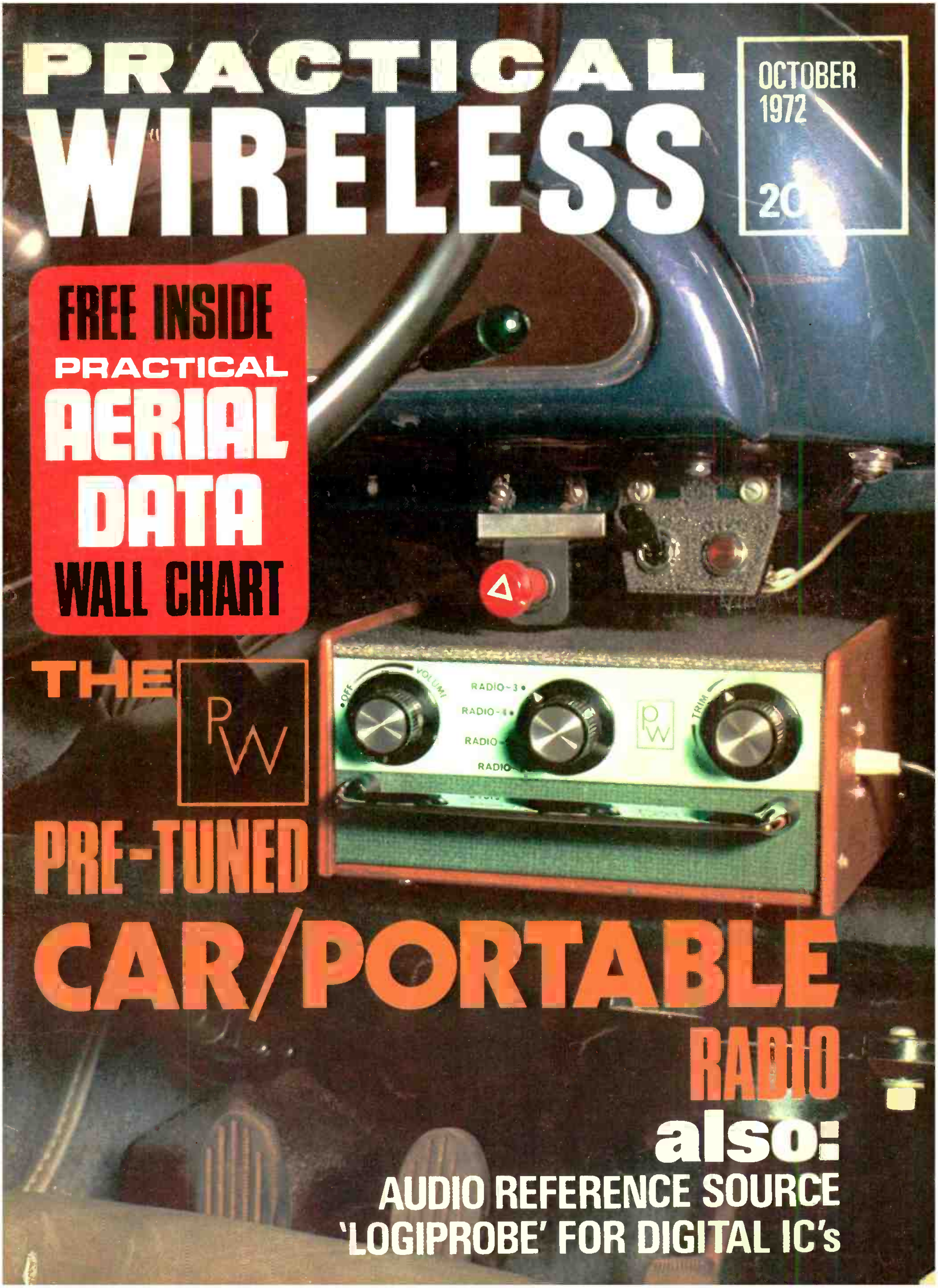
PRACTICAL WIRELESS

OCTOBER 1972

20



FREE INSIDE
PRACTICAL AERIAL DATA WALL CHART

THE PW PRE-TUNED CAR/PORTABLE RADIO

also:

AUDIO REFERENCE SOURCE

'LOGIPROBE' FOR DIGITAL IC's

ORGAN KITS

Build your own Electronic Organ, if you want the best value for your money. Yes you really save over 50% and get the best and up-to-date designs. There are four models to choose from.

★ Portable—4 octave keyboard with 10 voices, 3 pitches—vibrato, at **£103·00**, P/P £1·50.

★ Console—5 octave keyboard with 10 voices, 3 pitches . Keyboard can be split into solo and accompaniment. Vibrato built in amplifier and 50 watt 12" Goodmans speaker at **£167·00**, P/P £5·00.

★ Console—2 x 4 octave keyboards and 13 note pedal board, 29 voices, Vibrato, Delay Vibrato, Sustain Reverberation, Precussion, Wah Wah, etc. at **£406·00.** Carr. paid on complete kit U.K. only.

★ Console—2 x 5 octave keyboards and 32 note pedal boards, 32 voices. Vibrato, Delay Vibrato, Sustain Reverberation, Precussion, 3 Couplers, etc., at **£572·55** carr. paid on complete kit U.K. only.

We regret H.P. facilities are not available, but components can be bought separately. Trade and overseas enquiries welcomed. Send 25p for latest catalogue.

Please call in for demonstration. Business hours: 10 a.m. to 7 p.m. Monday to Saturday. Thursday closed.

ELVINS ELECTRONIC

MUSICAL INSTRUMENTS

8, PUTNEY BRIDGE RD., LONDON
S.W.18 TEL: 01-870 4949

Bus numbers 37, 220, 225, 168 pass the door. 10 minutes walk from East Putney or 15 minutes walk from Putney Bridge Underground Stations.

MICROJET WELDER

A TINY FLAME UP TO 5,000°F!
WELDS · BRAZES · SOLDERS

£11·50

INC. 3 FLAME TIPS

A precision tool using a combination of butane and compressed oxygen. U.S.A. manufactured. Gives two sizes of flame of pencil lead thickness. Adjustable temperatures up to 5,000°F. Lights instantly, no priming. Cuts metals, welds, brazes and solders, etc. gold and silver. Ideal for electronics and electrical engineering, jewellers, clockmakers, silversmiths. Up to 40 minutes' operation using fuel supplied. Replacement set of 2 oxygen and 1 butane cylinders £1·50 inc. post. Complete with instructions. Our price £11·50 + 31p P. & P. Send £11·81.

TWIST FREE STORAGE

WITH THE 'SAFE-WAY' MAINS EXTENSION LEAD

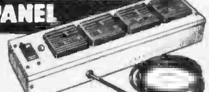
SUITABLE FOR ALL DOMESTIC APPLIANCES & POWER TOOLS

INTRODUCTORY PRICE ONLY

£1·69

Store cable tidily. Heavy duty 3-core cable fitted unbreakable rubber standard 13 amp fused 3-pin plug & 3-pin socket. Saves trouble fitting yourself. For Domestic Appliances, Garden Power Tools, Hedge Trimmers, Mowers, etc. 30ft app. cable & FREE storage reel £1·69 + 41p p. & p. Send £2·10. 15ft. app. £1·20 + 35p p. & p. 50ft. app. £2·20 + 41p p. & p. 75ft. app. £3 + 50p p. & p. 100ft. app. £3·75 + 55p p. & p. 50ft. app. 'Roverpoint' cable with winder reel, socket, plus carry handle £3·99 [illegible]

13 AMP DISTRIBUTION PANEL



From Only £2·40

Safe and quick. FOUR 13 amp 3-pin shuttered Socket Outlets Red neon warning indicator operates when in use. Only £2·40 + 35p p. & p. Total £2·75. Also De Luxe Model (illus.) PLUS Magnetic Contact Breaker—If you draw too much current it switches off automatically. PLUS 30ft. (9 metres) approx. lead. £6·75 + 40p p. & p. Total £7·15. Bonus offer: if required, set of four fused 13 amp plugs 50p extra. Post free if ordered with above.

BINOCULAR MAGNIFIER

FOR PRECISION CLOSE-UP WORK- LEAVES BOTH HANDS FREE

ONLY **£4·95**

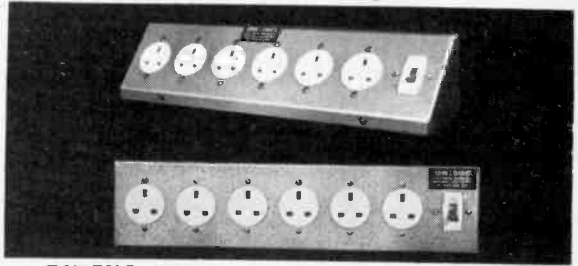
See close-up work with less eye strain & fatigue. Lightweight adjustable headband. Powerful optically ground lenses from Continental glassworks. Can be worn over normal glasses. An essential in modelling, industry, home and workshop. Stamp collecting. Jewellers, watchmakers and any fine work 2½ × magnification. £4·95 + 35p p. & p. Send £5·30. 3 × model 50p extra. State model.

TWIN-BEAM SPEC- LAMP—Worn just like a pair of spectacles. Two powerful spot lamps illuminate working area. Can be worn with Binocular Magnifier. Battery operated. Only £1·90 + 10p p. & p. Send £2.

JOHN DUDLEY & CO. LTD. DEPT WP2, 301 Cricklewood Lane, Child's Hill, London, NW2. Tel. 01-458 5917 Callers welcome

6 gang socket units

wall mounting or bench mounting



DIMENSIONS: 18 ins x 4½ ins. x 2½ ins. approx.

CONSTRUCTION: Metal box, hammer grey finish. Mk 13 amp Sockets. 45 amp Double pole switch internally wired.

PRICES: £4·87 each inc. carr. Cash with order. State if wall or bench socket is required. Quotation for 10 or more. Wholesale enquiries welcome.

MANUFACTURED BY

JOHN I. OAKES
NAYLAND · COLCHESTER · ESSEX
Telephone: Nayland 262405

Have fun with electronics...

PHILIPS

Radionic Construction Kits

NO SOLDERING
BATTERY OPERATED

Build your own radio receiver and many exciting experiments with the unique printed circuit board and mounted components. Easy to build, no soldering, battery operated, plus a fully illustrated instruction manual giving precise directions for each experiment. Ideally suitable for both the experimenter and beginner.

Radionic Products Limited
St. Lawrence House, Broad Street, Bristol BS1 2HF.
Tel: 0272 25351.

Amember of the ESL BRISTOL Group of Companies.

PHILIPS

Please send me literature on Radionic radio and electronics construction kits.

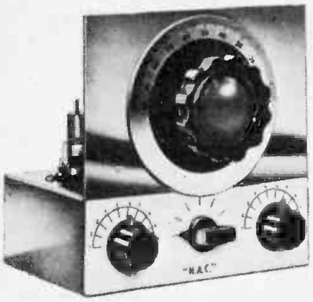
NAME ____________________

ADDRESS ____________________

____

H.A.C. SHORT-WAVE KITS

WORLD-WIDE RECEPTION



Famous for over 35 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, Hams, etc.

NEW "DX" RECEIVER

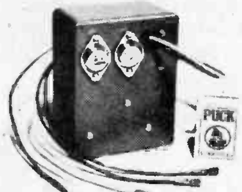
Improved one-valve model "DX" mark 2.
Complete kit—price £3.30 (post & packing 20p.).
Customer writes: "Australia, India and America at loud volume."—"I am 14 years of age and have logged over 130 stations, plus countless Amateurs from all over the world."

Send S.A.E. for test report.

This kit contains all genuine short-wave components, drilled chassis, valve, accessories and full instructions. Ready to assemble, and of course, as all our products—fully guaranteed. Full range of other S.W. kits, including the famous model "K" and "K plus" (illustrated above). All orders despatched by return. (Mail order only.). Send now for free descriptive catalogue & order form.

"H.A.C." SHORT-WAVE PRODUCTS
29 Old Bond Street, London W.1

CAPACITOR DISCHARGE IGNITION KIT



PW JUNE 71

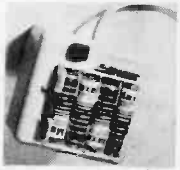
A comprehensive kit of parts with detailed constructional details, ready drilled diecast case, screws, leads, terminals etc.
Available in both 6 and 12v versions. State whether positive or negative earth. **£8·75** incl. p. & p.
De-coupling kit for impulse tachometer and interference suppression. **£1·00** incl. p. & p.
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 BATTERIES That Won't Let You Down! RECHARGEABLE

Mallory Cells in U2, U11 and Penlite U7 sizes, Kestral Battery Charging Unit



Uses :
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 provide it. The cells can be recharged many times, a simple job with the Kestrel Charging Unit which has been specially designed for these new type batteries.

PRICES

Batteries U2 equiv. £1·38

Penlite U7 equiv. 50p

U11 equiv. £1·03

Charging unit £3·90 with one battery holder

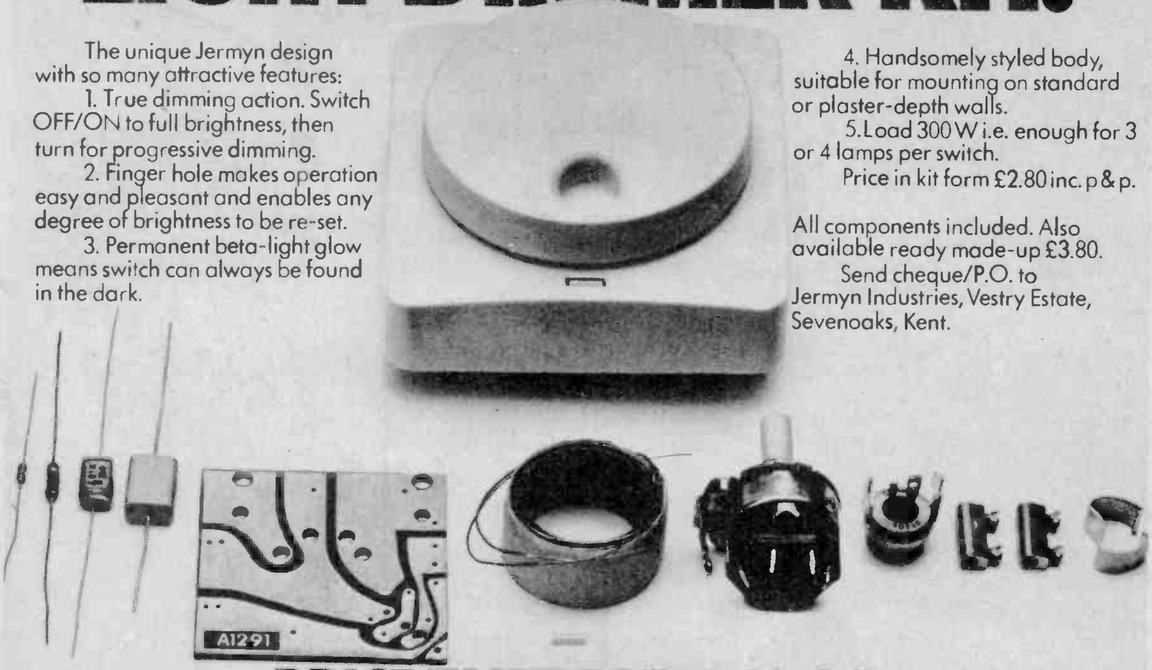
KESTREL
Bush & Meissner

Send to:
275 WEST END LANE
LONDON, N.W.6
01-794 9611

LIGHT DIMMER KIT.

The unique Jermyn design with so many attractive features:

1. True dimming action. Switch OFF/ON to full brightness, then turn for progressive dimming.
2. Finger hole makes operation easy and pleasant and enables any degree of brightness to be re-set.
3. Permanent beta-light glow means switch can always be found in the dark.



4. Handsomely styled body, suitable for mounting on standard or plaster-depth walls.
5. Load 300 W i.e. enough for 3 or 4 lamps per switch.

Price in kit form £2.80 inc. p & p.

All components included. Also available ready made-up £3.80.

Send cheque/P.O. to Jermyn Industries, Vestry Estate, Sevenoaks, Kent.

PRICE IN KIT FORM £2.80

---

introducing

ARROW ELECTRONICS LTD.

"Service the way it ought to be!"

an associate Company of LST ELECTRONIC COMPONENTS LTD

When it comes to retail distribution we're head and shoulders above the rest!

We're a new Company but our experience and ability in electronic components goes back a long way . . . .

Here at Arrow Electronics fast, reliable service is law!

We offer a rapid, same day turn round on all mail received up to 3 pm on any given weekday.

What's more, when we promise to clear all orders on receipt, we really mean it!

Our no fuss, no bother ordering system is a joy to behold. We'll give you all the forms and envelopes you could possibly need. Combine them with our simple Catalogue Coding and hey presto, you can order and order, time and time again without the slightest error or mistake.

You'll always be up to date with us—we're continually adding to our high quality stock range and always up dating our catalogue.

Get to know us and you'll soon raise your hat to our customer discount—it's tops with a total order value discount of 10% on orders exceeding £4.00.

Now's your chance to get to know us better. Our brand new Catalogue is now awaiting you, hot from the presses!

The New Arrow catalogue features the following:

- Extended Ranges of Bridge Rectifiers
- Capacitors
- Interference Suppression Kits
- Low Cost Integrated Circuit Mounting Pins
- Knobs
- Light Emitting Diodes
- A Novel Logic Testing Instrument giving immediate visual indication
- Magneto Resistors
- Optically Coupled Isolators
- Extended Range of Potentiometers
- Medium current and High current Rectifiers
- Temperature controlled Soldering Irons
- Extended Range of Thyristors

and many other items of great interest to the home constructor.

Arrow Electronics Limited
Dept. **PW1.**
7 Coptfold Road
Brentwood Essex
Tel: Brentwood 219435

LINEAR AMPLIFIERS

FOR GUITAR PICK-UPS GRAM PICK-UPS RADIO or TAPE

OVERLOAD PROTECTION INCORPORATED. SOLID STATE CIRCUITRY

Suitable for application of Loudspeakers impedances between 3 and 30 ohms. Combinations not to measure less than 6 ohms across both speaker output jacks simultaneously.

The Amplifier cover is made of rigid plastic, bonded metal on the top and two sides. Finished in Black to suitably contrast with anodised metal control panel. Size approx. 14″ x 4⅛″ x 9½″.

Rec. Retail Price **£39·75**

GENERAL PURPOSE AMPLIFIER

Model 40/60 **40 – 50 Watts Output Power**

Four individually controlled inputs plus Master volume control. Bass and Treble Controls providing both 'lift' and 'cut'.

Compact size, robust construction. Ideal for clubs, hotels, restaurants, schools etc.
Inputs for almost any type of microphone

GENERAL PURPOSE GROUP/DISCO AMPLIFIER Model T40/60D

40 – 50 Watts Output Power

Three individually controlled inputs plus Master volume control. Bass and Treble Controls providing both 'lift' and 'cut'. **Compact size. Robust construction. Ideal for discotheques, clubs, hotels, schools, etc. Inputs for most types of microphones. Facilities for head-phone monitoring with changeover switch from input (1) to input (2).**

Rec. Retail Price **£49·50**

Wholesale and Retail enquiries to the Manufacturers Send S.A.E. for leaflet/s **All Linear Amplifiers Guaranteed for 12 Months**

LINEAR PRODUCTS LTD., Electron Works, Armley, Leeds. LS12 3SA Tel.630126

TRANSISTORISED F.M. tuner head with A.M. gang, slow motion drive. 88—108Mcs, with circuit diagram. **£2·10p.**

B.F.W. 10 Fet. New (unmarked) 5 for **£1·00p.**

SPECIAL OFFERS of Unmarked Tested Power Transistors.
2N3055 Silicon NPN **30p each 4 for £1.**
2N3054 Silicon **20p each 3 for 50p.**
Plastic 40 Watt NPN 25 Volt **20p each 3 for 50p.**

P-C BOARDS (not computer panels).
1 off 6 transistors single wave band
1 off 4 transistor audio
1 off 3 transistor **£1·50 the three.**

Encapsulated bridge rectifier (itt usd 3 3mdh) 100 PIV 2 amps. **50p each.**

Transistor F.M. Stereo Multiplex Decoder. Size: 5½ x 2½ x 1½. As used in well known British stereo units with circuit. **£3·75.**

GARRARD SP25 MK. II less Cartridge. **£10·50.**

10 VOLUME CONTROLS consisting of 2 off each.
100K log. ganged L/S—20K log. ganged L/S
470K log. D/P Switch—10K lin. L/S—50K lin. L/S. **£1·25.**

4 PHONO SOCKETS ON PANEL. 10 panels for **£1·25.**

12 PLASTIC KNOBS. Chrome and Gold, 3 types—4 off each —spring clip **£1·25.**

10 COMPUTER PANELS packed with components including one panel with 2 Power Transistors. **£1·00.**

All items post paid in
GREAT BRITAIN

SURPLECTRONICS

216 LEAGRAVE ROAD, LUTON, LU3 1JD, BEDS.

PADGETTS RADIO STORE
OLD TOWN HALL, LIVERSEDGE, YORKS WF15, 6PQ

TEL. HECKMONDWIKE 4285

SPEAKERS EX TV SETS. Sound tested 7″×4″, 6″×4″, 8″×2½″, all 3ohm pm **25p** each. Post on any speaker **10p.**

Valve Voltmeter. Type CT54. Ohms Range 1K To 10 Meg in 5 Ranges. Volts Range 2·5 To 480 V AC DC. Untested Clean Condition. Less Batteries. **£5.** Carriage & Ins. £1.

T.V. Chassis. Plenty of spares on them. **Free of Charge—Callers only.** Up to one doz. per customer.

Latest Air Ministry Release Radio Receiver. Type R4187. 2·8 To 18 MHZ in Three Bands, Complete with 17 Miniature Valves. 26 Volt Motor. Power supply Motor and Manually Tuned. Very Clean. But not tested. £5. Carriage and ins. 75p.

Control Unit. Type 4190. Complete with three miniature valves. 1½″ 500μA meter. Six relays, model makers motor with gears, 24 press buttons. Lots of spares. Clean condition. £1·50. Carriage and ins. 75p.

Every one loves a bargain. And these T.V. sets we offer are the best you will find at the price.
Complete untested T.V. sets with all valves back and knobs BBC1 and ITV. 17″ 90° tube £2. 17″ 110° tube £3. 19″ slim **£5.** Carriage and ins. £1·50.
We are now breaking up many Slimline Sets. Send S.A.E. and please quote model and serial number and part you require.
For example tested L.O.P.T. **£1·45.** Fireball Tuners with Valves **75p.** Droppers all types **50p.**

Breaking up Ferguson Type 506T. Tested L.O.P.T. **£1·45.** Post paid. Fireball Tuner Unit with Valves less knobs **75p** post paid. S.A.E. for other spares for this set.

Reclaimed T.V. Tubes. All with 12 months guarantee.
AW43/88. **£1·50.** AW43/80 **£1·50.** MW43/69 **£1.** Special Offer. Brand New Brimar Tubes C17PM **£1.** Many older types in stock. Carriage and ins. on any tube **£1·50.**

Valve list ex equipment. All valves tested on a Mullard valve tester before despatched. 3 months guarantee on all valves. Single valves P/P 3p. Over post paid.

ARP12	5p	PCC84	5p	U191	20p
EB91	4p	PCF80	5p	U251	12p
EF80	8p	PCL82	12p	6BW7	10p
EF85	12p	PCL83	12p	6U4	10p
EBF80	12p	PCL84	12p	20PI	20p
EBF89	12p	PL36	20p	20P3	10p
ECC81	10p	PL81	17p	20D1	10p
ECC82	12p	PY81	8p	30P4	20p
ECC83	12p	PY33	17p	30F5	10p
ECL80	8p	PY82	8p	30P12	20p
EF91	4p	PL82	8p	30FL1	20p
EY86	20p				
EP50	60p per doz.	PL83	8p	6/30L2	20p

COMET HI-FI discount warehouses

NEW LOW PRICES

STEREO AMPLIFIERS

	Rec. Retail Price	Comet Price
ALBA UA 700	37·93	24·95
ALPHA 212 by Highgate	37·75	26·95
AMSTRAD Stereo 8000 Mk 2	27·95	14·50
AMSTRAD I.C. 2000	42·95	27·95
ARMSTRONG 521	59·00	44·95
DULCI 207M	32·00	19·50
FERROGRAPH F307 Mk. II (cased)	64·00	44·95
GOODMANS Maxamp	54·00	34·95
H.L. Audio Phoenix 707	29·00	15·95
JVC Nivico MCA 104Z	85·00	70·95
MCA 105E	130·50	110·95
MCA V5E Quadraphonic	89·00	74·95
MCA V9E Quadraphonic	148·00	124·95
LEAK Delta 30 (cased)	69·50	46·95
LEAK Delta 70 (cased)	85·00	57·95
METROSOUND ST20E	39·50	25·50
METROSOUND ST60	70·00	46·25
PHILIPS RH591	79·00	54·95
PHILIPS RH590	52·00	36·50
PHILIPS RH580	29·00	20·50
PIONEER SA500A	45·50	32·95
PIONEER SA600	89·60	57·50
PIONEER SA800	119·85	75·95
PIONEER SA900	133·83	86·95
PIONEER SA1000	147·83	93·75
PIONEER QL600 Quadraphonic converter	76·60	48·50
QD 210 Quadraphonic decoder	42·85	29·95
QA 800 Quadraphonic	179·05	113·66
QC 800 Quadraphonic pre-amp	123·50	71·95
QM 800 Quadraphonic pow. amp.	152·88	96·95
Reverberation 202W	51·05	33·95
RANK Rotel 210	34·90	23·95
RANK Rotel 310	47·50	31·95
RANK Rotel 610	74·50	48·95
ROGERS Ravensbourne	64·50	45·50
ROGERS Ravensbourne (cased)	69·50	49·50
ROGERS Ravensbrook Mk. II	50·50	35·95
ROGERS Ravensbrook (cased) Mk.II	55·50	39·95
SINCLAIR 2000	35·00	22·95
Project 60/2 x Z30/PZ5	23·90	15·95
Project 60/2 x Z50/PZ8/trans	34·86	21·95
Project 605	29·95	18·90
AFU	5·98	4·50
Neoteric	61·95	42·93
3000	45·00	29·50
TELETON SAQ 206B	33·00	20·50
307	33·00	20·50
GA202 15 watt RMS Per Chan.	45·75	28·95
WHARFEDALE Linton Amplifier	65·00	39·95

All take both ceramic and magnetic cartridges.

TUNERS

	Rec. Retail Price	Comet Price
AMSTRAD Multiplex 3000 FM	36·50	27·95
*ARMSTRONG 523 AM/FM	52·68	39·95
*ARMSTRONG 524 FM	40·97	31·95
ARMSTRONG M8 Decoder	9·50	6·95
*DULCI FMT.7 FM	24·43	17·50
DULCI FMT.7S Stereo	32·89	24·50
GOODMANS Stereomax	75·74	46·95
JVC Nivico		
MCT V5E AM/FM Quadraphonic	86·89	69·95
MCT V7E AM/FM Quadraphonic	122·42	99·95
LEAK Delta FM	79·50	53·95
LEAK Delta AM/FM	89·50	65·95
PHILIPS RH 690	44·15	31·95
PIONEER TX500 AM/FM	70·93	49·95
PIONEER TX600 AM/FM	100·37	68·95
RANK ROTEL 320	53·38	38·50
RANK ROTEL 620	86·33	63·95
ROGERS Ravensbourne chassis	57·95	43·95
ROGERS Ravensbourne in teak case	62·63	47·95
ROGERS Ravensbrook chassis	42·14	31·95
ROGERS Ravensbrook (cased)	48·00	35·95
SINCLAIR 2000	45·00	31·95
SINCLAIR 3000	45·00	31·95
SINCLAIR Project 60 tuner (stereo)	25·00	17·50
TELETON GT202	46·75	30·95

All above Tuners are complete with MPX Stereo Decoder except where starred.

TUNER/AMPLIFIERS

	Rec. Retail Price	Comet Price
AKAI CR80T FM/AM Tuner Amplifier with built in Eight Track Tape Recorder	149·84	89·95
AKAI AA 8500	228·34	175·00
AKAI 6600	145·26	109·00
AKAI 6300	125·83	94·95
AKAI 6200	97·09	74·95
ARENA 2600	111·30	65·95
ARMSTRONG M8 Decoder	9·50	6·95
ARMSTRONG 525	90·14	69·95
ARMSTRONG 526	102·72	77·95
CARLTONE M4000 AM/FM with 8 track player and speakers	69·95	39·95
GOODMANS Module 80, 35w. RMS	89·02	67·95
GOODMANS Module 80 Compact	160·38	122·95
GOODMANS Module 110 FM/MW/LW/SW 100W RMS	131·22	100·95
JVC Nivico VR 5501 AM/FM	96·96	81·95
VR 5521 AM/FM and SEA	165·00	139·95
4VR 5414 Quadraphonic	212·00	179·95
LEAK Delta 75	175·00	124·95
MIDLAND 19/542	49·56	36·75
PHILIPS RH 790	134·00	74·95
PIONEER SX525	135·80	94·95
SX626	181·59	126·95

TUNER/AMPLIFIERS—*continued*

	Rec. Retail Price	Comet Price
SX727	224·61	157·95
SX828	281·52	197·95
ROGERS Ravensbrook Chassis	96·57	73·95
ROGERS Ravensbrook (cased)	105·35	79·95
ROTEL RX200	89·02	64·95
ROTEL RX150	67·93	49·95
TANDBERG 1171 MPX	103·03	84·95
TANDBERG TR200 MPX	96·23	79·95
TANDBERG TR1000 FM MPX(teak)	149·56	124·95
TELETON F2000	51·50	27·25
TELETON CR55	125·26	68·50
TELETON R8000 AM/FM	42·16	21·95

All the above take magnetic cartridges except Teleton F2000 and 8000 which take ceramic only. All include MPX Stereo Decoder with the exception of Armstrong where M8 decoder is extra.

TURNTABLES

	Rec. Retail Price	Comet Price
GARRARD SP25 Mk III	16·17	10·25
GARRARD SL65B	20·93	13·95
GARRARD SL95B	49·21	32·95
GARRARD 401	39·04	27·95
GARRARD SL72B	32·60	21·95
GARRARD Zero 100A	57·42	40·95
GARRARD Zero 100S	52·83	38·50
GARRARD WB4 base Mk IIZ to fit Zero 100 & Zero 100S	6·55	4·95

The following Turntables are complete with base, plinth, perspex cover and cartridge. Fully wired and ready for use. All at special prices.

GARRARD SP25 Mk III with Goldring G.800	Special Price	£18·50
McDONALD MP60 with Goldring G800	Special Price	£18·50
McDONALD MP60 with SHURE M 44/7	Special Price	£19·50
McDONALD MP60 with SHURE M 44/E	Special Price	£20·25
GARRARD AP76 with Goldring G800	Special Price	£28·25
GARRARD AP76 with Shure M55E	Special Price	£30·95
GARRARD AP76 with Shure M75EJ	Special Price	£33·50
GARRARD 2025 with Sonotone 9TAHC	Special Price	£12·95
GOLDRING 705/P with G850	£26·00	£10·95
GOLDRING GL75 with G800	Special Price	£36·75
THORENS 150 AB with TX11 cover Shure M55E cartridge	£60·46	£47·95

	Rec. Retail Price	Comet Price
Base and Cover to fit GARRARD SP25, SL55, SL65B	Spec. Price	3·60
GARRARD 40B	13·63	10·95
GARRARD AP76	28·44	17·95
GOLDRING GL69 MKII	26·86	18·50
GL69P Mk. II	35·23	25·25
GL75	39·06	26·95
GL75P	47·43	33·50
Covers for 69P and 72P	4·36	3·70
Cover for 75P Deluxe	4·88	3·95
C99—plinth and cover for G99	10·75	8·95
GOLDRING G99	27·90	19·25
GOLDRING G101P/C	27·90	19·95
GOLDRING GL72 Chassis	27·90	19·95
GOLDRING GL72P	36·27	25·95
GOLDRING GL85	61·03	42·95
GOLDRING GL85P	70·80	49·95
LEAK Delta	69·50	49·95
JVC Nivico SRP 473 Quadraphonic, including plinth and cover	69·50	58·95
McDONALD MP60	14·80	9·95
610	18·79	12·95
HT70	20·68	14·50
HT70 inc. plinth and cover	29·89	20·95
Base and Cover for MP60 and 610	Spec. Price	3·95
PHILIPS 202 Electronic	64·65	49·50
PHILIPS 308 transcription unit complete with base and cover	36·55	28·50
PHILIPS GA 105 with base, cover and cartridge	20·00	13·95
PIONEER PL12AC with base & cover	47·15	32·95
THORENS TX25 cover	8·26	6·60
THORENS TD125	76·73	59·95
THORENS TD125 Mk. II	76·73	62·95
THORENS TD125AB	115·69	89·95
THORENS TD 125AB Mk. II with TP 16 arm	115·69	93·95
THORENS TD150 Mk. II	33·64	26·95
THORENS TD150A Mk. II	43·09	32·95
THORENS TD150AB Mk. II	46·63	36·95
THORENS TX11 Cover	4·13	3·50
WHARFEDALE Linton with base and cover and Shure M44-7 cartridge	37·50	25·95

SPEAKERS

	Rec. Retail Price	Comet Price
AKAI SW 155	59·50	39·95
AMSTRAD 138 (pair) 13"×8" twin cone teak	26·00	14·95
B & W Model 70	159·50	111·95
B & W DM2	60·76	47·95
B & W DM3	63·00	45·50

SPEAKERS—*continued*

	Rec. Retail Price	Comet Price
B & W DM1 (pair)	75·20	57·25
CELESTION County	23·97	18·50
CELESTION Ditton 120 (pair)	56·40	39·95
CELESTION Ditton 15	37·40	27·95
CELESTION Ditton 25	65·00	45·95
CELESTION Ditton 44	54·00	38·95
CELESTION Ditton 66	99·00	70·95
FERROGRAPH S1 inc. stand	95·00	69·95
GOODMANS Havant (pair)	54·42	39·95
GOODMANS Minister (pair)	50·62	35·95
GOODMANS Magister	65·63	44·95
GOODMANS Double Maxim	32·07	24·75
GOODMANS Mezzo 3	35·70	23·95
GOODMANS Magnum K2	46·20	28·95
GOODMANS Dimension 8	72·44	48·95
GOODMANS DIN 20NT kit	12·19	8·95
KELETRON KN400 2-speaker System (pair)	15·86	11·95
KN600 3-speaker System (pair)	26·46	17·50
KN800 3-speaker System	15·90	9·95
KN1100 4-speaker System	20·40	12·95
KN1600 3-speaker System	25·20	15·95
KN2100 3-speaker System	30·60	19·95
LEAK 150 (pair)	50·00	34·95
LEAK 250 (pair)	63·00	45·25
LEAK 600	49·50	32·45
LINEAR 10 watt teak (pair)	Sp. Price	13·95
METROSOUND HFS 103 (pair)	29·21	21·50
METROSOUND 202	21·50	14·75
METROSOUND Duplex 15	32·00	21·95
METROSOUND Duplex 25	56·00	37·95
PHILIPS RH 402 (pair)	44·70	33·95
PHILIPS 406	34·00	25·95
PIONEER CS53	44·25	28·95
SINCLAIR Q16	8·98	6·75
STE-MA 450	25·00	16·95
TANDBERG TAN 7	27·22	22·95
TANDBERG Tan 11 (pair)	36·94	31·20
TANDBERG Tan 12 teak (pair)	48·82	41·40
TANDBERG Tan 25 teak (pair)	66·08	55·95
TANDBERG Tan 50 teak	65·00	49·95
TELETON 8000 (pair)	21·08	11·95
THORPE Grenville TG 100 (pair)	28·95	17·95
Grenville TG 200 (pair)	41·95	25·95
Grenville TG 300 (pair)	55·95	31·95
WHARFEDALE		
Denton Mark II (pair)	42·00	27·95
Linton Mark II (pair)	52·00	35·95
Melton Mark II	35·00	23·95
Dovedale 3 Mark II	47·50	30·50
Rosedale	65·00	44·25
Triton III (pair)	65·00	44·95
Unit 3 Speaker Kit	12·50	8·75
Unit 4 Speaker Kit	19·00	12·25
Unit 5 Speaker Kit	27·50	17·60

CHASSIS SPEAKERS

	Rec. Retail Price	Comet Price
GOODMANS Twin-Axiom 8	8·65	6·95
Twin Axiom 10	9·58	7·50
Axiom 401	17·68	11·95
Audiom 8P	5·20	4·15
Audiom 10P	5·67	4·50
Audiom 12P	13·00	9·25
Audiom 15P	21·00	14·95
Audiom 18P	35·70	24·95
Audiom 100 40 watts DIN	12·00	8·95
ARU 172	4·50	3·20
Axent 100	6·90	4·90
Midex 650	13·59	9·50
Attenuator	3·73	2·70
Crossover Network XO/950	7·77	5·45
WHARFEDALE 8in. Bronze/RS/DD	4·75	3·40
Super 8/RS/DD	8·50	6·25
Super 10/RS/DD	14·00	9·95
WMT1 Matching Transformer	0·84	0·70

CARTRIDGES

	Rec. Retail Price	Comet Price
AMSTRAD 900C	4·95	3·50
AMSTRAD 900D	7·50	5·50
AMSTRAD 900 EX	11·00	8·75
AUDIO TECHNICA AT66	6·47	3·60
GOLDRING G850	6·10	2·95
GOLDRING G800	12·21	4·50
GOLDRING G800E	17·67	7·50
GOLDRING G800 Super E	24·41	15·95
*GOLDRING CS90 Stereo	4·88	3·95
*GOLDRING CS91/E	7·33	5·50
EMPIRE 1000ZE/X	59·12	44·95
EMPIRE 999VE/X	42·14	32·50
EMPIRE 999TE/X	24·58	19·25
EMPIRE 999SE/X	19·90	15·25
EMPIRE 999E/X	15·57	11·70
EMPIRE 909E/X	12·12	9·25
EMPIRE 90EE/X	9·37	7·15
ORBIT Magnetic NM 22	Sp Price	2·75
ORTOFON M15E	27·60	22·75
SHURE M3DM	6·10	3·75
SHURE M31E	11·63	6·95
SHURE M32E	10·73	6·50
SHURE M32-3	9·84	7·65
SHURE M44-G	6·30	4·95
SHURE M44-7	7·90	4·90
SHURE M-44C	7·90	4·90
SHURE M44E	8·60	5·25
SHURE M55E	9·70	5·95
SHURE M75G	14·70	8·45

OVER 1000 ITEMS ALWAYS IN STOCK

All items brand new and fully Guaranteed and backed by after-sales service

— latest models in manufacturers' sealed cartons

COMET for after-Sales Service THROUGHOUT THE U.K.

Pictured, Service Dept. at Clough Rd., Hull, also at Birmingham, Bridlington, Doncaster, Edinburgh, Goole, Leeds, Leicester, Rochdale, Sheffield, Stockton, Wakefield and York.

	Rec. Retail Price	Comet Price
CARTRIDGES—continued		
SHURE M75-6	13·60	7·90
SHURE M75EJ	15·40	9·25
SHURE M75E	19·00	11·50
SHURE M75 ED	19·00	11·50
SHURE M75E/95G	20·80	12·95
SHURE V15-11	39·40	26·95
*SONOTONE 9TAHC Diam/Saph.	3·75	1·45

Starred cartridges above are ceramic. All others are magnetic.

	Rec. Retail Price	Comet Price
BASES AND COVERS		
GARRARD WB1 Base	3·78	3·20
WB4 Base	5·60	4·70
SPC1 Cover	3·68	2·90
SPC4 Cover	4·38	3·50
Special offer of Base and Cover to fit SP25, SL55, SL65B and 3500	Special Price	3·60
WB4 base Mk IIZ to fit Zero 100 and Zero 100S	6·55	4·95
GOLDRING Plinth 75	8·37	7·00
GOLDRING Plinth 69	8·37	7·00
GOLDRING Covers for 69P and 72P	4·36	3·70
Cover for 75P De luxe	4·88	3·95
THORENS TX25 (for TD125AB)	8·26	6·60
THORENS TX11 Cover	4·13	3·50
Base and Cover for TD125	12·39	10·50
SME Plinth System 2000 with motor-board	46·20	34·50
MOTORBOARDS only	5·85	4·45
SME P1 Spacer	0·98	0·75
BLANK TAPES		
SCOTCH DYNARANGE CASSETTES		
C60	0·71	0·45
C90	0·99	0·55
C120	1·49	0·80
SCOTCH HIGH ENERGY COBALT CASSETTES		
C60	1·45	0·95
C90	1·90	1·25
SCOTCH Low Noise 8—TRACK BLANK CARTRIDGES		
40 mins	1·50	0·95
80 mins	1·80	1·10
SCOTCH LONG LIFE SPOOLED TAPES		
5" L.P. 900	1·41	0·95
5¾" L.P. 1200	1·76	1·20
7" L.P. 1800	2·52	1·70
SCOTCH DYNARANGE SPOOLED TAPES		
5¾" L.P. 1200	2·11	1·40
7" L.P. 1800	2·99	1·95

Postage—Tapes, cassettes and 8T cartridges 1-9 items 5p per order. Packs of ten post free.

	Rec. Retail Price	Comet Price
HI-FI STEREO SYSTEMS COMPLETE		
ALBA UA552	47·75	29·95
BUSH A1005	69·89	53·25
DANSETTE Consort Stereo	34·43	24·95
DANSETTE 4005	71·45	53·25
DECCA Sound 613	Special Price	49·95
DECCA Sound 614	Special Price	52·95
DECCA Sound 1204	Special Price	70·95
DECCA Compact 2	Special Price	76·95
DECCA Compact 3	Special Price	99·95
DECCA 403	Special Price	44·95
ELIZABETHAN LZ101	58·33	41·85
FERGUSON 3425	136·35	102·75
FERGUSON 3450 with Radio	74·20	55·95
FERGUSON 3451 with Radio	101·70	79·95
FIDELITY UA2 Music Master	43·50	30·95
UA1 Music Master with Radio	100·00	69·95
Stereo Nine	38·50	23·00
GOODMANS Module 80 compact system FM/35 watts. RMS (Less L/S)	165·00	125·75
HMV 2451	122·00	95·95
HMV 2452	66·00	48·95
HMV 2450 with Stereo Radio	138·00	106·95
KB1025 with 657 speakers	48·25	37·95
KB 2250 with 658 speakers	124·00	95·95
KB 2010 with 658 speakers	101·50	77·95
MARCONI 4452	77·00	56·95
McDONALD MP60 complete with base, cover and Goldring G800 cartridge, Amstrad IC 2000 amplifier. 2 Wharfedale Denton speakers	114·96	74·40
MURPHY 902 Studio 1, AM/VHF Radio	84·50	65·95
MURPHY 903	84·42	65·95
PHILCO FORD M1500	97·96	66·75
PHILIPS 808	93·50	71·95
PHILIPS GF824	65·30	49·65

	Rec. Retail Price	Comet Price
HI-FI STEREO SYSTEMS—continued		
PHILIPS 825	49·50	38·95
PHILIPS 826	75·00	52·95
PHILIPS 835	69·50	49·55
PHILIPS 836	95·00	69·95
PYE Black Box unit stereo 1022	90·93	68·95
RIGONDA Party Time	27·50	19·95
STEEPLETONE stereo system	41·75	25·95
TELETON STP 8 track stereo system	57·50	38·95
TELETON R 8000 Tuner/Amplifier with stereo decoder. Garrard 2025 TC turntable and one pair of Teleton 8000 speakers	87·95	47·80
ULTRA 6028	59·95	44·95
ULTRA 6450	74·20	54·95
ULTRA 6454	38·85	29·95
ULTRA 6455	41·35	31·95

Full range of headphones, Pick Up Arms & Heads available at discounted prices.

	Rec. Retail Price	Comet Price
TAPE RECORDERS AND TAPE DECKS		
AKAI 1720L 4-track Stereo	87·36	59·95
AKAI 4000D 4-track stereo deck	93·65	64·95
AKAI CR80D 8-track stereo tape deck	85·02	58·45
AKAI CR80 8-track stereo recorder	106·39	74·00
AKAI CR80T 8-track stereo recorder and tuner/amplifier	149·84	89·95
AKAI X200D	157·93	100·45
AKAI GX220D	223·00	164·95
AKAI 1800SD	162·79	102·30
AKAI 2000SD	289·07	223·30
FERGUSON 3247 4-track	47·95	34·95
FERGUSON 3248 4-track	53·75	39·95
FERGUSON 3252 4-track	98·00	74·95
FERGUSON 3258 4-track	70·45	51·95
FERROGRAPH 702/4 Dolby	264·38	224·50
FERROGRAPH 702H Dolby	274·95	233·50
FERROGRAPH 722/4 Dolby	301·98	255·95
FERROGRAPH 722H Dolby	312·55	264·95
FERROGRAPH 702 2-track tape deck	224·43	170·65
FERROGRAPH 704/W 4-track deck	224·43	170·65
FERROGRAPH 722	262·03	190·15
FERROGRAPH 724	262·03	190·15
FIDELITY BRAEMAR 4-track	34·75	19·95
GRUNDIG TK 121 twin track	56·25	38·95
GRUNDIG TK 141 4-track	62·10	44·95
GRUNDIG TK 146 4-track Auto	66·95	48·95
GRUNDIG TK 147 4-track Auto	98·65	74·95
GRUNDIG TK 148 (4-track auto 2 speed)	74·10	56·95
PHILIPS 4303 Twin-track	39·46	24·95
4307 4-track	48·65	34·95
4308 De luxe 4-track	56·85	41·45
4404 4-track stereo recorder	89·25	65·95

	Rec. Retail Price	Comet Price
TAPE RECORDERS—continued		
4407 4-track stereo recorder	108·50	73·95
4418 4-track stereo	189·75	139·95
4450 4-track stereo	272·50	199·95
4500 4-track stereo tape deck	124·30	91·65
TANBERG 2000 (Stereo)	125·61	103·95
TANDBERG 1841 4-track stereo tape deck	66·09	48·75
TANDBERG 3021X twin track stereo	104·00	80·85
TANDBERG 3041X 4-track stereo	104·00	80·85
TANDBERG 4021X twin track stereo	169·12	135·50
TANDBERG 4041X 4-track stereo	169·12	135·50
TANDBERG 6041X 4-track stereo	182·73	145·25
TANDBERG 6021X twin track stereo	182·73	145·25
TAPE RECORDERS (CASSETTES)		
AKAI CS 350 recorder	125·83	92·95
AKAI CS 50D Deck	104·46	77·95
AKAI GXC 40D Tape Deck	92·26	68·25
AKAI GXC 40 Recorder	111·75	83·85
APCO Batt./Mains with AM/FM Radio	35·00	22·95
BUSH Discassette DC70	20·62	15·95
BUSH TP60	27·62	15·95
BUSH TP 66 Batt./Mains	28·18	21·50
BUSH TP 70 battery/mains	28·13	19·95
CARLTONE LCR500	Sp. Price	11·95
DANSETTE DCT105	20·62	14·95
DECCA 2000 (batt./mains)	Sp. Price	22·95
DECCA CR1000 Cassette Recorder with VHF Radio	Sp. Price	32·95
EKCO 350 Bt./Mns. VHF/MW Radio	37·42	28·75
EKCO 351 Battery/Mains	23·23	18·45
FERGUSON 3240 with case	24·90	15·95
FERGUSON 3253	43·55	31·95
FERGUSON 3262 Battery/Mains	30·15	22·95
GRUNDIG C200 De Luxe	37·55	26·95
GRUNDIG C210 batt./mains	48·75	36·95
GRUNDIG C410	41·55	29·95
HARVARD Elite with AM/FM radio batt./mains	42·00	23·95
JVC NIVICO 9420 L/S with AM/FM radio batt./mains	61·45	42·95
PHILIPS R.R. 392 with MW/VHF Radio Cassette	49·95	36·55
2202	22·85	17·95
2204 battery/mains	29·10	23·95
3302	20·35	15·50
2400 stereo less L/S	66·10	51·95
PYE 9109	20·37	14·95
PYE 9116 Stereo	66·10	49·95
PYE 9118	29·11	22·95
TELETON TRC 130 with VHF/AM radio battery/mains	42·50	28·00
TC110 battery/mains	27·50	18·50

COMPLETE HI-FI SYSTEMS

Completely wired mounted and ready for use

H.L. Audio Phoenix 707 amp. McDonald MP60 turntable, complete with base, cover and Shure M44/7 cartridge. Fully wired plus 2 Thorpe Grenville 100 loudspeakers 86·65 53·40

ROTEL RA 210 amplifier with McDonald MP60, base cover and Goldring G800 magnetic cartridge. Plus two Linear 10 watts speakers (Teak) 88·91 56·40

AMSTRAD IC2000 integrated circuit amp. 20 watts per channel, with McDonald MP60 turntable, plinth, cover and Goldring G800 cartridge. Plus two Wharfedale Denton Mk. II speakers 114·96 74·40

PIONEER SA500A amp.. with McDonald MP60 turntable, plinth, cover and Shure M44-E cartridge. Plus two Wharfedale Denton speakers 113·90 81·15

PHILIPS RH802 Stereo Tuner/ Amplifier/Player. 2 x 15 watts. LW/MW1/MW2/SW/FM. MPX. with GP400 magnetic cartridge. Speakers extra 155·00 118·95

ARMSTRONG 525 FM Tuner/Amplifier. 25 watts RMS per channel, teak case, with M8 MPX Decoder. Goldring GL75 turntable, plinth, cover and G800 cartridge, plus two Wharfedale Dovedale III speakers 247·91 174·65

ARENA 2600 Tuner/Amplifier. FM/MW/LW 49m. Band. Marine Band. 15 watts. RMS per channel. Five pre set F.M. Stations and manual tuning with Garrard AP76 plinth, cover and G800 cartridge. Plus two Goodmans Havant speakers 213·37 134·15

ROTEL RX150 Tuner/Amplifier, AM/FM. MPX with McDonald MP60 plinth, cover and G800 cartridge, plus two Wharfedale Denton Mk. II speakers 139·94 96·40

AKAI CR80T Tuner Amplifier. AM/FM. MPX with 8-track stereo Recorder/Player, with McDonald MP60, plinth, cover and G800 cartridge. Plus two Wharfedale Linton Mk. II speakers 231·85 144·40

TELETON CR55 Tuner/Amplifier. AM/FM MPX with Garrard AP76 Turntable, plinth, cover and Shure M75EJ magnetic cartridge. Plus two Wharfedale Dovedale 111 speakers 266·10 163·00

PIONEER SX525 Tuner/Amplifier, including MPX Decoder with Pioneer PL12AC turntable, including plinth, cover and Shure M55E cartridge. Plus two Pioneer CS53 speakers 281·15 191·75

LEAK Delta 75. AM/FM tuner/amplifier, with LEAK Delta transcription deck, complete with plinth, cover and cartridge. Plus two Leak 600 speakers 326·50 239·80

FREE Technical Advisory Service. If in doubt ask us! Price list on request

Comet guarantees that all prices quoted are genuine. All items offered available at these prices at the time this issue closed for press. Add 75p for postage, packing and insurance on all orders (Cartridges 20p) **OR, IF SECURICOR DELIVERY REQUIRED ADD £1·75 ONLY.** Make cheques, Money Orders payable to 'COMET'.

COMET HIGH FIDELITY DISCOUNT WAREHOUSES

OPEN DAILY TO THE PUBLIC FROM:
9am-8pm Monday
9am-1pm Tuesday
9am-8pm Wednesday
9am-8pm Thursday
9am-8pm Friday
9am-5.30pm Saturday

Dept. PW BIRMINGHAM: Heeley Road, Selly Oak B29 6EY. *Tel.: 021-472 6181.*
Dept. PW BIRMINGHAM: Tivoli Shopping Centre, 1570–1572 Coventry Road, Yardley. B26 1BJ *Tel.: 021-706 0684.*
Dept. PW EDINBURGH: 1 Newhaven Road EH6 5QX. *Tel.: 554 8501 (5 lines).*
Dept. PW HULL: Reservoir Road, Clough Road HU6 7QD. *Tel.: 46441 (6 lines)*
Dept. PW LEEDS: 78 Armley Road LS12 2EF. *Tel.: Leeds 40551 (10 lines).*
Dept. PW STOCKTON: Teesway, Portrack Lane, Teesside TS18 2RH. *Tel.: 66132/65215.*
Dept. PW ROCHDALE: Corner of Well I'th' Lane and Queensway. *Tel.: 50606.*
Dept. PW LEICESTER: Syston Street. *Tel.: 0533 52236.*
Dept. PW SHEFFIELD: The Mill, 1 Loxley Rd., Malin Bridge, S6 4TN. *Tel.: 0742 341721/6.*

SECURICOR SPECIAL DELIVERY SERVICE

All in-stock items delivered by **SECURICOR** within 72 hours. *(Add £1·75 only for Securicor delivery)*
ALL GOODS FULLY INSURED AGAINST LOSS OR DAMAGE WHILST IN TRANSIT

SOOTHE YOUR NERVES, RELAX WITH THIS AMAZING RELAXATRON

CUTS OUT NOISE POLLUTION—SOOTHES YOUR NERVES! Don't underestimate the uses of this fantastic new design—the RELAXATRON is basically a pink noise generator. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. For instance, many people find a rainstorm mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops!—a well known type of pink noise. IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron. Once used you will never want to be without it—TAKE IT ANYWHERE. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life). CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones. Components, nuts, screws, wire, etc. no soldering.

Only **£2·75**

£2·75 + 25p p. & p. *Parts available separately*

FIND BURIED TREASURE! Transistorised Treasure Locator

This fully portable transistorised metal locator detects and tracks down buried metal objects—it signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. FINDS GOLD, SILVER, COINS, JEWELLERY, ARCHAEOLOGICAL PIECES ETC. ETC. *Extremely sensitive, will signal presence of certain objects buried several feet below ground.* No knowledge of radio or electronics required. *Can be built with ease in one short evening by anybody from nine years of age upwards,* with the clear, easy to follow, step-by-step, fully illustrated instructions—Uses standard PP3 battery. No soldering necessary. Kit includes nuts, screws, wire, etc. ONLY £2·85 + 25p p. & p. (Sectional handle as illustrated 95p extra). Parts available separately. Made up looks worth £15!

ONLY **£2·85**

ELECTRONIC ORGAN

ONLY **£3·25**

Don't confuse with ordinary electronic organs that simply blow air over mouth-organ type reeds etc. Fully transistorised. SELF CONTAINED LOUDSPEAKER. *Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night", play "Auld Lang Syne" etc. etc.* You have the thrill and excitement of building it together with the pleasure of playing a real, live, portable electronic organ. NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED. No soldering necessary, Simple as ABC to make. *Anyone over nine years can build it easily in one short evening following the fully illustrated step-by-step, simple instructions.* ONLY £3·25 + 25p p. & p. for kit, including case, nuts, screws, simple instructions, etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

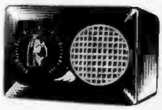
SHORTWAVE TRANSISTOR RADIO

only **£2·75**

Anyone from 9 years up can follow the step-by-step, easy as ABC fully illustrated instructions. No soldering necessary. 76 stations logged on rod aerial in 30 mins.—Russia, Africa, USA, Switzerland, etc. Experience thrills of world wide news, sport, music, etc. Eavesdrop on unusual broadcasts. Uses PP3 battery. Size only 3" x 4½" x 1½" Only £2·75 + 20p p. & p. Kit includes cabinet, screws, instructions, etc. (Parts available separately).

INGENIOUS ELECTRONIC SLEEP INDUCER

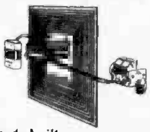
ONLY **£3·25**



CAN'T SLEEP AT NIGHTS? DO YOU WAKE UP IN THE NIGHT AND CAN'T GET OFF TO SLEEP AGAIN? WOULD YOU LIKE TO BE GENTLY SOOTHED OFF TO SATISFYING SLEEP EVERY NIGHT? Then build this ingenious electronic sleep inducer. *It even stops by itself so you don't have to worry about it being on all night!* The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sound gradually becomes less and less—until they eventually cease altogether, *the effect it has on people is amazingly very similar to hypnosis.* A control is provided for adjusting the length of times, etc., all transistor, can be built by anyone over 12 years of age in about two hours. No knowledge of electronics or radio needed. Extremely simple, easy-to-follow, step-by-step, fully illustrated instructions included. *No soldering necessary.* Works off standard batteries, extremely economical. Size only 3" x 4½" x 1½"—take it anywhere. Kit includes case, nuts, wire, screws, etc. SEND £3·25 + 25p p. & p. (parts available separately).

Find buried treasure with this READY BUILT & TESTED TREASURE LOCATOR MODULE

ONLY **£4·95**



FULLY TRANSISTORISED PRINTED CIRCUIT METAL DETECTOR MODULE. *Ready built and tested*—just plug in a PP3 battery and 'phones and it's working. Put it in a case, screw a handle on and YOU HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20! Extremely sensitive—penetrates through earth, sand, rock, water, etc.—EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC. Signals exact location by "beep" pitch increasing as you near buried metallic objects. *So sensitive it will detect certain objects buried* SEVERAL FEET BELOW GROUND! GIVES CLEAR SIGNAL ON ONE COIN! £4·95 + 30p carr. etc. (High quality Danish Stethoscope headphones £2·75 extra if required.)
EXAMINE AT HOME FOR 7 DAYS. YOUR MONEY REFUNDED IN FULL IF NOT 100% DELIGHTED.

BUILD 5 RADIO AND ELECTRONIC PROJECTS

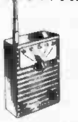
only **£2·45**

Amazing Radio Construction set! Become a radio expert for £2·45. A complete Home Radio Course. No experience needed. Parts including simple instructions for each design. Illustrated step-by-step plans, all transistors, loudspeaker, personal phone, knobs, screws, etc. all you need. Presentation box 45p extra as illus. (if required) (parts available separately) no soldering necessary. Send £2·45 + 20p p. & p.

Eavesdrop on the exciting world of Aircraft Communications

V.H.F. AIRCRAFT BAND CONVERTOR

ONLY **£2·85**



Listen in to AIRLINES, PRIVATE PLANES, JETPLANES. *Eavesdrop on exciting cross talk between pilots, ground approach control, airport tower, Hear for yourself the disciplined voices hiding tenseness on talk downs.* Be with them when they have to take nerve ripping decisions in emergencies—Tune into the international distress frequency. Covers the aircraft frequency band including HEATHROW, GATWICK, LUTON, RINGWAY, PRESTWICK, ETC. ETC. CLEAR AS A BELL. This fantastic fully transistorised instrument *can be built by anyone over nine in under two hours.* No soldering necessary. Fully illustrated simple instructions take you step-by-step. Uses standard PP3 battery. All you do is extend rod aerial, place close to any ordinary medium wave radio (even tiny portables). NO CONNECTIONS WHATEVER NEEDED. SEND ONLY £2·85 + 20p p. & p. for kit including case, nuts, screws, wire, etc. etc. (parts available separately).

CONCORD ELECTRONICS LTD. (PW10) 8, Westbourne Grove, London, W.2. *Callers welcome*

4-STATION INTERCOM

£7.25

Solve your communication problems with this **4-Station Transistor Intercom** system (1 **master** and 3 **Subs**), in de-luxe plastic cabinets for desk or wall mounting. Call/talk/listen from **Master** to **Subs** and **Subs** to **Master**. Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. and other accessories. P. & P. £0.40.

MAINS INTERCOM

No batteries—no **wires**. Just plug in the mains for instant two-way, loud and clear communication. On off switch and volume control. Price £12·40 P. & P. £0.55

INTERCOM/BABY ALARM

OUR PRICE ONLY **£3.35**

Same as 4-Station Intercom for two-way instant communication. Ideal as Baby Alarm and Door Phone. Complete with 66ft. connecting wire. Battery 14p. P. & P. £0.25.

Transistor TELEPHONE AMPLIFIER

£2.99

Why not boost business efficiency with this incredible De-luxe **Telephone Amplifier.** Take down long telephone messages or converse without holding the handset. A useful office aid. On/off switch. Volume Control. Battery 14p. extra. P. & P. 22p. Full price refunded if not satisfied in 7 days.

WEST LONDON DIRECT SUPPLIES (PW.8)
169 KENSINGTON HIGH STREET, LONDON, W.8.

EX COMPUTER PRINTED CIRCUIT PANELS 2in x 4in packed with semi-conductors and top quality resistors, capacitors, diodes, etc. Our price 10 boards 50p, P. & P. 7p. With a guaranteed minimum of 35 transistors. Data on transistors included.

SPECIAL BARGAIN PACK. 25 boards for £1 P. & P. 18p. With a guaranteed minimum of 85 transistors. Data on transistors included.

250 MIXED CAPACITORS **62p**
Plus 9p P. & P.

709C OPERATIONAL AMPLIFIER TO5
8 lead I.C. 1 off 50p. 50 off 35p. 100 off 20p.

250 MIXED RESISTORS **62p**
¼ & ½ watt.

150 MIXED HI STABS **62p**
¼, ½ & 1 watt 5% & better.

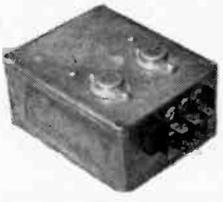
QUARTZ HALOGEN BULBS
12V 55W for car spot lights, projectors, etc. 50p each. P. & P. 5p.

GPO EXTENSION TELEPHONES
with dial but without bell. 95p each. P. & P. 30p. £1·75 for 2. P. & P. 50p.

BARGAIN RELAY OFFER
Single pole change over silver contacts 25V to 50V. 2·5k Ω coil. 8 for 50p. P. & P. 5p.

KEYTRONICS mail order only
44 EARLS COURT ROAD
LONDON, W.8 **01-478 8499**

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 these to his own layout, or the De-luxe version containing a ready-drilled roller-trimmed printed circuit board and fully machined die-cast case with electrical connection block. Each kit is supplied with a custom wound transformer, first-grade components and full construction details. Suitable for 12V. systems only, pos. or neg. earth. All components available separately. Case size 4½" x 3½" x 2" Complete assembly and wiring manual 25p, refundable on purchase of kit.

Price : Standard kit .. £7·25 post free
De-luxe .. .. £8·75 post free
Trade enquiries invited. Mail order only.

State pos. or neg. earth when ordering.

DABAR ELECTRONIC PRODUCTS

98a, LICHFIELD STREET, WALSALL, STAFFS. WS1 1UZ
Tel. Walsall 34365

Why take the risk?

of damage to expensive transistors and integrated circuits, when soldering?

Use Antex low-leakage soldering irons

selected for the DESIGN CENTRE

Model X25

220-240 Volts or 100-120 Volts

The leakage current of the NEW X25 is only a few microamps and cannot harm the most delicate equipment even when soldered "live". Tested at 1500v. A.C. This 25 watt iron with it's truly remarkable heat-capacity will easily "out-solder" any conventionally made 40 and 60 watt soldering irons, due to its unique construction advantages. Fitted long-life iron-coated bit 1/8".

2 other bits available 3/32" and 3/16".

Totally enclosed element in ceramic and steel shaft Bits do not "freeze" and can easily be removed

PRICE: £1.75 (rec. retail)

Suitable for production work and as a general purpose iron

Model CCN

220 volts or 240 volts

The 15 watt miniature model CCN, also has negligible leakage. Test voltage 4000v. A.C. Totally enclosed element in ceramic shaft. Fitted long-life iron-coated bit 3/32"

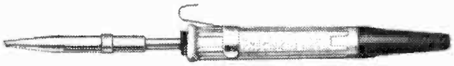
4 other bits available 1/8", 3/16" 1/4" and 1/16"

PRICE: £1.80 (rec. retail)

OR Fitted with triple-coated, (iron, nickel and Chromium) bit 1/8"

PRICE: £1.95 (rec. retail)

A SELECTION OF OTHER SOLDERING EQUIPMENT.



