PRACTICAL WIRELESS

NOVEMBER 1969

3'0

SPECIAL INSIDE
AUDIO FAIR
SUPPLEMENT

BUILD THIS
PEDAL STEEL GUITAR

PREMIER RADIO

23, TOTTENHAM COURT ROAD, LONDON, W.1 Tel: 01-636 3451

SPECIAL OFFER CARTRIDGES

SHURE

	List Price	Premier Price
M3D	£8.10.6	£6.19.6
M44-5	£14.9.1.	£10.10.0
M44C	£12.19.5	£9.9.0.
M44E	£17.8.4	£13.19.6
M55E	£20.15.1	£15.15.0
M75-6	£17.8.4	£13.19.6
M75E	£25.18.10	£21.0.0
AUDIO TECHNICA		
A.T.3-7 stereo/mono	£8.18.0	£5.19.6
A.T.3S stereo	£8.18.0	£5.19.6
A.T.3X eliptical	£13.0.0	£9.0.0
A.T.7S stereo	£22.0.0	£15.0.0
A.T.7X eliptical	£25.0.0	£18.0.0

Post and Packing 1/6 each

"NOVA" TRANSISTOR STEREO AMPLIFIER

A superb stereo amplifier offering every facility for the hi-fi enthusiast. Output 10 watts per channel. Frequency response 40-20,000 Hz ± 3dB. Inputs for radio, P.U. Ceramic, P.U. Magnetic Tape, Separate bass and treble controls, Volume and Balance controls Mono/Stereo Switch. Also features headphone socket and tape output. Teak case with attractive illuminated front panel. Size $14\frac{1}{4} \times 9\frac{1}{2} \times 3\frac{1}{2}$in. A.C. 200/250V.

WONDERFUL VALUE AT ONLY 25 Gns. Carr. 10/-.

PICK-UP CARTRIDGES

AT MONEY SAVING PRICES!

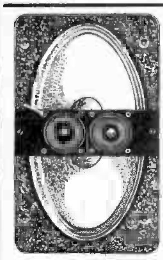
GOLDRING G800 (Stereo)	£8.19.6
SONOTONE 9TAHC/D (Stereo)	£2.15.0
ACOS GP91/18C (Mono compatible)	£1.13.5
ACOS GP93-1 (Stereo)	£2. 8.7
ACOS GP94 (Stereo)	£2.14.8
B S R X3M (Mono compatible)	£1.16.5
B S R X3H (Mono compatible)	£1.16.5
RONETTE 105 (Stereo)	£1.15.0
RONETTE 106 (Stereo)	£1.15.0

All complete with mounting brackets and instructions. Post and Packing 1/6 each.

The Premier Stereo System consists of an all transistor stereo amplifier. Garrard Model 2025 auto/manual record player unit fitted stereo mono cartridge and mounted in teak finish plinth with perspex cover and two matching teak finish loudspeaker systems. Absolutely complete and supplied ready to plug in and play. The 10 transistor amplifier has an output of 5 watts per channel with inputs for pick up, tape and tuner also tape output socket. Controls: Bass, Treble, Volume, Balance, Selector. Power on/off, stereo/mono switch. Brushed aluminium front panel. Black metal case with teakwood ends: Size $12 \times 5\frac{1}{2} \times 3\frac{1}{2}$in. high (Amplifier available separately if required £14.19.6. Carr. 7/6.)

WIDE RANGE OF HI-FI STEREO EQUIPMENT ON DEMONSTRATION

All leading makes available including Rogers, Armstrong, Dulci, Wharfedale, Goodmans, Goldring, Shure, etc. etc.

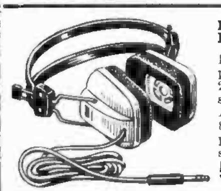


E.M.I. 13×8in. HI-FI SPEAKERS

Fitted two $2\frac{1}{2}$in. tweeters and crossover network. Impedance 3 and 15 ohms. Handling capacity 10 watts. Brand new. 99/6, p.&p. 7/6.

Also available without tweeters 49/6, p. & p. 7/6.

TEAK FINISHED CABINET Size $17\frac{1}{2} \times 10 \times 7\frac{1}{2}$in. Ideal for above speakers £5.10.0, p. & p. 10/-.



HI-FI STEREO HEADPHONES

Designed to the highest possible standard. Fitted $2\frac{1}{2}$" speaker units with soft padded ear muffs. Adjustable headband. 8 ohm impedance. Complete with 6ft. lead and stereo jack plug.

59/6 P. & P. 5/-.

MONO HEADPHONES 2000 ohm 14/6 P. & P. 2/6.
STEREO STETHOSCOPE SET Low imp. 25/- P. & P. 2/-.
MONO STETHOSCOPE SET Low imp. 10/6 P. & P. 2/-.

VERITAS V-149 MIXER

Battery operated 4-channel audio mixer providing four separate inputs. Size 6 × 3 × 2in. suitable for crystal microphone, low impedance microphone with transformer, radio, tape, etc. Max. input 1.5v. Max. output 2.5v. Gain 6 dB. Standard jack plug socket inputs, phonoplugs output. Attractive teak wood grain finish case.

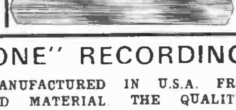
MONO MODEL 59/6 STEREO MODEL 69/6 P. & P. 2/6.

VERITAS V-313 TAPE HEAD DEFLUXER

A must for all tape users! Tape heads become permanently magnetized with constant use; this leads to background noise that prevents perfect recordings. Simply applied to recording head the V313 leaves head free of magnetism. Cleans any tape head in seconds. 34/6 P. & P. 1/6.

SPECIAL BARGAIN OFFER

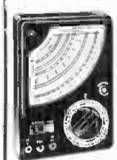
B.S.R. UA75 RECORD PLAYER UNIT COMPLETE WITH TEAK PLINTH. 4 speeds. Automatic or Manual operation. Low mass arm with cue and pause lever, bias compensator, stylus pressure adjuster, etc. Complete with B.S.R. C1 Stereo Cartridge. Original Price £25.18.8.



Our Price 14 Gns. Carr. 10/6

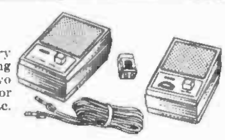
MULTI TESTERS

MODEL D14. A really versatile instrument that makes a handy pocket size tool. Measures AC or DC voltage in three ranges of 0–15–150–1000 volts. Resistance 0–100,000 ohms. Current 0–150 mA D.C. Size only: $3\frac{3}{4}$" x $2\frac{1}{4}$" x $1\frac{1}{4}$" Complete with battery, test leads and instructions. 49/6 P. & P. 2/6.



POCKET SIZE MODEL. With wide-angle, jewelled meter movement, ceramic long-life, low-loss switching, tough impact resisting case. Sensitivity 20,000 ohms/volt D.C. 10,000 ohms/volt A.C.
19 Ranges: 0-5-25-50-250-500-2500 volts DC. 0-10-50-100-500-1000 volts AC. 0-50µA-2·5 mA-250 mA DC. 0-6000 ohms-6 megohms, 10µ µf-0·001 mfd-1 mfd. -20 to +22dB. Complete battery, test lead and instructions. £4.19.6 P. & P. 3/6.

TWO STATION TRANSISTOR INTERCOMS.



Complete with battery and 50ft. connecting wire. Compact size, two way call system. Ideal for home, office, factory, etc. 65/- P. & P. 4/-.

FOUR STATION INTERCOM. Master unit and 3 slaves. Ideal for office and home. Complete with battery and connecting wire £7.19.6. P & P. 5/6.

"VERITONE" RECORDING TAPE

SPECIALLY MANUFACTURED IN U.S.A. FROM EXTRA STRONG PRE-STRETCHED MATERIAL. THE QUALITY IS UNEQUALLED.

TENSILISED to ensure the most permanent base. Highly resistant to breakage, moisture, heat, cold or humidity. High polished splice free finish. Smooth output throughout the entire audio range. Double wrapped—attractively boxed

LP3	3"	250'	P.V.C.	5/6	LP6	$5\frac{3}{4}$"	1200'	P.V C.	12/6
TT3	3"	450'	POLYESTER	7/6	DT6	$5\frac{3}{4}$"	1800'	POLYESTER	22/6
DT3	$3\frac{1}{4}$"	600'	POLYESTER	11/6	TT6	$5\frac{3}{4}$"	2400'	POLYESTER	37/6
SP5	5"	600'	P.V.C.	8/6	SP7	7"	1200'	P.V C	12/6
LP5	5"	900'	P.V.C.	10/–	DT7	7"	2400'	POLYESTER	25/–
DT5	5"	1200'	POLYESTER	15/–	TT7	7"	3600'	POLYESTER	50/–

TAPE SPOOLS 3" 1/-, 5", $5\frac{3}{4}$", 7" 1/9. TAPE CASES 5", 7" 2/6.
Post and Packing 3" 1/-, 5", $5\frac{3}{4}$" 1/6, 7" 2/-. (3 reels and over Post Free).

"PREMIER" TAPE CASSETTES

C60 (60 min.) 7/6
C90 (90 min.) 12/6
C120 (120 min.) 17/6

P. & P. 1/–.

CASSETTE HEAD CLEANER

Removes unwanted deposits from delicate tape heads. Fits all cassette recorders.

11/6 P. & P. 1/–

COMET Hi-Fi DISCOUNT WAREHOUSE

- ALL ITEMS OFFERED ARE FULLY GUARANTEED AND BACKED BY COMET.
- OPEN TO THE PUBLIC 9 to 5.30 p.m. daily (8 p.m. Thursday and Friday evenings) and 5 p.m. Saturdays.
- COMPLETE FREE PRICE LIST CONTAINING OVER 800 ITEMS ON REQUEST.

AMPLIFIERS

	Rec. Retail Price	Comet Price
DULCI 207 Stereo Amplifier	£25 0 0	£18 0 0
DULCI 207M Stereo Amplifier takes magnetic P/U	£30 0 0	£21 19 0
DULCI 220 Princess	£44 2 0	£34 19 6
GOODMANS Maxamp ..	£54 0 0	£42 18 0
New LEAK Stereo 30 Plus ..	£52 0 0	£41 19 6
New LEAK Stereo 30 Plus In teak case	£58 10 0	£48 14 6
New LEAK Stereo 70 ..	£63 0 0	£50 19 6
LINEAR LT.66 Stereo Amplifier	£15 15 0	£13 10 0
QUAD 33 Preamplifier ..	£43 0 0	£34 19 6
QUAD 303 Stereo Main Amplifier	£55 0 0	£46 19 6
ROGERS Ravensbourne 50 watt Stereo	£59 10 0	£48 19 6
ROGERS Ravensbourne In teak case	£64 0 0	£54 8 0
ROGERS Ravensbrook ..	£41 0 0	£34 19 6
ROGERS Ravensbrook in teak case..	£46 10 0	£39 19 6
TELETON 203E	£28 7 6	£23 7 6
TRUVOX TSA.200	£54 12 0	£42 9 0

TUNERS

	Rec. Retail Price	Comet Price
ARENA 211 Stereo with decoder	£39 18 0	£34 18 0
DULCI FMT.7FM Tuner ..	£22 1 0	£19 0 0
DULCI FMT.7S FM Stereo Tuner	£29 8 0	£23 0 0
GOODMANS Stereomax AM/FM Stereo Tuner ..	£82 10 5	£69 19 6
LEAK Troughline Tuner with multiplex	£51 10 6	£39 19 6
QUAD Stereo FM Tuner ..	£51 0 0	£43 19 6
ROGERS Cadet Mark III Tuner	£20 12 6	£17 13 0
ROGERS Ravensbourne Tuner with Decoder ..	£60 15 3	£52 2 0
TRUVOX FM 200/IC Tuner ..	£52 0 0	£39 19 6

TUNER-AMPLIFIERS

	Rec. Retail Price	Comet Price
ARENA 2400 with Decoder ..	£90 6 0	£69 19 6
ARENA 2500 complete with Decoder	£97 0 0	£79 0 0
(NEW) GOODMANS Model 3000 with stereo decoder ..	£77 14 7	£68 0 0
TANDBERG SolvSuper 10/71 Tuner/Amplifier AM/FM and 2 short wavebands ..	£75 18 0	£65 18 0
TELETON MX.990 Stereo Tuner/Amplifier with AM/FM Multiplex Stereo Radio c/w two Speakers, each speaker containing 8in. bass, 2in. tweeter	£64 13 2	£49 19 6
TELETON F.2000 AM/FM Stereo Tuner/Amplifier 2 x 5 watts RMS with silicon transistors	£43 0 0	£35 19 6
TELETON R.8000 AM/FM Stereo Tuner/Amplifier 2 x 6 watts RMS, complete with 2 speaker boxes	£60 19 6	£49 19 6
TELETON CMS.400 AM/FM Multiplex Tuner/Amplifier with 2 speaker boxes and turntable	£126 0 0	£99 0 0
TELETON 7AT1 Stereo Tuner/Amplifier AM/FM 50 watts RMS Stereo Decoder and F.E.T.	£133 0 0	£95 0 0

THE GOODMAN 3000 MUSIC AUDIO SUITE
A complete Audio Suite with Stereo Radio, complete with Speakers, Turntable and magnetic cartridge. All wired and ready to go. Beautifully finished in Teak
£140 9 0 £115 9 4

CARTRIDGES ALL MAKES STOCKED AT DISCOUNT PRICES

SPEAKERS

	Rec. Retail Price	Comet Price
CELESTION Ditton 10 ..	£21 13 1	£17 16 0
CELESTION Ditton 15 ..	£31 3 7	£26 5 0
DULCI AS3 Speaker	£8 8 0	£6 19 6
GOODMANS Maxim ..	£20 15 6	£16 19 6
GOODMANS Mezzo II ..	£30 18 0	£25 13 0
GOODMANS Magnum-K ..	£40 2 0	£29 19 6
GOODMANS Mirimba ..	£26 0 0	£18 19 6
GOODMANS Mambo ..	£22 6 6	£18 11 9
GOODMANS Loudspeaker System. Model 3005 (per pair)	£25 0 0	£21 0 0
KEF Celeste	£29 0 0	£23 19 6
KEF Concord	£43 10 0	£36 0 0
LEAK Sandwich	£43 10 0	£32 19 6
LEAK Mini-Sandwich ..	£29 15 0	£21 19 6
QUAD ELECTROSTATIC ..	£66 0 0	£55 0 0
WHARFEDALE New "Airedale"	£69 10 0	£57 14 0
WHARFEDALE Denton ..	£16 6 0	£12 19 6
WHARFEDALE Super Linton	£21 0 0	£16 19 6
WHARFEDALE Melton ..	£29 10 0	£22 19 6
WHARFEDALE New Dovedale 3	£39 10 0	£30 19 6
WHARFEDALE Rosedale ..	£55 0 0	£45 0 0
WHARFEDALE UNIT 3 Speaker Kit	£10 17 6	£9 10 0

Bowers and Wilkins Speakers also available at discount prices.

Most types of chassis, speakers, cross-over networks etc., available ex stock.

TURNTABLES

	Rec. Retail Price	Comet Price
GARRARD SP.25, Mark II ..	£15 11 11	£11 10 0
GARRARD AP.75	£23 16 7	£17 19 6
GARRARD SL.55	£13 17 9	£11 2 6
GARRARD SL.65	£18 8 4	£14 19 6
GARRARD SL.75	£35 12 5	£26 19 6
GARRARD SL.95	£45 9 1	£34 19 6
GARRARD 401	£31 14 2	£25 10 0
GARRARD 3000	£11 4 1	£9 10 0
GARRARD 3500	£12 4 10	£10 1 10
GOLDRING Lenco GL.68 ..	£22 7 2	£16 19 11
GOLDRING Lenco GL.75 ..	£35 15 5	£26 19 6
GOLDRING 75P	£46 18 8	£38 0 0
GOODMANS Model 3025 Complete with Magnetic Cartridge	£37 14 9	£31 19 6
THORENS TD.125	£63 4 9	£55 0 0
THORENS TD.150	£28 16 11	£25 7 0
THORENS TD 150A	£35 14 6	£29 10 0
THORENS TD.150B	£32 17 6	£28 18 0
THORENS TD.150AB ..	£39 16 9	£32 19 6
THORENS TD.124/11.. ..	£45 18 1	£40 7 0

Bases, plinths and covers stocked to suit all the above turntables.

HI-FI STEREO TAPE DECKS AND TAPE RECORDERS

	Rec. Retail Price	Comet Price
AKAI X-150D deck 4 track ..	£130 2 4	£109 0 0
AKAI X-360 4 track	£339 0 0	£284 0 0
AKAI X-360D deck 4 track ..	£290 0 0	£243 0 0
AKAI 1710 4 track w/o acc. ..	£109 0 0	£89 19 6
AKAI 1800 4 track	£158 0 0	£133 0 0
AKAI 1800SD 4 track.. ..	£199 0 0	£167 0 0
AKAI 4000D deck 4 track ..	£99 10 0	£79 19 6
AKAI X-V 4 track	£180 0 0	£151 0 0
AKAI M-9 4 track w/o acc. ..	£195 0 0	£139 19 6
MARCONI 4214 twin track Tape Recorder	£35 16 0	£31 0 0
MARCONI 4216 4-track Tape Recorder	£41 5 0	£35 19 6
MARCONI 4218 Stereo Tape Recorder	£88 0 0	£77 19 6
MARCONI 4238 4 track Tape Recorder	£58 11 0	£49 19 6
PHILIPS battery operated tape recorder Model 4200	£35 6 0	£21 19 6
SHARP 504 battery/mains tape recorder, complete with all accessories guaranteed 5 years ..	£35 5 3	£24 19 6
TELETON 7D 70 Stereo Tape Deck	£85 10 3	£62 0 0
TELETON FXB501D Stereo Tape Deck and preamplifier	£65 0 8	£49 0 0
TELETON 401X FM Multiplex Stereo tuner/amplifier 20 watts RMS	£67 2 6	£49 0 0
TRUVOX R54 3 speed 4-track	£72 2 0	£52 2 0
TRUVOX R52 3 speed 2-track	£72 2 0	£52 2 0

PICKUP ARMS

	Rec. Retail Price	Comet Price
GOLDRING Lenco L75 ..	£12 6 6	£10 10 0
GOLDRING Lenco G65 ..	£7 13 6	£6 10 0
SME 3009 with S2 shell ..	£27 19 2	£23 17 6
SME 3012 with S2 shell ..	£29 0 0	£25 17 6

COMET DISCOUNT WAREHOUSE

Reservoir Road, Clough Road, Hull. Tel 407906
68a Armley Rd (Artist St) Leeds LS12 2EF Tel 32055

Customers are welcome to call personally.
Ample Car Parking facilities

Comet guarantee that all prices quoted are genuine. All items offered available at these prices at the time this issue closed for press.
Add 9/- for post and packing on all orders. Make cheques, Money Orders payable to "COMET".

Complete stereo system – 28 gns.

The new Duo general-purpose 2-way speaker system is beautifully finished in polished teak veneer, with matching vynair grille. It is ideal for wall or shelf mounting either upright or horizontally.

Type 1 SPECIFICATION:–
Impedance 10 ohms. It incorporates Goodmans high flux 6"×4" speaker and $2\frac{1}{4}$" tweeter. Teak finish 12"×$6\frac{3}{4}$"×$5\frac{3}{4}$". **4 guineas each.** 7/6d. p. & p.
Type 2 as type 1. Size $17\frac{1}{2}$"×$10\frac{3}{4}$"×$6\frac{3}{4}$". Incorporating Elac $10\frac{1}{2}$"×$6\frac{1}{4}$" 10,000 lines and $2\frac{1}{4}$" tweeter. 3 ohms impedance **$5\frac{1}{2}$ guineas** plus 7/6d. p. & p.
Garrard Changers from £7.19.6d. p. & p. 7/6d.
Cover and Teak finish Plinth £4.15.0d. 7/6d. p. & p.

The items illustrated can be purchased together for 28 gns.

The Duetto is a good quality amplifier, attractively styled and finished. It gives superb reproduction previously associated with amplifiers costing far more.

SPECIFICATION:–
R.M.S. power output: 3 watts per channel into 10 ohms speakers.
INPUT SENSITIVITY: Suitable for medium or high output crystal cartridges and tuners. Cross-talk better than 30dB at 1 Kc/s.
CONTROLS: 4-position selector switch (2 pos. mono and 2 pos. stereo) dual ganged volume control.
TONE CONTROL: Treble lift and cut. Separate on/off switch. A preset balance control.

Duetto Integrated Transistor Stereo Amplifier **9GNS.** plus 7/6d. p. & p.

The above 5 items can be purchased together for 28 gns. + £1.10.0 p. & p.

The Classic $8\frac{1}{2}$ Gns. plus 7/6 p. & p.

Controls: Selector switch Tape speed equalisation switch ($3\frac{3}{4}$ and $7\frac{1}{2}$ i.p.s.). Volume. Treble. Bass. 2 position scratch filter and 2 position rumble filter.

Specification: Sensitivities for 10 watt output at 1KHz into 3 ohms. *Tape head:* 3mV (at $3\frac{3}{4}$ i.p.s.). *Mag.P.U.:* 2mV. *Cer.P.U.:* 80 mV. *Tuner:* 100mV. *Aux.:* 100mV. *Tape/Rec.output:* Equalisation for each input is correct to within $\pm$ 2dB (R.I.A.A.) from 20Hz to 20KHz. *Tone control range:* Bass $\pm$ 13dB at 60Hz. Treble $\pm$ 14dB at 15KHz. *Total distortion:* (for 10 watt output) $<$1·5%. *Signal noise:* $<$—60dB. A.C. mains 200–250v. Built and tested. Size $12\frac{1}{2}$in. long. $4\frac{1}{4}$in. deep, $2\frac{3}{4}$in. high. Teak finished case.

The Viscount $13\frac{1}{2}$ Gns. plus 7/6 p. & p.

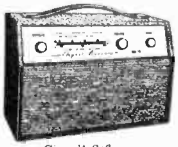
Integrated High Fidelity Transistor Stereo Amplifier. Specification—Output: 10 watts per channel into 3 to 4 ohms speakers (20 watts monaural). Input: 6 position rotary selector switch (3 pos. mono and 3 pos. stereo), P.U., Tuner, Tape and Tape Rec. out. Sensitivities: All inputs 100mV into 1·8M ohm. Frequency Response: 40Hz–20KHz $\pm$ 2dB. Tone Controls: Separate bass and treble controls; treble, 13dB lift and cut (at 15KHz); Bass, 15dB lift and 25dB cut (at 60Hz). Volume Controls: Separate for each channel. A.C. Mains Input: 200–240V. 50–60Hz. Size, $12\frac{1}{2}$" x 6" x $2\frac{3}{4}$" in teak finished case. Built and tested.
VISCOUNT MARK II for use with magnetic pick-ups specification as above. Fully equalised for magnetic pick-ups. Suitable for cartridges with minimum output of 4mV/cm/sec. at 1kc. Input impedance 47k. **15 gns.** plus 7/6 p. & p.

RADIO & TV COMPONENTS
R+TV
(ACTON) LIMITED

SPECIAL OFFER!

Complete stereo system comprising BALFOUR 4-speed autoplayer with stereo head, 2 Duo speaker systems, size 12in. x $6\frac{3}{4}$in. x $5\frac{3}{4}$in. Plinth (less cover) and the DUETTO stereo amplifier. All above items
19 Gns. plus 20/- p. & p.

Also see opposite page



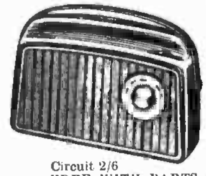
Circuit 2/6
FREE WITH PARTS.

The ELEGANT SEVEN
Mk. III (350mW Output)

7 transistor fully tunable M.W.–L.W. portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction.
MAINS POWER PACK KIT: 9/6 extra.

Price **£4.9.6** plus 7/6 P. & P.

The DORSET
(600mW Output)

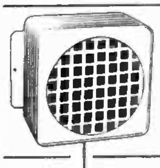


7-transistor fully tunable M.W.–L.W. superhet portable —with baby alarm facility. Set of parts. The latest modulised and pre-alignment techniques makes this simple to build. Sizes: 12 × 8 × 3in.

Price **£5.5.0** plus 7/6 P. & P.

MAINS POWER PACK KIT: 9/6 extra

Circuit 2/6
FREE WITH PARTS.

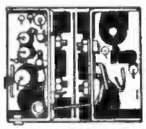


EXTRACTOR FAN

A.C. mains 230/250v. complete with pull switch. Size 6 × 6 × 4in.

Price **27/6** plus 7/6 P. & P.

X101 10W SOLID-STATE HI-FI AMP WITH INTEGRAL PRE-AMP



Specifications: *Power Output* (into 3 ohms speaker) 10 watts.
Sensitivity (for rated output): 1mV into 3K ohms (0·33 microamp).
Total Distortion at 1KHz at 5 watts, 0·35%, at rated output 1·5%.
Frequency Response: Minus 3dB points 20Hz and 40KHz.
Speaker: 3–4 ohms (3–15 ohms may be used).
Supply voltage: 24V. D.C. at 800mA (6–24V. may be used).

Price **69/6** plus 2/6 P. & P.

Control assembly: including resistors and capacitors. 1. Volume: PRICE 5/–. 2. Treble: PRICE 5/–. 3. Comprehensive bass and treble: PRICE 10/–. The above 3 items can be purchased for use with the X101.

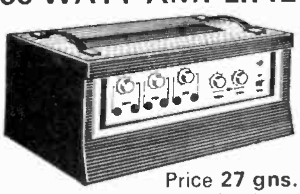
Power Supplies for the X101:
P101 M (for mono) 35/– plus 4/6 p. & p.
P101 S (for stereo) 42/6 plus 4/6 p. & p.

CAR TRANSISTOR IGNITION SYSTEM
by famous manufacturer

For 6 volt or 12 volt positive earth systems. Comprising: special high voltage working hermetically sealed silicon transistor mounted in finned heat-sink, high output ignition coil, ballast resistor and hardwear (screws, washers etc.).

Price **£4.19.6** plus 5/- P. & P.

50 WATT AMPLIFIER A.C. Mains 200-250V



Price **27 gns.**
plus 20/– p. & p.

An extremely reliable general purpose valve amplifier. Its rugged construction yet space age styling and design makes it by far the best value for money.

TECHNICAL SPECIFICATIONS
3 electronically mixed channels, with 2 inputs per channel, enables the use of 6 separate instruments at the same time. The volume controls for each channel are located directly above the corresponding input sockets. **SENSITIVITIES AND INPUT IMPEDANCES.** Channels 1 & 2 4mV at 470K. These 2 channels (4 inputs) are suitable for microphone or guitars. Channels 3 & 4 300mV at 1m. Suitable for most high output instruments (gram, tuner, organ etc.). Input sensitivity relative to 10w output. **TONE CONTROLS ARE COMMON TO ALL INPUTS. Bass Boost** +12dB at 60 Hz. **Bass Cut** —13dB at 60 Hz. **Treble Boost** +11dB at 15 KHz. **Treble Cut** —12dB at 15 KHz. With bass and treble controls central —3dB points are 30 Hz and 20 KHz. **POWER OUTPUT**: For speech and music 50 watts rms. 100 watts peak. For sustained music 45 watts rms. 90 watts peak. For sinc wave 38·5 watts rms. Nearly 80 watts peak. Total distortion at rated output 3·2% at 1KHz. Total distortion at 20 watts 0·15% at 1KHz. Output to match into 8 or 15 ohms speaker system. **NEGATIVE FEEDBACK** 20dB at 1 KHz. **SIGNAL TO NOISE RATIO** 60dB. **MAINS VOLTAGES** adjustable from 200–250V. A.C. 50–60 Hz. A protective fuse is located at the rear of unit. Output impedance 3, 8 and 15 ohms.

B.S.R. TD-2 TAPE DECK

Takes 5¾in. spools, fitted with B.S.R. ¼ Track Heads. Size 13¼in. long by 8¾in. wide.

Price **£8.19.6** plus 7/6 P. & P.

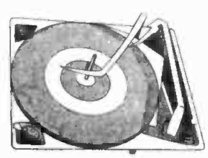
The RELIANT
SOLID STATE GENERAL PURPOSE AMPLIFIER

SPECIFICATIONS
Output—10 watts
Inputs—1. -xtal mic 10mV
2. -gram/radio 250mV
Output Impedance—3 to 4 ohms
Tone Controls—Treble control range ±12dB at 10 KHz
Bass control range ±13dB at 100Hz
Frequency Response—(with tone controls central) Minus 3dB points at 20Hz and 40KHz. Signal to Noise Ratio—better than —60dB. Transistors—4 silicon Planar type and 3 Germanium type. Mains input—220/250V. A.C. Size of chassis—10¼" × 4¾" × 2¼". For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Separate bass and treble lift control. Two inputs with control from gram. and mike. Built and tested. 8" × 5" speaker to suit price **14/6** plus 1/6 p. & p. Crystal mike to suit **12/6** plus 1/6 p. & p.

RELIANT Mk. I
As above less teak case
5½ gns. plus 7/6 P. & P.

RELIANT Mk. II
In teak finished case.
6½ gns. plus 7/6 P. & P.

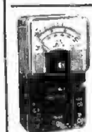
RECORD PLAYER SNIP A.C. Mains 240V



The "Princess", 4-speed automatic record changer and player engineered with the utmost precision for beauty, long life, and trouble free service. Will take up to ten records which may be mixed 7" to 10" or 12". Patent stylus brush cleans stylus after each playing and at shut off, the pick-up locks itself into its recess, a most useful feature with portable equipment—other features include pick-up height adjustment and stylus pressure adjustment. This truly is a fine instrument which you can purchase this month at only **£5.19.6** complete with cartridge and ready to play. Post and ins. 7/6 extra.

ONLY **£5.19.6** plus 7/6 P. & P.

POCKET MULTI-METER

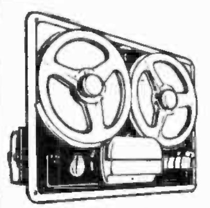


Size 3¼ × 2¼ × 1⅜in. Meter size 2¼ × 1⅞in. Sensitivity 1,000 O.P.V. on both A.C. and D.C. volts. 0–15, 0–150, 0–1,000 D.C. current 0–150mA. Resistance 0–100kΩ. Complete with test prods, battery and full instructions.

42/6 plus 3/6 P. & P.

FREE GIFT for limited period only. 30 watt Electric Soldering Iron value 15/– to every purchaser of the Pocket Multi-Meter.

MOTEK



3 Speed 2 track Tape Deck complete with heads, takes 7in. spool.
Incorporating 3 motors.
A.C. mains, 240 volts.

Listed at £21
Our Price **£9.19.6**
plus 10/- P. & P.

CYLDON 2 TRANSISTOR U.H.F. TUNER

Brand new. Complete with circuit diagram.

Price **£2.10.0** plus 1/- P. & P.

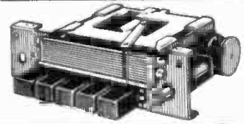
THREE-IN-ONE HI-FI 10 WATT SPEAKER

A complete Loud Speaker system on one frame, combining three matched ceramic magnet speakers with a low loss crossover network. Peak handling power 10 watts. Impedance 15 ohms. Flux density 11,000 gauss. Resonance 40–60 c/s. Frequency range 50c/s to 20Kc/s. Size 13½ × 8 1/16 × 4¼in. By famous manufacturer.

List price £7 OUR PRICE **74/6** plus 5/- P. & P.

Similar speaker to the above without tweeters in 3 and 15 ohms 44/6 plus 5/- p. & p.

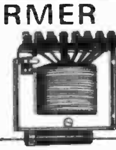
PYE CAR RADIO
Push Button Tuning Heart



This PRESTOLOCK 5 station Push-Button Tuner Heart with Manual Over-ride is an ideal basis for a quality AM car radio. Size 6¼" × 4" × 2".

25/- plus 3/- P. & P.

QUALITY MAINS TRANSFORMER



Input 250 volts. OUTPUT (All RMS values) 4 windings of 11·5 volts connected in series total 46 volts at 4·5 amps (conservatively rated). The following combinations may be used.
1. 23–0–23 volts. 2. 46 volts.
Both of these above voltages are commonly used in medium to high powered transistor amplifiers, power supplies, etc.

Price **35/-** plus 7/6 P. & P.

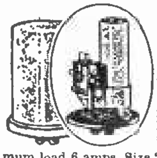
TERMS C.W.O.
All enquiries S.A.E.

RADIO & TV COMPONENTS
R+TV
(ACTON) LIMITED

Goods not despatched outside UK

RADIO & T.V. COMPONENTS (ACTON) LTD
21c High Street, Acton, London W.3.
Also at 323 Edgware Road, London W.2.
ALL ORDERS BY POST TO OUR ACTON ADDRESS

CAR LIGHT FLASHERS



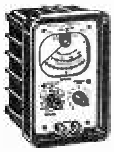
Heavy duty light flasher employs a condenser discharge principle operating on electro mechanical relay. (As inset). Housed in strong plastic case. Flashing rate between 60-120 per minute. 12V DC operation. Maximum load 6 amps. Size 2-11/16in. dia. x 4in. Supplied brand new at a fraction of original cost. 6/6 each P. P. 2/6. (3 for 17/6 P. P. 4/6).

R209 MK II COMMUNICATION RECEIVER

11 valve high grade communication receiver suitable for tropical use. 1·20 Mc/s on 4 bands. AM/CW/FM operation. Incorporates precision vernier driver, B.F.O., aerial trimmer, internal speaker and 12v. D.C. internal power supply. Supplied in excellent condition, fully tested and checked £15.0.0. Carr. 20/-

TYPE 13A DOUBLE BEAM OSCILLOSCOPES

An excellent general purpose D/B oscilloscope. T.B. 2 cps–750 Kc/s. Bandwidth · 5·5 Mc/s. Sensitivity 33mV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. £22.10.0. Or complete with all accessories, probe, leads, lid, etc. £25. Carriage 30/-.



MARCONI T/44/TF956

AF Absorption Wattmeter

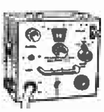
1 μ/watt to 6 watts.

£20. Carr. 10/-.

SOLARTRON CD-1016 OSCILLOSCOPE

Double beam. D.C. To 5 Mc/s. Excellent condition. £55 each. Carr. 20/-.

CLASS D WAVEMETERS



A crystal controlled heterodyne frequency meter covering 1·7–8 Mc/s. Operation on 6 volts D.C. Ideal for amateur use. Available in good used condition. £5.19.6. Carr. 7/6. Or brand new with accessories. £7.19.6. Carr. 7/6.

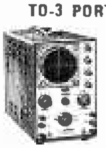
CLASS D WAVEMETERS No. 2

Crystal controlled. 1·2–19 Mc/s. Mains or 12V. D.C. operation. Complete with calibration charts. Excellent condition. £12.10.0. Carr. 30/-.

SOLARTRON CD.711S.2 OSCILLOSCOPES

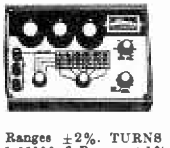
Double beam. D.C. to 9Mc/s. Perfect order. £65. Carr. 50/-.

TO-3 PORTABLE OSCILLOSCOPE



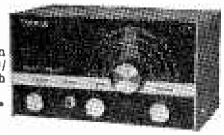
3in. tube. Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps–1·5 MHz. Input imp. 2 meg Ω 25pF. X amp. sensitivity 0·9v p-p/CM. Bandwidth 1·5 cps –800KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps–300 KHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½ lb. 220/240V. A.C. Supplied brand new with handbook. £35.0.0. Carr. 10/-

TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE



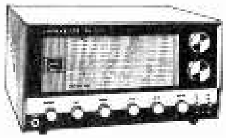
A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω–11·1 meg Ω 6 Ranges ±1%. L.1 μ H – 111 HENRYS 6 Ranges –2%. C. 10pF ±1110mFd. 6 Ranges ±2%. TURNS RATIO 1:1/1000–1:11100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case. Size 7¾ × 5 × 2in. £20. P. & P. 5/-.

UNR-30 4-BAND COMMUNICATION RECEIVER



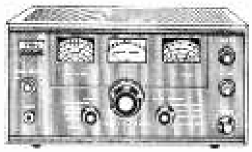
Covering 550 Kc/s–30 Mc/s. Incorporates BFO. Built in speaker and phone jack. Metal cabinet. Operation 220/240V. A.C. Supplied brand new, guaranteed with instructions. Carr. 7/6 **13 gns.**

LAFAYETTE SOLID STATE HA600 RECEIVER



5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE 150 Kc/s–400 Kc/s and 550 Kc/s–30 Mc/s F E T front end ● 2 mechanical filters ● Huge dial ● Product detector ● Variable BFO ● Noise limiter ● S meter ● 24in Bandspread ● 230V. A.C./12V. D.C. neg. earth operation ● RF gain control. Size 15in. × 9½in. × 8¼in. Weight 18 lbs. EXCEPTIONAL VALUE. £45. Carr. 10/-. S.A.E. for full details.

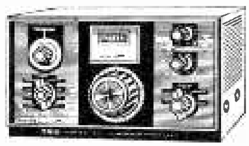
TRIO COMMUNICATION RECEIVER MODEL 9R-59DE



4 band receiver covering 550 Kc/s to 30 Mc/s continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit, 4/8 ohm output and phone jack. SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. bandspread dial ● IF 455 Kc/s ● Audio output 1·5 W. ● Variable RF and AF gain controls. 115/250V. A.C. Mains. Beautifully designed. Size: 7 × 15 × 10in. With instruction manual and service data. £42.10.0. carriage paid. **TRIO COMMUNICATION TYPE HEADPHONES.** Normally £5.19.6. OUR PRICE £3.15.0 if purchased with above receiver.

TRIO JR-500SE 10-80 Metre AMATEUR RECEIVER

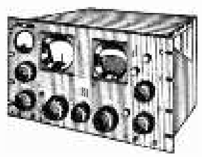
TRIO TS 510 AMATEUR TRANSCEIVER with speaker and mains P.S.U. £212. IN STOCK!



Covers all the amateur bands in 7 separate ranges between 3·5 and 29·7 Mc/s, 7 valves, 2 transistors and 5 diodes plus 8 crystals: output 8 and 500 ohm and 5,000 ohm phone jack. Crystal controlled oscillator. Variable BFO. VFO. AVC. ANL. S meter, SSB-CW. Stand-by switch. Special double gear dial drive with direct reading down to 1 kHz. Remote control socket for connection to a transmitter. Audio output 1 watt. 115/250v. A.C. mains. Superb modern styling. Size 7 × 13 × 10in. with instruction manual and service data. £69.10.0. Carr. Paid.

SPECIAL BONUS OFFER! TRIO SP5D Matching Speaker Mate and TRIO HS4 Communication Headphones. Normal Value £10.7.0. FREE OF CHARGE with every JR.500SE purchased.

HAMMARLUND SP600JX COMMUNICATION RECEIVER

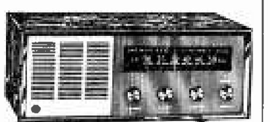


High quality professional dual conversion communication receivers available for the first time in this country at a reasonable price. Frequency range 540 Kc/s–54 Mc/s. in 6 bands variable tuning or 6 channel crystal controlled. 2·5 watt output into 600 ohms. Input 110/230V. A.C. 20 valve circuit incorporating: Xtal filter B.F.O. A.N.L. Xtal calibrator, S meter etc. Size 19 × 12 × 22in. (List £520). Offered in excellent condition, fully tested and checked. £100 each.

RCA COMMUNICATIONS RECEIVERS AR88D

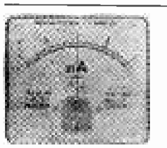
Latest release by ministry BRAND NEW in original cases. 110-250v. A.C. operation. Frequency in 6 Bands. 535 Kc/s—32 Mc/s continuous. Output impedance 2·5-600 ohms. Incorporating crystal filter, noise limiter, variable BFO, variable selectivity, etc. Price £87.10.0. Carr. £2.

LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER



A completely new transistorised receiver covering 152–174 Mc/s. Fully tunable or crystal controlled (not supplied) for fixed frequency operation. Incorporates 4 INTEGRATED CIRCUITS. Built in speaker and illuminated dial. Squelch and volume controls. Tape recorder output. 75Ω aerial input. Headphone jack. Operation 230V. A.C./12V. D.C. Neg. earth. £37.10.0. Carr. 10/-.

CLEAR PLASTIC PANEL METERS



First grade quality Moving Coil panel meters. Type MR 38P. $1^{31}/_{32}$in. square fronts.

