G34 0DQ.

**ELECTRONIC COMPONENTS PURCHASED.** All Types Considered – Must be new. Send detailed list – Offer by return –. WALTONS, 55A Worcester Street, Wolverhampton.

**JASON** Stereo valve amplifier J210MK III circuit diagram wanted CH10SS0, 49 Beaconsfield Villas, Brighton, Sussex. 505821.

## Ladders

**LADDERS** varnished 21' Extd. £39.39. Carr. £3.50. Leaflets. Callers Welcome. Alloy Ext. to 62½'. Ladder Centre (WLS3), Haldane, Halesfield (1) Telford. 586644.

## Service Sheets

**SERVICE SHEETS.** Radio, TV etc., 10,000 models. Catalogue 24p, plus S.A.E. with orders, enquiries. TELRAY, 154 Brook Street, Preston PR1 7HP.

**BELL'S TELEVISION SERVICES** for Service Sheets on Radio. TV etc., £1·00 plus SAE Colour TV Service Manuals on request. SAE with enquiries to B.T.S., 190 King's Road, Harrogate, N. Yorkshire. Tel: (0423) 55885.

## Service Sheets

**G.T. THE TECHNICAL INFORMATION SERVICE**
**76 CHURCH ST., LARKHALL, LANARKS ML9 1HE**

1000's of service sheets – any single sheet **£1** + L.S.A.E.
1000's of service manuals in stock for immediate despatch.
1000's of repair manuals in stock for immediate despatch.
S.A.E. for full details, quotations, newsletter, bargain offers eg. service sheets under **40p** each – by return post.

**FREE £4** vouchers when you send very large S.A.E. with £2 for our 2 GIANT SERVICE SHEET & MANUALS CATALOGUES + free gift.

**LARGE SUPPLIER OF SERVICE SHEETS**

and Colour Manuals, TV Mono Radios, Tuners, Tape Recorders, Record Players, Transistors, Stereograms, all at 75p each + S.A.E. except colour TV £1.00 and Car Radios £1.25. State if Circuit will do, if sheets are not in stock. All TV Sheets are full lengths 24 × 12, not in Bits & Pieces. Free Fault Finding Chart or TV Catalogue with order. All crossed PO's returned if service sheets not in stock.

**C. CARANNA**
**71, Beaufort Park, London, NW11 6BX**
**01-458 4882 (Mail Order)**

## Record Accessories

**STYLI,** Cartridges For MUSIC CENTRES, etc. FREE List No. 29 For S.A.E. includes Leads, Mikes, Phones etc. FELSTEAD ELECTRONICS, (PW), Longley Lane, Gatley, Cheadle, Ches. SK8 4EE.

## Educational

**COURSE IN ELECTRONICS** by correspondence. For free brochure, write to: The Dataspec Program, Box 23, Succ Laval West, Laval, Quebec, CANADA. H7R-5B7.

**TELEVISION & VIDEO SYSTEMS SERVICING**

**15 MONTHS full-time Diploma course to include a high percentage of practical work.**

- ELECTRONIC PRINCIPLES
- MONO & COLOUR TELEVISION
- CLOSED CIRCUIT TELEVISION
- VIDEO CASSETTE RECORDING
- DIGITAL TECHNIQUES
- TELETEXT & TV GAMES

**Shortened courses for applicants with suitable electronics background.**

*Next session starts January 7th.*

(Also available 2½ year course in Marine Electronics & Radar for employment as ships Radio Officer.)

Prospectus from:

**LONDON ELECTRONICS COLLEGE**

**Dept. B12, 20 Penywern Road, London SW5 9SU. Tel. 01-373 8721.**

**GO TO SEA** as a Radio Officer. Write: Principal, Nautical College, Broadwater, Fleetwood, FY7 8JZ.

**SERVICE SHEETS** from 50p and S.A.E. Catalogue 25p and S.A.E. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex.

## Educational

**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. P277 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. P277 Intertext House, London SW8 4UJ**
Tel. 01-622 9911 (all hours)
State if under 18

**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. P277 Intertext House, London SW8 4UJ**
Tel. 01-622 9911 (all hours)
State if under 18

## Miscellaneous

**THE SCIENTIFIC WIRE COMPANY**
**PO Box 30, London E.4**
**Reg. Office 22 Coningsby Gdns**

**ENAMELLED COPPER WIRE**

| SWG | 1 lb | 8 oz | 4 oz | 2 oz |
|---|---|---|---|---|
| 10 to 19 | 2.65 | 1.45 | .75 | .60 |
| 20 to 29 | 2.85 | 1.65 | .90 | .70 |
| 30 to 34 | 3.05 | 1.75 | 1.00 | .75 |
| 35 to 40 | 3.40 | 1.95 | 1.15 | .84 |
| 41 to 43 | 4.55 | 2.55 | 1.95 | 1.30 |
| 44 to 46 | 5.05 | 3.05 | 2.15 | 1.70 |
| 47 | 8.00 | 5.00 | 3.00 | 1.80 |
| 48 | 15.00 | 9.00 | 6.00 | 3.30 |

**SILVER PLATED COPPER WIRE**

| | | | | |
|---|---|---|---|---|
| 14, 16, 18 | 4.50 | 2.25 | 1.44 | .90 |
| 20 & 22 | 5.00 | 2.85 | 1.74 | 1.06 |
| 24 & 26 | 5.70 | 3.31 | 2.00 | 1.22 |
| 28 & 30 | 6.67 | 3.86 | 2.35 | 1.44 |

Prices include P & P and VAT
SAE brings list of copper & resistance Wires
Dealer Enquiries Invited

144 MHz MKII Converter with OSC Trimmer **£18.00,** Board & Parts **£9.00.**
144 MHz MKII Converter with 116 MHz Output for Transverter **£19.00,** Board & Parts **£9.30.**
144 MHz Class A PA 2w in >10w out **£22.00,** Board & Parts **£10.92.**
Units supplied with Beling Lee Sockets, BNC or SO239 at **60p** extra.