MODEL CN

Miniature 15 watt soldering iron fitted 3/32" iron-coated bit. Many other bits available from 1/16" to 3/16". Voltages 240, 220, 110, 50 or 24

PRICE: £1.70 (rec. retail)

MODEL CN2

Miniature 15 watt soldering iron fitted with nickel plated bit 3/32". Voltages 240 or 220.

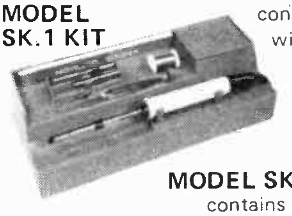
PRICE: £1.70 (rec. retail)

MODEL G

18 Watt miniature iron, fitted with long life iron-coated bit 3/32". Voltages 240, 220 or 110.

PRICE. £1.83 (rec. retail)

MODEL SK.1 KIT



contains 15 Watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32", heat sink, solder, stand and "How to Solder" booklet.

PRICE £2.75
(Rec. retail)

MODEL SK.2 KIT

contains 15 Watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32" heat sink, solder and booklet "How to Solder"

PRICE £2.40
(Rec. retail)

MODEL MES.KIT

Battery-operated 12v. 25 watt iron fitted with 15' lead and 2 heavy clips for connection to car battery. Packed in strong plastic wallet with booklet "How to Solder." **PRICE £1.95** (Rec. retail)

ANTEX

From radio or electrical dealers, car accessory shops or, in case of difficulty direct from:—
ANTEX LTD. FREEPOST (no stamp required) **Plymouth PL1 1BR** Tel: 0752 67377

☐ Please send the ANTEX colour catalogue.

☐ Please send the following:

____

____

____

____

I enclose cheque/P.O./Cash (Giro No. 2581000)

____

NAME ____________________

ADDRESS ____________________

____

PW/10

THIS IS THE FIRST PAGE OF THE GREAT BI-PAK SECTION

BRAND NEW FULLY GUARANTEED DEVICES

AC107	0·20	AD162	0·33	BC148	0·10	BD137	0·45	BF188	0·40	OC19	0·35	2G371	0·16	2N2219	0·20	2N3054	0·46	2N4059	0·10
AC113	0·20	AD161 &		BC149	0·12	BD138	0·50	BF194	0·12	OC20	0·63	2G371B	0·12	2N2220	0·22	2N3055	0·50	2N4060	0·12
AC115	0·23	AD162 (MP)		BC150	0·18	BD139	0·55	BF195	0·12	OC22	0·38	2G373	0·17	2N2221	0·20	2N3391	0·14	2N4061	0·12
AC117K	0·20		0·55	BC151	0·20	BD140	0·60	BF196	0·14	OC23	0·42	2G374	0·17	2N2222	0·20	2N3391A	0·16	2N4062	0·12
AC122	0·12	ADT140	0·50	BC152	0·17	BD155	0·80	BF197	0·14	OC24	0·56	2G377	0·30	2N2368	0·17	2N3392	0·14	2N4284	0·17
AC125	0·17	AF114	0·24	BC153	0·28	BD175	0·60	BF200	0·45	OC25	0·38	2G378	0·16	2N2369	0·14	2N3393	0·14	2N4285	0·17
AC126	0·17	AF115	0·24	BC154	0·30	BD176	0·60	BF222	0·95	OC26	0·25	2G381	0·16	2N2369A	0·14	2N3394	0·14	2N4286	0·17
AC127	0·17	AF116	0·24	BC157	0·18	BD177	0·65	BF257	0·45	OC28	0·50	2G382	0·16	2N2411	0·24	2N3395	0·17	2N4287	0·17
AC128	0·17	AF117	0·24	BC158	0·12	BD178	0·65	BF258	0·60	OC29	0·50	2G401	0·30	2N2412	0·24	2N3402	0·21	2N4288	0·17
AC132	0·14	AF118	0·35	BC159	0·12	BD179	0·70	BF259	0·85	OC35	0·42	2G414	0·30	2N2646	0·47	2N3403	0·21	2N4289	0·17
AC134	0·14	AF124	0·30	BC160	0·45	BD180	0·70	BF262	0·55	OC36	0·50	2G417	0·25	2N2711	0·21	2N3404	0·28	2N4290	0·17
AC137	0·14	AF125	0·25	BC161	0·50	BD185	0·65	BF263	0·55	OC41	0·20	2N388	0·35	2N2712	0·21	2N3405	0·42	2N4291	0·17
AC141	0·14	AF126	0·28	BC167	0·12	BD186	0·65	BF270	0·35	OC42	0·24	2N388A	0·55	2N2714	0·21	2N3414	0·15	2N4292	0·17
AC141K	0·17	AF127	0·28	BC168	0·12	BD187	0·70	BF271	0·30	OC44	0·15	2N404	0·20	2N2904	0·17	2N3415	0·15	2N4293	0·17
AC142	0·14	AF139	0·30	BC169	0·12	BD188	0·70	BF272	0·80	OC45	0·12	2N404A	0·28	2N2904A	0·21	2N3416	0·28	2N5172	0·12
AC142K	0·17	AF178	0·50	BC170	0·12	BD189	0·75	BF273	0·35	OC70	0·10	2N524	0·42	2N2905	0·21	2N3417	0·28	2N5457	0·32
AC151	0·15	AF179	0·50	BC171	0·14	BD190	0·75	BF274	0·35	OC71	0·10	2N527	0·49	2N2905A	0·21	2N3525	0·75	2N5458	0·32
AC154	0·20	AF180	0·50	BC172	0·14	BD195	0·85	BFW10	0·60	OC72	0·14	2N598	0·42	2N2906	0·15	2N3646	0·09	2N5459	0·40
AC155	0·20	AF181	0·45	BC173	0·14	BD196	0·85	BFX29	0·27	OC74	0·14	2N599	0·45	2N2906A	0·18	2N3702	0·10	2S301	0·50
AC156	0·20	AF186	0·45	BC174	0·14	BD197	0·90	BFX84	0·22	OC75	0·15	2N696	0·12	2N2907	0·20	2N3703	0·10	2S302A	0·42
AC157	0·24	AF239	0·37	BC175	0·22	BD198	0·90	BFX85	0·30	OC76	0·15	2N697	0·13	2N2907A	0·22	2N3704	0·11	2S302	0·42
AC165	0·20	AL102	0·65	BC177	0·19	BD199	0·95	BFX86	0·22	OC77	0·25	2N698	0·24	2N2923	0·14	2N3705	0·10	2S303	0·55
AC166	0·20	AL103	0·65	BC178	0·19	BD200	0·95	BFX87	0·24	OC81	0·15	2N699	0·35	2N2924	0·14	2N3706	0·09	2S304	0·70
AC167	0·20	ASY26	0·25	BC179	0·19	BD205	0·80	BFX88	0·22	OC81D	0·15	2N706	0·08	2N2925	0·14	2N3707	0·11	2S305	0·84
AC168	0·24	ASY27	0·30	BC180	0·24	BD206	0·80	BFY50	0·20	OC82	0·15	2N706A	0·09	2N2926 (G)		2N3708	0·07	2S306	0·84
AC169	0·14	ASY28	0·25	BC181	0·24	BD207	0·95	BFY51	0·20	OC82D	0·15	2N708	0·12		0·12	2N3709	0·09	2S307	0·84
AC176	0·20	ASY29	0·25	BC182	0·10	BD208	0·95	BFY52	0·20	OC83	0·20	2N711	0·30	2N2926 (Y)		2N3710	0·09	2S321	0·56
AC177	0·24	ASY50	0·25	BC182L	0·10	BDY20	1·00	BFY53	0·17	OC84	0·20	2N717	0·35		0·11	2N3711	0·09	2S322	0·42
AC178	0·28	ASY51	0·25	BC183	0·10	BF115	0·24	BPX25	0·85	OC139	0·20	2N718	0·24	2N2926 (O)		2N3819	0·28	2S322A	0·42
AC179	0·28	ASY52	0·25	BC183L	0·10	BF117	0·45	BSX19	0·15	OC140	0·20	2N718A	0·50		0·10	2N3820	0·50	2S323	0·56
AC180	0·17	ASY54	0·25	BC184	0·12	BF118	0·70	BSX20	0·15	OC169	0·25	2N726	0·28	2N2926 (R)		2N3821	0·35	2S324	0·70
AC180K	0·20	ASY55	0·25	BC184L	0 12	BF119	0·70	BSY25	0·15	OC170	0·25	2N727	0·28		0·10	2N3823	0·28	2S325	0·70
AC181	0·17	ASY56	0·25	BC186	0·28	BF121	0·45	BSY26	0·15	OC171	0·25	2N743	0·20	2N2926 (B)		2N3903	0·28	2S326	0·70
AC181K	0·20	ASY57	0·25	BC187	0·28	BF123	0·50	BSY27	0·15	OC200	0·25	2N744	0·20		0·10	2N3904	0·30	2S327	0·70
AC187	0·22	ASY58	0·25	BC207	0·11	BF125	0·45	BSY28	0·15	OC201	0·28	2N914	0·14	2N3010	0·70	2N3905	0·28	2S701	0·42
AC187K	0·20	ASZ21	0·40	BC208	0·11	BF127	0·50	BSY29	0·15	OC202	0·28	2N918	0·30	2N3011	0·14	2N3906	0·27	40361	0·40
AC188	0·22	BC107	0·09	BC209	0·12	BF152	0·55	BSY38	0·18	OC203	0·25	2N929	0·21	2N3053	0·17	2N4058	0·12	40362	0·45
AC188K	0·20	BC108	0·09	BC212L	0·11	BF153	0·45	BSY39	0·18	OC204	0·25	2N930	0·21						
ACY17	0·25	BC109	0·10	BC213L	0·11	BF154	0·45	BSY40	0·28	OC205	0·35	2N1131	0·20						
ACY18	0·20	BC113	0·10	BC214L	0·14	BF155	0·70	BSY41	0·28	OC309	0·40	2N1132	0·22						
ACY19	0·20	BC114	0·15	BC225	0·25	BF156	0·48	BSY95	0·12	P346A	0·20	2N1302	0·14						
ACY20	0·20	BC115	0·15	BC226	0·35	BF157	0·55	BSY95A	0·12	P397	0·42	2N1303	0·14						
ACY21	0·20	BC116	0·15	BCY30	0·24	BF158	0·55	Bu105	2·00	OCP71	0·43	2N1304	0·17						
ACY22	0·16	BC117	0·15	BCY31	0·26	BF159	0·60	C111E	0·50	ORP12	0·43	2N1305	0·17						
ACY27	0·18	BC118	0·10	BCY32	0·30	BF160	0·40	C400	0·30	ORP60	0·40	2N1306	0·21						
ACY28	0·19	BC119	0·30	BCY33	0·22	BF162	0·40	C407	0·25	ORP61	0·40	2N1307	0·21						
ACY29	0·35	BC120	0·80	BCY34	0·25	BF163	0·40	C424	0·20	ST140	0·12	2N1308	0·23						
ACY30	0·28	BC125	0·12	BCY70	0·14	BF164	0·40	C425	0·50	ST141	0·17	2N1309	0·23						
ACY31	0·28	BC126	0·18	BCY71	0·18	BF165	0·40	C426	0·35	TI843	0·30	2N1613	0·20						
ACY34	0·21	BC132	0·12	BCY72	0·14	BF167	0·22	C428	0·20	UT46	0·27	2N1711	0·20						
ACY35	0·21	BC134	0·18	BCZ10	0·20	BF173	0·22	C441	0·30	2G301	0·09	2N1889	0·32						
ACY36	0·28	BC135	0·12	BCZ11	0·25	BF176	0·35	C442	0·30	2G302	0·19	2N1890	0·45						
ACY40	0·17	BC136	0·15	BCZ12	0·25	BF177	0·35	C444	0·35	2G303	0·19	2N1893	0·37						
ACY41	0·18	BC137	0·15	BD121	0·60	BF178	0·30	C450	0·22	2G304	0·24	2N2147	0·72						
ACY44	0·35	BC139	0·40	BD123	0·65	BF179	0·30	MAT100	0·19	2G306	0·40	2N2148	0·57						
AD130	0·38	BC140	0·30	BD124	0·60	BF180	0·30	MAT101	0·20	2G308	0·35	2N2160	0·60						
AD140	0·48	BC141	0·30	BD131	0·50	BF181	0·30	MAT120	0·19	2G309	0·35	2N2192	0·35						
AD142	0·48	BC142	0·30	BD132	0·60	BF182	0·40	MAT121	0·20	2G339	0·20	2N2193	0·35						
AD143	0·38	BC143	0·30	BD133	0·65	BF183	0·40	MPF102	0·42	2G339A	0·16	2N2194	0·35						
AD149	0·50	BC145	0·45	BD135	0·40	BF184	0·25	MPF104	0·37	2G344	0·18	2N2217	0·22						
AD161	0·33	BC147	0·10	BD136	0·40	BF185	0·30	MPF105	0·37	2G345	0·16	2N2218	0·20						

DIODES AND RECTIFIERS

AA119	0·08	BY133	0·21	OA10	0·35
AA120	0·08	BY164	0·50	OA47	0·07
AA129	0·08	BYX38/30		OA70	0·07
AAY30	0·09		0·42	OA79	0·07
AAZ13	0·10	BYZ10	0·35	OA81	0·07
BA100	0·10	BYZ11	0·30	OA85	0·09
BA116	0·21	BYZ12	0·30	OA90	0·06
BA126	0·22	BYZ13	0·25	OA91	0·06
BA148	0·14	BYZ16	0·40	OA95	0·07
BA154	0·12	BYZ17	0·35	OA200	0·06
BA155	0·14	BYZ18	0·35	OA202	0·07
BA156	0·13	BYZ19	0·28	SD10	0·05
BY100	0·15	CG62		SD19	0·05
BY101	0·12	(Eg) OA91		IN34	0·07
BY105	0·17		0·05	IN34A	0·07
BY114	0·12	CG651		1N914	0·06
BY126	0·14	(Eq) OA70·		1N916	0·06
BY127	0·15	OA79	0·06	IN414B	0·06
BY128	0·15	OA5	0·35	IS021	0·10
BY130	0·16	OA5SL	0·21	IS951	0·06

Cut these 3 pages out and keep for reference

NEW COMPONENT PAK BARGAINS

Pack No.	Qty.	Description	Price
C 1	250	Resistors mixed values approx. count by weight	0·50
C 2	200	Capacitors mixed values approx. count by weight	0·50
C 3	50	Precision Resistors ·1%, ·01% mixed values	0·50
C 4	75	⅛th W Resistors mixed preferred values	0·50
C 5	5	Pieces assorted Ferrite Rods	0·50
C 6	2	Tuning Gangs, MW/LW VHF	0·50
C 7	1	Pack Wire 50 metres assorted colours	0·50
C 8	10	Reed Switches	0·50
C 9	3	Micro Switches	0·50
C10	15	Assorted Pots & Pre-Sets	0·50
C11	5	Jack Sockets 3 × 3·5m 2 × Standard Switch Types	0·50
C12	40	Paper Condensers preferred types mixed values	0·50
C13	20	Electrolytics Trans. types	0·50
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets etc.	0·50
C15	4	Mains Toggle Switches, 2 Amp D/P	0·50
C16	20	Assorted Tag Strips & Panels	0·50
C17	10	Assorted Control Knobs	0·50
C18	4	Rotary Wave Change Switches	0·50
C19	3	Relays 6—24V Operating	0·50
C20	4	Sheets Copper Laminate approx. 10″ × 7″	0·50

Please add 10p post and packing on all component packs, plus a further 10p on pack Nos. C1, C2, C19, C20.

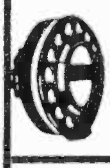
PLUS-MUCH MORE-
SEND NOW FOR THE
BI-PAK *"Component Catalogue"*

5p to cover postage etc.

JUMBO COMPONENT PAKS

MIXED ELECTRONIC COMPONENTS
Exceptionally good value

Resistors, capacitors, pots, electrolytics and coils plus many other useful items. Approximately 3lbs in weight. Price incl. P. & P. £1·50 only.



BRAND NEW POST OFFICE TYPE TELE-PHONE DIALS ONLY 75p each

THE NEW S.G.S. EA 1000 AUDIO AMP MODULE ****Guarantee***

3 Watts R.M.S. ONLY £2·63 each

Modual Tested and Guaranteed. Qty. 1—9 £2·63; 10—25 £2·28 Price each. Larger quantities quoted on request. Full hook-up diagrams and complete technical data supplied free with each modual or available separately at 10p each.

SYSTEM 12 STEREO

Each Kit contains two Amplifier Modules, 3 watts RMS, two loudspeakers, 15 ohms, the pre-amplifier, transformer, power supply module, front panel and other accessories, as well as an illustrated stage-by-stage instruction booklet designed for the beginner. Further details available on request.

ONLY £16·95 FREE P. & P.

NOW-TURN OVER FOR MORE FANTASTIC OFFERS

The largest selection

NEW LOW PRICE TESTED S.C.R.'s

PIV	1A TO5	3A TO66	5A TO66	5A TO64	7A TO48	10A TO48	16A TO48	30A TO48
50	0·23	0·25	0·35	0·35	0·47	0·50	0·53	1·15
100	0·25	0·33	0·47	0·47	0·50	0·58	0·63	1·40
200	0·35	0·37	0·49	0·49	0·57	0·61	0·75	1·60
400	0·43	0·47	0·56	0·56	0·67	0·75	0·93	1·75
600	0·53	0·57	0·68	0·68	0·77	0·97	1·25	—
800	0·63	0·70	0·80	0·80	0·90	1·20	1·50	4·00

SIL. RECTS. TESTED

PIV	300mA	750mA	1A	1·5A	3A	10A	30A
50	0·04	0·05	0·05	0·07	0·14	0·21	0·60
100	0·04	0·06	0·05	0·13	0·16	0·23	0·75
200	0·05	0·09	0·06	0·14	0·20	0·24	1·00
400	0·06	0·13	0·07	0·20	0·27	0·37	1·25
600	0·07	0·16	0·10	0·25	0·34	0·45	1·86
800	0·10	0·17	0·11	0·25	0·37	0·55	2·00
1000	0·11	0·25	0·14	0·30	0·46	0·63	2·50
1200	—	0·33	—	0·38	0·57	0·75	—

TRIACS

VBOM	2A TO-1	6A TO-66	10A TO-88
	£p	£p	£p
100	30	50	76
200	50	60	90
400	70	75	1-10

DIACS

FOR USE WITH TRIACS BR100 (D32) 37p each

FREE

One 50p Pak of your own choice free with orders valued £4 or over.

BRAND NEW TEXAS GERM. TRANSISTORS

Coded and Guaranteed

Pak No.		EQVT
T1	8 2G3713	OC71
T2	8 D1374	OC75
T3	8 D1216	OC81D
T4	8 2G381T	OC81
T5	8 2G382T	OC82
T6	8 2G344B	OC44
T7	8 2G345B	OC45
T8	8 2G378	OC78
T9	8 2G399A	2N1302
T10	8 2G417	AF117

All 50p each pak

2N2060 NPN SIL. DUAL TRANS. CODE D1699 TEXAS. Our price 25p each.

120 VCB MIXIE DRIVER TRANSISTOR. Sim. BSX21 & C407, 2N1893 FULLY TESTED AND CODED ND 120. 1-24 17p each. TO.5 N.P.N. 25 up 15p each.

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 5p each. Any Qty.

FULL RANGE OF ZENER DIODES VOLTAGE RANGE

2-33V. 400mV (DO-7 Case) 13p ea. 1½W (Top-Hat) 18p ea. 10W (SO-10 Stud) 25p ea. All fully tested 5% tol. and marked. State voltage required.

10 amp POTTED BRIDGE RECTIFIER on heat sink. 100PIV. 90p each

NEW LINE

Plastic Encapsulated 2 Amp. BRIDGE RECTS.

50 v RMS	32p each
100 v RMS	37p ,,
400 v RMS	46p ,,

Size 15 mm × 6 mm.

UNIJUNCTION

UT46. Eqvt. 2N2646, Eqvt. TIS43. BEN3000 27p each, 25-99 25p 100 UP 20p.

CADMIUM CELLS

ORP12 43p
ORP60, ORP61 40p each

GENERAL PURPOSE NPN SILICON SWITCHING TRANS.

TO-18 SIM. TO 2N706/8. BSY-27/28/95A. All usable devices no open or short circuits. ALSO AVAILABLE in PNP Sim. to 2N2906, BCY70. When ordering please state preference NPN or PNP.

		£p
20	For	0·50
50	For	1·00
100	For	1·75
500	For	7·50
1000	For	13·00

SIL. G.P. DIODES £p

300mW	30..	0·50
40PIV(Min.)	100..	1·50
Sub-Min.	500..	5·00
Full Tested	1,000..	9·00

Ideal for Organ Builders.

KING OF THE PAKS Unequalled Value and Quality

SUPER PAKS NEW BI-PAK UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED in Every Pak, or money back.

Pak No.		Description	Price
U 1	120	Glass Sub-Min. General Purpose Germanium Diodes	0·50
U 2	60	Mixed Germanium Transistors AF/RF	0·50
U 3	75	Germanium Gold Bonded Sub-Min. like OA5, OA47	0·50
U 4	40	Germanium Transistors like OC81, AC128	0·50
U 5	60	200mA Sub-Min. Silicon Diodes	0·50
U 6	30	Sil. Planar Trans. NPN like BSY95A. 2N706	0·50
U 7	16	Sil. Rectifiers TOP-HAT 750mA VLTG. RANGE up to 1000	0·50
U 8	50	Sil. Planar Diodes DO-7 Glass 250mA like OA200/202	0·50
U 9	20	Mixed Voltages, 1 Watt Zener Diodes	0·50
U10	20	BAY50 charge storage Diodes DO-7 Glass	0·50
U11	25	PNP Sil. Planar Trans. TO-5 like 2N1132, 2N2904	0·50
U12	12	Silicon Rectifiers Epoxy 500mA up to 800 PIV	0·50
U13	30	PNP-NPN Sil. Transistors OC200 & 28 104	0·50
U14	150	Mixed Silicon and Germanium Diodes	0·50
U15	25	NPN Sil. Planar Trans. TO-5 like BFY51, 2N697	0·50
U16	10	3 Amp Silicon Rectifiers Stud Type up to 1000PIV	0·50
U17	30	Germanium PNP AF Transistors TO-5 like ACY 17-22	0·50
U18	8	6 Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	0·50
U19	25	Silicon NPN Transistors like BC108	0·50
U20	12	1·5 Amp Silicon Rectifiers Top Hat up to 1000 PIV	0·50
U21	30	AF. Germanium Alloy Transistors 2G300 Series & OC71	0·50
U23	30	MADT's like MHz Series PNP Transistors	0·50
U24	20	Germanium 1 Amp Rectifiers GJM Series up to 300 PIV	0·50
U25	25	300 MHz NPN Silicon Transistors 2N708, BSY27	0·50
U26	30	Fast Switching Silicon Diodes like IN914 Micro-Min.	0·50
U27	12	NPN Germanium AF Transistors TO-1 like AC127	0·50
U29	10	1 Amp SCR's TO-5 can, up to 600 PIV CRS1/25-600	0·50
U30	15	Plastic Silicon Planar Trans. NPN 2N2926	0·50
U31	20	Silicon Planar Plastic NPN Trans. Low Noise Amp 2N3707	0·50
U32	25	Zener Diodes 400mW DO-7 case 3-18 volts mixed	0·50
U33	15	Plastic Case 1 Amp Silicon Rectifiers IN4000 Series	0·50
U34	30	Silicon PNP Alloy Trans. TO-5 BCY26 28302/4	0·50
U35	25	Silicon Planar Transistors PNP TO-18 2N2906	0·50
U36	25	Silicon Planar NPN Transistors TO-5 BFY50/51/52	0·50
U37	30	Silicon Alloy Transistors SO-2 PNP OC200, 28322	0·50
U38	20	Fast Switching Silicon Trans. NPN 400 MHz 2N3011	0·50
U39	30	RF. Germ. PNP Transistors 2N1303/5 TO-5	0·50
U40	10	Dual Transistors 6 lead TO-5 2N2060	0·50
U41	25	RF Germanium Transistors TO-5, OC45, NKT72	0·50
U42	10	VHF Germanium PNP Transistors TO-1 NKT667, AF117	0·50
U43	25	Sil. Trans. Plastic TO-18 A.F. BC113/114	0·50
U44	20	Sil. Trans. Plastic TO-5 BC115/NPN	0·50
U45	7	3A SCR. TO66 up to 600PIV	1·00

Code No's. mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked.

QUALITY TESTED SEMICONDUCTORS

Pak No.			Price £p
Q1	20	Red spot transistors PNP	0·50
Q2	16	White spot R.F. transistors PNP	0·50
Q3	4	OC 77 type transistors	0·50
Q4	6	Matched transistors OC44/45/81/81D	0·50
Q5	4	OC 75 transistors	0·50
Q6	5	OC 72 transistors	0·50
Q7	4	AC 128 transistors PNP high gain	0·50
Q8	4	AC 126 transistors PNP	0·50
Q9	7	OC 81 type transistors	0·50
Q10	7	OC 71 type transistors	0·50
Q11	2	AC 127/128 Complementary pairs PNP/NPN	0·50
Q12	3	AF 116 type transistors	0·50
Q13	3	AF 117 type transistors	0·50
Q14	3	OC 171 H.F. type transistors	0·50
Q15	7	2N2926 Sil. Epoxy transistors mixed colours	0·50
Q16	2	GET880 low noise Germanium transistors	0·50
Q17	5	NPN 2 × ST.141 & 3 × ST.140	0·50
Q18	4	MADT'S 2 × MAT 100 & 2 × MAT 120	0·50
Q19	3	MADT'S 2 × MAT 101 & 1 × MAT 121	0·50
Q20	4	OC 44 Germanium transistors A.F.	0·50
Q21	4	AC 127 NPN Germanium transistors	0·50
Q22	20	NKT transistors A.F. R.F. coded	0·50
Q23	10	OA 202 Silicon diodes sub-min.	0·50
Q24	8	OA 81 diodes	0·50
Q25	15	IN914 Silicon diodes 75 PIV 75mA	0·50
Q26	8	OA95 Germanium diodes sub-min IN69	0·50
Q27	2	10A PIV Silicon rectifiers IS425R	0·50
Q28	2	Silicon power rectifiers BYZ 13	0·50
Q29	4	Silicon transistors 2 × 2N696, 1 × 2N697, 1 × 2N698	0·50
Q30	7	Silicon switch transistors 2N706 NPN	0·50
Q31	6	Silicon switch transistors 2N708 NPN	0·50
Q32	3	PNP Silicon transistors 2 × 2N1131, 1 × 2N1132	0·50
Q33	3	Silicon NPN transistors 2N1711	0·50
Q34	7	Silicon NPN transistors 2N2369, 500MHz (code P397)	0·50
Q35	3	Silicon PNP TO-5. 2 × 2N2904 & 1 × 2N2905	0·50
Q36	7	2N3646 TO-18 plastic 300 MHz NPN	0·50
Q37	3	2N3053 NPN Silicon transistors	0·50
Q38	7	NPN transistors 4 × 2N3703, 3 × 2N3702	0·50

ELECTRONIC SLIDE-RULE

The MK Slide Rule, designed to simplify Electronic calculations features the following scales:— Conversion of Frequency and Wavelength. Calculation of L, C and fo of Tuned Circuits. Reactance and Self Inductance. Area of Circles. Volume of Cylinders. Resistance of Conductors. Weight of Conductors. Decibel Calculations. Angle Functions. Natural Logs and 'e' Functions. Multiplication and Division. Squaring, Cubing and Square Roots. Conversion of kW and Hp. A must for every electronic engineer and enthusiast. Size: 2 cm × 4cm. Complete with case and instructions. Price each: £3·35

SILICON PHOTO TRANSISTOR.

TO-18 Lens end NPN Sim. to BP × 25 and P21. BRAND NEW. Full data available. Fully guaranteed.

Qty.	1-24	25-99	100 up
Price each	45p	40p	35p

F.E.T.'S

2N3819	35p	2N5458	50p
2N3820	50p	2N5459	40p
2N3821	35p	BFW10	40p
2N3823	30p	MPF105	40p

INTEGRATED CIRCUIT PAKS

Manufacturers "Fall Outs" which include Functional and Part-Functional Units. These are classed as 'out-of-spec' from the maker's very rigid specifications, but are ideal for learning about I.C's and experimental work.

Pak No. Contents	Price	Pak No. Contents	Price	Pak No. Contents	Price
UIC00 = 12 × 7400	0·50	UIC46 = 5 × 7446	0·50	UIC86 = 5 × 7486	0·50
UIC01 = 12 × 7401	0·50	UIC47 = 5 × 7447	0·50	UIC90 = 5 × 7490	0·50
UIC02 = 12 × 7402	0·50	UIC48 = 5 × 7448	0·50	UIC91 = 5 × 7491	0·50
UIC03 = 12 × 7403	0·50	UIC50 = 12 × 7450	0·50	UIC92 = 5 × 7492	0·50
UIC04 = 12 × 7404	0·50	UIC51 = 12 × 7451	0·50	UIC93 = 5 × 7493	0·50
UIC05 = 12 × 7405	0·50	UIC53 = 12 × 7453	0·50	UIC94 = 5 × 7494	0·50
UIC06 = 8 × 7406	0·50	UIC54 = 12 × 7454	0·50	UIC95 = 5 × 7495	0·50
UIC07 = 8 × 7407	0·50	UIC60 = 12 × 7460	0·50	UIC96 = 5 × 7496	0·50
UIC10 = 12 × 7410	0·50	UIC70 = 8 × 7470	0·50	UIC100 = 5 × 74100	0·50
UIC13 = 8 × 7413	0·50	UIC72 = 8 × 7472	0·50	UIC121 = 5 × 74121	0·50
UIC20 = 12 × 7420	0·50	UIC73 = 8 × 7473	0·50	UIC141 = 5 × 74141	0·50
UIC30 = 12 × 7430	0·50	UIC74 = 8 × 7474	0·50	UIC151 = 5 × 74151	0·50
UIC40 = 12 × 7440	0·50	UIC75 = 8 × 7475	0·50	UIC154 = 5 × 74154	0·50
UIC41 = 5 × 7441	0·50	UIC76 = 8 × 7476	0·50	UIC193 = 5 × 74193	0·50
UIC42 = 5 × 7442	0·50	UIC80 = 5 × 7480	0·50	UIC199 = 5 × 74199	0·50
UIC43 = 5 × 7443	0·50	UIC81 = 5 × 7481	0·50		
UIC44 = 5 × 7444	0·50	UIC82 = 5 × 7482	0·50	UICXI = 25 Assorted 74's	1·50
UIC45 = 5 × 7445	0·50	UIC83 = 5 × 7483	0·50		

Packs cannot be split, but 25 assorted pieces (our mix) is available as PAK UIC X1.

POWER TRANS BONANZA!

GENERAL PURPOSE GERM. PNP

Coded GP100. BRAND NEW TO-3 CASE. POSS. REPLACE.:—OC25-28-29-30-35-36. NKT 401-403-404-405-406-430-451-452-453. TI3027-3028, 2N250A, 2N456A-457A-458A, 2N511 A & B. 2G220-222, ETC. VCBO 80V VCEO 50V IC 10A PT. 30 WATTS Hfe 30-170.

PRICE	1-24	25-99	100 up
	43p each	40p each	36p each

SILICON High Voltage 250V NPN TO-3 case. G.P. Switching & Amplifier Applications. Brand new Coded R 2400 VCBO 250/VCEO 100/IC 6A/30 Watts. HFE type 20/fT 5MHZ.

OUR PRICE EACH:	1-24	25-99	100 up
	50p	45p	40p

2N3055

115 WATT SIL POWER NPN 50p EACH

NEW EDITION 1971

TRANSISTOR EQUIVALENTS BOOK. A complete cross reference and equivalents book for European, American and Japanese Transistors. Exclusive to BI-PAK 90p each.

A LARGE RANGE OF TECHNICAL AND DATA BOOKS ARE NOW AVAILABLE EX. STOCK. SEND FOR FREE LIST.

BI-PAKS NEW COMPONENT SHOP NOW OPEN WITH A WIDE RANGE OF ELECTRONIC COMPONENTS AND ACCESSORIES AT COMPETITIVE PRICES—

18 BALDOCK STREET (A10), WARE, HERTS.
TEL. (STD 0920) 61593.
OPEN MON.-SAT. 9.15 a.m. to 6 p.m., FRIDAY UNTIL 8 p.m.

AD161/162 *PNP*

M/P COMP GERM TRANS. OUR LOWEST PRICE OF 55p *PER PAIR*

SILICON 50 WATTS MATCHED NPN/PNP
BIP 19 NPN TO-3 Plastic. BIP 20 PNP. Brand new. VCBO 100/VCEO 50/IC 10A. HFE type 100/ft 3mHZ.

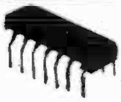
OUR PRICE PER PAIR:		
1-24 prs. 60p	25-99 prs. 55p	100 prs. 50p

All mail orders please add 10p post and packing. Send all orders to BI-PAK P.O. Box 6, WARE, HERTS.

All mail orders please add 10p post and packing.
Send all orders to BI-PAK P.O. BOX 6, WARE, HERTS.

-the lowest prices!

74 Series T.T.L. I.C's



BI-PAK STILL LOWEST IN PRICE. FULL SPECIFICATION GUARANTEED. ALL FAMOUS MANUFACTURERS

	1	25	100+
SN7400	0·15	0·14	0·12
SN7401	0·15	0·14	0·12
SN7402	0·15	0·14	0·12
SN7403	0·15	0·14	0·12
SN7404	0·15	0·14	0·12
SN7405	0·15	0·14	0·12
SN7406	0·35	0·31	0·28
SN7407	0·35	0·31	0·28
SN7408	0·18	0·17	0·16
SN7409	0·18	0·17	0·16
SN7410	0·15	0·14	0·12
SN7411	0·25	0·24	0·23
SN7412	0·35	0·31	0·28
SN7413	0·29	0·28	0·24
SN7416	0·43	0·40	0·38
SN7417	0·43	0·40	0·38
SN7420	0·15	0·14	0·12
SN7422	0·50	0·48	0·45
SN7423	0·50	0·48	0·45
SN7425	0·50	0·48	0·45
SN7427	0·45	0·42	0·40
SN7428	0·70	0·65	0·60
SN7430	0·15	0·14	0·12
SN7432	0·45	0·42	0·40
SN7433	0·80	0·75	0·70
SN7437	0·64	0·62	0·60
SN7438	0·64	0·62	0·60
SN7440	0·15	0·14	0·12
SN7441	0·67	0·64	0·58
SN7442	0·67	0·64	0·58
SN7443	£1·30	£1·25	£1·20
SN7444	£1·30	£1·25	£1·20
SN7445	£1·80	£1·77	£1·75
SN7446	0·97	0·94	0·88
SN7447	£1·00	0·97	0·95
SN7448	£1·00	0·97	0·95
SN7450	0·15	0·14	0·12
SN7451	0·15	0·14	0·12
SN7453	0·15	0·14	0·12
SN7454	0·15	0·14	0·12
SN7460	0·15	0·14	0·12
SN7470	0·29	0·26	0·24

	1	25	100+
SN7472	0·29	0·26	0·24
SN7473	0·37	0·35	0·32
SN7474	0·37	0·35	0·32
SN7475	0·45	0·43	0·42
SN7476	0·40	0·39	0·38
SN7480	0·67	0·64	0·58
SN7481	£1·20	£1·15	£1·10
SN7482	0·87	0·86	0·85
SN7483	£1·10	£1·05	0·95
SN7484	£1·00	0·95	0·90
SN7485	£3·60	£3·50	£3·40
SN7486	0·32	0·31	0·30
SN7489	£5·50	£5·25	£5·00
SN7490	0·67	0·64	0·58
SN7491	£1·00	0·95	0·90
SN7492	0·67	0·64	0·58
SN7493	0·67	0·64	0·58
SN7494	0·77	0·74	0·68
SN7495	0·77	0·74	0·68
SN7496	0·87	0·84	0·78
SN74100	£1·65	£1·60	£1·55
SN74104	0·97	0·94	0·88
SN74105	0·97	0·94	0·88
SN74107	0·40	0·38	0·36
SN74110	0·55	0·53	0·50
SN74111	£1·25	£1·15	£1·10
SN74118	£1·00	0·95	0·90
SN74119	£1·35	£1·25	£1·10
SN74121	0·40	0·37	0·34
SN74122	£1·40	£1·30	£1·10
SN74123	£2·80	£2·70	£2·60
SN74141	0·67	0·64	0·58
SN74145	£1·50	£1·40	£1·30
SN74150	£3·00	£2·70	£2·50
SN74151	£1·00	0·95	0·90
SN74153	£1·20	£1·10	0·95
SN74154	£1·80	£1·70	£1·60
SN74155	£1·40	£1·30	£1·20
SN74156	£1·40	£1·30	£1·20
SN74157	£1·90	£1·80	£1·70

LINEAR I.C's—FULL SPEC.

Type No.	Price 1-24	25-99	100 up
BP 201C—SL201C	63p	58p	45p
BP701C—SL701C	63p	50p	45p
BP 702C—SL702C	63p	50p	45p
BP 702—72702	53p	45p	40p
BP709—72709	36p	34p	30p
BP 709P—μA709C	36p	34p	30p
BP 710—72710	44p	42p	40p
BP 711—μA711	45p	43p	40p
BP 741—72741	75p	60p	50p
μA703C—μA703C	28p	26p	24p
TAA 263—	70p	60p	55p
TAA 293—	90p	75p	70p
TAA 350	170p	158p	150p

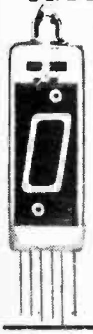
S.G.S. EA1000 2·63

ROCK BOTTOM PRICES LOGIC DTL 930 Series I.C's

Type No.	Price 1-24	25-99	100 up
BP930	12p	11p	10p
BP932	13p	12p	11p
BP933	13p	12p	11p
BP935	13p	12p	11p
BP936	13p	12p	11p
BP944	13p	12p	11p
BP945	25p	24p	22p
RP946	12p	11p	10p
BP948	25p	24p	22p
BP951	65p	60p	55p
BP962	12p	11p	10p
BP9093	40p	38p	35p
BP9094	40p	38p	35p
BP9097	40p	38p	35p
BP9099	40p	38p	35p

Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

NUMERICAL INDICATOR TUBES



MODEL	CD66	GR116	3015F Minitron
Anode voltage (Vdc)	170min	175min	5
Cathode Current (mA)	2·3	14	8
Numerical Height (mm)	16	13	9
Tube Height (mm)	47	32	22
Tube Diameter (mm)	19	13	12 wide
I.C. Driver Rec.	BP41 or 141	BP41 or 141	BP47
PRICE EACH	£1·70	£1·55	£1·90

All indicators 0·9 + Decimal point. All side viewing. Full data for all types available on request.

RTL MICROLOGIC CIRCUITS

Epoxy TO-5 case	Price each 1-24	25-99	100 up
uL900 Buffer	35p	33p	27p
uL914 Dual 2i/p gate	35p	33p	27p
uL923 J-K flip-flop	50p	47p	45p

Date and Circuits Booklet for IC's Price 7p.

DUAL IN LINE SOCKETS.

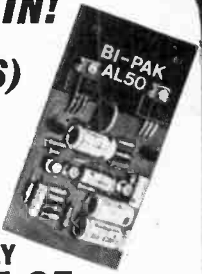
14 & 16 Lead Sockets for use with

DUAL-IN-LINE I.C's. TWO Ranges PROFESSIONAL & NEW LOW COST.

PROF. TYPE No.	1-24	25-99	100up.
TSO 14 pin type	30p	27p	25p
TSO 16 ,, ,,	35p	32p	30p
LOW COST No.			
BPS 14	15p	13p	11p
BPS 16	16p	14p	12p

BI-PAK DO IT AGAIN!

50W pk 25w (RMS)



0·1% DISTORTION!
HI-FI AUDIO AMPLIFIER

THE AL50

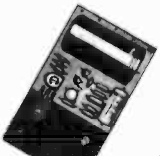
- ★ Frequency Response 15Hz to 100,000—1dB.
- ★ Load—3, 4, 8 or 16 ohms.
- ★ Distortion—better than ·1% at 1KHz.
- ★ Signal to noise ratio 80dB.

ONLY **£3.25p each**

- ★ Supply voltage 10–35 Volts.
- ★ Overall size 63mm × 105mm × 13mm.

Tailor made to the most stringent specifications using top quality components and incorporating the latest solid state circuitry and AL50 was conceived to fill the need for all your A.F. amplification needs.
FULLY BUILT — TESTED — GUARANTEED.

STABILISED POWER MODULE SPM80

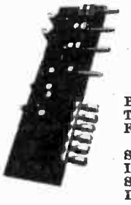


AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 30mm. These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including:—Disco Systems, Public Address, Intercom Units, etc. Handbook available, 10p **PRICE £2·95**

TRANSFORMER BMT80 £1·95 p. & p. 25p.

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL50 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.
Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.



SPECIFICATION

Frequency Response	20Hz – 20KHz ± 1dB
Harmonic Distortion	better than 0·1%
Inputs : 1. Tape Head	1·25 mV into 50K Ω
2. Radio, Tuner	35 mV into 50K Ω
3. Magnetic P.U.	1·5 mV into 50K Ω

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.

Bass Control	± 15dB at 20Hz
Treble Control	± 15dB at 20KHz
Filters : Rumble (High Pass)	100Hz
Scratch (Low Pass)	8KHz
Signal/Noise Ratio	better than – 65dB
Input overload	+ 26dB
Supply	+ 35 volts at 20mA
Dimensions	292mm × 82mm × 35mm

ONLY £11·95

SPECIAL COMPLETE KIT COMPRISING 2 AL50's, 1 SPM80, 1 BMT80 & 1 PA100 ONLY £23·00 FREE p. & p.

All prices quoted in new pence *Giro No. 388-7006*
Please send all orders direct to warehouse and despatch department

BI-PAK

P.O. BOX 6, WARE · HERTS

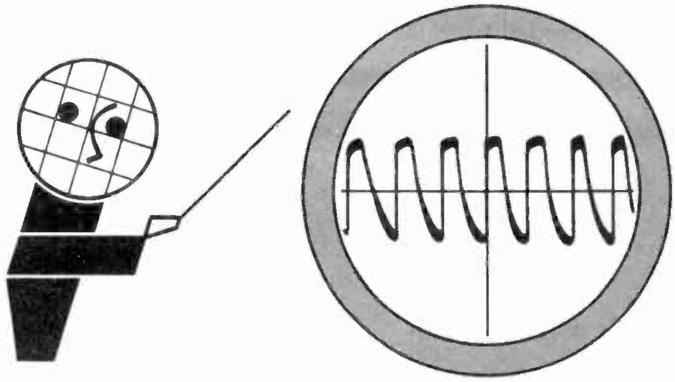
Postage and packing add 7p. Overseas add extra for airmail. Minimum order 50p. Cash with order please.

Guaranteed Satisfaction or Money Back

look! electronics really mastered

...practical
...visual
...exciting!

no previous knowledge
no unnecessary theory
no "maths"



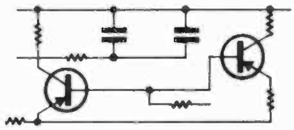
RAPY

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. experiments, 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 understand how to test, service and maintain all types of electronic equipment, radio and TV receivers, etc.

FREE POST NOW for BROCHURE

or write if you prefer not to cut page

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 — BLOCK CAPS

ADDRESS — PLEASE WL102

special free gift also to all our students

PRACTICAL WIRELESS

VOL 48 NO 6
Issue 788

OCTOBER 1972

Wires and Waves

ASKED what type of aerial he uses, an enthusiast of the new generation might well reply "What's an aerial?". Apart from those multi-rod devices on the roof associated with television, the aerial is usually just another component fitted snugly inside the case of a transistor radio.

DX enthusiasts and amateur transmitters are, of course, alive to the importance of the external aerial, but there must be thousands of would-be DX-ers battling against the odds by trying to find exotic stations on ordinary transistor radios and relying only on the pickup capabilities of the internal ferrite rod assembly or at best a diminutive pull-out rod. While some success is possible under these conditions, experienced listeners will testify as to the vastly improved results obtained by using a well-designed external system, perhaps terminated in an aerial tuning unit.

It is not, however, just a matter of throwing out a random piece of wire and hoping for the best. Some thought must be given to the wavebands on which peak performance is wanted and the directions from which optimum reception is needed. In fact, devising an aerial can be quite as absorbing as the building of active equipment.

The erection of an aerial system is more an art than a science, because the siting and lengths of wire are somewhat empirical. Formulae for dimensions and directions are based on the ideal conditions obtained in "free space" but the average amateur is rarely fortunate enough to have unrestricted space and a clear open site. The immediate terrain and features (hills, large buildings, etc.) may modify the ideal calculations and so there is a fruitful field here for experimentation.

Once embarked on the subject of aerials, it is a short step to begin thinking about what happens between the transmitter and the receiver. Here again is a complete field for exploration. One of the first things that an embryo DX-er has to learn is how the various phenomena associated with radio wave propagation are going to affect his listening activities. A good aerial system coupled with a knowledge of propagation are the foundations for successful long distance listening.

That there is a need for information on aerials is borne out by the many letters we have received asking for help in this direction. The wall chart enclosed with this issue should provide all the basic material for those wishing to install a good aerial system, or improve their existing set-up, and it is complementary to the DX Data Chart supplied with the March issue.

We have also included in this issue, an introductory article on radio wave propagation, which it is hoped will provide a further stimulus to investigation into this somewhat neglected, yet vital, sphere of interest.

W. N. STEVENS—*Editor*

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

FREE—AERIAL DATA WALLCHART

Some Readers may be aware of a slight loss of quality in printing. This is due to a shortage of our usual paper which has been brought about by the Dock Strike.

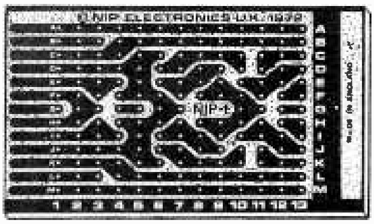
THE NOVEMBER ISSUE WILL BE PUBLISHED ON OCTOBER 6th

NEWS... NEWS... NEWS...

Nip-E-Board

Remember some time ago we mentioned Nippiboard — the etched P.C. Board? Well now NIP Electronics, the manufacturers have announced additions to their range.

The Nip-E-System provides for a number of basic etched printed circuit board arrangements that can be used in many circuit applications immediately. The user then goes ahead with the component layout assembly and wiring, knowing that he does not need to worry about special designs or messy etching procedures. The basic layout design

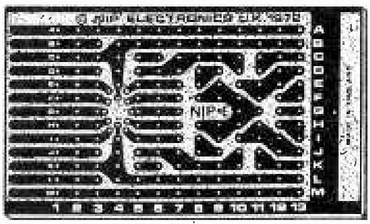


STANDARDISED P.C.B. FOR TRANSISTORS

procedures and photographic image transference have been done for the constructor. All the user needs to do is apply the standardised pattern to his circuit and assemble the components. Connectors are available as part of the Nip-E-System for single row and double row pattern arrangements of discrete or integrated circuits or both.

With the boards you get a choice of ready-made paper base laminate or epoxy glass fibre board 1/16in. (1·58mm.), a hole matrix 0·1in. (2·54mm.)×0·15in. (3·81mm.) and a choice of drilled or undrilled boards. A choice of board for discrete components only or a mixture of integrated circuits and discrete components is available and there is a choice of board size to take up to about

P.C.B. FOR I.C.



26 transistors (possibly more) in the 11E to 18E series or up to eight integrated circuits plus 16 transistors in the 21E to 28E series.

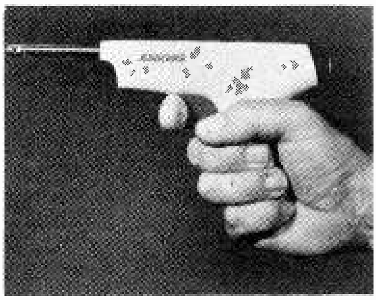
Constructors can have plug-in contacts for 14-way or 30-way gold-plated edge connectors (as supplied) for single row or double row boards, contact pitch 0·1in. (2·54mm.).

The customer choses the size most suitable to his application and the Company supplies a ready-made Nip-E-Board.

The boards are reasonably priced and they certainly help to make construction much easier and far neater.

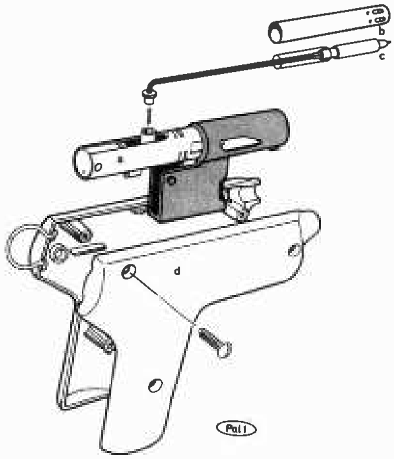
If you would like further details of prices, accessories and layouts, drop a line to *NIP Electronics, P.O. Box 11, St. Albans, Herts.* They will be pleased to send readers their comprehensive free booklet on the Nip-E-System.

Gas igniter



No. it's not a device for "doing-in" Editors—it's a piezo electric gas igniter! It's guaranteed for ten years, does not need any batteries or flints, you don't have to plug it in the mains or hold it under a hot tap! While you pause for breath, we'll explain:

The device, made in Germany by Junkers, operates on the principle that if a sudden force is applied to the interfaces of various crystals, an electric charge results. In practice, when the trigger on this igniter is pressed, it releases a "firing" pin which deforms the piezo crystal and causes a discharge voltage in the region of 20kV to appear at the end of the pistol "barrel". The end of the barrel is designed like a car



sparking plug so that the spark (of 50μS duration) jumps from the centre electrode to the barrel wall thus igniting the gas it is held near.

In the sketch (a) is the crystal mounting and housing unit. (b) and (c) are the points the spark jumps from and (d) is the plastic housing of the complete unit.

The Junkers Piezo Electric Gas Igniter is priced at £2·25 plus 15p postage and packing and may be obtained from *Servitronix Limited, 572 Kingston Road, Raynes Park, London, S.W.20.*

Anyone help?

Our squadron has recently started a radio section, and all projects are of a self help basis, thus you may understand that supplies and money are very limited. The boys' ages vary from 13 years to 16 years.

I would be most obliged if through your column, I might request any radio hams etc who have surplus to requirements any books, components or radio equipment, to contact us.

All expenses for postage and packing would be refunded, and all communications acknowledged.

Please address all letters, parcels, etc. to:—*Mr. G. H. Barker, "Training Officer", 2380, A.T.C. Dartmouth Sqdrn., "The Lodge", Longcross Cemetery, Townstal Road, Dartmouth, South Devon.*

NEWS... NEWS... NEWS...

BI-PRE-PAK LTD.
Due to a printer's error in our August issue an incorrect price was quoted for the Complete Telephone as offered for sale by the above Company. The correct price should have read 95p. We offer our apologies to BI-PRE-PAK LTD. and to any readers who may have been inconvenienced by this error.

Decoder

Motorola Semiconductors have announced the type MC1310 monolithic f.m. broadcast receiver stereo decoder which requires no external tuning inductors. Stereo channel separation is stated to be 40dB at 1kHz, with 0·3% total harmonic distortion.

Dymo Star 1710

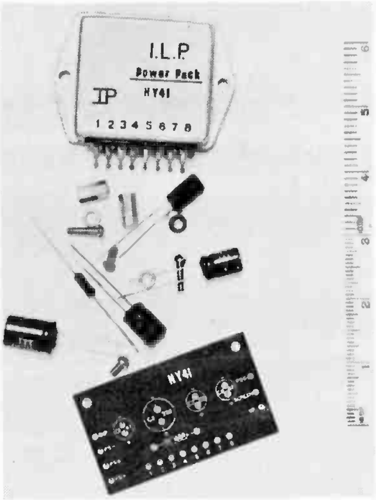
We recently had the opportunity to try out the Dymo Star 1710 labelling machine. This machine is ideal for stamping out the wording for the front panels of equipment.

Letter selection is made by turning the dial wheel until the required character appears in the letter slot.

Technical symbol and character wheels may be fitted to this machine quite simply and different colour tapes are available.

Full instructions are provided with each Dymo Star.

IC power amp



The HY41 is a linear integrated circuit, power amplifier with an output of 20 Watts r.m.s. into 4-16Ω having a total harmonic distortion of less than 0·15% (typical 0·05%) at 1kHz into 8 ohms.

P.C. board, resistor, capacitors, hardware mountings and comprehensive manual are all included in the basic kit, no further components being required in constructing a complete power amplifier of high performance.

Internally the HY41 is based on proven circuit techniques developed over recent years and is sufficiently versatile to provide power not only for Hi-Fi but for public address systems and industry.

Supplied by the Canterbury Company I.L.P. (Electronics) Ltd., the HY41 requires no adjustment whatsoever and can be assembled without recourse to sophisticated measuring equipment or electronics know how. *I.L.P. (Electronics) Ltd., Crossland House, Nackington, Canterbury, Kent.*

Rover-point

Nettle Accessories Limited, a member of the Aerialite Group of Companies, announce the introduction of a portable extension lead to their range of electrical accessories, known as the "Rover-point".

It consists of a 15 metre length of white 0·65 sq. mm. 3 core, P.V.C. cable, contained in a moulded plastic reel. A flush 13A socket is incorporated into the reel, and the cable is supplied complete with 13A plug.

The reel has a handle that can be utilised for carrying or hanging, and its rotating section is provided with two projections to facilitate easy rewinding.

Suitable for feeding loads of up to 1kW, with the cable fully extended and 500W with the cable coiled on the reel, "Roverpoint" sells at a recommended retail price of £3·99. *Nettle Accessories Limited, Warren Street, Stockport, Cheshire.*

Sonex 73

Sonex 73, the high fidelity equipment exhibition organised by British Audio Promotions, will be held at the Excelsior Hotel, London, from March 30 to April 1.

Erie catalogue

Erie Electronics have published a new comprehensive catalogue of their electronic components. It covers all product ranges, and catalogue contains specifications on all Erie distributor sales, Erie Electronics and Erie Controls products, as well as information on Erie thick film devices and Toshiba semiconductors. Copies are available from Erie Electronics Ltd., South Denes, Great Yarmouth, Norfolk.

Chadacre Electronics

Please note their new address: 63 Stratford Broadway, London, E.15. Telephone 01-534 1207.

PRINCIPLES OF propagation

HENRY HATCH

DESPITE the use of high power transmitters, used in conjunction with aerial systems of considerable gain and directivity, as well as extremely sensitive receiver techniques to accomplish a high standard of world-wide h.f. communication, the final merit of reception is controlled by many natural causes and variations.

The Pioneers

The medium through which a radio wave must propagate, termed the *Ionosphere*, determines this final pattern of reception including field strength, fading and even "black outs." The early pioneers were well aware of the electro-magnetic wave with its effects though proof of its vast potential only came when Guglielmo Marconi established contact between Bournemouth and the Isle of Wight in 1898. This was followed by an even greater breakthrough in 1901 when he transmitted the first telegraph signal from Poldhu, Cornwall to be intercepted at St. Johns, Newfoundland.

Research in this field by many workers revealed great discoveries. The name of mathematician Oliver Heaviside in England, who propounded the existence of a *Conducting Layer* in the upper atmosphere in 1892, as well as the work carried out by Kennelly in the U.S.A. as early as 1902 can never escape mention. Sir E. V. Appleton and M. A. F. Barnett, who determined the position of the *Heaviside Layer* in 1925 are also great names that we associate with early radio experiments.

The many effects acting in different ways on radio signals during their passage from transmitter to receiver is indeed a great scientific subject—yet perhaps to the majority of readers the fascination lies in the fact that, even by using only simple equipment, signals may be intercepted from the other side of the world.

Sun and Atmosphere

Let us consider how transmission of this kind is possible. A mode of propagation of this kind requires two essential and indispensible components, the atmosphere and the sun. The atmosphere, forming a gaseous envelope surrounding our planet, consists mainly of two gases, nitrogen and oxygen. This atmosphere is subjected to the full exposure and effect of the sun's rays, not only those of heat and visible light but of other radiations, including ultra-violet, gamma and X-rays, all bombarding our atmosphere after a journey of some 93 million miles. The effect of these rays falling on our atmosphere permits long distance radio communication.

The Solar Cycle

The difference in the amount of sunlight falling on the atmosphere will show considerable variations when we consider the changes from day to night, the four seasons of the year and the eleven year cycle of the sun's regular variation. This solar cycle appears to follow an average change of 11·4 years; from one of minimum activity to maximum in 4 years and falling from maximum to the next minimum in 7 years. (The last maximum occurred in 1968 and present predictions are estimating the next minimum will occur in 1975). Differences of this kind affect the conditions of the atmosphere and as a result have considerable influence on the propagation of radio waves. The solar radiations affect the atmosphere and cause it to assume a "mirror-like" reflecting surface which return radio waves to earth.

Ionization

The radiation from the sun unsettles and excites the normal arrangements of the atoms and molecules of gas. This brings about a condition known as *Ionization*; the atoms of gas become incomplete, having lost some of their electrons.

The region of ionization will, therefore, consist partly of free electrons and this process will continue so long as the earth's rotation permits that region of the atmosphere to be exposed to the sun.

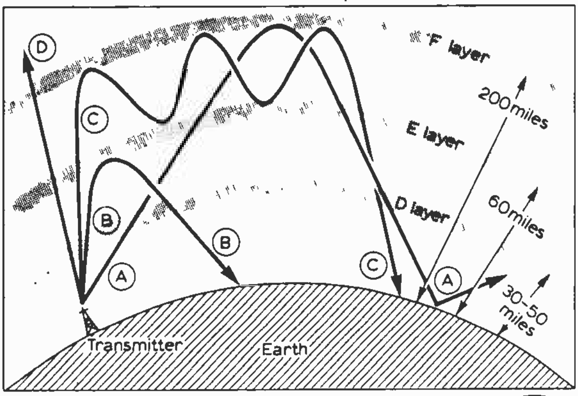
After sunset this process ceases and the free electrons rejoin their "mother" atoms, a process known as recombination, and this region will fall in ionized density. The ionized region is called a *Layer* and is able to reflect the wave back to earth though it must be remembered that radio (like light waves) travel only in straight lines. To make use of this reflecting property the transmitted signal must be beamed in a skyward direction, as well as towards that part of the earth where it is to be heard. For long distance communication the radiated signal must leave the earth at a low angle so that the first encounter with the ionosphere will be as far away as possible. In the same way a signal with a high angle of elevation will reach the layer at a much closer distance and may be regarded as being more suitable for reception in a nearby area.

Bending

It should be mentioned at this stage that the rays of the sun will be first absorbed by the upper part of the atmosphere so that the overall density of the layer will show some variation. The radio signal coming up from the earth's surface will first enter an area of comparatively low density but as it enters deeper into the ionized region it will encounter an area of greater free electron density. The wave will meet an adverse force, presenting some opposition to its progress. It is convenient to think of the radio wave behaving in a similar way to light when considering how it is turned in the ionosphere to be returned to earth (both travelling at a speed of 186,000 miles per second).

Hop and Skip

The word *Refraction* or *Deflection* explains this particular point in that a ray is changed in its course after entering a medium differing in density from one through which it has already passed. In this way the wave will be turned away from its original path and, providing the density of the medium and the frequency of the vibration are suitable, a point will be reached where the wave will be turned from its original route so as to follow a parallel course with the layer. Eventually it will be completely turned and leave the ionosphere at a similar angle as that of entry. The wave will return to earth having accomplished its first *Hop*—leaving a *Skip* distance between the sending and receiving points suggesting an area of silence existing between them. This is not so because the width of the transmitting beam will usually cover a considerable angle and the random scatter of the downcoming wave due to irregularities of the ionosphere tends to fill in this void. The second hop is made possible by an



Representation of the various methods by which radio waves are propagated. The main layers (D, E and F) are shown with their approximate heights above the earth's surface; the F layer is shown simplified —see text. The wave A is the normal long hop transmission; further reflection may take place when it meets the earth's surface. For reception in nearby areas the signal is beamed at a higher angle and is reflected by the E Layer.

C shows a form of propagation that is thought to occur at times. A number of reflections take place between the upper layers before the signal is returned to earth. If the angle of radiation is too high (and the frequency unsuitable) the waves will be lost in space as shown by D.

upward reflection from the earth's surface but the effectiveness of this is somewhat variable. It will depend upon the texture of the particular area of the earth's surface. Sea water is excellent, next comes pastoral land, while at the lower end of the scale desert areas may be regarded as poor; all have different conduction values. There is no rigid limit as to how many hops may take place since these are governed by the height of the layer at the time of transmission, the radiation pattern given by the aerial and the distance to be covered as well as the original transmitted power.

Some idea of a professional mode of transmission may help to make this point clear; the path from the United Kingdom to India needs three such hops and that to Australia six or seven. It will now be clear that although the wave will follow only a straight line, the curvature of the earth has been overcome by each individual hop although so far the ionosphere has been considered as one reflecting region. This is not so and it does in fact consist of several parts, each playing a different role and each one having a profound effect upon the wave.

D Layer

The basic structure of the ionosphere starts with that area known as the *D layer,* situated between 30 and 50 miles above the earth; this becomes very dense by day but falls to a very low level—almost non existent—at night. During the hours of daylight it will cause considerable attenuation of the signal due to absorption, particularly to the lower frequencies. This effect is well known to the medium wave DXer as long distance reception on this band is virtually confined to the 'locals' until after sunset when the D Layer will begin to fail.

E Layer

The *E Layer* (sometimes known as the *Kennelly-Heaviside Layer*) lies about 60 miles above the earth and although not the most important part of the ionosphere, it is responsible for the reflection of both medium and short waves.

A particular development of the E region, which at times can produce really sensational forms of propagation, is that known as *Sporadic E*. As the term implies this condition is irregular and cannot be forecast with any accuracy. An increase in ionization takes place usually around noon in our latitude. These abnormal conditions permit the reflection of very high frequencies and even enable TV signals to be observed from distant stations.

F Layer

The topmost layer is that known as the *Appleton* or *F Layer*. The height varies from about 200 miles upwards and ionization is mainly confined to nitrogen as at this height oxygen becomes rare. The F Layer is frequently considered as the most important. It becomes divided into two parts during daylight, the upper part designated as F_2 and the lower portion F_1. After sunset, and prior to dawn, it assumes the form of only one layer.

Frequency Choice

Having examined the structural and reflecting arrangements which affect the wave, let us now consider how these various parts are put to practical use. Most of us are aware of the general rule that high frequencies are most useful by day and the lower ones give the best performance by night, although the exact choice of frequency used is critical if reception is to be of a standard worthy of being termed a service. Indeed, numerous observations are needed to formulate the vast number of short wave schedules published in advance which have to take into account the many factors already mentioned.

