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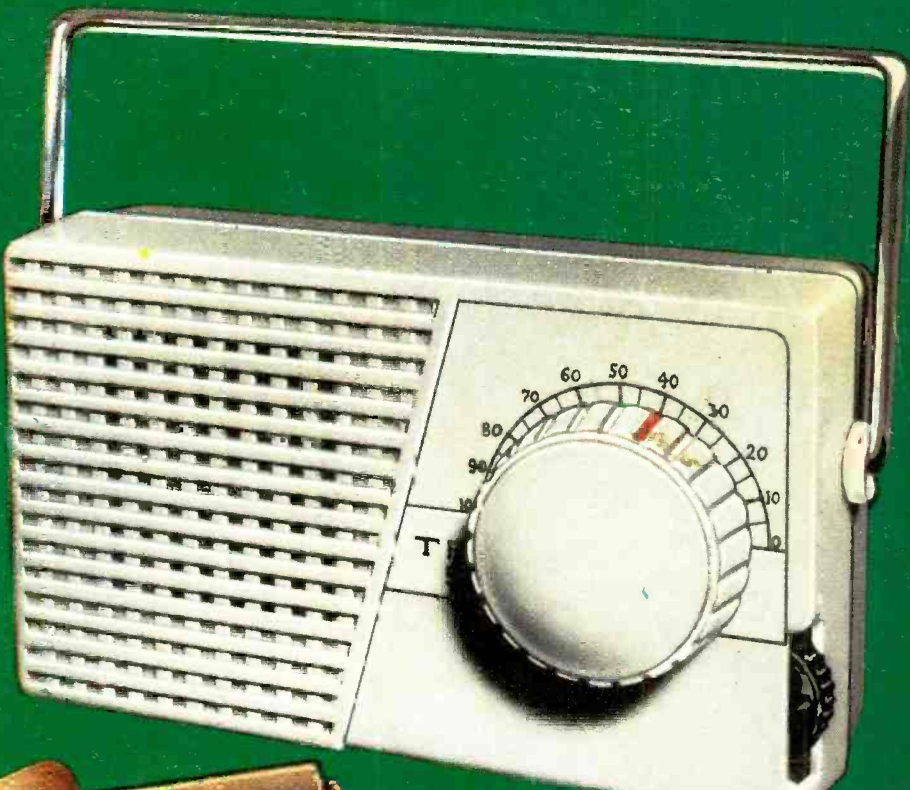

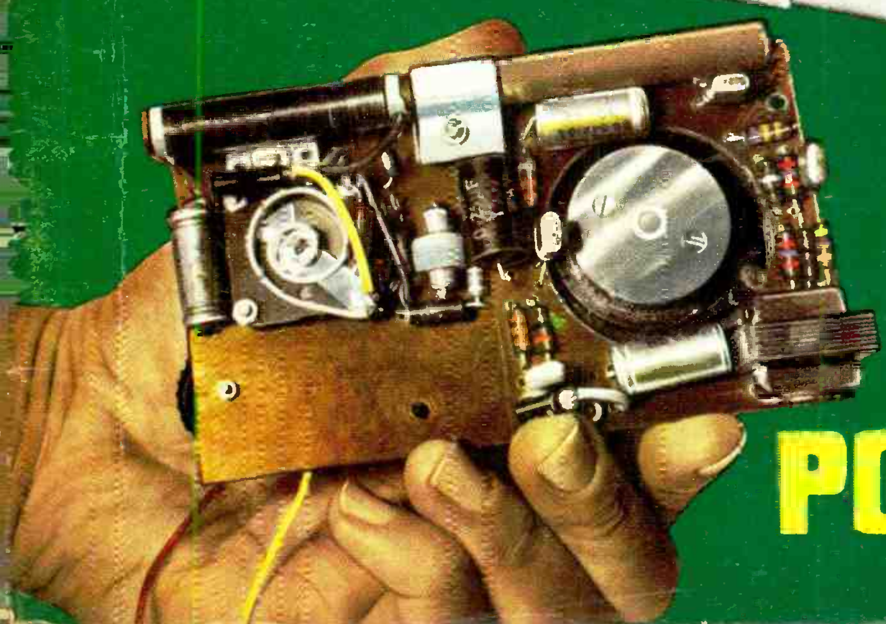

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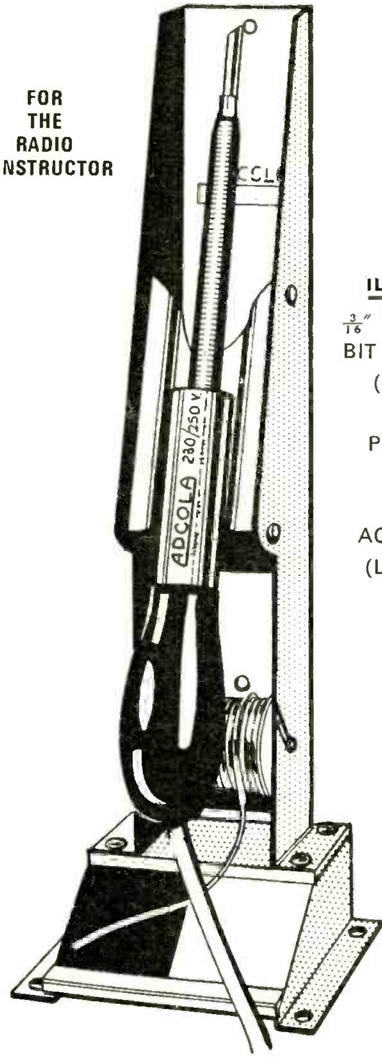
FOR THE RADIO CONSTRUCTOR



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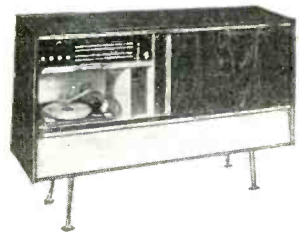

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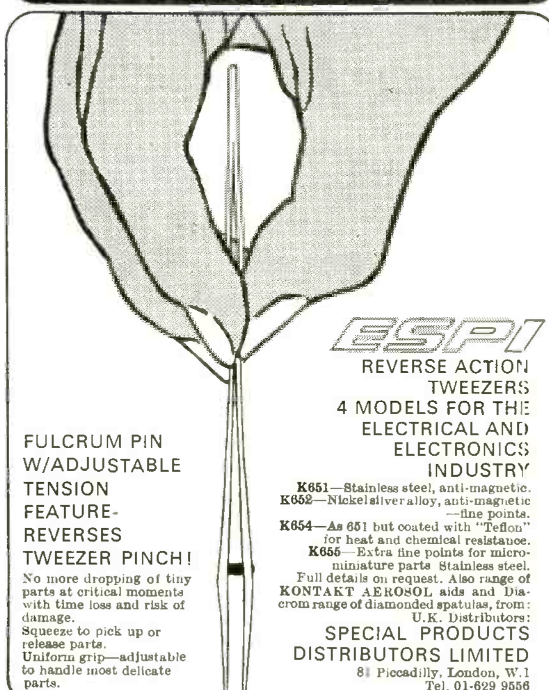
WHEN THE SQUEEZE IS ON THE PRESSURE IS OFF



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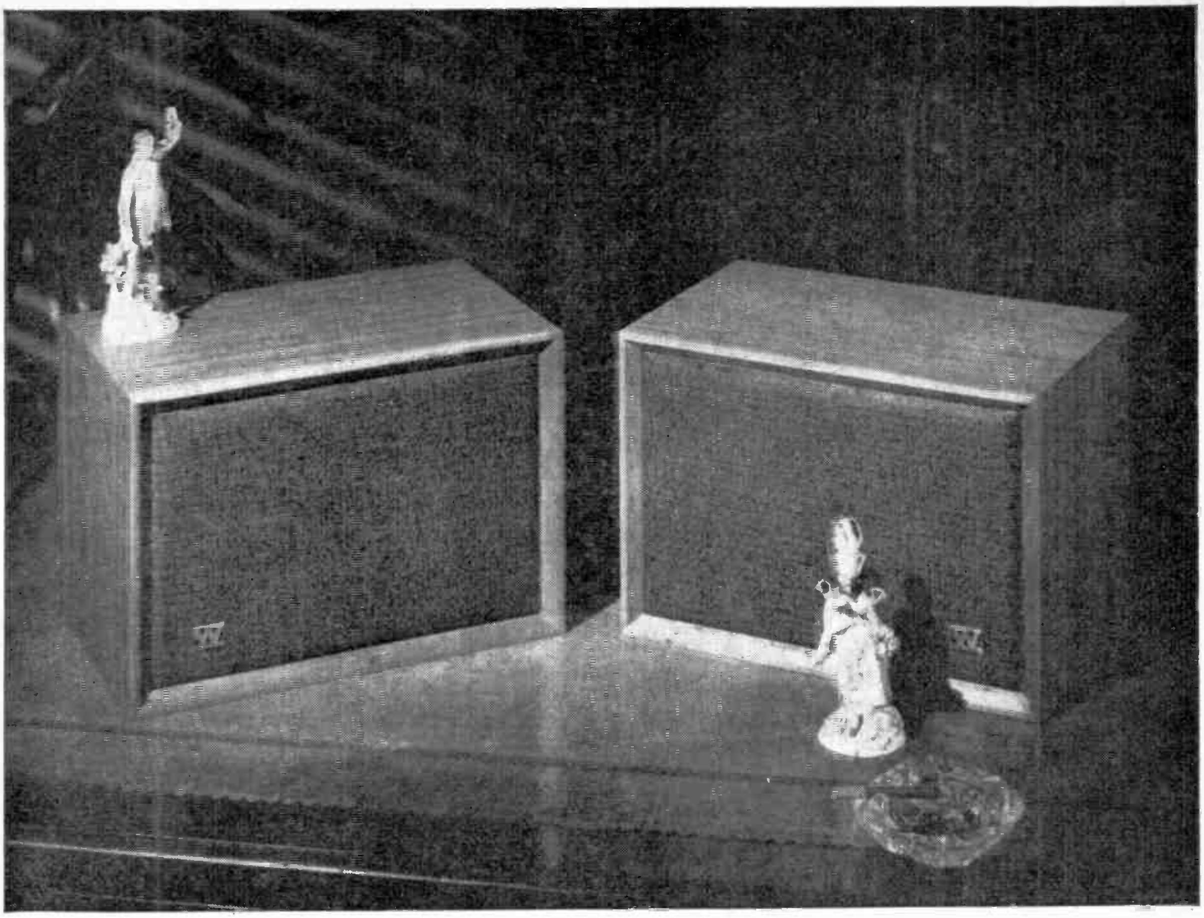

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- Each cabinet has two speaker units with a carefully designed cross-over network.
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- Response: 65 Hz to 17,000 Hz.
- Finish: Oiled Teak or Polished Walnut.

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PW5

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Valve amplifier to exact Mullard spec. With pre-amp tapped o/p transformer 3 and 15 Ω, all controls, H.T and L.T. outlet, mono, stereo and speaker phase switching. Complete with escutcheon, knobs, plugs, etc. Ready built. **£20.0.0**
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5 valve, 10W basic amplifier kit complete. **£9.19.6**
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Comprises improved "Cir-Kit" strip and "Cir-Kit" 0·1in. Matrix Board. "Cir-Kit" in 5in. x ⅛in. or 1/16in. strip 2/-. 0·1in. Matrix bd., 3¾in. long x 5in. 4/6; x 2½in. 2/6; x 2in. 1/9d.

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A superbly powerful high performance instrument for the keenest enthusiasts. Provides tuning on long, medium and F.M. wavebands. Excellent sensitivity Permeability tuning on F.M. Large clear dial, A.V.C., good neg. feedback. Magic eye. 3W output. A.c. 200/250V. Circuit diagrams available. Aligned, tested and ready for use (Carr. and insurance 7/6). **£13.19.6**
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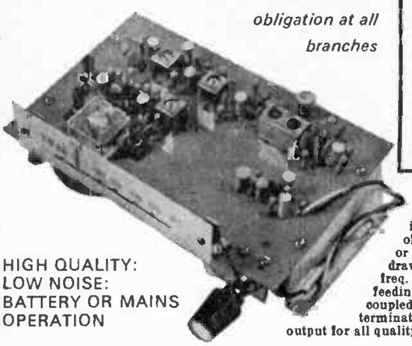

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Miniature Ceramic, Silver, Mica etc., 3pF to 5μF. LIST VALUE OVER £4.

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1S4	5/9	6P28	9/6	20P4	18/9	EBF89	8/-	EZ80	6/6	PY800	8/-
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5U4G	7/-	6SJ7GT	6/-	30C15	12/6	ECC81	5/9	GZ32	10/6	SP61	3/9
5Y3GT	7/6	6SL7GT	7/9	30C17	11/6	ECC82	5/6	GZ34	11/6	TDD4	8/6
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6/30L2	10/6	6V6G	4/9	30L15	12/6	ECC85	6/9	KT66	20/6	U26	10/6
6A8G	7/6	6V6GT	7/9	30L17	12/6	ECC88	10/6	KTW61	6/9	U35	13/6
6AK5	5/9	6X4	5/6	30P4	12/6	ECF80	8/9	KTW63	6/-	U191	13/6
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6F14	7/6	12AU7	5/6	DK91	5/6	EF183	9/-	PCL85	10/6	UF41	10/-
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6J6	4/3	12K7GT	6/-	DL96	8/3	EL41	10/9	PL82	5/9	UL44	15/-
6J7G	5/6	12K8GT	10/6	DY86	6/-	EL42	9/9	PL83	6/-	UL46	11/6
6J7GT	10/6	12Q7GT	7/6	DY87	6/-	EL84	7/6	PL84	8/-	UL84	7/8
6K7G	2/8	12SJ7	5/6	EABC80	7/9	EM80	8/-	PY31	7/6	UM80	10/6
6K7GT	6/9	14S7	15/6	EAF42	9/-	EM81	8/6	PY32	10/6	UY21	9/9
6K8GT	10/6	19AQ5	6/6	EB41	4/6	EM84	8/9	PY33	8/6	UY41	8/-
6L1	10/6	20D1	9/9	EB91	2/9	EY51	8/6	PY80	6/9	UY85	6/6
6L6G	9/6	20F2	9/6	EBC33	8/6	EY86	8/6	PY81	5/9	VR105	6/-
6L18	7/9	20L1	17/-	EBC41	10/6	EY88	9/6	PY82	5/6	VR150	6/-
6LD20	9/6	20P1	9/6	EBC91	7/9	EZ40	8/6	PY83	6/9	X66	7/9

Tubes

HIGHEST QUALITY— COMPARE OUR PRICES

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MOST MULLARD, MAZDA, COSSOR, EMITRON, EMI-SCOPE, BRIMAR, FERRANTI TYPES PROCESSED IN OUR OWN FACTORY

Carr. & Ins. 12/6	6 Months	12 Months
12in.	£2. 0.0	£3. 0.0
14in.	£2.10.0	£3.10.0
15-17in.	£3. 5.0	£4. 5.0
19in.	£3. 5.0	£4. 5.0
21in.	£3.15.0	£5.15.0
23in.	£3.15.0	£5.15.0

SATISFACTION GUARANTEED

NOTE: ALL TUBE ORDERS ONLY TO PORTSMOUTH BRANCH PLEASE

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Stockists of Leak, Quad, Chapman, Goodman, Armstrong, Tripletone, Linear Rogers, Truvox, Ferrograph, Wharfedale, etc., etc.

Post: 1 lb. 1/6, 1½ lb. 2/6, 2 lb. 2/9, 4 lb. 3/3, 6 lb. 4/-, 14 lb. 5/6.

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All Mail Orders to Brighton with names and addresses in BLOCK CAPITALS please.

Lasky's Radio

DON'T MISS THIS!

Lasky's Birthday Draw

The following 85 numbers have been drawn for prizes in our 35th Birthday Draw. Please refer to Page 12 of our Catalogue for details of entry if your number (on the front page of your Catalogue) is among those listed here:

000013	001415	002313	012603	024444	029686	034717
000092	001510	002414	012777	024818	029875	035900
000823	001582	002479	013626	024950	029900	036000
000899	001711	003060	013750	026515	029999	037017
000927	001777	003166	015000	027000	030166	038111
000929	001800	005000	016001	027009	030744	038212
000974	001900	005016	019020	028010	030844	039414
001054	001911	005161	020003	028455	030982	039565
001274	001922	005615	021414	028490	031010	043472
001288	001991	006768	021444	029030	032013	046782
001292	002101	006900	021500	029131	033417	047111
001333	002230	011717	023466	029444	034111	047388
						048001

The first 10 correct entries to be opened will receive £5 Lasky's Gift Vouchers, the next 25 will receive £1 vouchers and the next 50 will receive 10 6 vouchers.

Note: Members of Lasky's Radio staff and relatives are expressly excluded from entry in this competition.

HAVE YOU GOT YOUR LASKY'S CATALOGUE FREE Second Great Reprint Issue Now Ready. Just send your name, address and 1/- for post only.

RECORD PLAYERS

GARRARD AUTOCHANGERS

AP75 .... £22.11.6
AT60 Mk. II £13.19.6
3000LM with stereo cart £9.19.6
A70 .... £13.19.6
Lab. A Mono Stereo £14.19.6
Lab. A on plinth £15.19.6
A50 .... £7.7.0
A1000 .... £7.7.0
A2000 .... £7.17.6

SINGLE PLAYERS
Auto. start and stop. Complete with pick-up and crystal cartridge.
GARRARD SP25 Light t table £9.19.6
GARRARD SP25 Mk. I Heavy t/table £10.19.6
GARRARD SP25 Mk. II Heavy t/table £11.19.6
(Garrard SP25's are ex-cartridge)
GARRARD SRP12 .... £4.7.6
GARRARD SRP10 mains model .. £4.19.6
GARRARD SRP10 batt. model ... £4.19.6

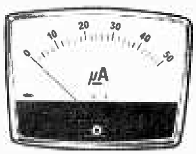
TRANSCRIPTION MOTORS
GARRARD 401 .... £27.19.0
GARRARD Lab. 80 Mk. II £25.0.0

GARRARD BASES
WB1 .... £3.16.3 WB2 ...... £5.5.0

CLEARVIEW PERSPEX COVERS
WB1 .... £3.17.0 WB2 ..... £5.7.11
Postage on all above 5/- extra.

SPECIAL INTEREST ITEMS!

LASKY'S CLEAR PLASTIC PANEL METERS



Precision made in Japan by HIOKI. Each meter boxed and fully guaranteed with all fixing nuts and washers. Sizes are of front panel. Add 1 6 P. on each. (Quotes for quantities)

Type KR-52 3 · 2½in. (illustrated)
1mA DC 47/6
5mA DC 32/6
300V DC 32/6
50μA 56/-
100μA 47/6
500μA 37/6
1mA S Meter 39/6

Type MK-38A 1½in. square
1mA DC 29/6
5 mA DC 22/6
300V DC 22/6
50μA 36/-
100μA 29/6
500μA 27/6
5 mA S meter 29/6

Type MK-45A 2in. square
5 mA DC 25/-
3 mA DC 25/-
300V DC 25/-
500μA 25/-
1 mA S meter 35/-

Type KR-65 3¾ · 3in.
1 mA DC 36/-
5 mA DC 35/-
300V DC 35/-
50μA 59/6
100μA 49/6
500μA 42/6
1 mA S meter 39/6

Type MK-65A 3in. square
1 mA DC 36/-
5 mA DC 35/-
300 V DC 35/-
500μA 39/6
1 mA S meter 37/6

NEW INTERNATIONAL TAPE

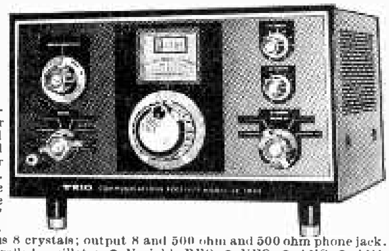
FAMOUS AMERICAN MADE BRANO TAPE AT RECORD LOW PRICES

3in. Message tape, 150ft.	2	6
3in. Message tape 225ft.	3	9
3in. Message tape, 300ft.	7	6
3¼in. Triple play, 600ft. Mylar	10	0
4in. Triple play, 900ft. Mylar	17	6
5in. Double play, 1200ft. Mylar	15	0
5in. Long play, 900ft. Acetate	10	0
5in. Standard play, 600ft. PVC	8	6
5in. Triple play, 1800ft. Mylar	35	0
5¾in. Double play, 1800ft. Mylar	22	6
5¾in. Long play, 1200ft. Acetate	12	6
5¾in. Standard play, 850ft. PVC	11	6
5¾in. Long play, 1200ft. Mylar	15	0
5¾in. Triple play, 2400ft. Mylar	45	0
7in Standard play, 1200ft Acetate	12	6
7in. Standard play, 1200ft. Mylar	12	6
7in. Long play, 1800ft. Mylar	19	6
7in. Double play, 2400ft. Mylar	26	0
7in. Long play, 1800ft. Acetate	15	0
7in. Triple play, 3600ft. Mylar	50	0

P. & P. 1/- extra per reel. 4 reels and over Post Free.

COMMUNICATION RECEIVERS

TRIO RECEIVERS

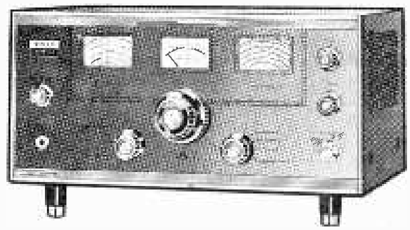


MODEL JR-500SE

This high performance receiver is made especially to cover the amateur bands and utilises a crystal controlled double heterodyne circuit for extra sensitivity and stability. **Brief spec:** Covers all the amateur bands in 7 separate ranges between 3·5 and 29·7 Mc/s. Circuit uses 7 valves, 2 transistors and 5 diodes plus 8 crystals; output 8 and 500 ohm and 500 ohm phone jack. **Special features:** 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. For use on 115/250V A.C. Mains. Superb modern styling and control layout—finished in dark grey. Cabinet size 7 × 13 × 10in. Weight 18 lbs. Fully guaranteed, complete with instruction manual and service data.

LASKY'S PRICE £68.0.0 Carriage and Packing 12/6. H.P. terms available.

MODEL 9R-59DE



Brief spec.: 4 band receiver covering 550 Kc/s to 30 Mc/s continuous and electrical band spread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. **Special features:** SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. band spread dial ● IF frequency 455 Kc/s ● Audio output 1·5 W ● Variable RF and AF gain controls. For use on 115/250 V A.C. Mains. Beautifully designed control layout finished in light grey with dark grey case, size 7 × 15 × 10in. Weight 19 lbs. Fully guaranteed, complete with instruction manual and service data.

LASKY'S PRICE £39.15.0 Carriage and Packing 12/6.

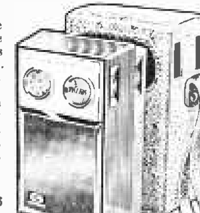
JOYSTICK VARIABLE FREQUENCY ANTENNA

Revolutionary variable frequency antenna for transmission and reception. With a variable matching unit these antennae perform as a high 'Q' device at any selected Medium or Short waveband. Send for S.A.E. for descriptive leaflet.

AERIALS (7ft. 6in. Long)		Matching units	
VFA Standard	£4 15 0	A.T.V. 3A	£3 12 6
VFA De Luxe	£5 19 6	A.T.V. 4	£4 4 0
		A.T.V. 4/RF	£6 6 0

HUGE PURCHASE OFFER

CROWN MODEL TRF-6 AM/FM 9 TRANSISTOR POCKET RADIO

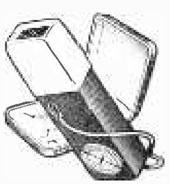


Unbelievably small for an AM/FM receiver—the Crown is only 4½in. × 2⅜in. × 1⅞in. Super sensitive 9 transistor superhet circuit with directionless stabilised reception. AM cover: MW 335–1605 Kc/s. FM cover: 88–108 Mc/s. Superb tone reproduction 2¼in. PM speaker. Precision tuning. 6 section (14¾in.) telescopic aerial—clips into side when not in use. Output 280 mW max. Beautifully styled and finished cabinet in black plastic with silver metal trim. Operates on one 9V battery. Complete with leather purse, ear-piece and battery. **List Price 13½ Gns.**

SCOOP Price £7.19.6 Post 2/6

IDEAL FOR USE WITH THE "TOMMY" WIRELESS MICROPHONE—BELOW

The TOMMY MODEL WO-11 WIRELESS MICROPHONE



This brand new wireless mic. combines sensitivity with miraculous miniature size. Only 0·72 × 0·62 × 2·24in. Easily concealed with many uses—ideal for parties, games or as a baby alarm, etc. Ideal for use with the Crown AM/FM radio and model A1004 FM Tuner. Brief Spec.: Short Range transmitting; frequency 9–107 Mc/s FM. External Antenna. Battery; Mercury 1·3V (Mallory 675 R). Weight 0·65 oz. Complete with battery and trimmer for tuning and instruction booklet.

Lasky's Price £5.19.6 Post Free

SPECIAL PACKAGE PRICE if bought with the Crown TRF-6 AM/FM RADIO. See above. £12.19.6 Post Free

This item cannot be operated in the U.K. owing to G.P.O. regulations.

LASKY'S FOR SPEEDY MAIL ORDER SERVICE

Lasky's Radio

PRESENT A NEW SENSATIONAL HI-FI UNIT

TRIO Model TK-60BE TRANSISTORISED AM/FM MULTIPLEX STEREO TUNER AMPLIFIER

AT A PRICE YOU CAN AFFORD !

The 36 Transistor TR10 TK-60BE incorporates superb modern styling with many features normally found in models costing £££'s more. This great value for money Hi-Fi unit offers the following superb features: Tuner AM/FM 4-gang tuning condenser all transistor front end provides FM 2·5mV sensitivity. *Automatic FM/Stereo Mono mode silent switching circuit with Stereo signal beacon. *Illuminated pinpoint AM/FM tuning meter. *4 diode time division multiplexer de-coder giving 35dB channel separation. Amplifier * All silicon transistor amplifier provides wide 20—50,000 Hz frequency response. *Exclusive blow-out free automatic circuit breaker for power transistor protection. *Speaker output terminals and power for 2 sets of stereo speakers—switch selected (A speakers, B speakers, A+B speakers, head phones). *Centre channel output. *Full range of controls. *Front panel stereo phone jack. *Direct tape monitor switch for tape monitoring without changing cable connections. *DIN connector for tape recorder. Brief spec.: Amplifier—Music Power 60 watts (IHF standard 4 ohms). Continuous power—20 watts per channel. Signal to noise ratio—Phono 60dB, Tape HD-60dB. Input sensitivity—Phono 2mV, Tape HD-2·5mV, AUX 150mV, Tape play 150mV. Speaker Impedance—4/16 ohms. Controls: Input selector. Mode, HF and LF filters, separate treble and bass controls for each channel, balance, loudness, tape monitor, output selector. Tuner: FM cover 88–108 Mc/s, AM cover 540–1600 Kc/s. FM Harmonic Distortion—0·6%. FM Signal to Noise Ratio—60dB. FM Selectivity—40dB. General: For 110/250V mains. Finish—brushed aluminium with hammer enamel case. Size $17\frac{3}{4} \times 5\frac{3}{4} \times 14$in.

LASKY'S GREAT VALUE PRICE 69 Gns. Carriage FREE in U.K.

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Every year we acquire a number of exceptional bargains which we offer first of all to the purchasers of our Catalogue, in the form of a special bargain list. To give you a taste of these tempting bargains we reproduce a part of the list here.

The rest of the list consists of many other most interesting bargain items—Diodes, Neon Lamps, Switches, Transformers, Valves, etc. We can supply the complete list for a shilling, but better still, why not buy our 1968 Catalogue and get the list free. The Home Radio Catalogue is acknowledged as one of the finest electronic components catalogues available today—its 256 pages list over 7,000 items, more than 1,300 of them illustrated. And with the catalogue, in addition to the bargain list, you get 5 vouchers, each worth a shilling when used as directed, a voucher worth another five shillings if used to purchase a Weller Soldering Iron, an order form and an addressed envelope. All this for 9/6! (7/6 plus 2/- p & p). Why wait? Send your cheque or P.O. with the coupon today!

List No.	Description	
DIALS		
1BG29	Elegant Bronze Dial $2\frac{7}{8}$" dia. engraved M.W. and L.W. Station Names	1/3
1BG30	Combined knob and dial $2\frac{1}{2}$" clear perspex knob with separate gold M.W. scale	1/6
DIODES		
1BG31	OA5 Diode	2/6
1BG32	High quality diode, suitable F.M.	1/6
JACKS		
1BG34	Jacks G.P.O. type	3/6
MICROPHONES		
1BG38	High quality Carbon Microphone inserts, 4 for 5/-, 10 for 10/- or each	2/6
MOTORS		
1BG40	Small $4\frac{1}{2}$–6 volts D.C.	3/6
1BG41	Small 1 x $1\frac{1}{4}$ x $1\frac{5}{8}$, 1–3 volts D.C.	4/6
NEON LAMPS		
1BG42	Small neon lamp suitable 200–240 AC/DC	2/6
PILOT LIGHT HOLDERS		
1BG43	PLH2 Pilot lamp holders M.E.S. with bracket, 3 for	1/6
PRINTED CIRCUIT BOARDS		
1BG45	BTS43 Suitable for the Mullard ECL86 amplifier	3/6
1BG46	BTS44 As above but Push Pull	7/6
1BG47	Resistor Packs, 60 assorted resistors, 30 different preferred values	6/-
SWITCHES		
1BG48	Toggle Switch centre off 4 pole change over	5/6
1BG49	WS97 Bulgin S594 Heavy duty on/off switch	2/6
MAINS TRANSFORMER		
1BG51	Primary 0–240V. L.T. sec. 7V at 1 amp. L.T. sec. 7V at $\frac{3}{4}$ amp. Ideal for Transistor Power Pack	17/6
VALVES		
1BG53	EF92 Mullard	5/6
1BG54	EF86 Mullard	13/6
1BG55	EZ81 Mullard	7/-
1BG56	EF80 Mullard	8/6
1BG57	ECC83 Mullard	8/6
1BG58	EL84 Mullard	8/6

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HOME RADIO LTD., Dept. PW, 187 LONDON ROAD, MITCHAM CR4 2YQ

SENSATIONAL VALUE IN HIGH FIDELITY STEREO SYSTEMS

Consisting of (1) Garrard Mk II SP25 4-speed Turntable with Pick-up. Heavy 12in. turntable, hydraulic lowering device and many other features inc. Plug in P.U. head. Fitted CS90 P.U. Cartridge ready wired on plinth (baseboard). Fitted plugs for instant use. (2) Super 30 Amplifier fully wired and fitted in cabinet above. (3) Pair of Stanton III Loudspeaker Units. Extremely attractive cabinets finished Satin Teak Veneer, tinted Perspex 'hinged' lid. Performance comparable with equipment at twice the cost and saving approx. £18 on above units. Special inclusive price **69½ Gns.** Carr. 35/-

Terms: Dep. £19 and 12 mthly payments of £5. Total £79. Send S.A.E. for leaflet. Supplied less Stanton Loudspeakers at 49½ gns. or Deposit £7.17.6 and 9 monthly paymts £5.10.10 (total 55 gns.).

Inc. Garrard SP25 MkII Player Unit (with heavy cast turntable) on plinth, ready wired, with plugs and fitted Goldring CS90 high compliance ceramic cartridge with diamond stylus. Assembled TA12 Stereo Amp. in cabinet and Pair of Dorset Speaker Units. **Total for above saving £12.** Carr. 25/-. Special Price **46 Gns.** Perspex cover 59/9 extra with above.
Terms: Dep £7.6 and 9 mthly pymts £5.3 (total £53.13).

AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS

Heavy cast construction. Latest high efficiency ceramic magnets. Treated Cone surround giving low fundamental resonance. "D" indicates Tweeter Cone providing extended frequency range. Impedance 3 or 15 ohms. Response 40–18,000 c.p.s. Exceptional performance at low cost.

HF800D	8"	8W	59/9	HF120	12"	15W	69/9
HF811D	8"	10W	£4.19.9	HF120D	12"	15W	79/9
HF101D	10"	15W	£5.19.9	HF126	12"	15W	89/9
				HF126D	12"	15W	5 gns.

HIGH FIDELITY LOUDSPEAKER UNITS

Cabinets of latest styling Satin Teak or Walnut acoustically lined (and ported where appropriate). Credit terms available on all units.

DORSET Size 16 x 11 x 9in. Response 45–18,000 c.p.s. Rating 8–10 watts. Fitted Audiotrine HF810D speaker. Impedance 3 or 15 ohms. **£8.19.9**

STANTON IIIS Size 18 x 11 x 10in. Rating 10 watts. Incorporating Audiotrine HF 815 speaker with roll rubber surround and 15000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Response 30–20,000 c.p.s. Impdnce 3 or 15 ohms. Gives smooth realistic sound output. **16 Gns.**

DORCHESTER Size 24 x 15 x 10in. Fitted Audiotrine HF101D speaker. Rating 15 watts. Impedance 3 or 15 ohms. Response 30–20,000 c.p.s. Provides really pleasing sound quality. **12½ Gns.**

GLOUCESTER Size 25 x 16 x 10in. 12in. High flux 12,000 line speaker. Cross-over unit and Tweeter. Rating 10 watts. Smooth response 40–20,000 c.p.s. Impedance 15 ohms. **12½ Gns.**

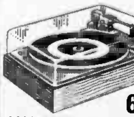
LINEAR TAPE PRE-AMPLIFIER. Type LP/1 Switched Equalisation. Positions for Recording at 1⅞in., 3¾in., 7½in. per sec., and Playback. EM84 Recording Level Indicator. Designed primarily as the link between a Magnavox Tape Deck and Hi-Fi amplifier suitable most Tape Decks. Terms available. **10½ Gns.**

RECORD PLAYING UNITS

All types available on Credit Terms. Ready to plug into Amplifier or Tape Recorder.
RP2 Consisting of Garrard SP25 Mk II (with heavy turntable) fitted Goldring CS90 high compliance ceramic Stereo/Mono cartridge with diamond stylus, plinth and cover. Normally approx. £26. **22 Gns.** Carr. 15/-.
RP3 As above but with Goldring Lenco GL68 Transcription unit and CS90 Cartridge. Normally approx. 32 gns. Carr. 15/-. ONLY **27½ Gns.**

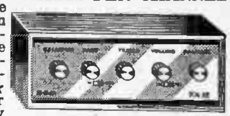
AUDIOTRINE PLINTHS

for Record Playing units. Teak finish cut for Garrard 1000, 2000, 3000, AT6, AT60, SP25 or Goldring GL68. **66/-** Available with clear Perspex cover as ill. Carr. 7/6 **£5.19.11** Or deeper type cut for TA12, Super 15 or 30 86/6 or with cover £6.19.11. Perspex cover sold separately at 3 gns. Limited number slightly damaged but repaired by Manufacturer. 39/9 to clear.



R·S·C·TA12 13 WATT STEREO AMPLIFIER

FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION HIGH FIDELITY OUTPUT OF 6·5 WATTS PER CHANNEL



Designed for optimum performance with any crystal or ceramic Gram P.U. cartridge, Radio tuner, Tape recorder, 'Mike' etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3–15 ohms ★ For 200–250v. A.C. mains ★ Frequency Response 30–20,000 c.p.s. —2dB ★ Harmonic Distortion 0·3% at 1000 c.p.s. Hum and Noise —70dB ★ Sensitivities (1) 300mV (2) 100mV (3) 100mV (4) 2mV ★ Handsome brushed silver finish Facia and Knobs. Complete kit of parts with full wiring diagrams and instructions. Factory built with 12 mth gntee 15 GNS. Or Deposit £4.16.0 and 9 mthly pymts. 29/- (Total 17 GNS.). **11 GNS.** Carr. 7/9
Teak finish cabinet as above 73/6 or as in stereo system 86/6.

AUDIOTRINE HI-FI SPEAKER SYSTEMS

Consisting of matched 12in. 12,000 line 10 watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **5 Gns.** Carr. 5/9
Or Senior 15 watt inc. HF 126 15,000 line Speaker **6 Gns.** Carr. 6/6.

FR3 3-SPEAKER SYSTEM Inc. Audiotrine HF126 12in. Bass unit, with 15,000 line magnet. 5in. 10 watt, 11,000 line mid-range speaker HF510M. High flux 4in. Tweeter, Crossover units for mid and high freq. and circuit. In suitable cabinet will provide quality comparable with very expensive units. Rating 15 watts. Imp. 15 ohms. **9½ Gns.** Carr. 7/6. Or assembled and wired on board for 10½ Gns.

HI-FI 'SPEAKER ENCLOSURES

Teak veneer finish. Modern design. Acoustically lined and ported.

JE8 Size 20 x 11 x 8in. Gives pleasing results with any 8in. Hi-Fi 'speaker. **4 Gns.**
SE8 For optimum performance with any 8in. Hi-Fi 'speaker. Size 22 x 15 x 9in. **5 Gns.**
SE10 For outstanding results with 10in Hi-Fi 'spkr. Size 24 x 15 x 10in. **6 Gns.**
SE12 For excellent performance with 12in Hi-Fi 'spkr and Tweeter. Size 25 x 16 x 10½in **7 Gns.**

R.S.C. TA6 6 Watt HIGH FIDELITY SOLID STATE AMPLIFIER

200-250v. AC mains operated Frequency Response 30–20,000 c.p.s. —2dB. Harmonic Distortion 0·3% at 1,000 c.p.s. Separate Bass and Treble 'lift' and 'cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3–15 ohm speakers. Max. sensitivity 5mV. Fully enclosed enamelled case, 9½ x 2½ x 5½in. Attractive brushed silver finish facia plate 10½ x 3½in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. Carr. 7/6
Or factory built with 12 months guarantee. Post Paid 8 Gns. **6 Gns.**

R.S.C. TFM1 SOLID STATE VHF/FM RADIO TUNER

Total cost of parts with detailed wiring diagrams & instructions. **12½ Gns.** Carr. 10/-
Or factory built 16½ gns. Or in Teak finished cabinet as illustrated 19½ gns.
Terms: Deposit £5 and 9 monthly payments £2. Total £23.

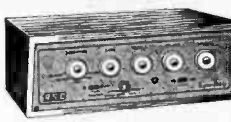
★**High-sensitivity** ★**200-250v. A.C. Mains operation.** ★**Sharp A.M. Rejection.** ★**Drift-free reception.** ★**Output ample for any amplifier (approx. 500 m.v.).** ★**Simple alignment instructions.** ★**Output available for feeding tuning meter.** ★**Output for feeding Stereo Multiplexer.** ★**Tuner head using silicone Planar Transistors.** ★**Designed for standard 80 ohm co-axial input.** Visually matching our Super 15 and 30 amplifiers and of the same high standard of performance and reliability. The pre-wired tuning head facilitates speed and simplicity of construction. Printed circuitry. Only first grade transistors and components used. A quality product at half the cost of comparable units. Stereo version, all parts 19½ gns. Assembled 25½ gns. Carr. 10/-.

R.S.C. SUPER 15 HI-FI AMPLIFIER

SOLID STATE CONSTRUCTION

FULLY TRANSISTORISED 200/250v. A.C. Mains.
OUTPUT 10 WATTS R.M.S. cont. into 15 ohms.
15 WATTS R.M.S. cont. into 3–4 ohms.
LATEST MULLARD TRANSISTORS. AD149, AD149, OC127Z, OC81Z, OC44, OC44, OC81Z, OC44, AC107.
5 POSITION INPUT SELECTOR SWITCH
EQUALISATION to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads.
FULL TAPE MONITORING FACILITIES.
SENSITIVITIES: Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV. Microphone 4.5 mV. Tape Head 2·5 mV. Radio/Aux or Ceramic P.U. 110 mV.
FREQUENCY RESPONSE: ±2dB 20–20,000 c.p.s.
TREBLE CONTROL: +15dB to —14dB at 10Kc/s. **NEG FEEDBACK**: 52dB.
BASS CONTROL: +17dB to —15dB at 50 c/s. **HUM LEVEL:** —75dB.
HARMONIC DISTORTION at 10 Watts 1,000 c.p.s. 0·25%.
Complete Kit of parts with full constructional details and point to point wiring diagrams. Carr. 12/6 **11½ Gns.**
Supplied factory built 15½ Gns. Carr. 12/6. Terms: Deposit 4 Gns. and 9 monthly payments 31/1 (Total £18.3.9). Or fitted in beautiful walnut or Teak veneered cabinet as illustrated. 3½ Gns. extra.
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.

