PRACTICAL WIRELESS

SEPTEMBER 1973

20p

*SIMPLE TWO I.C. RADIO

also: I.C. ANALOGUE D.C. VOLTMETER POWER REGULATED MODULE
...practical
...visual
...exciting!

no previous knowledge
no unnecessary theory
no "maths"

BUILD, SEE AND LEARN
step by step, we take you through all the fundamentals of
electronics and show how easily the subject can be mastered.
Write for the free brochure now which explains our system.

1/ BUILD AN
OSCILLOSCOPE

You learn how to build
an oscilloscope which
remains your property.
With it, you will become
familiar with all the
components used in
electronics.

2/ READ, DRAW
AND UNDERSTAND
CIRCUIT DIAGRAMS

as used currently in the
various fields of electronics.

3/ CARRY OUT
OVER
40 EXPERIMENTS
ON BASIC ELECTRONIC
CIRCUITS & SEE HOW
THEY WORK, including:

- valve experiments,
- transistor experiments,
- amplifiers, oscillators, signal tracer,
- photo electric circuit, computer circuit, basic
- radio receiver, electronic switch, simple
- transmitter, a.c. experiments, d.c. experi-
- ments, simple counter, time delay circuit,
- servicing procedures.

This new style course will enable anyone to
really understand electronics by a modern,
practical and visual method—no maths, and
a minimum of theory—no previous knowledge
required. It will also enable anyone to under-
stand how to test, service and maintain all
types of electronic equipment, radio and TV
receivers, etc.

FREE POST NOW
for BROchure

To: BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL,
P.O. Box 156, JERSEY. Please send your free brochure, without obligation, to:
we do not employ representatives

NAME
ADDRESS

special free gift also to all our students
**NEWS & COMMENT**

406 LISTENERS' CHOICE—Leader article and October preview
407 NEWS ... NEWS ... NEWS
417 TELEVISION—This month's attractions
418 PRODUCTION LINES—Products reviewed by Colin Riches
425 DEAR SIR—Readers' letters to the Editor
430 HOTLINES on recent developments
431 NEXT MONTH in Practical Wireless
437 CQ! CQ! Back numbers wanted
440 BOOK REVIEWS
448 ON THE AIR—Reports on Broadcast Bands
448 Short Wave—Malcolm Connah
451 Medium Wave—Charles Molloy
451 VHF/FM—Simon David
452 Amateur Bands, Short Wave/VHF—David Gibson G3JDG

**CONSTRUCTIONAL**

408 SHORT WAVE CONVERTER for 190m on MW
421 HIGH SENSITIVITY D.C. VOLTMETER—D. Silvester
432 'P.W. POP STAR' Two I.C. a.m. Radio—F. G. Rayer
441 'P.W.' STUDENT' OSCILLOSCOPE, Part 2—G. A. Cozens
446 TAKE 20 No. 52 Waa-Waa Unit—David Andrews
447 JOINING COAXIAL CABLES—R. A. Butterworth
455 I.C. POWER SUPPLY MODULE (2 to 20V up to 150mA)—J. Lewis, B.Sc.

**OTHER FEATURES**

411 BROADCASTING IN BERLIN—P.W. tour of Berlin
426 BETTER AERIALS FOR BETTER STEREO Part 1—Gordon J. King
438 GOING BACK Visits Sweden—Colin Riches and Arthur Dow

**COPYRIGHT AND QUERIES**

© IPC Magazines Limited 1973. Copyright in all drawings, photographs and articles published in "Practical Wireless" is fully protected and reproduction or imitation in whole or in part is expressly forbidden. 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. We regret that we cannot answer technical queries by telephone nor can we provide information or advice on manufacturers' products other than that given in the magazine. We will endeavour to assist readers who have queries relating to articles published but we cannot offer advice on modifications to our published designs. All correspondents expecting a reply should enclose a stamped addressed envelope.
**R.S.C. STEREO PACKAGE OFFERS**

**FOR ILLUSTRATED UNITS**

**R.S.C. 45X LOUDSPEAKERS**

**SAVE £30 approx.**

GARRARD 405

**LINEAR 505 AMP**

SEND S.A.E. FOR FREE COLOUR BROCHURE

‘SUPER 30’ AMP

**FANE 300 HIGH FIDELITY SPEAKER**

Incorporating a model 803 20.5 x 13060 Gauss Bass Speaker with ultra low resonance, P.W.C. surround cone. Printed circuit cross-over assembly with ferrite core coils. Model 30 Pressure Tweeter, Accentuating damping material, Screws, Panels and instructive diagrams, Frequency Response 25 Hz–20 kHz. £99.9 post, erected on 5-inch dia. £45, 5-6v. 350-0-300v. 150mA, 5-6v. 250v., 5-6v. 60mA, 6 3v. 2a. £1.65. Send for Illustrated leaflet.

**R.S.C. G66 Mkll 6-8 WAT HIGH QUALITY STEREO AMPLIFIER**


**R.S.C. 30X TIB 6 Watt HI-FI AMPLIFIER**

200–260v. A.C. mains operated. Frequency Response 30–30,000 c.p.s. at 1% deviation. Distortion at 1000 watts 0.5%. Frequency Response 30–20,000 c.p.s. at 1000 watts 0.5%. Channels balanced within 1% at 1000 watts. Power output 6 watts. Total harmonic distortion 0.1% at 6 watts into 8 ohms. Dimensions 16 x 6 x 9in. Weight 12lbs. £28.

**R.S.C. MKIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER**

BUILD AN AMPLIFIER WORTH APPROXIMATELY DOUBLE THE KIT PRICE INCLUDING CABINET

Only high grade components by leading manufacturers
- Batten Filters for Magnetic or
- Jack Socket for Headphone
- Neon Indicator
- Fakir Silver Plated Metal Flash
- Solid State Circuity
- Twenty Six Transistors
- Four Mosfet, Four Rectifiers

Send S.A.E. for full descriptive leaflet.

R.S.C. STEREO FM III TUNER

in cabinet Visually matches Super 30 Mk Ill

**£37-50**

**COMPLETE KIT**

FABRY BUILT UNITS. Inc. cabinet with 12-months guarantee, Dep. £7 and 9 month payments £4.54 (Total £47-86).

**£27-50**

**‘YORK’ HIGH FIDELITY SPEAKER SYSTEM**

Moderate size only 25 x 14 x 10in. approx.
- Response 30–22,000 c.p.s.
- Performance comparable with units costing considerably more
- Consists of (1) 12in. 15 watts Bass Enclosure with cast chassis. Roll rubber cone surround for ultra low resonance and ceramic magnet.
- Dimensions 23.5 x 8 x 11 inches. Weight 40 lbs.
- £25-25 Carr. 65p

**SMALL PHONOGRAPH AMPLIFIER**

AM 300X. 78–78, 45–45. £6.50

SELENIUM RECTIFIERS

F. W. (Bridged). A.T. and C.C. outputs. Max. A.C. output 1000 watts into 8 ohms. £3.50; 500 watts £2.50. £1.75

**SMOOTHING CHOKES**

500 mm, 1.5in. £1; 1.0in. £0.75

**CHARING TRANSFORMERS**

1500-0-1500 150m, 6–6v. 150m, £2.10

1000-0-1000 100m, 6–6v. 150m, £1.90

500-0-500 50m, 6–6v. 150m, £1.60

**£25-25**

**COMPLETE KIT**

**£42-50**
R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND DJ'S ADDRESS

SPECIFIED FOR BASS, TURNTABLE OR ELECTRONIC ORGAN

TYPE CI12 30-40 WATTS
Exceptionally efficient, low feedback character.
High flux 15" x 50" wall speakers.
Term: Dep. £3 and 4 x 8 months pay.
£237.50 Curr. £18.97

R.S.C. A10 30 WATT ULTRA LINEAR

HI-FI AMPLIFIER

Highly sensitive, Push Pull out.
For Clubs, Schools, Theatres, Dance Halls, Outdoor Functions, etc.
(For Electronic Organ, Rock'n'Roll, Disco, etc.)
Term: Dep. £2 and 12 monthly payments of £10.96 (Total £125.88)

F.A.L. DISCO PRE-AMPLIFIER

 Designed for use with a Player Units and Amplifier with Bass and Treble Controls. Incorporates MONITORING FACILITIES and Microphone input. Press controls are inter. Detector switch.
Gram (1), (2), and Tape. For operation on 200-250v A.C. Mains. 30Hz. Approx 16" x 7" x 4" deep. Brush Silver finished fascia. Fully enclosed but can be mounted in cabinet.

FAL PHASE 50 MK.II AMPLIFIER 50 WATT.

Term: Deposit £8 and 12 monthly payments of £22.83 (Total £282.60)

R.S.C. PHANTOM '50'

For Lead Guitar, Mic, Gram, Radio, Tape (Not for use with Bass inputs) through Amplifier. Individually controlled inputs. Current valves.
Term: Deposit £8 and 12 monthly payments of £10.60 (Total £133.20)

R.S.C. BASS-REENT 50 WATT AMPLIFIER

A powerful high quality all purpose unit for lead, rhythm, bass guitar, vocals, guitars, tape. Peak Output rating.
Loadspeaker unit either horizontal or vertical mounting.
4 x 200-250v A.C. Power Inputs. 5 x 200-250v A.C. Mains.
4 x 200-250v A.C. 100W Amps.
Term: Deposit £20 and 12 monthly payments of £17.95 (Total £215.40)

NOW SIX NEW BRANCHES

BOLTON 23 DEANSGATE

COVENTRY 17 SHELTON SQUARE

DONCASTER 3 QUEENSBURG

NOTTINGHAM 19/19A MARKET STREET

STOCKPORT 8 LITTLE UNDERSHANK

SUNDERLAND 5 MARKET SQUARE

NEW LARGER PREMISES AT HULL, DARLINGTON & NEWCASTLE.

R.S.C. BRANCHES OPERATE A 5-DAY WEEK OPEN ALL DAY SATURDAY

BRADFORD 10 North Parade (Closed Wed.). Tel. 23430

BOLTON 23 Deansgate. Tel. 33051

BIRMINGHAM 30/31 Great Western Arcade, 204 Newhall Street (Closed Wed.). Tel. 39000

COVENTRY 17 Shelton Square, The Precinct

DERBY 26 Gtainmore Rd., The Spot (Closed Wed.). Tel. 30633

DARLINGTON

EDINBURGH

101 Lothian Rd. (Closed Wed.). Tel. 229 8501

100 Stockbridge Rd. (Closed Wed.). Tel. 249 4105

HULL 7 Whitley Bridge. Tel. 20306

LEICESTER 32 High Street (Closed Thur.). Tel. 50420

LEEDS 5 County Arcade, Briggate

LIVERPOOL 73 Dale St. (Closed Wed.). Tel. 256 5753

MANCHESTER 60A Old Street, (Closed Wed.). Tel. 356 2770

MIDDLESBROUGH 106 Newport Rd. (Closed Wed.). Tel. 47006

NEWCASTLE UPON TYNE

4 Newgate Shopping Centre (Closed Wed.). Tel. 21469

NORTHAMPTON 8A St. Mary's Square (Closed Wed.). Tel. 44066

SHFEIELD 13 Exchange Street (Castle Mall). Tel. 50133

STOCKPORT 8 Little Underbank. Tel. 460 6177

SUNDERLAND 5 Market Sq. (Closed Wed.). Tel. 67557

Mail orders may only be sent to shops.
The Jermyn Invertor provides a completely portable source of 240v 50Hz power, working from an ordinary car battery. No noise. No smell. No fuel oil. No maintenance.

And much cheaper than a 2-stroke generator — 150W version (needs 12v battery) £29.00 (+£2.90 VAT), 300W version (needs 24v battery) £39.00 (+£3.90 VAT).

The circuit includes electronic short-circuit prevention and wrong-connection protection.

And you can work it backwards; plug into the mains to recharge the battery.

Ideal for all kinds of field radio equipment, and as a stand-by for the house.

Please send me ... 150W ... 300W Jermyn Invertor(s).
I enclose cheque/PO value £
Name
Address

Jermyn Industries 99 Vestry Estate Sevenoaks Kent
ADCOLA

ELECTRICAL SOLDERING EQUIPMENT OF THE FINEST QUALITY

Available from Stock

We don’t expect to hear from you for some time once you have purchased our Invader Soldering Kit containing a 3/16” bit soldering instrument, two spare bits, a soldering station and a pack of solder—everything you need.

The versatile Invader Range with a large selection of interchangeable bits

- L706 19 watt instrument 3/16” bit with cable
- L646 23 watt instrument 1/8” bit with cable
- L1076 27 watt instrument 1/8” bit with cable
- BL646 and BL1076 12 volt battery models 1/8” & 1/16” bit size come complete with crocodile clips and 12ft PVC cable. Just clip on to a car battery.
- 18 swg top quality cored solder in 1/2 kilo, 3 oz and handy pack sizes.
- Non-corrosive de-soldering braid allows quick easy de-soldering (5 1/2 ft spool).
- For extra safety use an L686 soldering station.
- L68 protective shield for your Invader

Please send me the following items

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>INVADER SOLDERING KIT</td>
<td>£4.39</td>
</tr>
<tr>
<td>B</td>
<td>L706 INVADER</td>
<td>£2.15</td>
</tr>
<tr>
<td>C</td>
<td>L646 INVADER</td>
<td>£2.33</td>
</tr>
<tr>
<td>D</td>
<td>L1076 INVADER</td>
<td>£2.40</td>
</tr>
<tr>
<td>E</td>
<td>BL646 BATTERY MODEL</td>
<td>£2.99</td>
</tr>
<tr>
<td>F</td>
<td>BL1076 BATTERY MODEL</td>
<td>£3.12</td>
</tr>
<tr>
<td>G</td>
<td>SOLDER REEL 1/2 KILO</td>
<td>£1.28</td>
</tr>
<tr>
<td>H</td>
<td>SOLDER REEL 3 OZ</td>
<td>£0.45</td>
</tr>
<tr>
<td>I</td>
<td>SOLDER PACK</td>
<td>£0.065</td>
</tr>
<tr>
<td>J</td>
<td>DE-SOLDERING BRAID</td>
<td>£0.66</td>
</tr>
<tr>
<td>K</td>
<td>L686 SOLDERING STATION</td>
<td>£1.88</td>
</tr>
<tr>
<td>L</td>
<td>L68 PROTECTIVE SHIELD</td>
<td>£0.59</td>
</tr>
</tbody>
</table>

All prices include 10% V.A.T. Please tick items required.

ADCOLA PRODUCTS LTD
ADCOLA HOUSE GAUDEN ROAD LONDON SW4 6LH
V.A.T. REGD.No. 235 6153 72
REGD. No. 442762

New Catalogue
Tate 4-channel equipment decodes all quadraphonic matrix records and broadcasts and adds dimensional realism to ordinary stereo programme sources. It also controls 4-channel tapes when played through your system and CD-4** records when used with a separate demodulator.

They are characterized by their ultra low distortion characteristics and six-pole wideband phase shift networks. These combine to produce an acoustic performance giving highly articulate sounds from the back as well as the front channels. The amplitude accuracy is better than ± 1dB from 5Hz to 100KHz.

**High definition SQ* quadraphonic decoder**

**Fully built home constructor module**

features: exclusive wide band phase shift network; distortion typically 0.04%. Ideal for use with other kit projects and even with the world’s finest amplifiers.

Recommended retail price (excluding VAT) **£12.95**

Dimensions: 85 x 60 x 25mm

Operating Voltages: 18 – 30VDC at 11ma

---

**High definition SQ* quadraphonic decoder**

**Fully built home constructor module**

featuring **wide band** matrix decoding circuit board with integrated power supply, switching, master gain and exclusive rear level control.

Recommended retail price (excluding VAT) **£21.95**

Dimensions: 165 x 140 x 26mm

Operating Voltages: 110 – 240VAC at 3watts

---

The only way to really understand the difference between ordinary stereo and SQ Quadraphonic sound is to hear it. However, if you remember the difference between mono and stereo upon hearing it for the first time, multiply the recollection of that experience by a factor of ten and you will be able to appreciate what is in store for you when you first hear SQ Quadraphonic sound.

Please send □ **tate 2** at £14.25 each (including VAT)

□ **tate 4** at £24.15 each (including VAT)

I enclose cash/cheque/money order

Name (BLOCK LETTERS)

Address

---

Reg. No. 105 9684

*TM CBS Inc. **TM Victor Japan

---

Tate Audio Transmission Equipment Limited
5-7 Covent Garden Cambridge CB1 2HS England
Telephone 0223 67873 Telex 81640

391
You’ll hardly be able to believe your ears!

Can you really get sound quality like this FOR LESS THAN £18? YES, YOU CAN! WITH THE NEW STEREO 21

Until now, richly satisfying sound has always cost a richly satisfying price. But not any more! For an almost unbelievable £17.95, you can have Stereo 21—audio for the connoisseur! Whatever your taste in music, you can hear it on STEREO 21 the way its composers heard it in their dreams! Beethoven or Mahler... Ellington or Jellyroll Morton... Das Nibelung or Jesus Christ Superstar... Carols from King’s College Chapel or the return of a Beatle... everything from a prettily fluting baroque organ to the newest pop group at full throttle—STEREO 21 does them all justice!

And have you ever seen a handsomer audio installation? Compact enough to go in a university student’s bedroom-study, elegant enough for the suavest penthouse pad in Town, STEREO 21 offers you all the pride of possession as well as a thrilling musical experience!

Top-quality amplifier, BSR turntable, matching speakers. Deck and speaker cabinets you simply wrap round and glue to build. Screw in the amplifier and connect up (all push fit no soldering whatsoever), so simple literally anyone can do it. Except for glue and panel pins all parts supplied including full instructions—all for £17.95 (plus the cost of post and packing if you buy by mail), and—to round it all off—a money-back Guarantee if your pleasure in STEREO 21 is not complete!

Just think—in only a few days you could be giving your ears the treat of a lifetime—AND introducing your envious friends to STEREO 21!

Personal shoppers and mail order price

£17.95 plus £1.50 post and packing.

Diamond stylii, if required, £1.37 extra

RADIO AND TV COMPONENTS (ACTON) LTD
21C HIGH STREET
ACTON, LONDON W3 6NG
323 EDGWARE ROAD, LONDON W2

Mail orders to Acton. Terms C.W.O. All enquiries Stamped Addressed Envelope Goods not despatched outside U.K.
VISCOUNT III — a boost in the output.

VISCOUNT III now gives you an imposing 20 watts per channel — and the price quoted is actually INCLUSIVE OF VAT!

The money's important, of course, but not nearly so important as value for money! And that's something you get in abundance with VISCOUNT III. We design it — we make it — we sell it direct to you — passing on all the economies that come from cutting out middle-men! That's the only way you can get so much quality for so little money!

The unique VISCOUNT III amplifier, plus the Garrard SP25 Mk III deck, plus the magnificent Duo Type III matched speakers (or Duo Type II for a small room) give you an audio installation that will prove indescribable for listening pleasure! And the finish will harmonize and enhance virtually any style of interior decor! On the brushed aluminium front panel of the amplifier you'll find all the facilities you need — volume, bass, treble and balance controls, plus switches for monophonic or stereo playback and selectable filters. Plus headphone socket on the back.

The heart-stopping timbre of Tom Jones at his most virile ... the last lingering harmonics of a solo performance by Heifetz or Menuhin ... the pathos and the passion of Lisa Minelli ... the majestic sonorities of the brass band and the elfin subletices of the virtuous clavichordist — hear every nuance with a fidelity that you have never experienced before!

Come and hear VISCOUNT III! If it's inconvenient to travel, boy! by post in the confidence that you won't be disappointed (and with a 24-carat Money-Back Guarantee to give you extra reassurance). Dotted to second-best!

SPEAKERS: Duo Type II! Size approx. 17" x 10½" x 6½". Drive unit 13½ x 8½ in with parasitic tweeter. Max. power 10 watts 8 ohms. Simulated Teak cabinet. £14-00 a pair + £2-20 p. & p. Duo Type III! Size approx. 23½ x 11½ x 9½ in. Drive unit approx. 13½ x 8½ in with HF speaker. Max. power 20 watts 8 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. £32-00 a pair + £3-30 p. & p.

PRICES: SYSTEM 1

<table>
<thead>
<tr>
<th>Viscount II</th>
<th>Power:</th>
<th>Price:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x Duo Type I speakers</td>
<td>£24-20 &amp; £ p &amp; p</td>
<td>£49-00 &amp; £3-50 p &amp; p</td>
</tr>
<tr>
<td>Garrard SP25 Mk III with MAG cartridge &amp; plinth &amp; cover</td>
<td>£18-00 &amp; £17-75 p &amp; p</td>
<td>£32-20</td>
</tr>
</tbody>
</table>

PRICES: SYSTEM 2

<table>
<thead>
<tr>
<th>Viscount R102</th>
<th>Power:</th>
<th>Price:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x Duo Type II speakers</td>
<td>£24-20 &amp; £ p &amp; p</td>
<td>£65-00 &amp; £4 p &amp; p</td>
</tr>
<tr>
<td>Garrard SP25 Mk III with MAG cartridge &amp; plinth &amp; cover</td>
<td>£18-00 &amp; £17-75 p &amp; p</td>
<td>£32-20</td>
</tr>
</tbody>
</table>

THE TOURIST PUSH-BUTTON CAR RADIO

KIT £6-60 p. The Tourist PB is suitable for 12 volt working on both negative and positive earth vehicles. It covers the full medium and long wave bands. It is completely welded and sturdily constructed. Output is a full 2½ watts into an 8 ohms speaker. But the Tourist PB will operate into any loud-speaker from 8 to 15 ohms.

Apart from the output stage, which is an integrated circuit, the only other electronic components that need soldering are some capacitors, resistors, etc. The kit includes a pre-built RF tuner unit, and fully modulated RF stages which are pre-aligned before dispatch. As well as electronic components this kit also contains 2 diamond-spond aluminium knobs, elegant matching front panel, dial, washers, screws and wire.

The Tourist PB can be mounted in any standard size dash panel and it has an illuminated tuning scale. Chassis size is: 7½ in wide, 2½ in high and 4½ in deep. Circuit diagram and comprehensive instructions are free with parts.


If you can solder on printed circuit board, you can build this push-button car radio kit. It's simple — just follow the step-by-step instructions.


RELIANT Mk IV


INPUTS 1. Crystal Mic or Guitar 9mV. 2. Moving coil Mic. or Guitar 8mV. Inputs: 3, 4 & 5 are suitable for a wide range of medium output equipment (Gram. Tuner, Monitor, Organ, etc.) All 250mV sensitivity. Output: 20 watts into 8 ohms, 8mV. (suitable for 15 ohms.) Size approx. 1½ x 6 x 3½. Ins. £13-50 p. & p. 60p.

UNISOUND MODULES

ONLY £7-64 + 55p. p & p

For the man who wants to design his own stereo — here's your chance to start with Unisound — pre-amp, power amplifier and control panel. No soldering — just simple screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum.

IN-CAR ENTERTAINMENT AT HOME

With this elegant stereo 8 track add on unit, audio enthusiasts now have the opportunity to extend their systems to include the playing of 8 track cartridges. Simply select your channel, by push button, four digital lamps indicate channel selected. The Viscount III, the fabulous Stereo 21 and the Unisound Modules will accept this unit, simply connect up. £9-90 plus p. & p.
Come and listen at the year's most exciting exhibition

Join thousands of Hi-Fi enthusiasts in an atmosphere that will set your ears tingling with excitement. The 1973 Audio Festival and Fair looks like being the best yet - and will run up to and include Sunday. The international giants of the Hi-Fi industry will be there - showing the latest specialist equipment: unit audio, tape recorders (cassette, cartridge and reel-to-reel), loudspeakers, tuners, receivers, amplifiers, radios, tapes and discs. There will be continuous demonstrations in specially constructed Audio Studios - and the Sunday Mirror is giving away £500 worth of equipment as prizes in exciting competitions. Don't miss this great event.

THE 1973 INTERNATIONAL AUDIO FESTIVAL AND FAIR
Sponsored by the Sunday Mirror

OLYMPIA London
Tuesday 23 October to Sunday 28 October
Weekdays 10 am to 9 pm
Sunday 11 am to 7 pm
Admission 45p

Electronic Organ Kits

- Portable—4 octave keyboard with 10 voices, 3 pitches—vibrato, £145 29.
- Console—5 octave keyboard with 10 voices, 3 pitches. Keyboard can be split into solo and accompaniment, Vibrato, built in amplifier and speaker £250 93.
- Console—2 x 4 octave keyboards and 13 note pedal board, 29 voices. Vibrato, Delay Vibrato, Sustain, Reverberation, Percussion, Wah Wah, £406 00.
- Console—2 x 8 octave keyboards and 32 note pedal board, 32 voices. Vibrato, Delay Vibrato, Sustain, Reverberation, Percussion, 3 Couplers, etc., at £572 55.

V.A.T. please add 10%—show separately on order.

ALL COMPONENTS CAN BE BOUGHT SEPARATELY, SEND 50p FOR LATEST CATALOGUE WHICH INCLUDES SPECIALIZED COMPONENTS, HI-FI EQUIPMENT, ELECTRICAL HOUSEHOLD APPLIANCES AND MUSICAL INSTRUMENTS.

ELVINS ELECTRONIC MUSICAL INSTRUMENTS
8, PUTNEY BRIDGE ROAD, LONDON, S.W.18
TEL: 01-870 4949
ALSO AT BRETT RD., HACKNEY E8, TEL. 986 8455

A special message to the Fumbling Fingered Freds among us

NEW STEPHENSPEAKERS

A new range of loudspeaker kits and cabinets with a style and specification for every purpose. You'll be cheating a bit if you tell your friends "made it myself". We supply superb craftsmen built fully finished cabinets in beautiful stain and scuff resistant vinyl in white or teak.

Just fit the speaker cloth (supplied) and screw in your speaker.

HIGH QUALITY AT LOW COST

Send for our free booklet "Choosing a Speaker"

STEPHENSPEAKERS,
WILMSLOW AUDIO, Dept. 'PW', Swan Works, Bank Square, Wilmslow SK9 1HF

394
Build yourself a TRANSISTOR RADIO

ROAMER 10 WITH VHF INCLUDING AIRCRAFT
10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND. VHF AND LOCAL STATIONS ALSO AIRCRAFT BAND
Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic ariel, can be angled and rotated for side short wave and VHF listening. Push Pull control tuning 600me Transistors. Car Aerial and Tape Record Sockets. 10 Transistors plus 3 diodes. Fine tone moving coil speaker. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft band. Volume on/off. Wave Change and tone Control. Attractive Case in black with silver blocking. Size 9 x 7 x 4". Easy to follow instructions and diagrams. Parts price list and plans 60p (FREE with parts).

Total building cost £9.35
(Overseas P. & P. 41-05)

ROAMER EIGHT Mk I
NOW WITH VARIABLE TONE CONTROL

Total building cost £7.62
(Overseas P. & P. 41-05)

POCKET FIVE
5 TUNABLE WAVEBANDS: MW, LW, SW1, SW2, SW3 and Trawler Band. Built in ferrite rod aerial for MW and LW. Retractable chrome plated 7 section Telescopic aerial for Short Waves. Push pull output using 600me Transistors. Car aerial and Tape record sockets. Selectivity switch. 5 transistors plus 3 diodes. Fine tone moving coil speaker. Attractive black and gold case. Size 9" x 3" x 4" approx. Easy to follow instructions and diagrams. Parts price list and plans 60p (FREE with parts).

Total building cost £2.50
(Overseas P. & P. 41-05)

"EDU-KIT"
BUILD RADIOS, AMPLIFIERS, ETC., FROM EASY STAGE DIAGRAMS. FIVE UNITS INCLUDING MASTER UNIT TO COMPLETE COMPONENTS INCLUDE: Tuning Condenser. 9 Volume Controls. 9 Slide Switches. Fine Tone Moving Coil Speaker. Terminal Strip. Ferrite Rod Aerial. 3 Fingers and Socket. Battery Clips. 4 Tag Boards. Balanced Armature. Unit: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three 2" knobs. Parts once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction. Parts price list and plans 60p (FREE with parts).

All parts including Case and Plans £6.05
(Overseas P. & P. 41-05)

FULL AFTER SALES SERVICE
* Callers on entry "Lawley's"
* Open 10-1, 2.30-4.30 Mon.-Fri., 9-12 Sat.

RADIO EXCHANGE CO
61a HIGH ST., BEDFORD, MK40 1SA. Tel. 0234 232367
Res. no. 7085732
I enclose £................ please send items marked.
ROAMER TEN ROAMER SEVEN
ROAMER EIGHT TRANS EIGHT
TRANSANova FIVE ROAMER SIX
POCKET FIVE EDU-KIT

Parts price list and plans for
Name...........................................
Address..........................................

(Dept. LPW22)

395
device of the month ZN414

The Ferranti ZN414 is a complete a.m. radio circuit which operates from 1.1 to 1.8 volts and requires only battery, earphones and antenna plus a tuning capacitor and two decoupling capacitors. The ZN414 features: medium and long waveband, good stability on assembly, no setting up of IF coils, plus much more.

**£1.20 + VAT**

compatible device MFC 4000B

The Motorola 1/4 Watt Audio Amplifier is designed for the output stage of battery powered portable radios.

- *250 mW of Audio Output Power*
- *Low Standby Current—3.5 mA typical*
- *Low Harmonic Distortion*
- *Reduces Component Count in Portable Radios by Two Transformers and Two Transistors*
- *Eliminates Costly Component Matching Requirements*

**motorola 1/4 watt audio amplifier MFC4000**

**£1.00**

**50p + VAT**

---

**TERMS** Retail mail order subject to £1.00 minimum order. Cash with order only. Trade and educational establishments M/AC on application (minimum £5.00). Postage 10p inland. 25p Europe. GUARANTEE: All goods carry full manufacturer's warranty. Get in touch today for a complete run-down of devices available from SCS (include SAE).

**SCS COMPONENTS**, P.O. Box 26, Wembley, Middlesex HA9 1YY
The 'Professional' Amateur Supplier

**Multicore Solder Cream**

for high quality joints in the Electronics Industry

New Multicore Solder Cream was designed for jobs where second heat will not do. Lis manufacturing dissolves flux instantly, Or making of tunes chassis or soldering thick film circuits. Multicore Solder Cream is specially prepared for a high-temperature, oxygen-free environment. New Multicore Cream is different. It doesn't tank or need stirring. It can be applied by syringe, automatic dispensers, or screen printing-\-without boiling solvents with great spread, strong joints with low contact angles. Suitable as a temporary adhesive during assembly: the clear, bright flux residue without solder globules—makes inspection easier. There are three types in Multicore Solder Cream; each of them may be left what you're looking for.

For full information on this or any other Multicore products, please write on your company's letterhead to

Multicore Solder Cream Ltd., Maylands Avenue, Hemel Hempstead, Herts SG4 7LP. Tel: Hemel Hempstead 36551. Telex 82484.

---

**TRANSISTORISED** F.M. Tuner Head with A.M. gang, slow motion drive. 88—108 Mcs, with circuit diagram. £2.30p.

**P.C. BOARDS** (not computer panels)
1 off 6 transistors single wave band
1 off 4 transistor audio
1 off 3 transistor £1.00 the three.

Transistor F.M. Stereo/Multiplex Decoder, Size: 5 x 2 x 1. £1.00 each.

**GARRARD SP25 MK. II** less Cartridge. £10.00.

**10 COMPUTER PANELS** packed with components including one panel with 2 Power Transistors. £1.00.

**LIGHT DEPENDENT RESISTORS** (RCA sq3530) 30p each. 4 for £1.00.

All Transistor STEREOMAG CHASSIS. Medium, Long and VHF/FM. 3 Watts per channel S/M rating. With circuit service manual. Less tuning scale which can be obtained from well known British manufacturer. . . £20.

Colour Transistor panels, as used on well known British E.V.R. Teleplayer. All new panels and components. Types and contents of transistors listed below. Each panel £5.00.

X605...14 off BC148, 2 RCA ca3054(c), 1 crystal 4-433618MHz.
Z607...12 off BC148, 1 BC158, 1 BC168, 1 RCA ca3046, 1 RCA ca3045(c).
Z610...12 off BC148, 2 BC158.
Z612...12 off ME4102, 2 BC251B, 1 BF50.

**CRYSTAL CALIBRATOR** (Second Hand) No. 12 crystal controlled heterodyne wave-meter covering 500kHz-10MHz (harmonics up to 30MHz) power required 300V DC 15mA. 12V 0.3A DC. Test equipment for £6T/M/RC. £5.00 each.

**ALL ITEMS INCLUDE VAT**
All items post paid in GREAT BRITAIN

**SURPLELECTRONICS**
216 LEAGRAVE ROAD, LUTON, LU1 1JD, BEDS.
Choose a Heathkit project... make your spare time more rewarding

And your first step is absolutely Free—simply send today for the latest Hi-Fi/Electronics catalogue from Heath, the world leaders in electronic kits. Every model is designed with the beginner in mind, and the assembly manuals are famous for their clarity and easy to follow step-by-step instructions. The latest Heathkit catalogue contains many new kit projects that will appeal to you and all our models offer unbeatable value for money. Payment is so easy too—choose cash or low deposit terms (starting at £2 per month for up to £40 credit).

Anyone can build a Heathkit model using only a few simple tools found in most homes and added to this is a technical consultant service both before and after purchase.

These are just a few of the unshakeable reasons why Heathkits are so popular throughout the world. Some samples from our range are shown here.

FREE Catalogue

Ask about our low deposit terms

LOUDSPEAKER KITS feature fully finished cabinets for fast, easy building.

STEREO HI-FI SYSTEMS and SEPARATES offer state-of-the-art performance and design.

AUTOMOTIVE TEST AND ANALYSER KITS make car testing and trouble-shooting a pleasure.

LOW PRICED TESTERS AND INSTRUMENTS for hobbyist and technician.

PORTABLE RADIOS AND HOME/OFFICE INTERCOMS

DESK AND POCKET ELECTRONIC CALCULATORS

METAL LOCATORS of advanced solid-state design.

AMATEUR RADIO AND SWL RECEIVERS etc.

even a robust BATTERY CHARGER KIT

And many more models too numerous to mention here.

Please send me a FREE Heathkit catalogue and details of your Cash and Low Deposit terms

Name

Address

- Heath (Gloucester) Limited, Dept PW-09-73
  Gloucester GL2 8EE. Telephone 0452 29451
Essential data for over 1500 popular models

With this vast 6-volume library at your fingertips you have all the necessary servicing data you need covering almost every popular model from 1967 to the very latest on the market today. And not only radio and TV but stereograms, record players and tape recorders too. Much of the earlier information on this equipment is quite unobtainable elsewhere and Radio & TV Servicing is now the only available source of technical data. The 1973 edition, now ready, brings the library right up-to-date with abstracts from manufacturers' service bulletins issued during the past year. Radio & TV Servicing is the only work of its kind - a money-spinner that no service engineer should be without.
6 volume library '67-'73 is now ready

Speedier, more efficient servicing means increased turnover...

