PRACTICAL WIRELESS

APRIL
1968

2/6

FREE INSIDE

1 COMPLETE SET OF **PANEL LABELS**

2 **FAULT FINDING CHART No.1** FOR TRANSISTOR RADIOS

F. E. T.
VOLT OHM METER

Transistorised FM Tuner

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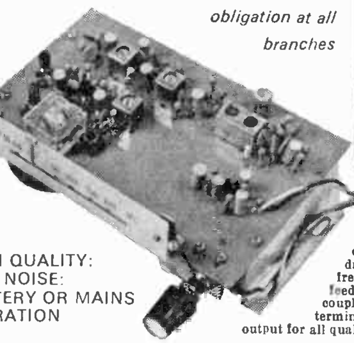

HIGH QUALITY: LOW NOISE: BATTERY OR MAINS OPERATION

This beautifully compact 6 transistor machine (size 6 x 4 x 2½in.) will give quieter, more interference free reception. Months of use from a standard 9 volt battery or its small power requirements can be drawn from any amplifier. Low noise freq. changer. Smooth 2 gang tuning feeding no less than three I.F. stages coupled to a double-tuned discriminator terminating in an L.F. stage giving ample output for all quality amplifiers.

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£6.19.0

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SRP12	£3.19.0
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Model 3.000	£8.10.0
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A70	£18.10.0
LAB80 Mk. II	£24.19.0
401	£27.10.0
Mono dual cartridges	12/6
Stereo ceramic cartridges	19/6
GP67-1 . . 15/- GP91-1	19/6
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PLINTHS

Universal fitting de luxe Teak for SP25, 1.000, 2.000, 3.000, AT60 — 59/-

Ditto Perspex Clear View Cover, Complete — £5.15.0

LAB80. 401. Superb Teak/Perspex top finish plinth Normally £12.10. — £9.19.0

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GUARANTEED TOP QUALITY

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AF114	6/6	OC26	7/6	OC81	5/-
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AF116	6/-	OC44	5/-	OC170	6/-
AF117	5/6	OC45	4/6	OC171	6/-
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Guaranteed performance. Top Makes. Tested 250v. working.

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1% to 5% 100Ω to 5mΩ.
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SIZES—¼—3 watt.
MICROPHONE CABLE. Highest quality black, grey, white, 9d. per yard.

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

PLEASE NOTE. *A wide range of cabinets to callers at all branches.*

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Factory fresh less Cartridges.

SRP 110/230V 59/-
(De Luxe Heavy Turntable).

Mono first-grade Cartridges . . 12/6
Stereo Ceramic Cartridges . . . . 19/- extra

EMI 4-speed heavy turntable player 200/250V with lightweight pick-up (dual cartridges 10/- extra) 49/-

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Satisfaction or Money Back Guarantee on goods if returned unused within 14 days
ALL VALVES ARE NEW UNLESS OTHERWISE INFORMED. FREE TRANSIT INSURANCE. POSTAGE 1 valve 9d. 2-11 6d. per valve. Free over 12

1L4	2/3	6P25	13/-	20P3	9/6	EBF80	8/9	EZ41	9/6	PY88	9/6
1S4	5/9	6P28	9/6	20P4	18/9	EBF89	8/-	EZ80	6/6	PY800	8/-
2D21	5/6	6Q7G	8/-	25L6GT	7/-	EBL21	12/-	EZ81	7/-	PY801	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
5Z4G	7/9	6SN7GT	6/9	30F5	10/-	ECC83	7/-	KT61	13/-	U14/18	8/-
5Z4GT	10/6	6U4GT	10/6	30FL1	10/9	ECC84	8/-	KT63	5/6	U25	10/6
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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6AT6	6/-	6X5GT	7/9	30PL1	12/-	ECH42	11/6	MU14	8/-	U282	16/-
6AU6	7/-	7B6	12/6	35A5	9/6	ECH81	7/9	N37	10/6	U801	20/-
6BA6	6/6	7B7	7/6	35L6GT	9/6	ECL80	5/9	N78	14/-	UABC80	7/6
6BE6	6/6	7C5	10/6	35W4	7/6	ECL82	8/6	N108	14/-	UAF42	8/9
6BH6	7/6	7C6	7/6	35Z4GT	6/9	ECL83	11/6	PC86	10/6	UB41	6/6
6BJ6	8/-	7H7	7/6	35L6GT	9/6	ECL86	10/6	PC97	8/6	UBC41	9/9
6BR7	10/6	7S7	15/6	42	6/6	EF36	5/9	PCC84	6/5	UBC81	7/9
6BW6	8/6	7Y4	8/-	80	8/6	EF39	8/-	PCC85	7/6	UBF80	8/6
6BW7	6/-	10C1	12/-	185BTA	20/6	EF40	11/-	PCC88	12/9	UBF89	8/9
6C4	4/-	10C2	13/6	807	10/6	EF41	10/-	PCC89	12/-	UBL21	11/3
6C6	4/-	10F1	7/6	955	3/6	EF42	7/9	PCC189	10/9	UCC85	8/6
6C9	12/-	10LD11	15/6	956	3/-	EF50	3/3	PCF80	6/9	UCF80	9/9
6CD6G	18/-	10P13	9/6	AZ31	9/6	EF80	5/3	PCF82	6/9	UCH21	11/6
6D6	4/-	10P14	9/6	DAF91	4/9	EF85	7/3	PCF86	9/3	UCH42	9/6
6F1	6/6	12AT6	7/6	DAF96	8/3	EF86	8/6	PCL82	7/9	UCH81	8/-
6F6G	6/-	12AT7	5/9	DF91	3/-	EF89	7/6	PCL83	10/6	UCL82	9/-
6F13	4/6	12AU6	6/-	DF96	8/3	EF91	3/6	PCL84	10/-	UCL83	11/6
6F14	7/6	12AU7	5/6	DK91	5/6	EF183	9/-	PCL85	10/6	UF41	10/-
6F15	9/6	12AX7	7/-	DK92	9/6	EF184	9/-	PCL86	10/6	UF42	6/9
6F23	9/-	12BA6	8/-	DK96	8/3	EL32	5/-	PL33	8/6	UF85	8/6
6J5G	4/-	12BE6	7/6	DL92	7/-	EL33	13/-	PL36	12/-	UF89	7/9
6J5GT	7/6	12J7GT	10/-	DL94	7/6	EL34	12/6	PL81	8/9	UL41	11/-
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

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HIGHEST QUALITY—COMPARE OUR PRICES

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Carr. & Ins. 12/6

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

	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
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21in.	£3.15.0	£5.15.0
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FANTASTICALLY POPULAR ★ TAPE ★

We offer you fully tensilised polyester/mylar and P.V.C. tapes of identical quality hi-fi. wide range recording characteristics as top grade tapes. Quality control manufacture. They are truly worth a few more coppers than acetate, sub-standard, jointed or cheap imports TRY ONE AND PROVE IT YOURSELF.

Standard Play			Long Play		
3in.	150ft.	2/3	3in.	225ft.	2/9
4in.	300ft.	4/6	4in.	450ft.	5/6
5in.	600ft.	7/6	5in.	900ft.	10/6
5¾in.	900ft.	10/6	5¾in.	1,200ft.	13/-
7in.	1,200ft.	12/6	7in.	1,800ft.	18/6
Double Play			**Triple Play**		
3in.	300ft.	4/-	4in.	900ft.	13/-
4in.	600ft.	8/-	5in.	1,800ft.	25/-
5in.	1,200ft.	15/-	5¾in.	2,400ft.	34/-
5¾in.	1,800ft.	19/6	7in.	3,600ft.	44/-
7in.	2,400ft.	27/-	**Quadruple Play**		
			3in.	600ft.	8/6

Postages 1/- reel.
Post Free less 5% on three reels.
Quantity and Trade enquiries invited.
NOTE. *Large tape stocks at all branches*

MAINS-BATTERY
Microsonic 7

7 TRANSISTOR RADIOS

Superhet, full medium wave coverage amazing volume, clarity and sensitivity from built-in PM speaker. Solid leather pocket wallet. Supplied with rechargeable cadmium cells (2 sets) and 230 VAC charger with 5 amp. plug. Fabulous present. Huge purchase enables us to offer the complete outfit at a fraction of market value. (If not amazed by the value and performance your money will be refunded if returned within 14 days). **49/-**

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MINI-MOTORS 3V to 4·5V operation. Ideal for mini-racing cars, etc. "Large" ($1\frac{1}{5}$ x $\frac{7}{10}$ x $1\frac{2}{5}$in.) 3/11. Medium (1 x $\frac{4}{5}$ x $1\frac{1}{4}$in.) 3/9. P. & P. 9d.

GENUINE DIAMOND STYLUS at 7/11 plus 6d. P.P. Available as replacements for the following popular types only at present: **BSR TC8LP—BSR TC8 STEREO—BSR TCS LP/STEREO—COLLARO STUDIO "O" LP/RONETTE—GARRARD GC8 LP—ACOS GP65/67 LP—RONETTE BF40/LP—GARRARD GC2 LP.**

SPEAKERS. 12in. round high quality British fitted tweeter cone. 6 watts, in 3 Ω or 15 Ω, 35/-, P.P. 3/6. **ROUND** 12in. R. & A. 3 Ω, 25/6, P.P. 3/6. Many other speakers from 2in. to 13in. available.
TWEETER. $2\frac{1}{2}$in. Black plastic cone, Square Frame, E.M.I. 3 Ω, 12/6, plus 1/6 P. & P.

MICROPHONES. LAPEL/HAND MIKE—$1\frac{1}{8}$in. dia. Lapel Clip, ideal for tape recording. With lead. Very sensitive, 7/6. P. & P. 1/-.
CRYSTAL HAND MIKE. Robust and sensitive. Cream plastic case. Just the thing for tape recorders, 8/6. P. & P. 1/6.
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TELESCOPIC FLOOR STAND. HEAVY BASE. Standard thread, ext. to 4ft. 7in. 49/6, Carriage and Packing 4/6.

TELEPHONE PICK-UP COIL. For recording or amplifying both sides of telephone conversation. Suction cup fitting to telephone, with lead, 7/6. P. & P. 1/-.

INTER-COMM. DE-LUXE 2-WAY. Highly efficient, safe **BABY ALARM.** Works off PP3 battery. Buzzer call system, complete with lead, plugs, battery, 55/-. P. & P. 2/6.