50μA 40/-
50-0-50μA 37/6
100μA 37/6
100-0-100μA 35/-
200μA 35/-
500μA 40/-

500-0-500μA 27/6
1mA 27/6
1-0-1mA 27/6
2mA 27/6
5mA 27/6
10mA 27/6
750mA 27/6
1 amp 27/6
2 amp 27/6
5 amp 27/6
20mA 27/6

50mA 27/6
100mA 27/6
150mA 27/6
200mA 27/6
300mA 27/6
500mA 27/6
3V. D.C. 27/6
10V. D.C. ... 27/6
20V. D.C. ... 27/6
100V. D.C. .. 27/6

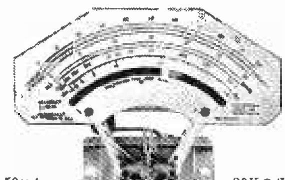
150V. D.C. .. 27/6
300V. D.C. .. 27/6
500V. D.C. .. 27/6
750V. D.C. .. 27/6
15V. A.C. ... 27/6
50V. A.C. ... 27/6
150V. A.C. . 27/6
300V. A.C. . 27/6
500V. A.C. . 27/6
S meter 1mA 32/-
VU meter .. 42/-

FULL RANGE OF OTHER SIZES IN STOCK. SEND S.A.E. FOR LEAFLET

POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range ex-stock. Single hole fixing, ¼in. dia. shafts. Bulk quantities available.
25 WATT. 10/25/50/100/250/500/1,000/1,500/2,500 or 5,000 ohms. 14/6. P. & P. 1/6
50 WATT. 10/25/50/100/250/500/1,000/2,500 or 5,000 ohms, 21/-. P. & P. 1/6.
100 WATT. 1/5/10/25/50/100/250/500/1,000 or 2,500 ohms, 27/6. P. & P. 1/6.

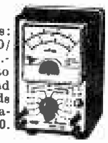
AVOMETER MOVEMENTS



50μA 20KΩ/V

Spare movements for Model 8 or 9. (Fitted with Model 9 scale) or basis for any multimeter. Brand New & Boxed. 69/6. P. & P. 3/6

TE-40 HIGH SENSITIVITY A.C. VOLTMETER

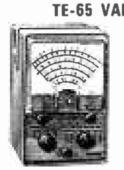


10 meg. input 10 ranges: ·01/·003/·1/·3/1/3/10/30/100/300V. R.N.S. 4cps.-1·2 Mc/s. Decibels –40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. £17.10.0. Carr. 5/-.

LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

Frequency 0–20 Kc/s. on 2 ranges. Output 500Ω or 5kΩ. Operation 200/250V. A.C. Supplied in perfect order. £12.10.0. Carr. 10/-.

TE-65 VALVE VOLTMETER



High quality instrument with 28 ranges. D.C. volts 1·5—1,500v. A.C. volts 1·5—1,500v. Resistance up to 1,000 megohms. 200/240v. A.C. operation. Complete with probe and instructions. £17.10.0. P. & P. 6/-. Additional probes available: R.F. 35/-. H.V. 42/6.

COSSER 1049 DOUBLE BEAM OSCILLOSCOPES

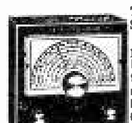
D.C. coupled. Band width 1Kc/s. Perfect order. £25. Carr. 30/-.

AM/FM SIGNAL GENERATORS

Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20-80 Mc/s. AM CW/FM. Incorporates precision dial, level meter, precision attenuator 1μV–100mV. Operation from 12 volt D.C. or 0/110/200/250 volt A.C. Size 12 × 8½ × 9in. Supplied in brand new condition complete with all connectors fully tested. £45. Carr. 20/-.

GEARED MAINS MOTORS

Parालux type SD19 230/250V. A.C. Reversible. 30 r.p.m. 40 lb./ins. Complete with capacitor. Excellent condition. 99/6. Carr. 10/-.



TE-16A Transistorised Signal Generator. 5 ranges 400kHz–30mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide easy to read scale. 800kHz modulation. 5¼ × 5¼ × 3½in. Complete with instructions and leads. £7.19.6. P. & P. 4/-.

FIELD TELEPHONES TYPE L

Generator ringing, metal cases. Operates from two 1·5V batteries (not supplied). Excellent condition. £4.10.0 per pair. Carr. 10/-.

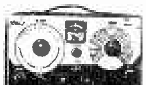
AUTO TRANSFORMERS

0/115/230V. Step up or step down. Fully shrouded.

150 W.	£1.12.6.	P. & P. 3/6.
300 W.	£2. 7.6.	P. & P. 4/6.
500 W.	£4.10.0.	P. & P. 6/6.
1,000 W.	£5.10.0.	P. & P. 7/6.
1,500 W.	£7.19.6.	P. & P. 8/6.
7,500 W.	£15.10.0.	P. & P. 20/-.

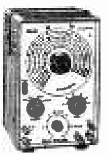
G. W. SMITH & CO (RADIO) LTD.
Also see oppos. page

ARF-100 COMBINED AF-RD SIGNAL GENERATOR



A.F. SINE WAVE 20-200,000 c/s. Square wave 20-30,000 c/s. O/P. HIGH IMP. 21V. P/P600Ω 3·8V. P/P. TF 100 Kc/s-300 Mc/s. Variable R.F. attenuation int/ext. modulation. Incorporates dual purpose meter to monitor AF output and % mod. on R.F. 220/240V. A.C **£30.0.0.** Carr. 7/6.

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. 7/6. Size 140 × 215 × 170 mm.

PEAK-SOUND PRODUCTS. Full range of Amplifiers, Kits, Speakers in stock.

TY75 AUDIO SIGNAL GENERATOR

Sine Wave 20c/s to 200 kc/s. Square Wave 20c/s to 30kc/s. High and low impedance output. Output variable up to 6 volts. 220/240 volts A.C. Size 210 × 150 × 120 mm. Brand new with instructions. **£16.** Carr. 7/6.

MARCONI TF142E DISTORTION FACTOR METERS. Excellent condition. Fully tested. **£20.** Carr. 15/-.

LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYSER

2 pF-2000 mFd 2 ohms 200 megohms. Also checks impedance, turns ratio, insulation, 200/250V. A.C. **Brand New £17.10.0** Carr. 7/6.

MODEL ZQM TRANSISTOR CHECKER

It has the fullest capacity for checking on A, B and Ico. Equally adaptable for checking diodes, etc. Spec.: A: 0·7-0·9967. B: 5-200. Ico: 0-50 microamps 0-5mA. Resistance for diode 200Ω-1MΩ. Supplied complete with instructions, battery and lead. **£5.19.6.** P. & P. 2/6

ADVANCE TEST EQUIPMENT

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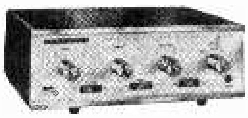

19 transistors, 8 diodes, IHF music power, 30W at 8Ω. Response 30-20,000 ± 2dB at 1W. Distortion 1% or less. Inputs 3mV and 250mV. Output 3-16Ω. Separate L and R. volume controls. Treble and bass control. Stereo phone jack. Brushed aluminium, gold anodised extruded front panel with complementary metal case. Size 10½ × 3 9/16 × 7 13/16in. Operation 115/230V. A.C. **£28.** Carriage 7/6.

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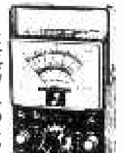

MODEL AS-100D. 100K Ω/VOLT. 5in. mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1,200v DC 0/6/30/120/300/600v AC. 0/10μA/6/60/300 mA/12 amp. 0/2K/200K/2M/200MΩ. -20 to +17dB. **£12.10.0.** P. & P. 3/6.

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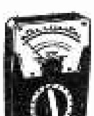

MODEL TE-90 50,000 OPV mirror scale overload protection 0/3/12/60/300/600/1200 v. DC. 0/6/30/120/300/1200v. DC. ·03/6/60/600mA. DC. 16K/160K/1·6/16meg Ω. -20 to +63dB. **£7.10.0.** P. & P. 3/-.

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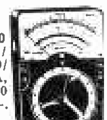
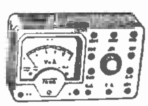


MODEL TE-80. 20,000 O.P.V. 0/10/50/100/500/1,000v A C 0/5/25/50/250/500/1,000v D C. 0-50μA, 5/50/500mA. 0/6K/60K/600K/6meg. **£4.17.6.** P. & P. 3/-.



MODEL PT-34. 1,000 OPV. 0/10/50/250/500/1,000v AC and DC. 0/1/100/500mA DC. 0/100KΩ. **39/6.** P. & P. 1/6.

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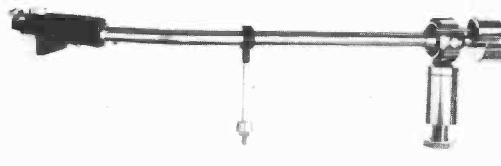
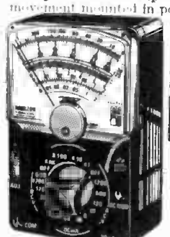
BRIEF DETAILS OF AD-76K. Magnetic cartridges: High compliance with stereo diamond LP stylus/ Output 5mV, frequency response: 20–20KHz, tracking weight 2 grammes.



LASKY'S PRICE £9.19.6 Post 5/-

TMK METER KITS ANOTHER LASKY'S EXCLUSIVE

These two meter kits by TMK offer both the professional, electronics hobbyist and student the unique opportunity of building a really first-class precision multimeter at a worthwhile saving in cost. The impact resistant bakelite cabinets are supplied with the meter scale and movement mounted in position; the model 200 also has the rotary range selector in position. The highest quality components and 1% tolerance resistors are used throughout Both offer professional standards of accuracy. Supplied complete in every detail with full constructional, circuit and operating instructions.



MODEL 200

20,000 O.P.V. Multimeter. Features 24 measurement ranges with mirror scale. Large 3 x 2in. meter. Full scale accuracy: DCV and current: ±2%, ACV: ± 3%, resistance ±3%. Special 0·6V DC range for transistor circuit measurements.

SPECIFICATION ● DCV: 0-0·6-6-30-120-600-1200V at 20K/OPV. ● ACV: 0-6-30-120-600-1200V at 10K/OPV. ● DC Current: 0-0·06-6-60-600mA. ● Resistance: 0-10K-100K-1M-10M ohms (58-580-5·8K-58K at mid-scale). ● Capacitance: 0·002-0·2uF (AC 6V range). ● Decibels –20 to +63dB. ● Output: 0·05uF blocking capacitor. Uses two 1·5V (U.7 type) batteries. Black bakelite cabinet—Size 5½ x 3⅞ x 1⅜in. Complete with test leads.

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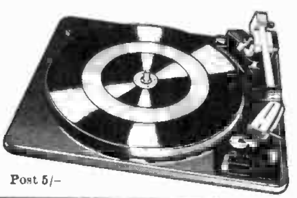
Garrard

SP25 MkII



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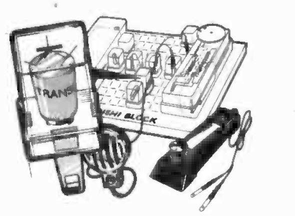

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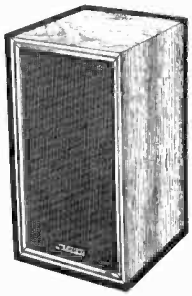

Another high quality sub-miniature bookshelf system from Foster. The "Criterion" Mk II is a sealed infinite baffle type enclosure using 5¼in. bass/mid range woofer with rolled cloth edge and a 2¼in. HF cone type tweeter. The compact cabinet is constructed of ½in. laminate with handsome oiled walnut veneer finish and black woven acoustic gauze front panel with satin chrome edge insert. SPEC: Frequency range 90–20,000Hz. Power handling 10 watts. Impedence 8 ohms. HF crossover. Screw tag connections at rear. Size 12½ x 7¾ x 6¾in. The performance of the "Criterion" is superior to many larger and more expensive units and at Lasky's exclusive price offers absolutely unbeatable value.

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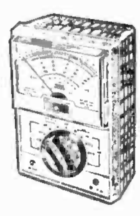
TTC MODEL C-1000



A really tiny 1,000 O.P.V. pocket multi-tester with "big" meter performance. Precision 2 jewel meter movement. Hand calibrated to ±3% accuracy on full scale of DC ranges, 4% on AC ranges. 2¼in. square meter. SPECIFICATIONS AC/V ranges: 0–10, 50, 250, 100V at 1K/O.P.V. DC currents: 0–1–100mA. Resistance: 0–150K/ohms (3,000 ohms centre scale). Decibels: −10 to +22dB. Operated on one penlight cell. Two colour buff/green case—size only 3½ x 2½ x 1in. Click stop range selection switch. Ohms zero adjustment. Complete with test leads, battery and instructions with circuit data.

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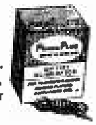

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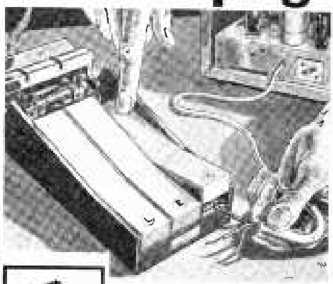

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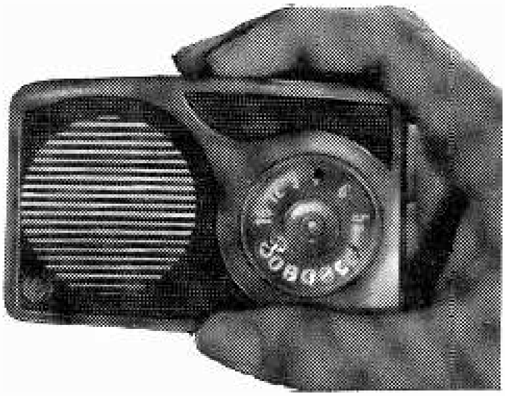

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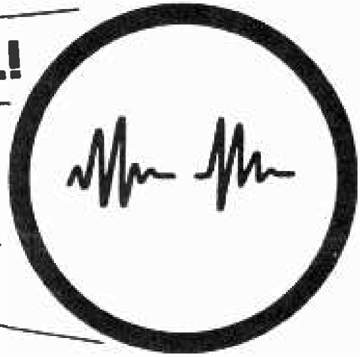

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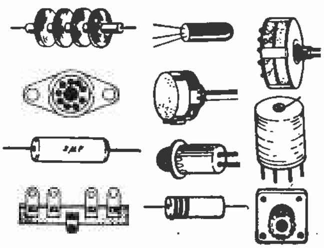

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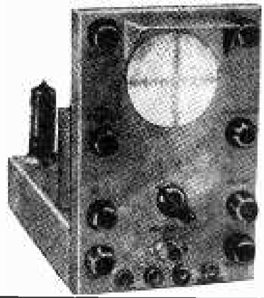

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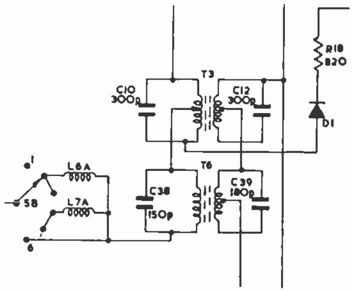

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PRACTICAL WIRELESS

VOL 45 No 7

Issue 753

NOVEMBER 1969

TOPIC OF THE MONTH

Fair Comment

FOR the manufacturer and retailer, audio is now very big business—and the build-up has by no means yet reached its peak. This is a good thing for several reasons. Apart from the smaller, specialised, hi-fi companies the big boys have jumped on the band-wagon with budget schemes of audio separates. These are attractive propositions to the purchaser with more limited means and most of those that we have heard make very acceptable listening. Not, perhaps, always true hi-fi but a definite giant step from the often awful radiograms and other instruments of torture long accepted by the public as music reproducers.

The optimists amongst us are really beginning to believe that the man in the street is at last learning to realise that audio (be it from tape, radio or record sound sources) can be so much more enjoyable when played through decent equipment. And with all this new gear, the emphasis in the tuners is on f.m. reception and stereo at that. Loud applause from all the P.W. staff, who marvel why any listener without cloth ears can still listen to low-fi a.m. when f.m. offers such incomparable improvement.

And on the home constructor front, a keen interest is being maintained in audio projects and shows no sign of abating. This, and the activity on the commercial side, are complementary factors. The sheer quantity of audio merchandise on the market, not to mention the number of technical innovations and ideas, serves to whet the appetites of the home constructors and experimenters for constructional and theoretical reading matter on the subject.

This is one reason why *Practical Wireless* and *Practical Electronics* will be sharing a demonstration booth at the Audio Fair this month—their first participation in the event—to display and demonstrate some of the audio projects now part and parcel of the coverage of the two journals. We hope as many readers as possible will get along and look us up on stand 73 on the ground floor. For those unable to visit the Fair, perhaps the special supplement in this issue will be some consolation.

W. N. STEVENS—*Editor.*

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

DECEMBER ISSUE WILL BE PUBLISHED ON NOVEMBER 7th

NEWS AND COMMENT...

FREE RADIO AND MORE FOR TELEVISION

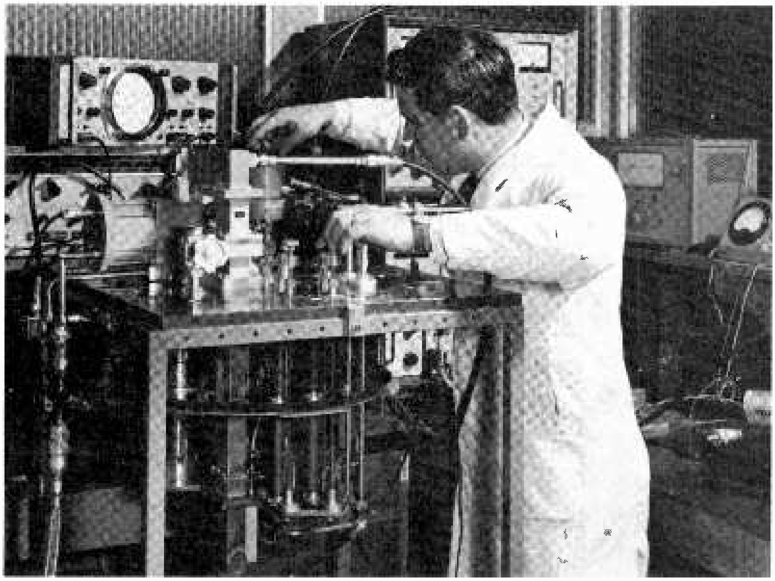
No, not pirate stations—but the abolition of the radio licence. On 1st April, 1970, the combined radio/TV licence will go up 10s to £6 10s. Also on this date, the 25s. separate sound and car radio licence will go.

Announcing these changes recently, Mr. Stonehouse, the PMG, said that the increased revenue of £5,600,000 would finance a general service of local revenue by the BBC.

A further £3,500,000 would be gained from licence evaders as a result of intensified measures against them. This would make a total of £9,100,000 extra revenue.

Mr. Stonehouse pointed out that abolition of the sound radio licence would benefit many elderly people. He said that the fee involved in collecting licence revenue was quite expensive—being 4s. 10d. per licence—this would be the same for the combined fee.

Goonhilly I uses Mullard Parametric Amplifiers



Goonhilly I station, inaugurated recently by the PMG John Stonehouse uses Mullard parametric amplifiers to boost the low power of 10-12W signals received from Japan and Australia via the new Intesat III communications satellite. This new link (over the Indian Ocean) provides for direct TV communication with Japan and it is planned to cover "Expo 1970" the international exposition whose site in the hills above Osaka is being completed for the opening next year.

Goonhilly I was used to receive Apollo 11 TV pictures bounced off satellites positioned above the Indian and Pacific oceans.

The only other device that could be used in the same role as the parametric amplifier is the maser but this has the disadvantage that it always needs to be cooled. Although the Goonhilly parametric amplifiers are cooled it is possible for them to operate at room temperature. The maser used in Goonhilly II uses a pumped liquid helium cooling system to keep it at a temperature of 1·4°K giving a "noise" temperature of 10°K. The parametric amplifier cooled with liquid helium to 4·2°K has a noise temperature of 20°K.

The parametric amplifier also has the advantage that it can handle a bandwidth of 500MHz and the maser can only handle 50MHz. This makes possible the reception and transmission simultaneously of TV programmes and hundreds of telephone channels.

The picture shows a development engineer at Mullards, Mitcham, checking one of the parametric amplifiers prior to installation at Goonhilly.

The Litegard

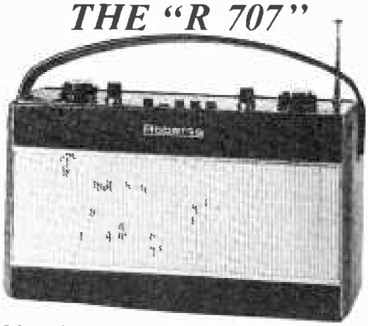
Soldering irons, like some predatory animal, have a nasty habit of leaping at you as soon as you move at your workbench. If you have, like some members of the P.W. staff, burnt hands, ruined shirts and scorched ties, the Litegard soldering iron stand is almost an essential.

Designed for virtually all soldering irons up to 35W, the Litegard incorporates a bit cleaning pad and screw holes for bench mounting. It retails at 25s. *Light Soldering Developments Ltd., 28 Sydenham Road, Croydon, CR9 2LL.*

ONE TO LISTEN FOR

GB3MAN, 28th September-5th October 1969. From the City of Manchester during Fresher's Week at the University of Manchester Institute of Science and Technology. It's intended to give novices an insight into the working of Amateur radio and the station is being operated by members of the UMIST Amateur Radio Society. Transmission is on all bands 10-160m running a.m./c.w./s.s.b./RTTY. Details and QSLs from T. F. C. Davis, G3YMM, Hon. Sec., Amateur Radio Society, Students' Union, UMIST, Sackville Street, Manchester 1.

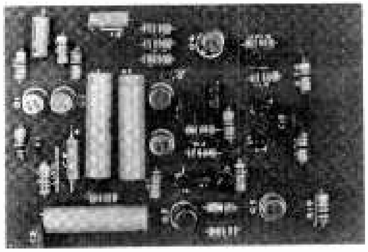
THE "R 707"



New from Roberts' Radio Co. Ltd., comes the model R 707 which incorporates v.h.f., medium, long and short wavebands. Twelve transistors and 7 diodes are used in the design and an i.f. amplifier module employing combined 10·7MHz and 470kHz is used. The a.f. amplifier has a transformerless output and power output is approximately 1·5W. Short waves covered are 41 and 49m bands. Price including batteries and PT is £34 10s. *Roberts Radio Co. Ltd., Molesey Avenue, West Molesey, Surrey.*

NEWS AND COMMENT...

MAINLINE MARKETS



An assembled amplifier

A new company, Mainline Electronics Ltd., has been formed specifically to give the amateur enthusiast the price and other advantages enjoyed by industrial and professional component buyers. The company is a subsidiary of Electronic Component Supplies (Windsor) Ltd. which was established in 1965 and now represents 12 of the leading electronic component manufacturers.

In addition to components, Mainline are introducing kits, starting off with a series of hi-fi amplifiers. Three basic types are available, in 12W, 25W and 70W r.m.s. versions, all universal quasi-complementary-symmetry amplifiers using the same assembly board (see picture) providing full power to beyond 20kHz. The kits are the result of joint research and development by RCA and SGS (UK) Ltd. Basic performance figures (of the Mainline 12) are 12W r.m.s. output, hum and noise 75dB input shorted, sensitivity 500mV at 20kΩ, intermodulation distortion (60Hz and 70kHz, 10dB below continuous power output) 0·2%.

The prices of the kits are £7, £8 5s., and £10 10s. which include all transistors, resistors, capacitors, heatsink, printed circuit board and full instructions for assembly. For those wishing to buy the transistor packs only, these are available at £5 3s., £6 2s. 6d. and £8 6s. 8d. respectively. Further kits are to be introduced, including suitable pre-amplifiers for the Mainline amplifiers, by the end of the year.

Detailed price lists and descriptive literature on the amplifiers is available from *Mainline Electronics Ltd., Thames Avenue, Windsor, Berks.* Also available, at 4s. post paid, is a catalogue containing full details of the numerous components available from the company.

WANSTEAD AND WOODFORD RADIO SOCIETY

Are any readers interested in re-establishing the Wanstead and Woodford Radio Society and helping it again to be active in forwarding the hobby of radio and electronics in London, E.11 and E.18? If so, please contact Ken Smith, G3JIX, at 82 Granville Road, Walthamstow, London, E.17 or at the Electronics Laboratory, The University, Canterbury, Kent.

HOME RADIO CREDIT ACCOUNT

Mr. A. Sproxton, Director of Home Radio (Components) Ltd., has announced a new scheme to help home constructors.

In a letter to P.W. he says: "It has often occurred to us that the serious experimenter must sometimes suffer frustrations at the time taken to obtain a certain component. Supposing he is working on a project Sunday afternoon and finds he needs a certain item; even if he has a cheque book, envelope and stamp to hand, his suppliers would not receive his order until Tuesday and the customer would not receive his item until Thursday or Friday.

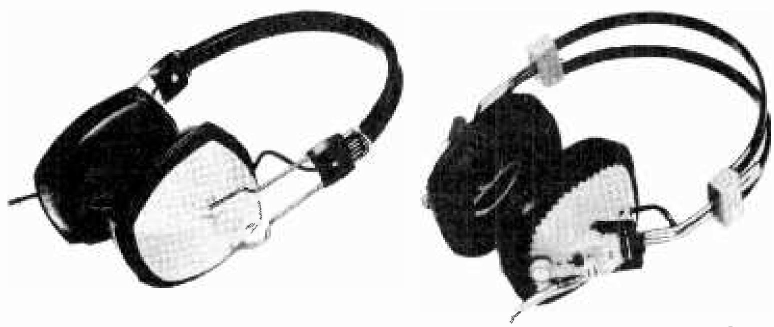
"If he could 'phone his requirements, how much easier and quicker the transaction would be. We would like to give customers this facility but it would be necessary to offer a credit account and the problem arises as to how this can be done without the tedious and often unreliable method of taking up references.

"After much thought we came up with this solution—the Credit Deposit Account. This offers to customers the facility for starting a credit account and at the same time protects us against incurring too great a loss through bad debts.

"This scheme of course is only offered to customers using our catalogue and we have a telephone answering machine for customers wishing to place orders outside business hours."

How it works is simple: the customer decides what monthly credit he requires to the nearest £10. He then fills in a simple form and sends it to Home Radio with his deposit (which is half the amount of credit he requires). For example, if he requires credit of £10, he sends Home Radio £5 deposit. He may then receive goods up to the value of three-quarters of the credit he has selected. This three-quarters only applies to the first month's buying—after this he may purchase goods to the full amount of his selected credit. Further details from *Home Radio (Components) Ltd., 234-240 London Road, Mitcham, Surrey, CR4 3HD.*

EAGLE STEREO HEADPHONES



Added to the Eagle range of stereo headphones are two new models—SE.5 and SE.30.

Model SE.5 is a budget model, retailing at 59s. 6d. The SE.30 (£7 7s.) is the more sophisticated of the units, incorporating a stereo/mono slider switch which eliminates any possibility of phase distortion when listening to a mono signal through stereo equipment. Leather ear-cushions make the SE.30 comfortable to wear even over long periods. Eagle products are available from retail radio stores.

A Pedal Steel Guitar

Part 1

F.C. JUDD

THE popularity of "Country and Western" style music has brought about a new kind of electrical musical instrument which stems from the Hawaiian steel guitar and which has become generally known as the "pedal steel guitar". The basic playing technique is similar to that of the Hawaiian guitar, i.e., the notes are selected with a "steel" and the strings are sounded with finger picks but here the similarity really ends.

The modern pedal guitar allows the production and rapid playing of full chords of the major, minor, diminished seventh, major sixth, minor sixth and minor seventh etc. etc. without complicated manipulation of the steel, in fact without the aid of the pedal controlled tuning system, rapid playing in chords of this calibre would be difficult, to say the least. The pedal steel guitar can be tuned in a number of different ways but the various combinations are far too numerous to deal with in these articles which are concerned with the construction of an otherwise very expensive musical instrument and not how to play it. Those who contemplate building such an instrument and then learn to play it are advised to have proper tuition because it is not an instrument that can be easily "played by ear". However, for the purpose of understanding the musical function of the pedal steel guitar a basic tuning is given for the instrument described in these articles. This is an 8 string E6th tuning which, with the aid of two pedals, will allow the playing of full major, minor, diminished 7th, major 6th, minor 6th and minor 7th chords without slanting or other difficult manipulation of the steel, i.e., such chords can be produced with what is called "straight steel" which means that the steel is across the strings and at right angles to them as in Fig. 1.

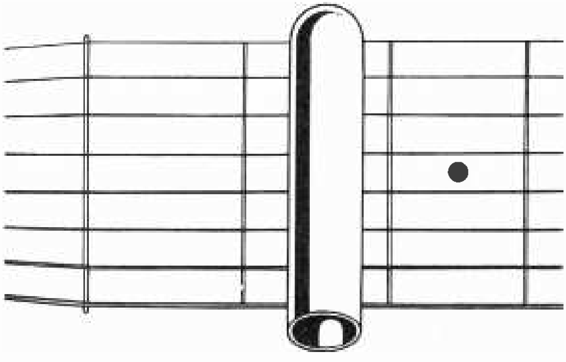


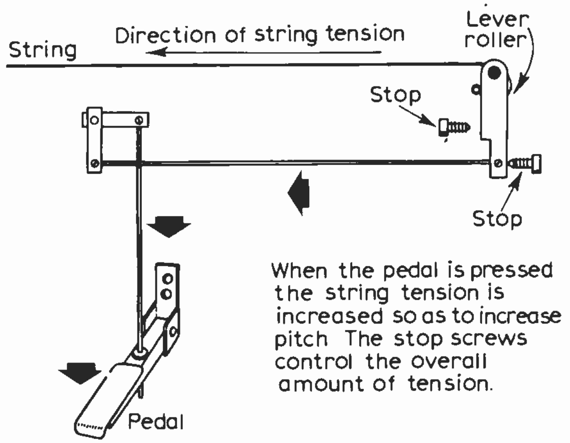
Fig. 1: As explained in the text; many different chords can be played with a straight steel, i.e., without slanting.

Readers with a knowledge of music and especially of either the plectrum guitar or Hawaiian steel guitar will of course realise that more than 8 strings and 2 pedals could be used. Some commercially available single neck models have 8 or 12 strings and up to 4 pedals whilst twin neck instruments may employ as many as 8 pedals divided between 8 or 12 strings per neck, hence the earlier comment about the many possible tuning and tuning change combinations. Incidentally the cost of a commercially made pedal steel guitar ranges from around £250 to £350. The instrument described here should not involve a total outlay of more than about £30. It is however only fair to point out that a very considerable amount of "mechanical" construction is called for and which must be quite accurate if the finished instrument is to play correctly and in perfect pitch at all fret positions. *None of the "mechanical" parts, except the machine head tuning pegs, can be purchased ready made*. The special fret board and the 8 string magnetic pick-up are however both available (details later).

Eight Strings—Two Pedals

The pedal guitar shown on the cover and described in this article could of course be modified for additional pedals by duplicating the pedal controlled string tension or release tension arrangements shown in Figs. 2 and 3 respectively. Otherwise the design featured here employs 8 strings for an E6/7th tuning with the pedals operating on strings 2 and 4. With the E6/7th tuning as shown in Fig. 4 it will be seen that string 2 is tuned to C sharp which is the 6th note of the scale of E major. This string can be raised a half-tone by a pedal so as to become D natural which is the diminished 7th of the scale of E. With no extra tension on string 2, i.e., with the pedal off, strings 1, 2, 3 and 4 together produce a chord of E6. When the pedal is pressed the pitch of string 2 is raised by a half-tone and strings 1, 2, 3 and 4 together will produce a chord of E diminished 7th or E7th.

To produce minor chords, string 4, which is G sharp and the third note of the scale of E, must be lowered in pitch to G natural so that it now becomes the minor 3rd



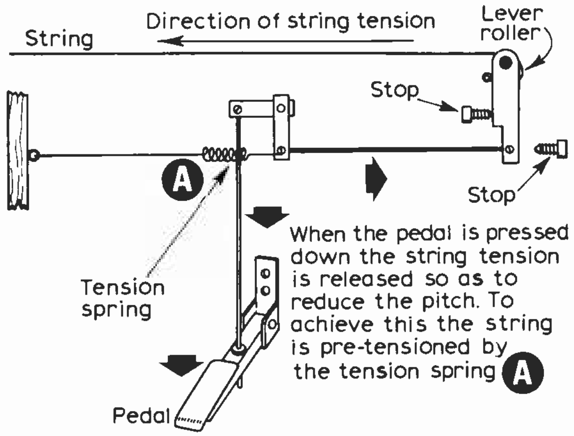
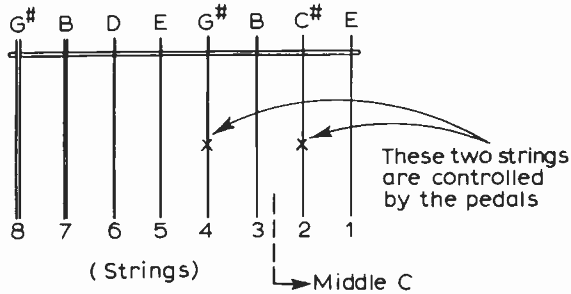
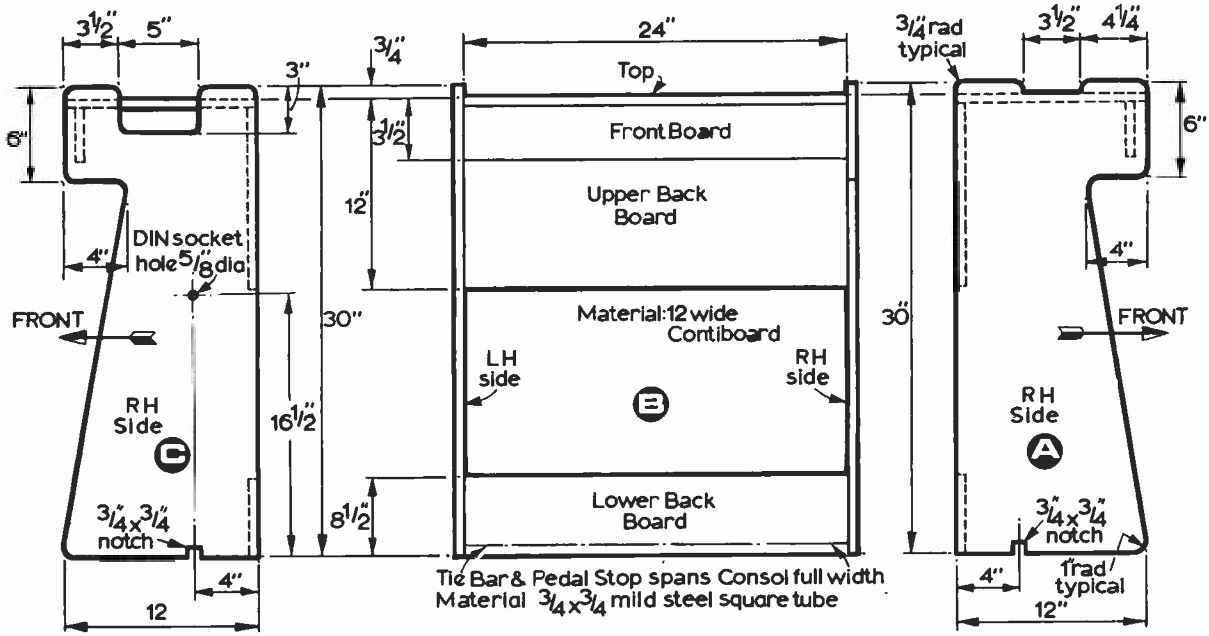


Fig. 2 (above): Pedal mechanism for tensioning a string, i.e., to raise the pitch by a tone or semitone.

Fig. 3 (top right): Pedal mechanism for de-tensioning a string, i.e., to reduce the pitch by a tone or semitone.

Fig. 4 (right): Tuning for the pedal guitar described in this article and for use with pedal control on strings 2 and 4 as shown.





Figs. 5A/B/C: Details for constructing the pedal steel guitar console. Note the different depths of the cutaways at the top of the left and right hand sides. The sections A, B and C are fitted together as in Fig. 6. Section A is the ***left-hand side*** *and not as indicated on drawing.*

of the scale of E. This string is pre-tensioned by means of a spring as shown in Fig. 4 so that it can be de-tensioned when the pedal is pressed. When this is done the chord of E minor can be obtained with strings 3, 4 and 5 or 1, 3 and 4. By playing strings 1, 2, 3 and 4 a chord of E minor 6th will be produced. If the other pedal is simultaneously pressed then strings 1, 2, 3 and 4 will produce a chord of E minor 7th. The remaining strings, 5, 6, 7 and 8, when played together will produce the chord of E7. If string 6 is not played then the chord produced by 5, 6 and 7 will of course be E major. As pointed out earlier the combinations of tuning and chord patterns obtainable with multiple stringed pedal guitars of this nature are almost endless so here all further reference to the musical possibilities must stop and we will go on to the actual construction.

Console Construction

Like the commercially available pedal guitars this is a small console type instrument which allows the player to be seated. The console itself, as shown in the photographs, was constructed from Contiboard and if the dimensions given are adhered to then standard 12 inch wide ¾ inch thick Contiboard can be used. This is supplied in cut lengths and two 6 foot lengths will make the entire console to the dimensions given in Fig. 5. The guitar itself is fitted to the top of the console as shown by the outline in Fig. 5D. Note also the cut-out on the top panel which is for the guitar preamplifier.

Although both sides of the console have the same overall dimensions please note that the right hand side has a wider and deeper cutaway at the top which extends below the level of the console top panel to allow the pedal rods to go through. This side also carries the DIN output socket to take the signals from the built-in preamplifier to a suitable external power amplifier. The complete console assembly is shown in Fig. 6. All the sections should be screwed together to provide a good solid structure and when the console is completed the wood, if it is Contiboard, should be sanded down and given two or three coats of Contipol varnish for a high gloss finish.

The Guitar Body

Next comes the woodwork for the guitar itself, the dimensions for this being shown in Fig. 7. The wood for this must be absolutely straight, completely free of any warping and 30¾ inches long, 3⅛ inches wide and 1 inch

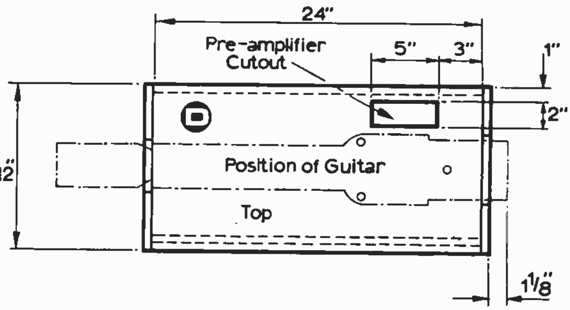


Fig. 5D (top right): Position of the pedal guitar and pre-amplifier on the console.

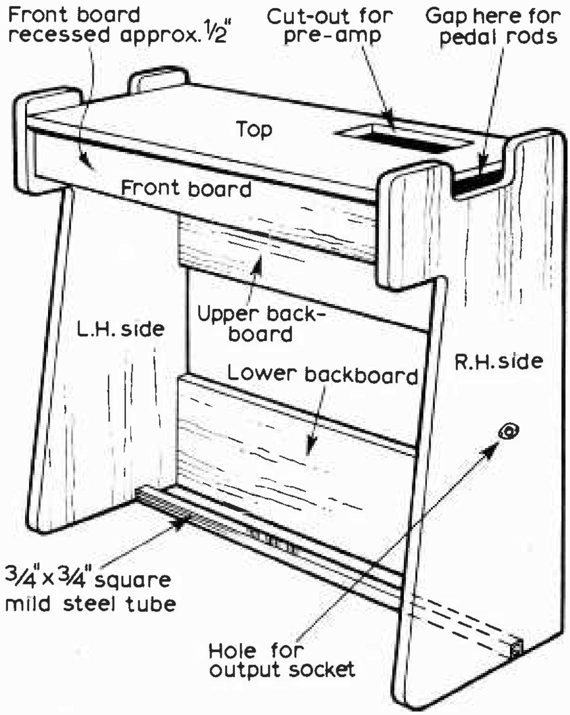
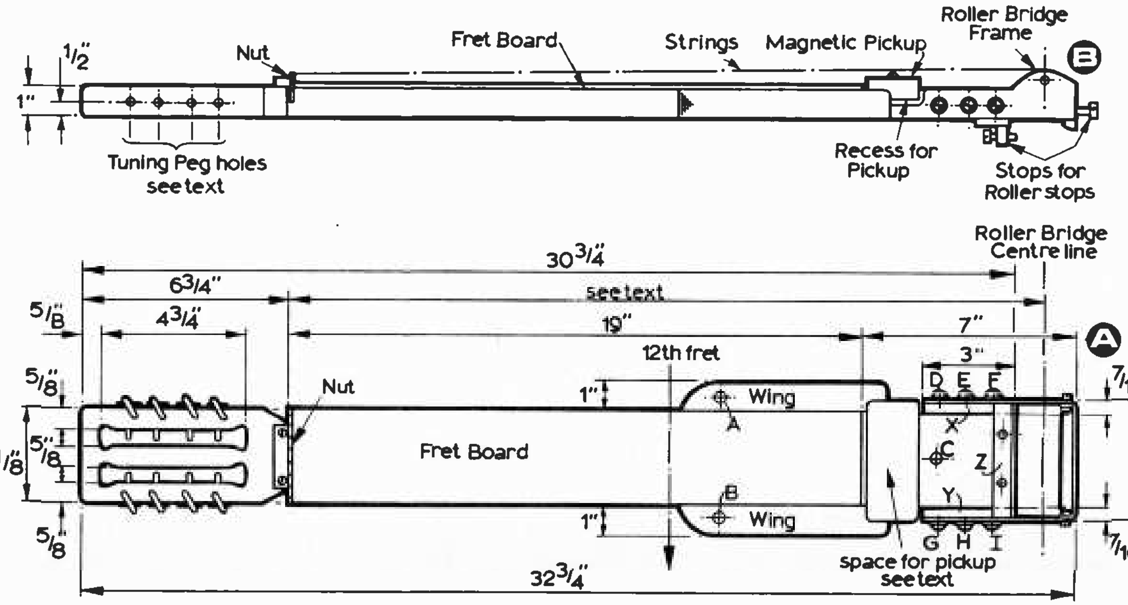


Fig. 6 (right): The assembly of the console. Note the tie bar at the bottom which also serves as the pedal stop.