This library is a gold-mine of technical information. Six hard-bound volumes giving vital data on more than 1500 models of Television (colour and mono), Radios, Car Radios, Stereograms, Record Players and Tape Recorders. More than 4000 pages clearly display thousands of circuits, printed panel diagrams, component layout diagrams, waveform graphs, block diagrams, etc. Over 800 pages, devoted entirely to Colour TV, include installation instructions, new term explanations, purity adjustments, colour balance, static convergence and a wealth of invaluable information. Here, in fact, is all the data you need for efficient and speedy repair work.

Your Guarantee
Sending for these valuable books, even though you also enclose your remittance, commits you to nothing. Unless you are absolutely satisfied you are perfectly free to return the set and if you do so within 10 days of delivery your money will be refunded in full and without question.

How to get your 6-volume set
Detach the Order Form below and send it, with the appropriate remittance to:

Purnell Book Service Ltd.,
Box 20 Abingdon, Berks, OX14 4HE

Makes of Colour TV include:

All these makes of Mono TV, Radios, Car Radios, Stereograms, Record Players, Tape Recorders:

Plus such developments as:

To: Purnell Book Services, P.O. Box 20, Abingdon, Berks OX14 4HE
Please send me the 6-volume set of RADIO & TV SERVICING for which I enclose cheque/P.O. No. , crossed and made payable to Purnell Book Services Ltd.
for the full cash price of £27.75
for £10 deposit to be followed by 4 successive monthly payments of £4.75 (total £29)

I understand that unless I am entirely satisfied I may return the volumes in good condition within 10 days and my money will be refunded in full.

BLOCK LETTERS PLEASE

Name: ____________________________
Address: _______________________

TRADE APPLICATION (To be accompanied by Trade Order)
Please supply . . . . . . . . . . . . . . . . . . . . . 6-volume set(s) of RADIO & TV SERVICING at £27.75 per set. (Credit 30 days)

Block Letters Please

Name: ____________________________
Company: _______________________
Signature: ________________________

IMPORTANT: Individual volumes are available on application.

Purnell Book Services Ltd, Reg London 988682, 49 Poland St., London W1.
The following items are new, BLOWER MOTORS SMALL double ended type 6 to 30V DC £1.70. HEAD & MIKE SETS for 19 set m/c type with soft rubber ear pads £1.70. CABLE 25 core colour on screened 25 5" lengths for 36p. METER UNIT X pointer dual 115 Us movements for 115Rx £1-58. METER UNIT center reading type scale marked L & R £1. TRIMMERS air spaced ceramic 20pf 10 for 55p also ceramic dielectric 10/110pf 5 for 55p. MIKES American type T17 carbon 100 ohm with press to talk switch £1. HEADPHONE matching trans & lead high to low res with 5ft cord & standard jack plug 60p. WAVEMETER & OSC unit covers 150 to 230 Mc/s with charts, spare, inst etc tested £16.90. VOLTAGE DIVIDERS ratio 10 & 100/200V pk pk wk for use with scope £1.25. TUNER/AMPLIFIERS for use on 115v 50c/s supplied in pairs with a 360° & pointer. £4. METER UNIT vehicle press gauge elec operated scale 0 to 120 with mk brk 40p. LAMPS & NEONS 24v double fil £1.25 watt ea with silvered reflector 5 for 65p. Neon wire ended type 1/25th watt size 1' 4" req 4700K res for 240v 10 for 55p. BATTERIES Aircraft type unspluggable 24v 25amp/hr can be split to maintain 10fps under £25. TRANSFORMERS all 230v pri. H.T. type sec 115-0-115v at 505Ma £7-70. H.T. type sec 415-140-145-415 at 360 Ma on 415 and 120 Ma on 415v £12.50. L.T. type sec 27v 41amps cont £13. 20. TAG STRIPS coded 21 to 24 wired £2.50. The following items are ex equip. SELECTOR UNIT with 24 mtrs, gears, large 24 way swt, meter 1 2ma 22½ ag, all in usefull case size 12 x 6 x 2" £7.20. RADAR TEST SET with 3" tube VCR138, 4" dia 50u-ma meter, £14.50. 21 inc valves min & octal all in case size 17 x 11 x 16 contains high cycle P.U. good fans for building scop £10.45. VIDICON CAMERA TUBES graded according to scan marks, by E.E. & E.M.I. data supplied £9 & £8 ea. PANEL METERS supplied as they come all service- able 4 for differ $ difference £11.25 METAL CASES 9 x 7 x 6" inc lid, fitted handle & feet, painted grey £8½ also 9 x 3½ x 3" with parts finish black 84p. RX UNIT motor tuned approx 180 to 240 Mc/s with L.F. strip, 24v mtr etc £13.50. METERS 500Us scale 0 to 5 1½" osd on panel with swts £1.25 also 1 Mc fad with special scale markings £2.50 R81 also 500u 2a OSD scale 0 to 5 £1.20. DIODES type Ferranti ZP200 P1V @ 8 amps for 4 for 65p. PANEL ASS with 18 200 P1V 1.5a diodes & misc parts 88p. L.F. STRIPS 45Mc/s with 6 valves, plus etc £1.40. RX UNIT R4017 xtal controlled Rx covers 2-8 to 18 Mc/s in 3 bands, double conversion req, 24v DC supplied with cord and case these also 3x4 flats for testing £9.90. TRANSFORMERS H.V. 230v pri. scale 2:8k 0.6Ma Biphase £4-63. RELAYS mun 12v 2p c/o x 2 x ½ for 66p.

INVERTER TRANS. 12v to 300v @ 150 Ma with circ. £1.90.

-all the above prices inc. carr./post & v.a.t. s.a.e. with enquiries, and for list

A.H. SUPPLIES
57 MAIN ROAD,
SHEFFIELD, S9 5HL
PHONE 444278 (0742)
TRANSISTORS BY SIEMENS AND NEWMARKET

32365 nph silicon power 60p
AC165K pnp germanium low power 60p
AC175K pnp germanium low power 60p
AD101 nph germanium medium power 60p
AD103 pnp germanium medium power 60p
AF106 pnp germanium UHF 60p
HC107 60p, BC108 10p, BC109 10p...)
BC169 10p, BC169 10p...
Standard groupings available.
DIODES: pnp and nph 60p
BD146 pnp medium power 60p
GAA-1, GAB-1, GAC-1 each 6p
GAA-60 sp (0.06GAA) each 6p
Other semiconductor devices
AC101, AC102 10p, AC103 10p
BFY13 10p
Full lists and technical data will be found in Catalogue No. 6. See also amendments list.

SIEMENS’ THYRISTORS

0-5A 600V 50p, 600V 100p
2A 600V 50p
2A 600V 100p
ZENER DIODES: Full range E24 values: 0.6V to 30V.
DIODES: 30p
SWITCHES:

DIN PLUGS & SOCKETS

by Hirschmann, 4A rating
2 way 10p—socket 10p; plug 12p. 3 way set—socket 10p; plug 12p. 5 way set—socket 10p; plug 15p.

TRANSISTOR ACCESSORIES

Torpedo 7p, Heat sinks 7p, type 6W, undrilled 60p

SWITCHES

101C SPST toggle 60p
409 DPDT toggle 60p
599 (These are chrome plated) 50p
2009 Sub-miniature DPDT 30p
NUTS:

WAVECHANGE SWITCHES

1P1W, 2P1W, 3P1W, 4P2W, each 60p

SWITCHBOARD 10p-

ELECTROVALUE

Electronic Component Specialists

LARGE STOCKS
ATTRACTIVE DISCOUNTS
DEPENDABLE SERVICE

Everything brand new & to makers specs.

ELECTROLYTIC CAPACITORS

AXIAL LEAD Prices subject to amendment by the manufacturer.
Rated voltage: 2V 4V 6V 8V 12V 16V 20V 22V 40V
Capacitance in µF: 0.002 0.01 0.02 0.05 0.1 0.15 0.2 0.25 0.5 1.0 4.7 10 22 47 100 1000

RESISTORS 10%, 5%, 2%

Code Power Tolerance Range Value
U 1W 2% 3Ω to 99kΩ
C 5W 1% 1Ω to 39kΩ
L 1W 2% 3Ω to 99kΩ
W 1W 1% 1Ω to 39kΩ
W 5W 1% 1Ω to 39kΩ

Codes: C—carbon film, high stability, low noise.
MO—metal oxide, E24, ultra low noise.
WW—wire wound.

Values:
E10 decade series: 10, 10, 15, 18, 22, 27, 33, 39, 47, 56, 68, and their decades.
E11 decade series: as E10 plus 11, 13, 16, 19, 22, 26, 30, 34, 39, 45, 51, 62, 70, 81, and their decades.

If you have already got your No. 6 catalogue and want to know latest added items and their prices, and S.A.E. for special supplementary list.

If you have already got your No. 6 catalogue and want to know latest added items and their prices, and S.A.E. for special supplementary list.

POTENTIOMETERS

Resistor track, double wiper SINGLE Pot 1m 100Ω to 1kΩ, 1m 20Ω to 200Ω, 2m 4Ω to 400Ω, 2m 1Ω to 1kΩ, 2m 10Ω to 10kΩ; Dual potentiometer 1m 100Ω to 10kΩ, 1m 10Ω to 1kΩ, 2m 1Ω to 10kΩ, 2m 10Ω to 100kΩ; Logarithmic, 10kΩ, 20kΩ, 50kΩ, 100kΩ, 470kΩ, 1MΩ to 10MΩ, 2.2MΩ, 10MΩ, 22MΩ, 50MΩ, 100MΩ, 1kΩ, 2kΩ, 4kΩ, 10kΩ, 22kΩ, 100kΩ, 1MΩ, 2MΩ, 5MΩ, 10MΩ; Vertical or horizontal mounting, each 2p.

Carbon Skeleton Pre-series Small high quality, 1Ω to 10Ω, 10Ω to 100Ω, 100Ω to 1kΩ, 1Ω to 10kΩ, 27Ω to 1MΩ, 1Ω to 100MΩ, 27Ω to 100MΩ, 27Ω to 1000MΩ; each 2p.

Sliders:

10% on orders for £5 or more, 15% on orders for £5 or more. Prices subject to alterations without prior notice. ALL ITEMS ON SALE - NO REFUNDS

DISCOUNTS

Not allowed on net price items.
10% on orders for £5 or more, 15% on orders for £5 or more. Prices subject to alteration without prior notice.

POSTAGE AND PACKING FREE

SUBSCRIPTION 10p on small mail orders under £5. Overseas orders carriage and insurance charged at cost.

Please see latest amendment list. Send S.A.E.

(Dept. P.W. 8) 28 ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY, TW20 0HB
Hours: 9-5.30: Sat. 1 p.m.
Tel.: Egham 3603
Telex 264475

ENG. REG. NO. 1097780. R.O. 28 ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY, TW20 0HB
**SPECIAL OFFER ! ! !**

**SMALL ELECTROLYTICS**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H1/2</td>
<td>1-2µf 25v</td>
<td>4p</td>
<td>H7/4A</td>
<td>64µf 35v</td>
<td>5p</td>
</tr>
<tr>
<td>H1/3</td>
<td>3µf 50v</td>
<td>4p</td>
<td>H7/6</td>
<td>100v 25º</td>
<td>5p</td>
</tr>
<tr>
<td>H1/4</td>
<td>4µf 100v</td>
<td>5µf</td>
<td>H8/8A</td>
<td>35µf 35v</td>
<td>4p</td>
</tr>
<tr>
<td>H1/5</td>
<td>6µf 150v</td>
<td>6µf</td>
<td>H9/1</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
<tr>
<td>H1/6</td>
<td>10µf 250v</td>
<td>10µf</td>
<td>H9/2</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
<tr>
<td>H1/7</td>
<td>16µf 350v</td>
<td>16µf</td>
<td>H9/3</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
<tr>
<td>H1/8</td>
<td>20µf 500v</td>
<td>20µf</td>
<td>H9/4</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
<tr>
<td>H1/9</td>
<td>30µf 750v</td>
<td>30µf</td>
<td>H9/5</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
<tr>
<td>H1/10</td>
<td>50µf 1500v</td>
<td>50µf</td>
<td>H10/1</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
<tr>
<td>H1/11</td>
<td>75µf 2500v</td>
<td>75µf</td>
<td>H10/2</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
<tr>
<td>H1/12</td>
<td>100µf 3500v</td>
<td>100µf</td>
<td>H10/3</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
<tr>
<td>H1/13</td>
<td>150µf 5000v</td>
<td>150µf</td>
<td>H10/4</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
<tr>
<td>H1/14</td>
<td>220µf 7500v</td>
<td>220µf</td>
<td>H10/5</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
<tr>
<td>H1/15</td>
<td>330µf 10000v</td>
<td>330µf</td>
<td>H10/6</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
<tr>
<td>H1/16</td>
<td>470µf 15000v</td>
<td>470µf</td>
<td>H10/7</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
<tr>
<td>H1/17</td>
<td>680µf 20000v</td>
<td>680µf</td>
<td>H10/8</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
<tr>
<td>H1/18</td>
<td>1000µf 30000v</td>
<td>1000µf</td>
<td>H10/9</td>
<td>150v 25º</td>
<td>4v</td>
</tr>
</tbody>
</table>

**ALL GOODS PLUS 10% V.A.T.**

**MULLARD ELECTROLYTIC CAPACITORS**

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Capacity Voltage</th>
<th>Max. Ripple Current at 50ºC</th>
<th>Weight Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>071</td>
<td>16</td>
<td>2-5 amps 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>072</td>
<td>16</td>
<td>2-5 amps 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>115</td>
<td>16</td>
<td>7-10 amps 1oz</td>
<td>22p</td>
</tr>
<tr>
<td>121</td>
<td>16</td>
<td>7-10 amps 1oz</td>
<td>22p</td>
</tr>
<tr>
<td>161</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>162</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>163</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>164</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>165</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>166</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>167</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>168</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>169</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>170</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>171</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>172</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>173</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
<tr>
<td>174</td>
<td>22</td>
<td>20000 ± 20% 1oz</td>
<td>15p</td>
</tr>
</tbody>
</table>

**P. C. BOARDS**

**FOR P.W. PROJECTS**

- **REVERBERATION UNIT! 6 WATT P.W. LOUDHailer & PRE-AMP**
- **LOUDHailer PRE-AMP & SIREN GENERATOR**
- **VIBRATING GUITAR & DIGITRONIC DIGITAL CLOCK**
- **AND ALSO FOR MANY P.E. PROJECTS**

**PHONOSONICS**

- **DEPT P.W., 25 KENTISH ROAD, BELVEDERE, KENT, DA17 5Bw**
  - **MAIL ORDER ONLY**

**LEARN RADIO & ELECTRONICS AT HOME**

No knowledge needed—build as you learn with the exciting new "Technatron" kit. No Extras. Tools, transistors, meter etc. All supplied. You could build a radio in 10 weeks.

**SEND FOR FREE 76 PAGE GUIDE TO RADIO/TV, ELECTRONICS, C & G, TELECOMMS**

- **Dep. BPWY**
- **Aldermaston Court, Reading RG7 4PF**

**DABAR ELECTRONIC PRODUCTS**

38A LICHIFIELD STREET, WALSALL, STAFFS. WS1 1UZ

Tel. Walsall 34355

**NEW ALL SILICON!**

**PRactical Wireless**

Electronic Ignition System

This Capacitor-Discharge Electronic Ignition System was recently described in Practical Wireless and has proved extremely popular. We are able to offer the kit in two forms; the standard kit containing the electronic components only, enabling the customer to tailor this to his own layout for the de-lux version containing a ready drilled roller-finned printed-circuit board and fully machined die-cast case with A.M.P. Electrical Spice Connector Block. Each kit is supplied with a custom wound transformer, first grade components and full constructional details.

The original circuit employed Germanium Power Transistors for the negative earth version. WE NOW SUPPLY SILICON P.N.P. POWER DEVICES AT NO EXTRA COST! All components available separately. Case size 4 3/4" x 3 3/4" x 9/8". Complete assembly and wiring manual 25ps, supplied with de-lux kit only, refundable on purchase of kit.

Suitable for 12V systems with Pos. or Neg. earth.

Price: Standard Kit £7.97 U.K. Post Free
- Deluxe Kit £8.92 U.K. Post Free

Quantity Discounts:
- Trade and Overseas 1-5 Nett 6-9 Less 10%
- Enquiries Invited 10-49 Less 15% 50-99 Less 20%
- Mail Order Only 100-999 Less 25% 1000 up Less 30%

**ALL PRICES INCLUDE VAT**

**PLEASE STATE POS. OR NEG. EARTH WHEN ORDERING.**

G. F. MILWARD 369 Alum Rock Road, Birmingham B8 3DR.

Tel. 021-327 2339

402
With the development of the HY200, ILP bring you the first COMPLETE Hybrid Power Amplifier.

COMPLETE: because the HY200 uses no external components!
COMPLETE: because the HY200 is its own heatsink!

By the use of integrated circuit technique, using 27 transistors, the HY200 achieves total component integration. The use of specially developed high thermally conductive alloy and encapsulant is responsible for its compact size and robust nature.

The module is protected by the generous design of the output circuit, incorporating 25amp transistors. A fuse in the speaker line completes protection.

Only 5 connections are provided, input, output, power lines and earth.

OUTPUT POWER: 100 watts RMS; 200 watts peak music power. INPUT IMPEDANCE: 10kΩ. INPUT SENSITIVITY: 0Dbm (0.775volt RMS). LOAD IMPEDANCE: 4–16Ω. TOTAL HARMONIC DISTORTION: less than 0.1% at 100 watts, typically 0.05%. SIGNAL : NOISE: better than 75Db relative to 100 watts. FREQUENCY RESPONSE: 10Hz–50KHz ±1Db. SUPPLY VOLTAGE: ±45volts. APPLICATIONS: P.A., Disco, Groups, Hi-Fi, Industrial. PRICE: £14.90 inc. VAT & P&P. Trade applications welcomed.
**NEW 6th EDITION TRANSISTOR EQUIVALENTS BOOK. A complete cross-section of the many equivalents books for European, American, and Japanese Transistors. Exclusively for BAY-PAK, 99 each.**

**A LARGE RANGE OF TECHNICAL AND DATA BOOKS AVAILABLE FOR FREE LIST.**

**INTEGRATED CIRCUIT PAKES**
Manufacturers "kit lists" which include Functional and Part-Functional Units. These are claimed as out-of-print from the maker's very few specifications, but are ideal for learning about IC's and experimentation.

```
Pak No. Costs Price
UC200 120 7.400 0.55
UC201 120 7.401 0.55
UC202 120 7.402 0.55
UC203 120 7.403 0.55
UC204 120 7.404 0.55
UC205 120 7.405 0.55
UC206 120 7.406 0.55
UC207 120 7.407 0.55
UC208 120 7.408 0.55
UC209 120 7.409 0.55
UC210 120 7.410 0.55
UC211 120 7.411 0.55
UC212 120 7.412 0.55
UC213 120 7.413 0.55
UC214 120 7.414 0.55
UC215 120 7.415 0.55
UC216 120 7.416 0.55
UC217 120 7.417 0.55
UC218 120 7.418 0.55
```

**BIP 18/20 TOX NPK PLASTIC SILICON**
```
BIP 18/20 Tox NPK Plastic Silicon
SIL. RECTS. TESTED
2000V 1000V 600V 300V 250V 100V 50V 30V 15V 10V 5V 3V 2V 1.5V 1.2V 1.0V 0.5V 0.3V 0.2V 0.1V
PVT 30m 40m 50m 60m 70m 80m 90m 100m 110m 120m 130m 140m 150m 160m 170m 180m 190m 200m
```