**SPECTRUM COMMUNICATIONS**
**12 Weatherbury Way, Dorchester, Dorset DT1 2EF**
Prices inclusive of P. & P.

**MORSE CODE TUITION AIDS**

Cassette A: 1-12 w.p.m. for amateur radio examination.
Cassette B: 12-24 w.p.m. for professional examination preparation. Each Cassette are type C90.
Morse Key and Buzzer unit for sending practice.
Price each Cassette (including booklets) **£4·75.** Morse Key and Buzzer **£4·75.**
Prices include postagetc. Overseas Airmail £1·50 extra.

**MHEL ELECTRONICS (Dept P.W.), 12 Longshore Way, Milton, Portsmouth PO4 8LS.**

**PRINTED CIRCUITS.** Make your own simply, cheaply and quickly! Golden Fotolak 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.

**MINI-POWER DRILL KIT**
**ULTRA HIGH-SPEED**
OVER
**25,000 R.P.M**


This mains operated Dremel Kit can grind, drill, polish, carve, sand, rout, engrave etc. Contains over 30 accessories inc. cutters, grinding wheels & points, brushes, polishing tips, sanding discs, drum sanders, sanding bands, mandrels, dressing stone, collet wrench etc. All you need for home, hobby and craft work, electronics, modelling and pattern making, gun-smithing, lapidary work–you name it, fitted case, £41.95 + £1.95 p&p. If required, 34 piece accessory kit, £15.75 + £1.50 p&p. Access accepted. Send Name, Address and No.

JOHN DUDLEY & CO. LTD. (Dept. WP12)
Carolyn House, Water Road, Wembley, Middx.
(MAIL ORDER), 01-435 5456 (before noon)

**NICKEL CADMIUM BATTERIES**

Rechargeable and suitable for fast charge HP7 (AA) **£1.05.** SUB C **£1.36**, HP II (C) **£1.98**, HP 2 (D) **£3.02**, PP 3 **£3.79**, PP 3 charger **£5.40**.
All the above nickel cadmium batteries are brand new and are guaranteed full spec. devices.
All cells are supplied complete with solder tags (except PP 3).
Brand new full spec. RECHARGEABLE SEALED ACID maintenance free batteries suitable for burglar alarms etc.
1.2 amp hr. 6v **£4.07**. 2.6 amp hr. 6v **£5.23.**
Quantity prices available on request. Data and charging circuits free on request with orders over £10, otherwise 30p post and handling (specify battery type). Please add 10% P&P on orders under £10 – 5% over £10. VAT at the current rate should be added to total order. Cheques, Postal Orders, Mail order to:-

**SOLID STATE SECURITY DEPT. (PW),**
**10 Bradshaw Lane, Parbold, Wigan Lincs.**
**Tel: 02575 4726.**

**SUBERB 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 90p. Chassis punching facilities at very competitive prices. 400 models to choose from. Suppliers only to Industry and the Trade. BAZELLI. (Dept No. 25) St. Wilfrids, Foundry Lane, Halton, Lancaster. LA 6LT.

**ELECTROLYTIC CAPACITORS – MODERN MINIATURE TYPE.**

2200 uf at 100 V.D.C. (75mm × 35mm) **£1.00 ea.** inc. P&P. 1 +– **75p ea.** 100 + **65p ea.**
**THREE CHANNEL SOUND/LIGHT** UNIT Boards 700 w.p.c. **£12.00 ea.** complete units **£21.50 ea.** inc. P&P. Also Sound chasers, Amps, Sirens, Alien Voice Simulators etc.
Send large S.A.E. and 10p for lists of range, or phone or call at

**N.J.D. LTD.**
**3, Marlborough Street, Dunkirk, Nottingham.**
**Phone Nottm. 703345 (0602).**
*Trade enquiries welcome – quantity discounts available.*

**LOSING DX?**

**RARE DX UNDER QRM?** Get 40dB more DX to QRM ratio with a Tunable Audio Notch Filter, between your receiver and speaker, only £8.90.
**NEW! MSF CLOCK** shows Date, Hours, Minutes, Seconds, 8 digit LED, also parallel BCD output, only 5 × 8 × 15cm, Time Signal accuracy always, £48.80.
**60KHz MSF** Receiver, serial data output, £13.70.
**OFF FREQUENCY?** GRAB the RARE DX with a Crystal Calibrator, between your antenna and receiver, 1MHz, 100, 25KHz markers, no missing "even" ones, £15.80.
**V.L.F.?** EXPLORE 10-150KHz. Receiver only **£10.70.**
**MAKE UP YOUR OWN TUNES** with a Programmable Chime, new carol each day? £23.50 less speaker.
**LONG WAVE DX?** 100-600KHz Converter, built-in antenna tuner, 4.1-4.6MHz output for FRG7 etc, £10.90.

*Each fun-to-build kit includes all parts, printed circuit, case, postage etc, money back assurance so SEND off NOW.*

**CAMBRIDGE KITS**
**45 (PZ) Old School Lane, Milton, Cambridge.**

## ORDER FORM PLEASE WRITE IN BLOCK CAPITALS

Please insert the advertisement below in the next available issue of Practical Wireless for .................................. insertions

I enclose Cheque/P.O. for £................................