Ionosphere Sounding

Such information is compiled by "sounding" the ionosphere. A radio wave with an adjustable frequency is sent vertically upwards to a layer so that it is able to engage it at right-angles and then the

Radio Propagation Characteristics

Frequency	Day	Night
A. 100kHz–400kHz	Reception very dependent on power of station. Reliable reception possible at distances of 1000 miles or more.	
B. 400 kHz–1·5MHz	Ground wave reception only, usually no more than 200 miles but certain winter conditions can increase this to 1000 miles.	'Skip' takes place and reception of stations up to 1000 miles is common with not infrequent reception of stations at much greater distances.
C. 1·5MHz–3MHz	Similar to B but distant reception more common.	Varies with conditions but similar to, and usually better than, B.
D. 3MHz–8MHz	Similar to C but distant stations much easier and more reliable. Distances of several thousand miles especially at night.	
E. 8MHz–15MHz	Generally the best frequencies for DX but ground wave absorption limits local reception.	Often good for long distance reception but depends on conditions and time of year.
F. 15MHz–25MHz	As for E but DX, although often better, is more dependent on conditions.	Usually poor for long distance reception but dependent on time of year and conditions.
G. 25MHz–45MHz	Highly dependent on conditions—sometimes excellent DX is possible but more often unsuitable.	Local reception only.
H. 45MHz–120MHz	Local reception except for occasional 'freak' conditions, usually associated with high pressure areas—when stations several hundreds of miles away can be received.	
I. 120MHz–250MHz	As for H but freak conditions much less common.	
J. 250MHz–1GHz	Local reception only—rarely more than 30 miles. Signals absorbed very easily. Very occasional freak conditions give reception of stations at a few hundred miles.	

frequency is adjusted so that it can be observed to either penetrate the ionosphere or be reflected back to earth. When this frequency is found—the highest limit to which the frequency can be raised and retain its reflection—it is known as the *Critical Frequency.*

Having obtained this frequency it may be increased up to three or even five times, provided the wave is radiated in such a manner and angle that it will meet the layer at a slanting or oblique angle. Such arrangements may appear straightforward but in the case of a multi-hop circuit—perhaps one crossing the equator or a dusk and night period—the requirements become complex, requiring many calculations and even some compromises to meet the variations over the path. The wave for reflection from the F Layer will, even during its first hop, need to be strong enough not only for reflection but to overcome losses through absorption when it passes through the D and E regions. It will, in fact, have to pass through these lower layers on two occasions even during its first hop.

S.I.D.

We often hear on the amateur bands comments such as "Conditions aren't too good today". Such remarks refer to changes in propagation which can broadly be placed in two categories, one type of disturbance is referred to as a *Dellinger* or *SID* (*Sudden Ionospheric Disturbance*). This is often of a sensational effect happening in a very short time—so suddenly that the receiving equipment is often suspected. The effect is brought about by solar action which causes an overwhelming ionization of the D Layer leading to almost complete absorption.

The lower frequency end of the shortwave band is most affected and signals in this part may even become inaudible. The higher frequencies are less affected and will be the last to suffer losses and the first to return to normal. The duration of such disturbance is usually short lived.

When the face of the sun looking towards the earth is subjected to an eruption, solar flare (often called a sun spot) this brings about the emission of numerous kinds of radiation. These vary in their intensity but when of a great magnitude, may persist for a long period. For these reasons this kind of unsettled condition may reoccur with a complete rotation of the sun in approximately 28 days. The *Dellinger* or *SID* will normally only effect that side of the earth facing the sun.

Ionospheric Disturbance

A more prolonged type of disturbance known as an *Ionospheric Disturbance*—or *Storm*—may also be associated with solar conditions and often occurs some 30 hours after observation of changes on the surface of the sun. The general merit of reception falls considerably with deep and sometimes rapid flutter fading due to a lower and variable density of the F Layer.

Having described such adverse conditions, the reader may begin to wonder how a wave survives for so many thousands of miles, and especally as variations in the signal strength may be as much as 1000 to 1, yet so much in modern receiver design is included to bring these variations to a stable and acceptable listening quality. The information given in the chart headed "Radio Propagation Characteristics" should be of value in helping to choose the correct wave bands.

Reception Reports

Considering the complexities and variations in propagation it is not surprising that all broadcasting organisations giving a service in the international broadcasting bands welcome accurate reception reports from listeners.

Considerable sums of money are spent each year to inform the listener of recommended frequencies and times of operation. Even after a schedule is published, the broadcaster is still in need of accurate information regarding the level of interference, as the shortwave bands are so congested—a situation which will become worse as we move to solar minimum conditions and the higher frequency bands become less useful.

Medium Waves

Most of these remarks have concerned the short waves or high frequencies as these are the ones most used for long distance reception. However, reception of distant stations is also possible in the medium wave band (525-1605kHz). MW Dxing is made especially difficult due to the large number of high powered stations operating in Europe. This wave band is basically designed for local reception and there are far fewer opportunities for long distance listening, even after midnight. Owing to so many broadcasters extending their hours of broadcasting such services frequently include an aerial system designed to avoid the sky wave and emphasise the ground wave. This reduces after dark interference and at the same time permits an economy by the sharing of frequencies. Listening to stations operating in the MW band is in any case confined to the hours of darkness if reception from a great distance is the aim. After dark these frequencies are reflected by the E Layer; the D Layer at night being almost non-existent. There are cases, however, when frequencies approaching 2MHz find reflection from the F Layer, having penetrated the E region.

Other Bands

Other bands are subjected to other influences; remarkable reception due to tropospheric propagation in the VHF and UHF bands occurs occasionally. An outstanding example of the abnormal mode of propagation is that in earlier sunspot maximum periods, BBC Television pictures have been resolved as far away as the West Indies and South Africa.

Many listeners appear to associate bad weather, such as rain and fog, with either good or bad reception but there is no real evidence to substantiate this, at least not as far as the medium and shortwave bands are concerned. As the frequency is increased towards the microwave portion of the spectrum, that above 1000MHz, these and other factors have to be taken into account.

At a recent press conference given by the GPO Telecommunications Department, many interesting facts were disclosed concerning the adverse effects of rainfall over even short path transmissions on these channels. ■

your PRACTICAL AERIAL DATA WALL CHART

WE expect rather a lot of our receivers don't we? In the early days of radio most homes sported a beautiful long wire aerial but with the tremendous improvement in receiver design and the vastly improved sensitivity we seem to have forgotten just how important a decent aerial is. Some receivers now being marketed claim that the silly little telescopic aerial which is an integral part of the set is all that is needed—rubbish!

For good DX results three things are needed, all of about equal importance: the receiver, the skill of the listener and the aerial. The receiver will cost quite a bit of money and the skill can only be learned with time; on the other hand an aerial will cost very little—wire isn't all that expensive after all—and the erection will take only a few hours.

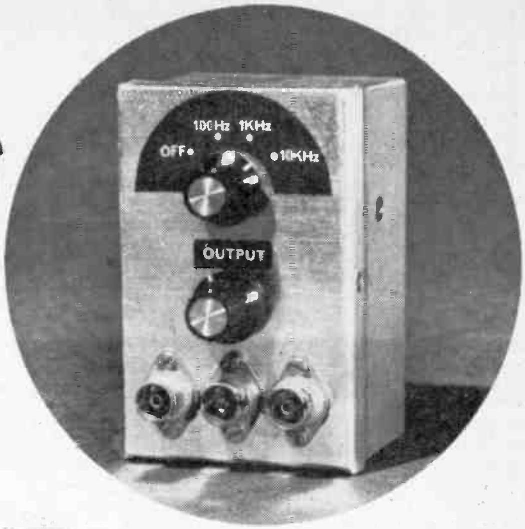
The type of wire is far from critical. Hard drawn copper is possibly the best, it doesn't stretch, but it is expensive. One of the best, and cheapest forms is aluminium garden binding wire. 250ft. reels cost only about 30p.

Ex-Government aerial wire is still available on the surplus market and this is excellent; it is usually made up from one strand of copper surrounded by steel wires for strength.

On the Wall Chart we have tried to deal with *practical* types; it is all very well to read about wonderful professional arrays but few of us have the room or the money to pay for the tall masts required. Instead we have dealt with the types that readers are likely to have space for. Even if you live in a small flat you will usually be able to find room for a pretty good Whip Type, or even an Inverted L.

The chart deals with aerials but of course any signals induced into them will only be with respect to earth and a good earth should be used. One always used to see comments such as ". . . the earth wire can be taken to a cold water pipe . . ." but in these days of plastic plumbing this will not always work. A good earth can be made by soldering a wire to a piece of copper clad board—such as is used for making printed circuits; this should be buried as deep in the ground as can be managed and a bucket of water should then be poured over it to make the earth resettle around it. The size of the board is not critical but the larger the better. The wire from this earth to the receiver should be of very low resistance and as short as possible. ■

AUDIO reference source



E. BUCKLAND

NO one would deny that a full-range, full-facility audio signal generator is not useful. The author has a good one (built from a design published in *Practical Wireless* some years ago) and it is continually in use for designing, testing and trouble shooting but only a few of the facilities account for 95 per cent of the usefulness. Most of the time the frequency is left on 1kHz and only the calibrated output is used. When the frequency is varied it is nearly always at the spot frequencies of 100Hz, 1kHz and 10kHz. Nearly all signal generators have a switch to give either a sine-wave or square-wave output. This is frequently used but it is rare that the type of wave-form matters very much. Where it does matter, it is nearly always the square-wave that is required.

The main signal generator was found to be so useful that the author decided on building another, this time to be battery operated for portability. Bearing in mind the points made above it was also decided to make a far simpler and less expensive version, incorporating only the most useful facilities.

This unit gives a constant square-wave output—irrespective of battery voltage and other factors—at three spot frequencies: 100Hz, 1kHz and 10kHz. The output is continuously variable over a wide range. To simplify the switching, the on-off switch is incorporated with the frequency selector and the decade outputs are provided from separate output sockets.

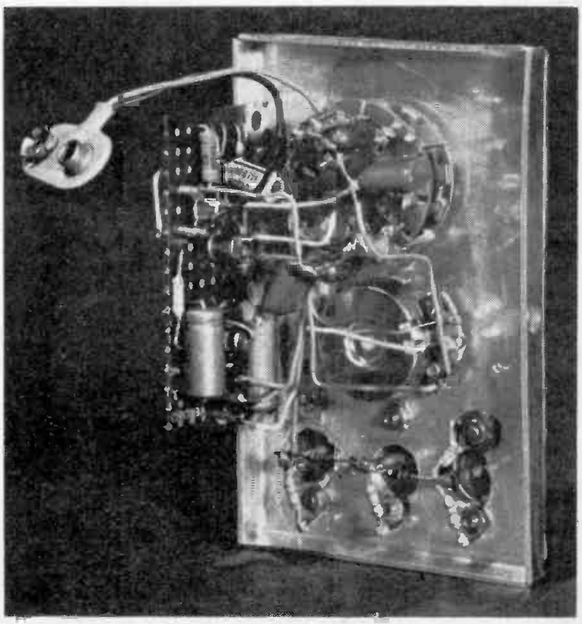
The complete unit is very small, fitting nicely into a small aluminium box, 4in. x 2$\frac{1}{2}$in. x 2in. and the total cost is only a fraction of that for a full facility audio signal generator.

This makes an excellent "back-up" unit but even by itself it should be useful for those without an a.f. signal generator.

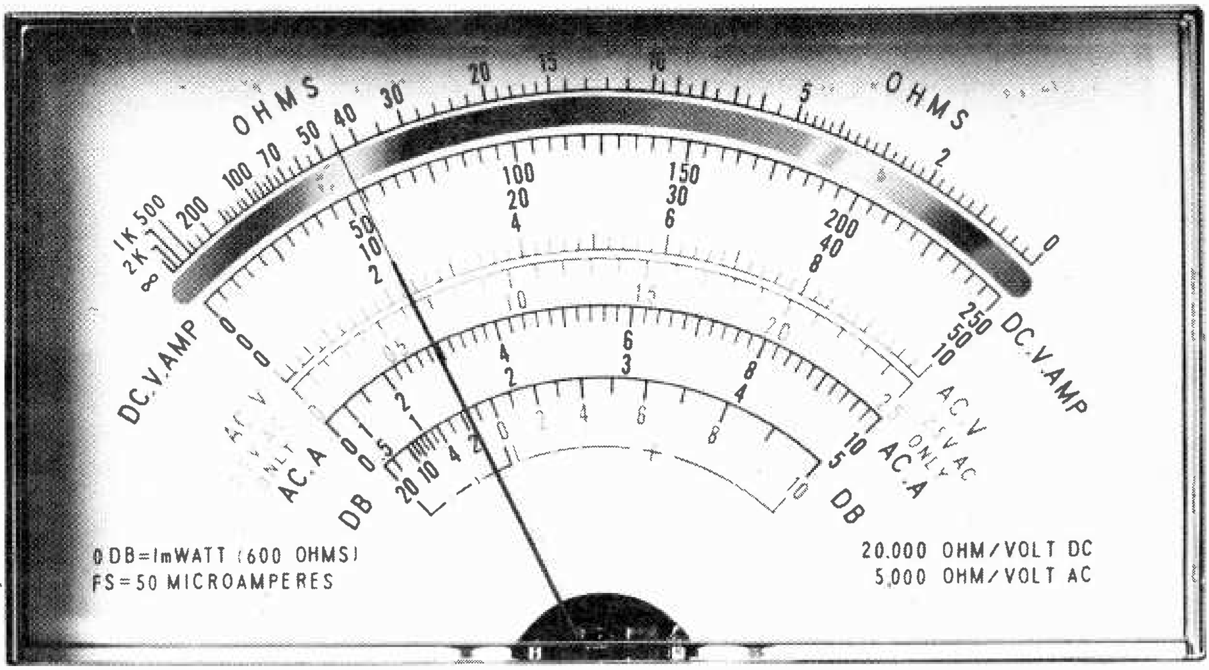
THE CIRCUIT

The signal oscillator is a basic multivibrator, made up from Tr1 and Tr2. Both halves of this are identical, with similar base bias resistors and the same collector load, although for Tr2 this is a variable potentiometer and not a fixed resistor as that for Tr1. The values of the coupling capacitors are altered by the main switch, SW1, and one of three capacitors can be selected. This balance in the two sections ensures a square wave output with a 1:1 mark space ratio, not vital but easy to incorporate and occasionally useful. The values of the bias resistors etc., ensure that the transistors are driven on hard when they are turned on, this ensures that the output will be constant.

The output is taken from the collector load of Tr2, the slider of VR1 is connected via C2 to the base of the emitter-follower Tr3. The high value of C2 is deliberate, this will ensure no degradation of the tops and bottoms of the square wave at 100Hz. Tr3 was found necessary to isolate the output from the



Internal view of the prototype.



You can see why we sell a lot of multimeters.

Ours are so much easier to read.

The Eagle K1400, for instance, has a big open face and a beautifully laid-out mirror scale.

Decibels and AC Voltage are picked out in red, and the others in black. Which makes it all crystal clear.

The K1400 is easier to use, too. There are two knobs: the left for functions, the right for range limits.

Again, you can't go wrong. Everything's clearly marked, including the 'Off' position which protects the meter movement against knocks and bangs.

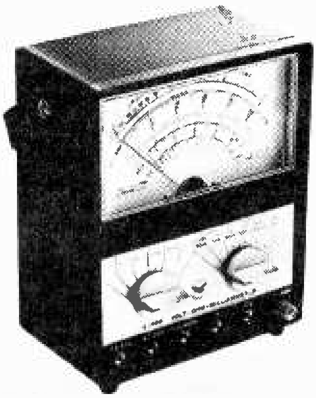
And, of course, Eagle's exclusive overload protection circuit is built in.

All Eagle test equipment is like this. Simple to use. Reliable. Backed by a full two year guarantee.

And like H.W. Hellyer, one of the country's leading technical experts said, "Not by any means expensive: it is well worth what it costs."*

If you send us the coupon, we'll send you our catalogue.

*R.E.R.-September, 1971.



SPECIFICATION Ranges -K1400

D.C. Volts: 0-0.25, 1, 2.5, 10, 50, 250, 1,000 and 5,000 volts.
Input resistance: 20,000 ohms/volt.
Accuracy: better than ±3% full scale.
A.C. Volts: 0-5,000 volts in six ranges, steps similar to above.
Input resistance: 5,000 ohms/volt.
Accuracy: better than ±4% full scale.
D.C. Amps: 0-50 microamps, 1 mA, 10, 100, 500mA and 10 amps.
Accuracy: better than ±3% full scale.
A.C. Amps: 0-10A in 4 ranges, steps as before.
Accuracy: better than ±4% full scale.
Resistance: 0-20M ohms in 3 ranges.
Accuracy: better than ±3% of scale length.
Decibel scale: −20 to +50dB.
Standard level: 0dB = 1mW, 600 ohms load.
Frequency Response: 10-100,000 Hz for 2.5V, 10V and 50V ±0.5dB.
Size: $6\frac{3}{8}$ x 8 x $3\frac{5}{8}$ in. **Weight:** $3\frac{3}{4}$ lb.
Rec. Retail Price: £28.00

Eagle International®

Eagle International Precision Centre Heather Park Drive
Wembley HA0 1SU Telephone 01-903 0144

Please send me your catalogue with full details of Eagle multimeters and other test equipment.

Name ____________________

Address ____________________

____

____

____________________ PW1

NEW FROM SAXON............

STANDARD & CUSTOM-BUILT SOUND EQUIPMENT — MUSICAL INSTRUMENTS, NEW & SECOND-HAND

THREE LOW-PRICED AUDIO MODULES — 100W — 35W — 25W (all rms ratings)

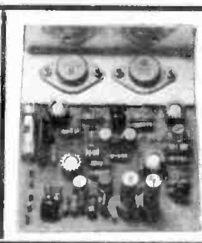
SA100 £10·90 carr. free
16 transistors—6 diodes
4½" x 4" x 1"

SA35 £4·45 carr. free
8 transistors—2 diodes
4" x 3" x 1"

SA25 £2·95 carr. free
8 transistors—2 diodes
4" x 3" x 1"

COMPLETELY BUILT AND TESTED — SATISFACTION GUARANTEED

Employing the latest silicon devices these three modules excel in the field of low-cost high quality audio. All three modules are short and open circuit proof and the 100 watt module has further protection against overheating and faulty inductive loads. All modules may be used with a wide range of supply voltages and loads.
ONLY ADVANCED DESIGN TECHNIQUES MAKE THESE EXTRAORDINARILY LOW PRICES POSSIBLE.



BRIEF SPEC. FOR ALL THREE MODULES

Response	15 – 40,000 Hz ± 1 dB
Distortion	0·2% @ 1 kHz
Loads	4 – 8 – 16 ohms
Quiescent current	15 mA
Noise	Better than – 75 dB
Supply voltage	25-45 volts SA25/35 40-70 volts SA100

ALL MODULES ARE CONSTRUCTED ON GLASS FIBRE P.C. BOARD

STABILIZED SUPPLIES

PS45—supplies **two** SA25 or **two** SA35. Fully assembled and tested, **£2·85.** MT45 to suit the above module **£2·85.** Carr. PS45 free, MT45 20p.

SPECIAL OFFER. Complete power supply if purchased with either two SA25 or two SA35, only **£5·00.**

PS70—Complete supply for two SA100's including mains transformer for music use, **£7·75.** Carr. 45p.

SOUND to LIGHT CONVERTER

This single channel light unit is the ideal low-priced addition to the D.J.'s equipment. It will operate from the bass notes thus flashing lights up to 1000 watts in time with the music. Complete with control and attractive case—fully tested and guaranteed.

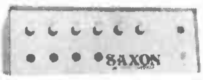
£8·90
Carr. Free

120 WATT MODULE for 8 ohm systems.
Rugged transformer driver stage.
£13·90 carr. 20p or with supply **£18·95** carr. 40p.

GOODMANS 12P
12" 50W 8/15Ω only **£10·90** carr. 30p
Famous British 25W 12" loudspeaker only **£4·95** carr. 20p

CSE AMPLIFIER **£32** carr. free. 70W cont. R.M.S. 100W music. Two inputs, bass, treble. FULLY GUARANTEED.

SAXON 100 AMPLIFIER. FET inputs four channels 100 watts R.M.S. 8 ohms, **£48·50.** 50W version, **£37·75.**



ANOTHER SAXON PRICE BREAK-THROUGH !

STEREO CONTROL UNIT only £15·80 Carr. Free

MONO VERSION with P.F.L. still available at £6·50, carr. 20p
SATISFACTION GUARANTEED

A UNIT TO SATISFY ALL THE NEEDS OF A HIGH QUALITY DISCOTHEQUE
LOOK AT THESE FEATURES
★ Left/right fader, treble and bass controls for decks.
★ Microphone input with own volume, treble and bass controls.
★ Headphone monitoring (P.F.L.) with 100mW undistorted output.
★ Master volume control—output levels up to 1 volt.
★ Suitable with all power amplifiers or with the SAXON SA series of amplifier modules.

★ Built-in mains operated power supply, or may be battery operated.
★ 20–25,000Hz response.
★ −65dB noise level.
★ Accepts all ceramic cartridges.
★ 26dB tonal variation.
★ Smart black panel.
(Illustration shows Mono Unit only)

S.A.E. WITH ALL ENQUIRIES PLEASE — TELEPHONE ORDERS & EXPORT ENQUIRIES WELCOME

CALLERS AND MAIL ORDER:
327-331 Whitehorse Road,
West Croydon CR0 2HS. 01-684 6385

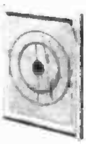
SAXON ENTERTAINMENTS

CALLERS ONLY:
6a Delce Road, Rochester, Kent.
Medway 44203

---

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–20 KHz **Sensitivity:** 85 dB/M for 1 watt electrical input. **Input impedance:** 8 ohms. **Operating temperature range:** —20°F to +175°F. **Size (WxDxL):** 1·7/16" x 11·3/4" x 14·11/16". **Weight:** 19 ounces.

£6·50 each Stereo pair £12·50
post free

web europa

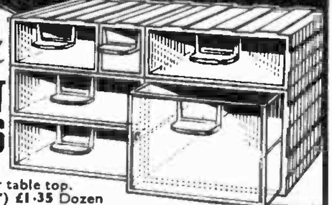
P.O. Box 162, Watford WD1 1AA

I-N-T-E-R-L-O-C-K-I-N-G PLASTIC STORAGE DRAWERS

Newest, neatest system ever devised for storing small parts and components: resistors, capacitors, diodes, transistors, etc. Rigid plastic units, interlock together in vertical and horizontal combinations. Transparent plastic drawers have label slots / removable space dividers. Build up any size cabinet for wall, bench or table top.

NEAT! HANDY! TIDY!

DISCOUNT PRICES



SINGLE UNITS (5"×2¼"×2¼") **£1·35** Dozen
DOUBLE UNITS £2·25 Dozen
TREBLE (3D) **£2·35** for 8
DOUBLE TREBLE 2 draws in one outer case (6D2) **£3·65** for 8 extra large size (6D1) **£3·30** for 8.

5 SIZES ALL INTERLOCK

PLUS QUANTITY DISCOUNTS! Order £5 and over Deduct 5% in the £. Order £10 and over Deduct 7½% in the £. Order £20 and over Deduct 10% in the £. Pack./Post./Carr.: Add 35p to all orders under £5. Orders over £5 P/P/C free.

IVORYET LIMITED (Dept PW10) 124 CRICKLEWOOD BROADWAY, LONDON N.W.2

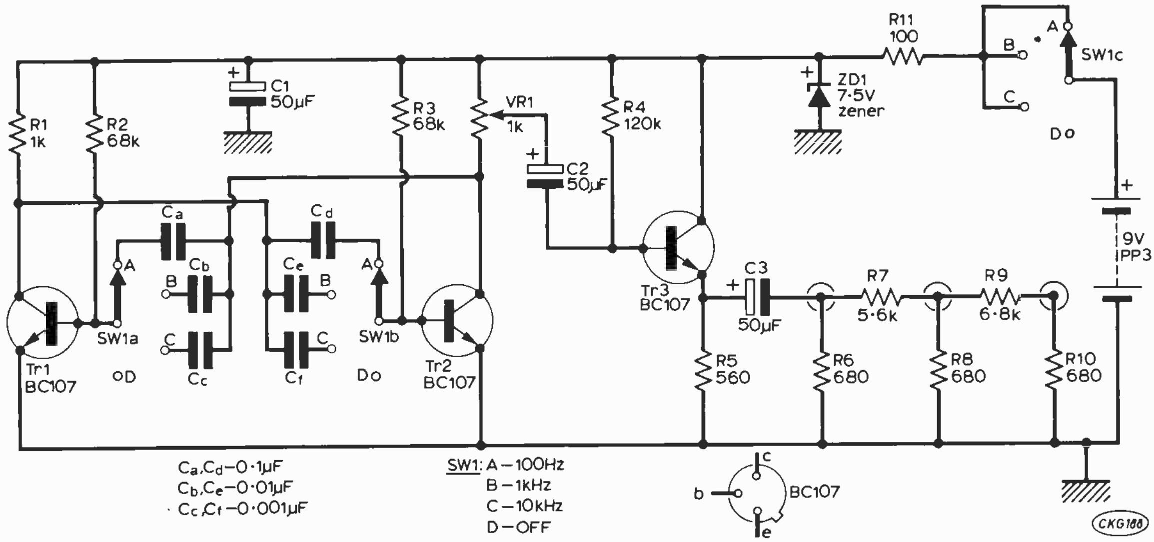


Fig. 1: Complete circuit of the Audio Reference Source.

multivibrator. As this stage contributes no gain it may be thought that the output network could be connected directly to the slider of VR1 but this would vary the load at the collector of Tr2 and affect the frequency and level. The inclusion of Tr3 makes certain that this interaction is minimal.

The output from the emitter of Tr3 is taken via the d.c. blocking capacitor C3 to a decade attenuator. At each of these output sockets the output is one tenth that of the previous one.

Because of the operation of a multivibrator, we can always be sure that the output will be constant, irrespective of frequency as long as the supply voltage is constant. This is done by including a zener diode with a rating of 7·5V in the positive supply line, the voltage drop taking place across the resistor R11. SW1 is a three-pole, four-way switch; three of the sections are used to alter the frequency of operation of the multivibrator, the fourth section acts as the on-off switch.

The whole circuit is very simple as can be seen from Fig. 1. BC107 transistors are specified but BC108, BC109 or their plastic versions (BC168 and BC169) can also be used, as can a 2N2926. None of these changes will affect the constant output which is controlled by the supply voltage and nothing else.

VR1 should of course be a linear control and the associated knob can be calibrated if required.

The capacitors in the multivibrator may not give the exact frequency specified, this will depend on their tolerance, but it should be close enough for all practical purposes.

The unit takes only a small current and this is adequately provided for by a PP3 battery.

★ components list

Resistors

R1	1kΩ	R7	5·6kΩ
R2	68kΩ	R8	680Ω
R3	68kΩ	R9	6·8kΩ
R4	120kΩ	R10	680Ω
R5	560Ω	R11	100Ω
R6	680Ω		

All resistors ½W, 5 per cent types.
VR1 1kΩ linear pot., carbon track

Capacitors

C1	50μF 10V min.	Ca,Cd	0·1μF Mylar or ceramic
C2	50μF ,,	Cb,Ce	0·01μF ,, ,,
C3	50μF ,,	Cc,Cf	0·001μF ,, ,,

Semiconductors

Tr1	BC107 see text	Tr3	BC107 see text
Tr2	BC107 ,,	ZD1	7·5V, 50mW zener diode

Miscellaneous

SW1, three-pole, four-way rotary switch; 3 off coax sockets—see text; battery clip; Veroboard, 16 x 9 holes, 0·15in. matrix; small aluminium case with lid.

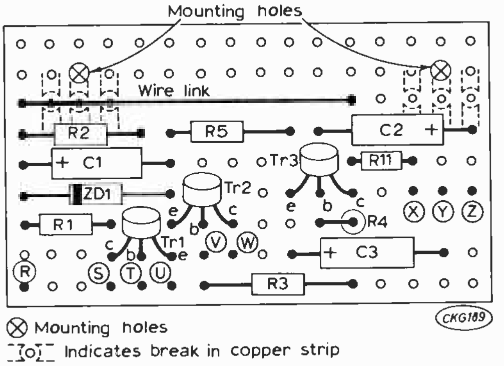


Fig. 2: The component layout on Veroboard. The only breaks in the copper strip are those near the mounting holes.

CONSTRUCTION

The component layout of such a unit is far from critical but that used in the prototype is both simple and neat. The majority of the components are mounted on a small piece of 0·15in. matrix Veroboard, 16 holes by 9 holes; this can be cut from a standard 2½in. width. The component layout is shown in Fig. 2. Various take-off points are letter coded R to Z to tie up with the main wiring diagram in Fig. 3.

No breaks are necessary in the copper conducting strip of the Veroboard other than those near the mounting screws. The battery negative is taken to the board by a wire running from a small solder tag which fits under one of these mounting screws.

The frequency determining capacitors are mounted directly onto the switch SW1, this can be seen from the photograph of the prototype.

The output sockets are mounted next to each other and the attenuating resistors are wired directly to these, the chassis connections being taken to solder tags under the mounting screws. Coax output sockets were used on the prototype mainly to continue standardisation in the author's test equipment but other types—such as phono sockets—can be used.

The component board is held onto the chassis by means of a short length of aluminium angle bracket.

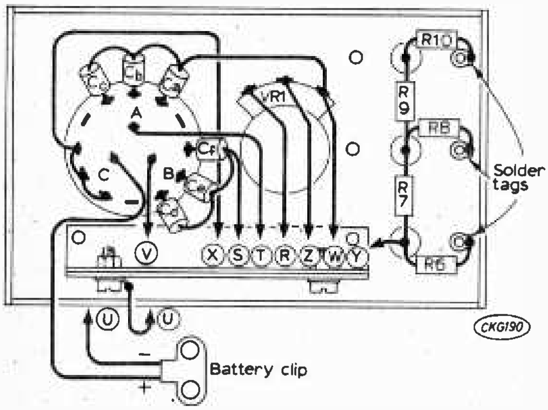


Fig. 3: The wiring diagram. The letters R-Z match up with those in Fig. 2.

CALIBRATION

It is not possible to say what the exact output will be for any particular version, this depends on the saturation of the individual transistors, but what can be said is that it will not vary with frequency or battery voltage. If a highly accurate output is required this is best measured on a 'scope. The output can also be reduced to a reference figure by wiring in an extra resistor between the collector of Tr2 and VR1. If the output is say 2V and the maximum output wanted is 1V then a 1kΩ resistor will be required. The output from the prototype is 1·8V and this level has been found sufficient. The output from the other decade outputs is 180mV and 18mV at maximum output. ■

BACK NUMBERS

We regret that the back numbers department of P.W. has now closed and consequently we are unable to supply these. Requests for specific back issues can usually be included in our 'CQ' section; there is no charge for this but it is a service between readers and P.W. is unable to meet any of these requests.

CHARLES MOLLOY

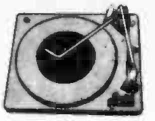
THE Medium Wave Column

NEWCOMERS to the medium waves are often surprised at the number of West African countries that can be heard on this band. La Voix de la Revolution located at Conakry in the Republic of Guinea, is a conspicuous signal on 1403kHz after 2300hrs GMT. Programming is African in style with announcements in French. The new high power broadcaster at Bissau, Portuguese Guinea can be logged on 1070kHz between 2300hrs and 0100hrs GMT with pop music, announcements and news being in Portuguese. From the Canary Islands, the high power Radio Nacional Espana outlet in Tenerife is a strong signal on 620kHz after 2300hrs. Programmes are in Spanish and there is interference at times from Batra in Egypt. Dakar, Senegal on 764kHz can be heard on weekdays with African music and French announcements after Sottons, Switzerland closes down. From the Republic of Zaire (Congo) the station at Kinshasa on 692kHz is on the air all night and is audible, with African programming after the East German station on this frequency signs-off, usually at 0100hrs GMT on weekdays. Radio Nigeria at Enugu is on 1320kHz until sign-off at 2300hrs GMT. Programmes are in English and can be found during the last half hour of transmission, as a weakish signal between the European channels 1313kHz and 1322kHz. Another English speaking broadcaster is occasionally heard on 629kHz. This is ELBC at Monrovia, Liberia which closes down at 0045hrs GMT and is usually logged towards the end of its transmission.

A new broadcaster in North Africa has appeared on the Long Waves. It is located in Algeria and is audible in the UK during the evening on 254kHz (1181m); a channel it shares with Lahti, Finland. Programmes are in French and reception reports, which are requested over the air, should be sent to Radio Television Algerienne, 21 Boulevard des Martyrs, Algiers, Algeria. This is the second North African to appear on the LWs in recent years: Azilal, Morocco is on 209kHz with programmes in Arabic and can be logged after dark with some interference from Kiev on the same channel. The range of long wave stations increases considerably at night—Europeans fade-in regularly along the eastern seaboard of North America after local sunset. Stations heard in the UK by the writer include Reykjavik, Iceland on 209kHz at 0100hrs GMT; Ashkhabad, Turkmenia on 200kHz after Droitwich signs-off; Ankara, Turkey 182kHz with sign-off at 1930hrs GMT; Baku, Azerbaijan on 218kHz at 0100hrs GMT; Novosibirsk 272kHz at 0130hrs and Omsk 394kHz at 1900hrs. In Europe, the long waves covers 151kHz to 282kHz but in Asiatic Russia the band extends to 400kHz. Regulars to be heard in the "hf" section are Orenburg 300kHz; Kharkov 384kHz and Minsk 400kHz.

Please send logs and information about the medium waves to the author at 132 Segars Lane, Southport PR8 3JG.

BSR LATEST SUPERSLIM
STEREO AND MONO



Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v. Size 13¼ × 11¼in. Above motor board 3¼in. below motor board 2¼in. with STEREO and MONO XTAL **£8·75** Post 25p.
MONO-COMPATIBLE Plays all records **£7·75** Post 25p.

RCS DE-LUXE 3 WATT AMPLIFIER. Ready made tested. Printed circuit. 3 watts output. Tone and volume controls. Complete with two knobs, output valve and rectifier and high performance loudspeaker. Double wound fully isolated mains transformer. A.C. Mains 200/250V. Response 50-12,000 cps. Sensitivity 200mV. **£4** Post 25p.

R.C.S. PORTABLE PLAYER CABINET
Really smart appearance with space for R.C.S. Amplifiers and most modern autochangers. Size 17 × 15 × 8in approx. Metal fittings. Carrying handle. Popular colours. Two-tone rexine covered. **£4** Post 25p.

GARRARD DISCO DECK
£10 Post Free

4 speeds. Plays all sizes of records. 4 pole heavy duty motor. 9in. steel turntable. Plug in head complete with stereo/mono cartridge. Adjustable stylus pressure. Autostop. Brown and Cream finish. AC mains 110/240V. Base plate size 12in. × 8in. Operating area 14in. × 12½in. Above motor board 3in., below motor board 2½in. Ideal for Home Hi-Fi or Discotheque.

GARRARD AUTOCHANGERS with Sonotone Cartridges Stereo Diamond and Mono Sapphire. Model 1025 £10. Model 3500 Stereo and Mono Autochanger £14. Post 25p.

BSR JUNIOR SINGLE PLAYER Turntable, 4-speed motor and separate pick-up **£4·50**

HI-FI PICK-UP CARTRIDGES. Diamond LP/Stereo Stereo/Mono 9TA £2·50; GP94 £2·50; GP93 £2·00; Sapphire Mono GP91 £1·50; Power-point LP/78. 60p.

E.M.I. WOOFER AND TWEETER KIT
£5·75 Post 25p

Comprising a fine example of a Woofer 10½ × 6½in. with a massive Ceramic Magnet, 44oz. Gauss 13,000 lines. Aluminium Cone centre to improve middle and top response. Also the E.M.I. Tweeter 3½in. square has a special lightweight paper cone and magnet flux 10,000 lines. Crossover condenser supplied.

Impedance Standard	8 ohms
Maximum Power	12 watts
Useful Response	35 to 13,000 cps
Base Resonance	45 cps

SUITABLE ENCLOSURE 20 × 13 × 9in, £9 POST 25p
MODERN TEAK DESIGN

WEYRAD P50—TRANSISTOR COILS

RA2W Ferrite Aerial	72p	Spare Cores	3p
Osc. P50/1AC	33p	Driver Trans. LFDT4	58p
I.F. P50/2CC 470 kc/s.	36p	Printed Circuit, PCA1	58p
3rd I.F. P50/3CC	36p	J.B. Tuning Gang	65p
P51/1 or P51/2	36p	Weyrad Booklet	10p
P50/3V	36p	OPT1	58p

Mullard Ferrite Rod 8 × ⅜in. 20p, 6 × ⅜in. 20p.

VOLUME CONTROLS
Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 15p. D.P. 25p. STEREO L/S 55p. D.P. 75p. Edge 5K. S.P. Transistor 25p

80ohm Coax 4p. yd.
BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. £1·40; 60 yd. £2.
FRINGE LOW LOSS Ideal 625 and colour. **10p yd.**

8in ELAC
HI-FI SPEAKERS

Dual cone plasticised roll surround. Large ceramic magnet. 50-16,000 cps. Bass resonance 55 cps. 8 ohm impedance. 10 watts music power. **£3·75**

BLANK ALUMINIUM CHASSIS 18 s.w.g. 2in. sides. 7 × 4in. 45p; 9 × 7in. 60p; 11 × 7in. 70p; 13 × 9in. 90p; 14 × 11in. 95p; 15 × 14in. 99p; 11 × 3in. 50p; 16 × 10in. £1
ALUMINIUM PANELS 18 s.w.g. 6 × 4in. 9p; 8 × 6in. 15p; 14 × 3in. 16p; 10 × 7in. 19p; 12 × 5in. 20p; 12 × 8in. 28p; 16 × 6in. 28p; 14 × 9in. 34p; 12 × 12in. 40p; 16 × 10in 50p.

1½ inch DIAMETER WAVE-CHANGE SWITCHES 25p. 2 p. 2-way, or 2 p. 6-way or 3 p. 4-way 25p each. 1 p. 12-way. or 4 p. 2-way, or 4 p. 3-way 25p.
TOGGLE SWITCHES, sp. 14p; dp. 18p; dp. dt. 23p.

"THE INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER

200/250v. A.C. Leaflet S.A.E. **£2·35** Post 15p

R.C.S. STABILISED POWER PACK KITS
All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifiers and Double Wound Mains Transformer input 200/240v. AC. Output voltages available 6 or 9 or 12 or 15 or 18 or 20v. DC at 100mA or less.
PLEASE STATE VOLTAGE REQUIRED. Details S.A.E. Size 3½ × 1½ × 1½in. **£2** POST FREE

GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER BRITISH MADE
Ideal for Mike, Tape, P.U., Guitar. Can be used with Battery 9-12v or H.T. line 200-300v D.C. operation. Size 1¾" x 1½" x ½". Response 25 c.p.s. to 25 Kc/s. 26db gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. **90p** Post 10p

NEW TUBULAR ELECTROLYTICS				CAN TYPES	
2/350V	14p	250/25V	14p	50+50/350V	35p
4/350V	14p	500/25V	20p	60+100/350V	58p
8/450V	14p	1000/25V	35p	32+32/350V	18p
16/450V	15p	1000/50V	47p	32+32/450V	33p
32/450V	20p	8+8/450V	18p	250+50/325V	50p
25/25V	10p	8+16/450V	20p	32+32+32/350V	43p
50/50V	10p	16+16/450V	25p	100+50+50/350V	48p
100/25V	10p	32+32/350V	25p		

LOW VOLTAGE ELECTROLYTICS
1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF. 15V. 10p.
500mF. 12V. 15p; 25V. 20p; 50V. 30p.
1000mF. 12V. 17p; 25V. 35p; 50V. 47p; 100V. 70p.
2000mF. 6V. 25p; 25V. 42p; 50V. 57p.
2500mF. 50V. 62p; 3000mF. 25V. 47p; 50V. 65p.
5000mF. 6V. 25p; 12V. 42p; 25V. 75p; 35V. 85p; 50V. 95p.

CERAMIC 1pF to 0·01 mF, 4p. Silver Mica 2 to 5000pF, 4p.
PAPER 350V-0·1 4p, 0·5 13p; 1mF 15p; 2mF 150V 15p, 500V-0·001 to 0·05 4p; 0·1 5p; 0·25 8p; 0·47 25p.
SILVER MICA. Close tolerance 1% 2·2-500pF 8p; 500-2·200 pF 10p; 2,700-5,600pF 20p; 6,800pF-0·01, mid 30p; each.
TWIN GANG. "0-0" 208pF+176pF, 65p; Slow motion drive 365+365 with 25+25pF, 50p 500pF slow motion, standard 45p; small 2-gang 500pF £1·60.
SHORT WAVE SINGLE. 10pF 30p; 25pF 55p; 50pF 55p.
NEON PANEL INDICATORS 250V AC/DC Red or Amber 20p.
RESISTORS, ⅛ w., ¼ w., 20% 1p; 2 w. 5p 10 ohms to 10 meg
HIGH STABILITY. ½ w. 2% 10 ohms to 1 meg., 10p.
Ditto 5% Preferred values 10 ohms to 10 meg., 4p.
WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K, 10p each; 2½ watt, 1 ohm to 8·2 ohms 10p

GARRARD DECCADEC SP25 MKII RECORD PLAYER

With Stereo/Mono Deram Cartridge transcription head and arm Four speeds. 10½in. turntable. Anti-rumble filter Bias compensation. Laboratory motor.

SPECIAL PRICE **£18·50** Post 25p

METAL PLINTH & PLASTIC COVER
Cut out for most Garrard or B.S.R. Will play with cover in position. Latest design. Covered in black leatherette. Antimagnetic. 12½ × 14½ × 7½in. **£5·50** Post 25p
ALSO AVAILABLE IN SOLID NATURAL MAHOGANY WAX POLISHED FINISH AT SAME PRICE

MAINS TRANSFORMERS
ALL POST 25p each

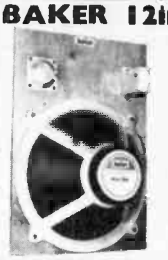
250-0-250 80 mA. 6·3 v. 4 amp.	£1·50
250-0-250 80 mA. 6·3 v. 3·5 a. 6·3 v. 1 a. or 5 v. 2 a.	£2·50
350-0-350 80 mA. 6·3 v. 3·5 a. 6·3 v. 1 a. or 5 v. 2 a.	£3·00
300-0-300 v. 120 mA., 6·3 v. 4 a. C.T.; 6.3 v. 2 a.	£3·25
MINIATURE 200 v. 20mA., 6·3 v. 1 a. 2½ × 2½ × 2in.	75p
MIDGET 220 v. 45 mA., 6·3 v. 2 a. 2½ × 2½ × 2in.	90p
MINI-MAINS 20v, 100mA. 1⅝ × 1⅝ × 1⅞in.	50p
HEATER TRANS. 6·3v. 3 a.	60p
Ditto tapped sec. 1.4 v., 2, 3, 4, 5, 6·3 v. 1½ amp.	95p

GENERAL PURPOSE LOW VOLTAGE. Tapped Outputs at 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. £2·25
1 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60, £2·25
2 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60. £3·25
5 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48,60. £8·75
AUTO TRANSFORMERS 115v. to 230v. or 230v. to 115v, 150w. £2·25; 500w. £6·25; 750w. £10; 1000w. £14.
CHARGER TRANSFORMERS. Input 200/250v. for 6 or 12v., 1½ amp., £1·50; 2 amp £1·80; 4 amp. £2·50.
FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12v. outputs, 1½ amp. 40p; 2 amp. 55p; 4 amp. 85p
LUCAS 2DS500 Bridge 70V 5 amp £1.

E.M I. 13½ × 8in. SPEAKER SALE!
With twin tweeters and crossover. 10 watt. State 3 or 8 or 15 ohm. (As illustrated) **£3·95** Post 25p
With flared tweeter cone and ceramic magnet. 10 watts. Bass res. 45-60 cps. Flux 10,000 gauss. State 3 or 8 or 15 ohm. **£1·95** Post 25p
Teak Cabinet Size 16 × 10 × 9in. Post 25p **£5**

ALL MODELS "BAKER SPEAKERS" IN STOCK
Hi Fi Enclosure Manual containing 20 plans, crossover data and cubic tables. 42p. Post Free

BAKER 12in. MAJOR £9



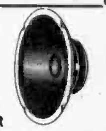
30-14,500 c.p.s., 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c.p.s. Rated 20 watts. Voice coils 3 or 8 or 15 ohms. Post Free
Module kit. 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. **£11·50**

BAKER "BIG—SOUND" SPEAKERS

'Group 25'	'Group 35'	'Group 50'
12 inch 25 watt **£7**	12 inch 35 watt **£9**	15 inch 50 watt **£19**
3 or 8 or 15 ohm	3 or 8 or 15 ohm	8 or 15 ohm

TEAK HI-FI SPEAKER CABINETS. Fluted wood front
For 12in. or 10in. dia. speaker 20 × 12 × 9in. £9. Post 25p
For 13 × 8in. or 8in. speaker 16 × 10 × 9in. £5. Post 25p
For 10 × 6in. or 6in. speaker 16 × 8 × 6in. £4. Post 25p
LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft.

GOODMANS 6½ in. HI-FI WOOFER



8 ohm, 10 watt. Large ceramic magnet. Special Cambric cone surround. Frequency response 30-12,000 cps. Ideal P.A. Columns, Hi-Fi Enclosures Systems, etc. **£4**

ELAC CONE TWEETER
The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 3½ × 3½ × 2in. deep. Rating 10 watts. 3 ohm or 15 ohm models. **£1·90** Post 10p

SPEAKER COVERING MATERIALS. Samples Large S.A.E.
Horn Tweeters 2-16kc/s, 10W 8 ohm or 15 ohm £1·50.
De Luxe Horn Tweeters 2-18 Kc/s, 15W, 15 ohm £3.
TWO-WAY 3000cps CROSSOVERS 3 or 8 or 15 ohm 95p.
SPECIAL OFFER! 80 ohm 2½in.; 2½in.; 35 ohm, 2in.; 3in 25 ohm, 2½in. dia.; 3in dia.; 6 × 4in.; 8 × 5in. 15 ohm, 3½in. dia.; 6 × 4in.; 7 × 4in.; 8 ohm. 2½in. 3in. 5 × 3in. **£1** EACH TYPE
LOUDSPEAKERS P.M. 3 OHMS. 7 × 4in. £1·25; 6½in. £1·50; 8 × 5in. £1·60; 8 × 2½in. £1·50 8 in. £1·75; 10 × 6in. £1·90.
RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8in. dia. 4 watt; 10in. dia. 5 watt; 12in. dia. 6 watt 3 or 8 or 15 ohm models £2.00 each. Post 15p.
VALVE OUTPUT TRANS. 25p; MIKE TRANS. 50:1 25p.
5 WATT MULTI-RATIO. 3, 8 and 15 ohms 80p.

BAKER 100 WATT ALL PURPOSE TRANSISTOR AMPLIFIER

4 inputs speech and music. Mixing facilities. Response 10-30,000 cps. Matches all loudspeakers. A.C. 200/250V. Separate Treble and Bass controls. Guaranteed. Details S.A.E. **£49** Post Free

BARGAIN AM TUNER. Medium Wave. Transistor Superhet. Ferrite aerial. 9 volt. **£4·50**

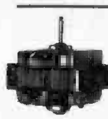
BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. **£3·50**
STEREO VERSION OF ABOVE £4·50.

BARGAIN FM TUNER 88-108 Mc/s Six Transistor. 9 volt Printed Circuit. Calibrated slide dial tuning. Walnut Cabinet. Size 7 × 5 × 4inch **£12·50**

BARGAIN FM TUNER as above less cabinet **£8·85**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume control. 9v. **£3·50**

COAXIAL PLUG 6p. PANEL SOCKETS 6p. LINE 18p.
OUTLET BOXES, SURFACE OR FLUSH 25p.
BALANCED TWIN FEEDERS 300 ohms 5p yard.
JACK SOCKET Std. open-circuit 14p, closed circuit 23p; Chrome Lead Socket 45p. Phono Plugs 5p. Phono Socket 5p.
JACK PLUGS Std. Chrome 15p; 3·5mm Chrome 14p. DIN SOCKETS Chassis 3-pin 10p; 5-pin 10p. DIN SOCKETS Lead 3-pin 18p; 5-pin 25p. DIN PLUGS 3-pin 18p; 5-pin 25p.
VALVE HOLDERS, 5p; CERAMIC 8p; CANS 5p.



E.M.I. TAPE MOTORS
Post 15p.
120v. or 240v. AC. 1,200 r.p.m. 4 pole 135mA. Spindle 0·187 × 0·75in. Size 3½ × 2½ × 2½in. (illustrated). **£1·25**

BALFOUR GRAM MOTORS
120v. or 240v. A.C. 1,200 r.p.m. 4 pole 50mA. Spindle ⅛ × 3/20. Size 2½ × 2½. × 1½in. Post 15p **85p**

HI-FI STOCKISTS — RETURN OF POST DESPATCH — MINIMUM POST AND PACKING 15p — CUSTOMERS FREE CAR PARK — CALLERS WELCOME

RADIO COMPONENT SPECIALISTS
337 WHITEHORSE ROAD, CROYDON
Open 9–6 p.m. (Wednesdays 9–1 p.m., Saturdays 9–5 p.m.)

Radio Books & Component Lists 5p. Written guarantee. (Export: Remit cash and extra postage.) Buses 50, 68, 159 Rail Selhurst. Tel. 01-684-1665

'THE logiprobe'

LAURENCE COOK

THE circuit to be described was designed to fulfil the need to see what was going on in TTL logic systems without having to use a voltmeter to determine whether a "1" or "0" existed at any point. To give a positive indication of the presence of a logic level it was decided at the outset to have two lamps, corresponding to a "0" or "1". Neither lamp would light with the probe either floating or at an inadmissible voltage (e.g. 1·2 volts).

Since the probe has been completed, it has proved extremely useful to me (and to those who have borrowed it!) and will doubtless soon repay its cost in time saved tracking down faults. It may even encourage people to "have a go" at logic circuitry, since it quashes the familiar cry, "I can't see what's going on inside those bugs".

CIRCUIT

Only four transistors, four resistors, two diodes and two bulbs are used (see Fig. 1). A few moments spent studying the circuit should enable one to spot the fact that it is really two circuits, one the inverse of the other; that is, Tr3 and Tr4 are arranged in a similar fashion to Tr1 and Tr2 but "upside down". The reason for this is simple.

With the probe on a logic "0" the voltage at Tr1 base, determined by the divider chain and probe voltage (>0·8V) causes Tr1 to turn on. Tr1 collector goes towards +5V and Tr2 emitter does the same, since Tr2 operates in common collector mode. LP1 therefore lights, indicating a logic "0". Similarly a logic "1" at the probe causes the voltage at Tr3 base to turn Tr3 on, and so Tr4 drives LP2, which lights up.

The resistors in the divider chain are of such values as to keep both lamps off when the probe is either floating or between 0·8V and 2·4V with respect to earth. Should the probe be accidentally touched on a voltage below earth or above +5V, then D2 or D1 respectively conduct to prevent the reverse base-emitter voltages of Tr3 or Tr1 being exceeded. Resistors R2 and R3 limit this current, but it is inadvisable to deliberately look for trouble by touching the probe onto higher voltage rails for long periods.

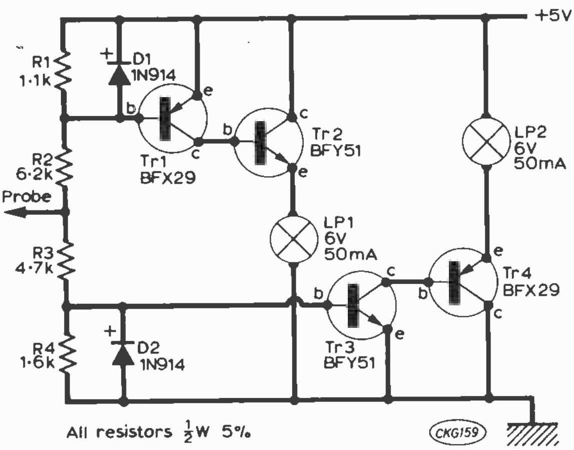


Fig. 1. Circuit of the Logiprobe.

CONSTRUCTION

The logiprobe is assembled on a piece of 0·15 in. matrix veroboard (see Fig. 2.), with flying leads for supply and lamps. This enables it to be housed in any convenient small plastic box. The probe may be made from an old ball-point pen. It is largely a matter of choice how one terminates the supply leads, but since the supply must be the same as that of the TTL circuitry to be tested, then small insulated crocodile clips would be handy.

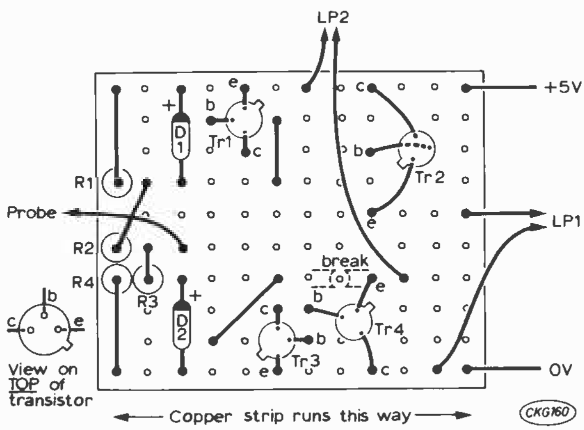
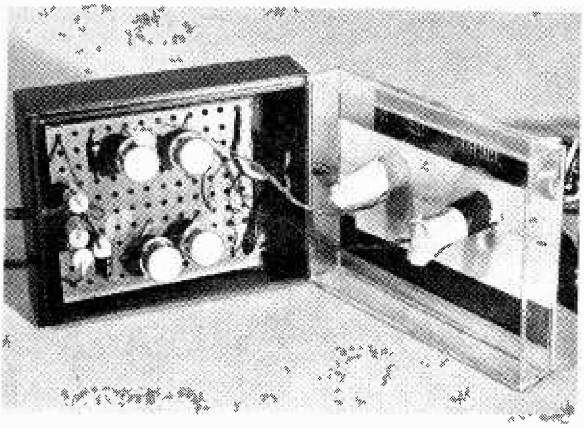


Fig. 2. Layout of the Logiprobe on a small piece of veroboard. Note that transistor leadout connections are shown as seen from on top. Compare this layout with photograph of completed unit.

Start by cutting a piece of veroboard to the right size for the box, then solder flying leads as shown. Next solder in the resistors, diodes and transistors. Use a heatsink and a small well-tinned iron just in case the resistor values are altered by overheating them, since these determine the levels at which LP1 and LP2 light. For this reason R1 to R4 should be 5% or better, and not nasty old things out of that TV set recently butchered! Finally solder LP1 and LP2 onto their respective leads.



The lid of the box carries the two lamps which should be of differing colours, representing "0" or "1". The lamp terminals are insulated to prevent short circuits when the lid is fitted to the box.

TESTING

Connect the logiprobe to a 5V supply. If all is in order both lamps will be off. If not, either the supply is wrong, or a mess has been made of the board. Look for blobs of solder bridging the copper strips and get rid of them! If both or either of the two lamps are still on, make sure that everything is connected the right way round; we all make mistakes!

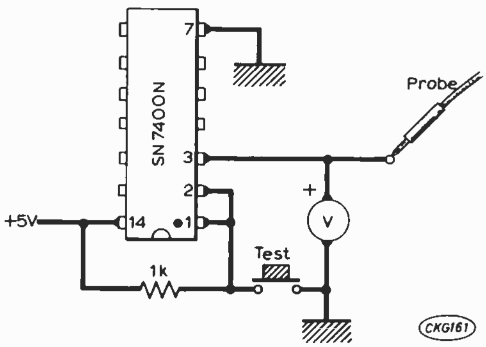


Fig. 3. Test set-up using an integrated circuit.

Touching the probe to earth or +5V should light LP1 or LP2; just to make sure all is well try the probe on an i.c. output with a voltmeter as a temporary check. (See Fig. 3).

Finally, a word of warning. Unless one is prepared to fiddle for hours with stacks of resistors, use the components specified. If you can't resist trying different transistors, at least use silicon of a similar type.

When your logiprobe is finished you'll wonder how you managed without it. But keep it hidden or people will borrow it from you! ■

Electronotes..

S. GINSBERG

ONE so often reads about the amazing advances and research programmes which take place in other parts of the globe. It is, therefore, refreshing to hear of some work which is being done in this country. This is particularly so since the establishment in question is the Post Office Research Department at Dollis Hill.

Workers at Dollis Hill are experimenting with those intriguing things called magnetic bubbles. A new generation of words is now fast coming into being. For example, a "bubble eater" and a "keyhole generator" are commonplace.

Basically, one method of employing magnetic bubbles is to lay down a series of minute conductive elements in the form of "T" shapes. These are typically formed of nickel-iron and are of the order of 1μm thick. The idea is that a tiny magnetic bubble can be transferred from one "T" to the next and even annihilated. Thus the bubbles can be used as a means of storing data. The bubbles themselves are only some 10-18μm in diameter.

The workers at Dollis Hill have developed, and I kid you not, a bubble detector bridge (see what I mean about the terminology?). The idea is an extremely clever one. Four minute resistive arms of a bridge circuit are formed by a deposition of a very thin nickel-iron alloy which is less than 1000Å thick. The resistivity of this alloy changes whenever it is subjected to a magnetic field. Thus, when a magnetic bubble arrives at the bridge, its magnetic field will affect, say, two of the "resistors" effectively altering their resistances and thus unbalancing the bridge.

This work is impressive and follows closely on the heels of a previous announcement of work done here on transistors rated at around 1·5 Watts in the 4GHz region. These transistors were reported to have base widths of only 0·14 microns. Truly it is a small world.

Occasionally one hears news which is disturbing. Not only because of the actual content and what it implies, but also because of the reliable source from which is comes. This piece of news concerns lasers. One can use a laser beam and modulate it, thus using it to convey communications. If you "shine" a laser beam down a light fibre you can carry it from one place to the next. Again, it is possible to get quite a few "channels" on a laser beam, far more than you can on a single, comparable coaxial cable, for example. The thought now goes that for all communications work, land lines etc., lasers plus light fibres will be used. If this is true, then it could mean our old friend the coaxial cable is on the way out!

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

CQ complaint

I wish to make a complaint regarding an advertisement in your CQ column of June 72.

I supplied a S.A.E. and requested lists of issues especially Nov. 71 from a reader.

This was over a month ago and as yet have received no word from him. I think he must be collecting 3p stamps!

Would you please put an advert in your CQ column for me? I require Nov. 71 *Practical Wireless* or a copy of the article on the organ.—**M. F. Longmore,** *(31 Kent Ave., Larne, Co. Antrim, N. Ireland).*

Construction award

The 2nd G3XBF Constructors Award, sponsored by the Barking Radio and Electronics Society G3XBF—Affiliated to the Radio Society of Great Britain will be held on Thursday, November 9th, 1972 at the new BRES HQ: Westbury Recreation Centre, Westbury School, Ripple Road, Barking, Essex, at 7.45 pm.

Talk-in facilities are: 160m-G3XBF, on 2m—G8EAY/A, (TX 145·0). Judges: G. M. C. Stone, CEng, MIEE, MIERE, G3FZD, Council Member and v.h.f. Manager RSGB. D. A. Findlay, DFC, FCA, G3BZG, General Manager and Secretary RSGB. R. S. Hewes, G3TDR, Region 7 Representative RSGB.

There will be an award for each section and an overall winner. Each award will consist of a hand produced certificate and a worthwhile cash prize.

A film will be shown during the judging and refreshments will be available. Closing date for entries Wednesday, October 25th, 1972. Entry forms and further information may be obtained from **Alan P. Foss,** *G8EAY, 73, Coolgardie Avenue, Chigwell, Essex. (01-500 6034).*

VHF hope

So interesting is your August editorial on "Hope for VHF" that I could write sufficient about it to fill another!

VHF has not "caught on" for several reasons, and I will list a few technical ones first. A v.h.f. radio costs 1½ to 3 times as much as a comparable type for m.w. Invariably it uses at least two more transistors, which, so far as batteries are concerned, raise the quiescent current by about 10 per cent, and this is aggravated by the fact that v.h.f. oscillators are not only less stable in the face of falling voltage, but in fact actually cut out completely when the battery has still an appreciable amount of "life" in it usable on m.w. With battery manufacturers seemingly not knowing where to stop with their price-rises, and many of the receivers being of the "pocket" type, the matter speaks for itself.

But away from technical aspects, the BBC *HAS* something to answer for. As an example, take Sundays on Radio 4.

At 8.20 a.m., v.h.f. and m.w. part company, and unless one wants a Pakistani programme, he scraps his m.w. and goes v.h.f. But some 45 minutes later he is assailed by "Open University", so, out has to come his trusty m.w. I have always said that v.h.f. and m.w. should never part course, and neither should have Radios 1 and 2, because in the latter case the 247m. transmission was to fill up locally the areas not well served by Droitwich on 1500m. Since the service areas of the v.h.f. stations more nearly coincide with the centres of Pakistani population this would be the more logical frequency for that service, but better still these should be on the "Local" stations, since for a large part of their time they just repeat BBC programmes available at better quality on the regional stations a little along the dial. In North-Northumberland, listeners have to rely upon m.w. because v.h.f. is not reliable there, and there is no Pakistani population either!

I run a v.h.f. tuner to Mr. Cameron's excellent design a year or two ago in "P.W." and it does enable me to hear the broadcast distortion more clearly, for the programmes are either full of badly received telephoned matter, or of the "popular" type to which a bit of distortion makes little difference anyway.—**James W. Robson,** *(Newcastle Upon Tyne).*

Thanks

In the issue August 1972 your contributors H. Hellyer and M. Hollier continue with Part 9 of their excellent series "Transistor Circuitry for Beginners".

Their style is lucid and most readable, and in this issue we were particularly gratified to note their suggestion, page 341, "if Mullard Ltd. didn't exist, they would have had to be invented".

We especially appreciate their acknowledgement of (sic), "a direct crib from Chapter 3 of the Mullard Transistor Handbook". It is perhaps carping to indicate that reference should be made to the end of Chapter 2, and that the title used is ambiguous, in connection with other Mullard publications. For the benefit of readers wishing to supplement the information provided by your contributors the correct title should be "Transistor Audio and Radio Circuits".

L. W. Owers, *Manager—Educational Service, Mullard Ltd.*

VHF services

With regard to your editorial column in the August *Practical Wireless,* I would, as a newcomer to the arts of practical electronic work, like to make one comment.

Although your column makes a fair general statement, I feel that one reason for the lack of use of v.h.f. services is the fact that reception in many areas (for example the Pennine valley in which I live) is very difficult. This problem may, I suppose, be overcome by the erection of a dipole aerial but the average radio listener is still faced with the fact that very few of the popular battery operated portables are equipped to take a co-axial or twin feeder from an external aerial (idea for a future article?). The so-called "v.h.f. telescopic aerials" fitted to these sets are virtually useless in these sheltered areas.

Of course, when one writes to the BBC commenting on the problems of receiving Radio 3 on **Medium Wave,** they in turn refer one to the v.h.f. services! Do they realise that v.h.f. is *not* easily available to all?—**T. D. Jackson** *(Lancashire).*

practically wireless commentary by HENRY

No. 92 what you mean is...

PICTURE, if you can, the tele-pundits squaring-off across the studio table, dissembling when flummoxed, leaping eagerly into the subject when a question slots into their pigeon-hole of knowledge. The scene is familiar.

But have you ever been exasperated by the overbearing type who listens with evident impatience to his opposite number's bumblings, then thrusts in with the verbal pike off: *"What you mean is . . ."* and proceeds to expound his own meaning?