**NEW LOW PRICED TESTED S.C.R.'S**
PVT 11A 16A 25A 30A 40A 50A 60A 70A 80A 90A 100A 110A 120A 130A 140A 150A 160A 170A 180A
```

**DIACOS**
10amp POTTED BRIDGE RECTIFIER 1000V 99p each
Free 10amp Pkt of your own choice if orders valued £1 or over

**POSTAGE & PACKING**
Postage and packing add 10p. Overseas extra add for airfreight.

**Money back refund if not satisfied**
LISTENERS' CHOICE

Things are hotting up on the sound broadcasting front. With a very large part of England now tuned up for local radio from the BBC, we look forward with fascinating interest to see how the independents, supported nobly by the IBA, will fare this autumn, when they start transmitting official commercially sponsored programmes. Already the test transmissions on the medium wave have acted as a preliminary publicity exercise. Their intentions are to go straight into v.h.f. as well and incorporate pilot-tone stereo facilities. Circular polarisation of transmitting aerials will be used so that car radios and portables stand a very good chance of receiving these broadcasts.

At the same time, the BBC is pressing ahead with expansion of stereo broadcasting using pulse-code modulation systems for better quality reception. It has taken too many years for them to improve stereo capability and (we suspect) it is due largely to pressure from commercial competition that such a hive of buzzing activity has now resulted in the extended service.

One other point not to be forgotten is the influence of television on radio audiences; with colour now commonplace, sound radio (or "steam" as you prefer) must have threatened to fall on hard times.

The much welcome uplift of interest in sound radio provides the manufacturing industry with impetus for meeting the demand for new receivers. In what proportions (a.m. or f.m. or both) these will need to be is anyone's guess. With the improved service of f.m. broadcasting techniques, allowing for the added interest in stereo, as well as the "booming" in-car entertainment business, we have a hunch that there will be a fairly even distribution.

In the following issues of Practical Wireless, you will find many articles devoted to sound broadcasting. We kick off this month with an article to help you understand how and why you should pay special attention to your f.m. aerial installation, particularly if you want to get the best from stereo. We also offer the constructor with little experience a simple a.m. radio, using two integrated circuits.

M. A. Colwell—Editor

Practical Wireless
The October issue (No 800), on sale 7th September, will start you on the road to making your own quadraphonic sound system, will include the first pair of PW Datacards on resistors and capacitors, will commence a tutorial series for learning how circuits work by practical experiments, and will give first details on our audio supplement for the November issue.

Further details on page 431

Television
The October issue of Television, on sale 17th September, will have for the first time an additional Colour TV Fault Finding Chart. Full colour photographs of fault conditions will be provided on a special quality paper in the magazine. With the additional fault-finding chart you can not only find where the trouble lies, but also learn a bit about how colour television works.

Further details on page 417

Britain/Canada telephone cable
Practical Wireless was recently invited to watch the loading of the Cable & Wireless Ltd. cableship “Mercury” with the first 200 miles of a £30m telephone cable linking Britain and Canada.

CANTAT-2 as it is called, will handle more than 1,800 phone conversations at the same time. It will have 473 repeaters at 6-mile intervals and 31 equalisers at 90 mile intervals.

The 2,800 nautical mile cable is financed by the Post Office and the Canadian Overseas Telecommunications Corp. S.T.C. Limited have supplied the system and the transistors used in the repeater are being supplied to them by the Post Office Research Dept. Dollis Hill. These transistors (2,800 in all) each have a design life of at least 25 years.

The 1,840 circuits in CANTAT-2 are arranged as 25 supergroups transmitting between 312-6,012kHz in the UK-Canada direction and 8,000-13,700kHz the other way.

The cable (see picture) weighs under 5 tons a mile, it has an outer conductor of aluminium and is strengthened by a core of steel rope inside an inner conductor of copper.
Practical Wireless in Italy

PRACTICAL WIRELESS will be taking part in the Italian International Music and High Fidelity Exhibition at the Milan Fair from September 6th to 10th 1973. This is the seventh time that the exhibition is being held and will cover hi-fi equipment, components and accessories. Also of related interest is the section devoted to musical instruments and amplifier equipment for them. Concerts, audio shows and lecture meetings will be held at the same time.

This exhibition will occupy about 20,000 sq metres and around 35,000 visitors are expected. There will be about 800 foreign buyers expected from 45 countries including African and Middle East countries.

Practical Wireless will take part in the Technical Journals section of the exhibition where visitors from all over the world will see some of the recent work that we have published and be given detailed information of our Project Q4 (see page 431) which will commence publication in next month's issue.

It is worth remembering that, if you are near Milan during that long weekend and hold a non-Italian passport you will be admitted free of charge.

London Independent Radio

THE IBA have announced officially the following allocations of broadcasting frequencies for the London area:

**London Broadcasting Company**
(News Service) 719kHz (417 metres) medium wave and 97-3 MHz v.h.f.

**Capital Radio** (entertainment) 557kHz (539 metres) medium wave and 95-8MHz v.h.f.

At the time of going to press no definite date had been announced for commencement but it is expected to be in October or November.

'English as she is spoke'

IMMIGRANT children who speak little or no English are now learning the language with the aid of the "Language Master System", marketed by Bell and Howell A-V Ltd.

This is a new card programme specifically designed for teaching English to foreign children. Entitled "Let's Speak English", the programme teaches the essential elements of everyday speech using the established Language Master technique of sentence repetition and Q&A.

The pupil learns from audio-visual cards bearing words, pictures and a magnetic tape recording of the same words in the teacher’s voice. When the pupil places a card in the machine, the teacher’s recording is automatically reproduced.

As the phrases and sentences on the cards are seen and heard at the same time, and are backed up by illustrations of the objects and actions described, new language forms and vocabulary can be grasped more easily and retained better. The system also makes provision for the pupil to record his own voice for practice of pronunciation. He can then listen to the teacher’s voice and compare it with his own.

Berlin F.M. Tx

NEW f.m. transmitter for broadcasts and mobile radio at Frohnau, West Berlin. See article "Broadcasting in Berlin" on page 411.

Diary Date

September 23—Harlow and District Mobile Rally will be held at Nettleswell Comprehensive School, Harlow, Essex. All the information can be obtained by writing to V. Neard, 106 Vicarage Road, Harlow, Essex.
THE shortwave converter is a unit that is connected between the aerial and the receiver and serves to convert radio signals in the shortwave bands into one fixed frequency. In our design, this frequency is 1600kHz (1·6MHz) or 190 metres, medium wave. This choice enables us to use the converter, in conjunction with a normal broadcast receiver tuned to 1·6 MHz, for the reception of the shortwave signals for which the converter was designed.

The connection between the converter and the receiver is effected by a few feet of coaxial cable, which is connected to the aerial and earth inputs of the receiver. So no changes in the circuitry of the receiver are needed, which is available for the reception of other radio signals as soon as the converter is disconnected and the aerial connection restored. The unit described here was designed to be acceptable for the listener with little experience in electronics.

The shortwave range of the unit runs from about 15 to 26·5 MHz, incorporating the 11, 13, 16 and 19 metres broadcasting bands. This range has been selected because it is not available on many radio receivers and yet comprises three of the best shortwave-bands for long-distance communication. For those listeners who prefer the range from 5·5-12 MHz (49-25 metres), we have listed additional data.

THE CIRCUIT

The circuit diagram of the converter is given in Fig. 1 which shows the tunable bandpass filter consisting of L1, L2 and the associated fixed and variable capacitors; the oscillator circuit, of which transistor Tr2 is the heart; and the frequency changer (mixer), comprising, among other things, the transistor Tr1 and output coil L4. The converter can be powered by a dry battery of between 6 and 12 volts since the current consumption is very small, about 3mA. The connection of the unit to the receiver is effected via the terminals A and E of the secondary winding of coil L4. They are connected respectively to the aerial and earth terminals of the receiver. At the converter, a long wire aerial is connected to Input 1 and Input 2 is connected to the chassis. If, however, a dipole is used this can be connected to both of the inputs. The chassis connection of number 2 is now omitted.

The bandpass filter comprises two circuits, which are mutually coupled. It serves to obtain a preselection for a limited frequency range, in which the desired stations can be found. A dual tuning capacitor of 2 x 470pF or 2 x 365pF is used for this purpose. If we use the 470pF variable capacitors, 350pF fixed (ceramic) series capacitors are necessary to arrive at the right 10-200pF capacity range. If the 365pF variable capacitors are used instead, series capacitors of 470pF must be applied.

The oscillator circuit frequency is determined by the properties of the tuned circuit comprising L3 and the capacities connected in parallel. The 92pF capacity (10pF and 82pF connected in parallel) can be inserted by a switch. This determines the range of the converter: the 15 and 17, or the 21 and 25MHz bands. For the 25 and 17MHz frequency ranges, the oscillator frequency is selected so as to be 1·6 MHz below the frequency to which the bandpass-filter is tuned. For the 21 and 15MHz, respectively, the oscillator frequency is chosen 1·6 MHz above the resonant frequency of the aerial circuit. This makes it possible to use a small tuning capacitor for the oscillator stage of the converter. A 30pF variable is used here, VC3.

The oscillator signal is coupled to the frequency changer stage via capacitor Ck. This consists of two

'Radio Nederland', the Dutch World Broadcasting System, is well-known to short wave listeners throughout the world. It was one of the early pioneers of broadcasting on the high frequencies and today it still keeps in close touch with its listeners through the DX Information Service.

Detailed technical data sheets are issued free of charge under such headings as crystal calibrators, aerial systems, radio interference suppression and many more.

We are pleased to publish here a suitably edited version of the data sheet on the Radio Nederland Short Wave Converter together with our photographs of the prototype so kindly provided by the Engineering Section of Radio Nederland.
To further support the dual tuning capacitor, another small wooden block of about 1" x 3/4" x 3/4" is glued in the appropriate place. It carries coil L4 and a small terminal strip to support the smaller components like the transistor and some capacitors. The woodscrews with which the tuning capacitor is fixed, must not touch the metal sheet on the back of the mounting plate, as they would then short-circuit the 1000pF series capacitor. After the chassis has been made the components can be put in their right positions. Care should be taken to insulate the aerial input terminals from the front panel, and to make the holes for the shafts of the tuning capacitor big enough to prevent metallic contact.

Preferably, the wiring should be made with a small 25 watt soldering iron. Keep the connections short and use the sheet metal for the chassis connections. Go carefully when connecting the transistors. If using the alternative types, make sure the connections are right. To prevent damage to the transistor by heat conduction hold the transistor wire near the semiconductor with a pair of pliers, which will act as a heat sink.

The coils of the converter can be easily home-made. For this, obtain a few short pieces of 3/8" outer diameter pvc (plastic) conduit. Use SWG 22 or 21 enamelled copper wire to wind the coils, each over a length of about 3/4", as illustrated in Fig. 2. Before putting them in their proper place, carefully clean the ends of the wires to remove the enamel insulation, and apply some solder. Proceed in the same manner for making the tap on coil L3. Slots are made in the insulated wires, twisted over a length of 1 inch as illustrated in Fig. 2.

The mixer uses a field-effect transistor (FET), Tr1, for best results. In its drain circuit, coil L4 and its 220pF parallel capacitor form a resonant circuit that is tuned to 1-6 MHz. The resonant frequency of this circuit can be determined more exactly when the unit is operating, when variation of the receiver tuning shows the spot where the combination of converter and receiver works most satisfactorily. If necessary, change the resonant frequency of this circuit by inserting a slightly different capacitor.

**CONSTRUCTION**

The front panel measures 8" x 4 1/2" and consists of hardboard or plywood, the inside covered with a piece of copper, brass, zinc or tin of the same size. In the middle, and at right angles to it, a piece of plywood measuring 4" x 4 1/2" is fixed. This is also covered with sheet metal of the same dimensions, stuck to it on the left side where the oscillator is located. The two metal sheets are interconnected by soldering while a wooden block of about 3" x 3/4" x 3/4" serves to reinforce the joint. It is glued in its proper place and also carries the dual tuning capacitor and coil L2.

---

**components list**

<table>
<thead>
<tr>
<th>Resistors</th>
<th>( R_1 \quad 68k \Omega \downarrow W \quad 10% )</th>
<th>( R_3 \quad 3.3k \Omega \downarrow W \quad 10% )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_2 \quad 47k \Omega \downarrow W \quad 10% )</td>
<td>( R_4 \quad 47k \Omega \downarrow W \quad 10% )</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capacitors</th>
<th>C1 470pF SM or Ceramic C6 0-01μF tubular</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2 470pF SM or Ceramic C7 39pF SM or tubular</td>
<td></td>
</tr>
<tr>
<td>C3 1000pF SM or Ceramic C9 92pF SM or tubular*</td>
<td></td>
</tr>
<tr>
<td>C4 5600pF tubular</td>
<td></td>
</tr>
<tr>
<td>C5 2200pF SM or ceramic C10 0-01μF tubular</td>
<td></td>
</tr>
</tbody>
</table>
* see text. |
| VC1/2 2 x 365pF (Jackson 02) |
| VC3 30pF variable air spaced (Jackson C804) |

<table>
<thead>
<tr>
<th>Semiconductors</th>
<th>Tr1 MPF102</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tr2 AF124</td>
<td></td>
</tr>
</tbody>
</table>

Note: In the prototype the BF295 and AF106 were used but since difficulty will be experienced in obtaining these types they have been substituted by the MPF102 and AF124.

| Miscellaneous | Material for chassis, see text. S1, S2, miniature on/off slide switches. Coil formers, see text. Tag strips 2 way (2). Aerial sockets (2). Insulated coupling or rod for VC1/2. |
plastic form, through which a small strip of metal is run with a hole in the middle. This is a commonly applied method for mounting the coils. Instead, however, you can use a proper cement, like Araldite, to fix the coils in place.

The wire used for L4 is SWG 30. The primary winding has 65 turns, the secondary is wound around the first one, after a thin strip of plastic is applied, to separate the windings. The secondary winding consists of 7 turns.

The layout of the components is illustrated in Figs. 3 and 4. It is possible to deviate from this design without trouble, but if you have little experience in electronics, we advise that you stick to it.

**OPERATION ON 5.5 TO 12.5 MHz**

This range covers the 25, 31, 41 and 49 metre bands. L1 should be wound with 15 turns over a length of 3\(\frac{3}{4}\)", the coupling winding consisting of 5 turns. L2 is the same as L1. Oscillator coil L3 also is the same as L1 but a tap is taken at 5 turns from the bottom end. L4 remains unchanged. The oscillator tuning capacitor should be increased to 120pF (VC3).

**ADJUSTMENT**

After all the connections have been made check the wiring thoroughly before the unit is connected. Join the converter output terminals to the aerial and earth terminals on the receiver, preferably with coaxial cable to prevent the direct pick up of signals by the receiver on 1-6MHz to which frequency the receiver should be tuned.

It is advisable to first tune the oscillator to the required signal and then to peak the signal with the aerial tuning which will be found to be comparatively flat. After the proper positions of the knobs have been found for all the bands mark them for easy tuning in the future with the help of some dabs of coloured paint or very small labels typed with the frequency bands.

When the whole unit works satisfactorily it can be put in a small wooden cabinet or preferably an aluminium case, again to protect the receiver from direct pick up.

**Information on the DX Information Service can be obtained from Radio Nederland, English Section, P.O.B. 222, Hilversum, Holland.**
Since 1920, when the German Post Office broadcast its first test programme from the long wave radio station Königs- westerhausen, German broadcasting services and associated equipment manufacturers have earned the respect and admiration of many people all over the world. This year they are celebrating fifty years of broadcasting with special events.

The International Radio and TV Exhibition (Internationale Funkausstellung 1973) brings together the combined resources of broadcasting organisations of West Germany and twenty other countries in the Palace at the Funkturm, Berlin, from August 31st to September 9th. Practical Wireless was privileged to be given a preview of some of the current activities in the industry in West Berlin recently.

The exhibition will cover all aspects of entertainment electronics and will show modern forms of transmission techniques using satellites and pulse code modulation, private radiophones, projection colour television, traffic guidance systems and s.s.b./a.m. radio.

Television Studios

The two television transmitting organisations in West Germany are the Arbeitsgemeinschaft der Rundfunkstalten (ARD) and the Zweite Deutsche Fernsehen (ZDF) which will broadcast the opening ceremony of the exhibition over the Eurovision network on August 31st. As well as the customary display of domestic equipment from industry there will be additional attractions including a fully operational television studio, transmitting equipment, a radio and television servicing workshop, demonstration of historic equipment by the Deutsches Rundfunk Museum, special transmissions by the Deutschen Amateur Radio club and numerous cultural and sporting events for visitors' relaxation.

The Television Centre in West Berlin is run by the SFB which now broadcasts from the new buildings completed in 1971. The photograph shows the tower block on which are mounted the directional parabolic reflectors linking the centre with the transmitting stations and mobile units. Of particular interest in the Centre is the use of unmanned television studios. Computer equipment installed can operate television cameras and lighting from a remote console, so that the control room has direct control of floor equipment.

SFB (Sender Freies Berlin) has only an 8% share in ARD and
broadcasts television programmes on Channel 7 (v.h.f.) and Channel 39 (u.h.f.). Sound radio on v.h.f. is on 88.75, 92.4 and 96.3 MHz, and on 202 m and 530 m medium wave, the third programme being distributed through Norddeutscher Rundfunk (NDR). SFB will broadcast during the exhibition using a specially converted hall in the exhibition centre.

New Video Disc

A special feature will be the demonstration of video recording techniques for the home and in particular a new video disc player shown by Telefunken. This system is the production model version of TELDEC (first demonstrated three years ago) and has been developed to provide up to 10 minutes on one side of a 21 cm flexible plastic disc. The first demonstration was designed for monochrome pictures but now the new version, affectionately renamed TED, can provide colour pictures of excellent quality in various simultaneous multiple geometric arrangements, including superimposition. Of significant interest is its ability to be “stopped” to provide still pictures and short excerpt repeats.

The video disc works on the principle of “out-of-contact” pressure scanning, using a small pick-up cartridge about the size of that used for sound record players. The first version introduced in 1970 contained monochrome programme material and a year later the TriPAL-D System was successfully recorded using this medium. Production of disc players is now at an advanced stage and will undoubtedly attract a large market at the exhibition.

The TED System is claimed to be the cheapest of all known video recording systems but, of course, the domestic unit will not have “record” facilities, only playback.

Other Recording Techniques

Of the five video recording techniques previously known, the only three to become the subject of further development in West Germany are magnetic tape cassettes, which are now enjoying a boom in demand, disc, and the “Super-8” film scanner, although the latter is only being developed by one company for production early next year.

The connection of a video recorder to the television receiver presents two main problems: mains isolation and time base stability. By connecting through the aerial socket the mains isolation problem is solved but this is only suitable for playback.

New Video Disc

A special feature will be the demonstration of video recording techniques for the home and in particular a new video disc player shown by Telefunken. This system is the production model version of TELDEC (first demonstrated three years ago) and has been developed to provide up to 10 minutes on one side of a 21 cm flexible plastic disc. The first demonstration was designed for monochrome pictures but now the new version, affectionately renamed TED, can provide colour pictures of excellent quality in various simultaneous multiple geometric arrangements, including superimposition. Of significant interest is its ability to be “stopped” to provide still pictures and short excerpt repeats.

The video disc works on the principle of “out-of-contact” pressure scanning, using a small pick-up cartridge about the size of that used for sound record players. The first version introduced in 1970 contained monochrome programme material and a year later the TriPAL-D System was successfully recorded using this medium. Production of disc players is now at an advanced stage and will undoubtedly attract a large market at the exhibition.

The TED System is claimed to be the cheapest of all known video recording systems but, of course, the domestic unit will not have “record” facilities, only playback.
machines. Video signal recording machines need an adaptor for use with a.c./d.c. sets but these are expensive and a cheaper solution is still being sought.

Timebase stability can be a problem with flywheel sync circuits and result in severe non-linearity in the horizontal deflection. This problem can be overcome to a large extent by reducing the time constant in the phase comparator circuit. This facility will be incorporated in some sets by adding an "AV" switch, the "AV" designating Audio-Visual. Some sets have already reduced the time constant without the need for a switch. Permissible maximum time deviations that a receiver should accept or a video recorder should produce is the subject of a German Standards Committee dealing with this aspect.

Seven German companies have now adopted the video cassette system and they are manufacturing cassette recorders on a large scale. All have built-in television tuners and timers, and stereo can be provided although up to now is not built-in. Over 40,000 VCR sets have been built and sold in Europe and manufacturers are having to work hard to satisfy a growing demand. The trend is to omit the u.h.f. tuner and connect to the video signal direct. Some domestic receivers are already being fitted with a video socket for this purpose specially for cassette recorders.

The German Post Office will be showing likely future developments in communications and to emphasise the theme they will give light and sound displays for visitors. Their exhibits include work in laser communications via glass fibres using pulse code modulation, which is particularly suitable for stereo broadcasting for sound only and television channels. Part of the work of the German Post Office is in monitoring the "air waves", particularly as stringent control must be exercised in Berlin because of its geographical position.

The Post Office is extending its transmission service capability by bringing into service its new "twin-dish" f.m. transmitter at Frohnau, Berlin. This station will handle telephone, telegraph, telex, gentex, and data traffic in two directions with a similar station in Lower Saxony, so extending communications from West Berlin without interference to East German transmissions. A fully automatic public land mobile service will also transmit via Frohnau.

The exhibition organisers, AMK Berlin, are to be congratulated on the magnificent organisation behind the exhibition programme. In turn they have received full co-operation from several Berlin organisations in promoting the 50 years anniversary celebrations including Philips, Telefunken, German Post Office, and broadcasting companies. We would hope that British exhibition organisers will visit Berlin to take notes.
A few years ago the letters column of Practical Wireless bristled with a controversy regarding the pros and cons as to whether the authorities should allow low level radio communication on a specified band analogous to the citizens band in America, without the requirements of having to pass the morse code test and radio theory examination. Allied to this was the profusion of American and Japanese equipment particularly walkie-talkies, available over the counter from many radio and electrical shops giving rise to the rather curious anomaly whereby a person could legally purchase such equipment and yet find himself in the position of using it illegally.

The sale of such equipment even here is quite high and as each specific market for a particular transistorised unit is identified, it is inevitable that the IC manufacturers should turn their attention to fulfilling this need, in integrated form, if at all possible.

Lithic Systems Inc. have now produced the first monolithic microtransmitter, designated the LP2000, the operating frequency being set by external tuning elements so that the device can operate at any frequency up to 150MHz with a power output in the region of 100mW.

Circuit

The complete circuit diagram of the LP2000 together with a functional block diagram is illustrated in Fig. 1. All the active components of the transmitter are incorporated in the IC with the operating frequency set by an external overtone type crystal and a tuned LC tank circuit picking out the required overtone frequency. Tr8 acts as the transistor oscillator operating with AC grounded base and having its DC bias controlled by the internal regulator. Further stability is ensured by having its emitter current controlled by the constant current source Tr7.

Two emitter follower buffer stages Tr12 and Tr13 directly couple the oscillator to the power output stage Tr15 and this rather unique design does away with the more conventional LC or RC interstage coupling networks. The modulator and output regulator form an integral part of the output stage and this is achieved by inserting Tr14 and Tr16 as the emitter loads with their currents controlled by the modulating preamplifier Tr9 and Tr10. In conjunction
The Catalogue you MUST have!

HOME RADIO COMPONENTS

Only 55p. plus 22p POST AND PACKING

POST THIS COUPON with cheque or P.O. for 77p.

Details of our popular Credit Account Service and our Easy Ordering System are included in the catalogue.

The price of 77p applies only to customers in the U.K. and to B.J.P.O. addresses.
We regret

of

All

required.

preferably 9" x 4" minimum) stating which project is of interest to you—we will forward an individually priced list of components required. No need to buy a full kit—you need only purchase the parts you require at any one time.

All Electro Spares supplied components are new, branded products of reputable manufacturers and carry full makers guarantee. We regret we cannot supply lists for projects published before July 1973 issue.

"ONE SOURCE" BUYING MAKES SENSE—IT CAN SAVE YOU TIME, MONEY AND POSTAGE.

"p.e." f.m. varicap stereo tuner

Features include push button "Spot On" tuning, with up to 5 pre-set stations (no difficult tuning dial and drive cord). Easy "no problem" construction, requiring only a few simple setting up adjustments with a D.C. Voltmeter. Uses NEW pre-set modules for R.F. and I.F. Circuits—no circuit alignment. High efficiency Integrated Circuit Phase Lock Loop Decoder for perfect stereo reception, with stereo lamp indicator.

Total Kit price only £28-50 Including VAT and postage

With Fibre Glass P.C. Board, neat slimline teak veneered cabinet with brushed aluminium front panel, push buttons, etc. IDEAL FOR USE WITH THE "TEXAN", "GEMINI" AND ANY GOOD QUALITY STEREO AMPLIFIER

Please send large S.A.E. for full details.

"p.e. gemini" stereo amplifier

QUALITY HI-FI FOR THE HOME CONSTRUCTOR

30 Watts per channel into 8 ohms Total Harmonic Distortion 0-02% Frequency Response (-3 DB) 20Hz-100kHz

We are still continuing to supply components for this fabulous Amplifier, which is now recognised as practically the ultimate in High Fidelity. We know of no better unit for the Home Constructor—hundreds supplied throughout the world. Booklet available, containing full specification, complete constructional information, wiring diagrams, fault finding guide, etc. Price £5.50, plus 4p postage.

Our New Low Price List is supplied with each booklet, or supplied separately on receipt of a large S.A.E.

FOR PEOPLE WHO REQUIRE THE BEST, IT HAS TO BE THE "p.e. gemini".

BROADWAY ELECTRONICS

92 MITCHAM ROAD, TOOTING BROADWAY, LONDON S.W.17 01-672 3984

CARTRIDGES—Stereo Sonitone 9TA H/C Diamond £2.47, Ronette S105 Medium Output £1.40, S106 High Output £1.40, Acos GP93/i Sapphire £1.95, GP94/i Sapphire £1.95, Japanese equivalent to B.S.R. TC8h £1.80.

CARTRIDGES—Mono GP9 Stereo Compatible £1.39, B.S.R. TC8h £1.49, equivalent £1.25

HI-FI STEREO HEADPHONES Padded ear cushions seal out room noise. Perfect coupling between reproducer and ears assure full response impedance 8 ohms, frequency range 20-20,000 Hz. Mfr. cord and standard stereo plug. Only £3.97.

STEREO HEADPHONE JUNCTION BOX Simple unit connects direct to amplifier and speakers to give attenuated headphone output has 3 position switch to give headphones only, speakers only, and speakers and headphones. Only £1.74.

VYNAIR Weight from 30 to 34½, 99p rd. off roll. ½ yard 37p. Send 5p stamps for samples. All prices inclusive of post and packing.

poly-planar

20-Watt Full Range Speaker

Completely replaces the conventional cone speaker Super-thin construction permits new installation ideas.

Power capability: 40 watts peak. Frequency range: 40 Hz to 20 KHz Sensitivity: 10 dB/m for 1 watt electrical input. Input impedance: 8 ohms. Operating temperature range: -20°F to +175°F. Size (W x D x H): 1 7/16" x 3 1/4" x 14-11/16". Weight: 10 ounces. £7.50 each Stereo pair £14.50 post free

web europa

P.O. Box 162, Watford WD1 1AA
with an ordinary dynamic loudspeaker used as a microphone sufficient drive is obtained to allow up to 100% modulation of the output stage.

When the transmitter is used as a portable, a latching mechanism allows the IC to be permanently connected across the power supply drawing little or no current until actuated. A positive going trigger pulse applied to pin 10 causes Tr4 to conduct and the resulting voltage drop across R6 causes Tr2 and Tr3 to conduct thereby providing regulated bias voltages for the oscillator and output stages. This quasi-stable state remains as long as the base of Tr4 is not grounded. Application of a negative going pulse or momentarily earthing pin 10 causes a reversal of the latch to the ‘off’ state.

A Practical Transmitter
A complete radio transmitter circuit, incorporating the LP2000, is shown in Fig. 2. The two pre-set resistors control the idling current and output modulation. One rather curious feature of the design is the DC short through the tank circuit between the base and collector of Tr8 but monolithic transistors still show a current gain even when operated in this mode. The tank coils and variable capacitors will have to be chosen to suit the operating frequency set by the particular crystal used, and while this IC can operate as a complete transmitter in its own right, it can also provide sufficient drive to operate a more powerful PA stage for amateur transmissions.

Also available is the LP2001, electrically interchangeable with the LP2000 but producing a minimum continuous output power of 250mW.

The suppliers, in this country, are Europartners Ltd., Shirley Lodge, 470 London Road, Slough, Bucks. The LP2000 costs £8.80 and the LP2001 £13.20 to which should be added VAT and postal and packing charges.

---

**PRACTICAL WIRELESS MULTIMETER COMPETITION**

**THE WINNERS OF THE FOUR DIGITAL MULTIMETERS WILL BEANNOUNCED NEXT MONTH**

---

August 1973

**Light Operated Switches**
The diode D1 in Figs. 1-4 is shown reversed. Positive side of diode should go to positive supply line.
PRODUCTION LINES

STORAGE BOXES
Kabi (Electrical & Plastics) Limited of Potters Bar, Herts. have introduced an entirely new series of compartment trays. The range comprises four sizes from 5½in x 7in to 6½in x 12in x 2in.

The largest model has moveable compartment modules, each module being capable of sub-division, so that compartments of virtually any size up to the total dimensions of the tray can be formed.

Most are available in a range of colours at prices ranging from 45p to £1.50 each according to size. Kabi Ltd., Cranborne Road, Potters Bar, Herts. EN6 3JP.

METRIC CUTTERS
Q-Max (Electronics) Ltd., now supply their chassis cutters in metric sizes and linear sizes.

We have illustrated the 25mm size which is priced at £1.05. An Allen key to fit costs 9p.

To use these punches, a hole must be drilled ensuring that the Allen screw will fit through easily. The screw is then passed through the die (see picture) then passed through the ready-drilled hole. The punch is then screwed onto the projecting Allen screw until it makes contact with the metal to be punched. The screw is then turned by means of an Allen key and the punch cuts cleanly through the metal.

Q-Max (Electronics) Ltd., 44 Penton Street, London, N1 9QA.

SOLDERING ALUMINIUM

In recent months Multicore Solders Limited have introduced to industry their new flux cored solder for soldering aluminium.

Multicore now believe that they have made a significant breakthrough and are announcing the release of ALU-SOL Multicore Solder which readily solders aluminium and many aluminium alloys, does not require any extra flux, and seems to provide joints having significantly better resistance to subsequent electrolytic corrosion than any other soft solder/flux combination previously for aluminium soldering.

Now a new pack (ref: Size 4) for Servicemen and Handymen is announced which comprises approximately 1/4kg, 16 swg ALU-SOL Multicore Solder wound on a plastic reel and packed in an attractive carton with full instructions, which will be available from electrical, hardware and do-it-yourself shops.

The recommended retail price is £1.50 per reel, excluding VAT. In case of difficulty please contact the manufacturers direct. Multicore Solders Ltd., Hemel Hempstead, Herts. HP2 7EP, England.

LOUDSPEAKER KITS

Helme Audio Products Ltd. announce the introduction of two new hi-fi loudspeaker kits, the XLK-25 and XLP-50. Ready made versions and matching cabinet kits are also available. Kit XLP-25 comprises an 8in. low resonance woofer and 3in. square tweeter with aluminium cone. Kit XLP-50 uses the same high grade tweeter but takes advantage of a 13 x 8in. woofer with Bextrene cone. Both kits offer very good value for money and include a half-section, parallel cross-over network and all leads, terminal panel etc. No soldering is necessary for their assembly.

The kits are also supplied with protective built-in fuse against accidental overload. Prices (incl.VAT):

XLP-25 @ £23.17 per pair.