(Cheques and Postal Orders should be crossed Lloyds Bank Ltd. and made payable to Practical Wireless).

| | | | |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

NAME..........................................................................................

ADDRESS ....................................................................................

..................................................................................................

*Send to:* Classified Advertisement Manager
**PRACTICAL WIRELESS,**
**GMG, Classified Advertisement Dept., Rm. 2337,**
**King's Reach Tower, Stamford Street,**
**London SE1 9LS** **Telephone 01-261 5846**

Rate
**22p** per word, minimum 12 words. Box No. **60p** extra.

Company registered in England. Registered No. 53626. Registered office: King's Reach Tower, Stamford Street, London SE1 9LS

# TRANSFORMERS

## Continuous Ratings

+ VAT 15%

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

| Ref | Amps | Price | P & P |
|---|---|---|---|
| 112 | 0·5 | **2·90** | 0·90 |
| 79 | 1·0 | **2·93** | 1·10 |
| 3 | 2·0 | **6·35** | 1·10 |
| 20 | 3·0 | **6·82** | 1·31 |
| 21 | 4·0 | **8·79** | 1·31 |
| 51 | 5·0 | **10·86** | 1·52 |
| 117 | 6·0 | **12·29** | 1·67 |
| 88 | 8·0 | **16·45** | 1·89 |
| 89 | 10·0 | **18·98** | 1·89 |
| 90 | 12·0 | **21·09** | 2·24 |
| 91 | 15·0 | **24·18** | 2·39 |
| 92 | 2·0 | **32·40** | O.A. |

**50 VOLT RANGE**
Pri 220/240V Sec 0-20-25-33-40-50V Voltages available 5, 7, 8, 10, 13, 15, 17, 20, 33, 40 or 20V-0-20V and 25V-0-25V.

| Ref | Amps | Price | P & P |
|---|---|---|---|
| 102 | 0·5 | **3·75** | 0·90 |
| 103 | 1·0 | **4·57** | 1·10 |
| 104 | 2·0 | **7·88** | 1·31 |
| 105 | 3·0 | **9·42** | 1·52 |
| 106 | 4·0 | **12·82** | 1·73 |
| 107 | 6·0 | **16·37** | 1·89 |
| 118 | 8·0 | **22·29** | 2·39 |
| 119 | 10·0 | **27·48** | O.A. |
| 109 | 12·0 | **31·79** | O.A. |

**MAINS ISOLATORS (SCREENED)**
PM 120/240 Sec 120/240V CT

| Ref | VA | Price | P & P |
|---|---|---|---|
| *07 | 20 | **4·84** | 0·91 |
| 149 | 60 | **7·37** | 1·10 |
| 150 | 100 | **8·38** | 1·31 |
| 151 | 200 | **12·28** | 1·31 |
| 152 | 250 | **14·61** | 1·73 |
| 153 | 350 | **18·07** | 2·12 |
| 154 | 500 | **22·52** | 2·47 |
| 155 | 750 | **32·03** | O.A. |
| 156 | 1000 | **40·92** | O.A. |
| 157 | 1500 | **56·52** | O.A. |
| 158 | 2000 | **67·99** | O.A. |
| 159 | 3000 | **95·33** | 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

| VA | Price | P & P | Ref |
|---|---|---|---|
| 20 | **6·55** | 1·03 | 56W |
| 75 | **8·50** | 1·31 | 64W |
| 150 | **11·00** | 1·31 | 4W |
| 200 | **12·02** | 1·67 | 65W |
| 250 | **12·55** | 1·67 | 69W |
| 500 | **20·13** | 1·89 | 67W |
| 1K | **30·67** | 2·65 | 84W |
| 1·5K | **33·02** | O.A. | 93W |
| 2K | **54·97** | O.A. | 95W |

**12 OR 24V OR 12-0-12V**
Pri 220-240 volts

| Ref | Amps 12V | Amps 24V | Price | P&P |
|---|---|---|---|---|
| 111 | 0·5 | 0·25 | **2·42** | 0·52 |
| 213 | 1·0 | 0·5 | **2·90** | 0·90 |
| 71 | 2 | 1 | **3·86** | 0·90 |
| 18 | 4 | 2 | **4·46** | 1·10 |
| 85 | 0·5 | 2·5 | **6·16** | 1·10 |
| 70 | 6 | 3 | **6·99** | 1·10 |
| 108 | 8 | 4 | **8·16** | 1·31 |
| 72 | 10 | 5 | **8·93** | 1·31 |
| 116 | 12 | 6 | **9·89** | 1·52 |
| 17 | 16 | 8 | **11·79** | 1·52 |
| 115 | 20 | 10 | **15·38** | 2·39 |
| 187 | 30 | 15 | **19·72** | 2·39 |
| 226 | 60 | 30 | **40·41** | O.A. |

**SCREENED MINIATURES**

| Ref | mA | Volts | £ | P&P |
|---|---|---|---|---|
| 238 | 200 | 3-0-3 | **2·83** | 0·63 |
| 212 | 1A, 1A | 0-6, 0-6 | **3·14** | 0·90 |
| 13 | 100 | 9-0-9 | **2·35** | 0·44 |
| 235 | 330, 330 | 0-9, 0-9 | **2·19** | 0·44 |
| 207 | 500, 500 | 0-8-9, 0-8-9 | **3·05** | 0·85 |
| 208 | 1A, 1A | 0-8-9, 0-8-9 | **3·88** | 0·90 |
| 236 | 200, 200 | 0-15, 0-15 | **2·19** | 0·44 |
| 214 | 300, 300 | 0-20, 0-20 | **3·08** | 0·90 |
| 221 | 700 (DC) | 20-12-0-12-20 | **3·75** | 0·90 |
| 206 | 1A, 1A | 0-15-20-0-15-20 | **5·09** | 1·10 |
| 203 | 500, 500 | 0-15-27-0-15-27 | **4·39** | 1·10 |
| 204 | 1A, 1A | 0-15-27-0-15-27 | **6·64** | 1·10 |
| 239 | 50 | 12-0-12 | **2·88** | 0·37 |