Figs. 7A/B (below): Details for constructing the guitar body including the positions of the peg heads, nut, fretboard, magnetic pick-up and roller bridge assembly.

COMPONENTS AND MATERIALS

Parts 1 and 2—The Console and Guitar

Console:

Contiboard—12ft. (2 × 6ft. cut lengths) 12in. × $\frac{3}{4}$in.
Mild steel square tube—$\frac{3}{4}$in. × $\frac{3}{4}$in. × 25in. (pedal stop rail)

Quantity c/s woodscrews—1$\frac{1}{2}$in. × size 5 or 6

Contipol varnish as required

Guitar and Pedal Mechanism:

Hardwood (mahogany)—30$\frac{3}{4}$in. × 3$\frac{1}{8}$in. × 1in. (guitar body)
Hardwood—2ft. × 1in. × 1in. (wing pieces and tail)

Mild steel—$\frac{1}{16}$in. thick (piece 12in. × 6in. should be sufficient for bridge frame and pedal plates etc.)

Aluminium angle—4in. × $\frac{1}{2}$in. × $\frac{1}{2}$in. (tail piece)

Aluminium angle—4in. × $\frac{3}{4}$in. × $\frac{3}{4}$in. (lower stop bar)

Mild steel square tube—12in. × $\frac{1}{2}$in. × $\frac{1}{2}$in. (pedals)

Dome head screws (with chromed dome caps) 1in. long × size 7 or 8 (6 off)

Dome head screws 1$\frac{1}{2}$in. long × size 7 or 8 (3 off)

2BA Allen screws 1in. long (12 off) (lever stops)

Compression springs $\frac{1}{2}$in. to $\frac{5}{8}$in. long with inside 2BA clear

Brass—$\frac{1}{4}$in. thick (1 piece approx. 12in. × 1$\frac{1}{2}$in. for roller levers and stop screw bars etc.)

Silver steel rod—$\frac{1}{4}$in. dia. 12in. long (roller bridge and foot pedal volume control)

Mild steel rod—$\frac{3}{16}$in. dia. Approx 5ft. (pedal linkage)

Mild steel rod—$\frac{1}{8}$in. dia. Approx 3ft. (lever linkage)

Brass tube—$\frac{3}{8}$in. dia. with $\frac{1}{4}$in. dia. inner bore (roller lever spacers)

Brass tube or rod—$\frac{5}{8}$in. dia. (tube with $\frac{1}{4}$in. dia. inner bore) (rollers)

Tension spring—Approx 2in. long × $\frac{1}{2}$in. dia. with loops

Fret board—24fret 25in. scale 8 string. Cyril Proctor. (see text for address etc.)

Magnetic pick-up—H.G. 8 string. Cyril Proctor. (see text for address etc.)

Machine head tuning pegs—4 LH and 4 RH Cyril Proctor (see text for address etc.)

3-pin DIN socket—(1 off) (preamp output)

Sundry 6BA, 4BA and 2BA screws and nuts as indicated in diagrams

Part 3—The Preamplifier and Footpedal Volume Control

The Footpedal Volume Control:

Contiboard or deal—(see text) cut as per diagrams.
Duraluminium—$\frac{1}{16}$in. thick. Piece approx. 14in. × 7in. (sides and front)
Aluminium angle—20in. × $\frac{1}{2}$in. × $\frac{1}{2}$in. (inside supports)
Aluminium angle—3in. × $\frac{3}{4}$in. × $\frac{3}{4}$in. (foot pedal bearings)
Silver steel rod—$\frac{1}{4}$in. dia. (allowed for in previous list)
Jack socket—standard (1 off)
3-pin DIN socket (1 off)
L.D.R.—type ORP12 (1 off)
6 or 12V lamp (1 off) see text
R9—47kΩ $\frac{1}{4}$W resistor
RL—(see text)
3-pin DIN plugs—(2 off)
Sundry screws, 4BA and 6BA screws and nuts, screened cable etc. as per text

The Preamplifier:

Panel—Aluminium $\frac{1}{16}$in. thick 6in. × 3in. Also aluminium angle $\frac{1}{2}$in × $\frac{1}{2}$in. and approx 5in. long
Assembly board—3$\frac{3}{4}$in. × 2$\frac{3}{4}$in. perforated s.r.b.p.
Control knobs—(2 off) type PK2 (Henrys Radio Limited)
On/Off switch—S.P. toggle type (1 off)

Transistors:

Tr1 and Tr2 BC109

Capacitors:

C1 0·05μF paper	C4 0·02μF paper
C2 100μF elec 12V	C5 100pF mica
C3 0·01μF paper	C6 100μF elec 12V
	C7 2·5μF elec 12V

Resistors:

R1 4·7kΩ	R5 150kΩ
R2 120kΩ	R6 470Ω
R3 1kΩ	R7 1·2kΩ
R4 12kΩ	R8 1·8kΩ

All 10% $\frac{1}{2}$W carbon

Potentiometers:

VR1 4·7kΩ preset
VR2 50kΩ linear
VR3 100kΩ log

Power supply:

Transformer T1	Henrys Radio type as per circuit
Rectifier MR1	Bridge type 1H3
Capacitor C	2500μF 25V wkg

Materials for chassis as suggested in diagrams.

Come and see the **Pedal Steel Guitar** on **Practical Wireless** Stand 73 at the International Audio and Photo-Cine Fairs, Olympia, 16–22nd October, 1969. Opening hours: daily 10 a.m. to 9 p.m. (excluding Sunday, 19th October).
Admission: Adults 4/–; Children 2/–.

thick. The writer eventually obtained a piece of 1 inch thick mahogany for this. Very soft wood should be avoided. The shaping of the machine peg head section is the most tedious part and calls for a little fancy work with files and sandpaper. The section between the "nut" and the recess for the magnetic pick-up is left flat to take the plastic fretboard and only requires a smooth sand-papered surface. The two "wings", each 1 inch wide, serve as decor and to anchor the guitar to the top of the console. Holes are drilled at a, b and c as shown in Fig. 7A. These take 1½ inch dome head screws to secure the finished guitar to the console. Similar dome head screws are used to fix the roller bridge frame to the tail of the guitar as in Fig. 7A. These screws are marked d, e, f, g, h, i and are each 1 inch long.

As the special bridge assembly is 4 inches wide, the tail of the guitar must be widened by ⅞ths of an inch. This is done by means of two pieces of wood shown in Fig. 7A as X and Y. The final part of the guitar "wood-work" is the recess for the magnetic pick-up and if the 8 string pick-up specified is used then the recess will be approximately 4 × 1¾ × ⅜ inches deep. If anything the recess may be a bit oversize to allow for a thin felt packing around the pick-up.

The guitar woodwork is completed by sandpapering and for a gloss finish two or three coats of Contipol varnish applied. Do not varnish the section for the fretboard because it has to be glued on and this should be left until all other assembly work is completed.

Please note that reference will be made later to Fig. 7 in connection with the fitting of the bridge frame and the magnetic pick-up. This is why the position of the 12th fret and the centre line of the bridge roller spindle are both indicated. Note also that no measurements have been given for the spacing between the holes for the geared tuning pegs as this will depend on the physical size of those obtained. The shafts of the pegs must however be located on the centre line (C/L) as shown in Fig. 7B and should be spaced at least 1¼ inches apart.

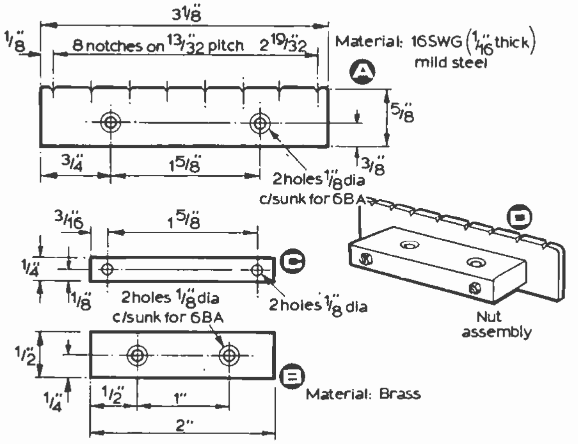


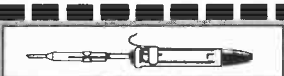
Fig. 8 (below): Details for constructing the "nut" which is the small bridge at the peg head end of the fretboard.

Next comes the mechanical work involved in the making of the "nut", the special roller bridge assembly and the pedal mechanism which not only calls for some ability in metal working but also reasonable accuracy. None of these parts can be obtained ready made.

Details of the "nut" which is the bridge at the top end of the fretboard are given in Fig. 8. It consists of a piece of 1/16th inch thick mild steel, the lower portion of which is recessed into the guitar body as shown in Fig. 7B, so as to leave the top edge containing the slots for the strings about ⅜th inch above the fretboard. The slots must be spaced as accurately as possible and can be made with a fine hacksaw blade or thin triangular file. They should not be more than about 1/32nd of an inch deep but those for strings 8, 7, 6 and 5 will have to be slightly wider because the strings are thicker. The nut itself is secured to a brass block which in turn is screwed on to the guitar body.

The next items include the roller bridge assembly and the pedal mechanism which will be dealt with in the next article. The final article, part 3, will cover the special tone control preamplifier for the magnetic pick-up and a "swell" pedal (pedal operated volume control) which employs a light-discriminating resistor instead of the more usual gear operated potentiometer.

To be continued



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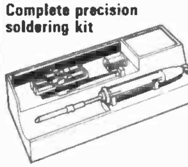

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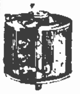

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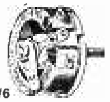

1 ohm, 10 a.; **5 ohm**, 4·7 a.; **10 ohm**, 3 a.; **25 ohm** 2 a.; **50 ohm**, 1·4 a.; **100 ohm**, 1 a; **250 ohm**, ·7 a.; **500 ohm**, ·45 a.; **1,000 ohm**, 280 mA; **1,500 ohm**, 230 mA; **2,500 ohm**, ·2 a. Diameter 3½in. Shaft length ⅝in.; dia. $^{15}/_{64}$ in. All at **27/6** each. P. & P. 1/6

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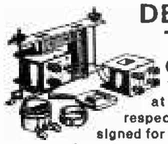

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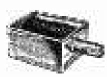

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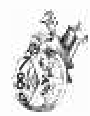

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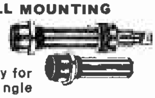

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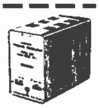

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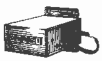

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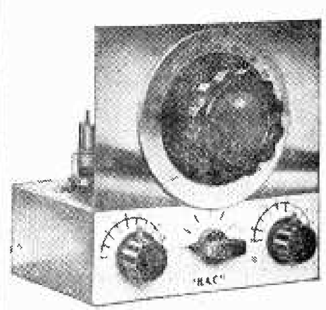

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L.A.J. IRELAND

Number 1 — The SL402A and SL403A, audio amplifiers

Since the word "microelectronics" first became current, this magazine has kept before its readers the latest developments in this field, and has repeatedly induced its readers to gain practical experience in the application of integrated circuits by the publication of realistic constructional projects. However, the stream of new devices has become a flood, so that it is totally impossible to give full instructions in article form for the wealth of i.c. projects now possible. At the same time such a source of ideas for the enthusiast must be tapped, and hence this new feature. It is intended, each month, to present a new device, idea, or theme from the world of microelectronics which readers can develop for themselves as their experience, interests, or leisure permit. Detailed instructions will not be given—for such articles will continue to appear as in past issues—but all sorts of goodies which must otherwise be left in obscurity as far as the amateur is concerned, will be sought out.

FOR a starter, a pair of interesting new audio amplifier circuits from the Plessey stable has been chosen. These products from a UK firm are emerging as strong favourites in a field until recently dominated by American imports, and are a really good example of the results available to the home constructor as a result of the fierce competition in the industrial world. The SL402A has a typical output power of 2 watts operating from up to 14 volts (a car battery is an ideal source, and car radios or tape players an obvious application), while the SL403A is rated for up to 21 volts, with a corresponding increase in power delivered, to 3 watts.

The internal circuit

Each unit, in a circuit containing 13 transistors, a zener, and several other diodes, provides a complete audio system, preamplifier as well as power amplifier, with an overall voltage gain of 50dB. Further, as a glance at the equivalent circuit will confirm, the input to both preamp and power amp is through an emitter follower chain, giving a very high input impedance in both cases. This obviously increases the utility of the circuit when used in conjunction with crystal record player cartridges; more sophisticated applications in the instrumentation field are also evident, since signal tracers, for example, are only useful to the extent that the loading they place on a test circuit is minimised.

It also permits the introduction of a really comprehensive tone control system, despite the severe signal attenuation this involves. This final point relies also on the fact that the noise level is −75dB relative to the output signal, while overall distortion is a negligible 0·5%. An attractive feature from the point of view of the constructor of economy mains-powered equipment utilising either of these new Plessey units is an inherent

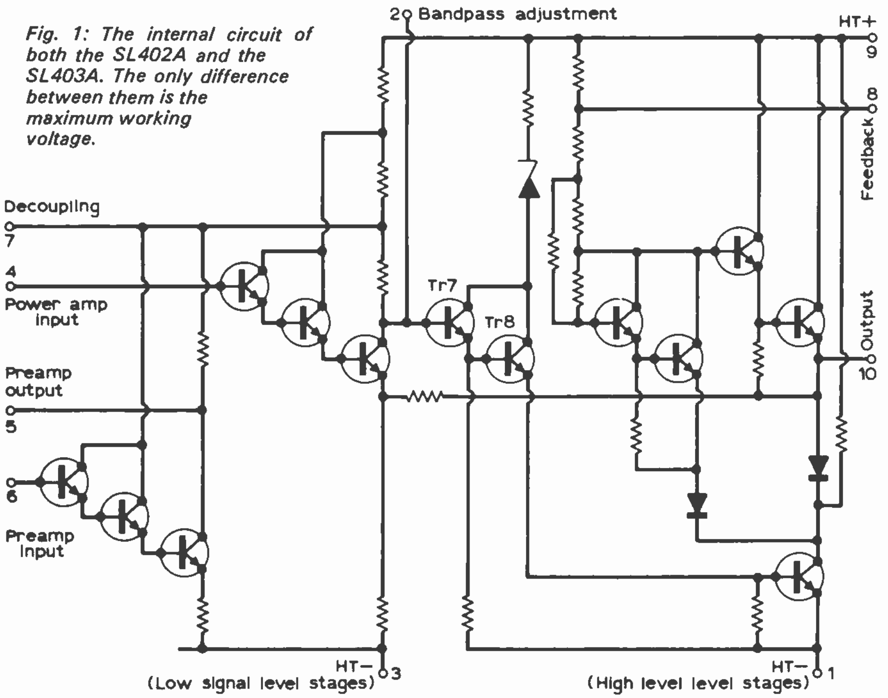


Fig. 1: The internal circuit of both the SL402A and the SL403A. The only difference between them is the maximum working voltage.

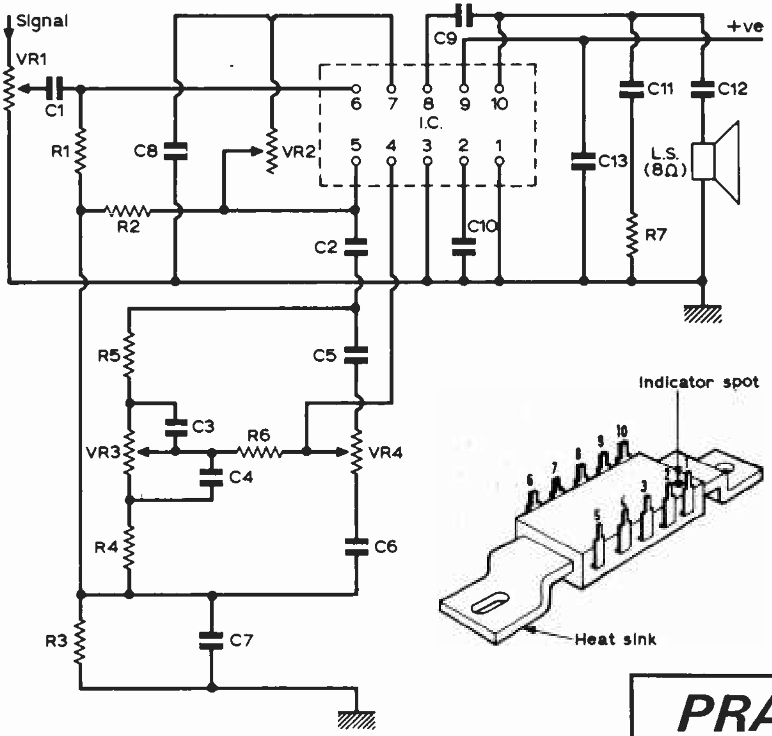


Fig. 2: The discrete components associated with the I.C. and the pin connections.

★ components list

Resistors:

R1	1MΩ	R7	10Ω
R2	150kΩ	VR1	2MΩ log.
R3	68kΩ	VR2	50kΩ lin. (preset)
R4	3·3kΩ	VR3	250kΩ lin.
R5	33kΩ	VR4	250kΩ lin.
R6	10kΩ		

All resistors ¼ Watt 10% miniature.

Capacitors:

C1	0·02μF	C8	25μF 25V
C2	2μF 25V	C9	25μF 25V
C3	0·01μF	C10	0·01μF
C4	0·1μF	C11	0·05μF
C5	0·001μF	C12	1,000μF 25V
C6	0·01μF	C13	1,000μF 25V
C7	2μF 25V		

I.C. SL402A or SL403A, available from S.D.S. Ltd., Hillsea Industrial Estate, Portsmouth.

ripple rejection of 30dB in a properly designed system. This is assisted by decoupling the supply line to the preamp and input section of the power amp using an external discrete capacitor. The device is self-protecting to some extent against transient overvoltages in the h.t. supply, since the emitter follower pair Tr7 and Tr8 break down first, biasing off the main amplifier, but with their own dissipation limited by a resistor.

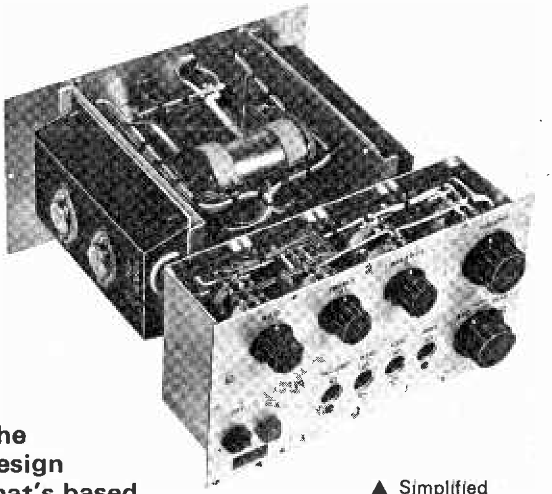
The chip carrying the elements of the integrated circuit is mounted directly on a metal bar which functions as a heatsink; the unit is then potted in epoxy, with ten leads for external connections.

Constructional notes

For safe operation, a heatsink of 20 square inches of 18s.w.g. aluminium is advisable; the integral heatsink of the device should be in good thermal contact with this larger metal sheet, which could well form part of the structure of the audio system in which the unit is incorporated.

The last point may well be the most attractive of all; these Plessey units are currently available from distributors at 39s. 6d. each, *plus postage*. This is a sample of what is available right now, if one knows where to look. More next month! ■

BUILD AND ENJOY
THE PW DOUBLE 12



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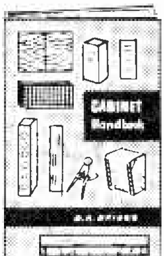

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Intended for the "Do-it-yourself" man and the audiophile, this book contains a lot of first-hand information about woodworking, veneering, polishing, etc. But its main value, probably rests on the vital information given on cabinet design and the acoustic principles involved, particularly in relation to compact enclosures which are now so popular for stereo.

CONTENTS

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SHOWTIME '69

NEARLY fifty firms exhibited in this year's radio-trade shows in late August. Most of them took space in London's best-known hotels, but a few staged exhibitions on their own premises. The shows were once again for the Trade only, the manufacturers obviously taking the view that their aim must be to sell to the dealers, leaving them to persuade the public to buy.

TRENDS

The emphasis of the shows this year was on colour TV, as might be expected, and we found no signs of startling developments in radio and audio. True, there were many new models to see, but the main differences between them and their predecessors was in the styling and cabinets rather than circuitry.

More of the "popular" firms seem to be bringing out better quality audio equipment such as record-players and stereograms. For example, many more stereograms now have detachable loudspeakers which give much better results than loudspeakers positioned about 3ft. apart and housed in the same cabinet. The makers seem to be realising at last that a lot of people want equipment somewhat better than the very cheap type, but at a price less than that charged for hi-fi units.

NEW ITEMS

Details of new TV receivers are contained in a special report in the November issue of our companion magazine *Practical Television,* on sale on 17 October.

News from *Alba* was model 665, an a.m./f.m. personal radio with eight transistors and four diodes. The receiver covers m.w. and v.h.f./f.m. and the recommended price is £9 17s. 0d. The *Alba* 5007 stereogram has a price of £95 2s. 0d. and features a mains-powered 15-transistor chassis. Later in the year, *Alba* will release the 6003 stereogram at about £71. Like the 5007, it will cover l.w., m.w., and f.m. (with a.f.c.).

The Beomaster 3000 from *Bang and Olufsen* gives 30W r.m.s. output per channel with less than 0·6% distortion. The radio tuner section has six keys to give instant selection of six f.m. programmes. The unit is available in teak or Brazilian rosewood finish at £135 9s. 0d. and £136 10s. 0d. respectively.

The Beocord 2400 tape recorder by *B. and O.* is a four-track machine with studio-type slide controls for microphone, radio, gram or line. A fifth slider controls the volume. The 2400 sells at £208 19s. 0d. in teak and £210 in rosewood.

A clock radio, model 450, from *Benkson* uses nine transistors and has an automatic alarm. It covers m.w. and l.w. and is available in green, brown and black. The suggested retail price is £9 19s. 6d. The *Benkson* 458 is a ten-transistor radio covering m.w., l.w., and f.m. and retails at 12gn.

A 3¾in./sec. tape recorder from *Bosch,* the Uher 714, retails at £49 17s 8d. and has a frequency range of 40Hz to 15kHz. It records mono on four tracks and will accommodate 7in. spools. On the radio side, *Bosch* have a new luxury receiver, the Supernova. This set covers f.m., l.w., m.w., and s.w. (187m. to 10m.) and operates from mains or batteries. The price is £93 10s. 0d. At the other end of the price scale is the Dixie covering a.m. and f.m. for £16 3s. 0d.

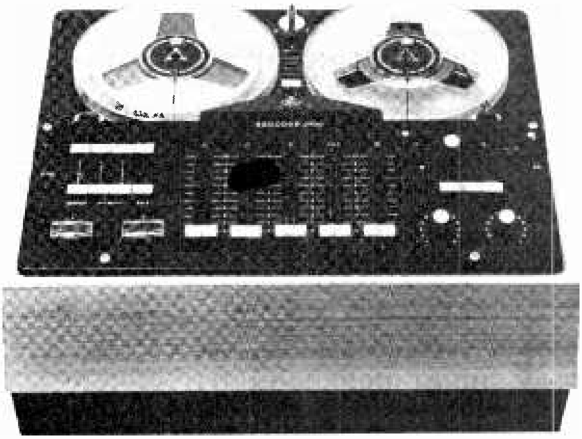
The New York stereogram from *Bosch* incorporates slider-type controls for tone and volume etc., and has an automatic stereo decoder which has 7μV sensitivity. The price of the New York is £330 13s. 2d.

The CR128 is a combined clock and radio introduced by *Bush.* It covers m.w. and incorporates an alarm clock. The price is 14gn. The *Bush* VHF101 is a mains-operated transistorised table radio with long low styling in teak or tropical olive veneer. Coverage is l.w., m.w., and v.h.f./f.m., and there are sockets for tape recording and external v.h.f. aerial. This model is priced at £30 19s. 9d.

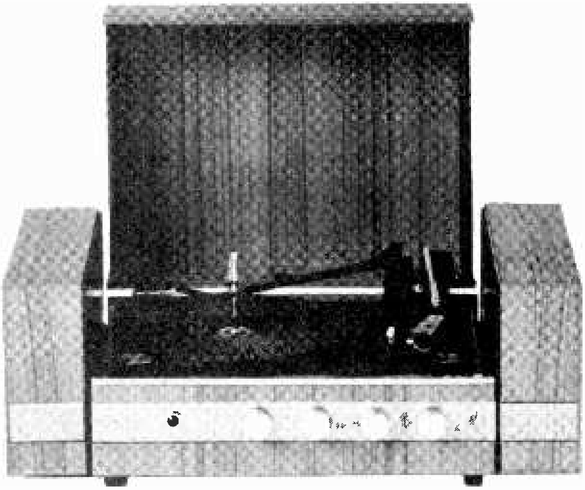
Model TR-145 from *Crown* is a four-band eleven-transistor portable with 1·8W output. It covers m.w. (525kHz to 1605kHz) and s.w. (1·6MHz to 22MHz in three wavebands). This model sells at £27 15s. 8d.

Among new items from *Dansette* was the Graduate stereo system, a record-playing unit and amplifier with separate loudspeakers. The retail price is £47 0s. 4d. The Dansette Compact is another new stereo record-playing system and retails at £39 9s. 4d. The cabinet is finished in teak and the two loudspeakers are detachable.

New to the *Decca* range of radios are the PR303, a three-band a.m./f.m. receiver with switchable car aerial, and the PR205 (Parade), a three-waveband set with switchable a.f.c. for the f.m. band. The prices of these two models have yet to be announced.



Beocord 2400 from Bang and Olufsen.



Dansette 'compact' with detachable speakers.

From *Ekco* at £21 was the Nautilus covering m.w., l.w., s.w., and f.m. This mains/battery radio has an olive green padded cabinet.

The 3247 from *Ferguson* is a new tape recorder in charcoal grey with teak or rosewood veneer. This four-track machine operates at 3¾in/sec. and retails at £42 10s. 0d.

A radio from *Fidelity*—the RAD16—covers m.w., l.w., s.w., and the marine band. Other features include an earphone or tape socket together with a push-button and socket for car aerial. The price is 17gn. The other new radio from *Fidelity* is the RAD18 which has a wrap-round dial and nine push-buttons for waveband selection and on/off switching. This set has a teak-veneered cabinet and retails at £28 7s. 0d.

The G989/1 stereo radio tuner from *G.E.C.* retails at £33 12s. 0d. and works with any stereo system or amplifier since it has its own power supply. Mono and stereo transmissions are kept in tune by a.f.c. and there is a pilot light to indicate stereo programmes.

The three-waveband Solo Boy from *Grundig* covers l.w., m.w., and f.m. This receiver has an r.f. stage for f.m. reception and gives 700mW audio output. The price is £17 19s. 6d.

The VHF Herald from *Hacker* is a portable receiver for f.m. only, and is finished in black padded leather-cloth with satin silver trim. The audio output is 1½W, and there are sockets for external aerial and output to tape recorder. The sensitivity is better than $1\mu V$ for 10dB signal-to-noise ratio, with full limiting at $5\mu V$. The price is £29 18s. 0d.

From *ITT KB* comes an unusual mains table radio which has a sloping front, with tuning scale on the right and loudspeaker on the left. The sides of the cabinet are finished in teak, the l.s. grille is black, and the trim is brushed aluminium. The list price of the receiver, model KR068, which covers l.w., m.w., and f.m., is £32 15s. 0d.

Interesting items at the *National* show included stereo headphones with built-in radio, and a miniature personal radio which can also be plugged into a separate amplifier unit to make a table radio. These two items formed a part of a display of equipment at present available in the USA, but not yet on sale here.

National also showed the RF-5000 19-transistor portable which covers l.w., m.w., f.m., and s.w. (1·6MHz to 30MHz). This eleven-band set sells at £169 4s. 0d.

A new receiver from *Perry and Pharo* is the Action by Nova-Tech. This portable five-band set covers 30MHz to 50MHz; 1·5MHz to 4·5MHz; 550kHz to 1600kHz; and 200kHz to 400kHz.

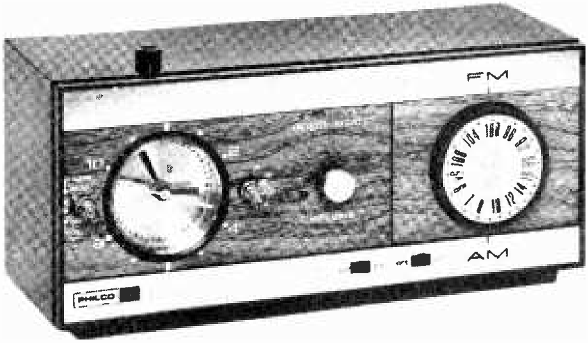
From *Philco* comes model R440WA, an elegant mains table radio covering m.w. and f.m. The price is £20 6s. 1d. An a.m./f.m. clock radio, model R530BK, retails at the same price.

The GF822 stereo record player by *Philips* features a new press-button auto-changer with built-in cueing device. Two dual-cone loudspeakers with teak-veneered enclosures are provided, and the retail price of the complete system is £61 19s. 0d.

The *Philips* RL693 mains/battery radio was also on show. This has two medium wavebands, and also covers l.w., s.w., and v.h.f. The price is £78 16s. 0d.

Sony unveiled a vast range of new items which included the ICR200, an integrated-circuit radio with rechargeable batteries. This receiver covers m.w. and is available in red or black, and comes complete with battery charger. The price is £18.

The ICF8500, also from *Sony*, covers f.m., m.w., and the aircraft, marine, and beacon bands. The retail price of this model is £60. The *Sony* TFM 6600L is a portable covering l.w., m.w., and f.m. It has a 3½in. l.s. and operates from internal batteries or a.c. mains (via an optional adapter). The retail price is £21 15s. 0d.



Philco's clock radio, model R530 BK.

One of the lowest priced items seen during the shows was the *Teleton* 6X705 single-waveband portable receiver which weighs only 8oz. The suggested retail price is £2 15s. 0d.

Two new stereograms were shown by *Unitra;* the Sandpiper at 62½ gn. covers l.w., m.w., and f.m. and has 4W peak output per channel. The DGS303 has five wavebands including f.m. and has an output of 2½W per channel into 5Ω loudspeakers. The DGS303 retails at 89½gn.

Van der Molen showed the Sonic 4+4 stereo record-player. One of the loudspeaker enclosures may be detached for optimum results. The system retails at £24.

The Stereo 88 unit audio system from *Videorama* sells at 39½gn. and consists of amplifier/record-player, and two loudspeaker enclosures. The Stereo 99 system has three units, too, but the record-player section also contains an f.m. radio tuner. The units are finished in teak veneer and the output is 5W per channel. The price of the Stereo 99 is 69½gn. ■

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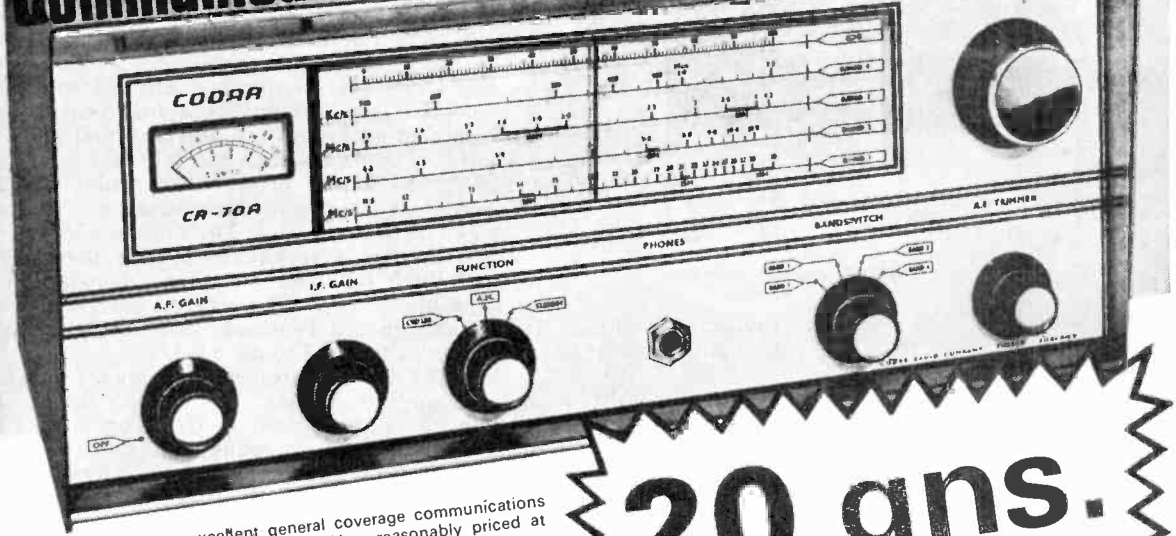

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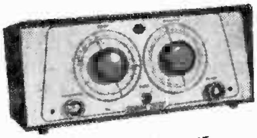

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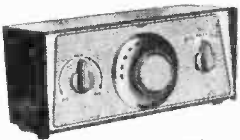

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30µF	10 volt
100µF	6 volt
125µF	4 volt
At 1/- each	
16µF	250 volt
50µF	10 volt
100µF	12 volt
100µF	25 volt
200µF	10 volt
320µF	10 volt
2000 MFD. 30V	4/6
1500 MFD. 30V	4/6

Additional Transistors—**AF147** and **AF150**, 24v. Larger envelope, 4 leads, collective current 10mA, gain 70—**4/-** each. **AF149**—gain 225—**4/6** each.
Also 8µF 350V **1/2**, 25µF 25V **1/3** and 50µF 50V **1/9**. Other electrolytics in current list
Postage, Packing and Insurance all above **1/-** up to 11, 12 and over charges paid.
2 GANG VAR. CONDENSER: Mod., air-spaced, ·0005 ea. sec. **5/-** (1/-).
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MULTIMETER: 20,000 Ω/V D.C., 10,000 Ω/V A.C. 0–5/25/50/250/500/1K volts D.C. ● 0–10/50/100/500/1K volts A.C. ● 0–50µA/2·5mA/250mA D.C. ● 0–6KΩ/6 megΩ ● 10µµF–·001mfd/1mfd. ● —20 to +22dB. ● Complete with test leads and instructions. ● Over-load protected 1969 model with every refinement. **£4.7.6** (2/6). **JUNIOR MODEL at 47/6** (2/6) 1000Ω/V described in free list.
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practically wireless commentary by HENRY

No. 62

Rally Round the Can Boys

with guest writer FRANK P. YOUNG

Every man was his own Merlin.

CHARLES Curran warns us that the long-term future for radio in this country lies with v.h.f. . . . . last year's total of v.h.f. receivers manufactured exceeded 119,000 . . . there are v.h.f. radio stations now in eight cities . . . we are all high-band minded. But what about the low band?

Just because the GPO allows Private Mobile Radio to operate in this country between 87·5-88MHz and cross-modulate our entertainment, we must not imagine we have entered the sophisticated world of open communications. As an example of what could happen, let's take a look at the States, where the Citizens' Band is open to all, up to about 40 miles coverage per set at maximum 5 watts on 27MHz, with up to 23 potential channels.

Our guest writer tells Henry that the women in USA have dropped their telephones and picked up microphones: 'They never could resist a party line,' says Frank Young, an American resident of Bristol, who sorely misses his CB facility. Now read on . . .

"Joe to Willie, Joe to Willie. Do you read me? Over . . ."

"Willie to Joe, receiving you five-by-five, over."

"Willie, they're moving up over the hill now, heading east pretty fast . . . circle around that lower road . . . don't let 'em spot you until you're ready to fire."

"Roger, Joe, keep your heads down—over and out."

The Dieppe Raid? Anzio Beach? Breaching the Siegfried Line? No. Deer season in Potter County, Pennsylvania.

It is walkie-talkie time in the woods, America's last stronghold of the male on the airwaves. Its khaki webbing is worn and batteries are increasingly hard to get, but the war surplus instrument is lovingly coddled by its master. Once a year, he contributes to the language by re-enacting—and thus preserving—the strange tongue of the Ardennes, *circa* 1944.

They're coming up the hill fellows—run for it!

He does this, to the infinite delight of all rifle-toting, back-at-the-lodge beer-swilling old soldiers, courtesy of the Federal Communications Commission. This is the same outfit that a few years ago, via an Act establishing Citizen's Band Radio, brought women into our preserve.

Time was when Amateur Radio was a comradely all-male secret society, with its own cabalistic language and signs. The whole thing was carried on in private seances in little back rooms, full of black boxes and huge dials and coils and throwswitches, all making peculiar noises and bakelite smells and bitty sparks. Every man was his own Merlin, staying awake long hours into the deep night in commune with fellow-wizards.

Citizen's Band was welcomed at first. It meant more wizards—a lower class, of course, but nevertheless. We men were wrong. It was a classic case of turning over the cauldron to the Sorcerer's Apprentice. The Apprentice, in this case, was Mum, and she simply didn't fit in.

To begin with, she wanted to talk, too. It was a novelty at the start, but you all know how women are. They never shut up. Then she wanted our sanctum door left open. Then she began hanging out in there. Then she said the place was untidy. Then, Lord help us, she cleaned it up.

Then she said it would be better as a sewing room. The radio would look nice in the kitchen, right next to the Super-Six-Burner-Over-And Under-Oven Mark VII All-Automatic Stove, with its IBM computer console for making tea. She figured that just because we were too stupid to figure out the stove, we couldn't work our radio, either.

Now they're making the damn things in mauve and pink cases to match refrigerators. I don't know how long we'll last out here in the woods. My buddy, Charlie, bought it last week when his wife zeroed in on the lodge with her auto receiver, and caught him calling the beer truck for an extra delivery.

But we're working on evasive action. We've invented a new gadget that can't be picked up by *any* radio. All it takes is two used bean cans. Then you take a piece of fishing string, see, and . . .

MEDIUM WAVE DX • RECEIVER •

D. GIBSON G3JDG

LAST month, in part one, we discussed the theoretical aspects of the receiver and considered various alternative front ends. In this part, we will be concerned with the construction and alignment of the unit.

It is not imperative that the layout shown be strictly adhered to. Experienced constructors, the type of person who might build this receiver, will have their own ideas. Providing the layout follows a sensible pattern and the rules of common sense are adhered to there should be no difficulty. Short leads carrying signal voltages and other obvious rules of construction must be observed.

The case is a bought item and is made of steel. The front panel is aluminium. The only hard work is making a cut-out for the loudspeaker in the steel side of the case. A neat group of holes would be the easiest way out. The writer made such a hash of this simple task that it was necessary to cover the resultant scars with a plastic fret gleaned from a "surplus" store.

The front panel is enamelled and although reasonably hard can still be scratched. It is best to make a template of paper marking out the position of the individual controls. These centre marks can then be transferred to the panel by laying the paper template in position and pressing with a sharp-pointed scriber. The meter cut out is made using a hacksaw while the other holes can be drilled.