XLP-50 @ £42.18 per pair.

Helme Audio Products Ltd., Summerbridge, Harrogate, HG3 4DR.
Announcing our improved range of constructor modules

FOR DOMESTIC & COMMERCIAL USE

New Versions using 3A "Plastic Power" Driver Transistors Now Available. To meet demand, we have included a more powerful module in our well-established and proven range. These power amplifiers are carefully assembled, tested and guaranteed. They offer superb values for reliability and versatility.

SA35 35 watts RMS, Uses 7 transistor and 7 diodes  Carr. paid.  £4.45

SA50 at £5.65

Carr. paid. A rugged, well built unit, capable of 50 watts R.M.S. output, with all the advantages of Saxon Amplifier design and quality. Ready now.

SA100 makes an ideal unit in disco assemblies. A real glutton for work, reliable, tough and compact, 11 transistors, 6 diodes. Carr. paid.

BRIEF SPEC. FOR ALL THREE MODULES

All modules incorporate OPEN AND SHORT CIRCUIT PROTECTION, plus proof against over-dissipation and faulty inductive loads in the SA.100.

Freq. response 15-40,000 Hz ± 1dB
Distortion 0.2% at 1 kHz
Load 4 to 15 ohms
Quiescent current 15 mA
Noiser than —75 dB
Supply voltage SA35 24-45 volts
SA50/SA100 40-70 volts
Size 4½” X 4½” X 1½” (SA35/SA50)
6” X 4½” X 2½” (SA100)

Circuits, connecting instruction and application data are supplied free with all modules.

POWER SUPPLIES FOR THE SA35/SA50 & SA100 AUDIO MODULES

P45 Unstabilized supply for 2 SA35/SA50  £8.75 Carr. 40p
P40 Unstabilized supply for one or two SA100  £7.75 Carr. 40p
P55 Stabilized module for 2 SA35’s or two SA50’s  £8.95 Carr. 40p
MT45 Transformer for above, heavy duty  £2.85 Carr. 30p
MT50 Transformer for unstabilized supply complete with rectifier diodes mounted  £3.95 Carr. 30p
P50 Stabilized supply module for one or two SA100’s  £4.95 Carr. 40p
MT70 Transformer for P570  £4.95 Carr. 40p

ALL MODULES ARE BUILT ON GLASS FIBRE P.C. BOARD AND SUPPLIED FULLY TESTED

TWO NEW PA/MIXER CONTROL UNITS

Using grouped pairs of inputs and outputs (high Z and low Z inputs) with individual bass, treble and volume controls on each pair, plus master control. These low-noise units will feed all makes of amplifiers, making them ideal for clubs, discos etc. Standard jack sockets. Compact design. In strong metal cases. All units guaranteed for 3 years.

M.4H 4 high Z, 4 low Z inputs, 4 sets of controls. Case 14” X 8” X 2½” Carr. pd. £18.50 + V.A.T.
M.6.H.L. Case 18” X 8” X 2½” 12 inputs (6 high Z, 6 low Z). Carr. pd. £27.50 + V.A.T.

Channel section modules, for building your own mixer. Gain=—16 x (48dB). Tone controls—48dB swing. Carr. pd. £3.50 + V.A.T.

SAXON CONTROL UNITS

Mono (as shown) 24.50 20p.
Stereo Carr. 30p.  £15.80

120 WATT HEAVY DUTY MODULE

Rugged class A driver stage, this module will run from all our mixers, etc. and most other makes. Delivers 120 watts into an eight ohm load and employs 4 T.G.15 (115 watt) output transistors. These are the modules where extra power is demanded.

Power output 120 watts into 8 ohms
Free response 20-20,000 MZ ± 2dB
Input sensitivity 200 mV in 10K
Construction Fibreglass board
Size 8” X 4½” X 4½” (5” with supply)
Low distortion parallel push-pull output stage

160 watt version £27 90
Stereo (Carr. 50p)

SOUND AND LIGHT UNITS

Our popular 3 channel model handles up to 3KW (3000 watts) of lighting and incorporates versatile sound control arrangement to enable professional standards to be achieved. Both units are excellent examples of Saxon quality and value.

3 CHANNEL UNIT

Includes bass, middle and treble as well as master controls. 2 amplifier sockets eliminate need for split leads. Up to 3KW lighting load. Smartly finished steel case. Carr. 50p.

120 watts RMS and continuous signal outputs of 70 watts. Two individually controlled inputs with wide range bass and treble controls.

SAXON 100 £48.50 Carr. free

COMPLETE AMPLIFIERS

CSE 100. £34.90 Carr. free

SINGLE CHANNEL UNIT

Operates from 6 to 100 watts amplifiers. Suitable for bass note operation. Is easily adapted for treble or mid-range at a cost of about 50p.

NEW!!!

LOUDSPEAKERS British made bargains!

12” 40 watt 15,000 gauss magnet system £15.15 Carr. 40p.

A.K.G. MICROPHONES

D1 H/DL IDEAL DISCO MIKE ONLY £3.45 (Carr. 40p)
L/00 RECENTLY INQUIRIES INVITED

SAXON ENTERTAINMENTS LTD., 327 Whitehorse Rd., W. Croydon, Surrey. CRO 2HS.

Orders and personal shoppers to:

SAXON ENTERTAINMENTS LTD., 327 Whitehorse Rd., W. Croydon, Surrey. CRO 2HS.

Phone 01-684 6385

Hours 9.30 a.m.—5.30 p.m.

TRADE & EXPORT ENQUIRIES INVITED

TERMS OF BUSINESS

Cash with order (C.W.O.) For C.O.D. please add 35p extra, cash by regd., letter, please

419
NEW VALVES
Individually boxed and guaranteed for European or other origin at greatly reduced prices.
Quotations for any valve not listed. Send SAE for lists.

NEW MULLARD & MAZDA VALVES
All individually boxed and guaranteed. Full trade discounts to bona fide companies. Price availability lists on application.

EXPRESS POSTAGE
Up for 1 Valve. Each additional Valve add 1p.

TRANSISTORS-INTEGRATED CIRCUITS
All transistors, I.C's offered are new and branded. Manufactured by Mullard, Texas, RCA, Ferndale, Motorola, ITT, Fairchild, Lucas, etc. Quantity discounts on application. Send SAE for full lists.

EXPRESS POSTAGE
Up for first Transistor, for each additional add 1p.

VAT
10% to be added to all orders including POSTAGE!

THIS MONTH'S
ITT NUMICATOR
TYPE GN4PA
LIST PRICE £2.70
OUR PRICE £1.25
Data Sheet Supplied

TERMS OF BUSINESS: C.W.O. A/c's available to approved companies on application. Telephone and telegraph orders accepted. Export and Travelers Cheques accepted. Closing Sat. 1-3 p.m.
OF ALL of the basic measurements that can be made with a normal multimeter, the determination of voltage is probably the one most commonly attempted and the measurement that is most likely to give rise to erroneous results.

MEASUREMENT ERRORS

Consider for a moment the circuit of a low power audio amplifying stage in any piece of equipment, Fig. 1. The current through R3 will, with no input signal, be constant value determined by the values of R1, R2 and R4, and will not be altered if the value of R5 is altered providing that the voltage at the collector of the transistor exceeds that at its base by 2 volts or more.

Let us suppose we wish to measure the voltage across R3, and given that the transistor delivers a current of 100μA and the value of R3 is 100kΩ, the voltage across the resistor will be 10V.

If we measure the voltage across R3 with a normal multimeter of 20kΩ/volt sensitivity then, on the 10V range, the meter will appear as a 200kΩ resistor. If a 200kΩ resistor is shunted across the 100kΩ resistor the apparent resistance drops to 66.7kΩ, and consequently the voltage across the combination drops to 6.67V, vastly different from the 10V correct value.

It is obvious therefore that a meter with a higher sensitivity would give much less error, but although valve and FET voltmeters can be built by the home constructor, difficulties can occur due to thermal drifts as the components in the circuit warm up. The circuit to be described uses a μA741C integrated circuit as the amplifying element of the circuit hence eliminating drift problems. Since it is difficult for the amateur to obtain high value, high tolerance resistors the sensitivity of the circuit has to be made 100kΩ/volt although 1MΩ/volt would be preferable.

![Fig. 1: Basic transistor circuit to demonstrate errors possible when using low sensitivity meters.](image1)

![Fig. 2: Use of the μA741C integrated circuit as an amplifier.](image2)

**components list**

<table>
<thead>
<tr>
<th>Resistors</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R1 100kΩ</td>
<td>R6 10kΩ</td>
<td></td>
</tr>
<tr>
<td>R2 300kΩ</td>
<td>R7 10kΩ</td>
<td>5%</td>
</tr>
<tr>
<td>R3 1MΩ</td>
<td>R8 10kΩ</td>
<td></td>
</tr>
<tr>
<td>R4 3MΩ</td>
<td>R9 820Ω</td>
<td></td>
</tr>
<tr>
<td>R5 10MΩ</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(R4 is 2 x 1.5MΩ)

VR1 10kΩ linear potentiometer
VR2 500Ω miniature preset pot

Miscellaneous
IC1, μA741C (TO5 or DIL). S1, 4-pole 6-way, (from 2 x 2-pole 6 way wafers). M1, 100μA FSD, scaled 0-3 and 0-10 (RS-MR31). Case, approx 7" x 4" x 2". Terminals (2). Knobs (2). Battery clips (2 pairs). Terry spring clips (2). Batteries, PP4 (9V-2 off). Veroboard.
Fig. 3: Full circuit of the high sensitivity voltmeter. If difficulty is experienced in obtaining a suitable wafer switch, S1c and S1d could be replaced by a separate double pole toggle switch.

Fig. 4: Layout of the small veroboard carrying the IC. Supporting brackets are cemented to the box lid.

Fig. 5: General layout of components on box lid with connections to range switch.

Fig. 2 shows the basic inverting amplifier used in the meter. If we assume that the IC is perfectly matched (it would give no output if both inputs were earthed), we can prove that if R2 and R3 are not the same value the output voltage will not be zero, due to the currents being drawn through these resistors.

The IC has two terminals for offsetting small differences due to mismatch of components in the IC and the tolerance of the external resistors, as well as frequency compensating components to prevent
E.M.I. WOOFER AND £5.75 TWEETER KIT.

Average woofer £4.05, Tweeter £1.90.

Comprising: a) 1X 8in. E.M.I. Woofer 842, £2.15.

b) 850 cm cone, with a massive Ceramic Magnet, 44 oz., Gross 12,000 grams. Aluminium Cone centre to improve middle and top range. Also the E.M.I. Tweeter. Quality has a special light-weight paper cone and magnet flux 15000 lines. Crossover conditioner and all instructions supplied.

IMPEDANCE STANDARDS: 8 ohms.

Maximum Power: 12 watts.

Useful Response: 30 Hz to 10,000 c.p.s.

Base Res. 40 c.p.s.

£5.75.

SUITECIBLE ENCLOSURE 20 x 13 x 8 in. £9.00 POST 25p.

MODERN DESIGN, FRONT DESIGN, TEAK FINISH.


R.C.S. STABILISED POWER PACK KITS.

All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifier, 12 Volt D.C. output, Input 230-240 V.A.C. Output voltages available 6 or 9 or 12 or 15 or 18 or 24 or 30 or 40 or 60 or 90 V.A.C. or at mains.


DETAILED S.A.R. Size 4x3 x 11 in.

£7.95.

GENERAL PURPOSE TRANS-AMPLIFIER BRITISH MADE.

Ideal for Home or Car. Can be used with Battery 6-12v or H.T. lines 200-300V D.C. operation.

Size 1 x 1 x 7 ½ inches. Responds 65  c.p.s. to 25,000 c.p.s. best. For use with valve or transistor equipment.


NEW ELECTROLIGHTS CONDENSERS

3.3pF 40v 400pF £2.80

500pF 60p

9pF 250pF £4.75

6.8pF 100pF £2.60

25pF 100pF £2.45

200pF 56p

15pF 220pF £2.25

5pF 220pF £1.50

1pF 220pF £1.20


NEON PANEL INDICATORS. 500V/AC/Dc/Amber 28p.

RECTIFIERS, 100v, 120 v, 150v, 200v, 250v, 300v, 350v, 400v, 450v, 500v, 550v, 600v, 650v, 700v, 750v, 800v, 850v, 900v, 950v, 1000v, 1050v, 1100v, 1200v.

LOW VOLTAGE ELECTROLYTICS

200v 30p

230v 35p

300v 40p

500v 50p

1,000v 125p

2,000v 250p

5,000v 500p

20,000v 10.00

POTTED CAPS & TRANSISTORS.

SPECIAL OFFER.

SMITHE’S CLOCKWORK 15 AMP TIME SWITCH.

Single pole two-way.

Maker’s last in 30,840, Bonded and fully guaranteed.

Surface mounting with fixing screws.

Will replace existing switch to give light for return house, garage, automatic anti-hallight fitting, etc. Variable brightness control with intermediates settings.

TWO TYPES AVAILABLE 6 TO 60 MINUTES OR 6 TO 60 DAYS.

£2.50 Post 50p.

PAIR. (STATE TYPE A OR B WHEN ORDERING.)

WEYRADS TRANSISTOR COILS.

RASW Ferrite Aerial. 72p.

Or. 34 oz. (suitable for Open or E.M.I. F.P.C. 600/4750. 79p.

Crystals. 2 ohm. 10p.

Space Cores. 2p.

Mullard Ferrite Rod 8 x 1.5 x 25m. 6p. 6 x 1m. 20p.

80 ohm Coax 4y.

SINGLE ENDED.

80 ohm Push Pull.

SPACE PLUGS.

B.G.A. AERIALITY.

ABER-AIRIAL-AXIAL-SPACE PLUG.

F.F. LOW LOSS.

ALPHADIAL.

£1.00 Post 25p.

COMPACT PORTABLE STEREO HI-FI.

Two full size loudspeakers 15 x 10 x 6 inches. Speaker unit can be used to loudspeaker unit or complete compact over all size only 15 x 15 x 5 inches. 8 watts per channel, plays all records, discs, tapes, 45 rpm. Separate volume and tone control. Good British Colour. Weight inclusive £10. 50p.

BRITISH FM/VHF TUNING HEART.

88 to 108 M赫 British made, 2 Transistor.

Our Price.

£3.95 Post 50p.

British electronic companies.

£7.95.

Mains Transformers.

All Post 25p.

£4.95 Post 25p.

£1.95 Post 25p.

Blind ALUMINIUM CHASSIS 18 x 9 x 3.5 in, 8p, 6 x 4 in, 6p, 4 x 6 in, 6p £9.40.

ALUMINIUM BOX 6 x 4 x 3p.

ALUMINIUM BOX 5 X 6 x 3p, £9.50.

ALUMINIUM BOX 10 x 10 x 2ins. £9.50.

ALUMINIUM BOX 10 x 8 x 10 x 8p.

4 x 8, 8 x 15in. 10p.

12 x 8in. 10p, 20p.

15 x 8in. 10p, 20p, 30p, 50p.

12 x 10in. 30p.

15 x 10in. 50p.

18 x 12in. 50p.

12 x 12in. 50p.

15 x 12in. 50p, 75p.

18 x 15in. 50p.

FAXOIN PAILIN 15 x 8in. 15p.

FACTORY ACT! Mains Isolating Transformer.

Primary 1000v 200v Secondary 40v 80v.

£7.95 Post 25p.

220 x 15v 200p.

110 x 15v 200p.

B.R.A.I.N. AMPLIFIERS.

£10.95 Post 25p.

B.R.A.I.N. AMPLIFIERS.

£10.95 Post 25p.

B.B.A.R.

£10.95 Post 25p.


£3.95 Post 25p.


£3.95 Post 25p.


£3.95 Post 25p.

STEREO VERSION OF £5.95.


£3.95 Post 25p.

STEREO VERSION OF £5.95.


£3.95 Post 25p.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.

STEREO VERSION OF £5.95.
Newest, nearest, nearly new, etc. are di-vised for storing small parts and components: readout capacitors, diodes, transistors, etc. Rigid, plastic units, inter-lock together in vertical and horizontal combinations. Transparent plastic drawers have label slots removable/ssl removable space dividers. Build up any size cabinet for wall, bench or table top.

SINGLE UNITS (30x25x25) £2.25 Dozen
DOUBLE UNITS (30x25x25) £3.25 Dozen

ALL PRICES INCLUDE VAT


NEW HEAVY COAX CABLE dia. 8" 70 ohms approx. 50ft. lengths £1.55, p. & p. 55p.

AERIALS. New Condition Whip Type. 4ft. 22p; 11ft. 82.5p. All collapsible type. l.p. 10p, l.d. 15p. New base on adjustable clamp for the above, 67p, p. & p. 27p.

CRYSTALS AS NEW. Hc 6u, 5345, 5030, 4945, 4875, 4840, 4795, 4580, 4660, 4520, 4510, 2295 Kcs, 55p each plus 8p p.p.

OUR SELECTION OF 6-Exa. EQUE. METERS consisting of 3in., 24in., 2m. mill amps, volts, amps. Mixed at the bargain price of £2.20 P. & P. 27p., minimum order of six.

ANY HEIGHT AERIAL TUBULAR SECTIONS 3" dia. x 3ft. long. Brass screws in ends, copper coated and painted. Good condition. 22.5p each. p. & p. 5p each. Minimum order 6.

AS NEW AERIAL TUNER UNIT No. 6 KE, consisting of 11 inch micro/autometer & sharp tuner. 75 PFT peared BNC type socket size 5" x 4 1/2" 5". Price £1.65, p. & p. 27p.

NEW AERIAL, WIRE ON BOARDS 7/22 UNCOVERED 90ft 50ft, 100ft, 60p. p. & p. 22p.

AERIAL POLES 4ft high 2" diameter push-in type as new 75p each p. & p. 25p each minimum four.

AERIAL MOLE POLES approx. 8ft high 2" dia. Interlocking ends, Minimum order three. New condition, £1.10 each section. Carriage 37p each section. 375 cm Coax in 50ft bins with BNC plugs good condition. Price £1.10 + 32p p.p.

AS NEW 5000p PENNY SIZE METERS complete with jack plug price £1.60 each p. & p. 20p.

COMMUNICATION RECEIVER PCB price £1.60 post paid.

C.W.O. CARRIAGE CHARGES MAINLAND ONLY. WOULD CUSTOMERS PLEASE ENSURE THAT ALL ORDERS ARE PRINTED IN BLOCK CAPITALS AND INCLUDE YOUR ADDRESS.

A. H. THACKER & SONS LTD. Radio Dept., High Street, Cheslyn Hay, Nr Walsall, Staffs.
oscillation. The final circuit, Fig. 3, is very simple to construct and is an excellent project for a beginner, as well as being a very useful instrument.

CONSTRUCTION

The entire circuit is built on the lid of a 7" × 4" × 2" diecast aluminium box using the base as a cover. The switch should be assembled so that the two wafers are separated by 6BA spacers, 1" long. The switch should only move through six positions, the “off” position being with the switch turned fully anticlockwise, when viewed from the front panel.

The resistors R1 to R5 are mounted on the switch so that as the switch is turned clockwise the value is reduced. The remaining switch positions are connected so that when the resistors are in circuit the batteries will be connected to the board.

The circuit board, Fig. 4, should present no constructional problems provided that reasonable care is taken and that the copper strips which are supposed to be cut are completely severed. Fig. 5 shows the details of the switch wiring. The remaining work consists of attaching the assembled parts to the lid. The circuit board is stuck to the case, two pieces of bent metal supporting the board, the Terry battery clips being attached in the same way, after which final wiring can take place.

CALIBRATION

The meter should now be in working order and can be switched on. By turning the offset potentiometers VR1 it should be possible to zero the meter. If the direction of rotation of the potentiometer and the movement of the needle do not coincide the wires to the ends of the potentiometer can be interchanged. The meter is calibrated by using either a known voltage source or a 1.5V mercury battery. This voltage is connected to the instrument and by rotating the present VR2 the meter can be set to the correct voltage.

After spending many hours sweating over an artist’s brush and hot copper laminate, I decided to try using women’s nail varnish on the laminate. This has proved far better than enamel paint and dries within minutes. Mistakes can be corrected when dry by just scraping with a modelling knife.—D. K. Baruth (Northumberland).

Improving VHF radio

Further to my article in the April issue of P.W, readers in areas of poor reception may obtain higher gain with the FET amplifier, Fig. 2, by shorting out R4 or reducing the value to 82 ohms. Experimentally, a 250 ohm preset potentiometer could be fitted and the optimum value found for a particular location.

Alan C. Ainslie (Worksop, Notts.)

Power supplies

Correspondents have pointed out to me that in “Regulated Power Supplies for your Transistor Radio”, PW June 1973, there is a minor error.

It is not, of course, true to say that the output voltage is higher than the zener voltage, it is lower. This hardly affects the operation of a transistor radio, which is designed to function at low voltages, as supplied by a partly exhausted battery.

The mistake crept into the article due to my misreading a hastily written workshop note. — J. N. Watt (Surrey).

Play the game Lads!

Would it be possible to enlist your aid in bringing to the notice of “CQ!” Column participants that some of them are just bad-mannered opportunists.

I am no eccentric old buffer but admit to having had your magazine every month for years. My grouse relates to having, time after time, sending free copies of P.W, P.E, TV etc. to various people who do not even acknowledge receipt—let alone refund any postage. The last time this happened was in response to a “CQ!” published in the February issue. I’ll not mention any names or addresses but hope the recipients’ consciences will bother them.—R. Williams (Gloucestershire).
THE BBC is currently adopting a new approach with regard to the linking of studio centres to transmitters, notably for mono and stereo VHF radio programmes on the FM system of broadcasting. This is facilitating the introduction of stereo to FM transmitters which have hitherto been too remote from studio centres for equalised and balanced linking via the earlier radio and line analogue circuits.

Stereo demands high performance links capable of conveying two audio signals in isolation over hundreds of miles without quality impairment, imbalance or variation in transit time. Unless these requirements are adequately satisfied degradation of the stereo effect at the receiving points is bound to follow. On mono, of course, the requirements are significantly less critical; for a start there is only a single circuit to bother with, and phase distortion (i.e., transit time variation) on this is of minor consequence.

PULSE-CODE MODULATION

The new approach is based on translating the analogue signal (i.e., the type of signal yielded by a microphone or gramophone pickup, for example) to digital form, linking the signal in this form and translating it back to the original analogue for modulating the transmitter. The series of digits so produced corresponds to amplitude samples of the audio analogue. The digits are of simple zero/one form (i.e., binary) and the nature of the series (i.e., 011, 101, 111, etc.) reflects the instantaneous amplitude and polarity of the real audio signal.

In other words, the manner in which the digit series is coded is a direct function of the audio signal at that instant. It is thus a relatively simple matter to decode the pulse train to reform the original audio analogue.

A major advantage of this scheme is that it is far less worried by noise and repeater non-linearity than direct analogue linking. Indeed, any noise on the digits or pulses can be sliced off without impairing quality of the ultimately decoded signal.

The system, which is not new—the BBC has been experimenting for ten years with digital techniques applied to audio signals, is known as pulse code modulation (pcm). A high quality pcm system requires more than a mere three digits to secure the necessary number of sampling levels. The number of levels sampled is related to the number of digits in terms of 2^n. Thus only eight audio amplitude levels can be sampled with a three-digit binary code. The BBC uses a thirteen-digit binary code which corresponds to the sampling of 8192 levels—but the system also employs a parity 'bit' for error correction—and the sampling rate is 32kHz.

13-CHANNEL CAPACITY

The system carries thirteen high-quality audio signals in a single wideband circuit. The sending equipment is located at the London Control Room and the thirteen-channel multiplexed output is communicated by coaxial cable to the microwave system which directs the pcm signals to the transmitters. The thirteen-channel capacity provides the necessary scope for any future activities, since any one circuit can be used either as a mono channel or one of a stereo pair, and it would be possible to utilise four channels for quadraphony. Thus the future is well looked after!

It is noteworthy that the thirteen, high-quality circuits of 15kHz bandwidth and each of thirteen-digit binary code can be accommodated by any link capable of handling a single 625-line television signal. Each channel has a signal/noise ratio of 70dB (peak signal to peak weighted noise).

The pcm linking thus means that listeners will obtain improved quality signals from their FM tuners, even when the programme source is remote from the transmitter, and that transmitters which have hitherto been out of range of an equalised two-channel link of the earlier kind will be able to pick up high-quality signal pairs from the pcm system.
BI-PRE-PAK LTD
DEPT D, 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX SS0 9DF
TELEPHONE: SOUTHEND (0702) 46344

FREE CATALOGUE FOR
TRANSISTORS, RECTIFIERS, DIODES, INTEGRATED CIRCUITS, FULL PRE-PAK LISTS

100,000 Plastic Power Transistors in stock, more on way

NOW IN TWO RANGES

These are 40V and 50V Silicon Power Transistors of the highest reputation in either NPN or PNP at the most shatteringly low prices of all time. We have been selling these successfully in quantity to all parts of the world and we are proud to offer them under our own Guarantee. Ranges: Ranges 1/2 to 1,000.

<table>
<thead>
<tr>
<th>Range</th>
<th>VCE</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>122</td>
<td>700</td>
<td>£0.35</td>
</tr>
<tr>
<td>123</td>
<td>1500</td>
<td>£0.55</td>
</tr>
<tr>
<td>124</td>
<td>2000</td>
<td>£0.75</td>
</tr>
</tbody>
</table>

Send for list to our Sales Department.

INTEGRATED CIRCUITS

We stock a large range of ICs at very competitive prices (from £1 each). All these are listed in our FREE Catalogue, see section below.

METRICATION CHARTS now available

This fantastically detailed conversion calculator carries thousands of desirled references between metric and British (U.S.A.) measurements of length, area, volume, liquid measure, weight etc.

Pocket size. 18p.

LOW COST DUAL IN LINE IC SOCKETS

14 pin type at 16p each. Now new low profile 16 pin type at 16p each.

BOOKS

We have a large selection of Reference and Technical Books in stock. These are just two of our popular lines:

B.P.1 Transistor Equivalents and Substitutes: 40p

This includes many thousands of British V.D.A., European and C.V. equivalents.


 Characteristics of 3,000 valves and tubes, 4,500 Transistors, Diodes, Rectifiers and Integrated Circuits.

Send for list of publications. N.B. Books are sent of VAT.

A CROSS HATCH GENERATOR FOR £3.85 !!!

YES, a complete kit of parts including Printed Circuit Board. A four position switch gives X, Y, Z and X' Y' Z' directions. This complete kit of parts costs £3.85, post paid.

A MUST for colour T.V. Alignment.

~ ELECTRONIC TRANSISTOR IGNITION ~

Now in kit form, we offer this "up to the minute" electronic ignition system. Simple to make, full instructions supplied with these outstanding features:

- Designed especially for electronic ignition
- Complete kit including all parts
- 12V or 24V operation
- Compact size
- Low cost

Please send me the FREE BI-PRE-PAK Catalogue.

NAME: ____________________________
ADDRESS: _________________________

ALL PRICES INCLUDE 10% VAT, MAINLAND ORDER 50p POSTAGE. PLEASE ADD 11p post and packing per order OVERSEAS ADD EXTRA FOR POSTAGE.

BI-PRE-PAK LTD
CO. REG. No. 820919

SUPPLIERS OF SEMI-CONDUCTORS TO THE WORLD

COMPLETE TELEPHONES
EX. G.P.D. NORMAL
HOUSEHOLD TYPE
ONLY £1.05

POST & PACKING 45p EACH

TELEPHONE DIALS
Standard Post Office type. Guaranteed in working order.
ONLY 27p

TESTED AND GUARANTEED PAKS

B79 4 IN4007 Sil. Rect. diodes, 1,000V 1A, £0.60
B81 10 Reed Switches, 1" long, 12V Max. 1A, £0.80
B89 200 Mixed Capacitors. Approx. quantity, coated by wire. P & P 85p
F44 250 Mixed Resistors. Approx. quantity coated by wire. P & P 85p
F47 40 Wirewound Resistors. Mixed types and values.
F95 2 DIY Printed Capacitive Photo Transistor
R39 20 123C200 1/2" PNP Silicon unceded TO-93
R42 20 12750 1/2" PNP Silicon unceded TO-93
R61 100 Mixed Diodes. Germ. Gold bonded, etc. Marked and Unmarked.
R70 30 Shottky Transistor, NPN Silicon Planar types
R136 6 Integrated Circuits 4 Gate BIP. 6NP. 2N708, £0.45
R20 20 1N5402, 2N5965, 2N5970 £0.65
R41 2 Silicon Power transistors camp duo DI 111/332 £0.95

UNMARKED UNTESTED PAKS

B66 150 Germanium Diodes Mini. glass type
B80 200 Trans. manufacturers' rejects all types NPN, PNP, Sil. and Germanium.
B84 100 Silicon Diodes 1A, 200V, 1A, £0.50
B86 100 Silicon diode sub. min. 1N4148 and IN 4007 types
B88 50 Sil. Trans. NPN, PNP, equal to 1N914, BAV95A, etc. £0.85
B5 50 Germanium Transistors AF and HF
E 40 35E16 W. Zener Diodes 6.3V Min. Glass type
H17 20 3 amp Silicon Stud Rectifiers, 750mA. £0.65
H15 30 3 amp Silicon Rectifiers, 750mA. £0.65
H18 15 Experimental Pa lots of Integrated Circuits. Data Book...
H20 20 BY1067 Type Silicon Rectifiers 1 amp plastic. £0.65
H34 15 clipper, PNP. Germ. £0.65

MAKE A REV COUNTER FOR YOUR CAR

The 'TACHO BLOCK'. This encapsulated block will turn a 0-1mA meter into a linear and accurate rev. counter for any car with normal coil ignition system.

£1.10 each

OVER 1,000,000 TRANSISTORS IN STOCK

We hold a very large range of fully marked, tested and guaranteed transistors, power transistors, diodes and rectifiers at very competitive prices. Please send for free catalogue.

600,000 Silicon planar plastic transistors. Unmarked, untested, factory clearance. A random sampling showed these to be of remarkably high quality.

Audio PNP, similar to ZTX500, 2N3702/3, BC770 etc.
Audio NPN, similar to ZTX310, 2N3708/9, BC107/9, BC169/9 etc.
Please state Audio NPN or Audio PNP when ordering.

ALL AT £30 for this £50, 10,000 for £100 for £15, 100 for £1.00.

OUR VERY POPULAR 4P TRANSISTORS

TYPE "A" PNP Silicon alloy, TO-5 can.
TYPE "B" PNP Silicon, plastic encapsulation.
TYPE "E" PNP Germanium AF or HF.
TYPE "F" NPN Plastic encapsulation.
TYPE "G" NPN silicon, ZTX 300 range.
TYPE "H" PNP silicon similar ZTX 500 range.

8 RELAYS FOR VARIOUS TYPES

P & P 75p

£1.10

Our famous PI Pak is still leading in value for money.

Full of Short Lead Semiconductors & Electronic Components, approx. 170. We guarantee at least 30 really high quality factory marked Transistors PNP & NPN, and a host of Diodes & Rectifiers mounted on Printed Circuit Panels. Identification Chart supplied to give some information on the Transistors. Please ask for Pak P.I. Only 55p.

11p P & P on this Pak.

Please ask for Catalogue, see section above.
Moreover, the capacity of the pcm system allows the transmission of more than one programme in stereo. Already a number of the main FM transmitters are radiating in stereo on several programmes and plans are in hand to extend the coverage with the least delay.

**IMPORTANCE OF RECEIVING AERIAL**

From the actual receiving point of view the conditions are unchanged. That is, there is no change in the transmission system. It is still FM from the transmitters and the same tuners and FM receivers will work just the same as before the introduction of pcm.

However, since stereo will be available to an increasing number of listeners the receiving aerial will assume a greater importance than for mono-only reception. The reason for this is that for a given mono signal/noise ratio threshold, the aerial input required for a similar ratio on stereo can be up to ten times that required for mono. Thus, while a tuner might require, say 50µV for a 50dB mono signal/noise, up to 500µV could be required for the same ratio on a stereo signal.

There are some hi-fi tuners significantly more sensitive than implied by this example, of course, where for an acceptable ratio about 10µV (or less) might be required on mono and 100µV (or less) on stereo, but the fact remains that whatever the tuner or receiver a greater aerial signal at the threshold signal/noise ratio is required for stereo than for mono. If a receiver or tuner is receiving just about enough aerial signal for an acceptable mono signal/noise ratio, the same station switching to stereo would almost certainly give rise to an unacceptable signal/noise ratio (obtrusive background hiss) on the same installation working in the stereo mode.

When a station goes stereo and the receiver is not equipped with a stereo decoder, the reproduction, of course, will be in mono. This results from the compatible design of the stereo system. That is, the mono information is carried by it in the usual manner, with the stereo information on a subcarrier, so a receiver devoid of a decoder responds merely to the mono information and takes no account at all of the stereo information. Since the stereo information is contained in sidebands centred on a 38kHz subcarrier frequency, the normal after-detector de-emphasis of a mono receiver or tuner eliminates or filters out this information. A 19kHz pilot tone signal is also transmitted on stereo for synchronising the stereo decoder in the receiver or tuner, and this too is rolled-off by the de-emphasis.

Thus a listener using a mono-only receiver or tuner is not aware that the station is transmitting a stereo signal. The signal/noise ratio is barely changed. There is a mild intrinsic impairment to the ratio under this condition owing to the pilot tone accommodating just under 10% of the total deviation of the system and leaving 90% (not 100%) deviation (i.e., modulation depth) for the mono components, but this is rarely detected subjectively by the average mono installation in receipt of a reasonable aerial signal.

**SENSITIVITY AND S/N RATIO**

A signal/noise ratio much below about 40dB is generally unacceptable by critical listeners. Indeed,
for true hi-fi results the ratio should approach 60dB referred to 100% modulation (i.e., ±75kHz deviation on the British system). The top curve in Fig. 1 shows how the audio output gradually increases with rise in aerial signal strength from the very low level. At point A on the curve, corresponding to an aerial input of 60µV, the output stabilises due to the FM limiting action of the receiver or tuner. This represents the 'limited' output and is referred to 0dB.

The noise on this signal is very low, but at aerial inputs below the limiting level shown the noise constitutes a greater proportion of total output. At zero signal input there is no real signal, of course, just noise, and in the example this corresponds to an output 50dB below the limited output.

The full-line mono noise curve shows how the noise contribution falls as the aerial signal is increased. At 50µV input, for example, the noise curve is at -50dB. Now, the signal/noise ratio is the dB difference between the noise and output curves, the ratio thus increasing as the signal strength increases. At 10µV input the ratio is just under 20dB, while at 20µV it is up to about 58dB. At 100µV it has maximised to about 60dB (the ultimate signal/noise ratio of the receiver or tuner), the noise then being so small as to be totally inaudible. This is on mono, but what about stereo?

S/N RATIO AND STERE0

The broken-line stereo noise curve shows this action. At 10µV input the ratio is a mere 15dB, and even at 20µV it is not much better than about 24dB. Thus noise on stereo at the input would be very troublesome though possibly acceptable on mono. At 60µV input there is almost a 20dB difference between the mono and the stereo signal/noise ratios, and on stereo the ultimate signal/noise ratio rarely reaches the mono ultimate. Nevertheless, the ratio of almost 60dB for stereo at highish aerial inputs is perfectly acceptable.

It must be stressed that these curves are not typical of any particular receiver or tuner. The overall design greatly influences the nature of the curves, and the greater the sensitivity of the receiver or tuner the lower the aerial signal required for full limiting and for an acceptable signal/noise ratio, and this applies both to mono and stereo, but with stereo always requiring more signal for a given signal/noise ratio, particularly at the low signal input end of the scale.

RECEIVER REQUIREMENTS

Clearly, then, the type of aerial required for the best stereo reception depends not only on the strength of the prevailing signal field but also on the sensitivity of the receiver or tuner. Some hi-fi tuners are capable of providing a mono signal/noise ratio of 40dB or more from an aerial input as low as 2 or 3µV and a similar stereo ratio from 20 or 30µV, with the ultimate ratio occurring at 10 or 100µV respectively. On the other hand, relatively inexpensive receivers might require up to 1mV signal (or more) for an acceptable stereo signal/noise ratio.

It is a fair indication that the aerial signal strength is insufficient should a tuner or receiver exhibit undue background noise on stereo, while producing an acceptable signal/noise ratio on mono. It is sometimes necessary to have a decoder fitted into a tuner or receiver to take advantage of the stereo signals when the 'local' FM transmitter goes over to stereo. On the other hand, the tuner or receiver may be 'stereo-ready', meaning that the stereo decoder is already incorporated. Most hi-fi tuners are of this kind.

Working with a stereo signal, a stereo tuner delivers signals in the left and right channels for application to the left and right channels of the amplifier, these two channels then feeding the stereo loudspeaker pair. A fully-fledged stereo receiver contains not only the stereo decoder but also the two amplifier channels, two loudspeakers then being required for stereo reproduction in the normal way.

The Antiference FM244 has the usual folded dipole, with two directors and one reflector element.

To glean some idea as to whether the aerial which is feeding a mono receiver is delivering sufficient signal for reasonably noise-free stereo, a 20dB attenuator can be connected in series with the aerial (coaxial plug-in types of various attenuation values can be obtained from dealers). If the mono reception is then still noise-free, it can be basically assumed that the signal will be strong enough to operate a stereo receiver or the same receiver after a decoder has been installed.

SIGNAL FIELD

The strength of the signal field locally from the nearest stereo-encoded station will depend on how far away the site is from the station and on the site elevation, while the amount of signal induced into the receiving aerial will depend on its height above ground, on the degree of local screening (by hills, large buildings, etc.), on the gain of the aerial (how many elements it possesses), on the attenuation of the downlead or feeder and on how well the aerial is orientated with respect to the station (some high-gain aerials are very directional such that almost half the signal is lost by a mere 30deg. misbeaming).
"PAPER" I.C. TRANSISTORS

ANY people have watched and wondered where integrated circuit technology will go next. The amount of semiconductor terminology in current usage gives some idea of the path along which i.c. development has rushed headlong.

In America, development has been quietly proceeding over the past few years with some interesting thin film technology. Yes, it had to come—the paper transistor! Devices have been successfully produced on a variety of flexible materials which include metal foils plus numerous plastic films and paper.

These days one thinks of an i.c. as being very small with the latest ones either smaller still, or the same size but with more packed in them. It is surprising, therefore, to hear of a six-inch square i.c. with some 14,000 transistors on it. Such is the state-of-the-art with these flexible circuits. It is envisaged that when this art is perfected further, some half a million transistors will be put onto the same size i.c.