**BRIDGE RECTIFIERS**

| | | | |
|---|---|---|---|
| 100V | 25A* | **£2·10** |
| 200V | 2A | **£0·45** |
| 400V | 4A | **£0·85** |
| 400V | 6A | **£1·25** |
| 500V PM7A6 | 12A* | **£2·85** |

P & P 17p VAT 15%

**HIGH QUALITY AMPLIFIER MODULES**

| | | |
|---|---|---|
| 10W | (AL30) | **£3·75** |
| 25W | (AL60) | **£4·95** |
| 35W | (AL80) | **£7·79** |
| **125W** | **(AL250)** | **£18·74** |

F.M. Tuner 4 push buttons **£23·60**
Pre-Amps and Power Supplies available P & P 40p VAT 15%

**END OF LINE OFFERS**

Ref P+ P

**30**-Isolator 240V:240V 200VA **£4·54** £1·04
**62**-Isolator 240V:240V 250VA **£5·62** £1·04
**6**-250-0-250 @ 100ma 1) Sec 6·3V @ 3·5A 2) Sec 0-5V, 6·3V @ 2/1 amp **£3·20** 78p
**7**-350-0-350V @ 100ma 1) Sec 6·3V @ 3·5A 2) Sec 0-5V, 6·3V @ 2/1 amp **£4·10** 96p
**27**-250-0-250 @ 60ma 1) Sec 6·3V @ 2·5A 2) Sec 6·3V @ 1 amp **£3·00** 78p
**82**-4 amp Battery Charger (transformer) **£4·81** £1·04
**86**-6 amp Battery Charger (transformer) **£5·80** £1·04
**M184** – To match EL84 15W **£1·62** 32p
**M616** – 0-240V: Screen 1) 13-0-13 1A. 2) 12V 150ma **£2·10** 60p
**M489** – 0-240V: 1400V @ 150ma, 6·3V @ 4A **£5·50** £1·04
**M708** – 6K to 3KΩ matching trans. 5 watt **90p** 40p
**M679** – 0-120V x 2: 36V 1·6A **£3·00** 78p
**M865** – 100V Line to 4Ω 10 watts **£1·90** 60p
**M973** – 100V Line to 8Ω 40 watts **£2·90** 60p
**M1015** – Choke 8A @ 5mH 150A Surge **£1·50** 45p
**M1020** – 0-240V 12-0-12V @ 50ma **97p** 41p
**M1126** – 120/240V: 9-0-9V @ 1A **£1·79** 71p
**M1130** – 0-240 4500V @ 10ma **£4·86** £1·08
**M1165** – 0-115-240V; 14V 50ma **75p** 30p

**Metal Oxide Resistors** ¼W 5% TR4 (Electrosil) 24K/470μ/560μ 1K/1K8/2K4/1K1/270K/1K6/82K/20K/820μ/16K/180K/390μ/3K/510μ/300K/220K/2K/100K/22K/130K/47K/1K2/120K/110K £1·50/100 + VAT.

**P.W. Purbeck** osciloscope transformer 250-0-250V; 6·3V; 12·9V **£7·51** £1·04

**Solderless bread boarding** U Dec B for IC's etc **£6·99** P & P 40p VAT 15%

**AVO TEST METERS**

| | |
|---|---|
| AVO 8 MK5 | **£91·50** |
| AVO 71 | **£38·00** |
| AVO 73 | **£50·70** |
| AVO MM5 minor | **£35·95** |
| Wee Megger | **£76·28** |
| TT169 in circuit transistor tester | **£41·53** |
| EM272 | **£59·80** |
| DA116 Digital | **£110·90** |
| BM7 Megger | **£53·76** |
| Clamp Meter to 300A | **£54·60** |

All Avos Meggers and accessories available. **P & P £1·32 VAT 15%**

**U4315 Budget Meter.** 20KΩ/V Ranges to 1000V, 2·5A AC/DC 500KΩ Res. In steel case **£15·85.** PP £1·15 VAT 15%

**20,000 ohm/V Multimeter,** mirror scale Ranges AC/DC to 1000V DC current to 250mA Resistance to 3 Mohms. 5" x 3½" x 1½" **£14·36 P&P £1.00 VAT 15%**

**NEW RANGE TRANSFORMER**
Pri 120V or 220/240V. Sec 0-36-48 twice to give 36-0-36V 48-0-48V 72V or 92V.

| Ref | | P & P |
|---|---|---|
| 3A | **16·17** | 1·76 |
| 4A | **20·65** | 2·11 |
| 5A | **29·30** | 2·47 |

VAT 15%

**PANEL METERS**

| 43mm × 43mm | | 82mm × 78mm | |
|---|---|---|---|
| 0-50μA | **6·20** | 0-50μA | **6·70** |
| 0-500μA | **5·95** | 0-500μA | **6·70** |
| 0-1mA | **5·95** | 0-1mA | **6·70** |
| 0-30V | **5·95** | 0-30V | **6·70** |
| **VU** ind. Panel 48mm x 45mm | | | **2·60** |