I think we could do with a few of those pikers in the hushed rooms and holy corners where Users' Manuals, Operating Handbooks and Service Instructions are compiled. In one classic example of the dismantling instructions for a Japanese radio-cum-portable tape recorder, a sequence of nearly a dozen operations had to be made to get the chassis from the cabinet. Following the quaint orders was bad enough, but after action 3 one reached an impasse. The next stop in the sequence could only be taken if you tugged, pulled, shoved, wrenched and twisted the loudspeaker mounting. Some plastics break with a gut-rending "Crack", don't they?

The solution comes, after one failure, at about Stage 12, when we are told: *"Before unloosing the regulator board, take off the two clips marked A and B in diagram."*

Leaping eagerly into the subject.

But even when meanings are explicit there can be an embarrassing contretemp. Five times in a fortnight, soon after Garrard brought out their SP25 Mark III autochanger, we had to explain patiently to new users that rejecting during Manual Play required one to flick the lever to Auto and then bring it back to Manual. If you left it in the Auto position, the pickup arm would reject—sure—but cycling commenced and the record would be replayed in the selected size position. The instructions are there, plainly enough on Page Nine of the handbook issued with the gramophone deck, but who reads handbooks?

Not so good are those handbooks, usually printed in several expensive colours and all sorts of languages from Serbo-Croat to Sanskrit, which have such convoluted language that the English version is as ambiguous as the hieroglyphics.

Henry has whiled away many hours cross-referencing the English with adjacent columns of French and German, which deluded tutors were under the impression he had learned in his younger days.

Instructions in some strange Scandinavian tongue translate curiously if one attempts to be literal. Take the phrase: *"Nun das Stromkabel in eine Steckdose anschliessen."* That comes near the beginning of the Bedienungsanleitung (which everybody knows is the manual de Instrucciones) for the Sanyo STD-100 stereo cassette recorder.

Well, if we have to cope with the Common Market, let's have a go. Looks like a tale about this nun who climbs some mountain to get more living room. And lower down we see . . ." *reglers so einstellen, dass optimale Aufnahmequalität erzielt wird."* That one

Who reads handbooks?

is obvious: *"if you've go to instal it regularly, cheer up and do not use that naughty word."*

It becomes quite deflating to learn that the first phrase tells you to plug the power cord into an a.c. outlet, while the second is about adjusting the input level for optimum recording quality.

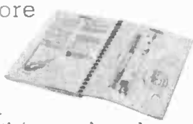
The section in Japanese was most intriguing, especially as English words like ON, OFF and EJECT larded the text like plums in a pudding.

Henry has campaigned for years to make suppliers add at least a circuit diagram to their equipment, and to put the specifications where they can be seen. In the June issue of *Hi-Fi News*, the B & O publicity boys mention that *they* always include a circuit diagram in a cute little pocket inside each piece of their equipment. In the same issue, a reader tells us he could not get a service manual with his tape recorder. He received, instead, a courteous letter pointing out that it was not Company policy to supply service manuals to the consumer public.

He answers that he, too, has a policy, which stated quite simply says: "No Manual—No Machine." Henry feels that more people should wield that pike.

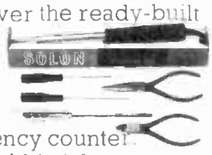
You can make any of these just as well as we can. And save yourself money into the bargain.

We at Heathkit do all the donkey-work – the rest is up to you. If you're handy with a soldering iron, pliers and screwdrivers you'll have no difficulty putting the bits and pieces together in a few hours. Even if you're not used to soldering you can still do it. Because we tell you how in an introductory booklet. And we give you bits and pieces to practise on before you take the plunge.



Just think what you could make yourself this weekend.

How about building the world's first electronic calculator kit? It's easier than you think. The new Heathkit IC-2008 desk-top calculator adds, subtracts, multiplies and divides up to eight digits. Electronically. You can multiply or divide a series of numbers by a pre-selected figure; fix the decimal point in one of eight positions or in a floating decimal mode. And a ninth display tube indicates overflow. It's smart, highly sophisticated – and shows a big saving over the ready-built price.



Or you could make yourself an IB-1101 frequency counter. New from Heathkit, it has a range from 1 Hz to over 100 MHz – and an input frequency that'll accept levels from below 50 mV to over 2000V. The decimal point is automatically placed with range selection. A truly professional piece of equipment.

Maybe radio is more in your line. Well, you could make our new version of the successful Tiger transistor portable – the Tiger FM. Designed specifically for the high-quality sound of VHF broadcasts (BBC radio 2, 3, 4 and local stations), it's particularly easy to build. Ideal for beginners.

And if you're bored with teak or walnut finishes on audio equipment, you'll be glad to know that we do Hi Fi in colour. You can choose from snow white or sunshine orange, besides the usual teak or walnut. That goes for our AA14 30 watt stereo amp, AR14 tuner/amp, and Trent speakers.

If you want a demonstration of any Heathkit equipment we'll be pleased to see you at either of our showrooms – 233 Tottenham Court Road, London W.1 (open 9–6, six days a week), and 17–18 St. Martin's House, Bull Ring, Birmingham (open Tues-Sat, 9–6).

Like we said, you can make them all as well as we can. But if, by any remote chance, you do manage to go wrong with your assembly, we'll put you right again. In fact, that's a firm guarantee.

You simply can't fail.

Want to know more? Mail the coupon for our free catalogue – it's packed with Heathkit goodies.

Please send me the FREE 1972 Heathkit catalogue.

Name ....

Address ....

HEATH (Gloucester) Ltd., Gloucester GL2 6EE.

PW 10/72

HEATHKIT
Schlumberger

We won't let you fail.

TAKE 20

JULIAN ANDERSON

No. 41
FROST ALARM

A series of simple transistor projects, each using less than twenty components and costing less than one pound to build.

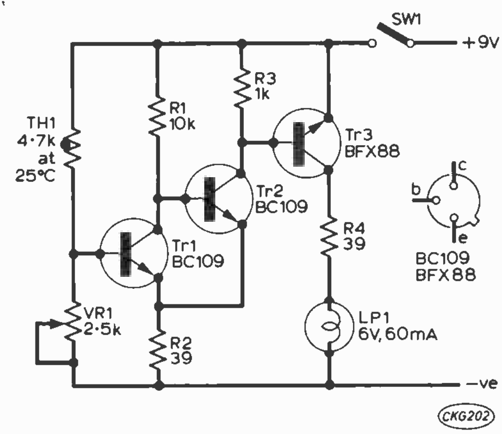


Fig. 1: The circuit of the Frost Alarm.

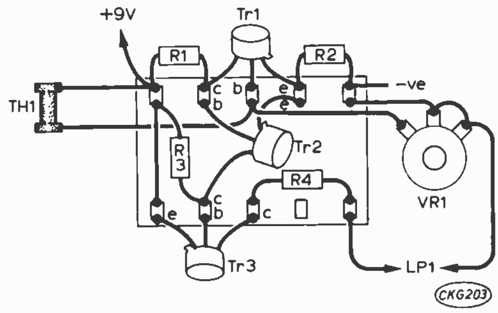


Fig. 2: Suggested component layout on tag-board.

AT this time of year the nights are closing in and unless something miraculous occurs, winter will follow shortly. As a nation we are supposed to ignore that season until it actually happens; iced points on the railways and the resulting chaos is just one example. However *Take 20* is going to set an example to the nation with this month's circuit—a Frost Alarm. You may think that such a project has few uses, but think about it. Freezing pipes in the loft can be prevented, the greenhouse heating can be turned on and the fruit growers can take the necessary precautions if you are given some warning that the air temperature is approaching 0°C. The circuit falls within our £1 limit but if it is to become a permanent fixture, rather than built up for interest, a mains operated power supply must be used, batteries are quite unsuitable unless you are prepared to keep switching the unit on and off.

We are calling the circuit a Frost Alarm but it can be made to operate over a wide range of temperatures, it is simply a matter of adjustment. The alarm device is a bulb which will light as soon as the temperature falls below the preset level. The warning device can be situated in any convenient position where it will be seen easily with the temperature sensor up to 100 yards away. This is the main advantage; you don't have to go out in the cold to look at a barely readable mercury thermometer.

The Circuit

The circuit of the frost alarm is shown in Fig. 1. The temperature sensing device is a thermistor. This is a device whose ohmic resistance varies with the temperature. At 25°C the resistance of the one specified is about 4·7kΩ. Above this the resistance falls to a low level but below it the resistance increases. On the one used for the prototype this was measured as 8kΩ at 0°C.

The thermistor is wired in series with a variable resistor, VR1, and the junction of these is taken to the Schmitt Trigger circuit which comprises Tr1 and Tr2. The voltage at the junction of TH1 and VR1 will depend on two factors; the temperature and the setting of VR1. We can easily arrange for this voltage to be just sufficient to bias Tr1 into conduction and set VR1 so that when the temperature falls, and TH1 increases in value, that Tr1 will have insufficient voltage at the base to maintain conduction.

While Tr1 is switched on, Tr2 will be held switched off since the saturation voltage (which is that voltage between the emitter and the collector when the transistor is fully conducting) is below that necessary to bring Tr2 into conduction. The connection of these two transistors is such that when one is conducting, the other is off and vice versa. The switching action is very rapid and very positive. We have explained the operation of this circuit before in this series in more detail. When Tr2 is off there will be no voltage drop across R3 and so Tr3 will be off. When Tr2 is on, this will turn on Tr3 and current will pass through the bulb. The reason for R4 is only because 9V bulbs

★ components list

R1	10kΩ 5%, ¼W		1p
R2	39Ω 5%, ¼W		1p
R3	1kΩ 5%, ¼W		1p
R4	39Ω 5%, ¼W		1p
VR1	2·5kΩ lin. pot		12p
TH1	VA1066S, 4·7kΩ thermistor (Henry's Radio)		20p
Tr1	BC109		10p
Tr2	BC109		10p
Tr3	BFX88		20p
LP1	6V, 60mA bulb		5p
Bulbholder			11p
SW1	On-off switch		7p
			99p

Prices are those recently advertised and may have changed. No allowance is made for minimum order costs or for postage and packing and these points should be checked carefully before ordering.

do not seem widely available, unlike 6V versions, and this resistor prevents the bulb being overloaded. A switch is shown only for convenience. If a mains operated power supply is used, as it should be, the switch should be on the input to this. As we mentioned before the thermistor can be connected to the circuit by a long length of wire, as the resistance of this will be negligible compared to that of the device itself.

Calibration

It is not too difficult to calibrate VR1. Put the thermistor with its leads into a small plastic bag and put this into a bowl of water and melting ice. The temperature among the melting ice will be 0°C but this may mean that the warning will come too late. If a decent sized bowl is used, it is better to calibrate using the water temperature at the bottom of the bowl, here the temperature will be 4°C. Once calibrated the unit can be tested by putting it into a fridge, checking the switch-on temperature against a mercury thermometer. The inside of a fridge should be just above freezing, say 3°C or so.

A suggested layout on a small tagboard is shown in Fig. 2. ■

CQ! CQ! CQ! CQ! CQ! CQ! CQ!

ISSUES WANTED

...November and December (and October) 1971 issues of P.W.—P. G. Quatermain, 138 Three Bridges Road, Crawley, Sussex, RH10 1JP.

...August 1967 to January 1968 issues of P.W.—M. Shipton, 48 Clockhouse Lane Collier Row, Romford, Essex.

...P.W. May 1968, also RX/TX not Ex-army.—C. Boswell, 120 Abergele Road, Colwyn Bay, Denbighshire.

...P.W. June 1969 or copy of article on the P.W. 12 Amplifier Part 3 included in this edition. Will buy or borrow.—Nick Salmon, 20 Bridge Street, Rugby, Warks.

...issues of P.W. containing the Hawaiian Guitar article.—H. Powers, Burbage Hinckley, Leicestershire.

...April 1954 Practical Television.—P. Brocombe, 2 Brede Valley View, Icklesham, Sussex.

...issue containing gen on P.W. Multimeter.—S. C. Burns, Worley, Worcs.

...P.W. August 1971.—W. Heasman, 20 Myrtle Crescent, Slough, Bucks. SL2 5BB.

...back numbers of P.W. since August 1971.—Q4132503 FS Sebbage, W. R., Sergeants Mess, R.A.F. Laarbruch, BFPO 43.

...issue of P.W. for May and June 1971 on payment.—G. Probert, 54 Replingham Road, Southfields, London, S.W.18.

...June 1965 issue of P.W.—A. Hughes, 16 Tritton Fields, Kennington, Ashford, Kent.

...August 1971 of P.W.—R. Green, 22 Branksome Close, Norwich, Norfolk, NOR 51D.

...copy of P.W. for November 1970. Good price paid.—B. Thomas, 48 Musgrove View, Leeds, LS13 2QN.

...buy or loan Aug. 1971 P.W.—A. C. Wray, 12 Lansdowne Square, Rodwell, Weymouth, Dorset.

...December 1968 and January 1969 issues of Television.—H. Gillott, 5 The Close, Birchanger Road, S.E. 25 5BW.

...Practical Wireless issues Jan. to July (incl.) 1971, in exchange for Israeli mint stamps, postcards or international coupons as requested.—Z. B. Sadeh, P.O. Box 128, Dimona, Israel.

...P.W. Feb. 1972, March 1972.—E. Marsh, 118 Knightsbridge Road, Solihull, Warwickshire.

...P.W. Feb. 1972. I will photostat required article (oscilloscope) and return, with postage.—J. Badger, 8 Hunger Hill Road, Whiston, Rotherham, S60 4BA.

...P.W. November 1970 and October 1970.—M. D. Jawle, Laxmi Nivas 77/79, Mugbhat Lane, Girgaum Bombay 4, India.

...P.W. Vol. 45 No. 7 for data on Pedal steel Guitar.—A. Nicholson, 7 Blawarthill Street, Glasgow, G14 OEB.

...P.W. November 1970.—J. F. Glavin, 3 North Lodge, Northlands, Salthill, Chichester, Sussex.

...P.W. Feb. 1971 issue or the circuit diagram for P.W. Stereo tape recorder.—C. Daniels, 22 Hadfield Street, Stabrook Georgetown, Cooperative Republic of Guyana South America.

...P.W. Feb. 1972 (first part of the transistorised Oscilloscope).—D. R. Gardiner, 12 Lambley Lane, Burton Joyce, Nottingham, NG14 5BG.

...Jan./Feb./March and August 1970 issues P.W. Please state price.—C. J. Toplis, 14 Beech Avenue, Darwen, Lancs.

...P.W. Dec. 1971 will pay full price.—C. Jones, 45 Currock Park Avenue, Carlisle, CA2 4DJ.

...blueprint published in Practical Wireless issue November 1964. The Autocrat Car Radio.—N. W. Davidson, "Church View", Upper Ballinderry, Co. Antrim, N. Ireland.

...P.W. Jan. and Feb. 1972.—A. M. Denning, 6 Reginald Road, Northwood, Middx.

...September 1971 to January 1972 issues of P.W.—A. Conbie, 1 Courtral Avenue, Helensburgh, Dumbartonshire.

...Television Nov. 1970 (Murphy Conversion Plinth).—R. Malcolm, 66 Low Garth, Kendal.

...1955–1971 P.W. 1969–1971 P/Electronics. Face Value Plus postage.—N. Hughes, 24 Peter St., Eccles, Manchester, M30 OJF.

...P.W. for May 1971 which includes Station focus six.—S. Vinden, Burcott Hall, Forn, Wing, Leighton Buzzard, Beds. LU7 OJP.

...P.W. for Sept. 1964, Jan. to May inclusive for 1966, January 1967, Aug. 1967, Dec. 1967, April 1968, June 1968, Nov. 1968, April 1969, May 1969, June 1969, July 1969, Aug. 1969, Sept. 1969, May 1970, Dec. 1970, Feb. 1971, July 1971, Aug. 1971, Oct. 1971—D. G. Harrington, Carnbrae, 25 Poynter Road, Bush Hill Park, Enfield, Middlesex.

...P.W. January and February 1972 issues wanted.—D. Kathrecha, 405 Sydenham Road, Croydon, Surrey.

PROJECT Autumn

Practical Wireless Designer's Trophy 1972

To encourage new authors, entries for the 1972 Trophy will be restricted to readers who have not previously had an article published in PW. This leaves the field wide open for those wanting to try their hand at writing technical constructional articles. Contestants will not be in competition with well-known authors, only with other newcomers, so the cup can only be won by a new writer. **It Could Be You.**

TURN YOUR CONSTRUCTIONAL PROJECT INTO CASH—AND MAYBE WIN THE CUP!

RULES

1. The winning entry will be chosen by a panel of judges from among articles published in issues of PW dated September 1972 to August 1973 inclusive. The Editor's decision on all matters arising will be final.
2. The winner of the competition will receive and retain outright the PW Designer's Trophy 1972. Other prizes will be awarded to the best runners-up. Articles will be paid for shortly after publication.
3. The competition is open only to authors who have not previously had any work published in PW.
4. Articles submitted for the competition should conform to the general style of material published in PW and must describe the operation and construction of a piece of radio, audio or test equipment that has been designed and built by the author.
5. Articles should, preferably, be typed using double spacing, leaving wide margins, on one side only of each sheet. Circuit diagrams and any other drawings must be separate and numbered to agree with the text. Author's roughs must be clear enough to permit re-drawing. Components list must also be separate and laid out to the standard PW format.
6. Photographs of the equipment are desirable and should be in black and white, sharp and clear. Photographs may be identified by sticking a label on the reverse instead of writing on the back of the photograph itself.
7. Components used in the design must be readily available from retail sources.
8. Articles should be sent to the Editor, Practical Wireless, Old Fleetway House, Farringdon Street, London, E.C.4. Authors will be advised as soon as possible of the acceptance or rejection of their articles. Equipment, the subject of an article, must not be sent to the Editor until advised to do so.
9. Employees and staff of PW are not eligible for entry to this competition.

SUBMIT YOUR ARTICLES NOW

IN NEXT MONTH'S PRACTICAL WIRELESS

EXTRA THE abc OF hi-fi SUPPLEMENT

The prospective buyer of hi-fi equipment can rightly feel a little bemused as he attempts to make sense of the welter of technical literature showered on him by manufacturers. With the audio 'season' now upon us we thought readers would like hi-fi expert Gordon King to explain and comment on the confusion of hi-fi jargon that now besets the man-in-the-street. Hi-fi is not cheap. A study of our ABC will ensure that your money is well spent.

8 WATT SILICON AUDIO AMPLIFIER

The falling cost of silicon output transistors now makes them an attractive alternative to germanium types. This article describes a high specification, all-silicon, 8W power amplifier with a suitable power supply. In addition a circuit is given for a matching high quality preamplifier.

SIMPLE RF SIGNAL GENERATOR

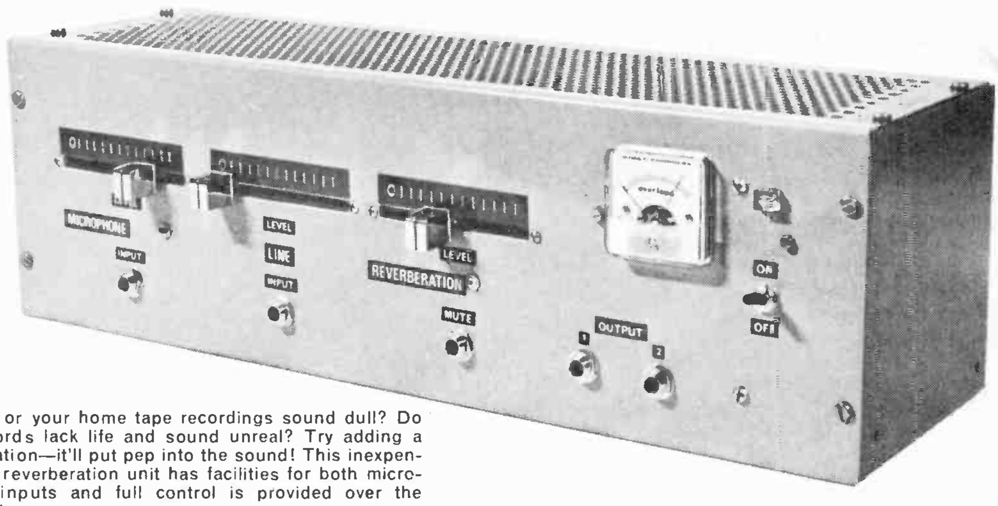
One of the problems in building test gear is range switching. This project uses plug-in coils (no switching) meaning, of course, that these are not permanently 'tied-up' in the circuit. The signal generator has wide coverage with outputs of r.f. modulated r.f. and audio.

MANY OTHER CONSTRUCTIONAL ARTICLES PLUS ALL THE REGULAR FEATURES. PRICE 20p.

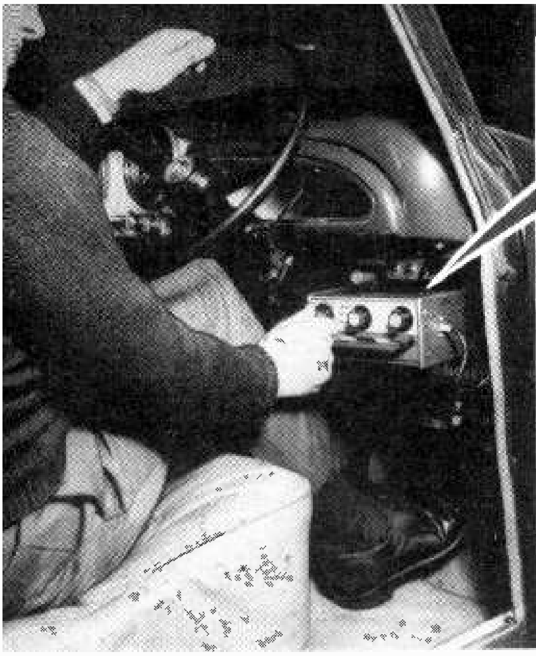
ALL IN THE NOVEMBER ISSUE ON SALE 6th. OCTOBER

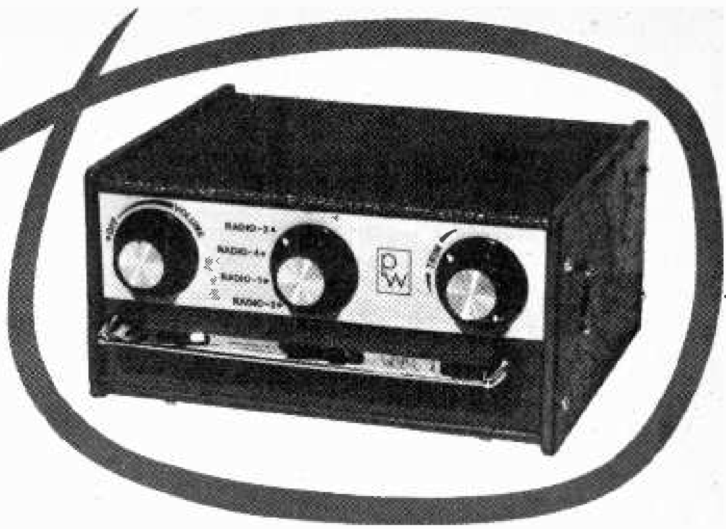
PW REVERBERATION UNIT

COVER PROJECT



Does your group or your home tape recordings sound dull? Do your old '78' records lack life and sound unreal? Try adding a touch of reverberation—it'll put pep into the sound! This inexpensive, high quality reverberation unit has facilities for both microphone and line inputs and full control is provided over the reverberation level.





R. H. LONGDEN

THE PW PRE-TUNED CAR/PORTABLE RADIO

FOR general use it is an advantage to have a receiver with a number of pre-selected stations available so this receiver is pre-tuned to four frequencies with provision for adding two more stations, or variable tuning, if wanted later. Three m.w. stations are available, with one l.w. station for reception of the BBC on 1500m. This is very convenient for day to day use and reception of a variety of programmes.

Reception normally is on the loudspeaker but there is provision for plugging in a personal earphone or headset, when this is more convenient for listening. A car aerial connector socket is provided, so that the receiver can be placed in a car where the use of pre-set station selection is a decided advantage. The receiver shape allows it to rest on a parcel shelf with its speaker upwards, or suspended under a shelf with the speaker downwards.

A diode output socket is fitted which is of advantage when a tuner is required for a tape recorder or other audio equipment. The receiver audio stages may then provide a signal for monitoring purposes.

The circuit is shown in Fig. 1 and is a straightforward and reliable one using easily obtained components. L1 is the ferrite aerial rod, and section S1a of the 6-way switch selects TC1, TC2, TC3 or TC4 pre-set trimmers, to give automatic tuning of the wanted stations. L1, TC4 and the parallel capacitor C1 provide l.w. reception, no additional winding being required.

Switch S1b similarly selects one of four oscillator trimmers, TC5 to TC8, and these tune the oscillator coil L3 to the required frequency. In practice, it is sometimes found that changes in battery voltage, temperature or slight changes in oscillator capacitor values, throw some pre-set stations slightly off tune. This is avoided by using a small panel control VC1, which can if necessary be adjusted to compensate. In use, the trimmers are set with VC1 half closed, then it is only necessary to adjust VC1 if signals are heard to be off-tune.

It will be noted that alignment between L1 and L3, throughout one or more fully variable tuning ranges, is not necessary, as when ordinary tuning is used. There are thus no ganging difficulties here, as it is only necessary to adjust pairs of capacitors TC1/TC5, TC2/TC6 etc., for the wanted stations.

As the ferrite rod aerial is unsatisfactory in a vehicle, coil L2 allows a car aerial to be coupled to the receiver.

The 2-stage i.f. amplifier has three single-tuned i.f.t.'s, and a.g.c. via R9 from the detector diode D1. Audio signals may be taken directly from the diode circuit by the outlet provided. VR1 is then turned to zero, unless audio signals for monitoring are wanted from the receiver.

The remaining outlet is for a personal earphone or headset, when required, inserting the plug silencing the receiver speaker. A large external speaker can also be plugged into this socket.

SWITCHED CAPACITOR ASSEMBLY

This consists of the switch, with eight pre-sets and C1, wired on a paxolin panel 4 x 2in., as in Fig 2. TC1 and TC5 are both 60pF max as are TC2 and TC6. These were set for 1214kHz, Radio 1 and

1088kHz, Radio 4. TC3 is 50-450pF, and TC7 is 20-250pF, for 647kHz, Radio 3. For 200kHz, Radio 2 TC8 is 450pF and TC4 is 1250pF with C1 1000pF in parallel.

It is unlikely that other values will be wanted for TC1 and TC5. TC2 and TC6 can be 100pF if a lower frequency than about 1088kHz is needed here, or may have small fixed capacitors in parallel. In some parts of the country Radio 2 on 200kHz may not be required when TC4 and TC8 can then be 100-400pF, for an additional m.w. station in which case C1 is omitted. Ranges with the pairs of pre-sets overlap considerably. The oscillator circuit requires less capacitance than the aerial circuit.

Washers on the switch keep leads and tags clear of the metal panel of the receiver and when the assembly is wired, it is fixed with the selector switch nut.

CIRCUIT BOARD

This is 5 x 3in., a piece $1\frac{3}{4}$ x $1\frac{3}{4}$in. being cut out to accommodate the speaker, as in Fig. 3. Wiring will be simplified if the perforated board is cut so that there are 19 rows of holes one way, and 32 rows the other. Components can then be placed with their wire ends exactly as shown, and wiring will closely follow the diagram of the underside of the board.

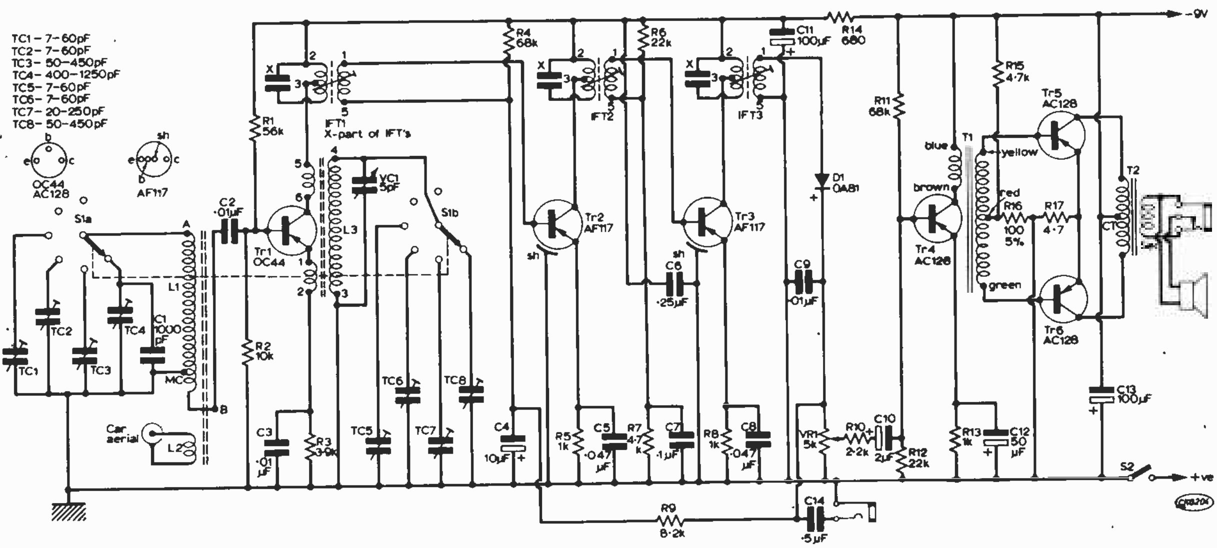
Holes have to be drilled for L3 and the i.f.t.'s. A very small round file will be found useful to obtain a fit if any holes prove to be out of position. The identification spot on L3 falls between pins 1 and 6, and these pins should come as in Fig. 4.

Check resistor values as they are inserted, and note also the polarity of the electrolytic capacitors and diode D1. When some components are in position, turn the board over and connect as in Fig. 4, snipping off excess wire.

If each item and its leads are marked in coloured ink or pencil on the drawing as inserted and connected, it is unlikely that anything will be overlooked, or wrongly connected. It may prove helpful to use red 1mm sleeving on positive circuits, black on negative and some other colour for remaining connections.

Pieces of coloured sleeving about $\frac{3}{8}$in. long can be put on the transistor wires. This will identify them, and also hold these at a suitable height from the board.

Transformer T1 is held by its leads plus a little adhesive. Other driver transformers of similar type will give the same results, but connections must be



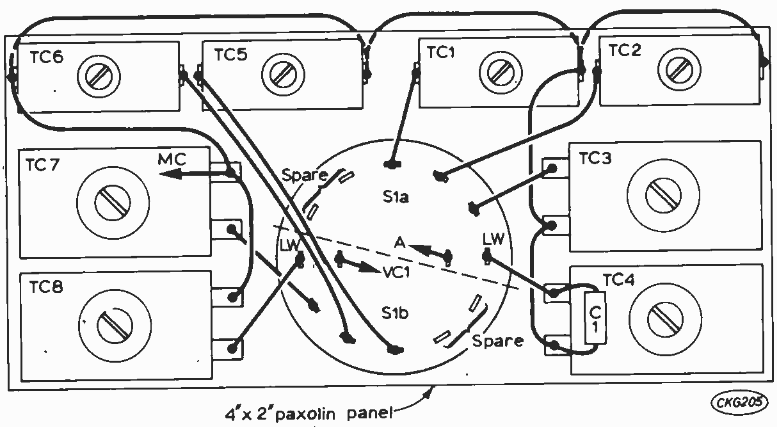


Fig. 1: above, shows the complete circuit diagram for the PW pre-tuned radio, together with the base data for the transistors. Values of pre-set trimmers TC1-8 are tabulated separately. Fig. 2: left, gives the layout of the trimmer capacitors and connections to station selector switch, all mounted on a separate paxolin panel.

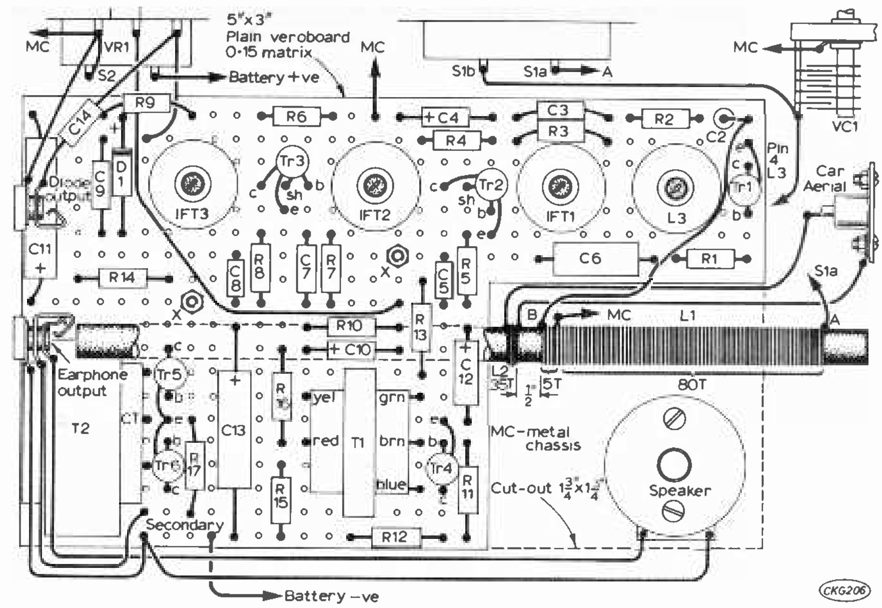
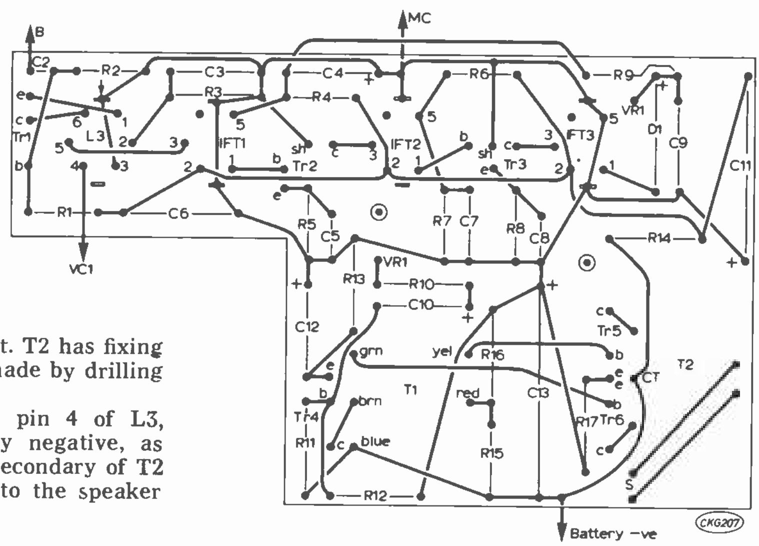


Fig. 3: above, layout of components on the front of the veroboard panel. For clarity the framework of the speaker has been omitted. Fig. 4: right, shows the component wiring on the reverse side of the board. Note polarity of electrolytic capacitors and diode D1.

The photograph at the bottom of the page is a general view inside the receiver which may be compared with Fig. 3 above.



taken from the maker's data or leaflet. T2 has fixing lugs which pass down through slots made by drilling small holes close together.

Leave flying leads from D1, R10, pin 4 of L3, earth (positive) line, C2, and battery negative, as shown in Fig. 3. Two leads from the secondary of T2 are anchored on the board and run to the speaker circuit.

FERRITE AERIAL

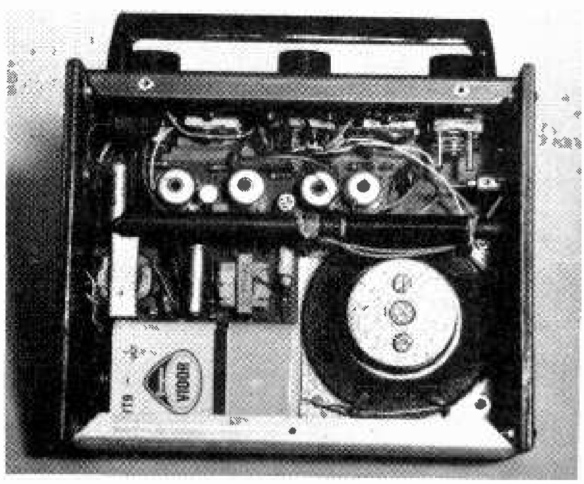
L1 is wound with 24 s.w.g. enamelled wire, with turns side by side, on a 6 x $\frac{3}{8}$in. diameter rod. Anchor the wire $\frac{1}{2}$in. from one end, at A, Fig. 3, with tape or adhesive. Wind on 80 turns and form loop of wire at MC. Continue for a further 5 turns in the same direction and finish off at B. A lead runs from MC on the aerial winding to MC at TC7, Fig. 2, A runs to S1a, and B to C2.

The aerial is mounted by cutting two strips of paxolin about 2 x $\frac{1}{2}$in. and mounting these with small brackets held under bolts that secure the speaker. A "V" is cut in the end of each strip, and the rod held by thin string round it and through small holes in the strips.

L2 is 35 turns of any thin insulated wire, placed on the rod about $\frac{1}{2}$in. from B.

The car aerial socket is mounted on the right side of the case, viewing the receiver from behind, Fig. 3.

The diode output socket is near VR1, on the side of the case, and C14 is for d.c. isolating purposes.



★ components list

Resistors

R1	56kΩ	R7	4·7kΩ	R13	1kΩ
R2	10kΩ	R8	1kΩ	R14	680Ω
R3	3·9kΩ	R9	8·2kΩ	R15	4·7kΩ
R4	68kΩ	R10	2·2kΩ	R16	100Ω 5%
R5	1kΩ	R11	68kΩ	R17	4·7Ω
R6	22kΩ	R12	22kΩ	All 10% ¼W	

VR1 5kΩ log potentiometer with switch, S2

Capacitors

C1	1000pF SM	C8	0·047μF
C2	0·01μF	C9	0·01μF
C3	0·01μF	C10	2μF 6V
C4	10μF 6V	C11	100μF 12V
C5	0·047μF	C12	50μF 6V
C6	0·25μF	C13	100μF 12V
C7	0·1μF	C14	0·5μF 150V
TC1	7–60pF	TC5	7–60pF
TC2	7–60pF	TC6	7–60pF
TC3	50–450pF	TC7	20–250pF
TC4	400–1250pF	TC8	50–450pF

All compression trimmers
VC1 5pF variable (Jackson C804)

Semiconductors

Tr1	OC44	Tr4	AC128
Tr2	AF117	Tr5	AC128
Tr3	AF117	Tr6	AC128
D1	OA81		

Miscellaneous

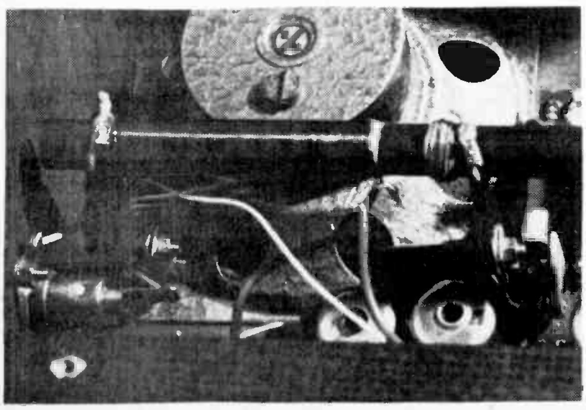
L1–2, see text. L3, oscillator coil (Osmor PW/01). IFT1 (Weyrad P51/1). IFT2 (Weyrad P51/2). IFT3 (Weyrad P50/3V). T1, driver transformer (Osmor QXD1). T2, output transformer 6·2:1 CT (Henrys MOP). Switch S1a–b, rotary water switch, 2 pole 6 way. Speaker 3½in. 3Ω. Universal chassis flanged members, 7 x 3in. (2) (Home Radio). Knobs (3). Handle. Veroboard, plain, 0·15in. 5 x 3in. Coaxial aerial socket. Output jacks (2, 1 shorting type). Battery PP9 and clips.

The a.f. output jack socket is below this, and has contacts which open when the plug is inserted. It is connected as in Fig. 3, so that inserting a plug breaks the internal speaker circuit.

CABINET

The receiver can be tested out of its case, by wiring the circuit board to VR1, VC1, and S1a-b, as in Fig. 3.

Close-up shot of the method of attaching the ferrite rod to paxolin brackets.



The leads MC from VR1 and VC1 go to tags bolted to the panel flanges.

The parts of the cabinet are quite easily prepared, and holes should of course be drilled before fitting the speaker or any other items.

Top and Bottom These are 7 x 3in. flanged universal chassis members. Punch the top for VR1, S1a-b and VC1, and drill holes for the handle fixing bolts. Drill the front flanges for 6BA bolts or self-tapping screws (to secure the front) and the back flanges for self-tapping screws. Cover the top with self-adhesive material of the required colour.

Sides Each side is 3-ply, 6⅛ x 3⅝in., to allow overlapping the front and back, with a small projection at the top and front. The end flanges of the top and bottom are secured to the sides by two bolts in each position.

Front and Back These are 3-ply, each 7 x 6in. Place the speaker to the bottom right, mark its fixing holes, and cut an aperture to match the speaker cone. Put the circuit board in place, and drill the two holes X-X in Fig. 3, through board and front, so that the board can later be fixed in this position.

Speaker Fitting Pass two countersunk headed 6BA bolts through from the front, to hold the speaker and also the brackets for the ferrite rod supports. Use other bolts or small wood-screws for the remaining speaker fixing holes.

Circuit Board Two countersunk bolts are put through the holes which match with X-X, and held with nuts. Extra nuts are then put on, so that when the circuit board is on these bolts, a clear space of ⅜in. or so remains between it and the case front, to clear the wiring. Nuts at X-X then hold the board in place.

Finishing A piece of fabric about 8 x 8in. of the required colour has its top edge placed between the plywood front and the top flange. Temporarily fold this fabric over the knobs, so that the screws holding the front to the flange can be tightened. Also spread Bostik 1 or other adhesive along the top edge of the front. Screw the case bottom to the front. The fabric is then drawn taut over the whole front, and is folded over and fixed with adhesive at the case bottom, and front edges. The two sides are then fitted with bolts or screws.

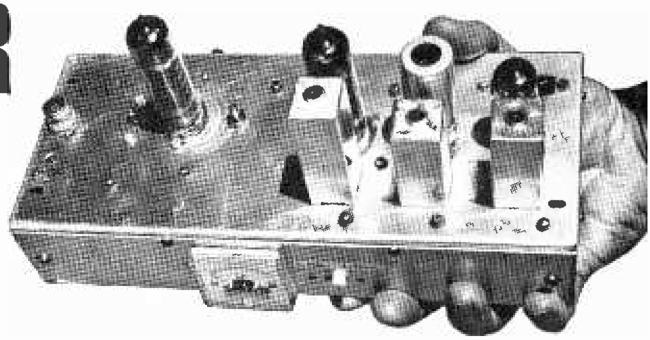
TUNING ADJUSTMENTS

The receiver is tested and tuned before fixing it in the case, as mentioned. If no signal generator is available, the i.f.t. cores are adjusted for best volume, any transmission being tuned in by means of a pair of trimmers. Once this has been done, the cores need no further adjustment.

When setting the trimmers for the wanted stations, deal with each pair of trimmers in turn, according to the position selected by the rotary switch. The position of the core of L3 has considerable influence on frequency, so needs to be left alone once a suitable setting has been located. VC1 is half closed while adjusting the trimmers.

Pre-sets having a range of 7-60pF will cover about 1500-1000kHz in aerial and oscillator positions. For oscillator tuning, 20-250pF trimmers will cover the remainder of the m.w. band, with 50-450pF trimmers for aerial tuning. For 200kHz, extra capacitance is necessary, up to about 450pF for oscillator, and 2,000pF for aerial circuits. ■

TRANSMITTER for 2 metres



PART 2 F. G. RAYER G3OGR

POWER SUPPLY/MODULATOR

This power-supply/modulator was made for use with the 2-metre Transmitter described last month, for which it will provide all power requirements, and adequate modulation. It is only necessary to insert an octal plug from the transmitter into the modulator. The modulator is designed to have other uses, to increase its utility, as follows:—

(1) It will supply approximately 12 to 15W of audio for one or more speakers.
(2) It will modulate a transmitter of up to about 25W d.c. input where the transmitter has its own power supply.
(3) It will supply power and modulation for a transmitter in the 10W power range.
(4) The modulator can be switched off, leaving 300V at 120mA available for, say c.w. working.
(5) Optional choke input drops the supply to about 240V for receiving equipment and similar uses.

An h.t. current meter is included to check working of the modulator and associated equipment, and an h.t. "ON" switch allows the modulator and a transmitter used with it to be switched on and off.

CIRCUIT

The circuit is shown in Fig. 1. The first section of the double triode 12AX7 is an amplifier for the usual type of crystal microphone, with contact potential bias from R1. Potentiometer VR1 is the audio gain or modulation level control. The triode 6C4 is a phase-splitter, driving the two 6BW6's of the output stage, V3 and V4. This is a very straightforward and troublefree circuit.

The h.t. circuit is well smoothed, by C10, C11 and L1 while R16 is a safety bleeder resistor. Some modification to working conditions can easily be made, if better suited to other associated equipment.

HT Voltage. With the values given, the h.t. supply is 300V when loaded to 120mA. If R14 and R15 are each 270Ω, the supply obtained is 280V when loaded with 100mA. A terminal board with pairs of small terminals is fitted under the chassis, so that the positive connection to C11 can be interrupted. The power supply then works as a choke input circuit, giving a reduced supply of about 240V at 120mA.

Output Stage. Operating conditions with cathode bias provide about 9 watts of audio with 250V, and about 12 watts with 285V. For modulating a transmitter the audio output required is about half the d.c. input of the transmitter, say 7 to 8 watts, for a 15 watt d.c. input. If wished, it will be found that R12 can be considerably increased in value, to reduce the current taken by the 6BW6's, without loss of audio quality.

Modulated HT. This is derived from the h.t. line and secondary of T1, the fixed ratio transformer being intended for a p.a. load of about 3 to 8kΩ.

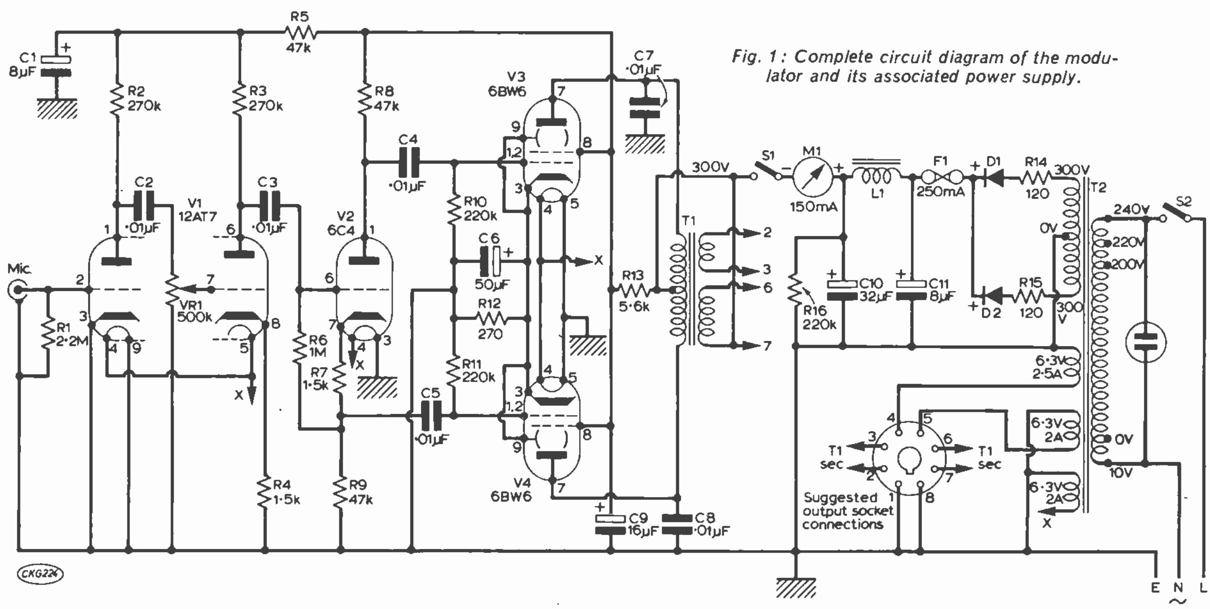


Fig. 1: Complete circuit diagram of the modulator and its associated power supply.

★ components list

Resistors

R1	2·2MΩ ¼W 10%	R9	47kΩ ½W 5%
R2	270kΩ ½W 10%	R10	220kΩ ½W 5%
R3	270kΩ ½W 10%	R11	220kΩ ½W 5%
R4	1·5kΩ ½W 10%	R12	270Ω 2W 10%
R5	47kΩ ½W 10%	R13	5·6kΩ 1W 10%
R6	1MΩ ¼W 10%	R14	120Ω 2W 10%
R7	1·5kΩ ½W 10%	R15	120Ω 2W 10%
R8	47kΩ ½W 5%	R16	220kΩ 1W 10%
VR1	500kΩ log. potentiometer		

Capacitors

C1	8μF 450VW	C7	0·01μF 750VW
C2	0·01μF 350VW	C8	0·01μF 750VW
C3	0·01μF 350VW	C9	16μF 450VW
C4	0·01μF 350VW	C10	32μF 450VW
C5	0·01μF 350VW	C11	8μF 450VW
C6	50μF 50VW		

Valves

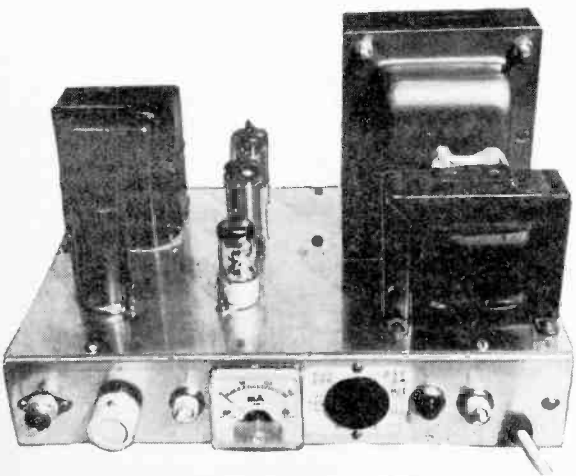
V1	12AT7	V3	6BW6
V2	6C4	V4	6BW6

MISCELLANEOUS

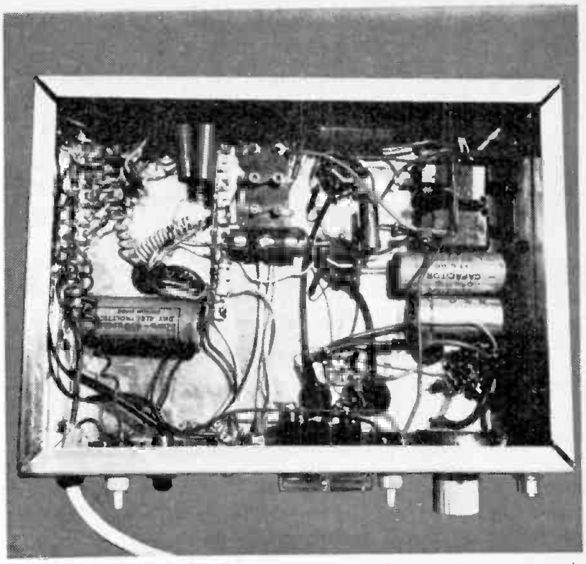
Valveholders, B9A with skirt and screening can (1), B9A plain (2) B7G with skirt and screening can (1). Meter M1, 150mA. Toggle switches (2). Microphone socket. Octal valveholder, for power outlet. Mains neon indicator. Fuse, 250mA and holder. D1/D2 silicon rectifiers, 1000 p.i.v. 1A or better. Chassis 10 x 7 x 2in. L1, about 10H at 120mA. T1, modulation transformer Type 223 (Garex, Chinnor, Oxon) T2, mains transformer to provide 300–0–300V at 120mA, 6·3V at 2·5A and 6·3V 2A twice (Douglas, Parmeko etc.).

A multi-ratio transformer may be used for other load impedances. The transmitter d.c. input is VxI, for example, 300V at 40mA or 12 watts. So the transmitter p.a. modulating impedance is approximately V/I or 300/0·04=7·5kΩ. (For the impedance calculation, remember to add the p.a. screen grid current to the p.a. anode current.)

Unmodulated HT. This is derived from the h.t. line, after the switch, to allow metering of the total h.t. drain, and control of h.t. to the transmitter. When using the 2-metre transmitter described, more grid current that required was available, so h.t. to the earlier stages was reduced to about 260V by placing a 1kΩ/2W resistor in series with pin 7 of the octal socket, Fig.1.



General view of the prototype chassis.



Underneath the chassis. Suggested layout of the major components should be followed. Otherwise component positioning is not particularly critical.

CONSTRUCTION

This is on a 10 x 7 x 2in. "universal chassis" so that the front runner can be prepared for the meter, etc., before it is fixed in position. Securing bolts for the mains transformer and modulation transformer also pass through the side and back flanges for additional strength and rigidity.

In the layout adopted, the microphone socket and VR1 are to the left, adjacent to the 12AX7 holder. Grid leads here are screened, and clear of heater wiring. The 6C4 is towards the centre, and the two 6BW6's in line towards the back, with the modulation transformer to the left, and the mains transformer to the right. This leaves the front right of the chassis for the smoothing choke. The only live circuits above the chassis are leads to the choke, and these were covered with tape.

The front runner carries the following, left to right:—microphone socket, VR1, h.t. switch, meter, octal socket, AC "ON" neon indicator, AC switch, and outlet for the mains lead. Transmitters, speakers or other associated equipment employ octal plugs wired to match.

The small terminal board mentioned has two terminals wired to the modulation transformer secondary, so that it can be shorted in a few moments with a wire link for c.w. when the same equipment is also used for a.m. If frequent changes are made from c.w. to a.m. in this way a switch can be placed across the secondary.

The modulator should never be used without a load connected to the modulation transformer.

AERIALS

The output of the transmitter can be matched into any of the usual aerials requiring a low impedance feed.

A simple dipole will give good results over local

—continued on page 540

EXPERIMENTERS CORNER

INTERCOMM CALLING SYSTEM

R. A. BUTTERWORTH

MOST intercomms use three wires or a complicated relay/switch system. The system described here uses only two wires and can be adapted to any amplifier already available providing it has both input and output transformers. The two wire cables connecting the units can be any cheap twin type. A bonus in this system is that only one *Slave* unit is necessary because by paralleling several pairs at a convenient junction point, communication can be had from any two points.

In the author's arrangement the *Master* unit is usually in the shack at the bottom of the garden but the *Slave* can be in the lounge (telephone) hall (door bell) and bedroom or kitchen. By moving the units and plugging in, communication can be had between any two locations. Another bonus is that the units consume current only when communication/calling is made.

OPERATION

Figure 1 is the full schematic of the author's unit to enable the reader to follow the way in which the unit operates. With SW3 "OFF", when SW1 or SW2, which are spring loaded, are pressed it causes a loud bleep in the other unit's loudspeaker in the following manner. If the master wishes to call the remote unit, SW1 is pressed, shorting contacts 5 and 6, thus completing the positive line through the primary of the input transformer/switch/speech coil of the loudspeaker to the common line. The amplifier is in operation and at the same time the current through the primary winding induces a low frequency note in the secondary which is amplified. Contacts 2 and 3 have been connected at the same time so that the *Slave* speaker is connected to the output of the amplifier so the resultant amplified audio note (generated in the input transformer) is heard in the *Slave's* speaker. Switch 3 is now operated to await the reply, if no response, put SW3 "OFF" and press SW1 again. Once contact is established, the *Master* controls all Speak/Listen operations and switches "OFF" SW3 ready for the next call. A similar operation takes place when the *Slave* wishes to call the *Master*. The 50μF electrolytic blocks what would otherwise be a direct d.c. connection but not the audio signal. It will become obvious that the *Master* can monitor the *Slave* by simply switching "ON" SW3 and so act as a baby alarm, telephone/door bell warning.

Any pair of miniature 3Ω speakers can be used and the transformers are a pair of miniature transistor single ended output (3Ω) types. The potentiometer VR1 is a preset skelton type, the required volume, once set, does not require further adjustment. As will be seen from Fig. 1, SW1 is a DP/DT type, SW2 is a SP/ST, and SW3 a simple ON/OFF type. Switches 1 and 2 are, of course, biased types (spring loaded); there are many varieties on the

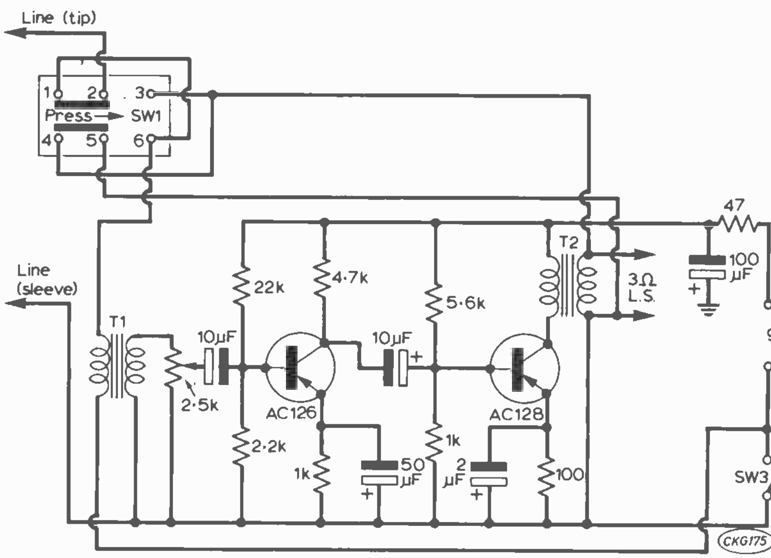


Fig. 1: The circuit of the Master unit—see text for an explanation of the unusual calling system.

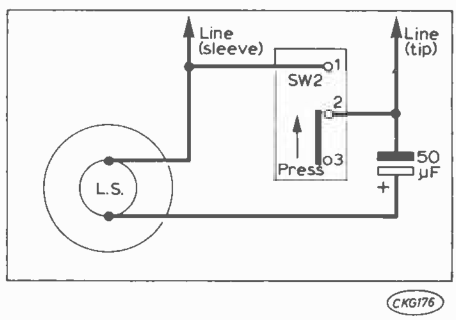


Fig. 2: The circuit of the Slave unit.

market, the most easily available is the toggle type, but the constructor has a choice.

As stated at the beginning, the main reason for offering yet another intercomm unit is the novel method of calling and the use of only two wires. This gives a versatile and flexible installation, well worth the few hours needed to construct. It may interest the reader to know that this method of calling was developed as a result of a mistake made when making up a conventional system and to the best of the writer's knowledge has never been used before. ■

25W D.C. to A.C. INVERTER

S. SOAR

THE inverter described here will operate 240V 50Hz appliances of up to 25W consumption. It was originally built to drive an electric shaver or a 25W soldering iron from a car battery.

The circuit is a simple resistance coupled inverter with a square wave output of 240V 50Hz.

Considering the circuit in Fig. 1, assume that Tr1 starts to conduct; voltage induced in N1 rapidly drives Tr1 into saturation and biases Tr2 off. Flux increases in the transformer core until saturation is reached which results in a sudden rapid increase in current in Tr1. This current exceeds the current which Tr1 can supply with the available drive, Tr1, therefore, comes out of its saturated state. Voltage induced in N1 falls to zero as the transformer core saturates and Tr1 is returned to the "off" state, this ends the first half cycle. Flux collapse in the transformer core results in an induced voltage in such a direction as to turn Tr2 on so initiating the start of the second half cycle.

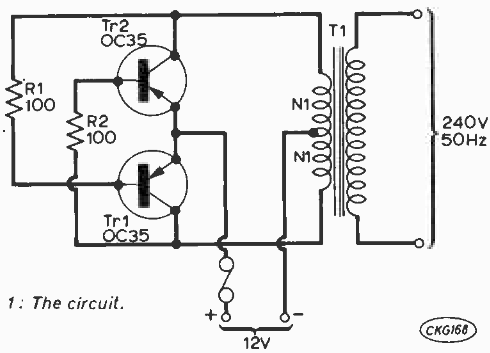


Fig. 1: The circuit.

Performance

No Load	......Input current 700mA (8·4W)
Load 15W	....Input current 2·0A, efficiency 62·5%
Load 25W	....Input current 2·8A, efficiency 75%.

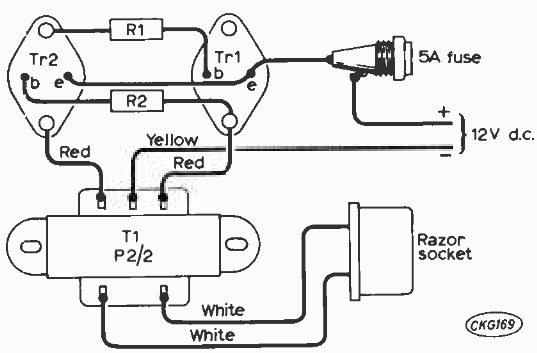


Fig. 2: Wiring of 25W inverter

★ components list

R1, R2	100Ω, 2W
Tr1, Tr2	OC35
Fuse	5 Amps
Transformer:	Type P2/2 available from Magtor Limited, 68 Dale Street, Manchester 1.

Construction is straightforward and operation is little affected by position of components. However, it is advisable to keep interconnections as short as possible to reduce inductance.

Since transistors Tr1 and Tr2 are not operating at maximum load, large heat-sinks are not necessary and the entire unit can be inserted in a metal case measuring only 3in x 3in x 4in. Care must be taken to ensure that the collectors of both transistors are isolated from each other, this can most easily be done by mounting these in the side of the case on insulating washers, alternatively a plastic case can be used.

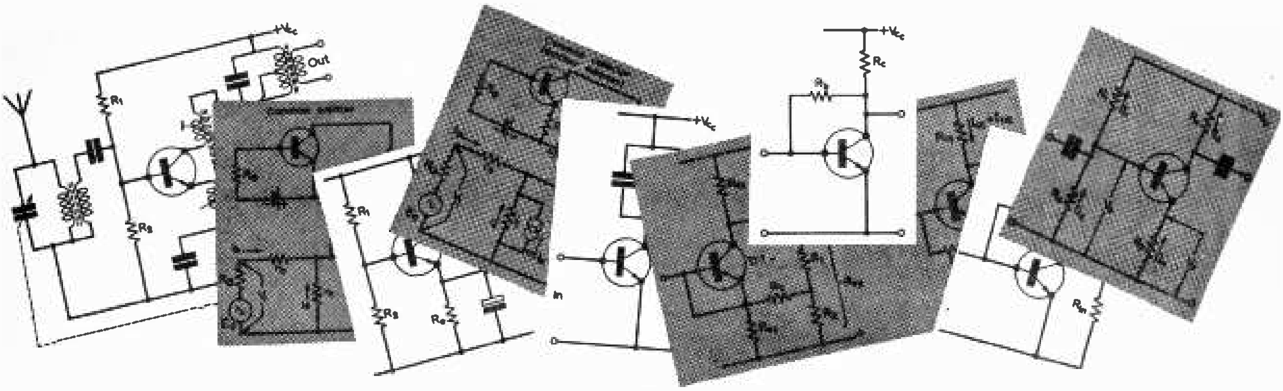
If a d.c. output is required, this can be easily obtained by connecting a bridge rectifier to the secondary, since the output is square wave, smoothing represents no problem and a capacitor of 2μF will suffice for most requirements.