INTER-COMMS—DE-LUXE MODEL 2-WAY. Highly efficient 2-way, safe. Ideal **BABY ALARM.** Transistorised—no warm-up time required. Remote station can call master with latter switched off. Very easily fitted. Complete with battery, cable and plugs 77/6. P. & P. 2/6.
We can also offer a limited supply of a model made by Philips to retail at 6 gns.—Loud and Clear—Our Price 59/11, P. & P. 2/-. Complete with cable and plug. Standard battery 3/6 extra. This is a high quality product.
AMPLIFIER. Compact for use in mains portable grams $6\frac{3}{4}$ x $2\frac{1}{4}$ x $5\frac{1}{4}$in., printed circuit, vol. and tone controls attached by fly leads, over 2 watts output, 55/-. P. & P. 4/6.
4 TRANSISTOR 3W AMPLIFIER. Size $2\frac{1}{4}$ x $2\frac{3}{4}$ x $1\frac{1}{4}$in., 3, 8 or 15 Ω output. 9 volt battery operated. Highly sensitive. Price (less battery) 52/6. P. & P. 1/6.

GARRARD RECORD PLAYER DECKS			
AT60 Mk. II	£12	19	0
A70 Mk. II Laboratory Series	£15	15	0
SP25 Mk. II (Heavy turntable)	£12	15	0
Cartridges for the above: Mono dual		12	6
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P. & P. on each of the above 5/- extra.

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TAPE RECORDER. Magnificent portable solid state, battery tape recorder. The best yet. 2 speeds, capstan drive, as good for music as speech, 3in. reels. Absolutely complete with remote control, mike, tape, batteries, etc. **£10.19.6.** P. & P. 5/-.
PICK-UP CARTRIDGE REPLACEMENTS (Standard Fitting for all Record Players). ACOS GP/67-2 MONO 15/-. ACOS GP/73-2 STEREO 30/-. ACOS GP/91-1 MONO-DE-LUXE 21/-. Postage and Packing 9d.
Finest Quality British made MYLAR Recording Tape. Fully Guaranteed. In Cartons.

3in. 240ft. Message	5/-	$5\frac{3}{4}$in. 1200ft. Long Play	12/6
5in. 600ft. Standard Play	8/6	7in. 1800ft. Long Play	19/6
$5\frac{3}{4}$in. 850ft. Standard Play	11/6	5in. 1200ft. Double Play	15/-
7in. 1200ft. Standard Play	12/6	$5\frac{3}{4}$in. 1800ft. Double Play	22/6
5in. 900ft. Long Play	10/-	7in. 2400ft. Double Play	24/-

P. & P. 1/- per reel. Four reels and over post paid.
POCKET MULTI-TEST METER. 1000 Ω per volt. Volts 0/10/50/250/500/1000 A.C. and D.C. Current: 0–1–100–500mA. Resistance: 0–100k Ω. Complete with test prods, instructions. 37/6. P. & P. 1/6.
MULTITESTER—Pocket size: with built in meter protection. Wide angle, jewelled meter movement. 20,000 Ω per volt D.C. 10,000 Ω per volt A.C. 19 ranges—0/5, 25, 50, 250, 500 volts D.C. 0/10·50, 100, 1000 volts A.C. 0–50mA, 2·5mA–250mA D.C. ● 0–6000 Ω–6 megohms. 10μμF–0·001 mFd–1mFd. ● —20 to +22dB. Mirror Scale. Complete in cloth-lined leather case with carry strap and test leads. Exceptional value at £4.11.0 (P. & P. 3/6).

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NEW HIGH FREQUENCY TRANSISTORS. Sinclair ST140 4/-; ST141 6/-. both capable of operating up to 700 Mc/s. **ALSO** MAT100 7/9. MAT101 8/6. MAT120 7/9. MAT121 8/6. ADT140 15/-.
All Transistors postage 6d. up to 3. Over 12 sent P. & P. paid.

R.F. FIELD INDICATOR. For use with radio controlled models. Checks radiation from existing antenna. Tunes 1 to 250Mc in 5 bands. Sensitive 200mA meter movement. 5 section plug-in aerial. Phone jack and crystal earpiece for monitoring. No battery required. Powerful magnet for attaching to metal surfaces. Complete with instructions. 47/6. P. & P. 2/6.

TERMS. Cash with order. No C.O.D. Orders total £5 and over sent carriage paid (excepting record player decks where carriage is shown). Guaranteed money refunded if goods returned perfect within 7 days of despatch.

ERSIN Multicore 5 CORE SOLDER

for quick, easy, reliable soldering

Contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux required. Ersin Multicore Savbit Alloy also reduces wear of copper soldering iron bits.

SIZE 5 HANDY SOLDER DISPENSER

Contains 10 ft. coil of 18 s.w.g. Ersin Multicore Savbit Alloy. 2/6 each.

SIZE 15 SOLDER DISPENSER

Contains 21 ft. coil of 60/40 Alloy, 22 s.w.g. Ideal for small components, transistors, diodes, etc. 3/- each.

SIZE 12

Ideal for home constructors. Contains 90 ft. of 18 s.w.g. Ersin Multicore Savbit Alloy on a plastic reel. 15/- each.

BIB MODEL 8 WIRE STRIPPER AND CUTTER

Strips insulation cleanly and quickly, fitted with unique 8 gauge wire selector. Plastic handles. 9/6 each.

From Electrical and Hardware shops. If unobtainable, write to: Multicore Solders Ltd., Hemel Hempstead, Herts.

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TRANSISTORISED STEREOPHONIC HIGH FIDELITY AMPLIFIER 15 + 15 watts · Silicon solid state · Integrated pre-amplifier · Negligible distortion · **£49.10.0.**

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MATCHING AM/FM STEREOPHONIC FM TUNER
Transistorised · Outstanding specification · Stereo de-coder (optional) **£60.0.0.** + £11.18.3. P.T. inc. Surcharge.

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SUPERB 30 WATT SYSTEM

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.).

R·S·C·13 WATT HI-FI STEREO SYSTEM

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.** Terms available. Carr. 25/-. Special Price **46 Gns.** Perspex cover 59/9 extra with above.

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.

HF510	5"	8W	49/9	HF120	12"	15W	69/9
HF800D	8"	8W	59/9	HF120D	12"	15W	79/9
HF811D	8"	10W	£4.19.9	HF126	12"	15W	89/9
HF101D	10"	15W	£5.19.9	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 III 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.** Or **Senior 15 watt** inc. HF 126 15,000 line Speaker **6 Gns.** Carr. 6/6. Carr. 5/9

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. Carr. 7/6. Or assembled and wired on board for **10 Gns.** **9 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 2¾ x 5¼in. Attractive brushed silver finish facia plate 10¼ x 3¼in. 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 TRANSISTORISED VHF/FM RADIO TUNER

Total cost of parts with detailed wiring diagrams & instructions. Carr. 10/-. **12½ Gns.** 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.** Made to visually match 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/-.

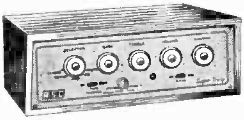
R.S.C. SUPER 15 HI-FI AMPLIFIER

SOLID STATE CONSTRUCTION

R.S.C. SUPER 30 STEREO AMPLIFIER

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:** +12dB 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.

SPECIFICATIONS COMPARABLE WITH UNITS AT ALMOST TWICE THE COST



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 Fascia 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 27Gns. 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*

ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.

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BRISTOL 14 Lower Castle St. (Half-day Wed.) Tel. 22904
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DARLINGTON 13 Post House Wynd (Half-day Wed.) Tel: 68043
EDINBURGH 133 Leith St. (Half-day Wed.) Tel. Waverley 5766
GLASGOW 326 Argyle St. (No half-day) Tel. CITy 4158; 403 Sauchiehall St. (Opp. Locarno) Tel. 332-1572
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R·S·C HI-FI CENTRES LTD.

MAIL ORDERS TO: 102 Henconner Lane, Bramley, Leeds 13. No C.O.D. under £1. Terms C.W.O. or C.O.D. Postage 4/6 extra under £2. 5/9 extra under £5. Trade supplied. S.A.E. with enquiries please. Hi-Fi Catalogue 4/6.

Open all day Sats. except High Holborn

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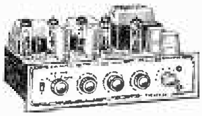
AUDIOTRINE HI-FI TAPE RECORDER KIT

REALISM AT INCREDIBLY LOW COST Please send S.A.E. for leaflet.
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 8¼in. 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

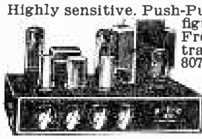


PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL. SUITABLE FOR "MIKE", GRAM, RADIO OR TAPE. (7) valves ECC83, (2) ECL86, (4) EZ81. **Frequency Response:** ±2dB 30-20,000 c.p.s. **Hum Level:** 65dB down. **Sensitivity:** 20 millivolts max. **Harmonic Distortion:** 0·2% ★**Four-position 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**

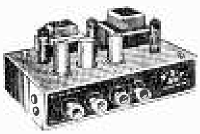
R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER



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/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

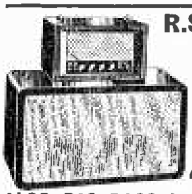
PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP.



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. Full instructions and point-to-point wiring diagrams Carr. 11/6 **£8.15.0** Send S.A.E. for leaflet. (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.

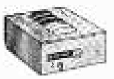
G80 80 WATT AMPLIFIER

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

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.**

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.**

POWER PACK KIT

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**

SELENIUM RECTIFIERS F.W. (Bridged)

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.**

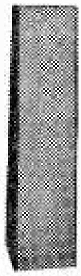
R.S.C. 6/12v CAR BATTERY CHARGERS

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.

LONDON-GLASGOW New branches now open—see addresses

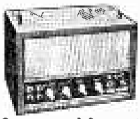
R.S.C. COLUMN SPEAKERS



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**).

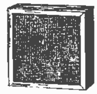
30 WATT HI-FI AMPLIFIER

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.**
30 Watt Model. Rexine covered **10 Gns.**

LOUDSPEAKERS

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 £5.11.9
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.**

FANE 'POP' 100 L'SPEAKER

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**

TWO-WAY TELEPHONE AMPLIFIERS

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

TRANSISTOR SALE

Mullard OC71 OC72, OC81, **2/11**
OC44, OC45, **3/11.**
OC75, **7/9.**
AF117, **6/9.**
Post 6d. for 3.

INTEREST CHARGES REFUNDED

on H.P. and Credit Sale Accounts settled in 3 months.

R.S.C. MAINS TRANSFORMERS

FULLY GUARANTEED. Interleaved and Impregnated. Primaries 200-250v. 50c/s. Screened.

MIDGET CLAMPED TYPE 2⅝ × 2⅝ × 2¼in.