Tuning Drive

The dial must be positioned carefully in order to line-up with the spindle of the tuning capacitor. Any inaccuracy here will result in undue strain on the spindle of the tuning capacitor, which is very undesirable. The hole for the drive was cut with a B9A cutter. Fortunately, the dials are supplied with a paper template, and this can be laid on the front panel and the position of the holes marked quite accurately. The writer's somewhat cowardly method was to pitch the main spindle hole a little high and then to pack the tuning capacitor with brass washers under the small aluminium plates which hold it to the chassis.

All controls, with the exception of the dial plate and "S" meter, should be mounted and the panel then bolted to the chassis with four bolts. The chassis was cut from aluminium to form a final shape 10in. wide by 5½in. deep. The back drop is 2in. and the front lip is bent upwards forming a ½in. strip to which the front panel is bolted.

The wiring is in a modular form, this being an easy way to build most complex projects. The front end is wired up on its small plain Veroboard "chassis" which, when completed, is bolted to a cut out in the main aluminium chassis by four 6BA bolts. This Veroboard holds the mixer, oscillator and buffer stages.

The r.f. stage is wired separately and the pins of the r.f. coil are used as anchoring points for the discrete components. This has the advantage that the entire r.f. section is under the chassis well away from the mixer. The chassis affords excellent screening and the physical distance combines with this to ensure that undesirable feedback and instability due to the stages "seeing" each other are eliminated. Constructors varying the layout should bear this point in mind when deviating.

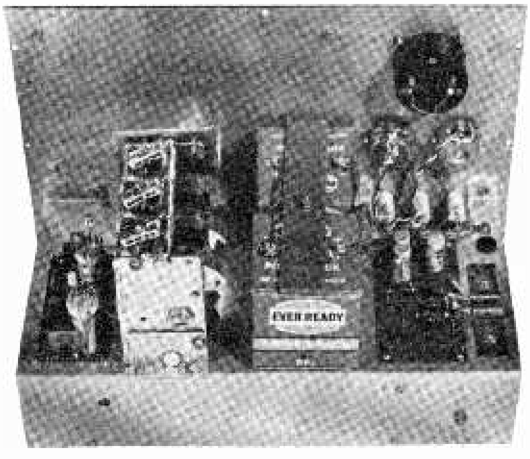
The layout shown offers several advantages. Placing the r.f. coil and components as shown ensures the shortest possible leads from aerial to input. Again, the positioning of the Veroboard strip and i.f. strip allows short leads between mixer and i.f. input.

The i.f. strip is also a bought item. It was thought that many constructors would not have access to sophisticated test equipment and that the building and alignment of a strip with a half lattice crystal filter would present difficulties. Constructors with both test gear and confidence might consider building their own i.f. section.

Filter Matching

If one of the transistor front-ends is used, then the extra i.f. transformer is needed, coupling being via a small capacitor. If this capacitor is made too large in value, then the filter characteristics will be impaired because of the heavier loading effects.

As an experiment, the collector of the mixer was connected direct to the input transformer on the strip which amounted to a large mismatch of impedances and consequent distortion in the shape of the filter



Top view of the completed receiver.

passband. However, surprisingly enough results were still quite passable and the tuning remained tolerably sharp, although the filter passband shape was not viewed on an oscilloscope which might have told a harrowing story. Brave men with suitable 'scopes proceed with caution.

If the f.e.t. front end is used and the extra i.f. transformer is to be used, then a simple modification is well worth while and is shown in the diagram. This modification is very easy and ensures a higher impedance load to the f.e.t.

The a.f. section follows the same pattern of construction as the front end. It may be built on its Veroboard "chassis" and tested before bolting it to the main aluminium chassis. Heavy decoupling was found necessary due mainly to the high gain of the amplifier. The two 1,000μF decoupling capacitors were mounted by means of a small aluminium plate which in turn was bolted to the backdrop of the main chassis. A single 2,000μF 15V capacitor would be equally suitable providing it will fit into the space available.

The 200μF loudspeaker "coupling" capacitor C18 is more usually some ten times this value. However the value was gradually decreased to 200μF with no apparent effect on performance and thus this value was used since it takes up a very much smaller volume.

The complementary pair output transistors have small slip-on heatsinks. These were drilled and cleaned with emery cloth and bolted to the chassis with 6BA bolts thus utilising the main chassis as a heatsink. Although probably not strictly necessary, it does afford a neat layout and an additional safety factor.

The two batteries are wired in series to give a 12V line. They are held in position with a length of 4BA brass studding bolted to the chassis at one end, while the other end is pushed through a hole in a strip of Paxolin which traverses the length of both batteries. This method is hardly elegant and constructors might consider making a small aluminium bracket or some form of more secure housing for them.

When the wiring of the two Veroboards is completed and these are bolted in position the various interconnecting wiring may be completed.

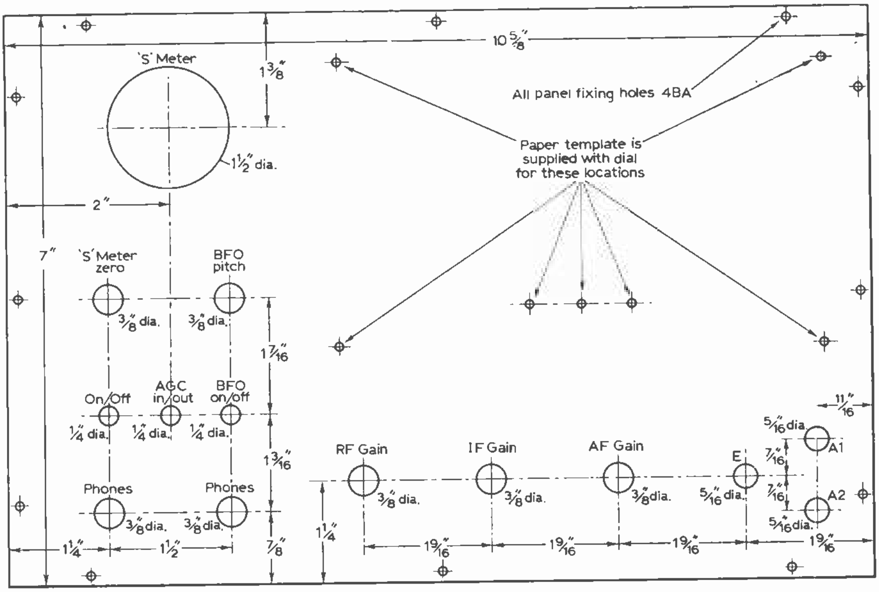


Fig. 7: Front panel drilling and layout.

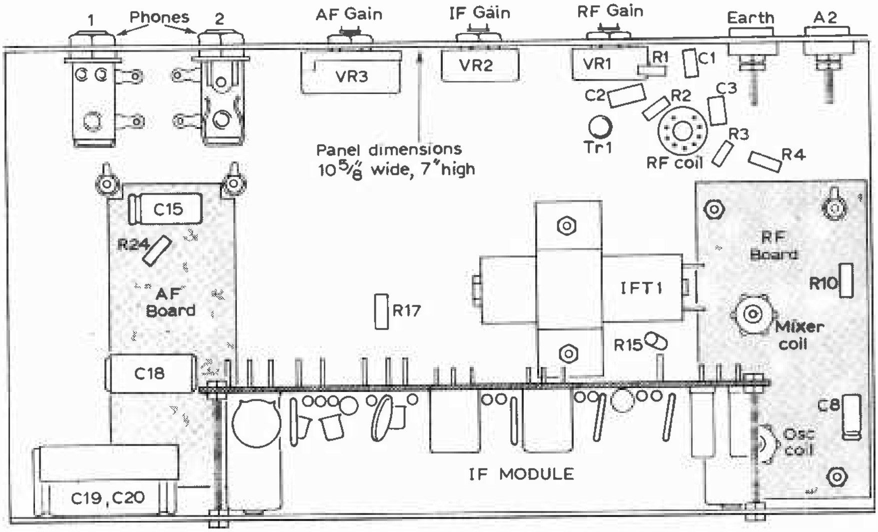
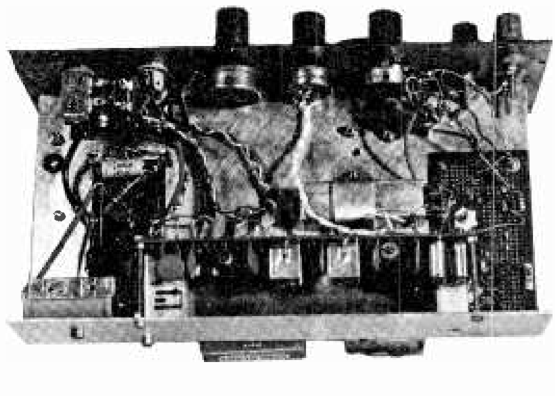


Fig. 8: Layout of components on the underside of the chassis.



Underside view of the receiver. Compare this with Fig. 8.

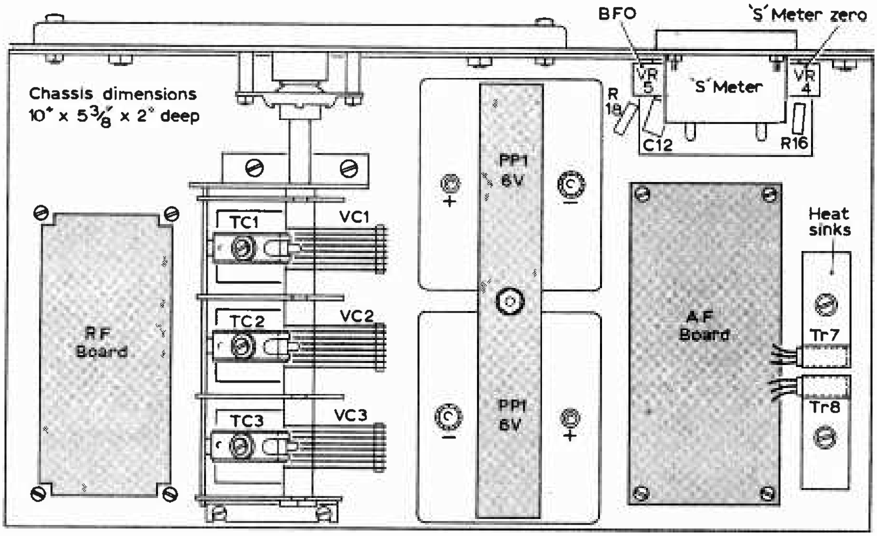


Fig. 9: Layout on the above side of the chassis.

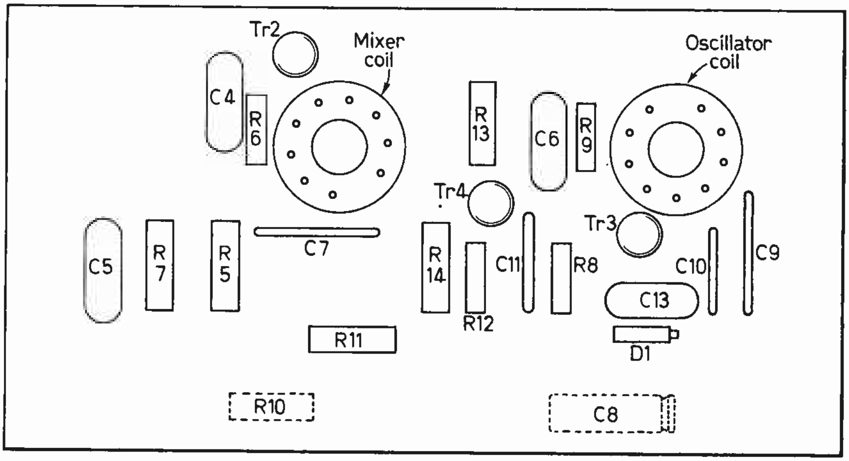


Fig. 10: Layout of components on the r.f. board.

The "S" meter should now be mounted and wired in last. This has a plastic front which is easily scratched as is the dial cover which is not fitted until after final calibration of the dial itself.

The circuit which the manufacturers show for the i.f. strip depicts a resistor in series with the meter, nominally 1kΩ. In the prototype this resistor was found to be unnecessary and was thus omitted. The "meter zero" front panel control provided adequate adjustment of the meter.

After all wiring has been completed it is prudent to re-check the entire receiver. In the front end the coils used are Denco miniature transistor plug-in types, the surplus pins being used as anchoring points. Check that the wiring around these coils is correct as it is extremely easy to make an error here.

With both n-p-n and p-n-p devices, and possibly f.e.t.s used in the design, it is also all too easy to make a mistake. Check wiring of all devices, including the zener diode.

For proper alignment a signal generator is imperative. Lucky types who possess a 'scope and wobbulator will have a decided advantage.

First, check the a.f. section. Touching the "live" terminal of the a.f. gain control should produce a violent hum in the speaker with the gain turned three-quarters up.

The values shown in the amplifier were adjusted on test mainly with an eye to battery conservation. If the circuit as shown is strictly adhered to, then, under no-signal conditions, the a.f. section on its own will draw approximately 8mA. On peaks of signal this will rise to 100-150mA. Although the circuit will, in theory, produce around 1W of audio, turning up the a.f. gain fully does introduce noticeable distortion. It was found in practice that with half this amount belting out of the loudspeaker, volume was more than adequate. Perhaps "fiddling" the circuitry for low-standing current together with ruthless pruning of components brings distortion as the price to be paid, however, this is only noticeable when the gain is fully up.

Once the a.f. section is functioning the i.f. strip may be checked roughly. Touching the pins of the crystals with a finger will produce an agonising cacophony of pure audio bedlam from the speaker.

The front end is by far the most difficult section to check and align and extreme care is required. The trouble-taking in alignment here will dictate whether the receiver is a communications type or just a sophisticated m.w. receiver.

Alignment

The signal generator should be adjusted throughout the lining-up procedure for minimum output voltage at all times. It should be connected via a capacitor to the circuitry, a value of 0·01μF is suitable. For alignment, it will be assumed that the constructor has only a signal generator. This can be conveniently used in conjunction with the "S" meter which gives an indication of the signal level and can thus show when a peak is reached.

The signal generator output is applied via a 0·01μF capacitor to the input side of the extra i.f. transformer. A 1·62MHz signal must be produced which is accurate in frequency. This is a "must" because the filter will strongly attenuate anything outside its passband which is set at around 2kHz. If there is any doubt here, check the frequencies of the individual crystals. These will be stamped on the top of each crystal case and the signal generator should be adjusted to fall midway between these two frequencies.

Adjust the generator output so that the "S" meter reads about ¼ deflection. Now *carefully* adjust the bottom core of the *first i.f. transformer on the strip.* **Note,** only the bottom core should be adjusted and it will only require small variation. The top core of this transformer is carefully set by the manufacturers and should on no account be touched. The bottom core only is gently adjusted for peak reading on the "S" meter. Following this, the cores of the extra i.f. transformer should be adjusted for peak meter reading.

The generator is now connected, via the capacitor, to the aerial terminal. The input arrangement will vary here depending on the type of aerial to be used. If it is to be a balanced 80Ω input, then the aerial leads will go to the two connections on the input winding of the r.f. coil. If, as in the prototype, a long wire aerial is to be used, then one side of the winding will be earthed and the aerial taken to the other end of the winding, which is the place to inject the signal generator voltage.

The signal generator should be set to 0·515MHz and the tuning capacitor fully meshed. The core of the oscillating coil is now adjusted for peak signal on the meter.

Set the generator to 1·545MHz and fully open the tuning capacitor. The oscillator trimmer is now adjusted for peak signal. These two steps, at either end of the tuning range, are repeated until no further adjustment is necessary.

Now adjust the cores in the extra i.f.t. again and repeat the high and low frequency alignment to check that this still holds. If there is any slight deviation, these steps should be repeated.

Re-tweek the bottom core of the i.f.t. on the i.f. strip. This adjustment will be very fine so care should be exercised. Now repeat the high and low frequency checks for peak reading on the meter.

This procedure will take time and patience but is very necessary if the receiver is to function at its best.

The generator is now set to 566kHz, which is the l.f. tracking point, and the signal tuned-in with the tuning capacitor, again for peak meter reading. The tuning capacitor should be around 20° from the fully-meshed position. The cores of the mixer and r.f. coils are now adjusted.

Set the generator to the h.f. tracking point, 1,390kHz, and tune-in the signal. Here, the tuning capacitor should be approximately 15° from minimum. The mixer and r.f. trimmers are now adjusted for maximum response.

The method of "mounting" the trimmer capacitors is not really satisfactory. It would be far better

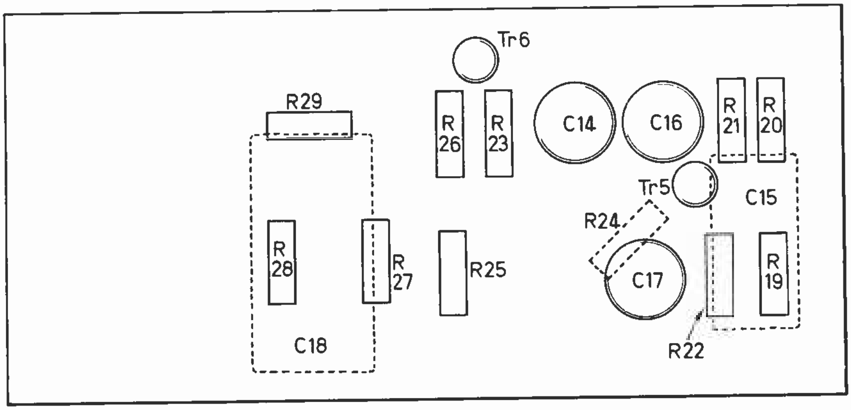


Fig. 11: The layout on the a.f. board.

to obtain a copper strip and bolt this along the upper length of the tuning capacitor, soldering the trimmers to this. A strip of this sort will offer far superior support to the trimmers than the length of 16s.w.g. tinned copper wire used in the prototype which tends to buckle very slightly when the trimmers are adjusted and requires a very light touch if tuning and alignment is not to be affected. Again, beehive trimmers may well prove better than the postage-stamp types used.

Once the alignment has been successfully carried out the main dial may be marked in. A crystal frequency marker giving 100kHz points would be useful here, otherwise stations with known frequencies might be used. Two dials are included when purchased and one has five blank scales plus a logging scale marked 0 to 100. Thus one scale might be marked in kHz or MHz, while the others can be left blank or used to pinpoint stations.

"S" Meter

The "S" meter would need to be calibrated if a meaningful report is to be furnished. In this case it would be necessary to know the exact output from the signal generator so that a signal of known strength could be fed in. This is left to individual constructor's discretion and those possessing a signal generator of this calibre will not need the whole procedure outlined. Even uncalibrated, the meter offers a very useful comparison of signal strengths comparing one station with another.

The a.v.c. may be switched in and checked, thus ensuring that the switch is wired-in correctly. The b.f.o. may also be checked and will produce a definite indication of its presence. The b.f.o. pitch may be altered some ±5kHz of centre frequency. A stability of better than 0·002% is claimed.

The i.f. strip has a product detector and an a.m. detector, the correct one being automatically switched via the b.f.o. switch. The i.f. gain control provides some 50dB of gain control and the a.g.c. is quite remarkable on strong signals affording some 6dB increase in output for 80dB increase in input when receiving s.s.b. On a.m., the i.f. strip sensitivity is such that a 10μV 80% modulated (400Hz) signal will produce 180mV ±3dB across the a.f. gain control. The crystal filter is immediately apparent when tuning across the band. Bandwidth is 2kHz min. (6dB) and 5kHz at 60dB down.

—continued on page 534

P.W. GUIDE TO COMPONENTS

PART 11

M.K.TITMAN, B.Sc.(Eng)

DIODES are essential components in most electronic circuits and have been available since the early days of radio. Indeed diodes were the first useful thermionic devices. They are used for power rectification and in signal paths for rectification and transmission.

Zener diodes however are of fairly recent origin and have only been available since the general use of transistors. This is mainly due to their reliance on modern semiconductor materials and processes. They are used as voltage reference elements and for specialist applications in transistor circuits. The circuit symbols for both diodes and zener diodes are still not completely standardised and they are shown

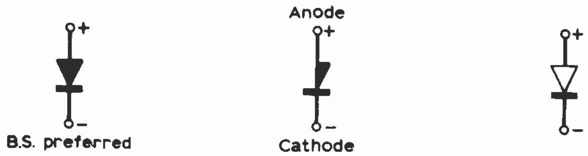


Fig. 1: Commonly used diode circuit symbols.

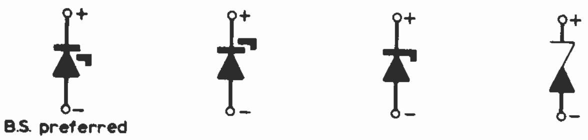


Fig. 2: Circuit symbols for zener diodes.

in Figs. 1 and 2 respectively. In both cases the British Standard preferred symbols are indicated. In Fig. 1 the polarity indicated is *for conduction through the diode* and in Fig. 2 for the zener reference voltage.

Diode Characteristics

The ideal diode would have zero voltage drop in the forward conducting direction and zero current flow in the reverse or non-conducting direction. In practice these conditions are not fully met, although modern semiconductor diodes closely approach the ideal for most practical purposes, as can be seen in the forward and reverse characteristics of a silicon diode shown in Figs. 3(a) and 3(b) respectively. In contrast to the early metal rectifiers—which used semiconductor properties—the modern rectifier has a considerably smaller voltage drop in the forward direction. The voltage drop is 0·5 to 1V for silicon diodes and 0·2 to 0·7V for germanium diodes. Hence the power dissipation (Vf × If) is lower, and smaller devices can be used. From the reverse characteristic it can be seen that a small reverse current flows and can be as low as 1nA or 10^{-9}A in certain silicon diodes. The reverse current in germanium diodes is considerably larger and can be as much as 0·5mA. In order to illustrate how closely the silicon diode approaches the ideal a combined foward and reverse characteristic, using normal transistor circuit values, is shown in Fig. 4.

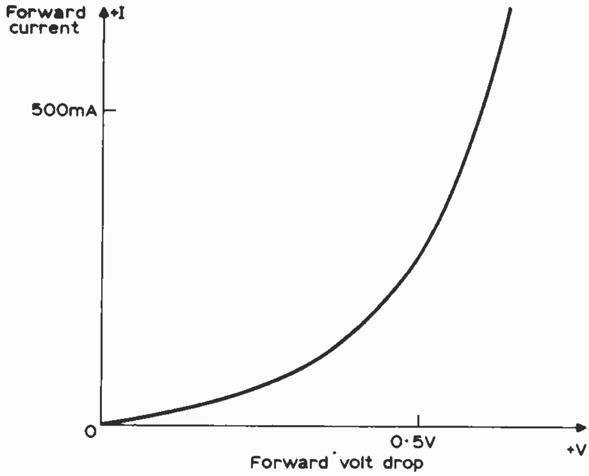


Fig. 3(a): Silicon diode forward characteristic.

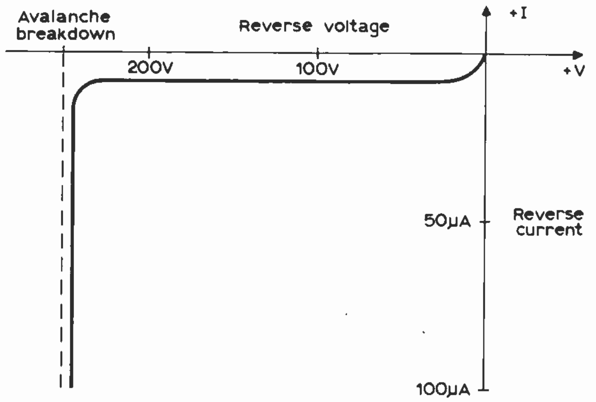


Fig. 3(b): Silicon diode reverse characteristic.

The reverse current and forward voltage drop at a maximum forward current are given by manufacturers as diode parameters. Both the voltage drop and reverse current are considerably affected by changes in temperature. The forward voltage drop reduces with increased temperature by between 2 and 2·4mV per °C rise in temperature, resulting in a re-

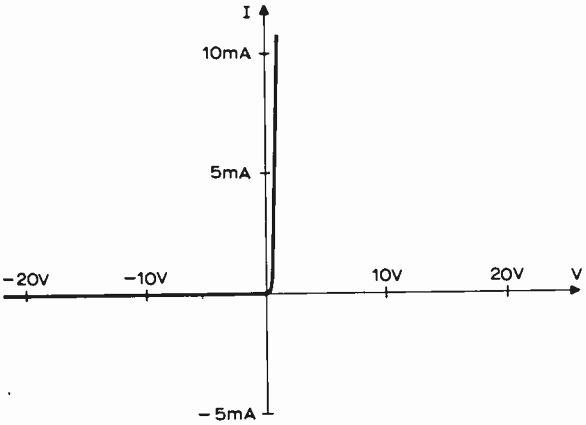


Fig. 4: Silicon diode characteristic curve drawn using normal circuit current and voltage values.

duction in forward voltage drop from say 0·7 to 0·46V for a 100°C rise in temperature. The reverse current increases with temperature but the increase is of little importance in most applications utilising silicon diodes. Due to the structure of the semiconductor junctions the practical maximum operating temperatures of the junctions are +85°C for germanium diodes and +175°C for silicon.

A further significant diode parameter is the maximum reverse voltage which it can withstand, and this is determined by the avalanche breakdown point shown in the reverse characteristic. At this point the current suddenly increases rendering the diode useless as a blocking component. Ranges of diodes are produced with differing maximum reverse voltages and a comparison of cost for differing reverse voltages and forward currents is given in Table 1.

Table 1: Rectifier cost comparison

Forward current (A)	Maximum reverse voltage	Prices from £ s. d.	Encapsulation
1	50	1 6	Plastic or metal
1	1,000	5 0	Wire ended
5	50	7 0	Stud mounting
5	1,000	15 0	metal Fig. 9(b)
25	50	7 0	Large stud
25	1,000	2 0 0	mounting
100	50	1 0 0	Large stud
100	1,000	10 0 0	mounting
250	50	1 5 0	Large stud
250	1,000	12 0 0	mounting

Zener Diode Characteristics

Zener diodes utilise both the avalanche effect and the true zener effect to obtain the typical characteristic shown in Fig. 5. Stabilising, or commonly zener, diodes using the avalanche effect—which is due to breakdown of the junction—are usually greater than 6V and have a positive temperature coefficient. True zener diodes, which utilise the zener effect (due to break-up of the atomic bonds in a high impurity concentration junction), have values between 2·7 and 6V and have a negative temperature coefficient. Ranges of values are produced and a list of standard zener voltages for the 5% range is shown in Table 2. Commonly 30 or 33V is the maximum voltage in a given range but zeners up to 100V are available. The normal tolerance ratings are 5% and 10% but 1% ranges and special purpose zeners of 0·1% tolerance are available.

The ideal zener characteristic shown dotted in Fig. 5 would provide a constant voltage reference over a wide range of current, whilst the practical characteristic illustrates two main divergences from this ideal. First, there is the knee of the characteristic, at which point the voltage changes rapidly and non-linearly with current; following this there is the useful range, which is linear as the voltage changes proportionately with current. To eliminate the effect of the knee of the characteristic the zener diode is biased with a standing current—usually 5mA—which biases it into the working range where the voltage change with current is linear. But unlike the ideal this is of finite resistance and is known as the slope or dynamic resistance. This resistance determines the usefulness of the device as a voltage stabiliser and the aim should always be towards the ideal of zero resistance.

The temperature coefficient also affects the usefulness of the zener as a voltage stabiliser. As we have seen the temperature coefficient varies from negative below 6V to positive above, with 5·6V as the almost zero coefficient value. However at 5·6V the range of temperature coefficient is wide and a more generally zero coefficient can be obtained by matching a diode and a 6·2V zener as shown in Fig. 6.

The maximum current which can be passed through

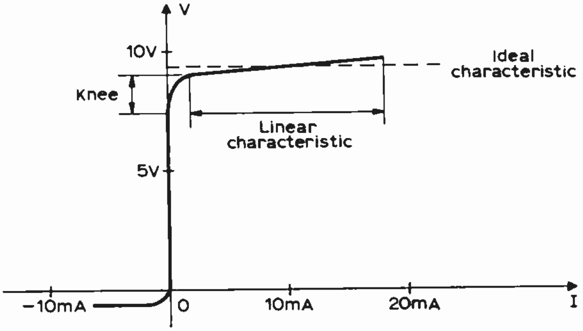


Fig. 5: Zener diode characteristic.

Table 2: Standard zener diode values
(5% tolerance range)

2·4	6·2	16	43
2·7	6·8	18	47
3·0	7·5	20	51
3·3	8·2	22	56
3·6	9·1	24	62
3·9	10	27	68
4·3	11	30	75
4·7	12	33	82
5·1	13	36	91
5·6	15	39	100

Table 3: Selected zener diode characteristics *(400mW range)*

Zener voltage (V)	Maximum zener current (mA)	Slope resistance $R_Z(\Omega)$	Mean temperature coefficient % per °C	5% Tolerance voltage limits (V)
3·3	85	75	—0·060	3·1- 3·5
3·6	80	75	—0·055	3·4- 3·8
3·9	75	75	—0·050	3·7- 4·1
4·3	68	62	—0·040	4·0- 4·6
4·7	60	55	—0·020	4·4- 5·0
5·6	50	25	+0·005	5·3- 6·0
6·8	42	6	+0·030	6·4- 7·2
7·5	38	5	+0·045	7·1- 7·9
9·1	31	7	+0·060	8·5- 9·6
10	28	10	+0·065	9·4-10·6
12	23	14	+0·080	11·4-12·7
15	19	22	+0·085	13·8-15·5
18	15	32	+0·090	16·8-19·0
22	13	40	+0·090	20·8-23·0
27	10	52	+0·090	25·4-28·6
33	8	60	+0·090	31·3-34·5

a zener diode is limited by the maximum power of the device. Since the power dissipation is fixed by the construction, and for each device is given by the zener voltage multiplied by the current through it, the maximum current reduces as the zener voltage increases. As an illustration a 300mW range of zeners is capable of carrying 100mA maximum at 3V zener voltage (100×3) or 10mA maximum through a 30V zener (10×30). Power dissipation up to 10W is commonly available.

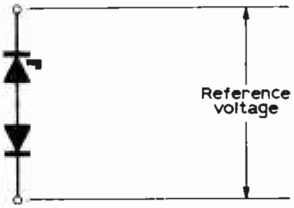


Fig. 6 (left): Use of an ordinary diode and zener diode combination to provide a zero temperature coefficient assembly.

Table 3 illustrates a typical 400mW range of zener diodes and only selected values have been incorporated. From the parameters shown it can be clearly seen that the 5·6V zener is almost of zero temperature coefficient whilst the 7·5V zener has the lowest slope resistance. The current decreases rapidly with zener voltage and is somewhat lower than expected due to allowance for elevated ambient temperatures and tolerances.

Let us now consider the construction of modern semiconductor diodes. The early metal oxide semiconductor rectifiers have been neglected since they are used only in special applications. In general zener diodes are manufactured by diffusion processes in the same way as diodes, except that impurity concentrations are varied to give the required reverse characteristics.

Point Contact Diodes

Point contact diodes were an early form of miniaturised diode. They are manufactured from germanium wafers usually of n-type impurity mounted on a header and connected to a lead-out wire as shown in

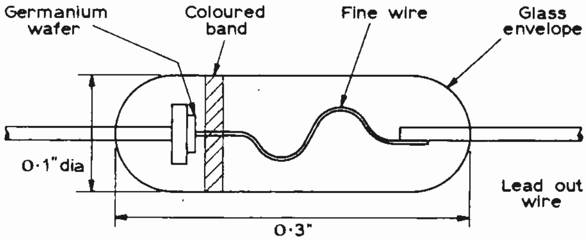


Fig. 7: Typical point contact diode.

Fig. 7. The contact is formed by a fine wire attached to the second lead-out wire so that the fine wire is sprung with a point contact to the wafer. The glass envelope encapsulation maintains the contact which is also stuck to the wafer. The actual junction is formed by passing a high current pulse through the device and this forms a junction at the point contact. The diode is then identified by coloured bands or numerals, and the cathode indicated by the proximity of the bands.

The main advantage of this form of construction is that the junction area is small so that the junction capacitance is low (about 1pF) and as a result operation at high frequencies is possible. The point contact diode is therefore particularly suited for use as a signal diode at v.h.f. and for switching circuits. A further advantage is that it is cheap to construct and point contact diodes are available at between 1s. and 5s. each.

Disadvantages with this form of construction are that the maximum forward current is low (<100mA) and the reverse current relatively high—typically 10-50μA at ambient temperature and 25-250μA at elevated temperatures. The forward voltage drop is also high, a drop of 0·5V at 1mA is common. Also the mechanical structure is not as robust as other forms, although perfectly sufficient for all but the most stringent requirements.

Junction Diodes

The title junction diode usually refers to the alloy junction construction shown in Fig. 8. The alloy junction is formed by alloying a pellet of impurity material at high temperature on to a p- or n-type wafer.

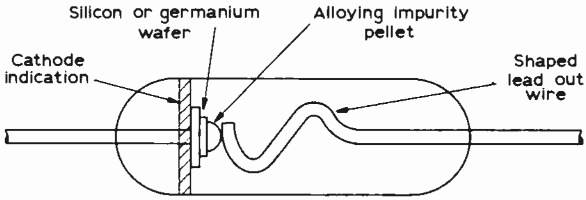


Fig. 8: Alloy junction diode construction.

One lead-out wire is connected directly to the wafer whilst the other is connected via an "S"-shaped metal connection. This shape is sprung to the junction prior to bonding in order to allow latitude in alignment and after encapsulation to prevent damage to the glass encapsulation or junction by expansion of the materials. The glass encapsulation is often paint coated and designation numerals or coloured bands are used to indicate the device type. The cathode is indicated by a coloured band.

continued on page 534

David Cameron's

PREVIEW OF AUDIO FAIR

This is not intended to be a comprehensive description of the exhibits to be seen at Olympia—there are some 80 exhibitors, most of them with large ranges of equipment and some (notably importers) with several manufacturers' ranges to display. This supplement, then, may be taken as a guide to some of the more interesting exhibits known to the compiler at the time of going to press serving as a general impression for those unable to get along and as an appetite-whetter to those fortunate enough to be Olympia-bound for the Fair.

Come and see P.W. on stand 73!

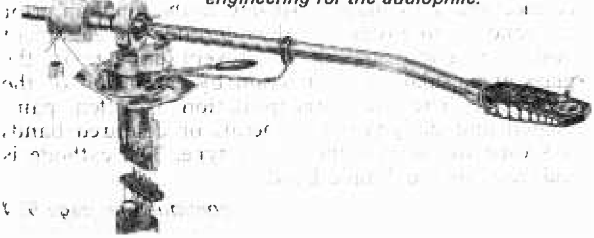
Pick-ups and Players

Pick-ups are not the simple things they used to be. The modern arm is a futuristic-looking device, slender and tubular, and hung with an assortment of weights, wires, levers and other attachments. This has spread to even the cheaper models, and stylus pressure adjustment, cueing devices, bias compensators and lifting systems are becoming almost standard. To set up a modern pick-up arm on installation is nowadays an engineering exercise.

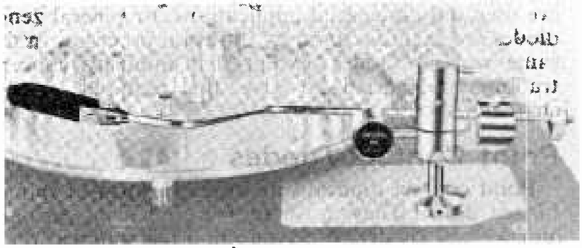
This section of the hi-fi field is dominated by British manufacturers. Perhaps the first of the modern precision pick-ups was introduced in 1962; its descendent can be seen on the **SME** stand in their Series II arm. Its features include very light gauge aluminium alloy arm carried on virtually frictionless knife edges, bias adjuster graduated to correspond with tracking force (sidethrust being compensated in the form of a weight on the end of a nylon thread running over a guide at the rear of the arm), a baseplate sliding on a graduated bed plate for precise tracking adjustment, pillar bearing with high precision ball races totally enclosed against dust. This unit has been described elsewhere as "the best pick-up arm in the world" and the price is £31 6s. 3d.

Another advanced design will be shown by **Transcriptors** who will exhibit their Transcriptor Fluid Arm, so called because of its unique pivot arrangement incorporating a fluid as a damping and supporting agent. Using a precision unipivot working down into a deep oil well, the arm beam assembly relies for its lateral support, stability and resonant damping, on the fluid by which the pivot is surrounded. The friction generated by the unipivot is claimed to be so low as to defy measurement. A secondary feature is the bias compensating device which produces a pure rolling motion. An adjustable bias weight, operating through a pulley, provides correction as the stylus moves to the centre of the record. The lowering (cueing) device is also noteworthy in that the whole assembly swings round the support tube, facilitating positioning. The fluid arm costs £22 16s. 4d.

Goldring are introducing a new transcription deck and pick-up arm. The GL69 unit follows the tradition of previous Goldring-Lenco turntables and features continuously variable speeds from 30-86 r.p.m. It is fitted with the new L69 arm, which is also obtainable separately, and which can be lowered

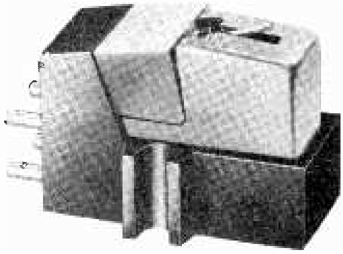


The SME Series II pickup arm—precision engineering for the audiophile.



Transcriptors fluid arm, another British precision product.

PREVIEW OF 69 AUDIO FAIR -2



The Audio-Technica AT35, a typical example of the modern magnetic cartridge with detachable stylus assembly.

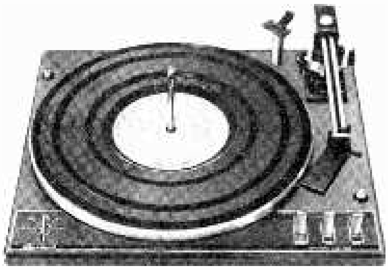
on to the record by a viscously damped lowering device. Height of arm and position of stylus on the headshell can be adjusted for optimum tracing. Stylus pressure is adjustable by a sliding counterweight. The idler wheel is automatically disengaged from both turntable and drive as the unit is switched off. The GL69 costs £25 1s. 6d. and the L69 alone £9 5s. 9d. A lid and plinth are optional extras.

Another respected name on the British hi-fi scene is **Garrard** who will be showing four new additions to their well-known range of Synchro-Lab record playing units. Model SL95B is an automatic transcription turntable fitted with a Synchro-LAB motor which combines the best features of both induction and synchronous motors. Other points include automatic play of single records, cue and pause facilities, bias compensation and calibrated stylus force adjustment. A novelty is the low resonance pick-up arm of wood and aluminium which incorporates a resiliently mounted counterbalance weight and gimbal-type pivots. Like almost all the modern pick-up arms, a detachable cartridge carrier is fitted (this one slides in; others plug in). The SL75B, SL72B are similar in many respects and all have tab controls for easy operation. The fourth new one is the SL65B which offers the facility of combined record size and speed selection.

Also new from Garrard are two units based on the recently introduced "compact" mechanism of the CC10 4-speed autochanger. Features include automatic play of single records, single record repeat provision, automatic switch off at at end of a single record.

The name of **Leak** is normally associated with amplifiers, but at the Fair the company is introducing a new transcription turntable. Operating at two speeds ($33\frac{1}{3}$ and 45 r.p.m.) it incorporates a 12-pole hysterisis motor with belt drive and has less than 1·15% wow and 0·02% flutter. A neoprene drive belt decouples the turntable and pick-up from motor vibrations giving rumble levels below audibility. An isolated pick-up platform and balanced turntable mounting plate greatly reduces the effects of acoustic feedback and shock excitation. The *Truspeed* unit is fitted with a pick-up arm with raising and lowering device, bias compensation and adjustable counterweight. The frequency response of the cartridge is claimed to be free from resonances within the range 20-20,000Hz and the stereo separation is better than 25dB at 1kHz. Less plinth the price is £61 11s. 6d, with plinth £65 13s. 3d.

BSR, the world's largest manufacturer of record changers will include in their display many keenly priced units, including the latest models in the range—MA65, MA70 and MA75. They will also feature the AA50 "minichanger", which weighs only $4\frac{1}{2}$ lb. and is 35% smaller and 40% lighter than conventional record changers. Visitors will be able to see a display showing all the working parts of a BSR deck in action.