SPECIFICATIONS COMPARABLE WITH UNITS AT ALMOST TWICE THE COST



R.S.C. SUPER 30 STEREO AMPLIFIER

A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. Close tolerance Ganged Pots. Matched Components. **CROSS TALK:** —52dB at 1,000 c.p.s.
CONTROL: 5 position Input Selector, Bass Control. Treble Control. Volume Control. Balance Control. Stereo/Mono Switch. Tape Monitor Switch. Mains Switch. **INPUT SOCKETS** (Matched Pairs). (1) Magnetic P.U. (2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/Microphone. Operation of the Input Selector Switch assures appropriate equalisation. Rigid 18 s.w.g. Chassis. Size approx. 12in. wide, 3in. high and 8in. deep. Neon Panel indicator. Attractive Facia Plate and Spun Silver Matching Knobs. Above facilities, etc., except for Ganging and Balance Control, apply also to Super 15.
THESE UNITS ARE EMINENTLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic, Magnetic, Moving Coil, Ribbon). CURRENTLY AVAILABLE SUPERB SOUND OUTPUT QUALITY CAN BE OBTAINED BY USING WITH FIRST RATE ANCILLARY EQUIPMENT. All required parts, point to point wiring diagrams and detailed instructions. Carr. 15/- **19 Gns.**
Unit factory built 27 Gns. or deposit £6.2.0 and 9 monthly payments 56/3. (Total £31.8.3). Fitted cabinet as Super 15 30 Gns. Carr. 15/- or Deposit £6.2.6 and 9 monthly paymts 64/- (Total £34.18.6). *Send S.A.E. for leaflet*

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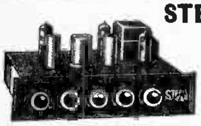
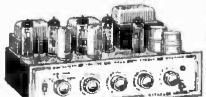
CAN BE ASSEMBLED IN AN HOUR
ONLY 4 PAIRS OF SOLDERED JOINTS PLUS MAINS.
Incorporating latest Magnavox Tapedeck. High quality Tape Amplifier with switched equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool. Reel of Best Quality Tape and handsome Portable Cabinet of latest styling, finished dark grey leathercloth. Size 14¼ x 17 x 8½in. and circuit. Purchased separately would total approx. £34. Performance equal to units in the £50-£60 class. **Deposit** 4 gns. and 9 monthly payments 59/6 (Total 29½ gns). 4 Track Model 3 gns. extra. Carr. 19/6 **26½ GNS.**

STEREO/TEN HIGH QUALITY AMPLIFIER



5 watts high quality output on each channel. Sensitivity 50 millivolts. Suitable all crystal or ceramic stereo heads. Ganged Bass and Treble Controls. Valves ECC83, (2) EL84, (2) EZ81. For 2-3 ohm speakers. Complete kit with full wiring diagrams and instructions. Or supplied factory assembled with 12 months' guarantee for 11 gns. Carr. 11/6 **£8.15.0**
Terms: Dep. 3 gns. and 9 monthly payments 22/9 (Total £13.7.9).

R.S.C. STEREO/20 HI-FI AMPLIFIER

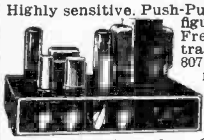


PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL. SUITABLE FOR "MIKE", GRAM, RADIO OR TAPE. (7) valves ECC83, (2) ECL86, (4) EZ81. **Frequency Response:** ±2dB 30-20,000 c.p.s. **Hum Level:** 65dB down. **Sensitivity:** 20 millivolts max. **Harmonic Distortion:** 0·2%
★**Four-position tone compensation and Input Selector Switch.** ★**Stereo/Mono switch.** ★**Neon panel indicator.** ★**Handsome Perspex Frontplate.** ★**Separate Bass and Treble controls.** Output transformers are high-quality sectionally wound. Outputs for 3 and 15 ohms speakers. Complete set of parts, point-to-point wiring diagrams and instructions. Or factory assembled with our usual 12 months' guarantee 19 gns. Or Deposit £4.10.0 and 9 monthly payments £2 (Total £22.10.0). *Send S.A.E. for leaflet.*
14 Gns. Carr. 12/6

R.S.C. 4/5 watt A5 HIGH GAIN AMPLIFIER

A highly-sensitive 4-valve quality amplifier for the home, small club, etc. Suitable for all crystal or ceramic P.U. heads and most "mikes". Separate Bass and Treble controls. Hum level 71dB down. Negative Feedback 15dB. For A.C. mains 200-250v. Speaker output 3 ohms. Complete Kit with point-to-point wiring diagrams and instructions. **£4.17.9**

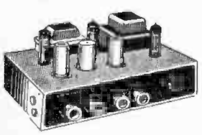
R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER



Highly sensitive. Push-Pull high output, with Pre-amp./Tone Control Stages. Performance figures equal to most expensive amplifiers. Hum level —70dB. Frequency response ±3dB 30-20,000c/s. Sectionally wound output transformer. All first grade components. Valves EF86, EF86, ECC83 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 12 millivolts so that **any kind of Microphone or Pick-up is suitable.** Designed for **Clubs, Schools, Theatres, Dance Halls or Outdoor Functions,** etc. For use with **Electronic Organ, Guitar, String Bass,** etc. Gram. Radio or Tape. Reserve L.T. and H.T. for **Radio Tuner.** Two inputs with associated volume controls so that two separate inputs such as Gram and "Mike" can be mixed. 200-250v. 50c.p.s A.C. mains. For 3 and 15 ohm speakers. Complete kit of parts with point-to-point wiring diagrams and instructions. Carr. 12/6 **12 Gns.** Twin-handled perforated cover 25/-. Supplied factory built with EL34 output valves. 12 months guarantee for 15 gns. **TERMS: Deposit** £4.13.0 and 9 monthly payments of 28/9 (Total £17.11.9). Send S.A.E. for leaflet.

R.S.C. A11 HIGH FIDELITY 12-14 WATT AMPLIFIER

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP.



Two input sockets with associated controls allowing mixing of "mike" and gram. etc., etc. High sensitivity. Valves ECC83, ECC83, EL84, EL84, EZ81. High quality sectionally wound output transformer. INDIVIDUAL CONTROLS FOR BASS AND TREBLE Frequency response ±3dB 30-20,000c/s. Hum level —60dB. SENSITIVITY 23 millivolts. Suitable for Crystal or Ceramic P.U.s, all types "mikes". Comparable with the best designs. For **Musical Instruments** such as **String Bass, Electronic Guitars,** etc. **Reserve Power** 300v. 30mA. and 6.3v. 1.5a. for **Radio Tuner** or **Tape Pre-amp.** Size approx. 12 x 9 x 7in. For A.C. mains 200-250v. 50 c.p.s. Output for 3 and 15 ohm spkrs. **£8.15.0** Send S.A.E. for leaflet.
Full instructions and point-to-point wiring diagrams Carr. 11/6
(or factory built £11.15.0). Metal cover with 2 handles available for 25/-. **TERMS ON ASSEMBLED UNITS. Deposit** 72/6 and 9 monthly payments of 22/- (Total £13.10.6).

R.S.C. A11T TRANSISTORISED VERSION of above complete kit 9 gns. Carriage 9/6.

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

AN EXCEPTIONALLY POWERFUL HIGH QUALITY ALL-PURPOSE UNIT For lead, rhythm, bass guitar and all other musical instruments. For vocalists, gram, radio, tape, and general public address.
★ UNUSUALLY POWERFUL LOUDSPEAKER COMBINATION consisting of a FANE HIGH FLUX 12in. 30 watt unit PLUS a FANE 12in. 20 watt unit with extended frequency response.
★ 4 Jack inputs and two Volume Controls for simultaneous use of up to 4 pick-ups or "mikes".
★ Separate Bass and Treble Controls giving "lift" and "cut".
49½ Gns. Carr. 30/- Or dep. £7.17.6 and 9 mthly pymts of £5.10.10. (Total 55 gns.) Send S.A.E. for leaflet.

ALSO B20 BASS inc. 15in. 25w. SPKR 29½ Gns. G15 inc. 12in. 20w. SPKR 19½ Gns.

G80 80 WATT AMPLIFIER

2 Channels, 6 inputs, Tremolo, 2 Columns and 1 Bass Speaker unit with two 15in. Extra Heavy Duty Speakers. **99 Gns.** Carr. £3

R.S.C. BATTERY/MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces batteries supplying 1·5v. and 90v. where A.C. mains 200/250v. 50c/s is available. Complete kit with diagram 47/9 or Ready for use 59/11.

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Consisting of Mains transformer. Metal Rectifier. Electrolytics, smoothing choke, chassis and circuit. 200/250v. A.C. mains. Output 250v. 60mA 6·3v. 2a. Supplied with case in lieu of chassis 26/11. Or assembled 39/11. **22/11**

LINEAR TREMOLO/PRE-AMP UNITS

Suitable for use with any of our Amplifiers. Controls: Speed (frequency of interruptions) Depth (for heavy or light effect) Vol and Switch. **4½ Gns.**

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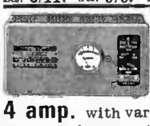
All 6/12v. D.C. output. Max. A.C. input 18v. 1a. 3/11. 2a. 6/11. 3a. 9/9. 4a. 12/9. 6a. 15/9. 10a. 25/9.

R.S.C. 6/12v CAR BATTERY CHARGERS



Complete kit of parts incl. Ammeter and Circuit.
4 amp. with variable charge rate selector **49/9**
6 amp heavy duty with variable charge rate selector **69/9**
Both types 200-250 A.C. mains. Ready built 10/- extra.

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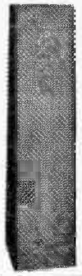

Covered in two-tone Rexine/Vynair. Ideal for vocalists and Public Address. 15 ohm matching. **Type C48, 25-30 watts.** Fitted four 8in. high flux 7 watt speakers. Overall size approx. 42 x 10 x 5in. Or deposit 44/- and 9 mthly pmts 34/9 (Total £18.1.6) Carr. 10/- **15 Gns.**
Type C412. 40 watts. Fitted four 12in. 12,000 line 10 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/- **22 Gns.** Or Deposit £3.13.0 and 9 monthly payments of 50/- (Total £26.3.0).

30 WATT HI-FI AMPLIFIER

for Guitar, Vocal or Instrumental Group

A 2 Input, 2 volume control Hi-Fi unit with Separate Bass and Treble controls. Peak rating 60 watts. Latest valves. Strong Rexine covered cabinet with handles. Attractive black/gold perspex facia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. **18 Gns.** Carr. 12/6 Deposit 3 gns. and 9 monthly payments of 39/8 (Total £21).

12in. HIGH QUALITY L'SPEAKERS

In teak veneered cabinets. Size 15 x 15 x 7in.
10 Watt Model. Gauss 12,000 lines. 3 or 15 ohms. **5 Gns.**
20 Watt Model. 15 ohm. Size 18 x 18 x 10in. Gauss 12,000 lines. **8 Gns.**
Rexine covered £1 extra. **Terms available.**
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Limited number at fraction of list price 15 ohms impedance. Brand new, guaranteed. Terms available over £8.

12in. 10 watt HIGH FLUX 59/11 **12in. 20 watt DUAL CONE £5.15.0** Carr. 6/9
12in. HEAVY DUTY 30 watts. Dual cone Normally £13 approx. **£6.19.9** Carr. 10/-
15in. EXTRA HEAVY DUTY 40 watts Massive units. Usually 18 Gns. Carr. 15/-. **12 Gns.**

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18" 100 Watt Post Free **19 Gns.**
Fantastic power handling. Guaranteed 2 years.

R.S.C. GRAM AMPLIFIER KIT. 4 watts output. Negative feedback. Controls: Vol., Tone and Switch. Mains operation 200-250v. A.C. Fully isolated chassis. Circuit etc. supplied. ONLY **49/11**

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Speak and Listen with both hands free. Compact transistorised Dry Battery operated. **£3.19.9**

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OC44, OC45, 3/11.
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350-0-350v. 150mA, 6.3v. 4a., 0-5-6.3v. 3a.	42/9
425-0-425v. 200mA, 6.3v. 4a. c.t., 5v. 3a.	67/9
425-0-425v. 200mA, 6.3v. 4a., 6.3v. 4a., 5v.3a.	69/9
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250-0-250v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	32/9
300-0-300v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	32/9
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Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω	7/9
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SMOOTHING CHOKES

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80mA,	10H,	350 Ω	7/9
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OC72	5/-	ACY20	5/6
OC73	6/6	ACY21	6/-
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OC76	5/-	AF102	18/-
OC77	7/-	AF114	7/-
OC78	5/-	AF115	6/6
OC78D	5/-	AF116	7/-
OC81	5/-	AF117	5/-
OC81D	5/-	AF118	17/6
OC82	6/-	AF124	10/-
OC123	11/6	AF125	10/-
OC139	8/-	AF126	10/-
OC140	10/-	AF127	9/6
OC170	6/-	AF139	10/-
OC171	7/-	AF186	17/6
OC200	7/6	AFZ11	17/-
OC201	12/6	AFZ12	12/6
OC202	13/6	ASY26	6/6
OC203	10/6	MAT100	7/9
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OC205	15/-	MAT120	7/9
OC206	19/6	MAT121	8/6
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PCL85	11/6	DY87	9/6
PCL82	10/6	ECC83	8/6
PCL86	11/6	ECC81	5/6
KT66	27/6	EABC80	8/6
KT88	27/6	UL84	8/6
DY86	9/6	UF41	10/6
EBC33	9/6	UY41	8/6
DK96	9/6		
DAF96	7/9		
DL96	8/6		
DF96	8/-		
PY81	7/6		
PL81	9/6		
PY33	10/6		
PL36	15/6		

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OA71	3/6
OA81	2/6
OA95	1/9
OA200	3/3
OA202	4/3
OA203	4/-
OA210	7/6
OA9	4/6
OA10	3/-
OA47	3/-
OA70	2/-
OA79	2/6
IN91	3/-
IN253	7/-
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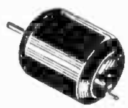
INU59	3/6
GEX44	2/6
GEX54	2/-

PGT Power Mounting Kits 3/9

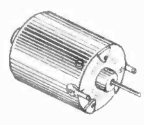
P.P. and insurance 2/-

MOTOR BARGAINS

Ideal for model makers, record players, tape decks, etc.

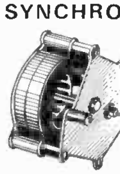


6.3 D.C. Motor. 10,900 r.p.m. at 230mA. 1½in. x 1in. diameter. Shaft ¼in. long x 3/64in. diameter, **9/6.** P. & P. 2/6.



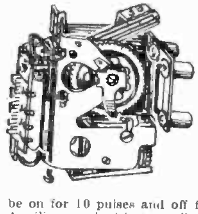
9v. D.C. Gram deck replacement motor. 2in. x 1½in. diameter. Shaft ¼in. long x 3/32in., **17/6.** P. & P. 2/-.

SYNCHRONOUS CLOCK MOTORS



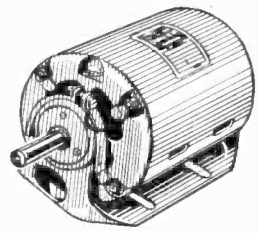
Geared for 40 revolutions per hour. 230v. 50 cycle, with mounting flanges. Size approximately 1⅝in. deep x 2¾in diameter. **ONLY 22/6.** P. & P. 2/6.

SELECTOR DRIVE



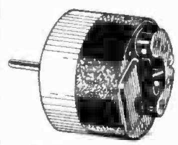
Numerous applications. Electro magnet and brass tooth wheel. A switch wafer and contacts are coupled to this and arranged to be on for 10 pulses and off for 15. An Auxiliary contact is normally on but off 1 in every 25. Complete with suppressor, resistors, plus series contact for continuous operation. Ideal window displays, switching lamps, models, etc. 12v. or 24v. D.C. Brand new and boxed, **12/6.** P & P. 2/6.

⅛ H.P. MAINS MOTOR



Made by Crompton Parkinson. Single phase ⅛th h.p. Motor. 230/250v. 50 cycles. 1·3 amps. 1,425 r.p.m. Continuous rating. Spindle 1⅞ x ⅜in. dia. Overall size less spindle approx. 8 x 6in. Perfect condition. A bargain for the work bench. **ONLY 79/6.** Carr. 20/- (¼ h.p. Motor also available, **99/6.** Carr. 29/-.)

DELAY ACTION TIME SWITCH



Made by Smiths. A.C. operation 200/250 v. Double pole. Will give time delays from 0–10 minutes. Size 2⅜in. dia. x 2⅞in. long inc. ⅜in. x 3/16in. dia. spindle. **BARGAIN PRICE 17/6.** P. & P. 2/6.

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Output 110V.

50W	£1.7.6	1,000W	£9.9.0
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100W	£2.5.0	2,000W	£18.10.0
150W	£2.15.0	3,000W	£25.10.0
200W	£3.5.0	4,000W	£34.18.0
300W	£4.5.0	0·30V, 1A	30/-
400W	£4.19.6	0·30V, ½A	17/9
500W	£5.9.6	0·30V, 2A	37/6
600W	£6.9.6	0·30V, 3A	42/-

Post extra

MAINS TRANSFORMERS

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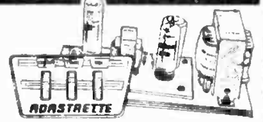
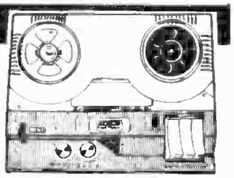


An ideal basis for building your own portable record player. Just add speaker and turntable and you will have an above-average model for a mere fraction of the cost. 2-3 watt printed circuit with control panel on flying lead. ON, OFF. TONE CONTROL AND VOLUME, colourful escutcheon. Brimar valves: EZ80, ECL82 and composite installation booklet. Only **85/-** P. & P. 3/6.

MAGNAVOX-COLLARO 363 TAPE DECKS



The very latest 3-speed model—1⅞, 3¾, 7½ i.p.s. available with either 2 track or 4 track head. Features include: Pause control; digital counter; fast forward and rewind; new 4-pole, fully screened induction motor; interlocking keys. Size of top plate 13½ x 11 x 5¼in. deep below unit plate. For 200/250v. A.C. mains. 50 c.p.s. operation. New, unused and fully guaranteed.

2 track model **£10.10.0** 4 track model **£13.19.6**

Carriage and Packing 12/6 extra.

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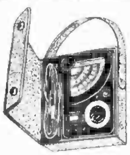
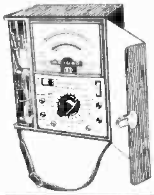
FOR USE WITH ABOVE DECKS. 2 tracks model £14.19.6; 4 track model £15.19.6. Carriage and Packing 12/6.

MULTIMETERS



MODEL TTC.1001. 20,000 O.P.V. with overload protection. D.C. Volts 5, 25, 125, 500, 2,500v. A.C. volts 10, 50, 250, 100v. D.C. MA 250mA-50A. With prods and carrying case. ONLY **85/-** P. & P. 3/6.



MODEL TTC.1030. 50,000 O.P.V. D.C. Volts, 0-3, 12, 60, 120, 300, 600, 1,200v. A.C. Volts, 6, 30, 120, 600, 1,200v. D.C. mA. 0-3-300. With prods and carrying case. ONLY **£11.19.6** P. & P. 5/-.

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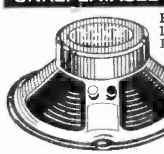
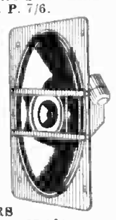


FANE 122/17. 12in. in 25 WATT HEAVY DUTY HI-FI LOUD SPEAKERS. With high efficiency Antistropic Ferrite magnet. 17,000 gauss. Imp. 3-5 ohms. Brand new and guaranteed. List Price £12. LIND-AIR PRICE £8.19.6. P. & P. 7/6.



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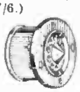

FANE 301 3in. TWEETERS Imp. 3-5 ohms. 17,000 gauss. 12 watt. Brand new and guaranteed. List price £3.15.0. LIND-AIR PRICE 59/6. P. & P. 3/6.

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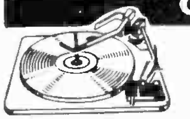
GARRARD DECKS



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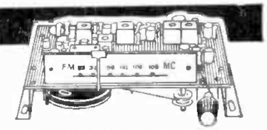

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MULTIPLEX ADAPTOR for Stereo Radio Reception £5.19.6 extra.

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LIND-AIR PRICE **£9.19.6** Carr., pkg. and Ins. 5/-.

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ONLY **59 GNS.** CARR. 20/-

ALL TRANSISTOR 6 WATTS PER CHANNEL STEREO HI-FI SYSTEM OFFERING A PERFORMANCE EQUAL TO, IF NOT BETTER THAN, SIMILAR SYSTEMS COSTING UP TO DOUBLE THE PRICE. Modern styling plus advanced circuitry using latest silicon transistors throughout. The famous GARRARD 3000 Record Change fitted lightweight tubular arm with SONOTONE 9TAHC STEREO/MONO DIAMOND CARTRIDGE will play all sizes of records. (4 speeds 78, 45, 33 1/3, 16 2/3 r.p.m.) Will play up to 9 records automatically, also provision for manual play. Amplifiers and controls are mounted below record player and incorporate Bass, Treble, Volume and Balance controls and On/Off, Gram/Radio, Mono/Stereo slide switches. TWO IDENTICAL LOUDSPEAKER SYSTEMS each incorporating separate bass speakers and high frequency units with crossover network provide full frequency reproduction and are complete with 10ft. leads and plugs for connection to amplifier. Will fit easily on to bookshelves, room dividers or existing furniture. BRIEF SPEC. Player/Amplifier unit. Teak finish, size 16½ x 14 x 8¼in. 200/250v. A.C. operation. Inputs for Radio Tuner/Tape Recorder also outputs for Tape Recorder. Loudspeaker Systems. Teak finish, size (each) 13 x 7 x 8in. Supplied complete with instruction booklet, ready to plug in and play. SEND YOUR ORDER NOW OR CALL AND HEAR THIS MARVELLOUS HI-FI STEREO SYSTEM (Teak finish). Only 59 gns. plus 20/- Carriage and insurance. (Rosewood 3 gns. extra.) (Clear Perspex Cover 3 gns. extra.)

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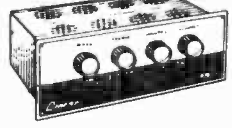

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AF115	3/-
AF116	3/-
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OC28	7/6
OC35	5/-
OC36	7/6
OC41	2/6
OC42	2/6
OC44	1/11
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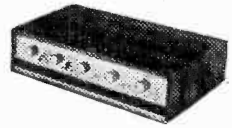
Versatile recording facilities. So easy to build—so easy to use.

Latest STEREO AMPLIFIER, TSA-12

12 x 12 watts output.



Kit £30.10.0 *less cabinet*

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High-performance CAR RADIO, CR-1

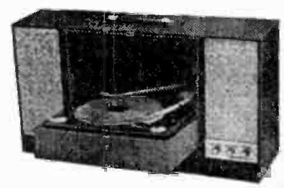
Superb long and medium wave entertainment wherever you drive. Complete your motoring pleasure with this compact outstanding unit.

8 Latest semi-conductors (6 transistors, 2 diodes). For 12 volt positive or 12 volt negative earth systems. Powerful output (4 watts). Pre-assembled and aligned tuning unit. Push-button tone and wave change controls. Positive manual tuning. Easy circuit board assembly. Instant operation, no warm-up time. Tastefully styled to harmonise with any car colour scheme. High quality output stage will operate two loudspeakers if desired. Can be built for a total price.

KIT (less speaker) £12.17.0 inc. P.T.

8″ × 5″ Loudspeaker £1.10.0 extra.

Latest Portable Stereo Record Player, SRP-1



Automatic playing of 16, 33, 45 and 78 rpm records. All transistor—cool instant operation. Dual LP/78 stylus. Plays mono or stereo records. Suitcase portability. Detachable speaker enclosure for best stereo effect. Two 8in. x 5in. special loudspeakers. For 220-250V ac mains operation. Overall cabinet size $15\frac{9}{16}$ x 3⅞ x 10¼in.

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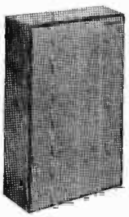
KIT £27.15.0 incl. P.T. Ready-to-Use **£33.18.0**

A wide range of SPEAKER SYSTEMS

SSU-1



Berkeley

HI-FI SPEAKER SYSTEM. Model SSU-1. Ducted-port bass reflex cabinet "in the white". Two speakers. Vertical horizontal models with legs, Kit **£12.12.0** without legs, Kit **£11.17.6** incl. P.T.

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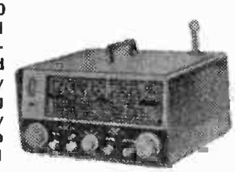
"Mohican" General Coverage Receiver, GC-1U



Powerful 10 transistor, 5 diode circuit. Tunes 580 to 1550 kc/s and 1·69 to 30 Mc/s in five bands. Bandspread on all bands. Fixed-aligned ceramic IF transfilters for best selectivity. Pre-assembled and aligned 'front-end' for fast, easy assembly. Built-in 6 x 4in. speaker. Tuning meter for pin-point tuning. Completely self-contained for portability—can be operated on 230 volt AC with Model UBE-1. Kit £2.17.6 extra.

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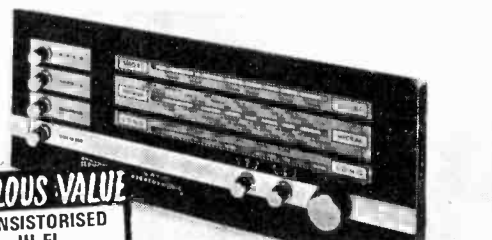

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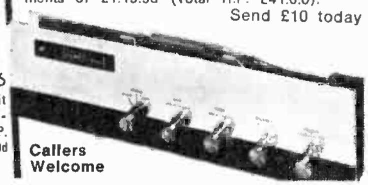

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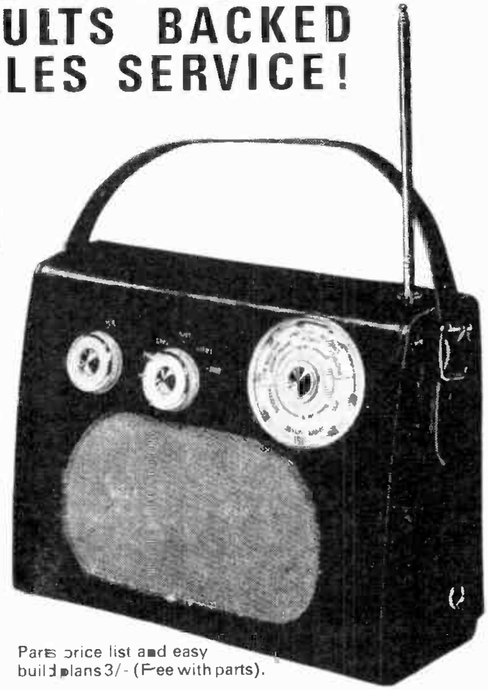

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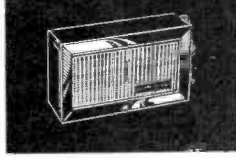

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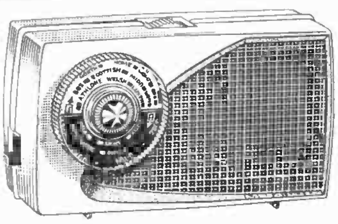


3 WAVEBAND PORTABLE

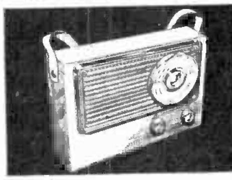
8 stages—6 transistors and 2 diodes

Covers Medium and Long Waves and EXTRA BAND FOR EASIER TUNING OF LUXEMBOURG, etc. Top quality 3in. Loudspeaker for quality output. Two RF stages for extra boost. High "Q". Ferrite Rod Aerial. Push-pull output. Handsome pocket size case with gilt fittings. Size $6\frac{1}{4}$ x $3\frac{3}{4}$ x $1\frac{1}{2}$in.

This amazing receiver may be built for only **69/6** P. & P. 3/6

Parts Price List and easy build plans 2/– (Free with parts).

ROAMER SIX



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Attractive case with gilt fittings, size $7\frac{1}{4}$ x $5\frac{1}{4}$ x $1\frac{3}{4}$in. World wide reception. 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 Philco 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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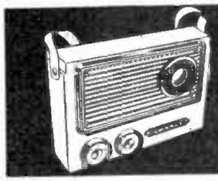

THREE WAVEBAND PORTABLE WITH 3in. SPEAKER

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Channel 1 4mV at 470K } These 2 channels (4 inputs) are suitable for
Channel 2 4mV at 470K } microphone or guitars.
Channel 3 200mV at 1m } Suitable for most high output instruments
Channel 4 200mV at 1m } (gram, tuner, organ etc.).
Input sensitivity relative to 10w output.

TONE CONTROLS ARE COMMON TO ALL INPUTS
Bass Boost +12dB at 60 Hz/s. **Bass Cut** −13dB at 60 Hz/s.
Treble Boost +11dB at 15 KHz/s. **Treble Cut** −12dB at 15 KHz/s.
With bass and treble controls central −3dB points are 30 Hz/s and 20 KHz/s.

POWER OUTPUT
For speech and music 50 watts rms. 100 watts peak.
For sustained music 45 watts rms. 90 watts peak.
For sine wave 38·5 watts rms. Nearly 80 watts peak.
Total distortion at rated output 3·2% } at 1 KHz/s
Total distortion at 20 watts 0·15% }
Output to match into 8 or 15 ohms speaker system.
NEGATIVE FEED BACK 20dB at 1KHz/s.
SIGNAL TO NOISE RATIO 60dB.
MAINS VOLTAGES
Adjustable from 200–250v A.C. 50–60 Hz/s.
A protective fuse is located at the rear of unit.
VALVE LINE UP
Double purpose ECC83 x 3, EL34 x 2 and GZ34.

Price 27 gns
P & P 20/-

FOUR *PLUS* FOUR *Stereo Amplifier*

A superb high quality, yet inexpensive stereo amplifier. Due to the great demand we are now able to offer this precision made instrument at a fantastically low price. The high quality, reliability and styling has been maintained in spite of its low price.

SPECIFICATIONS
Elegant styled cabinet (sizes 16″ wide 5″ high 8½″ deep) in black rexine and woodgrained sides. Brushed aluminium front panel with contrasting black / silver knobs.

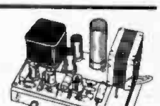
CONTROLS
Stereo/Mono switch. Gram/Aux switch. Volume left. Volume right. Treble (cut and lift). Bass (cut and lift). Separate on/off switch. Neon pilot indicator.

INPUTS AND OUTPUTS
(per channel)
Gram, aux, tape out and speaker out. A switched mains socket is also provided at the rear of unit. Employs Mullard valves throughout. ECC83 and 2 x ECL 86 with a metal bridge rectification.

TECHNICAL SPECIFICATIONS
Gram sensitivity 40mV at 1 KHz. Aux sensitivity 50mV at 1 KHz. (Sensitivities are given for rated output). 4 watts r.m.s. (8 watts r.m.s. in monoral position). Output matches into standard 3 ohms speaker system. Suitable 10″ x 6″ speakers are available at 29/6 each, plus 5/- p. & p. Bass control at 100 Hz lift + 9dB cut − 10dB. Treble control at 10 KHz lift + 8dB cut − 13dB. Total harmonic distortion 0·35% at 3 watts and 2% for rated output at 1 KHz. Negative feedback 13dB at 1 KHz. Mains supply 220–250V A.C. 50–60 Hz.

Price 13 gns
P & P 15/-

8-watt 4-valve PUSH-PULL AMPLIFIER & METAL RECTIFIER



Size: 9″ x 6″ x 1⅜″. A.C. Mains, 200–250V, 4 valves. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Output 8 watts at 5 per cent of total distortion. Separate bass and treble lift control. Two inputs with controls for gram. and mike. Output transformer tapped for 3 and 15 ohm speech coils. Built and tested. **£4.4.0.** P. & P. 11/-, 8″ x 5″ speaker to suit price **14/6** plus 1/6 P. & P. Crystal mike to suit **12/6** plus 1/6 P. & P.

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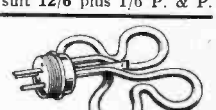

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Size 3⅞ x 2½ x 1⅛in Meter size 2¼ x 1⅞in Sensitivity 1000 O.P.V. on both A.C. and D.C. volts. 0–15, 0–150, 0–1000 D.C. current 0–150mA. Resistance 0–100kΩ. Complete with test prods, battery and full instructions, 42/6. P. & P. 3/6. **FREE GIFT** for limited period only. 30 watt Electric Soldering Iron value **15/-** to every purchaser of the Pocket Multi-Meter.

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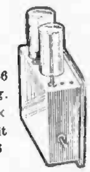
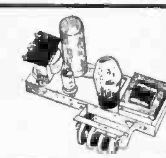


Complete with PC88 and PC86 Valves. Full variable tuning. New and unused. Size 4½ x 5¼ x 1¾in. Complete with circuit diagram. **35/-** p. & p. 3/6

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 cross over 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 13¼ x 8¹/₁₆ x 4¼ inches. By famous manufacturer. List Price £7. Our price **69/6** plus 3/6 P. & P.

3 to 4 Watt AMPLIFIER



3-4 watt Amplifier built and tested. Chassis size 7 x 3½ x 1in. Separate bass, treble and volume control. Double wound mains transformer, metal rectifier and output transformer for 3 ohms speaker. Valves ECC81 and 6V6. **£2.5.0** plus 5/6 p. & p.

600 mW FOUR TRANSISTOR AMPLIFIER

Features N.P.N. and P.N.P. complementary symmetrical output stage, 2¼″ x ⅞″ x ⅞″ Speaker. Output impedance 12 ohms frequency response 3dB points 90 c/s and 12 Kc/s. Price **15/-** plus 1/- P. & P. 7 x 4″ Speaker to suit, **19/6** plus 2/- P. & P.

2½ watt ALL TRANSISTOR AMPLIFIER

AC mains 240V. Size 7″ x 4¼″ x 1¾″. Frequency response 100 c/s—10 Kc/s Semi conductors, two OC 75's two AC 128's and two stabilizers AA129. Tone and volume controls on flying leads. **£2.10.0** plus P. & P. 3/6. Suitable 8″ x 5″ 10,000 line high flux speaker, **18/6** plus 2/- P. & P.

NEW TRANSISTORISED SIGNAL GENERATOR

Size 5¼ x 3½ x 1¼in. For IF and RF alignment and AF output 700 c/s frequency coverage 460 kc/s to 2 mc/s in switched frequencies. Ideal for alignment to our Elegant Seven and Musette. Built and tested. **39/6** P. & P. 3/6.

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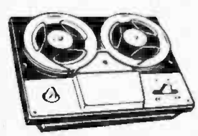
200/250V A.C. mains



Type TD2 Tape speed 3¾ twin track, **£6.19.6.**
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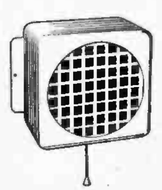
FIRST QUALITY P.V.C. TAPE

5¾″	Std.	850ft.	9/-	5″	L.P.	850ft.	10/6
7″	Std.	1200ft.	11/6	3″	T.P.	600ft.	10/6
3″	L.P.	240ft.	4/-	5″	T.P.	1800ft.	25/6
5¾″	L.P.	1200ft.	11/6	5¾″	T.P.	2400ft.	32/6
7″	L.P.	1800ft.	18/6	7″	T.P.	3600ft.	42/6
5¾″	D.P.	1800ft.	18/6	4″	T.P.	900ft.	15/-

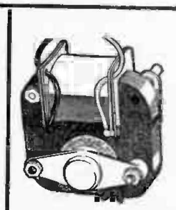
P. & P. on each 1/6, 4 or more post free.

EXTRACTOR FAN



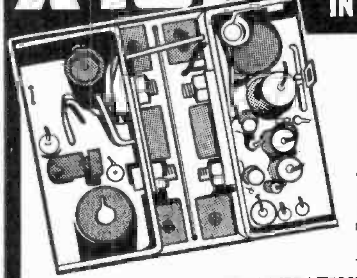
AC Mains 230/250 v. complete with pull switch. Size 6″ x 6″ x 4″. Price 27/6 plus 5/- P. & P.

AC MAINS MOTOR



1400 R.P.M.
230/250v
PRICE
9/6
P. & P. 3/-

X101 10 WATTS (RMS) SOLID-STATE HI-FI AMP WITH INTEGRAL PRE-AMP



Its great versatility ranges from: A simple intercom. to a modern HI-FI STEREO AMPLIFIER (2 are required for Stereo).

The X101 is a brilliant new addition to our highly successful range of products. Its professional performance and advanced solid-state circuitry techniques ensures reliability, combined with high fidelity reproduction at **AN UNBEATABLE PRICE.**

SPECIFICATIONS

R.M.S. Power Output: 13 W (music power), 10 W (Sine Wave).
Sensitivity: for rated output 1 mV into 3 K ohms load.
Frequency Response: minus 3dB points are 20 Hz and 40 KHz.
Total Distortion: at 1KHz for rated output 1·5%, for 5 W output 0·35%.
Output Impedance: 3 ohms (3–15 ohms may be used).
Supply Voltage: 24 V D.C. at 800 mA (6–24 V may be used) output at 14 V D C. supply with 3 ohms speaker. 7 watts.
Size: 2½" x 3" x 1⁹⁄₁₆".

The fully comprehensive instruction manual does not only show the basics, such as circuit diagram and connections, but also gives practical easy-to-understand detailed information about the X101. Standard equalisation networks are given for most types of conventional inputs. They include: Tape Head, Mag. P.U., Xtal P.U., Tuner, Mic, etc.

Built & Tested **49/6** + 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) p. & p. 2/6 **35/-** P101 S (for stereo) p. & p. 2/6 **42/6**

PR 101/M A HIGH QUALITY MONAURAL PRE-AMP & CONTROL UNIT

Particularly suitable for use with the X101 if a ready-built, comprehensive, multi-input system is desired.

CONTROLS

Selector Switch, Tape Speed Equalisation Switch (3¾ and 7½ i.p.s.). Volume, Treble, Bass, 3 position scratch filter and 3 position rumble filter.

SPECIFICATION

Sensitivities for 200 mV output at 1 KHz.
Tape Head: 3 mV (at 3¾ i.p.s.) **Radio:** 100 mV
Mag. P.U.: 2 mV **Aux.:** 100 mV
Cer. P.U.: 80 mV
Tape/Rec. Output: 100 mV
Equalisation for each input is correct to within ±2dB (R.I.A.A.) from 20 Hz to 20 KHz.
Tone Control Range: Bass ±13dB at 60 Hz
Treble ±14dB at 15 KHz
Total Distortion: (for 200 mV output) < 0·02%
Signal Noise: > —60dB
Supply Voltage: 24 V D.C.

59/6 plus 2/6 p. & p.

A STEREO VERSION (PR101/S) WILL BE ANNOUNCED SHORTLY

The CLASSIC HIGH QUALITY SOLID-STATE AMPLIFIER (MONO)

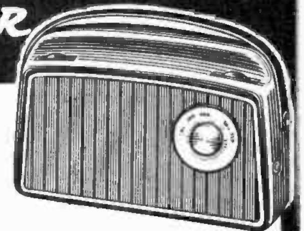
SPECIFICATION

Switched inputs for: Tape Head, Mag. P.U., Cer. P.U., Radio and Aux. **Mains Input:** 220–250 V A.C. 50 Hz.

THE CLASSIC IS THE COMBINATION OF THE ABOVE DESCRIBED ITEMS (X101, P101/M AND PR101/M) ON ONE COMMON CHASSIS: ITS PERFORMANCE AND SPACE-AGE STYLING MAKE IT THE IDEAL CHOICE FOR THE VALUE-CONSCIOUS HI-FI ENTHUSIAST. AVAILABLE WITHIN 4 WEEKS.