250v., 60mA, 6.3v. 2a.	14/11
250-0-250v., 60mA, 6.3v. 2a.	15/11

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250v. 60mA, 6.3v. 2a., 0-5-6.3v. 2a.	19/9
250-0-250v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	33/9
300-0-300v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	33/9
300-0-300v. 130mA, 6.3v. 4a., c.t., 6.3v. 1a. For Mullard 510 Amplifier	41/9
350-0-350v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	33/9
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
450-0-450v. 250mA, 6.3v. 4a., c.t., 5v. 3a.	79/9

TOP SHROUDED DROP-THROUGH TYPE

250-0-250v. 70mA, 6.3v. 2a., 0-5-6.3v. 2a.	19/9
250-0-250v. 100mA, 6.3v. 3.5a.	21/9
250-0-250v. 100mA, 6.3v. 2a., 6.3v. 1a.	22/9
350-0-350v. 80mA, 6.3v. 2a., 0-5-6.3v. 2a.	23/9
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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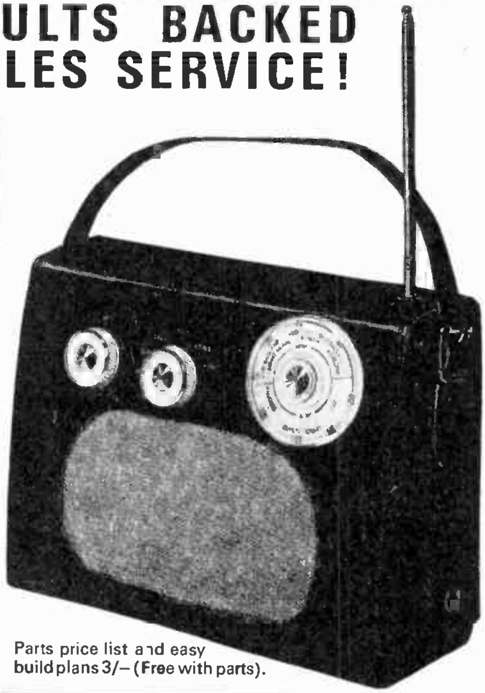

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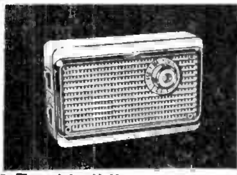

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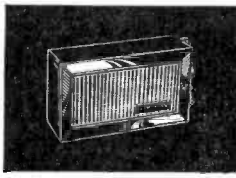

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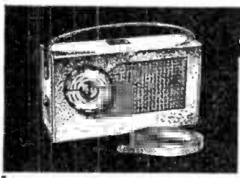
MELODY SIX



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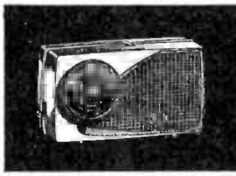
MELODY MAKER 6



THREE WAVEBAND PORTABLE WITH 3in. SPEAKER

Smart pocket size case, 6¼ x 3¾ x 1¼in. with gilt fittings. Fully tunable over both Medium and Long Waves with extra M.W. band for easier tuning of Luxembourg, etc. 8 stages—6 transistors and 2 diodes, top grade 3in. speaker, 2 R.F. stages for extra boost, high "Q" ferrite rod aerial. Easy build plan and parts price list 2/- (FREE with parts).

Total building costs **69/6** P. & P. 3/6

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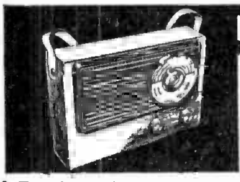

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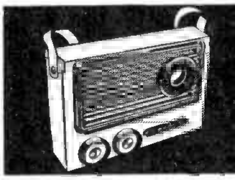

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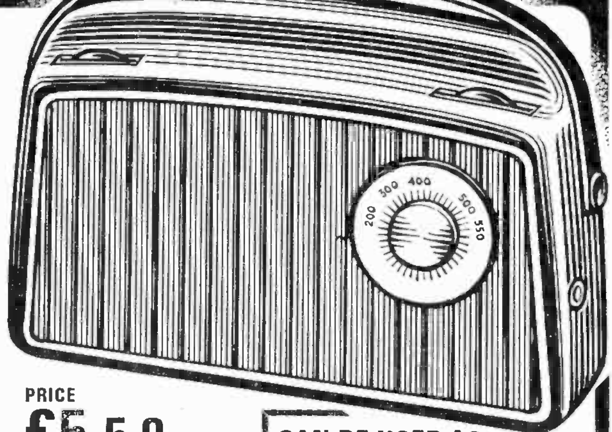

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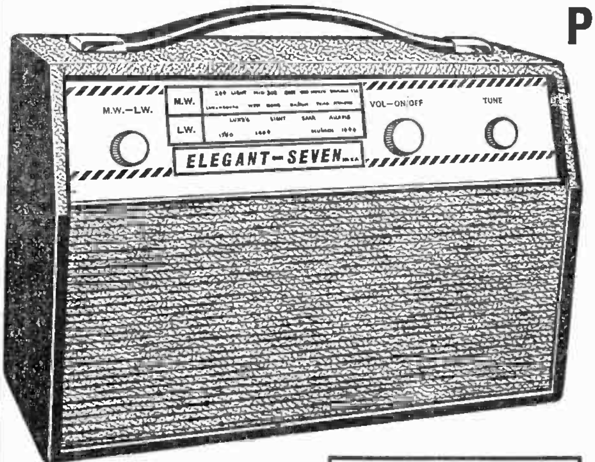

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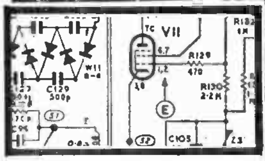
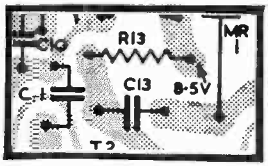
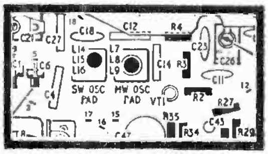


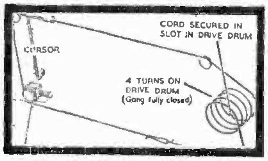
Circuit diagrams



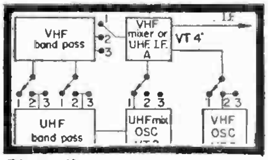
Printed panel diagrams



Component layout diagrams



Drive-cord diagrams



Block diagrams

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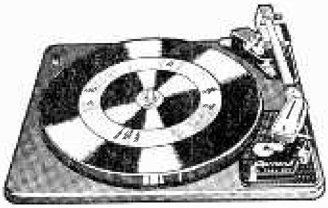

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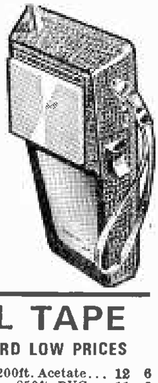

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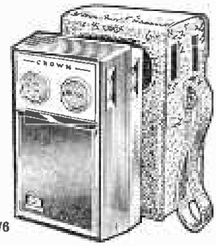

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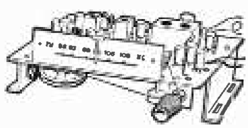

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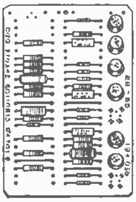
In metal case size 4×6×1¾in. Fully tunable—complete with PC86 and PC88 valves.

LASKY'S PRICE 29/6 Without valves 7/6

LASKY'S FOR SPEEDY MAIL ORDER SERVICE

PRINTED CIRCUITS



Five assorted printed circuit boards with transistors, diodes, resistors, condensers, etc. Guaranteed minimum 20 transistors. Ideal for experimenters. 5 boards for 10/-. P. & P. 2/-.

★ TRANSISTORISED FM TUNER ★

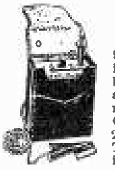
6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6×4×2½in.. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88–108Mc/s. Ready built ready for use. Fantastic value for money. £6.7.6. P. & P. 2/6. Stereo multiflex adaptors 5 gns.

CATALOGUE

★ ELECTRONIC COMPONENTS
★ TEST EQUIPMENT
★ COMMUNICATIONS EQUIPMENT
★ HI-FI EQUIPMENT

We are proud to introduce our first comprehensive catalogue of Electronic Components and equipment. Over 150 pages fully illustrated, listing thousands of items, many at bargain prices. Free discount coupons with every catalogue. Everyone in electronics should have a copy.

F.M. WIRELESS MICROPHONES



94–104Mc/s. Transistorised. Operates from 9V battery. Complete with additional secret tie-clip microphone. List £12.10.0 ONLY £6.15.0. P. & P. 2/6.
These cannot be operated in U.K.

AVOMETERS

Supplied in excellent condition, fully tested and checked. Complete with prods, leads and instructions.

Model 47A £9.19.6.
Model 7 £13.10.0.
Model 8 £18.
Model 9 £20.
P. & P. 7/6 each.

MODEL TE.80. 20.000 O.P.V. MULTIMETER

0/10/50/100/500/1,000v A.C. 0/5/25/50/250/500/1,000v D.C. 0-50µA. 5/50/500mA. 0/6k/60k/600k/6 meg. £4.17.6. P.P. 3/-

TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20c/s to 200 Kc/s on 4 bands. Square: 20c/s to 30Kc/s. Output impedance 5,000 ohms, 200/250V A.C. Supplied brand new and guaranteed with instruction manual and leads, £15. Carr. 7/6.

CLEAR PLASTIC PANEL METERS

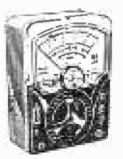
First grade quality Moving Coil panel meters available ex-stock. S.A.E. for illustrated leaflet. Discounts for quantity. Available as follows: Type MR 38P, $1^{21}/_{32}$in. square fronts.

100-0-100µA 37/6	200mA 25/-	100V D.C.....25/-
500-0-500µA 25/-	300mA 25/-	150V D.C.....25/-
1-0-1mA 25/-	500mA 25/-	300V D.C.....25/-
1mA 25/-	750mA 25/-	500V D.C.....25/-
2mA 25/-	1A D.C......25/-	750V D.C.....25/-
5mA 25/-	2A D.C......25/-	15V A.C......25/-
10mA 25/-	5A D.C......25/-	50V A.C......25/-
20mA 25/-	3V D.C......25/-	150V A.C.....25/-
50mA 25/-	10V D.C.....25/-	300V A.C.....25/-
100mA 25/-	20V D.C.....25/-	500V A.C.....25/-
150mA 25/-	50V D.C.....25/-	'S' meter 1mA 29/6

50µA 37/6
100µA 35/-
200µA 32/6
500µA 27/6
50-0-50µA 35/-

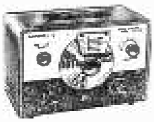
POST EXTRA. Larger sizes available—send for lists.

NEW MODEL 500



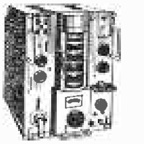
30,000 o.p.v. With overload protection, mirror scale 0·5/1/2·5/10/25/100/250/500/1,000V D.C. 0/2·5/10/25/100/250/500/1,000V A.C. 0/50µA/5/50/500mA 12A D.C. 0/60kΩ/6/60MΩ. £8.17.6. Post Paid.