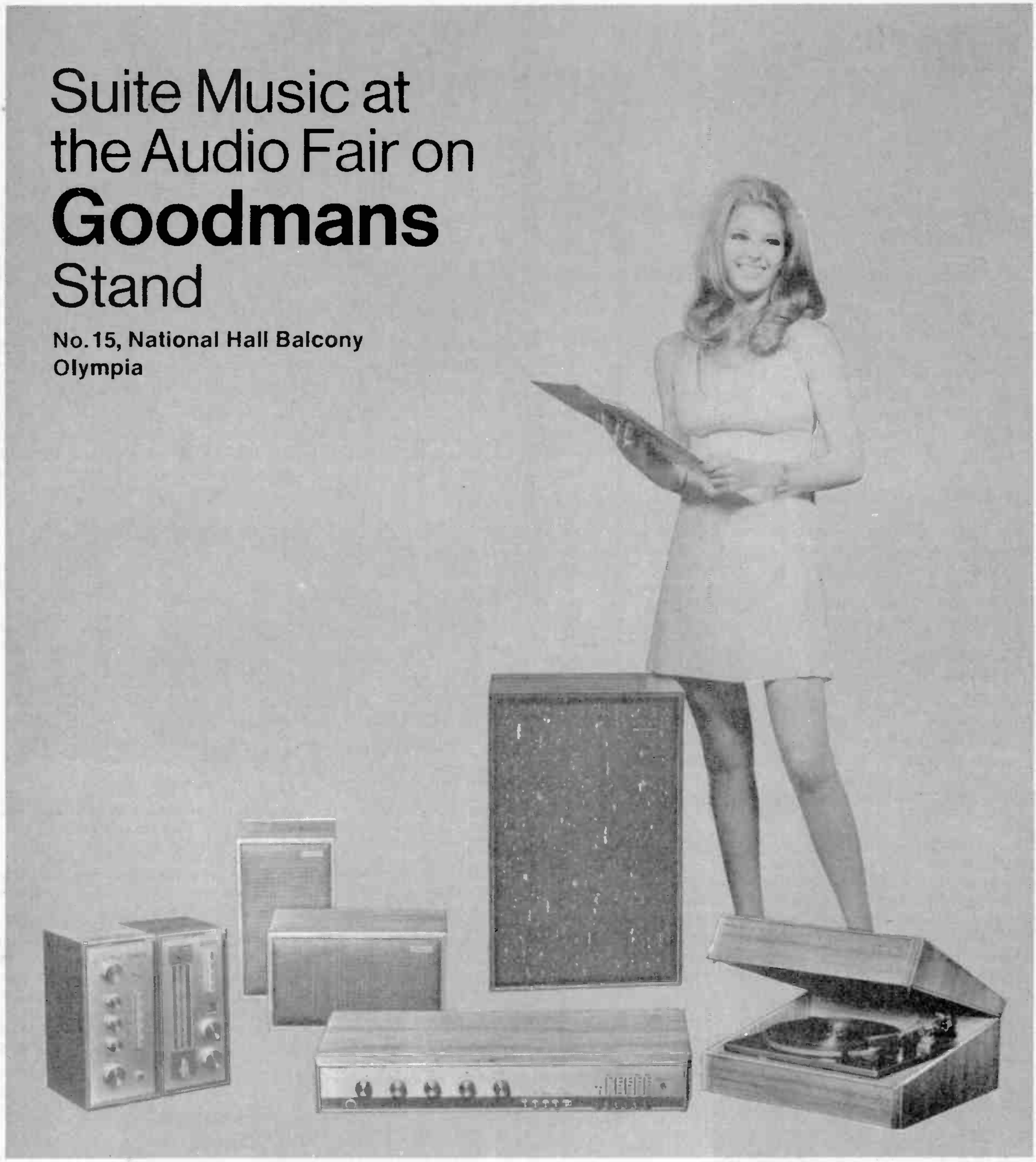
Three new high quality turntable units. Left—the Goldring GL69 fitted with the new L69 arm. Centre—the Leak Truspeed unit with isolated pickup platform. Right—the Garrard SL75B with Synchro-LAB motor and tab controls.

The modern trend in cartridges is decidedly towards the miniature magnetics with detachable cantilever systems and there is a lot of overseas competition here by companies such as **Shure, Audio-Technica, Dual, Orbit, Audio Development**, etc. On the **Shriro** stand, for instance, visitors can see the Audio-Technica cartridges such as the AT35 which features a V-shaped lightweight moving element supported by a wired damper mechanism. Specification figures include frequency response 10-25,000Hz, stereo channel separation 30dB at 1kHz, compliance 23 cu's, tracking force 0·5-2·5gm, tracking error less than 1·5°, output voltage 5mV. The AT33 is an economical version retaining many of the features but at very competitive price. While here, also note the AT1007 pick-up arm which has a direct reading stylus pressure control calibrated every 0·1gm, two balance weights to minimise dead mass, hydraulic arm lift and inside force cancellation device.

Loudspeakers

Just as there have been notable changes and improvements in pick-up and cartridge design, so has there been advancement at the opposite end of the audio chain. The old maxim of "the bigger the better" still holds a certain amount of truth but for average home listening this is not nearly so important today. A lot of research and development has gone into improved cone materials, enclosures and multiple unit assemblies, resulting in a veritable rash of shelf-mounting infinite baffle boxes, many of them producing remarkable results considering their size (and price). There will be so many of these, both imported and home grown, that it would be pointless attempting a run through in this review.

There is, however, a current trend to offer kits of speaker assemblies to the home constructor, usually with instructions for mounting and making enclosures. **P. F. & A. R. Helme**, importers of the Peerless speaker kits (described recently in



We will be demonstrating our Audio Suite and the recently introduced Music Suite. See and hear Goodmans quality for yourself.

All the units in Goodmans Suites – amplifiers, radio tuners, tuner/amplifiers, record players and loud-speaker systems – are of course available separately.

You will be able to compare, too, our famous 'M' range of loudspeaker systems. And see all our latest products.

We'll be waiting to welcome you each day from 10 a.m. to 9 p.m. October 16th to 22nd.

If you are unable to visit the Audio Fair, make an early call on your Goodmans dealer and find out about Goodmans High Fidelity. Or send the coupon for our free 28 page Manual.

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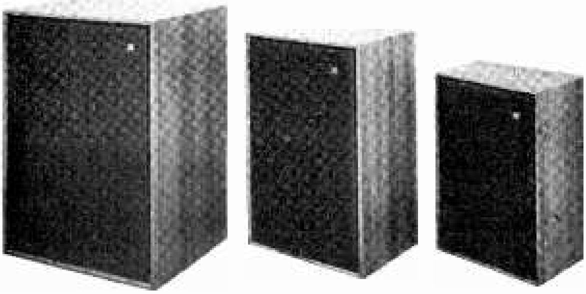
Goodmans Loudspeakers Ltd
Axiom Works, Wembley. Middx.
Telephone: 01–902 1200 P W11



Three of the latest in the Goodmans M range of IB enclosures —left to right, the Magister, the Magnum and the Mezzo.

PREVIEW OF AUDIO FAIR -3

News and Comment) will be showing a new one—the 4-30 KIT/12. This comprises a 12in. bass speaker, a 5 × 7in. mid-frequency unit, and two closed-back $2\frac{1}{2} \times 2\frac{1}{2}$in. tweeters, with dividing network crossing over at 500Hz and 3·5kHz. The system frequency range is 30-18,000Hz and the power handling capacity 40W at 4Ω (8 or 16Ω available if required). Complete with mounting instructions and drawings for 1·75 cu. ft. cabinet, the kit costs £23 5s.

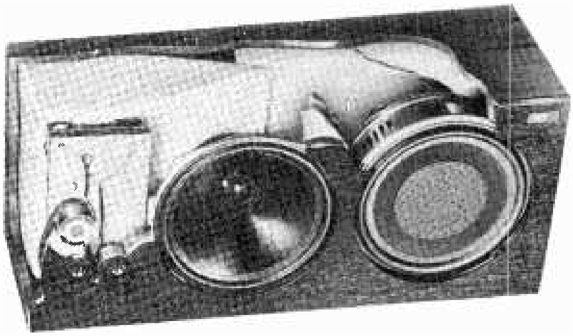
E.M.I. also have matched speaker kits. Set 215 comprises a 14 × 9in. bass unit with heavy ceramic magnet and new laminated glass reinforced cone, two 5in. mid-range units with preformed p.v.c. suspensions, a high frequency unit and panel-mounted crossover network with input terminals and "brightness" adjustment switches. Overall frequency range is 20Hz to 20kHz and the power handling capacity is 30W at 8Ω. Set 315 has a new 15in. bass unit capable of handling 35W with a bass resonance of 20Hz, two new 5in. mid-range high-flux units, two moulded chassis h.f. units and a switch plate/crossover network.

Rola Celestion will be demonstrating a full range of hi-fi loudspeaker systems and will also be running an interesting electronic demonstration designed to offer visual evidence of the way in which the auxiliary bass radiator functions. Also on display will be a range of Celestion high fidelity drive units for the home constructor, in addition to the well known range of *Ditton* enclosures.

Wharfedale will be showing their new Unit 3 hi-fi speaker kit. An 8in. unit of 48,000 Maxwells covers bass and mid-frequencies, leaving the h.f. to be dealt with by a pressure unit featuring the new Acoustiprene dome diaphragm with diffuser cap. With a suitable enclosure the system has a frequency range of 40-17,000Hz. Power handling capacity is 15W at 4-8Ω. The kit comes complete with crossover network, connecting wire, mounting bolts, acoustic wadding and instructions.

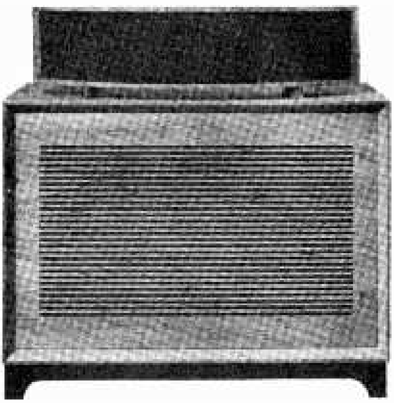
Another one for the home constructor is the new **Heathkit** *Ambassador* 3-way speaker system. Using ceramic magnet speakers a frequency range of 30-20,000Hz is obtained. There is a 15,000 gauss 12in. bass unit, a 5in. enclosed mid-range unit and a 1in. dome direct radiator type tweeter (16,000 gauss). Crossovers are at 1kHz and 6kHz. The teak or walnut veneered infinite baffle cabinet is supplied ready-assembled, the front and rear being of high density chipboard and the frame lined with Celotex. Assembly time for the complete system is estimated at 3-4 hours. The kit costs £29 16s., plus 15s. carriage.

The electrostatic speaker, with moving elements some 200 times lighter than the diaphragms of m.c. speakers and freedom from cabinet resonances and coloration, are still popular with those seeking the ultimate in natural reproduction and have the cash to spare. The **Quad** model has a bandwidth of 48Hz to 18kHz with a rate of attenuation asymptomic to 18dB/octave. The speaker is enclosed within expanded metal grilles with polished wood end frames and feet and is designed for use in rooms of up to 500 cu. ft. per speaker. Impedance is 30-15Ω at 40Hz to 8kHz after which it falls; it is therefore important that this type of speaker should be used only with amplifiers designed for such applications.



Interior view of the Rola Celestion Ditton 25, showing the advance in design of modern compact enclosures.

To see what *can* be achieved in speaker design the visitor should seek out the Model 70 being shown by **B & W Electronics.** It is a hybrid comprising a new low distortion bass unit and enclosure, on which is mounted a 701 electrostatic unit. The latter is an 11-module assembly covering frequencies above 400Hz providing performance figures such as input distortion at 30W r.m.s. in the order of 0·5% and dispersion over a 60% arc showing a variation of not greater than ±1·5dB.



On the left is the B & W Model 70 hybrid monitor speaker system.

On the right is the new Unit 3 high fidelity speaker kit from Wharfedale.

PREVIEW OF AUDIO FAIR -4

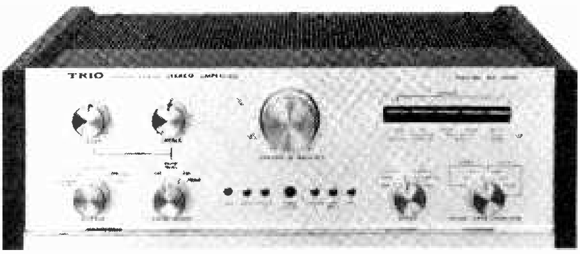
Amplifiers

Most of these are becoming so sophisticated, with their banks of controls, knobs, buttons and switches, that they look more like something from a Space Control Centre than an item of domestic equipment. Silicon and f.e.t. transistors are the order of the day, with quite a few incorporating integrated circuits, the ICs permitting considerable elaboration of circuit features in less space. Wattage (even real, r.m.s. ones) are creeping up and input and output facilities more comprehensive. Most are stereo.

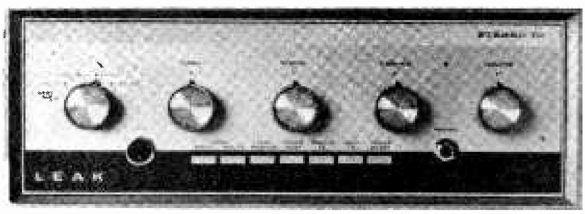
One magnificent amplifier to catch the eye is the **Grundig** SV140, which incorporates 51 transistors, 20 diodes and 3 rectifiers and delivers 50W per channel r.m.s., the output being monitored by two calibrated meters. No less than 5 tone controls are fitted, each operated by slider-type controls, the centre frequencies being 40, 200Hz, 3, 7·5 and 16kHz. Apart from the general versatility it is possible to use this system to form a type of presence control to bring soloists and vocalists, etc., more into prominence. The frequency response is 20-20,000Hz $\pm$1dB with a power bandwidth of 10-50,000Hz measured at 1% distortion. The distortion factor at full rated output is less than 0·5% within 40-16,000Hz and 0·1% at 1kHz. Signal-noise ratio is 60dB (pick-up) or 86dB (tuner, tape) at full output.

Inputs are PU1, PU2, Mic, Tape, Tuner. Outputs are for speakers, stereo headphone, additional amplifiers. An electronic protection circuit disconnects the amplifier whenever the output load exceeds a predetermined level, responding to capacitive and inductive overload. A thermal cut-out is also provided to switch off the amplifier if excessive internal temperatures reach danger level. There are provisions for volume compensation through two contour buttons (1) up to 25dB bass lift at 30Hz, (2) up to 33dB bass lift at 30Hz and treble lift up to 10dB at 15kHz. Price not available at time of going to press.

Few companies are marketing Class A amplifiers, fewer are producing separate control units and companion main amplifiers. **J. E. Sugden** are doing both with their C51 and A51 units released in time to show at the Audio Fair. The C51 control unit has inputs for magnetic, ceramic (2·5mV) and special (250μV) cartridges, all equalised to RIAA, plus radio, tape and auxiliary, with overload capabilities of 25dB for disc and infinite for other inputs. Total harmonic distortion is better than 0·1% (mainly 2nd harmonic) at rated output of 600mV. Frequency response is 30Hz to 20kHz $\pm$0·5dB. Controls are provided for rumble filter, h.f. filter, h.f. filter slope, quiet (16dB at 1kHz). Price is £42. The companion Class A amplifier delivers 25+25W r.m.s. at clipping level into 8 or 15Ω with a total harmonic distortion of better than 0·1% at 20+20W, better than 0·01% at 1+1W. Signal-noise ratio is 90dB and frequency response 30-20,000Hz $\pm$0·5dB. Price is £65.



Trio KA-6000 with 58W per channel r.m.s.



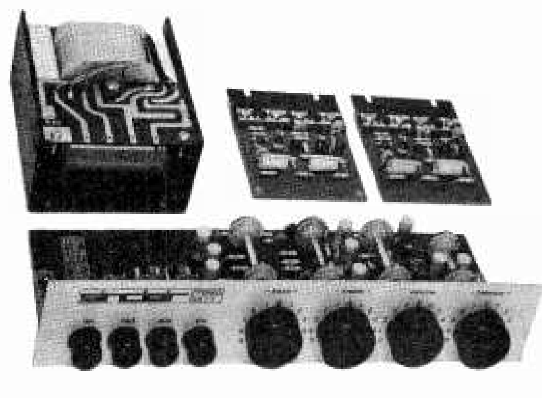
The new Leak Stereo 70 stereo amplifier.

There are so many other fine amplifiers that it is hard to select representatives. The Trio KA6000, distributed here by **B. H. Morris & Co.** is, however, a good example of the more expensive imported item, selling at £105. Inputs are provided for magnetic pick-ups at 2mV, 0·5mV and 0·05mV, tape head, mic, tuner, tape play, and main amp. Features include a $-$20dB muting switch for momentary quietness (during telephone calls, etc.), high and low filters, 2dB step-type tone controls with tone mode switch, preamplifier outputs for use with another amplifier or multichannel system, speaker terminals for two sets of stereo speakers (A, B, A & B and phones selection by front control knob), automatic circuit breaker to protect power transistors, frequency response 20–50,000Hz $\pm$1dB at high level input.

On the home front again, the latest **Leak** amplifier—*Stereo 70*—is less flamboyant but quietly efficient. With 35+35W r.m.s. output, it boasts specification figures such as 0·1% total harmonic distortion for all power levels up to 25+25W, total intermodulation distortion less than 0·5% for all power levels, overload distortion less than 0·1% for input signals up to 20dB above stated sensitivities, hum and noise 66dB below 30W output (tuner and replay), crosstalk between channels 50dB up to 1kHz, 30dB at 10kHz. Price is £69 10s, in cabinet.

Another adherent to the policy of separate control unit is, of course, **Quad,** who will be showing their latest range. The 33 control unit follows Quad tradition in comprehensive filter facilities. Push buttons provide selection of 5k, 7k and 10k filters, with separate variable filter slope control and a fixed filter to take out unwanted signals below 20Hz. The main amplifier, model 303, features symmetrical triples in the output stage to reduce distortion and to render the quiescent current independent of output transistor temperature. Output is 45+45W at 8Ω with distortion less than 0·03% at 70Hz, 0·1% at 10kHz and the frequency response is $-$1dB at 1kHz reference between 30–35,000Hz. Hum and noise is 100dB below full output. Prices are £43 (33), £55 (303). A matching f.m. tuner costs £51.

New to this country is the range of Nikko equipment, marketed here by **Howland-West.** The TRM50 uses four silicon output transistors, the rest of the circuitry being built up around ICs. It gives 17+17W r.m.s. output with a frequency



Component units of the new Sinclair Stereo-60 audio module system—power unit, main amplifiers and control unit.

The Nikko TRM-50 amplifier built up around ICs.

response of 10Hz to 70kHz ±1·5dB. Channel separation is better than 50dB and hum/noise at rated output is −65dB (pick-up) or −75dB (tuner, tape). Price is approximately £58. A budget-priced model from the range is the TRM40 retailing at around £35. On the same stand, the Dynaco SCA80 is worth inspecting. This is Dynaco's first integrated solid state amplifier; price not yet known.

Sinclair usually come up with something to talk about. This time it is their *Stereo-60* module system. The basic unit is the preamplifier/control chassis, providing bass, treble, volume and balance facilities, push-button selection of three inputs (sensitivities up to 3mV, equalised to within ±1dB of RIAA). The unit drives two Z30 amplifier modules, each of which provides 15W r.m.s. output at 8Ω with a frequency response of 20–30,000Hz ±1dB, 0·02% total harmonic distortion at full output. Silicon epitaxial planar transistors are used throughout. Alternative power supplies are the PZ5 (30V unstabilised) and the PZ6 (35V stabilised). Prices for the modules are control unit £9 19s. 6d., Z30 89s. 6d. each, PZ5 99s. 6d., PZ6 £7 19s. 6d.

Tuners and Tuner/Amplifiers

These reflect the same increasing sophistication as the amplifiers. Many facilities and controls—not always pure gimmickry—are common tendencies, all aimed at more rewarding listening and appreciation of good quality reproduction. Circuitwise, we again see the infiltration of FETs and ICs, with ceramic filters in the i.f.s and multiplex stereo decoders well established.

Of major interest is the new **Leak** *Stereofetic* tuner. It features FETs in the front end, ICs in the i.f. strip and decoder to increase rejection of ignition interference and to improve stereo separation, ceramic filters to improve i.f. selectivity and reduce stereo distortion, no less than three 19kHz and two 38kHz band stop filters to eliminate pilot tone whistles when using the tuner with a tape recorder and a double-action muting circuit to eliminate inter-station noise and reducing "in-and-out" tuning plops.

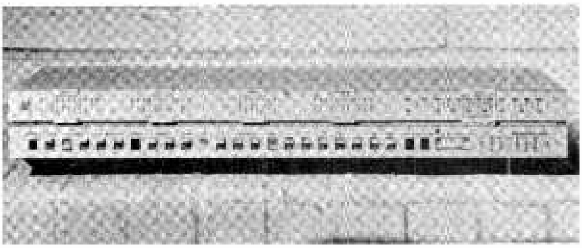
It has been designed as a dual-purpose tuner. For casual listening to local stations, by pressing the appropriate buttons, only signals above 12μV will be heard, with a.f.c. operative. For reception with minimum distortion, low noise and for long distance reception, input signals as low as 2·5μV will produce reasonably noise free and low distortion output. There is also a "Quasi Stereo" button which, when depressed, reduces noise on distant stereo signals without losing the stereo effect. This fine tuner costs £56 11s. (chassis only) or £63 14s. 5d. in wooden case.

Bang & Olufsen will be displaying the latest *Beomaster* Model 3000/stereo tuner/amplifier. This clinical looking unit also incorporates FETs, ICs and ceramic filters in the tuner section, which provides instant selection of six f.m. programmes by means of panel keys. It is also equipped with a new tuning aid—a double finger wheel on the tuning slide (see photograph) which gives effective slow motion drive and a tuning indicator with two illuminated panels. On each panel is an arrow and the panel which lights more brightly indicates by its arrow which way the slide control should be moved for optimum tuning. A calibrated tuning meter is also provided. Comprehensive input and output sockets are fitted including the provision to individually switch each of two pairs of speakers to one of two programme sources. Power output is 30+30W r.m.s. with less than 0·6% distortion. Cost? £135 9s.

Another impressive new offering from **Grundig** is the TR100 stereo tuner, which incorporates 45 transistors, 35 diodes and 2 rectifiers. Coverage is LW, MW, SW1 and SW2 plus v.h.f.–f.m. The a.m. and f.m. circuits are entirely separate. Five auxiliary f.m. scales allow press-button selection of up to six stations and manual tuning is aided by a *Tunoscope* arrangement based on light-sensitive transistors which, like the B. & O. 3000, shows the correct direction of rotation. On f.m. there are 17 tuned circuits (4 tunable, 11 i.f., 2 absorption); on a.m. there are 10 (2 tunable, 4 i.f., 2 i.f. with bandwidth selection, 2 absorption). The stereo decoder is fitted with level controlled mono/stereo changeover, the trigger level may be varied between 6 and 60μV. A low-pass filter controls the audio bandwidth, the narrow band reducing the a.m. bandwidth to 3kHz. The specification figures for this tuner as every bit as good as the recommended price of £171 7s. 11d. suggests.

Trio have an assortment of tuner and tuner/amplifiers. In the high price bracket, the KT7000 features three FETs, four ICs and two crystal filter i.f. stages, with interstation muting circuit, automatic stereo/mono switching with stereo beacon lamp, filter for eliminating noise on stereo signals, signal strength and tuning indicators and heavy flywheel tuning system. Usable sensitivity is 1·5μV and capture ratio 1·3dB. Price is £132. Also using ICs are a.m.–f.m. tuner KT3500 (£65) and a.m.–f.m. multiplex stereo tuner KR77 at £125.

Another tuner/amplifier using FETs(3) and ICs (3) is the Lux HQ555 shown by **Shriro**. The tuner f.m. section has five i.f. stages and a practical sensitivity of 2μV. The amplifier has



The Beomaster 3000 tuner/amplifier—an advanced design.

The HQ555, new from Lux, incorporates three FETs and three ICs.

PREVIEW OF AUDIO FAIR -6

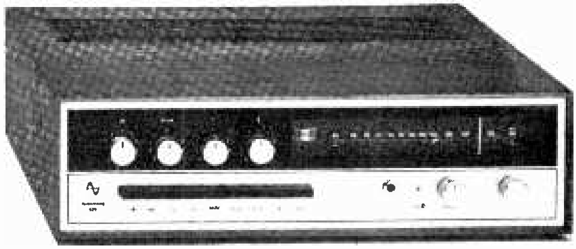
all the usual controls, filters and facilities including a loudness control and A/B speaker system selection. This one sells at £159 18s. 9d.

Also with an FET front end and ICs is the **Nikko** STA301 tuner/amplifier, with 12 + 12W output and a frequency response of 20–50,000Hz ±1dB (IHF). Price is £99 10s.

From **Armstrong** are two additions to their recently introduced 500 Series of audio equipment—the 525 and 526 tuner/amplifiers. The 525 has inputs for magnetic and ceramic pick-ups and tape playback; outputs for tape recording and headphones. Features include tape monitor, f.m. interstation noise suppression, automatic stereo/mono switching on f.m. with stereo indicator, tuning meter. Price is £87 16s. 9d. The 526 is similar but has MW and LW a.m. coverage also and costs £98 15s. 6d.

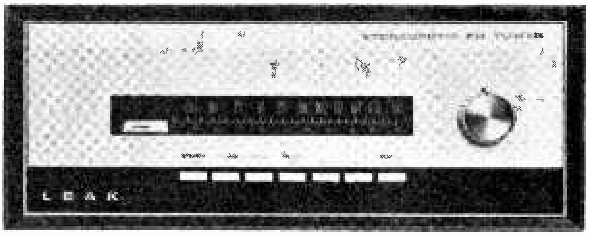
Heathkit add to their range with model AR-17, a stereo f.m. tuner/amplifier using 28 transistors and 7 diodes. It has many points of interest, such as 6-position source selection switch, pre-aligned f.m. front end, a clutched volume control allowing simultaneous or independent adjustment for each channel, automatic stereo indicator lamp, adjustable phase control for optimum stereo separation, stereo headphone socket, output of 5W r.m.s. per channel and a frequency response of 25–35,000Hz ±1dB. This adds up to good value at £36 10s. for the kit, with full constructional details.

Brush Clevite will be showing a large range of Sansui products, from which we select the new 800 a.m.–f.m. stereo tuner/amplifier as of considerable design interest. It provides



Above—the 525 tuner/amplifier, latest in the Armstrong range.

Below—the new Leak Stereofetic f.m. tuner.



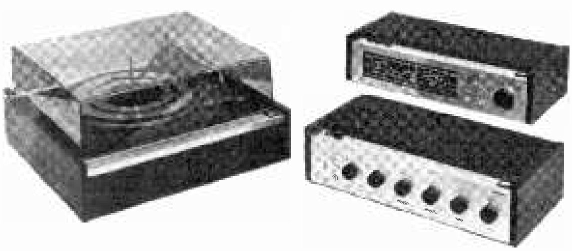
28 + 28W r.m.s. output at 8Ω and has a frequency response of 15–50,000Hz ±1dB at normal listening levels. Features include FET front end, a 4-stage i.f. section and 3-stage limiter (3dB capture ratio and 50dB selectivity), a new style noise limiter, muting switch to suppress interstation mush, a sophisticated switching matrix system giving stereo separation above 35dB and keeping distortion down to 1% at 1kHz, automatic stereo/mono switching, ceramic filter in a.m. section i.f. protection circuit for output transistors, two-system speaker selection, multiplex separation adjustor, tape monitor and stereo headphone sockets, and comprehensive filters and input facilities. Another expensive one, the Model 800 sells at £145 19s. 7d.

Unit Systems

For those who find the out-and-out hi-fi installations fascinating but out of reach financially, the now popular audio budget systems present a way to build up gradually to a worthwhile hi-fi ensemble. **Goodmans** is one company showing such a system of matching units—their recently introduced *Music Suite*, comprising stereo tuner/amplifier 3000, record player unit 3025 and loudspeaker enclosures 3005, which add up to just under £140 of merchandise. Five f.m. tuning scales are provided, the station being preset by push-and-turn knobs; sensitivity is 3μV for 26dB signal/noise ratio and limiting level better than 10μV. The amplifier delivers 15 + 15W output with total harmonic distortion less than 0·5% at 1kHz and frequency response of 30–20,000Hz ±3dB.

Following the successful launching of the Ferguson Unit Audio range, **British Radio Corporation** are entering the hi-fi market with their new HMV units, both ranges being shown at Olympia. The HMV High Fidelity is a package deal consisting of a record player, a tuner/amplifier and a pair of speakers. **Philips** will be showing their Audio Plan units, a very comprehensive range of equipment in which the various bits and pieces can be permutated virtually to suit almost any pocket from the modest to the affluent.

Bush will be showing their Sound System units, eight pieces in all: A746 amplifier (35 gns.), A747 tuner (35 gns.), A749 record player (28 gns.), A758 tuner/amplifier (67 gns.), A762 equipment trolley (16 gns.), A764 shelf speakers (32 gns. pair), A763 column speakers (29 gns. pair), A765 floor standing speakers (58 gns. pair). All equipment is stereo.



Above—audio units from Bush: A746 amplifier, A747 tuner and A749 record player.

Right—the latest unit system: HMV High Fidelity.

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Heathkit Present The 'Compact'

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'COMPACT' AD17

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New models include two stereo 'compacts' models AD-17 and AD-27. The AD-17 comprises a BSR MA65 Turntable with Shure M44-MB magnetic cartridge and a 10 watt (rms) per channel stereo amplifier all mounted on a teak or walnut plinth. The AD-27 is similar but uses the MA70 turntable and includes an FM stereo tuner. In this case the 'plinth' is better described as a small cabinet. It has a 'roller shutter' lid and is available in teak or walnut.

A new loudspeaker has been added to the Heathkit range. The 'Ambassador' is a first-class hi-fi loudspeaker. The cabinet comes ready assembled and finished in teak or walnut to match other current Heathkit equipment. It uses three loudspeaker units—a 12″ bass unit, a 5″ mid range and a small tweeter.

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Compacts

The modern version of the "radiogram" is the audio compact, presented in various forms but basically consisting of an amplifier or tuner/amplifier with record playing deck in the same shelf-mounting cabinet. Of considerable interest to P.W. readers are the two new ones shown for the first time at the Fair by **Heathkit.**

The AD–27 has a stereo f.m. tuner with a sensitivity of 5μV and a 27dB channel separation. Capture ratio is 4dB. The amplifier delivers an output of 10 + 10W r.m.s. and the harmonic and intermodulation distortion throughout the system are both less than 1%. Frequency response is 12–60,000Hz ±1dB at 1W. The playing deck is a BSR MA70 fitted with a Shure M44–MB cartridge. The complete kit costs £82, plus 13s. carriage.

The AD–17 is a similar compact without the f.m. radio section and is provided with a BSR MA65 deck and Shure magnetic cartridge. Price is £54 plus 13s carriage.

A large range of "portable phonographs" and "home music systems" will be shown by **Dual Electronics** in addition to audio "separates". The HS33 comprises an automatic player deck with cue and pitch control mounted atop a 6W per channel stereo amplifier with loudness/contour control, and two separate

speaker enclosures. It sells at £87 10s. A similar model but with more advanced turntable is an intermediate version between the HS33 and the expensive (£165) HS35.

This incorporates a 9W per channel r.m.s. amplifier with a frequency response of 20Hz to 20kHz ±3dB, power bandwidth of 30–20,000Hz, S/N ratio of better than 55dB and crosstalk damping at 1kHz of better than 20dB (pickup), 40dB (tuner, tape). It has 17 semiconductors. The HS35 is fitted with a type 1209 turntable unit which features 4-pole high-torque synchronous motor, anti-skating device which can be set even during playing, pitch control (range approx. 1 semitone), silicone-damped cue control, elestically damped counterbalance with calibrated increments of 0·01 gram, maximum tracking error of 1¾ gram. A Shure M71 magnetic cartridge is fitted.

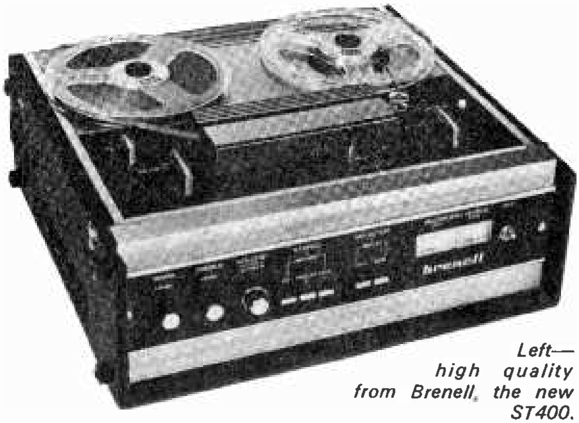
Tape Recorders

Readers will not need reminding that tape recorders are proliferating in a bewildering manner. We can only pick out one or two of particular interest that will be seen at the Audio Fair.

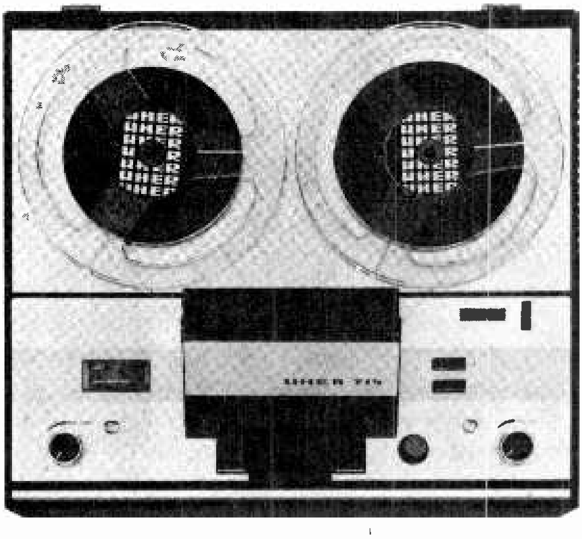
The compact cassette, still looked at rather condescendingly in some quarters, continues to gain ground and with the introduction of the **Teac** A20, shown by B. H. Morris takes another stride forward. For this machine has been designed as a high quality machine. This stereo model features a 4-pole hysterisis synchronous motor, twin VU meters, easy cassette loading and unloading and other refinements, and sells at £78.

Bosch are showing several new Uher recorders. Most interesting are the models 23 (2W output) and 63 (6W output) *Variocords* and their stereo counterpart model 243. Common features include interchangeable head mounts (changing from 2 to 4 track simply), optional modification to automatic recording level, a new tape tension comparator in which the tape tension is determined by the tension of a coil spring enabling thin tapes to be used without danger of looping during braking. Also shown is a model aimed at the budget hi-fi market—the 714, which can accommodate up to 7in. spools and features a recording level meter calibrated in dB, a 4-digit counter, monitoring facilities via loudspeaker or headphones, automatic end-of-tape shut off, silicon transistor circuitry, three inputs, frequency response 40–15,000Hz (at 3¾ i.p.s.), wow and flutter better than ±3%, signal/noise ratio 48dB. All this for £49 17s. 8d.

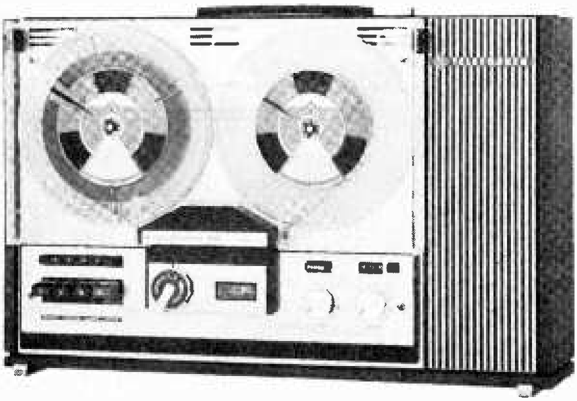
High quality equipment shown by **Brenell** will include a new stereo tape recorder ST200 (or ST400 for 4-track operation). This is a 3-speed, 3-motor machine with a hysterisis synchronous motor for capstan drive, and all-silicon transistor circuitry including a quasi-complementary output stage producing 6W r.m.s. per channel. Push buttons select record mono upper track, record mono lower track, record stereo, monitor during mono recording, replay mono (either track) into both speakers, combine both tracks for playback through both speakers, replay stereo tapes. Low and high level inputs are fitted and three pairs of output sockets for driving an external hi-fi amplifier, for monitor outputs (headphones) or for driving an external amplifier requiring a higher input level, and for feeding external speakers (which automatically switch out the internal speakers).



Left—high quality from Brenell, the new ST400.



Right—one of the new tape recorders from Uher, the budget-priced Model 714.



The first automatic recorder from Telefunken, Model M202.

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From **Bang & Olufsen** there is the new *Beocord* 2400 which features hyperbolically ground tape heads which present a smaller contact area to the tape and thus improve frequency response and dynamic range. Also, with the stronger magnetic field, and coupled to the result of using silicon transistor circuitry, the signal/noise ratio has been improved to better than 60dB using low noise tapes. The 2400 has four pairs of slide potentiometers to adjust independently the levels for mic, radio, gram and line inputs, a fifth slider being used to adjust output volume. The sliders give independent adjustment to the left and right channels and the two VU meters show the level in dB. Together, these facilities provide professional style mixing, with eight mono or four stereo channel inputs. In addition to the conventional metal foil system, the 2400 uses a thyristor controlled auto stop.

Accessories

Colton & Co., apart from their standard lines of replacement stylii, record storage racks and record carrying cases, will be showing a fascinating range of accessories including a series of pick-up arm raising and lowering devices which can be used with any arms—the *Precise,* the *Varilift* and the *Magnalift.* Quite new is the *Cueoptic,* an optically enlarged vernier slide for groove cueing, contact of the cue feeler with the pick-up arm being registered by a neon light. It reads clearly to 0·004in., the average pitch of an l.p. groove. Also new is a Tape/Slide Synchroniser, a purely mechanical device operated by paper stickers attached to the tape causing the switch to open and shut at the preset intervals on electrically operated slide projectors. Being mechanical, it does not tie up a track for impulse recording and thus leaves both tracks clear for stereo sound, Colton also show a ×50 *Microscope,* a pen-like microscope for examining small parts such as stylus tips, the new *Variscale* stylus timer, a range of precision circular bubble levels, plus antistatic fluids, antistatic turntable mats and cleaning cloths, etc.

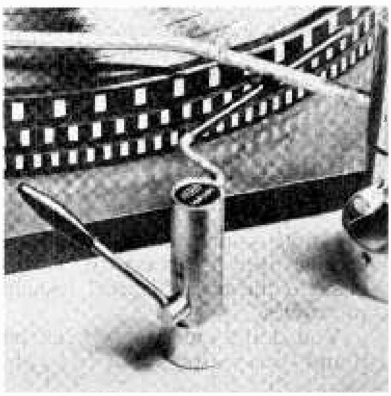
A lively business is done these days in the accessory field, due to the fact that the more one gets interested in audio, the more involved it becomes. Our old friends the Bib Division of **Multicore Solders** have catered proudly for us over the years with tape slicers, tape cleaning kits, instruments, cleaners, wire strippers and the like. They have now come up with a Stylus and Turntable Cleaning Kit comprising 30c.c. bottle of antistatic cleaner, a cleaning brush with a suction cap end (so that it can be kept conveniently near the turntable) and an absorbent, washable, cleaning cloth. The cleaner is non-flammable and cannot harm stylii, cartridges or records. On a card with instructions it costs 6s. 10d.

A novelty from **Diamond Stylus Co.** is their *Record-Matic* which, in their words, is a "self-flipping album browser". It looks like a flat tray, into which l.p. records are stacked vertically. A flip of the first record sets the stack flipping forward until the required record is extracted at which time the motion stops, and so on. The makers claim "no strings, no magnets, no motor".

Highgate Acoustics will be showing a new range of Schweizer record cleaning accessories. The *Record Grip* is a special circular pad used to hold the record correctly and safely during handling (5s. 9d.). The *Record Service* is a cleaning cloth and stylus cleaning brush package (17s. 6d.). There are also two record cleaner brushes—one is a hand-operated brush with reservoir of cleaning fluid, the other is an automatic cleaner with infinitely adjustable degree of moistening from a container holding enough fluid to clean 150 l.p. records. (Prices 9s. 6d. and 65s. 6d.). There is also a new record stacking system which can be built up as required, each flexible section holding from 5–7 records and costing 5s. 6d.

Useful stylus microscope from Colton gives x50 magnification.

The new Varilift from Colton, one of several lowering devices which will be seen at the Audio Fair.



New record stacking system introduced by Schweizer.