VU. Ind. Edge 54 × 14mm 250μA F.S.D. **2·60**
**Carriage 76p VAT 15%**

Send 15p for Catalogue

**15V RANGE** (7·5-0-7·5V) 0-CT 15V

| Ref | | | P & P |
|---|---|---|---|
| 171 | 500 mA | **2·30** | 0·52 |
| 172 | 1A | **3·26** | 0·90 |
| 173 | 2A | **3·95** | 0·90 |
| 174 | 3A | **4·13** | 0·99 |
| 175 | 4A | **6·30** | 1·10 |

VAT 15%

Mini Multimeter:—DC1000V AC 1000V AC/DC 1000 /V DC 100ma Res—150K **£7·20** P & P **71p VAT 15%**

**Plug in Save Batteries:-** fits into 13A Skt 3-6-9-12V multiplug outlet 300ma **£4·60 P & P 55p VAT 15%**

**Electronic Construction Kit**
Home electronic starter. Start simply and progress to a TRF radio or electronic organ. No soldering. All parts included in presentation box. Full instructions. **£8·29. P & P £1·10 VAT 15%**

**AUTO TRANSFORMERS**

| Ref | VA (Watts) | | £ | P&P |
|---|---|---|---|---|
| 113 | 15 | 0-115-210-240 | **2·73** | 0·81 |
| 64 | 75 | 0-115-210-240 | **4·41** | 1·10 |
| 4 | 150 | 0-115-200-220-240 | **5·70** | 1·10 |
| 67 | 500 | 0-115-200-220-240 | **12·09** | 1·91 |
| 84 | 1000 | 0-115-200-220-240 | **20·64** | 2·39 |
| 93 | 1500 | 0-115-200-220-240 | **25·61** | 0A |
| 95 | 2000 | 0-115-200-220-240 | **38·31** | 0A |
| 73 | 3000 | 0-115-200-220-240 | **65·13** | 0A |
| 80S | 4000 | 0-10-115-200-220-240 | **84·55** | 0A |
| 57S | 5000 | 0-10-115-200-220-240 | **98·45** | 0A |

**Step up or step down**

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

# RADIO CONTROL

## P.W. F.M. SYSTEM

**TELERADIO R/C ELECTRONICS ARE STOCKING ALL PARTS**

**Send S.A.E. for leaflets to**

## TELERADIO R/C

325 Fore St., London N9 0PE 01-807 3719

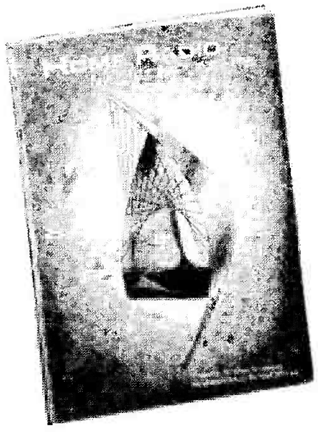
Closed Thursdays

## PROGRESSIVE RADIO

*ALL ORDERS DESPATCHED BY RETURN POST*

**SEMICONDUCTORS.** 2N5062 (100V 800mA) SCR **18p.** BX504 opto isolator **25p.** CA3130 **95p.** TBA800 **50p.** C106D 400V 2·5A SCR Cropped Heatsink **20p.** TDA1151 **25p.**
**SWITCHES.** Min. toggles. SPST 8x5x7mm **52p.** DPDT 8x7x7mm **62p.** DPDT c/off 12x11x9mm **77p.** HEAVY DUTY-DPDT 240VAC 10 Amp **35p.** PUSH TYPE, push on 16x6mm **15p,** push to break version **17p.** 16 pin D.I.L. switch **40p.**
**SURPLUS BOARDS.** No.1 car radio IF. Board 2 transistors and IM382 I.C. I.F.'s etc., **65p.** No.2 with 11 50V 2,5 Amp SCRS, relay and various transistors. Including unijunction type **£1.75p.** No.3 with 2 BDY61 T03 transistors **45p.**
**LIGHT DIMMER.** Wall mounting 250VAC 800 watts max., has built in photo cell for automatic switch on when dark **£4.50p.**
**RECORDING TAPE.** Low noise Mylar, supplied spooled unboxed, 7" 1200' **£1.00,** 7" 1800' **£1.45p,** 10½" 3,600' **£5.00. BLANK CASSETTES** C60 10 for **£2.75p,** C90 10 for **£3.85p.**
**TAPE HEAD DEMAGNETISER,** 240VAC curved probe **£2.65p. LOW COST ¼" tape splicer £1.95p.**
**TOOLS.** 5 piece precision screwdriver sets, individual handles only **£1.05** set.
**JUMPER TEST LEAD SETS.** 10 pairs of leads with insulated crocs each end **90p.**
**MURATA 40KHZ TRANSDUCERS,** RX/TX **£3·50** pair.
**TELEPHONE PICK UP COIL** suction type with lead and plug **62p.**
**MINIATURE SOLID STATE BUZZERS.** 33x17x15mm, output at 3 feet 70db., 15ma drain, 4 type, 6-9-12 or 24 volts **80p. LOUD** 12 volt buzzer **63p.**
*Cash with order please, official orders welcome from schools etc., please add 30p postage and packing. VAT inclusive. SAE for latest illustrated stock list.*

**31, CHEAPSIDE, LIVERPOOL L2 2DY**



# FIRST

## *and STILL BEST!*

We've been producing our Electronics Components Catalogue for *over 20 years.* During that time we've learned a lot, not only in the art of catalogue production but in building a business that serves the needs of constructors. Little wonder that we have a reputation *second to none* for our catalogue – *and* for the service that backs it up. Experience both for yourself. Just send £1.30 with the coupon and a catalogue will come by return of post.