TE-20RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120Kc/s–260 Mc/s on 6 bands. Directly calibrated Variable RF attenuator. Operation 200/240V A.C. Brand new with instructions £12.10.0. P. & P. 7/6. S.A.E. for details.

ADMIRALTY B.40 RECEIVERS

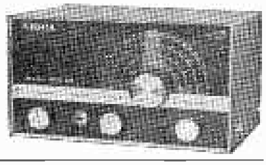


Just released by the Ministry. High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 650 Kc/s–30 Mc/s. I.F. 500 Kc/s. Incorporates 2 R.F. and 3 I.F. stages, bandpass filter, noise limiter, crystal controlled B.F.O., calibrator. I/F. output, etc. Built-in speaker, output for phones. Operation 150/230 volt A.C. Size 19½ x 13¼ x 16in. Weight 114 lbs. Offered in good working condition. £22.10.0. Carr. 30/-. With circuit diagrams. Also available B.41 L.F. version of above. 15 Kc/s–700 Kc/s., £17.10.0. Carr. 30/-.

MODEL ZQM TRANSISTOR CHECKER

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

UNR-30. 4-BAND COMMUNICATION RECEIVER



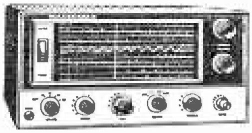
Covering 550 Kc/s—30 Mc/s. Incorporates variable BFO for CW/SSB reception. Built in speaker and phone jack. Metal cabinet. Operation 220/240v. A.C. Supplied brand new, guaranteed with instructions. Carr. 7/6. **£12.10.0**

LAFAYETTE TE46 RESISTANCE CAPACITY ANALYSER

2 pF–2,000 mfd 2 ohms 200 megohms. Also checks impedance, turns ratio, insulation, 200/250V A.C.

Brand New £15. Carr. 7/6.

NEW LAFAYETTE MODEL HA-700 AM/CW/SSB AMATEUR COMMUNICATION RECEIVER



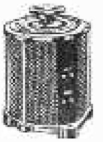
8 Valves, 5 bands incorporating 2 MECHANICAL FILTERS for exceptional selectivity and sensitivity. Frequency coverage on 5 bands 150–400 Kc/s, 550/1,600 Kc/s, 1·6–4·0 Mc/s, 4·8–14·5 Mc/s, 10·5–30 Mc/s. Circuit incorporates R.F. stage, aerial trimmer, noise limiter. B.F.O. product detector, electrical bandspread, S meter, slide rule dial. Output for phones, low to 2kΩ or speaker 4 or 8Ω. Operation 220/240V A.C. Size 7¾ x 15 x 10in. Supplied brand new and guaranteed with handbook 36 GNS. Carr. 10/-. S.A.E. for leaflet.

R.C.A. AR88 SPEAKERS

8in. 3 ohm speakers in metal case. Black crackle finish to match our 88 Receivers. Available Brand New and Boxed with leads. 59/6. Carr. 7/6.

VARIABLE VOLTAGE TRANSFORMERS

Brand New—fully Shrouded. Input 230V 50/60c/s. Output 0-260 Volts.



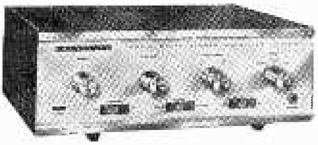
1A..........	£5.10.0
2·5A........	£6.15.0
5A..........	£9.15.0
8A..........	£14.10.0
10A.........	£18.10.0
12A.........	£21.0.0
20A	£37.0.0

Post extra.

ARF-100 COMBINED AF-RF SIGNAL GENERATOR

AF. SINE WAVE 20–200,000 c/s. Square wave 20–30,000 c/s. O/P HIGH IMP. 21V P/P 600Ω 3·8V P/P. TF 100Kc/s–300 Mc/s. Variable R.F. attenuation int/ext. modulation. Incorporates dual purpose meter to monitor AF output and % mod. on R.F. 220/240V A.C. £27.10.0. Carr. 7/6.

LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER



19 transistors, 8 diodes, IHF music power, 30W at 8Ω. Response 30–20,000±2dB at 1W. Distortion 1% or less. Inputs 3mV and 250mV. Output 3–16Ω. Separate L. and R. volume controls. Treble and bass control. Stereo phone jack. Brushed aluminium, gold anodised extruded front panel with complimentary metal case. Size 10½ x $3^{9}/_{16}$ x $7^{13}/_{16}$in. Operation 115/230V A.C. £25. Carr. 7/6.

SILICON RECTIFIERS

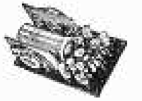
200V P.I.V. 200mA................	2/-
200V P.I.V. 6A....................	5/6
400V P.I.V. 3A....................	7/6
1,000V P.I.V. 5A..................	7/6
400V P.I.V. 6A....................	5/6
400V P.I.V. 8A....................	7/6
1,000V P.I.V. 650mA	6/6
800V P.I.V. 500mA.................	5/6
800V P.I.V. 5A....................	7/6
400V P.I.V. 500mA.................	3/6
70V P.I.V. 1A	3/6
150V P.I.V. 165mA.................	1/-
150V P.I.V. 25A	19/6
700V P.I.V. 100A..................	49/6
400V P.I.V. 3A (S.C.R.)...........	7/6
100V P.I.V. 5A (S.C.R.)...........	13/6
200V P.I.V. 5A (S.C.R.)...........	15/6
400V P.I.V. 5A (S.C.R.)...........	17/6

Discounts for quantities. Post extra.

TE-65 VALVE VOLTMETER

High quality instrument with 28 range. D.C. volts 1·5–1,500V A.C. volts 1·5–1,500V Resistance up to 1,000 MΩ. 220/240V A.C. operation. Complete with probe and instructions. £15. P. & P. 6/-. Additional probes available: R.F. 35/-, H.V. 42/6.

SINCLAIR EQUIPMENT



Z12 12 watt amplifier, 89/6. PZ4 Power Supply Unit 99/6. Stereo 25 Preamp., £9.19.6. Q14 Speakers, £6.19.6. Micromatic Radio Kit, 49/6. Built 59/6. Micro FM Radio Kit £5.19.6. All Post Paid.

SPECIAL OFFER

2 Z12 Amps., PZ4 Power Supply, Stereo 25 Preamplifier, **£22**

G.W. SMITH & CO (RADIO) LIMITED

Phone: GERRARD 8204/9155
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

PRACTICAL WIRELESS

VOL 43 No 12

issue 734

APRIL 1968

TOPIC OF THE MONTH

Top of the Pops

READERS with good memories may recollect that it was exactly one year ago that we began a series of articles destined to head the P.W. Top Ten. It ran for six issues and now returns for a second run, still using the title "Repairing Radio Sets".

The new series, while continuing the successful formula of alternating articles on theory and practice, leaves aside valves and gets down to the servicing of transistor equipment.

From time to time, as our budget allows, we like to present readers with the occasional bonus. Last April, the servicing series was launched with a fault-finding record; this time we have devised some very novel fault-finding charts, one of which is contained in this issue and the other next month. The charts can be used independently or in conjunction with the complete series of articles to be published.

While it is obviously impossible to tabulate every possible fault which can occur in a transistor radio set or amplifier it will be clear from the Symptoms Chart issued this month that we have at least tried! From the nine main symptoms "blocks", the user is guided to more specific symptoms which total almost one hundred.

The key reference numbers relate to 21 lines of approach to trace the offending component(s). This part of the process—diagnosis in detail—is covered in the chart presented next month, which will show recommended checking procedures for each group of faults, amounting to well over one hundred different possibilities to try.

Apart from their practical value in actual fault-finding, the charts can be used as a source of training for the lesser experienced, since by following the flow lines of checking procedures a good deal can be gleaned on the correct approach to tackling faulty equipment. For it is just as important, if not more so, to know *why* a fault produces certain symptoms than to actually locate the source of trouble.

And just in case there are readers whose sets never go wrong we have also included a set of panel labels this month! Just peel off the ones you want and press into position—no additional adhesive is necessary. If you have a lot of gear that needs smartening up we have a limited supply of extra sheets available at 2s. 6d. each.

W. N. STEVENS—*Editor.*

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

MAY ISSUE WILL BE PUBLISHED ON APRIL 5th

NEWS AND COMMENT...

STEREO TRANSISTOR TAPE RECORDER

Daystrom Ltd., Gloucester, have now developed their STR-1 portable transistor stereo tape recorder. It has an 18 transistor circuit and records $\frac{1}{4}$ track stereo or mono at $1\frac{7}{8}$, $3\frac{3}{4}$ and $7\frac{1}{2}$ i.p.s. A moving coil record level meter is used and a digital counter with zero reset is standard fitting. Two 8 x 5in. speakers are employed and the amplifiers give 4W r.m.s. output per channel. Supply voltage is 230V a.c.

In kit form the STR-1 costs £45 18s. and if a ready-to-use model is required, the cost is £59 15s. Delivery in the UK is free.

NEW EQUIPMENT FOR THE R.A.F.

The Royal Air Force has accepted delivery of new radar equipment having a high immunity to any confusion caused by electronic attack and designed to scan the skies of the United Kingdom and the adjacent airspace. It is located at R.A.F. Station Staxton Wold, Yorks.

This radar, the largest ever delivered to the R.A.F., has been designed, developed, manufactured, installed and commissioned by Associated Electrical Industries (Electronics Group) under the direction of the Ministry of Technology. The Royal Radar Establishment at Malvern have co-operated throughout the development with A.E.I. who have been continuously involved in the design and production of defence radar systems for the Government since, as Metropolitan Vickers, they designed and built the world's first operational radar transmitters. It was these that helped win the Battle of Britain.

£50,000 FOR A RADIO STATION

It is reported that Manx Radio, frequently described as the only legal radio station in the British Isles, has been acquired at a cost of £50,000 by the Isle of Man Government.

The Manx Government is planning to increase coverage of the station to the UK mainland. The original licence, negotiated with the GPO restricted coverage substantially to the Isle of Man.

This station was formerly owned jointly by Pye and Mr. Richard Meyer and is said to have made a profit of £4,400 in the half-year to the end of September.

ROYAL NAVAL AMATEUR RADIO SOCIETY

Membership of the R.N.A.R.S. is open to serving and past members of the Royal Navy, Commonwealth Navies and their associates (R.F.A. service, Sea Cadets etc.).

The headquarters station, G3BZU is on 7,071kc/s ±5kc/s between 1200 and 1300 weekdays and 3,520kc/s at 2000 on the first Tuesday of each month.

The Society conducts Morse code proficiency transmissions at 3,520kc/s at 2000 on the first Tuesday of each month at speeds of 20, 25, 30, 35 and 40 w.p.m. and a proficiency certificate is issued for 100% copy of a particular speed.

The Society also runs an award scheme—the "Mercury" award—and its members are invited to join in on the C.H.C. Nets on 40m each Sunday.