It is not recommended that half wave rectification be used as this will tend to saturate the transformer core in one polarity only and this may cause malfunction of the inverter. ■

MAXWELL

by G8DSH

"—about eighty turns tapped ten turns up, please!"



TRANSISTOR CIRCUITRY for beginners

H.W. HELLYER & MICHAEL HOLLIER

PART 11

A breather

Before we can progress with our look at transistor circuits, we must halt, survey the battlefield of some of our illusions, and reconnoitre the lines of our next advance.

In other words, having taken single stage circuitry and combinations of stages, we must now consider the effect of the sub-circuits on those before and those after. The more we delve into transistor circuitry, the less we can regard each "block" as an entity unto itself. Black boxes, so beloved of the academic, are seldom darker than a shade of mottled grey when we come to put them into practice.

One such circuit concept, that seems primarily to make hay of basic theory, is the so-called "virtual earth".

We have reached a stage in our talk about circuits where we can see, without the aid of equivalent transistor circuits or little arrows showing electron flow, that the d.c. conditions and the a.c. conditions in any given configuration will be different, though interdependent.

As an example, consider the plain problem of decoupling. In your humble transistor radio you have a perfect example. As you bothered your neighbours on the beach with Bach's Partita and Fugue while all they wanted was to be Woganised (how I've longed to do that!) the signal current in the power supply circuits were being bypassed from the battery by a relatively hefty electrolytic capacitor. Fig. 55 illustrates this, and shows that the h.t. line is, as far as the a.c. signals are concerned, at the same potential as the chassis.

From there, it is a small step to think in terms of impedance and frequency rather than resistance and direct current when considering a signal-handling circuit.

Why, for instance, do we need that hefty capacitor back there, across the supply, when the decoupling of the tuner section is efficiently performed by a fraction of a microfarad? The answer lies in the frequency. At the supply, signal currents at audio frequencies are having to be bypassed, and 2000µF to a 100Hz signal is an impedance (a.c. resistance) of 0·81ohm.

At the front end, taking the FM radio that you, of course, will be using, despite the BBC's recent retrograde step to duplicate local radio on medium waves, the frequency you want to bypass is somewhere near a million times as great and so the capacitance need only be a millionth of the former, that is 2 picofarad against 2,000 microfarad, to have the same effect. Of course, to safeguard over a wider bandwidth, the actual value will be a couple of hundred picofarad,

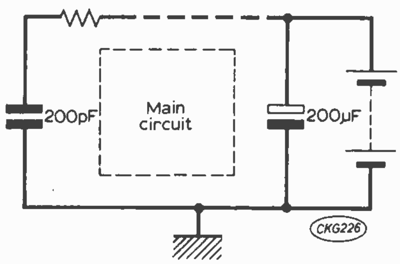


Fig. 55: Simple decoupling. The capacitors represent a virtual short-circuit to signal currents.

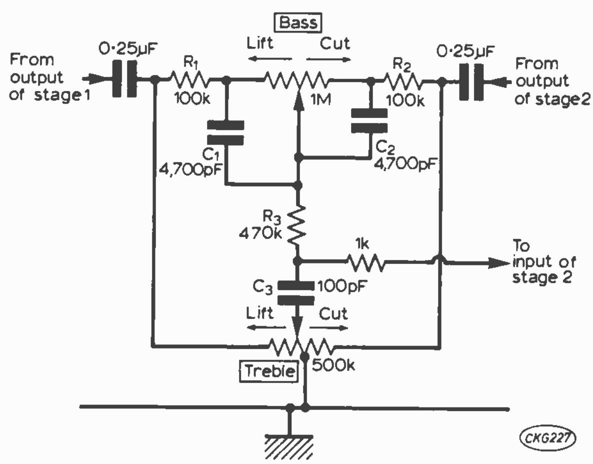


Fig. 56: The original Baxandall tone control circuit, to suit an input of less than 10kΩ, for use with an SP61 valve.

but the comparison—and the point—remains. When considering circuits, you must consider the effect of the a.c. signals they will be handling as well as the d.c. conditions that provide basic biassing, etc.

Virtual earths

Which brings us back to the concept of the virtual earth. Fig. 56 shows a simple circuit, again a practical one, and very familiar, that of the Baxandall tone control circuit, widely used in all sorts of constructions, and not always completely understood. If it serves no other purpose, it should remind us that Peter Baxandall dreamed this one up in 1952, based on an SP61 valve (or, in war surplus terms, a VR65).

The underlying reason for choosing such an example is (a) to make the opportunity of talking a bit more about feedback, (b) to introduce tone control circuitry, which will feature in our next constructional project and (c) to get over as well as we can, to satisfy a number of enquirers, the concept of the "virtual earth".

Feedback has featured already in our potted circuits, d.c. feedback to bring bias conditions to the operating state we require and a.c. feedback to regulate the signal flow through a stage, and, as we shall have to consider later, to make a stage non-linear in an especially controlled way (as, for example, in designing an RIAA corrected magnetic pickup pre-amplifier).

The whole point about the Baxandall tone control circuit, first considered in a *Wireless World* article of October 1952, is that its action depends on negative feedback and that it requires an understanding of the virtual earth concept to grasp its principles of operation. Having once got hold of this, we can step forward briskly into the world of "closed-loop gain" and "variable feedback control", which scares so many students away from what is really quite elementary circuitry. Incidentally, the virtual earth concept preceded Baxandall by quite a few years and he was quick to give credit to Professor F. C. Williams for the coining of the term.

Feedback

Enough waffling: Feedback is the principle of taking part of the output from a stage, or stages, and applying it to the input. If it is positive feedback, the signal you re-apply to the input is in phase, and thus aids the input, eventually driving the stage beyond its working limits. Control this positive feedback and you have a simple oscillator—the more output it delivers, the more it wants to deliver, until it blocks the stage off, things revert to normal, and away we go again.

But we are more concerned at this juncture with negative feedback. If you are audio-oriented (as you must have guessed by now that Mike and I are!) you will have read all manner of attributions for negative feedback. In the late Forties and early Fifties there were so many articles on negative feedback, interlaced with symbolic formulæ, that one would have imagined it could cure all amplifier ills from operator's twitch to the galloping parasitics!

In fact, the principle is simple: take off a portion of the output signal from a stage (or stages) and apply it to the signal in such a way as to oppose the input, i.e., in antiphase, and you have a method of

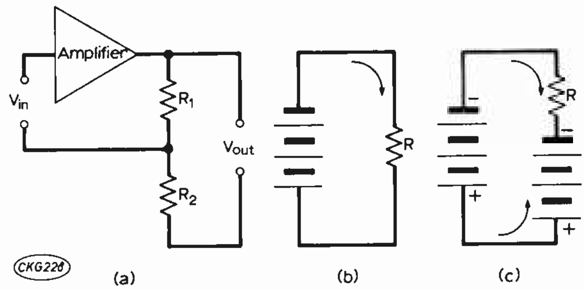


Fig. 57: (a) Negative feedback in series with the input signal. If R1 = R2 the gain is unity. (b) a battery analogy, with no feedback. (c) with feedback equal to the drive, voltage across R is virtually zero.

exercising control that depends on the nature of the input—it is to some extent, and within certain limits, self-regulating.

When we take a brief recap. of some previous articles in this series, we shall also appreciate that negative feedback from the output to the input of an amplifier stage *effectively changes the impedance* as well as reducing the gain.

This is important, and I am not going to insult regular readers by going, chapter and verse, over our earlier chats about R_{IN} and R_{in}, etc. But to summarise a few points, take a look at Fig. 57(a). Here we have an amplifying stage with a signal voltage applied and negative feedback in series with that input signal. (Again, this is important).

Let's assume, for easy figuring that the amplifier has an open-loop gain of 100. That's to say, it would increase its applied signal 100 times if there was no extra circuitry to consider. Then, commonsense tells us that if the values of R1 and R2 are the same, the gain will be unity, not 100 times, because the feedback is in series with the input. To get the hang of this, we have to look at things in terms of the impedance that the signal "sees". Fig. 57(b) shows a battery driving a current through a resistor. The battery "sees" the impedance of the resistor. But what if, Fig. 57(c), we put another battery of the same sort in series with R? We haven't changed the value of R but little or no current flows—so the *effective* impedance seen by the source voltage, the prime battery, is now high.

Back to the amplifier

Let's now get back to our amplifier with its feedback and instead of applying the feedback in series as before, we shall apply it in parallel, Fig. 58(a). Again, R1 = R2. But as the feedback is now in parallel with the input signal, we can see, applying the battery analogy, in Fig. 58(b) that it effectively shorts out the signal. In other words, adding V1 to V2 produces an *effective* zero.

Sorry about that repetitious word "effective", but if I say "this is zero", some pedant is going to hurl a wad of mathematical treatises at me to prove that Isaac Newton never went near the orchard, or something!

Go back to that mini-circuit of Fig. 58(a) and you can now see that the voltage at the junction X of R1 and R2 is very low indeed. Not zero, for we have to take into account the voltage across the amplifier, and the best we can say is that the voltage at this junction, R1/R2, is very low, virtually at

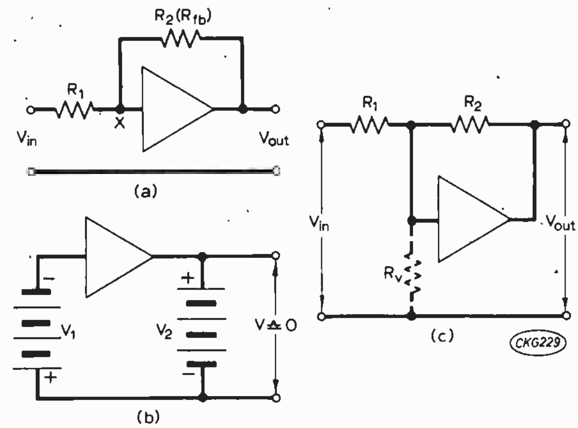


Fig. 58: (a) Parallel feedback, point X is virtual earth point. (b) battery analogy repeated. (c) choice of amplifier gain and resistors gives virtual impedance, dotted, between virtual earth point and true earth.

earth potential. Hence the term, virtual earth. From this, it follows that the input impedance of the circuit is low *at this point.*

Here, we have one of the bones of contention over which audio pundits have worried, and with which we shall not concern ourselves now—suffice to say, the source signal "sees" an impedance equal to R1 in parallel with whatever the virtual resistance R_v in Fig. 58(c) may be, while the amplifier sees an impedance of about R_v. And the beauty of this arrangement is that by juggling with amplifier gain and feedback component values, we can make the input match our source exactly, for best signal energy transfer conditions, while making our amplifier "see" a source resistance (impedance) that is just right for its job. In many audio applications, an impedance of around 600Ω would do us very nicely for lowest noise conditions, and this case can be met quite easily.

The important factor to remember is that the imaginary resistor we produce by the virtual earth application is approximately equal to the value of R2 divided by the amplifier gain. Its value is not affected by R1. There is no need for R1 and R2 to be equal in all cases, although we have chosen this circumstance for ease of explanation—the performance depends on the ratio between resistor values.

Back to Baxandall

So now back to Baxandall, and a circuit that originated from valved techniques.

This time we shall split the circuit into its "Lift" and "Cut" conditions first, showing the virtual earth points. Forget, at the moment, the tapped potentiometer of Fig. 56 and consider the treble lift circuit. This, shorn of all extraneous detail, could be redrawn as Fig. 59(a). If V_R is made low enough so that the voltage at the slider when in the middle of its travel is not affected by the current supplied by C (even at higher frequencies) then the total current flowing toward the virtual earth point, X, is I_1+I_2. I_1 is approximately equal to V_{in}/R_{in} and I_2 depends on the value of capacitance. If we make R_{fb} equal to R_{in}, merely to simplify combination of lift and cut control, and call this simply R, then the output voltage has one component independent of frequency, for a constant value of V_{in} while the other one, leading in phase by 90° is both proportional to frequency and to *k* which is the fraction of the potentiometer setting.

What this means, in practical terms, is that for any particular potentiometer setting the response of the cut circuit will be down by the same number of decibels as the lift circuit is up. As we know from Baxandall tone controls published many times before, the curves are a mirror image of each other. This is one of the virtues of the control.

The tapped control is just a convenience and it can be seen that there is actually a small voltage between the centre point of the practical circuit (Fig. 56) and virtual earth, across the capacitor. But its value makes this voltage practically negligible.

A look at the combined bass control in its simplified layout of Fig. 59(c) may help to understand better the working of the tone control. To give level

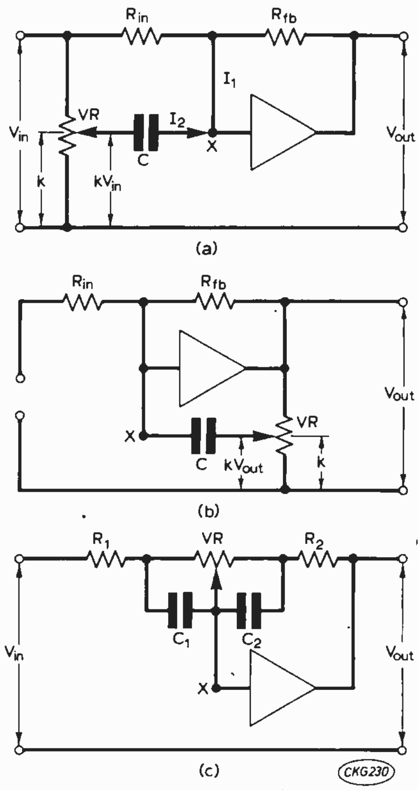


Fig. 59: Fundamental Baxandall treble lift circuit. (b) treble cut circuit. (c) bass lift and cut section of combined circuit.

response at mid-setting, R1 and C1 are the same as R2 and C2. At middle and high frequences the potentiometer, V_R is almost shorted out by the low reactances of C1 and C2, so we are back to Fig. 58(a) with $R_{in}=R_{fb}$ and unity gain. As the frequency of the signal falls, the gain rises (or, if the potentiometer setting is changed, falls to the level determined by the response curve), and, just as with the treble circuit, the curves are mirror images.

The symmetrical beauty of the finished control, with components calculated to suit Baxandall's original case, the VR65 valve, a high-gain pentode, can be seen in Fig. 56. One of the interesting points about its chosen values is that the treble response will be up or down 3dB at full lift or cut settings of the control when the reactance of C3 is numerically equal to R1 + 2R3. The values of C1 and C2 must be equal, as are R1 and R2, for reasons already stated, and values are chosen to give the correct bass response.

In practice

Coming to the present time, we can see an example of virtual earth circuitry used in the much-vaunted input stage of the Cambridge P40 amplifier, Fig. 60, where the aim was to get a high-gain, low-noise input amplifier, controlled so that the local feedback loop alters the gain, and thus provides a volume control right at the front of the circuit, in a low-signal level stage—just where we are told never to put it! The aim succeeded to some extent, because there was indeed a very low-noise result, and the overload capability, where most input amplifiers fall down badly, was a phenomenal 60dB.

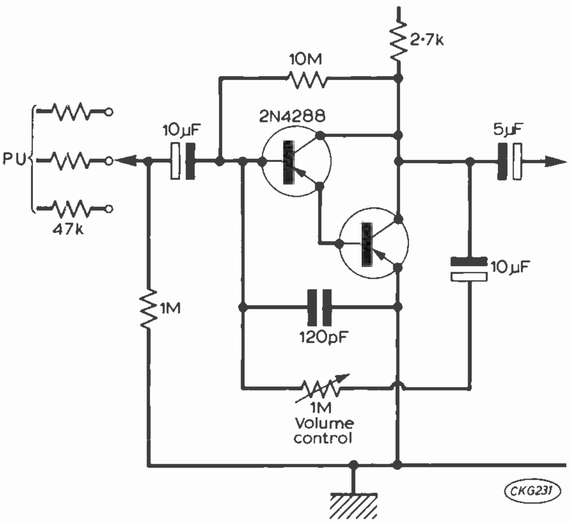


Fig. 60: Virtual earth input stage used in Cambridge P40 and P50 amplifiers.

But later versions of Cambridge amplifiers reverted to an uncontrolled input stage and put the virtual earth amplifier in the second stage, mainly because the original design gave a peculiar volume control "law". You see, the accepted use of a control is a 20dB attenuation when the knob is half-way from maximum (or the slider half retarded). By putting a twin-gang 1MΩ log law potentiometer in the virtual earth feedback circuit, Cambridge limited the attenuation to between 3 and 6dB for the same movement, with its action accelerating as it was turned farther down.

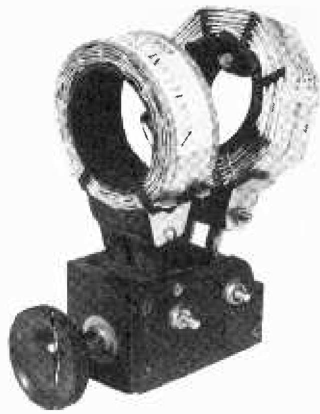
To get the range of input levels, the control had to be shunted with a 47kΩ resistor, except in the Pickup 1 mode, so except in this mode, only about three-quarters of the control action was effective. Later versions use a 50kΩ linear potentiometer to get the approximate log law (using the fixed resistor, 22kΩ, across part of it).

So we have now considered practical ways of using virtual earth circuitry, and can go on to the even more practical matter of building a circuit whose action may not seem quite so mysterious.

TO BE CONTINUED

GOING BACK...

1970 60 50 40 30 20



COLIN RICHES
ARTHUR DOW

DEVOTEES of this column will be highly delighted at the publicity currently being given by the Post Office to the 50th. anniversary of broadcasting in this country by issuing a set of three postage stamps to commemorate the event. Since we mentioned the subject in the last issue details of the stamps have been released by the Post Office and they are reproduced here.

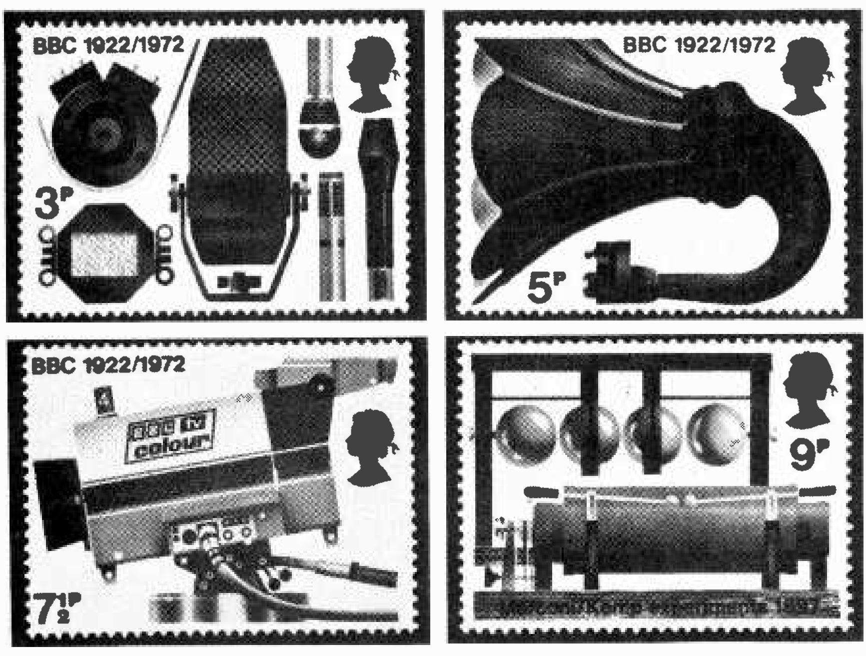
The 3p stamp depicts six of the many types of microphones used in broadcasting since 1922. Observant old-timers will recognise the Marconi-Sykes electromagnetic microphone of 1924 as well as the Marconi-Reisz carbon microphone of 1926 among the collection. On the 5p stamp a typical domestic wooden horn loudspeaker of the 1920's is illustrated. Some readers may recall the S.G. Brown conical horn speaker and the Amplion horn of the same period.

No doubt there are many of these speakers still hidden away in attics and cupboards so let us hope that this invaluable publicity will cause the public at large to appreciate the value and significance of these treasures from the early days of wireless and thus prevent their needless destruction.

The third stamp, for $7\frac{1}{2}$p, brings us right up to date with a fine illustration of one of the latest colour TV cameras as used by both the BBC and the independent TV companies.

The fourth stamp, to be issued at the same time as the other three, is for 9p and shows an early form of spark transmitter as used by Marconi in establishing wireless contact between Lavernock Point, Glamorgan, and Brean Down, Somerset, in May 1897. On the 75th. anniversary of this historic event the name of George Kemp is coupled with that of Marconi. Kemp was a Post Office engineer loaned to Marconi as a senior assistant. Their experiments resulted in the first successful tests over water and, incidentally, the first between two countries.

All four stamps are the work of David Gentleman who was also the designer of the Philympia series of stamps issued in 1970. The anniversary stamps described will be on sale on September 13th.



The 3p stamp is printed in several shades of grey with black, brown and yellow while the 5p stamp is grey, beige, red, brown, black and umber. The 7½p stamp featuring the TV camera also has several shades of grey combined with black and red. The 9p Marconi-Kemp commemorative issue combines light and blue grey with black, yellow and brown. A special first-day cover and two pictorial handstamps are being provided by the Post Office.

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz • Times in GMT

FOR a change this month I think it will be useful to all readers if we start with some news of DX stations around the world. The source of the information is Sweden Calling DXers and my own listening efforts.

BOLIVIA: The Bolivian station on 4845 is CP-72, *Radio Fides de La Paz.* This station is scheduled to broadcast from 1030 to 0330 GMT only but has been heard on an extended schedule. The station has also been heard in Europe on 4875kHz.

CP-103, *Radio 27 de Diciembre,* listed on 3350kHz is presently operating on 3439kHz with sign-off at 0215 GMT or later.

BRAZIL: The new European service from *Radio Nacional de Brasilia* has been noted on 15450kHz with weak signals and splash from *VOA, Monrovia,* on 15445kHz at 2245. The programme consists of Brazilian music and short talks in English, reports are requested.

MONGOLIA: Radio Ulan Bator has introduced a Russian service which is on the air on Tuesdays at 1030 and on Fridays at 1040. These broadcasts have been heard on 7260kHz, the station announces 41·3, 48 and 1321 metres.

PARAGUAY: ZPA-1, *Radio Nacional, Asuncion* can be occasionally logged on 4615kHz with special sports newscasts in Spanish after 2200 hours.

SWEDEN: Due to heavy interference on 15105kHz during the broadcasts in English and Swedish to the Far East at 1230-1330, *Radio Sweden* has moved this transmission to 17815kHz as from Thursday 22nd June. Reports will be much appreciated. A change of frequency for South Asia at 1400-1530 is also being considered.

The first report this month comes from **Mervyn Winters** of Greenisland, Co. Antrim who used an AR88 with a 12 foot whip antenna to pull in several interesting stations including:

4980 *Ecos del Torbes* in Spanish at 2350
4995 *R. Brazil Central,* LA music at 2340.
6030 *RSA, South Africa* noted at 2355.
6140 *RNE, Spain,* English to NA at 0110.
9570 *R. Australia* noted at 0714.
11620 *AIR, Delhi,* India at 1930.
11720 *R. Nacional de Brazilia* at 2307.
15018 *R. Hanoi,* N. Vietnam in English at 2015.
15190 *R. Ankara,* Turkey in English at 2200.
21570 *R. Japan* in English to Europe at 0800.
21605 *R. Kuwait* in Arabic at 0900.

Roger Hunter of Carmarthen has added a PR 30 preselector to his Codar CR-70A receiver enabling him to hear the following stations:

6025 *R. Portugal* in English at 2058
6080 *R. Berlin International* at 2145.
7235 *R. Australia* with Newsreel at 1000.
9009 *Kol Israel,* 'In the Jewish World' at 2115.
9640 *TWR, Monte Carlo,* DX programme at 0945.
11755 *R. Finland* in English at 1815.
15105 *R. Japan,* news and comment at 2000.
17735 *R. Free Europe,* music at 1740.
21545 *R. Ghana,* talk in English at 1050.
21595 *CBC, Canada* in English at 1900.

Michael Berry of Dewsbury in Yorkshire has again used his outdoor vertical wire and Eddystone EB-35 receiver to good effect, hearing:—

3264 *R.T.V. Congolaise* noted at 1910.
4765 *R.T.V. Congolaise* in French at 2100.
4832 *R. Capital, Costa Rica* in Spanish at 0205.
4880 *R. Once Sesenta,* Peru in Spanish at 0335.
4940 *R. Yaracuy, Venezuela,* Spanish at 0135.
4965 *R. Santa Fe, Colombia,* Spanish at 0430.
4970 *R. Rumbos, Venezuela,* Spanish at 0435.
4980 *Ecos del Torbes,* Ven., Spanish at 0025.
5030 *R. Reloj Continente,* Ven., Spanish at 0310.
6255 *Schulungssender, Austria,* German at 1245.
11862 *R. Lubumbashi,* Zaire in French at 1655.
11865 *R. Club Pernambuco,* Brazil at 0330.

Nigel Knowlman of Cullompton in Devon has a Lafayette HA-600A and a 50 foot inverted L antenna, this combination enabled him to hear the following stations:—

11520 *R. Bangladesh* in English at 1745.
11720 *R. Nacional de Brazilia* in English at 0700.
11940 *R. Bucharest, Romania,* English at 1300.
11955 *FEBA, Seychelles* in English at 1730.
15170 *Beirut, Lebanon* in English at 1830.
15185 *Voice of Nigeria,* English at 0700.
17655 *R. Cairo, U.A.R.,* English at 1800
17815 *HCJB, Quito, Ecuador,* English at 1945.

Next month the series of instructional articles for newcomers will continue with a discussion of the various types of aerials. This will include details of construction and the advantages and disadvantages of the various types.

Reports should arrive by the 15th of the month and be addressed to me at 5 Ranelagh Gardens, Cranbrook, Ilford, Essex.

OUR "CQ" COLUMN

If you wish to have a "CQ" request in *Practical Wireless*, we would be grateful if you could write it out in the same style we print it. This helps us to help you by saving time trying to take extracts from long letters and deciphering names and addresses.

ON THE SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

IT'S September already and the summer has almost gone. This is sad news for the sun bathers but good news of the l.f. enthusiasts. How about having a really good "go" at topband this year? Once the leaves turn and the darker evenings arrive you can be sure of hearing a few interesting tweets on 160 metres. Quite a number of European countries are active as are stations from further afield. You only need to monitor the bottom 50kHz of the band (i.e. from 1800kHz to 1850kHz) to hear quite a bit of topband d.x. The American stations are usually active at the very edge of the band and usually on c.w. Stewart, W1BB, is a good one to listen for and a few VO and VE stations have put in an appearance from time to time.

Czechoslovakia is a country well represented on 160 metres. Apparently, novice licences are awarded and OL stations are limited to 10W on 160 and 2 metres. What a splendid idea. There was a time when the British Post Office exercised its wisdom and imposed a 10W limit plus c.w.—only for the first year —Ah, happy days. Rumour has it that LU (Argentine) EL and ZS will be in evidence on 160 metres which should offer a challenge from sitting comfortably on 14MHz and just letting the d.x. drop into ones lap.

Letter from **Peter Martin** (Nottingham) informs that KR6 stations are now signing KA6 and that 7P8AM is on from Lesotho—anyone heard him yet? He also mentions the RSGB news Bulletin Service. The latter is broadcast on Sundays on both eighty metres and two metres and is put out from various parts of the country, so you should have no problems in receiving all the latest information on Amateur radio, both for licensed operators and s.w.ls. Time depends on which area you're in. However, try listening on 3·6MHz at 0930 for transmissions from Bromley in Kent.

Speaking of the RSGB, don't forget that many of its members put out special slow morse transmissions to help those trying to get up to the magic twelve words/minute. These stations are on from all over the country and at many different times. There is almost certainly somebody on in your locality—usually on topband. The RSGB will give you all the information (you get this and many other things all the time if you become a member).

Alan Smith (Nelson) took "one of my rare trips down on to eighty metres". Reward was ZD8RR at 5 and 7 but Alan queries the authenticity of this station. Any offers? Gear in use is a JR310 and a twiddle on twenty revealed squirts of s.s.b. from;; CE3AIU, CO2FA, CX2AL, CX2BR, EL2GY, FC9VN, FM7WN, HC1HV, HC1SS, HC2HM, HK3COC, HK6CBS, HV3SJ, LU3FAQ, LX1DV, OD5HD, PY2BCQ, PY4EP, PZ6AA, SL2ZZM, TI2FCD, TI8PE, TR8GD, VE1RB, VE2WY, VE3BYI, VE5AZ, VE7MT, VE7YF, VK2AVA, VK2BHR, VK3MO, VK4SD, VK5DK, VK6TW, VK7RX, VO5GJ, VP1TB, VP2GB, VP2MZ, VP7NO, VP9HA, VQ9MC, VQ9R, VR1FL, VU2HLU, W8JXM, W9YRA, XE1DO, XE1EH, ZD3D, ZD7SD, ZE1CS, ZE6JS, ZL1GY, ZL2FA, ZL4CO, ZM2TG, ZP5CF, 4X4NJ, 4X4VB, 8P6EK, 9J2DT, 9K2CA, 9K2CI, 9M2CP, 9M2CW, 9V1QJ. Antenna was a sneaky sixty foot end fed.

R. Dickens (Shepherds Bush) has a "modified" R1155 and a 20ft. aerial. He reports signals from many EU stations on 3·5MHz but also includes a couple of goodies heard in the form of M1B and 6W8DY. Best on 7MHz was 4U1ITU.

G. Benson (G8FBL) tells gleefully of contacts made by special station GB3CRC run by the Chad Radio Club, Lichfield. Over 300 contacts were made including chats on 21MHz with CT2BG, CX4CR, HC1RF, 7Q7BQ, 9H1DL, 9J2TB and 9Q5RA—no mention of mode. (Don't tell me, brightly coloured flags and it was a clear day!)

"I wonder how much of the inside is original", says an unsigned letter from **Nicholas Dean** of Loughborough. The antenna is a 20 metre bow tie (bet it suites you and, of course, you'll get d.x. in necks to no time) at 20ft and fed into an a.t.u. It is then pressed into service on 3·5MHz. Signals received from; CE8AA, CN8BQ, CT1HE, CT2BG, PY2FYQ, ZB2A, ZL6MP, ZS1MH, 4X4UF, 7X0GF, 9Q5BJ.

Graham Armstrong (Jedburgh) reports hearing some good EU d.x. on topband; DL5XF, GI3GRD, GW3UPK. He reports a station on c.w. signing 2LO which will doubtless raise a smile. (LO LO, what's all this then?). Anyone else hear this character? Apparently he was on for at least a week.

David Lawley (Gravesend) sends in some interesting sigs heard on 160 metres. Among the c.w. offerings are; DL9KR, EI9J, EL2CB, GC3ZES/A, GM2HCZ, GW3UCB, OK1HBT, OL1AOH, OL1APC, OL5APO, PA0PN (on s.s.b.).

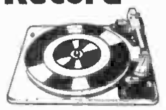
B. Spencelayh (Enfield) has got his version of the Deluxe 9/12 receiver (*PW* April/May 1972) perking. First attempts on 21MHz brought sigs from; EA3SA, HB9AJO, JA4BLY, OD5LX, VQ9MC, WA1JTT, W9YFV, 4X4HK, 4Z4MO, 5H3JL, 9J2SS, 9M2DQ.

Happenings for September include the Harlow Mobile Rally on September 24 at Magdalen Laver, near Harlow. Contests in my little black book inculude: September 9-10, WAE phone contest; 10, 3·5MHz field day; 17, final d.f. round at Oxford.

ELECTRONICA 72

Electronica 72, recognised by many as the most important trade fair in the electronics industry, will take place this year at Munich, Germany, from November 23-29. Included in the exhibits will be components and assemblies, production facilities, testing apparatus, information and training. Running at the same time as the exhibition will be the conference Mikroelektronic consisting of some 40 lectures.

Garrard Record Players



SP25 Mk. III
Deck Only
4 speed
Automatic Single Player
Lasky's price **£11·50**

Garrard SL95B Deck	£35·00
Add £9·00 for Garrard Base & Cover. C & P £1·50	
Garrard AP76 deck only	£23·00
Garrard 40B deck only	£9·50
complete with stereo cartridge	£11·50
Garrard SL55B deck only	£9·00
Garrard 2025TC deck only complete with KS40A stereo ceramic cartridge	£7·95
Garrard ZERO 100 Automatic	£43·50 C & P £1·50
Garrard ZERO 100S Single Player	£42·75 C & P £1·50

Garrard Plinths & Covers

WB4 Mk. II Plinth	£5·45
SPC4 Mk. II cover	£4·25
Price together	£8·70
WB1 Plinth	£3·70
SPC1 cover	£3·60
Price together	£6·50

SP 25 Package

SP25 Mk. III Single player	List	£15·85
AD76K stereo magnetic cartridge	List	£4·35
Lasky's teak plinth & cover	List	£4·75
Total List Price		£24·95

Package Price £18·50

AP 76 Package

AP76 Single Player	List	£29·26
SHURE M44E Cartridge	List	£8·59
Lask's Base and Cover	List	£5·95
Total List Price		£43·80

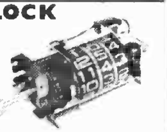
Package Price £35·00

CARRIAGE—all units
DECK ONLY 50p. PLINTH & COVER ONLY 25p.
DECK WITH PLINTH AND COVER 75p.

TWO BAND CAR RADIO

W1/700 MW/LW
By famous maker
Two waveband all transistor car radio that covers full Medium and Long wavebands with slide switch wave change. Large easy to grip controls. Illuminated dial with "easy to read" scale. Externally adjustable aerial trimmer. Powerful output through either one or two speakers. Operates on 12 volt D.C. Negative or positive earth. Standard size 6¼in (W) x 4¾in (D) x 2in (H). Black with chrome trim. **Complete with speaker, baffle, leads, mounting brackets.**
LASKY'S PRICE **ONLY £7·50** C & P 25p

NEW DIGITAL CLOCK NOW WITH ILLUMINATED DIAL EXCLUSIVELY FROM LASKY'S

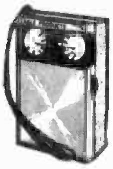


The clock measures 5¾ W x 2¾ H x 3in D (overall from front of drum to back of switch). SPEC.: 210/240V a.c. 50Hz operation; switch rating 250V, 3A. Complete with instructions. ● **COMPLETE WITH KNOBS. FEATURES: ● MAINS OPERATION ● 12-HOUR ALARM ● AUTO "SLEEP" SWITCH ● HOURS, MINUTES AND SECONDS READ-OFF ● FORWARD AND BACKWARD TIME ADJUSTMENT ● SILENT OPERATION ● SHOCK AND VIBRATION PROOF ● BUILT IN ALARM BUZZER**
SPECIAL QUOTES FOR QUANTITIES LASKY'S PRICE **£6·75** C & P 25p

SINCLAIR PHASE LOCK LOOP STEREO FM TUNER

Incorporates varicap diodes, printed circuit, coils, squelch circuit I.C. Decoder, etc., supplied completely built and tested and ready to be mounted into any cabinet you choose. It may be used with any High Fidelity Amplifier. Power requirements 25/30V DC. Size 8¼" x 1¼" x 3¾".
LIST PRICE £25·00 LASKY'S PRICE **£15·75** C & P 25p
PZ5 power supply £4·15 extra.

EAGLE AM/FM POCKET TRANSISTOR RADIO



This super compact two-band radio **ORIGINALLY COST £9·81! The ideal pocket set for all ages. Receives all Med. wave and FM stations (local news, etc.) —separate tuning scales. Grey/chrome trim cabinet with carry strap. Excellent tone. Uses single PP3 type battery. Telescopic FM aerial.** Size: 4½ x 2¾ x 1⅜in. comp. with battery and ear-piece.
LIST PRICE £9·81 LASKY'S PRICE **£4·75** C & P 15p

LASKY'S NEW LOW NOISE CASSETTES FROM THE USA

Type	Single	5	10	15
C60	28p	£1·37	£2·70	£3·99
C90	38p	£1·86	£3·67	£5·42
C120	48p	£2·35	£4·63	£6·84

Each cassette individually boxed in Philips, type plastic library.
C & P: each 7p, 5—25p, 10—40p, 20—68p.

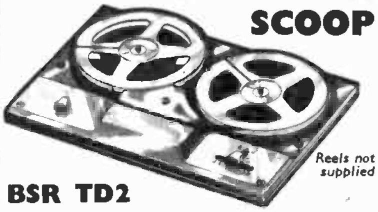
Leak Speaker "Scoop"

Leak 150 Speakers
List price £49·00 per pair
Lasky's Price **£38·95** C & P £2·00

Leak 250 Speakers
List price £63·00 per pair
Lasky's Price **£48·95** C & P £2·00

Leak 600 Speakers
List price £99·00 per pair
Lasky's Price **£68·75** C & P FREE

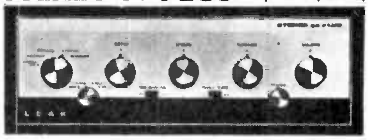
BSR TAPE DECK SCOOP



Reels not supplied

BSR TD2
FANTASTIC VALUE, ONLY Lasky's can offer you a tape deck at such an amazing price. The BSR TD2 tape deck operates by a simple reliable mechanism using the minimum of controls.
Available with ½ track or ¼ track mono or stereo heads. Incorporates fast wind and fast rewind, records at 3¾ ips. giving up to 3 hrs playing time, takes up to 5¾in. spools. Size 13in. x 8⅞in. front to rear, 2⅞in. below plate, 1⅝in. above plate.
ALSO SUITABLE FOR USE AS A TAPE TRANSPORTER
LASKY'S PRICE **£8·95** C & P 35p

LEAK BARGAINS
STEREO 30 PLUS amplifier (cased)

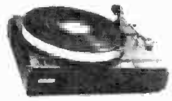


List Price £62·50 PRICE **£43·95** C & P 75p

STEREO 70 amplifier (cased)
List Price £75·00 LASKY'S PRICE **£54·95** C & P 75p

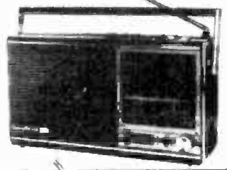
LEAK WOOD CASES
Teak or walnut case for Stereofetic tuner only.
List Price £7·37 LASKY'S PRICE **£2·50** C & P 35p
Teak or walnut double case for Stereo 30 or Stereo 70 and Stereofetic tuner.
List Price £10·37 LASKY'S PRICE **£4·95** C & P 35p

LEAK TRUSPEED



2 speed belt drive turntable comp. with plinth, cover and SHURE cartridge.
LIST PRICE £69·50
LASKY'S PRICE **£47·50** C & P £1·50

RADIO BARGAINS
Nordmende Galaxy 4000
AM/FM/LW/SW Battery/Mains Portable Radio
Both these sets offer fantastic quality and almost unbelievable value! Each superbly finished in teak black and chrome. Covers medium, long and FM waves plus 3 band spread short wave ranges. Fitted with slider volume and tone controls. Size: 13¼ x 7¾ x 3in. Power: Batteries/Mains 220/240, 50/60Hz.



ORIGINAL LIST PRICE £49.50
LASKY'S PRICE **£36·50**
C & P 25p

Nordmende Galaxy 6000
ORIGINAL LIST PRICE £69.50

AM/FM/LW/SW Battery/Mains Portable Radio
Covers medium and long waves, FM (local) and world-wide short waves cover in 6 band ranges. Size: 16½ x 8 x 3in. Filter switch, ext. speaker socket, tape record and record player socket. Batteries or 220/240v. Mains, 50/60Hz.
LASKY'S PRICE **£44·50** C & P 35p

Lasky's Radio Limited

Branches
207 EDGWARE ROAD, LONDON, W.2 Tel: 01-723 3271
33 TOTTENHAM CT. RD., LONDON, W.1 Tel: 01-636 2605
Open all day 9 a.m.-6 p.m. Monday to Saturday
152/3 FLEET STREET, LONDON, E.C.4 Tel: 01-353 2833
Open all day Thursday, early closing 1 p.m. Saturday

The Home of High Fidelity
42-45 TOTTENHAM CT. RD., LONDON, W1 Tel: 01-580 2573
Open all day 9 a.m.-6 p.m. Monday to Saturday
NEW CITY BRANCH *NOW OPEN*
109 FLEET STREET, LONDON, E.C.4 Tel: 01-353 5812
Open all day Thursday, early closing 1 p.m. Saturday

LASKY'S RADIO OVER 38 YEARS ESTABLISHED

ALL MAIL ORDERS AND CORRESPONDENCE TO: 3-15 CAVELL ST. TOWER HAMLETS, LONDON, E.1 Tel.: 01-790 4821

Fully guaranteed Individually packed VALVES

B12H	£1·75	ECH84	45p	N78	£1·75
CY31	35p	ECH200	62p	OA2	35p
DAF96	43p	ECL80	45p	OB2	35p
DF96	45p	ECL82	35p	PABC80	37p
DK96	48p	ECL83	70p	PC97	45p
DL92	32p	ECL86	40p	PC900	48p
DL94	45p	EF36	45p	PCC84	40p
DL96	45p	EF37A	£1·25	PCC89	50p
DM70	30p	EF40	50p	PCC189	55p
DY86	33p	EF41	65p	PCE800	75p
DY87	32p	EF80	25p	PCF80	30p
DY802	48p	EF83	55p	PCF82	33p
E88CC/01		EF85	35p	PCF84	60p
	£1·00	EF86	30p	PCF86	60p
E180CC	42p	EF89	28p	PCF200	75p
E181CC	90p	EF91	30p	PCF201	75p
E182CC		EF92	35p	PCF801	50p
	£1·20	EF95	35p	PCF802	50p
EA50	20p	EF183	30p	PCF805	80p
EABC80	32p	EF184	35p	PCF806	70p
EAF42	55p	EFL200	75p	PCF808	85p
EB91	18p	EL34	50p	PCH200	70p
EBC33	50p	EL41	60p	PCL81	47p
EBC41	52p	EL42	58p	PCL82	35p
EBC81	30p	EL84	25p	PCL83	65p
EBF80	40p	EL85	42p	PCL84	42p
EBF83	40p	EL86	40p	PCL85	42p
EBF89	30p	EL90	35p	PCL86	43p
ECC81	30p	EL95	35p	PFL200	66p
ECC82	28p	EL500	85p	PL36	53p
ECC83	30p	EM31	25p	PL81	50p
ECC84	30p	EM80	40p	PL82	40p
ECC85	40p	EM84	35p	PL83	42p
ECC86	45p	EM87	70p	PL84	35p
ECC88	37p	EY51	40p	PL500	73p
ECC189	52p	EY86	40p	PL504	75p
ECF80	35p	EY81	40p	PX4	£2·50
ECF82	35p	EY88	40p	PY33	60p
ECF83	75p	EZ41	50p	PY80	35p
ECF801	62p	EZ80	25p	PY81	27p
ECF802	62p	EZ81	27p	PY82	35p
ECH35	90p	GZ34	58p	PY83	35p
ECH42	75p	GZ37	70p	PY88	37p
ECH81	28p	KT66	£2·05	PY800	40p
ECH83	45p	KT88	£2·40	PY801	50p

29/41ft. AERIALS each consisting of ten 3ft. ⅞in. dia. tubular screw-in sections. 11ft. (6-section) whip aerial with adaptor to fit the 7in. rod. Insulated base, stay plate and stay assemblies, pegs, reamer, hammer, etc. Absolutely brand new and complete ready to erect. In canvas bag £4. P. & P. £1·50

METERS Full List of our very large stock of meters on request.

SPECIAL OFFER p & p **O9J TUBE £2·50** 50p

TRANSISTORS, ZENER DIODES etc.

OA5	20p	OC71	12p	1N823A	£1·30	3N154	95p	BC108	10p	GET115	45p
OA10	25p	OC72	20p	1N4785	50p	3N159	£1·45	BC113	10p	GET116	50p
OA70	10p	OC73	30p	1ZMT5	35p	6FR5	45p	BC118	20p	GEX66	£1·50
OA71	10p	OC75	25p	1ZMT10	33p	12FR60	73p	BCY72	15p	NKT222	20p
OA73	7p	OC76	25p	1ZT5	67p	40954	£1·25	BF115	25p	NKT304	50p
OA74	7p	OC81	20p	1ZT10	63p	40595	£1·25	BF173	20p	RAS310AF	
OA79 (6D15)		OC81D	20p	2G385	51p	40636	£1·25	BFY51	20p		33p
	10p	OC81DM	20p	2G403	51p	40668	£1·25	BFY52	20p	SD918	26p
OA81	8p	OC82	25p	2N918	37p	40669	£1·40	BS	45p	SD928	31p
OA91	7p	OC82DM	30p	2N1304	22p	AC126	25p	BS2	47p	SD938	32p
OA200	7p	OC83	25p	2N1306	25p	AC127	25p	BSY29	25p	SD94	21p
OA202	10p	OC83B	15p	2N1307	25p	AC128	20p	BU100	£1·80	SD988	46p
OA210	25p	OC84	25p	2N2147	64p	AC176	20p	BYZ13	25p	V405A	40p
OA211	30p	OC122	50p	2N2411	£1·50	ACY17	25p	BYZ16	68p	Z2A51CF	78p
OAZ200	55p	OC139	25p	2N2904A	25p	ACY28	17p	CR81/10	25p	ZR11	33p
OAZ201	50p	OC140	40p	2N2989	£4·00	AD149	50p	CR81/20	38p	ZR21	46p
OC16	50p	OC170	25p	2N3053	20p	AD161	35p	CR81/30	40p	ZR22	42p
OC22	50p	OC171	30p	2N3054	50p	AD162	35p	CR81/35	43p		
OC25	40p	OC172	37p	2N3055	64p	AF118	50p	CR81/40	48p		
OC26	25p	OC200	40p	2N3730	50p	AF127	20p	CR83/05	30p	**ZENER**	
OC28	60p	OC201	75p	2N3731	£2·75	AF139	30p	CR83/20	38p	**DIODES**	
OC29	60p	OC206	95p	2N4172	50p	AF178	48p	CR83/30	43p		
OC35	50p	IN21B	30p	82303	50p	AF186	40p	CR825/025		All preferred	
OC36	56p	IN25	60p	3F100	62p	ASY26	25p		55p	voltage	
OC38	42p	IN43	10p	3FR5	32p	ASY28	25p	CR83/40	50p	¼W	0·17
OC44	17p	IN70	7p	3N128	87p	ASY67	48p	C82A	65p	1W	0·37
OC45	12p	1N677	12p	3N139	£1·75	BAW19	28p	CV102	25p	1·5W	0·25
OC70	12p	1N702-725	36p	3N140	97p	BC107	10p	GET103	23p	7W	0·40

QQV03-10		UAF42	55p	UY85	40p	3S4	35p	6AK8	32p	6BG6G	55p
	£1·25	UBC41	47p	VR105/30	35p	3V4	45p	6AL5	15p	6BJ6	45p
QQV06-40A		UBF80	40p	VR150/30	35p	5B254M	£2·20	6AL5W	40p	6BQ7A	40p
	£5·40	UBF89	35p	Z801U	£2·00	5B/255M		6AM6	30p	6BR7	85p
R17	48p	UCC85	40p	Z803A	£1·25		£2·00	6AN8	50p	6BW6	85p
R19	37p	UCF80	55p	Z900T	95p	5R4GY	75p	6AQ5	35p	6BW7	80p
STV280/40		UCH42	70p	IL4	15p	5U4G	35p	6AQ5W	50p	6C4	30p
	£3·40	UCH81	40p	IR5	40p	5V4G	45p	6AS6	37p	6C6	25p
STV280/80		UCL82	35p	1S4	40p	5Y4G	40p	6AS7G	80p	6CH6	55p
	£9·00	UCL83	60p	1S5	30p	5Y3GT	35p	6AT6	30p	6CL6	49p
TT21	£8·00	UF41	50p	IT4	22p	5Z3	55p	6AU6	25p	6D6	20p
U25	80p	UF80	36p	1X2A	40p	5Z4	75p	6AX4GT	60p	6EA8	55p
U26	80p	UF89	40p	1X2B	50p	5Z4GT	40p	6AX5GT	70p	6F23	75p
U27	50p	UL41	65p	2K25	£7.50	6AB7	30p	6B7	40p	6F33	£1·50
U191	78p	UL84	60p	3A4	35p	6AC7	30p	6BK7	60p	6H6M	20p
U801	80p	UU5	55p	3D6	15p	6AH6	50p	6BA6	25p	6J4WA	75p
UABC80	35p	UY41	65p	3Q4	45p	6AK5	30p	6BE6	30p	6J5	40p

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves. U.K. P. & P. Up to £1 12p, £1-£2 17p, £2-£3 22p. Over £3 post free. C.O.D. 20p extra.

Integrated Circuits—Many others in Stock

RCA, CA 3005 wide band R.F. Ampl. 300mW diss £1·20
CA 3012 wide band ampl. 150m W diss .. .. £0·90
CA 3020 Audio power ampl. .. .. .. £1·20
CA 3036 Audio pre-ampl. .. .. £0·75
General Electric PA 222 £3·25; PA 234 £1; PA 237 £1·85
Mullard TAA 263 £0·75; TAA 320 73p
MOTOROLA MC 1435p £2·25; MC 170GCG £1·15

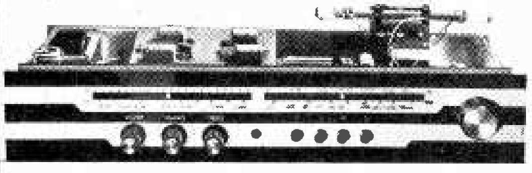
COLOMOR ALL valves guaranteed

6J5GT	25p	19G3	£4·25	6065	65p
6J6	20p	19G6	£1·50	6080	£1·50
6J7G	35p	19H4	£5·00	6146	£1·75
6J7M	40p	20P4	£1·00	8020	£2·25
6K6GT	56p	25L6GT	40p	9001	20p
6K7	32p	30C15	80p	9002	25p
6K7G	20p	30C17	90p	9003	50p
6K8GT	40p	30C18	80p	9004	15p
6K25	70p	30F5	85p	9006	15p
6SA7	40p	30FL1	75p		
6SA7GT	32p	30FL12			
6SC7GT	25p		£1·20	**C.R. Tubes**	
6SG7	35p	30FL13	50p	VCR97	
6SJ7	37p	30FL14	85p		£4·50
6SJ7GT	32p	30L15	85p	VCR517B	
6SK7	40p	30L17	80p		£5·50
6SL7GT	32p	30P12	80p	VCR517C	
6SN7GT	32p	30P19	85p		£7·50
6SQ7	39p	30PL1	75p	5FP7	£1·32
6SQ7GT	35p	30PL13	92p	88D	£9·00
6V6G	17p	30PL14	90p	88J	£9·00
6V6GT	40p	35L6GT	50p	88L	£9·00
6X4	30p	35W4	35p		
6X5G	30p	35Z4GT	45p	**Photo Tubes**	
6X5GT	37p	50C5	50p	CMG25	
6Y6G	60p	50CD6G	70p		£2·75
6-30L2	80p	50EH5	60p	931A	£4·00
6Z4	38p	75	40p	6097C	
7B7	45p	76	40p		£17·50
7Y4	60p	78	40p		
9D6	37p	80	50p		
11E2	£2·80	723A/B	£7·00	**Special Valves**	
12AT6	30p	803	£3·25	CV2339	
12AT7	30p	805	£8·00		£20·00
12AU7	29p	807	50p	JP9/7D	
12AV6	38p	813	£3·75		£37·50
12AX7	30p	832A	£3·00	K301	£5·00
12BA6	37p	866A	75p	K305	£12·00
12BE6	40p	931A	£4·00	K308	£16·00
12BH7	27p	954	40p	K337	£16·00
12C8	32p	955	25p	KRN2A	
12E1	£2·70	956	20p		£3·50
12K5	55p	957	30p	WL417A	
12K7GT	40p	991	40p		£1·50
12K8GT	45p	2051	55p	3J/92/E	
12Q7GT	35p	5933	£1·12		£37·50
12SG7	35p	6057	50p	5C22	£18·00
1487	75p	6060	50p	714AY	£4·00
19AQ5	40p	6064	45p	725A	£16·00

Colomor (Electronics) Ltd.
170 GOLDHAWK ROAD, LONDON W12.
RETAIL: 743 4946 **TRADE:** 743 0899
Open 9–12.30, 1.30–5.30 p.m. Thursday 9–1 p.m.

Why pay more - look at our Fantastic Bargain Offer!

THE AVON AUDIO SYSTEM



This uncabineted 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 of 7in., 10in. and 12in. Mono or 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 £46.20. OUR PRICE £37.00. Credit Terms £4.17 deposit plus 88p Post & Packing followed by 9 payments of £4.17 (Total Credit Terms £41.70) Don't miss this bargain. **SEND £5.05 TODAY.**

ALL EQUIPMENT COVERED BY 12 MONTHS FULL GUARANTEE.

CALLERS WELCOME

Post coupon NOW for ... **FREE** leaflets

Please send me free details of your range

Name ....

Address ....

PW 10.72

LEWIS radio 100, Chase Side London N.14 Tel: 01-886 3733/9666

FELSTEAD ELECTRONICS (PW 61)
LONGLEY LANE, GATLEY, CHEADLE, CHES. SK8 4EE

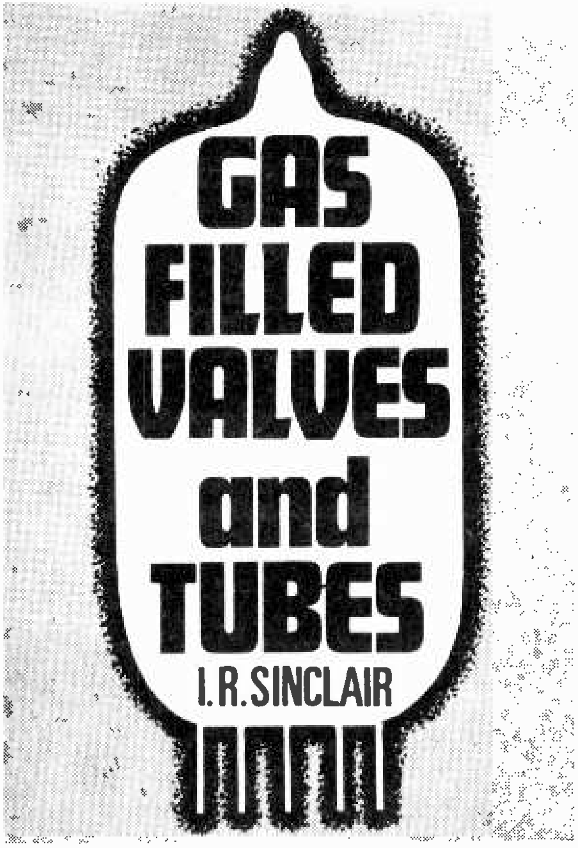
Selection from our List, sent free for stamped addressed envelope. (Free overseas.) Cash with order only—No C.O.D. or Caller service. Charges (Min. 6p) in brackets after all items apply to G.B. and Eire only. Regret orders under 25p plus charges unacceptable. S.A.E. please for enquiries or cannot be replied to. Overseas Orders welcomed.

RECORDING TAPE: Finest quality/value British Mylar available: STANDARD 5″ 600ft. **36p**; 5¾″ 900ft. **50p**; 7″ 1200ft. **56p**; LONG PLAY 5″ 900ft. **50p**; 5¾″ 1200ft. **56p**; 7″ 1800ft. **90p**. (Charges for 5″ and 5¾″, singles **8p**, two to four **7p** each; five and over **30p** the lot. For 7″, one or two **10p** each reel, 3, 4 and 5 reels **30p** the lot. 6 reels and over **35p** the lot.) Other sizes and accessories in list. **CASSETTES** in lib. cases for min. 5 cassettes, C60 **28p**, C90 **38p**, C120 **48p**. (10p per 5, 6–10 **20p**, 11 and over **25p**.) Under 5 cassettes **33p**, **45p** and **55p** each respectively (1 to 4, **10p**).

CARTRIDGES all with standard fittings and stylii. Stereo-compatible Mono GP91/SC **£1·10**; STEREO GP93 **£1·40**; Stereo Ceramic GP94 **£1·95**. (All at **6p** each.) Comparatives shown in List, with more types inc. Sonotone 9TAHC, Stereo Ceramic Diamond **£1·97½** (6p). **DIAMOND STYLII**: single tip types: Acos GP37, GP59, GP65/67, GP71, BSR TC8/LP/ST: COLLARO O.P. and DC284, GARRARD GC2, GC8, GC810, GCE12, RONETTE BF40, O.P. and T. PHILIPS 3301 (3060, 3066, 3302, 3304), 3010/12/13/16. SONOTONE 19T/20T ALL AT **40p** each (6p). SAPPHIRE **17½p** (6p). DOUBLE TIP TURNOVER TYPES (78 sap. on other side). For ACOS GP73, GP91 (for cartridges GP93, GP94 etc.) GP91SC (for stereo compat. types) GP104 BSR ST4 (ST3, ST5), ST9 (ST8), ST12/14/15, SONOTONE 8TA, 9TA, 9TAHC. PHILIPS 3306 3310, 3224, 3228/22, GP280. GARRARD GCM21, 22, GCS23, GKS25 and 26, GCM21T and 22T, GCM24T, GCS23. GKS25T and 26T, GCM31, GCS36, GCS35, GCS38, KS40A, KS41B ETC. ALL AT **75p** (6p). SAPPHIRE **35p** (6p). **DOUBLE DIAMOND STYLII**: (same dia. tip each side: no 78) All types **£1·50** (6p). SAPPHIRE DOUBLE ST/LP, TIPPED **40p** (6p).

PICK-UP WIRE: super thin twin flex screened, sheathed, **6p** per yard (up to 6 yds., **6p**. Over, charges paid. **MICROPHONES**: CRYSTAL: LAPEL 1½″, clip/hand, lead 3·5mm jack plug **35p** (8p). CM20 Cream Plastic hand **52½p** (8p); MIC60 **£1·03** (10p); CM70 "PLANET" Metal, tapered with neck cord, adaptor for stand **£1·50** (10p); "MIC 91" hand/desk **81p** (8p); "MIC 45" Curved metal hand grip **£1·00** (10p) ALL with leads. DYNAMIC: 209 Cardioid Ball. 50K/600 Ω built in volume control, on/off switch, special 20ft. lead, the best value anywhere at **£6·00** (30p); UD130, uni-dir mesh ball 50K/600 Ω jack plug, cable, adaptor, **£4·80** (20p); DM160, omni-dir, Ball mesh, 50K, cable adaptor, jack plug, **£3·90** (30p each). **SPEAKERS**: Very popular 12″ ROUND, fitted tweeter, 3, 8 or 15 ohms (state which) **£1·87½** (30p) or pair for stereo **£4·25**, charges paid. **SMALL** 2½, 3 Ω, 8 Ω or 64 Ω (state which) **40p** (8p). More speakers in List. **HEADPHONES**: High resistance 2000 Ω adjustable **£1·00** (10p). **EARPIECES**: with lead and min. 2·5mm or 3·5mm (state which) jack plug. MAGNETIC **10p**. CRYSTAL (3·5mm plug only) **25p** (up to 6 for **8p** any size). **SOLDERING IRON**: Slim, modern, British high speed, 8½″, all parts replaceable, highest quality, fully guaranteed **£1·17½** (10p). **TRANSFORMERS**: Sub-min 11 × 11 × 12mm, OUTPUT (3 Ω for OC72, etc.) **14p** or DRIVER **15p** (Up to 12 for 6p). **CONNECTING WIRE**: Packs of 5 coils. each coil 5yds. Asstd. cols. SOLID CORE **14p** (6p). FLEXIBLE CORE **16p** (8p). SUPER THIN flexible for transistor wiring, etc. **16p** (6p). **RETRACTABLE FLEXIBLE LEADS** (CURLIES): With phono plug, each end, 6ft. **24p**, 12ft. **40p**. With phono plug/phono socket other end 6ft. **26p**, 12ft. **45p** (6p lead any type). **VIBRATORS**: 12v/4 pin non-synch 121HD4, 2¾″ ex. plus, **30p**. SAME but 3¼″ ex. pins, USA **15p**. 12v/7 pin synch. (12SR7) 2¾″ ex. pins, **65p** (8p any type). **MAINS NEONS**, fly leads **10p**. **NEON SCREWDRIVER** (pocket tester) **17½p** (6p either). **MAINS BATTERY ELIMINATOR**. Input 240v-AC. Output 3, 4½, 6, 7½, 9 and 12 volt D.C. by switch selector. On/off switch, pilot lamp, leads, plug to suit most cassette recorders, **£3·75** (25p). Highly suitable for all transistor receivers.

Our LIST (see heading or sent free on request with all orders) contains, in addition to many more of several of the above types of items, Cartridge and Stylii comparisons, special non-repeatable bargains, also details of car and portable aerials, new Battery amplifiers (inc. stereo) Buzzers, Condensers, Eliminators, Dials, F.M. Tuners, Indicator lamps, Intercom, Telephone amplifier and telephone pick-ups, Meters, Mike inserts, Testers, Vol. controls, Microphone and other cable, etc., etc.



PART TWO

Trigger tubes

THE discharge between the anode and cathode in a gas-filled tube can be started in ways other than that of raising the voltage to striking voltage. One of these ways is to use a trigger electrode to generate ions which will then carry the current of the main discharge. The trigger electrode is a pointed wire very close to the unheated cathode and pointed to the cathode surface. Because of the close spacing, it is easy to start ionisation with a small voltage applied between trigger and cathode, as the creation of ions is dependent on field strength (volts per metre spacing).

In addition to this effect, ions are discharged at high speed from a pointed wire due to the particularly high field strength around points. The old electrostatic experiment of blowing out a candle with a point discharge from an electrostatic generator is an illustration of this effect (Fig. 9). With the voltage between anode and cathode less than the striking voltage but above the running voltage, current will start to flow only when the discharge is triggered by the injection of ions from the trigger circuit. This is achieved by applying a small positive pulse at the trigger electrode. The amplitude and width of this trigger pulse must be above certain critical values (depending on the shape and spacing of the electrodes) to start the main discharge. Once the main discharge has started, it cannot be stopped by any voltage applied to the trigger electrode, only by dropping the anode-to-cathode voltage below a level called the "sustaining voltage." Fig. 10 shows the characteristics of a typical trigger tube, the HIVAC XC23.

Applications

Figure 11 shows a trigger tube used as a pulse amplifier. The trigger pulse causes current to flow,

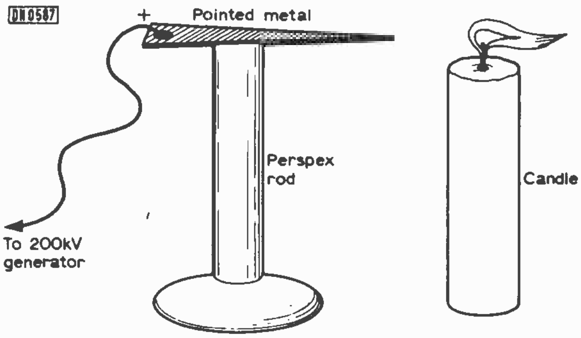


Fig. 9: The high concentration of electric charge around a point causes ionisation of the air. The movement of ions of the same sign away from the point creates a wind capable of blowing out a candle.