8 gns p. & p. free

NEW! THE Dorset TRANSISTOR PORTABLE RADIO



CAN BE USED AS BABY ALARM

600 milliwatt solid state 7 transistor plus diode and thermistor. Completely modulised high quality portable radio featuring complementary NPN and PNP output stage. The comprehensive easy-to-follow drawings supplied make this the easiest-ever transistor radio set of parts, with the following features:

5gns. plus 7/6 postage and packing. *Circuit and parts list 2/6 free with parts.*

- Simple connections to only 6 tags on the R.F./I.F. module, 3 I.F. stages, osc. coil and 3 transistors which with their associated components are completely wired.
- Only 4 connections on the A.F. module to complete the 4 transistor 600 milliwatt solid state amplifier.
- Pre-aligned R.F./I.F. module built and tested.
- A.F. module built and tested.
- Fully tunable over M.W. and L.W. bands. M.W. 540–1640 Kc/s (557–183 metres). L.W. 150–275 Kc/s (2000–1100 metres).
- Intermediate Frequency 470 Kc/s.
- Sensitivity: M.W. at 1 Mc/s 10 microvolts plus or minus 3dB. L.W. at 200 Kc/s 40 microvolt plus or minus 4dB.
- High Q internal ferrite rod aerial on both wavebands.
- Class 'B' modulised output stage with thermistor controlled heat stabilisation. Class 'B' output stage ensures long battery life. Current drain is proportional to the output level. Total current drain of the receiver under no signal conditions is 10–12 mA. At reasonable listening level 20–30 mA.
- Extension sockets for car aerial input, tape recorder output (Independent of volume control) and External Speaker.
- All components (except speaker) mount on the printed circuit board. Easy-to-follow instructions. Size of cabinet 12in. long, 8in. high and 3in. deep.
- Finger-tip controls.

Special Offer—Power Supply Kit to purchasers of Dorset Portable Radio parts incorporating mains transformer, rectifier and smoothing condenser, AC mains 200/250V output 9V 100mA, 9/6 extra.

ELEGANT SEVEN Mk III COMBINED PORTABLE and CAR RADIO

Buy yourself an easy to build 7 transistor radio and save at least £10.0.0. Now you can build this superb transistor superhet radio for under £4.10.0. No one else can offer such a fantastic radio with so many de luxe star features.

SPECIAL OFFER

£4.9.6

POWER SUPPLY KIT
To purchasers of 'Elegant Seven' parts, incorporating mains transformer, rectifier and smoothing condenser. A.C. mains 200/250 volts. Output 9v 100mA. 9/6 extra.

Plus 7/6 P. & P. Parts List and circuit diagram 2/6 FREE with parts.

★ De luxe wooden cabinet size 12¼" x 8¼" x 3¼".
★ Horizontal easy to read tuning scale printed grey with black letters, size 11¼" x 2".
★ High 'Q' ferrite rod aerial.
★ I.F. neutralization on each separate stage.
★ D.C. coupled push pull output stage with separate A.C. negative feedback.
★ Room filling output 300mW.
★ Ready etched and drilled printed circuit board back printed for foolproof construction.
★ Fully comprehensive instructions and point-to-point wiring diagrams.
★ Car aerial socket.
★ Fully tunable over medium and long wave. 168-535 metres and 1250–2000 metres.
★ All components ferrite rod and tuning assembly mount on printed board.
★ 5" P.M. speaker.
★ Parts list and circuit diagram 2/6, free with parts.

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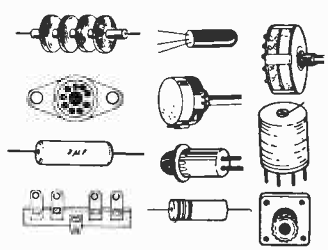

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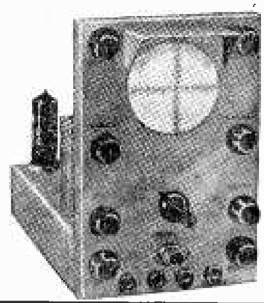
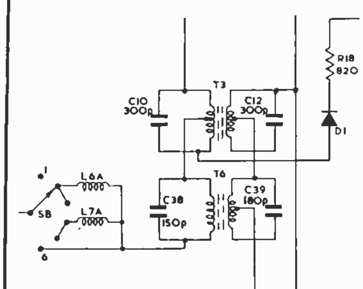


3 READ and DRAW and **UNDERSTAND CIRCUIT DIAGRAMS**



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

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PRACTICAL WIRELESS

VOL 44 No 1

issue 735

MAY 1968

TOPIC OF THE MONTH

End of the Road

WE hope that just because the manufacture and import of certain radio equipment became illegal as from April 1st, owners, or prospective owners, of such equipment will not be tempted to become April Fools!

P.W. long campaigned for some action on the question of illicit walkie-talkies and last year, at long last, the Postmaster-General introduced a Bill covering the situation.

Under Section 7 of the Wireless Telegraphy Act, 1967, importers and manufacturers must seek the authority of the PMG to make or import apparatus designed to transmit between 26·1–29·7 and 88–108 Mc/s. Most of the trouble was caused by 27Mc/s walkie-talkies which created interference with other (legitimate) services and since 27Mc/s is not available for amateur use their operation was in any event illegal.

A curiosity of the law is that it is *still* not illegal either to *sell* or to *buy* such equipment, but only illegal to *use* it. Thus unscrupulous dealers could sell the units to innocent purchasers; or buyers, knowing the risks, could buy them over the counter with no questions asked.

One suggestion we made (*) to end this anomaly was that *any transmitting equipment* should only be sold to purchasers able to produce a transmitting licence for the frequencies covered. The PMG chose to tackle the problem by tightening up on the manufacture and import side. At the same time, the 1967 Act raised the maximum fine for operating such equipment without a licence to £400, while retaining the maximum penalty of three months' imprisonment.

Readers, particularly newcomers, should bear these facts in mind if they are tempted to buy, or use, such equipment from any source whatsoever! The only licences issued to use walkie-talkies and other small radio transmitters are for such users as police, fire and other public services, organisers of sporting events, yachtsmen, the press, schools, entertainers and various business (factories, building sites, etc.). Even so, a condition is that the equipment must meet performance requirements and operate on specified frequencies.

Amateur licences and frequencies, of course, remain unaffected by the provisions of the Act.

W. N. STEVENS—*Editor*

*see p97 June 1967, p276 August 1967, p437 October 1967 for comments and details of the Bill.

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

JUNE ISSUE WILL BE PUBLISHED ON MAY 10th

All correspondence intended for the Editor should be addressed to: The Editor, "Practical Wireless", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2. Phone: TEMple Bar 4363. Telegrams: Newnes Rand London. Subscription rates, including postage: 36s. per year to any part of the world. © George Newnes Ltd., 1968. Copyright in all drawings, photographs and articles published in "Practical Wireless" is specifically reserved throughout the countries signatory to the Berne Convention and the U.S.A. Reproductions or imitations of any of these are therefore expressly forbidden.

NEWS AND COMMENT...

"BETTER SOUND"

There will be four programmes in a new series "Better Sound" which will be broadcast on Fridays at 7.00-7.30 p.m. in Study Session, Radio 3 from May 3 to 24. Listeners will be invited to send questions of general interest, or requests for more information on particular topics covered in the series and these will be dealt with in two extra programmes which will follow the repeat of the series later in the year.

The series will be repeated on Radio 4 on Saturday mornings at 11.00-11.30 a.m. from August 17 to September 14. There will be no programme on August 31 (Bank Holiday weekend), but there will be two additional programmes on Saturdays, September 21 and 28.

The series is planned for home enthusiasts and those who use sound equipment as a teaching aid, or in amateur dramatics and so on. The aim is to help them to get the best out of their hi-fi equipment, tape-recorders and radios. This will be done by giving information about the basic principles involved in the transmission, recording and reproduction of sound, and practical advice on the choice and use of different types of equipment. Advice on particular makes cannot be given and the construction and repair of equipment will not be dealt with.

Speakers will include Donald Aldous, technical editor of *Audio Record Review*, John Borwick, technical editor of *The Gramophone*, John Crabbe, editor of *Hi-Fi News* and members of the BBC's staff.

Each programme will focus attention on one area of this wide field. A number of topics (e.g. microphones, loudspeakers, stereo) will therefore be treated in more than one programme.

Programme 1: Transmission and reception of radio, including stereophonic broadcasting. Explanation of a.m. and f.m., etc. Programme 2: The nature of sound, and room acoustics, with demonstrations of the effect of different placings of microphones and loudspeakers. Programme 3: The reproduction of music in mono and stereo; hi-fi equipment. Programme 4: Tape-recording for the amateur.

The diagrams in the *Study Notes* (BBC Publications, 2s. 6d. plus 5d. postage) will be helpful in following the broadcasts and the explanations in the text of the basic principles of the transmission, recording and reproduction of sound in mono and stereo will be useful for reference, particularly for the less knowledgeable listeners.

GB2LO AT CITY OF LONDON FESTIVAL

An unusual feature of the 1968 City of London Festival, July 8–20, will be the Amateur Radio station installed and operated by the RSGB.

The location is still under negotiation, but the station will be in a very prominent place within the 1·03 square miles of the City of London, and easily accessible to the public.

The GPO have granted the use of the callsign, GB2LO.

Equipment will be loaned by Messrs. K. W. Electronics Ltd. and will be operated by volunteers on the amateur frequencies in the 10, 15, 20, 40 and 80 metre wavebands. The society's public relations personnel will be on hand to explain the station and its function to visitors. Operation will be on single sideband only.

SPRING IS HERE!

We were delighted to snip the following from the price list of a well-known semiconductor manufacturer:

1N34A-C Geranium Diode 4s 6d

Zenobia diodes, of course, cost more!

RADIO SPEEDS UP RAIL MAINTENANCE

With increased efficiency as the prime objective, British Rail Eastern Region have introduced a new system of v.h.f. communication between their London Area Electric Traction Engineer's mobile maintenance units and the overhead line depots at Romford, Cheshunt, Pitsea and Colchester, via a control at Romford, Essex.

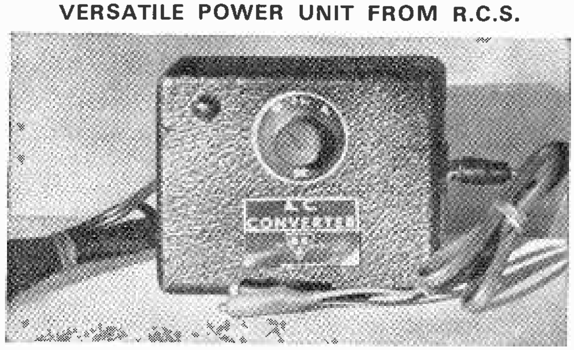
This system operates over an area bounded by London, Bishop's Stortford, Colchester, Walton-on-the Naze and the Essex Coast.

There are two fixed radio stations and aerials at Danbury in Essex and Highgate in Middlesex. Any signal transmitted from a mobile unit, all of which are on a common frequency, is received simultaneously at each aerial and, after automatic comparison for strength, the station receiving the stronger signal feeds it direct to Romford Control.

Here the switchboard operator can communicate with all mobile maintenance units and extend calls between selected extensions in overhead line depots to such units.

Each mobile unit is equipped with a receiver/transmitter which is operated by the car-starter battery carried by the vehicles. Incoming calls are heard on a loudspeaker mounted in the cab and a telephone handset is used for carrying on conversations.

VERSATILE POWER UNIT FROM R.C.S.



R.C.S. Products Ltd., 11 Oliver Road, London, E.17, announce the latest in their range of power units. It is called the "Plus Three" and provides three separate switched voltages of 6V, 7·5V and 9V d.c. at 250mA.

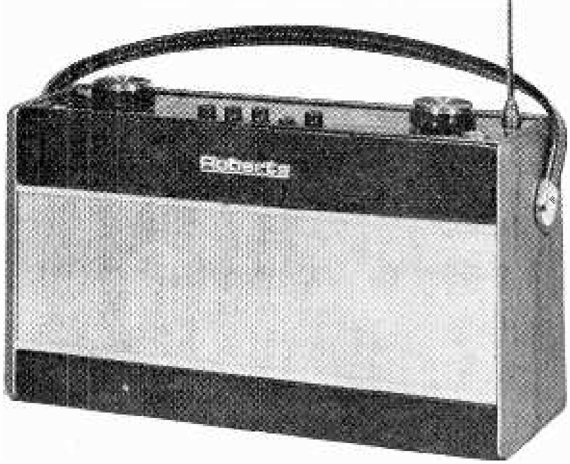
It is ideal for most types of transistor equipment including record players, tape recorders and radio receivers, and makes a good test bench power supply. It is housed in an attractive rexine-covered wooden cabinet measuring $4\frac{1}{4}$ x $3\frac{1}{2}$ x $2\frac{1}{2}$in.

An indicator lamp is standard fitting to ensure that the unit is not left running when the equipment has been switched off, and an optional extra is a lead fitted with a din plug so that the unit can be used in conjunction with the Philips battery operated tape recorders. Also, the makers state that connection leads can be made up to individual specifications.

The "Plus Three" costs 57s. 6d, p.p. is 2s. 6d.

NEWS AND COMMENT...

THE R600 FROM ROBERTS' RADIO



The R600 is a f.m./a.m. transistor portable. A transformerless audio amplifier is employed and press-button switches are provided for waveband selection, automatic frequency control for the v.h.f. band and treble cut.

The circuit employs 11 transistors and 5 diodes and the output stage delivers power in excess of 1W to a 7 x $3\frac{1}{2}$in. elliptical speaker.

A hinged and rotatable telescopic rod aerial is provided for f.m. reception, and a built-in ferrite rod aerial for the a.m. bands. Sockets are provided for use with a car-type aerial and an earpiece.

The receiver is housed in a wooden case covered with black leathercloth set off with silver trim and natural teak end-panels and is mounted on a ball-bearing turntable.

Approximate size is $11\frac{1}{4}$ x $6\frac{1}{8}$ x $3\frac{1}{2}$in., weight is 5 lb. and the recommended price, including battery and purchase tax is 23 guineas.

HEATHKIT AT IDEAL HOME EXHIBITION

The feature of the Heath stand was a presentation in a domestic setting of music in the home. Items from their Hi-Fi range were demonstrated under simulated home conditions.

Hi-Fi audio equipment on view included a.m./f.m. tuners, both mono and stereo, amplifiers and speaker systems for reproducing sound from these sources and from record and tape decks: portable and car radio receivers, stereo record players and stereo tape-recorders were also shown.

BBC RADIO DURHAM

The BBC has placed an order with Bovis Ltd., of Harrow, Middlesex, for building work at the headquarters of BBC Radio Durham, Park House, Durham. Studio and ancillary accommodation will be formed here for this new local radio station, which is expected to be brought into service early this summer.

Radio Durham will transmit on 96·8 Mc/s in the v.h.f. band, from a transmitter at the BBC's Pontop Pike station. The area served will cover most of the County of Durham, except the western part, and will include the City of Durham, Sunderland, Bishop Auckland, Chester-le-Street and the greater part of Consett.

INDUSTRIAL TRAINING FILMS

A comprehensive catalogue of audio visual material for industrial and other training uses has been published by Rank Audio Visual Limited. In its sixty-four pages it lists a wide range of audio visual material on a multitude of training applications in industry, commerce and education.

It includes a total of 346 titles of 16mm. films, 8 mm. concept loop films, 35mm. filmstrips, and sound filmstrip kits. The catalogue is available free of charge from Rank Audio Visual Limited, P.O. Box 613, Woodger Road, Shepherd's Bush, London W.12.

NEWS FROM THANET

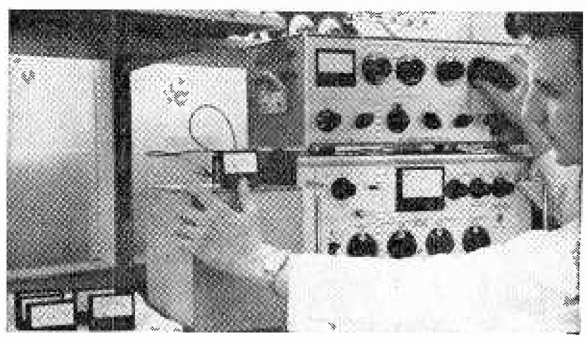
GB2MHE will be operated by the Thanet Radio Society at the Hobbies Exhibition run by the Rotary Club of Margate at the Lausanne School April 24–27. A.M. Phone on 80-40-20-15-10m 4 and 2m. Special QSL's. Contacts and reports will be appreciated. Dick Trull, G3RAD.

BBC RADIO STOKE-ON-TRENT

So that the start of the local broadcasting service for the Stoke-on-Trent area, on March 14, would not be delayed, the BBC brought into service a temporary low-power transmitting installation. This was on the site of the permanent transmitter, at Alsagers Bank, near Newcastle-under-Lyme.

Radio Stoke-on-Trent transmits on 94·9 Mc/s in the v.h.f. band. The local programmes are originated from the new BBC premises at Conway House, Cheapside, Hanley.

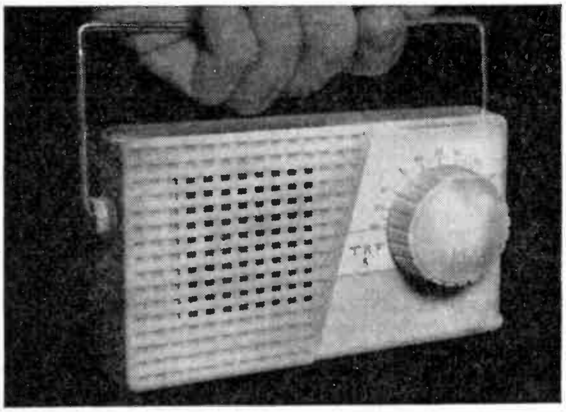
SIFAM METERS FOR AMPEX TAPE RECORDERS



The picture shows special "VU" meters for use in a new, portable professional tape recorder being tested at the Torquay factory of Sifam Electrical Instruments Co. Ltd.

Sifam have received a large initial contract from Ampex Electronics Ltd., Reading, Berks., for these meters for fitting to the new Ampex AG–20 battery-operated audio recorder. Built into a modified Sifam "Director 24" instrument case, the meter movements have specially designed ballistics based upon the stringent USA Standards Institute specification for volume measurement of electrical speech and programme waves.

The meters were subjected to severe tests both in the UK and by the Ampex parent corporation in the United States. The most dramatic of these was an environmental test of the recorder in which an interview was taped by sky-divers from the British Green Jackets Parachute Club during free fall from an altitude of 12,000 feet.



TRF5 POCKET PORTABLE

COVER SUBJECT

R. F. GRAHAM

THE t.r.f. type of receiver avoids the more complicated circuits and alignment difficulties of the superhet, yet will normally give good loudspeaker volume plus a reasonable selection of stations. This circuit has five transistors in a 6-stage reflexed arrangement which is sensitive, easy to build, and provides excellent volume from an economical single-ended push-pull output stage.

Figure 1 shows the circuit, and a personal phone or headphones may be used to test it in three sections, during construction. This ensures that progressive wiring is correct. Tr1 acts as r.f. amplifier, with regeneration through TC1 controlled by the potentiometer VR1. R.F. is blocked by the r.f. choke and passes to diodes D1 and D2, the demodulated signal passing through L1 to Tr1, which furnishes audio signals across R1, taken through C6 to Tr2. When the circuit is wired as far as C6, phones from C6 to battery positive give moderate phone volume from some local stations, while tuning and regeneration will be found in order if this section is working correctly.

Tr2 and Tr3 are audio amplifiers, connected to obtain d.c. stabilisation of their working conditions. For example, assume Tr2 collector current is too high. The voltage drop across R4 rises, moving Tr3 base positive and Tr3 emitter current falls, reducing the voltage drop across R6, and moving Tr2 base positive through R3, to restore working conditions. Should Tr2 collector current be too low, the reverse arises. With Tr3, excess collector and emitter current increases the voltage drop across R6, shifting Tr2 base negative, increasing Tr2 collector current and the voltage drop across R4, which in turn moves Tr3 base slightly positive, to restore conditions.

With Tr2 and Tr3 added, phones from Tr3 collector to battery negative should give more than enough volume, with good quality of reproduction, thereby showing this section is in order. Transformer T1 drives Tr4 and Tr5 in a popular and economical push-pull circuit, operating directly into a 75Ω speaker.

Components

There is some latitude in transistors and some other items, but miniature transistor receiver type components have to be used throughout. All resistors are 10% (silver band) except R7, R8, R9 and R10, which *must* be either 5% (gold band) or selected with a reliable meter for accuracy. VR1 is a midget pot with switch and actual results are the same with 10kΩ or 20kΩ. VC1 is a midget solid-dielectric (300pF) but there is space for a midget air-spaced capacitor, if to hand, and 365pF or other larger value can be fitted.

Various transformers for single-ended push-pull, for use with OC71 and 2xOC72, or OC81D and 2xOC81, or similar transistors, are satisfactory for T1. The ratio is generally about 7:1+1, to 3·5:1+1. Tags are

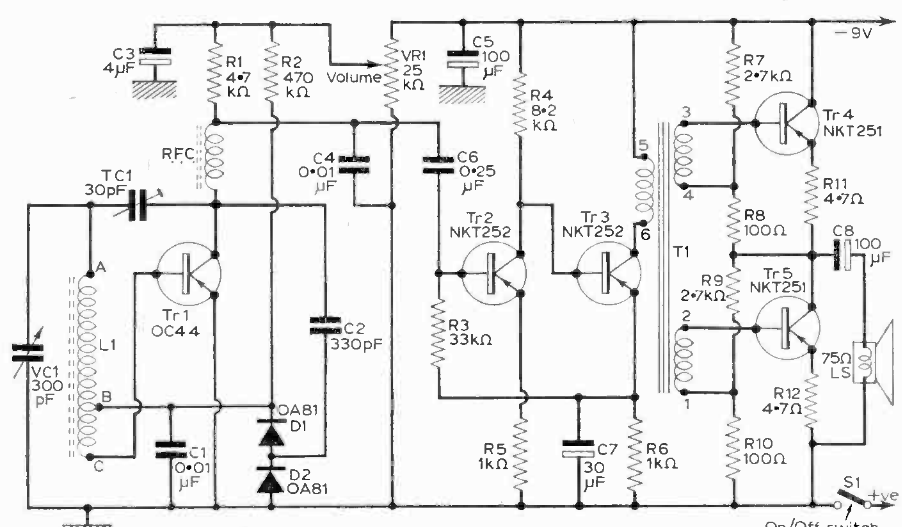


Fig. 1: Complete circuit of the TRF5 pocket portable.

numbered in Fig. 1 and a wiring plan shows location of tags or pins and must of course be for the actual transformer, if different from that listed.

The speaker is a 75-80Ω 2in. or similar unit, but 35Ω units are also in order, while a 25 or 35Ω speaker is particularly suitable for 2xOC81 or similar transistors. The receiver is easily accommodated in a plastic case which is approximately 5½ x 3¼ x 1¾in. external dimensions.

Chassis and Case

This is 5 x 3in., 1/16in. paxolin, with all components except VR1 and the speaker mounted on the back as in Fig. 2. Cases of the type mentioned have three projections inside, tapped 6 B.A. Bolts in holes X, Fig. 2, secure the finished receiver in its case. These three holes can be positioned by cutting thin card 5 x 3in., placing it in the case, piercing over the tapped holes, then using the card as a template for drilling the paxolin. Should any holes be inaccurately placed, they can be elongated with a small round file. The two holes marked S are for bolts with extra nuts, which secure the speaker. Somewhat similar cases are made with tapped holes to fix a speaker inside, and two flexible leads can then run from speaker to receiver.

The speaker opening, Fig. 2, is about 1¾in. in diameter, to clear the speaker. As many holes as possible should be drilled before fitting any components to the panel.

Ferrite Rod Aerial

This has 88 turns of 26s.w.g. enamelled wire, side by side on a 5 x ⅜in. ferrite rod. Glued paper is wound round the rod, and the wire fixed at A with tape, adhesive, or cotton. After winding 76 turns, the small loop B is made, and winding continued in the same direction for a further 12 turns, the wire being fixed at C.

A loop of some insulating material, such as cardboard, leather or plastic is cut to go round the rod, and drawn tight with a bolt, which also goes through the panel. Extra nuts or a spacer lifts the rods so that the winding clears the trimmer TC1. Note that a wire also passes from the moving plates of VC1 through the panel to the "earth" or battery positive circuits the other side.

If the receiver is to be tested in sections as mentioned, insert components up to C6.

The underside of the panel (or front when the receiver is in its case) is shown in Fig. 3. VR1 is fixed with a small bolt. The simplest method of wiring is to use 26s.w.g. or similar bare tinned copper wire, with 1mm red sleeving for "earth" and black sleeving for negative line. Joints (especially for transistors and diodes) are soldered rapidly, the iron being removed immediately the joint is formed.

To test the first stage, connect phones from the free end of C6 to battery positive and unscrew TC1. Set VR1 at about half its travel. Tune in a signal with VC1 and screw down TC1 until the receiver just begins to oscillate, backing off VR1 slightly should then control regeneration. A meter in one battery lead should show a current of about 1—1·5mA, falling

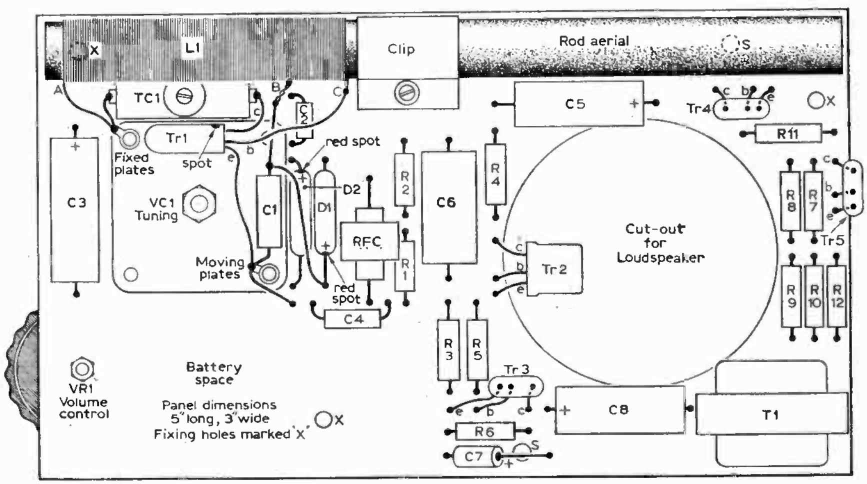


Fig. 2: Component layout. The volume control VR1 is mounted on the reverse side (see Fig. 3).

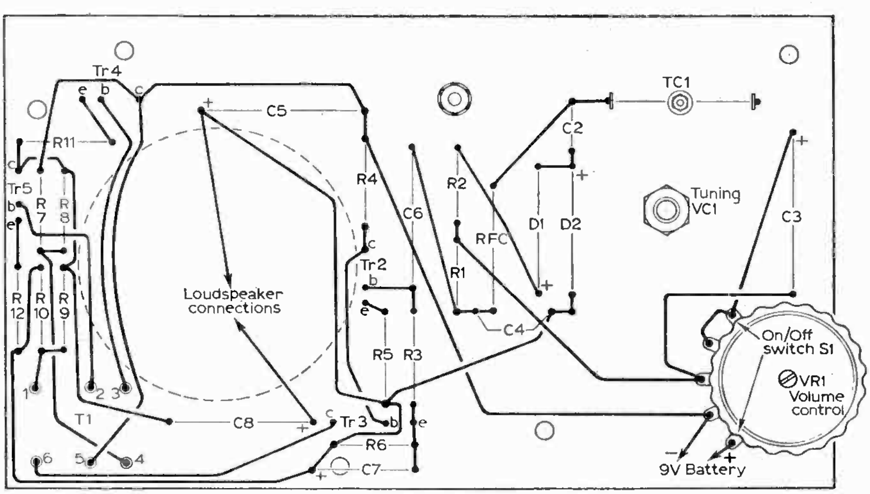
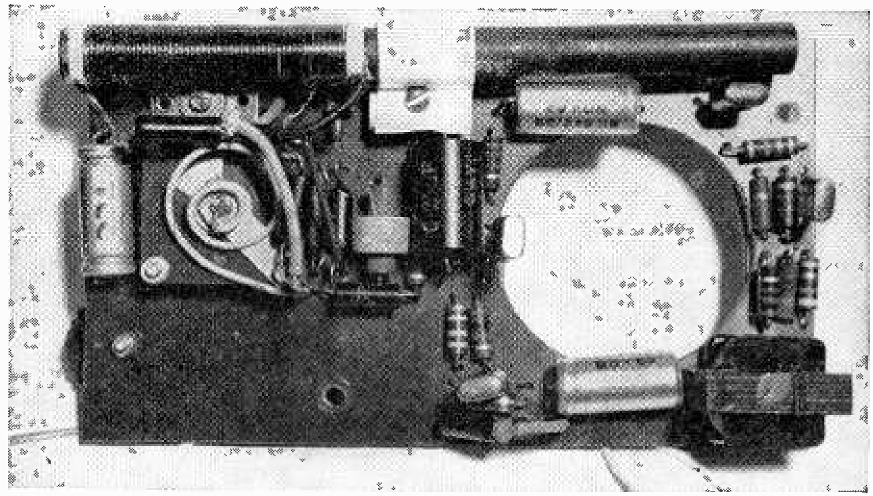


Fig. 3: Underside wiring of the paxolin panel.

by about 0·2mA on tuning in a strong signal, due to increased base bias from the diodes. Regeneration becomes less easy towards the low frequency end of the waveband, so TC1 can be readjusted slightly later, for best over-all reception.

During normal use, VR1 *must* be adjusted as a regeneration control, *not* as a simple audio volume control. Rotating VR1 towards maximum builds up volume, until oscillation begins. Sensitivity is very high just below this oscillating point. Should no results be obtained, connections in this part of the circuit should be checked.



Internal view of assembled receiver (less loudspeaker).

When Tr2, Tr3, and associated components have been added, it is worth checking results by connecting phones between the collector of Tr3 and the battery negative line. This corresponds to points 5 and 6, Fig. 1. Volume on local signals should be very great, and more stations may be heard. There should be no audio distortion. If results are poor or distortion has arisen since adding Tr2 and Tr3, check resistor values and connections here.

Current drain with Tr1, Tr2 and Tr3 in use depends somewhat on transistors, but can be expected to be around 3—4mA. Should there be any fault, correct this before wiring the output stage.

★ components list

Resistors:

R1	4·7kΩ	10%
R2	470kΩ	10%
R3	33kΩ	10%
R4	8·2kΩ	10%
R5	1kΩ	10%
R6	1kΩ	10%
R7	2·7kΩ	5%
R8	100Ω	5%
R9	2·7kΩ	5%
R10	100Ω	5%
R11	4·7Ω	10%
R12	4·7Ω	10%
VR1	25kΩ pot. with switch	

Semiconductors:

Tr1	OC44	
Tr2	NKT252	
Tr3	NKT252	
Tr4	NKT251	matched
Tr5	NKT251	matched
D1	OA81	
D2	OA81	

Capacitors:

C1	0·01μF 150V
C2	330pF 150V
C3	4μF 25V electrolytic
C4	0·01μF 150V
C5	100μF 12V electrolytic
C6	0·25μF 150V
C7	30μF 6V electrolytic
C8	100μF 12V electrolytic
VC1	300pF miniature variable
TC1	30pF trimmer

Inductors:

L1	see text
RFC	miniature 7·5mH r.f. choke
T1	Single ended push-pull transformer 7:1 + 1 (Fotiphone L442 or similar) see text

Miscellaneous:
Ferrite rod, wire, solder, paxolin 5 x 3 x $\frac{1}{16}$in., 75Ω speaker, case to suit, knob, dial, 9V battery.

Output Stage

As mentioned, connections to T1 in Fig. 3 are for the listed transformer, and tag 1 is red. Other transformers have tags in different positions, but are equally suitable.

Resistor values R7 to R12 are suitable for OC72's, OC81's, and many similar transistors, in addition to those listed. The output transistors are best purchased as a matched pair. It should then be found that the voltage at the junction of R8 and R9 is about half the supply voltage. This will not be so with unmatched transistors in Tr4 and Tr5 positions or with an error in value in R7, R8, R9 or R10. In practice, it is usually found that results are satisfactory if transistor voltages lie within about 20% of each other, if the transistors are otherwise matched.

Current taken by the whole receiver should be about 8—10mA, rising to 12—20mA peaks with good volume. Should current be around 8—10mA but extreme distortion spoil results after adding the output stage, check connections to T1. In particular, leads to one half secondary may need to be reversed. Should current be much under 8mA, with weak, distorted reception, check that a mistake is not made in reading the values of R7—R11. Should current be much over 10mA, with no signals tuned in, but reception nevertheless good, R8 or R10 may be too high in value, or R7 or R9 too low. This is not expected with 5% resistors.

Loudspeaker Mounting

There is space for the usual 9V miniature battery, and receiver leads should have correct positive and negative clips. If the speaker is bolted to the paxolin panel, a piece of thin felt, thick blotting paper, or similar material with a central hole can be placed between speaker and cabinet, to prevent vibration sounds. The tuning scale is drawn on card, afterwards cemented to the case front. A knob of fairly large diameter is most suitable for tuning. ■

SIMPLE AUTOMATIC SWITCH

J.E.KASSER

THIS simple but useful device is an all solid state switch, i.e., it has no moving parts to go wrong, such as relays etc., although it can easily be made to utilise a relay if desired. However, the unit as described here may be used without a relay to control load currents of up to 2·5 amps. The unit can be used with a variety of input circuits for a wide range of applications requiring a switch which is not self-latching, i.e., is only activated as long as the original trigger input lasts.

No signal

The circuitry is very simple, but a brief description might prove useful for those not familiar with this type of device. When there is no signal applied to the input (i.e., the base terminal of Tr1) Tr1 is switched off and is in a non-conducting state. Current flows through the potentiometer formed across the supply lines by R1, R2 and R3. Because of this flow of current, the base terminal of Tr2 is forward biased due to the voltage drop across R3, and thus Tr2 is conducting, or is switched on. The collector current of Tr2 is controlled by VR1, while R4 functions as a limiting resistor to set the limit for maximum current through the transistor. Since Tr2 is conducting and the emitter drawing current, and because of the direct connection to the base of Tr3, Tr3 is conducting also and thus current flows through the load, its maximum value being approximately $h_{fe} \times I_b$.

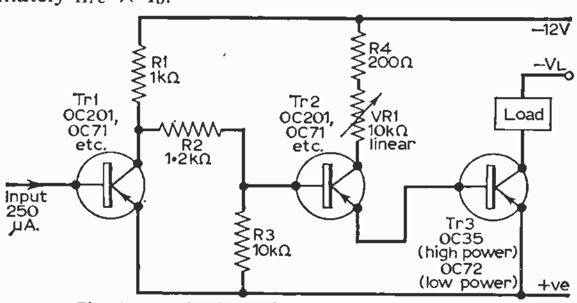


Fig. 1: Circuit of the simple automatic switch.

The choice of transistor for Tr3 is made according to the power dissipation required. In the prototype it is an OC35 for high power applications. The prefix VL is the load supply voltage and this can be made any value within the V_{MAX} of the transistor Tr3. It can, in fact, be connected to the 12 volt negative rail if required.

Signal applied

If an input signal is applied to the base of Tr1 the transistor will conduct, and the potentiometer network (R1, R2 and R3) is now starved of current, the current now flowing through the transistor Tr1. The effect on Tr2 base is that it drops to a potential of practically zero volts and thus, being robbed of its forward bias, transistor Tr2 cuts off and ceases to conduct. Since Tr3 base potential is more or less dependent upon whether Tr2 conducts, i.e., it is connected directly to Tr2 emitter, it (Tr3) now ceases to conduct and thus cuts off. Obviously if Tr2 is not conducting then the potential presented at Tr3 base by virtue of the current flowing through Tr2 emitter is removed. Since it was this bias which caused Tr3 to conduct, once Tr2 cuts off and ceases to draw current, then Tr3 also will cease to conduct and will become cut off. It is plain that with Tr3 not passing any current, the load will be robbed of

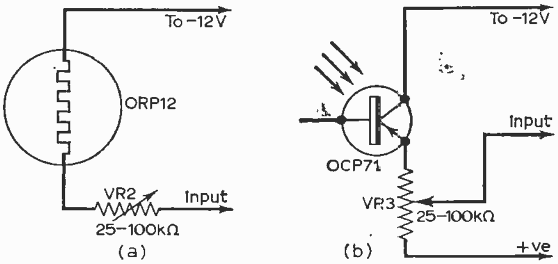


Fig. 2a: Suitable input circuitry for a parking lamp.
Fig. 2b: The same circuit using a photo-transistor.

current too and will thus switch off the device to which it is attached. This means that current is flowing in the load circuit as long as there is no input to the base of Tr1. Directly a signal is applied, Tr3 will cut off, and thus no current will flow in the load.

Transistors

Silicon transistors were used in the prototype mainly because they were to hand, however, there is nothing really critical about the circuit and most transistors should work. It should be borne in mind, however, that changing the transistors could easily vary the switching sensitivity.

Parking light

This type of circuit would be ideal as a parking light if the load was furnished by a suitable lamp and the input circuit triggered by a photocell or photo-transistor as suggested in Fig. 2. The potentiometer regulates the sensitivity of the device and, if preferred, Tr1 might be replaced with a photo-transistor direct, such as the OCP71.

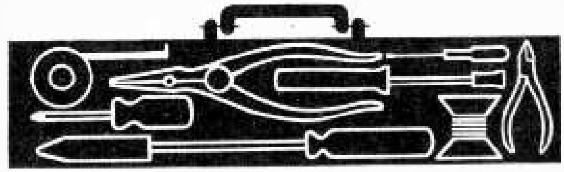
Burglar alarm

The photo-transistor will also prove very useful if a burglar alarm is envisaged, since the breaking of the light beam will switch on the alarm. Other uses include any sort of alarm or level detector, and the unit will replace a relay but only with one set of terminals. The actual switching speed is dependent only on the characteristics of the transistors used. ■

repairing radio sets

PART 2

H. W. HELLYER



Last month we dealt with the basic operation of the transistor. We go on to discuss their identification, handling and replacement

HALF the trouble of servicing transistorised equipment lies in the difficulty of handling small and often unfamiliar parts. It is all very fine for the professional to whom experience has given confidence and who, let it be whispered, may have access to an immediate replacement for the part he damages by haste or clumsiness! For the ordinary chap, however, transistor radio repairs pose a very real problem.

IDENTIFICATION

The first requirement is identification. There are literally hundreds of different sorts of semiconductor devices already in use. Components, likewise, have proliferated; and in doing so have shrunk to very small proportions. A magnifying glass, tweezers and a pencil-bit soldering iron are obligatory, no longer optional, servicing aids.

Because of this problem of identification much of the space available for this article has been taken up by diagrams which may seem superfluous to our more experienced readers. Figure 11 shows the actual shape and size (to scale) of the more popular transistors, with the electrode arrangement of their bases. The code is c collector, b base, and e emitter, with the letter s denoting screen where this applies. On some of the power transistors the collector is internally connected to the outer casing, which forms the collector connection, and some care must be taken when dealing with these for the mounting is often arranged so that the maximum heatsink operation takes place. A very thin film of insulant is fitted between the outer casing and the plate on which the transistor is mounted, giving maximum heat transference, but electrical insulation. Obviously this must be treated with great care. A split, a crease, or even a slight sideways movement during reassembly, may cause a shorted electrode and irrevocable damage.

Similarly, insulating sleeves, bushes and washers will be found that serve the same purpose, to keep the wire pins away from the main chassis while permitting electrical connection. When removing one of these power transistors always take great care to retain the bits and pieces as these *must* not be omitted later.