Further details of the Society can be obtained from G3JFF, Hon. Secretary, R.N.A.R.S., H.M.S. Mercury, Leydene, Petersfield, Hampshire.

STEREO SOUND LINKS

The Post Office and the BBC have apparently agreed to arrangements under which the BBC will distribute to its stations, stereo sound programmes.

It is believed that present plans call for such links as far north as Holme Moss. Additionally, some localised arrangements include BBC microwave links for colour TV.

The stereo sound links will allow the extension to the North and Midlands of the stereo sound service. These should have been ready at the end of March but have been delayed for some weeks because of the severe January weather which delayed work on the buildings intended to house the microwave equipment.

SEMICONDUCTOR LITERATURE

Westinghouse Brake and Signal Company Ltd., 82 York Way, King's Cross, London, N.1 announce three new publications describing Westinghouse semiconductors. They are 26-127, 26-128 and 26-138 which describe additions to the extensive range of Westinghouse medium power thyristors with current ratings of 25A, 30A and 65A respectively and voltages from 100 to 1200V.

Engineering Publication 25-20 provides revised data on the well established 200A silicon diode type SxBN200, and 25-42 describes a new low power miniature silicon diode, encapsulated in an epoxy resin case, rated at 500mA with voltages of 100 to 1000V.

SWITCHES THAT RESPOND TO FREQUENCY

The Industrial Instrument Division of Smiths Industries Ltd., Kelvin House, Wembley Park Drive, Wembley Park, Middx. have designed a range of frequency-sensitive switches, responding to a signal of varying frequency.

Switches are available for over and under-speed protection and to give a signal when the frequency falls below a predetermined value.

The basic switch unit has been designed to operate with a suitable follow-up relay and will continue to give a 24V d.c. output signal until the predetermined frequency is reached. At the required level, the output voltage ceases, de-energises the relay and indicating alarm or shut-down action.

NEWS AND COMMENT...

NEW REFERENCES AVAILABLE

A series of seven selection guides and cross reference charts covering a wide range of semiconductor devices is now available from Motorola Semiconductors Limited.

The series covers Zener diodes and temperature compensated reference diodes; silicon power transistors; thyristor products; germanium p-n-p power transistors; unibloc plastic silicon annular transistors; silicon power rectifier assemblies; unibloc plastic small-signal transistors.

The guides feature characteristics, performance and case configurations of the most popular devices.

All but two of the guides (silicon power rectifier assemblies and thyristor products) contain cross reference charts which give EIA type numbers against Motorola replacements, with one column listing industry preferred types recommended for new designs and another giving available types not recommended for new designs.

The publications are available on application to: The Technical Information Centre, Motorola Semiconductors Limited, York House, Empire Way, Wembley, Middlesex.

SOUND AND SCIENCE CATALOGUE

A new 90-page catalogue costing 3s. 6d. has just been published by Sound & Science Limited, 3–5 Eden Grove, London, N.7, pioneers in the Science-Hobby field in the U.K.

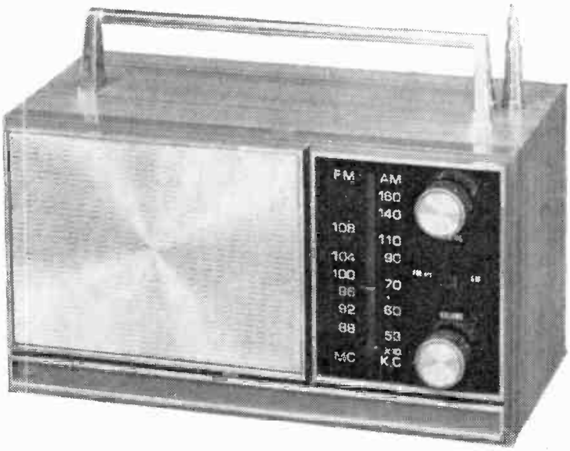
It is the biggest catalogue yet from Sound & Science, containing more than 20 separate sections listing over 500 items of hobby and do-it-yourself equipment, much of which is available in varying degrees of sophistication to satisfy all age-groups: microscopes, for example, are priced from 42s. for a small but effective hand-held model to £98 for an advanced, industrial-standard instrument.

COMARK RESISTANCE METER

The Resistance Meter Type 220 just released by Comark Electronics Limited will measure resistance on a linear scale from 1mΩ f.s.d. to 300kΩ in 18 ranges. By using a stable external current supply, the range of the instrument may be extended to give sensitivities of 300μΩ, 100μΩ and 30μΩ f.s.d. A very low test voltage is employed, eliminating self-heating effects and permitting measurements on very low dissipation components.

The instrument is in production and available with delivery of 8 weeks from receipt of order at a cost of £47 from Comark Electronics Ltd., Gloucester Road, Littlehampton, Sussex.

MORE F.M. FROM H. O. THOMAS



H. O. Thomas Electronics Ltd., 26/27 Avenue Chambers, Vernon Place, London, W.C.1 have introduced the Wein 9, a battery/mains receiver housed in a wood case and covering v.h.f. and medium waves.

The circuit comprises 10 transistors, 4 diodes and 1 selenium rectifier. Tuning range is 88–108Mc/s v.h.f. and 535–1605kc/s m.w. Output power is 400mW maximum. A built-in swivel telescopic aerial is provided for f.m. reception. Dimensions are $7\frac{1}{16}$ x $3\frac{15}{16}$ x $3\frac{3}{4}$in. and power requirements are 6 x 1·5V Ever Ready HP5 or equivalent or 220–240V a.c. mains (an adaptor is built-in).

Retail price is $13\frac{1}{2}$ guineas complete with batteries and earpiece.

COUNTING AND COUNTING CIRCUITS BOOK FROM MULLARD

A new Mullard publication—*Electronic Counting: circuits, technique, devices*—reflects the revolution that has taken place in the fundamental industrial operation of electronic counting. The book deals with all aspects of electronic counting, giving emphasis to the use of integrated circuits, transistors and semiconductor diodes.

Copies can be obtained for 27s. 6d. plus 1s. 6d. for packing and postage from Distributor Sales Division, Mullard Limited, Mullard House, Torrington Place, London, W.C.1, or from any Mullard Industrial Distributor.

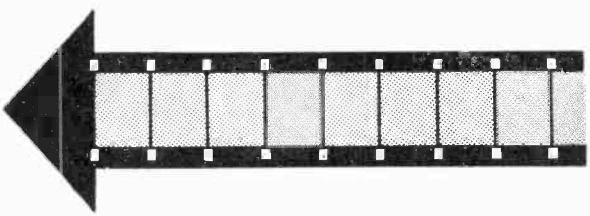
"PRACTICAL WIRELESS"
and
"PRACTICAL TELEVISION"
FILM SHOW
(In collaboration with Mullard Ltd.)

Caxton Hall, Caxton Street, London, S.W.1.
(Great Hall Site)

Friday, 29th March, 1968
7.15 p.m. Sharp

In the Chair: W. N. Stevens
Editor: *"Practical Wireless"* and *"Practical Television"*

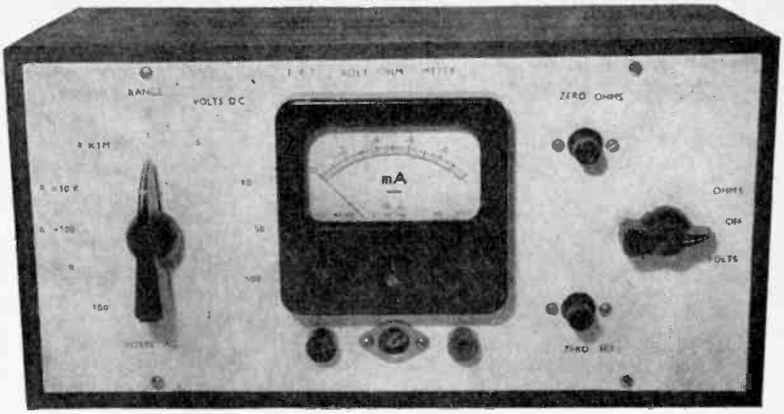
GET YOUR FREE TICKET



Send **large** *s.a.e., minimum 5 x $3\frac{1}{2}$in., to: Practical Wireless, Film Show, Tower House, Southampton Street, London, W.C.2.*

FET VOM

J.B.HORSLEY



A VALVE voltmeter with its high input resistance has many advantages over the ordinary test meter which has a comparatively low resistance and can give many misleading readings. However a valve voltmeter has certain disadvantages, its much greater initial cost, and the need for a mains supply, or in the case of a battery model the running costs of h.t. and l.t. batteries. Attempts at making a transistor high resistance voltmeter were not very successful due to the much lower input resistance of transistors and also the necessity of zero adjustments when changing from one voltage range to another.

With the advent of the field effect transistor (F.E.T.) with its very high input resistance and lower power requirements, a fresh attempt was made. A few 2N3819 F.E.T's were purchased, the circuit of Fig. 1 constructed and the following facts established:

1. Less than 0·5 volt was required to give an f.s.d. with all the F.E.T.'s tested. 2. The scale was linear using the basic 0-1mA meter. 3. No perceptible movement could be observed on the meter when the 10MΩ gate resistor was shorted to earth. 4. Lowering the power supply from 9·5 volts to 7·5 volts made little or no difference to the gate input sensitivity, and only a small adjustment of the zero control was needed. Thus there was no need for the extra expense of a zener diode stabilisation network.

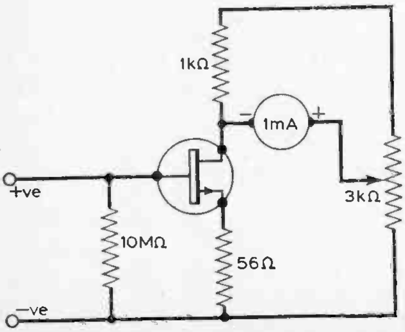
The finalised circuit is shown in Fig. 2. Five ranges of d.c. volts, three of a.c. volts, and four ranges of resistance are provided. The instrument being required only for work on transistor circuitry the highest range covered is 0—100 volts. The resistance coverage is very comprehensive from 1Ω to 1,000MΩ. Two types of output correction are provided, a coax one mainly used for voltage checks and a plug and socket type for resistor checks. The current drain is approx. 7—9mA.