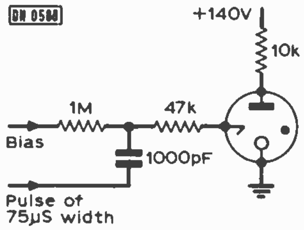


Fig. 10: Characteristics of the Hivac XC23. With bias at 0V, pulse amplitude for transfer equals 91-98V; with bias of +80V, pulse required is 20V min.; trigger resistance equals 47kΩ. Deionisation time is 2mS (time for which Va = 0 to switch off tube).

so that a negative voltage pulse is generated in the anode load resistor and a positive pulse in the cathode load resistor. The voltage drop can be designed to be sufficient to cause the tube to extinguish at the peak of the pulse, so that the tube is ready to fire again at the next trigger pulse. The repetition rate which can be used is limited by the time which must be allowed for all the ions created in the first discharge to recombine before the full voltage is again applied between anode and cathode. For this reason, trigger tube circuits working at rates greater than 4kHz are seldom found, and the circuits are notable for the use of capacitors to spread pulse widths out rather than to sharpen them, as is usually the case.

Figure 12 shows a ring counter circuit using gas trigger tubes. This type of counter circuit is not so familiar to constructors as the binary counters used in transistor circuits, and a description of its opera-

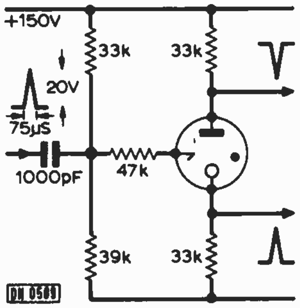


Fig. 11: If the negative pulse is not needed, a capacitor can be connected from anode to earth. The discharge of this will then provide the cathode pulse and the anode load can be raised so that the anode recovers slowly and the tube has ample time to switch off.

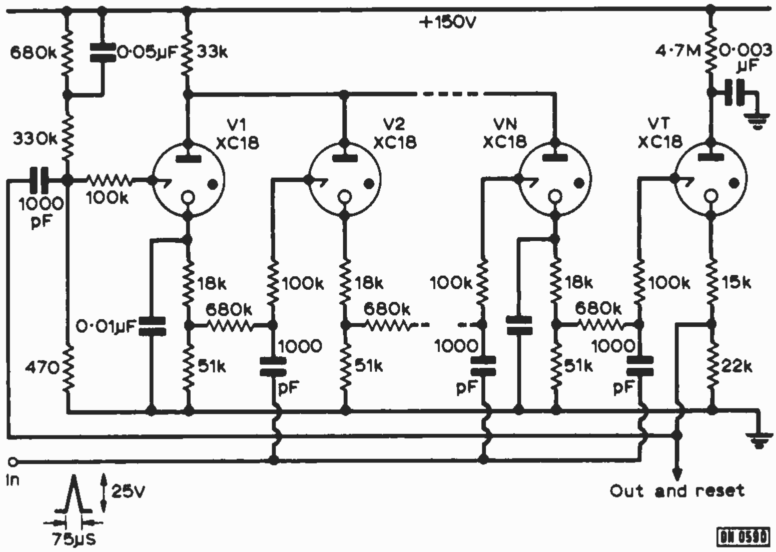


Fig. 12 (right): Ring counter circuit working at 500Hz.

tion might be of interest. The basic principle of any ring counter is that a set of bistable elements is connected in a closed ring in such a way that each trigger pulse fed to a common point turns on the element next to the one previously on, and also turns *off* that previous element. In the circuit of Fig. 12, imagine that V2 is passing current and that the rest of the tubes are not. Because of the current in V2, there will be a voltage positive to earth developed across the resistor in the cathode lead of V2, and this voltage will bias the trigger electrode of V3 (not shown, but wired in exactly the same way as V2) positive, not enough to fire the tube but enough to make certain that a trigger pulse of about 50V will fire V3. This value of trigger pulse is not sufficient to fire any tube whose trigger electrode is not raised in voltage already, so when a pulse is received at the common input terminal and applied to all the trigger electrodes, V3 is the only tube to fire. When V3 fires, however, the voltage in the common anode line drops, and this drop of voltage is sufficient to extinguish the discharge in V2. The result is that the discharge has moved one tube on with the receipt of one trigger pulse. This action continues from tube to tube as each pulse is received, until the last tube in the set, Vn, is glowing. In a ring-of-ten counter, this would be the tube indicating number nine, and wired to the number nine indicator of a display. This tube is connected to a transfer tube, Vt, and when the next trigger pulse is received, Vt will fire, causing a positive pulse to appear at its cathode load resistor. Vt will extinguish immediately after, however, as the value of its anode load is far too high to permit a continuous discharge, and the current which does flow is due to the capacitor between anode and earth discharging through the tube. The positive pulse at the cathode switches on V1, which has a positive bias on its trigger electrode already, and is also the zero indicator. The same positive pulse is also used as the output pulse of the counter stage, carrying to the next counting ring or to some other output.

Counting tubes

The action of a trigger tube, in which the trigger electrode starts off a discharge path which can then spread to the nearest anode, can be used in a tube in which the discharge is passed from one *cathode* to another, and which also makes use of the fact that the glow in a gas discharge is concentrated at the cathode. The best-known example of this technique is the well-known **DEKATRON** counting tube in which a central anode rod is surrounded by ten cathode rods (see Fig. 13). The structure of different types of Dekatrons differs in detail, but the type GC10B can be taken as an example of the way in which these fascinating tubes work. In the GC10B, the cathode pin which is used to indicate zero is taken to a base connection (k_o), and all the other cathodes are connected together and taken to another base connection, k_c. At the opposite end, the pins are visible through the glass end of the tube, and the glow round any particular cathode can be clearly seen. Escutcheon plates with the numbers 0-9 can be fitted against the end of the tube and lined up so that the zero of the escutcheon is adjacent to the zero pin of the tube, and the other numbers line up with successive cathodes.

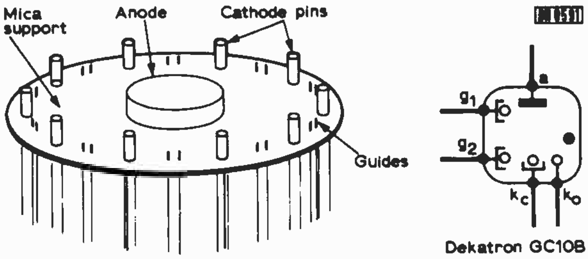
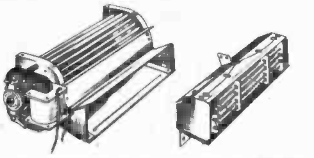


Fig. 13: On the left is shown the principle of construction of a Dekatron; the symbol of the Dekatron GC10B is shown right).

To transfer the discharge from one electrode to another, guide electrodes are used. These are pins located in pairs between the cathodes; all the first pins of each pair in clockwise order are connected together and taken to base connection G_1, and the second pins of each pair are brought together to the G_2 base connection.

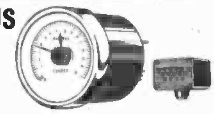
LINDAIR (ELECTRO-TECH) LTD



TANGENTIAL HEATER

Silently driven by a shaded pole Mycalex motor. Compact, powerful and quiet running with aluminium impeller (outlet 5¾ × 1½). Mains voltage. PLUS matching heater unit with spiral element. May be switched for 500 or 1,000 watts. PRICE ONLY **£1·60** P. & P. 40p

SYNCHRONOUS AUTO-RESET PROCESS TIMER



By LONDEX LIMITED

Type IMP Mk. 2. Brand New and Boxed. These well known timers are already in world-wide use and are perfect for Industrial Electronic Timing. Research and for all machine control timing problems. Repetitive accuracy better than 0·5% of full scale setting. Two or more can be interconnected to give control of a series of processes. 230/250v. 50Hz, also available 60Hz. 15 minutes full scale, 15 secs. per division. Driven by self-starting sync. motor. Contact rating 5 amp at 250v. a.c. Incorporates solenoid operated clutch Also, lever actuated micro switches. Normal price probably in excess of £16. Complete with multi-pin connector as illustrated.

OUR PRICE ONLY **£6·50**

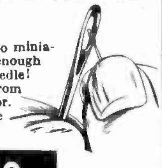
SEEN THIS?

This is the only way way we could illustrate this fabulous item.

NORPLEX the famous American fibre-glass copper-clad laminate. Finest quality with Woven Glass base of Epoxy-resin. Excellent mech. and elec., conductive properties. Heat Resistant. Ideal for P.Cs., etc. THIS IS A SPECIAL PURCHASE AND ONLY AVAILABLE WHILE STOCKS LAST. Sizes: 12" × 12": 24" × 12": 24" × 24": FULL SHEET 43" × 37" (11 sq. ft.). Single sided copper with ticknesses of 1/32", 3/64", 1/16" 3/32", also Double sided 1/32", 1/16", 3/32"

PRICE ONLY £1 per sq. ft. £8 per full sheet. P. & P. 25p up to 4 sq. ft. Over 4 sq. ft. (cut sizes only) Post FREE. Full sheets post by rail G.B. only £1 one or more sheets.

MICRO-LITES



Wonderful engineering—micro miniature incandescent lamp small enough to pass through the eye of a needle! 1,000's of uses. Will operate from the output of a transistor. Rating: 1·5v, 10-15ma. Size 4·4 × 1·4mm. dia. Leads 22mm. These fantastic lamps have a life expectancy of 1,000 hrs.

OUR PRICE **£3·25** per doz. Free p. & p.

NEW AND UNUSED

Postal or carriage charges are for Great Britain only. We welcome orders from established companies. educational depts., etc. All orders under £2·50, cash with order please.

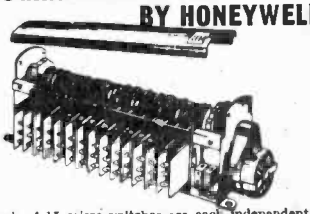
FURTHER BULK PURCHASE

SILVANIA MAGNETIC SWITCH

NOW COMPLETE WITH REFERENCE MAGNET! A magnificently activated switch. Vacuum sealed in a glass envelope. Silver contacts normally closed, rated 3 amp at 120v, 1½ amp at 240v. Size (approx.) 1 7/16" long × ¼" dia. Ideal for Burglar Alarms, Security systems, etc., and wherever non-mechanical switching is required. New Lower Price. Only £2·10 for 12, £8 for 50 or £15 for 100 complete with magnet.

£2·10

PROGRAMMER TIMER BY HONEYWELL



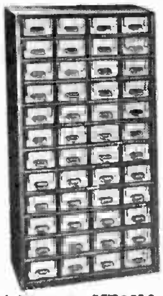
A bank of 15 micro-switches are each independently operated by 15 pairs of cams which in turn are individually adjustable to give switching periods of zero to 12 seconds with infinitely variable combinations. A mains synchronous motor drives the cam shaft at 1 rev. per 12 seconds (5 R.P.M.). Designed originally for vending machines at a cost of £15·00 plus. Many applications where continuous sequence programmes are required, such as lighting effects etc. New in original makers cartons. First class value at £5·75 plus 25p P. & P.

£5·75

315 EDGWARE ROAD, LONDON W2. Tel: 01-262 2251. Open 9 a.m.-6 p.m. MON to SAT

SAVE TIME AND MONEY

LIST PRICE £6·25 | OUR PRICE £4·84



As supplied by us to SCHOOLS, TECHNICAL COLLEGES, SHOPS, OFFICES AND INDUSTRY. Silver grey stove enamelled steel cabinet with 48 transparent styrene drawers fitted with moulded handles and label slots. Dividers can be supplied at an extra charge to enable each drawer to be sub-divided into six compartments. Transparent drawers allow swift selection of components at a glance and eliminates duplication of stock. A really first class time saving unit. Size of cabinets 21½" × 11¾" × 6¼". Size of drawers 6¼" × 2¼" × 1¾". Other sizes available. Callers welcome Mon.–Sat. 9 a.m.–1 p.m. 2 p.m.–6 p.m. NEW as illustrated OUR PRICE ONLY £4·84 plus 35p carriage on orders less than £10. Money back guarantee. SEND FOR FREE COLOUR BROCHURE.

TRADE AIDS

(DEPT. PW3), 111 CHILTERN DRIVE, BERRYLANDS, SURBITON, SURREY

01-399 4383

100 yds. Berrylands Railway Station.

TRANSFORMERS

DOUGLAS GUARANTEED

12 or 24 volts

Output V.	& Amps.	Ref. No.	Price	P. & P.
12V × 2	250 mA × 2	MT111 CS*†	£0·91	9p
12V × 2	500 mA × 2	MT213 CT*†	£0·97	16p
12V × 2	1A × 2	MT 71 AT‡	£1·48	24p
12V × 2	2A × 2	MT 18 AT	£2·06	30p
12V × 2	3A × 2	MT 70 AT	£2·59	32p
12V × 2	4A × 2	MT 108 AT	£2·92	34p
12V × 2	5A × 2	MT 72 AT	£3·33	42p

30 volts. All tapped at 0-12-15-20-24-30V

Output Amps.	Ref. No.	Price £	P.P.	Output Amps.	Ref. No.	Price £	P.P.
500 mA	MT 112 CT‡	1·12	16p	3A	MT 20 AT	2·64	32p
1A	MT 79 AT‡	1·55	29p	4A	MT 21 AT	3·10	40p
2A	MT 3 AT	2·23	30p	5A	MT 51 AT	4·31	42p

50 volts. All tapped at 0-19-25-33-40-50V.

500 mA	MT 102 AT‡	1·45	24p	3A	MT 105 AT	3·91	41p
1A	MT 103 AT	2·00	32p	4A	MT 106 AT	5·06	41p
2A	MT 104 AT	3·10	32p	6A	MT 107 AT	7·47	50p

60 Volts. All tapped at 0-24-30-40-48-60V.

500 mA	MT 124 AT‡	1·46	30p	2A	MT 127 AT	3·16	41p
1A	MT 126 AT	2·24	32p	3A	MT 125 AT	4·59	41p

AUTO-WOUND RANGE

Power output	Winding tapped at	Ref. No.	Price	P. & P.
20 VA	0-115-210-240	MT 113 CT	£0·89	16p
75 VA	" "	MT 64 AT	£1·72	30p
150 VA	0-115-200-220-240	MT 4 AT	£2·15	32p
200 VA	" "	MT 65 AT	£3·00	32p

400 V. Output at 50 HZ. Ref. IT3 AT Price P. & P.
C-D Ignition system by R. M. Marston Esq. £2·30 20p

EQUIPMENT RANGE

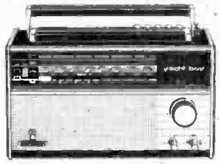
Sec. Output (r.m.s.)		Ref. No.	Price	P. & P.
3-0-3 V.	200 mA	MT 238 CS*†	£0·89	8p
9-0-9 V.	100 mA	MT 13 CS*†	£0·91	8p
12-0-12	50 mA	MT 239 CS*†	£0·91	8p
20-0-20	30 mA	MT 241 CS*†	£0·91	8p
0-20 × 2	300 × 2	MT 214 CT*‡	£1·21	16p
0-8-9 × 2	500 mA × 2	MT 207 CT*‡	£1·46	19p
0-15-20 × 2	500 mA × 2	MT 205 AT*‡	£2·12	29p
0-15-27 × 2	500 mA × 2	MT 203 AT*	£2·45	29p
0-15-27 × 2	1A × 2	MT 204 AT*	£3·42	30p
10-12-0-12-20	700 mA (d.c.)	MT 221 AT*	£1·11	26p

AT indicates open universal fixing with tags; CT is open U-clamp fixing with tags; CS is open U-clamp fixing with P.C. spills; *with interwinding screen; † untapped 240V Primary; ‡ Primary tapped at 210-240V. other Primaries tapped at 200-220-240V.

Over 200 types in stock through agents or direct. Send for list.

DOUGLAS ELECTRONICS INDUSTRIES LTD.
(Dept. MO6PW), Thames St., LOUTH, Lincs. LN11 7AD

RADIO BARGAINS



Grundig Mariner TR865	£35·00
Grundig Solo Boy	£16·50
Grundig Music Boy	£26·00
Grundig TR600	£28·50
Grundig Elite Boy 210	£29·00
Grundig Elite Boy 500	£26·50
Grundig Melody Boy 500	£26·50
Grundig Melody Boy 1000E	£41·50
Grundig Satellit 1000	£125·00
Grundig Ocean Boy 3005	£62·00
Grundig Yacht Boy	£34·50
Grundig RF430	£26·50
Koyo KTR1661 8w.b.	£40·25
Koyo KTR 1663 or 1664 8w.b.	£47·50
Koyo KTR1770 11w.b.	£66·00
Aiwa AR158	£31·00
Toshiba IC70	£16·50
Aiwa AR158 6w.b. (inc. air)	£31·00
Hitachi WH1160 with D.F.	£22·50
ITT/KB Golf	£26·50
ITT/KB Touring Int. Marine	£45·00

FREE With each set "Guide to Broadcasting Stations" (160 pages)

WILMSLOW AUDIO, Dept. PW,

10 Swan St. Wilmslow, Cheshire, SK9 1HF

The action is as follows (Fig. 14): with about 475V applied to the anode through an 820kΩ resistor, and other details as shown in Fig. 14, a discharge must exist between the anode and one cathode. Since all the cathodes are joined together, and since the running voltage of a gas discharge is well below the striking voltage, once one cathode has started a discharge it cannot spread to any other cathode except by the action of the guides which will be described, unless one cathode is made more negative than any other. The only cathode with which this can be done is the zero cathode which is taken to a separate pin, so that the Dekatron can be made to read zero when power is first applied, or when a fresh count is wanted.

If now all the first guides (G_1) are pulsed negative, the glow will shift from the cathode to the nearest guide 1 and stay there. If the second guides are now pulsed negative just as the first guides are rising again in voltage, the discharge will shift to the nearest G_2, which will again be one step clockwise. When this guide's voltage rises again, the glow transfers to the next cathode, which is one cathode on from the starting point. The result is that every time a set of pulses is applied to the guides, the glow shifts clockwise from one cathode to the next, and so counting has been achieved. This process continues until the glow lands on the zero cathode, which is taken to the −20V line through a 150kΩ load resistor, so that a positive pulse is obtained across the resistor whenever the glow lands on zero. This can be used to transfer the count to the next stage, as the positive pulse can be inverted by a valve or trigger tube and processed to provide the double pulse needed for the next stage.

The Dekatron system is at present the most economical method of counting and displaying, since both operations are achieved in one tube. It is, however, essential that the circuits published by HIVAC should be adhered to exactly. Any variation in the pulse width and amplitude, or in the time lag between the pulses applied to guides 1 and 2 can cause misfiring, and most of the problems encountered in Dekatron circuits are easily cured by attention to the pulse system. Fig. 14 shows the circuits which should be used for driving with single pulses, double pulses and sine waves respectively. The sine wave circuit is of particular interest, as the 50Hz mains provide an accurate frequency standard for digital clocks, the design of which is particularly easy using Dekatrons.

Not every count is to ten, however, particularly in the case of digital clocks, and the Dekatron Selector tubes such as the type GS10C are designed with this in mind. Each cathode is taken to a separate pin on the 12-pin base, with the anode as a centre pin, and can be wired as a counter or as a transfer cathode. A transfer cathode is one which passes the count as a pulse to the next stage, and also acts as the zero to which some other cathode will reset. This enables us to have any count up to nine followed by a zero, and the range has been extended by tubes which count to 12. Another advantage of the selector type of tube is that it no longer ties us to the Dekatron type of display, but enables us to display on a **Digitron** type of tube, described later.

The standard range of Dekatrons includes counters and selectors working at rates up to 4kHz, but another range or Dekatrons using a third set of guides connected to the reset line through a 220kΩ resistor, and an output cathode guide connected to the output cathode by a 220kΩ resistor, can be operated at speeds up to 20kHz.

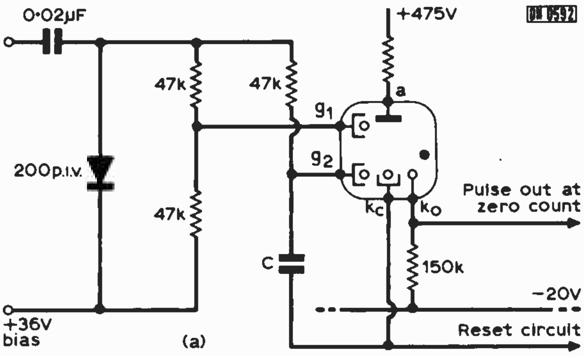


Fig. 14a: Integrated pulse drive. The value of C depends on the pulse width and repetion rate being used.

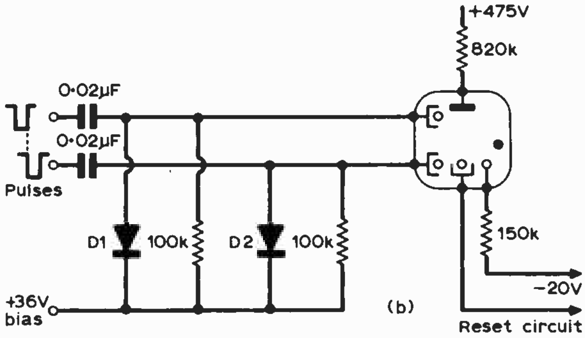


Fig. 14b: Double pulse drive for the GC10B.

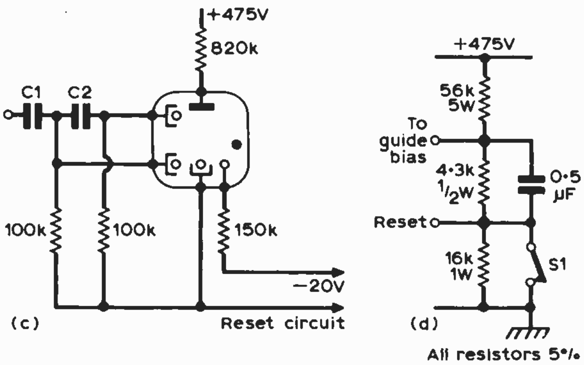


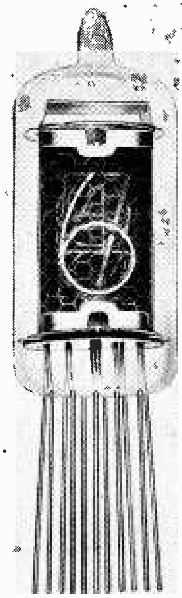
Fig. 14c: Sine-wave circuit (left)

Frequency	*50Hz*	*100Hz*	*200Hz*	*500Hz*	*1kHz*	*2kHz*	*4kHz*
C1 (μF)	*1·5*	*0·82*	*0·33*	*0·15*	*0·082*	*0·033*	*0·015*
C2 (μF)	*0·1*	*0·05*	*0·02*	*0·01*	*0·005*	*0·002*	*680pF*

Reset circuit is shown on right. To reset, S1 is opened, taking cathode Kc and guides to +120V and so transferring the glow to Ko.

Alpha-numerical indicators

As we have seen earlier, when a voltage is applied between the anode and the cathode of a gas-filled tube, a glow appears round the cathode. When a.c. is applied, of course, both electrodes are seen to glow.



A typical gas filled read-out tube. When a voltage is applied between the anode and cathode a glow appears around the cathode. By making the cathode in the shape of numbers or letters, it will glow when the voltage is sufficiently negative to cause striking.

The glow is due to the recombination of ions which have been formed by collisions and is most noticeable at the cathode because this is the place where electrons are being rapidly accelerated in the face of negative ions moving in the opposite direction. The glow exactly surrounds the shape of the cathode, and does not extend to more positive electrodes.

If the cathode is made in the shape of a letter or a number, this figure or number will be seen as a glowing shape whenever the cathode is sufficiently negative to the anode to strike and run. If a number of separately connected wires are shaped in the form of numbers 0-9, each number will display only when the wire forming it is sufficiently negative to the anode to form a gas discharge.

The *Hivac* **Numicators** are tubes of this type, and the range of types is large. Tubes may be viewed end-on or side-on according to the type of construction of the tube. Numicators can be driven from Dekatrons, provided that trigger tubes or other invertor stages are used to change the positive pulses at the cathodes of the Dekatron to the negative pulses used at the cathodes of the Numicator. Perhaps "pulse" is a misleading word in this application, because the top of the pulse will be as long in the time sense as the figure is to be displayed.

Most Numicators are designed for steady operation, but some are intended to be used in what is called the "anode stroking technique," often used in connection with digital counters.

Digital counters can readily be arranged to give a readout whenever a clock pulse is received, and the readout can be converted to decimal form and used to drive Numicators. Considerable economy in circuitry can be arranged if the decimal readout is attached to all the Numicator cathodes; for example, in a five figure readout, there would be one decimal converter with the zero output connected to all the five Numicator zeros, the "one" output to all the Numicator "ones", the "two" to all the "twos" etc. The decimal output and the tubes are then switched in sequence, so that the units tube has its anode volts pulsed just as the decimal output gives the unit figure pulse to all the Numicator cathodes, with the result that only the units tube displays a figure. On the next pulse, the tens tube is activated to display the decimal output from another store, so that each tube flashes a digit in sequence. Because of the clock pulse rate used, the display looks continuous. This is not a technique which would be used in small counters, but it is extremely useful in small computers, particularly in conjunction with integrated circuit counters.

Thyratrons

Thyratrons are the big brothers of trigger tubes. Like trigger tubes, they are made to conduct by the application of a positive pulse to a third electrode; unlike trigger tubes, they use hot cathodes and can operate at very high voltages indeed—one type listed by *English Electric* quotes a peak forward voltage of 120kV and with large currents, up to several thousand amps, flowing. Small thyratrons are made in glass envelopes and resemble output valves at first sight, the larger types have ceramic casings.

The small type of Thyratron has a heated cathode, a grid similar to the control grid of an output valve, and an anode which is often finned and connected to a thick pin set in the glass bulb for maximum heat dissipation. In operation, the heaters must be switched on before high voltage is applied, this is usually done automatically by means of a thermal delay circuit, since failure to observe the correct delay period would be fatal to the thyratron. When the heaters have reached full temperature, the grid voltage can be applied, this is a negative bias sufficient to prevent any electrons passing the grid, enough, in fact, to prevent electrons from being emitted to any noticeable extent from the cathode. The positive anode voltage can then be applied.

If the grid is now pulsed positive, the tube conducts strongly due to the ionisation of the gas by the electrons from the cathode, and this current will continue until the voltage at the anode is reduced to a low value. After a short "recovery time", the tube can be fired again if the anode voltage has also recovered to its previous value. What makes the thyratron unique is its ability to switch very high currents very rapidly and at a high forward voltage. By very rapidly, we mean delay times of around 20-120 nanoseconds in the most advanced types.

Thyratrons are used to control spot welders, to pulse radar transmitter magnetrons, and to operate other short time, high energy devices such as the *Kerr Cell* used in high speed photography. They also find extensive use in large invertors (converting a.c. to d.c.) such as are used at each end of the cross-channel d.c. cable. One intriguing use is as "electronic crowbars". In modern electronic equipment, protection against faults by means of fuses is not very effective because of the time which a fuse needs to blow. Even if this time is measured in milliseconds, much damage can be done, and the idea of the electronic crowbar is a device which will come into operation much more quickly than a fuse, shorting out the voltage across the circuits and taking the current which will eventually blow the fuse. This use demands a device which can be switched into conduction very quickly and which will take a large current in the time before a fuse blows—the Thyratron is ideal, though for the smaller sizes thyristors are taking over. ■

The Author gratefully wishes to acknowledge the help of HIVAC LTD. in the preparation of this article.

BENTLEY ACOUSTIC CORPORATION LTD.

38 CHALCOT ROAD, CHALK FARM, LONDON, N.W.1

THE VALVE SPECIALISTS Telephone 01-722-9090

OA2	.30
OB2	.30
OZ4	.25
1A3	.23
1A7GT	.32
1B3GT	.35
1H5GT	.33
1L4	.13
1N5GT	.87
1R5	.26
1S4	.22
1U4	.29
1U5	.48
2D21	.35
2GK5	.50
3A4	.25
3D6	.19
3Q4	.38
3Q5GT	.35
3S4	.23
4CB6	.50
5CG8	.50
5T4	.30
5U4G	.30
5V4G	.33
5Y3GT	.25
5Z4G	.33
5Z4GT	.38
6/30L2	.53
6A8G	.33
6AC7	.15
6AG5	.25
6AK5	.25
6AK6	.30
6AM8A	.50
6AN8	.49
6AQ5	.21
6AR5	.30
6AT6	.18
6AU6	.19
6AV6	.28
6AW8A	.54
6AX4	.39
6B8G	.13
6BA6	.19
6BC8	.50
6BE6	.20
6BH6	.43
6BJ6	.39
6BQ7A	.38

6BR7	.79
6BR8	.63
6BW6	.72
6BW7	.50
6BZ6	.31
6CB6A	.26
6C4	.28
6C9	.73
6CD6G	1.06
6CG8A	.50
6CH6	.38
6CL6	.43
6CM7	.50
6CU5	.30
6CW4	.63
6DE7	.50
6DT6A	.50
6EW6	.55
6F1	.59
6F6	.63
6F13	.33
6F14	.40
6F18	.45
6F23	.65
6F24	.68
6F25	.51
6F28	.60
6F32	.15
6GH8A	.50
6GK5	.50
6GU7	.50
6H6GT	.15
6J5G	.19
6J5GT	.29
6J6	.18
6J7G	.24
6J7(M)	.38
6JU8A	.50
6K7G	.10
6K8G	.16
6LI	.98
6L6GT	.39
6L7	.38
6L18	.44
6L19	1.38
6LD20	.48
6N7GT	.40
6Q7GT	.43
6Q7M	.43
6R7G	.35

6R7M	.55
6SA7GT	.35
6SA7M	.35
6SC7GT	.33
6SG7GT	.33
6SH7	.53
6SJ7	.35
6SK7GT	.23
6SQ7GT	.38
6U4GT	.60
6V6G	.17
6V6GT	.27
6X4	.20
6X5GT	.25
7B6	.58
7B7	.32
7H7	.28
7R7	.65
7Y4	.60
7Z4	.50
9BW6	.50
9D7	.78
10C2	.49
10DE7	.50
10F1	.75
10F9	.45
10F18	.35
10LD11	.53
10P13	.54
10P14	1.08
12A6	.63
12AC6	.40
12AD6	.40
12AE6	.48
12AT6	.23
12AT7	.16
12AU6	.21
12AU7	.19
12AV6	.28
12AX7	.21
12BA6	.30
12BE6	.30
12BH7	.27
12J7GT	.33
12K5	.50
12K7GT	.34
12SC7	.35
12SG7	.23
12SH7	.15
12SJ7	.23

12SK7	.24
14H7	.48
14S7	.75
19AQ5	.24
19BG6G	.80
19G6	.50
20D4	1.05
20F2	.65
20L1	.98
20P1	.50
20P3	.76
20P4	.89
20P5	1.00
25A6G	.29
25L6G	.20
25Y5G	.43
25Z4G	.28
25Z5	.40
25Z6G	.43
30A5	.44
30C15	.55
30C17	.74
30C18	.58
30F5	.61
30FL1	.58
30FL2	.58
30FL12	.67
30FL14	.66
30L15	.55
30L17	.65
30P4MR	.95
30P12	.69
30P19/30P4	.55
30PL1	.57
30PL13	.75
30PL14	.62
30PL15	.87
35A3	.48
35L6GT	.42
35W4	.23
35Z4GT	.24
35Z5GT	.30
50CD6G	2.17
50EH5	.55
50L6GT	.45
85A2	.43
85A3	.40
90C1	.59

150B2	.58
807	.59
5702	.80
5763	.50
AC/PEN	.98
AC2/PEN/DD	.98
AC6PEN	.38
AC/TH1	.50
AC/TP	.98
AL60	.78
ATP4	.12
AZ1	.40
AZ31	.46
AZ41	.53
CL33	.90
CV63	.53
CY1C	.53
CY31	.29
DAF91	.20
DAF96	.33
DF91	.14
DF96	.34
DH76	.28
DK40	.55
DK92	.35
DK96	.35
DL96	.35
DM70	.30
DM71	.38
DY87/6	.22
DY802	.29
E80CC	1.65
E80F	1.20
E83F	1.20
E88CC	.60
E92CC	.40
E180F	.90
E182CC	1.00
E1148	.53
EA76	.88
EABC80	.29
EAC91	.38
EAF42	.48
EAF801	.50
EB34	.20
EB91	.10
EBC41	.48
EBC81	.29
EBF80	.30

EBF83	.38
EBF89	.26
EBL21	.60
EC86	.59
EC88	.59
EC92	.34
ECC32	1.50
ECC33	1.50
ECC40	.60
ECC81	.16
ECC82	.19
ECC83	.21
ECC84	.28
ECC85	.32
ECC88	.35
ECC189	.48
ECC807	1.70
ECF80	.27
ECF82	.25
ECF86	.64
ECF804	2.10
ECH21	.63
ECH42	.57
ECH81	.25
ECH83	.38
ECH84	.34
ECL80	.28
ECL82	.28
ECL83	.52
ECL84	.54
ECL85	.54
ECL86	.33
EF22	.63
EF40	.49
EF41	.58
EF42	.83
EF73	.75
EF80	.21
EF83	.54
EF85	.25
EF86	.27
EF89	.23
EF91	.17
EF92	.28
EF98	.65
EF183	.25
EF184	.27
EH90	.34

EL32	.18
EL34	.44
EL35	1.00
EL37	.74
EL41	.53
EL42	.53
EL81	.50
EL83	.38
EL84	.21
EL85	.40
EL86	.38
EL91	.23
EL95	.32
ELL80	.75
EM80	.87
EM81	.37
EM83	.75
EM84	.31
EM85	1.00
EM87	.34
EY51	.29
EY81	.35
EY83	.54
EY84	.50
EY87/6	.27
EY88	.40
EZ40	.40
EZ41	.42
EZ80	.19
EZ81	.20
FW4/800	.75
GY501	.75
GZ30	.33
GZ32	.39
GZ33	.70
GZ34	.47
GZ37	.67
HABC80	.44
HL23DD	.40
HL41DD	.98
HL42DD	.50
HN309	1.40
HVR2	.53
HVR2A	.53
KT2	.25
KT41	.98
KT44	1.00
KT66	.80
KT81	2.00
KTW61	.63
KTW62	.63

KTW63	.50
MHLD6	.75
P61	.44
PABC80	.32
PC86	.44
PC88	.44
PC95	.53
PC97	.36
PC900	.29
PCC84	.27
PCC85	.24
PCC88	.39
PCC89	.42
PCC189	.46
PCF80	.26
PCF82	.30
PCF84	.40
PCF86	.44
PCF200	.67
PCF801	.28
PCF802	.37
PCF806	.55
PCH200	.62
PCL82	.29
PCL83	.54
PCL84	.32
PCL805/85	.37
PCL86	.36
PD500	1.44
PEN4DD	1.38
PEN45DD	.75
PEN453DD	.98
PENDD-4020	.88
PEN45	.40
PEN46	.20
PFL200	.50
PL33	.38
PL36	.46
PL81	.42
PL81A	.48
PL82	.28
PL83	.30
PL84	.28
PL504/500	.60
PL505	1.30

PL508	.90
PL509	1.30
PL802	.75
PM84	.31
PX4	1.16
PY33/2	.50
PY80	.33
PY81	.24
PY82	.23
PY83	.26
PY88	.31
PY500	.95
PY800	.31
PY801	.31
PZ30	.48
QQV03/10	1.20
QS75/20	.63
QS95/10	.49
QV04/7	.63
R10	.75
R11	.98
R16	1.75
R17	.88
R19	.28
SP61	.33
TH233	.98
TP2620	.98
UABC80	.30
UAF42	.49
UBC41	.45
UBC81	.40
UBF80	.28
UBF89	.28
UBL21	.55
UC92	.35
UCC84	.33
UCC85	.33
UCF80	.31
UCH21	.60
UCH42	.57
UCH81	.29
UCL82	.30
UCL83	.48
UF41	.50
UF42	.60
UF80	.35
UF85	.34
UF86	.63
UF89	.27
UL41	.54

UL84	.28
UM80	.33
UY41	.38
UY85	.23
U10	.45
U12/14	.38
U19	1.73
U22	.39
U25	.62
U26	.53
U45	.78
U52	.30
U191	.56
U251	.62
U301	.40
U403	.33
U404	.38
U801	.76
U4020	.38
VP23	.40
VP41	.38
VT61A	.35
VT501	.15
VU111	.44
VU120	.60
VU120A	.60
VU133	.35
W107	.50
W729	.60
X41	.50
Transistors & Diodes	
2N404	.18
2N2297	.23
2N2369	.22
2N3053	.33
2N3121	2.50
2N3709	.20
2N3988	.50
2S323	.50
AA119	.15
AA120	.15
AA129	.15
AAZ13	.18
AC107	.15
AC113	.25
AC126	.13
AC127	.17
AC128	.20
AC132	.20
AC154	.25

AC156	.20
AC157	.25
AC165	.25
AC166	.25
AC168	.38
AC176	.55
AC177	.28
ACY17	.25
ACY18	.20
ACY19	.19
ACY20	.18
ACY21	.19
ACY22	.15
ACY28	.18
AD140	.36
AD149	.50
AD161	.45
AD162	.45
ADT140	.63
AF106	.50
AF114	.25
AF115	.15
AF117	.19
AF121	.30
AF124	.25
AF125	.17
AF126	.18
AF139	.65
AF178	.68
AF180	.48
AF186	.55
AF239	.38
BA102	.45
BA115	.14
BA116	.25
BA129	.13
BA130	.10
BA153	.15
BC107	.13
BC108	.13
BC113	.25
BC115	.15
BC116	.25
BC118	.23
BCY10	.45
BCY12	.50

BCY33	.20
BCY34	.23
BCY38	.23
BCY39	.25
BCZ11	.38
BF158	29
BF159	.25
BF163	.20
BF173	.38
BF180	.30
BF181	.40
BF185	.40
BF194	.15
BFY50	.23
BFY51	.19
BFY52	.20
BY100	.18
BY105	.18
BY114	.18
BY126	.15
BY127	.18
BYZ10	.25
BYZ11	.25
BYZ12	.25
BYZ13	.25
CG12E	.20
FSY11A	.23
FSY41A	.23
GD9	.20
GET113	.20
GET118	.20
GET119	.20
GET573	.38
GET587	.43
GET873	.15
GET887	.23
GET897	.23
GET898	.23
M1	.15
OA5	.28
OA9	.13
OA10	.43
OA47	.10
OA70	.15
OA73	.15
OA79	.09

OA81	.09
OA85	.08
OA90	.13
OA91	.09
OA95	.09
OA200	.09
OA202	.10
OC22	.38
OC23	.38
OC24	.38
OC25	.38
OC28	.60
OC29	.68
OC35	.32
OC36	.43
OC42	.63
OC44	.10
OC45	.11
OC46	.15
OC70	.13
OC71	.11
OC72	.11
OC74	.23
OC75	.11
OC76	.15
OC77	.27
OC78	.15
OC78D	.15
OC81	.11
OC81D	.11
OC82	.11
OC82D	.11
OC83	.20
OC84	.24
OC123	.23
OC139	.23
OC140	.95
OC169	.23
OC172	.35
OC200	.22
OC201	.38
OC202	.43
OC203	.30
OC204	.30
OC205	.43
ORP12	.53

MATCHED TRANSISTOR SETS:— LP15 (AC113. AC154. AC157. AA120) ·53p per pack. 1—OC81D & 2—OC81, 43p. 1—OC44 & 2—OC45, ·43p. 1—OC82D. & 2—OC82 ·48p. Set of 3—OC83 ·65p.

All valves are unused. boxed, and subject to the standard 90 day guarantee. Terms of business — Cash or cheque with order only. Post/packing 3p. per item, subject to a minimum of 9p. per order. Orders over £5.00 post/packing free. Same day despatch by first class mail. Any parcel insured against damage in transit for only 3p. extra per order. Complete catalogue with conditions of sale price 7p. post paid. Business hours Mon.-Fri. 9–5.30 p.m. Sats. 9–1 p.m.
We do not handle seconds nor rejects, which are often described as "New and Tested" but have a limited and unreliable life. No enquiries answered unless S.A.E. is enclosed for reply.

ERSIN Multicore 5 CORE SOLDER

for fast, easy reliable soldering

Ersin Multicore Solder contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux is required.

IDEAL FOR HOME CONSTRUCTORS

Size 1 cartons all at 25p each in 40/60, 60/40, or Savbit alloys in 7 gauges

EASY-TO-USE DISPENSERS

Size 5 (Savbit) 18swg. 18p (illustrated)

Size 19A (60/40 alloy) 18swg. 18p

Size 15 (60/40 alloy) 22swg. 22p

BIB WIRE STRIPPER AND CUTTER

Model 3A. Strips insulation from cable or flex without nicking wire. 4 different settings. 4&6BA spanner ends, ground cutting edges Price 32p. Also available. de luxe Model 8. Price 58p

NEW!

From Electrical and Hardware Shops. If unobtainable, write to: Multicore Solders Ltd., Hemel Hempstead, Herts.

SPEAKER SELECTION

(Dept W) 611 FOREST RD LONDON E17 4QD
Telephone: 01-531 3117

Hours: 10 am-6 pm Tues—Sat

GOODMANS Module 1-10 £103
GOODMANS Module 80 £68
ARMSTRONG 521 ... £44
ARMSTRONG 525 ... £70
ARMSTRONG 526 ... £80
CONNOISSEUR BD2 P&C (wired) £32
Carriage £1·00

SPEAKER SYSTEMS

CELESTION
Ditton 15 ... ... £55 (B)
Ditton 44 ... ... £75 (B)
Ditton 25 ... ... £89 (C)

IMF ... ... On application

LNB
Para-Lab Super ... £43 (B)
Para-Lab 20 ... ... £80 (C)

GOODMANS
Havant ... ... £42 (B)
MEZZO 3 ... ... £48 (B)
Double Maxim ... ... £50 (B)
Magnum ... ... £58 (B)
Magister ... ... £88 (C)
Dimension 8 ... ... £95 (C)

RICHARD ALLAN
Chaconne ... ... £30 (B)
Flamenco ... ... £45 (B)
Pavanne ... ... £50 (B)

WHARFEDALE
Denton II ... ... £29 (A)
Linton II ... ... £36 (B)
Melton ... ... £47 (C)
Dovedale ... ... £60 (C)

KITS

PEERLESS
2-8 ... ... £11·50 (A)
10-2 ... ... £16 (A)
20-2 ... ... £21 (A)
3-15 ... ... £22 (B)
2-25 ... ... £33 (B)
20-3 ... ... £29 (B)
430-12 ... ... £40 (C)

AMPLIFIERS
Leak Delta 30 ... £50 (B)
Leak Delta 70 ... £60 (B)
Metrosound ST20E ... £27 (B)
Ravensbrook Cased ... £44 (B)
Linton ... ... £45 (A)
Cambridge P50 ... £65 (A)

RICHARD ALLAN
Twin Assembly £16·50 (A)
Triple Assembly ... £29 (C)
Triple 8 ... ... £26 (B)

WHARFEDALE
Unit 3 ... ... £18 (A)
Unit 4 ... ... £23 (B)
Unit 5 ... ... £34 (B)

TURNTABLES
SP25 III ... ... £11 (A)
AP76 ... ... £20 (A)
401 ... ... £30 (A)
GL75 P&C ... ... £41 (A)
MP60 ... ... £11·25 (A)

Many more Items in Stock.

Delivery—A-50p B-£1·00 C-£1·50

I.C. OF THE MONTH

L.A.J. IRELAND

Number 33 — Motorola MFC6040 Electronic Attenuator

ACOUSTIC feedback—that deafening howl which occurs when a microphone picks up the sound from the loudspeakers of a public address system and thereby completes a feedback loop, setting the whole system into oscillation—will be familiar to readers. It is particularly embarrassing when, for example, an announcer is using a microphone with a considerable length of cable, and by moving to a new location initiates this response from a previously well-behaved system. It would therefore be convenient if, in addition to his microphone, the announcer could have to hand the gain control of the amplifier, so that it could be adjusted for best results from his own position, without having an assistant constantly at the amplifier controls.

However, it is not a practical proposition to remove the volume control of the amplifier to the end of a long cable for such remote operation. There would be a considerable increase in the noise level of the system, despite the best efforts to screen the cable; there is also the consideration that the audio signal may have been amplified prior to the volume control, and at the higher level, may itself produce some feedback effects due to the stray capacitance of the cable.

It may be suggested that a volume control could be incorporated in the microphone case, to control the signal level before it is applied to the amplifier; however, the microphone may not be the sole signal source. It is common practice to use several inputs to a public address system, with part of the pre-amplifier stages acting as an audio mixer, so it would be desirable for the remote unit to control the gain of the "mixed' signal, rather than just that of the microphone channel.

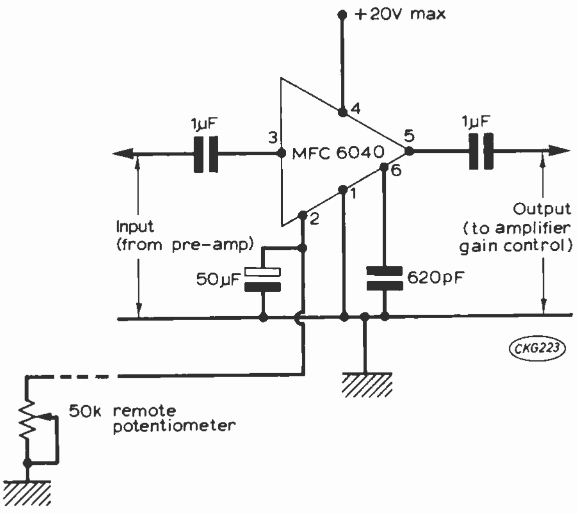
What is required, therefore, is a method of remote control of amplifier gain which does not involve long signal-carrying cables, is therefore impervious to noise and does not introduce feedback or degrade signal quality. It is just this requirement which is satisfied by the new Motorola Electronic Attenuator integrated circuit, type MFC6040.

Operation

In operation, the device is inserted in series with the master gain control of the mixer section of the preamplifier, and, depending on the setting of a remote potentiometer, attenuates the signal applied to its input terminal. Only a d.c. potential appears on the leads to the remote potentiometer; capacitative effects are therefore irrelevant. The leads may be of any desired length and need not be screened. All the difficulties visualised above are therefore avoided.

Practicalities

It is possible to obtain microphone cable in which two conductors are incorporated within the braiding. One of these may then be used in the conventional fashion, applying the microphone signal between it and the screening. The other can then be used for the remote control potentiometer, with the screening as an earth return. There is no question of capacitative crosstalk as the control connection is decoupled at the i.c. by a 50μF capacitor.



Wiring for an amplifier remote gain control system using the Motorola MFC6040 integrated circuit.

The circuit indicates the connections and components required for the provision of the remote control facility outlined. A beginner should find little difficulty in assembling it on a piece of veroboard, and it can easily be accommodated close to the master gain control inside even the most compact amplifier. A d.c. supply of 20V max. is required to operate the i.c.; this is commonly available in modern transistor amplifiers and for mobile operation the 12V car battery supply is adequate. The i.c. itself is presented in a miniature 6-pin epoxy package with pin 1 indexed.

Alternatives

Alternative applications will be evident to the experimenter. The unit can clearly be employed as an audio automatic gain control by rectifying part of the output of the unit and applying it to pin 2 as a control voltage. Similarly, feedback systems can be designed which produce a control voltage dependent on signal frequency, for pre-emphasis or de-emphasis operations, or to investigate Dolby effects. A suitable low-frequency signal applied to pin 2 could be used for tremolo. It is clear, then, that the field for experiment with the MFC6040 is extremely wide, and we are likelv to hear much more of it.

2 METRE Tx *—continued from page 517*

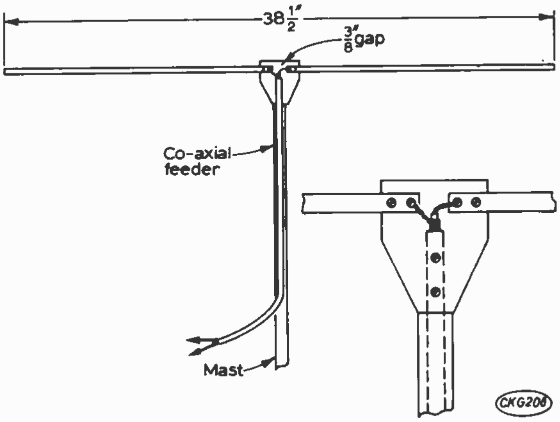


Fig. 2: Construction of a simple half wave dipole for 2 metres.

ranges. One can easily be made, using ¼in. aluminium tubing, as shown in Fig. 2, the elements being bolted to a piece of insulating material. A more weather-proof aerial can be made on the same lines, but using a closed box as fitted to TV and similar aerials. This aerial is easily raised on a light mast or post, with the co-axial feeder running down to the transmitter. ■

CQ! CQ! CQ! CQ! CQ!

ISSUES WANTED

...August 1971 Practical Wireless.—F. Maxwell, 21 Byron Close, Buyton, Liverpool, Lancs.

...Feb. and March 1972 Practical Wireless.—G. Lane, 18 Hertford Road, New Barnet, Herts.

...May 1969 Practical Wireless.—T. Ardley, 17 Elmwood Road, North Shields, Northumberland.

...issues of Practical Wireless containing article on Pedal Steel Guitar.—B. R. Currow, 31 Acorn Grove, Ditton, Maidstone, Kent.

...November 1971 Practical Wireless.—B. Featherstone, 24 Glenville Road, Rustington, Sussex.

...issues of Practical Wireless containing article on Expander/Compressor.—S. Butt 6 Childs Close, Shotley Gate, Ipswich, Suffolk.

...issues of Practical Wireless containing article on Pedal Steel Guitar.—B. S. Wylie, Daffs Tankerness Lane, Kirkwall, Orkney.

...all issues of Practical Wireless that contain "Transistor Circuitry for Beginners". B. P. Bamfield, 256 Stephenson Avenue, Leamore, Walsall, Staffs.

...March 1965 Practical Wireless.—W. A. Dorloff, Block A3 Flat, 6 Bleomendhal Flats, Kotahena, Colombo 13, Ceylon.

...Issues of Practical Wireless containing articles on Beginners Guide to Transistor Circuitry.—K. McIlroy, 24 Deramore Drive, Portadown, Co. Armagh.

...Practical Wireless November 1970, T.V. June 1971.—J. F. Glavin, North Lodge, Northlands, Salthill, Chichester, Sussex.

...issues of Practical Wireless containing details of 19 set circuits.—C. A. Campbell 7 Fairfax Crescent, Biarley, Bradford, 4, Yorks.

...issues containing details on Electric Steel Guitar.—R. J. Saunders, Carpenter & Joiners, 20 Berkeley Avenue, Chesham, Bucks.

...Practical Wireless October 1971 and November 1971.—L. Herman, 58 Herongate Road, Wanstead, E.12.

...Practical Wireless June 1966 and December 1971.—D. Whalley, 17 Mornington Rise, Matlock, Derbyshire.

...back issues of P.W. and P.E. required containing articles on electronic organs.—H. D. Briggs, 53 Gilkin Road, Admaston, Telford, Salop.

...wanted back number of P.W. Feb. 1971 second part to P.W. Stereo Tape Recorder. —D. C. Bathurst, 7 Keates Est., Kyerdale Road, Stoke Newington, N16 7AD.

...back issues of P.W. in good clean condition (in binders if possible) especially 1970, 1969 and 1968 complete volume.—B. G. J. Simeon, P.O. Box 213, Mahe, Seychelles, Indian Ocean.

...P.W. Oct. 1971—Feb. 1972 (inclusive).—J. S. Gaythorpe, 36 Granville Terrace, Guisley, Nr. Leeds, Yorks. LS20 9DY.

...P.W. November 1971–Vol. 47, Nos. one, two, three, four, five, six—E. Blackman, 89 Myatt Avenue, Parkfields, Wolverhampton, WV2 2DN, Staffs.

...P.W. May 1971, and June 1971.—H. Hunt, 13 Chiltern Drive, Walshaw, Bury, Lancs.

...issues of P.W. with article on F.E.T. Transistor Voltmeter.—F. M. Milburn Esq., Pitts Farm House, Vanity Lane, Linton, Kent.

...issues of P.W. containing articles on decoders.—D. E. Ross Esq., Lord Mayor Hospital, Allan, Herts.

...P.W. October 1967, December 1970, April 1971, August 1971.—R. J. S. Gowe Esq., Celtic Fields, Celtic Way, Bleadon Hill, Weston-Super-Mare, Som., BS24 ONA.

...issues of P.W. containing details of the "Sixteen" multimeter.—H. E. Lupton Senior Lecturer in Educational Psychology, Saint Martin's College, Lancaster.

...January 1968 with details of P.W. clubman Mark I. Will buy or hire and will pay for postage.—M. Farrall, 17 Priory Road, Cottingham, Yorkshire.

...Dec. 1971 P.W.—P. A. Townsend, 24 Ronald Drive, Rayleigh, Essex.

...P.W. DCC. 67.—Carl's Radio and T.V. Engineers, 11 Scott Vale, Sheepridge, Huddersfield.

...P.W. August 1971.—C. J. Rayner, 6 Westley Road, Fornhal All Saints, Bury St. Edmunds, Suffolk.

...issues of Practical Wireless containing the Explorer VHF Receiver or Just loan the above issue C1967.—A. J. Bartlett, 4 Kelsall Close, Kidbrook, London, SE30 OJJ.

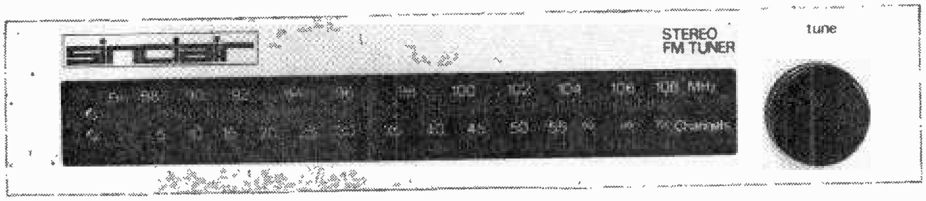
...P.W. for Jan. and Feb. 1971.—M. F. Bowen, 44 Elder Crescent, R.A.F. Wattisham Ipswich, Suffolk.

...August and September 1969 issues of Practical Television.—N. F. Beardmore, 9 Alder Road, Prescot, Lancs. L34 2SG.

...Digital Frequency Counter/Timer.—E. De Smedt, Bureau D'Etudes, 9 Avenue de Levis Mirepoix, 1090 Bruxelles.

Sinclair Project 60

Project 60 Stereo FM Tuner



Built and tested.
Post free.
£25

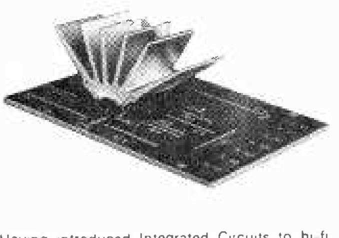
with phase lock-loop principle

Amongst the many advanced electronic features to be found in this remarkable stereo tuner, use of the phase lock loop principle ensures standards of audio quality better than from any other method of detection yet used. Varicap diode tuning, accurately formed printed circuit coils, an I.C. in the special stereo decoder section and switchable squelch circuit for silent tuning between stations contribute to the unsurpassed performance of this tuner, irrespective of price consideration. But the Project 60 FM Stereo Tuner is far from expensive – indeed, it offers fantastic value for money and will bring the thrill of stereo radio to many who previously may not have been able to afford it. The tuner may be used with any good system as well as Project 60, but if you use it with other Project 60 modules, you will find the matching front panels particularly impressive in appearance as well as function.

SPECIFICIATIONS

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 20 μV
Signal to noise ratio: ± 65dB.
Audio frequency response: 10Hz–15Khz (± 1dB).
Total harmonic distortion: 0·15% for 30% modulation.
Stereo decoder operating level: 2μV.
Cross talk: 40dB.
Output voltage: 2 · 150mV R.M S max. (typically 2 · 50mV. stereo)
Operating voltage: 25–30V DC at 100mA.
Indicators: Stereo on : tuning
Size: 93 × 40 · 207mm.

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 make possible. It is the equivalent of a 22 transistor circuit contained within a 16 lead DIL package, and the finned heat sink 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 manual and printed circuit board

SPECIFICATIONS

Output power: 6 watts RMS continuous (12 watts peak). 6–8Ω **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 28V **Quiescent current:** 8mA at 28V. **Size:** 22 · 45 · 28mm including pins and heat sink

Manual available separately 15p post free

With FREE printed circuit board and 40 page manual
£2.98 Post free

Project 605

The easy way to buy and build Project 60

Project 605 is one pack containing one PZ5, two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting

Complete Project 605 pack with comprehensive manual, post free **£29.95**

Everything you need to assemble a superb 30 watt high fidelity stereo amplifier without having to solder

sinclair

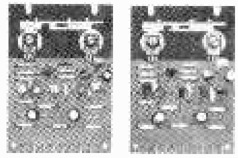
Sinclair Radionics Ltd, London Road, St. Ives, Huntingdonshire PE17 4HJ. Tel: St. Ives 64311

the world's most advanced high fidelity modules

Z.30 & Z.50 power amplifiers

Built, tested and guaranteed with circuits and instructions manual **Z.30 £4.48** **Z.50 £5.48**

The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to provide unsurpassed standards of performance Total harmonic distortion is an incredibly low 0 02% at 15w (8Ω) and all lower outputs. Whether you use Z 30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and are intended for use principally with other units in the Project 60 range Their performance and design are such, however, that Z.50s and Z.30 may be used in a far wider range of applications.

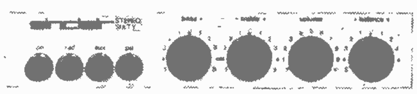


SPECIFICATIONS ***(Z.50 units are interchangeable with Z.30s in all applications).*** **— Power Outputs:** **Z.30** 15 watts R.M.S. into 8 ohms using 35 volts 20 watts R M S into 3 ohms using 30 volts **Z.50** 40 watts R.M.S into 3 ohms using 40 volts 30 watts R M S into 8 ohms using 50 volts **Frequency response:** 30 to 300.000Hz - 1dB **Distortion:** 0 02% into 8 ohms. **Signal to noise ratio:** better than 70dB unweighted. **Input sensitivity:** 250mV into 100 Kohms (for 15w into 8Ω) For speakers from 3 to 15 ohms impedance. **Size:** 14 x 80 x 57mm.

Stereo 60 Pre-amp/control unit

Built, tested and guaranteed **£9.98**

Designed specifically for use on Project 60 systems. the Stereo 60 is equally suitable for use with any high quality power amplifier. Since silicon epitaxial 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.

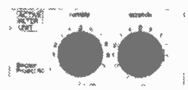


SPECIFICATIONS—Input sensitivities: Radio – up to 3mV Mag. p u 3mV correct to R I A A. curve ±1dB 20 to 25,000 Hz Ceramic p u – up to 3mV Aux – up to 3mV **Output:** 250mV **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB **Tone controls:** TREBLE + 12 to —12dB at 10KHz BASS + 12 to —12dB at 100Hz **Front panel:** brushed aluminium with black knobs and controls **Size:** 66 x 40 x 207mm

A.F.U. High & Low Pass Filter Unit

Built, tested and guaranteed **£5.98**

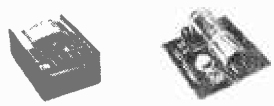
For use between Stereo 60 unit and two Z.30s or Z.50s. The unit is very easily mounted and is unique in that the cut-off frequencies are continuously variable. As attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A F U is suitable for use with any other amplifier system. There are two filter sections – rumble (high pass) and scratch (low pass). H F. cut-off (—3dB) variable from 28KHz to 5KHz. L.F. cut-off (—3dB) variable from 25Hz to 100Hz Distortion at 1KHz (35V. supply) 0.02% at rated output Operating voltage from 15 to 35V Current 3mA **Size:** 66 x 40 x 90mm.



Power Supply Units

Designed specifically for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 or PZ.8 where a stabilised supply is essential.

PZ.5 *30 volts unstabilised* **£4.98**
PZ.6 *35 volts stabilised* **£7.98**
PZ.8 *45 volts stabilised (less mains transformer)* **£7.98**
PZ.8 *mains transformer* **£5.98**



Typical Project 60 applications

System	The Units to use	together with	Units cost
Simple battery record player	**Z.30**	Crystal P.U., 12V battery volume control, etc	**£4.48**
Mains powered record player	**Z.30, PZ.5**	Crystal or ceramic P U. volume control, etc	**£9.45**
12W. RMS continuous sine wave stereo amp. for average needs	**2 x Z.30s, Stereo 60; PZ.5**	Crystal, ceramic or mag. P U , F M Tuner, etc	**£23.90**
25W. RMS continuous sine wave stereo amp. using low efficiency (high performance) speakers	**2 x Z.30s, Stereo 60; PZ.6**	High quality ceramic or magnetic P U., F M. Tuner, Tape Deck, etc.	**£26.90**
80W. (3 ohms) RMS continuous sine wave de luxe stereo amplifier. (60W. RMS into 8 ohms)	**2 x Z.50s, Stereo 60; PZ.8, mains transformer**	As above	**£34.88**
Indoor P.A.	**Z.50, PZ.8, mains transformer**	Mic , guitar, speakers, etc., controls	**£19.43**

F.M. Stereo Tuner **(£25)** & A.F.U. **(£5.98)** may be added as required.

Guarantee

If, 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.

sinclair

SINCLAIR RADIONICS, ST IVES, HUNTINGDONSHIRE PE17 4HJ

Please send ____________________

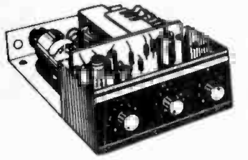
I enclose cash/cheque/money order

Name ____________________

Address ____________________

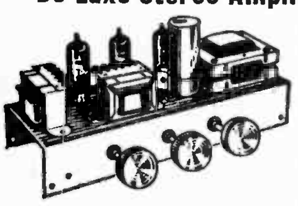
PE 1072

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohm. Frequency response 12Hz—30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high x 6" wide x 7½" deep. AC 200/250V.
PRICE £10·50. P. & P. 25p.

De Luxe Stereo Amplifier



A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built & tested to a high standard. **PRICE £8·92 P.&P. 45p.**

NEW! POWER SUPPLY UNIT

200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp continuous (1½amp intermittent).
Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3½" × 2½".
Suitable for Transistor Radios, Tape Recorders, Amplifiers etc. etc. Ready built and tested.

PRICE £4·50 P & P 35p.

BLACK ANODISED 16g. ALUMINIUM HEAT SINKS. For TO3, complete with mica's and bushes. Size 2½" × 3" approx. 25p pair. P. & P. 5p.

HIGH GRADE COPPER LAMINATE BOARDS. 8 × 6 × $\frac{1}{16}$in. FIVE for 50p. P. & P. 13p.

COILED SPRING BACK TELEPHONE CABLE. Closed approx. 10" extends to 36". 4 core or 6 core. 25p each P. & P. 5p. 5 or more post free. LIMITED NUMBER!

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0–210–240v. Secondary combinations 0–5–10–15–20–25–30–35–40–60v. half wave at 1 amp. or 10–0–10, 20–0–20, 30–0–30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3in. deep. Price £1·75 P. & P. 30p.

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240v. Sec. 9–0–9 at 500mA. 70p. P. & P. 13p. Pri. 200/240v. Sec. 12–0–12 at 1 amp. 88p. P. & P. 13p. Pri. 200/240v. Sec. 10–0–10 at 2 amp. £1·38. P. & P. 30p.

SPECIAL MAINS TRANSFORMER 200/240v. A.C. Input 35v at 1½ amp A.C. output overall size 2½" × 2½" × 3" approx. Suitable drop through or vertical mounting 75p. P. & P. 30p.