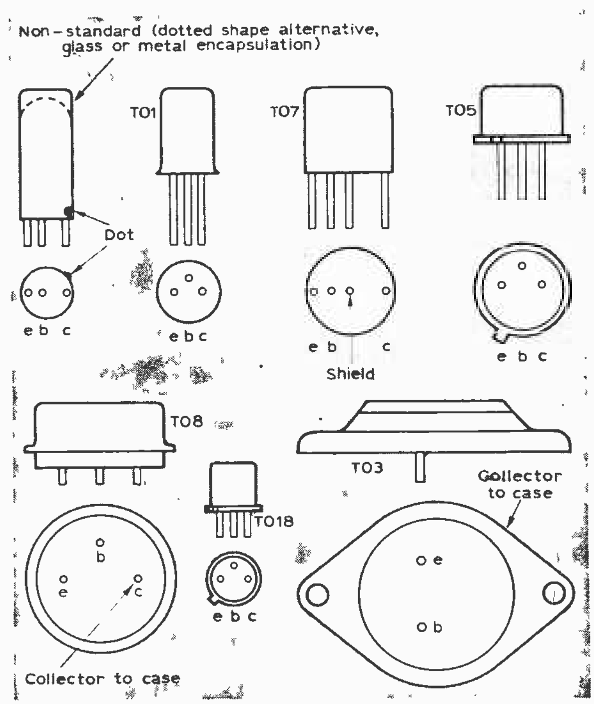


Fig. 11: Popular encapsulation shapes, with bottom view of electrode connections. Examples: Non-standard: OC71, OC74, OC81, OC82, TO1; OC45M, OC81M; TO7; OC170; TO5: 2G401, NKT162; TO18: AF127; TO3: OC26, AD140; TO8: NKT303.

REFITTING TRANSISTORS

When refitting such a transistor a smear of silicon grease on the mica, porcelain or other insulant will aid heat transference and help prevent cracking. Remember that there is often a good deal of heat to be transferred. A finger on the casing of the output transistors of a car radio, for example, will soon convince one that these are not "cold-running" devices. The important factor is the ambient temperature. In the specifications for transistors one finds the power output given for a particular ambient temperature, with the symbol T_{amb} denoting this figure and perhaps a symbol T_{case} or perhaps twice as much denoting the temperature at which the outer casing is designed to operate. The other relevant operating currents depend on this rating and will be drastically altered if it changes.

To emphasise this point Fig. 12 shows some of the heatsink mountings in common use. Note the insulating bushes, etc., and always remember that good thermal contact *must* be made. Even a bit of swarf, or a dirty surface beneath the mounting, will be enough to raise the operating temperature perhaps beyond safety limits. In Part 1 last month Gordon J. King dealt with the phenomenon of thermal runaway and I need only add that in some receivers it is a very real threat so that all efforts must be made to keep operating temperatures within the design limits.

An example would be the modification of a receiver to use perhaps a transistor preamplifier stage. If this is fitted near a heat-generating source such as a valve or power transformer great care is needed to remove the heat before it can do any damage to the vulnerable semiconductors.

WATCH SPECIFICATIONS

I apologise for this Jeremiah-like note, but bitter experience of certain car radios which had their output transistors mounted on the back of the case inviting fitting methods that put them in areas of a very poor ventilation—sometimes right in the air-stream of the heater of the car—taught the author that makers' parameters must be respected if breakdown is to be avoided.

Even the simple heatsink, the brass or copper clip that apparently floats in mid-air, is a vital part of the design and should not be omitted. A popular trap is the temptation to "open" these with a knife or screwdriver blade to facilitate removal of the transistor. When the new transistor is fitted, the case is loose within its heatsink, and if a little extra trouble is not taken to tighten this thermal contact operating conditions may be altered. Pinch the curl of the heatsink slightly before re-insertion of the transistor, but make sure that the pinching is even, i.e. over the whole length of the casing, so that no heat spots are caused. If the original was bolted to the chassis, then do the same with the new fitting, even if it is a little more trouble.

Always remember that manufacturers work to very tight costing schedules. The fraction of a penny that the heatsink costs may be a significant figure when multiplied by mass-production quantities. It was not put there for fun!

LEAD-OUT WIRES

Another point is the lead-out wires on some semiconductors. For r.f. and i.f. transistors, particularly in frequency-modulated receivers, the length of the lead can be important. When fitting a new transistor try to keep to the original dimensions even if this is a bit more trouble to do. In particular try to simulate the routing of the wire ends, do not cross collector and base leads just because it makes a neater fitting, do not bend wires too close to the capsule, and avoid running screen connectors to the nearest convenient place. The specific point that comes to mind is that of mounting a transistor on the opposite side of a printed circuit board from which it was removed—often easier to do. Nine times out of ten you may get away with it; the tenth time, however, there will be an increase in noise level or the chance of instability.

Microphonic transistors may seem a contradiction in terms. But longer leads than necessary on replacement transistors can cause this trouble, which again emphasises the need to keep leads to the right length.

On the other hand, the mounting lead is some-

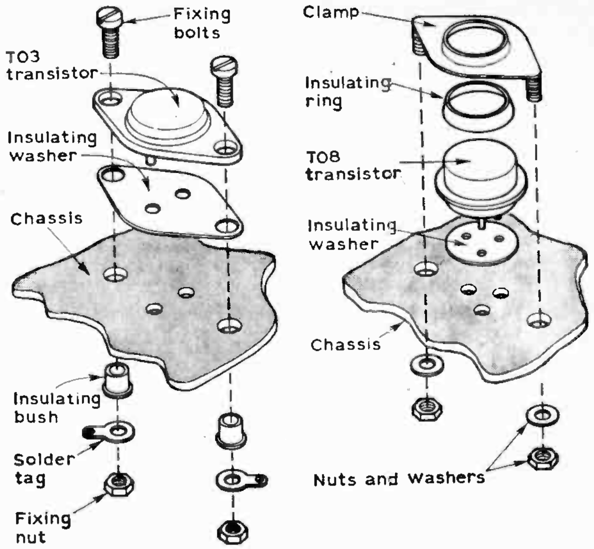


Fig. 12: Power transistor heat-sink mountings. It is important that the electrode pins do not touch sides of clearance holes and that good contact of the transistor with insulating washer and the latter with chassis is ensured.

times employed as a primitive sort of heatsink. This was a popular technique in fitting semiconductors in some television receivers. The wire ends of silicon rectifiers and other diodes were twisted into small loops and the components wired to tag strips. So cutting leads shorter simply invited overheating. The curl was to provide a mechanically stable mounting and had nothing to do with inductance!

Mechanically stable mountings—how important that phrase can be. The encapsulation of tiny components often means delicate leads in confined spaces, and to succumb to temptation and bend these leads sharply is to ask for trouble. Sharp bends should be avoided. Once again, the emphasis is on the proper tool for the job. A good pair of fine-nosed pliers or strong tweezers are part of the standard equipment of anyone wanting to work on transistorised equipment.

SOLDERING

Soldering transistor leads is perhaps the most difficult part of the job. To attempt this task with a clumsy bit is to invite disaster. We have already pointed out that heat is a danger—both in operation and in handling. A fine bit, just enough heat exactly where it is wanted, and the use of some form of heat shunt should be standard procedure. In emergency quite simple heat shunts can be made. Even a twist of wire around a transistor lead, between iron and component can be of some help.

Correct preparation of the job is more important with transistorised equipment than with receivers using valves. The joint to be soldered should be cleaned, the printed circuit board prepared, and any fixing hole thoroughly cleared (a match-stick inserted into the hole to clear it immediately the solder is molten is most useful) before the transistor itself is brought anywhere near the board. Soldering should be quick, direct and efficient. The greatest mistake is to use an inadequate iron for a greater length of time than is desirable. You will melt the solder, true, but you could possibly melt a few components also in the process!

SMALLER ITEMS

Some of the problems of repair arise from the disparity between the original components and whatever replacements are available. There has been a steady shrinking of components—and, despite old-fashioned opinion, a steady increase in quality. This is underlined by the current attention given to integrated circuits. Fortunately my brief stops short at the discrete bits and pieces more often associated with the common transistor radio.

Removing these smaller items very often means damaging or destroying them. It is a hard fact, but one that must be faced. It is thus more than ever important to make *in situ* tests rather than to remove components. This procedure was stressed by Gordon J. King and the theoretical tests need not be repeated here. Some of the practical points arising from them are, however, worth a few lines.

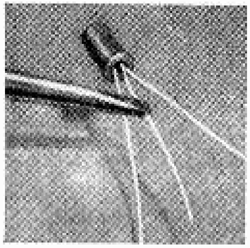
First—servicing transistor radios needs a totally different approach from previous methods used for dealing with valved equipment. Careful diagnosis and correct measurement are much more important. While it is easy and the common practice to remove and replace a valve for test, and often quicker than taking the measurements that would prove its failure, the opposite situation holds with transistor radio testing. Therefore it is vital to know what we are testing, what readings to expect, and how to prove the fault without unnecessarily disturbing the circuit.

But there is a catch here. Suppose a transistorised circuit has broken down and preliminary inspection reveals a burnt-out resistor, what then? A logical approach is needed. We must ask ourselves Why? and indulge in a little theoretical conjecture before grabbing the tools. What could cause the failure; what secondary symptoms would we expect to find; what "cold" measurement tests will help us to prove the fault before we switch on again?

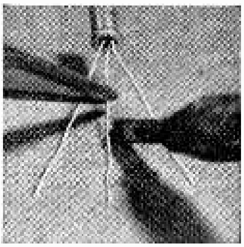
EXAMPLE

To take an example, the output stage burnout of a high quality and expensive tape recorder. The obvious signs were blackening of two emitter resistors, indicating that the output transistors had been passing heavy current. These were low-ohm components and their exact value had to be observed. But preliminary tests could be made with temporary resistors, all "cold" measurements giving readings that appeared normal. By hooking up several series-parallel "christmas-tree" arrangements, the working values were simulated. (This is where a good resistor/capacitor substitution box is a very handy workshop aid. The actual components do not need to be fixed into place; flyleads serve the temporary purpose.)

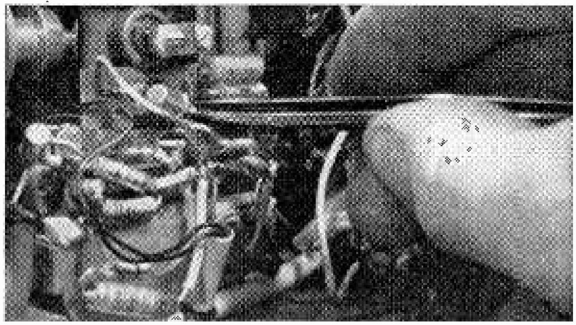
Applying power and taking measurements of current and voltage we found that the output transistors had indeed been damaged. Input conditions, at d.c., were apparently normal.



A simple pair of tweezers aids in the handling of small parts, such as transistors.



A suitable heat-shunt such as a pair of long-nosed pliers between capsule and solder joint prevents damage.



Removing transistor from congested circuit board is made easier by tweezers with blade end.

Now comes the trap. If we replace the output transistors and damaged components, then resume operation, all seems to be in order. But in a short while the equipment is returned to us with the self-same components burnt out. Why? The answer, in this particular case, was failure of a small-signal transistor some *five* stages earlier. This was permitting larger signal current swings than the design parameters should have allowed. The intermediate stages could handle this overload, which gradually increased toward the output section. The output pair handle quite heavy currents, and the large input signal swing drove them way beyond their limits on a strong signal. The trouble was cumulative and until we got to the root of it by more careful measurements under dynamic rather than static conditions the fault could not be proved. Now we fly straight toward the known culprit and replace the AC128 with an AC153.

CARE NEEDED

This example is given only as a warning that testing needs to be more careful than we may have been accustomed to in previous times. A valve voltmeter is now an accepted part of the bench rig, in general rather than intermittent use. An oscilloscope is even more useful for taking spot measurements of incoming signals without disturbing the circuit. But even where the only gear one has is a multimeter, the need to use this diligently becomes obvious. If a manufacturer says there is 2·1V at the base of a transistor he means this—and the difference of even point one of a volt can be significant. Gordon J. King is treating the important subject of signal testing more fully in the next part. His advice is well worth studying.

From the practical point of view, and even at the risk of repetition, we must stress the dangers to transistorised equipment in making the tests themselves. A careless probe can damage a transistor irrevocably in less time than it takes to curse one's clumsiness. If we accidentally slip and short-circuit a transistor's base to collector, or, in some cases, its emitter to chassis, we can write off that transistor almost immediately. If we apply too great a signal from our generator or other source, small-signal stages in the earlier part of the circuit will suffer, and again transistors may saturate on negative peaks (assuming p-n-p types with positive chassis). Thermal runaway can occur when leakage current rises, a rise in junction current causing more heat, causing more current, and so on.

HIGH IMPEDANCE

It is essential that we do not bring about these conditions by our tests. The volt-meter, for example, should be at least 20,000 ohms/volt to give accurate readings down to one-tenth of a volt or even less without disturbing the circuit. This is because to read these voltages one must switch to a low-voltage range, and the meter imposes a greater load on the lower ranges. Hence the very obvious advantages of the valve volt-meter, which has a very high impedance.

But the valve voltmeter is often a main-powered item, and here another snag arises. Leakage currents can be caused if unearthed test equipment is used—or if earthed equipment and test gear is used with phase-change differences in wired connections. Figure 13 shows the connection of a signal generator to an a.c. operated radio or amplifier. Both the chassis of the signal generator and the set should be earthed, and this means properly bonded from the metal parts, not just from the earth connector of a three-wire lead.

One reason is that the dotted capacitor shown is actually a distributed capacitance between the windings of the transformer and the core, and perhaps across any r.f. filter that may be included in the mains circuit of the test gear. Connecting the test gear to the set, even via the isolating capacitor C2 whose job is to prevent transients that can also damage transistors, does not remove the danger as the coupling is electrostatic.

If we now apply a soldering iron to the set, even with the set switched off, and if the metal bit of the soldering iron itself is not adequately earthed, a fairly large current can flow from the iron to earth via the transistor. Soldering a base connection of a radio with an unearthed iron is simply inviting trouble. So the prime rule, before commencing, is to make sure that all the equipment is earthed to a common point. Five minutes extra in setting up before starting work can save quite a bit of trouble later.

Any output meter used should be of correct load impedance. Conditions with transistor output stages in respect of possible damage are virtually opposite to valve stages. A short-circuit across the output will cause breakdown. A load lower than that required in the design will draw extra power from the output circuit. Hence the need to observe correct loading when fitting extension loudspeakers. Hence also the reason that some amplifiers are rated at higher power output for lower impedance loudspeakers.

Finally, any ohmmeter used will be powered by a small battery. On the × 100 ranges, this can be several volts more than the circuit may handle. This is a point that should be considered when testing.

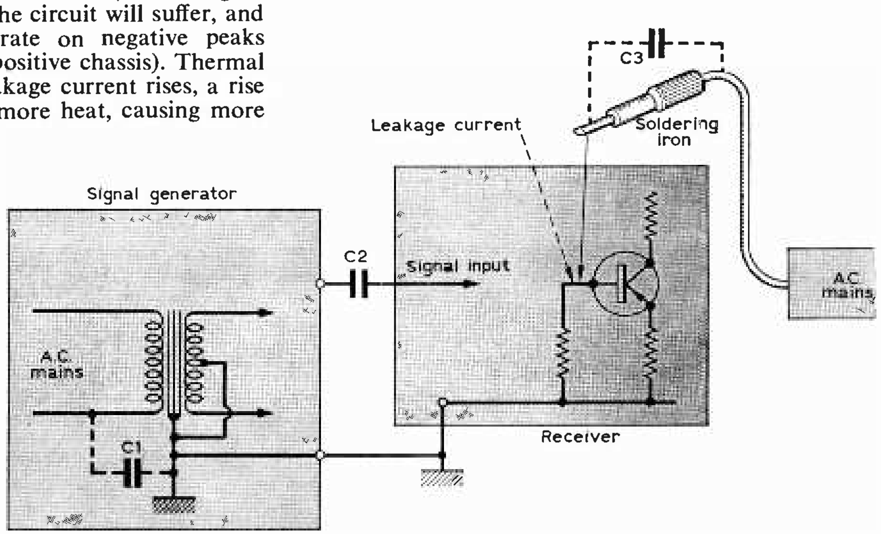
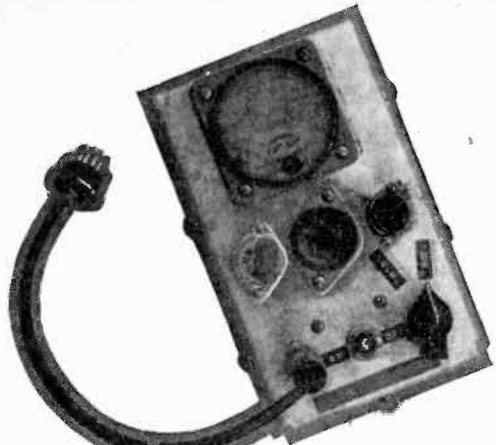


Fig. 13: Leakage currents due to electrostatic charges between mains wiring and chassis can be transmitted to the receiver from test gear, despite isolating capacitors. The great danger is the use of an unearthed soldering iron, which can cause heavy leakage current to pass through transistors to chassis and back to earth.

TO BE CONTINUED

★ FAULT FINDING CHART No. 2

The fault finding chart presented with this issue is to be used in conjunction with last month's chart. This month the chart, however, deals with diagnosis. The two charts together form a comprehensive guide to fault diagnosis and tracing, and will be found useful either on their own or used in conjunction with the new series of Repairing Radio Sets.



MODULATED Crystal MARKER

HUGH WAGNER

DURING odd sessions of experimentation in the workshop, the writer came across some stubborn crystals that would not easily oscillate in conventional valve circuits, but would sometimes do so in transistorised circuits. Accordingly, an attempt was made to put together a simple transistorised oscillator, using the minimum of parts, that could be used for sub-standard crystals. The circuit shown works well in spite of the fact that no tuned circuits are used.

For prolonged use a fairly large 9 volt battery should be used since the drain of the oscillator alone is about 10 milliamps, whilst it is double this when the modulator is in use. A 12 volt battery may be used provided attention is paid to the dissipation of the audio transistor used.

It is preferable to use a meter, which may be either a 1 or 2mA unit. A meter does give one an idea if the crystal is functioning, and some indication of its activity. To set up the meter, use, initially, a 2kΩ potentiometer and set this to give almost f.s.d. with the hottest crystal in stock. A fixed resistor of that value (R7) is then soldered into the circuit.

The type of modulation is simple and the low level; nevertheless it is very effective. The wave shape should ideally be sinusoid, and if the constructor is keen on this he can insert, temporarily, a 15kΩ potentiometer in place of the 470Ω resistor shown in the circuit diagram, and adjust it to give a good wave shape. However, the note produced may not be as distinctive and pleasing as that obtained at a sacrifice in wave-shape. In the prototype, and a copy that was built later, the most suitable note (to the writer's ear) was one of a little less than 1800c/s.

Construction

A glance at the circuit diagram shows that, contrary to usual practice in p-n-p transistor circuitry, positive is not at ground potential. Battery negative is grounded to the chassis and covering box, and the on-off switch is in the positive line. It is worth while cutting the three holes for the commonest valveholders, as this enables most crystal types to be accommodated.

The two-pole switch shown in the diagram was a two-pole six-position wafer switch, as it happened to be handy. The unused tags are used for supporting components. If this system is copied, make sure the stop lugs on the switch are bent into position, so that the switching range is restricted to two positions only. Likewise, the unused pins on the valve-holders may also be put to good use. Quite apart from driving the first stage of a transmitter, there are other uses for this useful unit, and most

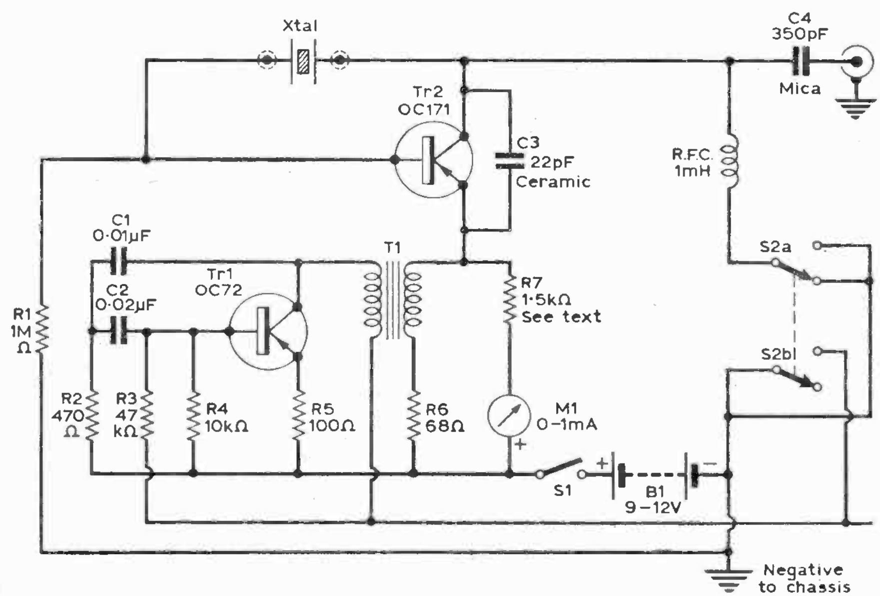


Fig. 1: Circuit diagram of the modulated crystal marker.

—continued on page 32

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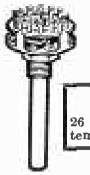

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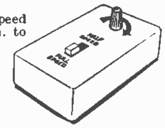

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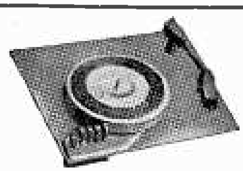

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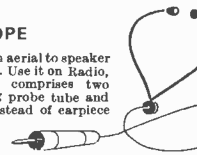

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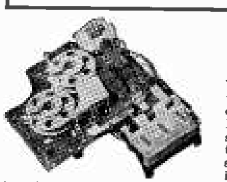

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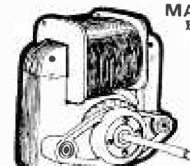

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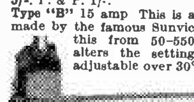

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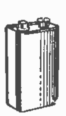

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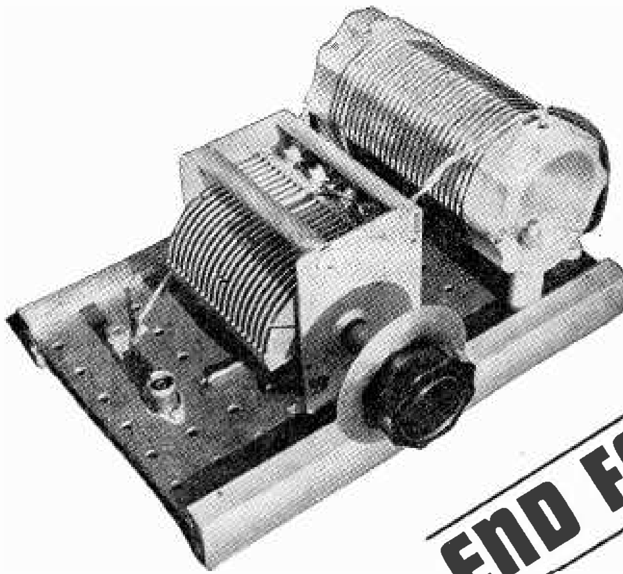


END FED AERIAL TUNER

F.G.RAYER G3OGR

A COUNT of amateur stations contacted on 80 metres shows that over half are using some form of end-fed aerial, and that a large percentage of these aerials are near a ½-wavelength long, that is, roughly 125-130ft. Many kit and commercial transmitters have a pi output circuit which should work into a fairly low impedance circuit, and it is commonly found that a ½-wave end-fed aerial cannot be operated from these transmitters unless a tuner is added. The tuner described here is extremely simple and can be assembled in a very short time. It is suitable for 150 watts, but could be scaled down for lower powers.

The circuit is shown in Fig. 1. L1 is tunable to 80m, and can be 26 turns of 18s.w.g. enamelled wire, on a ribbed former 2½ in. in diameter, the winding being spaced to occupy about 3½in. (An easily obtainable Eddystone former of this size can be purchased.) Other coils of about equal inductance should be equally satisfactory. The coupling loop L2 is 3 turns of stout, well insulated wire, overwound on the earthed end of L1.

For tuning, a 150pF or similar capacitor is used, and it should have plate spacing at least equal to that of the transmitter p.a. anode tuning capacitor. The capacitor actually fitted was a 2-gang component with sections wired in parallel. Non-miniature receiver type capacitors will do for low power only. If the capacitor sparks over in use, this shows its spacing is too small, for the power and aerial employed.

LAYOUT

The tuner can be built on a piece of varnished hardboard or pegboard about 5½ x 9in. with wooden runners to give clearance for fixing bolts etc., with components placed as in Fig. 1. A coaxial socket was used for connecting up the transmitter. A stand-off insulator or insulated terminal is provided for the aerial. The aerial lead itself should be well insulated, by passing it through sleeving, if necessary.

Many transmitters have a coaxial socket for output. The connection between the transmitter and tuner can then consist of a piece of 75Ω transmitter grade coaxial cable with a coaxial socket each end. It is as well to place the tuner near the entry point of the aerial, but within reach, so that it can be adjusted.

AERIAL LENGTH

An aerial which is a ½-wave at about the middle of the 80m band is approximately 128ft. long, although the actual length is often increased to as much as 138ft., because this is a multiple of ½-waves on some higher frequency bands, and may be convenient for multi-band operation. This includes the horizontal section, down lead, and connection to the tuner. Height, bends, and other features also modify the effective length. The aerial may be 14s.w.g. hard-drawn, or 7/26 or similar covered aerial wire. All joints should be soldered. Signal strength is increased by having the whole as far from earthed objects as possible.

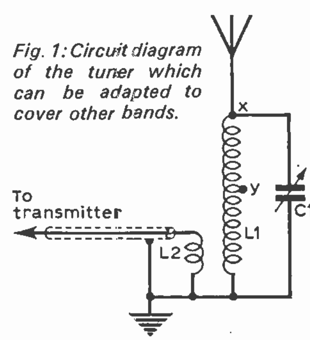


Fig. 1: Circuit diagram of the tuner which can be adapted to cover other bands.

If the receiver has a 75Ω input and a signal strength meter, the aerial tuner can be adjusted by observing the strength of some station tuned in. It should then be possible to load the transmitter pi output circuit into the tuner, without changing the tuning of the latter. In other cases, it may be found that the tuner has to be adjusted, as the setting of C1 considerably modifies loading on the transmitter. If a 75Ω non-inductive dummy load is available, a check can be made by loading the transmitter into it. Then connect the aerial tuner instead, and adjust it for similar loading, with the transmitter tuning untouched.

Another method is simply to adjust the aerial tuning and pi output capacitor of the transmitter until the p.a. anode current is at the wanted loaded figure, with the p.a. capacitor dipped for minimum current. If this is done, the same loading can be achieved with a number of settings of the aerial tuning capacitor and pi output capacitor. These correspond to different impedance conditions in the coaxial line from transmitter to tuner, but have no practical result on efficiency, as can be checked with a field strength meter.

OTHER BANDS

As an end-fed wire is easily used for other bands, the top half of L1 may be shorted out, for 40m. (Join X and Y in Fig. 1.) A comparison of signal strength showed no difference if the 80m coil were used in this way, or a coil wound for 40m only was substituted.

For still higher frequencies, relatively few turns are needed, so it was decided to employ a separate coil and capacitor. Using the same size former, a 15/20m tuner had 8 turns of 14s.w.g. wire, occupying 2½in., for L1, and 2 turns for L2. A 100pF capacitor was sufficient to tune the coil to resonance.

The tuned circuit naturally provides some harmonic suppression. In addition, the transmitter pi output circuit can now work into the low impedance

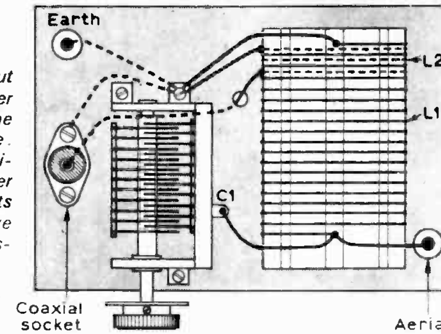


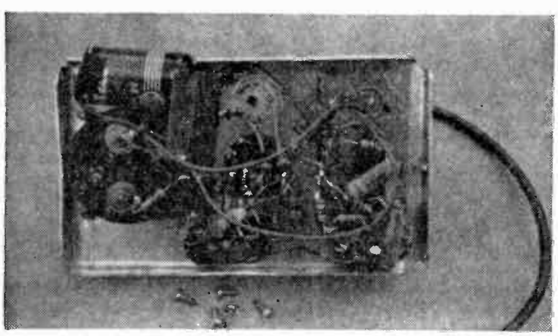
Fig. 2: Layout of the tuner used in the prototype. This is uncritical and other arrangements should prove equally satisfactory.

coaxial line, and this further reduces any harmonics which may be present. If a standing wave indicator or harmonic filter should be available, these can be included in the coaxial line. Tuner adjustment can then be for the minimum s.w.r., and this is also necessary to match the harmonic filter impedance, if used. When a filter or s.w.r. indicator is not used, the presence of standing waves in the coaxial line has no practical result on the signal radiated from the aerial. This is because the line is short, and the transmitter pi output can always perform satisfactorily with some standing waves present.

Should available space result in the aerial being rather more or less than a ½-wave, or multiple of ½-waves or some bands, then its end impedance will no longer be very high. As a result, it should be tapped down L1, until loading is satisfactory. ■

MODULATED CRYSTAL MARKER

—continued from page 28



Internal view of the modulated crystal marker.

constructors interested in this type of unit will already have thought of them.

If the valveholders are used for both crystal and components, it is mandatory that the vacant sockets be plugged with sealing-wax or plastic cement. However, this treatment should not be given to the B7G socket. ■

★ components list

Resistors:

R1	1MΩ
R2	470Ω
R3	47kΩ
R4	10kΩ
R5	100Ω
R6	68Ω
R7	1·5kΩ

Transistors:

Tr1	OC171
Tr2	OC72

Capacitors:

C1	0·01μF
C2	0·02μF
C3	22pF ceramic
C4	350pF mica

Inductors:

T1	1:1 miniature driver transformer (Radiospares)
RFC	1mH r.f. choke

Miscellaneous:

Meter 0–1mA f.s.d.; valveholders—one of each, B7G, B9A and I.O.; co-ax socket; 2-pole 2-way switch—S2; 1-pole 2-way switch—S1.

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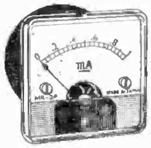

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100mA 25/-	20V D.C.....25/-	500V A.C.....25/-
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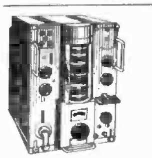

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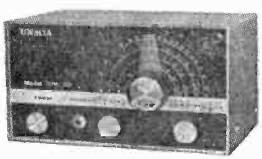
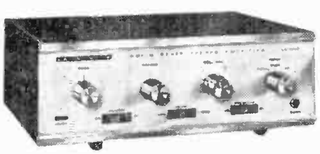


LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER



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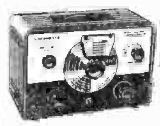

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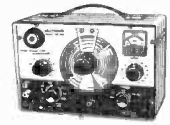

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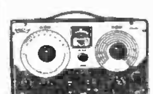

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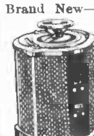

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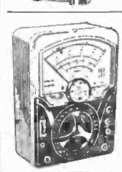

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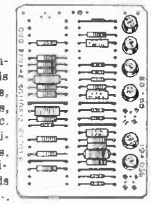

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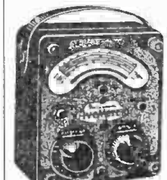

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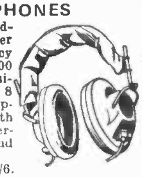

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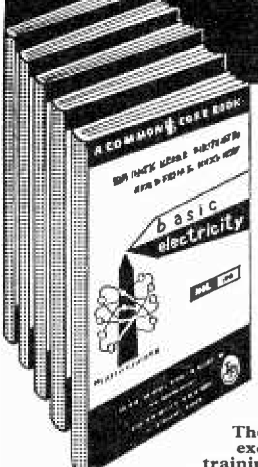

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practically wireless commentary by HENRY

No. 44

Pat. Pending

WHEN Henry began indulging his penchant for airing his views, the long period between submission of some journalistic gem and the almost inevitable thud of its rejection on the doormat was hardly endurable. Offering a crumb of comfort, Mrs Henry used to say: *"I'll bet they have taken your ideas and published them under someone else's name."* Something of the same idea must haunt those who design some electronic wizardry and then try to take out a patent.

Between the final flourish of the soldering iron and the yacht off the Bahamas and sports car with built-in blonde there lies a tedious, obstacle-strewn road that is enough to deter all but the most diligent Blumlein. Looking at some of the conditions and restrictions recently to check the amazing resemblance between two colour-TV circuits, convinced this experimenter that it would be better to stick to garden-shed hook-ups and leave the breakthroughs to those more adequately equipped. But let us follow the fortunes of a humble back-alley inventor. We will call him Bill Smith; after all, his parents did!

Bill had been tinkering with a relaxation oscillator when the thought of the musical mousetrap occurred. Unlike Prof. Geiseling and his zoological researches on animal response, he had no notions of lulling the rodents to sleep, or measuring their responses. He was more concerned with trap clearance.

A musical mousetrap.

In short, Bill had a disposal problem. All very fine setting the coiled wire mechanism with the best Double Gloucester. All very fine bribing the laziest cat in New Malden not to pinch said D-G. All very fine triumphantly removing the mangled remains of some pathetic Mickey and burying it where said lazy cat would not bother to dig it up. But Bill was not always on hand, and mice, though nocturnal creatures, did not always conveniently make their rendezvous with the Big Spring when they heard his flat feet approaching. Then, it was as likely that Mrs Bill Smith would come across said mangled etc., and dissolve in a fit of the vapours. Women are like that.

So it was necessary to organise some form of warning that would alert Bill, and only Bill, when the poor *mus domesticus* tripped the catch. A buzzer was out of the question; a bell might have been mistaken for the telephone; chimes were the front door early warning system and the construction of a voice-pulsed gadget that shouted *"Hey You"* was, Bill felt, somewhat beyond the resources of PRACTICAL WIRELESS Advisory Service. *(Not according to some readers!—Ed.)*

The solution came as he tried to attract his wife's attention from the kitchen transistor radio. She was oblivious, lost in a world of Jimmy Young—probably waiting for the telephone to ring! He snapped the switch and she blinked to the surface like a cod coming into warm waters. That was the answer: a transistorised alarm on her deaf side, to beat out a rhythmic signal, preferably in discordant tones. He would leap with jarred nerves; she would never notice!

Soon he was off to the Patents Office to register the unique, unparalleled musical mousetrap, only to be met with a frosty-faced glare and the remark: *"You cannot simply patent an idea. Show us a working model."*

"Show us a working model."

More midnight oil, more curious noises behind the wainscot, more wailing protestations from Mrs S and Bill had his "vendible product"—a new process of doing something. He was ready to file his patent.

Sixteen years is the protection period, and then even the best musical mousetrap becomes public property. And during that time, the renewal fee has to be paid. Just to apply, and then write Pat. Pending, or Pat. Applied For and a string of fancy numbers, can be quite meaningless, as Bill discovered. Moreover, just because a device does not bear that magical six or seven figure number, it does not signify the patent is invalid, or does not exist.

Bill gave up the day his wife came back from the supermarket humming *The Sound of Music*. Somewhere there must be a sale for musical mousetraps, Patent Applied For—1/432.666. Perhaps if Bill had fitted a d.f. loop and a homing device, he could have interested some party behind the Iron Curtain, or in the Common Market or somewhere . . .

Five steps to hi-fi

PART ONE . . . . . . PICK-UPS

IAIN SMITH

A HIGH fidelity sound system can be considered as a chain with the pick-up, turntable, amplifier and loudspeaker each being the individual links making up the chain. It is often said that the amplifier is the strongest link in the chain, which is true. It is also said that the loudspeaker is the weakest link in the chain. This is not true. The loudspeaker is suspect for several reasons; one being that the average loudspeaker is between 5 and 10 per cent efficient, another being the loudspeaker's tendency to produce Doppler distortion (more of this later in the series).

There is, however, a far weaker link producing far more distortion, namely, the pick-up. The pick-up transducer itself does not produce any significant distortion. Most distortion is produced at the point of contact between stylus and groove, the stylus mounting and cantilever with pick-up arm construction providing another distortion factor. An important feature of any pick-up head is its "compliance".

Compliance

The compliance of a pick-up transducer as used in record reproduction can be defined as "the ability of the stylus to trace accurately the pattern of modulations of the recorded groove without damage to the groove walls". Compliance is measured as the distance in centimetres that the stylus will move for a thrust of 1 dyne. This distance is usually very small and normal compliances are in the order of units x 10^{-6}. Two compliances are usually stated for stereo pick-ups; a lateral and a vertical compliance. All pick-ups have a lateral compliance but for safe tracking of stereo records, a vertical compliance is the one and only essential factor. This is because stereo records have modulations on each groove wall, which are at forty-five degrees to the vertical, therefore, some vertical motion is unavoidable.

By the above definition a good compliance is one which allows the pick-up to track the record without damage to the grooves. A figure of 5 x 10^{-6} cm/dyne laterally and 2 x 10^{-6} cm/dyne vertically is about the minimum acceptable to meet this condition. Obviously, higher figures than this are better. The compliance of a pick-up determines, to some extent, the output from the pick-up. With high compliance pick-ups there is so much flexibility in the stylus cantilever or coupler that a movement of the stylus by the groove only produces a small movement of the transducer hence a smaller output. This is why high output crystal pick-ups used with low sensitivity amplifiers, found in portable record players, have a low compliance. Because of the low compliance a high tracking weight, around the 10 gramme mark, is usually necessary which is not very healthy for records.

Stylus Tip Mass

Another factor affecting the wear on records by pick-ups is the stylus tip mass. It is thought by some authorities to be *the* most important factor and experiments carried out so far confirm this. Tip mass is the mass of the stylus as seen by the groove of the record. This is not related to tracking weight, as mass is effective in all directions not just vertically. Many expensive pick-ups have a tip mass of 3 milligrammes. Experiments have shown that this, even when combined with a high compliance, produces measurable record wear. It is thought that something less than $1\frac{1}{2}$ to 2 milligrammes is desirable. The Decca Deram ceramic stereo pick-up has a tip mass of 0·6 milligrammes. This pick-up shows no measurable record wear after 250 playings under a 400 times magnification. Its compliance 9·0 x 10^{-6} lateral and 5·0 x 10^{-6} vertical is also somewhat less than some expensive pick-ups with a 3 milligramme tip mass, whose performance cannot compare.

Other factors affecting performance are tracking weight and electrical impedance. Tracking weight should be as low as the compliance allows but within the manufacturer's specification. Too little tracking weight causes more record wear, slightly more than is necessary.

Impedance

The electrical impedance required by the pick-up as a load should be matched by the input impedance of the amplifier. If the impedance, presented as a load to the pick-up, is too low, then a loss of the lower frequencies will result. Little effect will be noticed by putting a larger load than required across the pick-up. The minimum voltage required by the amplifier to drive it should also be matched by the maximum output of the pick-up.

Pick-up heads should be mounted in a lightweight shell coupled to a lightweight arm. This is to reduce the effective mass of the arm as seen by the stylus, thereby reducing lateral forces which cause record groove deformity. Friction in vertical and lateral pick-up arm bearings should be as low as possible, again to reduce lateral and vertical forces. Certain bearings such as brass bush and spindle types have limitations in this respect. Bearings should at least be of the small ball type.

The type of pick-up arm material affects pick-up performance. Plastic is notorious for causing resonance and die-cast aluminium is only one step better. Best materials are tubular aluminium or low resonance wood.