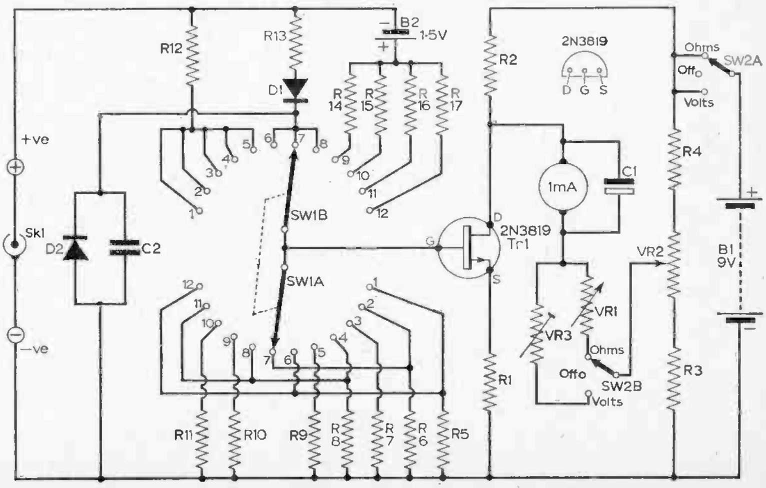
The front panel is a piece of white plastic 10 x 5 x ⅛in. This is drilled as shown in Fig 3. The meter, two switches, two pots and the three sockets are screwed on to the panel. A small stand-off bracket (Fig. 4) on which to mount the tagboard is made and drilled, and this is screwed on to the back of the meter using the meter connection terminals, two 4BA solder tags being fitted under the screws. The tagboard can now be wired up as shown in Fig. 7. At this stage it is advisable to wire up SW1 using 9in. lengths of plastic covered single strand wire and using as many different colours as possible. This makes for easier identification when connecting to the tagboard. The tagboard is now fixed on to the stand-off bracket using two 4BA 1½in. long bolts as shown in the photograph.

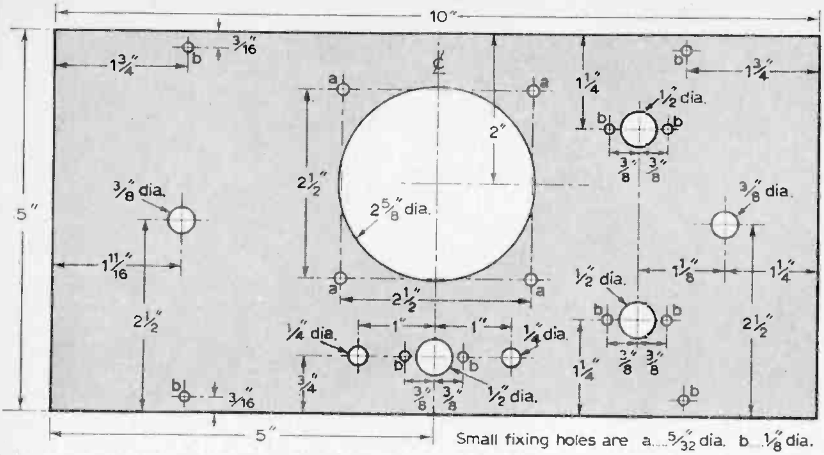
A battery housing for the 1½V cell is made using a small piece of plastic and three Terry clips (Fig. 6), one clip being used to hold the battery and the other two cut down to form spring battery connections. The housing is then glued to the panel above SW1A/SW1B with impact adhesive. The battery holder is wired up to the tagboard and the

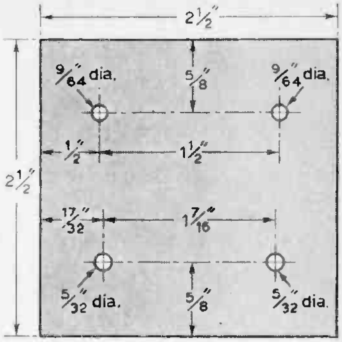
Fig. 1: Circuit used to establish basic design.

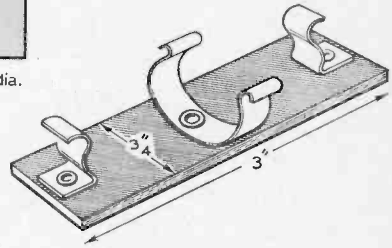
Fig. 2: Complete circuit of the Field Effect Transistor Volt—Ohm Meter.











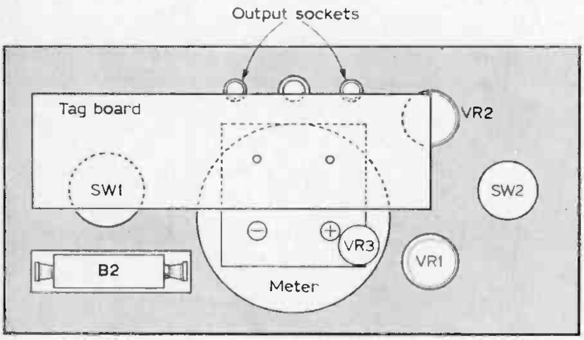


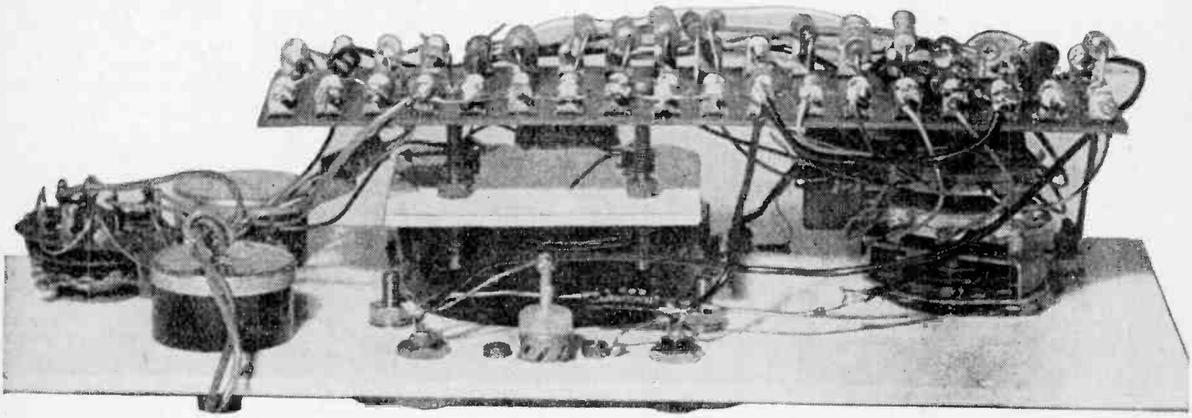
Fig. 3: Front panel drilling details.

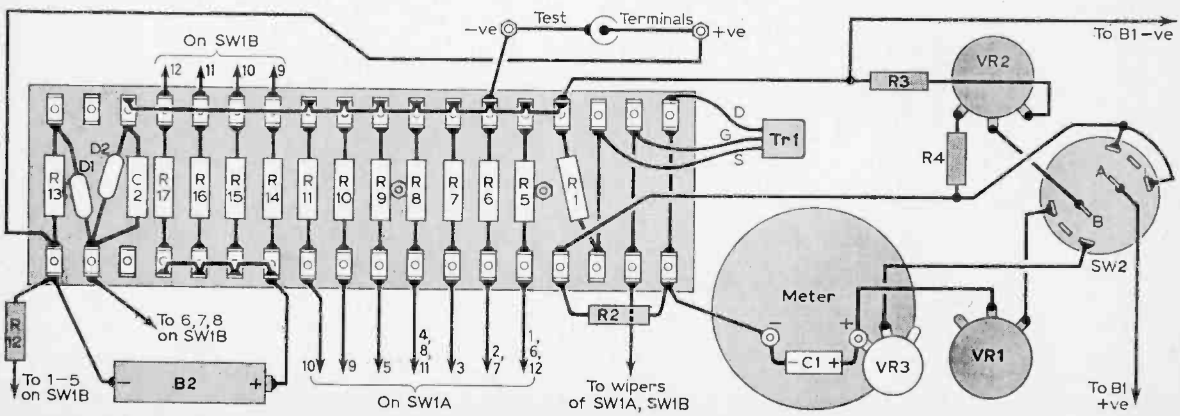
Fig. 4: Details of the plastic stand-off bracket.

Fig. 5: Layout of main components viewed from rear.

Fig. 6: Battery housing for the 1·5 volt cell.

Fig. 7: Wiring diagram of the tagstrip.



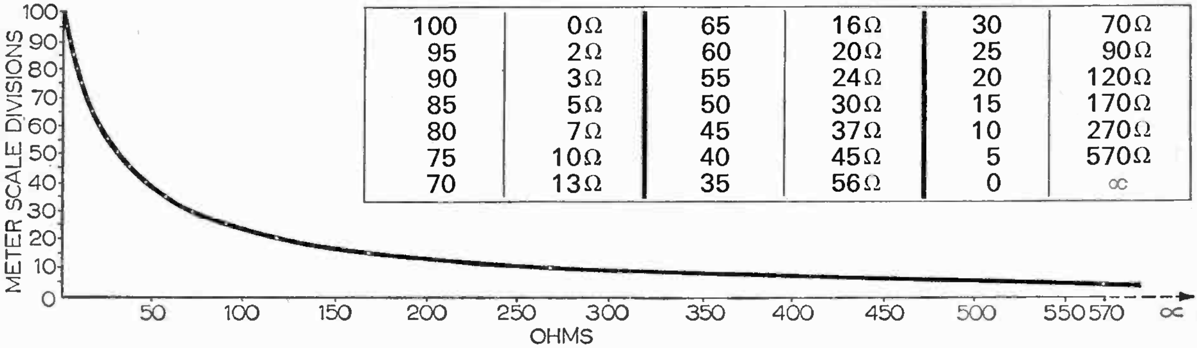


unit is now ready for testing and calibrating.

Place the battery B2 in its holder and connect up B1. Turn the switch (SW2) to volts and adjust the ZERO SET control to zero the meter. This should happen near the centre position of the track. If the zero position can be found only with the control near either end of its track, the value of R1 should be altered. Values between 22 and 100Ω should be tried.

A known d.c. voltage between 0 and 100 volts should be applied to the test terminals, with the range switch set to the appropriate position. Preferably the voltage should be one that would give f.s.d. or near f.s.d. on the range selected, i.e. on the 10 volt range a test voltage of between 8 and 10V would be suitable. The internal preset VR3 can now be adjusted to show the correct reading on the meter. The instrument is now calibrated on all of its voltage ranges. SW2 is now turned to the OHMS position and the range switch SW1 to R x 1MΩ. The test leads are inserted and the leads shorted together. The panel ZERO OHMS control VR1 is adjusted to read zero (f.s.d. on the meter). The other OHMS ranges are tested in the same way.

The cabinet can now be constructed using simple butted joints, panel pinned and glued with contact adhesive. Two pieces of $\frac{3}{8}$in. square wood $2\frac{3}{8}$in. long may be glued into the cabinet to hold the battery B1 in position. Square wood ($\frac{3}{8}$in.) can also be fixed around the inside of the cabinet and set $\frac{1}{8}$in. in, this being the mounting for the front panel. With the cabinet painted dull black, and transfer-type signs being used on the front panel the instrument will have a professional look.