THIN FILM

The interesting thing about these flexible i.c.'s is that they are not hybrids—the only production method used is that of thin film.

Thin film transistors were announced by one researcher back in 1968. The devices were f.e.t. types with insulated gates and were successfully reproduced on paper. Both p-channel and n-channel devices were made.

At this point, gate voltages around 200V were possible and power dissipation was about 0·5W. Two years later this power dissipation capability had been doubled. These flexible beastsies are not fragile, either. The active devices will function happily when bent round a radius of some 0·06in. Production-wise it would appear that the flexible substrate—film, paper or whatever, is simply wound onto a spool. From here, it is fed into a deposition "processor" and is subsequently wound onto a take-up spool much the same way in which a cine film travels through a projector.

Please note: these devices are not on the market and no further information is available to date.

ACTIVE FILTERS

Although the above application may indicate a rise in fame for thin film, there are other areas where this technology could have very stiff competition. Hybrid thin film devices may find this from some miniature active bandpass filters which have just appeared. These have pre-tuned centre frequencies from 3,500Hz down to 200Hz. Gains available range from 0 to 40dB with Q factors from 2 to 50. Twist in the tail of this story is the size. These active filters are only 0·25 x 0·25 x 0·25 inch.

S.H.F.—AND HOW!

Still with components but looking at high frequencies, I note that the quest for higher and higher frequency requirements is still very much an active field in every sense of the word. The r.f. enthusiasts were elated when news of the first 1GHz devices appeared. Goodness knows what realms of ecstasy my news will bring but I have just learnt of oscillators using Impatt diodes which give some 120mW at—wait for it—140GHz. Outputs at 200GHz are expected later this year with 100mW at 170GHz already being mentioned.

8192-BITS

Charge-coupled devices are fascinating creatures. Space does not permit a discussion on how they work. However, as a point of information, one company is currently developing an 8,192-bit shift register which should cause a few hiccups in the computer hardware circles. The result could be a system which is 20-30 times faster than comparable rotating discs.

TIME IS PRECIOUS

For those who like to be in contact with electronics all the time, electronic watches are catching on fast. My own wrist watch has an accuracy (written guarantee) of an error not greater than 60 seconds in any one calendar year which, I thought, was pretty fantastic. Unbelievers might care to work out the number of seconds in 365 days and then work out the percentage error.*

Omega has gone one better. This Company's latest wrist time piece has an accuracy of one second a month or 12 seconds/year. Readers will be pleased to know that these electronic watches will be available next year; and not so pleased to know that prices start from £425. Truly, time is precious.

SPIN OFFS

Very often there is a useful spin off of products for the Amateur. Some professional industrial idea has, say, consumer applications. Tape recorders may benefit further from the design and development of tape heads for data applications. An example is the latest tape heads on the data market which are 0·4mil flying lead types. In practical terms this means a recording density on the record discs of 1,500 tracks per inch. A 600 tracks/inch density can allow storage of something like 60 million bits of information. If this ever spreads to tape recorders, then the cassette tape you get with your new recorder will last you for life. How you would locate a particular item on such a tape is quite another matter.

RED CURRENTS?

Radio waves are attenuated by a variety of things. Often the terrain over which they pass is an important factor although the frequency involved is a major consideration. Workers in Russia have been looking into the effects of forests on medium and long wave radio transmissions. The findings are as follows. A tree with a circulating sap was found to be a good current conductor (no, not a Red current bush). Thus an electric current is induced in the tree when it "interacts" with radio waves. The induced current creates an electrical field, albeit a small one, which is radiated into space and thus dissipated. Doubtless we will now have some ingenious Amateurs using centre-fed yagis or root-loaded rows.

* Sixty parts in thirty one million, five hundred and thirty six thousand.
IN NEXT MONTH'S
PRACTICAL WIRELESS

OCTOBER ISSUE
No.800
ON SALE
SEPTEMBER 7th

QUADPHONIC SOUND SYSTEM

PW Q4 PROJECT

PLUS EXPERIMENTAL WORKSHOP

FREE INSIDE

DON'T MISS ANY ISSUE OF PRACTICAL WIRELESS

NOW YOU CAN HAVE QUADPHONIC SOUND AT LOW COST.
FOLLOW PW PROJECT Q4 FOR THE FIRST FULLY COMPREHENSIVE 'DO-IT-YOURSELF QUAD' DECODING SOUND SYSTEM TO BE PUBLISHED WITH FULL CONSTRUCTIONAL DETAILS.

Part 1 in the October issue gets you started with "GOING QUADPHONIC", a broad outline of the various quad systems that are incorporated in the project. It gives you an understanding of the different principles involved so that you can choose the systems you need. Parts 2 and 3 present the exclusive PW practical design in detail. You can make up one, two or more of the systems as you like but the complete Q4 quad unit shown here is designed to give you decoding for all of them: CD-4 Victor-RCA discrete system, RM Regular matrix surround sound, QS Sansui system, SQ CBS system. You can use this system with your own choice of amplifier. It will convert two-channel stereo to any four-channel quad system, so you can use it to play any quad or stereo recordings, as well as being ready for any of the quad broadcasting systems that may be adopted.

DON'T MISS OUT ON THIS NEW EXCLUSIVE SCHEME FOR READERS OF PRACTICAL WIRELESS. PW DATACARDS ARE DESIGNED ATTRACTIVELY AND CLEARLY TO GIVE YOU AT-A-GLANCE TECHNICAL INFORMATION THAT YOU WILL BE CONSTANTLY REFERRING TO. THEY ARE PRINTED IN FULL COLOUR SO THAT YOU CAN IDENTIFY EACH CARD EASILY. COLLECT THE WHOLE SERIES FOR YOUR WORKSHOP. PW DATACARDS WILL FIT INTO THE AVERAGE JACKET POCKET, STAND ON THE WORK BENCH, HANG ON THE WALL, OR CAN BE USED AS A PLACE MAT, OR EVEN A BOOKMARK. THE SERIES WILL BE PRESENTED IN PAIRS IN THE OCTOBER, NOVEMBER AND DECEMBER ISSUES AS FOLLOWS:

- **October issue**
  1. Standard Resistor values and colour code.
  2. Common Capacitor values and colour code.

- **November issue**
  3. DIN Plugs and Sockets.
  4. Using decibels.

- **December issue**
  5. Combined resistance or capacitance calculator.

Don't miss the first pair in next month's issue. No other radio or electronics magazine has given such a comparable free service to its readers.
THIS is a neat portable table receiver covering medium waves and 200kHz on long waves and capable of a substantial loudspeaker output. It has an attractive but quite easily made case. Operation is from a 9V battery.

Fig. 1 is the circuit, using the ZN414 10 transistor network in the r.f. section, and SL403D as audio amplifier. The latter incorporates 16 transistors and 4 diodes. The following details will help clarify working of various parts of the receiver.

Tuning

A ready made Litz wound ferrite rod is used, and this will be found to have greater efficiency than a home made winding of ordinary enamel or cotton covered wire. For maximum efficiency the tuning capacitor VC1 is air-dielectric. The small Jackson 208/176pF type of capacitor, extensively used for aerial and oscillator tuning in superhets, is easily obtainable, and is fitted. As L1 is designed for a 208 pF capacitor this provides correct band coverage, with the added advantage that an attractive ready-calibrated transparent dial is available for tuning.

C1 is fitted to limit h.f. coverage to about 1600kHz, the MW band being approximately 1600-550kHz. For reception of the BBC on 200kHz, S1 is closed. This places TC1 and C2 across L1, and the full swing of VC1 then covers about 195-250kHz. For full LW coverage it would be necessary to have a LW winding on the ferrite rod instead.

RF Section

The ZN414 radio receiver silicon network requires a reasonably stable supply in the 1.1 to 1.8V range, and this is obtained by the potential divider R3 and R4. It was found that best results were obtained with a supply of about 1.4V here.

The best possible supply voltage may depend somewhat on the exact layout of wiring, and in the receiver shown two Veropins were inserted so that R4 could easily be changed. This is scarcely necessary, but the importance of the voltage present here should not be overlooked. It must not exceed 1.8V (this can be checked by clipping a high resistance voltmeter across R3). If it is rather high (in the 1.6 to 1.7V range) instability is likely, and is shown by whistles accompanying the tuning-in of weak signals, though the whistles may disappear with strong transmissions. On the other hand, if the supply is rather low (1.1 to 1.2V or so) receiver sensitivity falls off considerably.

It is thus recommended that the values given are fitted, and R4 only need be changed if instability, or very low sensitivity, is apparent when the receiver...
Fig. 1: Circuit of the RW POP Star Receiver.

Switch S2 in the usual way.

This control incorporates the on-off audio output is taken from C5 to the volume control. VR1. This control is best possible results, the effect of reducing the K2 level to 680 to 690 or 470 ohms can be tried.

If the circuit experiences are a few minutes of running, the best in this manner, CI is of somewhat higher value than recommended.

Tested.

Or very low sensitivity, is apparent when the receiver sensitivity falls off considerably.

Supply is rather low (1.1 to 1.2V or so) receiver is satisfactory lower transmission. On the other hand, if the strong signal is removed, there is no difference when the whistle or weak signal is applied. By themselves accompanying the tuning-in of weak signals is likely, and is shown 1.6 to 1.7 V range. Inability is likely, and is shown...
is tested.

R2 is of somewhat higher value than recommended by the manufacturers, but was found best in this circuit. If experiments are afterwards made to secure the best possible results, the effect of reducing R2 to 680, 560 or 470 ohms can be tried.

Audio output is taken from C5 to the volume control, VR1. This control incorporates the on-off switch S2 in the usual way.

\* components list

<table>
<thead>
<tr>
<th>Resistors</th>
<th>Capacitors</th>
<th>Miscellaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1: 400kΩ</td>
<td>C1: 12µF</td>
<td>IC1: Jackson 00, 200/176F</td>
</tr>
<tr>
<td>R2: 1kΩ</td>
<td>C2: 470pF</td>
<td>IC2: SL403D</td>
</tr>
<tr>
<td>R3: 470Ω</td>
<td>C3: 0.01µF</td>
<td>15Ω 3¾in square speaker</td>
</tr>
<tr>
<td>R4: 2.7kΩ</td>
<td>C4: 0.1µF</td>
<td>IC3: SL403D, 1250pF compression type</td>
</tr>
<tr>
<td>R5: 1MΩ</td>
<td>C5: 0.047µF</td>
<td>100µF/10V, 10V, 10V, 10V, 10V</td>
</tr>
<tr>
<td>R6: 220kΩ</td>
<td>C6: 6.4µF, 6.4V</td>
<td>100µF, 10V, 10V, 10V, 10V, 10V, 10V</td>
</tr>
<tr>
<td>VR1: 100kΩ log pot, switch</td>
<td>C7: 2.5µF, 10V</td>
<td>100µF, 10V</td>
</tr>
<tr>
<td>VR2: Miniature 100kΩ potentiometer</td>
<td>C8: 0.01µF</td>
<td>100µF, 10V</td>
</tr>
</tbody>
</table>

Audio Section

To assist wiring, pins for the SL403D are shown in their actual positions in Fig. 1. Pin 6 is the pre-amplifier input, from the volume control VR1. This employs cascaded emitter followers and a common emitter stage. Output is at pin 5, which is directly connected to the main amplifier input at tag 4.

VR2 is a miniature pre-set potentiometer, provided
to trim the bias operating point, and it requires no further adjustment, when once set.

The main amplifier has 13 transistors, with cascaded emitter followers between stages. Although up to 18V may be applied to the SL405D, the circuit here is intended for a 9V battery. Output is approximately just under 1 watt with a 9V supply, using a 7·5 ohm speaker. The speaker impedance actually selected is 15 ohms, this allowing approximately 400mW with the 9V supply, with additional current economy. This power output is considered easily adequate for a receiver of this kind.

C10 is a by-pass for the main amplifier input, and R7/C13 are for h.f. compensation, and should not be omitted.

Components

R3 and R4 are shown as 5 per cent, for the reason explained. This tolerance is so generally available that it can be used throughout. There is actually no reason why 10 per cent resistors should not be fitted, provided the voltage across R3 is checked as mentioned.

For the 9V supply, all capacitors could be of 10V rating. In numerous circuit positions a lower rating could be fitted. However, there seems little point selecting the lowest possible voltage ratings, as the usual small capacitors of up to 150V rating are of course perfectly suitable.

Circuit Board

This is 0·15in. matrix plain Veroboard approximately 5 x 1·5sin., see Fig. 2. Brackets are bolted at holes D-D to support the ferrite rod. Holes B-B are to secure the finished board to the bottom of the receiver.

The a.f. amplifier is bolted with the spot (near pin 1) located as shown. Connecting wires then pass down through convenient holes in the board.

Wiring underneath is shown in Fig. 3. Insert a few components at a time as in Fig. 2, turn the board over and solder as in Fig. 3, cutting the wire ends of components down as required. Insulated sleeving should be put on any leads which may touch other connections.

Veropins are inserted for external connections to L1, the loudspeaker, and battery circuits. The three thin flexible leads X, Y and Z are for connection to VR1.

Leads from the ZN414 are shown in Fig. 3. Position these so that lead E comes between the other wires, when they are in line as in Fig. 2. Stray feedback from output to input circuits may easily cause instability, so the lead is taken directly to C4, which in turn goes directly to the earth or negative line. The usual care to avoid lengthy heating is taken when soldering the two semiconductor devices.

Ferrite Aerial

The usual superhet type aerial has a small coupling winding, provided for base coupling to the mixer. This is not required here and is removed.

Two pieces of 1·5sin. thick paxolin or similar material are cut, about 1·2in. wide and 2in. long. A "V" is cut in the top of each, a small hole being drilled just below this.

Small brackets are bolted to the strips, and secured in the holes D-D, Fig. 2. The rod, with winding, is then secured with string around it and through the holes in the paxolin strips. The ends of L1 are soldered to the pins provided on the board.

Front Panel

This is a 8 x 4in. flanged universal chassis side. An aperture is cut to match the speaker cone—this is most easily done with an adjustable tank or washer cutter. Also position holes for VR1 and S1, as in Fig. 4, and 1in. from the bottom edge.

VC1 has to be set back as in Fig. 4, to allow the
transparent dial to be fitted, and the frame of VC1 must also be insulated from the aluminium panel. The spindle is 1\(\frac{1}{2}\)in. from the top.

Three 3\(\frac{1}{8}\)in. 4BA bolts were used to secure the capacitor. A piece of paper with a hole for the spindle is pushed on to the front of the capacitor, so that the location of the fixing holes can be marked. This paper is then placed on the front and drilling positions are marked with a sharp tool. The central hole is 1\(\frac{1}{8}\)in. diameter and the three fixing holes are 1\(\frac{1}{4}\)in.

An insulated bush and washer is placed on each bolt, followed by a plain washer, and two nuts.

The bolts pass into the threaded holes of the capacitor, and are adjusted so that it is square with the panel. The nuts are then locked against the frame, and front washers.

An alternative is to drill two pieces of thin paxolin, about 1\(\frac{1}{2}\) x \(\frac{1}{8}\) in., to match the capacitor fixing holes. One piece can then be used each side the metal panel. Contact between the bolts and metal can be avoided by carefully locating the bolts before tightening the nuts, or by placing thin insulating washers on them, or using extremely short pieces of insulated sleeving.
The dial is a tight push fit on the spindle, and has a metal clip. A check should be made that this can be fitted. If not, the end of the capacitor spindle will have to be filed slightly, to produce a taper to get the push fit started. If necessary, the centre hole of the dial can be enlarged slightly with a $\frac{1}{4}$in. drill, using very light pressure indeed.

If an ordinary knob or dial is used instead, the capacitor should be insulated from the panel, but with its spindle projecting.

A piece of $\frac{1}{4}$in. hardboard 8 x 4in. is fixed to the inside of the lower flange with 6BA bolts. The circuit board can then be fixed as in Fig. 4, using screws or bolts with extra nuts or spacers to give a little clearance to underside wiring.

Connections are then completed as in Fig. 4. Note that the metal panel is earthed to the negative line by the lead Z, from VR1. This was found necessary.

**Adjustments**

These are very few, as there is no alignment in the manner required with a superhet.

Band coverage is adjusted by the position of the winding on the ferrite rod. This can be placed nearly at one end. Or the dial can be set at 550kHz, with VC1 closed, and the winding moved along the rod to tune to this frequency.

VC1 is then set half open, S1 is closed, and TC1 is rotated to tune in the BBC on 200kHz. When this is done, VC1 merely acts as a fine tuner for this frequency. The position of L1 on the rod has considerable effect on the setting of TC1. Should TC1 be fully open without 200kHz being reached, L1 must be moved a little towards the end of the rod. On the other hand, if TC1 is fully compressed without 200kHz being reached, L1 must be pushed a little further on the rod. As there is considerable adjustment, and L1 is of suitable inductance, no difficulty should arise here.

VR2 has to be rotated with a small screwdriver, for best audio results. If VR2 is too far one way, reproduction is very distorted indeed. Moving VR2 too far the other way will cause a considerable increase in battery current, as shown by a meter in one battery lead. With normal adjustment, which is not at all critical, current should be about 20mA with low volume, peaking up to 40mA or more with considerable volume. If wrong adjustment of VR2 causes an extremely heavy current, this may persist. If so, momentarily break one battery connection (or switch off). This effect arises from the automatic s.c.r. protection integral in the module, and does not cause damage.

**Finish**

A piece of self-adhesive material, as used for shelves etc., and about $4\frac{1}{2}$ x 5in., is placed on the control side of the front. It is better to cut this to clear the bushes before striping the backing paper.

A piece of silk material about 4 x 5in. is stretched over the speaker, which is secured with countersunk bolts. This material is held at the edges only with Bostik 1 or similar adhesive. A vertical strip about $\frac{3}{4}$in. wide and 4in. long covers the joint. This can be wood, metal, plastic, or as sold for shelf edgings etc.
In some parts of the country there may be no point in providing 200kHz coverage. If so, TCI, C2 and S1 may be omitted.

Case Construction

This is made just to clear the receiver (see photograph) so that it needs to be very slightly outside on the 8in. dimension to avoid a tight fit. The pieces were secured together by spreading adhesive on the meeting surfaces, and securing them with a few panel pins. Some 1/4 x 1/2in. strips were also cemented inside to strengthen the joints. When the adhesive is hard, the outside is glasspapered. Dust is blown or wiped away (this is essential) and the outside is covered with a wood-grained self-adhesive material.

At the bottom, about strips 1in. wide and 8in. long were fixed at the front and back, the front strip being covered with the wood-grained material first. Rubber feet at the front raise this a little.

An alternative is to make the case complete with bottom and back the full depth, so that the whole receiver can be slid in from the front.

Copy from readers for inclusion in this reader service is published on a space available basis. Copy must be forwarded on a separate sheet of paper and in the style shown above, otherwise it cannot be accepted.

EQUIPMENT REQUIRED

I have recently received an S.W.I. a Corder CR704A in good working order. I will pay around £20—£25, 50 Western Road, Kilnarnock, Ayrshire, KA3 1SB.

...correspondence or exchange or buy any technical data with someone in U.K.—V. Jackson, 33 Main Street, Enniskillen, Co. Fermanagh, N.I.

...wanted October P.W. 1971.—P. Smith, 66 Gadsden Road, Fetcham, Leatherhead, Surrey.

...two Electrodynas (1 transformer type D.F.68 series 11 plus electrodynamic O-Multiplier cell type GLZ, please state price.—J. Dickey, 17 Meley Avenue, West Norwood, S.E.27.

...24 Novice 84 requires Pye "Cambridge" or similar rig to cut teeth on. Will collect in North East & Yorkshire.—J. Collings, 6 Ripon Road, Northall, Hull, Co. Durham.

...a case for an Ultra Road Ranger Translator portable model 6116 serial 2567.—R. Williams, 204 Dyas Road, Grimsby, Lincs.

...a cheap X70 valve.—S. Taylor, 30 Ospahaw Road, Abbey Wood, London, SE2 0TD.

...a cessor X9 valve. I have tried equivalents but they all have a lower stage gain.—D. R. Goodwin, 3 Marl House Gardens, Hamble, Hampshire.

...Leadbottle HA. 60A, required operating instructions circuit diagram alignment information.—B. Thomas, 8 Whitehall Road, Barntley, Kes, Bedford.

...static tuning scale (black) for Pye valve car radio, Type No. 14331.—M. Stanley 9 Orminton Gardens, Belfast BT3 6JD.

...a 400Hz. 30 micro-amp meter (soldered with books wanted. Reasonable price).—A. Forster, 14 Mandells Court, Norwich, NR2.

...collars wanted. Can anybody help me find two off. 243 formers, for transistor Collins. If you can sell me one (or two), please ring me on 01-938 5113.—J. G. Manning, 63 St. Dunstan’s Close, Hampton, London W73 8PG.

...RCA AR820 good condition, table or rack mounting.—N. Thompson, 5 Beachcroft, Ashtead, Surrey.

...Chassis of a Murphy type U880. I require the Osc. coil for L.W. & M.W.—A. S. Holwood 8 Dock Street, Penkridge, Denbach, Leicestershire.

ISSUES WANTED

I have issues of Practical Wireless—T. A. Griffiths, 14 Willans Road, Reading, Berkshire.

...I am interested in QRP, and especially Transmitter Amplifiers...—J. H. Hitchcock, 119 Old Brompton Road, South Kensington, London, SW3.

...I am interested in 40 meter v.h.f. and W20B is still the best one I have heard.—J. A. Hyatt, Beech House, Beechway, Guildford, Surrey. —J. T. F. Smith, 35 Boundary Road, London, W8.

...issues of P.W. from Nov. 1971 to Aug. 1972. Interested.—J. H. Pilkington, 16 Station Road, Ipswich, Suffolk, IP2 0T3.

...February 1965 issue of Practical Wirelesses—T. A. Griffiths, 11 Berryfields Long Buckley, Nr. Rugby.

...January 1971 issue required giving details of the stereo tape recorder amplifier.—A. Harbour, 1/04 High St., Brundish, Midlands.


...February 1969, which had a Servicing Television Receivers No. 105. Dallant 9A81 U Series (Part 3) to it.—H. McBeth, 67 Castle Hill Road, Bearesden, G61 4DZ.

Photograph of the PW POP STAR cabinet. In this photograph the cabinet back is shown face downwards.
WHILE visiting Sweden recently, Colin Riches called on one of our Going Back readers—Gunnar Carlström, SM6KT who has a fine collection of Vintage radio equipment.

He told how, when broadcasting started in Sweden about 1925 he was a boy of twelve and became very interested in the new wonder of radio. His financial situation did not permit him to buy much equipment but he managed to build one or two crystal sets then progress to valved receivers. A simple receiver of that time consisted of a one-valve detector. Headphones would have to be used as there was not enough power to drive a speaker.

In some more advanced receivers Gunnar built, one or two valves were used as r.f. amplifiers with tuned circuits. After the detector, one or two stages of audio amplification were used.

A very common type of receiver used in Sweden in the early '20s was equipped with one valve as detector and two others for amplification. This set-up gave good volume over a loudspeaker when tuned to the local station and British and European stations could be picked up but at vastly reduced volume.

Feedback was frequently used in order to increase the amplification and selectivity of Gunnar’s receivers. When he tried using it in some of his home-built sets which had no r.f. amplifier stages it often brought irate neighbours rushing in complaining of oscillations on their receivers!

In those days, the high tension batteries were very expensive and if a 90V supply was required, Gunnar said that poor boys like he had to wire a lot of torch batteries in series so that they could get the required voltage. Accumulators were used for the 4V supply.

Around 1930, receivers working from the mains supply were made available in Sweden and Gunnar told how he remembered his first experiment to build a unit so that he could work his battery receivers from the mains. The great difficulty was to eliminate the hum because only low capacity paper condensers were available at the time.

Gunnar explained that the experimenting of those earlier years really inspired him and made radio his hobby for life. In 1938 he gained his licence to transmit with the callsign SM6KT.

He has found the rapid development of radio very fascinating and he has realised that so many of the old pieces of equipment are very well worth saving.

Some items in his collection of Vintage gear have been in his possession for 40 years but most of the others have been collected quite recently. Gunnar explained how he took great delight in completely restoring old sets to their former glory.

A particular interest of Gunnar’s is his collection of old valves. He describes them as his “Aladdin Lamps”, and says that it was really them that made radio possible but now their rôle in ordinary receivers is almost terminated, and he feels that this is a great shame. He has a collection of receiving valves which covers 50 years of valve development. They are all put together in chronological order and although Gunnar has only valves dating from the early 1920s at the moment, he hopes to obtain some earlier types. He is also very interested in pre-1920 receivers and speakers.

Incidentally, Gunnar has asked if anyone can help him locate a mains transformer for the Philips 2514 receiver shown in the pictures. It must have an output of 200-0-200V and two 4V windings. The width must be 72mm. He has one 75mm wide transformer but this will not fit.

If anyone wishes to write to Gunnar on any aspect of Vintage radio, his address is: Gunnar Carlström, S-540 MOHOLM, Sweden.
This receiver has four valves—1 detector and 3 audio. The feedback coil is shown on the right of the picture. The manufacturer is unknown but could possibly be VDFI. Date is about 1924 and the type number “E36” is printed on a small panel.

This receiver was bought from a local farmer in 1936 and is dated c1926. It is in good working condition and is made by Stern & Stern of Stockholm. Called the “Concerto II” it employs two valves and uses a wirewound pot for the filament supply. The speaker is a Philips type 2016 and was a common design in the mid to late 20’s. This set would be quite sensitive using only a short indoor aerial.

This receiver has a detector and audio valves and is dated about 1926. Power supplies are 4V and 60V.

The “E36” shown with a “Tefag” loudspeaker. Manufacturer of the speaker is not known.

An external view of the above (left) receiver. The cabinet is in very fine condition and the control panel is of black Bakelite.

The Telefunken receiver. The three valves are held in place by three sprung holders. This set was found in an attic in very bad condition but Gunnar Carlström has completely renovated it and built a new lid to the cabinet. Date is c1927. The speaker is a NORA type and more gen on this would be appreciated.

The Philips 2514 for a.c. operation. Contains a universal supply unit for filament current, anode current and grid bias. Valves used are SV4, 154V and PM24. The a.f side of this set could be used with a pickup to reproduce records. A popular design in the mid to late 20’s, this set would be quite sensitive using only a short indoor aerial.

Interior view of a home-constructed receiver. It has a detector and audio valves and is dated about 1926. Power supplies are 4V and 60V.

Interior view of the Telefunken receiver. Bandswitching for m.w./l.w. is on the front panel. Power supplies are 100V and 4V.

Another view of the Philips 2514 showing the tuning capacitors. This is the set that lacks a mains transformer (see opposite page).
Lusitania Messages

T. A. Ledward, 4 Haulfryn Terrace, Blaenau Ffestiniog, Merioneth writes . . . “In the year 1910 a school friend, living only a quarter of a mile away, suggested that we should make a transmitter and receiver. We did so and were licensed by the Post Office who allotted us a call sign and wavelength. The transmitter utilised a spark coil and the receiver a crystal, with coil and slider for tuning, and a single headphone. It worked well. I became so interested that after spending some time apprenticed to heavy engineering between the age of fifteen and eighteen, I took a course in Wireless at the Manchester School of Wireless Telegraphy. I quickly became proficient in Morse and had quite a thrill when listening at home on my own crystal set. I picked up messages passing between the Lusitania at Liverpool Landing Stage (I was only six miles away), and the Seaforth Station. I joined the Marconi Company, as a sea-going operator, and after serving on several merchant ships, I volunteered at the beginning of the first World War in 1914 for service on H.M.S. Victorian, an armed merchant cruiser, only just fitted with guns, etcetera. My sea-going career ended in 1917, when the ship on which I was serving was torpedoed and sunk. The German submarines had been having so much success that there were not enough armed merchant cruisers left to give employment to all the available operators, and I joined the R.A.F. (just re-named from the R.F.C.) and was appointed radio instructor in a home camp.

“Make Your Own Wireless Valves”

W. A. Field, 10 Thurlestone Gardens, Dartmouth, Devon says . . .

“I have been reading your article Going Back with very great interest. My practical experience goes back to 1916. I made my first radio set in 1917, then continued to complete the transmitter in early 1918. The entire equipment was made with the help of “The Boy Electrician”, published in 1915 by A. P. Morgan (Duckworth & Co.), 3 Henrietta Street, Covent Garden W.C. (Little did I know that this subject was to be my career). This book was wonderful. It described each item, how to construct it, what it was for, then building the item into a complete circuit.

I constructed everything in this book from the crystal detector, tuning coils and condensers to the complete wireless station for amateurs, which I ran for many years. When the BBC started regular transmissions I constructed sets for the market. I had quite a lot of experience with the S T Manual. This was the first edition. I used the ST 200 as a basis for a radio set which could be used from a car, the audio side had to be altered and increased. Triode valves were coming in, and the famous Model Engineer came out with Make Your Own Wireless Valves. These were made of carbon filament motor car bulbs. The filament acted as the heater and a small ring or copper plating on the outside of the bulb as the anode. The deficiency here was the electrons had to pass through the glass first, later on we improved on these. All through my experiments I kept notes, and I have an old crystal set procured in 1917 and still working by my side now. (Is this a record?)

Amateur Radio Techniques (Fourth Edition)
By Pat Hawker G3VA
Published by the Radio Society of Great Britain
256 pages, 9½ x 7⅛in. Price £1.60.

EVERY radio amateur has a few favourite reference manuals on his bookshelf and among these must surely be numbered Amateur Radio Techniques, published by the Radio Society of Great Britain. Their monthly magazine Radio Communication features “Technical Topics” and the reviewer knows that he is not alone in making this priority reading as each copy drops through the letter box. ART is a collection of choice items from TT since Pat Hawker G3VA began the series in 1958. If a quick recap on a particular circuit or idea is needed the chances are that it will be found in ART. It would be quite wrong to imagine that this book is just for the “ham” fraternity because it can be found on the desk of many professional electronics engineer, in Government departments and in the Services. This much enlarged edition contains over 600 diagrams with all necessary component values helping to illustrate and explain the plethora of practical ideas under such headings as Receiver Topics, Oscillator Topics, Transmitter Topics, Audio and Modulation, Aerial Topics and Fault-Finding and Test Units. Chapters on Semiconductors and Components and Construction fill in the gaps to provide an excellent publication. As the author points out, this is an “ideas” book rather than a conventional text book, the reader being left to use his own knowledge and experience in making up a particular circuit but it would be a poor experimenter who would not glory in doing just that. Altogether a fabulous book which can be picked up and read to advantage at any time but particularly useful when inspiration is needed.

Published by The Butterworth Group—Lliffe Books
201 pages, 7½ x 4½in. Price 75p (paperback).

THIS latest edition of a well established reference book lists broadcasting stations from information supplied by the BBC. It includes articles on various related topics for the listener and a listing of V.H.F. Sound Broadcasting Stations.
Construction

Because of the length of the 3BP1 cathode ray tube, it is necessary to use a deep chassis. In fact the oscilloscope chassis is 14in long (from back to front). The overall oscilloscope chassis dimensions are 14 x 9 x 2½in.

The front panel has to accommodate the c.r.t., seven variable controls, two input sockets, sync on/off switch, pilot lamp and an earth terminal. The overall oscilloscope dimensions are 14 x 9 x 212in.

The drilling layout for the oscilloscope front panel is given in Fig. 5.

The astigmatism (VR7) X shift (VR6) and the X linearity (VR5) controls are mounted along the side of the chassis. The a.c. inputs from the mains transformer sub-chassis (containing T1, T2, and T3 etc) enter the oscilloscope chassis via the 10 way cable. This saves space on the front panel and simplifies the layout.

The Veroboard panel containing the main oscilloscope circuitry is mounted in a 12 x 3½in. cut-out in the oscilloscope chassis. Use the Veroboard panel as a template when drilling the fixing holes in the oscilloscope chassis.

The oscilloscope front panel also has an aperture covered by a piece of laminated plastic sheet. This is necessary because the brilliance control VR9 is approximately 720 volts negative with respect to the chassis and therefore needs to be well insulated. There is about 50 volts across the brilliance control. The focus control VR8 is also at a high negative potential with respect to the chassis and this has about 300 volts across it.

The laminated plastic sheet is extended to make a mask for the face.

The angle pieces holding the front panel to the chassis should be 16 or 18 s.w.g. aluminium and the bolts are 2BA with shake proof washers and firmly tightened nuts.

The method of supporting the c.r.t. is unconventional but it allows the tube to be adjusted to level the X axis (timebase) and at the same time the tube is held against a rubber ring glued to the back of the front panel.

The bracket which supports the back of the c.r.t. is secured to the chassis by four 4BA bolts which pass through grommets in the chassis and make the tube mounting more flexible. All the bolts have a full nut and a half nut for locking.

The main transformer sub-chassis carrying the three mains transformers, T1, T2 and T3 utilises a

---

Fig. 3: Component layout and wiring on the EHT panel.
Fig. 4: General view of the PW 'Student' Oscilloscope, showing the location of major components.

Note:
A laminated plastic tube mask is fitted to front panel (shown chain dotted).
Hole diameters,
A...4BA csk. for bolting front panel to chassis.
B...4BA csk. for bolting tube mask to front panel.
C...to suit fixing of various potentiometers and switches etc.

Fig. 5: Drilling layout for the front panel.
Individual windings have the tags transformer) used.

Note: left section of S2 is used only for earthing C5, 6, 7, 8, 9 and C10.

Rubber gasket stuck onto rear of front panel to cushion CRT face.