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES

A must for servicemen and home constructors. Including many 1000's of British, U.S.A. European and Japanese transistors. ONLY **40p**. Post 5p.

4-SPEED RECORD PLAYER BARGAINS
Mains models. All brand new in maker's packing.
LATEST B.S.R. C109/C129 4-SPEED AUTOCHANGER. With latest mono compatible cartridge £6·97 Carr. 50p. With stereo cartridge £7·97 Carr. 50p.
LATEST GARRARD MODELS. S.A.E. for latest Prices!

PRECISION ENGINEERED PLINTHS
Beautifully constructed in heavy gauge "Colorcoat" plastic coated steel. Resonance free. Designed to take Garrard 1025, 2000, 2025TC, 2500, 3000, 3500, 5100, SP25 II and III, SL65B, AT60 etc. or B.S.R. C109, C129, A21 etc. Choice of Black leatherette or Teak grain finish. Size 12¾" x 14½" x 3½" high (approx. 7½" high, including rigid smoked acrylic cover).
PRICE £5·50. P. & P. 60p.

LATEST ACOS GP91/18C mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. £1·50 P. & P. 8p.
SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78.
ONLY £2·50 P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. £3. P. & P. 10p.
LATEST RONETTE T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. £1·63 P. & P. 10p.
LATEST RONETTE T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only £1·50 P. & P. 10p.

QUALITY RECORD PLAYER AMPLIFIER MK II
A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. Ready built and tested. PRICE £3·75 P. & P. 40p
ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE £4·88 P. & P. 50p.
DELUXE QUALITY PORTABLE R/P CABINET MK II. Uncut motor board size 14½ × 12in. clearance 2in. below, 5½in. above. Will take above amplifier and any B.S.R. or GARRARD changer or Single Player (except AT60 and SP25). Size 18 × 15 × 8in. PRICE £4·75, P. & P. 50p.

SPECIAL OFFER !
HI-FI LOUDSPEAKER SYSTEMS

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16½" high x 10½" wide x 5½" deep. Fitted with E.M.I. Ceramic Magnet 13" x 8" bass unit, two H.F. tweeter units and crossover. Power handling 10 watts. Available 3 or 8 or 15 ohms impedance.
OUR PRICE £8.40 Carr. 65p
Cabinet Available Separately £4·50 Carr 60p
Also available in 8 ohms with EMI 13" x 8" bass speaker with parasitic tweeter £6·50 Carr. 65p

LOUDSPEAKER BARGAINS
5in. 3 ohm £1·05, P. & P. 15p. 7×4in. 3 ohm £1·15, P. & P. 20p. 10 × 6in. 3 or 15 ohm £1·90, P & P. 30p. E.M.I. 8 × 5in. 3 ohm with high flux magnet £1·62, P. & P. 20p E.M.I. 13½ × 8in. with high flux ceramic magnet 3, 8 or 15 ohm £3·20, P. & P. 30p. E.M.I. 13 × 8in. 3, 8 or 15 ohm with two inbuilt tweeters and crossover network £4·20, P. & P. 30p. E.M.I. 13 × 8in. twin cone (parasitic tweeter) 8 ohm £2·25, P. & P. 30p.
BRAND NEW. 12in. 15w. H/D Speakers, 3 or 15 ohms. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly £6·25. Guitar models: 25w. £6·50, 35w. £8·50. P. & P. 38p
E.M.I. 3½in. HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3 or 8 or 15 ohms 93p each. P. & P. 13p.
12in. "RA" TWIN CONE LOUDSPEAKER. 10 watts peak handling. 3, 8 or 15 ohm £2·20, P. & P. 30p.
35 ohm SPEAKERS 3in. only 63p P. & P. 13p.
"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11½" x 14$\frac{11}{16}$" x 1$\frac{1}{16}$" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. Only £5·75 each. P. & P. 25p.
VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Usually £1·75 yd., our price 75p yd. length. P. & P. 15p (min 1 yd.) S.A.E. for samples.

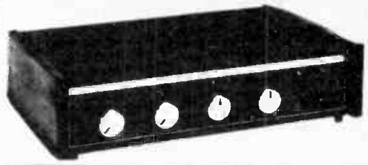
HI-FI STEREO HEADPHONES

Adjustable headband with comfortable flexifoam earmuffs. Wired and fitted with standard stereo ¼in jack plug. Frequency response 30–15.000Hz. Matching impedance 8-16 ohms. Easily converted for Mono. PRICE £2·95, P. & P. 15p.
HIGH IMPEDANCE CRYSTAL STICK MIKES.
OUR PRICE £1·05. P. & P. 8p

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER
For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1½" x 1½" x ½". Brand new complete with instructions. Price 88p. P. & P. 13p.

CENTRE ZERO MINIATURE MOVING COIL METER. 100μA. For balance or tuning. Approx. size 1" x 1" x ½" deep. Limited number. 75p. P. & P. 10p.

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



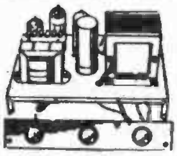
NEW FURTHER IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED FIBRE GLASS PRINTED CIRCUIT BOARD WITH COMPONENT IDENTIFICATION CLEARLY MARKED FOR EVEN EASIER CONSTRUCTION

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 5 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled fibreglass printed circuit board, smart brushed anodised aluminium front panel with matching knob, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12–30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12–15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1.0 amp. Overall Size 12"w. x 8"d. x 2½"h.
Fully detailed 7 page construction manual and parts list free with kit or send 18p plus large S.A.E.

AMPLIFIER KIT	£10·50	P. & P. 15p
(Magnetic input components 30p extra)		
POWER PACK KIT ..	£3·00	P. & P. 30p
CABINET	£3·00	P. & P. 30p

(Post Free if all units purchased at same time)
Full after sales service
Also available ready built and tested £21·00. Post Free.
Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc.) and will then provide mixing and fading facilities for medium powered Hi Fi Discotheque use, etc.

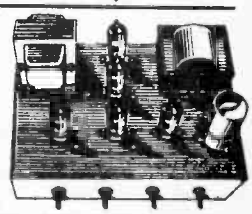
3-VALVE AUDIO AMPLIFIER HA34 MK II.



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½" w. x 4" d. x 4½" h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £4·75. P. & P. 35p.
HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. £3·98. P. & P. 40p.

HARVERSON'S SUPER MONO AMPLIFIER
A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3.5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with good quality output transformer.
BARGAIN PRICE **£2.75** P. & P. 35p

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω speaker and 2 independent volume controls, and separate base and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 13p (Free with parts). All parts sold separately. ONLY £7·97 P. & P. 55p.

Open 9–5.30 Monday to Saturday
Early closing Wed. 1 p.m.
A few minutes from South Wimbledon Tube Station.

HARVERSON SURPLUS CO. LTD.

170 HIGH ST., MERTON, LONDON, S.W.19 — Tel.: 01-540 3985

SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

(Please write clearly)
PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

DRILL CONTROLLER

NEW IKW MODEL

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £1·50 plus 13p post and insurance. Made up model also available. £2·25 plus 13p post & p.

MAINS OPERATED CONTACTOR

220/240v. 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10 amps. Extremely well made by a German Electrical Company. Overall size 2¼ × 2 × 2in. £1·50 each.

NEED A SPECIAL SWITCH?

Double Leaf Contact. Very slight pressure closes both contacts. 6p each, 60p doz. Plastic push-rod suitable for operating, 5p each, 45p doz.

MICRO SWITCH

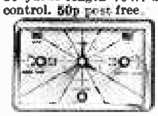
5 amp changeover contacts, 9p each, £1 doz. 15 amp Model 10p each or £1·05 doz.

MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at 20p each, £1·80 for ten, your assortment.

WATERPROOF HEATING ELEMENT

26 yards length 70W. Self-regulating temperature control. 50p post free.



15A ELECTRICAL PROGRAMMER

Learn in your sleep: Have radio playing and kettle boiling as you awake—switch on lights to ward off intruders—have warm house to come home to. All these and many other things you can do if you invest in an electrical programmer Clock by famous maker with 15 amp. on/off switch. Switch on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price £1·95 + 20p p & p or with glass front chrome bezel 75p extra.

TREASURE TRACER MARK II

Complete Kit (except battens) to make the metal detector similar to the circuit in Practical Wireless August issue. £3·95 plus 20p post and insurance.

SNAP ACTION SLIDE SWITCH

Rated 5a. 240v. Made by Arrow. Type fitted in the handles of electric drills, vacuums, etc. 5p each, 10 for 45p.

NUMICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Hi-vac XN. 3, Price £1·45 each. 10 for £13.

12 WAY SUB-MINIATURE MULTI-CORE CABLE

7·0076 copper cores each core P.V.C. insulated and of different colour. P.V.C. covered overall and approx. 3/16in. thick. Price 20p per yard.

LIGHT CELL

Almost zero resistant in sunlight increases to 10 K Ohms in dark or dull light, epoxy resin sealed. Size approx. 1in. dia. by ½in. thick. Rated at 500 MW, wire ended. 43p with circuit. Also ORP 12 light cell 45p.

Coiled Leads. Extend to about 2 yards—as fitted to telephones etc. the flex conductors of these use a tinsel wire which makes them virtually unbreakable with normal usage. 3 core 15p, 4 core 20p, 6 core 25p per lead. All less 10% in lots of 10 or more.

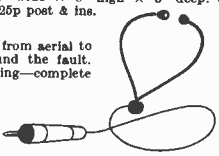
MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only £1 plus 20p postage.

GOOD COMPANION

We can now offer these again in modular version using Mullard AF & IF Modules and Radiomobile Permeability Tuner. Shouldn't take more than an evening to make. Cabinet size approx. 11″ wide × 8″ high × 3″ deep. Complete assembly instructions—£4·75 plus 25p post & ins.

RADIO STETHOSCOPE



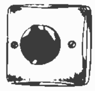
Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. £2—twin stetho-set instead of earpiece 75p extra post and ins. 20p

STANDARD WAFER SWITCHES

Standard size 1¼″ wafer—silver-plated 5-amp contact, standard ¼″ spindle 2″ long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10way	12way
1 pole	40p	40p	40p	40p	40p	40p	40p	40p	40p
2 poles	40p	40p	40p	40p	40p	40p	40p	70p	70p
3 poles	40p	40p	40p	40p	70p	70p	70p	95p	95p
4 poles	40p	40p	40p	70p	70p	70p	70p	£1·20	£1·20
5 poles	40p	40p	70p	70p	95p	95p	95p	£1·45	£1·45
6 poles	40p	70p	70p	70p	95p	95p	95p	£1·70	£1·70
7 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£1·95	£1·95
8 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£2·20	£2·20
9 poles	70p	70p	95p	95p	£1·45	£1·45	£1·45	£2·45	£2·45
10 poles	70p	70p	95p	£1·20	£1·45	£1·45	£1·45	£2·70	£2·70
11 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£2·95	£2·95
12 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£3·20	£3·20

THYRISTOR LIGHT DIMMER



For any lamp up to 200 watt. Mounted on switch plate to fit in place of standard switch. Virtually no radio interferences. Price £2·50 plus 20p post and insurance.

MULLARD AUDIO AMPLIFIER MODULE

Uses 4 transistors, and has an output of 500mW into 8 ohms speakers. Input suitable for crystal mic. or pick-up 9V battery operated. Size 2in long × 1½in wide × 1in high. SPECIAL SNIP PRICE 65p each. 10 for £5·90.

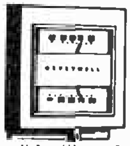
THIS MONTH'S SNIP

REPEATING TIME SWITCH

1 or 2 on/offs per 24 hours. Repeats until reprogrammed. Switches up to 15 amp. Switching time completely adjustable through 24 hours. Precision made with 24 hour dial. Miniature—will fit into 2″ cube. Mains operated clock but switch may be isolated for switching battery sets. Ideal for:—shop window lighting, anti-thief devices, central heating control and many other automatic processes. Price with instructions £2 each + 20p post and insurance.

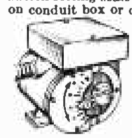
HORSTMANN "TIME & SET" SWITCH

(A30 Amp Switch.) Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc. up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special snip price £1·50 Post and ins. 23p.



HONEYWELL THERMOSTAT

Made by Honeywell for normal air temperatures 40°-80°F (5-25°C). This is a precision instrument with a differential which can be adjusted to better than 1·5°F. A mercury switch breaks on temp. rise—the switch is operated by a coiled bi-metal element and adjustable heater is incorporated for heat anticipation. Elegantly styled and encased in an ivory plastic case with clear plastic windows thermometer above and switch setting scale below-size approx 3·8″ × 3·2″ × 1·4″ deep—can be mounted on conduit box or directly on wall. Price £1·25 each or ten for £11·25.



ZPM—MODULATION MOTOR

Could also be used to open vantilators, doors, valve, damper etc. particularly suitable for remote control. Made by Satchwell. Essentially a reversible geared motor fitted with internal limit switches to stop it at the end of its travel. Size approx. 6″ × 6″ × 5½″ and weighing approx. 10 lbs. This is extremely powerful and would lift a heavy door or open a long line of ventilators. To operate this motor you put the 50 cycle supply through a change over switch. For instance a thermostat with change-over contacts could automatically regulate the temperature in a growing house, chicken hatchery etc. An indicator on the motor graduated 0–10 shows the state of open or close. Also internally fitted is a variable resistor, wires from this to a volt meter would give a remote indication of the open or close position. A very expensive motor if both direct from Satchwell, our price complete with step down Transformer is £15.

INTEGRATED CIRCUIT BARGAIN

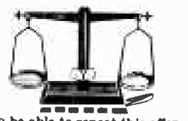
A parcel of integrated circuits made by the famous Plessey Company. A once-in-a-lifetime offer of Micro-electronic devices well below cost of manufacture. The parcel contains 5 ICs all new and perfect, first-grade device, definitely not sub-standard or seconds. 4 of the ICs are single silicon chip GP amplifiers. The 5th is a monolithic NPN matched pair. Regular price of parcel well over £5. Full circuit details of the ICs are included and in addition you will receive a list of many different ICs available at bargain prices 25p upwards with circuits and technical data of each. Complete parcel only £1 post paid.

DON'T MISS THIS TERRIFIC BARGAIN.

MULLARD I.F. MODULE

This is a fully screened intermediate frequency module for amplification and detection of f.m. signals at 10·7MHz and a.m. signals at 470kHz. The first stage is used as an i.f. amplifier for f.m. and a self oscillating mixer for a.m. operation, in conjunction with an external oscillator coil. 85p each. 10 for £7·85 100 for £62·50p. With connection dig.

EDUCATIONAL KITS—all with pictorial instructions



THIS BALANCE KIT FREE Eagle educational kits. Japanese made these are excellent value for money. We do not expect to be able to repeat this offer once stocks are sold. Brief description of each kit is given below and with 3 kits or more we give FREE an accurate 11 piece balance kit. Price of kits 40p each post paid. Special price for all 7 kits £2·50 with free balance kit.

KA2 Lens Kit. Eleven parts, including candle one concave lens, one convex lens, glass and slit frame, etc. Watch light rays bend as they pass through different lenses.

KA3 Water Pump Kit. Thirteen parts. Top of pump is transparent so that operating parts may be observed. Small parts are brightly coloured to be seen easily while working. Three types of pump may be made: Lift pump, Force Pump and Force Pump with reservoir and nozzle.

KA4 Buzzer Kit. Eleven parts. Transparent covers allow the operation of buzzer to be seen. Illustrates and teaches how electromagnetism with an automatic switch results in an operating buzzer.

KA5—2-Pole Motor Kit. Twenty-four parts, including enamel wire, armature and pole piece, etc. Motor operates from 1½ volt battery. Illustrates and teaches how electro-magnetism operates a motor.

KA7 Electro-Magnet Kit. Fifteen parts, includes compass. Makes two electro-magnets, one with one layer of wire and one with several layers of wire. Picks up tacks, nails and any small parts showing how magnetism works.

KA8 Current and Resistance Kit. Twenty-nine parts, including bench and light bulb. Conduct interesting and educational projects to learn the application of "OHMS LAW" and see the difference in current and resistance with different types and lengths of wire.

KA9 Bell Kit. Eight parts, including bell and push button switch. Build a complete electric bell and see how the hammer is triggered to make the bell ring.

TAPE HEADS

Miniature size ¼″ square front × ¾″ deep. Understand made for Truvox. Double wound, maybe wired in series or parallel for high or low impedance working. Each supplied with matching erase head. 2 track 50p pair, 4 track 75p pair. Less 10% 10 or more pairs.

KA10 Morse Key buzzer and bell kit. 25 part kit easy to construct, simple to operate.

Instrument Motors fitted with Gear Box. These made by Smiths Industries are as fitted into electric clocks, chart recorders etc. Motor size approx. 1½″ dia. × 1″ deep, gear box attached approx. 2″ diameter × ½″ thick with good length of spindle. Most motors are fitted with a ¼″ long × ⅛″ diameter drive spindle. Suitable for 200/240v mains 50 c.p.s. unless marked otherwise. Following speeds available:—8 revs per min., 16 revs per min., 20 revs per hour, 6 revs per hour (60 cycles), 4 revs per hour (60 cycles), 2 revs per hour, 8 revs per day, 6 revs per day. All £1 each or 10 for £9.

Micro Switch. Made by Burgess. 15 amp off/on—normally closed. Size 1⅛″ × ⅜″ × ⅝″. Price 15p each or 10 for £1·35. Operation is by pressure on tiny ball.

2 Amp Switched Sockets. Oblong, brown bakelite surface mounting—2 pin Standard domestic type. 10p each or 10 for 90p.

Surface Switches. 5 amp British make. Brown bakelite—oblong—1 way 10p each, 2 way 15p each.

Torch Bulbs. Empire made. 2·5v and 3·5v. Boxes of 25—25p or 10 boxes for £2·25.

3 Core Maroon Cotton Covered Flex. Very best makers but old coloured code. 6 amp—23/36 × 100 yd coil £2 plus 50p. 15 amp—70/36 × 50yd coil £3·95 plus 50p post.

Delay Switch. Glass tubular enclosed on 4 pin base gives a delay of 60 secs. when 3v are applied to the electrically isolated heater. Delay can be shortened to approx 1 second by increasing the heater voltage up to 6 or 7v. Price 50p each or 10 for £4·50.

Miniature Tubes. These are approx. ¼″ diameter and need miniature bi-pin end connectors. 3 sizes available:—9″ 6 watt, 12″ 8 watt, 21″ 13 watt All are 55p each. Less 10% on 10 or more.

A.C. Mains Buzzer. These are open constructions intended for fitting into instruments etc. Size approx. 1⅝″ high × 1″ deep × ⅝″ wide. 25p each. 10 for £2·25.

4 Watt Amplifier Module. Made by Mullard Ref. No. EP9000. Part of the Unilex system. This has an output of 4 watt speech and music into a 12–15 ohm speaker. A powerful amplifier with a thousand uses—completely encased. Size approx. 3½″ × 2½″ × 1½″. Screw down input and output terminals. Price £1·45 each or 10 for £13·05.

Pre-Amplifier Module. 2 channel for Stereo. Input sensitivity 320mV. Part of the Mullard Unilex system and completely encased. Size 4″ × 4″ × 1″. Screw down input and output terminals. Price £1·80 each or 10 for £16·20.

Where postage is not stated then orders over £5 are post free. Below £5 add 20p Semiconductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

J. BULL (ELECTRICAL) LTD.

(Dept. P.W.), 7 Park Street, Croydon CRO IYD

Callers to: 102/3 Tamworth Road, Croydon.

SEW PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES, ETC.

● LOW COST ● QUICK DELIVERY ● OVER 200 RANGES IN STOCK ● OTHER RANGES TO ORDER

NEW "SEW" DESIGNS!

CLEAR PLASTIC METERS

TYPE SW.100
100 x 80 mm.

50μA	£3·60	20V. D.C.	£3·10
50-0-50μA	£3·45	50V. D.C.	£3·10
100μA	£3·45	300V. D.C.	£3·10
100-0-100μA	£3·35	1 amp. D.C.	£3·10
500μA	£3·20	5 amp D.C.	£3·10
1mA	£3·10	300V. A.C.	£3·10
		VU Meter	£3·75

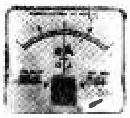
BAKELITE PANEL METERS

TYPE S-80
80 mm.
square fronts

50μA	£3·20	50V. D.C.	£2·60
50-0-50μA	£3·10	300V. D.C.	£2·60
100μA	£3·10	1 amp. D.C.	£2·60
100-0-100μA	£3·00	5 amp. D.C.	£2·60
500μA	£2·75	300V. A.C.	£2·60
1mA	£2·60	VU Meter	£3·37
20V. D.C.	£2·20		

"SEW" CLEAR PLASTIC METERS

Type MR.85P. 4½in. × 4¼in. fronts.



50μA	£3·60	50mA	£2·80
50-0-50μA	£3·10	100mA	£2·80
100μA	£3·10	500mA	£2·80
100-0-100μA	£3·00	1 amp.	£2·80
200μA	£3·00	5 amp.	£2·80
500μA	£2·90	15 amp.	£2·80
500-0-500μA	£2·80	30 amp.	£2·90
1mA	£2·80	20V. D.C.	£2·80
1-0-1mA	£2·80	50V. D.C.	£2·80
5mA	£2·80	150V. D.C.	£2·80
10mA	£2·80	300V. D.C.	£2·80
		15V. A.C.	£2·80
		300V. A.C.	£2·80
		8 Meter 1mA	£2·87
		VU Meter	£3·60
		1 amp. A.C.*	£2·80
		5 amp. A.C.*	£2·80
		10 amp. A.C.*	£2·80
		20 amp. A.C.*	£2·80
		30 amp. A.C.*	£2·80

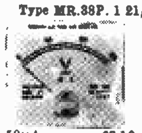
Type MR.52P. 2½in. square fronts.

50μA	£3·10	10V. D.C.	£2·00
50-0-50μA	£2·60	20V. D.C.	£2·00
100μA	£2·60	50V. D.C.	£2·00
100-0-100μA	£2·50	300V. D.C.	£2·00
500μA	£2·30	15V. A.C.	£2·10
1mA	£2·00	300V. A.C.	£2·10
5mA	£2·00	8 Meter 1mA	£2·10
10mA	£2·00	VU Meter	£3·20
50mA	£2·00	1 amp. A.C.*	£2·00
100mA	£2·00	5 amp. A.C.*	£2·00
500mA	£2·00	10 amp. A.C.*	£2·00
1 amp.	£2·00	20 amp. A.C.*	£2·00
5 amp.	£2·00	30 amp. A.C.*	£2·00

Type MR.65P. 3½in. × 3¼in. fronts.

50μA	£3·37	10V. D.C.	£2·20
50-0-50μA	£2·75	20V. D.C.	£2·20
100μA	£2·75	50V. D.C.	£2·20
100-0-100μA	£2·65	150V. D.C.	£2·20
200μA	£2·65	300V. D.C.	£2·20
500μA	£2·40	15V. A.C.	£2·30
500-0-500μA	£2·20	50V. A.C.	£2·30
1mA	£2·20	150V. A.C.	£2·30
5mA	£2·20	300V. A.C.	£2·30
10mA	£2·20	500V. A.C.	£2·30
50mA	£2·20	8 Meter 1mA	£2·37
100mA	£2·20	VU Meter	£3·37
500mA	£2·20	50mA A.C.*	£2·20
1 amp.	£2·20	100mA A.C.*	£2·20
5 amp.	£2·20	200mA A.C.*	£2·20
10 amp.	£2·20	500mA A.C.*	£2·20
15 amp.	£2·20	1 amp. A.C.*	£2·20
20 amp.	£2·20	5 amp. A.C.*	£2·20
30 amp.	£2·30	10 amp. A.C.*	£2·20
50 amp.	£2·50	20 amp. A.C.*	£2·20
5V. D.C.	£2·20	30 amp. A.C.*	£2·20

Type MR.38P. 1 21/32in. square fronts.



50μA	£2·10	200mA	£1·60
50-0-50μA	£1·90	300mA	£1·60
100μA	£1·90	500mA	£1·60
100-0-100μA	£1·75	750mA	£1·60
200μA	£1·75	1 amp.	£1·60
500μA	£1·65	2 amp.	£1·60
500-0-500μA	£1·60	5 amp.	£1·60
1mA	£1·60	10 amp.	£1·60
1-0-1mA	£1·60	3V. D.C.	£1·60
2mA	£1·60	10V. D.C.	£1·60
5mA	£1·60	15V. D.C.	£1·60
10mA	£1·60	20V. D.C.	£1·60
20mA	£1·60	100V. D.C.	£1·60
50mA	£1·60	150V. D.C.	£1·60
100mA	£1·60	300V. D.C.	£1·60
150mA	£1·60	500V. D.C.	£1·60
		750V. D.C.	£1·60
		15V. A.C.	£1·70
		50V. A.C.	£1·70
		150V. A.C.	£1·70
		300V. A.C.	£1·70
		500V. A.C.	£1·70
		8 Meter 1mA	£1·70
		VU Meter	£2·10

Type MR.45P. 2in. square fronts.

50μA	£2·25	5 amp.	£1·70
50-0-50μA	£2·10	10V. D.C.	£1·50
100μA	£2·10	20V. D.C.	£1·50
100-0-100μA	£1·87	50V. D.C.	£1·50
200μA	£1·87	300V. D.C.	£1·50
500μA	£1·75	15V. A.C.	£1·80
500-0-500μA	£1·70	300V. A.C.	£1·80
1mA	£1·70	8 Meter 1mA	£1·85
5mA	£1·70	VU Meter	£2·25
10mA	£1·70	1 amp. A.C.*	£1·70
50mA	£1·70	5 amp. A.C.*	£1·70
100mA	£1·70	10 amp. A.C.*	£1·70
500mA	£1·70	20 amp. A.C.*	£1·70
1 amp.	£1·70	30 amp. A.C.*	£1·70

"SEW" BAKELITE PANEL METER

Type MR.65. 3½in. square fronts.

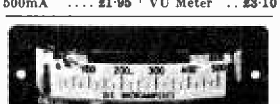
25μA	£3·50	1 amp.	£1·95
50μA	£2·75	2 amp.	£1·95
50-0-50μA	£2·35	5 amp.	£1·95
100μA	£2·35	15 amp.	£1·95
100-0-100μA	£2·25	30 amp.	£1·95
500μA	£2·20	50 amp.	£1·95
1mA	£1·95	5V. D.C.	£1·95
1-0-1mA	£1·95	10V. D.C.	£1·95
5mA	£1·95	20V. D.C.	£1·95
10mA	£1·95	50V. D.C.	£1·95
50mA	£1·95	150V. D.C.	£1·95
100mA	£1·95	300V. D.C.	£1·95
500mA	£1·95	30V. A.C.*	£1·95
		50V. A.C.*	£1·95
		150V. A.C.*	£1·95
		300V. A.C.*	£1·95
		500mA A.C.*	£1·95
		1 amp. A.C.*	£1·95
		5 amp. A.C.*	£1·95
		10 amp. A.C.*	£1·95
		20 amp. A.C.*	£1·95
		30 amp. A.C.*	£1·95
		50 amp. A.C.	£1·95
		VU Meter	£3·10

*MOVING—IRON
ALL OTHERS MOVING COIL
Please add postage

SEW EDUCATIONAL METERS

Type ED.107. Size overall 100mm × 90mm × 108mm.
A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

50μA	£5·00	20V d.c.	£4·80
100μA	£4·65	50V d.c.	£4·40
1mA	£4·40	300V d.c.	£4·40
50-0-50μA	£4·65		
1-0-1mA	£4·40	Dual range	
1A d.c.	£4·40	500mA/5A d.c.	£4·65
5A d.c.	£4·40	5V/50V d.c.	£4·65
10V. d.c.	£4·40		



EDGWISE METERS

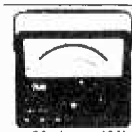
Type PE.70. 3 17/32in. × 1 15/32in. × 2½in. deep

50μA	£3·10	500μA	£2·75
50-0-50μA	£3·00	1mA	£2·45
100μA	£3·00	300V. A.C.	£2·45
100-0-100μA	£2·90	VU Meter	£3·40
200μA	£2·90		

Send for illustrated brochure on SEW Panel Meters—discounts for quanitties.

MULTIMETERS for EVERY purpose!

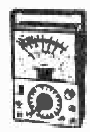
HIOKI MODEL 720X
20,000 O.P.V.
Overload protection
5/25/100/500/1000 VDC.
10/50/250/1000 VAC.
50uA/250mA. 20K/2 meg ohm. −5 to + 62db.
£4·97. P. & P. 15p.



MODEL PL436
20kΩ/Volt D.C.
8kΩ/Volt A.C.
Mirror scale.
·6/3/12/30/120/600V D.C. 3/30/120/600V A.C. 50/600uA/60/600 mA. 10/100K/1 Meg/10 MegΩ −20 to +46db. **£6·97½ P & P 12½p**

MODEL 5025 57 Ranges, Giant 5¼in. Meter, Polarity Reverse Switch.
Sensitivity: 50K/Volt D.C. 5K/Volt A.C. D.C. Volts: ·125, ·25, 1·25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.C. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.C. Current: 25, 50IA, 2·5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 2K, 10K, 100K, 1MEG, 10 MEG. Decibels: −20 to +85 dB. **£12·50**, P. & P. 17½p.

HIOKI MODEL 700X
100,000 O.P.V. Overload protection. Mirror scale.
·3/·6/1·2/1·5/3/6/12/30/60/120/300/600/1200VDC
1·5/3/6/12/30/60/150/300/600/1200 V.A.C.
15/30μA/3/6/30/60/150/300mA 6/12 AMP. DC. 2K/200K/2 Meg/20 Meg ohm −20 to +63 db **£13·50**. P. & P. 20p.



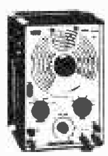
ROUND SCALE TYPE PENCIL TESTER MODEL TS.68

Completely portable, simple to use pocket sized tester. Ranges 0/3/30/300V AC and DC at 2,000 o.p.v. Resistance 0·20K ohms. ONLY **£1·97** P. & P. 13p

TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER

Battery operated, 11 meg input, 26 ranges. Large 4¾" mirror scale. Size 5¾" × 4¾" × 2¾". DC VOLTS 0.3–1200V. AC VOLTS 3–300V RMS. 8·0–800V P-P. DC CURRENT ·12–12MA. Resistance up to 2000M ohm. Decibels −20 to + 51 db. Complete with leads/instructions. **£17·50**, P. & P. 20p.

TE-20D RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 Kc/s-500 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator, audio output, Xtal socket for calibration. 220/240V. A.C. Brand new with instructions **£15**. Carr. 37½p. Size 140 × 215 × 107 mm.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20cps to 200 kc/s on 4 bands. Square: 20cps to 30 kc/s. Output impedance 5,000 ohms, 200/250V. A.C. operation. Supplied brand new and guaranteed with instruction manual and leads. **£17·50**. Carr. 37½p.

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 kc/s-260 Mc/s on 6 bands. Directly calibrated variable R.F. attenuator. Operation 200/240V A.C. Brand new with instruction. **£15** P. & P. 37½p. S.A.E. for details.

240° Wide Angle 1mA Meters

MW1-6 60mm square	£3·97½
MW1-8 80mm square	£4·97½

P. & P. extra

MODEL LT.101 1000 O.P.V 0/10/50/250/1000 V. D.C. 0/10/50/250/1000 V. A.C. 0/1/100 M.A. 0/150 K ohms. **£1·97**. P. & P. 15p.

TMK MODEL MD.120
Mirror scale. 20k/Volt D.C. 10k Ω Volt A.C. 30/60/300/600/3,000 V. D.C. 6/120/1,200 V. A.C.
Current 0·60μA/0 — 12/0 300mA. 0·60K/0·6 MegΩ. −20 to + 63 dB. **£4·62½** P & P 15p

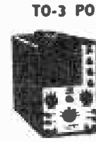
MODEL 500 30,000 O.P.V with overload protection mirror scale 0/·5/2·5/10/25 100/250/500/1,000v. D.C 0/2·5/10/25/100/250/500/1,000V. A.C. 0/50μA/5/50/500mA. 12 amp. D.C. 0/60/K/6 Meg./60 Meg Ω. **£8·87½**. Post paid.

TMK LAB TESTER. 100,000 O.P.V. 6½in. Scale Buzzer Short Circuit Check. Sensitivity: 100,000 O.P.V. D.C. 5K/Volt A.C. D.C. Volts: ·5, 2·5, 10, 50, 250, 1,000 V. A.C. Volts: 3, 10, 50, 50, 250, 500, 1,000V. D.C. Current: 10, 100μA, 10, 100, 500mA, 2·5, 10 amp. Resistance: 1K, 10K, 100K, 10MEG, 100MEG Ω. Decibels: −10 to +49 db. Plastic Case with Carrying Handle. Size: 7½in. × 6¾in. × 3¼in. **£18·90**. P. & P. 25p

RUSSIAN 22 RANGE MULTIMETER

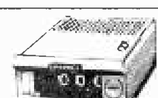
Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2·5/10/50/250/500/1000v D.C. 2·5/10/50/250/500/1000v A.C. DC Current 100 wA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3m Ω. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE **£5·97** P. & P. 25p.

TO-3 PORTABLE OSCILLOSCOPE



3in. tube, Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps–1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1·5cps –800kHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps–300kHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½lb. 220/240V. A.C. Supplied brand new with handbook. **£40·00**. Carr. 50p.

HONEYWELL DIGITAL VOLTMETER VT.100



Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt. current and ohms with optional plug in cards. Specification: Accuracy: ±0·2, ±1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1·999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100v. D.C. Input: Fully floating (3 poles). Input power: 110-230v. A.C. 50/60 cycles. Overall size: 5¾in. × 2 13/16in. × 8 3/16in. AVAILABLE BRAND NEW AND FULLY GUARANTEED AT APPROX. HALF PRICE. **£49·97½**. Carr. 50p.

G. W. SMITH & CO (RADIO) LTD.
Also see next two pages

SEMI-CONDUCTORS/VALVES

ALL DEVICES BRAND NEW AND FULLY GUARANTEED

Transistors

2G301	20p
2G302	20p
2G303	20p
2G306	42p
2G308	30p
2G309	30p
2G371	15p
2G374	20p
2G381	22p
2N388A	49p
2N404	20p
2N696	15p
2N697	15p
2N698	25p
2N699	30p
2N706	10p
2N706A	12p
2N708	15p
2N709	62p
2N718	25p
2N718A	30p
2N726	30p
2N727	30p
2N914	17p
2N916	17p
2N918	30p
2N929	22p
2N930	20p
2N987	40p
2N1090	22p
2N1091	22p
2N1131	25p
2N1132	25p
2N1302	17p
2N1303	17p
2N1304	22p
2N1305	22p
2N1306	25p
2N1307	25p
2N1308	25p
2N1309	25p
2N1507	17p
2N1613	20p
2N1631	35p
2N1632	30p
2N1637	30p
2N1638	27p
2N1639	27p
2N1701	162p
2N1711	24p
2N1889	32p
2N1893	37p
2N2147	72p
2N2160	57p
2N2193	40p
2N2193A	42p
2N2194	27p
2N2194A	30p
2N2217	25p
2N2218	20p
2N2219	20p
2N2220	25p
2N2221	25p
2N2222	20p
2N2222A	25p
2N2297	30p
2N2368	15p
2N2369	15p
2N2369A	15p
2N2410	42p
2N2483	27p
2N2484	32p
2N2539	22p
2N2540	22p
2N2613	35p
2N2614	30p
2N2646	40p
2N2711	25p
2N2712	25p
2N2713	27p
2N2714	30p
2N2904	20p
2N2904A	25p
2N2905	25p
2N2905A	20p
2N2906	20p
2N2906A	25p
2N2907	23p
2N2923	15p
2N2924	15p
2N2925	15p
2N2926G	10p
2N2926O	10p
2N2926Y	10p
2N3011	20p
2N3014	32p
2N3053	18p
2N3054	46p
2N3055	60p
2N3133	30p
2N3134	15p
2N3135	25p
2N3136	25p
2N3390	25p
2N3391	20p
2N3391A	30p
2N3392	17p
2N3393	15p
2N3394	15p
2N3402	22p
2N3403	22p
2N3404	32p
2N3405	45p
2N3414	22p

2N3415	22p
2N3416	37p
2N3417	37p
2N3439	130p
2N3440	97p
2N3564	17p
2N3565	15p
2N3566	22p
2N3568	25p
2N3569	25p
2N3570	125p
2N3572	97p
2N3605	27p
2N3606	27p
2N3607	22p
2N3638	18p
2N3638A	20p
2N3641	18p
2N3642	18p
2N3643	20p
2N3644	25p
2N3645	25p
2N3691	15p
2N3692	18p
2N3693	15p
2N3694	18p
2N3702	10p
2N3703	10p
2N3704	11p
2N3705	10p
2N3706	9p
2N3707	11p
2N3708	7p
2N3709	9p
2N3710	9p
2N3711	12p
2N3713	187p
2N3714	200p
2N3715	123p
2N3716	130p
2N3773	240p
2N3791	206p
2N3819	34p
2N3820	55p
2N3823	50p
2N3854	27p
2N3854A	27p
2N3855	27p
2N3855A	30p
2N3856	30p
2N3856A	35p
2N3858	25p
2N3858A	30p
2N3859	27p
2N3859A	32p
2N3860	30p
2N3866	150p
2N3877	40p
2N3877A	40p
2N3900	37p
2N3900A	40p
2N3901	97p
2N3903	20p
2N3904	25p
2N3905	30p
2N3906	25p
2N4058	12p
2N4059	10p
2N4060	12p
2N4061	12p
2N4062	12p
2N4244	47p
2N4248	15p
2N4249	15p
2N4250	18p
2N4254	42p
2N4255	42p
2M4284	17p
2N4285	17p
2N4286	17p
2N4287	17p
2N4288	15p
2N4289	17p
2N4290	12p
2N4291	15p
2N4292	15p
2N4294	17p
2N4303	47p
2N4964	15p
2N4965	18p
2N5027	52p
2N5028	57p
2N5029	47p
2N5030	42p
2N5172	12p
2N5174	52p
2N5175	52p
2N5176	45p
2N5232A	30p
2N5245	45p
2N5246	42p
2N5249	67p
2N5265	325p
2N5305	37p
2N5306	40p
2N5307	37p
2N5308	37p
2N5309	62p
2N5310	42p
2N5354	27p
2N5355	27p
2N5356	32p
2N5365	47p
2N5366	32p
2N5367	57p
2N5457	30p

2N5458	35p
2N5459	40p
28102	25p
28103	25p
28104	25p
28301	50p
28302	50p
28303	60p
28304	75p
28501	32p
28502	35p
28503	27p
3N83	40p
3N128	70p
3N140	77p
3N141	72p
3N142	55p
3N143	67p
3N152	87p
40050	55p
40250	50p
40251	32p
40309	32p
40310	45p
40311	35p
40312	47p
40314	37p
40315	37p
40316	47p
40317	37p
40319	55p
40320	47p
40323	32p
40324	47p
40326	37p
40329	30p
40344	27p
40347	57p
40348	52p
40360	40p
40361	40p
40362	50p
40370	32p
40406	57p
40407	40p
40408	52p
40409	55p
40410	62p
40412	50p
40467A	57p
40468A	35p
40528	72p
40600	57p
40603	50p
AC107	30p
AC126	20p
AC127	24p
AC128	20p
AC151	18p
AC152	22p
AC154	22p
AC176	20p
AC187	25p
AC188	25p
ACY17	27p
ACY18	24p
ACY19	24p
ACY20	20p
ACY21	20p
ACY22	10p
ACY28	17p
ACY39	47p
ACY40	20p
ACY41	15p
ACY44	25p
AD140	47p
AD149	47p
AD150	62p
AD161	35p
AD162	35p
AF109	45p
AF114	25p
AF115	25p
AF116	25p
AF117	20p
AF118	60p
AF121	30p
AF124	22p
AF125	19p
AF126	19p
AF127	16p
AF139	28p
AF178	42p
AF179	45p
AF180	50p
AF181	40p
AF186	39p
AF239	30p
AF279	47p
AF280	47p
AFZ11	32p
ASY26	25p
ASY27	30p
ASY28	24p
ASY29	27p
ASY50	25p
ASY51	32p
ASY54	25p
ASY67	45p
ASY86	32p
ASZ21	51p
AUY10	150p
BC107	10p
BC108	10p
BC109	10p
BC113	10p

BC114	15p
BC115	15p
BC116	15p
BC118	15p
BC119	30p
BC121	20p
BC122	20p
BC125	15p
BC126	20p
BC134	12p
BC135	12p
BC136	15p
BC137	15p
BC138	20p
BC140	35p
BC141	35p
BC147	10p
BC148	10p
BC149	12p
BC152	17p
BC153	20p
BC154	20p
BC157	15p
BC158	11p
BC159	12p
BC160	35p
BC167	11p
BC168B	11p
BC168C	11p
BC169B	11p
BC169C	12p
BC170	12p
BC171	15p
BC172	15p
BC175	22p
BC177	20p
BC178	20p
BC179	20p
BC182	10p
BC182L	10p
BC183	9p
BC183L	9p
BC184	11p
BC184L	11p
BC186	25p
BC187	27p
BC212L	12p
BC213L	12p
BC214L	15p
BCY10	27p
BCY30	27p
BCY31	30p
BCY32	50p
BCY33	25p
BCY34	30p
BCY38	40p
BCY39	60p
BCY40	50p
BCY41	15p
BCY42	15p
BCY43	15p
BCY54	32p
BCY58	22p
BCY59	22p
BCY60	97p
BCY70	15p
BCY71	20p
BCY72	15p
BCY78	30p
BCY79	30p
BCZ10	27p
BCZ11	40p
BD112	50p
BD116	112p
BD121	65p
BD123	80p
BD124	60p
BD131	75p
BD132	80p
BDY10	125p
BDY20	105p
BDY61	125p
BDY62	100p
BF115	25p
BF117	47p
BF152	28p
BF154	20p
BF158	15p
BF159	35p
BF163	35p
BF167	18p
BF170	33p
BF173	19p
BF177	30p
BF178	25p
BF179	30p
BF180	35p
BF181	32p
BF182	30p
BF184	30p
BF185	20p
BF194	15p
BF195	15p
BF196	15p
BF197	15p
BF198	15p
BF200	35p
BF224	14p
BF225	20p
BF237	22p
BF238	22p
BF244	23p
BFW61	47p
BFW87	25p
BFW88	23p
BFW89	20p

BFW90	22p
BFW91	20p
BFX12	22p
BFX13	22p
BFX29	25p
BFX30	25p
BFX37	30p
BFX44	37p
BFX68	67p
BFX84	25p
BFX85	30p
BFX86	25p
BFX87	25p
BFX88	20p
BFX89	82p
BFX93A	70p
BFY11	42p
BFY18	25p
BFY19	20p
BFY21	42p
BFY24	45p
BFY29	40p
BFY30	40p
BFY41	50p
BFY43	62p
BFY50	20p
BFY51	20p
BFY52	20p
BFY53	15p
BFY56A	57p
BFY76	42p
BFY77	57p
BFY90	65p
BSX19	17p
BSX20	15p
BSX21	20p
BSX26	45p
BSX27	47p
BSX28	32p
BSX60	82p
BSX61	62p
BSX76	15p
BSX77	20p
BSX78	25p
BSY24	15p
BSY25	15p
BSY26	17p
BSY27	15p
BSY28	17p
BSY29	17p
BSY36	25p
BSY37	25p
BSY38	20p
BSY39	22p
BSY43	50p
BSY51	32p
BSY52	32p
BSY53	37p
BSY54	40p
BSY56	90p
BSY79	45p
BSY90	57p
BSY95A	12p
C424	15p
C450	15p
GET102	30p
GET113	20p
GET114	20p
GET118	20p
GET120	25p
GET873	12p
GET880	30p
GET887	20p
GET889	22p
GET890	22p
GET896	22p
GET897	22p
GET898	22p
MAT100	25p
MAT101	25p
MAT120	25p
MAT121	25p
MJ400	107p
MJ420	80p
MJ421	80p
MJ430	102p
MJ440	95p
MJ480	97p
MJ481	125p
MJ490	100p
MJ491	137p
MJE340	50p
MJE370	80p
MJE371	80p
MJE520	60p
MJE521	70p
MPF102	42p
MPF103	35p
MPF104	37p
MPF105	37p
MPS3638	32p
NKT124	42p
NKT125	27p
NKT126	27p
NKT128	27p
NKT135	27p
NKT137	32p
NKT210	30p
NKT211	30p
NKT212	30p
NKT213	30p
NKT214	20p
NKT215	22p
NKT216	35p
NKT217	40p

NKT219	30p
NKT223	27p
NKT224	22p
NKT225	22p
NKT229	30p
NKT237	35p
NKT238	25p
NKT240	27p
NKT241	27p
NKT242	20p
NKT243	62p
NKT244	17p
NKT245	20p
NKT261	20p
NKT262	30p
NKT264	20p
NKT271	20p
NKT262	20p
NKT274	20p
NKT275	20p
NKT278	25p
NKT281	27p
NKT401	87p
NKT402	90p
MKT403	75p
NKT404	55p
NKT405	75p
NKT406	62p
NKT451	62p
NKT452	62p
NKT453	47p
NKT713	20p
NKT717	42p
NKT734	27p
NKT736	35p
NKT773	25p
NKT781	30p
OC16	50p
OC19	37p
OC20	75p
OC22	50p
OC23	60p
OC24	60p
OC25	40p
OC26	25p
OC28	60p
OC29	60p
OC35	50p
OC36	60p
OC41	22p
OC42	25p
OC44	15p
OC45	12p
OC46	15p
OC70	12p
OC71	12p
OC72	12p
OC73	30p
OC74	30p
OC75	22p
OC76	22p
OC77	30p
OC78	20p
OC81	20p
OC81D	20p
OC82	25p
OC82D	15p
OC83	25p
OC84	25p
OC139	25p
OC140	32p
OC170	25p
OC171	30p
OC200	40p
OC201	60p
OC202	75p
OC203	40p
OC204	40p
OC205	75p
OC206	95p
OC207	75p
OCP71	42p
ORP12	50p
ORP60	40p
ORP61	40p
P346A	22p
ST140	15p
ST141	20p
TI834	62p
TI843	40p
TI844	10p
TI845	27p
TI846	11p
TI847	11p
TI848	12p
TI849	12p
TI850	12p
TI851	10p
TI852	11p
TI853	22p
XB112	12p
XC141	35p
ZTX107	15p
ZTX108	12p
ZTX109	15p
ZTX300	15p
ZTX301	15p
ZTX302	20p
ZTX303	20p
ZTX304	25p
ZTX500	15p
ZTX501	15p
ZTX502	20p
ZTX503	17p
ZTX504	40p
ZTX531	25p

Integrated Circuits

CA3000	180p
CA3005	117p
CA3007	262p
CA3011	75p
CA3012	88p
CA3013	105p
CA3014	124p
CA3018	84p
CA3018A	110p
CA3019	84p
CA3020	126p
CA3020A	160p
CA3021	156p
CA3022	130p
CA3023	126p
CA3026	100p
CA3028A	74p
CA3028B	105p
CA3029	87p
CA3029A	165p
CA3030	137p
CA3035	122p
CA3036	72p
CA3039	82p
CA3041	109p
CA3042	109p
CA3043	137p
CA3044	120p
CA3045	122p
CA3046	81p
CA3047	137p
CA3048	204p
CA3049	160p
CA3050	185p
CA3051	134p
CA3052	165p
CA3053	46p
CA3054	109p
CA3055	240p
CA3059	165p
CA3064	120p
FCH101	85p
FCH111	105p
FCH121	105p
FCH131	50p
FCH141	105p
FCH151	105p
FCH171	105p
FCH181	105p
FCH191	105p
FCH201	130p
FCH211	130p
FCH221	130p
FCH231	150p
FCJ101	160p
FCJ111	150p
FCJ121	275p
FCJ131	275p
FCJ141	525p
FCJ201	100p
FCJ211	275p
FCK101	430p
FCL101	230p
FCY101	102p
FJH101	25p

FJH111	70p
FJH121	25p
FJH131	25p
FJH141	25p
FJH151	25p
FJH161	70p
FJH171	25p
FJH181	25p
FJH221	25p
FJH231	25p
FJH241	25p
FJH251	25p
FJJ101	50p
FJJ111	50p
FJJ121	60p
FJJ131	60p
FJJ141	125p
FJJ181	75p
FJJ191	65p
FJJ211	125p
FJJ251	125p
FJL101	125p
FJY101	25p
IC12	£1·80
L900	40p
L914	40p
L923	40p
LM380	122p
MC724P	60p
MC780P	247p
MC788P	146p
MC790P	124p
MC792P	66p
MC799P	66p
MC1303L	200p
MC1304P	225p
MC1305P	386p
MC838P	549p
MC1435P	345p
MC1552G	461p
MC1709CG	94p
MFC4000P	55p
SN7400	20p
SN7401	20p
SN7402	20p
SN7403	20p
SN7404	20p
SN7405	20p
SN7406	80p
SN7408	20p
SN7409	20p
SN7410	20p
SN7411	23p
SN7412	48p
SN7413	30p
TE7416	84p
SN7417	84p
SN7420	20p
SN7423	51p
SN7427	48p
SN7428	80p
SN7430	20p
SN7432	48p
SN7433	80p

SN7437	64p
SN7440	20p
SN7441AN	75p
SN7442	75p
SN7446	100p
SN7447	135p
SN7448	125p
SN7450	20p
SN7451	20p
SN7453	20p
SN7454	20p
SN7460	20p
SN7472	30p
SN7473	40p
SN7474	40p
SN7475	45p
SN7476	45p
SN7483	87p
SN7486	33p
SN7490	87p
SN7492	87p
SN7493	87p
SN7495	87p
SN7496	87p
SN74107	52p
SN74153	135p
SN74154	200p
SN74160	180p
SN74161	260p
SN74164	220p
SN74165	225p
SN74192	175p
SN74193	175p
TAA241	162p
TAA242	425p
TAA243	150p
TAA263	75p
TAA293	97p
TAA300	175p
TAA310	125p
TAA320	72p
TAA350	175p
TAA435	147p
TAA521	132p
TAA522	360p
TAA530	495p
TAA611	445p
TAB101	97p
TAD100	150p
TAD110	150p
SL403D	15 p
SL702C	147p
UA702A	280p
UA702C	77p
UA703C	137p
UA709C	45p
UA710C	125p
UA716	187p
UA723C	100p
UA730C	160p
UA741C	80p

BRIDGE RECTIFIERS PLASTIC ENCAPSULATED

600 PIV 1A	50p
50 PIV 2A	45p
100 PIV 2A	50p
200 PIV 2A	55p
400 PIV 2A	60p
50 PIV 4A	40p
100 PIV 4A	50p
200 PIV 4A	55p
400 PIV 4A	65p
600 PIV 4A	70p
50 PIV 6A	45p
100 PIV 6A	55p
200 PIV 6A	65p
400 PIV 6A	75p
600 PIV 6A	85p

SILICON RECTIFIERS MINIATURE WIRE ENDED PLASTIC

SERIES	IN 1 AMP	PL 1·5 AMP	CL 3 AMP
4001 50PIV	7p	8p	19p
4002 100PIV	7p	9p	20p
4003 200PIV	8p	10p	22p
4004 400PIV	8p	10p	25p
4005 600PIV	10p	12p	26p
4006 800PIV	12p	15p	27p
4007 1000PIV	15p	16p	30p

50 + less 15% 100 + less 20%

SILICON RECTIFIERS STUD MOUNTING

	6A	10A	17·5A	35A
100PIV	—	45p	50p	£1·22
200PIV	25p	50p	55p	£1·42
400PIV	30p	55p	62p	£1·77
600PIV	32p	60p	72p	£2·12
800PIV	35p	75p	87p	£2·47
1000PIV	40p	85p	£1·05	£2·77

50 + less 15% 100 + less 20%

ZENER DIODES

400MW	1·5 WATT	10 WATT
3·3-33 V	2·4—100	3·9—100V
10p each	25p each	40p each

25 + less 15% 100 + less 20%

TRANSISTOR DISCOUNTS:- 12 + 10%; 25 + 15%; 100 + 20% any one type. Postage on all Semi Conductors 7p extra.
S.A.E. FOR FULL LISTS.

VALVES

OA2	38p
OB2	45p
OZ4	30p
1L4	20p
IR5	40p
IS5	30p
IT4	25p
IU4	30p
IU5	60p
2D21	35p
3Q4	50p
3S4	35p
3V4	48p
5R4	75p
5U4	35p
5V4	45p
5Y3	40p
5Z4G	40p
6/30L2	80p
6AC7	40p
6AG7	40p
6AK5	35p
6AK6	60p
6AL5	20p
6AM6	30p
6AQ5	38p
6AS6	40p
6AT6	35p
6AU6	25p
6AV6	30p
6BA6	25p
6BE6	30p
6BH6	75p
6BJ6	50p
6BQ7A	40p
6BR7	90p
6BR8	70p
6BW6	85p
6BW7	80p
6BZ6	40p
6C4	33p
6CD6	125p
6CL6	50p
6CW4	65p
6F1	62p
6F6G	35p
6F13	45p
6F14	70p
6F15	65p
6F18	50p
6F23	85p
6H6	17p
6J4	50p
6J5	25p
6J5GT	30p
6J6	20p
6J7	45p
6K8G	40p
6L6GT	45p
6LD20	50p
6Q7	40p
6SA7	40p
6SG7	40p
6SJ7	40p
6SK7	40p
6SL7	35p
6SN7	35p
6SQ7	40p
6U4	65p
6V6G	25p
6V6GT	32p
6X4	35p
6X5G	30p
6X5GT	40p
10C2	50p
10F1	75p
10P13	60p
10P14	£1·10
12AT6	30p
12AT7	30p
12AU7	30p
12AX7	30p
12AV6	40p
12BA6	40p
12BE6	40p
12BH7	45p
19AQ5	35p
20D1	50p
20F2	65p
20L1	£1·10
20P1	50p
20P3	60p
20P4	£1·10
20P5	£1·20
25L6	50p

25Z4	30p
25Z5	42p
25Z6	65p
30C15	80p
30C17	90p
30C18	80p
30F5	85p
30FL1	75p
30FL12	120p
30FL14	95p
30L15	85p
30L17	80p
30P12	80p
30P19	85p
30PL1	75p
30PL13	93p
30PL14	90p
35L6	50p
35W4	35p
35Z4	35p
35Z5	50p
50B5	50p
50C5	50p
80	55p
85A2	50p
807	50p
1625	50p
5763	70p
6146	160
AZ31	55p
CY31	35p
DAF91	30p
DAF96	45p
DF91	22p
DF96	45p
DK91	40p
DK92	55p
DK96	50p
DL92	35p
DL94	48p
DL96	45p
DM70	40p
DY86	32p
DY87	33p
E88CC	100p
E180F	100p
EABC80	35p
EAF42	35p
EB91	20p
EBC41	55p
EBC81	30p
EBF80	40p
EBF83	40p
EBF89	32p
EBL21	60p
EC86	60p
EC88	60p
ECC40	65p
ECC84	30p
ECC85	40p
ECC88	40p
ECF80	35p
ECF82	35p
ECF86	65p
ECH21	57p
ECH35	100p
ECH42	75p
ECH81	30p
ECH83	45p
ECL80	45p
ECL82	35p
ECL83	70p
ECL86	40p
EF37A	120p
EF39	50p
EF40	50p
EF41	65p
EF42	70p
EF80	25p
EF85	35p
EF86	30p
EF89	28p
EF91	30p
EF92	35p
EF183	35p
EF184	35p
EH90	40p
EL34	50p
EL41	60p
EL42	65p
EL81	55p
EL84	25p
EL85	43p
EL91	35p
EL96	35p

EM80	45p
EM81	60p
EM84	35p
EM85	£1·00
EM87	70p
EY51	40p
EY86	40p
EY87	42p
EZ40	55p
EZ41	50p
EZ80	27p
EZ81	29p
GZ32	48p
GZ34	60p
KT66	£2·05
KT88	£2·00
MU14	75p
PABC80	40p
PC86	60p
PC88	60p
PC97	45p
PC900	48p
PCC84	40p
PCC85	40p
PCC88	55p
PCC89	50p
PCC189	55p
PCF80	30p
PCF82	34p
PCF84	60p
PCF86	60p
PCF800	80p
PCF801	50p
PCF802	50p
PCF805	80p
PCF806	70p
PCF808	75p
PCL82	35p
PCL83	65p
PCL84	45p
PCL85	40p
PCL86	45p
PFL200	65p
PL36	55p
PL81	50p
PL82	45p
PL83	45p
PL84	40p
PL500	75p
PL504	80p
PY32	55p
PY33	63p
PY80	40p
PY81	30p
PY82	35p
PY83	38p
PY88	40p
PY800	40p
PY801	50p
U25	80p
U26	80p
U50	40p
U52	35p
U191	75p
U281	40p
U282	40p
U301	40p
U801	£1·80
UABC80	40p
UAF42	55p
UBC41	50p
UBC81	40p
UBF80	40p
UBF89	35p
UCC84	49p
UCC85	40p
UCF80	55p
UCH21	60p
UCH42	70p
UCH81	40p
UCL82	35p
UCL83	60p
UF41	60p
UF80	35p
UF85	40p
UF89	40p
UL41	65p
UL84	40p
UY41	48p
UY85	40p
VR105/30	38p
VR150/30	35p

Add 12p in £ for postage

DIODES & RECTIFIERS

1N34A	10p
1N914	7p
1N916	10p
AA119	7p
AA129	10p
AAZ13	10p
AAZ15	10p
BA100	15p
BA102	30p
BA110	25p
BA111	27p
BA112	70p
BA115	7p
BA141	32p
BA142	32p
BA144	12p
BA145	20p

BA154	12p
BAX13	12p
BAX16	7p
BAY31	7p
BAY38	15p
BY100	15p
BY103	22p
BY122	37p
BY124	15p
BY126	12p
BY127	15p
BY164	52p
BY210	35p
BYZ11	30p
BYZ12	30p
BYZ13	25p
BYZ16	40p

GJ7M	87p
OA5	17p
OA6	12p
OA10	22p
OA9	10p
OA47	8p
OA70	7p
OA73	10p
OA79	7p
OA81	8p
OA85	7p
OA90	7p
OA91	7p
OA95	7p
OA200	7p
OA202	10p
OA210	17p

← See previous page • G.W. SMITH & Co. (RADIO) LTD. • See opposite page →

Practical Wireless Classified Advertisements

CONDITIONS OF ACCEPTANCE OF CLASSIFIED ADVERTISEMENTS

1. The advertiser warrants that the advertisement does not contravene any of the provisions of the Trade Descriptions Act, 1968.
2. The Publishers reserve the right to refuse or withdraw any advertisement.
3. Advertisements accepted for publication cannot be cancelled without the Publishers' express consent.
4. Although every care is taken, the Publishers shall not be liable for clerical or printers' errors or their consequences however caused.

Miscellaneous

NO NEED TO WORRY ABOUT A TRANSMITTING LICENCE

because this GPO approved transmitter/receiver kit does not use R.F. and you can get one easily. Your transmissions will be virtually SECRET since they won't be heard by conventional means. Actually it's TWO KITS IN ONE because you get the printed-circuit boards and components for both the transmitter AND receiver. You're going to find this project REALLY FUN-TO-BUILD with the EASY-TO-FOLLOW instructions. An extremely flexible design with quite an AMAZING RANGE—has obvious applications for SCHOOL PROJECTS, LANGUAGE LABORATORIES, SCOUT CAMPS, etc.

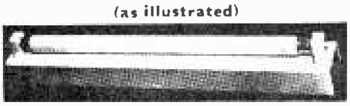
GET YOURS ! SEND £5·50 NOW
'(S.A.E. for details)'

TO: 'BOFFIN PROJECTS'
DEPT. KW2010
4 CUNLIFFE ROAD
STONELEIGH, EWELL, SURREY

CHROMASONIC ELECTRONICS is well and living at 56 Fortis Green Road, London N10 3HN. 40 page illustrated catalogue 20p post free.

"SHORTWAVE Voices of the World," £1·55; an exceptional book. "SWL address book," Stations' QSL Policies, £1·35. "World Radio TV Handbook," December 1971, £2·80. Under £2, postage 10p. Deliveries First Class Mail, send 3p for price list. Send no money —COD 25p. David McGarva, Box 114A, Edinburgh EH1 1HP.

12 VOLT FLUORESCENT LIGHTS
(as illustrated)



Beat power cuts. Be independent. Ideal for caravans, tents, emergency lighting, etc. Works anywhere where 12v is available. Guaranteed for six months. Ready to use at:

12 ins. 8 watt £3·60 post paid
21 ins. 13 watt £4·60 post paid

Callers welcome.
For lists or enquiries, large s.a.e.
SALOP ELECTRONICS, 23 WYLE COP SHREWSBURY, SHROPSHIRE.

RECORD TV SOUND using our loudspeaker isolating transformer. Provides safe connection to recorder. Instructions included. £1 post free. CROWBOROUGH ELECTRONICS (P.W.), Eridge Road, Crowborough, Sussex.

Classified advertisements 9p per word (minimum 12 words). Semi-display setting £6·50 per single column inch. Advertisements must be prepaid and addressed to Classified Advertisement Manager, PRACTICAL WIRELESS, IPC Magazines Ltd., Fleetway House, Farringdon Street, London EC4A 4AD. All cheques, postal orders, etc., to be made payable to PRACTICAL WIRELESS and crossed "Lloyds Bank Ltd."

Darned Electronic Wizardry
by Dewtron

Famous kits, e.g. waa-waa complete kit £2·95; Fuzz kit £4·75, auto rhythm, modules from £18 per set. Ring Modulator modules £7 and whole range of synthesiser modules, musical novelties, etc. Catalogue 15p from D.E.W. Ltd., 254 Ringwood Road, Ferndown, Dorset.

TAPE HEADS PICK-UP CARTRIDGES

SERVICE MANUALS for Pre 1958 H.M.V. and E.M.I. MODELS. Radio and Record Player Manuals 25p each. Television Manuals 37½p each. Send C.W.O. stating model required.

Send stamp for comprehensive lists of transformers, condensers, resistors, cartridges and tape heads.

R.D.I. LTD., Chilton Works, Garden Road, Richmond, Surrey.

PRINTED CIRCUIT BOARD

In 6 standard widths: 2in, 2½in, 3in, 3½in, 4in. and 5in × any length. 1/16in Fibreglass, single sided, **2p** per 3 sq. inches. Doublesided, **1p** per sq. inch. P. & P. **5p** per order. SAE. Quotations for other sizes and quantity discounts.

J. KNOPP, 11 Connaught Gardens, Braintree, Essex, CM7 6LY. Tel. Braintree 25254.

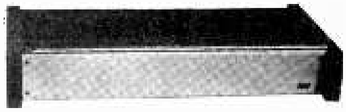
TOP TRANSISTORS

Brand New and Individually Tested Transistors supplied unmarked, but packed separately for identification and guaranteed to be within their correct specification or money refunded. All at 9p. each or

Any 25 transistors for only £1·90

ACY22	BFY51	OC72	2N3702
BC108	BFY52	OC202	2N3703
BC109	BSY27	ZTX300	2N3705
BC168	OC45	2N706	2N3706
BC169	OC71	2N2926	2N3708

Money back guarantee, P. & P. 10p.
J. M. KING (G)
17 Buckridge, Portpool Lane, London, E.C.1



Build your next project in a BEC (Book End Chassis)—a new concept in Chassis buying. No cabinet to build when you have finished. Contemporary design with wooden end cheeks. 3 sizes. These cabinets are adaptable to all projects in P.W. and P.E., Texan, Gemini etc. Send large S.A.E. for details.
H. M. ELECTRONICS, 275a Fulwoow Road. Sheffield, S10 3BD *Phone* **55951** *anytime*

BUILD IT in a DEWBOX quality cabinet. 2in x 2½in x any length. D.E.W. Ltd., Ringwood Road, FERNDOWN, Dorset. S.A.E. for leaflet. Write now—Right now.