100	0Ω	65	16Ω	30	70Ω
95	2Ω	60	20Ω	25	90Ω
90	3Ω	55	24Ω	20	120Ω
85	5Ω	50	30Ω	15	170Ω
80	7Ω	45	37Ω	10	270Ω
75	10Ω	40	45Ω	5	570Ω
70	13Ω	35	56Ω	0	∞

Fig. 8: Graph and chart for calibrating the meter on the Ohms range.

Terminating a coax lead with crocodile clips is a tricky business and a neat and serviceable job very difficult to achieve. My way round this is to terminate both ends of the coax cable with coax plugs. A small ali can (the type Denco miniature coils are supplied in) is used. A coax socket being fixed to the lid. Two wires from the socket pass through a grommeted hole in the bottom of the can and are terminated with crocodile clips.

Intermediate values of either meter reading or resistance can be found by using the formula: $\frac{3{,}000}{30+Rx}=$ Deflection (0—100), or $\frac{3{,}000}{\text{Defl. (0–100)}}=30+$ Rx. No attempt was made to re-figure the meter scale as it was considered that the meter readings could easily be calculated with a little practice.

The range switch, as supplied, has a stop after the twelfth position. In use, this can be inconvenient, therefore, the lug on the switch assembly which prevents movement of the rotor from the twelfth to the first position should be punched flat to the switch plate.

★ components list

Resistors: ($\frac{1}{2}$ watt)

R1	56Ω 10%	R11	1kΩ 2%
R2	1kΩ 10%	R12	10MΩ 2%
R3	470Ω 10%	R13	10MΩ 2%
R4	470Ω 10%	R14	20Ω 2%
R5	10MΩ 2%	R15	2kΩ 2%
R6	1·1MΩ 2% (1MΩ+100kΩ)	R16	200kΩ 2%
		R17	20MΩ 2%
R7	526kΩ 2% (470kΩ+56kΩ)	VR1	1kΩ w/w. TV preset
		VR2	1kΩ w/w. TV preset
R8	100kΩ 2%	VR3	1kΩ carbon skeleton preset
R9	50kΩ 2%		
R10	10Ω 2%		

Semiconductors:

D1 EC401 } Electrovalue
D2 EC401 }
Tr1 2N3819

Capacitors:

C1 100μF 6V electrolytic
C2 0·04μF

Miscellaneous:

Tagboard 7 x 2in. 36 tags; flush-mounting coax socket; one pair plugs and sockets (red and black); two knobs; batteries—PP9 and U11; meter, 0–1mA MR65; 2P 12W switch ("Makaswitch"); 2P 2W switch; wire; solder, etc.

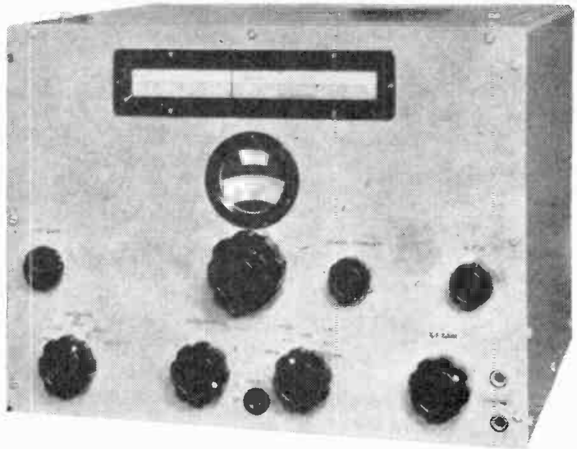
Ranges

Input resistance 10MΩ a.c. and d.c.

0–1V d.c.	0–10V a.c.
0–5V d.c.	0–100V a.c.
0–10V d.c.	RΩ
0–50V d.c.	R x 10^2Ω
0–100V d.c.	R x 10^4Ω
0–2V a.c.	R x 10^6Ω

The ranges of the completed instrument are quoted above for interested constructors to peruse at their leisure. ■

IMPROVING THE CR100



C. MOLLOY

THE Marconi CR100 communications receiver, often met under its Naval designation B28, was supplied in large numbers to the Services during the last war. It is currently available on the surplus market and often changes hands in amateur circles for as little as £15—a good buy for a coverage of 60kc/s to 30Mc/s with 2 r.f. stages, 3 i.f.s, a crystal filter, b.f.o., 200 to 250 volt internal mains power pack and an output capable of driving a loudspeaker. Numerous "mark" numbers of the receiver exist, the difference in the main being confined to the aerial sockets and the output stage. Mark 2 has a muting circuit with a "U" link for switching this facility in and out as required, otherwise the basic receiver is the same for all models.

Octal valves are used throughout, the receiver giving excellent results on low and medium frequencies though above 20Mc/s the performance falls off somewhat. It can be "hotted-up" considerably by fitting modern miniature valves in place of the octal types used in the r.f. stages. Further improvements include the provision of a tuning mV-meter, a front panel control for the noise limiter and modifications to the output wiring to allow a tape recorder and an external loudspeaker to be driven simultaneously.

Not only do modern miniature valves provide higher gain than their octal counterparts, their equivalent noise resistance and hence the internal noise generated is much lower. Valve noise becomes important at higher frequencies where signal noise is low. The noise generated within the first r.f. valve, being subject to the full amplification of the receiver, becomes a significant part of the total noise.

The 6BA6 chosen as a replacement for the KTW62 in the r.f. stages offers a good compromise between gain, noise and crossmodulation. Figure 1 is the circuit of the "front end" before modification, one set of coils only being drawn for the sake of clarity. The general layout of V1 and V2 below the chassis after modification is shown in Fig. 2. The bottom plate of the receiver is easily removed allowing access to the chassis without dismantling the cabinet. Adaptor plates (Fig. 3) are cut and drilled from sheet metal, being used to cover the space vacated by the octal holders thus helping to make a neat job as well as discouraging the flow of circulating air currents.

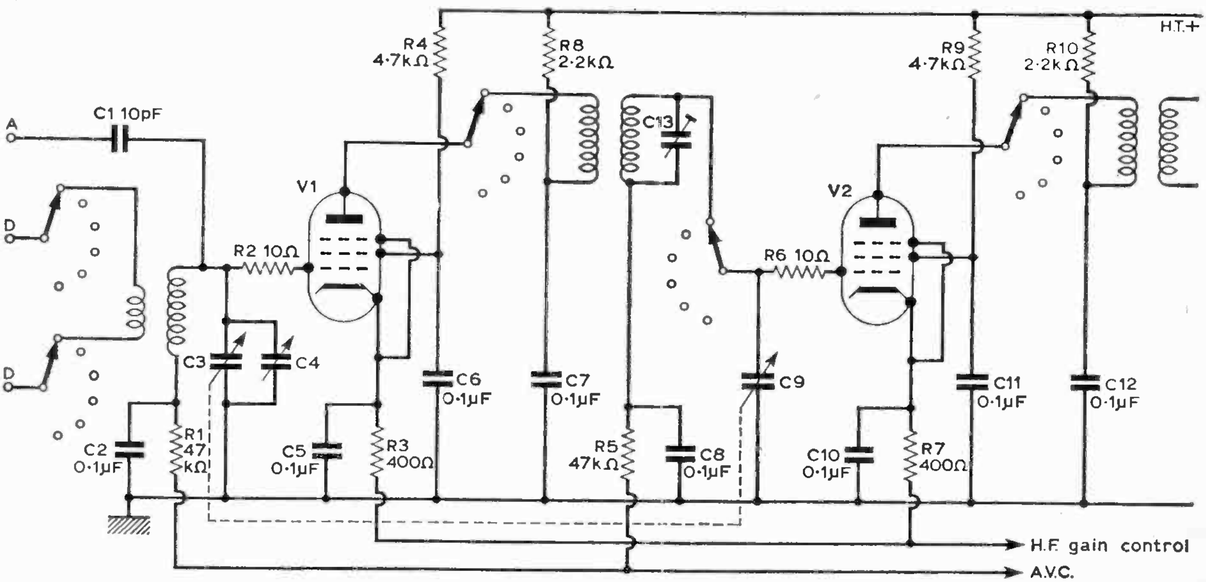


Fig. 1: R.F. stages before modification.

The only component changes required are R3 and R7 which are changed from 400Ω to 68Ω respectively. These resistors are mounted on a tag-strip adjacent to the valve holders (Fig. 2). Stand-off insulators are employed to terminate the free ends of the 10Ω grid stoppers R2 and R6, a small hole being drilled in the chassis beside each, enabling a screened lead to be run from the resistor to the appropriate section of the main tuning capacitor. Small tinplate screens are placed across the underside of the B7G valveholders in the position indicated in Fig. 2, and soldered to the chassis. Their purpose is to screen anode from grid to prevent instability.

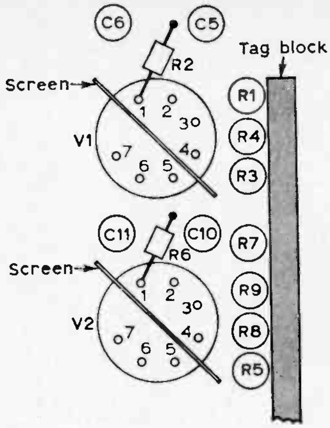
In order to improve the signal to noise ratio, the first r.f. valve is disconnected from both the a.v.c. line and the h.f. gain control and is run at maximum gain. To remove V1 from the a.v.c. line, cut the black lead from R1 and solder it to the chassis. This lead runs from the screened coil compartment at the rear of the receiver to the end of R1 nearest to the chassis. When the a.v.c. is removed it may be necessary, occasionally, to reduce the gain of V1 to prevent overloading. Unfortunately, the h.f. gain control adjusts the bias of both i.f. and r.f. valves and in effect is a combined r.f/i.f. gain control. Therefore, in order to prevent overloading at the r.f. and mixer stages one has to reduce i.f. gain as well as r.f. gain! To remedy this situation a separate gain control is provided for V1 by fitting a 2 to 5kΩ potentiometer between the cathode resistor of V1 and chassis. Remove the red lead from the outer end of R3 and run a wire from this tag to the new gain control connecting the other two tags of the potentiometer to chassis. The new r.f. gain control is situated on the front panel between the main tuning control and the h.f. gain control giving a more balanced appearance to the front panel layout. The front panel can be removed easily for drilling by taking off the control knobs and taking out the PK screws. On some models of the CR100 a hole is already drilled in this position with an unused bracket suitable for mounting a potentiometer, fixed to the chassis behind it. The circuit of the modified r.f. stages together with component values is given in Fig. 5. The writer carried out these modifications in stages, replacing V1 to start with, trying it out before proceeding.