Another way in which pick-up arm construction affects performance is the angle at which the head is offset. Unless the stylus cantilever is tangential to the portion of the groove beneath it, distortion in the output waveform will be set up (see Fig. 1). The

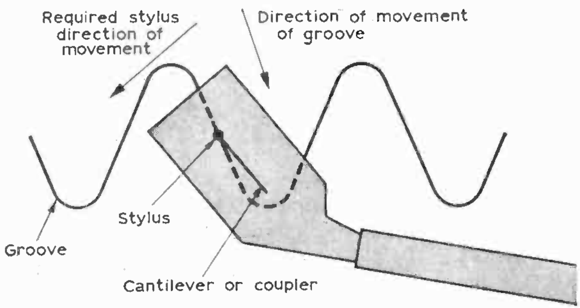


Fig. 1: An illustration of how tracking error occurs through the pick-up being incorrectly offset.

reason for the distortion is that it is direct lateral movement of the stylus that creates the output and the resultant movement of the stylus in the diagram would not conform to the recorded pattern.

A method of checking for tracking error is as follows. Take an old disused 78 r.p.m. disc and draw a line across the diameter. Mark a point on this line 2½in. from the record centre. With the stylus placed on this point the pick-up head should be at right angles to the diameter. If there is more than a three degree error, this should be corrected if the arm is of sufficient length. Correction can be made by either moving the pick-up head along the arm or by adjusting the arm length. Distortion caused by tracking error will be more noticeable towards the centre of the record.

Buying Guide

To sum up here are the main points to look for when purchasing a pick-up.

1. The pick-up should have a high compliance.
2. The tip mass should be less than two milligrammes.
3. The electrical impedance and output should be matched to the amplifier.
4. The pick-up arm bearings should be of the low friction type.
5. The pick-up arm construction should be of low resonance material.
6. The pick-up arm construction should be of such a length as to avoid tracking error.

Obviously a book could be written on this subject but the points outlined in this part should prove helpful.

to be continued

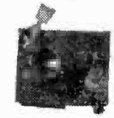
SATELLITE EARTH TERMINALS

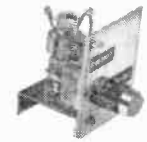
APRIL ISSUE, PAGE 915

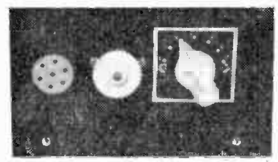
We regret that due to a printers error, the power of the signals referred to in the 28th line, second column, was given incorrectly.

This should read "...10^{-18} watts" and not 10 watts as stated.

SIMPLE RECEIVERS







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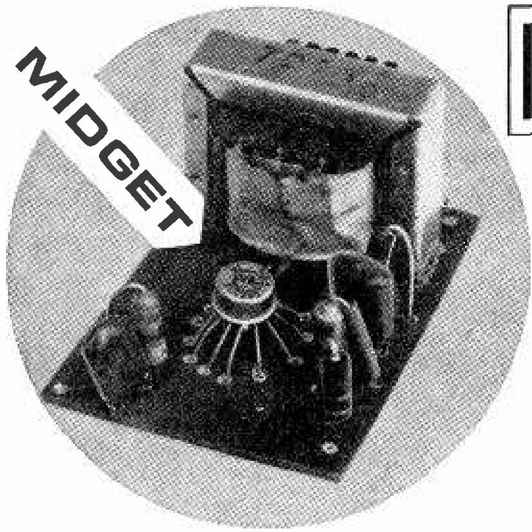


I.C. AMPLIFIER

L. McNAMARA B. Sc.

THE great controversy in the world of electronics at the moment concerns the present status of the integrated circuit. No one really queries the assertion that over the next few years these devices will win for themselves a considerable share of the components market. Inevitably, as costs of conventional assembly increase, while the manufacturers become more expert in the design and production of semiconductor devices, use of the latter must become the approach dictated on terms of economy for more and more applications. It is the purpose of this article to point out that this breakthrough has already occurred for small audio amplifiers, and describe one particular design in which an integrated circuit is used to economic advantage. The circuit diagram of Fig. 1 which illustrates the equivalent of the I.C. in discrete circuitry, should be sufficient to prove that for the sum for which this device can be obtained, it is certainly money well spent. In all, it contains the equivalent of seven functional transistors (a word about the diodes D1—D3 in due course), with nine resistors, arranged to provide the functions given in the block diagram, Fig. 2. We find five separate functions—a high impedance buffer amplifier, a voltage regulator, a phase splitter, and a pair of power output transistors, all n-p-n silicon planar epitaxial types, with identical characteristics except for Tr6 and Tr7 which are specially designed and fabricated for the higher currents they carry as output transistors.

The Integrated Circuit

The operation of this rather complex unit deserves fuller attention. The first block in Fig. 2 represents the transistor Tr1, which functions as a single emitter follower amplifier stage. With a higher input impedance than the conventional common emitter stage, it provides a better match to the output of a signal source such as a crystal gram cartridge. In a practical circuit, there is an emitter load resistor external to the I.C. (R13 in Fig. 3), and the signal developed across it is applied to the following differential amplifier type phase splitter, with its two transistors Tr2 and Tr3. The chain of diodes D1, D2 and D3 are actually further silicon transistors with their collectors unconnected; it would therefore be expected that the voltage developed across each would be the characteristic emitter-base voltage of a good silicon transistor, about 0·7 volts. Con-

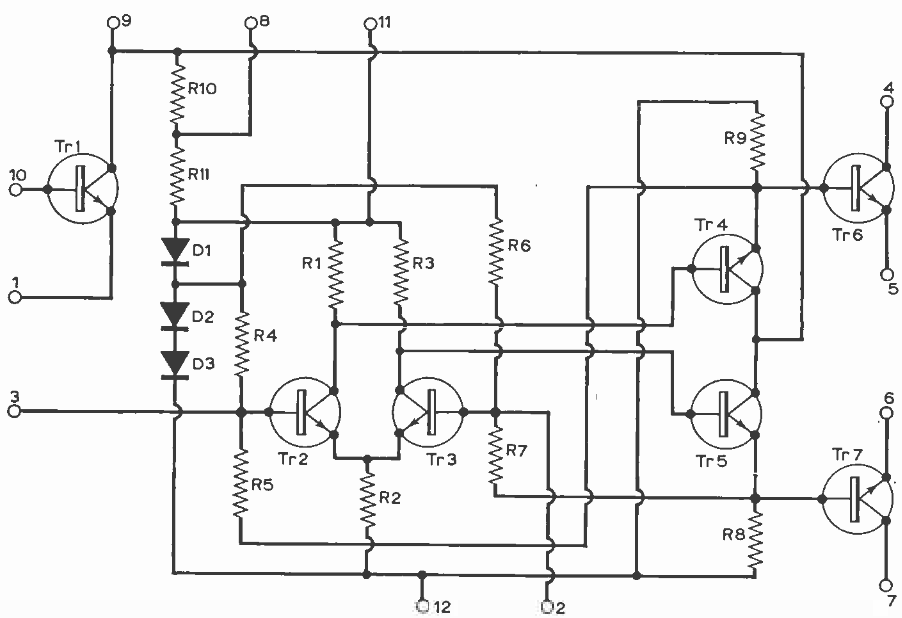


Fig. 1: Complete theoretical circuit diagram of the CA3020 integrated circuit. Component values are not listed, as these are not included in the manufacturer's data (see text).

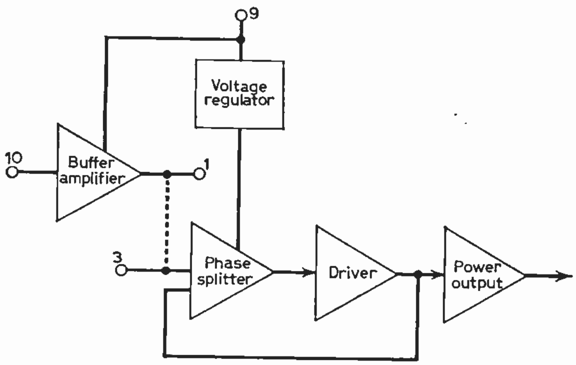


Fig. 2: Block diagram showing the functions of the I.C.

sequently these diodes perform the voltage regulator function, setting the base and collector voltages of the transistors of the phase splitter stage. The driver and output stages are therefore controlled also, as they are direct-coupled to the phase splitter. As for the operation of the differential amplifier, Tr2 produces out-of-phase signals in the collector and emitter load resistors, R1 and R2. As the base of Tr3 is by-passed by an external capacitor, this transistor acts as a common base amplifier, producing a signal at the collector in phase with that applied at the emitter. It follows that the audio signal in R3 will be equal in amplitude but opposite in phase to that in R1. The driver transistors Tr4 and Tr5 are directly coupled across these resistors, and act as emitter follower amplifiers; although in this mode they do not provide as much gain as in a common emitter amplifier, they are also performing an impedance matching function which eliminates the need for a transformer to drive the output pair. They are also responsible for providing a suitable level of base bias for these transistors.

Performance

Now that the operation of the I.C. has been considered, it is possible to devote some attention to the performances which could be expected from the unit. The values of the resistors and parameters of the transistors in the monolithic chip of the I.C. are not given in the supplier's data on the unit. This is perhaps because the tolerance to which a resistor can be fabricated by epitaxial diffusion is not yet as great as that expected in discrete components, and should any values be quoted, they could be no more than typical values. On the other hand, the ratios of resistances are very closely controlled in this type of manufacture, and the circuits are such that this ratio is more important than any absolute values of components. As a result, while the resistances found in individual circuits may vary, all samples will give a maximum power output of 550mW, and a power gain of 58dB. As the components within the chip are all direct coupled, there are no components to limit the bandwidth of the unit; the figure quoted of 6Mc/s is probably set by the structures of the higher power output transistors. As a result there can be no loss of fidelity at audio frequencies due to phase distortion in the I.C., and it will be the components external to the chip which will provide the frequency limitation, e.g. the inductance of the output transformer used to couple the output transistors to a loudspeaker. The transistors themselves are high quality types, as would be expected from silicon epitaxial units, and this contributes to the good noise figures claimed for the I.C., typically a signal-to-noise ratio of 70dB. The input impedance of, typically, 50kΩ ensures that the loss of signal in feeding a CA3020 amplifier from a gram pickup is minimised. However, perhaps the most striking aspect of the performance of the unit is in the efficiency of the voltage regulator system, which ensures efficient running of the circuit over a wide range of supply voltages and thermal and load conditions. The CA3020 will operate at line voltages

—*continued on page 43*

★ components list

Resistors:
R12 470kΩ
R13 4·7kΩ
R14 4·7Ω
All 10% ¼W

Capacitors:
C1 0·1μF
C2 0·01μF
C3 0·1μF
C4 5μF electrolytic
all miniature, 12V minimum wkg.

Miscellaneous:
Output transformer Ardente D3027; RCA* integrated circuit type CA3020; VR1 500kΩ with s.p. switch; VR2 50kΩ.

*RCA Great Britain Ltd., Lincoln Way, Windmill Road, Sunbury, Middlesex.

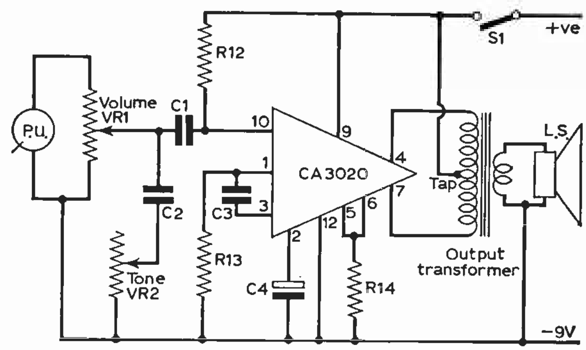


Fig. 3: Complete circuit of the I.C. gram amplifier.

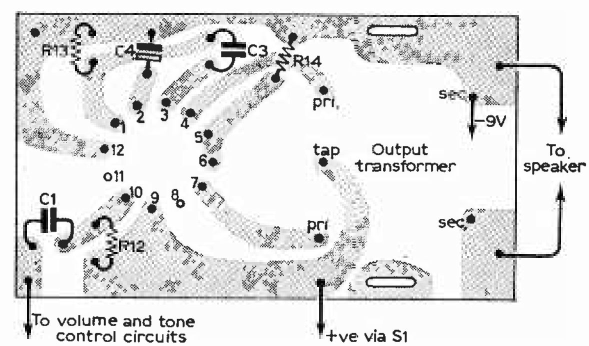
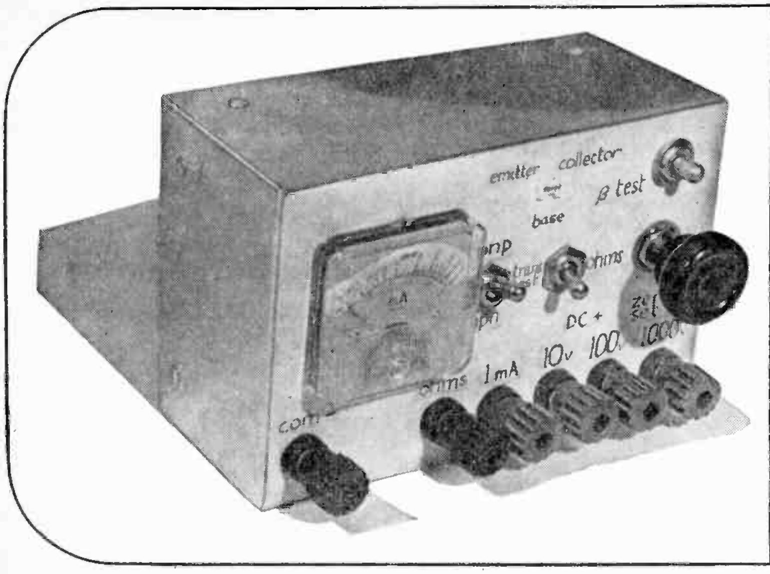


Fig. 4: The printed circuit. When viewed from the underside the tab on the I.C. can indicates lead 12.



A COMPR CHECKE

C. R. BRADLEY

An economical instrument which tests p-n-p and n-p-n transistors for relative BETA (current gain) and leakage. It will also test diodes and give useful voltage, current and resistance measurements.

USING new parts and an easily obtainable surplus 1mA meter movement, this simple instrument was built for less than £2. It is designed to fill the needs of servicing home-built and commercial transistor equipment and will give a positive good/bad test for commonly used low voltage transistors. It will also prove its worth in weeding out the "junk box" which, in the author's case, provided most of the components.

Before the transistor testing circuit can be considered one must have a basic understanding of the operation of a transistor. The basic properties of a typical small p-n-p transistor are illustrated in Fig. 1. Here it is seen that a small current (e.g. $50\mu A = 50 \times 10^{-6}$ amps) is drawn out of the base of the transistor (I_b) while a larger current (e.g. $2mA = 2 \times 10^{-3}$ amps) is drawn from the collector (I_c). The sum of the currents ($I_b + I_c$) is the emitter current (I_e) which flows in the direction indicated by the arrow inside the transistor symbol.

The amplifying properties of the transistor depend on the fact that a large change in I_c may be produced by a small change in I_b. The graph in Fig. 1 shows a signal with a current swing of $25\mu A$ applied as input to the base producing an output signal from the collector with a current swing of 1mA. Thus a *current amplification* has taken place. The amount of amplification depends on the *current gain* of the transistor or the steepness of the I_c/I_b graph. The current gain or BETA (β) of the transistor is defined mathematically by: $\beta = \frac{\delta I_c}{\delta I_b}$ where $\frac{\delta I_c}{\delta I_b}$ is merely calculus notation for the ratio: $\frac{\text{change in Ic}}{\text{corresponding change in } I_b}$. In our example (see graph), $\beta = 1mA/25\mu A = 40$.

Note that when $I_b = 0$ there is still a small collector leakage current. In a small germanium transistor this should not exceed 0·15mA and will generally be much less; certainly so for silicon transistors. For a useful listing of values of I_{cbx} see the article "In-circuit Transistor Tester" (P.W. Dec. 1967, p. 605).

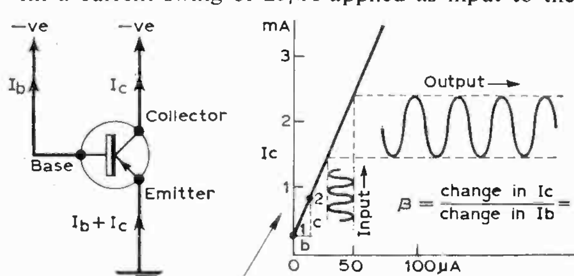


Fig. 1: Basic amplifying properties of a typical p-n-p transistor. The graph shows how I_c depends on I_b and is for a fixed collector voltage.

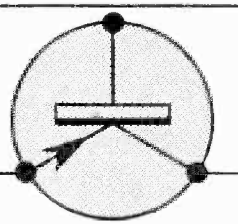
Transistor tests

The transistor testing circuit is shown in Fig. 2. When S1 is open the base and emitter of the transistor under test are at earth potential and no current should flow across the reverse biased base-collector junction. What does flow is a small leakage current which is indicated on the meter; we are at point *1* on the graph in Fig. 1. Discard the transistor if this exceeds 0·15mA. The leakage current may be too small to indicate on the meter at all.

When S1 is closed ("BETA TEST") a small emitter-base current flows (assuming this junction is good) and a substantial collector current should result. Remember that a transistor's action is as follows: a small increase in the emitter-base current produces a large increase in the emitter-collector current. The meter reading should rise by about 0·5mA, the amount depending on the BETA of the transistor. We are now at point *2* on the graph. If the current does not rise, or only slightly, the transistor is faulty. But the budget-minded user will not discard it yet as either the emitter-base or collector-high voltage measurements. A 500 volt range (R_v= 500k Ω†) might be thought more useful although this range would not match the existing 0–1·0 meter calibrations so easily.

Only the basic 1mA d.c. current range is provided as this will suffice for many transistor circuit measurements. Higher current ranges are obtained by the use of "shunts" or resistors in parallel with the meter as shown in Fig. 4 where R_c(*OHMS*)=R_i/(current for f.s.d. (*milliamps*)—1). The internal resistance (R_i) of the meter *must* be known and will probably be 100Ω. Shunts may be built into the instrument to give additional ranges or wired externally when required. The author finds a 10mA range obtained with an 11Ω shunt (near enough to 11·11Ω given by the formula for R_i = 100Ω) occasionally useful.

EHENSIVE
R



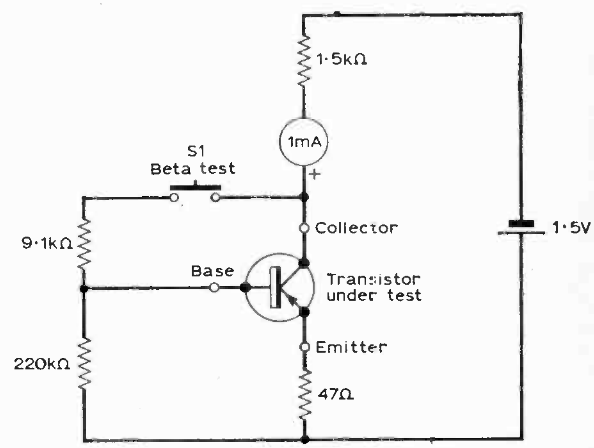


Fig. 2: Circuit of transistor leakage and beta tester. Close S1 for "BETA TEST".

base junctions may be usable as a diode!

As a low battery voltage (1·5 volt cell) is used, small transistors cannot be damaged by excessive currents. This does however limit the tester's use to common low voltage transistors. It will be found that even new transistors of the same make and type have widely varying BETAS; the tester makes it possible to select high gain transistors for critical circuits and find matched pairs for push-pull output stages. The same circuit is used for testing n-p-n transistors with the battery polarity reversed. The low voltage means that incorrect setting of the p-n-p/n-p-n switch in the final circuit is unlikely to damage the transistor under test.

Additional ranges

The 1mA meter used in the transistor testing circuit may also be used for simple voltage, current and resistance measurements. For d.c. voltage tests a resistor is placed in series with the meter as in Fig. 3 and by

$$\text{Ohm's law: } R_v\ (OHMS) = \frac{\text{(voltage for f.s.d.) } (volts).}{1/1000 \qquad (amps)}$$

In this instrument the voltage ranges shown in Table I were obtained.

Ordinary 10% resistors were used for R_v by the author as the simplicity of the instrument and the small 1mA meter used did not seem to justify closer tolerance (and more expensive) resistors. However 5% or even 1% components can certainly be used for greater accuracy. The 1,000 volt range is optional and if it is built into the tester then proper insulated terminals and test prods *must* be used and great care taken in making

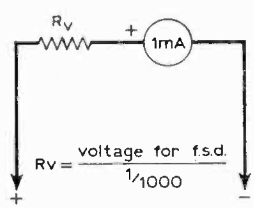


Fig. 3: Voltage measurement circuit.

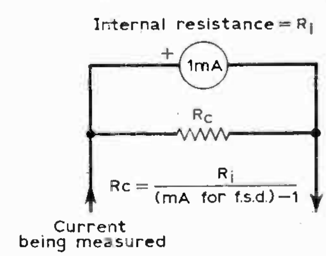


Fig. 4: Current measurement circuit.

A single resistance measurement range is obtained by the circuit in Fig. 5. The two test leads are first shorted together and the potentiometer VR1 adjusted for full scale meter deflection (zero ohms). The leads are then connected across the test resistance and a reduced current flows. The resistance may then be calculated from the formula: $R(ohms) = 1500\left(\frac{1-I}{I}\right)$ where

TABLE 1

R_v*	f.s.d. volts
10kΩ	10V
100kΩ	100V
1MΩ	1,000V

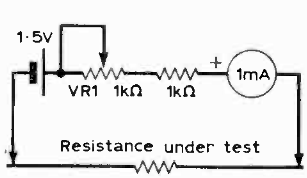
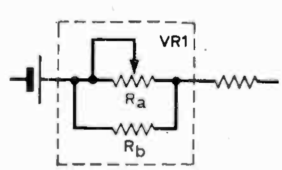


Fig. 5a: Resistance measurement circuit.



RaΩ	RbΩ
2·5kΩ	2kΩ or 2·2kΩ
5kΩ	1·5kΩ
10kΩ	1·2kΩ

Fig. 5b: Use of alternative potentiometer values.

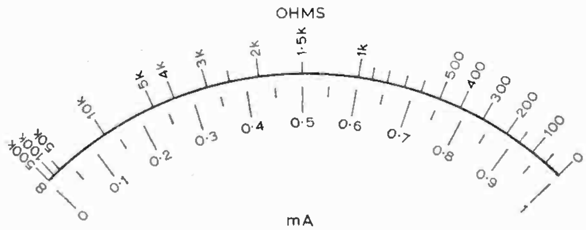


Fig. 6: Additional calibration of the 1mA meter for resistance measurements using formula in text.

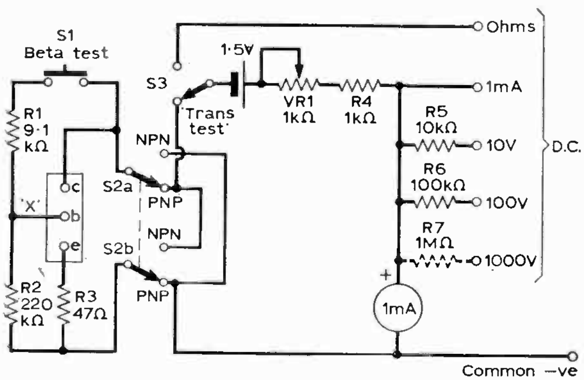


Fig. 7: Complete circuit of the instrument. The 1000V range is optional.

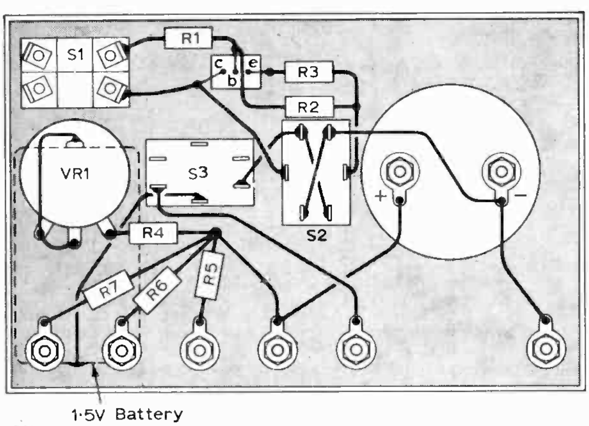


Fig. 8 (above): Suggested layout of the transistor tester.

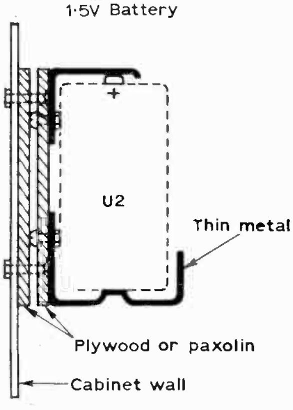


Fig. 9 (left): Insulated holder for the U2 battery.

I(mA) is the meter reading. It is more convenient to have an ohms calibration on the meter. This will be a non-linear scale ranging from infinity to zero ohms as in Fig. 6. To make the calibration, open the meter carefully and remove the scale taking great care not to damage the hairspring or pointer or let dust into the movement. The ohms scale is drawn carefully with indian ink and should not be calibrated too closely, particularly towards the high end, or legibility will be lost.

★ components list

Resistors:
- R1 9·1kΩ
- R2 220kΩ
- R3 47Ω
- R4 1kΩ
- R5 10kΩ
- R6 100kΩ
- R7 1MΩ
- VR1 1kΩ potentiometer

Switches:
- S1 push button type
- S2 DPDT toggle
- S3 SPDT toggle

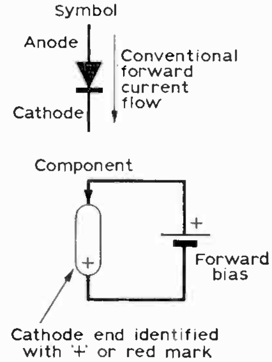
Meter:
0—1mA d.c.

Miscellaneous:
Terminals; 1·5V battery and holder; transistor socket; cabinet, wire, solder etc.

Construction

The complete circuit of the instrument is shown in Fig. 7. A transistor socket is provided for transistor tests while other functions are selected by connection to the appropriate terminal. COMM is the common negative terminal for all ranges.

The non-standard value of R1 may be obtained by wiring 10kΩ and 100kΩ resistors in parallel. If a 1kΩ potentiometer is not available for VR1 other values may be used as detailed in Fig. 5(b). The layout of the instrument is not critical and is left to the constructor. The meter, switches, terminals and transistor socket need only be mounted on a panel and the remaining few components wired in behind. A suitable layout is shown in Fig. 8. The cabinet could be built with a hinged back for test lead stowage. If a metal cabinet is used it should be left electrically "floating", i.e. not connected to any part of the circuit. The author used the $6 \times 4 \times 2\frac{1}{2}$in. size of a popular range of four-sided aluminium chassis as a neat cabinet. The battery (a U2 size cell) is held in a simple home-made holder as in Fig. 9.



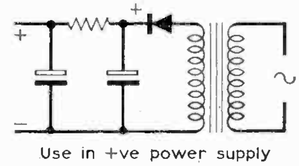


Fig. 10: Diode polarity. When using the tester, the positive end must go to the "COLLECTOR" test point.

Before making a resistance or transistor test the "OHMS" terminal must be shorted to the "COMM" and VR1 adjusted for full-scale deflection (zero ohms) with S3 in the "OHMS" position. This adjustment compensates for the voltage drop of the battery with time although for accurate readings the battery should be fresh.

Diodes and rectifiers may be tested as follows: connect the diode between "EMITTER" and "COLLECTOR" on the transistor socket. Try both settings of the p-n-p/n-p-n switch. In one direction the diode will be forward biased and a substantial current should flow (0·6mA or more); in the other direction no more than a tiny leakage current should flow. If the diode fails this test it is faulty. There often seems to be confusion in people's minds about which end of a diode is which; this can be cleared up by reference to Fig. 10. On this instrument the cathode (red or "+ve" end of the diode is the one connected to the "COLLECTOR" test point if forward conduction is obtained with S2 in the p-n-p position.

Footnote

This instrument is intended to give a relative indication of transistor BETA only. Accurate BETA measurements are possible however if a 100μA meter is placed at "X" in Fig. 7 to measure I_b when S1 is closed. Hence BETA is calculated from the definition given.

* *Rv actually includes the internal resistance of the meter which is usually about 100Ω. This is negligible compared with these values.*

† *Or two 1mΩ resistors in parallel.* ■

MIDGET I.C. AMPLIFIER

—continued from page 39

of as low as 3V, though at a reduced power level, and as high as 9V, though here a heat sink is advisable to hold down the temperature of the transistor junctions in the chip. Such sinks are commonly available as the I.C. is supplied mounted in a standard transistor-type format, according to the accepted TO-5 specification, and push-fit heat sinks are supplied for these transistors. Incidentally, although this property is unlikely to be of great advantage to the designer of amplifiers for entertainment and domestic purposes, the fact that the regulator keeps operation stable over the temperature range −55deg. to +125deg.C. is certain to be of interest to industrial and military users. In the past, too, it would have been expected that the efficiency of the circuit would be lower than that of a discrete-component amplifier of the same output power, due to the loose tolerance of integrated resistors biasing the transistors. In this circuit, however, maximum power is obtainable with a current drain of no greater than 22mA.

Constructional Details

Now for an actual prototype amplifier using the RCA type CA3020 integrated circuit audio amplifier. The circuit of Fig. 3 was found to be a satisfactory competitor with typical discrete-component transistor amplifiers when used in a portable record player. Construction could not be simpler, and without any crowding it is possible to mount the whole amplifier on a printed circuit board less than 3 x 2in. As is clear from Fig. 1, all connections to the output transistors with the exception of the bases must be through external circuitry. This allows for an emitter resistor which introduces a slight degeneracy or negative feedback at that stage of the amplifier. It also allows a selection of the operating conditions for the output stage, as both the idling current, that is, the current drawn by the unit under no signal conditions, and the power output, depend on R14. Lowering it allows a greater output but increases this idling current and the dissipation in the I.C. In the prototype a value of 4·7Ω was selected; the power output dropped to about 350mW, which, however, is sufficient to enjoy the reproduction of recordings on a portable gram deck. Under these conditions a heat sink was not required. The printed circuit shown in Fig. 4 contains all the necessary interconnections between the components of the amplifier except C2 and the volume and tone controls, which are mounted separately and connected to the amplifier by screened flying leads. The output transformer whose tapped primary serves as a load to the output transistor pair, coupling them to the loudspeaker, is the only other major component on the board besides the I.C. I will not go into the details of the production of the printed circuit board by the conventional method of applying a paint pattern over the areas which are to form the conductors, and etching off the remainder of the copper foil coating of a section of clad paxolin using $FeCl_3$ solution; this process has been described repeatedly, to that the experimenter capable of working with integrated circuitry will be familiar with such a basic operation. The common alternatives, Veroboard and Cir-Kit, are also acceptable, but rather more difficult to use than is common with these methods, due to the close spacing of the 12 leads from the TO-5 can of the I.C. If these techniques are chosen, the leads of the I.C. must be carefully "spidered" or bent apart close to the seals in the base of the I.C. can so that they can reach the spacing of the Veroboard. Care is necessary in this operation, lest the leads or the seals of the can are damaged by bending too close. It must be remembered that a damaged I.C. can't be disregarded like a broken transistor—it represents almost a complete amplifier, and costs a lot more than an OC72!

Of course, the amplifier described is only one of the applications of this versatile circuit, and the imagination of inventive readers will find further applications for an effective and economical unit such as this one. The writer, for one, expects to hear a lot more about it in the future, and hopes it will find the commercial success the ingenuity of the design deserves. Perhaps such success will lead its manufacturers and their competitors to follow it up with more of the same, and perhaps even more exciting developments. ■

Full constructional details of an integrated circuit pre-amplifier (I.C. Preamplifier) with an input impedance of 10MΩ, will be published next month.

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times GMT
Frequencies in kc/s

THE BROADCAST BANDS by CHRISTOPHER DANPURE

WITH the spring schedules halfway through the operation period, and DX-ing conditions good, you should now be logging the world. With sunspot prediction of 132 for April, all the broadcast bands are open at different times of the day. So first off, here are the propagation predictions for April.

West and East Africa: 0600-1800 GMT 25, 21, 17 and 15Mc/s are the best bands, after 1800 and up to 2000 GMT 21, 17, 15, 11 and 9Mc/s, and 2000-0600 GMT 15, 11, 9, 7 and 6Mc/s bands.

South Africa: 0800-1400 GMT the best bands are 25 and 21Mc/s, 1400-1800 GMT 25, 21, 17 and 15Mc/s, 1800-2400 GMT 21, 17, 15, 11, 9, 7 and 6Mc/s, 2400-0400 GMT 11, 9, 7 and 6Mc/s, 0400-0800 GMT 15, 11 and 9Mc/s.

South Asia: 0800-1200 GMT use 25, 21 and 17Mc/s, 1200-1800 GMT up to 1600 GMT 25, 21, 17 and 15Mc/s, 1600 GMT drop 25 and 21Mc/s and add 11 and 9Mc/s, 1800-0200 GMT 11, 9, 7, 6 and 5Mc/s, 0200-0800 GMT 11 and 9Mc/s.

South East Asia: During morning hours 25 and 21Mc/s, in the afternoon 21, 17 and 15Mc/s, evening hours up to 2200 GMT 15, 11, 9 and 7Mc/s, 2200-0800 GMT 15 and 11Mc/s.

North East Asia: 0800-1400 GMT 21, 17 and 15Mc/s are the only bands open, 1400-1600 GMT 17, 15 and 11Mc/s 1600-2400 GMT 15, 11 and 9Mc/s, 2400-0400 GMT 11Mc/s only, 0400-0800 GMT 15 and 11Mc/s.

Australia via Asia: 0800-1200 GMT listen on 25 and 21Mc/s, 1200-1600 GMT 21, 17 and 15Mc/s, 1600-2000, GMT 15, 11, 9 and after 1800 GMT 7Mc/s, 2200-2400 on 11Mc/s only, 2400-0800 GMT this circuit is closed most nights, but signals may come through on 15Mc/s.

South America (North of the Amazon): From 1200-2000 GMT 25, 21Mc/s after 1800 GMT 17Mc/s as well, 2000-2200 GMT 21, 17, 15 and 11Mc/s, 2200-0400 GMT 17, 15, 11 and 9Mc/s, 0400-0800 GMT 15, 11 and 9Mc/s, 0800-1200 17 and 15Mc/s.

North America: During mornings on 17 and 15Mc/s, after 1200 GMT 25, 21 and 17Mc/s, evenings 17, 15 and 11Mc/s, night hours and early mornings on 15, 11 and 9Mc/s.

Those were the propagation conditions for April, listing the various shortwave bands which are "open" to different parts of the world.

ASIA

Rep. of Korea: *The Voice of Free Korea* has now the following schedule for its English programmes all over 50kW transmitters, 0500-0530 on 9,640 General Service to Asia, 0600-0700 on 15,130 to North America, 0800-0830 on 9,640 and 6,035 to South East Asia 1030-1100 on 9,640 General Service to Asia, 1430-1500 on 15,430 to South East Asia, 2100-2130 on 9,640 General Service of Asia, 0300-0400 on 15,430 to North America. The only transmission to Europe from *The Voice of Free Korea* is one in French from 0700-0730 on 15,130.

Thailand: *R. Thailand* is now using a 100kW transmitter on 11,910 at following times: 0415 0515 to North America in English; 0530-0600 to Europe in French; 0930-1020 to Far East in Thai, Vietnamese and Cambodian; 1025-1157 to Asia in English, Malay and Kuoyu; 1300-1400 to S.E. Asia in Thai.

EUROPE

Federal Republic Germany: *The Voice of Germany* is now as follows for its English Services transmitted from Jülich. 0300-0340 to South Asia on 11,945 and 9,640; 0445-0545 on 11,945 and 9,640 to West North America; 0600-0630 on 17,845 15,275 and 11,785 to Africa; 0845-0940 on 21,650, 17,845 and 15,275 to Far East, Australia and New Zealand; 1045-1100 on 21,560, 17,875 and 15,275 to Africa; 1045-1055 on 11,905 and 9,605 to North America; 1550-1620 on 17,875 and 15,275 to South Asia; 1900-1910 on 17,790 and 15,405 to North America; 2110-2200 on 9,765 and 7,290 to East Asia and Australia; 2145-2205 on 15,275 and 11,925 to Africa; 0130-0250 on 11,945 and 9,640 to East North America.

Norway: *R. Norway* transmits daily in Norwegian and on Sundays the last 30 minutes of each transmission is in English, 0700-0830 on 25,900, 25,730, 21,730, 21,655 and 15,175; 1100-1230 on 25,900, 25,730, 21,730, 21,655 and 7,240; 1300-1430 on 25,900, 25,730, 21,730, 21,655 and 17,825; 1500-1630 same as at 1300-1430; 1700-1830 on 25,900, 25,730, 21,730, 21,655 and 15,175; 1900-2030 on 25,730, 21,730, 21,655, 17,825 and 15,175; 2100-2230 on 21,730, 21,655, 17,825 and 15,175; 2300-0030 on 15,345, 15,175 and 11,850; 0300-0430 on 11,860, 11,850 and 9,610.

AFRICA

South Africa: *R.R.S.A.* has altered the frequencies for the following English transmissions, now as follows; weekdays only 0415-0427 11,900 and 9,525; 0430-0442 11,900 and 9,525; 0500-0512 7,270 and 5,980; 0515-0527 15,220 and 11,900. Daily 1700-1750 21,535 and 17,805; to North America from 2326-0020 on 15,220 and 11,875; 0026-0320 on 11,875 and 9,705.

Many thanks for the *Radio R.S.A.* schedule to Mr. A. J. Jenkins, and items for the July issue please send them in by April 20th, 73's and good listening.

THE AMATEUR BANDS by DAVID GIBSON, G3JDG

A DEFINITE stirring down in the r.f. forest this past month. The sunspots are perking nicely and all the little peaks on those propagation prediction charts are getting better and better. All six bands from 1·8 to 30Mc/s are buzzing and, if trends continue, it could well be a bumper year for DX. There should be something somewhere on one of the bands whatever time you listen at present.

Derek Pearson (Worcs), proves that you don't have to be rich to qualify as an s.w.l. His set cost one shilling at a jumble sale but he has already logged VE3, VE6, YV4 and 3V8 on 14Mc/s.

SEVEN AND DOWN

F. McVerry (Lanarkshire), 7 valve s'het, 40ft., indoor antenna heard these on 160 metres c.w.—EI9J, GM3OXX, GI3OQR, GW3FSP, HB9TTH, OK1AHZ, OK1KP, OK2BKW, OK2RZ, PAØPN. On 3·5Mc/s s.s.b. his best were—CN8AW, EP2GI, HA2KRB, K2RBT, W1HKK, W1FZJ/KP4, 5Z4KL, 7XØAH, YU2HDE. On 7·0Mc/s c.w.—CT1MU, EA8UC, HB9AHC, HK7XI, IT1AGA, K2OTC, K3JH, PY7ARW, SL3AW, UA6KLA, UA9BN, VO2AW, WB4CIB, and on s.s.b.—EA4DO, ET3FMA, HC2AM, LX1BW, YV4UA.

M. Higgins (Sussex), 19 set, 132ft., l.w., bagged goodies on forty—CT1LN, F5TA, XE1CCW, ZL1HEO, ZL2BCG, 8P6BH.

J. East (Worcs), R1475, dipole, reckons 8 a.m. for the Pacific and evenings for Africa and S. America. He also informs that the 8P6 callsign is a new one for VP6 (Barbados). On 80 s.s.b.—CN8AW, CT1JH, K3UZE, VE1—ADA, AFI, IE, PL, UG, VE2XO, VE3ALX, VO1GL, VP2AA, WB2YFY/MM, ZB2A, ZB2AP/MM, ZC4MO, ZC4RB, 4U1ITU, 7XØAH. While on 40 s.s.b.—CM2DC, CR6AD, CT1LN, EA3JE, ET3FMA, HB9RC/P/HP1 (in Panama City), IS1EP, IT1LTF, W1FZJ/P/KP4, PY2AST, UB5KAW, W3ZKH/P/3, WB4CPW, ZS1JA, ZS1NR, 4U1ITU.