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

More Stereo

As a long established reader of your magazine I am suggesting that you start a campaign through your editorial column concerning the BBC's failure to provide stereo reception THROUGHOUT the UK. I am prompted to suggest this to you after reading *Broadcasting in the Seventies* just released. I quote the second paragraph from the sub-heading "Stereo":

"There is, however, an insistent demand for stereo to be extended to other networks and to more parts of the country. It would be idle to pretend that, at present, there is much chance of this, but it would be relatively simple to equip local radio stations to transmit in stereo and we are studying other ways of doing more to meet one of radio's long-term priorities."

Note particularly the second sentence which seems to indicate that the BBC simply do not care about stereo north of Manchester, nor about the equipment such as stereo recorders, stereo radios, decoders, etc., that have been purchased in anticipation of stereo reception.—**J. B. Morris** (*Glasgow*).

The BBC replies . . .

The BBC is well aware of the demand for more stereo transmissions and we have for some time been installing new equipment in studios and modifying recording channels to enable us to increase the stereo content of Radio 3.

We want to extend stereo to other parts of the country and to other networks, but this involves the manufacture and installation of new networks of special radio links suitable for the distribution of the stereo signal to the transmitters. It is not possible at this time to give any dates for these developments, since much depends on our financial situation and on the availability of technical manpower and equipment.—**H. T. Greatorex** (*Assistant Head of Engineering Information Department*).

Some notes on early radio

I thought some notes on Early Radio may be of some interest to readers.

I obtained my first licence in 1920 direct from the PMG London after obtaining a reference from my local magistrate and the local postmaster who inspected the position of the proposed aerial. This licence was to operate a crystal set *only*.

Owing to radio components being very difficult to obtain, I constructed this set from cardboard lino tube formers, a section from my father's wooden grocery counter and phones from two old wall telephones. After completing the construction of this set, I listened many nights for nearly three months without receiving a signal of any type! Eventually Eiffel Tower was heard on a long wavelength (after silencing my watch to hear the very feeble signal).

In 1921 a revised licence was obtained together with necessary permits to purchase a valve and other components suitable for this new set. I may add that John Scott Taggart, Leslie McMichael and Peto Scott were just a few of the early suppliers of diagrams and components. I also had a mobile licence which enabled me to carry out experiments within 15 miles of the fixed station. These experiments were tried out with the use of a kite aerial which gave much improved reception.

I well remember hearing Madam Melba singing on 5th June, 1920, when I laid the phones in a china hand basin to enable three more members of my family to listen.

In 1924 I built a 4-valve portable receiving set with a frame aerial in the lid and the whole set complete with batteries weighed 28lb. In 1926, a 4-valve preset receiver with push-button control was my favourite and now I own a modern a.m./f.m. receiver from which I get many hours of enjoyable listening.—**F. Towndraw** *(Newquay, Cornwall).*

Oh dear, so this is progressiveness!

I note your comments on the change over by PRACTICAL WIRELESS to the term "Hertz" instead of "cycles".

You don't sound very keen on it and your reason is not very convincing either. I can't help wondering what the powers that be would have done, had the name of the gentleman who first noticed the alternating effect had had a name like Pong for instance! (apologies to all Pongs of course).

Likewise we have the idiocy of the recent official announcement that in future it will be obligatory to drop red as the "live" lead in an a.c. circuit and use brown.

It seems to me that the only gains are made by manufacturers who will have a glorious time supplying new equipment to replace that rendered obsolete by these moves.

The adopting of a decimal currency based upon the division of the £1 into 100 parts when it was only necessary (if at all) to decimalise the pence column, using the 10s. and decimalised pence for day to day stuff and retaining the £ for the bankers (bless their cotton socks) if they couldn't cope without it—everyone else could. Regarding temperature measurement, I understand that on the Continent, Fahrenheit is used now for cold store plants, being a more sensitive calibration.

The fairly obvious one, namely inches or millimetres, is equally stupid. Any engineer who cannot work either in inches or millimetres is hardly worthy of the name.

As in most of the "changes for the best" these days, they are merely changes for the sake of change, and so that someone can trot around and say how clever he has been. Honestly, because some of our rulers appear to have gone barmy, do we have to quietly acquiesce and let them mess everything up?—**J. T. Harold** *(Oxford).*

[*Amen.*]—Editor.

A SUB-MINIATURE

POWER SUPPLY

A. RING

A VERY SMALL STABILISED POWER SUPPLY USING AN UNUSUAL METHOD OF REGULATING AND MAKING USE OF A SPECIAL TRANSFORMER NOW AVAILABLE.

THE circuit to be described was designed to fulfil the need for a low-voltage supply unit which may be used to power radios, tape-recorders, and other transistorised equipment in the workshop where continual supplies of batteries would prove expensive.

Design criteria were that an output similar to that of the large layer batteries (e.g. Ever Ready PP9) should be provided, furthermore this output should be stabilised and have low ripple current and also be short-circuit proof without the annoyance of fuses. Miniature dimensions and low cost with reliability were further requirements.

The circuit shown (Fig. 1) uses as few components as possible to fulfil the specification, and is consequently as small, reliable and as cheap as possible; the prototype costing about 30s.

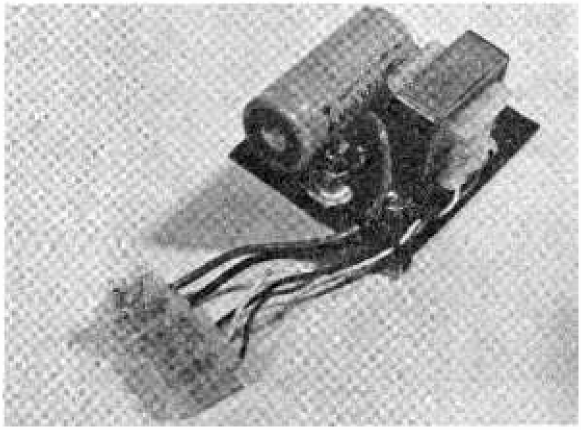
The Circuit

A.C. mains is fed to the primary of T1, a subminiature transformer and 12V a.c. is generated across the secondary. The centre tap is not used. The inter-winding screen may be connected to mains earth.

The secondary is connected to a bridge rectifier consisting of four miniature silicon rectifiers and the pulsating d.c. output of this bridge is clipped to the required voltage by ZD1. The excess voltage between the bridge output and the zener diode when it is conducting is dropped in the secondary winding of the transformer which is wound with resistance wire. A small proportion of this voltage also appears across the diodes D1-D4. Explanatory waveforms are shown in Fig. 2.

The clipped pulsating d.c. across ZD1 is then applied to an electrolytic capacitor and the resultant d.c. is taken to the output terminals. The internal resistance of the transformer secondary limits the short-circuit current to about 300mA maximum and the output may be shorted for fairly prolonged periods without damage. This low short-circuit current prevents further damage to any faulty equipment that is connected to the power supply and its intrinsic safety in this respect makes it ideal for powering prototype circuits.

A 9V output was required from the prototype and thus ZD1 is a 9V type. The output voltage remained very close to the zener voltage when drawing currents up to 100mA (the maximum recommended current to be drawn from a PP9 battery) and reduced gradually to zero when 300mA were drawn. However, for different output voltages ZD1 can be



The completed power supply.

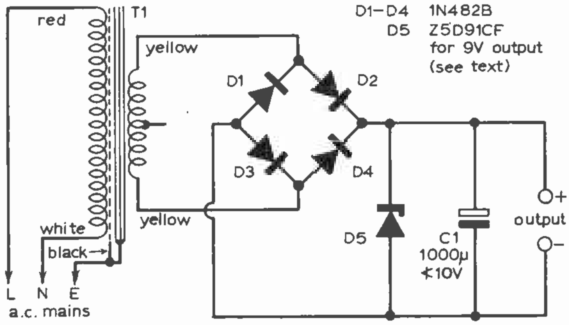


Fig. 1: The circuit of the p.s.u. See text for explanation of the stabilising method.

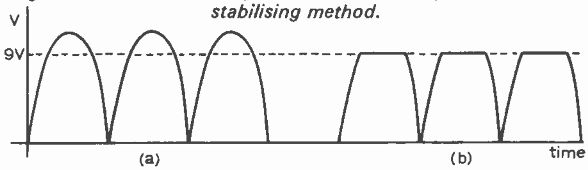


Fig. 2: a) The waveform at the output of the bridge rectifiers. b) The waveform after being clipped by D5 but before smoothing by C1.

★ components list

Transformer, subminiature mains type, primary 240V, secondary 12V, available from Bell, 59 Fairfield Drive, West Monkseaton, Whitley Bay, Northumberland, at 13s. 6d.

Capacitor, C1, miniature electrolytic 1,000μF 12V. D1—4 silicon rectifiers 1N482B or similar; ZD1, Z5D91 CF; Veroboard 2·3 by 2·0 ins.

(A complete kit of the above, including Veroboard is available from Bell, address as above for 30s) chosen for any voltage between 6 and 12V. The maximum stabilised current will be less with a 12V zener and greater with a 6V one.

Construction

The unit is constructed on a small piece of Veroboard and details of this are given in Fig. 3. Only two breaks are necessary in the copper strip and three holes must be drilled for the transformer mounting screws and the zener. Use a large nut for securing ZD1 so that it contacts strips 1, 2 and 3 and hence has an adequate heatsink.

The Veroboard on which the unit is constructed may be the same as an amplifier, radio etc. is built on its small size making it suitable for use as a "built-in" unit.

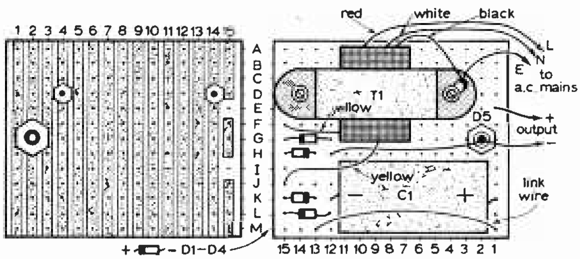


Fig. 3: The component layout.

In the interests of safety the primary should not be taken to the circuit board but rather via flying leads, as shown in Fig. 3.

Uses

If the power unit is to be used on the workbench it may be conveniently mounted in a plastic box from some household product and will take up very little room. If required as a battery eliminator it should be noted that the prototype is half the size of a PP9 battery and can easily be fitted with press-stud connectors and fitted into the battery compartment. ■

THE MW COLUMN

With longer nights rapidly approaching, the medium waves will start to provide good DX listening. For those who want to try this hobby a few notes on aerials are given.

WHICH type of aerial is best for MW DXing? Is it essential to have an outdoor aerial? These questions, put to the writer on numerous occasions, have left the impression that many potential MW DXers are deterred simply because they lack the facilities for erecting an outdoor aerial.

An ordinary TV aerial will give good results on the medium waves. Unplug the coax cable from the TV and connect the outer conductor (braiding screen) to the aerial socket of the MW receiver. Join a good earth to the receiver earth terminal and the TV aerial plus downlead will now act as a vertical aerial. If electrical interference is troublesome connect the inner conductor to the receiver aerial terminal and the outer screen to earth. A reader of this column who lives in Hull used his TV aerial last season to receive a number of US stations including WJR (760) Detroit and WCFL (1000) Chicago!

One of the best MW aerials is the loop; the writer does most of his DXing on one. The loop is an indoor antenna based on the popular frame aerial used in the early days of radio. Its main advantage is that it is directional. There are two nulls—directions of little or no pick-up—pointing in opposite directions at right angles to the plane of the loop. These nulls are very useful indeed for dealing with the crowded conditions prevailing on the medium waveband in Europe, many stations become audible simply by rotating the loop until interference is at a minimum.

The writer's loop consists of 7 turns of plastic covered hook-up wire of about 22s.w.g. wound in the shape of a square of 40in. side. The supporting framework is made of two pieces of wood joined to each other to form a letter X. The turns are wound on to spacers fitted to the ends of the frame and are joined to a 500pF variable capacitor mounted at the centre of the cross-shaped frame. An additional single turn acts as a coupling winding and is wound beside the main turns. This is joined to the MW receiver via a short length of coax cable or 300 ohm feeder which terminates on either the dipole inputs or the aerial and earth terminals. The loop is fixed to a stand so that it can be rotated on its vertical axis. Constructional details of a MW loop appeared in the November 1966 issue of PRACTICAL WIRELESS.†

To operate the loop, tune-in a station on the receiver, peak it with the 500pF variable on the loop and rotate the loop until interference is at a minimum. Interference-free reception of more than one station on the same frequency is often possible by rotating the loop until one of the nulls points in the direction of the station to be suppressed. Although the pick-up of a loop is less than a long wire aerial the signal-to-noise ratio is superior as a result of the loop's directional properties; consequently a clearer signal can frequently be obtained, even in the absence of interference.

CHARLES MOLLOY

† Unfortunately now out of print—Ed.

BASIC SEMICONDUCTOR TECHNOLOGY

PART SIX

by M. F. DOCKER, M.Sc.

THIS month some other types of transistor will be discussed. The reason for manufacturers producing different types of transistor is the fact that it is difficult to meet all possible requirements with a single type. One user may require an audio amplifier with low distortion and high power handling capacity at low cost, another may require a transistor which is good when used as a switch, and yet another may require a device which will amplify signals at v.h.f.

Surface barrier transistors

In order to increase the frequency range in which transistors can be applied it is necessary to reduce the time that the injected current carriers spend in the base region. This can be done in two ways. First the width of the base can be reduced and secondly the velocity of the carriers can be increased. The surface barrier transistor exploits the first method.

They are essentially p-n-p or n-p-n transistors with very thin bases. In order to produce these devices a germanium dice is etched on both sides to produce two depressions opposite each other as shown in Fig. 1. In this way it is possible to produce a base

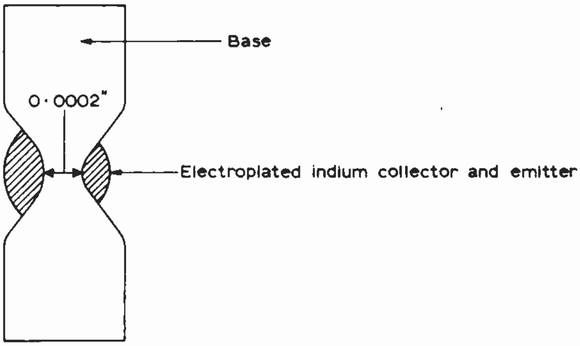


Fig. 1: Structure of a p-n-p surface barrier transistor.

which is only one ten-thousandth of an inch across. After this etch collector and emitter regions are added by electroplating a suitable metal such as indium on to the depressed regions.

The current gain for this type of transistor is lower than for the p-n-p alloy junction device because they have a lower injection efficiency and because the combination of small base width and high resistivity leads to the device having a low punch through voltage. Finally the small collector size limits the maximum power dissipation of the device. These all lead to limitations on the usefulness of the device, the only real applications being low power, high frequency amplifiers.

Micro-alloy transistors

A second type of surface barrier transistor is the micro-alloy transistor, or the MAT as it is commonly called. This is produced in a similar way to the SBT. However instead of using a low melting point solder to attach leads to the metal electrodes as is done in the SBT a higher melting point solder is used together with suitable dopents. The electrodes are then melted and micro-alloy junctions formed. In this way a very low emitter resistance can be obtained leading to a much higher injection efficiency than can be obtained with the SBT. Also higher punch through voltages and higher current gains can be achieved.

A third type of surface barrier transistor is the micro-alloy diffused base transistor, or MADT for short. This again uses a similar process in manufacture but instead of starting by etching directly into a high resistivity base slice, a thin layer of low resistivity material is formed by diffusing in phosphorus (a donor impurity). Etching is then carried out in the same way as before, but with this technique the collector is etched more deeply than the emitter. This leads to a base region which has a graded impurity concentration, resulting in a higher collector-to-base breakdown voltage because of the higher resistivity of the collector base junction region. A higher punch through voltage and a lower base resistance result from the low resistivity material near the emitter-base junction.

Another important fact which results from the variation in the impurity concentration in the base region is the drift field which is developed across the base region. This accelerates carriers across the base region from the emitter to the collector resulting in an increased frequency response (this is in fact the second method of increasing the frequency response mentioned previously).

Severe disadvantages of all the surface barrier transistors is that they have a low emitter-to-base breakdown voltage and a rather low injection efficiency.

Diffused transistors

It has been shown how very carefully alloy junction transistors have to be prepared in order to get a narrow base region. It is necessary for the emitter and collector to penetrate a distance of one mil into the dice from each side and they have to stop at a distance of about one-hundredth of a mil from each other. Naturally the difficulties of achieving this accuracy are very great and this

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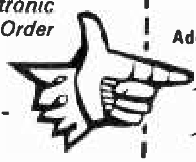

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results in the devices having a large spread in their characteristics.

It was soon recognised that diffusion processes were far easier to control than the alloying processes. Alloying takes place at about 500°C and this temperature has to be maintained accurately for about ten minutes. Diffusion takes place over a much longer period, perhaps an hour or so, and during this period the temperature can be far more easily controlled. This means that the characteristics of the devices made this way are far more reproducible. The basic process of diffusion has been described in the section dealing with the doping of semiconductors but more details are required to understand how the transistor can be prepared in this way.

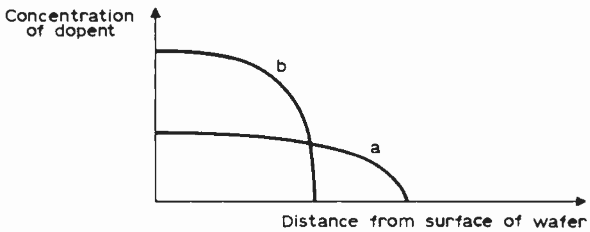

Fig. 2: Concentration of different dopents at different distances from the surface of the semiconductor wafer.

When an impurity is diffused into a dice it does not form a doped region of uniform concentration but rather the sort of distribution shown at *a* in Fig. 2. Different dopents have different rates of diffusing into the dice; thus for example gallium diffuses faster than does phosphorus. In Fig. 2 the concentration of gallium is represented by curve *a* and that for phosphorus by curve *b*.

Early diffused transistors

The first diffused transistors were formed by a single diffusion. For example an n-type wafer of germanium could be used to make a p-n-p transistor in the following way: First the wafer would be cleaned by etching in a suitable acid and washed in de-ionised water to remove all surface defects which would result in degradation of the transistor performance. The wafers would then be put in an atmosphere containing the appropriate dopents and heated to a high temperature for sufficient time for the impurity atoms to diffuse into the wafer. This results in an n-type base region with p-type emitter and collector regions. The wafer is then cut up to give single transistor chips.

The diffused base, alloyed emitter transistor

In this device a p-type dice has a region of n-type material produced on one surface by diffusion of phosphorus. The p-type material acts as a collector and the n-type region as the base. The emitter is produced by alloying an aluminium strip into the base as an acceptor impurity to give a p-type region. A gold wire doped with antimony is also alloyed into the base to provide an ohmic junction which acts as the base contact. In order to reduce the area of the emitter and collector junctions the device can now be etched to produce the shape seen in Fig. 3. The structure is called a mesa transistor because of the similarity between the shape of the transistor and a mountain plateau.

The diffusion process produces a graded impurity

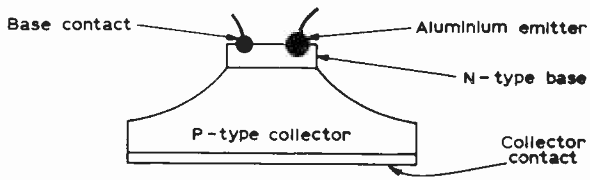

Fig. 3: The structure of the diffused base, alloyed emitter mesa type of transistor.

concentration in the base region which of course introduces the advantages mentioned during the discussion of surface barrier transistors.

The diffused base, diffused emitter transistor

In the diffused base, diffused emitter transistor a similar approach is used in producing the base region as just described. However instead of alloying the emitter a second diffusion is used. After the base region has been prepared a layer of silicon dioxide is grown over the surface of the wafer. A mask of wax is prepared over the surface and a small hole cut into it where the emitter is to go. The oxide layer, which is resistant to the diffusion process, is then etched away in the area of the hole in the wax, the wax preventing the oxide being etched away elsewhere. A second diffusion, this time of a p-type dopent, is then carried out to produce the emitter.

Using this technique higher emitter-to-base and collector-to-base breakdown voltages are obtained and higher power ratings at high frequencies can be obtained.

The alloy diffusion transistor

Another process frequently used to produce transistors is the alloy diffusion process. This uses a combination of alloying and diffusion in order to produce a very thin base region with the built-in field characteristic of the graded junction. The emitter is produced by alloying a lead-antimony-gallium button on to a thin n-type layer which has been produced on a p-type dice. This mixture is allowed to diffuse into the n-type skin and because of the different diffusion coefficients of antimony and gallium a separation of the dopents occurs leading to the production of a thin n-type base region. Contact with the base is made by diffusing an n^+-type region into the base, through emitter, and a lead is subsequently soldered to this. Using this technique high frequency devices with relatively high power capabilities are available.

Phototransistors

The phototransistor is similar in operation to the ordinary transistor. A reverse biased junction is provided between the collector and base. However it is possible to dispense with the emitter junction! The depletion layer of the collector-to-base junction is exposed to the light and this light liberates current

continued on page 530

MONO-STEREO AMPLIFIER

JAMES HOSSACK

Part 2

As its name implies, this amplifier was designed with the experimenter, rather than the sound enthusiast, in mind. For this reason, it was thought desirable to make it not only adaptable to a variety of experimental stereo arrangements, but also capable of fairly easy modification should the need arise.

Figure 2 shows the complete wiring diagram. It should be emphasised at the outset that this is merely a detailed guide to the under-chassis wiring, rather than a blueprint in the strictest sense of the word. The position of cut-outs for valve-holders, transformers, sockets, etc. will depend on the size of the individual components which are available. As this is the case, no precise dimensions are given for preparing the chassis. It is recommended that the larger components are first of all collected, and a cardboard template made up, to simulate the chassis, of the approximate dimensions indicated in Fig. 2, or perhaps ½in. larger all round. Sketch in on this template the required cut-outs, together with holes for fixing bolts and chassis lead-through wiring. *Make sure that these holes will not later be obscured by the components mounted above the chassis.* Figure 3 shows the position which this top wiring will be likely to occupy, and can therefore be used as a guide at this stage.

The wiring operation will be simplified if the position of valveholders and tagstrips, which carry most of the smaller components, corresponds approximately with that shown in Fig. 2, but this will depend to some extent on the size of the two output transformers. The actual spacing used in the amplifier was, in fact, slightly closer than that shown. Tagstrips carrying additional tags can, of course, be employed if desired, since the spare ones will provide handy anchoring points for additional wiring should modifications to the original circuit be contemplated later on.

Having decided on the exact position of the valveholders and all the larger components, and prepared a suitable chassis, the main components can now be mounted in position, making sure that the valveholders have their terminals facing in the correct direction. Commence with the wiring to the valve heaters. For the sake of clarity, the full heater wiring is not included in Fig. 2. If unbalanced heaters were adopted, it is probable that hum, picked up from the single heater wire, and chassis

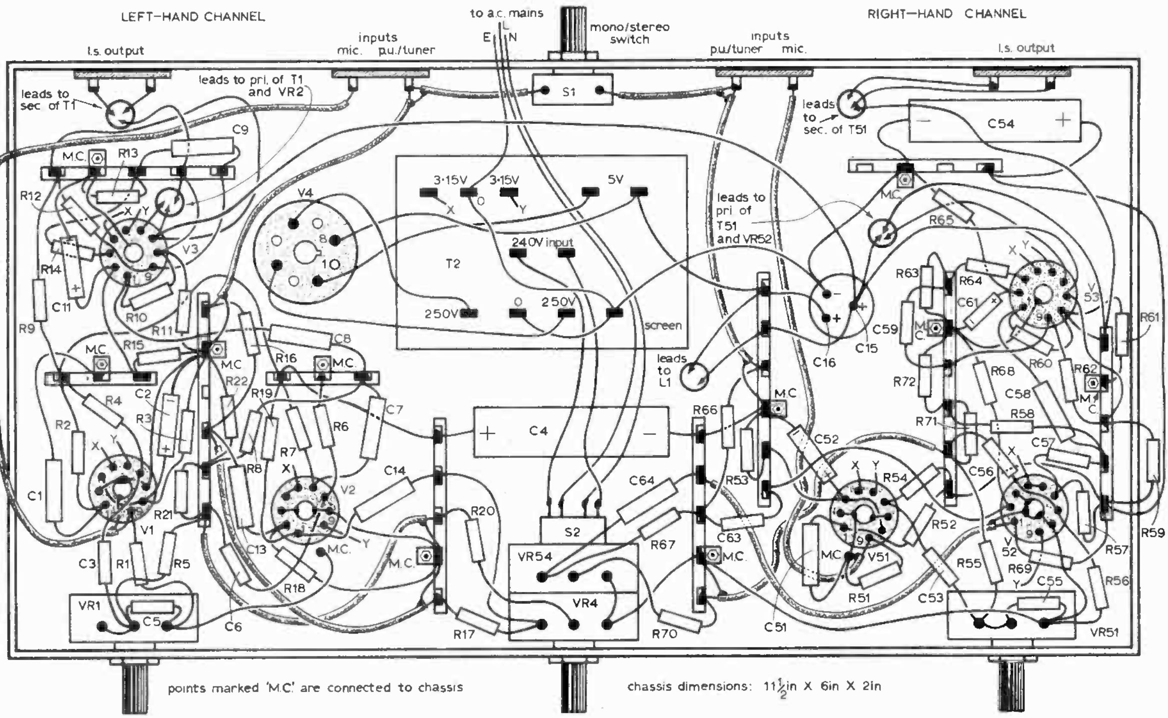

Fig. 2: Chassis underside wiring.
The interconnection of valve heaters have been omitted in this diagram. Refer to the text for details.

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4in. 300ft.	4/6	4in. 450ft.	5/6
5in. 600ft.	7/6	5in. 900ft.	10/6
5¾in. 900ft.	10/6	5¾in. 1,200ft.	13/-
7in. 1,200ft.	12/6	7in. 1,800ft.	18/6
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4in. 600ft.	8/-	5in. 1,800ft.	25/-
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7in. 2,400ft.	27/-	**Quadruple**	
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earth return, would find its way to the input circuits, and be amplified by the remaining stages. To prevent this it is recommended that the valve heaters be wired as follows: Obtain several feet of stiff twisted twin flex of fairly heavy gauge, and run this from the 6·3V output on the mains transformer to V3, V1 and V2 in that order, soldering one lead to the "X" valveholder terminal and the other to "Y". Now do the same for V53, V51, and V52, starting with fresh wire from the transformer. These twisted leads should be routed as close to the chassis as possible.

Now, go back and complete all the earth connections to each valveholder including the centre spigots—refer to Fig. 2. Finally, run a fairly heavy piece of single insulated wire between all the tagstrip and valveholder earths, not forgetting the soldering tags which, in some cases, are mounted below the valveholder fixing nuts, and take this wire by the shortest route either to the point marked "screen" on the mains transformer, or to the centre-tap of the h.t. winding. Neither this "bus-bar" nor the twin heater wiring already mentioned are indicated in Fig. 2, but their inclusion can lead to a marked reduction in hum level, particularly when operating the EF86 stage at high gain.

The wiring proper of Fig. 2 can now be tackled, completing one valveholder at a time, and keeping leads, as short and direct as possible. Although not indicated —again in the interests of keeping the main diagram as clear and uncluttered as possible—the following leads should be screened and the screen braiding earthed: (1) all four leads from the coaxial input terminals; (2) the connections to S1; (3) the connection between R16 and R17; (4) the connection between C64 and R69; (5) the connection between R20 and R21; and finally that between R70 and R71.

After completing the valveholder wiring, proceed to the power supply connections.

All wiring should be carefully checked over, and an ohmmeter connected in circuit across the h.t. line to ensure that no short or low-resistance path exists here. If all is well, plug in the valves for one channel (V1-V4), connect a loudspeaker, and, with the amplifier on its side, turn the balance to mid-position and all other controls to minimum. Switch on and, after a few seconds, check for valve glow and hum from the loudspeaker. The latter should be easily audible, since there is, as yet, no negative feedback to counteract it. Touching terminal 3 on V3 valveholder with the blade of an insulated screwdriver should result in a loud buzz from the speaker, proving that the output stage is functioning. If a high-impedance voltmeter is available, a careful check is recommended at this stage, which should reveal a voltage pattern similar to the figures indicated in Fig 1.

Switch off, and temporarily solder the unconnected "A or B" arrowed lead above chassis (Fig. 3) to one side (either A or B) of the output transformer secondary, and, with the set switched on again, touch the unconnected feedback lead below chassis to the *opposite* wire leading from the transformer (if the A and B wires through the chassis are distinctively coloured, identification of the correct connection is simplified). The occurrence of positive instead of negative feedback on doing this will then be indicated by a loud squeal from the speaker, while, if feedback is in the correct phase, a noticeable reduction of hum should be heard. If the phase is incorrect, simply reverse the two connections.

With the mono-stereo switch in the stereo position, feed an audio signal, from a pick-up, etc., into the high-level input for the appropriate channel, and advance the ganged volume control, VR4/VR54. Check that bass and treble controls are satisfactory. The balance control should provide a fair degree of attenuation of the signal without having too much interaction with the bass control, but some effect is unavoidable for the reasons already discussed. Now, inject a signal of a few millivolts from, for example, a microphone, into the low-level input, advance VR1, and check that mixing and general stability are satisfactory when both inputs are applied simultaneously.

All the above tests refer to one channel. Insert the valves for the second channel and repeat the above procedure exactly as outlined. Finally, with S1 in the "mono" position, both speakers connected, and a suitable high-level input, test the range of the balance control over both channels, and verify that its mid-position gives approximately equal outputs to both speakers. ■

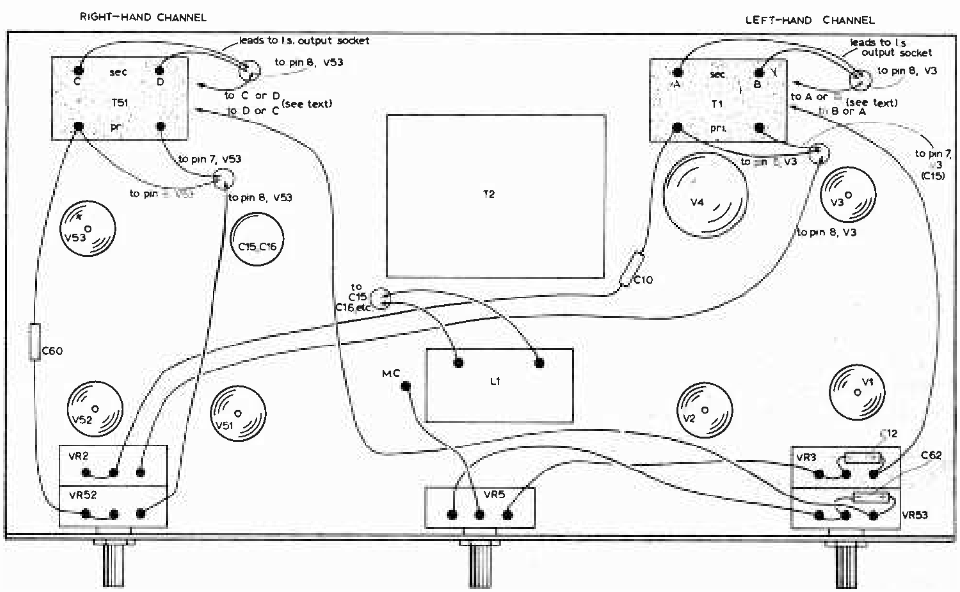

Fig. 3: Above chassis layout and wiring of the mono-stereo amplifier. The actual positions of the larger components—transformers—will depend to some extent upon their size.

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times in GMT • Frequencies in kHz

THE BROADCAST BANDS

Malcolm Connah

THERE has been a great deal of discussion of late on the subject of countries' lists. Every DX organisation seems to have its own definition of what constitutes a "country" and hence its own, individual countries' list.

Most organisations recognise the different states of the USSR as separate countries because they form part of a federation and each can, theoretically, leave the Union at any time.

Biafra was part of the Federation of Nigeria until it seceded and by the same reasoning that applies to the USSR, Biafra should count as a separate country. Hardly any of the DX organisations, however, recognise it as such. (Biafra was taken as an example not for political reasons but because it is one of the countries which are, or were, part of a federation that have a Broadcast Bands transmitter within their boundaries.)

This is only one example of the dozens of anomalies that exist in this field. What is needed is an international agreement between all the DX organisations on a common list of DX countries. The *European DX Council* (*EDXC*) has already begun the work of compiling such a list but, unfortunately, Britain is not, as yet, represented on this body. Britain is one of the foremost countries in the field of DXing and it is surely time that one of the British based clubs thought of joining the Council.

PROPAGATION FORECAST

The predicted smoothed sunspot number for the month of October is 93 (Switzerland Calling) and as we are still in the equinox period the bands that I predicted last month are still the most suitable.

The comments that I made about propagation last month may have confused newcomers to the hobby so I will try to clarify the situation.

World-wide reception of shortwave broadcasts is possible because of the existence of ionised layers in the atmosphere; one of these layers, the F layer, is the most important to DXers. Under certain conditions this layer reflects the electromagnetic radiation from the transmitter and returns it to the earth. A series of hops from the earth to the layer and back again can cause the signal to travel round the world.

The highest frequency that can be reflected from the F layer is determined by the level of ionisation in the layer. The higher the level of ionisation the higher the frequency that can be reflected.

The ionisation is caused by radiation from the sun hitting the atmosphere and exciting the molecules of the air. The level of ionisation obviously depends on the length of time that the layer is exposed to the sun's radiation.

An area which is in daylight is exposed to the radiation and the level of ionisation increases but when darkness falls the source of the radiation is removed and the level falls gradually until the sun reaches the area again. If a transmission path is entirely in daylight the Maximum Usable Frequency (MUF) is high but as soon as darkness falls on any part of the path the MUF is reduced. This is because the layer has a lower level of ionisation and can only reflect lower frequencies.

AFRICA

Angola: *A Voz de Angola* has been heard at 0530 in Portuguese on the new frequency of 5,960; this was in parallel with the usual frequency of 9,660.

Ivory Coast: *Abidjan* has an English transmission on 11,920 from 1830 to 1900. There is also a programme in local languages from 1900 to 1930 and in French from 1930 to 2400.

ASIA

Kuwait: Since the last article the *Kuwait Broadcasting Service* has altered some of its frequencies. The English programme from 0400 to 0600 is now on 15,370 and the Arabic programme from 0900 to 1100 has been heard on 21,525 and 21,590. The English programme for Europe at 1600-1900 has changed frequency from 15,405 to 15,345.

Pakistan: The Home Service from *Karachi* in English at 1500 uses the new frequency of 9,513 in parallel with 17,935. The European Service of *Radio Pakistan* uses the new frequency of 15,240 for its English transmission from 1945 to 2030.

EUROPE

Finland: *Radio Finland* has changed frequency from 9,550 to 9,590 for its English programme at 1800.

Sicily: It may have escaped the attention of some of the "country chasers" among our readers that there is a Broadcast Bands transmitter on the island of Sicily. Most of the DX organisations regard this as a separate country although the transmitter is part of the *Radio-Televisione Italiana* (RAI) network.

The programme broadcast is *Notturno dall'Italia* from 2306 to 0459 which consists of continuous "piped" music. The main distinguishing feature of the programme is the fact that news is given in English and Italian on the hour and in French and German on the half-hour. The station is situated at *Caltanisetta* and broadcasts on 6,060 and 9,515 with a power of 5/25kW.

Switzerland: The *Swiss Broadcasting Corporation* made the following frequency changes on the 7th September: the old frequency of 17,795 from 1715-1915 for Africa became 21,540 and 15,305 to North America from 0130 to 0300 became 6,120.

SOUTH AMERICA

Columbia: *Radio Nacional in Bogota* has been heard at 0300 on the frequency of 6,030, this frequency is given as inactive in the *World Radio TV Handbook*.

73s and good DXing until next month.

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7 Tunable Wavebands: Medium Wave 1, Medium Wave 2, Long Wave, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for Medium and Long Waves. Five section 22in. chrome plated Telescopic aerial for Short Waves can be angled and rotated for maximum performance. Push pull output using 600 mW transistors. Socket for car aerial. Tape record socket. Selectivity switch. Switched earpiece socket complete with earpiece for private listening. Eight transistors plus 3 diodes. Famous make 7in. x 4in. Speaker. Air spaced ganged tuning condenser. On/Off switch volume control. Wave change switch and tuning control. Attractive case in rich chestnut shade with gold blocking. Size 9 x 7 x 4in. approx. First grade components. Easy to follow instructions and diagrams make the Roamer Eight a pleasure to build. Total Building Costs **£6.19.6**

Parts Price List and Easy Build Plans 5/- (FREE with parts).

P & P 7/6.

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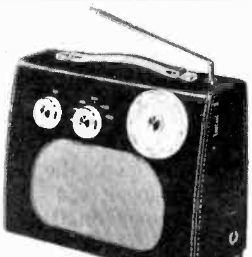


SEVEN FULLY TUNABLE WAVEBANDS—MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for Medium and Long Waves. Five Section 22in. chrome plated telescopic aerial for Short Waves—can be angled and rotated for peak S.W. listening. Socket for Car Aerial. Powerful push-pull output. Seven transistors and two diodes including Micro-Alloy R.F. Transistors. Famous make 7 × 4in. P.M. speaker. Air spaced ganged tuning condenser. Volume/on/off control, wave change switches and tuning control. Attractive case with carrying handle. Size 9 × 7 × 4in. approx. First grade components. Easy to follow instructions and diagrams make the Roamer 7 a pleasure to build.
Parts price list and easy build plans 3/- (FREE with parts).
Personal Earpiece with switched socket for private listening, 5/- extra.

Total building costs **£5.19.6** P. & P. 7/6

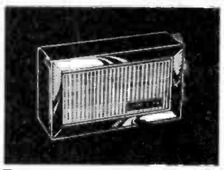
NEW! trans eight

SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case in black with red grille and cream knobs and dial with polished brass inserts. Size 9 x 5½ x 2¾in. approx. Tunable on Medium and Long Waves, three Short Waves and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. Eight improved type transistors plus 3 diodes. All top grade components. Push pull output. Ample power to drive a larger speaker. Parts price list and easy build plans 5/- (FREE with parts). Earpiece with switched socket for private listening 5/- extra.

Total building costs **89/6** P & P 5/6

pocket five



MEDIUM WAVE, LONG WAVE AND TRAWLER BAND (to 50 metres approx.) PORTABLE WITH SPEAKER AND EARPIECE

Attractive black and gold case. Size 5½ x 1½ x 3¼in. Tunable over both Medium and Long Waves with extended M.W. band for easier tuning of Luxembourg, etc. All first grade components—7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker, also Personal Earpiece with switched socket for private listening. Easy build plans and parts price list 1/6 (FREE with parts).

Total building costs **44/6** P. & P. 3/6

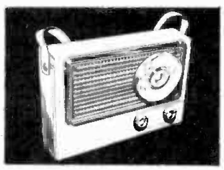
transona five

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND (to 50 metres approx.) PORTABLE WITH SPEAKER AND EARPIECE

Attractive case with red speaker grille. Size 6¾ x 4¼ x 1¾in. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker also Personal Earpiece with switched socket for private listening. All first grade components. Easy build plans and parts price list 1/6 (FREE with parts.)

Total building costs **47/6** P. & P. 3/9

roamer six



SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case with gilt fittings. Size 7½ x 5½ x 1¾in. Tunable on Medium and Long waves, two short waves, Trawler Band Plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short waves. All top grade components. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors etc. (Carrying strap 1/6 extra). Easy build plans and parts price list 2/-. (FREE with parts).

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THE AMATEUR BANDS
David Gibson, G3JDG

FOR those who are firm followers of the occult, the prediction that conditions are calculated to be improving will come as no surprise. For ordinary mortals not blessed with prophetic powers, the news of these improvements, particularly on the h.f. bands, will come as a pleasant surprise.

This is the time of year when the summer doldrums of propagation and freak skip conditions fade out and give way to the autumn and winter happy hunting grounds for the DX enthusiasts. A period when old-timers fondly polish gleaming 807 p.a. bottles and the student of solid state pays his last instalment on an innocent looking transistor assured by the manufacturers to offer at least 30 watts of r.f. at up to 50MHz.

This is also a good time to check over the gear, ensure that the dial calibration is accurate etc., and get ready for the long winter evenings when all that lovely frosty DX will play sweet music on each headphone simultaneously.

Ten metres should prove an interesting band to monitor this autumn. The summer has produced mostly African signals with an occasional burst from Oceana. A dipole for the band is only some 16ft. 6in. and could be suspended vertically from the eaves of the house thus taking up no room at all. Give it a whirl and let me know how you got on.