- About 2,500 items clearly listed and indexed.
- Profusely illustrated throughout.
- 128 A-4 size pages, bound in full-colour cover.
- Bargain list of unrepeatable offers included free.
- Catalogue contains details of simple Credit Scheme.

**HOME RADIO (Components) LTD.,**
**Dept. PW., 234-240 London Road, Mitcham, Surrey CR4 3HD**

POST THIS COUPON
*with cheque or P.O. for £1.30*

*Please write your Name and Address in block capitals*

NAME ______________________

ADDRESS ______________________

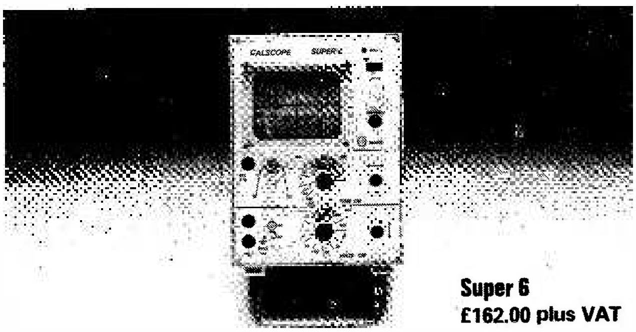
______________________

______________________

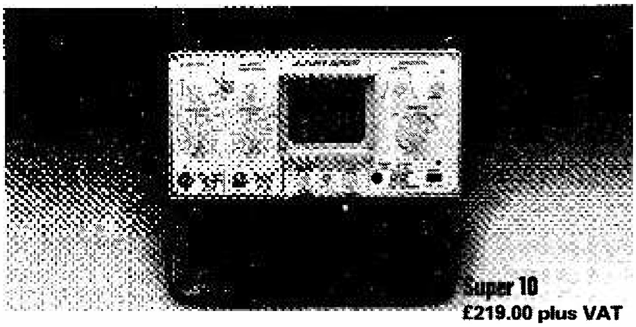
HOME RADIO (Components) LTD Dept PW
234-240 London Road, Mitcham, Surrey CR4 3HD

Regd No. 912966 London

# The professional scopes you've always needed.



**Super 6**
**£162.00 plus VAT**



**Super 10**
**£219.00 plus VAT**

When it comes to oscilloscopes, you'll have to go a long way to equal the reliability and performance of Calscope.

Calscope set new standards in their products, as you'll discover when you compare specification and price against the competition.

The Calscope Super 10, dual trace 10 MHz has probably the highest standard anywhere for a low cost general purpose oscilloscope. A 3% accuracy is obtained by the use of stabilised power supplies which cope with mains fluctuations.

The price £219 plus VAT.

The Super 6 is a portable 6MHz single beam model with easy to use controls and has a time base range of 1μs to 100ms/cm with 10mV sensitivity. Price £162 plus VAT.

Prices correct at time of going to press.

**CALSCOPE DISTRIBUTED BY**
**Watford Electronics**
**33-35 Cardiff Road,**
**Watford, Herts.**
**Tel: 0923 40588**

Audio Electronics,
301 Edgware Road, London W.2.
Tel: 01-724 3564
Access and Barclay card facilities
(Personal Shoppers)

Maplin Electronics Supplies Ltd.
P.O. Box 3
Rayleigh, Essex.
Tel: 0702 715 155
Mail Order

# CALSCOPE

---

**HOME COMPUTING BARGAINS**
All of this months offers have full key boards, use your TV as a VDU and will read and write onto most cassette recorders:— Ohio Scientific Superboard II fully assembled. 8K basic, 4K ram £188 + VAT. Tandy TRS80 level II basic, converted to UK TV standard, includes modulator and PSU:— with 4K ram £399 + VAT, with 16K ram £450 + VAT.

**SINCLAIR PRODUCTS**
PFM200 £52·69, case £3·40, adaptor £3·40, connector kit £11·27. Microvision TV £91·44, mains adaptor £6·88. PDM35 £29·76, mains adaptor £3·40, case £3·40. DM350 £71·82, DM450 £102·17, DM235 £52·66. Accessories for all 3 models:— rechargeable batteries £7·99, mains adaptor/charger £3·94, case £9.
Enterprise prog calculator £23·27. New 10MHz scope £149.

**COMPUTER GAMES**
Chess challenger 7 £84. Chess challenger 10 £139·70. Voice challenger £229. Checker challenger 2 £46. Checker challenger 4 £84. Atari video computer £147. Cartridges £14·32. Star Chess £62. Chess champion 6 £61.

**CONTINENTAL SPECIALITIES PRODUCTS**
EXP300 £6·61. EXP350 £3·62. EXP325 £1·84. EXP650 £4·14. EXP4B £2·64. LP2 £20·70.

**TV GAMES**
Tank battles kit £6·34. AY-3-8500 chip £5·27, kit £4·26. Stunt cycle AY-3-8760 chip £12·46, kit £4 26. 10 game paddle 2 AY-3-8600 chip £10, kit £7·03. Racing car chip AY-3-8603 £13·63. Modified shoot kit £5·28. Rifle kit £5·27. Colour generator kit £9·05. Joystick 220K £1·80.

**MAINS TRANSFORMERS**
6-0-6V 100ma 76p, 1½a £2·60. 9-0-9V 75ma 76p, 1a £2·22, 2a £2·89. 12-0-12V 100ma 92p, 1a £2·75. 15-0-15V 1a £3·09.