R. Miller (Essex), SR150, 30ft. l.w. plus an a.t.u. (good lad), logged these on 80 s.s.b.—CT1LN, CT2AA, F2RD, HB9MQ, ON5EL, OY7S, OY4OV, OZ6AE, SL3ZV, TF2PL, TI2NA, VE1— AX, APZ, IE, VO1CE, W1FZJ/KP4, W2LX, W4BVV, W8MMC, W9ARV, YV1PW, YV2GK, ZB2A, ZC4MO, ZD3F, 3A2MJC, 4X4WN, 7XØAH, plus one query—OR9SN.

FOURTEEN AND UP

K. Weston (Wales) has been an s.w.l. since Santa unobtrusively popped a Trio 9R59 in his sock. He reports hoards of W's invading 28Mc/s.

H. E. Thornton (Surrey) started radio in the 1920s with an Experimental *Receiving* licence (not easy to get). With his "Portable One" he was permitted to " . . . conduct experiments in the open air but not within two miles of a Government Station". His latest receiver to date is an Eddystone 940 complete with 100ft. l.w. On twenty he reports sigs. from—CR4AJ, KP4DCP, LU7DH, PY2ALE, TF2WKW, ZL4BX. On ten metres—CO2HQ, PJ2CQ, UN1CP, UA3AYN, VE1ATV, ZS1BV, 9J2WR. He also reports a regular sked between the Science Museum station GB2SM and ZD9BE on Tristan da Cunha.

R. Dinning (Ayrshire), HA-350, PR-30, dipole, heard s.s.b. emanating from—CN8AB, CR6IK, CR7JA, CT2AA, ET3REL, HS1AF, HS3DR, HV3SJ, KL7EBK, KR6BD, OD5BN, OX3YK, PZ1BD, PY7YN, TF2WKI, VE8RCS, VK2ON, VP8HZ, W6VPH, YV5CID, ZB2BM, ZL1AH, ZL4BX, 6Y5CB, 9Y4VT, W's 1-Ø.

M. Crawshaw (Lancs.), SR600 (triple conversion s'het), 80 metre dipole at 20ft. A peep at 28Mc/s revealed—CT3AO, EI5AL, F9CT, I1AIG, K3AFO, K8GLL, ON4VT, OZ1LO, VE1AKC, VE2AJV, VE3FWG, XE2BBO, ZE1BR, ZS1BV, ZS6OI all a.m. and on s.s.b.—CP1LN, CT1BH, DJ5RR, K1CTQ, OE5ARL, SV1AB, VE2LY.

P. Pollak (S.W.15), 840A plus Q multiplier, 60ft. end fed, states the case for twenty metres in no uncertain terms with—CE3ZN, CE6FK, CN8GE, CR4AJ, CR6GQ, CR7IC, CT2AA, ET3ZU, HI5BK, HKØBKW, HK3BLF, HK4PX, HS1AF (Thailand), JA1HMJ, KL7GDS, KP4BKF, KR6KN, LU5AQ, OD5EJ, OY2H, PJ4AC, PZ1BW (Surinam), TG5HC, TI2JCC, VE4SA, VE7AAF, VE8IY, VK1PI, VK2BK, VK3HW, VK4SD, VK6CF, VK7TR, VP2AA (Antigua), VP2GAI, VP8JD, W6HVN, W7HEU, XE1KV, XP1AA, ZD7KH, ZD9BE, ZL1AHD, ZL2KC, ZL3OY, ZL4BX, ZP3AB, ZS1JU, ZS2EV, 4X4RW, 5H3JL, 5N2AAS, 5Z4KL, 6W8DY, 6Y5RA, 7Q7BN, 7XØAH (Algeria), 9L1DW, 9Y4VT. All these on s.s.b. and a very neat log too.

M. Guest lives in Mousehole (so help me that's the address) . . . (thereby hangs a tail). Anyway, it's in Cornwall and he has a CR100 and almost has a dipole for ten metres. Logged on this band—CR6QK, CX2CO, CX2BR, CX6BA, K2DPA, K9PPX, OA1MKA, OA7RP, OX3KM, VK6TXI, WØBQL, W8CIQ, W9IUO, YV1WX, ZS1FH, 5N2LF, 9G1KM, 9G1FF, 9H1BA, 9J2DT, all on s.s.b.

M. Pasek (Notts.), HRO, 150ft. l.w., logged these on ten—CR4BC, CT3AH, UV3ACI, UW1DB, VK2OXB, VK3DL, VK3AGX, VK4PJ, VK5XV, VK5NY, ZE2JA, 9J2BC.

J. Preece (Cheshire), PCR3 modified as per P.W., Jan. 1968, accuses me of having printed his logs twice before. Guilty Sir! and just to prove there's no hard feeling, here's what you heard on twenty s.s.b.—CN8GE, CR6AR, CR7CR, LA9TI/MM (17°S 4°E—go on, look it up), LU5AQ, LX1AJ, OZ9DX, PY4ATG, PY7CP, TR8AJY, UA9KDL, UT5KTH, VE3AA, VK3SK, YV4QG, ZC4MO, 5Z4KL, 6Y5GB. Also reported—7P8AB located at Maseru in Basutoland.

COMPOTE DE CONTEST

Are you sitting comfortably? Then I'll begin—6th—7th April, one I haven't heard of before but it's down as c.w. only from 3·5 to 30Mc/s; 20th—21st, 4 metre contest; 27th—28th, VERON—all bands—every man for himself; 4th—5th May, 70 and 20cms. contest; 4th—5th May, another 3·5 to 28Mc/s c.w. special.

YOUR ? QUESTIONS ANSWERED

Interference

In my living-room I have a fluorescent light which gives interference on high frequencies, especially 2 to 4Mc/s. Can you suggest what and how I can fit something to this light to suppress this interference?—P. McKay (Leeds).

First, check the contacts at the ends of the tube to make sure that they are clean and making good contact with the holders. Then try rotating the tube through 180deg., and reversing it end for end. Renew the suppressor capacitor, using one of, identical ratings. Earth the metalwork of the fitting and if possible, feed the unit via metal-clad cable with the cladding earthed. Suitable cable is M.I.C.C. but you will need an electrician to install it unless you know how to do it.

Also, buy two 5nF (0·005μF) capacitors 500V a.c. working and connect them in series. Connect this combination across the tube. In fitting, connect a capacitor of 0·1μF 500V a.c. working across the mains supply cable. Connect two 0·5μF 500V a.c. capacitors in series across the mains cable, wiring the junction of these components to earth i.e., to the frame of the unit which will be earthed as above.

Rechargeable Cells

I would be obliged if you could tell me where I can obtain a charging set for mercury cells RM640 and E640.—E. Stuart (Edinburgh).

It is not possible to recharge cells of the mercury type since these are primary cells and not secondary cells. The only type of cell which looks rather like a mercury cell and which can be recharged is the nickel-cadmium cell.

Pulse Counter

With reference to the pulse counting f.m. circuit in the February, 1967, issue of P.W., and to one published a couple of years ago, I would like to know if either is suitable for use with a standard multiplex decoder. Also if the bandwidth of any pulse counting detector is sufficient, does it need a special decoder?—D. Webb (London, N.W.9).

A pulse-counting descriminator is not really suitable for use with a Multiplex decoder. There are several reasons for this, the main one being the use of a low i.f. in the receiver. If you wish to obtain really good results from stereo programmes, we would suggest you make a small tuner of a more conventional type especially for this type of reception.

Radio Teletype

On a visit to the last R.S.G.B. exhibition I noticed an exhibit by a teleprinting society.

Can you tell me if there is a society for radio teletype (R.T.T.Y.) enthusiasts, and the name and address of the secretary?—H. Beaumont (Margate).

Yes, there is a very active society, the name and address to write to is as follows: British Amateur Radio Teletype Group, D. J. Goacher, G3LLZ, 51, Norman Road, Swindon, Wilts.

Speaker Impedances

Is there any way of finding the impedance of speech coils in loudspeakers? I have two unmarked speakers but only a voltmeter for making tests.—T. Cropper (Middleton).

Loudspeakers normally have impedances of 3, 7 or 15Ω. These impedances are measured at 1kc/s. To find the impedances of a loudspeaker, the simple way (although it is approximate) is to measure the d.c. resistance of the speech coil. The d.c. resistances of speech coils of 2, 5 and 10Ω will correspond to impedances of 3, 7 and 15Ω respectively.

Short Wave Conversions

Could you please say whether there is a simple way to convert an existing receiver for short wave reception?—L. Ballard (Reading, Berkshire).

It is possible to convert short wave signals to a frequency on the medium waves in order to receive them on a normal receiver. A suitable converter for this purpose was described in our "Keybook" entitled "More Simple Radio Circuits" which you can obtain for 3s. 6d. from your local bookseller.

Transmitting Licence

I am keen to own and operate my own transmitting station. I understand that I will need a special licence. Can you tell me how I get a licence and what is involved?—E. Ledger (St. Albans).

We suggest that you write to Radio Service Branch, GPO Headquarters Buildings, St. Martin's le Grande, London, E.C.1, and ask for a free copy of their pamphlet "How to become a Radio Amateur".

Interference Suppression

Could you please let me have any information on any publication or literature regarding the suppression of electrical interference to a car radio from a car engine?—H. Wilkinson (Willington, Derby).

We suggest that you incorporate the following suppression measures in your car: 0·5μF from D terminal of dynamo to chassis; 0·5μF from D terminal of regulator to chassis; 2μF from B terminal of regulator; 2μF from outer terminal of coil; 0·5μF from "live" side of any interfering accessory such as clock etc.; 5kΩ cut-lead suppressors at each end of each plug lead; 5kΩ cut-lead suppressor at distributor-end of lead to centre of distributor; special non-capacitive filter in F lead of regulator. You can obtain all of these components from garages and radio component stockists.

If when driving along, you switch off the ignition, and the interference continues, it may be due to static electricity. If so, paint rubber conducting-paint on the walls of the tyres (the walls not visible from the road) and use a conducting grease such as a graphite-based type in the wheel bearings.

Earthing

I have just installed a shortwave receiver and I have been told that I should take the earth lead to one of the metal pipes in the house which will be a better earth. Is this in order please?—F. J. McDonald (Walsall, Staffs.)

We strongly advise against earthing any electrical apparatus to metal pipes in the house. Many water pipes are now of the plastic variety outside the building and thus would be a poor earth. On no account should a metal gas supply pipe be used as an earth.

TRANSISTOR STEREO 8+8

A really first-class Hi Fi Stereo Amplifier Kit. Uses 14 transistors giving 8 watts push-pull output per channel (16W mono). Integrated pre-amp with Bass, Treble and Volume controls. Suitable for use with Ceramic or Crystal cartridges. Output stage for any speakers from 3 to 15 ohms. Compact design, all parts supplied including drilled metal work, Cir-Kit board, attractive front panel, knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of.
Brief Specification: Freq. response ±3dB 20–20,000 c/s. Bass boost approx. to +12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 25V at ·6 amp.

PRICES

Amplifier Kit	£9 10 0	P. & P. 4/6
Built & Tested	£12 10 0	P. & P. 4/6
Power Pack Kit	£2 10 0	P. & P. 4/-
Built & Tested	£3 0 0	P. & P. 4/-
Cabinet (as illus.)	£2 10 0	P. & P. 4/-

(Special offer—£14.10.0 post free if all above ordered at same time or built and tested for £18.0.0. post free.)

Circuit diagram, construction details and parts list (free with kit) 1/6 (S.A.E.)

QUALITY RECORD PLAYER AMPLIFIER

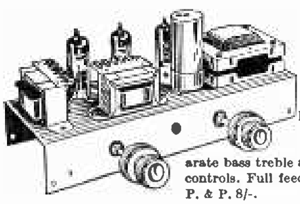
A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves. Separate Bass Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w. x 3in. d. x 6in. h. Ready built and tested. **PRICE 75/-.** P. & P. 6/-.
ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. **PRICE 97/6.** P. & P. 7/6.

DE-LUXE QUALITY PORTABLE RECORD PLAYER CABINET

Uncut motor board size 14¼ x 12in. Clearance 2in. below, 5½in. above. Will take above amplifier and any B.S.R. or Garrard Autochanger or Single Player Unit (except AT60 and SP25). Size 18 x 15 x 8in. Price **£3.9.6.** Carr. 9/6.

STEREO AMPLIFIER

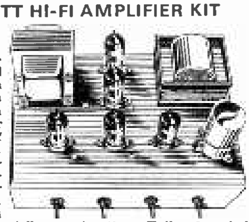
Incorporating 2 ECL86s and 1 EZ80, heavy duty, double wound mains transformer. Output 4 watts per channel. Full tone and volume controls. Absolutely complete.



ONLY £5.9.6 P. & P. 8/-

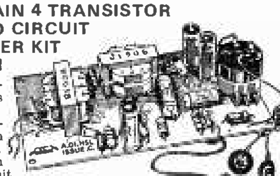
Super De-luxe version with ECL86 valves separate bass treble and balance controls. Full feedback 8gns. P. & P. 8/-.

10/14 WATT HI-FI AMPLIFIER KIT



A Stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 1/6 (Free with parts). **All parts sold separately.** ONLY **£7.9.6.** P. & P. 8/6. **Also available ready built and tested complete with std. input sockets. £9.5.0.** P. & P. 8/6.

HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1



● Peak output in excess of 1½ watts.
● All standard British components.
● Built on printed circuit panel, size 6 x 3in.
● General size Driver and Output Transformers.
● Output transformer tapped for 3 ohm and 15 ohm speakers. ● Transistors GET 114 or 81 Mullard OC81D and matched pair of OC81 o/p. ● 9 volt operation.
● Everything supplied, wire battery clips, solder, etc.
● Comprehensive easy to follow instructions and circuit diagram 1/6. (Free with Kit). All parts sold separately.
SPECIAL PRICE 45/-. P. & P. 3/-.
Also ready built and tested, **52/6.** P. & P. 3/-.
A pair of TA1s are ideal for stereo.

BRAND NEW TRANSISTOR BARGAINS

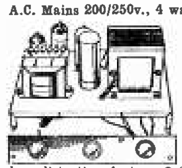
GET 15 (Matched Pair) **15/-**; V15/10p, **10/-**; OC71 **5/-**; OC76 **6/-**; AF117 **7/6.**
Set of Mullard 6 transistors OC44, 2—OC45 OC81D matched pair OC81 **25/-**, ORP12 Cadmium Sulphide Cell **10/6.** All post free.

3-VALVE AUDIO AMPLIFIER HA34

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in. w. x 4in. d. x 4¾in. h. Incorporates ECC83 EL34, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£4.5.0.** P. & P. 6/-.

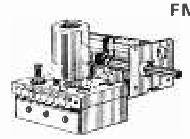
HSL 'FOUR' AMPLIFIER KIT

A.C. Mains 200/250v., 4 watt, using ECC83, EL84, EZ80 valves.



● Heavy duty double-wound mains transformer with electrostatic screen. ● Separate Bass, Treble and Volume controls, giving fully variable boost and cut with minimum insertion loss. ● Heavy negative feedback loop over 2 stages ensures high output at excellent quality with very low distortion factor. ● Suitable for use with guitar, microphone or record player. ● Provision for remote mounting of controls or direct on chassis. ● Chassis size only 7½in. wide x 4in. deep. Overall height 4¾in. ● All components and valves are brand new. ● Very clear and concise instructions enable even the inexperienced amateur to construct with 100% success. ● Supplied complete with valves output transformer (3 ohm only), screened lead, wire, nuts, bolts, solder, etc. (No extras to buy).
PRICE 79/6. P. & P. 6/-.
Comprehensive circuit diagram, practical layout and parts list 2/6 (free with kit).
This kit although similar in appearance to HA34 employs entirely different and advanced circuitry.

FM/AM TUNER HEAD



Beautifully designed and precision engineered by Dormer and Wadsworth Ltd. Supplied ready fitted with twin ·0005 tuning condenser for AM connection. Prealigned FM section covers 86–102 Mc/s. I.F. output 10·7 Mc/s. Complete with ECC85 (6L12) valve and full circuits diagram of tuner head. Another special bulk purchase enables us to offer these at **27/6** each. P. & P. 3/-.

MATCHED PAIR AM/FM I.F.'s

Comprising 1st I.F. and 2nd I.F. discriminator (465kc/s /10·7Mc/s). Size 1 x 1¼ x 2½in. high. Will match above tuner head. **11/-** pair. P. & P. 2/-.

GORLER F.M. TUNER HEAD

88–100 Mc/s, 10·7 Mc/s. I.F. **15/-** plus 2/6 P. & P. (ECC85 valves **8/6** extra).

NEON A.C. MAINS INDICATOR. For panel mounting, cut out size 1⅛ x ⅝ x ¾in. deep inc. terminal. White case with lens giving brighter light. For mains 200/250v. **2/6** each. P. & P. 6d (6 or more post free).

TWIN TELESCOPIC AERIAL

Comprising two 3-section heavily chromed rods. Closed 12in. each extending to 32in. Completely adjustable from vertical to horizontal. Supplied complete with universal mounting bracket, coax lead and plug. Suitable for F.M. or TV. **12/6.** P. & P. 2/6.

VIBRATORS. Large selection of 2, 4, 6, 12, 24 and 32 volt. Non sync **8/6**; Sync **10/-.** P. & P. 1/6 per vibrator. S.A.E. with all enquiries.

S.T.C. SILICON AVALANCHE HALF-WAVE RECTIFIERS

Type RAS. 508 AF. 6 amps. 960 P.I.V. 1in. long x ¼in. dia. approx. List **50/-** OUR PRICE **8/6.** Post Free.

SPECIAL OFFER! PLESSEY TYPE 29 TWIN TUNING GANG. 400pF + 146pF. Fitted with trimmers and 5:1 integral slow motion. Suitable for nominal 470 kc/s I.F. Size approx. 2 x 1 x 1½in. Only **8/6.** P. & P. 2/6.

FEW ONLY! SIEMENS MINIATURE RELAYS, D.P.C.O. Gold-plated contacts. 6v. at 30mA. Size approx. 1¼ x ⅝ x 1⅜in. Only **15/-.** P. & P. 1/6.

4-SPEED PLAYER UNIT BARGAINS

Mains Models. All brand new in maker's original packing.

LATEST B.S.R. MODELS

TU/12 Single Player with mono Cart.	£3.9.6
GU7 Single Player with mono Cart.	£4.18.8
UA25 Changer with mono Cart.	£6.7.6

All plus Carriage and Packing 6/6.

LATEST GARRARD MODELS
ALL types available 1000, SP.25 3000, AT60, etc. Send S.A.E. for latest bargain prices!
See below for suitable stereo cartridge!

BRAND NEW CARTRIDGE BARGAIN

SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE with diamond stylus **50/-** or with sapphire stylus **40/-.** P. & P. 1/- each. Ideal for use with above units.

LATEST B.S.R. X3M MONO COMPATIBLE CARTRIDGE With turnover sapphire styli suitable for playing 78, EP, LP and Stereo records with mono equipment.
ONLY 22/6. P. & P. 1/6

BRAND NEW 3 OHM LOUDSPEAKERS

5in. **14/-**; 6½in. **18/6**; 8in. **27/-**; 7in. x 4in. **18/6**; 10in. x 6in. **27/6.**
E.M.I. 8in. x 5in. with high flux magnet, **21/-.**
E.M.I. 13½ x 8in. with high flux ceramic magnet, **42/-** (15 ohm **45/-**). P. & P. 5in. 2/-. 6½ & 8in. 2/6, 10 & 12in. 3/6 per speaker.

35 OHM SPEAKERS

3½in. **12/6**; 7 x 4in. **21/-.** P. & P. 2/- per speaker.

E.M.I. 3½" HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3, 8 or 15 ohms, **15/-.** P. & P. 2/6.
BRAND NEW HEAVY DUTY 12in. SPEAKERS. Response 45 c/s—13 Kc/s. 1½in. voice coil. Available in 3 or 15 ohms. Guaranteed full 15 watts British rating. Heavy cast aluminium frame. These are current production by world famous maker and as they are offered well below list price we are not permitted to disclose the name. LIMITED NUMBER ONLY. UNREPEATABLE at **89/6.** P. & P. 5/-. Also 25 watt Guitar Model available at **£5.5.0.** And 35 watt Guitar Model **£8.8.0.**

12 in. 'RA' TWIN CONE LOUDSPEAKER

10 watts peak output. 3 or 15 ohm. **35/-** P. & P. 3/6

VYNAIR AND REXINE SPEAKER AND CABINET FABRICS. Approx. 54in. wide. Usually 35/- yard. Our PRICE **13/6** per yard length. P. & P. 2/6 (min. one yd.). S.A.E. for samples.

LATEST COLLARO MAGNAVOX 363 STEREO TAPE DECK. Three speeds, 4 track, takes up to 7in. spools, **£12.10.0.** Plus 7/6 Carr. & Ins. (Tapes extra).
B.S.R. TD2. 4-TRACK STEREO TAPE DECK, 9 Gns. Carr. & Ins. 7/6.
QUALITY PORTABLE TAPE RECORDER CASE. Brand new. Beautifully made. Only **49/6.** P. & P. 8/6.
Dual Purpose Bulk Tape Eraser and Tape Head Demagnetiser 35/-. P. & P. 3/-.
ACOS CRYSTAL MIKES. High imp. for desk or hand use. High sensitivity. **18/6.** P. & P. 1/6.
ACOS HIGH IMPEDANCE CRYSTAL STICK MIKES. Listed at 42/-. OUR PRICE **21/-.** P. & P. 1/6.

SPECIAL OFFER! MOVING COIL STICK MIKE. Fitted on/off switch for remote control. High quality. High or low impedance. (State imp. required.) BARGAIN PRICE 30/- P. & P. 2/6.

MAINS TRANSFORMER. For transistor power supplies. Tapped pri. 200-250v. Sec. 40-0-40 at 1 amp. (with electrostatic screen) and 6·3v. at ·5 amp. for dial lamps etc. Drop thro mounting. Stack size 1½ x 3½ x 3½in. **27/6.** P. & P. 4/6.
MAINS TRANSFORMER. For Transistor power supplies. Pri. 200/240v. Sec. 9-0-9v. at 500mA, **11/-.** P. & P. 2/6. Pri. 200/240v. Sec. 12-0-12 at 1amp. **14/6.** P. & P. 2/6.
MATCHED PAIR OF 2½ WATT TRANSISTOR DRIVER AND OUTPUT TRANSFORMERS. Stack size 1¼ x 1¼ x ⅞in. Output trans. tapped for 3 ohms and 15 ohm output. **10/-** pair, plus 2/- P. & P.
7-10 watt OUTPUT TRANSFORMERS to match pair of ECL86's in push-pull to 3 ohm output. ONLY **11/-.** P. & P. 2/6.
PARMEKO 7-10 watt OUTPUT TRANSFORMERS to match pair of ECL82's in push-pull. Secondary tapped 3·75, 7·5 and 15 ohm. Stock size approx. 2½ x 1 x 2in. high. ONLY **12/-.** P. & P 3/-.
10-12 watt OUTPUT TRANSFORMERS. Size 2½ x 2in. Clamp fitting. For two EL84's in push-pull. State 3 or 15 ohm impedance. **12/6.** P. & P. 2/6.

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A few minutes from South Wimbledon Tube Station

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THE 'CLUBMAN'

J. THORNTON-LAWRENCE GW3JGA

continued from the April issue

THE Clubman Mk IV is a further development of the Mk III version, previously described and includes an output stage with built-in loudspeaker. The complete circuit is shown in Fig. 30.

The Output Stage

This stage consists of a single transistor, Tr9, operating in class A and providing approximately 30 milliwatts of audio power to a 2½in. loudspeaker mounted at the left-hand side of the cabinet.

The input to Tr9 is taken from the headphone jack socket J1 and may be replaced with a closed circuit type, if preferred, so that the output stage is disconnected when the headphone jack is inserted, as shown in Fig. 30. With the jack plug removed, input signals are passed to Tr9 base and amplified a.f. signals appearing in the collector circuit are passed through T1 to the loudspeaker. D.C. biasing of Tr9 base is provided by the potential divider R29 and R30, the emitter stabilising resistor is R31. C25 provides extra decoupling of the −9 volt supply.

Two forms of negative feedback are incorporated in the output stage to improve the quality of reproduction. Negative series current feedback is provided by omitting the usual by-pass capacitor across R31, in this way the output signal current develops a signal voltage across R31 and this voltage appears in phase and in series with the input signal. Negative shunt voltage feedback is provided by connecting R29 to the collector of Tr9 instead of to the −9 volt line. The a.f. voltage across the primary of T1 produces an a.f. current through R29 and this is out of phase and in shunt with the input signal.

The output stage is constructed on a small Veroboard panel which is fixed to the chassis by a bracket, identical to those used for fixing the i.f./a.f. panel in the Mk II receiver. The Veroboard panel is 2⅛ x 1¼in. and the layout of components is shown in Fig. 31. To fix T1 to the panel, it is necessary to make a slot between two pairs of holes, so that the mounting tags on the transformer may be passed through the slots and bent over on the reverse side of the panel.

The output stage panel is fixed near to the b.f.o. box, as shown in Fig. 33. The three connecting leads may be connected as follows, chassis to J1 earth, J1 to J1 live and −9V to S2.2.

Loudspeaker Mounting

The loudspeaker is mounted at the left-hand side of the chassis near to the output stage as shown in Fig. 33. It is necessary to make a clearance hole in the chassis, to allow the loudspeaker to sink through, until the magnet is resting on the top of the chassis. With a little care, it is relatively easy to cut out the required shape using an Abrafile and finally finishing off the edge with a small flat file.

The vertical edge of the chassis is left intact and

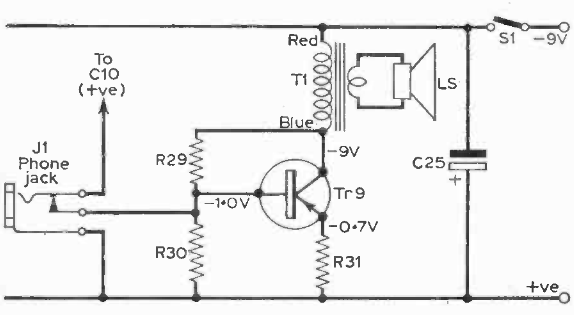


Fig. 30: Theoretical circuit of the output stage.

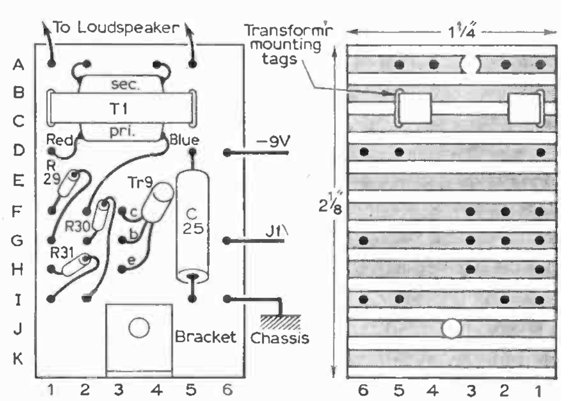
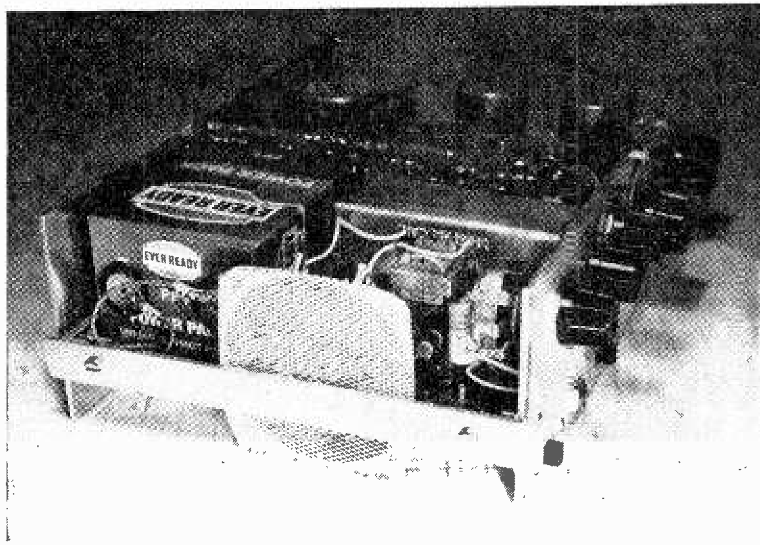


Fig. 31: Veroboard panel layout and connections.

appears across the front of the loudspeaker as shown in Fig. 32. The speaker is fixed to this edge using two clips, fixed with two countersunk 6BA screws and nuts. A piece of speaker fret material is fastened over the front of the speaker to complete the external appearance. Two wires connect the loudspeaker to the output stage panel. It is necessary to cut a $2\frac{3}{8}$in. diameter hole in the end of the cabinet to "let the sound out" and this is done partly in the top cover.

To mark out the hole, the covers should both be fitted normally to the receiver, the centre of the hole is marked, as shown in Fig. 32. A circle of $2\frac{3}{8}$in. diameter is then marked on the covers, using a pair of compasses or dividers. The covers are then removed and the



Photograph of the Mk. IV Clubman. A loudspeaker and output stage have been added.

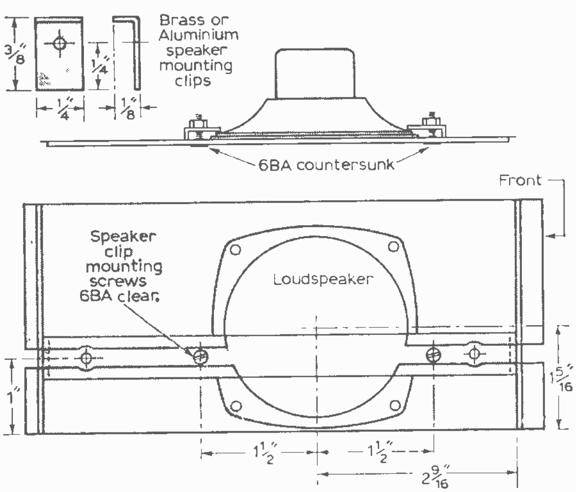


Fig. 32: Sketch showing method of mounting the loudspeaker.

★ components list

Resistors:
- R29 15kΩ carbon, ½W, 10%
- R30 2·2kΩ
- R31 100Ω

Capacitor:
- C25 100μF, 15V electrolytic

Transformer:
- T1 9·2:1 ratio T/T4 Radiospares

Semiconductor:
- Tr9 OC82

Loudspeaker:
- 2½in., 3Ω

Jack:
- J1 Jack (insulated) closed.

Veroboard:
- $2\frac{1}{8}$ x $1\frac{1}{4}$in. 0·2in. matrix

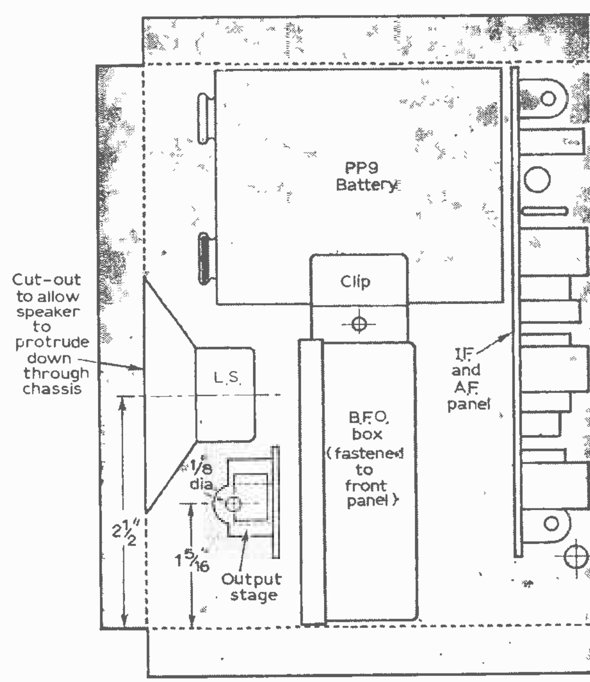


Fig. 33: Layout of the extra stage.

shapes cut away using an Abrafile. The edges should then be smoothed off using a fine half-round file.

Where the covers have previously been covered with plastic Contact or Fablon material, it will probably be necessary to re-cover them completely, as once the plastic material has been stuck to the metal for some time, it cannot easily be removed and re-fitted. Care should be taken to get a good finish when trimming the material around the speaker cut-outs.

This completes the Mk IV version of the Clubman.

TO BE CONTINUED

THE semiconductor diode

BARRY C. FRANCIS

KNOWLEDGE of semiconductors can be traced back as far as Michael Faraday who noticed the negative temperature coefficient of silver sulphide. But it was not until the second world war that the semiconducting properties of silicon and germanium were properly realised. Silicon and germanium occur in group IVB of the periodic table along with tin and carbon, and are similar in that they both possess four electrons in the outer, valence band of their atoms.

An atom consists of a centrally placed nucleus, positively charged, surrounded by negatively charged particles known as electrons. These electrons orbit the nucleus and although they exist in the space outside the latter they are not able to occupy just any old place. They are only permitted to rotate around the nucleus at certain discrete distances which correspond to certain energy levels. Thus to an isolated atom there is assigned a fixed number of energy levels at which its electrons can exist. But atoms do not exist in isolation, and as a result of this the picture is complicated by the fact that the electrons and energy patterns of adjacent atoms influence each other. This means that instead of an electron occupying an energy level associated only with its own nucleus, its energy level is modified

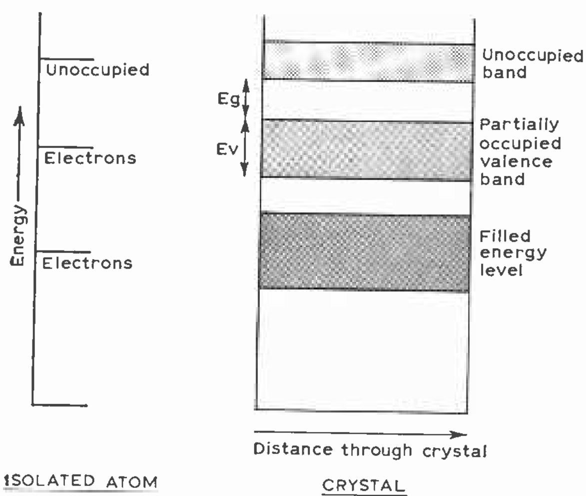


Fig. 1: Electron energy levels and bands.

by the presence of neighbouring atoms. The result of this is that an electron can occupy a band of energies (Fig. 1).

CRYSTAL STRUCTURE

Germanium is a crystalline material, which means that its atoms are arranged in a regular fashion throughout in a lattice-like structure. Each germanium atom has 32 electrons, of which four are valence electrons. These are the ones that are of importance because it is they that contribute to the electrical properties of a substance. The valence electrons form bonds with the valence electrons of adjacent atoms and it is these bonds that hold the lattice together. The valence electrons occupy the partially filled energy band shown in Fig. 1. Above this band is an energy gap where electrons cannot remain and a conduction band that they can enter if given sufficient energy to surmount the energy gap Eg, Fig. 1. The conduction band is an unoccupied band of energies into which electrons may pass. Obviously an electron at the top of the valence band requires an amount of energy equal to Eg to just scrape into the bottom of the conduction band, while an electron at the bottom of the valence band requires $(Eg + Ev)$ energy in order to scrape into the bottom of the conduction band.

On its own germanium is not a good conductor since in the pure substance (at absolute zero temperature) there are no free electrons available to produce a flow of current. If, however, an impurity that possesses either three or five valence electrons—remember germanium has four—is introduced into germanium during its preparation its conductivity is greatly improved. We must next see how this happens.

DONOR IMPURITY

Consider the situation when a pentavalent atom (i.e. one with five valence electrons) such as antimony has been added. Since the antimony atom has five valence electrons and only four can form valence bonds with the adjacent germanium atoms one is left "unpaired". This is free and can move about the lattice and thus contribute to conduction. One small point here: an atom with all its electrons present is electrically neutral, the charge on the positive nucleus being exactly balanced by the collective negative charge of the electrons. Thus if an electron leaves its parent atom the result is a positively charged atom since the charge on the positive nucleus is greater than the collective negative charge of its electrons. In the above case with antimony when the fifth valence electron leaves the atom it leaves behind a positively charged atom.

An impurity that contributes electrons to a semiconductor in this way is called a donor impurity, since it donates electrons, and because the electrical conduction thus made possible is by means of electrons the doped germanium is referred to as n-type, the n denoting the presence of negative carriers.

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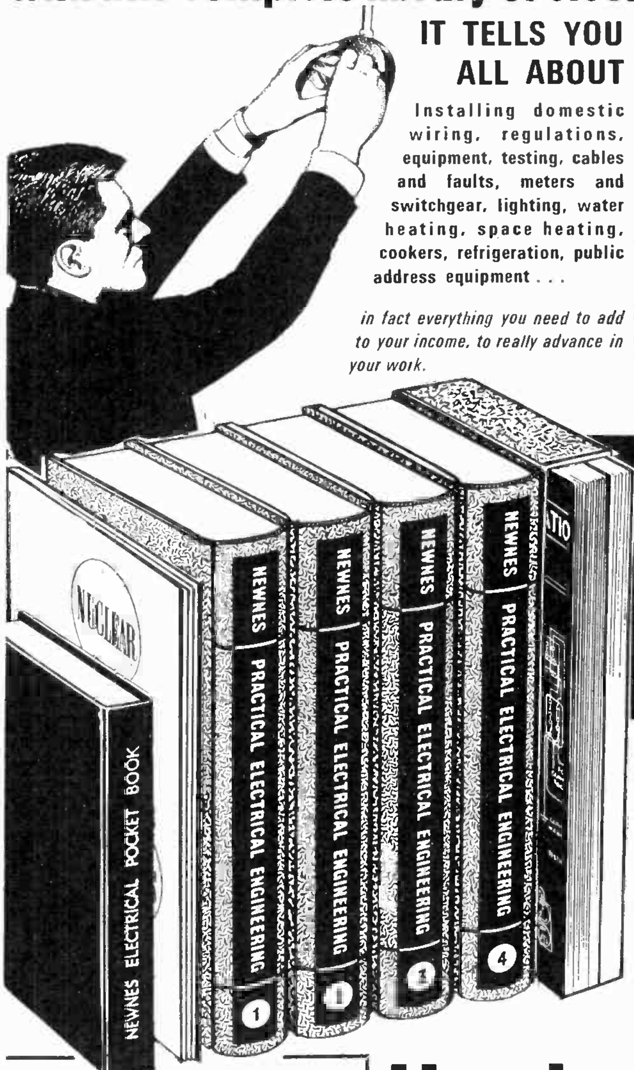

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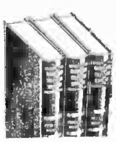

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UBF80	5/6
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UBL21	9/-
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UF41	7/-
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UF80	6/9
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UF89	5/6
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UL84	6/-
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UR1C	6/6
UU5	7/-
UU8	16/6
UY1N	10/3
UY21	9/-
UY41	6/6
UY85	5/6
U10	9/-
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GD16	4/-
GET102	4/9
GET103	4/-
GET105	18/-
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GET119	4/6
GET573	8/6
GET587	8/6
GET872	10/-
GET873	4/-
GET874	23/6
GET882	10/-
GET887	4/6
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M1	2/10
M3	2/10
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ACCEPTOR IMPURITY

An impurity material the atoms of which have three valence electrons will also increase the conductivity of semiconductor material if introduced into the crystal lattice structure. In this case, however, instead of there being a free electron as in the case of the n-material there appears a gap or *hole* in the crystal lattice structure since germanium atoms, having four valence electrons, form four valence bonds with adjoining atoms in a complete lattice. The hole thus introduced into the crystal lattice structure represents a positive charge—equal to the negative electrical charge which an electron carries—and in fact will attract to it any free electrons that happen to be present. For this reason a trivalent impurity material is termed an acceptor impurity—since it will accept an electron to complete its electron pairing with adjacent atoms in the crystal structure and, since the holes introduced by it represent a positive charge, semiconductor material doped with an acceptor impurity is called p-type semiconductor material.