S. Norris (Suffolk) queries the JW prefix which, according to my little black book is Spitzbergen. Stan also mentions that he's heard a whisper that Lord Howe Island and Bouvet Island will be active later this year. Anyone else heard anything on this?

THIS AND THAT

Important. If you send in a log to The Amateur Bands, please send it direct to my home QTH. This will avoid the delay in mail being sent on via the magazine's London office. Only logs to: 5 Edward Close, St. Albans, Herts. Any other mail to PW in London please. The deadline for logs is such that they must reach me before the 18th of each month, otherwise, no matter how good they are, they miss the boat and are out of date by the following month and thus cannot be used.

C. J. Morris, G3ABG, sends word of the Worked All Britain award (WAB) but more interesting is a parallel award for s.w.ls called a Heard All Britain award (HAB). He claims 43 UK stations took part in a recent Sunday afternoon WAB net on 7MHz s.s.b. A special book is available which contains 114 sheets of foolscap and gives full information on the awards. The price is 10s. and is available from G3ABG, The School House, 24 Walhouse Street, Cannock, Staffs. Those requiring any further information should drop John a line, but don't forget the s.a.e.

J. Moore (Leicester) complains of the static and general noise level on topband. This should improve now, with a bit of luck. John also informs that Polish stations are beginning to use a 3Z prefix beside the more usual SP callsigns. 3Z5CJT was heard to remark that although the new prefix attracted attention, contacts took twice as long because of explaining the new 3Z5 tag. How about everyone using their callsigns backwards—just to be with it?

E. Marner (Swansea) has taken me up on the "radio maps" idea. He suggests that a useful exercise might be to monitor the various beacon stations which are liberally sprinkled throughout the r.f. spectrum. Provided the receiver is always set up exactly the same each time this would seem a good idea. Some (in fact most) "S" meters are affected by the setting of the gain controls, usually the r.f. and i.f., so these would need to be set the same when each reading was made. Needless to say, everything must remain constant, the same aerial, earth etc., otherwise the readings and logs would be inaccurate.

THE OTHER

On topband—GM3VIO/A, GM3YCB, GW3DZJ, GW3YGH. The aerial is a 60ft. end fed and on 3·5MHz—CN8AW, CR6IV, F9RY/FC, 3V8NC. On 7MHz s.s.b.—PY1CAD, UW9AF, YV1PR. The receiver is a CR100/2 and on 14MHz s.s.b.—CE3FI, CEØAE, EA8FE, ET3ZU, FØHI/FC/M, FL8MB, HC2RZ, HV/SJ, I1BUP/P (DXpedition to Tremiti Is.), K6MHO. KF7BSA (Scouts Jamboree station in Idaho), HG6AAY KL7EBK, LG5LG, LI2B, LU3FAN, OX5BA, OY9LV, PY6OA, TF2WLW, TI2AD, VE1RA, VE3BPV, VE7AZT/KL7 (Ice Is. 84·5°N 123·6°W), VE8RCS, VK2ADJ, VK7AZ, VP7NN, VU2BX, W6VQD, W7JRT, WA5YRG/P/VE8 (Baffin Is.), WA9LXG/P/KP4, XE1IX, YN2JS, ZL1AV, 3V8NC, 3Z3PS, 9G1DY. The listener is **J. Moore** (Leic.), and on 28MHz he logged—CR6AR, EA8CL, HG8QF, LU3DTV, PY1BKQ, PY1BOR, PY1DBE, UP2PG, 5A1TN, 5H3MA, 9J2DT.

A. Watson (Dartford) has recently wrapped his lucky digits around a new Star 200 receiver. Another addition is a 100ft. long wire. A tentative eavesdrop on 80 disclosed—HV3SJ, PY1NBF and 5A2TR the latter in a DX net with GW3AX in the chair.

Twenty proved more fruitful with sigs from—CT1SQ, DU1AA, FØOX/FC, HBØXWS, HC4WM, HZ1AB, JA4ZA, JX3DH, KP4BBN, OD5FB, PY2DOS SVØTE, TF2EA, VE3FOR, VK3MO, WA3HIA/AM, 5H3LV, 5Z4LW, 6Y5SR, 9N1MM.

Many logs unhappily, did not qualify this month because they weren't in alphabetical order or did not have signal reports. Please, slaves, dates, times, frequencies, standard RST (and not some weird mixture of SINPO and Arabic) and, most important, alphabetical order, it makes life so much easier this end.

NEWS AND CONTESTS

October proves to be quite a busy time for Hams. October 5th, 1296MHz contest; 5th, Scottish mobile rally in Aberdeen; 11th–12th, 28MHz telephony contest (quick, get that dipole cut); 12th, Peterborough mobile rally, talk-in stations on topband, 4 and 2 metres; 25th–26th, 7MHz c.w. contest; 25th–26th, CQ WW contest (phone section); this should be a good one to log a few of those extra zones.

On November 3rd, there's the 2 metre s.s.b. contest and on November 8th–9th, the phone section of the 7MHz contest.

Jamboree-on-the-air

The twelfth annual opportunity for Scouts to participate in amateur radio will take place on the weekend of 18/19 October. The Jamboree will start at 01.00 Saturday morning, and conclude at 23.59 Sunday night. This event is not, incidentally, a contest but a chance for Scouts in all countries to exchange news and establish international friendships. Information on how to help Scout troops during the event can be obtained from G3BHK, Katoomba, Tyneham Close, Sandford, Wareham, Dorset.

KEITH JOHNSON

a beginner's TRANSISTOR CAPACITANCE BRIDGE

PART 2

CONSTRUCTION

The unit is built up on a Cir-kit board measuring 5in. × 3in. Switches, batteries, meter, and the main potentiometer, VR1, are located on a separate front panel. The Cir-kit system results in a very presentable and easily made printed circuit, with the copper channels consisting of adhesive strip pressed into position on the underside of the board, following the diagram of Fig. 7. This figure also shows the component layout on the upper side of the board. Commence operations by drilling $\frac{1}{32}$in. holes for all components and wires leading into the board. The approximate positions for these holes are shown by small crosses, the exact positions depending on the precise size of the transformer and other components used. Now, cut and press the Cir-kit strip into position, piercing this with a pin where it overlays each hole. Finally, place all resistors, capacitors, etc. in position, and thread the wire ends through to the copper strip side of the board, finally soldering them into position on the strip. Place a drop of solder, also, at each strip junction (marked J in Fig. 7) where pairs of copper strips overlap.

The flying leads to the battery connectors, meter, VR1, etc. and the capacitor bank can now be inserted from the top of the board. If fairly long wires are necessary, e.g. the battery leads, a useful tip is to cover the wire with a piece of thick sleeving (unless the sleeving round it is already fairly thick), leaving a small wire end protruding to pass through the hole and solder on to the copper strip. It is most important that no component is left held loosely by the copper to which it is soldered, as the latter will inevitably come adrift from the board, and, with the flexing of the connecting leads, eventually break. For the same reason, no components should be soldered directly to the copper strip side of the board (except temporarily for experimental purposes), the only exceptions being the five jumper wires, marked W in Fig. 7.

The two holes at the front of the panel are for small metal brackets to hold the front panel to the p.c. board. Drilling details for this panel are given in Fig. 8. After drilling, scribe a line 1in. from the bottom, and bend the top portion of the panel back to make an angle of approximately 130 deg. with the

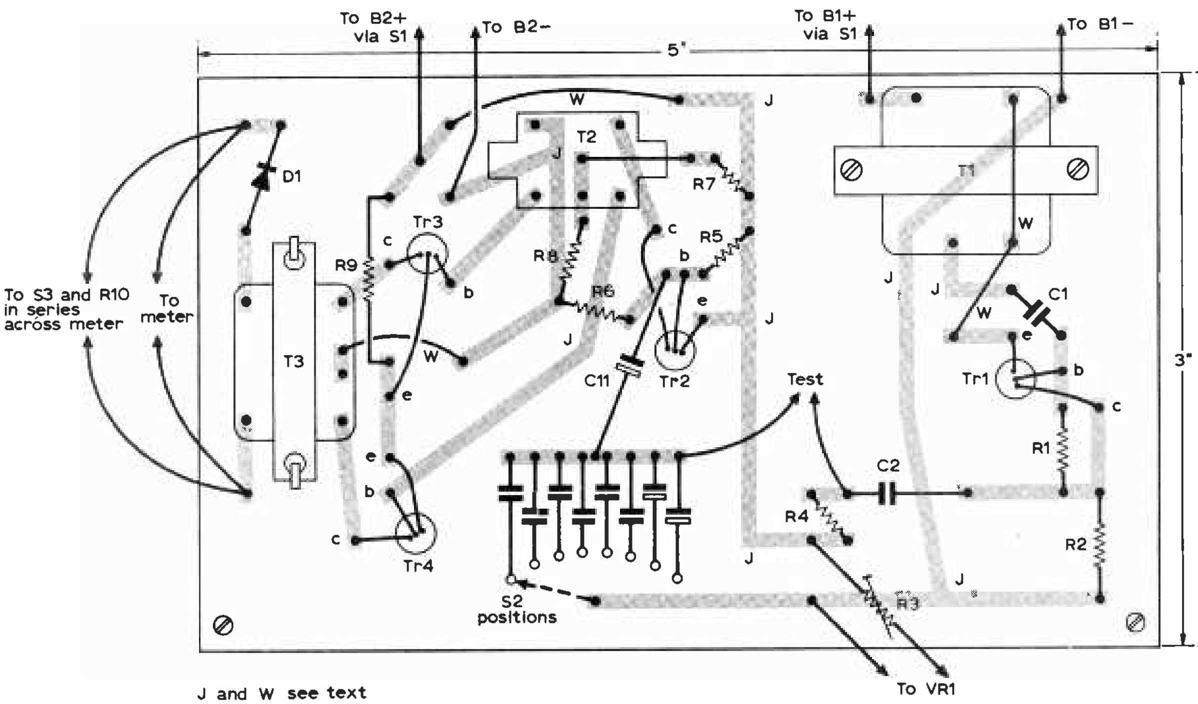


Fig. 7: The Cir-kit wiring board layout used by the author.

60 r.p.m. Geared Motor. This is a powerful unit, driven by a mains motor of similar type to, but rather larger than the average Tape Deck or Record Player motor. The gear boxes may be detached. It is, in fact, a unit measuring approximately 3½ x 2½ x 1½in. thick. The final drive shaft is ⅛in. wide, 1in. long. **35/-**

A Micro Meter bargain. Limited quantity only, centre zero 50–0–50 micro amps. This is a Weston Meter enclosed in clear perspex case for flush mounting. Dial size approximately 2½in. wide. The scale is not engraved but has a red part in the centre and a green part to the left of centre. Scale could be cleaned off and re-written to suit your particular requirements. Regular price probably over £5 each, our price **29/6** each.

Battery Record Player. Made by Collaro. This is made up on a unit plate with speed selector and pick-up. The turntable is a heavy one and measures approximately 9½ins. Pick-up is fitted with the famous "Studio" cartridge. Price **69/6**, postage and insurance 6/6.

E.H.T. Condenser. 28Kv. 0·0011 mfd. Suitable for transmitting test conditions 6A at 300k/c. Bakelite case. **18/6** each.

85 Watt Tubular Element. Very well made unit. The element is wound on a porcelain former then encased in a brass tube terminated with beaded leads 12in. long. Normal mains voltage. Price **5/-** each or **54/-** per doz.

Press to Make Switch. Double pole, 5 amp contacts or can be used as single pole, 10 amp, contacts 250 volt working. Single hole fixing. **2/6** each, **24/-** dozen.

Door Switch. Contacts open when plunger is depressed. Prevents lights being left on. 15 amp contacts, 230 volt working. Made by Arrow. **3/6** each, **36/-** per dozen.

Rotary Appliance Switch. 16 amp, 230 volt on moulded ceramic base. Operated by pointer knob (not supplied). **2/-** each, **18/-** per dozen.

1/40th h.p. Motor. Made by the French (Cassor) Company. This is an excellent totally enclosed motor, powerful enough to operate small lathe, drilling machine, washing machine, etc. It's speed is 1,450 r.p.m. Made for normal 50 cycle, 230/250 volts mains, totally enclosed, size 2½ x 3½in. dia. with 1in. of ¼in. spindle. Price **19/6** plus 4/6 postage and insurance.

Burglar Alarm Kit. Protect your home and family by frightening away the intruder. With our circuit a mains operated bell rings loudly directly the door or window is opened. Kit comprises 12 reed switches, 12 magnets, relay, mains transformer and bell with circuit. Price **49/6**.

NICAD RECHARGEABLE BATTERIES

3·6V 500mA size 1½ x 1½in. dia. type ref DKZ500. Really powerful, will deliver 1 amp for ½ hour. Regular price 32/6. Our price **17/6** each. New and guaranteed. Other voltages available, single cell 1·2V **6/6**. 5 cell 6V, **29/6**.

ELECTRIC CLOCK WITH 25 AMP SWITCH

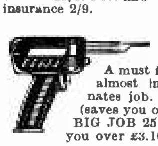
Made by Smith's, these units are as fitted to many top quality cookers to control the oven. The clock is mains driven and frequency controlled so it is extremely accurate. The two small dials enable switch on and off times to be accurately set. Ideal for switching on tape recorders. Offered at only a fraction of the regular price—new and unused only **39/6**, less than the value of the clock alone—post and insurance 2/9.

INDICATOR LAMP

Panel mounting, consists of neon lamp in red Plastic lens with resistor in leads for mains operation. **2/6** each. **24/-** dozen.

BECKASTAT

This is an instant thermostat, simply plug your appliance into it and its lead into wall plug. Adjustable setting for normal air temperatures. 13A loading Will save its cost in a season. **19/6.** Post and insurance 2/9.



SOLDER GUN

A must for every busy man. Gives almost instant heat; also illuminates job. 100 watt 220/240v. **39/6** (saves you over 30/–), post & ins. 4/6. BIG JOB 250 watt model **99/6** (saves you over £3.10.0), post & ins. 6/6.

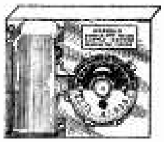
FLEX BARGAINS

Screened 3 Core Flex. Each core 14/0076 Copper PVC insulated and coloured, the 3 cores laid together and metal braided overall. Price **£3.15.** per 100 yds. coil.

15 Amp 3 Core Non-kink Flex. 70/0076 insulated coloured cores, protected by tough rubber sheath, then black cotton braided with white tracer. A normal domestic flex as fitted to 3 Kw. fires. Regular price 3/6 per yd. 50 yd. coil **£4.10.0**, or cut to your length **2/6** per yard.

10 Amp 3 Core Non-kink Flex. As above but cores are 28/0076 Copper. Normal price 2/6 per yd. 100 yd. coil **£7.10.0**, or cut to your length **1/9** yd.

6 Amp 2 Core Flex. As above, but 2 Cores each 23/0076 as used for Vacuum Cleaners, Electric Blankets, etc. **39/6** 100 yd. coil.

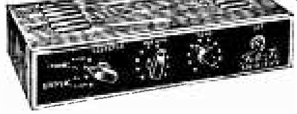


ELECTRIC TIME SWITCH

Made by Smiths these are AC mains operated, NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. 2 completely adjustable time periods per 24 hours, 5 amp changeover contacts will switch circuit on or off during these periods. **59/6**, post and ins. 4/6. Additional time contacts 10/- pair.

The Full-Fi STEREO SIX

The amplifier sensation of the year



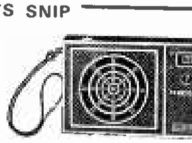
You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal cabinet elegantly styled and teak finished to blend with modern furnishings, this amplifier uses an integrated solid state circuit with an output power of 6 watts R.M.S. split over the two channels. The amplifier is ideal for use with normal pick-ups and tuners, it has a double wound mains transformer and ganged volume and tone controls—also switching for Mono to Stereo, tuner or pick-up. Other controls include "treble lift and cut", "balance" and separate mains on/off switch. Price is **£9.9.0**, plus 7/6 post and insurance. Speakers (with tweeters) in oiled teak finish cabinets to match amplifier, **£8.8.0** per pair.

DRILL CONTROLLER

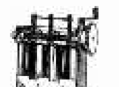
Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. **19/6** plus 2/6 post and insurance. Or available made up **29/6**, plus 2/6 post.

THIS MONTH'S SNIP

'Gladiator' 2 wave band transistor radio

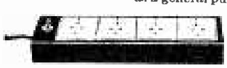


7 transistor, 2 wave band (medium and long) pocket radio with carrying handle and earplug. These radios use a ferrite slab aerial and a conventional superhet circuit with built in moving coil speaker. Completely built up, ready to play. Offered at less than importers price due to bankrupt purchase. A remarkable bargain. **39/6** plus 3/6 post and insurance.



3 STAGE PERMEABILITY TUNER

This Tuner is a precision instrument made by the famous "Cyldon" Company for the equally famous Radiomobile Car Radio. It is a medium wave tuner (but set of longwave coils available as an extra if required) with a frequency coverage 1620 Kc/s–525 Kc/s and intended to operate with an I.F. value of 470 Kc/s. Extremely compact (size only 2½ × 2 × ⅞ins. thick) with reduction gear for fine tuning. Snip price this month **12/6**, with circuit of front end suitable for car radio or as a general purpose tuner for use with Amplifier. Post Free.



DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs. Supplied complete with 6 feet of heavy cable and 13 amp plug. Similar advertised at £5. Our price **39/6**, + 4/6 P & I.

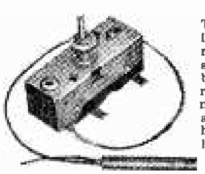
VARYLITE

Will dim incandescent lighting up to 600 watts from full brilliance to out. Fitted on M.K. flush plate, same size and fixing as standard wall switch so may be fitted in place of this, or mount on surface. Price complete in heavy plastic box with control knob **£3.19.6**.

BUY TIME SLOT METERS

If you hire out equipment such as TV sets by the hour then these slot meters are what you require. We have 3 types, 6d. an hour, 1/- an hour and 1/6 an hour. Brand new. Made by the famous Weston Company. Price **£3.19.6**, postage and insurance 6/6.

THERMOSTAT WITH PROBE



This has a sensor attached to a 15A switch by a 14in. length of flexible capillary tubing—control range is 20°F to 150°F so it is suitable to control soil heating and liquid heating especially when in buckets or portable vessels as the sensor can be raised out and lowered into the vessel. This thermostat could also be used to sound a bell or other alarm when critical temp. is reached in stack or heap subject to spontaneous combustion or if liquid is being heated by gas or other means not controllable by the switch. Made by the famous Teddington Co., we offer these at **12/6** each. Postage and insurance 2/9.

HI FI BARGAIN

FULL FI 12 INCH LOUDSPEAKER. This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi load and Rhythm Guitar and public address.

Flux Density 11,000 gauss—Total Flux 44,000 Maxwells—Power Handling 15 watts R.M.S. Cone Moulded fibre—Freq. response 30-10,000 c.p.s.—specify 3 or 15 ohms—Mains resonance 60 c.p.s.—Chassis Diam. 12in.—12⅜in. over mounting lugs—Baffle hole 11in. Diam.—Mounting holes 4, holes —¼in. diam. on pitch circle 11⅝in. diam.—Overall height 5⅛in. A £6 speaker offered for only **£3.9.6** plus 7/6 p. & p. Don't miss this offer. **15in. 30 watt £7.19.6. 18in. 100 watt £24.10.0.**

REED SWITCHES

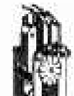
Glass encased, switches operated by external magnet—gold welted contacts. We can now offer 3 types:

Miniature. 1in. long × approximately ⅛in. diameter. Will make and break up to ½ amp up to 300 volts. Price **2/6** each. **24/-** dozen.

Standard. 2in. long × 3/16in. diameter. This will break currents of up to 1 amp, voltages up to 250 volts. Price **2/-** each. **18/-** per dozen.

Flat. Flat type, 2in. long, just over 1/16in. thick, approximately ⅛in. wide. The Standard Type flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating lamp, 200 volts. Price **6/-** each, **£3** per dozen.

Small ceramic magnets to operate these reed switches **1/3** each. **12/-** dozen.



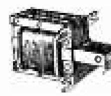
ROTISSERIE MOTOR

Very powerful 7 r.p.m., operates from standard A.C. mains. **29/6**, plus 3/6 P. & P.

EXTRACTOR FAN

Cleans the air at the rate of 10,000 cubic ft. per hour. At the pull of a cord it extracts grease, grime and cooking smells before they dirty decorations. Suitable for kitchens, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 6in. casing with 5¼in. fan blades. Suitable wherever it is necessary to move air fast. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector and fixing brackets.

39/6 + 6/6 post and ins.



230 VOLT SOLENOID

⅜in. stroke. Size 2⅛in. × 2in. × 1⅝in. **14/6**, postage 2/9.

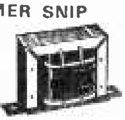
FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15-20 w. **19/6**. Kit B—30-40w. **19/6**. Kit C—80 w. **19/6**. Kit E—65 w. **19/6**. Kit MF1 is for 6in., 9in. and 12in. miniature tubes, **19/6**. Postage on Kits A and B 4/6 for one or two kits then 4/6 for each two kits ordered. Kits C, D and E 4/6 on first kit then 3/6 for each kit ordered. Kit MF1 3/6 on first kit then 3/6 on each two kits ordered.

DEAC RECHARGEABLE BATTERY

1·2V–2000 mA/hr. type (2000DKZ). Size 2in. dia. × ⅜in. thick approx. Tremendously powerful, will deliver 4 amp for ½ hour. Regular price over £2 each. Snip price **19/6** each. NEW AND UNUSED.

MAINS TRANSFORMER SNIP

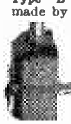


Making a power pack for amplifier or other equipment? These transformers have normal mains primaries (230/240v.) and isolated secondaries two types (1) 12v. 500mA. at **8/6**; (2) 15v. 500 mA at **8/6**.

THERMOSTATS

Type "A" 15 amp. for controlling room heaters, greenhouses, airing cupboard. Has spindle for pointer knobs. Quickly adjustable from 30–80°F, **9/6** plus 1/- post. Suitable box for wall mounting. **5/-**. P. & P. 1/-.

Type "B" 15 amp. This is a 17in. long rod type made by the famous Sunvic Co. Spindle adjusts this from 50–550°F. Internal screw alters the setting so this could be adjustable over 30° to 1000°F. Suitable for controlling furnace, oven, kiln, immersion heater or to make flame-stat or fire alarm. **8/6** plus 2/6 post and insurance.



Type "D". We call this the Ice-stat as it cuts in and out at around freezing point. 2/3 amps. Has many uses one of which would be to keep the loft pipes from freezing, if a length of our blanket wire (16 yd 10/-) is wound round the pipes. **7/6.** P. & P. 1/-.

Type "E". This is standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature. **7/6**, plus 1/- post.

Type "F". Glass encased for controlling the temp. of liquid—particularly those in glass tanks, vats or sinks—thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developers and chemical baths of all types. Adjustable over range 50° to 150°F. Price **18/-** plus 2/- post and insurance.

Where postage is not stated then orders over £3 are post free. Below £3 add 2/9. Semi-conductors add 1/- post. Over £1 post free. S.A.E. with enquiries please

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For student or professional musician.
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Tunes 108-136 MHz. Portable.
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Luxury motoring entertainment.
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TECHNICIANS LOW COST 'VVM'.
7AC, 7DC, 7 ohms ranges
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PORTABLE VVM
For householders, hobbyists.
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Record playing plus FM stereo.
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Carr 13/- on each

STEREO RECORD PLAYER
Exciting sound/Budget price.
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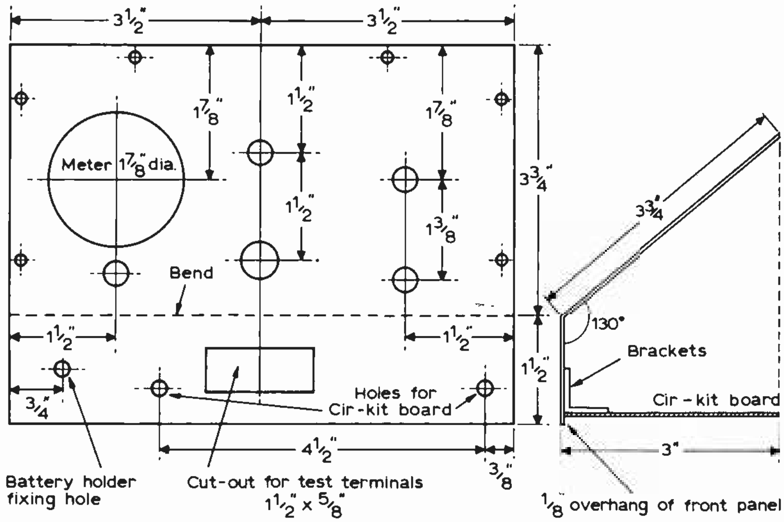

Fig. 8: (a) Cutting and drilling details for the capacitance bridge panel. Aluminium sheet of any gauge between 22 and 16 is quite satisfactory. (b) How to bend the panel to fit the case shown in Fig. 10.

bottom half; so that a ruler, placed at right angles against the back of the Cir-kit board (after bolting to the panel), would just touch the top edge of this angled portion. These details will be clear from Fig. 8b.

Before finally bolting the panel and printed circuit board together, mount the switches and other components in position on the panel and solder on the interconnecting wires, keeping leads conveniently short. Colour coding, especially of the capacitor bank leads will be found a considerable help at this stage.

Figure 9 gives details of the battery holder. This actually consists of a small aluminium box designed to hold two PP3 batteries fairly tightly in position, and is bolted to the front panel by means of a single fixing screw—indicated by "B" in Fig. 8a. With the intermittent use of this type of tester, replacing batteries will be an infrequent operation. Because of the different current requirements of oscillator and amplifier sections, interchanging PP3s after a period of use may, in fact, be all that is necessary to restore the bridge to a fully-operational state.

A suitable cabinet can be constructed from ½in. plywood, cut and nailed together as shown in Fig. 10. Self-tapping screws, bolted to three metal brackets which are screwed to the inside of the cabinet, as shown in the figure, serve to hold the bridge securely in place. Before mounting the instrument in its cabinet, however, it will be advisable to complete (in pencil only, at this stage) the details on the range and other scales, since, as mentioned in the theoretical section, it may be necessary to alter some of the capacitors in order to obtain best agreement on all the ranges.

TESTING THE BRIDGE

When all the wiring and constructional work has been completed, and the oscillator and amplifier tested individually as already described, set R3 to zero resistance, VR1 to maximum, S2 to the ×1 range, and switch S1 on. If desired, headphones can be connected across T3 primary in order to monitor the signal. (In the completed instrument, an earpiece jack was connected across this point, and mounted on the front panel (see photograph) for connecting a pair of high-impedance headphones. This was found useful, not only for monitoring purposes, but also for greater accuracy when testing very small capacitors on the ×1 range, where the meter deflection can be very small.)

At this stage the meter reading should be zero. Touching the test points with one hand should now cause the meter to read, provided S3 is in the sensitive position. Now, switch to the ×10 range, and a meter reading should be obtained without touching the terminals, together with a noticeable increase in headphone response. Operating S3 should decrease the reading without affecting the volume of note heard in the phones. Check also that a decrease in the value of VR1 resistance causes an increase in current on both of the ranges mentioned. Now switch to the ×100 range. The meter should go from the hard-over position (minimum value of VR1) to about mid-scale, on operating VR1. This is as far as one can go at this stage, since a maximum meter reading will almost certainly be obtained on all the higher ranges.

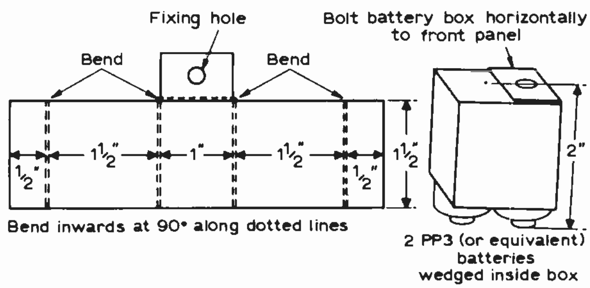

Fig. 9: The battery holder box, also cut out of thin aluminium sheet.

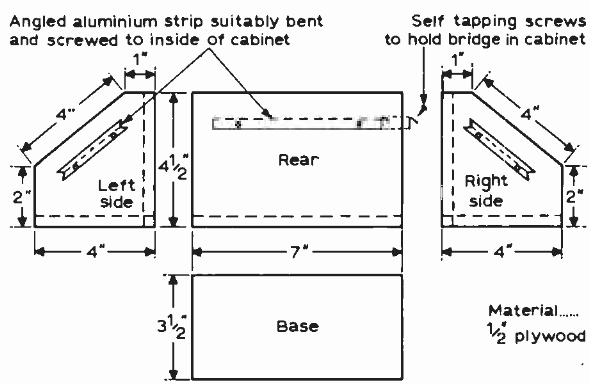

Fig. 10: An attractive style of cabinet, designed to be made from ½in. plywood.

Assuming all the above tests are satisfactory, a test capacitor can now be connected across the test points; 300pF is a suitable value to start with. On range ×100, a dip should be obtained about mid-scale, and a pencilled "3" scribed at this spot. Now check that a dip is obtained at roughly the same spot with 3, 30, 3000pF etc., as discussed in the previous section, on operating the range switch. If necessary, alter the fixed capacitors, as recommended. If cramping of the scale is noticeable, increase resistance R3 slightly, until a suitable spread is obtained, finally locking this in position with a spot of wax or Duco cement.

APPLICATIONS

The most common application for a capacitance bridge is, of course, to determine whether a capacitor is showing its rated value, to evaluate the capacitance of an unknown component or one from which the marking has been obliterated. In addition, the present instrument is a very sensitive indicator of capacitor leakage, since a leaky component will give either a very shallow dip, or perhaps none at all, depending on the extent of the resistance which it exhibits. This effect is particularly noticeable with faulty electrolytics. In some commercial bridges, the extent of these "losses" can be precisely evaluated, by incorporating a variable resistance in parallel with the range capacitor, thus effectively neutralising the "resistance" of the test capacitor, and enabling the full dip to be once more obtained. This refinement was not considered necessary in the present case.

An interesting application of the measurement of capacitance occurred recently, when the writer was asked to help with the final lining-up of a "Progressive Short-Wave Receiver", built according to this popular P.W. blueprint. In the text accompanying that article, instructions for bandspreading are given, which include the removal of vanes from a ganged capacitor, so as to give the requisite maximum capacitance on each section. Use is made of a mathematical formula, taking the intital capacitance of the capacitor as a guide. Instead of this procedure, it was decided to measure the maximum capacitance directly with the bridge, removing some vanes and adjusting the remainder at each stage until the correct capacitance for satisfactory bandspreading, coupled with perfect oscillator tracking, was obtained. ■

BASIC SEMICONDUCTOR TECHNOLOGY

—continued from page 517

carriers which are swept across the junction. Consequently the device is sensitive to the presence of light. The reader may by now have realised that the device is identical to the photodiode.

A much greater sensitivity however can be obtained by using a different device, the n-p-n phototransistor. This device makes use of a hook-collector, which is found in p-n-p devices.

The frequency response of phototransistors is limited by the time taken for the liberated carriers to diffuse to the collector junction. This depends on the distance away from the junction that the carriers are produced, with the consequence that phototransistors have to be physically. small if they are to operate at high frequencies.

Operating limitations of transistors

Several factors have to be taken into account when a transistor is connected in circuit if it is not to be immediately destroyed after switching on.

Maximum power dissipation

The power which a transistor can dissipate is limited by its physical construction. The temperature at which the device can work is the limiting factor and it is necessary to remove the heat dissipated in the device so that this temperature is not exceeded. All three methods of heat transfer—radiation, conduction and convection—come into play in cooling a transistor. In order to avoid a large temperature of operation power transistors are mounted on large heatsinks which provide a large area to dissipate the heat. When using them care should be taken that sufficient air can reach the sink in order to keep it cool. A matt black or anodised aluminium heatsink is better for radiating heat than a shiny aluminium one. The manufacturer of the transistor normally specifies the type of heatsink to use to get the maximum performance with a particular transistor.

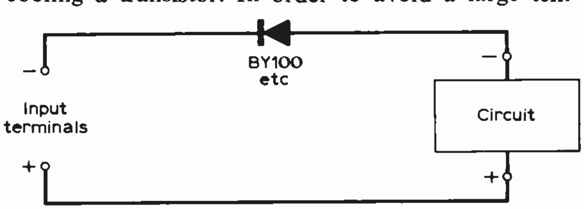

Fig. 4: Use of a rectifier diode to protect equipment against accidental reversal of the power supply connections.

Maximum voltage ratings

There is a maximum voltage to which the collector junction can be exposed. Two effects can give this limitation. First, avalanche multiplication of carriers can cause an excessive current to flow and cause breakdown of the junction. Secondly punch through can occur. This is due to the depletion layer in the base region extending to the emitter and causing an effective short-circuit of the transistor. The type of breakdown which occurs at the lowest voltage sets the limit of the maximum collector voltage, and this is determined by the construction of the particular device.

When a transistor is used as a switch very little power is dissipated in the device except during the actual switching operation, so care must be taken to avoid overloading it during this period.

Safety precautions

Whereas in valve circuits some measure of overloading can be tolerated with transistor circuits none of the maximum ratings given by the manufacturer should be exceeded. In the interests of economy it is wise for the amateur to derate these specifications by 25% and to incorporate protective devices such as resistors, fuses and current limiters wherever possible. A diode wired in series with the power supply lead as in Fig. 4 will avoid damage to the circuit if the power supply is inadvertently connected the wrong way.

Next month majority carrier devices such as the field effect transistor and MOST will be described.

TO BE CONTINUED

DE LUXE PLAYERS

PORTABLE CABINET As illustrated To fit standard player or autochanger **75/-**

RCS AMPLIFIER 3 WATT. Ready made and tested. This is a 2-stage unit using a triode pentode condenser coupled valve, giving 3 watts output into a 3 ohm loudspeaker. Tone and volume controls mounted on panel. Supplied with knobs, loudspeaker and valves UCL82, UY85. Frequency response 50-12,000 cps. Sensitivity 200mV. **59/6**

Post 5/6 each item

SINGLE PLAYERS MONO		AUTOCHANGERS MONO.	
EMI Junior Mains	£2.19.6	Balfour Princess	£5.5.6
Garrard SRP22 ...	£6.19.6	BSR Superslim UA25	£6.19.6
Garrard SP25 MkII	£12.19.6	MA70 Transcription	£13.19.6
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All fitted LP/78 stylii and pickup cartridge complete. Stereo/mono pick-ups 20/- extra except 3000.

GARRARD TEAKWOOD BASE WB.1. Ready cut out for mounting 1025, 3000, SP25, AT60, etc. **65/-**

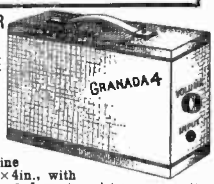
GARRARD PLASTIC COVER SPC.1 for WB.1 BASE. Durable tinted attractive appearance. **65/-**

E.M.I. PICK-UP ARM. Complete with mono cartridge 29/6; XTAL GP67 17/6; Stereo Ceramic 35/-. ACOS LP only 10/6.

CRYSTAL MIKE INSERTS

1¼" dia. 6/6; ACOS 1¾" dia. 9/6. BM3, 1" dia. 9/6.
QUALITY RIBBON MIKE WITH GOOSENECK £11.11.0.

PORTABLE TRANSISTOR AMPLIFIER PLUS DYNAMIC MICROPHONE



A self-contained fully portable mini p.a. system. Many uses — ideal for Parties, or as a Baby Alarm, Intercom, Telephone or Record Player Amplifier, etc. Attractive rexine covered cabinet, size 12×9×4in., with powerful 7×4in. speaker and four transistor one watt power amplifier plus ultra sensitive microphone. Uses PP9 battery. Brand new in makers' carton with full makers' guarantee. World famous make. Only **90/-** Post Free

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RA2W 6in. Ferrite Aerial with car aerial coil	12/6	Spare Cores	6d.
Osc. P50/1AC	5/4	Driver Trans. LFDT4	9/6
I.F. P50/2CC 470 kc/s	5/7	Printed Circuit, PCA1	9/6
3rd I.F. P50/3CC	6/-	J.B. Tuning Gang	10/6
		Weyrad Booklet	2/-

Telescopic Chrome Aerials 6in. extends to 23in. 5/-.
Ferrite Rods Only 8×⅜in. 4/-. 6×¼in. 5/-.

VOLUME CONTROLS

Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 3/-. D.P. 5/-. STEREO L/S 10/6, D.P. 14/6. Edge 5K. S.P. Transistor, 5/-.

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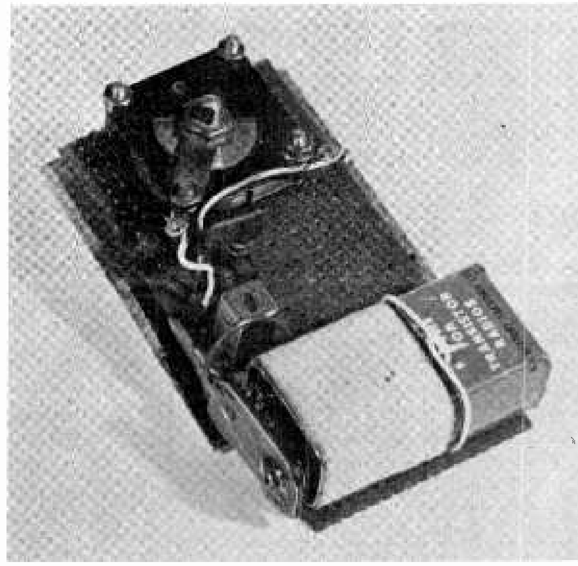
TAKE 20

JULIAN ANDERSON

No. 7
M.W. SIGNAL GENERATOR/B.F.O.

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

ONE of the main aims of the *Take 20* series is to introduce readers to a wide variety of simple circuits. With some exceptions, a few components can be made to do the job of a large number of components though less efficiently; however efficiency and accuracy are not always of prime importance. By designing and writing articles on very simple projects I am not pretending that highly complicated circuits are a waste of time. This shows up the *Take 20* philosophy; some designers—most of them in fact—try very hard to make their equipment as perfectly as possible, the *Take 20* attitude is to use the absolute minimum of components that will do the job. Of course the fewer components used, the easier the project is to build and the less the likelihood of mistakes. I mention this because our project this month is an r.f. signal generator, which while very simple, will prove very useful when building other equipment and lining up superhet receivers, as well as acting as a Beat Frequency Oscillator (B.F.O.) for radios using either a 465kHz or 1·6MHz i.f., it cannot however be compared to other designs for signal generators or commercial equipment of this type.



The m.w. signal generator and B.F.O.

The Circuit

Figure 1 shows the circuit. It consists of a straightforward Hartley Oscillator using a high gain n-p-n transistor. There is however no need to use the BC169B, almost any r.f. transistor could be used—such as the old faithful OC44—except of course when p-n-p transistors are used the battery polarity must be reversed.

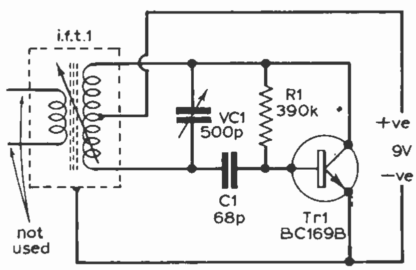


Fig. 1. The circuit of the signal generator.

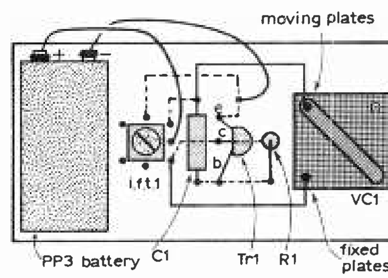


Fig. 2. Suggested component layout.

Coils are not the easiest things to construct and where possible I try to use readymade ones, in this case an i.f. transformer of 465kHz. Most of these are fitted with a capacitor of 250pF or below and by removing this and replacing it with a variable capacitor we will not only be able to tune to the i.f. but also cover the complete range of the medium wave broadcast band, if not on fundamentals than on harmonics. The tuned circuit comprising the i.f. coil and VC1 is in the collector circuit and feedback is by means of C1 which couples back part of the signal to maintain oscillation. The value of C1 can be almost anything between 10pF and 1,000pF, its actual value being unimportant. R1 provides the base bias.