A suitable mains on/off switch, pilot lamp and a 2A mains fuse and holder may also be fitted to the sub-chassis front panel. It is recommended that the complete mains transformer sub-chassis is suitably enclosed to avoid accidents.

It is also possible to include a 100mV a.c. calibrating source from the 6.3V winding on T1 mains transformer. This is obtained from a 620Ω and a 10Ω resistor in series across the winding, and the junction is taken to a coaxial socket on the sub-chassis panel. The bottom of the 10Ω resistor goes to chassis. Because the 100mV signal will be fed into the Y input it is important to use a screened lead to avoid stray pick-ups. When wiring the 6.3V winding to the coax socket, make sure that it is the earthy side of the socket that goes to the earthy side of the 6.3V winding (remember—one side of this winding is earthed on the oscilloscope chassis).

Other Facilities

The design as outlined is a compromise, being mainly concerned with the construction of a basic oscilloscope. For instance, no oscilloscope is complete without flyback suppression, but this requires further circuitry. The author so far has been unable to decide upon a suitable circuit.

Another area in which the instrument could be improved is the Y input, but the author believes that the best solution here would be to design a separate unit which can be plugged into the Y input, capable of accepting any signal from 10mV/cm to 50V/cm.

Beam slitting facilities and a mixer for two inputs could be added. However, such a unit would require complete screening which would be difficult to attain within the present design.

As the instrument is used for checking the performance of Hi-fi equipment as well as general laboratory work, it is housed in 1/2 in chipboard cases covered with imitation mahogany laminated plastic.

Both cabinets have aluminium instrument case handles, 4 ins centre to centre.

In part 1, last month, LP2 as shown in Fig. 1 would not function. The upper lead from LP2 should go to the top end of the 6.3V winding instead. Attention is drawn to the breaks in the Veroboard strips—especially between Tr3 base and Tr4 collector.

Caution

This instrument should not be used on TV or radio or any apparatus where the chassis is live to the mains supply.
The Sinclair Cambridge... no other calculator is so powerful and so compact.

Complete kit-£29.95! (inc. VAT)

The Cambridge - new from Sinclair
The Cambridge is a new electronic calculator from Sinclair, Europe's largest calculator manufacturer. It offers the power to handle the most complex calculations, in a compact, reliable package. No other calculator can approach the specification below at anything like the price - and by building it yourself you can save a further £14!

Truly pocket-sized
With all its calculating capability, the Cambridge still measures just 4½" x 2" x ½". That means you can carry the Cambridge wherever you go without inconvenience - it fits in your pocket with barely a bulge. It runs on ordinary U16 batteries which give weeks of life before replacement.

Easy to assemble
All parts are supplied - all you need provide is a soldering iron and a pair of cutters. Complete step-by-step instructions are provided, and our service department will back you throughout if you've any queries or problems.

The cost? Just £29.95!
The Sinclair Cambridge kit is supplied to you direct from the manufacturer - you can't get it anywhere else. Ready assembled, it costs £43.95 - so you're saving £14! Of course we'll be happy to supply you with one ready-assembled if you prefer - it's still far and away the best calculator value on the market.

Features of the Sinclair Cambridge
- Uniquely handy package. 4½" x 2" x ½", weight 3½ oz.
- Standard keyboard. All you need for complex calculations.
- Clear-last-entry feature.
- Fully-floating decimal point.
- Algebraic logic.
- Four operators (+, -, x, ÷), with constant on all four.
- Constant acts as last entry in a calculation.
- Constant and algebraic logic combine to act as a limited memory, allowing complex calculations on a calculator costing less than £30.
- Calculates to 8 significant digits, with exponent range from 10⁻²⁰ to 10⁷.
- Clear, bright 8-digit display.
- Operates for weeks on four U16 batteries. (Replacement set costs about 15p.)
A complete kit!

The kit comes to you packaged in a heavy-duty polystyrene container. It contains all you need to assemble your Sinclair Cambridge. Assembly time is about 3 hours.

Contents:
1. Coil.
2. Large-scale integrated circuit.
3. Interface chip.
5. Case mouldings, with buttons, window and light-up display in position.
6. Printed circuit board.
7. Keyboard panel.
8. Electronic components pack (diodes, resistors, capacitors, transistor).
9. Battery clips and on/off switch.
10. Soft wallet.

This valuable book — free!
If you just use your Sinclair Cambridge for routine arithmetic — for shopping, conversions, percentages, accounting, tallying, and so on — then you'll get more than your money's worth.

But if you want to get even more out of it, you can go one step further and learn how to unlock the full potential of this piece of electronic technology.

How? It's all explained in this unique booklet, written by a leading calculator design consultant. In its fact-packed 32 pages it explains, step by step, how you can use the Sinclair Cambridge to carry out complex calculations like:
- Logs
- Sines
- Cosines
- Tangents
- Reciprocals
- nth roots
- Currency
- Compound
- conversion
- interest
- and many others...

sinclair

Sinclair Radionics Ltd, London Road, St Ives, Huntingdonshire, PE17 4HJ

Reg. no: 693483 England
VAT Reg. no: 213 6170 88

Why only Sinclair can make you this offer
The reason's simple: only Sinclair — Europe's largest electronic calculator manufacturer — have the necessary combination of skills and scale.

Sinclair Radionics are the makers of the Executive — the smallest electronic calculator in the world. In spite of being one of the more expensive of the small calculators, it was a runaway best-seller. The experience gained on the Executive has enabled us to design and produce the Cambridge at this remarkably low price.

But that in itself wouldn't be enough. Sinclair also have a very long experience of producing and marketing electronic kits. You may have used one, and you've almost certainly heard of them — the Sinclair Project 60 stereo modules.

It seemed only logical to combine the knowledge of do-it-yourself kits with the knowledge of small calculator technology.

And you benefit!

Take advantage of this money-back, no-risks offer today
The Sinclair Cambridge is fully guaranteed. Return your kit within 10 days, and we'll refund your money without question. All parts are tested and checked before despatch — and we guarantee a correctly-assembled calculator for one year.

Simply fill in the preferential order form below and slip it in the post today.

Price in kit form: £27.23 + £2.72 VAT. (Total: £29.95)
Price fully built: £39.95 + £4.00 VAT. (Total: £43.95)

To: Sinclair Radionics Ltd, London Road, St Ives, Huntingdonshire, PE17 4HJ

Please send me
☐ a Sinclair Cambridge calculator kit at £27.23 + £2.72 VAT. (Total: £29.95)
☐ a Sinclair Cambridge calculator ready built at £39.95 + £4.00 VAT. (Total: £43.95)

* I enclose cheque for £ made out to Sinclair Radionics Ltd, and cross.

* Please debit my *Barclaycard/Access account. Account number .

Name

Address

PW 973

445
A series of simple transistor projects, using not more than twenty components.

W E'VE got very good value for the enthusiastic guitarist this month; a very simple Waa Waa unit that gives quite a dramatic effect with either guitars or electronic organs. There might need to be a little work done to the basic circuit to make it suitable for every application, but as there are so many different permutations on signal levels and input/output impedances we thought we would compromise with a circuit that can be inserted into the signal line where there is a typical level of between 50 and 100mV at medium to high impedance. Most equipment should have some point in it where this type of signal can be located.

Circuit

The circuit is basically a phase shift oscillator using the twin T bridge as the frequency selective element. C4, 5, 6 and R6 with R7 and VR2 form the bridge. Feedback is taken from the collector of Tr1 via C2 into the bridge and then back to Tr1's base. Negative feedback is also applied to Tr1 by means of VR1 in its emitter by-pass circuit; the level of the latter has to be adjusted so that the feedback is just insufficient for oscillation to be maintained.

The Waa-Waa effect is obtained by giving preferential amplification to certain frequencies within the musical note and then sweeping this frequency up and down. The chosen frequency is set by the component values of the twin T bridge and this can be varied over a useful range by adjustment of VR2. The gain of the circuit is greatest at the frequency when the level of positive feedback is greatest.

Chords or single notes will give the effect but in the case of the latter there should be a good range of harmonics present as well as the fundamental. A pure sine wave input, for example the flute stop of an organ, will give no effect whatsoever.

Almost any npn silicon transistor can be used for Tr1; the only feature of importance is that its $h_{FE}$ should be in the order of 150 minimum (this is easily met by most BC108s). C4, 5 and 6 have been chosen to keep the Waa-Waa effect within the higher band of frequencies which adds more "sparkle" to the sound. If, however, a more mellow effect is required increase the values of these capacitors keeping the same ratio between them.

<table>
<thead>
<tr>
<th>Star components list</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R1</strong></td>
</tr>
<tr>
<td><strong>R2</strong></td>
</tr>
<tr>
<td><strong>R3</strong></td>
</tr>
<tr>
<td><strong>R4</strong></td>
</tr>
<tr>
<td><strong>R5</strong></td>
</tr>
<tr>
<td><strong>R6</strong></td>
</tr>
<tr>
<td><strong>R7</strong></td>
</tr>
<tr>
<td><strong>VR1</strong></td>
</tr>
<tr>
<td><strong>VR2</strong></td>
</tr>
<tr>
<td><strong>C1</strong></td>
</tr>
<tr>
<td><strong>C2</strong></td>
</tr>
<tr>
<td><strong>C3</strong></td>
</tr>
<tr>
<td><strong>C4</strong></td>
</tr>
<tr>
<td><strong>C5</strong></td>
</tr>
<tr>
<td><strong>C6</strong></td>
</tr>
<tr>
<td><strong>C7</strong></td>
</tr>
<tr>
<td><strong>Tr1</strong></td>
</tr>
</tbody>
</table>

No allowance is made for minimum order costs or for postage and packing and these points should be checked carefully before ordering.

Adjustment

When wired up it is only necessary to adjust the value of the pre-set potentiometer VR1 to give the correct level of negative feedback. To do this start with VR1 at minimum resistance and then turn VR2 over its full range. At some point a loud howl will be heard from the amplifier; this is the unit oscillating. Leave VR2 in the position for loudest howl and then slowly increase the value of VR1 (increasing the negative feedback) until oscillation stops. Readjust VR2 over its full range; if oscillation occurs at another point carry out the same procedure until VR2 can be swept from one extreme to the other with no oscillation occurring. The unit is then ready.

Circuit of the Waa-Waa unit which is essentially a phase-shift oscillator.
THE usual and accepted way of extending coaxial cable is to use the back-to-back coaxial connector. After a few months exposure to the elements it is not uncommon to find that the whole contraption has become oxidised, despite the fact that it was 'protected' by a generous layer of insulation tape of one kind or another. If, after you have managed to get the joint apart, close examination of the plugs and connector will usually reveal your so believed good electrical joint in an advanced state of corrosion.

The method to be described should appeal to those who like the writer, wish to join up these odd lengths of coaxial cable and forget about them.

Proceed as follows referring to the sketches for any clarifications necessary:
1. Cut the ends of the coaxial cable to be joined to give clean ends. Carefully cut off \( \frac{3}{4} \) in. of the vinyl covering at the end of each cable, taking care not to cut the outer braid.
2. Loosen and push back the braid like a concertina. Bell-out the outer braid of one cable.
3. Now carefully cut off \( \frac{3}{4} \) in. of the inner insulation, again taking great care not to cut any strands of the inner conductor, so that the insulation slides off the wire. Conserving one of these pieces of material, it will be required later.
4. Lay both cables down on the bench and clamp down in position so that the two inner copper conductors lay close together and parallel. Now solder the two inner conductors together.
5. Take one of the pieces of inner insulation and slit it length wise with a sharp razor blade. Slip it over the soldered inner conductors.
6. Cut a piece of aluminium cooking foil \( \frac{3}{4} \) in. wide and long enough to make a double thickness cylinder to cover the areas marked 'B', 'C', and 'D'. Heat this cylinder to about 100°C with a soldering iron when the insulation will be pliable enough to weld together. Discard the foil and leave the insulation to cool.
7. Now tightly wrap a single layer of \( \frac{3}{4} \) in. adhesive vinyl insulation tape over the section 'B,C,D'. Now smooth section 'A' over section 'E'. Roll and smooth this overlap to make it even. Spot solder the edges where 'A' overlaps 'E'.
8. Starting at one end of the outer conductor braid close wind the whole areas of 'A,B,C,D,E,' with 40 s.w.g. tinned copper wire. Lightly solder several spots of this covering. Don't try to make it a solid soldered job, or you will ruin the inner insulation.

---

**Take—20 Waa-Waa Unit**—continued from previous page

Suggested layout of components on a piece of 0.1" matrix Veroboard.

For operation. If the Waa Waa effect is too fierce increase the value of VR1 further.

It might be that no oscillation occurs with the above procedure. This means that the transistor has low gain but do not give up—you will probably find you still get a useful effect when signal is applied at the input.
British Honduras: Radio Belize has been noted with an extended schedule in Spanish. The frequency is 3500kHz and programmes have been heard up to 0730.

El Salvador: Radio Nacional de El Salvador has moved from 5980 to 6010kHz and has been heard at 0550 to 0655 with news, advertisements and music.

Malagasy Republic: RTVM Tananarive is using a new frequency of 6170 for the French Service. The transmissions have been noted in parallel with 7105 from 1400 to after 1900.

U.S.A.: According to 'DX Party Line' on HCJB, WNYW has now been taken over by Family Radio. Programming will, however, remain the same and the schedule for May-September is:

<table>
<thead>
<tr>
<th>Time</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1700-2200</td>
<td>21525kHz</td>
</tr>
<tr>
<td>1700-1900</td>
<td>17845kHz</td>
</tr>
<tr>
<td>1905-2130</td>
<td>17845kHz</td>
</tr>
<tr>
<td>2135-2300</td>
<td>15440kHz</td>
</tr>
<tr>
<td>2215-2400</td>
<td>11855kHz</td>
</tr>
</tbody>
</table>

All transmissions in English to Europe.

Vietnam: The Voice of Vietnam, 58 Quan-Su Street, Hanoi broadcasts in English at the following times: 0100-0130, 0200-0230, 1000-1030, 1300-1330, 1530-1600, 1800-1830 and 2230-2300. The frequencies announced are 10040 and 15105kHz but the later frequency has been noted at 15012kHz.

South Vietnam Liberation Radio, c/o Bureau d’Information du C.R.P. de la R.S.V.N., 39 Avenue Georges Mandel, Paris 16e, France. Broadcasts in English on 10010 and 7470kHz start at 1100, 1230, 1450 and 2330 respectively. The programme at 2030 uses 14990 and 12155kHz.

The last two items came from Adrian Pell of Wareham in Dorset, other items courtesy of Sweden Calling DXers.

Readers’ Logs

Once again Roy Patrick of Derby kicks-off with the following log using his Trio 9R59DS and National 1400 receivers:

4854 R. Clube de Mozambique, Portuguese at 2130.
4940 R. Abidjan, Ivory Coast, in French at 2100.
4995 R. Brazil Central noted as early as 2230.

6030 T.W.R., Monte Carlo testing in Norwegian, 2030.

9023 R. Tehran, Iran, heard in English at 2000.
11650 R. Bangladesh, news in English at 1700.
15084 R. Iran, Home Sec. in Farsi at 2100.
15415 R. Kuwait heard in English at 1700.
15520 R. Bangladesh in English at 1700.

Fred Wall of Walthamstow returns to the page after a long absence having used his Plessey PR55 and 50 foot long-wire with A.T.U. to hear:

6065 R. Vilnius, Lithuania in English at 0045.
9540 R. New Zealand with news at 0800.
9655 R. Damascus, Syria, light music at 2045.
11780 R. New Zealand with news at 0800.
11855 Saudi Arabia B.S. news in English at 1700.
15125 Voice of Free China, Taiwan, English at 1800.
15265 R. Afghanistan noted in English at 1810.
21545 R. Accra, Ghana, with local music at 1730.

Ian Gordon of Birmingham has again been busy using his Codar CR70A receiver, 25 metre (Metrication no less!) long-wire and A.T.U. to hear:

7230 T.W.R., Monaco in German at 0905.
9560 ORTF, France in Russian.
9620 R. Belgrade, Yugoslavia noted at 2200.
9640 Adventist World Radio DX News at 0935.
9745 R. Baghdad, Iraq noted at 1955.
9912 All India Radio, Delhi at 2000.

Christopher Hodgson of Sunderland is a new reporter to this page, his equipment consists of a Codar Multiband-6 receiver with a 50 foot long-wire aerial and the PW A.T.U. His log included:

6100 R. Belgrade, Yugoslavia at 2200.
6150 R. Norway from Oslo at 1810.
7260 R. Berlin International at 1850.
9006 R. Tehran, Iran noted at 2000.
9525 All India Radio, Delhi at 2100.
9525 R. Warsaw, Poland at 1200.
9645 Vatican Radio noted at 1305.

The last report for this month comes from Patrick Henderson of Ledbury, Herefordshire who used a six transistor superhet with a 3 metre Windom aerial to hear the following stations:

6025 Radio Portugal with DX News at 2105.
6070 Radio Sofia, Bulgaria, Mailbag at 1930.
9570 Radio Australia noted at 0750.
15012 Voice of Vietnam, Hanoi at 1805.
15130 R. New York Worldwide at 2300.
15165 Kol Israel noted at 2030.
15175 RSA, South Africa in English at 1825.

During the next few months I hope to devote some space to the topic of ex-government Communication receivers which are now available at very reasonable cost compared with modern sets. I would be grateful if any readers with an interest in this topic would write to me with their opinions and any information that they may have.
NEW FROM DENMARK
Already Established As One Of
The Best Selling Kits in Europe

JOSTY KIT today

is counted among the leading manufacturers of electronic kits in Europe. Constantly the experienced engineers at the JOSTY laboratories work on improvement of existing kits and on new developments. Only the best materials and components have been used. The circuit-boards are manufactured according to the newest developments in this field and are supplied with all holes drilled and printed showing the exact placing of the components. Our long standing experience enables us to guarantee every JOSTY KIT for ONE YEAR for all parts as well as the correct function of the assembled kit. JOSTY KITS are a quality produce of DENMARK.

Photo-cell Amplifier AT30

NO more searching for Components, it's all in the bag the Josty way.

**JOSTY KIT RETAIL PRICE LIST**

(APRIL, 1973)

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Description</th>
<th>RRP Excluding VAT</th>
<th>V.A.T.</th>
<th>Total RRP Incl'd. VAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF20</td>
<td>Mono Transistor Amplifier</td>
<td>4.80</td>
<td>0.46</td>
<td>5.26</td>
</tr>
<tr>
<td>AF30</td>
<td>Mono Transistor Pre-Amplifier</td>
<td>5.91</td>
<td>0.59</td>
<td>6.50</td>
</tr>
<tr>
<td>AF310</td>
<td>Mono Amplifier (for Stereo use)</td>
<td>3.68</td>
<td>0.36</td>
<td>4.04</td>
</tr>
<tr>
<td>AT5</td>
<td>Automatic Light Control</td>
<td>4.60</td>
<td>0.48</td>
<td>5.08</td>
</tr>
<tr>
<td>AT30</td>
<td>Phone Call Switching Unit</td>
<td>5.70</td>
<td>0.57</td>
<td>6.27</td>
</tr>
<tr>
<td>AT50</td>
<td>400W Trac Light Dimmer Speed Control</td>
<td>4.60</td>
<td>0.48</td>
<td>5.08</td>
</tr>
<tr>
<td>AT55</td>
<td>1,500W Trac Light Dimmer Speed Control</td>
<td>5.70</td>
<td>0.57</td>
<td>6.27</td>
</tr>
<tr>
<td>AT56</td>
<td>2,200W Trac Light Dimmer Speed Control</td>
<td>6.00</td>
<td>0.69</td>
<td>6.69</td>
</tr>
<tr>
<td>AT60</td>
<td>Psychodonic Light Control, Single Channel</td>
<td>7.80</td>
<td>0.76</td>
<td>8.56</td>
</tr>
<tr>
<td>AT65</td>
<td>Psychedonic Light Control, 3 Channel</td>
<td>14.55</td>
<td>1.45</td>
<td>16.00</td>
</tr>
<tr>
<td>HF61</td>
<td>Medium Wave Transistor Radio</td>
<td>3.31</td>
<td>0.33</td>
<td>3.64</td>
</tr>
<tr>
<td>HF65</td>
<td>F.M. Transistor Transmitter</td>
<td>2.70</td>
<td>0.27</td>
<td>2.97</td>
</tr>
<tr>
<td>HF75</td>
<td>F.M. Transistor Receiver</td>
<td>2.88</td>
<td>0.28</td>
<td>3.16</td>
</tr>
<tr>
<td>HF310</td>
<td>F.M. Tuner Unit</td>
<td>15.81</td>
<td>1.58</td>
<td>17.39</td>
</tr>
<tr>
<td>HF325</td>
<td>Deluxe F.M. Tuner Unit</td>
<td>14.12</td>
<td>1.41</td>
<td>15.53</td>
</tr>
<tr>
<td>HF330</td>
<td>Stereo Decoder for use with HF310 or HF325</td>
<td>9.96</td>
<td>0.99</td>
<td>10.95</td>
</tr>
<tr>
<td>HF395</td>
<td>Aerial Amplifier for AM/FM Bands 1, II and III</td>
<td>1.77</td>
<td>0.17</td>
<td>1.94</td>
</tr>
<tr>
<td>GP310</td>
<td>Stereo Pre-Amp to use with 2, AF310</td>
<td>21.27</td>
<td>2.12</td>
<td>23.39</td>
</tr>
<tr>
<td>GP1500</td>
<td>Transistor Unit for graphite, etc.</td>
<td>7.50</td>
<td>0.75</td>
<td>8.25</td>
</tr>
<tr>
<td>NT10</td>
<td>Power Supply 100Vdc 9V Stabilised, 12V Unstabilised</td>
<td>4.15</td>
<td>0.41</td>
<td>4.56</td>
</tr>
<tr>
<td>NT300</td>
<td>Professional Stabilised Power Supply</td>
<td>12.51</td>
<td>1.25</td>
<td>13.76</td>
</tr>
<tr>
<td>NT305</td>
<td>Transistor Converter 12/15V, a.c.</td>
<td>4.50</td>
<td>0.45</td>
<td>4.95</td>
</tr>
<tr>
<td>NT310</td>
<td>Power Supply 240V a.c. to 2 x 10V d.c. at 5A</td>
<td>4.80</td>
<td>0.48</td>
<td>5.28</td>
</tr>
<tr>
<td>NT315</td>
<td>Power Supply 240V a.c. to 4-5/15V d.c. 500mA</td>
<td>9.57</td>
<td>0.95</td>
<td>10.52</td>
</tr>
</tbody>
</table>

**Sole UK Distributors**

**RADIO SUPPLIES**

(Components) Ltd.

P.O. BOX 27 - 39 WHITBY STREET - HARTLEPOOL TS24 7BR
TELEPHONE 0429-5750 or 68002
Another winner!

**High Fidelity Loudspeaker Kit**

Consisting of a Fane Model 803 ultra-low resonance 8" speaker unit with PVC cone surround, and a Fane Model 303 high frequency pressure tweeter together with a printed circuit cross-over assembly with ferrite cored coils.

**SPECIFICATION OF UNITS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Overall Diameter</th>
<th>Natural resonance</th>
<th>Main resonance</th>
<th>Magnet Pole Diameter</th>
<th>Magnet Flux Density</th>
<th>Frequency response</th>
<th>Impedance</th>
<th>Power Handling</th>
</tr>
</thead>
<tbody>
<tr>
<td>803</td>
<td>8&quot;</td>
<td>30Hz</td>
<td>&quot;35Hz&quot;</td>
<td>1&quot;</td>
<td>13,000 gauss</td>
<td>30Hz-8kHz</td>
<td>8-15 ohms</td>
<td>15 watts</td>
</tr>
<tr>
<td>303</td>
<td>3&quot;</td>
<td>1200Hz</td>
<td>12kHz-17kHz</td>
<td>8-15 ohms</td>
<td>10,000 gauss</td>
<td>8-15 ohms</td>
<td>15 watts</td>
<td></td>
</tr>
</tbody>
</table>

**Very easy to assemble, this boxed kit comes with acoustic foam damping material, panels, screws, wire, wiring diagrams and instructions to provide a remarkable loudspeaker assembly—a pair is ideal for stereo.**

CABINETS for the 'Mode One' are available in Teak veneer finish. SIZE 15" x 10" x 9".

*When used with above cabinet.*

Send S.A.E. for fully descriptive leaflet.

Distributors to the wholesale and retail trade

**LINEAR PRODUCTS LTD.**

Electron Works, Armley, Leeds LS12 3SA.
Tel. 630126

Manufactured by

**FANE ACOUSTICS LTD.**

Hick Lane, Batley, Yorkshire.
Tel. Batley 6431

---

**Lasky’s Audio-Tronics Catalogue 1973**

The new 1973 VAT edition of Lasky’s famous Audio-Tronics catalogue will be available in early April—FREE on request. The 48 tabloid size pages—many in full colour—have been reprinted with VAT price changes for your convenience, together with many new items. Over half the pages are devoted exclusively to every aspect of Hi-Fi (including Lasky’s budget Stereo Systems and Package Deals), Tape Recording and Audio Accessories. Send for your copy now and see for yourself that VAT can mean a saving on many of the 1000’s of items we offer.

**FREE** Send this coupon with 15p for post and inclusion on our regular mailing list.

NAME.................................................. ADDRESS..................................................
..................................................

LASKY’S RADIO LIMITED, 3-15 CAVELL STREET, LONDON E.1.

---

**A Guide to Broadcasting Stations** 17th Edition

A new edition of a title which has sold more than 250,000 copies. The first few chapters contain useful information on radio receivers, aerials and earths, propagation, signal identification and reception reports. The bulk of the book is devoted to lists of stations broadcasting in the long, medium, short and v.h.f. bands in both frequency and geographical alphabetical order. The lists are based on information provided by the Tatsfield Receiving Station of the BBC.

1973 206 pp., illustrated 0 592 00081 8 75p

Obtainable through any bookseller or from

**The Butterworth Group**

88 Kingsway, London WC2B 6AB
Showroom: 4-5 Bell Yard, WC2
MEDIUM WAVE BROADCASTS

by CHARLES MOLLOY

SEARCHING out BBC local radio stations is becoming popular and there are a number of reporters this month. G. M. Christie (N.L.S. Pole Star) used his Eagle Rx 60 while sailing off the east coast of Shetland to log BBC Radio Newcastle on 1457kHz. Richard Ellis (Ruscombe Glos.) has an Eddystone EC10 Mk2 and a 50m longwire feeding and aerial tuning unit. He reports reception of BBC Radio Blackburn on 854kHz; Solent on 998kHz; Sheffield 1034kHz; Birmingham 1457kHz; London 1457kHz; Oxford 1484kHz; Bristol 1546kHz; Leicester 1594kHz.

Martin Hall (Southsea) heard BBC Radio Teesside 1546kHz under Radio Bristol at 0502hrs while during the daytime he logged Radio Blackburn 854kHz and Radio Leeds 1106kHz. Martin has received a QSL card from Radio Blackburn and a QSL letter from Radio Leeds. Hunting out BBC local radios can be interesting at this time of year and all of these stations will confirm a correct reception report with either a letter or a QSL card.

Paul Petty (Canterbury) has been trying his Midland 9 transistor portable on the medium waves using its internal aerial and he has heard programmes in English from Trans World Radio, Montecarlo 1466kHz at 2130hrs; Radio Tirana, Albania 1394kHz at 2050hrs; Vatican Radio 1529kHz at 2100hrs; American Forces Network, Frankfurt 872kHz; Radio Berlin International 1511kHz at 2130hrs; Radio Prague, Czechoslovakia 1286kHz at 2200hrs, all times in GMT.

Jeff Driver (Woodham, Surrey) reports hearing Milan, Italy 899kHz which is on the air nightly from 2355hrs until 0500hrs GMT with news in English at 5 minutes past the hour. Jeff has also heard Radio Norway 1579kHz which broadcasts in English every Monday at 0200hrs and 0400hrs GMT. John Thompson (Gillingham) has heard the IBA on 719kHz. This transmission is in parallel with the tests on 557kHz which are on the air 24 hours a day.

Roger Thomas (Port Talbot) enquires about the possibility of using his AR88LF receiver on the medium waves. There is unfortunately no easy way of doing this as the intermediate frequency of this version of the popular AR88, lies well inside the medium waveband. The writer would be glad to hear from any reader who has successfully made this conversion.

Portugal is well represented on the medium waves. The international service of the Emissora Nacional de Radiodifusao is on the air every night in English at 2245hrs GMT from its transmitters at Lisbon on 755kHz and Norte on 1061kHz and these are easily heard in the UK. Among the commercial stations, look for CSB2 Porto on 1054kHz, which is on the air all night with pops; CSB3 Lisbon on 1286kHz; CSB4 Lisbon on 1594kHz and CSB5 Porto on 1578kHz. All these stations will QSL, the cards issued from the international service being particularly colourful.

Sp-E on VHF

by SIMON DAVID

SINCE I last wrote to you, a number of outbursts of “foreign” noises has been taking place. That sporadic-E interference I mentioned has been having a field-day. Continental stations have been coming in all over the place, but in particular around the 65 to 75MHz region. This is outside the usual f.m. band, but it shows that f.m. stations turn up in odd places.

Hugh Cocks of Mayfield, Sussex, tells me that he has picked up several stations from Yugoslavia on 23rd May around midday. He also reports channel-5 television buzz from the vision signal on 93.25MHz. Other signals include Albania television sound on 87-75MHz and vision signal interference on 82-25MHz; a Dutch station on 98-6MHz; APN Stuttgart; West Germany on 102-4MHz.

The eastern European f.m. stations have come in around 66 to 72 MHz using a four-element aerial and two BF180 pre-amps but Mr. Cocks has a problem. When his aerial is directed north or south he gets i.f. breakthrough which disappears when the aerial is due east or west. He thinks that this is largely due to burbles and interference from Radio Moscow in Austria. Any readers have a theory?

Peter Tyler of Whiton, West Middlesex, has sent in a long and detailed log. His home-made “curtain-rod” three-element Yagi is in his loft and drives an old valve Pye Fen Man I. His long list includes several French, Dutch, Belgian and German stations. The latter were NDR II Oldenburg 99-8MHz, Radio Bremen II 88-3MHz. Peter has also received an Italian station in 87-7MHz on 23rd May; signal strength was generally very good but subject to fading. On 24th June he received eight different Dutch stations and three German stations. He rightly complains of the effect of police transmissions on the band which spoil DXing. Further to his big bag was a bonanza of 10 Scandinavian stations, possibly Danish, on 16th June between 1400 and 1500 hours, between 87-7MHz and 99-5MHz. There was a high pressure area over the North Sea near Denmark at the time, which could be responsible for the good reception he obtained.

Recent information issued by the BBC includes a complete list of BBC local radio transmitting stations, revised reception area maps to cover BBC Radio Programmes in stereo from Wrotham and BBC Radios London, Brighton, Oxford, Teesside, Leicester, Birmingham, and Bristol. The BBC has also issued information sheet 1608 (1) which has some advice to help listeners to get the best they possibly can from BBC v.h.f. stereo broadcasts (see also Gordon King’s article elsewhere in this issue).

Test tone transmissions on Radio 3 v.h.f. for stereo programmes are detailed on information sheet 1605 (9). These transmissions are usually broadcast on Mondays, Tuesdays and Thursdays to facilitate channel identification and adjustment of cross-talk, and on Wednesdays to assist in technical assessment and setting-up of stereo receivers. All such tests occur after close down in the late evening. Full details on these BBC Information Sheets from: Engineering Information Department, BBC Broadcasting House, London W1A 1AA. Please enclose a stamped envelope.
SHORT WAVES

by DAVID GIBSON, G3JDG

It is a strange thing. Summertime is just the time for the DX-type listeners to flap their ever eager earholes all over 14MHz. What ever has happened? Far from multiple earhole flappings there is barely the twitch of a lonesome lobe. Just at the time when this band is the main one for most DX traffic, everyone is sending in logs for—you'll never guess—two metres. Nobody seems interested in hearing juicy jingles on 20 metres from people like SU1MA, XT2AK, KG6AAY and YB3CW to mention but a few who were about last month.

Equally strange is the marked lack of logs for 21MHz too. On this band, African countries and most of South America were all happily squirting r.f. everywhere. Wait till I get my 700 element Yagi for 14MHz, I'll put you all to shame.

Twenty eight megacycles (or Hertz?) has apparently been abandoned by practically everyone. This is rather sad because this particular band is probably one of the most interesting now that the sunspot peak has passed.

One station who puts in an appearance is ZS4AA on 28-60MHz. Name is Basil and he also appears on 21-42MHz most weekdays from 1600 hours. Sundays finds Basil on 21-20MHz around 0900 hours. Location is Kroonstad.

Anyone living in the Torquay district and would like to join an Amateur Radio Club you're in luck. The Torbay Amateur Radio Society has its headquarters in Bath Lane (rear of 94 Belgrave Road) Torquay. Hon. Sec. is at 23, Waverley Road, Newton Abbot and the telephone number is Newton Abbot 3055. There is a Club magazine and quite a lot of activity. If you're in the area, give the Secretary a buzz.

Readers' reports

According to Bill Yates (Bedford) it is well worth listening for W6KNH on Tuesdays around 1700 hours. Frequency quoted is 14-24MHz and a sked is usually heard with ZK1MA. Another piece of information for DX types is that Andaman Island is due for a surge of extra activity. Twist is that it could mean yet another callsign change—listen for VU7.

Russell Corner sends a log of G stations heard on topband and eighty metres. Russell's best from further afield on 5-5MHz includes: 2M1MH, 5A2AOO and 4ZS7NJ. All these on a 9R5DE and 560ft. of wire in the loft at Walworth Grove in Middlesbrough.

Tony Mountfield (Gosport) claims to be a member of the RSGB and a passer of RAE. He also says, "I have read your column for a few years" (splendid fellow this Mountfield). Receiver is an R1155L (aren't those the ones you have to light with a match?) and amongst the best heard on twenty were:

A6XP, C5IMA, EA8BX, LX1DU, SV5HH, TF3EB, VE5SR, W6UFG, ZD8RW, 4Z4GH, 9G1AR.

Bernard Hughes (Worcester) has sent in an updated portion of the Potty callsign lists. In all seriousness, I do hope these will help those with computers to keep up to date with these callsigns. Bernard lists them as follows: HA25—25 years of post war Amateur Radio; HA100—Budapest Centenarian; OK5OR—celebrates 50 years of Amateur Radio; KW9WEZ—station operating from Indianin{a} in 1920s; (now I've heard it all); VE3RCMP—Centenary of the Royal Canadian Mounted Police; IT57—Targa Florio award.

Just to show what's about on 14MHz, Bernard lists the following heard with the aid of his JR-310 and dipole; CR5AJ, HC2YL, JA4FAB, JA3LOJ/MM, JA6CNI, JY5HC, JX9XP, KW9WEZ, MP4BJR, PY9KC, PT2JB, VE8RCS, VP7ND, YA1IDT, ZL1AUM, ZL2CE, ZL3FM, ZD7SD, ZD7SS, 7X2MD, 9K2CA.

Andrew May (Bromsgrove) got these on 28MHz with an HA-350 and 67ft. long wire (all s.s.b.); WAT7CAE/P/YV5, YV56WO, YV5DEO, 4Z25SF, 4Z25MQ, 5L7BA, 6W8DY.

Lindsay Pennell is leaving Hong Kong and is due back in the UK. Perhaps we will see some UK-type logs (I was getting fed up with translating Chinese, anyway). Heard from Hong Kong on 28MHz; 9M2DQ, A4XFE, CR6SR, 9J2DT.

Two metre tweets heard from: DL7FQ, F1CCP, F6CKU, GI4AT, GM3BA, GW3UUC/T, ON5NY/P, PA0FHV. These were bagged by Paul Marks, G6PVK, who lurks at Woodford Green with an 8-element beam, homebrew converter and Edystone 730/1A.

Diary dates

The National Agricultural Centre at Stoneleigh, Kenilworth, Warwickshire is the place to be on the 25/26/27 of August. The Town and Country festival is to include a complete introduction to the world of Amateur Radio. This will include morse code demonstrations, display of radio equipment, homebrew demonstration, transmitters on the air, a radio rally and the Amateur Radio Emergency Service in action.

Other Mobile Rallies in August will take place at: Newton Abbot August 12; Derby 12; Bristol 19, Preston 19. Contests for August: WAE DX c.w. 11-13; 70MHz 12; 144MHz low power 12; 144MHz s.s.b. 19.
Mains Motor

A useful motor for use in record decks and tape recorders—ideal also for extracting records and for use in small portable devices. 1102 and 240v. 10amp plug 10p each for the complete set.

Balanced Armature Unit

The重量级三极管 amplifier complete with suitable connections, has been supplied. It delivers a signal of 1102v at 10amps. Price 159 for single, £2-20 for first one.

Centrifugal Blower

This unit is designed for use in the ventilation of small rooms, where a continuous supply of fresh air is required. It is suitable for use with heavy or light weight doors. Price 83p.

Mullard Audio Amplifiers

All in module form, each rated 100 watts, these items are ideal for use with all types of loudspeakers. Price £2.50 each. Model EPP20 20 watts output 35p. EPP2000 4 watt output 40p. EPP2001 1 watt output 10p. Note: 10% discount if 10 or more ordered.

Control Drift Speeds

Drill Controller New I.K.W Model

This controller is designed to operate from 10v to 15v, and is adjustable to 20v. Price £2-50. Note: 10% discount if 10 or more ordered.

Mains Transistor Power Pack

This pack contains the transistors, rectifiers and capacitors required for use with 1102v systems. Price £2.50. Note: 10% discount if 10 or more ordered.

Switch Trigger Mats

These mats are 12x12" and are available at the following prices: 12x12" 10p, 12x12" 20p. The mats are ideal for use with 1102v systems and are suitable for use in workshops or laboratories.

Summer Cooler

A unit designed for use with air conditioning units. Price £2-20 for first one, 15p for subsequent ones. Suitable for use with all types of air conditioning units.