EFFECT OF IMPURITIES

We must now relate these impurity introductions to the energy diagrams previously described. In the case of the donor impurity the spare electrons contributed have energies just below the conduction band. This means that with a small "push" (in this case a quantity of energy) they will move into the

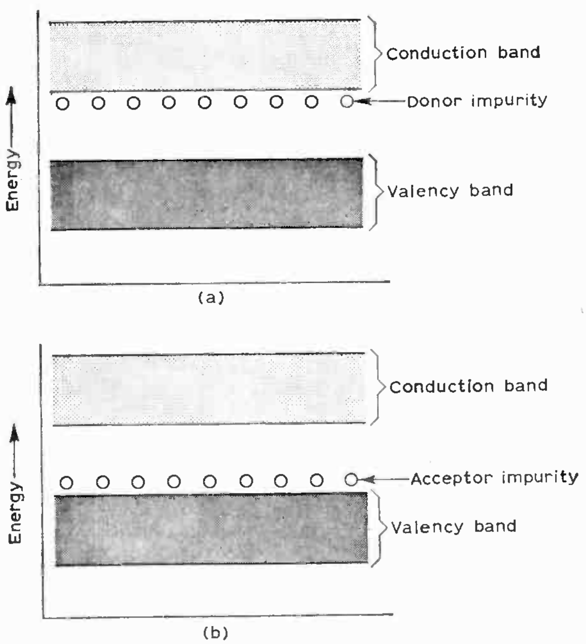


Fig. 2: Energy level diagrams for (a) donor and (b) acceptor impurities.

conduction band and be able to take part in electrical conduction (Fig. 2a). In the case of the alternative acceptor impurity the energy of the holes contributed lies just above the valency band (Fig. 2b). This means that electrons can be easily moved from the valency band into this level to take part in conduction.

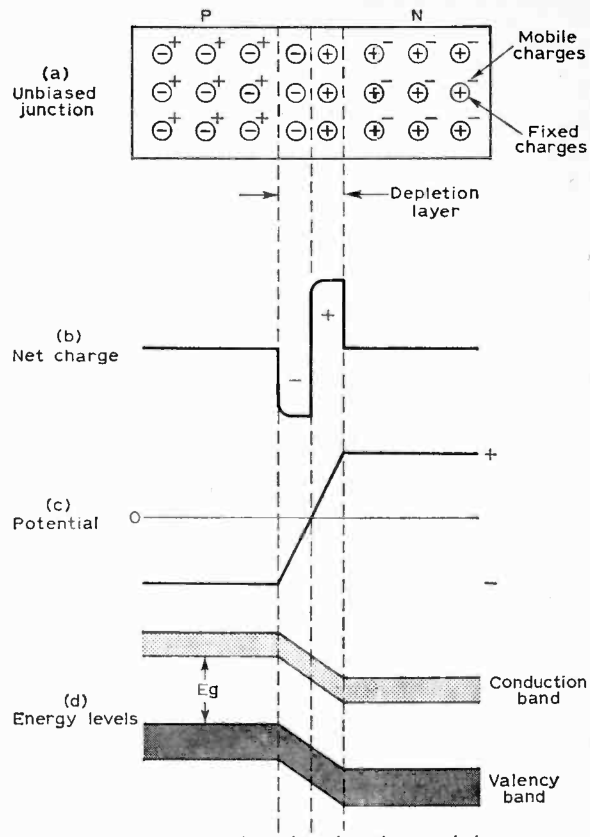


Fig. 3: Unbiased p-n junction characteristics.

THE P-N JUNCTION DIODE

A diode allows current to flow easily in one direction but not in the other. A semiconductor diode consists of two regions of oppositely doped germanium formed together (Fig. 3). In the p-region we have mobile positive carriers and stationary negative charge centres and in the n-region mobile negative carriers and stationary positive charge centres.

On forming the two regions mobile negative carriers from the n-region travel across the junction and combine with the positive holes in the p-region, while mobile positive carriers move in the other direction to combine with the electrons of the n-region.

This occurs in the region very close to the junction. As can be seen from Fig. 3a all the mobile charges in this region have been eliminated leaving only the fixed positive and negative charges associated with the donor and acceptor atoms. This region next to the junction containing only fixed positive and negative charges is called the depletion layer.

Thus the charge in the depletion layer on the p and n side is as shown in Fig. 3b falling to zero through the rest of the crystal. Fig 3c shows the potential throughout the crystal and it is this that is of importance when considering diode action. In the n-region the potential gradually rises to some positive

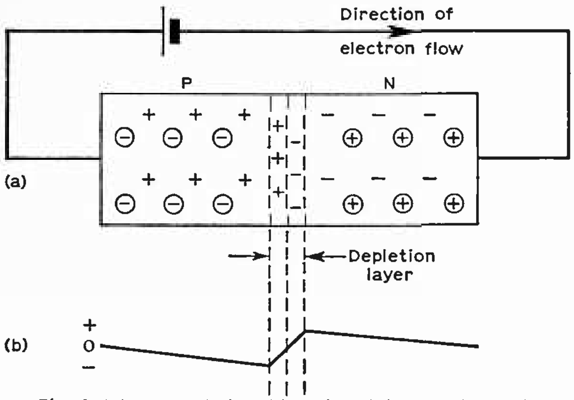


Fig. 4: (a) Forward biased junction. (b) Potential barrier.

value because of the positive charges in the depletion layer, but increases no further than the end of the depletion layer. In the p-region the reverse occurs and a negative potential is set up across this half of the depletion layer.

The energy diagram (Fig. 3d) is interesting: associated with both halves of the depletion layer are conduction and valency bands but these vary across the width of the depletion layer as shown. Notice that the energy gap Eg between conduction band and valency band remains constant. We must next consider the flow of electrons that occurs across the whole crystal if a potential difference is placed between opposite faces of the semiconductor, bearing in mind that (a) the crystal is neither an insulator nor a conductor and (b) a potential difference already exists between its ends (see Fig. 3c).

If the negative terminal of a battery is connected to the n side and the positive terminal to the p side and the voltage is sufficient it will reduce the potential barrier across the junction as shown in Fig. 4. In this case electrons will flow from the negative terminal of the battery via the semiconductor diode to the positive terminal with very little hindrance from the semiconductor. In this condition the diode is said to be forward biased and acts as a conductor. The application of the battery in this way drives the free electrons and holes nearer the junction, thus decreasing the size of the depletion layer and making easier the passage of current across the junction.

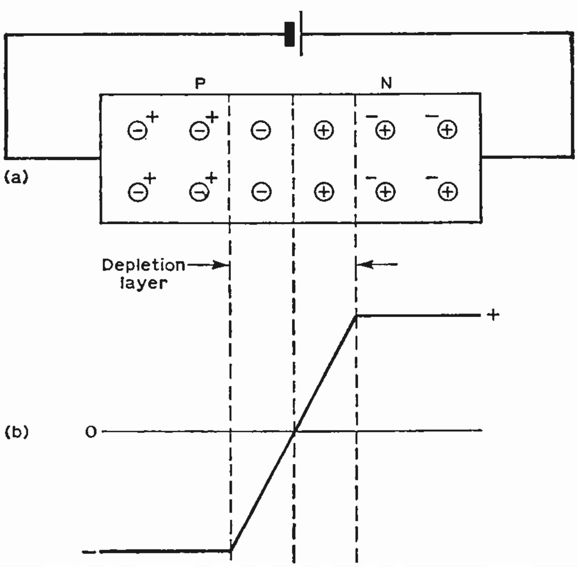


Fig. 5: (a) Reverse biased junction. (b) Potential barrier.

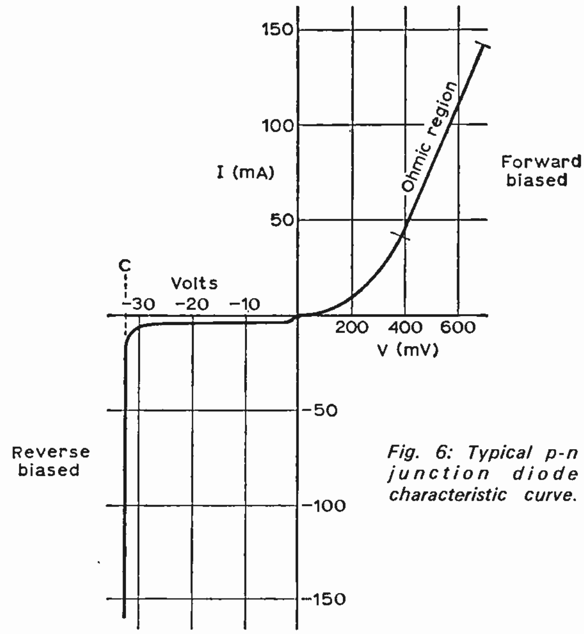


Fig. 6: Typical p-n junction diode characteristic curve.

If, however, the negative terminal of the battery is connected to the p-region and the positive terminal to the n-region, the situation will be reversed and the potential barrier increased as shown in Fig. 5. This means that before electrons can travel from the p to the n-region they have to acquire sufficient energy to surmount this considerable potential barrier and thus under normal conditions no flow of current occurs. The diode is said to be reverse biased, and acts as an insulator obstructing the flow of current.

Thus the diode is a conductor with the applied voltage in one direction and an insulator with the applied voltage in the other.

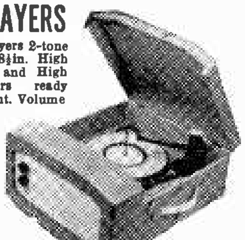
DIODE CHARACTERISTICS

A typical diode characteristic is shown in Fig. 6, and may be obtained by using the arrangement shown in Fig. 7. With switches A and B in the position shown the diode is forward biased, and in the other position the diode is reverse biased. The variable resistance is used to alter the voltage applied across the semiconductor diode, this being measured on the voltmeter. The corresponding current flowing through the diode is recorded on the ammeter.

Taking first the forward biased case shown in Fig. 6 we see that the relationship between voltage and current is initially curved so that only small increases in voltage are required to produce quite substantial changes in current. This curve is exponential in shape. In the reverse direction it can be seen that a very large voltage has to be applied before any appreciable current will flow, so that up to this point (C) the device can be said to act as an insulator. What happens beyond this point is known

—continued on page 57

DE LUXE PLAYERS



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TRIMMERS. Compression ceramic 30. 50, 70 pF., 9d.; 100 pF., 150 pF., 1/3; 250 pF., 1/6; 600 pF.. 750 pF., 1/9.

250v. RECTIFIERS. Selenium ½ wave 100mA 5/-; BY100 10/-.
CONTACT COOLED ½ wave 60mA 7/6; 85mA 9/6.
Full wave 75mA 10/-; 150mA 19/6; T.V. rects. from 10/-.

'SONOCOLOR' CINE RECORDING TAPE

5″ reel, 900′ LP with strobe markings also cine light deflector-mirror for synchronisation. Suitable all tape recorders and cine projectors. List 28/-.
OUR PRICE **14/-**

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60 min. Cassette C60 (For Philips, etc.) 17/6
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350-0-350- 80 mA. 6.3 v. 3.5 a, 6.3 v. 1 a, or 5 v. 2a	35/-
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H.R. HEADPHONES 2000 ohms Super Quality.... 35/-
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Three Wavebands: Long, Med., Short, Gram. Five Valves: ECH81, EF89, EBC8. EL84, EZ80. 12-month guarantee. A.C. 200-250 v. Ferrite Aerial 5 watts 3 ohm. Chassis 13½in. × 7in. × 5in. dial size 13in. × 4in. Two pilot Lamps. Four Knobs. Aligned calibrated. Chassis isolated from mains **£10.19**
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BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in. sides, 7 × 4in., 5/6; 9 × 7in., 6/6; 11 × 3in.. 6/6: 11 × 7in., 7/6; 13 × 9in.. 9/6; 14 × 11in., 12/6; 15 × 14in., 15/-.
ALUMINIUM PANELS 18 s.w.g. 12 × 12in., 6/6; 14 × 9in., 5/6; 12 × 8in., 4/6; 10 × 7in.. 3/6; 8 × 6in.. 2/6; 6 × 4in., 1/6.

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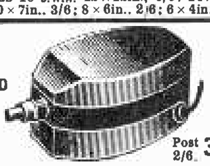

200/250 v. A.C. Leaflet S.A.E. Post 2/6 **35/-**

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¼ w. ½ w, 1 w, 20% 3d.; 1½ w. 8d.; 2 w. 1/-; ½ w. 10% 6d.
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10 watt 1/9
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WIRE-WOUND 3-WATT POTS. T.V. Type. Values 10 ohms to 30 K.. 3/3. Carbon 30 K, to 2 meg., 3/-.

WIRE-WOUND 4-WATT STANDARD SIZE POTS. LONG SPINDLE VALUES 50 OHMS to 100 K.. 7/6.

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SANGAMO 3 inch SCALE METERS 45/- ea.

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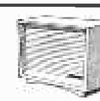

Black plastic cabinet, 20ft. lead and adaptors. For any radio, intercom, tape recorder, etc. 3 to 15 ohm. Size: 7½″ × 5½″ × 3″. POST 2/6 **30/-**

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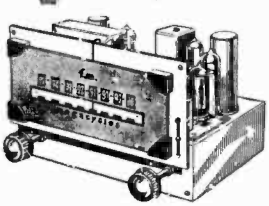
PEAK-SOUND 8+8W. TRANSISTOR STEREO AMPLIFIER IN KIT FORM

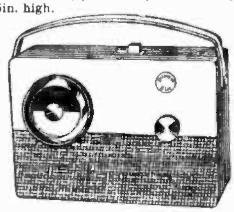
Build this for £9.10.0 (4/6 post). Power Pack Kit £2.10.0 (4/- post). Cabinet (see illustration) 50/- post paid or £14.10.0 the three items post paid. Parts List Booklet and full details 1/6 (free with kit). A.E.I. Circuit of 14 Transistors; 8W per Channel into 3 to 15 ohm Speaker. 50mV Input. Ceramic, Crystal Cartridge, Radio Tuner or Output from Tape Recorder may be used. 20 to 20,000 Hz ± 3dB. Neg. Feed Back 13dB. 12in. × 3in. high × 8in. Cabinet. Cir-Kit Board Construction Bass, Treble and Vol. Controls, for A.C. mains of 200-250V. Bass Cut and Lift; Treble Cut and Lift. Fully built £3 extra. Delivery by return post.



VHF/FM TUNER. 88–102MHz. Self-powered. Valves ECC85, EF89, 6BW7, ECC82, two diodes and metal rect. 8 x 6 x 5½in. high. Full instruction book, circuit diagrams, etc. 2/6; free with chassis. With front panel and brackets £7.19.6 tax paid and carr. paid. Can be supplied built for £8.17.6.

2 x 4 WATT STEREO AMPLIFIER. Printed circuit. Separate power pack. Metal rectifier. ECC83 and 2—EL84. Negative feedback. Vol., base, treble each channel. Muting switch and on/off. £5.10.0 (7/6 P. & P.).

8 WATT. PUSH-PULL OUTPUT AMPLIFIER, 200-250 Volts A.C. EZ80, ECC83, 2—EL84. Bass, treble, vol/on-off. £5.15.0 (7/6 P. & P.). Size 12 x 3½ x 5in. high.

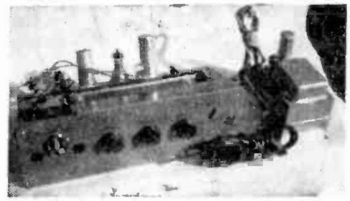


6 TRANSISTOR "SUPER SIX". M.W. and L.W. kit, £4 (5/- P. & P.). Wooden cabinet 11 x 7½ x 3½in. All parts may be purchased separately. 3½in. 10,000 line speaker, or 7 x 4in. 6000 line.

STEREO AMPLIFIER 2 x 3 watt

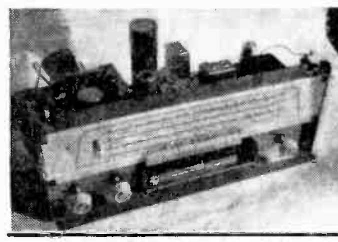
200-250v. A.C. Mains. EZ80 and 2 x ECL86. Vol., Tone, Balance controls. With o.p. Trans for 3 ohms. 9 x 3½in. (plus trans. 2in. extra) x 3½in. high. £6.17.6 (P. & P. 7/6 extra).
Three tone grey record player cabinet (by well known manufacturer) taking above amplifier, complete with two 6½in. speakers (one speaker in removable lid). Size 17½ x 15½ x 7½in. high. Takes Garrard 1000, 2000, 3000 autochangers. £4.17.6 (plus 7/6 carr.).
Complete Stereo Record Player using above equipment 18gns. carriage paid.

TAPE AMPLIFIER FOR MAGNAVOX TAPE DECKS — 2 or 4 TRACK



Chassis 12½ x 5½ x 4½in. high. Plastic front panel "gold" finish—12½ x 4½in. 200-250 A.C. Record/Playback amp. switch: Off/On-Tone; Vol./Mc.; Vol./Gram; Mic. Input; Gram. Input; Monitor; Speaker Socket. Valves 6BR7; 12AX7; EM84; EL84; 6X4. Separate power pack. Complete amp. and power pack. £8.17.6. (6/- P. & P.). Rexine covered cabinet (tan) 15½ x 17 x 9½in. high with sloping front for amp.; complete with two tweeter speakers, and special adapting brackets for Magnavox Deck 85/- (8/- carr.) 3 speed Magnavox 2-track tape deck £10.17.6; 4-track £12.15.0. Complete Recorders (with speed compensation) 2-track £29; 4-track £32 (carr. 25/-). Worth £10 more on normal retail prices.

6 PUSH-BUTTON STEREOGRAM CHASSIS



M.W.; S.W.1; S.W.2; V.H.F.; Gram; Stereo Gram. Two separate channels for Stereogram with balance control. Also operates with two speakers on Radio. Chassis size: 15 x 7 x 6½in. high. Dial silver and black 15 x 3in. 190-550M; 18-51M; 60-187M; VHF 86-100 Mc/s. Valves: ECC85, ECH81, EF89, 2 x ECL86, EM84 and Rect. Price £19.19.0. carr. paid or £6.13.0 deposit and 5 monthly payments of 56/6. Total H.P. price £20.15.6. Cream moulded escutcheon included.

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(2 mins. from Station and Buses). FULL GUARANTEE Aldershot 22240
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3 gns. each only, p/p 5/6

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1A7GT	7/6	12AT7	3/9	DH77	4/-	EF97	7/6	PCL85	8/3	UCC84	7/9
1H5GT	7/3	12AU6	4/9	DH81	12/6	EF183	6/6	PCL86	8/6	UCC85	6/6
1N5GT	7/9	12AU7	4/9	DK32	7/9	EF184	6/6	PENA4	6/9	UCF80	8/3
1R5	5/6	12AX7	4/9	DK91	5/6	EH90	6/6	PEN36C	15/-	UCH42	9/9
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1S5	3/9	20F2	10/6	DK96	7/-	EL34	9/6	PL36	9/6	UCL82	7/6
1T4	2/9	20L1	16/9	DL33	6/9	EL41	9/6	PL81	7/8	UCL83	9/3
3A5	8/6	20P1	11/9	DL35	5/-	EL84	4/9	PL82	6/6	UF41	10/6
3S4	4/9	20P3	14/9	DL92	4/9	EL90	5/-	PL83	7/-	UF80	7/-
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5Y3GT	5/9	30C15	11/6	DY87	5/9	EM81	6/9	PL820	15/-	UL84	6/6
5Z4G	7/6	30C17	12/6	EABC80	6/6	EM84	6/3	PX25	10/6	UY41	7/-
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6AL5	2/3	30F5	12/-	EB91	2/3	EY51	7/-	PY33	9/6	VP4B	10/6
6AM6	3/6	30FL1	12/6	EBC33	7/-	EY86	6/3	PY80	5/3	VP1321	21/-
6AQ5	4/9	30FL14	12/6	EBC41	8/-	EZ40	7/6	PY81	5/3	Z77	3/6
6AT6	4/-	30L1	6/-	EBF80	6/-	EZ41	7/6	PY82	5/-	Transistors	
6AU6	5/6	30L15	14/-	EBF89	5/9	EZ80	4/6	PY83	5/9	AC107	3/6
6BA6	4/6	30L17	13/-	EC90	2/9	EZ81	4/9	PY88	7/3	AD140	7/6
6BE6	4/3	30P4	12/-	ECC81	3/9	KT61	8/9	PY800	6/9	AF102	18/-
6BG6G	15/-	30P12	11/-	ECC82	4/9	KT81	15/-	PY801	6/9	AF115	3/-
6BJ6	6/9	30P19	12/-	ECC83	7/-	N78	14/9	R19	6/6	AF116	3/-
6F1	7/9	30PL1	12/6	ECC84	5/6	PC86	9/6	R20	12/9	AF117	3/3
6F13	3/6	30PL13	14/6	ECC85	4/9	PC88	9/6	TH21C	9/6	AF118	3/-
6F14	9/-	30PL14	14/6	ECF80	7/-	PC97	8/6	U25	11/6	AF124	7/6
6F23	12/6	35L6GT	8/-	ECF82	6/9	PC900	9/-	U26	11/6	AF125	7/6
6K7G	1/6	35W4	4/6	ECF86	9/-	PCC84	6/-	U47	13/6	AF126	7/-
6K8G	4/3	35Z4GT	5/-	ECH35	6/-	PCC89	10/6	U49	13/6	AF127	3/6
6L18	6/-	85A2	7/3	ECH42	10/-	PCC189	9/9	U52	4/6	OC26	5/-
6V6G	3/6	6063	12/6	ECH81	5/9	PCF80	7/-	U78	3/6	OC44	3/9
6V6GT	6/6	AZ31	9/-	ECH84	6/9	PCF82	6/-	U191	11/-	OC45	3/3
6X4	3/6	B36	4/9	ECL80	6/9	PCF86	9/9	U301	13/6	OC71	3/6
6X5GT	5/9	B729	12/6	ECL82	6/9	PCF800	11/6	U801	18/9	OC72	4/9
7B6	10/9	CCH35	9/-	ECL86	8/3	PCF801	7/9	UABC80	6/3	OC75	5/9
7B7	7/-	DAC32	7/3	EF39	3/9	PCF802	9/6	UAF42	7/9	OC81	3/6
7C5	15/-	DAF91	3/9	EF41	9/6	PCF805	9/-	UB41	6/6	OC81D	3/6
7C6	6/9	DAF96	6/-	EF80	4/9	PCF806	11/6	UBC41	7/9	OC82	5/9
7H7	5/6	DCC90	8/6	EF85	5/6	PCF808	12/6	UBF80	6/-	OC82D	5/-
7Y4	6/6	DF33	7/9	EF86	6/3	PCL82	7/3	UBF89	6/9	OC170	2/6

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Postage on 1 valve 9d. extra. On 2 valves or more, postage 6d. per valve extra. Any Parcel Insured against Damage in Transit 6d. extra.

THE SEMICONDUCTOR DIODE

—continued from page 54

as the avalanche effect, but for the moment it can be seen that provided the diode voltage is kept below point C it will perform as required.

The fact that a small current flows in the reverse biased condition before point C is reached may seem to conflict with the theory outlined earlier concerning potential barriers. However there is quite a simple explanation. In order for an electron to take part in conduction it has to enter the conduction band and to do this it has to obtain an amount of energy (*Eg*, Fig. 1) to lift it out of the valency band. Sufficient energy is provided for a few electrons to do this by heat that is transferred to them from outside the crystal. Ordinary room temperature is enough to impart sufficient energy to allow a few electrons to cross into the conduction band, and this gives rise to the small amount of current that flows even when a semiconductor diode is reverse biased.

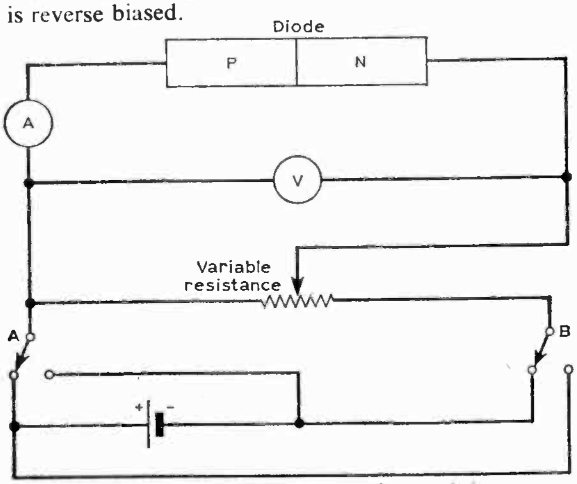

Fig. 7: Circuit for plotting diode characteristics.

The reason for the sharp change that occurs at point C in the reverse characteristic is that at this point—usually known as the zener voltage or reverse breakdown voltage—the potential is such that the electrons forming the "reverse current" are travelling at very high velocity. The result is that a considerable number of electron collisions occur, resulting in a rapidly increasing number of electrons being separated from their parent atoms—in short, an avalanche effect takes place.

As light is a form of energy its effect on a pn junction is similar to that of heat, i.e. exposure of a biased pn junction to light gives rise to a flow of current proportional to the strength of the illumination. This effect, known as photoconduction, is made use of in photocells and phototransistors.

Another feature of the pn junction that is of practical use is the junction capacitance. Since the depletion layer in the reverse biased condition has very few charge carriers while the p and n regions on either side are conductors, the device is akin to a capacitor; and since the width of the depletion layer is proportional to the bias applied across it this junction capacitance is inversely proportional to the bias. Consequently we have a device that can be used for frequency stabilisation in oscillator circuits. ■

THE MW COLUMN

THERE is little DX news this month since the generally poor conditions of this season have continued. But readers should note that the seasonal change in propagation which occurs around March-April might well help matters and, in particular conditions should be more favourable for signals coming from South and Central America. This could well provide an opportunity to log a few of the more difficult ones from these parts and the chances can be assessed by the reception of the more likely ones to come through. Some to look for are CMCN (550kc/s); HJHJ *Radio Libertad* (610); *La Voz de la Victor*, Costa Rica (625), HJBJ *La Voz de Santa Marta* (640); YVLH *Radio Giradot* (650); CMCH Havana (770); CMCA Havana (830); HJKC *Emisora Nuevo Mundo* (850); YVLW *Radio America* (890); YVRQ *Radio Aeropuerto* (910); YVNZ *Radio Calendario* (1020); 4VEF Haiti (1035); YVQJ *Radio Barcelona* (1080); WUNO Rio Pedras P.R. (1320); WIVV (1370).

Reception from Asia sometimes improves around this time of year, notably from the India/Pakistan region, so keep an ear open for stations such as Lahore (630), Quetta (750), Indore (650), Vijayawada (840), Ahmedabad (850), Sambalpur (860), Lucknow (910), Raipur (980), Rajkot (1070), Sangli (1250) and others. The North Regional stations sign-on at 0130, 0200 and 0330, West Regional stations at 0130 and 0230. East Regional stations 0130 and 0200, South Regional stations 0130, most of them starting off with news in English.

The fact that GMT has now disappeared completely is rather unfortunate for MW work, since it now means that everything starts an hour later *all* the year round instead of only during the summer months. This has been taken care of in the above times for the Indian stations. (Note: I have sometimes heard Indian stations on the air *before* the scheduled sign-on times, so it is still worth while listening around on their frequencies earlier than the times listed—*Editor*.)

Among the oddments of news this month is a report that Malta on 1241 has stopped transmitting. CJRS is a new Canadian on 1510 with 10kW. CKOC on 1150 has pushed up its power to 10kW.

Some of the items noted this month have been Tanzania on 638, Dakar on 764, *Radio Carve* Montevideo (850), LR3 *Radio Belgrano* Buenos Aires (950), CKBW Bridgewater (1000), LR1 *Radio el Mundo* (1070), YVQT *Radio Carupana* (1110). Glyn Morgan has a tentative logging of Saudi Arabia on 647 and Johannesburg on 1286 at 0220.

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J. McCARTHY describes

A METHOD OF REPETITIVE MORSE BROADCASTS

THIS article describes a circuit which can be used to send automatic Morse transmissions of a repetitive nature. For example, to transmit manually: CQ CQ CQ de G3ABC several times and receiving no reply is not only frustrating but tiring. Using the circuitry to be described, the "CQ" calls may be automatically broadcast, leaving the operator completely free during the period of transmissions. The equipment used would probably be readily available in the "ham's" shack, and the small amount of additional circuitry required can be built in an evening. The equipment required is: a tape recorder; transmitter, preferably with automatic break-in facilities (when the key is up, the receiver is automatically un-muted); a simple two-transistor switch; a controllable tone source.

PICK-UP

In the author's case, hum was picked up using a conveniently available metal bed. The Morse key's back-contacts shorted the tape recorder's input to earth when the key was released. When, however, the key was depressed, the hum from the bed was fed into the recorder's input. If a less barbarian method is preferred, a tone source may be constructed, but this is left to the amateur's choice. The equipment is used as follows:

SOURCE

The call, for example as above, is recorded on the tape recorder using the tone source and the Morse key. The call is thus recorded on tape. The call is then played back when required into the switch, which keys the transmitter. At the end of the call, the receiver is automatically activated, and the tape can be either wound back, or turned over in order to use the other track which would be recorded in the same way. Another possibility with a $1\frac{7}{8}$in recorder would be to use an endless tape spilling into a conveniently positioned rubbish bin. This, too, is left to the individual constructor.

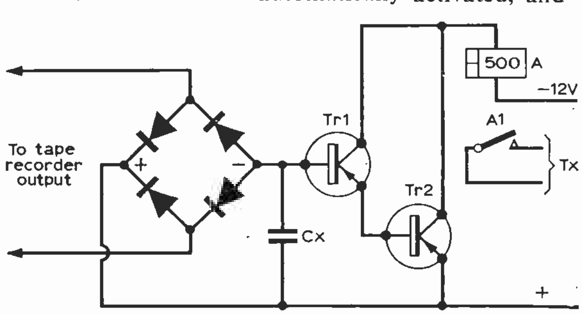

Fig. 1: Two transistors wired in a super-alpha configuration receive impulses from the tape recorder via the bridge rectifier made up from the four diodes.

If the transmitter lacks break-in facilities, a modification can be made to the transistor switch. The circuit of the switch is given in Fig. 1. As will be seen, the tape recorder's loudspeaker is muted, and a suitable resistor (3 or 5Ω) wired across the input of the switch. The smoothing capacitor, Cx, is dependent on the speed of Morse required; it must be great enough to prevent relay chatter, but not so great as to blur the Morse characters. The value should be found by experiment, $0{\cdot}1\mu F$ being a reasonable starting value. The two transistors, which were two red-spot surplus types, are connected in a "super-alpha" configuration, and operate the switch's own relay, which should be a high-speed type. The contacts on the relay are used to key the transmitter. The four diodes are ordinary germanium "crystal" diodes.

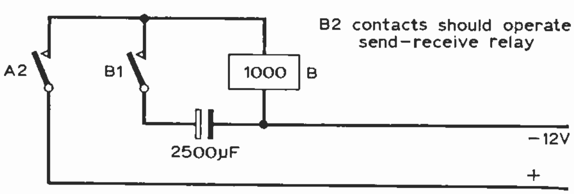

Fig. 2: Using an extra relay to facilitate break-in working. The electrolytic used to slug the relay might need to be varied in value dependent upon morse speed.

The chassis used for the construction of the switch was a piece of paxolin—$1\frac{1}{2}$ x $\frac{3}{4}$in., to which the wiring was actually stitched, using a large needle, thin wire, and a sewing machine (no kidding). More conventional methods, such as Veroboard are, of course, suitable. The whole was constructed within a metal box roughly 3 x 3 x 2in.

BREAK-IN

If a transmitter is used which does not have break-in facilities, then an extra relay is used which is switched on by the A relay, but is rendered slow-to-release by the large electrolytic in parallel with it. This second relay, the B relay, should be connected to the transmitter in such a way as to switch on the transmitter at the first Morse character, and to hold on the transmitter till shortly after the last character. If the Morse is excessively slow, trouble will probably arise due to this relay energising, and releasing, between each letter, and the value of the electrolytic should be increased.

The supply for the switch is 12 volts which was obtained in the author's case from a transistor radio power supply unit. Alternatively, the tape recorder or transmitter may be persuaded to supply the required voltage. ■

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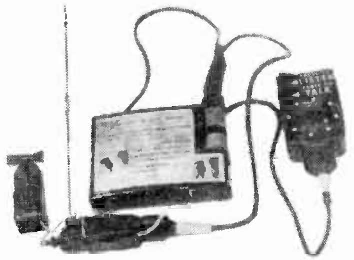

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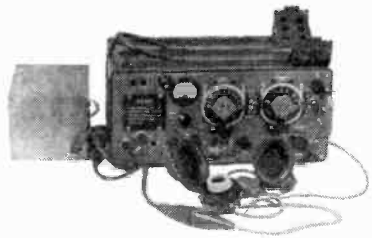

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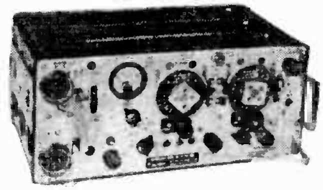

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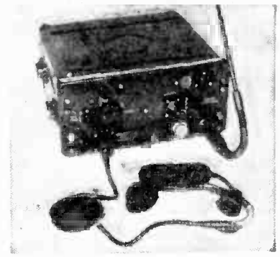

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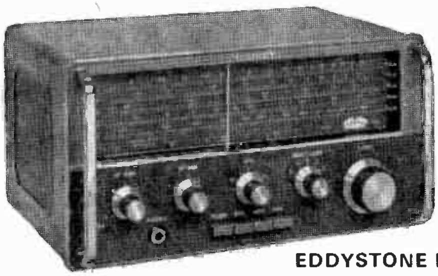

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LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents.

Oh, so slow!

Your March Editorial dealing with the warning of amateurs who transmit their call-signs faster than the prescribed maximum of 12 w.p.m. is a timely one. So far as I know no other periodical has spoken out on the subject, and I think I am right in saying that no official reason was ever given for lowering the acceptable maximum speed from 20 to 12 w.p.m. One club to which I belong has for some time been concerned at the seeming persecution of progressive c.w. operators and its newsletter has commented greatly on this.

From its membership it has been established that the following countries do *not* find it necessary to restrict the sending of call-signs to 12 w.p.m.: Australia, Belgium, Brazil, Bulgaria, Canada, Denmark, Finland, East and West Germany, Italy, Netherlands, Nicaragua, Norway, Poland, South Africa, Sweden Switzerland and USA.

Why, then, do the UK authorities see fit to impose such a backward step on British amateurs?

As for the reason some amateurs find themselves in trouble, perhaps the GPO has left us to our own devices for so long (my station has not been inspected for 15 years) we think they will never enforce *any* regulation. What a pity the station inspectors only show any interest when TVI or BCI are reported. An occasional, but unexpected visit would do much to keep the standard of equipment, operating and log-keeping up to scratch.

However, regulations are regulations, and it would be as well for all amateurs to re-read their licences, especially the sections limiting the operating of stations to qualified persons *only*, the sending of the station call-sign, at not more than 12 w.p.m., at the beginning and end of each "over", on changing frequency and every 15 minutes, when transmissions exceed that length of time and the ban on "Third Party" messages.

Until such time as the GPO re-adopt the more realistic 20 w.p.m., we c.w. operators can only hope that equal notice will be taken of "Joe", "Fred" and "Tom", all s.s.b. users, who seem to have forgotten they were ever issued with call-signs.—**F. Allan Herridge, G3IDG** *(Hampshire)*.

A dig at Ed.

Your Topic of the Month for March refers to the fact that the Radio Services Department has been sending letters of complaint to amateurs who have been sending their call-signs faster than 12 w.p.m.

You refer to this as "petty niggling by the GPO", and say you cannot understand "why it should suddenly become necessary to throw the book at operators."

Before you put your big feet any deeper in the mire let me invite you to read my AMATEUR (SOUND) LICENCE A which has been drawn up in accordance with the WIRELESS TELEGRAPHY ACT, 1949. Section 9(2) reads: "The call-sign, which may be sent either by morse telegraphy at a speed not greater than 12 words per minute or by telephony . . . "

In short, you are knocking the GPO for insisting that amateurs operate within the terms of their licence.

Just watch it, Ed, or you'll end up in the Tower—and I don't mean the Post Office Tower!—**John Mayall, G3VPH** *(Droitwich, Worcs.)*.

[*Why should I read your amateur licence G3VPH—I have quite a few of my own, more than one of which says I can send call-signs at no more than 20 w.p.m. That, of course, was in the days before the GPO started to niggle and reduced it to the 12 w.p.m. crawl asked for today. As you say, I may well end up in some sort of tower but so long as it isn't the Tower of Babel occupied by some of the a.m. and s.s.b. boys I shall not complain. I'll just set up my rig and send out slow morse practice sessions for the benefit of the GPO!—Editor*]

PCR mods

The "Trawler-band" coils mentioned in the article "Mods to the PCR" as used by the writer are Repanco Types RA3, RHF3 and RO3. The writer has made inquiries and confirms their availability at 3s. 9d. each through retail shops.

The PCR3 which does not have a Long Wave band, covers the ranges 13-43, 43-120 and 200-550m. The trawler band coils could be substituted for the middle range if the 160m band is desired or alternatively the existing coils could be padded up with trimmers.—**G. L. K. Crawford, B.Sc. C.Eng.** *(Tonbridge, Kent)*.

The art of unsoldering

I was recently faced with the unenviable task of unsoldering numerous components from a printed circuit board, the job being further complicated as I had no "desoldering" tool.

To overcome my difficulties I made use of an old foot pump. After removing the original connector, I fastened a piece of rubber tubing to the outlet of the pump. To the other end of the tube was inserted an old ball-pen case. This provided me with an excellent tool with which to blow away molten solder from the joints.

I find a pair of arterial forceps (obtained from a local surgical shop) just the job for a heat sink, as they can be locked on a wire and left, thus leaving both hands free.—**A. Parkinson** *(Grimsby, Lincs.)*.

Me too!

I wonder how many of your readers are being duped daily by the actions of firms advertising in your pages? Like Mr. Haworth (Letters, March issue) I too required a crystal for a project. I wrote to a firm whose name appears regularly in your magazine requesting a copy of their list of transistors, and their 24-page illustrated brochure on Valves and Quartz Crystals for which I enclosed a postal order for one shilling.

An envelope duly arrived in which were six mail-order forms, the list of transistors, a leaflet giving information and prices of components for a superhet receiver, and a coloured pamphlet extolling the contents of their new 1968 catalogue which could be obtained for eight shillings and six pence—no Quartz Crystal list, and no postal order!

The mind boggles at the fortune these people must be amassing from the odd shillings pouring in from people like Mr. Haworth and myself!—**Harry B. T. McLaren** *(Cheshire)*.

Members wanted

Would anyone be interested in joining a new Radio Club (Fulford & District Amateur Radio Club) Nr. York, with premises behind the Social Hall in School Lane, Fulford, please contact me.—**G. B. Widnall, G8ATJ** *Hon. Secretary, 5 Heslington Croft, Fulford, York*).

new books

Books reviewed on this page are normally obtainable through any retail bookshop. In this instance, the information printed in **heavy** type should be quoted.

TRANSISTOR TECHNOLOGY
By Robert G. Middleton. Published by Foulsham Sams. 288 pages, 8½ x 5¼in. Price 30s.

THIS book appears to be originally intended for the American market and was reviewed with some trepidation. However, all fears regarding confusion proved groundless, and, like mathematics, the basic principles of semiconductors are the same in any language. There are four pages at the beginning which discuss any slight misunderstandings which might arise.

The book would be ideal for students taking telecommunications and who need a basic primer in the field of transistors and diodes. Others, whose knowledge of semiconductors is a little vague or needs brushing up, will also find this a very useful volume.

Starting with a brief coverage of solid state physics and the atomic concept, *Transistor Technology* goes into details of diode operation, describing the electrical and mechanical properties of solid state diodes, From here it explains the principle of transistor action, outlining the detailed physical construction techniques, electrical characteristics (gain and leakage, for example), and the use of various types of amplifiers. In addition, such useful information as feedback, equivalent circuits, bias stabilisation, and distortion is thoroughly presented.

A useful feature of the book is the questions at the end of each chapter forming a useful yardstick with which to measure how much information has registered. Model answers to these questions are included at the end of the book. Verdict—a useful addition to the bookshelf for the layman, and a handy volume for the student.—*DLG.*

HOW TO BUILD SPEAKER ENCLOSURES
By Alexis Badmaieff and Don Davis.
Published by Foulsham-Sams Technical Books Ltd.
144 pages, 8¾ x 5¾in. Price 25s.