Construction and Uses

Building the signal generator is a simple matter and should present no problems; the layout of the components is shown in Fig. 2. The prototype was built on a pin-board but Veroboard or Paxolin could easily be used. For equipment of this type an on/off switch is hardly necessary and removing the battery terminals will serve this function.

After switching on place the unit near a superhet radio tuned to a station and adjust VC1 until a whistle is heard. Unscrew the i.f. adjusting core and retune until VC1 is nearly in the fully-meshed position (maximum

Next month's *Take 20* describes an intercom unit which doubles as a baby alarm. It makes use of two balanced armature earpieces or 80Ω loudspeakers and a simple amplifier.

★ components list

R1	390kΩ ¼ watt miniature 10%	3d.
C1	68pF—see text	9d.
VC1	500pF variable	5s. 0d.†
Tr1	BC169B—see text	2s. 3d.
I.F. Transformer, 465kHz.		1s. 6d.†
Miscellaneous		
Paxolin board, 9V battery, battery clips, knob etc.		5s. 0d.
		14s. 9d.

†A.J.H. Electronics, 59 Waverley Road, The Kent, Rugby, Warwickshire. Both items for 8s. inc. postage.

capacitance) when the whistle is heard. Some i.f. transformers will not be suitable for tuning this low but the actual position is unimportant. Set your radio to 530kHz (567 metres) and mark the position of the setting of VC1 when the signal generator is on that frequency, similarly tune to 1,602kHz (187 metres) and mark the position. These two points, together with a mark where a whistle is heard on *all* stations, will be all that is necessary for lining up a superhet on the medium wave band. If the unit is tuned to the i.f. frequency of a receiver and placed near it a beat note will be heard enabling c.w. and s.s.b. transmissions to be heard; all in all your signal generator should prove to be a very useful piece of equipment. ■

MEDIUM WAVE DX RECEIVER

—*continued from page 495*

A number of queries have arisen with regard to the first part of this article that appeared last month. IFT1 is made by Electroniques and not Denco. Capacitors C7, 9, 10, 11 should be silver mica and VR1, 2, 4, 5 are linear. VR3 is log.

Fig. 1.—The junction of C9, C10, VC3, TC3 should be shown going to earth and not the negative line via R11.

Fig. 2.—IFT1 lead marked "from Tr2 collector" should go to tapping point and not to top of winding as shown.

Fig. 3.—Gain of this circuit may be improved by decoupling the 5·6kΩ resistor in the source lead of Tr1, with a 0·1μF capacitor.

Fig. 3/Fig. 4.—The 30pF capacitor shown at the right hand lower side in both diagrams is in fact C7 in Figure 1 and should not be duplicated.

Fig. 3.—Add to caption . . . "IFT1 modified as Fig. 6".

Fig. 6.—Add to caption . . . for f.e.t. front end (IFT1 modification is only required for f.e.t. front end). ■

QUERY COUPON

This coupon is available until 7th November, 1969 and must accompany all queries in accordance with the rules of our Query Service.

PRACTICAL WIRELESS, OCTOBER 1969

GUIDE TO COMPONENTS

—*continued from page 498*

Junction diodes have a greater current capability than point contact devices and are used as power rectifiers as well as general purpose signal diodes. Both silicon and germanium are used but silicon diodes predominate for rectification as they are capable of operating at high temperatures (+175°C). The junction capacitance and charge storage is high in junction diodes and they are therefore of limited value at high frequencies.

Diffused Diodes

The great majority of rectifiers and general purpose low-frequency diodes are manufactured by gaseous diffusion techniques. They are manufactured by passing a stream of gases containing impurity

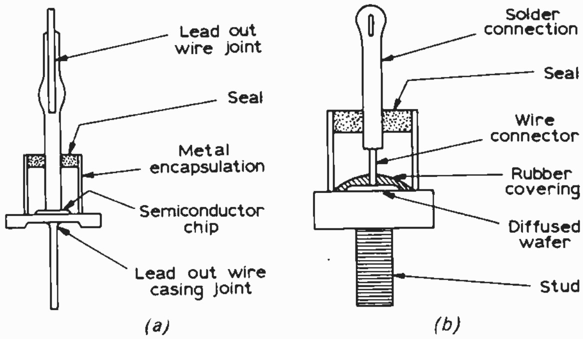


Fig. 9: Sections through diffused power rectifiers. (a) Medium power diffused rectifier. (b) Power rectifier—stud mounting.

elements over the doped p- or n-type slice to give a p-n junction. The slices are mounted on metal headers for power rectifiers as shown in Fig. 9, or in glass encapsulations as shown in Fig. 8.

The power rectifiers shown in Fig. 9 are designed to give increased thermal dissipation from the junction and hence increased power dissipation. This is achieved by attaching the header to the metal casing. Figure 9(a) illustrates a medium power rectifier of 1-2A rating and is of a wire ended configuration which can be used directly in printed circuits. Figure 9(b) is a stud mounting encapsulation and is used for rectifiers in the range 2-15A. In both cases the slice is bonded to the casing and the lead-out terminal is brought out through a resin or glass seal. The casing is therefore electrically connected to one side of the junction but usually diodes are available with either anode or cathode connected to the casing.

TO BE CONTINUED

CQ2 VHF RECEIVER

(September 1969 issue)

The value of R6 is correctly shown in the circuit diagram as 22kΩ and not 220kΩ as given in the components list.

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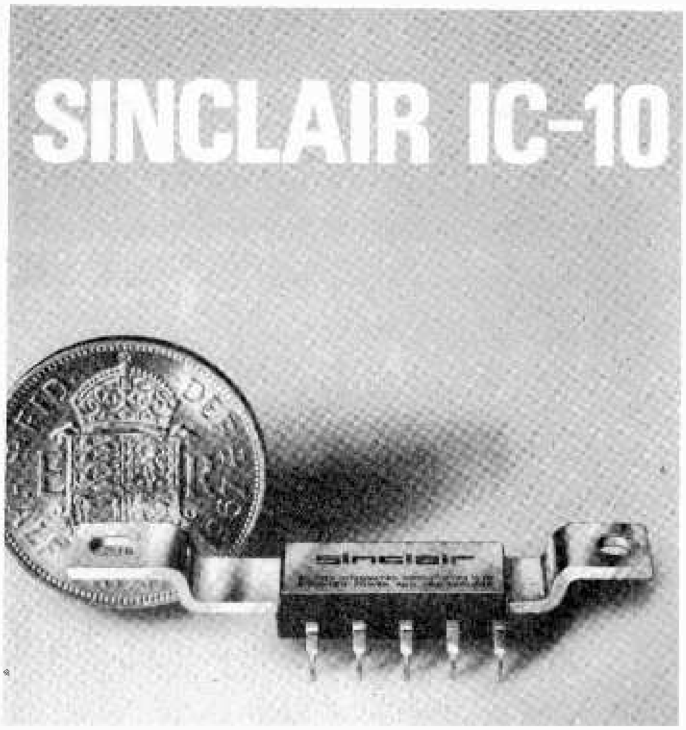
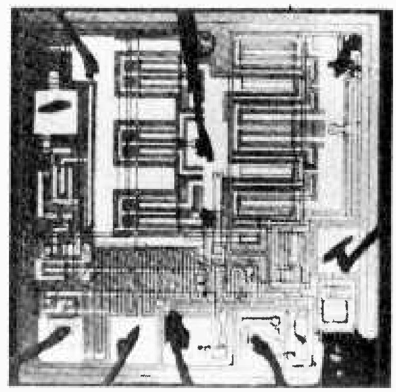


MONOLITHIC INTEGRATED CIRCUIT HIGH FIDELITY AMPLIFIER AND PRE-AMP



the world's most advanced high fidelity amplifier

The Sinclair IC-10 is the world's first monolithic integrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself, a chip of silicon only a twentieth of an inch square by a hundredth of an inch thick, has an output power of 10 watts. It contains 13 transistors (including two power types), 2 diodes, 1 zenor diode and 18 resistors, formed simultaneously in the silicon by a series of diffusions. The chip is encapsulated in a solid plastic package which holds the metal heat sink and connecting pins. This exciting device is not only more rugged and reliable than any previous amplifier, it also has considerable performance advantages. The most important are complete freedom from thermal runaway due to the close thermal coupling between the output transistors and the bias diodes and very low level of distortion.

The IC-10 is primarily intended as a full performance high fidelity power and pre-amplifier, for which application it only requires the addition of the usual tone and volume controls and a battery or mains power supply. However, it is so designed that it may be used simply in many other applications including car radios, electronic organs servo amplifiers (it is d.c. coupled throughout) etc. The photographic masks required for producing monolithic I.Cs are expensive but once made, the circuits can be produced with complete uniformity and at very low cost. It also enables us to give a 5 year guarantee on each IC-10 knowing that every unit will work as perfectly as the original and do so for a lifetime.

■ SPECIFICATIONS

Output	10 Watts peak, 5 Watts R.M.S. continuous.
Frequency response	5 Hz to 100 KHz±1dB.
Total harmonic distortion	Less than 1% at full output.
Load impedance	3 to 15 ohms.
Power gain	110dB (100,000,000,000 times) total.
Supply voltage	8 to 18 volts.
Size	1 × 0.4 × 0.2 inches.
Sensitivity	5mV.
Input impedance	Adjustable externally up to 2.5 M ohms.

■ CIRCUIT DESCRIPTION

The first three transistors are used in the pre-amp and the remaining 10 in the power amplifier. Class AB output is used with closely controlled quiescent current which is independent of temperature. Generous negative feedback is used round both sections and the amplifier is completely free from crossover distortion at all supply voltages, making battery operation eminently satisfactory.

■ APPLICATIONS

Each IC-10 is sold with a very comprehensive manual giving circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include stabilised power supplies, oscillators, etc. The pre-amp section can be used as an R.F. or I.F. amplifier without any additional transistors.

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89/6

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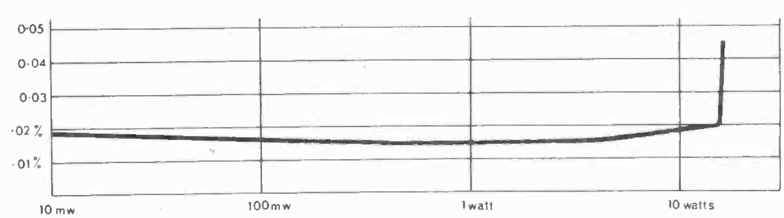
- Power requirements 8-35 volts from batteries or PZ.5



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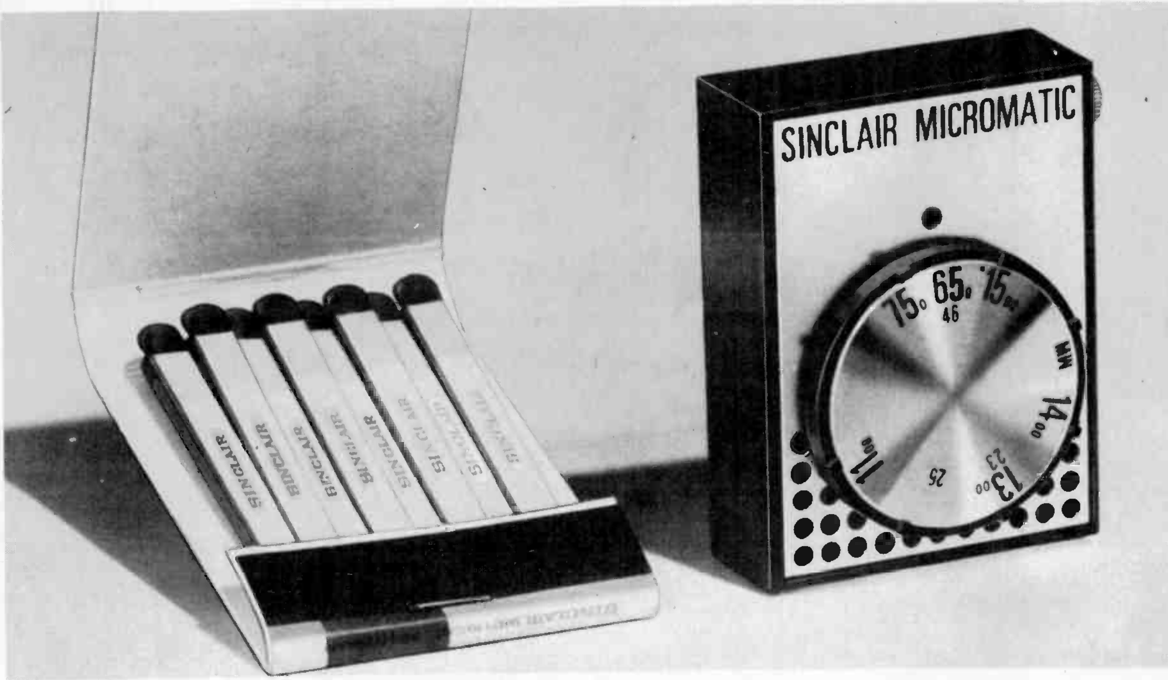

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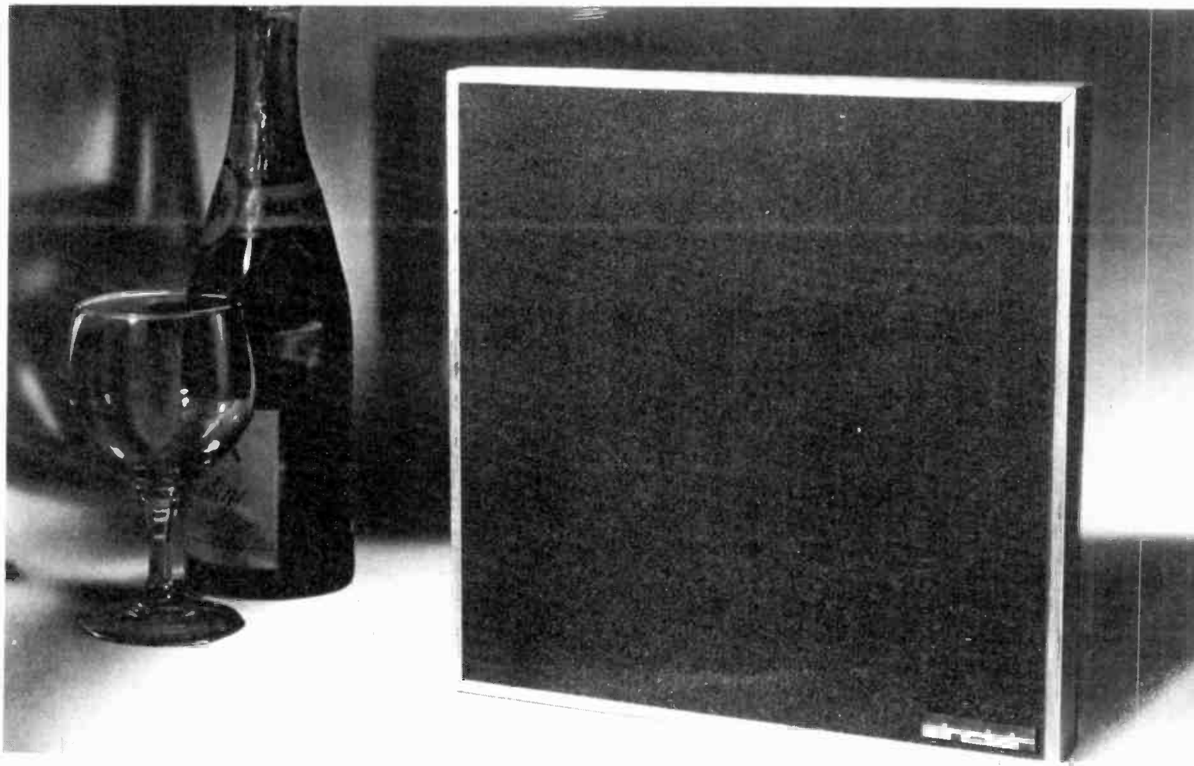

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UABC80 5/9; UAF42 9/6; UB41 6/6; UBC41 7/6; UBC81 7/-; UBF80 5/9; UBF89 6/9; UBL21 9/-; UC92 5/6; UCC84 8/-; UCC85 6/6; UCF80 8/3; UCH21 9/-; UCH42 9/9; UCH81 6/6; UCL82 7/-; UCL83 10/-; UF41 9/6; UF42 9/-; UF80 6/9; UF85 6/9; UF86 9/-; UF89 6/3; UL41 9/6; UL46 12/6; UL84 6/6; UM80 6/6; UR1C 10/6; UU5 7/-; UU8 14/-; UU9 7/3; UU12 4/6; UY1N 9/-; UY21 9/6; UY41 6/9; UY85 5/6; U10 9/-; U12/14 7/6; U16 15/-; U17 5/-; U18/20 10/-; U19 34/6; U22 7/9; U25 13/-; U26 11/9; U31 6/-; U33 29/6; U35 16/6; U37 34/11; U43 6/9; U45 15/6; U47 13/-; U49 11/9; U50 5/6; U52 4/9; U76 4/9; U78 3/6; U107 18/3; U151 6/9; U153 5/3; U154 5/-; U191 12/6; U192 5/-; U193 6/6; U251 16/-; U281 8/-; U282 8/-; U291 9/6; U301 11/-; U329 16/-; U339 12/6; U403 6/6; U404 7/6; U709 4/6; U801 18/-; U4020 6/9; VP4B 10/6; VP13C 7/-; VP23 2/6; VR75 24/-; VR105 5/-; VR150 5/-; VT61A 7/-; VT501 3/-; VU111 7/3; VU120 12/-; VU120A 12/-; VU133 7/-; W42 10/6

W63 10/6; W76 5/9; W77 2/6; W81M 6/-; W101 26/2; W107 7/-; W729 10/-; X24 16/6; X41 10/-; X61 5/9; X63 5/6; X64 12/6; X65 5/-; X66 7/6; X76M 7/6; X81M 30/6; X101 29/1; X109 26/-; X119 6/6; X719 5/9; Z63 4/9; Z77 3/3; Z152 4/6; Z329 13/6; Z719 4/6; Z729 6/-; Z749 13/3; Z759 45/-

Transistors and diodes

2G225 10/6; 2N404 6/-; 2N1756 10/-; 2N2147 17/-; 2N2297 4/6; 2N2369A 4/3; 2N2613 7/9; 2N3053 6/6; 2N3121 50/-; 2N3703 3/9; 2N3709 4/-; 2N3866 20/-; 2N3988 10/-; 28323 10/-; AA119 3/-; AA120 3/-; AA129 3/-; AAZ13 3/6; AC113 5/-; AC114 8/-; AC127 2/-; AC154 5/-; AC155 6/6; AC156 4/-; AC157 5/-; AC165 5/-; AC166 5/-; AC167 12/-; AC168 7/6; AC169 6/6; AC176 11/-; AC177 5/6; ACY17 3/-; ACY18 3/8; ACY19 3/9; ACY20 3/6; ACY21 3/9; ACY22 3/6; ACY28 4/-; AD140 7/6; AD149 8/-; AF102 18/-; AF106 10/6; AF114 4/-; AF115 4/3; AF119 3/-; AF121 6/-; AF124 7/6; AF125 3/6; AF126 5/-; AF139 13/-; AF178 13/6; AF179 13/6; AF180 9/6; AF181 14/-; AF186 11/-; AF239 7/6; ASY27 8/6; ASY28 6/6

ASY29 10/-; B1181 10/-; BA102 9/-; BA115 2/8; BA116 9/-; BA129 2/6; BA130 2/-; BCY10 5/-; BCY12 5/-; BCY33 5/-; BCY34 4/6; BCY38 5/-; BCY39 4/6; BCZ11 3/6; BC107 4/-; BC108 3/6; BC113 5/-; BC115 3/-; BC116 5/-; BC118 4/6; BD119 9/-; BFY50 4/-; BFY51 4/-; BFY52 4/6; BF154 5/-; BF159 5/-; BF163 4/-; BF173 7/6; BF180 6/-; BF181 8/-; BF185 8/-; BTX34/400 40/-; BY100 3/6; BY101 11/6; BY105 10/6; BY114 6/6; BY126 5/-; BY127 5/-; BY234 4/-; BY236 4/-; BY238 4/-; BYY23 20/-; BYZ10 5/-; BYZ11 5/-; BYZ12 5/-; BYZ13 5/-; BYZ15 35/-; CG12E 4/-; CG64H 4/-; GD4 6/6; GD5 5/6; GD6 5/6; GD8 4/-; GD9 4/-; GD10 4/-; GD11 4/-; GD12 4/-; GD14 10/-; GD15 8/-; GD16 4/-; GET103 4/-; GET105 18/-; GET113 4/-; GET115 17/-; GET116 6/6; GET118 4/-; GET119 4/-; GET573 7/6; GET587 8/6; GET872 19/-; GET873 8/-; GET882 10/-; GET887 4/6; GET889 4/6; GET890 4/6; GET896 4/6; GET897 4/6; GET898 4/6; GEX13 3/6; GEX35 4/6; GEX36 10/-; GEX45 6/6; GT3 5/-; M1 2/10; M3 2/10; OA5 5/6; OA9 2/6

OA10 8/6; OA47 2/-; OA70 3/-; OA73 3/-; OA79 1/9; OA81 1/9; OA85 1/6; OA86 4/-; OA90 2/6; OA91 1/9; OA182 2/-; OA200 1/-; OA202 2/-; OA210 9/6; OA211 13/6; OAZ200 12/-; OAZ201 10/6; OAZ202 9/-; OAZ203 9/6; OAZ204 9/-; OAZ205 9/-; OAZ206 9/-; OAZ207 10/6; OAZ210 7/-; OAZ213 7/-; OAZ224 16/6; OC19 25/-; OC22 5/-; OC23 5/-; OC24 5/-; OC25 5/-; OC26 5/-; OC28 5/-; OC29 23/6; OC30 5/-; OC35 5/-; OC36 7/6; OC38 11/6; OC41 10/-; OC42 12/6; OC43 23/6; OC44 2/-; OC44PM 8/3; OC45 1/9; OC45M 8/-; OC46 3/-; OC65 22/6; OC70 2/3; OC71 2/-; OC72 2/-; OC73 16/-; OC74 2/6; OC75 2/-; OC76 2/6; OC78 3/-; OC78D 3/-; OC79 8/-; OC81 2/-; OC81D 2/-; OC81M 5/-; OC82 2/3; OC82D 2/3; OC83 2/-; OC84 3/-; OC123 4/6; OC139 12/-; OC140 19/-; OC169 3/6; OC172 4/-; OC200 4/4; OC201 5/6; OC202 4/6; OC203 4/6; OC204 5/6; OC205 7/6; OC206 10/-; OC812 8/-; OCP71 27/6; SM1036A 10/-; ST1276 10/-; SX1/6 3/6; MAT100 7/9; MAT101 8/6; MAT120 7/9; MAT121 8/6; ZE12V7 1/9

MATCHED TRANSISTOR SETS 1—OC44 and 2—OC45 8/6; 1—OC81D and 2—OC81 7/6; 1—OC82D and 2—OC82 8/6; Set of three—OC83 (GET118/119) 8/6; LP15 package (AC113, AC154, AC157, AA120) 10/6; Postage 6d. per set. S.T.C. 1 watt Zener diodes. 2·4v: 2·7v: 3·0v: 3·6v: 4·3v: 13v: 15v: 16v: 18v: 30v. All 3/6d. each.

WE REQUIRE FOR PROMPT CASH SETTLEMENT ALL TYPES OF ABOVE GOODS LOOSE OR BOXED, BUT MUST BE NEW

ELECTROLYTICS. Can types: 8×8mfd/500v 7/6; 8×16mfd/500v 7/9; 16mfd/500v 6/-; 16×16mfd/500v 8/9; 16×32mfd/450v 9/9; 32mfd/500v 8/-; 32×32/350v 8/9; 32×32mfd/450v 5/9; 50×50mfd/350v 5/6; 60×250mfd/275v 9/9; 50×50mfd/275v 8/6; 64×100mfd/450v 21/-; 64×120mfd/350v 8/6; 100×200mfd/275v 8/-; 100×200mfd/350v 10/6; 100×200×60mfd/300v 18/6; 100×300×100×16mfd/275v 24/9; 100×400mfd/275v 12/9; 100×400×16mfd/275v 23/3; 100mfd/100v 5/6; 200mfd/350v 12/3; 200×200×100mfd/350v 27/9; 300×300mfd/300v 31/6; 1000mfd/50v 9/6; 2000mfd/50v 13/3; 5000mfd/25v 15/-; 5000mfd/50v 27/9; 8mfd/600v 11/3; 16×16×16mfd/275v 7/-; 50×50×50mfd/350v 12/3; 16mfd/600v 15/9; 10000mfd/30v 29/6.
Tubular types: 1mfd/25v 2/-; 1mfd/500v 2/6; 2mfd/150v 2/-; 2mfd/500v 2/9; 4mfd/150v 2/-; 4mfd/500v 3/-; 5mfd/50v 2/-; 8mfd/150v 2/3; 8mfd/450v 1/9; 8mfd/500v 3/6; 8×8mfd/450v 2/9; 8×16mfd/450v 3/-; 10mfd/50v 2/3; 16mfd/450v 2/6; 16mfd/500v 4/6; 16×16mfd/450v 3/6; 25mfd/25v 1/6; 25mfd/50v 2/6; 32mfd/350v 3/-; 32mfd/450v 3/6; 32×32mfd/350v 4/9; 50mfd/12v 1/6; 50mfd/25v 1/6; 50mfd/50v 1/9; 50mfd/350v 6/-; 64mfd/450v 9/6; 100mfd/12v 1/6; 100mfd/25v 1/6; 100mfd/50v 1/9; 100mfd/100v 5/6; 100mfd/450v 10/9; 250mfd/25v 2/-.

SAVE POSTAL COSTS. CASH AND CARRY CALLERS WELCOME!

Terms of business—Cash with order only. Post/Packing 6d. per item. Orders over £5 post free. No C.O.D. Any parcel insured against damage in transit for 6d. extra per order. Hours of business, Mon.—Fri. 9 00 to 5 30 p.m. Sats 9 00 to 1 p.m. Complete list of modern and obsolete valves, resistors, condensers, transformers, etc., with terms of business 10d. Please enquire for any item not listed with S.A.E. Please note that no enquiries can be answered unless a S.A.E. is enclosed for reply.

SUPER-BARGAIN STOCKTAKING SALE!

Use the form below for your order. CONDENSERS MUST BE ORDERED BY STOCK NUMBER ONLY. If any sale item is 'sold-out' when order received we shall substitute items of equal value.

ELECTROLYTIC CAPACITORS

Stock No.	Capacity	Voltage	Price	No. Req'd	£ s. d.
1	1uf	6	4d.		
2	4uf	25	4d.		
3	4uf	4	4d.		
4	6uf	6	4d.		
5	3uf	25	4d.		
6	64uf	9	4d.		
7	20uf	6	4d.		
8	20uf	50	6d.		
9	30uf	15	6d.		
10	8uf	12	4d.		
11	8uf	6	4d.		
12	1uf	350	6d.		
13	8/8/8	350	1/-		
14	50uf	6	4d.		
15	100/200	275	6/-		
16	32	150	9d.		
17	64	2·5	3d.		
18	100/200/200/50	275	7/6		
19	50/80	300	3/-		
20	150/200	275	6/-		
21	24	275	1/-		
22	10	25	3d.		
23	125	2·5	3d.		
24	2	150	3d.		
25	16/32	350	2/6		
26	32	275	1/6		
27	350	12	6d.		
28	75/75/75/75	150	2/6		
29	1	20	3d.		
30	12·5	40	9d.		
31	640	2·5	3d.		
32	3,000	35	7/6		
33	3,000	15	3/-		
34	3,000	30	7/-		
35	250	70	2/-		
36	2,500	9	2/-		
37	32	50	9d.		
38	750	12	1/9		

Stock No.	Capacity	Voltage	Price	No. Req'd	£ s. d.
39	100uf	275	2/6		
40	30uf	10	3d.		
41	2,000/2,000	25	7/6		
42	16uf	50 REV	2/-		
43	16/16	275	2/-		
44	16	275	1/-		
45	350	12	9d.		
46	20/4	275	1/-		
47	250	50	2/-		
48	500	25	1/6		
49	400	15	1/-		
50	400	2·5	3d.		
51	64	275	1/9		
52	32/32	350	2/6		
53	8/8/8	275	1/9		
54	500	6	6d.		
55	64	275	1/3		
56	25	6	3d.		
57	100	9	6d.		
58	400	50	2/-		
59	400	30	1/6		
60	500	4	3d.		
61	150	30	1/6		
62	64/32/8	275	2/6		
63	200	275	2/6		
64	40	6·4	3d.		
65	50	25	6d.		
66	250	50	1/9		
67	30	6	3d.		
68	100/100/50	275	5/-		
69	50/50/50	350	4/-		
70	40/40/20	275	2/-		
71	400	6·4	3d.		
72	320	10	3d.		
73	32/32 + 25	275 + 25	2/6		
		TOTAL			

RESISTORS.

5% EXCELLENT QUALITY. 7/6 per 100 or 2/- per dozen
Tick the values required.

13 ohms	1 k ohm	5·6 k ohm	30 k ohm	130 k ohm	1·8 meg ohm
22 ohms	1·5 k ohm	6·8 k ohm	39 k ohm	360 k ohm	3·6 meg ohm
36 ohms	1·8 k ohm	7·5 k ohm	43 k ohm	430 k ohm	5·1 meg ohm
47 ohms	2·2 k ohm	10 k ohm	47 k ohm	470 k ohm	6·2 meg ohm
91 ohms	2·4 k ohm	16 k ohm	51 k ohm	560 k ohm	7·5 meg ohm
220 ohms	3·3 k ohm	18 k ohm	62 k ohm	620 k ohm	8·2 meg ohm
470 ohms	3·6 k ohm	22 k ohm	75 k ohm	1·2 meg ohm	9·1 meg ohm
560 ohms	4·3 k ohm	24 k ohm	82 k ohm	1·5 meg ohm	10 meg ohm
750 ohms	4·7 k ohm	27 k ohm	91 k ohm		

or our selection (mixed) 6/6 per 100.

TOTAL

SILVER MICA/CERAMIC/POLYSTYRENE CONDENSERS

10/- per 100. 3/- per dozen.

Available in following values. Tick those required.

2 pf	12 pf	50 pf	135 pf	250 pf	1,000 pf
3·9 pf	15 pf	58 pf	140 pf	330 pf	1,100 pf
4 pf	18 pf	62 pf	158 pf	420 pf	1,500 pf
4·7 pf	22 pf	72 pf	170 pf	600 pf	2,200 pf
5 pf	25 pf	80 pf	180 pf	680 pf	2,500 pf
6 pf	27 pf	82 pf	190 pf	800 pf	2,700 pf
8 pf	30 pf	100 pf	200 pf	820 pf	3,000 pf
10 pf	39 pf	125 pf	240 pf	900 pf	6,200 pf

TOTAL

COMPARE THESE PRICES!!!

MULLARD POLYESTER CONDENSERS

	Price	Voltage	No.
1,000 pf	3d. each	400V	
1,500 pf	3d.	,,	
1,800 pf	3d.	,,	
2,200 pf	3d.	,,	
·15 uf	6d.	160V	
·22 uf	6d.	160V	
·27 uf	6d.	160V	
1 uf	1/-	125V	

Total

25% discount lots of 100 per type.
50% discount lots of 1,000 per type.

GANGED STEREO POTS. 250K. 2/6 each.

SKELETON PRESETS. Mixed. 6/- dozen.

VOLUME CONTROLS. ½meg. 1meg. with D.P. switch. 2/- each.

TELEVISION REMOTE CONTROLS. Philips, contain 11' 7-way cable, 1 double pot., 5 resistors, 2 condensers, 10/- each. (Cost £3.3.0.)

THIN CONNECTING WIRE. 10yds 1/-, 100yds 7/6, 1,000yds 50/-.

CO-AXIAL CABLE. Black. 6d. yd. £1 50 yds.

CRYSTAL MIKES. 10/- each.

TRANSISTOR BARGAIN! THEY CAN'T GET ANY CHEAPER!!!! P.N.P. Audio. Untested, unmarked. Mainly O.K., 10/- per 100. N.P.N. Silicon. R.F. types, unmarked. All Useable. 10/- per 50. Power Output (similar OC35). All Tested, 4/- each. £2.0.0. dozen.

SILICON PLANAR TRANSISTORS. All Tested. No Leaks or Shorts. Gain of 20/50, 6d. each; 50/100, 9d. each; 100/200, 1/- each. Transistors similar to OCP71 (light sensitive). 2/- each.

THYRISTORS. 400 volt BTY 79, 7/6 each; SCR 51 (10 amp.), £1 each.

RECTIFIERS. Latest type. All marked. 800 volt peak. 1 amp. mean current type 1N4006 2/6 each. 24/- dozen. £7.10.0 100. S.T.C. 3/4 (400 volt) 2/6 each, 24/- dozen. £7.10.0 100. BYZ 13 or 19 (6 amp.) 2/6 each, 24/- dozen. £7.10.0 100.

RECORDING TAPE GIVE-AWAY!!!! ALL BRITISH MADE, BEST QUALITY. 5" 600', 7/3; 5¾" 900', 9/-; 7" 1,200', 12/-; 3" 'odd-ends'—may be standard, long or double play—but minimum 150', 2/3.

MAINS DROPPER TYPE RESISTORS. Hundreds of types from ·7 ohm upwards. 1 watt to 50 watts. A large percentage of these are Multi-tapped droppers for radio/television. Owing to the huge variety these can only be offered 'assorted', 10/- per dozen.

GIANT SELENIUM SOLAR CELLS. Last few to clear at half price! Circular, 67 m.m. diameter, 5/- each. 50mm × 37mm, 3 for 10/-.

RECORD PLAYER CARTRIDGES ACOS GP67/2, 15/-(Mono); GP91/3, 20/-(Compatible); GP93/1, 25/-(Stereo); GP94/1, 30/- (Stereo, ceramic); GP93/1 with diamond needle, 32/6; GP94/1 with diamond needle, 37/6.

TRANSISTORISED SIGNAL INJECTOR KIT. 10/-
TRANSISTORISED SIGNAL TRACER KIT. 10/-
TRANSISTORISED REV. COUNTER (CAR). 10/-

VERO-BOARD

2½" × 1" × ·15	1/3	5" × 3¾" × ·15	5/6	3¾" × 3¾" × ·1	4/9
3¾" × 2½" × ·15	3/3	17" × 2½" × ·15	11/-	5" × 2½" × ·1	4/7
3¾" × 3¾" × ·15	3/11	17" × 3¾" × ·15	14/8	5" × 3¾" × ·1	5/6
5" × 2½" × ·15	3/11	3¾" × 2½" × ·1	4/2		

Spot Face Cutter, 7/6. Pin Insert Tool, 9/6. Terminal Pins, 3/6 for 36.
Spot Face Cutter and five 2½" × 1" boards, 9/9.

TRANSISTORISED FLUORESCENT LIGHTS. 12 VOLT. 8 watt 12" tube, Reflector type, 59/6. 15 watt 18" tube, Batten type, 79/6. Complete with tube. Postage 3/-.

These prices cannot be repeated. Order now. Don't forget to add your name and address! Please include suitable amount to cover post and packing Minimum 2/-.

G. F. MILWARD, DRAYTON BASSETT, NEAR TAMWORTH, STAFFS. 'Phone Tamworth 2321

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Satisfaction GUARANTEED in Every Pak, or money back.

Pak No.		
U1	120 Glass Sub-min. General Purpose Germanium Diodes	10/-
U2	60 Mixed Germanium Transistors AF/RF	10/-
U3	75 Germanium Gold Bonded Diodes sim. OA5. OA47	10/-
U4	40 Germanium Transistors like OC81, AC128	10/-
U5	60 200mA Sub-min. Sil. Diodes	10/-
U6	40 Silicon Planar Transistors NPN sim. BSY95A. 2N706	10/-
U7	16 Silicon Rectifiers Top-Hat 750mA up to 1,000V	10/-
U8	50 Sil. Planar Diodes 250mA OA/200/202	10/-
U9	20 Mixed Volts 1 watt Zener Diodes	10/-
U11	30 PNP Silicon Planar Transistors TO-5 sim. 2N1132	10/-
U12	12 Silicon Rectifiers EPOXY BY126/127	10/-
U13	30 PNP-NPN Sil. Transistors OC200 & 28104	10/-
U14	150 Mixed Silicon and Germanium Diodes	10/-
U15	30 NPN Silicon Planar Transistors TO-5 sim. 2N697	10/-
U16	10 3-Amp Silicon Rectifiers Stud Type up to 1,000 PIV	10/-
U17	30 Germanium PNP AF Transistors TO-5 like ACY 17-22	10/-
U18	8 6-Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	10/-
U19	30 Silicon NPN Transistors like BC108	10/-
U20	12 1·5-amp Silicon Rectifiers Top-Hat up to 1,000 PIV	10/-
U21	30 AF Germanium alloy Transistors 2G300 Series & OC71	10/-
U22	10 1-amp Glass Min. Silicon Rectifiers High Volts	10/-
U23	30 Madt's like MAT Series PNP Transistors	10/-
U24	20 Germanium 1-amp Rectifiers GJM up to 300 PIV	10/-
U25	25 300 Mc/s NPN Silicon Transistors 2N708. BSY27	10/-
U26	30 Fast Switching Silicon Diodes like IN914 Micro-min.	10/-
U28	Experimenters' Assortment of Integrated Circuits, untested. Gates, Flip-Flops. Registers, etc., 8 Assorted Pieces	20/-
U29	10 1-amp SCR's TO-5 can up to 600PIV CRS1/25-600	20/-
U30	15 Plastic Silicon Planar trans. NPN 2N2924-2N2926	10/-
U31	20 Sil. Planar NPN trans. low noise Amp 2N3707	10/-
U32	25 Zener diodes 400mW D07 case mixed Volts. 3-18	10/-
U33	15 Plastic case 1-amp Silicon Rectifiers 1N-4000 series	10/-
U34	30 Sil. PNP alloy trans. TO-5 BCY26, 28302/4	10/-
U35	25 Sil. Planar trans. PNP TO-18 2N2906	10/-
U36	25 Sil. Planar NPN trans. TO-5 BFY50/51/52	10/-
U37	30 Sil. alloy trans. SO-2 PNP, OC200 28322	10/-
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Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked

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AC126-7-8	2/6
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AF139	10/-
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BFY50-51-52	7/6
BSY26-7	3/6
BSY28-9	4/6
BSY95-95A	4/6
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OC28-29	7/6
OC44-45	1/9
OC71-81	1/6
OC72-75	2/6
OC81D-82D	2/3
OC82	2/6
OC140	5/-
OC170	2/6
OC171	3/6
OC201	7/6
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OCP71	8/6
OA5-10	1/9
OA47	2/-
OA70	1/3
OA79	1/9
OA81-85	1/6
OA91	1/3
OA95	1/9
OA200	3/-
OA202	3/6
2N696-7	5/-
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2N708	5/-
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50	7/6	8/6	10/6	35/-
100	8/6	10/-	15/-	45/-
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300	15/-	20/-	25/-	—
400	17/6	25/-	35/-	80/-
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600	—	40/-	50/-	—

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100	1/3	3/3	4/6	15/-
200	1/9	4/-	4/9	20/-
300	2/3	4/6	6/6	22/-
400	2/6	5/6	7/6	25/-
500	3/-	6/-	8/6	30/-
600	3/3	6/9	9/-	37/-
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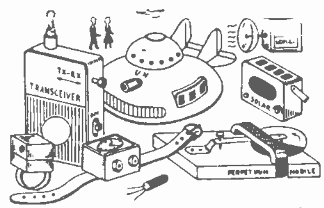

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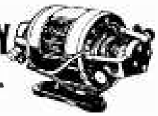

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6¼″	4⅞″	13 6	18 0	1 0 0
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8¼″	6⅞″	1 1 0	1 6 6	1 11 3
10¼″	7⅞″	1 8 6	1 15 6	1 18 9
12¼″	3⅞″	1 1 0	1 6 6	1 11 0
12¼″	5⅞″	1 8 0	1 14 0	1 17 6
12¼″	8⅞″	1 16 0	2 3 0	2 7 3
14¼″	3⅞″	1 5 0	1 11 6	1 14 0
14¼″	9⅞″	2 3 0	2 15 9	2 18 6
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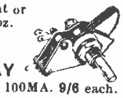

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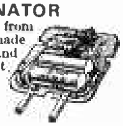

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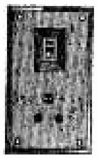

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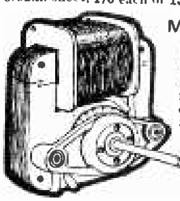

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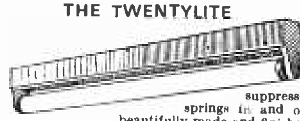

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