**JC12 AND JC20 AMPLIFIERS**
Integrated circuit audio amplifier chips with data and printed circuits. JC12 6 Watts £2·08. JC20 10 Watts £3·14.

**FERRANTI ZN414**
IC radio chip 85p. Extra parts and pcb for radio £4·10. Case £1·06.

**PRINTED CIRCUIT MATERIALS**
PC etching kits:— economy £2·32, standard £4·36. 40 sq. ins pcb 66p. 1 lb FeCl £1·30. Etch resist pens:— economy 50p, dalo 84p. Drill bits 1/32" or 1mm 27p. Etching dish 89p. Laminate cutter 82p.

**S-DECS AND T-DECS**
S-Dec £3·79. T-Dec £4·59. u-DecA £4·69. uDecB £7 16. 16 dil adaptor £2·31.

**BATTERY ELIMINATORS**
3-way types with switched output and 4-way multi-jack:— 3/4½/6V 100ma £2·39, 6/7½/9V 300ma £3·14. 100ma radio types with press stud connectors 9V £3·57, 6V £3·57, 4½V £3·57, 9+9V £4·79, 6+6V £4 79, 4½+4½V £4·79. Cassette recorder mains unit 7½V 100ma with 5 pin din plug £3·57. Fully stabilized type 3/6/7½/9V 400ma £5·76. Car convertors 12V dc input, output 9V 300ma £1·19, output 7½V 300ma £1 19, output 3/4½/6/7½/9/12V 800ma £2·66.

**BATTERY ELIMINATOR KITS**
100ma radio types with press-stud connectors 4½V £1·49, 6V £1·49, 9V £1·49, 4½+4½V £1·92, 6+6V £1·92, 9+9V £1·92. Cassette type 7½V 100ma with din plug £1·49. Heavy duty 13 way types 4½/6/7/8½/11/13/14/17/21/25/28/34/42V 1A £4·95 2A £7·72. Car convertor input 12V dc, output 6/7½/9V 1A stabilised £1·35.

**STABILIZED POWER KITS**
The first price is for kit without transformer, the bracketed price includes transformer. 8-way types 3/4½/6/7½/9/12/15/18V 100ma £1·74 (£2·50), 1A £2·98 (£5·10), 2A £4·10 (£6·87). Variable voltage models 2-18V 100ma £2·12 (£2·98), 1-30V 1A £2·98 (£5·95), 1-30V 2A £4·98 (£11·24).

**BI-PAK AUDIO MODULES**
AL30 £4·04. PA12 £7·77. PS12 £1·42. T538 £2·70. S450 £24·03. AL60 £4·97. PA100 £17·33. SPM80 £4·57. BMT80 £6·08. Stereo 30 £20·57. MA60 £36·23.

**COMPONENTS**
1N4148 0·9p. 1N4002 3·1p. 741 8 dil 16p. 723 14 dil 31p. NE555 8 dil 25p. bc183, bc213, bc547, bc549 4·2p. bc182, bc184, bc212, bc214, bc548 5p. tip31c, tip32c 30p. tip41c 39p. bd131, bd132 27p. Plastic equiv. bc107 5p. Fuses 20mm×5mm cartridge ·15, ·25, ·5, 1, 2, 3, 5 Amp quickblow 1p, anti-surge 3·6p. Resistors 5% ¼W E12 10R to 10M 1p, 0·8p for 50+ of one value. Polyester capacitors 250V ·015, ·068, ·1mf 1·5p, ·01, ·033, ·33 2·8p, ·022, ·047mf 3·3p, ·22, ·47mf 4·9p. Polystyrene capacitors E12 63V 10 to 1000pf 3p, 1n2 to 10n 4p. Ceramic capacitors 50V E6 22pf to 47n 2p. Electrolytic capacitors 50V ·5, 1, 2mf 5p, 25V 5, 10mf 5p, 16V 22, 33mf 5p, 47, 68mf 3·5p, 100mf 6p, 220mf 7·5p, 330, 470mf 9p, 1000mf 10p. Zeners 400mW E24 2V7 to 33V 7p. Preset pots subminiature 0·1W horiz or vert 100 to 4M7 6p. Potentiometers ¼W 4K7 to 2M2 log or lin single 27p, dual 67p. ⅛" red LEDs 9·7p. IC sockets 8 dil 8·7p, 14 dil 10·1p, 16 dil 12p.

**SWANLEY ELECTRONICS**
**Dept. PW, 32 Goldsel Road, Swanley, Kent BR8 8EZ.**

Mail order only. Please add 30p to the total cost of your order for postage. Prices include VAT unless stated. Lists 24p post free. Overseas customers deduct 13%. Official credit orders welcome.

---

## CASH & CARRY PRICES
## SHORT-WAVE RECEIVERS

SONY-ICF 6700. 5 band. General coverage. Digital readout. B/I spkr. and ant. **£198.00**
SONY-ICF 6800. 31 band. Dual conversion. Crystal synthesizer. Digital. Fet balanced mixer. Tuned RF pre-selector **£318.00**
NATIONAL DR26. 6 band portable receiver. Digital read-out. Preselector **£159.00**
NATIONAL DR48. 11 band communication RX. Digital. 2 speed tuning. Rugged steel cabinet **£270.00**
GRUNDIG 3400 SATTELITE. Latest model of FI famous receiver. Superb audio. £ to be announced.