DO you find loudspeaker jargon infinitely baffling? Are you likely to construct an exponential acoustical horn expansion, with 12¼-foot diameter mouth and 16 feet long? Or are you generally content with the humble radiogram, despised by the hi-fi-fanatic?

Whatever your audio interest, you are sure to find some of the answers to your questions in this stimulating book. What is more important, you will probably find, also, a number of new questions to which you may not have previously given much thought. It is that sort of volume.

The authors preach the need for a good enclosure, designed to suit the driver unit, if any serious listening is intended. The days of "bung it in a box" are far behind us. From the several detailed constructional designs, it should be possible to find an enclosure to suit most purposes, even though most of the driver units are transatlantic in origin. There are many similar units—and I submit, a few better designs—available in this country.

The book covers Infinite Baffles, Bass-reflex enclosures, Horn enclosures, Labyrinths, and Crossover networks, as well as discussing enclosure design and the theory of driver units. A few details of electronic and acoustical measurement are given, but this is primarily a practical book, amply illustrated, occasionally controversial and never dull. Recommended for all except those with cloth ears.—*HWH.*

THE PRACTICAL AERIAL HANDBOOK
By Gordon J. King. Published by Odhams. 224 pages, 8¾ x 5¾in. Price 35s.

ALTHOUGH Mr. King is an established writer, I regret that I am unable to review this book with much enthusiasm.

"Practical Aerial Guide" would be a more suitable title since handbook is usually the title for those works which delve deeply and often technically into a subject, far more so than the author. The inside flyleaf claims that "Expert guidance is given on choosing the best aerial system to suit any particular purpose". This is rather a sweeping statement and the book does not substantiate this.

The volume contains a great deal of useful information, of this there is no denying; however, many of the illustrations appear to have already made their debut in *Practical Television.* There are informative and useful chapters on propagation, feeders, signal combining and splitting, shared aerial systems and TV interference. A section on signal boosters is notable in including circuit diagrams with all component values given. But the chapter "Practical Aerial Systems", while containing plenty of theoretical material, stops short of providing actual practical constructional details.

One startling constructional detail is the use of a four-foot ferrite rod ⅜in. in diameter on which the reader is advised to wind a coil to "load" an aerial.

The book is, in general, well written and certainly well illustrated, but for my money it's a subscription to *Practical Television* every time.—*DLG.*

AMATEUR RADIO CALL BOOK (1968 Edition)
Published by the Radio Society of Great Britain, 28 Little Russell Street, London, W.C.1. 104 pages. Size 9⅜ x 7⅛in. Price 6s.

THIS new edition, like its predecessors, lists in call sign order the addresses of licensed amateurs in England, Wales, Scotland, Channel Islands, Isle of Man, Northern Ireland and Eire. More than 1,800 changes of address, reissued calls and cancellations have been recorded, in addition to 900 new call signs since the 1967 edition. For the first time, a list of British amateurs holding reciprocal licences with other countries is given.

Miscellaneous information includes amateur prefixes (by both prefix and country order), International Q Code, Great Circle bearings from London, a list of R.S.G.B. affiliated societies and clubs, Zonal and Regional boundaries, etc.

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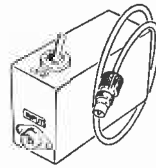

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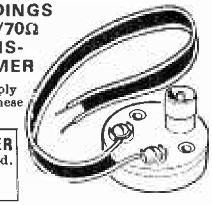

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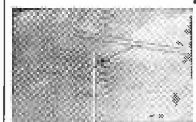

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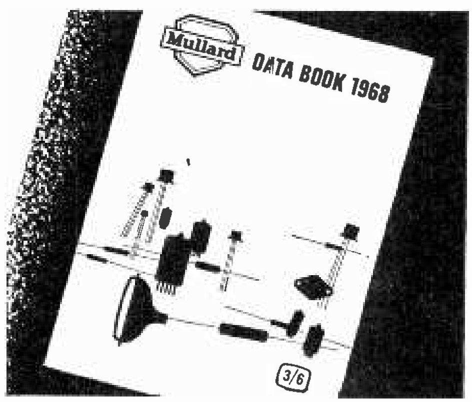

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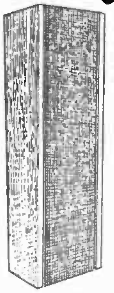

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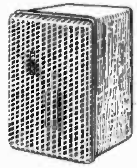

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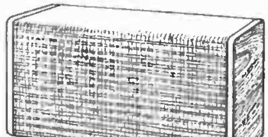

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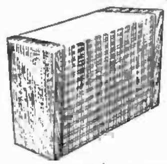

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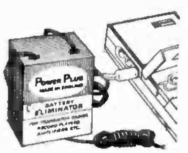

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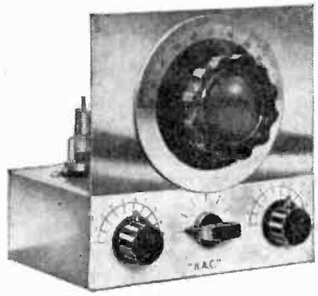

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The Circuit

The circuit used is shown in Fig. 1, it consists of a multivibrator, which is tuned to operate in the frequency range required, and a simple class A amplifier capacitively coupled to it. The frequency

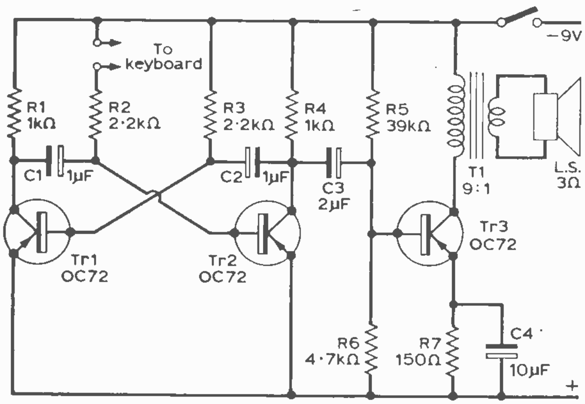

Fig. 1: Circuit for the simple musical toy.

at which the oscillator works is altered by the addition of resistances in series with R2. The methods of tuning and keyboard construction are discussed later.

Construction

The instrument was built on a base board 12 x 18in. of ¼in. plywood. Square (½in.) wood strip was used to mark the outline of the resonator box, and was glued into position on the base board (as shown in Fig. 2). The top of the box was made of ⅛in. plywood 12 x 4½in. A hole 2½in. in diameter was cut in the centre of the plywood with a fret-saw, so that a 2½in. miniature speaker could be fitted facing into the box. The top was glued on to the box, and the speaker was glued into its position over the hole in the top. On one side of the speaker two 4in. lengths of ½ x ½in. wood strip were glued 3in. apart to hold the 4in. square sheet of Veroboard on which the electronic circuit was mounted. On the other side of the speaker, two similar strips were mounted to steady the battery. Since a PP9 battery was used, these strips had to be 2½in. apart. The battery was secured by a strong rubber band stretched over it between panel pins half protruding from these blocks.

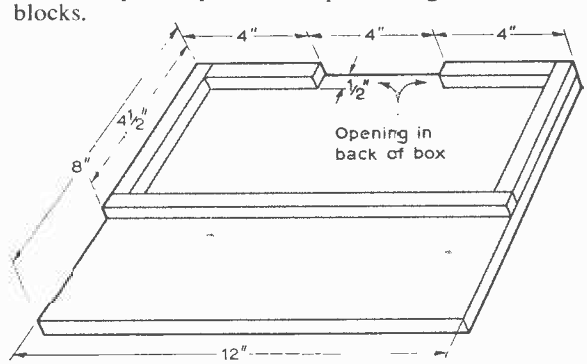

Fig. 2: Constructional details including relevant dimensions of the box on the base board.

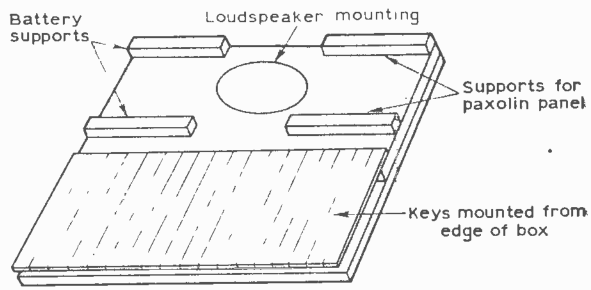

Fig. 3: Layout of the box and the keys showing position of speaker cutout and supports for veroboard.

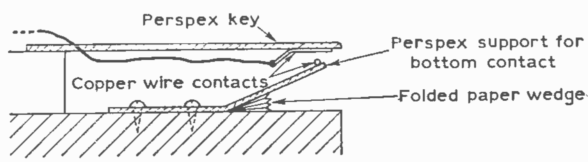

Fig. 4: Constructional details of suitable but simple keys showing positioning of keying contacts.

The keyboard consists of eighteen strips of 4 x ⅔ x 1/16in. Perspex. Each key has a thick gauge wire contact on its underside, with a length of thinner wire soldered to it. The keys are pressed on to a common contact which is a thick copper wire supported on four flexible 1/16in. Perspex supports so that the key will give after contact is made, this gives the keyboard a more pleasant feel, and reduces noise from the keys. The copper contacts are glued to their Perspex supports.

When the keyboard has been completed, the electronic circuit may be screwed on to its supports. One of the terminals leading to the keyboard is connected to the common base contact of the keyboard. The second terminal is connected through a tuning resistance to the key, each key having a different tuning resistance for a different note.

Preferred Values

It is possible to tune an instrument using standard resistance, but this suffers from three main disadvantages:

1. Resistances are only available in standard values which may not coincide with any note required, although by combination of components it should be possible to obtain all the necessary notes.
2. Resistors are not made to high accuracy so may not give the required note.
3. Since other components are of doubtful accuracy experimentation with resistors is necessary, and this increases the expense of the instrument. If, however, it is decided to tune the instrument using standard resistors, values of 0-10kΩ will give a range of about three octaves, the higher resistances producing lower notes.

Simple Tuning

A cheaper and more accurate method of tuning the instrument is to make resistors of the correct value. This can be done quite simply by using a thin film of graphite. If a wire lead is taken from the keyboard terminals and laid along the base of the Perspex keys, it can be inlaid into the Perspex by putting a hot soldering iron on to it until the Perspex softens and the wires start to sink into it. The wire should be held down with a pair of pliers until the Perspex resets around the wire; only short sections of wire can be done at a time, so the process should be repeated along the length of the keyboard. The wire from the contact on each key should be inlaid into the key in the same way so that the two wires tie parallel about 2mm. apart. The wires are then bared, and the Perspex between them roughened by sandpapering the area. With the key prepared in this way, it is now ready for tuning.

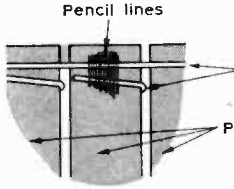

Fig. 5: How the wires are inset and tuned with the aid of a soft pencil.

With the key depressed no note will be produced until contact is made by scribbling across and between the two wires with a soft pencil until enough graphite has been deposited between the two wires to create the resistance required to give the note wanted.

The keyboard consists of eighteen keys, but some may wish to extend the keyboard with a second one above it for "black" notes. ■

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

ISSUES WANTED

. . . November 1964 issue of *Practical Wireless*.—A. Holmwood, 8 Dock Street, Pembroke Dock, Pembs.

. . . a copy of the July 1967 issue of *Practical Television*.—M. Hews, 28 Oak Tree Close, St. Ives, Huntingdonshire.

. . . copies of *Practical Wireless* for the years 1964, 1965 and 1966.—R. James, 14 Hotblack Road, Norwich, Norfolk.

. . . issues of *Practical Wireless* containing details of VALVE version of a switched v.h.f. tuner (the transistor one was in August 1967). Issues required are believed to be April 1965 and possibly May and June 1965.—S. Fisher, 146 Hilton Street, Springfields, Wolverhampton, Staffordshire.

. . . *Practical Wireless* Issues between May 1964 and October 1966 inclusive.—S. V. Austen, Hamilton House, Stone Cross, Bilsington, Ashford, Kent.

. . . the August 1960 Issue of *Practical Wireless*.—J. Brown, 38 Muirfield, Perth, Scotland.

. . . The September 1965 issue of *Practical Wireless*.—Tan Ke Huat, 19 Wolskel Road, Singapore 13.

. . . a copy of the January 1966 issue of *Practical Wireless*.—J. Evans, Tyddyn Y Garreg, Glanrafon, Corwen, Merionethshire.

. . . the November and December 1964 issues of *Practical Wireless*, covering "Preparing for the R.A.E." parts 1 and 2.—A. Givens, 41 Veronica Crescent, Kirkcaldy, Scotland.

. . . copies of the periodical "CQ" dated from August 1966 to April 1967 inclusive —even loan for a week would be greatly appreciated.—D. Hule, Marieville, Campbeltown, Argyll.

. . . the issue of *Practical Wireless* containing details of the "Multipurpose Audio Switch" by F. L. Thurston.—I. Grewar, 55 Dens Road, Dundee, Angus, Scotland.

. . . the January 1967 Issue of *Practical Wireless* containing details of the "Explorer v.h.f. Receiver".—T. Cridland, "Whitworth", Zuyder Road, 60 Acres, Canvey Island, Essex.

. . . the copy of *Practical Wireless* dated November 1953 containing details of an electrically-operated coil winder.—A. Moat, 29 Dwyer Street, Toowoomba, Queensland, Australia.

. . . Issues of *Practical Wireless*, January 1967—June 1967 Inclusive.—A. Staneveld, "Hollingside", 127 Welldon Crescent, Harrow, Middlesex.

. . . *Practical Wireless* wanted, July, August and September 1963.—J. Struthers, "Ravello", Wilton Hill, Hawick, Roxburghshire, Scotland.

. . . the issue or just the circuit of the Transistor Solo Organ. Also the circuit of the P.W. Electronic Organ originally published in 1951/52.—J. A. Philpott, P.O. Box 200, P & T Dept., Francistown, Botswana.

. . . the last five issues of *Practical Wireless* that covered the series "Preparing for the R.A.E." also the issues covering the "Versatile Double Trace Oscilloscope" or details of any other 'scope using the VCR517B tube.—G. Evans, 7 Cadbury Road, Portishead, Nr. Bristol.

. . . Issues of *Practical Television*: August, September and October 1960 and April, May, June and July issues.—J. Hart, 24 Firtree Way, Sholing, Southampton.

. . . September 1966 Issue of *Practical Television*.—S. Wickremesinghe, 132 Weston Park, London, N.8.

. . . *Practical Television* dated May 1965. I have two copies of *Practical Television* dated October 1965 and October 1966 if any one wants them.—B. Rooney, Glencar P.O., Sligo, Eire.

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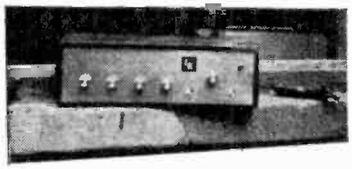

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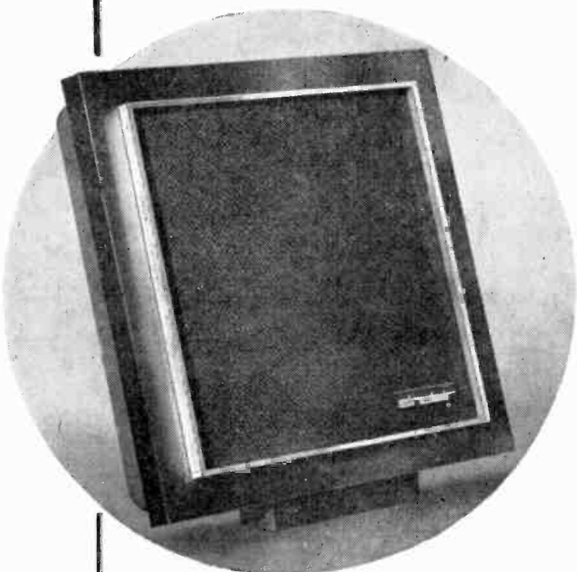

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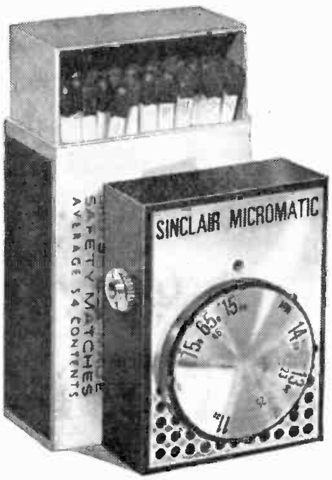

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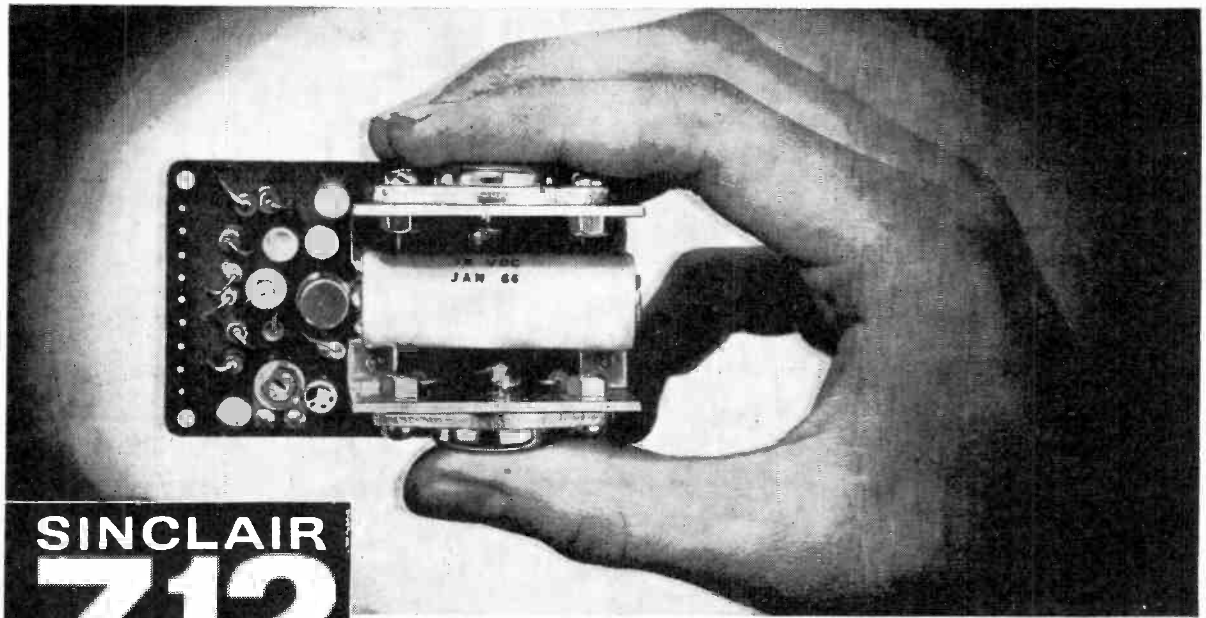

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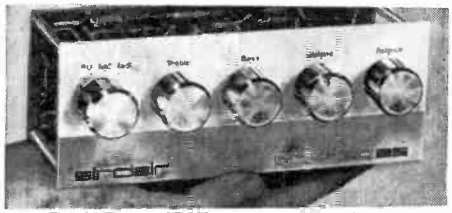

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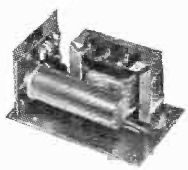

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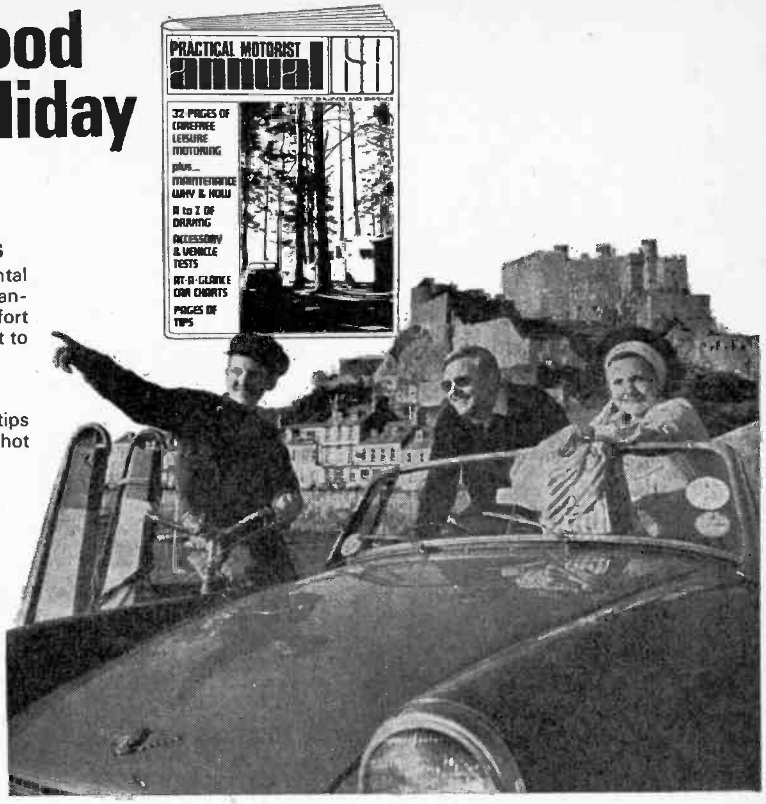

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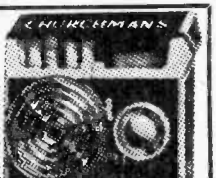

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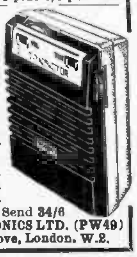

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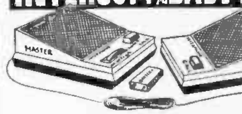
Solve your communication problems with this 4-Station Transistor Intercom system (1 master and 3 Subs), in de-luxe plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs and Subs to Master. Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. and other accessories. P. & P. 7/6.

WIRELESS INTERCOM

No batteries—no wires. Just plug in the mains for instant two-way, loud and clear communication. On/off switch and volume control. Price 12 gns. P. & P. 7/6 extra.

INTERCOM/BABY ALARM



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Same as 4-Station Intercom for two-way instant communication. Ideal as Baby Alarm and door Phone. Complete with 66ft. connecting wire. Battery 2/6. P. & P. 3/6.

Transistor TELEPHONE AMPLIFIER

Usually ~~6 gns.~~ **59/6**

Why not boost business efficiency with this incredible De-luxe Telephone Amplifier. Take down long telephone messages or converse without holding the handset. A useful office aid. On/off switch. Volume Control. Battery 2/6 extra. P. & P. 2/6. Full price refunded if not satisfied in 7 days.

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800μF	15 volts	1/2	50 + 50	275 volts	2/-
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16/16/16, 350v	2/2	100/100, 50v	3/2	12,500μF, 30v	16/-
50/50/50, 350v	2/7	150/350, 300v	4/-	30,000μF, 30v	25/-
1,000μF 70v	3/2	250/250, 325v	4/-	1,000μF, 15v	1/6
100/200, 275v	3/2	2000/2000, 25v	4/6	1,000μF, 18v	1/-
100/200/200/50, 275v	4/-	250μF 50v	10d.	500μF, 15v	10d.
3,000μF, 35v	3/9				

0·25μF	3 volt	6μF	3 volt	50μF	9 volt
1μF	50 volt	8μF	3 volt	64μF	2·5 volt
1μF	350 volt	8μF	6 volt	64μF	9 volt
1·25μF	16 volt	8μF	350 volt	100μF	3 volt
2μF	3 volt	8μF	450 volt	100μF	6 volt
2μF	9 volt	8μF	50 volt	100μF	9 volt
2μF	70 volt	8μF	275 volt	150μF	12 volt
2μF	150 volt	10μF	25 volt	200μF	3 volt
2μF	350 volt	16μF	150 volt	200μF	4 volt
2·5μF	16 volt	20μF	3 volt	200μF	16 volt
2·5μF	25 volt	20μF	6 volt	250μF	2·5 volt
3μF	3 volt	20μF	9 volt	250μF	9 volt
3μF	25 volt	20μF	15 volt	320μF	2·5 volt
3·2μF	6·4 volt	25μF	6 volt	350μF	9 volt
3·2μF	64 volt	25μF	12 volt	350μF	10 volt
4μF	4 volt	25μF	15 volt	400μF	2·5 volt
4μF	12 volt	25μF	25 volt	400μF	15 volt
4μF	25 volt	30μF	6 volt	500μF	4 volt
4μF	64 volt	30μF	10 volt	500μF	6 volt
4μF	100 volt	40μF	3 volt	640μF	2·5 volt
5μF	6 volt	40μF	6·4 volt	750μF	12 volt
5μF	25 volt				

All at 1/- each, 9/- per dozen. Mixed Packets of 20 (our selection) 10/-.

PAPER CONDENSERS

0·001μF	500 volt	0·02μF	600 A.C.	0·25μF	350 volt
0·001μF	1000 volt	0·02μF	350 volt	0·5μF	150 volt
0·002μF	500 volt	0·1μF	350 volt	0·5μF	350 volt
0·005μF	750 volt	0·1μF	750 volt	0·5μF	500 volt

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0·0022μF	400 volts	4d.	0·15μF	160 volts	7d.
0·0018μF	400 volts	4d.	0·22μF	160 volts	7d.
0·0015μF	400 volts	4d.	0·27μF	160 volts	8d.
0·001μF	400 volts	4d.	0·056μF	125 volts	7d.
0·01μF	400 volts	4d.	1μF	125 volts	1/6
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ECC83	7/4	PC97	10/6	PL81	8/5
ECL80	7/1	PCC84	7/4	PL83	8/5
ECL86	8/5	PCC89	10/6	PL84	6/6
EF80	7/1	PCF80	8/5	PL500	12/5
EF85	7/1	PCF86	10/1	PY32	9/-
EF183	9/5	PCL82	8/5	PY81	6/9
EF184	9/5	PCL83	9/10	PY82	4/9
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2½ in. × 5 in.	0·15 matrix	3/11	5 in. × 2½ in.	0·1 matrix	3/11
3¾ in. × 3¾ in.	0·15 matrix	3/11	3¾ in. × 2½ in.	0·1 matrix	3/9
3¾ in. × 5 in.	0·15 matrix	5/6	5 in. × 3¾ in.	0·1 matrix	5/2
17 in. × 2½ in.	0·15 matrix	11/-	3¾ in. × 3¾ in.	0·1 matrix	3/11

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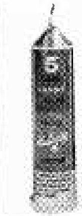

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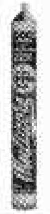

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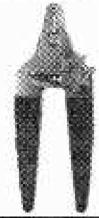

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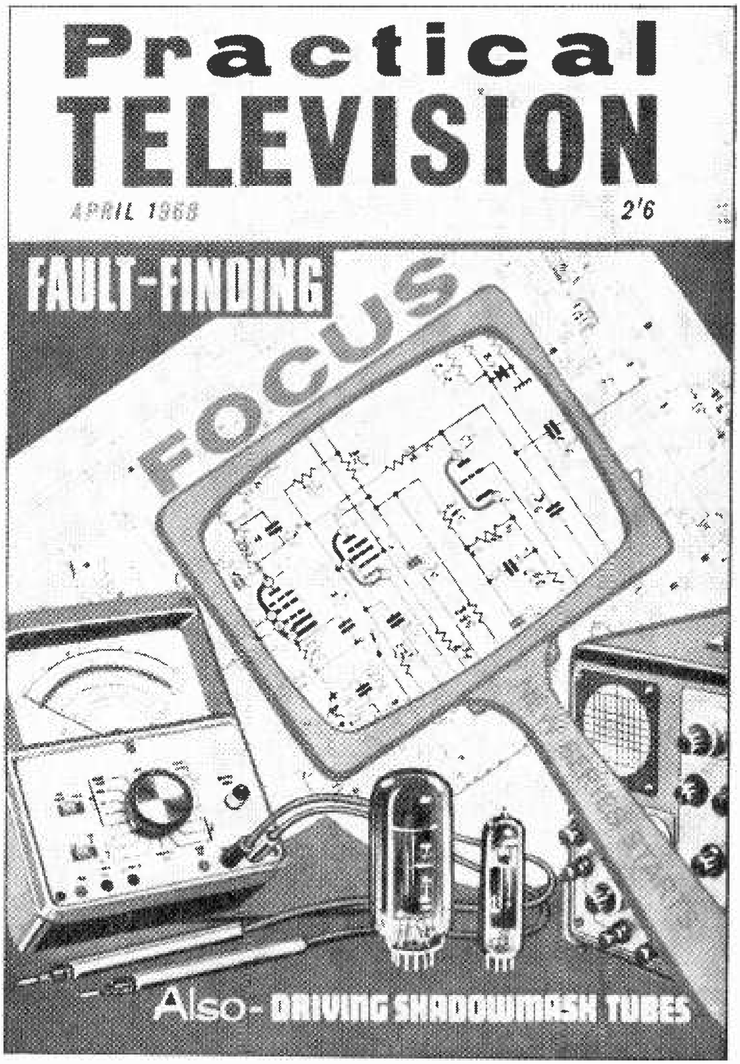

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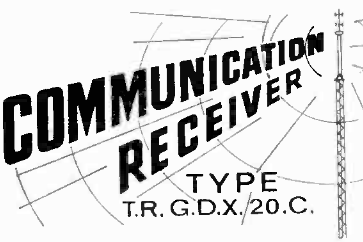

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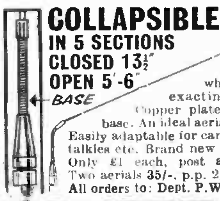

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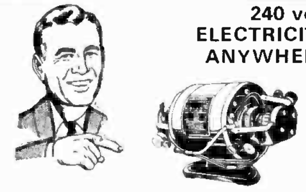

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DK96	7/–	EF80	4/9	PCC84	5/6	PY82	5/–
DL92	3/9	EF85	5/3	PCC89	10/–	UABC80	5/9
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DL96	7/–	EF91	1/9	PCL82	6/3	UCH81	6/3
EABC80	5/6	EF93	3/6	PCL83	9/–	UCL82	6/9
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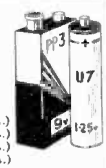

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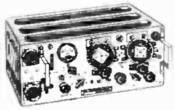

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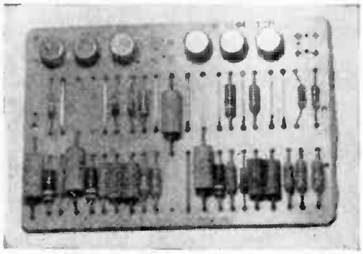

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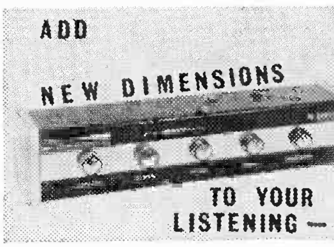

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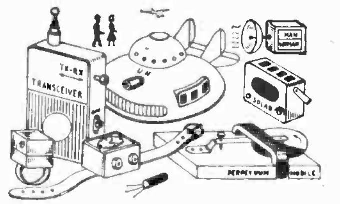

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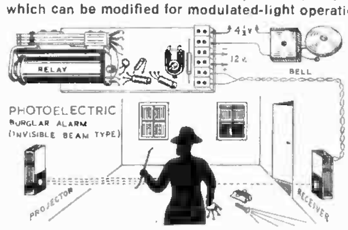

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EF812	14/-
EH90	7/-
EL34	9/6
EL35	9/6
EL36	8/6
EL38	22/6
EL41	8/6
EL42	9/6
EL81	9/-
EL82	8/-
EL83	6/6
EL84	4/6
EL85	7/6
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EL90	5/6
EL95	5/-
EL360	22/-
EL821	8/-
EL822	17/-
ELL80	13/-
EM34	13/-
EM71	12/6
EM80	7/-
EM81	6/9
EM84	8/-
EM85	11/-
EM87	10/-
EN91	5/6
EY51	7/-
EY70	10/-
EY80	8/-
EY81	7/-
EY83	9/-
EY84	9/6
EY86	6/6
EY87	8/-
EY88	8/6
EZ35	5/-
EZ40	7/6
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EZ80	5/-
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FW4/800	10/-
GS10H	40/-
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GTE175M	12/-
GZ30	7/-
GZ31	5/-
GZ32	10/-
GZ33	12/6
GZ34	10/-
GZ37	12/6
HABC80	8/-
HBC90	4/6
HBC91	5/6
HF93	6/-
HF94	5/-
HL42DD	8/-
HL92	6/-
HL94	7/-
KT8	30/-
KT66	19/-
KT88	27/6
PABC80	7/6
PC86	10/6
PC88	10/6
PC95	6/6
PC97	7/6
PC900	8/6
PCC84	5/6
PCC85	7/-
PCC88	11/-
PCC89	10/6
PCC189	11/-
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PCE800	15/-
PCF80	6/3
PCF82	6/-
PCF84	8/-
PCF86	8/-
PCF87	14/6
PCF800	13/6
PCF801	9/-
PCF802	9/-
PCF805	14/-
PCF806	12/-
PCF808	13/-
PCH200	12/-
PCL80	15/-
PCL81	9/-
PCL82	7/-
PCL83	8/6
PCL84	7/6
PCL85	8/6

PCL86	8/-
PCL88	16/-
PCL800	16/-
PCL801	16/-
PEN4DD	6/-
PEN45	6/6
PEN45DD	12/-
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PENDD 402	10/-
PF86	10/-
PF818	14/-
PFL200	13/6
PL36	9/-
PL81	7/-
PL82	7/-
PL83	6/6
PL84	6/-
PL302	14/-
PL500	13/6
PL504	14/-
PL801	13/-
PM84	8/-
PX4	20/-
PX25	15/-
PY31	5/-
PY32	8/6
PY80	5/6
PY81	5/6
PY82	5/-
PY83	5/6
PY88	7/6
PY301	14/-
PY800	9/-
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U21	7/-
U22	6/-
U25	14/-

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U33	26/-
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U282	8/-
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U404	5/-
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UAF42	9/-
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UCC84	9/-
UCC85	6/6
UCF80	9/6
UCH21	9/6
UCH42	9/-
UCH43	8/-
UCH81	6/3
UCL81	9/-
UCL82	7/3
UCL83	9/-
UF9	10/-
UF41	9/-
UF42	9/-
UF43	8/-
UF80	6/6
UF85	7/3
UF86	9/-
UF89	7/-
UL41	8/6
UL84	6/6
UM4	10/-
UM80	5/-
UU5	8/-
UU8	7/-
UU9	7/6
UU10	8/-
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UY82	9/6
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OC23	12/6	OC170	5/-	AF125	6/6	MAT121	8/6
OC24	15/-	OC171	6/-	AF126	6/-	V30/30P	20/-
OC25	7/6	OC200	7/6	AF127	6/-	2G309	5/-
OC26	6/-	OC201	10/-	AF178	12/6	2G371A or B	3/-
OC28	12/6	OC202	13/-	AF186	17/6	2G381	3/6
OC29	14/9	OC203	10/6	AFY19	22/6	2G403	8/6
OC35	13/-	OC204	12/6	AFZ11	17/-	2N410	3/6
OC36	12/6	OC205	15/-	AFZ12	10/-	2N412	3/6
OC42	5/-	OC206	22/6	ASY26	6/6	2N696	6/6
OC43	9/-	AC107	10/-	ASY28	6/6	2N697	7/6
OC44	4/-	AC125	3/6	ASZ20	7/6	2N706	3/4
OC45	3/6	AC126	6/6	ASZ21	12/6	2N753	6/6
OC58	12/6	AC127	7/6	BC107	7/6	2N1132	37/-
OC70	4/-	AC128	6/6	BCY30	7/-	2N1304	6/-
OC71	3/6	AC176	7/6	BCY33	7/6	2N1756	15/-
OC72	5/-	ACY17	8/6	BCZ11	10/-	2N2068	20/-
OC73	7/6	ACY18	5/6	BFY50	8/6	2N2369A	4/6
OC75	6/-	ACY19	6/6	BFY52	6/6	2N2926	5/6
OC76	5/-	ACY20	5/-	BSY26	5/-	2S002	20/-
OC77	8/-	ACY21	6/-	BSY28	5/-	2S003	20/-
OC78	5/-	ACY22	3/6	BSY65	5/-	2S004	15/-
OC78D	5/-	AD140	16/-	GET103	5/-	2S005	50/-
OC81	5/-	AD149	16/-	GET104	8/-	2S006	20/-
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Note: W.E.—Wire Ended; S.M.—Stud Mounted.

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PRACTICAL WIRELESS blueprints

The following blueprints are available from stock. **Descriptive text is not available** *but the date of issue is shown for each blueprint. Send, preferably, a postal order to cover cost of the blueprint (stamps over 6d. unacceptable) to Blueprint Department, Practical Wireless, George Newnes Ltd., Tower House, Southampton Street, London, W.C.2.*

The Strand Amplifier; The PW Signal Generator	(Oct. 1962)	5/-
The Berkeley Loudspeaker Enclosure; The Luxembourg Tuner	(Dec. 1962)	5/-
The PW Troubadour; The PW Everest Tuner	(June 1962)	7/6
The PW Britannic Two; The PW Mercury Six	(May 1962)	6/-
Beginner's Short Wave Two; S.W. Listener's Guide	(Nov. 1963)	5/-
PW "Sixteen" Multirange Meter; Test Meter Applications Chart	(Jan. 1964)	5/-
The Celeste 7-transistor Portable Radio; The Spinette Record Player	(June 1963)	5/-
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Beginner's 5-Band Receiver; Home Intercom Unit	(Dec. 1966)	5/-

★ **PLEASE NOTE THAT WE CAN SUPPLY NO BLUEPRINTS OTHER THAN THOSE SHOWN IN THE ABOVE LIST. NOR ARE WE ABLE TO SUPPLY SERVICE SHEETS FOR COMMERCIAL RADIO, TV OR AUDIO EQUIPMENT.** ★

PRACTICAL WIRELESS query service

Before using the query service it is important to read the following notes:

The PW Query Service is designed primarily to answer queries on articles published in the magazine and to deal with problems which cannot easily be solved by reference to standard text books. In order to prevent unnecessary disappointment, prospective users of the service should note that:

(a) We cannot undertake to design equipment or to supply wiring diagrams or circuits, to individual requirements.

(b) We cannot undertake to supply detailed information for converting war surplus equipment, or to supply circuitry.

(c) It is usually impossible to supply information on imported domestic equipment owing to the lack of details available.

(d) We regret we are unable to answer technical queries over the telephone.

(e) It helps us if queries are clear and concise.

***(f)* We cannot guarantee to answer any query not accompanied by the current query coupon and a stamped addressed envelope.**

QUERY COUPON

This coupon is available until 10th May, 1968 and must accompany all queries in accordance with the rules of our Query Service.

PRACTICAL WIRELESS, MAY 1968

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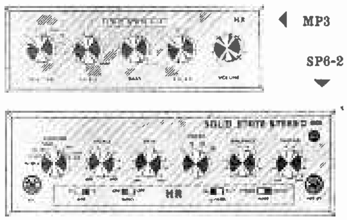
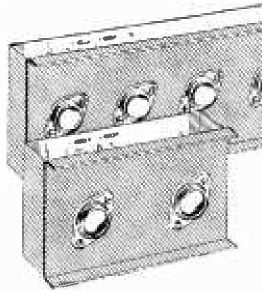


MP3

SP6-2



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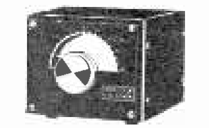

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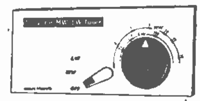

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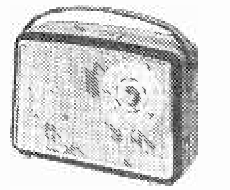

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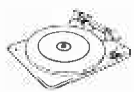

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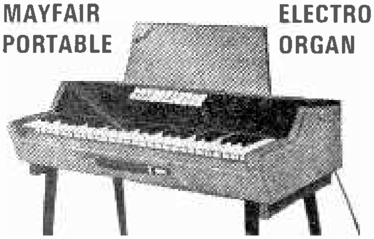

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