ISA Electrical Piping

Liners in your deep: Have you ever noticed how easily you can control the flow of air and water in an industrial setting? This system, which has been developed in recent years, is ideal for use in workshops and laboratories. It is designed to be easily installed and maintained, and is suitable for use in all types of industrial applications.

Protectable Devices

Thyristors, rectifiers and transistors are included in this section, along with all the necessary instructions. £165.

Rocking Switch

A unit designed for use with 12v systems. Price £2-20 for first one, 10p for subsequent ones. Suitable for use with all types of 12v systems.

Thermal Cutout

As used in some modern machines, each switch is designed to operate on a set of contacts that are suitable for use with 12v systems, or for use with 1102v systems. Price £2-50.

Honeywell Push Button Micro Switch

As used in some modern appliances, each switch is designed to operate on a set of contacts that are suitable for use with 12v systems. Price £2-50.

Kettle Elements

Designed for use with all types of kettles, this element is suitable for use with both 12v and 1102v systems. Price £2-50.

Maclean Thermostat

Designed to break 20 amp A.C. with a street probe compatible with 12v systems. Price £2-50. Note: 10% discount if 10 or more ordered.

J. Bull (Electrical) Ltd.

Dept P.W. 7 Park Street, Croydon CRO 1YD

Callers to: 101 Tamworth Road, Croydon
PRINTED CIRCUIT KIT

BUILD 60 INTERESTING PROJECTS on a PRINTED CIRCUIT CHASSIS with parts and Transistors from your SPARES BOX

COMMUNICATIONS Printed circuit Kit

70p
Postal & Pack. 10p (UK) Commonwealth:
SURFACE MAIL 15p
AIR MAIL 60p
Australia, New Zealand, South Africa, Canada

(1) Crystal Set with bias.
(2) Crystal Set with voltage-quadraphone detector.
(3) Crystal Set with Dynamic Loudspeaker.
(4) Crystal Tuner with Audio Amplifier.
(5) Carrier Power Conversion Receiver.
(6) Split-Load Intergrated Double Radio.
(7) Matchbox or Photocell Radio.
rise only £1/0/0 x 0/4/0 x 0/105. (12) Ring Radio £1/0/0 £1/0/0 £1/0/0. (13) Bacteria-powered Radio. Runs on sugar or bread. (14) Radio Control Tone Receiver.
(50) Photoelectric Circuits. Simple Alarms, Long Range Alarms, Projector, etc.

YORK ELECTRICS, Mail Order Dept.
355 BATTERSEA PARK ROAD, LONDON, S.W.11
Send a S.A.E. for full details and brief description of all kits and Projects.

Baker 12" Major £9.90
30-14500 c.p.s. Double cone woofer and tweeter combination. 1/2" ceramic magnet assembly flux density 145000 gauss.
Base resonance 40 c.p.s. 20 watt RMS.

Major Module Kit £12.50
30-7000 c.p.s. response. Tweeter, crossover and baffle as illustrated.

Massive Clearance Bargains

Bargain component packs contain Resistors, Capacitors, Switches, Potentiometers, Knobs, LED's, Transistors, Diodes, Trimmers, Switches, Panels etc., etc. Save yourself £3 on these well selected packs 12s net weight £1-00, p. 40p.
Assorted Electrolytic Capacitors, 6lbs net weight £1-00, p. 40p.
Brand new Wire-wound Resistors, Good Selection, £1.00 for £1-15, p. 40p.
Assorted Computer Panels, £1.00 for £1-15, p. 40p.
Millard Ferrite Bar Magnets 1/2" x 1/2" x 1/8", 100 for £1-25, p. 40p.
Assorted Computer Panels. These panels are exceptionally good value and contain a minimum of 75 transistors, stacks of diodes plus Trim Pots, Polymer Capacitors, Resistors and include a few I.C.s. 10 panels for £1-00, p. 25p.
Millard Ferrite Cores, LA1 100 to 500kHz, 50p, LA4 10 to 30kHz 75p.
LA2100 3 to 200kHz 50p.
Please include 10% V.A.T. to total cost of goods.

MAIL ORDER ONLY
XEROZA RADIO
1, EAST STREET,
BISHOPS TAWTOW, DEVEN

Also OA2 MAINS STABILISER 74p., 2KW LINEAR AMP. TL911 £207.90; TR2200 2M Personal transceiver £27-45; TR7200 2M Car transceiver £142-45; Spare set values for TR908S £2-35.
P.L.E. CONSULT US REFERENCE SUITABLE SPEAKER

NEW: World-wide reception on the amazing "DX—CRYSTAL SET" £2-20 including unique aerial.

NEW: PARTRIDGE ARE APPOINTED STOCKISTS OF AMTRAN QUALITY KITS—send for fully illustrated brochure and price list.

PARTRIDGE BUDGET LINE—

ARTIFICIAL EARTH—SOLVES YOUR EARTH PROBLEMS £5-28; AERIAL BANDSWITCH—TUNED AERIAL £5-28; A.T.U. KIT—FULL COVERAGE TX/RECEIVER £3-28; ASSEMBLED £6-38.

Send 3p stamp for full illustrated details of Partridge Products. TR10 brochures (state which) 3p stamp extra.

NO V.A.T. ON OVERSEAS ORDERS!

CARRIAGE & INSURANCE EXTRA OVERSEAS.

Box 5

PARTRIDGE ELECTRONICS LTD.
BROADSTAIRS, KENT

Phone: 0843 62535 or 62839 cheap periods.
THE majority of circuits constructed by amateurs these days are transistorised and so their power supply requirements are quite modest compared with the valve sets of yesteryear. Most of these modern circuits can be driven either by batteries or by mains derived D.C. supplies. In some cases there is no real necessity to ensure that the power supply provides a constant voltage, this may vary without too much harm to the performance of the equipment. Others, though, may not be so tolerant, oscillators and integrated circuits are two that spring to mind. In these the output and the performance can be directly related to the stability of the supply voltage—especially if the voltage varies with the current drawn.

STABILISING CIRCUITS

To overcome these difficulties it has become common practice to use zener stabilised supplies or to add a transistor to that simple arrangement to give series or shunt stabilised supplies. Examples of these are shown in Figs. 1-3. Fig. 1 shows a simple zener circuit; the trouble here is that when no load is applied the zener has to be capable of dissipating all the power which should be consumed by the circuit, and due to zener spread and tolerance it is sometimes difficult to get an exact voltage. Fig. 2 shows a transistor-aided zener as a shunt regulator whilst Fig. 3 is a series regulator. Both these have the advantage that they can deal with higher currents and the output voltage can be varied continuously. The shunt circuit is also short-circuit proof though it does have a relatively high output resistance; the series circuit on the other hand has a low output resistance but it is not short-circuit proof. Short the output on this one and the transistor can easily blow.

The stabilisation offered by these simple circuits leaves a lot to be desired and some constructors have devised extra circuitry to add to them to give a feedback sensing of the output voltage. Fig. 4 shows this in block form. The idea is that as the output voltage changes this is sensed and the input to the base of the output transistor is varied to oppose the change. With the advent of cheap integrated operational amplifiers it became easy to replace the sensing circuit with, say, a 741 and this gave very satisfactory control. An outline of such a circuit is shown in Fig. 5.

As the shunt circuit had this high output resistance plus poor efficiency, as all the current flowed through it continuously, the practice was to use a series output transistor—but this suffered from the short circuit trouble. To overcome this a means was devised to sense a short across the output and then to limit the current flowing through it, achieved as shown in Fig. 6.

All these refinements meant that the power supply unit was becoming quite large and complex so the manufacturers started to produce integrated circuits which combined the functions of regulation and protection in one package. One of these is the Signetics 550 which is a precision voltage regulator designed for general purpose use. It will work from input voltages of 8-5 volts to 50 volts making it ideal for amateur use. On its own it can supply an output of up to 150mA and if an external power transistor is added the current output can be increased to a number of amperes. It also features current limiting and continuously variable output.

USING THE 550

The 550 is available either as a 14-pin DIL or a 10-lead 'transistor type' can. The actual internal circuitry is complex having some 15 transistors, 7 diodes and 8 resistors in it. To understand its operation it may be better to look at a block diagram of its internal functions, Fig. 7.

A reference voltage is produced of about 1.6 volts which is independent of supply variations, this being fed into the noninverting input of an operational
Figs. 1 to 6, above, show the development of a simple zener circuit into one incorporating an IC operational amplifier providing greatly improved stabilisation and proof against short circuits by current limiting.

Fig. 7, left, is a block diagram of the functions performed by the 550 IC voltage regulator.

The photograph below is of the author's prototype dismantled to show the veroboard carrying the IC and other small components. The board fits into the slots at the right of the box. The output is variable between 1.5 and 20V, current limited to 300mA.
**INTEGRATED CIRCUITS**

Why buy alternatives when you can buy the genuine article from us at competitive prices from stock. BRANDED FROM TEXAS I.TT.

**SPECIAL OFFERS!**

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD177 Mullard 25p</td>
<td>2 x 25p</td>
</tr>
<tr>
<td>BC107, BC108, BC109 Each</td>
<td>100p</td>
</tr>
<tr>
<td>BY127 Mullard 15p</td>
<td>2 x 15p</td>
</tr>
<tr>
<td>OA202</td>
<td>10p</td>
</tr>
<tr>
<td>OC35 Mullard 50p</td>
<td>100p</td>
</tr>
</tbody>
</table>

**ZENER DIODES**

- 400 mW 5% Miniature
- 500 mW Range
- Low power

**LINEAR (O/P AMPS)**

- 7805C TO95 15p
- 7809C TO95 15p
- 7812C TO95 15p
- 7814C TO95 15p
- 7815C TO95 15p

**TRIACS**

- STUD WITH ACCESSORIES
- Type
- 3 Amp T048
- 15 Amp T048

**NEW BRIDG RECTIFIERS**

- SMALL SIZE AND LOW COST
- Type
- 30 Amp 10p

**SILICON CONTROLLED RECTIFIERS**

- Type
- 3 Amp T048

**VAT**

- Prices DO NOT include Value Added Tax. From 1st April, 1973 10% must be added and shown separately to your total order. Please ask us to help you with your order without delay.

**QUANTITY DISCOUNTS**

- 10% 10 – 15%
- 20% 20 – 25%
- 50% 50%

- From above sections except Integrated Circuits and Special offers where discounts are included.

- Minimum order value £1.00.

**PRIXES OF 7400 SERIES ARE CALCULATED ON THE TOTAL NUMBER ORDERED REGARDLESS OF MIX.

**LARGER QUANTITY PRICES**

- Low power stock

- For list No. 36

**FREE WITH PURCHASES**

- GAS SCREWDRIVER
- TWIN SCREWDRIVER
- TOOL KIT

**NEW FREE BOOKLET**

- OVER 1500 TYPES
- Send for yours today!

**FELIX INTER CIRCUIT**

- ELECTRONIC SIMPLIFIED
- Complete with 8-page book on integrated circuit and data
- £1.50 each

**TUBULAR**

- Half AMP 50p
- 10 AMP 100p
- 15 AMP 150p

**SILICON**

- CONTROLLED RECTIFIERS
- Type
- 3 Amp T048

**OPEN**

- 8 a.m. to 6 p.m.
- Closed Saturday and Sunday

**HOURS**

- All stores open all day Saturday
amplifier. The inverting input gets its voltage from a potentiometer across the output. The op. amp. senses any change between these two voltages and the output is controlled accordingly. There is also the current limiting part which monitors the voltage developed across an external resistor. When this voltage exceeds a specified value limiting starts, the output voltage starts to fall until the output transistor is switched off, the current remaining at a safe level which is within the capabilities of the IC.

**Fig. 8. External circuitry of the 550 to provide currents up to about 60mA from 2 to 20V.**

Fig. 8 shows the IC connected for use as a power supply unit to give 2 to 20 volts at a maximum current of 60mA. R_s is chosen to be 10 ohms so that it will limit if the output current should exceed 60mA. If R_s is increased to say 20 ohms the limiting current now drops to about 30mA. If R_s is decreased to 5 ohms the current is increased to about 100mA. Care must be taken not to reduce the value too far or the short-circuit current could exceed 150mA. It is possible to replace R_s by a preset to give adjustable current limiting. The potentiometer VR1 is connected so that the output voltage can be adjusted. C1 is added to provide frequency compensation.

**HIGHER CURRENTS**

If more than 100mA or so is required all that need be added is a single NPN external power transistor as shown in Fig. 9, which is also the complete circuit of the practical unit.

The maximum current then available is given by:

\[ I_{max} = \frac{I_{limit}}{h_{FE(\text{min})}} \]

For a 2N3055 whose \( h_{FE(\text{min})} \) is about 50 the maximum current which can be obtained is 3 amps assuming that one is keeping to an output current of 60mA from the IC. If this is uprated to 100mA then the current is 5 amps.

In order to calculate the value of \( R_s \), the following formula is used:

\[ R_s = \frac{0.6}{I_1} \]

Where \( I_1 \) is the current at which limiting is to start. The wattage rating for the resistor \( R_s \) is given by

\[ W = 0.6 \times I_1 \]

Thus, in the prototype, the limiting current \( I_1 \) was set at 300mA which meant that \( R_s \) had a calculated value of 2 ohms and a power rating of 0.18 watts. In point of fact the only available resistor of about this value was a 2-2 ohm 3 watt one, so this was used.

**ALTERNATIVE TRANSISTORS**

There is no need to use a 2N3055 if lower powers are anticipated. In fact almost any silicon NPN power transistor will do provided that its current rating is about twice the expected maximum. Its \( V_{CEO} \) should be about 1.5 times the maximum unregulated input voltage and the power rating is calculated by:

\[ W = (V_{IN(\text{max})} - V_{IN(\text{min})}) \times I_1 \]

**CONSTRUCTION**

The IC is best mounted on 0.1" matrix veroboard together with \( R_s \) and \( C_1 \), and also VR1 if this is to be a preset. Should an external transistor be needed then this should go on a heat sink together with the rectifier. The case size will depend on the size of transformer used; a suitable case can be found from the

**Fig. 9. Complete circuit of the prototype power supply module. The value of R1 for different output current ratings is discussed in the text.**
Why pay more - look at our Fantastic Bargain Offer!

PENTHOUSE
A COMPLETE AUDIO SYSTEM
An all "White" Hi-Fi Stereo System to blend with modern furnishings. Solid state, fully transistorised tuner/amplifier with Stereo Multiplex Decoder. 4 wavebands Long/Medium/Short/VHF. 8 watts per channel (music power) output. The latest BSR C125 4 speed Mono/Stereo record changer. Two white matching bookshelf speaker units.
OUR PRICE £38-00
Credit terms £5-00 deposit plus £2-00 p. & p. followed by 12 payments of £4-80. Total Credit Terms £65-00 SEND £7-00 TODAY.

BENSON
BENSON MW/FM/MPX STEREO 8 TRACK
AM/FM radio with decoder for stereo radio with integral 8 track cartridge player. Portable for operation from internal batteries or A.C., mains or 12V Car/Boat cigar lighter socket. Unit divides into two for stereo reproduction.
Our price £39-95. Credit terms £5-00 deposit plus 12 monthly payments of £3-40 (Total £45-80). p. and p. £1-00. Send 66 Today!

THE AVON AUDIO SYSTEM
The unencased system is ideal as an economical replacement for an outdated chassis. The Stereo Tuner Amplifier with medium, long and short wavebands provides Worldwide coverage, even the weakest continental stations can be received with superb clarity. Push button band selection, 10 watts total output. Frequency response 25-18000 Hz.
BSR 4 SPEED STEREO/MONO RECORD CHANGER plays all types or 7in., 10in., and 12in. Mono of Stereo records. Manual or automatic play.
TWIN ELLIPTICAL SPEAKER. These low impedance, permanent magnet units have been specially selected to provide the fullest range of audio reproduction.

EASY TO INSTALL—NO TECHNICAL KNOWLEDGE REQUIRED. List Price £45-74. OUR PRICE £35-00. Credit Terms £3-50 deposit plus £2 Port & Packing followed by 12 payments of £2-10 (Total Credit Terms £40-70) DON'T MISS THIS BARGAIN. SEND £5-50 TODAY.
ALL EQUIPMENT COVERED BY 12 MONTHS FULL GUARANTEE
CALLERS WELCOME
Post coupon NOW for...
FREE leaflets
LEWIS Radio
100 Chase Side London N.14 Tel: 01-866 3733/9666

Veroboard range and this will make an elegant container. VR1 can be fitted with a suitable pointer and calibrated.

Fig. 10 Layout of components on the strip of veroboard.

It should be noted, with reference to the formulae previously given, that this is not a linear scale and tends to become cramped at the top end. This means that it is better to preset the value or use a voltmeter across the output terminals. The control can then be mounted on the top panel together with a mains switch, neon and output terminals. The circuit of the completed unit is shown in Fig. 9, with the veroboard layout in Fig. 10.

On test the module's output voltage was set to 10V and the load current increased until limiting occurred, as shown by this graph.

It was found that a residual ripple on the output could be eliminated by adding a 100μF capacitor across the output terminals. This also helped to remove some RF noise that was present.

The 550A (DIL) costs 88p and the 550L (10-lead) is 93p inclusive of VAT and post and packing and can be obtained from SCS Components, POB 26, Wembley, Middx. The 2N5295 is also available from SCS at 68p inc.
## Electronic Digital Clock

For complete kit of parts including case.

### Electrolytic Capacitors

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Value</th>
<th>Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Volt</td>
<td>47µF</td>
<td>100µF</td>
</tr>
<tr>
<td>16 Volt</td>
<td>6.8µF</td>
<td>15µF</td>
</tr>
<tr>
<td>40 Volt</td>
<td>6.8µF</td>
<td>150µF</td>
</tr>
</tbody>
</table>

### Linear Integrated Circuits

<table>
<thead>
<tr>
<th>Device</th>
<th>Value</th>
<th>Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td>301</td>
<td>1 µF</td>
<td>10 µF</td>
</tr>
<tr>
<td>109</td>
<td>22 µF</td>
<td>100 µF</td>
</tr>
</tbody>
</table>

### Transistors

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC110</td>
<td>1 µA</td>
<td>10 µA</td>
</tr>
<tr>
<td>BC125</td>
<td>2.5 µA</td>
<td>50 µA</td>
</tr>
</tbody>
</table>

### Mullard Polyesters

Mullard Polyester Capacitors C200 Series

- 0.01 µF, 0.022 µF, 0.047 µF, 0.068 µF, 0.1 µF, 0.15 µF, 0.22 µF, 0.33 µF, 0.47 µF, 0.68 µF, 0.8 µF, 1 µF, 2 µF, 3 µF, 4.7 µF, 6.8 µF, 10 µF, 15 µF, 22 µF, 33 µF, 47 µF, 68 µF, 100 µF, 150 µF, 220 µF, 330 µF, 470 µF, 680 µF, 1,000 µF, 2,2 µF, 4.7 µF, 10 µF, 15 µF, 22 µF, 33 µF, 47 µF, 68 µF, 100 µF, 150 µF, 220 µF, 330 µF, 470 µF, 680 µF, 1,000 µF.

### Fully Marked Types

- 0.01 µF, 0.022 µF, 0.047 µF, 0.068 µF, 0.1 µF, 0.15 µF, 0.22 µF, 0.33 µF, 0.47 µF, 0.68 µF, 0.8 µF, 1 µF, 2 µF, 3 µF, 4.7 µF, 6.8 µF, 10 µF, 15 µF, 22 µF, 33 µF, 47 µF, 68 µF, 100 µF, 150 µF, 220 µF, 330 µF, 470 µF, 680 µF, 1,000 µF.

### Rhythm

- FM: 1 AM, 8 AM
- BRIDGE RECTIFIERS: 1 AM, 8 AM

### Resistors

- 1% wire, 1/8 w, 120 µV to 1 µV
- MINITRON DIGITAL INDICATOR TYPE 3015
- 10 DIL socket, 32 pin, 40 pin, 50 pin, 60 pin
- MINIATURE NEON LAMPS
- 24V or 115V, 1-4 W, 5-8 W each per PHI.

### Zener Diodes

- 3.0 Volt 5 W, 6 W, 7 W, 8 W
- 3.6 Volt 5 W, 6 W, 7 W, 8 W
- 4.5 Volt 5 W, 6 W, 7 W, 8 W
- 5.0 Volt 5 W, 6 W, 7 W, 8 W

### Price

- £19.50

---

**This 4 digit 24 hour clock is available to readers at this special price.**

Parts would normally cost over £25. A selection of price breaks, indicators, and a smart white plastic case.
**SEW PLASTIC PANEL METERS**

**CLEAR PLASTIC PANEL METERS**

**USED EXTENSIVELY BY INDUSTRY, GOVT. DEPTS., EDUCATIONAL AUTHORITIES, ETC.**

Over 200 ranges in stock—other ranges to order. Quantity discounts available. Send for fully illustrated brochure.

---

**Type SW.100 100 x 80 mm.**

- 60µA to 60mA
- 100µA to 100mA
- 600µA to 60mA
- 500µA to 50mA
- 300µA to 30mA

**Type MR.85P. 4½ in. x 4½ in. front.**

- 60µA to 60mA
- 100µA to 100mA
- 500µA to 50mA
- 300µA to 30mA

**Type MR.38P. 2½ in. square fronts.**

- 60µA to 60mA
- 100µA to 100mA
- 500µA to 50mA
- 300µA to 30mA

---

**RP14 REGULATED POWER SUPPLY**


**PS.200 REGULATED P.S.U.**


**PS.1000B REGULATED POWER SUPPLY**


---

**SEW BAKELITE PANEL METERS**

Type MR.65. 3½ in. square fronts.

- 10mA to 10A
- 100mA to 100A
- 5mA to 5A
- 1mA to 1A

---

**SEW EDUCATIONAL METERS**

Type ED.107. Size overall 100mm x 100mm. A new range of high quality moving coil instruments ideal for school examinations and other bench applications. 2¼ mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

- 1A D.C.
- 200mA A.C.
- 200mA D.C.
- 100mA A.C.
- 100mA D.C.
- 50mA A.C.
- 50mA D.C.
- 10mA A.C.
- 10mA D.C.
- 1mA A.C.
- 1mA D.C.

---

**SEW EDGWISE METERS**

Type PE.70. 3½ in. x 1½ in. x 2½ in.

- 50mA to 5A
- 1A to 10A
- 5mA to 5A
- 1mA to 1A

**HAND HELD 2-WAY WALKIE TALKIES**

Battery operation. Volume and sopeh controls. Call button and tone to talk button. Telescopisc aerial. Complete carrying cases.

- 2-way walkie talkie
- Licence required for operation in U.K.
AUDIOTRONIC

EMI LOUDSPEAKERS
Model 350, 12" x 8" with single tweeter/crossover 28-20,000 Hz. 15 watt RMS. Available in 8 or 15 ohms. £25.90 each.
Model 450, 12" x 8" with twin tweeter/crossover 32-20,000 Hz. 8 watt RMS. Available in 8 or 15 ohms. £43.92 each. P. & P. 55p.

SPECIAL OFFER! STEREO SPEAKERS
Matched pair of stereo bookshelf speakers. Deluxe test veneer/finish. 150 x 45 x 71cm. £50.00

ACD-660 Stereo Cassette Deck
A beautifully designed stereo deck with an outstanding specification at a remarkably low price. Incorporates a host of features including switchable noise filter, normal/chrome tape selector, twin VU meter, slidable playback level controls, front panel headphone socket, recording indicator lamp, phone/DIN Holes input sockets, 3.5mm micro input sockets, 1/4" TRS 30kHz-100kHz; 8kHz-1kHz/CW2) Separation 35dB, Noise limiter 6dB at 8kHz, and phone connecting leads.

Our Price £12.95 Curr. £11.95

HA-10 STEREO HEADPHONE CASE
All silicon transistor circuit, with magnetic or ceramic tweeter inputs with twin headphone outputs and separate volume controls for each channel. Operates from 9v battery. Input 3.5kHz/100MHz. Output 320mV.


1021 STEREO LISTENING STATION
- Remote selection of some loudspeakers with on/off switch.
- Facility for stereo headphone switching. 5 gain controls, on/off side switch, stereo head phone sockets, 0.6 x 4.2 x 27cm.


MP7 MIXER PREAMPLIFIER
- 5 mikes/phone inputs with individual 300 ohm inputs.
- Complete mixing facilities. Battery operated.
- Input Mics: 3.5mV 60K, 2x 8mV 100K, 40mV 100K, 6K. Phone: 4mV 100K, 1K, 10K, 60K, 60kHz.


EA14 REVERBERATION AMPLIFIER
Self contained, transistorised, battery operated. Simply plug into microphone, guitar, etc. and output into your amplifier. Volume control, depth of reverberation control. Sensitivity: 500 microamps. 43 x 3 x 41cm.

Our Price £7.50 P. & P. 15p.

AUDIOTRONIC DOLBY ' B ' NOISE REDUCTION UNITS
Reduce tape hiss by 25dB at 60kHz, 40dB at 10kHz and 15dB for all frequencies above 300Hz. Suitable for home/AC 120/240 volts.

Our Price £50.00 P. & P. 50p.

PROGRESS FOUR
For use with semi-professional tape recorders. Frees, res. 30Hz-20kHz. 0-15dB, 0-15dB. Complete with test tape.

Our Price £50.00 P. & P. 50p.

AHP-8 8 Track Stereo Tape Deck
- With most 8 track decks.
- Push button switch.
- Track selector.
- Tuning indicator.
- Attenuator with black and silver trim. Output level 10-15mV. 40kHz.

Our Price £119.50 Curr. £90.00

AHP-8A 8 Track Stereo Tape Player
- Incorporates built in amplifiers giving 15-20 watts RMS output. Includes tuned FM/AM radio, selector and illuminated tuning indicators, selector for signals, balance, tone controls. Attenuator control with black and silver trim. Impedance 6 ohms. AGC 220/240V.

Our Price £175.25 Curr. £135.00

STEREO HEADPHONES
- LEM 20 Individual volume controls.
- Stereo mono with selector 40-15,000Hz.
- Earphone size: 3.5mm.
- Output: Balanced.

Our Price £15.00 P. & P. 20p.

LSE 20 Open back type, individual volume controls. 50-15,000Hz.
- Earphone size: 3.5mm.
- Output: Balanced.


LSE 40 Two-way speakers for individual volume controls. 50-15,000Hz.
- Earphone size: 3.5mm.
- Output: Balanced.

Our Price £15.00 P. & P. 20p.

LSE 50 Three-way speakers for individual volume controls. 50-15,000Hz.
- Earphone size: 3.5mm.
- Output: Balanced.

Our Price £20.00 P. & P. 30p.

LSE 60 Electro-acoustic dynamic headphones. Earphone size: 3.5mm.
- Output: Balanced.

Our Price £15.00 P. & P. 20p.

LSE 70 Electro-mechanical headphones. Earphone size: 3.5mm.
- Output: Balanced.

Our Price £15.00 P. & P. 20p.

LSE 80 Electro-thermic headphones. Earphone size: 3.5mm.
- Output: Balanced.

Our Price £15.00 P. & P. 20p.

LSE 100 Electro-magnetic headphones. Earphone size: 3.5mm.
- Output: Balanced.

Our Price £15.00 P. & P. 20p.

LOW NOISE TAPE CASSETTES
- 1/4" high quality Ferrodisc tapes.
- Price: £1.39 34. £2.03 45. £3.92 79.

ACR-3500 CAR RADIO
Manual tuning of Medium and Long waves 12" pannel. Complete with speaker, mounting brackets and instructions.

ACP-8 8 TRACK CAR PLAYER
Manual tuning of Medium and Long waves 12" pannel. Complete with speaker, mounting brackets and instructions.
Our Price £12.50 40p.

ACACES ELECTRIC CAR AERIAL
5 section. Fully automatic: 12v DC, 100mm. Price £6.50. Complete with switch, all leads and instructions.
Our Price £5.95 P. & P. 50p.
WILMSLOW AUDIO

THE Firm for speakers!

SPEAKERS
EMI 13 x 8, 3, 8 or 15 ohm
£2.95
EMI 13 x 8, 150 d/c 3, 8 or 15 ohm
£2.75
EMI 13 x 8, 450 c/tw, 3, 8 or 15 ohm
£2.35
EMI 13 x 8 type 350 8 ohm
£2.15
EMI 8 x 5, d/c Roll/s 8 ohm
£2.00
Baker Group 25 3, 8 or 15 ohm
£1.95
Baker Group 35 3, 8 or 15 ohm
£1.80
Baker De Luxe 12 d/c/ohm
£1.80
Baker Major 12"
£1.65
Kef T27
£2.85
Kef T15
£2.65
Kef B110
£2.40
Kef B200
£2.20
Kef B139
£2.10
Kef DB18
£2.10
Kef DB12
£2.00
Kef DB12
£2.00
Fane Pop 100 wats 8/15 ohm
£5.45
Fane Pop 60 wats 8/15 ohm
£4.25
Fane Pop 50 wats 8/15 ohm
£3.75
Fane Pop 25/2 25 wats 8/15 ohm
£3.00
Fane Pop 15 wats 8/15 ohm
£2.75
Fane Crescendo 15 8 or 15 ohm
£2.75
Fane Crescendo 12A 100v 8 or 15ohm
£2.75
Fane Crescendo 12B 75w bass 8 or 15 ohm
£2.25
Fane T-810 c/rails 8 or 15 ohm
£2.00
Fane T-808 d/c/roon 8 or 15 ohm
£1.50
Goodmans Axent 100 tweeter
£6.60
Goodmans 8P 8 or 15 ohm
£6.00
Goodmans 10P 8 or 15 ohm
£5.50
Goodmans 12P 8 or 15 ohm
£5.00
Goodmans 15P 8 or 15 ohm
£4.75
Goodmans 18P 8 or 15 ohm
£4.50
Goodmans Twinax 8
£4.25
Goodmans Twinax 10
£4.00
Elac 6 x 5 59RM/59 PM 15 ohm,
£8.10
99RM14 8 ohm
£7.75
Elac 6 x 8/12 c/roon 8 ohm
£7.00
Elac 4" tweeter TW4
£6.75
Wharfedale Bronze 5.4 RS/DD
£7.25
Wharfedale Super 8 RS/DD
£6.75
Wharfedale Super 10 RS/DD
£6.25
Coral 6/8 d/c/roon 8 ohm
£5.75
Silent 9" 3 or 8 ohm
£5.50
Richard Allan 12 d/c 3 or 15 ohm
£5.25
10" 6 x 3, 8 or 15 ohm
£4.75
8" 3 x 3 or 8 ohm
£4.50
7" 4 x 4 or 8 ohm
£4.25
21/2 64 ohm or 70 ohm 80 or 15 ohm
£4.00
Adstra Hison 10 10/4 ohm 8 or 15 ohm
£3.75
Eagle DT33 dome tw.
£3.50
Eagle HT 15 tweeter
£3.25
Eagle CT5 tweeter
£3.25
Eagle CT10 tweeter
£3.25
Eagle MHT10 tweeter
£3.25
Eagle FR4
£3.25
Eagle xover CN23, 28, 216
£3.15
Spe. matching transformer 3-15 ohm
£3.10
Celestion MF1000 25w horn 8 or 15 ohm
£3.00
Celestion PS3 (for Unilex)
£2.85
Celestion GT19 8 or 15 ohm
£2.75
Celestion GH12 8 or 15 ohm
£2.65
Celestion G15C 8 or 15 ohm
£2.50
Celestion G15B 8 or 15 ohm
£2.40
Car Stereo speakers—ask for leaflet.
£1.45

SPEAKER KITS
Wharfedale Unis 3
£2.25
Wharfedale Unis 4
£2.25
Richard Allan Twinnik
£2.25
Richard Allan Triple 8
£2.25
Richard Allan Triple Assem.
£2.25
Richard Allan Supertwinnik
£2.25
Goodmans DIN 20
£2.25
Fane Mode One
£2.25
Kefik 3
£2.25
Peerless 2-8
£2.25
Peerless 3-15
£2.25
Peerless 3-25
£2.25
Peerless 10-2
£2.25
Peerless 10-3
£2.25
Stephanpeakers kits and cabinets—send for free booklet "Choosing a Speaker".
£2.25
Prices include VAT.
Carriage and insurance 50p per kit.
£2.25

RADIO/CASSETTES/AMPS.
Grundig Mariner TRB65
£3.00
Grundig Party Boy 210
£2.50
Grundig Elite Boy 500
£2.25
Grundig Melody Box 500
£2.25
Grundig Melody Boy 1000
£2.25
Grundig Yacht Boy 210
£2.25
Grundig RF430 mains
£2.25
Grundig RF310 mains
£2.25
Grundig Top Boy
£2.25
Grundig Satellite 1000
£2.25
Grundig Custom cassette
£2.25
Tandberg TP14
£2.25
Nordmende 7000
£2.25
Nordmende 9000
£2.25
Bush RPT100 radio/cassette
£2.25
Tri-O 1000 radio/cassette
£2.25
Hitachi TRQ22S stereo cassette
£2.25
Hitachi TRQ237 Cassette
£2.25
Hitachi CT210L radio/cassette
£2.25
Hitachi KH88
£2.25
IT/KB Golf Press
£2.25
IT/KB Weekend Auto
£2.25
IT/KB Compact Auto
£2.25
IT/KB Europa
£2.25
IT/KB LS53 cassette
£2.25
IT/KB Studio 60M cassette
£2.25
IT/KB Studio 73 stereo cassette
£2.25
Koyo KTR.164 8 waveband
£2.25
Koyo KT.177 11 waveband
£2.25
Prices include VAT.
Carriage and insurance 50p. FREE with each order—"Guide to Broadcasting Stations" (160pp)
£2.25

PA/DISCO AMPLIFIERS
Carriage and insurance £1.00.
£2.25

FREE with speaker orders over £7
"Hi-Fi Loudspeaker Enclosures" book. All units guaranteed new and perfect. Prompt despatch.

WILMSLOW AUDIO Dept. P.W.
Loudspeakers: Swan Works, Bank Square, Wilmslow, Cheshire SK9 1HF. Radios etc: 10 Swan St., Wilmslow, Cheshire SK9 1HF.
Telephone Wilmslow 29599

H.A.C.

WORLD-WIDE RECEPTION

Famous for over 5 years for Short-Wave Equipment of quality, "H.A.C." were the Original suppliers of Short-Wave Receiver Kits for the amateur constructor. Over 10,000 satisfied customers—including Technical Colleges, Hospitals, Public Schools, R.A.F., Army, Halls, etc.

NEW "DX" RECEIVER Complete kit—price £3.50 (incl. p. & p. & V.A.T.)
Customer reviews: "Australia, India and America at full volume.”—"I am 14 years of age and have logged over 120 stations; plus colonies and all over the world.”
This kit contains all genuine short-wave components, drilled chassis, valve, accessories and full instructions. Ready to assemble, and of course, as our products—fully guaranteed. Full range of other R.W. kits, including the famous model "K" and "K plus" (illustrated above). All orders despatched by return. Send now for descriptive catalogue, test report and order form.

EXCITING COMPETITION for Short-Wave Listeners. Send stamped envelope for details.

"H.A.C." SHORT-WAVE PRODUCTS
29 Old Bond Street, London W.1

SAVING TIME AND MONEY

LIST PRICE OUR PRICE INCL. V.A.T.
£8.75 £5.50
£8.50 £5.25
£8.25 £4.95
£8.00 £4.70
£7.75 £4.45
£7.50 £4.20
£7.25 £4.05
£7.00 £3.90
£6.75 £3.75
£6.50 £3.60
£6.25 £3.50
£6.00 £3.35
£5.75 £3.25
£5.50 £3.10
£5.25 £3.00
£5.00 £2.90
£4.75 £2.80
£4.50 £2.70
£4.25 £2.60
£4.00 £2.50
£3.75 £2.40
£3.50 £2.30
£3.25 £2.20
£3.00 £2.10
£2.75 £2.00
£2.50 £1.90
£2.25 £1.80
£2.00 £1.70
£1.75 £1.60
£1.50 £1.40
£1.25 £1.10
£1.00 £0.90
£0.75 £0.65
£0.50 £0.45
£0.25 £0.20
£0.05 £0.02
£0.00 £0.00

TRADE AIDS
(Dept. PW14), 111 Chiltern Drive, Berrylands, Surbiton, Surrey
01/299 4031
100 pds. Berrylands Railway Station.
FELSTEAD ELECTRONICS (PW 72)
LONGLEY LANE, GATLEY, CHEAL, CHS. SK8 4EE

Selection from our List. Send for stamped addressed envelope. (Free overseas, and with all orders on request). Cash with order only. No C.O.D. or Cash orders accepted. Returns orders under 25p plus charges unacceptable. N.A.E. please for enquires or cannot be replied to. Overseas including Fax and Channel islands, order 10% off prices below, which include V.A.T..Recording Tape: First quality type Magnetic Tape available, £5.00 a 250 ft. spool, 40p, 2800 ft. spool, 5p, 12000 ft. spool, 60p, 5 spin. 12500 ft. spool, 7£ 12500 ft. £1.00 (Charges for £5 and £10, single spool, two to four spools free and over 50p free lot. For £7, one or two 13p each, 2, 4 and £5 35p the lot. 4, 6, 8 each over 50p the lot.)


ORDER NOW TO: ELECTRONICS DESIGN ASSOCIATES, 86 Bath Street, Walsall W.S. 1DE. Phone: 33652

Please send me one SPARKRITE Kit complete. I enclose P.O./Cheque for £9.35. Or for ready built unit £11.55.

NAME
ADDRESS

(Live near Walsall? Call in for an actual workshop demo. It really is convincing).

PW9
SANSEI TEST EQUIPMENT

10 IN ONE MINI LAB
10 instruments in one, including AC & DC Voltmeter, Ohm Meter, etc.
£11.95 Including VAT & P.P.

SIGNAL TRACER/INJECTOR
Designed to receive audio frequency, built in amplifier with high gain of 60dB.
£11.55 Including VAT & P.P.

SIG MITTER
Powerful trouble shooting signal injector. Model SE900.
£2.20 Including VAT & P.P.

DC POWER SUPPLIES
Regulated power supply variable up to 15V 0-5A. Model SE800... ideal for development work.
£10.00 Including VAT & P.P.

NEW HIGHLY SENSITIVE MULTITESTERS
Model M660 with mirror scale.
£7.70 Including VAT & P.P.

Cased Amplifiers
Polished wooden cabinet
14 x 13 x 9" with hinged lid containing a sensitive (20V) 4-valve amplifier with tone and volume controls, giving about 3 watts output to the 7 x 4" 30 speaker. Also a non-standard single motor tape deck. Easily converted to record player, guitar practice amp, baby monitor, etc. Supplied in good working condition with circuit diagram. Mainly operated. Only £3 (up to 200 miles, £1.20 over). Special cases £5 (25p). Spares heads 40p. Damaged machines from £5-10 to callers only.

Tested amplifier chassis, 2 x ECC83, EL84, E280, £1.65 (35p).

Computer Panels
Type A: 4 OC13, 4 GET103, etc. 30p; Type D: 4 OC36, 8 GET103, etc. 40p. 25p ea; Type E: 4 OC29, 4 ACV19, 8 other Transformers. 4 Trimpots, 35 Diodes, etc. £1 (10p). Parcel of 12 top quality boards £2 (25p), 7½ of lower quality some broken £1 (40p), £1.65 £1.25 (c.p.). Boards from 3p to callers.

7½ BARGAIN PARCELS
Hundreds of new components—capacitors, resistors, switches, crystals, pots, PR boards, etc. Outstanding value £1-35 (35p). 500 assorted resistors, good selection £1 (15p); 40 assorted pots £1 (25p); 300 assorted capacitors, all types £1 (25p). Heavy duty heat sinks 6 x 5 £1.50. Wt. 3lbs 8oz with 2 power transformers. OC36 or 2N148A £1 (25p). These sets of panel meters for callers. Audio oscillator 50kHz-20kHz, BFO No. 6 £10; RF Signal generator Marconi TF144G 85kHz-22MHz from £12. Oscilloscopes in stock. 7½" x 10½ or 8 pin DIL, 38p; 5C107-9 14 for £1; 2N3055 35p. Varicaps in stock. Post in brackets, small parts 3p. VAT NOT INCLUDED. SAE List, details.

GREENWELL ELECTRONICS (PW4)
24 Goodhart Way, West Wickham, Kent. SHOP AT 21 Deptford Broadway, SE8 (Next to old cinema). Callers most welcome. Tel: 01-692 2009.

FIRST TIME EVER
at £22-50
Solartron CD1115.2
Double Beam
Oscilloscope d.c.-9MHz; 3mV/cm; trigger delay; crystal calibrator; 600ft flat faced probes. £22.50. Carriage £1.50.

Solartron CT 316 (DIN range)
DC to 6 mca. 3" tube. 100 up to 0-10 MHz micro seconds per division. £22.50. Carriage £1.50.

Marconi Valve Voltmeter type TF 958
DC to 100 mca. 3" mirror backed meter complete with probe, leads etc. £25.50. carriage £1.50.

Wobblulator
Sweeps 5 to 45MHz ready to use, 0-3V e.c. required. £8 each. £25. (Not eased, not calibrated.)

Graticules, 12m x 14m in High Quality plastic. 20p ea. P. A. £15.

MODERN TELEPHONES
Type 706. Two tone gray, £2.75 ea. The same but black, £2.75 ea, P. A. £2.50 ea. Also TOPAZ YELLOW £2.50 ea. P. A. £2.50.

Standard Spod Dial Telephone
(Black or white) £2.75 ea. P. A. £2.50. All telephones complete with bell and dial.

Light Emitting Diodes
(Model 801) £2.50 each, P. A. £2.50. With wire only £1.50. With wire & P. A. £1.75.

Electronic Timer Units
- wall or bench mounting—Hybrid timer boards may be removed leaving excellent 12V battery charger; d.c. Power supply, etc. Price only £2.95 inc carriage.

American Scope type USMC6.
A 10 Neo scope—all mini valves complete with circuit diagram. Matrix input 115 volt 50 cycles therefore £29.95. With 26-Volt down transformer £32.95. Carriage £1.50.

Light Emitting Diodes
Model 801 £2.50 each, P. A. £2.50. With wire only £1.50. With wire & P. A. £1.75.

Electronic Timer Units
Wall or bench mounting—Hybrid timer boards may be removed leaving excellent 12V battery charger; d.c. Power supply, etc. Price only £2.95 inc carriage.

Photocell say OCD71—15p each. PHOTO-RESIST type Claire 703. Two lots.

Delivered to your door
1 c/w Electronic Scratch chassis. Boards etc. No Rubbish. For ONLY £3.50.

Chill Med LTD
79 Arthur Road, Reading, Berks. (rear Tech College)
Tel: 01-802 95516 (Reading 85705) 65916

Please add V.A.T.
The latest B.S.R. 8 Track cartridge Replay Deck. Ready to install in your Hi-Fi Stereo System. This unit comes complete with Hi Gain Stereo Pre-Amplifier, 4-Programme Indicator Lamps, Track Selector Switch, all leads and plugs, etc. for 230 volt A.C. mains operation.

5W & 10W AMPS
5W ONLY £1.98
10W ONLY £2.49
incl. P. & P. and V.A.T.

Specification:

<table>
<thead>
<tr>
<th>Watts</th>
<th>Nominal Voltage</th>
<th>Input Impedance</th>
<th>Frequency Response</th>
<th>Distortion</th>
<th>S/N Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>5W</td>
<td>10-14V</td>
<td>6 Ohms</td>
<td>10Hz-30kHz</td>
<td>0.5%</td>
<td>20dB</td>
</tr>
<tr>
<td>10W</td>
<td>20-30V</td>
<td>10 Ohms</td>
<td>10Hz-30kHz</td>
<td>1%</td>
<td>25dB</td>
</tr>
</tbody>
</table>

Cheapest in the U.K. Built and tested

STEREO DECODER
£4.95
incl. P. & P. and VAT

A ready built unit, ready for connection to the I.F. stages of your existing FM Radio or Tuner. A tell tale light can be connected to show the presence of a Stereo transmission and correct operation.

The unit is in the form of a small printed circuit, and no further alignment is necessary, as all preset adjustments have already been carried out at the factory. It is recommended that a L.E.D. is used as the indicating light and a suitable device is available from us at 36p. Supplied with all necessary instructions.

If you’re willing to give up one hour or more a day we can help you get into the lucrative growth industries of electronics, television, radio.

And if you’re already in, we can help you get on!