Ladders

LADDERS. Timber 20ft, £7·80; 29ft, £11·20. Carr. 80p. Brochure (Dept. WLS), Home Sales, Baldwin Road, Stourport, Worcs. Callers Welcome. Phone 02-993 5222. Ansafone installed.

Tape Recorders

ROBIN HOOD
(NOTTM) LTD.

Special Offer—Post Free. First Class British Made Non-stretch Mylar Tapes

5¾ins.	¼" x 900ft.	55p
5¾ins.	¼" x 1200ft.	60p
7ins.	¼" x 1200ft.	60p
7ins.	¼" x 1800ft.	85p

10% discount on orders over £5
23 Wadham Road, Woodthorpe, Nottingham

Hi-Fi Equipment

Peerless

HI-FI LOUDSPEAKERS
.... Acclaimed by the Experts
MULTI-UNIT SYSTEMS IN KIT FORM
MATCHING CABINET KITS ALSO AVAILABLE
Full details & address of your local dealer from:
P.F. & A.R. Helme Ltd. (Dept PW10)
Summerbridge: Harrogate HG3 4DR
Yorks. Tel. Darley 279 (STD 0423-72)

Books and Publications

COMPONENT CATALOGUE AND DISCOUNT VOUCHERS
25p Post FREE (UK)

W.E.C. LTD.
HIGH ST., RIPLEY, Surrey

Educational

Situations Vacant

NIP-E-BOARD

PRINTED CIRCUIT SYSTEMS

FOR DISCRETE COMPONENTS AND INTEGRATED CIRCUITS

Standardised multi-purpose boards

SAMPLE PACKS=3 DIFFERENT SIZES WITH FULL DETAILS IN EACH

SRBP Undrilled 95p Drilled £1·84

GLASS FIBRE Undrilled £1·09 Drilled £2·15

Please state whether for i.c.s or discrete transistors.

SPECIAL OFFER! FREE Mounting Pillars with above packs

STARTER PACKS of mixed undrilled boards (small) 50p & 70p

CARD HANDLES—5p. Gold plated Edge Connectors 14-way, 35p 30-way, 68p

Insulated Mounting Pillars—from 3p each.

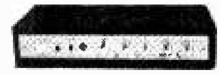
PLANNING CHART SUPPLIED WITH BOARDS

Quantity discounts. We supply retail trade, industry, export, schools

NIP ELECTRONICS DEPT. NE W, P.O. Box 11, St Albans, Herts

Build the TEXAN hi-fi amp

Kit price only £28·50 (incl. case)



Pack 1.	RESISTORS	80p
Pack 2.	SMALL CAPS	£1·50
Pack 3.	LARGE CAPS	£1·40
Pack 4.	SUNDRIES	£1·90
Pack 5.	SWITCHES	90p
Pack 6.	CONTROLS	£1·45
Pack 7.	SEMI COND	£8·25
Pack 8.	TRANSFORMER	£4·95
Pack 9.	P.C. BOARD	£2·50
Pack 10.	CHASSIS etc.	£4·20

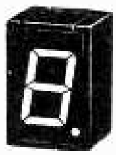
Post extra—parts available separately. Send for list.

Kits also available for

- ★ Radio Control Systems
- ★ Digital Clock Systems
- ★ Integrated Circuit Amplifiers (to 50W)
- ★ Hi-Fi Pre-amps
- ★ Stabilized Power Supply Units

TELERADIO HI FI, 325 Fore Street, London, N.9. 01-807 3719

Trampus electronix



All Brand New, Money Back Guaranteed, Fast Service. **5V DIGITAL INDICATOR** 0–9 DP, with socket £1·49 7447 driver £1·49. SAE free data. **LED** micro type £5·99. **LIGHT EMIT DIODES.** Visible red 1·6V & free panel clip 49p. Infra-red £1·49. ORP 12 40p. IC Photo Detector/amp 44p. **ZENERS** BZY88 400mW 12p. **CAPACITORS** 25V 10/50/100 uF 5p. DISC 22 pF to ·01uF 4p. ·01 to ·5 uF 6p. **RESISTORS** ¼W 5% 1½p. **ULTRASONIC** transducer transmit/receive £2. **DIL SOCKETS**, plastic for 74N etc. 14 & 16 Pin 12p. TEXAN: 72741 80p. 72748 80p. IN 4002 5p. TIP 41A £1. TIP 42A £1·30. BC182 11p. BC 212 13p. **BC107 8p; BC108 8p; BC109 8p; BC177/9 17p. 2N3055 40p; FET** 2N 3819, 28p. ME 0404-2 17p. ME 0411-2. 18p. ME 4001 12p. ME 4102 11p. 2N 3702/3/4/5/6/7 11p. 2N3708/9/10/11 9p. AC 125/6/7/8, AC 127/8, AF 117 All 16p each. TIS 43 29p. BFY 51 16p. 2N2926Y 9p. 2N3053 19p. 2N706A 12p.

INTEGRATED CIRCUITS with data. 709 TO5 23p, DIL 30p. 741 TO5/DIL 29p 710 37p. 748 39p. TAD100/110 RX £1·75. Data Booklet 15p. STEREO: MPX Decoder £1·67. Dual Preamp £1·49. AUDIO AMP 3·5W HiFi £1·29. 703 RF 59p. GAS detector: Smoke, Butane, Petrol etc. £2·19. **FREE** CATALOGUE SAE DATA SHEETS 5p ea. C.W.O. P & P 7p. Overseas 35p. Discount 10+ 10%

P.O. BOX 29, BRACKNELL, BERKS.

RAPID SERVICE — GOOD VALUE

Money Back Guarantee

MICROCIRCUITS: 709 30p; 710 36p; 723 71p; 741 32p; 748 40p; PA230 90p; PA234 84p; SL402A £1; SL702C 40p; SN76013 (like IC12) £1·24; 74 SERIES TTL: 00 16p; 01 18p; 02 18p; 04 18p; 08 18p; 10 16p; 11 21p; 20 16p; 30 19p; 40 16p; 47 £1·35; 51 18p; 72 30p; 73 41p; 74 33p; 75 44p; 81 £1·26; 86 41p; 90 72p; 91 £1·21. **RECTIFIERS** 1 AMP: 50V 3½p; 100V 4p; 200V 5p; 400V 6p; 600V 9p; 800V 12p; 1000V 14p. 3 AMP 200V 11p; 400V 12p. TRIAC 10 AMP 500V £1·20. SCR 1·6 AMP 600V 75p. **TRANSISTORS:** 2N2926 RED 6p; ORANGE 7p; GREEN 9p; 2N3054 38p; 2N3055 42p; 2N3819 28p; BC107B 9p; BC108A 8p; BC108C 90; BC109C 9p; BC115 20p; BC179 18p; BCY 70 10p; BCY 71 22p; BD142 85p; BF115 20p; BFX86 15p; BFY50/51/52 10p; OC44/45/71/72 12p; OC81 19p; ME SERIES: 0401 19p; 0402 18p; 0404-2 16p; 0411 18p; 0412 19p; 0413 14p; 0414 24p; 1002 10p; 1120 16p; 3001 16p; 4101 10p; 4102 11p; 4103 10p; 6001 12p; MEF104 42p; MEL11 35p; MEL12 44p; MP8111 32p; MP8112 42p; IC SOCKETS 14 pin DIL 12p. **SOLDERCONS** 0·7p per pin. **LED** 45p. **PC MARKER** 80p.

JEF ELECTRONICS (P.W.10)

York House, 12 York Drive, Grappenhall, Warrington, WA4 2EJ. Mail Order Only. C.W.O. P & P 9p per order. O/seas 65p. Discounts start at 10% for 10+. List free on application. NEW FULL SPEC. GOODS.

NEW

15 watt Hi Fi AMPLIFIERS

£3·75 each plus 25p P&P

Frequency response 15 to 19,000 cs. Signal to noise > 70db. Input sens. 750mv into 2k

HI ELECTRONICS

105, GRANGE ROAD, LONDON S.E. 25

FERRIC CHLORIDE

ANHYDROUS, 1 lb 40p + 15p post, 10 lbs £3·50 + 50p post.

REED SWITCH UNITS

Contains 31 1½A. 250V. **REEDS** mounted round a drum. Magnet inside operates them, also 1% R's, plugs etc. £1·25 + 25p post. **GREENWELD** (PW5), 24 Goodhart Way, W. Wickham, Kent. 01-777 2001.

SOUND SUPPLIES (Electronics) Co. Ltd.

P.A. EQUIPMENT. Marshall amps, instruments and guitars, etc. TOA and Eagle amps and accessories, Reslo mics, etc.

COMPONENTS: Resistors, capacitors, plugs, sockets, cables, audio leads, semi-conductors, valves, vero board, etc., for the constructor.

Power packs and car droppers for the cassette recorder or radio.

S.A.E. for list and enquiries. P.A. list 15p

12 Smarts Lane, Loughton, Essex

Tel. 01-508 2715 Closed all day Thursday

THE WORLD RENOWNED "GLOBE KING" SHORT WAVE RADIO KITS now back in production!

New, exciting range of **short-wave** units covering 10 to 350 metres. Transistor 9v. and AC mains versions. Ideal for Flats etc.—range the World with just 25' length of wire or Rod aerial! Acclaimed by professional and amateur alike "Globe-King" receivers are in use all over the world. Modern technique plus a precision mechanical standard opens up a new era for this famous product. Send for free copy of our interesting literature, price lists, and order form—kindly enclose self-addressed long envelope. Overseas inquiries must be accompanied with International Reply Coupon. (See also our advert on page 558).

JOHNSONS (RADIO)

St. Martins Gate, Worcester, WR1 2DT (a John Banner Co.)

NEW POTENTIOMETERS, 4p. Resistors, 50 16p. Magnetic counters 10p. 6BA Bolts 10p 100. Samples and lists 20p. Post extra. We buy communications receivers for cash. S.a.e. Derwent Radio, Scarborough.

RECEIVERS and accessories. B40/62B fine-tuning, S-meter and product detector kits and information. SAE details. P. R. Golledge, G3EDW, Glen Tor, Torrington, Devon. Tel: 08-052 2411.

GEIGER COUNTERS (FOR MAINS OR PORTABLE BATTERY USE)

Latest Home Office release and probably the last, of this well known Contamination Meter No. 1, this very useful Instrument is used for the measurement of Radio-Activity. Indicated on an Internal Meter scaled 0·1 to 10 milli Rontgens/Hour, a socket is also provided for additional sound Monitoring on Head-phones. This Instrument is housed in a Strong light Alloy Case, placed in a carrying Haversack with shoulder strap. Containing Cable and Hand held Probe, Instruction Card, plus the latest plug in Vibrator Power Unit, which uses current small Transistor Radio Batteries (4 Mallory Long Life RM12 or 4 EverReady H.P.7 or equivalent makes). For Mobile use anywhere. (Cost Gov. approx. £70 each). Supplied Brand New in Carton only £5·50 carr. 50p. An additional plug in Power Unit for Laboratory use, operating from 100–120 volts or 200–250 volts A.C. Mains is available. Supplied Brand New in Carton at only £2·50 post 25p. Headphones (not necessary) if required £1·50. A few Geiger Counters as above but not boxed in cardboard cartons, available at only £4·50.

JOHNS RADIO Dept. D, 424 Bradford Road, Batley, Yorks. *Phone Batley 7732*

REED COILS

3, 6, 9, 12, 24V Miniature	27p
Small	27p
Standard	34p

P & P. 7p on all orders.

REED SWITCHES

Large range of many sizes, types and manufacture

Popular types:

E Small n/o	10 for 50p
A Miniature n/o	24p each
B Standard c/o	40p each

REED PUSH BUTTON SWITCHES

Momentary Action

1 contact	£1·00
2 contacts	£1·25
Illuminated 1 contact	£1·30
Illuminated 2 contacts	£1·55

REED RELAYS

Many versions available, popular types: 3, 6, 9, 12, 24V

Miniature 1/A normally open	56p
Small 2/E 1 contact	36p
2/EE 2 contacts	44p
2/EEE 3 contacts	52p
STD 3/B change over	87p

REELS OF ENAMELLED COPPER WIRE

20 s.w.g. to 47 s.w.g. 50, 100 & 200 grams. Send for prices

C.B.M. ELECTRONIC COMPONENTS LTD.

26 Avon Trading Estate, Avonmore Road, London, W.14

★ SERVICE SHEETS • MANUALS • BOOKS ★

SERVICE SHEETS 30p + Postage | OVER 12,000 SERVICE SHEETS AND MANUALS IN STOCK ON RADIOS, TV's, R.PLAYERS AND T.RECORDERS, ETC.. PLEASE ENCLOSE S.A.E. WITH ENQUIRIES... | **SERVICE SHEET Catalogue 20p.**

No.	NEW BOOKS & PUBLICATIONS	PRICE	+ P. & P.
23.	FOUNDATIONS OF WIRELESS AND ELECTRONICS by M.G. Scroggie. 552 pages	£3.00	25p
24.	WIRELESS SERVICING MANUAL by W.T. Cocking. 286 pages	£1.50	15p
25.	BEGINNER'S GUIDE TO RADIO by G.J. King. 7th Edition. 204 pages	£1.00	15p
47.	RAPID SERVICING OF TRANSISTOR EQUIPMENT by G.J. King. 160 pages	£1.50	15p
48.	BEGINNER'S GUIDE TO ELECTRICITY by Clement Brown. Assoc.Brit.I.R.E.	£1.00	10p
49.	BEGINNER'S GUIDE TO ELECTRONICS by Terence L. Squires. AMIERE	£1.00	10p
50.	BEGINNER'S GUIDE TO TRANSISTORS by J.A. Reddihough	£1.00	10p
51.	PRINCIPLES OF SEMICONDUCTORS by M.G. Scroggie. BSc.CEng.FIEE. 156 pages	£1.50	15p
52.	THE PRACTICAL AERIAL HANDBOOK by G.J.King. 232 pages	£2.70	20p
70.	TRANSISTOR EQUIVALENTS AND SUBSTITUTES HANDBOOK by B.B.Babani. 78 pages	£0.40	7p
71.	RADIO AMATEURS OPERATORS HANDBOOK by Data Publications Ltd., 80 pages	£0.45	7p
82.	QUESTIONS & ANSWERS ON ELECTRIC MOTORS by A.J. Coker	£0.60	10p
83.	QUESTIONS & ANSWERS ON ELECTRICITY by K.G. Jackson	£0.60	10p
84.	QUESTIONS & ANSWERS ON ELECTRONICS by Clement Brown. Assoc. Brit. IRE	£0.60	10p
99.	RADIO SERVICING by G.N. Patchett. Vol.1. Basic Electrotechnology	£0.60	10p
100.	RADIO SERVICING by G.N. Patchett. Vol.2. Intermediate Radio Theory	£0.90	10p
101.	RADIO SERVICING by B. Fozard, B.Sc.Eng.C.Eng.MIEE. Vol.3.Final Radio Theory	£0.75	10p
102.	RADIO SERVICING by G.N. Patchett. Vol.4. Fault-Finding	£0.70	10p

Send S.A.E. for Free LISTS of Practical and Technical Books on Radio & Television now available to

BELL'S TELEVISION SERVICES

★ Albert Place, Harrogate, Yorks. Tel. 0423-86844 ★

PRECISION
POLYCARBONATE CAPACITORS

FRESH STOCK — FULLY TESTED

Close tolerance. High stability. All 63V d.c.

0·47μF:	±5% 30p;	±2% 40p;	±1% 50p
1·0μF:	±5% 40p;	±2% 50p;	±1% 60p
2·2μF:	±5% 50p;	±2% 60p;	±1% 75p
4·7μF:	±5% 70p;	±2% 90p;	±1% £1·15
6·8μF:	±5% 95p;	±2% £1·15;	±1% £1·50
10μF:	±5% £1·10;	±2% £1·40;	±1% £1·80
15μF:	±5% £1·60;	±2% £2·10;	±1% £2·70

TANTALUM BEAD CAPACITORS—Values available 0·22, 0·47, 1·0, 2·2, 4·7, 6·8 μF at 35V, 10 μF 25V. 15 μF 20V, 22 μF 15V. 33 μF 10V, 47 μF 6V, 100 μF 3V—all at **9p** each; 6 for **50p**; 14 for **£1**. Special pack 6 off each value (72 capacitors) **£5.**

NEW!—TRANSISTORS. BC107, BC108 BC109, All at **9p** each; 6 for **50p**; 14 for **£1.** All brand new and marked. Full spec. devices. May be mixed to qualify for quantity prices.

POPULAR DIODES IN914—7p each, 8 for **50p**; 18 for **£1. IN916-9p** each, 6 for **50p**, 14 for **£1. IS44-5p** each, 11 for **50p**, 24 for **£1.** All brand new and marked.

SPECIAL OFFER—400 mW Zeners. Values available 6·8, 7·5, 8·2, 9·1, 10, 11, 12, 13·5, 15V. Tol. ± 5% at 5 mA. All new and marked Price **12p** each, 5 for **50p**, 12 for **£1·00.**

RESISTORS. Carbon film ¼W 5%. Range from 2·2Ω to 2·2MΩ in E12 series, i.e. 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades. High stability, low noise. All at **1p** each; **8p** for 10 of any one value; **70p** for 100 of any one value. Special development pack—10 off each value 2·2Ω to 2·2MΩ (730 resistors) **£5.**

440V A.C. CAPACITORS. 0·1μF, size 1¼in × ⅝in, **25p**; 0·25μF, size 1⅜in × ⅝in, **30p**; 0·47 and 0·5μF, size 1⅜in × ⅝in, **35p**; 1·0μF, size 2in × ⅞in, **45p**; 2·0μF, size 2in × 1in, **75p** each.

C.D.I. (CAPACITOR DISCHARGE IGNITION)—440v AC capacitors listed above are ideal for use as discharge capacitors in popular ignition systems. Approved for **P.E. Scorpio** and **P.W. (June 1971)** systems. Improved reliability.

5p post and packing on all orders below £5.

V. ATTWOOD, DEPT. D2, P.O. Box 8, ALRESFORD, HANTS.

LARGE SUPPLIER OF SERVICE SHEETS

(T.V., RADIO, TAPE RECORDERS, RECORD PLAYERS, TRANSISTORS, STEREOGRAMS, RADIOGRAMS, CAR RADIOS)

Only 40p each

"PLEASE ENCLOSE LARGE S.A.E. WITH ALL ENQUIRIES & ORDERS"

Otherwise cannot be attended to

(Uncrossed P.O.'s please, original returned if service sheets not available.)

C. CARANNA
71 BEAUFORT PARK
LONDON, N.W.11

We have the largest supplies of Service Sheets (strictly by return of post). Please state make and model number alternative.

Free TV fault tracing chart or TV list on request with order.

Mail order or phone 01-458 4882

SERVICE SHEETS. Radio, TV etc. 8,000 models. List 10p. S.A.E. enquiries. TELRAY, 11 Maudland Bank, Preston.

Receivers and Components

NEW MODEL V.H.F. KIT MK2

Our latest kit. Improved design and performance plus extra amplifier stage, receives aircraft, amateurs, mobile, radio 2, 3, 4, etc., this novel little set will give you endless hours of pleasure and can be built in one evening. Powered by 9 volt battery, complete with easy to follow instruction and built in jack socket for use with earphones or amplifier.

Only £3·50 + p.&p 10p U.K. only.

Illustrated catalogue of selected kits and components. 15p P&P free.

Galleon Trading Co,
12, Burrs Way,
Corringham.
Stanford-Le-Hope,
Essex.

BRAND NEW COMPONENTS BY RETURN. Electrolytics 16V or 25V—1, 2·2, 4·7, 10 mfds—3½p, 22, 47—4p, 100—5p. 50V—½p extra. Subminiature bead-type tantalums—·1/35V, ·22/35V, ·47/35V, 1/35V, 2·2/35V, 4·7/35V, 10/16V—8p. Mylar Film 100V—·001, ·002, ·005. ·01, ·02—2p. ·04, ·05—2½p. ·068, ·1—3p. Polystyrene 63V—10 pf.—10,000 pf. E.12 series—2p.Mullard miniature Carbon Film Resistors E12 series 1/3W 1Ω—10MΩ 8 for 5p. Insured postage 8p. The C.R. Supply Co., 127 Chesterfield Road, Sheffield S8.

AARVAK ELECTRONICS Soundlight. Convertors 3 Channel 1·2kW £17. 3kW £25. Strobes 1 Joule £16. 4 Joule £25. Mail or call, 74 Bedford Ave., Barnet, Herts. 01-449 1268.

MORSE PRACTICE OSCILLATORS

Consisting of Integrated Circuit, Loudspeaker, and battery fully wired, 85p, post 5p.

available from:

The Amateur Radio Shop (G4MH)
13 CHAPEL HILL, HUDDERSFIELD
Tel: 20774

VERNITRON CERAMIC RESONATORS for i.f. filtering. FM4, 10·7MHz (bandwidth 235kHz), matched pair £1·50. 455kHz types: **TF-01A**, 38p; **TO-02A**, 45p; **TF-04 442**, 40p; **TFN-3A** kit, £1·50; **TFN-3ADX**, £1·50; **TF-2D5**, 40p. Data supplied with orders. Mail order only, U.K. post 5p. AMATRONIX LTD., 396 Selsdon Road, South Croydon, Surrey CR2 0DE.

BUILD YOUR OWN LIQUID OIL WHEEL PROJECTOR SUITABLE FOR DISCO OR HOME ENJOYMENT — TOP QUALITY

6 inch dia. MULTICOLOURED OIL WHEEL
plus
1 R.P.M. MINIATURE GEARED MOTOR
COMPLETE KIT. £6·50. incl. postage.

C. T. ELECTRONICS

267 ACTON LANE, LONDON W4 01-994 6275

SURPLUS ELECTRONICS WAREHOUSE NOW OPEN AT 20-24. BEAUMONT RD, LONDON, W.4.
Thousands of component and equipment bargains.

NEW VALVES! GUARANTEED AND TESTED

24-HOUR SERVICE

1R5	·25	30FL14	·67	EABC80	·30	EF91	·12	PCC189	·48	PY82	·24
1S5	·21	30L17	·66	EB91	·09	EF92	·28	PCF80	·25	PY800	·30
1T4	·14	30P19	·63	EBC33	·38	EF183	·25	PCF86	·44	PY801	·30
3S4	·24	30PL1	·58	EBF89	·27	EF184	·27	PCF801	·27	R19	·27
3V4	·48	30PL13	·87	ECC81	·17	EL33	·54	PCF802	·38	U25	·63
6/30L2	·52	30PL14	·63	ECC82	·18	EL84	·21	PCF805	·56	U26	·54
6AQ5	·21	DAF91	21	ECC83	·21	EY51	·36	PCL82	·28	U191	·57
6BW7	·48	DAF96	35	ECF82	·26	EY86	·27	PCL83	·53	U251	·60
6F1	·57	DF91	·14	ECH35	·53	EZ80	·19	PCL84	·31	U329	·65
6F23	·67	DF96	·35	ECH42	·56	EZ81	·21	PCL85	·36	U801	·75
6F25	·49	DK91	·25	ECH81	·26	KT61	·54	PCL86	·35	UBF89	·29
6SN7GT	·28	DK92	·47	ECL80	·35	LT66	·75	PFL200	·49	UCC85	·34
12AU7	·18	DK96	·43	ECL82	·27	N78	·85	PL36	·45	UCH81	·28
25L6GT	·18	DL92	·24	ECL86	·32	PC86	·44	PL81	41	UCL82	·31
30C15	·56	DL94	·46	EF39	·36	PC88	·44	PL82	·29	UF89	·28
30C17	·75	DL96	·36	EF80	·22	PC97	·35	PL83	·31	UL84	·27
30C18	·56	DY86	·21	EF85	·26	PC900	·28	PL84	·28	UY41	·37
30F5	·63	DY87	·21	EF86	·28	PCC84	·27	PL500	·59	UY85	·22
30FL1	·59	DY802	·28	EF89	·24	PCC89	·41	PL504	·59	W77	·42
								PY81	·23	Z77	·18

Post/Packing on 1 valve 7p. plus 3p. per valve on each extra valve. Any parcel insured against damage in transit 3p. extra. Office address, no callers.

GERALD BERNARD 83 Osbaldeston Road, Stoke Newington, London N.16

BELLING LEE INSULATED TERMINALS. Red or Black, 5 amp. max. 10p pair, pp 3½p

BERCOSTAT WIREWOUND RHEOSTAT. 50 volt, 800 Ω 25 watts, 2" dia. 25p. pp 7½p.

FINNED ALUMINIUM HEATSINK 9" x 1¾". Ready Drilled. 20p, pp 6½p

SMITHS CIRCULAR TAPE POSITION INDICATORS Resetable, 50p, pp 5p.

G.E.C. 5 AMP 240 VOLT A.C. CIRCUIT BREAKER. 75p, pp 10½p.

SUB MIN CROC CLIPS. Red or Black, insulated 4p. Min. quantity, 6 pp. 3½p.

GARRARD MAG TAPE DECKS: 1⅞ips, 50v solenoid operated brakes etc., Mains voltage motors £7·50 each, pp £1·23.

4½" PLANNAIR FANS. Complete, capacitor, ex-equip. 2,800 r.p.m. £3·50, pp 40p.

ELECTRIC MOTORS, HOOVER OR CROMPTON PARKINSON. 250v. Single Phase A.C.

¼ h.p. 1,440 r.p.m. £3·75 pp £1·00

½ h.p. 1,425 r.p.m. or 2,800 r.p.m. £6·75 pp £1·25

⅛ h.p. 1,440 r.p.m. £2·25 pp 75p

AUDIO CONNECTORS

3 pin Din Plug	13p each
5 pin Din Plug A type, B type	13p „
2 pin Din Speaker Plug/socket	10p „
3 pin Din Line Socket	13p „
3·5mm Jack Plug Screened	10p „
Standard Jack Plug	10p „
Screened Standard Jack Plugs	15p „
Stereo Jack Plug	13p „
Screened Stereo Jack Plug	18p „

Phono Plugs: Red or Black 8p each.

pp on above items 3½p.

B.S.R. MINI AUTO-CHANGER Mono Cartridge £4·75 pp 30p.

MAINS NEONS. Red or Green. Size: ¼" × 1¼" 15p, pp 3½p.

LEVER ACTION P.O.1000 TYPE SWITCHES. Lock 4-pole changeover 15p, pp 3½p. (ex-equip.)

Lock 2 Pole Changeover 10p pp 3½p. (ex-equip.)

AUDIO LEADS

Screened Phono Leads 46" long, 15p

3·5 mm JACK/3·5mm JACK 7' 6" long 40p

5-Pin Din A Type, 5-PIN A TYPE. Approx 5' long 70p. pp above items 5½p.

PIEZO DYNAMIC MICROPHONE 50k Ω £1·00 pp 8p.

MULLARD SCREW TERMINAL CAPACITORS 4,500 uf 64v. 7100 uf 40v. 50p each pp 10p.

BELLING LEE 1·5 amp in-line rubber covered interference suppressor 25p pp 8p.

RUBBER 3 PIN 5 AMP NON REVERSIBLE CABLE CONNECTORS 20p pp 5½p.

SOLENOIDS 12 VOLT PULL ACTION 2"×1"×¾" 40p pp 8p.

SIEMENS MINIATURE RELAY. Double pole changeover dust cover/base 48v 2500 50p pp 5p new.

OMRON MK2 MIDGET POWER RELAY. 12v DC Double pole Changeover. New. 70p pp 5p.

STC MINIATURE RELAY 280 Ω Perspex Cover 6-15v new, 35p pp 5p.

GARDNER'S POTTED TRANSFORMER 0-250v Input: 18v 500m/n 50v 150 m/a, 6v 250 m/a Output. Size 3" × 2½" × 2½", £1·00, pp 20p. Ex equip tested.

TELESCOPIC AERIALS Chromed 7" closed 28" extended 6 section ball jointed base 23p pp 8p new.

MULLARD 4 DM 160 INDICATORS in plastic holder/cover ex-equip. size approx. 1½"×1½"×½" 36p pp 8p.

PRINTED CIRCUIT BOARD/19 ACY 19's 10 OA200 Diodes: 1 reed relay: 1 AZ 229 zenner ass. capacitor/resistors. Power supply 22v 250 m/A DC. Output 240v. AC £1 pp 20p ex-equip.

TOGGLE SWITCHES. Single pole Double Throw ex-equip. new condition. 50p doz. pp 13p.

PAINTON PLUG SOCKETS Type 159 series working voltage 350v AC/DC current max. 3 amp AC/DC 7 pin plug & socket 50p pp 6p. 15 pin plug & socket £1 pp 6p. 31 WAY PLUG & SOCKET. £1·50. pp 6p.

CASH WITH ORDER PLEASE

FIELD ELECTRIC LIMITED

3 Shenley Road, Borehamwood, Herts.

Adjacent Elstree Mainline Station

Tel: 01-953 6009.

WOT MORE?

2N3819 29p, 2N5245 44p. F.E.T. Design ideas by Texas 12p. p.&p. 6p

Transistors, Resistors, Capacitors, Chips, Vero board, and more, send S.A.E.—The F.E.T. KING, 518 Nelstrop Road, M/C 19 3JL

TV Line out-put transformers

Replacement types ex-stock.
For "By-return" service, contact:
London: 01-948 3702
Tidman Mail Order Ltd., Dept. PW,
236 Sandycombe Rd., Richmond, Surrey
TW9 2EQ

Valves. Tubes, Condensers. Resistors. Rectifiers and Frame out-put Transformers also stocked.

CALLERS WELCOME

B.H. COMPONENT FACTORS LTD. DEPT. PW.

For Eagle, Sinclair, Data Books and Components. ¼W 5% resistors 1p, or 50p/100. Electrolytic C426 4/40, 8/40, 10/16, 32/10, 25/25. 100/6·4 all 4p. IN914 6p, 100V 1A Bridge 35p. Panel neon 15p. Mains Transformers 32-0-32 at 150mA 50p. Bargain Electrolytics. send for list. Electrolytic 100/50 10p, 500/25 10p, 1000/12 12p. 1,000/25 25p. 1,000/50 35p. uL914 30p. 7,400/01/10/30 15p. Free list, CWO. pp UK 10p. Discount £10—10%. Money back guarantee. Brand new to spec. P.O. Box 18, Luton, Beds, LU1 1SU.

INCOMPARABLE V.H.F. KIT

Johnsons CV2—unique triple-purpose (Converter, Receiver, Tuner-Feeder) kit for the Amateur enthusiast. Fantastic transistorized performance. World Wide Sales. Complete kit of top grade parts with coils covering 80-180 mHZ, plus easy/build diagrams and instructions. £4 direct from makers or S.A.E. for free literature.

Crystal Set Kits—one or two waveband now available. Send S.A.E. for free literature.

See also advert. on page 557.

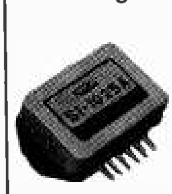
JOHNSONS (RADIO)

St.Martins Gate, Worcester, WR1 2DT
Est. 1943 (a John Banner Co. Tel. 24864

RADIOSPARES (R.S.) COMPONENTS specified for projects in this, and other magazines supplied on request. SAE with all enquiries. The Hobbies Shop, 32 The Parade, Cwmbran Town Centre, Cwmbran, Mon.

SANKEN HYBRID HI-FI AUDIO AMPLIFIER

Integrated Circuit



We have made a fortunate purchase of these 25 watt audio amplifier modules from which you can build your own quality equipment. Requires only the addition of 3 capacitors and a resistance (apart from power supply). Two modules provide 50 watts of power. Heat sink requirements are simple. Distortion at 1Khz. (10 watts) is only ·02%!

Price: 25 watts amplifier type 1025A £7·95 (P/P 15p) including technical data. Leaflet available. (50w version can be supplied).

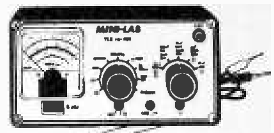
A complete kit is available to make a 25 watt+ 25 watt stereo outfit (giving 100 watts of music power) and this incorporates an integrated circuit pre amplifier of very low distortion, plus P.S.U. Price is only £37·50 and a case to suit can be supplied. Demonstrated at our showrooms.

Teleradio Hi-Fi

325, FORE STREET, EDMONTON, LONDON N.9.
01-807-3719

Versatile

10 in ONE



"MINI-LAB" *Comprising*

AC/DC Voltmeter : Audio Generator : Resistance Substitution : Capacitance Substitution : DC Ammeter : Battery Supply : RF Signal Generator : RF Field Strength Indicator : Ohm Meter

All you need for testing. Money back guarantee. **£11·25** + 25p P. & P.

Cash with order or write for data sheet to:

RSL Components, (Dept. PW), Cricketfield Lane, Bishops Stortford, Herts

For Sale

MORSE MADE EASY!!

FACT NOT FICTION. If you start RIGHT you will be reading amateur and commercial Morse within a month (normal progress to be expected).

Using scientifically prepared 3-speed records you automatically learn to recognise the code RHYTHM without translating. You can't help it, it's as easy as learning a tune. 18 W.P.M. in 4 weeks guaranteed.

Beginner's Section only £3·30, Complete Course £4·50 (Overseas £1·00 extra) details only, 4p stamp. 01-660 2896

G3HSC (Box 19), 45 GREEN LANE, PURLEY, SURREY

YUKAN SELF-SPRAY SO PROFESSIONAL THE YUKAN AEROSOL WAY—

Get these NOW! air drying GREY HAMMER OR BLACK WRINKLE (CRACKLE) finishes

DEPT PW YUKAN, 307a EDGWARE ROAD, LONDON W2 1BN

Open all day Saturday Closed Thursday afternoons

SEEN MY CAT? 5,000 items. Mechanical & Electrical Gear, and materials. S.A.E. K. R. WHISTON, Dept. PW, NEW MILLS, Stockport.

TELEPHONE ANSWERING machines. New and Reconditioned. £55/160. STAM Co., 182a New North Road, N1. 01-286 6119.

Wanted

TOP PRICES PAID for NEW VALVES

popular T.V. and Radio types.

KENSINGTON SUPPLIES (C),

367 Kensington Street, Bradford 8.

Yorkshire.

HIGHEST POSSIBLE cash prices for Akai, B. & O., Brenell, Ferrograph, Revox, Sanyo, Sony, Tandberg, Uher, Vortexion, etc. 9.30-5.00. 01-242 7401.

CASH PAID for New Valves. Payment by return. WILLOW VALE, ELECTRONICS, 4 The Broadway, Hanwell, London, W.7. 01-567/5400-2971.

WE BUY New Valves, Transistors and clean new components, large or small quantities, all details, quotation by return. WALTON'S. 55 Worcester Street, Wolverhampton.

INDEX TO ADVERTISERS

Published approximately on the 7th of each month by IPC Magazines Limited, Fleetway House, Farringdon Street, London, E.C.4. Tel: 01-634 4444. Printed in England by Index Printers, Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/sia) Ltd.; South Africa—Central News Agency Ltd.; Rhodesia and Zambia—Kingston Ltd.; East Africa—Stationery and Office Supplies Ltd. Subscription rate (including postage): For one year to any part of the world £2·65.

U.K's LARGEST ELECTRONICS CENTRES!

HENRY'S RADIO LTD. EDGWARE ROAD, LONDON, W.2.

NOW OPEN!

404-406 ELECTRONIC COMPONENTS & EQUIPMENT 01-402 8381/8382
354-356 HIGH FIDELITY & TAPE EQUIPMENT 01-402-5854/4736
309 PA - DISCO - LIGHTING HIGH POWER SOUND 01-723 6963
303 BARGAIN STORE SPECIAL OFFERS 01-723 1008 All Mail to: 303, Edgware Rd., London, W.2.

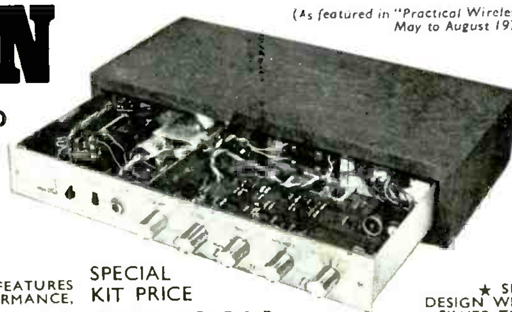
ALL YOUR ELECTRONIC REQUIREMENTS WITHIN 200 YARDS. CALL IN AND SEE FOR YOURSELF.

BUILD THE TEXAN

(As featured in "Practical Wireless" May to August 1972)

20 + 20 WATT INTEGRATED I.C. STEREO AMPLIFIER

★ FREE TEAK CABINET with complete kits!



FEATURES. New slim design with 6 - IC's, IC Sockets, 10 silicon transistors, 4 rectifiers, 2 zeners, special Gardeners low field slim line transformer. Fibre glass PC panel. Complete chassis work.

HIGH QUALITY & STABILITY ARE PREDOMINATE FEATURES —DEVELOPED BY TEXAS ENGINEERS FOR PERFORMANCE, RELIABILITY AND EASE OF CONSTRUCTION.

FACILITIES. On/off switch indicator, headphone socket, separate treble, bass, volume and balance controls, scratch and rumble filters, mono/stereo switch, Input selector; Mag. P.U. Radio Tuner, Aux. Can be altered for Mic., Tape, Tape-head, etc (Parts list Ref. 20 on request).

SPECIAL KIT PRICE **£28·50** P & P 45p

★ SLIM DESIGN WITH SILVER TRIM
Overall chassis size 14½" x 6" x 2" high

COMPLETE WITH FREE TEAK CABINET
Designer approved kits only available from Henry's

RECORD DECKS

CHASSIS (Post 50p)
SP25/3 £10·75 HT70 £15·00
MP60 £10·40 MP610 £14·15
AP76 £18·95 GL72 £22·25

WITH PLINTH/COVER (Post 70p)
MP60 £17·20 TD150AB
HT70 £21·60 £41·45
HL(GL75) PL12AC
£35·25 £35·25
MP610 £20·35 BD2 £32·25

CART/PLINTH/COVER (Post 70p)
(HL) AP76/G800/PC £29·95
(HL) SP25-3/G800H/PC £18·95
HT70/G800/PC £27·00
(HL) 2025TC/9TAHCD/PC £13·50
MP60/SC5MD/PC £17·25
(HL) GL75/G800E/PC £44·15
(HL) GL72/800/PC £35·50

ULTRASONIC TRANSDUCERS

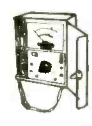
Operate at 40kc/s up to 100 yds. Ideal remote switching and signalling. Complete with data and circuits.
£5·90 per pair. Post 10p

LOW COST HI-FI SPEAKERS

E.M.I. Size 13½" × 8½". Large Ceramic Magnet.
TYPE 150 6 watt, 3, 8 or 15 ohms £2·20. Post 22p.
TYPE 150 TC Twin cone version £2·75. Post 22p.
TYPE 450 10 watt with twin tweeters and crossover. 3, 8 or 15 ohms. £3·85. Post 25p.
TYPE 350 20 watt with tweeter and crossover. 8 and 15 ohms. £7·70: Post 28p.

POLISHED CABINETS 150, 150TC 450 £4·60. Post 30p.

TEST EQUIPMENT

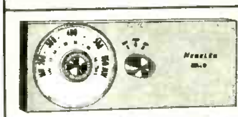


SE250B	Pocket Pencil Signal Injector £1·90
SE500	Pocket Pencil Signal Tracer £1·50
TE15	Grid Dip Meter 440 KHz–280 mHz £13·45
500	30 K/V Multimeter £9·25 With leather case £10·50
200H	20K/V Multimeter £4·20. With case £4·95
AF105	50K/V Multimeter £8·50. With case £9·50
U4341	AC/DC Multimeter with transistor tester with steel case £10·50
TE20D	RF Generator 120KHz–500MHz £15·95. Carr. 35p
TE22D	Audio Generator 20Hz–200KHz £17·50. Carr. 35p
TO3	3" Scope 1½Hz–1½MHz £39·00. Carr. 50p
CI-5	3" Pulse Scope 10Hz–10mHz £39·00. Carr. 50p
TE65	Valve Voltmeter 28 ranges £17·50. Carr. 40p

MARRIOT TAPE HEADS
4 TRACK MONO or 2 TRACK STEREO

'17' High Impedance £2·00
'18' Med. Impedance £2·00
'36' Med.-Low Imp. £3·50
Erase Heads for above 75p
'63' 2 track mono— Hi Imp. £1·75
'43' Erase Head for above 75p

ML-3 MW/LW TUNER to BUILD

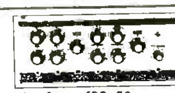


Uses Mullard Module. Slow motion tuning. Built in battery. Ferrite aerial. Overall size 7" x 2¼" x 3¾". TOTAL COST TO BUILD £4·85, Post 15p. All parts sold separately. Leaflet No. 6

POWER INTEGRATED CIRCUITS

Plessey SL403D—3 watt with 8-page data, layouts and circuits £1·50. P.C. Board 60p. Heat Sink 14p.
Sinclair IC12—6 watt with data and circuits £1·80.
TH9013P—20 watt Power Amp Module £4·57.
TH9014P-IC Preamp £1·50.
Data/Circuits for above No. 42 10p

PA-Disco-Lighting



UK's Largest Range—Write phone or call in. Details and demonstrations on request.

DJ30L	3 Channel sound to light unit, 3kw £28·50
DJ40L	3 Channel Mic (Built in) to light, 3kw £37·50
DJ70S	70 watt Disco amp/mixer £49·75
DISCOAMP	100 watt Disco amp/mixer £67·50
DJ105S	30 watt Disco amp/mixer £31·00

Anti-Feedback Quality Mic. £11·50
SDL 12" 50 watt 8 ohm Full range speaker £12·95
DECKS. Use MP60 or SP25/3 see above
Matching cartridge SC5M £2·62
FIBRE OPTICS, LIGHTING EFFECTS, PROJECTORS, SPOTS, DIMMERS, MIXERS. Everything for PA—Disco—Lighting. FREE Stock List Ref. No. 18.

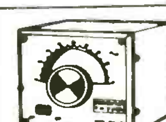
"BANDSPREAD" PORTABLE TO BUILD

Printed circuit all transistor design using Mullard RF/IF Module. Medium and Long Wave bands plus Medium Wave Bandspread for extra selectivity. Also slow motion geared tuning, 600 mW push-pull output, fibre glass PVC covered cabinet, car aerial. Attractive appearance and performance.
TOTAL COST TO BUILD £7·98, p.p. 32p. (Battery 22p). All parts sold separately—Leaflet No. 2

7 SEG & NIXIE TUBES

(Post 15p per 1 to 6)
XN3, XN13, GN6 0–9 side view with data, 85p.
GNP-7, GNP-8 0–9 side view with decimal points and data, 95p.
3015F 7 seg £2 each. £7 per 4 with data.
12 and 24 hour clock circuits for above Ref. No. 31 15p.

BUILD THIS VHF FM TUNER



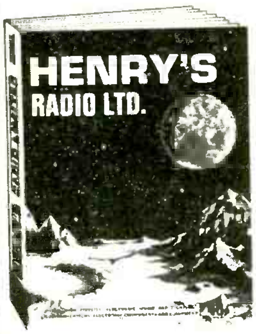
5 TRANSISTORS 300 kc/s BANDWIDTH, PRINTED CIRCUIT, HIGH FIDELITY REPRODUCTION. MONO AND STEREO

A popular VHF FM Tuner for quality and reception of mono and stereo. There is no doubt about it—VHF FM gives the REAL sound. All parts sold separately. Free Leaflet No. 3 & 7.
TOTAL £6·97, p.p. 20p. Decoder Kit £5·97.
Tuning meter unit £1·75
Mains unit (optional) Model PS900 £2·47. Post 20p
Mains unit for Tuner and Decoder PS1200 £2·62. Post 20p

Miniature Amplifier

5 transistor. 300mW o/p. Fitted volume and sensitivity control, 9 volt operated. £1·75 each P/P 15p.

CATALOGUE



Fully detailed and illustrated covering every aspect of Electronics—plus data, circuits and information. 10,000 Stock lines at Special Low Prices and Fully Guaranteed.

PRICE **55p** Post Paid (40p FOR CALLERS)

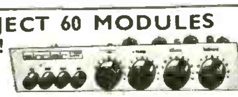
PLUS! FIVE 10p VOUCHERS

Send to this address—HENRY'S RADIO LTD. (Dept. PW) 3 ALBEMARLE WAY, LONDON, E.C.1.—for catalogue by post only. All other mail and callers to "303" see below.

Quality Slider Controls

60mm stroke singles and ganged. Complete with knobs. 5K, 10K, 25K, 100K, 500K, 1 meg, Log and Lin. 45p each, 10K, 25K, 50K, 100K, Log and Lin ganged. 75p each.

SINCLAIR PROJECT 60 MODULES —SAVE POUNDS!

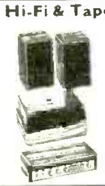


Z30 £3·57; Z50 £4·37
STEREO 60 £7·97; PZ5 £3·97
PZ8 £4·77
PZ6 £6·37;

Transformer for PZ8 £2·95
Active Filter Unit £4·45
Stereo FM Tuner £16·95
IC12 £1·80; Q16's £15 pr.
Post etc. 20p per item

PACKAGE DEALS Post 25p
2xZ30, Stereo 60, PZ5 £15·95
2xZ30, Stereo 60, PZ6 £18·00
2xZ50, Stereo 60, PZ8 £20·25
Transformer for PZ8 £2·95
PROJECT 605 KIT £19·95

Hi-Fi & Tape Equipment



Acknowledged as U.K.'s Largest Stockists with Lowest Prices Plus 12 months Guarantee. Write or call for FREE 16 page lists (Ref. 16/17)

MORE OF EVERYTHING AT LOW PRICES ALWAYS AT HENRY'S
All the parts you need plus Data and Circuits — Get a Catalogue — it's all in there!

Prices subject to change without notice E. & O.E.

Transistors - IC's - SCR'S - Rectifiers - Triacs, etc.
NEW FREE LISTS
Ref. No. 36 on request.

309-354-356-404-406 Open 6 days a week 9am - 6pm (303 closed Thurs.) All Stores open all day Saturday.

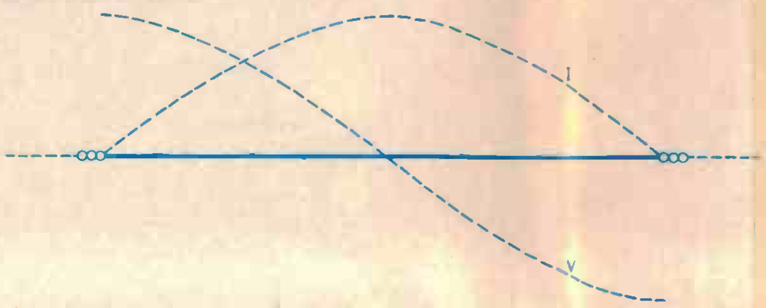
H MORE OF EVERYTHING AT THE RIGHT PRICE ALWAYS AT HENRY'S H

Aerial Data Chart

PRACTICAL AERIAL DATA CHART

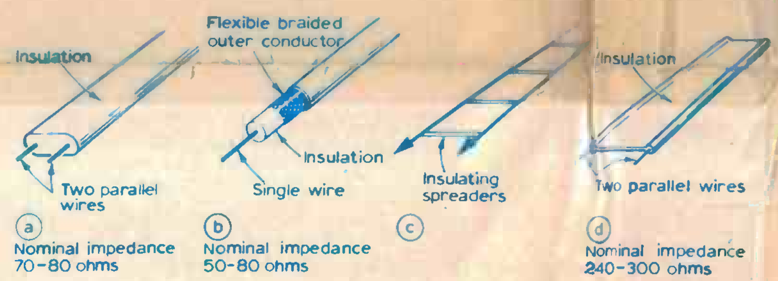
PRESENTED FREE WITH PRACTICAL WIRELESS OCTOBER 1972

BASICS



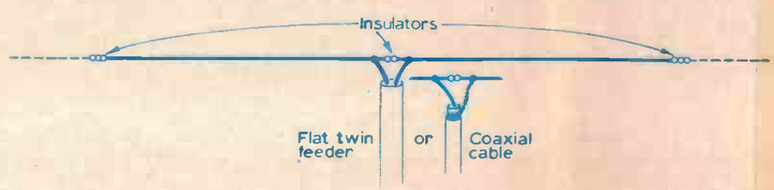
The basic horizontal half wave aerial (½λ). In practice, the physical length required for resonance is reduced by a factor of 0·95 (0·95 x ½λ) due to the effect of insulators and nearby objects. A simple formula for the practical half wave aerial is 468/F(MHz) feet. At resonance the induced voltage V will be maximum at the ends of the aerial (high impedance) while the current I will be maximum at the centre.

FEEDERS



Since the aerial should be located in the clear and generally as high as possible to produce maximum signal strength it is necessary to use a feeder to connect the aerial to the receiver. Low Impedance feeders may be flat twin (a), coaxial (b) or flat ribbon (d). High impedance feeders consist of two wires spaced apart by insulators every foot or so (c).

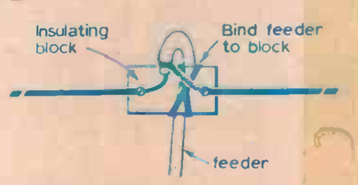
HALF WAVE DIPOLE



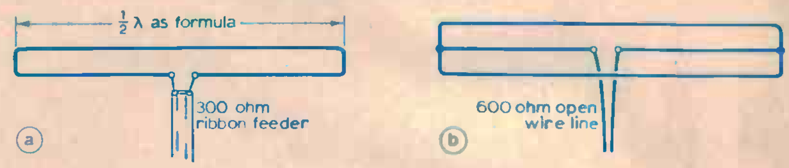
As the impedance at the centre of a half wave aerial is approximately 70 ohms feeders (a) or (b) will provide a good impedance match to the aerial ensuring maximum signal transference. The aerial, length calculated from the formula given, is cut at the centre and an insulator inserted, the wires of the feeder being connected either side of the insulator.

CONSTRUCTION

A practical method of feeding the aerial with low impedance feeder. The loop in the top of the feeder is essential to prevent the ingress of rain and dirt. The end of coaxial cable can be sealed with plastic insulating tape or compound.



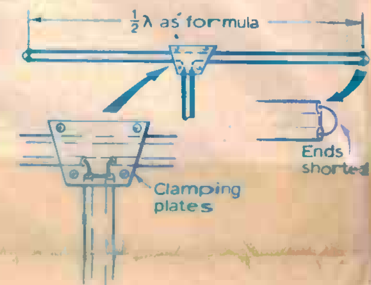
FOLDED DIPOLE



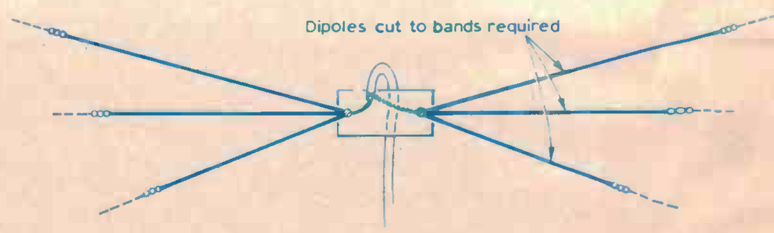
The folded dipole (a) will transform the input impedance by a factor of 2^2 or 4 x 70 = 280 ohms so that it can be fed with a flat ribbon feeder of 300 ohms impedance, provided the wires forming the folded dipole are the same diameter. If a three fold dipole is used the input impedance will be 70 x 3^2 = 630 ohms which will provide a good match to an open line feeder.

FOLDED DIPOLE CONSTRUCTION

A practical folded dipole using 300 ohm ribbon feeder for both the aerial and the feeder. One conductor only of the aerial is cut at the centre and the feeder inserted and the joints soldered. The junction should be clamped between pieces of insulating material and properly waterproofed.



MULTIBAND DIPOLE



If dipoles are required for optimum performance on several frequency bands they can be connected in parallel at their centres, and fed with a common feeder thus providing multiband facilities in a minimum of space. The ends of the dipoles may be tied off to any convenient supports and the dipoles need not all be in the same plane. Note that a dipole cut for, say, the 7MHz amateur band, will be three half waves on the 21 MHz amateur band thus eliminating the need for a separate aerial for that band.

DIPOLE DIMENSIONS

The table gives the length of a half wave aerial in the various HF amateur and broadcast bands.

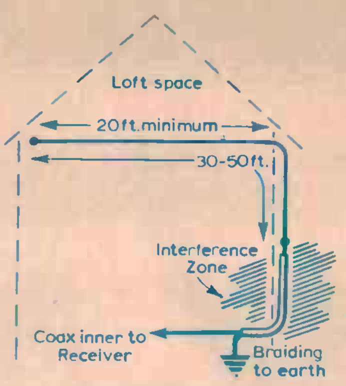
Broadcast		Amateur	
Band	Length	Band	Length
11m	18ft 2in	160m	256ft
13m	21ft 7in	80m	128ft
16m	26ft	40m	66ft
19m	30ft	20m	33ft
25m	39ft 4in	15m	22ft
31m	48ft	10m	16ft
41m	65ft		
49m	76ft		

LONG WIRE

A long length of copper wire, with one end connected to the receiver, is probably the most commonly used aerial. This is often fitted onto a picture rail and even quite a small room will enable a 40ft. length to be used. One convenient form of aerial can be obtained by using the coaxial cable of a TV aerial, the outer braiding being connected to the aerial socket of the receiver. Important! disconnect the TV aerial from the TV set before using it in this form. Probably the best and only *true* long wire aerial is the Beveridge. This is used by many major monitoring stations. It comprises a straight wire about a mile long mounted on short poles over the ground. One end goes to the receiver and the other to earth via a resistor. It is very directional and provides excellent reception but there are few who have sufficiently long back gardens to accommodate this one!

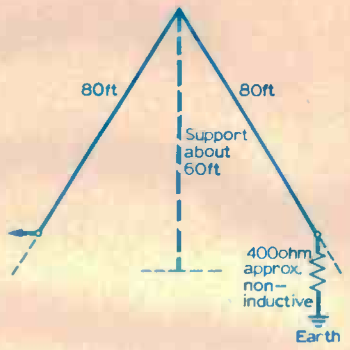
INVERTED L

A simple, general purpose aerial which, when connected to an ATU, will give good results. The length should be between 30ft and 50ft. of which the horizontal part should be at least 20ft. A wire across the loft and running down the outside of the house is a simple method of arranging this. In areas of high local interference the vertical portion can be screened using coaxial cable, the outer braid being taken to the earth terminal on the receiver and thence to an outside earth.



INVERTED V

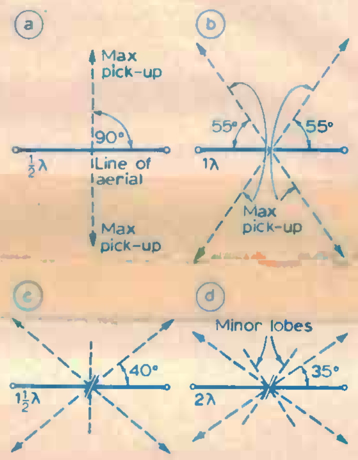
With only a single support required this form of "Inverted Vee" can be very effective. The 400 ohm resistor renders the system aperiodic i.e. not resonant at any particular frequency. It will be useful over most of the HF bands favouring signals in the plane of the aerial.



DIRECTIVITY

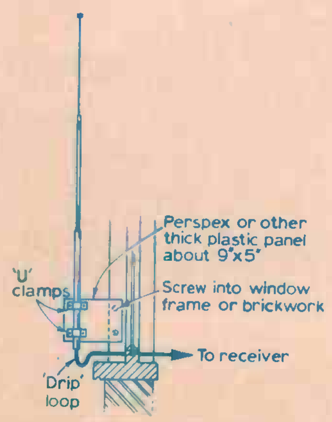
Signal pick-up of a half wave aerial is maximum at right angles to the line of the wire (a). If the wire is one wavelength long maximum pick-up is from four directions (b). By choosing the right length of aerial and adjusting its orientation the maximum pick-up lobes can be made to cover all the land areas of the world.

Longer aerials result in the appearance of minor lobes (c) and (d) which reduce directivity and improve all round coverage. With an aerial many wavelengths long maximum reception is along the line of the wire.



WHIP TYPES

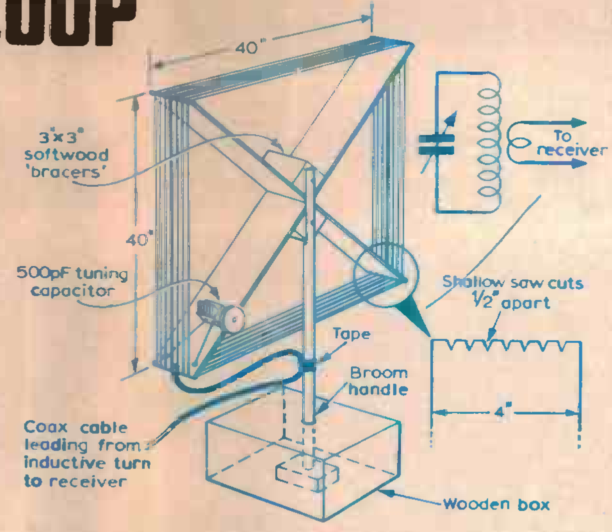
Whip aerials come in a variety of forms, many being ex-Government and very cheap. They can be telescopic, lengths of rod which screw into each other or several tubular sections with a single wire running through them which holds the sections rigid when tightened. In certain locations a whip aerial is about the only practical type since it can simply be mounted outside a window, as shown. The whip should be as long as possible, but very tall ones present mounting problems due to wind pressure. Generally a whip aerial will be non-resonant on the HF bands and should, ideally, be connected to an ATU. If not it may be connected to the aerial terminal directly or via a variable capacitor.



TV AERIALS

It is hardly worth making a TV aerial since commercial ones generally cost much less than the materials would cost to buy. Band I aerials (Channels 1-5) are nearly always cut for an individual channel and take the form of a simple dipole or an H or X arrangement. Band III aerials are available for individual channels, semi-broad-band encompassing three channels or broad-band (Channels 6-13). These aerials are generally more elaborate than Band I types due to the poorer propagation at these frequencies and incorporate one or more directors. The UHF frequencies (Channels 21-68) are divided into groups for aerial purposes: A, B, C, D and E and the correct type must be used in a particular area. Broadband UHF aerials, usually log-periodic, are also available but their gain is rather less than with conventional types. UHF aerials are much smaller than VHF types and usually incorporate from 3 to 19 directors plus a reflector in order to increase the gain. The dimensions are fairly critical and this, together with the low cost of the commercial product, makes home construction an unrealistic proposition.

MW LOOP



For frequencies between 500kHz and 2MHz the loop aerial takes a lot of beating. It consists of 7 turns of wire (5 or 6 turns for higher frequencies) around a wooden framework as illustrated. The ends of the wire connect to a 500pF tuning capacitor. A second wire, wound around the centre turn connects to a coax cable which goes to the aerial and earth sockets on the receiver or preferably to a balanced input.

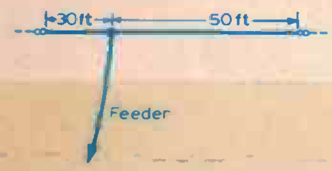
The loop forms a tuned circuit in conjunction with the capacitor with the inductive loop providing a low impedance feed to the receiver. The capacitor has to be tuned for each frequency and the selectivity is excellent. The loop is highly directional and by rotating it, interfering stations can be virtually eliminated. The tuning is very sharp and it is advantageous to fit either a slow motion drive to the capacitor or to wire a small value variable trimmer in parallel with it (10pF to 20pF).

The gain is not as high as that of a long wire aerial but this is more than outweighed by the much improved signal-to-noise ratio and the directional characteristics. The direction of a station can be determined within a few degrees by nulling it out to take its bearing. The broom-handle can be fitted into a box as shown with the bottom fitting into a recessed slot to prevent it slipping.

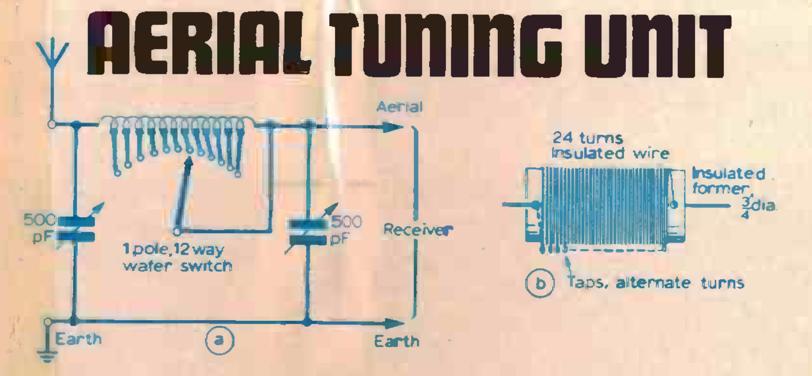
The main frame can be made of 6mm (¼in.) plywood or softwood. The wires should be wound very tight and should be kept that way (under tension the wire tends to stretch slightly). The softwood blocks merely act as bracers and as supports for the broom handle.

WINDOM

A useful general coverage aerial for the HF bands is the Windom which uses a single wire feeder tapped on to the horizontal wire. An aerial length of about 80 feet will work especially well on the 13, 25 and 49 metre bands.

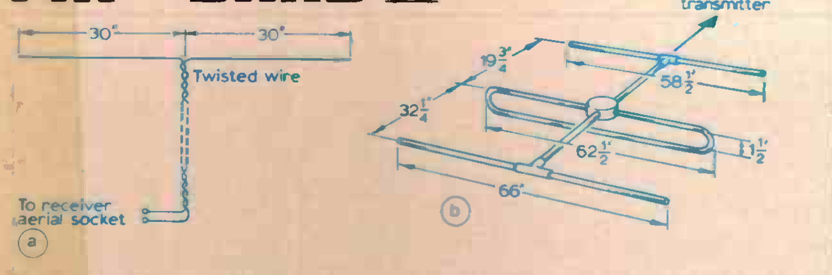


AERIAL TUNING UNIT



For best results an end fed wire aerial or rod aerial should be matched to the receiver input circuit with an Aerial Tuning Unit (a). The inductor (b) is wound making a loop every other turn, the loops then being soldered to the switch tags. Fit each tuning capacitor with a calibrated knob or dial and number the switch positions. Adjust the capacitors and switch position for maximum signal strength noting that the three adjustments are very much interdependent. Log dial and switch readings for future reference.

FM—BAND II



The signal strength of FM broadcasting stations is quite high over most of the country and elaborate aerials are rarely necessary. Many receivers are now fitted with telescopic aerials for FM but these will be poor in some areas. A very simple FM aerial can be made from ordinary twisted bell-wire, as shown. One end should be unwound and pinned along a picture rail to form a dipole. The dimensions given are for 95MHz. If within range of a BBC local radio station, the dipole should be modified to resonate at the frequency of this station as the signal strength is likely to be comparatively low. Length of each leg in inches = 2808 /Frequency in MHz. For DX FM reception or in difficult areas, more elaborate roof or loft mounted arrays should be used. Dimensions of a typical array are given although these aerials usually are cheaper to buy ready made.