*Established over 50 years on good service.*

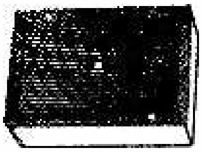
**G3ST PARK ELECTRIC G8HGE**
**211 Streatham Road, Mitcham, Surrey 01-648 6201**

---

## BURGLAR ALARMS

**WE HAVE STOCKS OF EVERYTHING YOU NEED.**
**CALLERS WELCOME. OPEN 6 DAYS**
**EXPRESS POSTAL SERVICE FREE CATALOGUE SEND S.A.E.**

**SPECIAL OFFER**
18 SWG steel plastic coated bell box with FREE ADE sticker



**£5.00**
Inc. VAT and postage

**A. D. E. (SECURITY) CO.,**
217 WARBRECK MOOR
AINTREE, LIVERPOOL
TEL: 051-525-3440
**STOP PRESS ! Trade Price List Available Applications on Official Stationery only**

# INDEX TO ADVERTISERS

Advance Design ... .. 94
A. J. H. Electronics ... .. 44
A. J. P. Electronics ... ... 77
Amateur Electronics 18
Amateur Radio Exchange ... 67
Ambit International . . Cover II
Amcomm Services . . . 67
Antex . Cover III
Armon Products . 74

B. P. M. . . 44
Barrie Electronics .. . 93
Bearman, Phillip ... ... 90
B.I.E.T. .. .. .. 19
Bib Hi-Fi .. .. ... 4
Bi-Pak Limited ... 20, 21
Bi-Pre-Pak . . ... ... 43
Birkett J. ... ... 2
Bowes C. ... ... . . 84
British National Radio & Electronics School . . 15, 92
Bredhurst .. . ... 68
Brooks B. . . . ... 73
J. Bull ... ... ... 13

Calscope .. ... ... 94
Cambridge Kits . . ... 91
Caranna C. . . .. 91
Catronics (VHF Communications) 6
Chromasonics Electronics ... 88
Chromatronics . . ... 19
Continental Specialities Corporation Ltd. ... ... 89
Contour Electronics .. ... 58
Cooper A. S. . . ... 88
Cox Radio (Sussex) Ltd. ... 90
C. & R. Supply Co. ... ... 90
C.W.A.S. Alarm ... ... 92

Dudley & Co. Ltd., John . . 91

Electronic Design Associates 2
Electronic Mail Order Ltd. ... 90
Electrovalue .. . . 88
Electrovance ... .. 8
Europrize Competitions Ltd. 92

Fane Accoustics ... ... 86
Fidelity Fastenings .. ... 6
Fleet Control Systems ... 44

Galaxy ... ... . . 43
George, David Sales .. 6
Golledge Electronics, P. R. ... 90
G.T. Information Services ... 91
G2 DYM ... ... ... 90

HAC Shortwave ... .. 14
Harvesons Surplus Co. ... 12
Heathkit ... ... 61
Home Radio ... ... 93

Illiffe Promotions ... ... 4
I.L.P. Electronics .. 82, 83
Intertext I.C.S. . 91, 95

Leeds Amateur Radio ... 73
London Electronics College ... 91
Lowe Electronics ... 30

M.H.E.L. Electronics ... 91
MacGregor Radio Control ... 43
Maclin-Zand ... ... 14
Magnum Audio Limited ... 18
Manor Supplies ... .. 12
Micron ... . . ... 44
Maplin Electronic Supplies 5, Cover IV
Marshall A. (London) Ltd. ... 8
Metac, Ltd.... ... 10, 11
Monolith Electronics Ltd. ... 95

Neway Models ... .. 43
N.J.D. Ltd. ... ... ... 91
Northern Communications .. 73

Osmabet ... ... ... 14

Park Electronics ... ... 94
Partridge Electronics . . 84
P.C. Radio . . . ... 12
Progressive Radio ... ... 93

Radio Component Specialists 50
Radio Exchange Ltd. ... ... 7
Radio Shack ... ... 67
Radio Society of Great Britain ... . . 16
R.S.C. (Realistic Sound Centres Ltd.) .. ... 9
R.S.T. Valve Mail Order Co. 87

Science of Cambridge ... 51
Scientific Wire Co., The ... 91
Smallcraft ... ... 44
Solid State Security . ... 91
Sonic Discount ... ... 14
Sota Communications ... 73
South Midlands Communications Ltd. ... ... 29
Southern Communications .. 74
Spectrum Communications . . 91
Squires, Roger . . 2
Stephen-James Ltd. ... 12
Swanley Electronics ... 94

Tandy Corporation Ltd. ... 85
Technomatic Ltd. ... ... 58
Teleradio ... ... .. 93
Tempus ... ... ... 3
Thanet Electronics ... ... 68
Trident Electronics . . ... 62
T.T. Electronics ... ... 74
TUAC . ... 18

Van Karen Publishing ... 90
Vero ... ... ... ... 61

Wales P. J.... ... ... 96
Waters & Stanton Electronics 30
Watford Electronics ... 17
Welberry (TMEC) ... ... 84
Western Electronics ... 68
West London Direct Supplies 95
Williamson Amplification ... 92
Wilmslow Audio ... ... 4

Z & I Aero Services ... ... 96



Published on approximately the 7th of each month by IPC Magazines Limited, Westover House, West Quay Road, POOLE, Dorset BH15 1JG. Printed in England by Chapel River Press, Andover, Hants. Sole Agents for Australia and New Zealand—Gordon and Gotch (Asia) Ltd.; South Africa—Central News Agency Ltd. Subscriptions INLAND and OVERSEAS £10·60 payable to IPC Services, Oakfield House, Perrymount Road, Haywards Heath, Sussex. PRACTICAL WIRELESS is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, excluding Eire where the selling price is subject to V.A.T. and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.