With our know-how and our wide experience in teaching, plus your determination to study, we can turn your interest into the technical knowledge you need for success. Once you’ve got the qualifications you need, you’ll be in a good position to take full advantage of the opportunities which exist today in all fields of electronics – in television (colour and black/white) and in radio. (We teach you the theory and practice of valve and transistor portable circuits while you build your own 5 valve receiver, transistor portable and high grade test instruments).

With ICS you study at home – at your own pace, when you choose, in the time you’ve got available. Your ICS tutors will give you all the help and encouragement you need to pass any exams you want to take.

Don’t waste another day. Take your first step now towards a better paid, more assured future. Send for your FREE Careers Guide today.

Subject of interest

☐ Society of Engineers Graduateship (Electrical Engineering)
☐ C & G Telecommunications Technicians Certificate
☐ C & G Electrical Installation Work
☐ C & G Certificate in Technical Communication Techniques
☐ MPT General Certificate in Radio Telegraphy
☐ Audio, Radio & TV Engineering & Servicing
☐ Electronic Engineering, Maintenance, Engineering Systems, Instrumentation & Control Systems
☐ Computer Engineering and Technology
☐ Electronic Engineering, Installations, Contracting, Appliances
☐ Self-build radio courses

Name

Address

Occupation

Age

Acredited by the Council for the Accreditation of Correspondence Colleges
Sinclair Project 60

Now—the Z.50 Mk.2 with built-in automatic transient overload protection

When originally introduced, the Sinclair Z.50 proved how it was possible to design and produce a popularly priced modular power amplifier having characteristics to challenge the world’s costliest amplifiers. Many thousands of Z.50’s are now giving excellent service day in, day out. But we have also learned that constructors do not always use their Z.50’s ideally. That is why we have introduced modifications whereby risk of damage through mis-use is greatly reduced and performance further enhanced. The Z.50 Mk.2 has improved thermal stability, more accurately regulated D.C. limiting to ensure more symmetrical output voltage swing and clipping and still less distortion at lower power. Z.50 Mk.2 is compatible with all other Project 60 modules, and may be incorporated to advantage in existing systems. Eleven silicon epitaxial planar transistors are now used, two more than in the original Z.50. circuitry has been re-designed, making this versatile high performance amplifier better than ever.

Z.30 the power amplifier for quality and economy

The Z.30 provides excellent facilities for the constructor requiring a high fidelity audio system of less power than that available from Z.50’s. Using a power supply of 35 volts, Z.30 will deliver 15 watts RMS into 8 ohms, or 20 watts RMS into 3 ohms using 30 volts. Total harmonic distortion is a fantastically low 0.02% at 15 watts into 8 ohms with signal to noise ratio better than 70 dB unweighted. Input sensitivity 250mV into 100K ohms. Size 80 x 57 x 13 mm (3 x 2 x ½). Z.30, Z.50 and Z.50 Mk.2 modules are compatible and interchangeable.

Guarantee

It, within 3 months of purchasing any product direct from Sinclair Radionics Ltd., you are dissatisfied with it, your money will be refunded at once. Many Sinclair appointed Stockists also offer this same guarantee in co-operation with Sinclair Radionics Ltd.

Each Project 60 module is tested before leaving our factory and is guaranteed to work perfectly. Should any defect arise in normal use, we will service it at once and without any charge to you, if it is returned within two years from the date of purchase. Outside this period of guarantee a small charge (typically £1.00) will be made. No charge is made for postage by surface mail. Air Mail is charged at cost.

Brilliant new technical specifications

- Input impedance 100 KΩ
- Input (for 30W into 60) 40mV
- Signal to noise ratio, referred to full o/p at 30V HT: 80dB or better
- Distortion 0.02% up to 20W at 8Ω. See curve
- Frequency response 10Hz to more than 200KHz ±1dB
- Max. supply voltage 45v (4Ω to 8Ω speakers)
- (50v 15Ω speakers only)
- Min. supply voltage 8v
- Load impedance minimum: 4Ω at 45v HT
- Load impedance maximum: safe on open circuit

£4.48

Typical Project 60 applications

<table>
<thead>
<tr>
<th>System</th>
<th>The Units to use together with</th>
<th>Units cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple battery record player</td>
<td>Z.30</td>
<td>Crystal P.U., 12V battery volume control, etc.</td>
</tr>
<tr>
<td>Mains powered record player</td>
<td>Z.30, P.Z.5</td>
<td>Crystal or ceramic P.U., volume control, etc.</td>
</tr>
<tr>
<td>12W. RMS continuous sine wave stereo amp. for average needs</td>
<td>2 x Z.30a, Stereo 60; P.Z.5</td>
<td>Crystal, ceramic or mag. P.U., F.M. Tuner, etc.</td>
</tr>
<tr>
<td>25W. RMS continuous sine wave stereo amp. using low efficiency (high performance) speakers</td>
<td>2 x Z.30a, Stereo 60; P.Z.6</td>
<td>High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.</td>
</tr>
<tr>
<td>80W (3 ohms) RMS continuous sine wave de luxe stereo amplifier. (60W. RMS into 8 ohms)</td>
<td>2 x Z.50a, Stereo 60; P.Z.8, mains transformer</td>
<td>As above</td>
</tr>
<tr>
<td>Indoor P.A.</td>
<td>Z.50, P.Z.8, mains transformer</td>
<td>Mic., guitar, speakers, etc., controls</td>
</tr>
</tbody>
</table>

F.M. Stereo Tuner (£25) & A.F.U. (£5.98) may be added as required.

Sinclair Radionics Ltd., R.O. London Road, St. Ives, Huntingdonshire, PE17 4HJ (Phone St. Ives 4311) Reg. No. 698463 England
Stereo 60 Pre-amp/control unit

Designed specifically for use on Project 60 systems, the Stereo 60 is equally suitable for use with any high quality power amplifier. Since silicon epitacial planar transistors are used throughout, a really high signal-to-noise ratio and excellent tracking between channels is achieved. Input selection is by means of press buttons, with accurate equalisation on all input channels. The Stereo 60 is particularly easy to mount.

SPECIFICATIONS—Input sensitivities: Radio - up to 3mV, Mag. p.u. 3mV; correct to R.I.A.A. curve +1db at 25 to 25,000 Hz. Ceramic p.u. - up to 3mV. Aux - up to 3mV. Output: 250mV. Signal to noise ratio: better than 70dB. Channel matching: within 1dB. Tone controls: TREBLE +12 to -12dB at 10kHz; BASS +12 to -12dB at 100Hz. Front panel: brushed aluminium with black knobs and control. Size: 19 x 40 x 207mm.

Built, tested and guaranteed: £9.98

Project 60 Stereo F.M. Tuner

The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other advanced features include the varicap diode tuning, printed circuit boards, an I.C. in the specially designed stereo decoder and switchable squelch circuit for silent tuning between stations. In terms of high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with most other high fidelity systems.

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. Tuning range: 87.5 to 108MHz. Sensitivity: 7µV for lock-in over full deviation. Squelch level: Typically 20µV. Signal to noise ratio: >85dB. Audio frequency response: 10Hz – 15kHz (+ -1db). Total harmonic distortion: 0.15% for 30% modulation.

Stereo decoder operating level: 3µV. Cross talk: 40dB. Output voltage: 2 x 150mV R.M.S. maximum. Operating voltage: 25–30VDC. Indicators: Stereo on. Tuning. Size: 93 x 40 x 207mm.

Built and tested. Post free. £25

Super IC.12 Integrated circuit high fidelity amplifier

Having introduced Integrated Circuits to hi-fi constructors with the IC.10, the first time an IC had ever been made available for such purposes, we have followed it with an even more efficient version, the Super IC.12, a most exciting advance over our original unit. This needs very few external resistors and capacitors to make an astonishingly good high fidelity amplifier for use with pick-up, F.M. radio or small P.A. set-up, etc. The free 40 page manual supplied, details many other applications, which this remarkable IC makes possible. It is the equivalent of a 22 transistor circuit contained within a 18 lead DIL package, and the finned heat sinks is sufficient for all requirements. The Super IC.12 is compatible with Project 60 modules which would be used with the Z.50 and Z.30 amplifiers. Complete with free manuals and printed circuit board.

SPECIFICATIONS
Output power: 6 watts RMS continuous (12 watts peak). Frequency Response: 5Hz to 100kHz ± 1db. Total Harmonic Distortion: Less than 1%. (Typical 0.1%) at all output powers and frequencies in the audio band (28V). Load Impedance: 3 to 15 ohms. Input Impedance: 250 Kohms nominal. Power Gain: 90dB (1,000,000,000 times) after feedback. Supply Voltage: 6 to 38V. Quiescent current: 8mA at 28V. Size: 22 x 55 x 28mm incuding pins and heat sink. Manual available separately 75p post free.

With FREE printed circuit board and 40 page manual. £2.98 Post free

Power Supply Units
The new
PZ.8 Mk.3

The most reliable power supply unit ever made available to constructors. Brilliant circuitry makes failure from overload and even direct shorting of the output impossible. This is due to an ingenious re-entrant current limiting principle which, as far as we know has never before been available in any comparable unit outside the most expensive laboratory equipment. Ripple and residual noise have been reduced to the point of almost total elimination. This is, of course, the perfect unit for Project 60 assemblies, particularly where the new Z.50 MK.2 amplifiers are used. Nominal working voltage – 45.

PZ.8 Mk.3 — £7.98
(Please transformer, if required) £5.98
PZ.6 3V. un-stabilised
(not suitable for Project 60 tuner) £4.98
PZ.6 3V. stabilised
(not suitable for IC. 12) £7.98

Project 605

the easy way to buy and build
Project 60
without soldering

Project 605 in one pack contains: one PZ.5, two Z.30’s, one Stereo 60 and one Masterlink, which has input sockets and output components grouped on a single module and all necessary leads out to length and fitted with clips to plug straight on to the modules thus eliminating all soldering.

Complete with comprehensive manual, post free
All you need for a superb 30 watt high fidelity stereo amplifier

£29.95

Order form
Please send
enclose cash/cheque/money order.
Name
Address

PW7
SINCLAIR RADIONICS LTD., R.O. London Road, St. Ives, Huntingdonshire, PE17 4HJ
ADD 10% V.A.T. ON PRICES ON PAGE OPPOSITE AND ABOVE
Classified advertisements 10p per word (minimum 12 words). Box No. 2040. Send display advert 25p per single column inch. Advertisements must be typewritten and addressed to Classified Advertisement Manager, PRACTICAL WIRELESS, IPC Magazines Ltd., P.O. Box 5, Farrington Street, London EC4A 4AD. All cheques, postal orders, etc., to be made payable to PRACTICAL WIRELESS and crossed "Lloyd's Bank Ltd."

Radio BOOKS

HANDBOOKS

Handbook of Transistor Theory and Substitutes 45p
Handbook of Basic Circuit Principles and Techniques 40p
Hi-Fi, PA & Disco Amplifier Design Field 35p
Pulse, VCO & Simple Circuits 40p
How to Make FM & TV Aerials 20p
Radio 101 40p
Radio 101 Electronic Manuals 50p
High Fidelity Loudspeaker Enclosures 50p
Practical Tape Recording Handbook 35p
Practical Stereo Handbook 35p
Practical Sound Handbook 35p
Practical Circuitry Handbook 35p
Transistor Circuits Manual No. 1 50p
Transistor Circuits Manual No. 2 40p
Circuit Design and Construction Manual 35p
Radio TV Audio & Electronic Data Book 40p
Trance Radio Circuits for Radio Controlled Models 40p
In Par Tlto Audio Amplifiers Book 1
Transistor TV and Servicing Manual 35p
Handbook of Simple Transistor Circuits 35p
Modern Transistor Circuits for Beginners 40p
Sound and Loudspeaker Manual 40p
Resistor Colour Code Disc Calculator 25p
Manual Transistor Audio Amplifiers 25p
Practical Car Radio Handbook 35p
Radio TV & Industrial Fm & Valve Equiv 30p
Practical Transistor Novoty Circuits 40p
Television Servicing Vol. 1 40p
Television Servicing Vol. 2 40p
Television Servicing Vol. 3 40p
Using an Oscilloscope 30p
Servicing Transistor Radio Receivers 30p
Transistor Timebase Circuits 40p
Pal-D Colour Receiver Questions & Answers 80p

All prices include postage & packing

FREE list of other titles away on request. Send to:

RADIO BOOK SERVICE
40 Ewells Way, Beckenham BR3 2RZ

DENCO CLACTON LIMITED
355-7-9 Old Road
Clacton-on-Sea, Essex
Catalogue 20p post paid
S.A.E. all enquiries

LADDERS

LADDERS 24-ft. £9-80. Carr 80p.
(Price includes V.A.T. to total order).
Leaflet. Home Sales Ladder Centre,
(WLS) Haldane, Halesfield (1) North,
Telford, Salop. Tel: 0952 889544.

Situations Vacant

MEN!
£50 p.w. can be yours

Jobs galore! 144,000 new computer
personnel needed by 1977. With
our revolutionary, direct-from-
America, course, you train as a
Computer Operator in only 4 weeks!
Pay prospects £250-p.a.
After training, our exclusive ap-
pointments bureau—one of
the world's leaders—introdu-
duced you FREE to world-wide
opportunities. Write or 'phone
TODAY, without obligation.
London Computer Operators
Training Centre
P1, Oxford House
Telephone: 01-734 2874
127, The Plaza, Dept. P1,
Piccadilly Plaza, Manchester 1.
Telephone: 061-236 2935

Computer Commissioning Engineers

Resulting from our expansion programme, our
Quality Control Department have vacancies in
Letchworth and Stevenage factories for Engineers
to commission and test computer equipments
before delivery to the customer.

We offer attractive conditions and salaries to
applicants who should have practical experience
in fault finding and testing of complex electronic
equipment. Whilst qualifications to ONC
standard are desirable they are not essential.
Housing may be available for applicants living
in the Greater London Council's area.

Write for an application form, quoting
reference PW412M to Area Personnel Recruitment
Officer, ICL House, Broadway, Letchworth,
Herts SG6 3PG.

International Computers

ICL
FOR SALE
UK Distributor "W2AU" baluns, antenna hardware, toroid cores also Electro-Voice microphones plus many Large S.A.E. T.M.F. (Electronic Supplies) address, (Dept PW), 3 Bryn Court, Blythwood, Mold, Flintshire, CH7 4RU.

EDUCATIONAL
RADIO, TV, REB Certs., City and Guilds, Comm. A.M. Certs., Practical Electronics (with kit). Thousands of successes. Details of home study courses and illustrated book—FREE. BIET (Dept ZL BPW 30), Aldermaston Court, Reading RG 4P. Accredited by CACC.

CIE, AMSE, City & Guilds, etc. Thousands of success stories. Postal courses in all branches of Engineering. Prospectus FREE. State subject of interest: BIET (Dept ZL BPW 41), Aldermaston Court, Reading RG 4P. Accredited by CACC.

CIE, AMSE, City & Guilds, etc. Thousands of success stories. Postal courses in all branches of Engineering. State subject of interest: BIET (Dept ZL BPW 41), Aldermaston Court, Reading RG 4P. Accredited by CACC.

CIE, AMSE, City & Guilds, etc. Thousands of success stories. Postal courses in all branches of Engineering. State subject of interest: BIET (Dept ZL BPW 41), Aldermaston Court, Reading RG 4P. Accredited by CACC.

FOR SALE
UK Distributor "W2AU" baluns, antenna hardware, toroid cores also Electro-Voice microphones plus many Large S.A.E. T.M.F. (Electronic Supplies) address, (Dept PW), 3 Bryn Court, Blythwood, Mold, Flintshire, CH7 4RU.

EDUCATIONAL
RADIO, TV, REB Certs., City and Guilds, Comm. A.M. Certs., Practical Electronics (with kit). Thousands of successes. Details of home study courses and illustrated book—FREE. BIET (Dept ZL BPW 30), Aldermaston Court, Reading RG 4P. Accredited by CACC.

CIE, AMSE, City & Guilds, etc. Thousands of success stories. Postal courses in all branches of Engineering. Prospectus FREE. State subject of interest: BIET (Dept ZL BPW 41), Aldermaston Court, Reading RG 4P. Accredited by CACC.

CIE, AMSE, City & Guilds, etc. Thousands of success stories. Postal courses in all branches of Engineering. State subject of interest: BIET (Dept ZL BPW 41), Aldermaston Court, Reading RG 4P. Accredited by CACC.

CIE, AMSE, City & Guilds, etc. Thousands of success stories. Postal courses in all branches of Engineering. State subject of interest: BIET (Dept ZL BPW 41), Aldermaston Court, Reading RG 4P. Accredited by CACC.

FOR SALE
UK Distributor "W2AU" baluns, antenna hardware, toroid cores also Electro-Voice microphones plus many Large S.A.E. T.M.F. (Electronic Supplies) address, (Dept PW), 3 Bryn Court, Blythwood, Mold, Flintshire, CH7 4RU.

EDUCATIONAL
RADIO, TV, REB Certs., City and Guilds, Comm. A.M. Certs., Practical Electronics (with kit). Thousands of successes. Details of home study courses and illustrated book—FREE. BIET (Dept ZL BPW 30), Aldermaston Court, Reading RG 4P. Accredited by CACC.

CIE, AMSE, City & Guilds, etc. Thousands of success stories. Postal courses in all branches of Engineering. Prospectus FREE. State subject of interest: BIET (Dept ZL BPW 41), Aldermaston Court, Reading RG 4P. Accredited by CACC.

CIE, AMSE, City & Guilds, etc. Thousands of success stories. Postal courses in all branches of Engineering. State subject of interest: BIET (Dept ZL BPW 41), Aldermaston Court, Reading RG 4P. Accredited by CACC.

CIE, AMSE, City & Guilds, etc. Thousands of success stories. Postal courses in all branches of Engineering. State subject of interest: BIET (Dept ZL BPW 41), Aldermaston Court, Reading RG 4P. Accredited by CACC.
TV's Colour TV's
Reservoir, perfect working order, reconditioned.
16in. ECR 2800, £195
21in. ECR 3200, £295
25in. ECR 4000, £350
25in. CEC 2835, £275
30in. Amstrad 7000-85, £425
31in. DECCA 7000-85, £450
32in. TESLA 2000, £525
32in. THORN 3000, £675
One month comprehensive written guarantee. These sets can be sold on collection. Delivery quotations by phone.

Mono U.H.F.
Fabulous TVs. No rubbish, from good source. Reconditioned cabinets. Many working, recent manufactured models. Inc., Dual Circuits, etc.
Valve AF 114 £12 each. B8X20 £12 each.
B710 £12 each. GEC Valves.

U.H.F. Tuners
For Ferguson 650, 500 series only but adaptable for most D/S TL chassis £25 each, two post included. Send, e.g. for lists of tubes, valves, etc. For England:
TRADE DISPOSALS, 104 Leeds Road, Warrington. Telephone: 065570.
For Scotland:
TRADE DISPOSALS, Unit 5, Peak Cross Industrial Estate, 2 Burnbank Road, Hamilton. Telephone: Hamilton 2991/2.

BATTERY ELIMINATOR KITS.
Our well-known Mini Mains Pack Kits now complete with drilled insulated base 52 x 55mm. Fits into space of most large transistor batteries. Easy wiring instructions. Safe, silent mains transformer, silicon rectifier, smoothing capacitor, all top grade. For any ONE of these voltages (state which): 3V, 300mA max.; 6V, 180mA; 9V, 120mA; 12V, 60mA. £1.85 each by mail order only, UK post 5p. Amstrad Ltd., 596 Selction Rd., South Croydon, Surrey CR2 0DE.

TUNBRIDGE WELLS, Components from Teleservice, S.A.E. or call in for list. Special offer limited quantities—Matched AD161/2 68p, 10 transistors £5.75, 2N3702 £2.25, 2N3703 £2.25, 2N3714/6 £2.50 unmarked, air spaced twin gan receiver tuning capacitors, unlined; £1.50; 27p, thin glass flex 1p yd. Minimum order 40p post free, but add “10% V.A.T.” 108 Camden Road, Tunbridge Wells, Kent. Telephone 51803.

Miscellaneous

"AT LAST YOU CAN TRANSMIT AND FORGET ABOUT LICENCE EXAMINATIONS" because this Ministry approved transmitter/receiver kit does not use R.F. Your transmissions will be perfectly secret since there is no conventional means. Actually it's TWO KITS IN ONE because you can choose any frequencies and components for both the transmitter AND receiver. We're sure you'll find this project REALLY FUN-TO-BUILD with the EASY-TO-FOLLOW instructions. An exciting design, and quite an AMazuING RANGE—has obvious applications for SCHOOL PROJECTS, LANGUAGE LABORATORIES, etc.

Send YOURS! SEND £5-80 (inc. VAT) NOW TO: "S.A.E. for details" MAIL ORDER ONLY TO: ELECTRONICS PROJECTS DEPT., KW200 4CULiffe LANE, BLENHEIM, EVEL, SURREY

GLASS FIBRE P.C. BOARD. Large supplies available, in single sided one ounce copper, 2p per sq. in (under 1 foot), 75p per sq. ft. (over 1 foot). £1 per sq. foot (over 1 foot). Please add 10p per sq. foot postage and packing. We will cut to any size. E.N.T. Specialist Solid State Lighting, The Firs, Southwold Lane, Garboldisham, Diss, Norfolk.

CONSTRUCTION AIDS—Screws, nuts, spacers, etc., in small quantities. Aluminium panels punched to spec. or plain sheet supplied. Facia panels etched aluminium to individual requirements. Printed circuit boards—masters, negatives and boards, one-off or small numbers. £50 or per Ramor Constructor Services, 29 Sheilbourne Rd., Stratford on Avon, Warwicks.

DIMMER SWITCH
200, 300 and 500 WATT TYPES
Separate on-off switch from the brightness control so that the light can be switched without need to re-adjust the dimmer. Ideal for television room, dining room, bedroom or for that special occasion. 250V 50-60Hz. Takes about 2 mins to fit. Can be used on fluorescent and tungsten lamps.

150W £7.95
200W £8.95
300W £12.95
400W £17.95
250W £11.95
500W £16.95

Also available, Solid State CONTROLLER FOR DRILL etc. £7.50. 500W £9.50.4 p.

FROM LECTRON, Dept. J, Kings Alfred Way, Basingstoke

**RECHARGEABLE**

Mallite Cells in U2, U11 and Penlite U7 sizes, Ketrel Battery Charging Unit...

Use for Tape recorders, Portable radio and TV, Radio controlled model aircraft and boats, Cine cameras, Flashguns, Cordless shavers and other battery appliances.

Whenever you must have utterly dependable battery power—then these new Alkaline-Manganese rechargeable cells will prove ideal. The cells can be recharged many times, a simple job with the Ketrel Charging Unit which has been specially designed for these new type batteries.

**ALL PRICES INCLUDE V.A.T.**

Send to:

**KETREL**

275 West End Lane
London, N.W.6 1QS

01-784 9611

---

**EX COMPUTER PC PANELS**

2 x 4 in. packed with semiconductors and 6p quality resistors, capacitors, diodes etc. Guaranteed min. 35 transistors plus data. 10 boards 50p (9p)

**SPECIAL BARGAIN PACK**

25 boards for £1 (25p). Panels with 4 Power transistors sim OC28 50p (9p)

**ELECTROLYTICS**

68,000u 16, 4 x 2 in. dia., 25,000u 25v, 20,000u 30v, 5,000u 90v, 35,000u 15v, 8,000u, 4 x 40v, 50v 15u (15p) 15,000u 5v, 10,000u 35v, 4 x 2 in. dia., 30p (10p), 2,000u 25v wire ends 15p (5p), 12 for £1.50 (15p)

20A DIODES 4 for £1 (7p)

3A DIODES 4 for 50p (5p)

8 BLACK TOGGLES 4p (8p)

250 MIXED CAPACITORS 60p (8p)

250 MIXED RESISTORS 60p (8p)

150 HI-STAB RESISTORS 60p (6p)

200 2N PLANAR DIODES 50p (5p)

SUB MIN. CO-AX PLUGS & SKTS. 4 pairs 50p (5p)

---

**REED RELAYS, MIXED 10 for 50p (5p)**

**MICRO SWITCHES**

8 for 50p (6p)

**ASSORTED RELAYS 8 FOR £1 (12p)**

**MIN. GLASS NEONS**

12 for 50p (5p)

**10 WAY TERMINAL BLOCKS**

10 for 55p (5p)

**PAPST EXTRACTOR/BLOWER FANS**

100 cm 4 x 4 x 2 in. £3 - 50 (28p)

G-H BULBS 12v 55w 12p 50p (5p)

Postage and package shown in brackets. Please add 10p VAT to prices.

**KEYTRONICS**

(Mall Order only)

44 Earls Court Road
London W8. 01-478 8499

---

**CAPACITOR DISCHARGE IGNITION KIT**

A comprehensive kit of parts with detailed constructional details, ready drilled diecast case, screws, leads, terminals etc. Available in both 6 and 12v versions. State whether positive or negative earth. £3.92 incl. p. & p. U.K. only.

De-coupling kit for impulse tacho-meter and interference suppression. £1.10 incl. p. & p. U.K. only. All our kits use guaranteed quality components and have been approved by the Author.

**MAGTOR LTD.**

68 Dale St., Manchester M1 2HS

061-236 3031

---

**THE RADIO SHOP**

16 Cherry Lane, Bristol BS1 3NG

Tel.: Bristol 421196. STD Code 0272 Your West Country shop for electronic components and kit state devices

---

**2 METRE CONVERTER KIT**


Price £6, post paid.

---

**2 METRE PRE-AMP**

Single F.E.T. Pre-amp. neg. earth. Gain app. 12d. Circuit, Instructions and Components. All you need is a tobacco tin.

Price £1.40, post paid.

---

**AIRCRAFT BAND CONVERTER**

Circuit, instructions and components. All you need is a tobacco tin.

Price £1.40, post paid.

---

**NEW BIGGER**

1973 CATALOGUE

Over 25 kits. Over 30 books. Plus components, cases, chassis, etc. Only 10p, post paid.

---

**WE STOCK “WECO” Television Tubes.**

All prices include V.A.T.

TRIO STOCKISTS
**First Quality Fully Guaranteed**

**Zacrix BRAND ELECTRONIC VALVES**

<table>
<thead>
<tr>
<th>Value</th>
<th>Model</th>
<th>Brand</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>480</td>
<td>50125</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>44A</td>
<td>60013</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>275</td>
<td>28748</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>50125</td>
<td>0.26</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>44A</td>
<td>29634</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>275</td>
<td>38748</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>50125</td>
<td>0.90</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>44A</td>
<td>48748</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>275</td>
<td>58748</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>50125</td>
<td>1.75</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>44A</td>
<td>68748</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>275</td>
<td>78748</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>50125</td>
<td>2.63</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>44A</td>
<td>88748</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>275</td>
<td>98748</td>
<td>Zacrix</td>
<td></td>
</tr>
</tbody>
</table>

**TRANSISTORS**

<table>
<thead>
<tr>
<th>Value</th>
<th>Model</th>
<th>Brand</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>50125</td>
<td>0.15</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>44A</td>
<td>0.15</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>275</td>
<td>0.15</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>50125</td>
<td>0.15</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>44A</td>
<td>0.15</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>275</td>
<td>0.15</td>
<td>Zacrix</td>
<td></td>
</tr>
</tbody>
</table>

**MULTIMETERS MADE IN USSR**

Prices of these exceptionally well made instruments range from £4.95 to £10.50. Please write for illustrated catalogue.

**SYNCHROSCOPE TYPE C1-5**

Made in USSR

3½-in tube fitted with cedarwood viewing hood, giving bright display in full daylight. Sensitivity 100V/mm (narrow band) to 10mV/mm (full scale). Bandwidth 10 c/s-10 MHz. Triggered sweep pre-set at 1-2-3-4-5-10-20-50-100-200-500-1000-2000 µsec per stroke. Free-running time base 20 c/s to 20kHz, with built-in crystal calibrator providing timing marks at 0.2-2-5-10-20-100 µsec. Amplitude calibrator directly calibrated in volts. Input attenuator 0-20-100. Power supplies 127/230V AC.

**DIODES**

<table>
<thead>
<tr>
<th>Value</th>
<th>Model</th>
<th>Brand</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>47.40</td>
<td>60125</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>44A</td>
<td>60125</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>275</td>
<td>60125</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>50125</td>
<td>0.55</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>44A</td>
<td>0.55</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>275</td>
<td>0.55</td>
<td>Zacrix</td>
<td></td>
</tr>
</tbody>
</table>

**MINIATURE SILICON HALF-WAVE WIRE-ENDED RECTIFIERS**

<table>
<thead>
<tr>
<th>Value</th>
<th>Model</th>
<th>Brand</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>50125</td>
<td>0.95</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>44A</td>
<td>0.95</td>
<td>Zacrix</td>
<td></td>
</tr>
<tr>
<td>275</td>
<td>0.95</td>
<td>Zacrix</td>
<td></td>
</tr>
</tbody>
</table>

**VALUE ADDED TAX**

The above prices do not include VAT. When remitting cash with orders please ensure 10% of the value of goods including postage and handling.
Which of these 165 career opportunities could earn you £10...£15...even £30 extra a week?

In a job you really enjoy

How to qualify in your spare time for a better job

Make yourself worth more and you'll earn more. It's as simple as that. There are always plenty of people to do the routine work - but, right now, key jobs are going begging for lack of suitably qualified men to fill them. The basic qualification is technical know-how. When you've got that, you're in demand - of course.

Are you ambitious - willing to set aside about 60 minutes a day for home study? If you are, B.I.E.T. can give you the technical knowledge you need - change your entire future prospects.

It's easier than you think...

Make no mistake about it - you could do it. Most people have unused ability. A low-cost B.I.E.T. course helps you discover this hidden ability - makes learning enjoyable and so much easier than it used to be. The B.I.E.T. simplified study system gets results fast.

We've successfully trained thousands of men at home equipped them for higher pay and better, more satisfying jobs, steered them safely through City and Guilds examinations - enabled many of them to put letters after their name.

With the help of B.I.E.T., you too could soon be on your way to better things.

OTHERS HAVE DONE IT - SO CAN YOU

Many of the successful B.I.E.T. students who get a recognised qualification never thought they had the brains to do it. But you don't need outstanding brain-power or talent - not even any special education. With enthusiasm, a little determination and a B.I.E.T. home training, ordinary, average people will see you through. We've proved it over and over - thousands of times, in fact!

BEST VALUE FOR MONEY HE EVER OBTAINED

"Yesterday I received a letter from the Institution informing that my application for Associate Membership had been approved. I can honestly say that this has been the best value for money I have ever obtained - a view echoed by two colleagues who recently commenced the course" - Student D.I.B., Yorks.

HE GOT OUT OF A BAD JOB INTO ONE HE LOVED.

"Completing your course, meant going from a job I detested to a job that I love, with unlimited prospects" - Student J.A.O., Dublin.

HE MADE FOUR TIMES AS MUCH MONEY.

"My training with B.I.E.T. quickly changed my earning capacity and in the next few years, my earnings increased fourfold" - Student C.G.F., Bath.

FREE 76-PAGE BOOK

can put you on the road to success through a B.I.E.T. Home Study Course. It's yours for the asking, without obligation. Post coupon for your FREE COPY TODAY!

1. MECHANICAL
A.M.S.E. (Mech.)
C & G Agric. Mechanics
Dipl. Eng. (Mech. Eng.)
Inst. of Engineers, Ireland
Inst. of Engineers, Scotland
Inst. of Engineers, Wales

2. ELECTRICAL & ELECTRONIC
A.M.S.E. (Elec.)
C & G Agric. Electronics
C & G Elec. Eng.
C & G Elec. Inst.
C & G Elec. Tech.
Computers (B.E.)
Elect. Eng.
Inst. of Electrical Engineers
Inst. of Engineering Surveyors

3. MANAGEMENT & PRODUCTION
Agric. Science
Agric. Tech.
Animal Science
Animal Industry
Animal Husbandry
Animal Husbandry & Management
Agric. Tech.
Agric. Work
Articulated Courses

4. AUTO & AERO
Aero Eng.
Aerodynamics
Aircraft Design
Airframe Design
Aviation Engineering
Aviation Maintenance
Aviation Pilot

5. CONSTRUCTIONAL
A.M.S.E. (Civil)
A.M.S.E. (Archty)
A.M.S.E. (Build.
Architectural Engineering
Building

6. ENGINEERING TECHNOLOGY
Constructional Engineering
Conveyors & Elevators
Contractors
Constructional Surveyors

7. RADIO & TELE-COMMUNICATIONS
C & G Radio/TV
C & G Telecomm.

8. GENERAL
A.M.S.E. (Agric.)
A.M.S.E. (Animal)
A.M.S.E. (Aerospace)
A.M.S.E. (Architectural)
A.M.S.E. (Building)
A.M.S.E. (Civil)
A.M.S.E. (Electrical)
A.M.S.E. (Electronic)
A.M.S.E. (Mechanical)
A.M.S.E. (Metallurgical)
A.M.S.E. (Nautical)
A.M.S.E. (Power)
A.M.S.E. (Wiring)

Choose from this list

MECHANICAL
A.M.S.E. (Mech.)
C & G Agric. Mechanics
Diesel Eng.
Eng. Inspection
Eng. Metallurgy
Inst. Eng. & Tech.
Mainten. Eng.
Mechanics Eng.
Sheet Metal Work
Soldering

DRAFTSMANSHIP
A.M.S.E. (Eng.)
Design of Elec.
Design of Equip.
Design of Machines
Design of Metals

ELECTRICAL & ELECTRONIC
A.M.S.E. (Elec.)
C & G Agric. Electronics
C & G Elec. Eng.
C & G Elec. Inst.
C & G Elec. Tech.
Computer Elec.
Elect. Eng.
Elec. Maths
Elec. Science
Electronic Eng.
Electrical Eng.
Inst. & Wiring

MANAGEMENT & PRODUCTION
Aero, Auto. Control
Aircraft Prop.
Computers
Computer Programming
Computer Programming

RADIO & TELE-COMMUNICATIONS
C & G Elec.
C & G Radio TV
C & G Telecomm.

GENERAL
A.M.S.E. (Agric.)
A.M.S.E. (Animal)
A.M.S.E. (Aerospace)
A.M.S.E. (Architectural)
A.M.S.E. (Building)
A.M.S.E. (Civil)
A.M.S.E. (Electrical)
A.M.S.E. (Electronic)
A.M.S.E. (Mechanical)
A.M.S.E. (Metallurgical)
A.M.S.E. (Nautical)
A.M.S.E. (Power)
A.M.S.E. (Wiring)

PLUS 58 'O' & 'A' LEVEL GCE SUBJECTS

tick here

IT PAYS TO BE QUALIFIED!
POST TODAY FOR A BETTER TOMORROW

To B.I.E.T.,
Aldermaston Court, Reading RG7 4PF

NAME

Block Capitals Please

ADDRESS

AGE

OTHER SUBJECTS

Accredited by C.A.C.C.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

£30...even £30 extra a week?
BUILD THE
TEXAN
FREE TEAK CABINET with complete kit
FEATURES. New slim design with 6 1/4", 1C sockets, 10 silicon transistors, 4 rectifiers, 2 zeners. Special Gardens low field slim line arc-fume, Fibre glass PC panel, Complete chassis work HIGH QUALITY & STABILITY ARE PREDOOMINATE FEATURES—developed by Texas engineers for performance, reliability and ease of construction.

CONSTRUCTED FEATURES. Metal indicator, headphone socket, separate treble, bass, volume and balance controls, rotatable and filter, monostereo switch (input selector), Mic. PSU Radio Tuner, Aux. Can be altered for Mic. Tape, Tape-head, etc.

(Special list Ref. 20 on request) Constructional details Ref. No. 21 30p

SPECIAL KIT PRICE £28.50 P & P 45p

COMPLETE WITH FREE TEAK CABINET

Designed approved kits distributed by Henry's

LOW COST HI-FI SPEAKERS

E.M.I. Size 13" x 3/4" Large Ceramic Magnet, TYPE 150 6.3 watt, 3, 8 or 15 ohms £3.50, Pair £6.50

TYPE 150 T.C. Cone cone voice coil driven, 22p.

TYPE 450 10 watt with twin tweeters. 3, 8 or 15 ohms £5.30, Pair £9.60

TYPE 350 20 watt with tweeter £7.50. Pair £15.00

POLISHED CABINETS 150; 100TC 64-60. Pair 30p.

ASSEMBLED IN POLISHED CABINETS 8 ohms.

SERIES 6 (Assembled) £11.25 per pair £15.00 Post 70p

SERIES 8 (Assembled) £15.00 per pair £20.00 Post 70p

ML3 MW/LW TUNER TO BUILD


Size 7" x 2" x 3". TOTAL COST TO BUILD £6.05. Post 15p. All parts sold separately. List 334.

"BANDSPREAD" PORTABLE TO BUILD

Printed circuit all transistor design using Mullard REJF Module. Medium and Long Waves plus Medium Wave Bandspread for extra selectivity. Also slow motion geared tuning. 600 ohm push-button output for panes—Fy covered cabinet, car aerial. Attractive appearance and performance. TOTAL COST TO BUILD £7.99.

CATALOGUE

Fully detailed and illustrated covering every aspect of Electronic—and plus data, circuits and information. 10,000 Stock line at Special Low Prices and Fully Guaranteed

PRICE 55p Post Paid (40p for CALLERS)

PLUS! FIVE 10p VOUCHERS

Send to this address—HENRY'S LTD (Dept. FW) 3 ALBEMARLE WAY, LONDON, E.C.1., for catalogue by post only. All other mail and callers to "HENRY" see below.

All prices are exclusive of 10% VAT which must be added to all orders inc. car/packing. (Note: Catalogue is not subject to VAT.)

20 + 20 WATT INTEGRATED I.C. STEREO AMPLIFIER

(After featured in "Practical Wireless"

May to August 1972)

20 + 20 WATT INTEGRATED I.C. STEREO AMPLIFIER

P.W. Triclovil as designed by Hi-Fi Ltd. June 1973. Parts list on request.

SPECIAL DESIGN WITH SLIM DESIGN TRIM

OVERALL CHASSIS SIZE TALL x WIDE x 2" INCH HIGH

TEST EQUIPMENT

Just a selection!

N9008 Pocket Pencil Signal Generator £1.90

N9008 Pocket Pencil Signal Generator £1.90

THL110 Robust 2K/hf 64-94 with case £4.95

TE15 Grid Dip Meter 400 KHz-200M Hz £3.65

R00 High Quality, 2K/ Voltmeter £3.95

With leather case £5.00

400H SOKKEN Multimeter £1.95. With case £4.95

AF105 5K/ Voltmeter £3.50. With case £5.95

400H SOKKEN Multimeter £1.95. With case £4.95

TE289 RF Generator 100KHz-500KHz £1.95. Carr. 35p

TE65 Valve Voltmeter 2 range £7.50. Carr. 35p

PS - MIRROR MODELS IN STOCK

PA-Disc-O-Tuner

UK's Largest Range—Write phone for full details and demonstrations on request.

DISCO 3 Channel sound on light unit. 3w. £2.75

DISC2 3 Channel Mic. (built-in) to light. £3.25

DISC2 70 watt Disco amp/mixer. £8.75

DISC20 100 watt amp/mixer, £12.75

DISC123 30 watt Disco amp/mixer. £22.25

Anti-Flicker Quality Mic. £1.99

DISC22 50 watt PA. Amplifier £4.95

DISC70 70 watt disc amplifier. £6.95

DISC70 70 watt disc amplifier. £6.95

GROUP 300/50 watt ring "Group" Amplifier £8.00

PIECE OPTICS LIGHTING, MICS. EFFECTS, PROJECTORS

SPOTTS, DIMMERS, STANDS, MIXERS, SPEAKERS

Everything for PA — Disco — Lighting.

Made by EMJ especially for Henry's.

ULTRASONIC TRANSUDCERS

Operate on 40kHz up to 100 yards. Ideal remote switching and signalling. Complete with drive unit and 140ft cable. £9.50 per pair. Post 10p.

MARROW TAPE HEADS

4 for £9.90. 8 for £19.90

2 TRACK STEREO

17" High Impedance £3.95

14" High Impedance £3.95

9" Med.-Low Imp. £2.95

9" Scratch Heads for £4.20

7" 6-2 track mono. £1.75

4/3 Head for above £7.50

7 SEG & NIXIE TUBES

£2.10 each (per 6) £15.55

XNI, XNL, GNP 9-9 side views with decimal points and data £9.95

Gnp7, Gnp8 0-9 side view with decimal points and data £9.95

15p. each 30p. each 60p. each

Miniature Amplifier

5 transistor, 300mW o/p, fitted volume and sensitivity control. 9 volts. operation. £4.95.

Quality Slider Controls 60mm stroke single and panel. "Gates" model to £9.00. 3K, 10K, 25K, 50K, 100K, 200K, 500K, £1 each. 10K, 25K, 50K, 100K, 200K, £6 each. 3K, 5K, 10K, 25K, 50K, 100K, 200K, 500K, £10 each.

E. & O.E.