Finally, the mixer and r.f. stages are re-aligned. Figure 6 gives the position of the cores and where fitted, the trimmers. During alignment, the operational switch is set to MOD MAN, the passband control to 3,000 cycles, and all 3 gain controls are set to maximum. The alignment frequencies are:

Band 1 60kc/s and 160kc/s
Band 2 160kc/s and 400kc/s
Band 3 400kc/s and 1400kc/s
Band 4 1·4Mc/s and 4Mc/s
Band 5 4Mc/s and 11M/cs
Band 6 11Mc/s and 30Mc/s

Alignment is carried out in the usual way, adjusting the cores at the l.f. end and the trimmers and the h.f. end of each band in turn.

Some mark numbers of the CR100 are provided with a noise limiter comprising an EB34 double diode valve, a 1MΩ resistor and a toggle on/off switch, all mounted on a small sub-chassis fixed to the top of the main chassis near the tuning capacitor. The switch is rather inconveniently situated as one has to open the hinged lid of the receiver



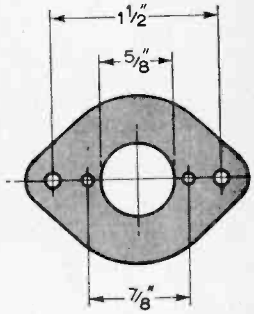


Fig. 2 (left): Below chassis layout of V1 and V2. Fig. 3: (right) Octal to B7G adaptor plate.

to obtain access to it with the consequent risk of shock. A simple but useful modification is to move the switch to the front panel (extending the wiring of course), a suitable location being above the b.f.o. control. The writer fitted a rotary type toggle switch here, wiring it in parallel with the existing switch which was left *in situ*. If this method is adopted be sure to leave the existing switch in the on position, otherwise the new panel control will be ineffective.

Only one diode of the EB34 is used by the noise limiter and a germanium diode can be substituted without loss of performance. An OA81 (CV448) is specified as this type is readily obtainable on the surplus market. It is wired across pins 3 and 4 of the octal valveholder (positive end to pin 3); the EB34 should be removed. The circuit of the noise limiter and its connections to the receiver are shown in Fig. 7.

As there is neither an S meter nor a magic eye on the CR100 the addition of a simple tuning indicator

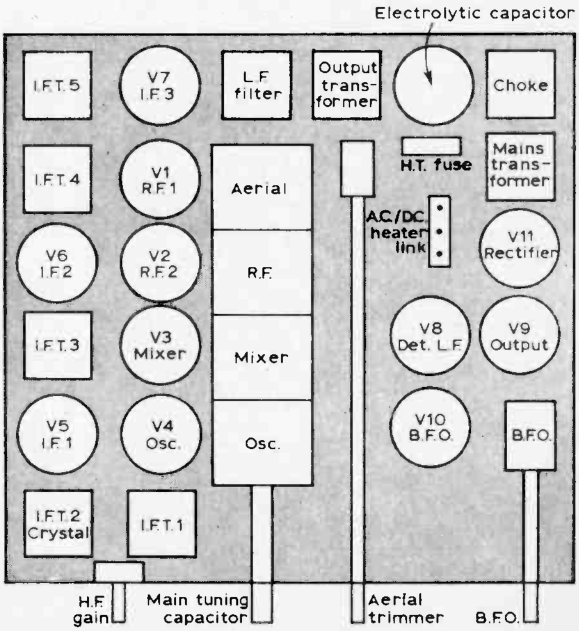


Fig. 4: Plan view of chassis.

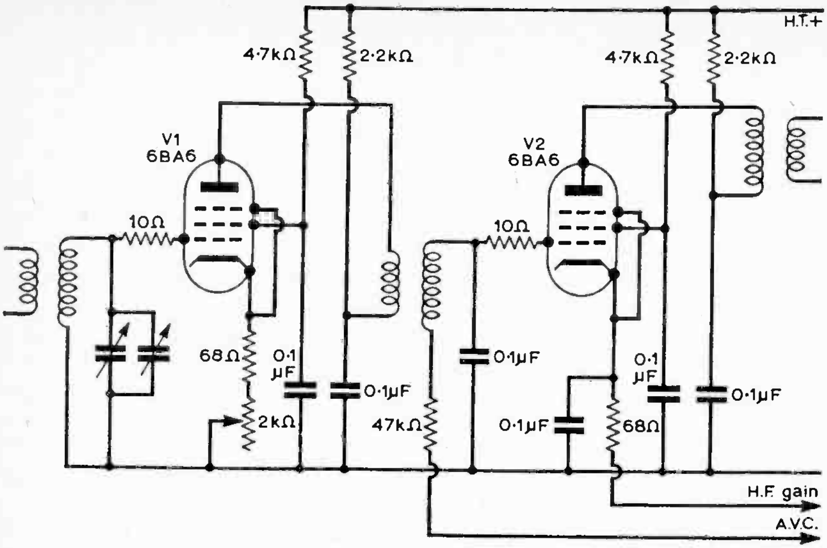


Fig. 5: R.F. stages after modification (switches omitted).

is worth while. No attempt was made to install an S meter since, in the opinion of the writer, the markings on such a meter would be largely meaningless unless some accurate method of calibration were available. A 5mA meter is used, shunted by a variable resistor, the two being placed in series with the anode of the second i.f. valve V6 (Fig. 8). The anode current is proportional to the a.v.c. voltage which in turn is proportional to the signal strength. The anode circuit of V6 is broken at the h.t. end of the 2·2kΩ resistor mounted on the tag block underneath the chassis beside the valve-holder, and leads are run from here to the tuning meter.

The meter is fitted to the front panel above the r.f. gain control space being left between them for the variable resistor which is the SET ZERO control. The meter is adjusted to full-scale deflection (5mA) in the absence of a signal, with the a.v.c. on and the r.f. and h.f. gain controls set to maximum. When a signal is tuned-in, the meter reading will decrease in value giving an indication of signal strength. A left-to-right indication is obtained by mounting the meter upside down, i.e. with the meter needle pointing downwards.

The two telephone-type sockets situated at the bottom right-hand corner of the front panel are connected in parallel and are suitable for high impedance headphones. One of them can be used for phones and the other, to drive a tape recorder. However, there are break-jacks associated with these sockets which, in some models, are wired to disconnect the loudspeaker output (situated at the rear of the receiver) whenever a plug is inserted. This means that a tape recorder and a loudspeaker cannot be used simultaneously. It is a simple matter to solder a short piece of wire as a strap across the break-jack tags associated with the lower socket. The upper socket is now the phones output, insertion of a plug disconnecting the loudspeaker as before while the lower socket is reserved for tape output. Figure 9 shows the wiring arrangement, the location of the two isolating capacitors and the wire strap.

An alternative arrangement is to remove the leads from the break-jack tags and extend them to a toggle switch mounted on the front panel this becoming the loudspeaker on/off switch. ■

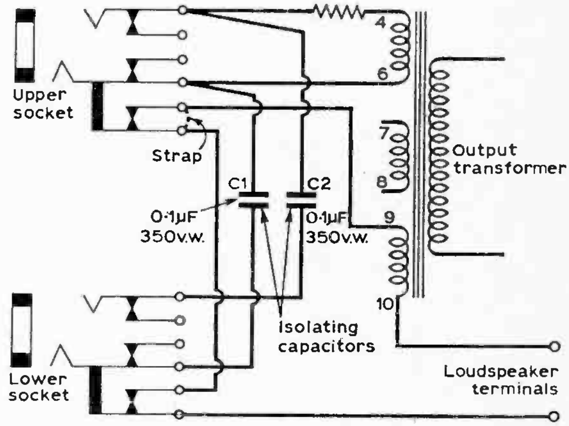


Fig. 9: Wiring of the phone sockets.

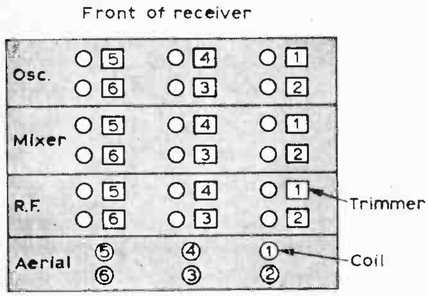


Fig. 6: Coil-pack layout.

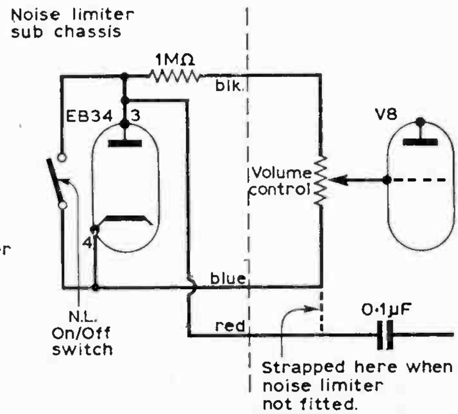


Fig. 7: Noise limiter.

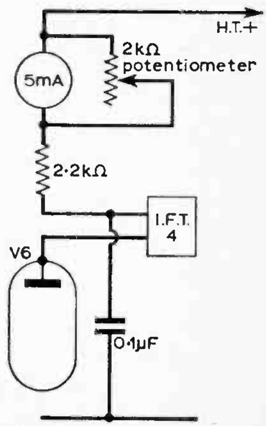
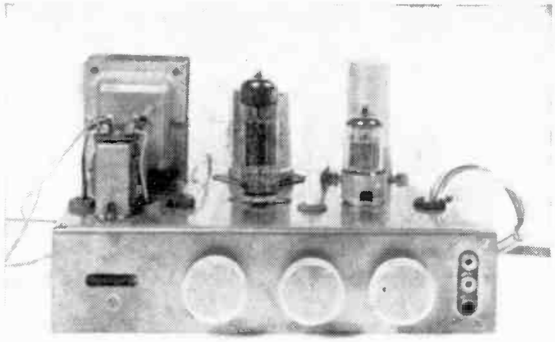


Fig. 8: Tuning meter.

THE RHODIAN TAPE RECORDER

PART 2

JULIAN ANDERSON



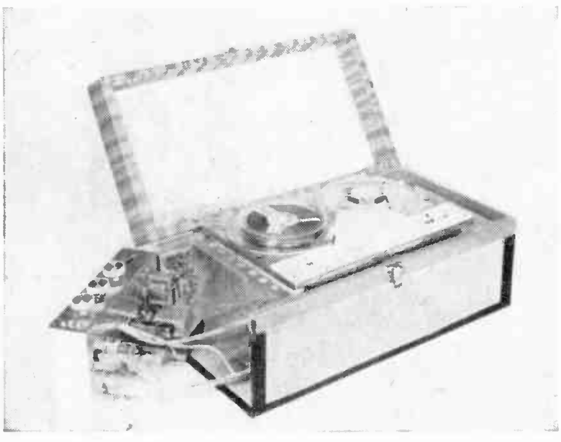
As mentioned last month, component layout is important in a tape recorder. Tagboard construction was chosen as it is the easiest way to keep a neat layout. The final arrangement for the major components and the control panel are shown in Figs. 5 and 6.

Using the chassis in this way the mains transformer is well away from the head, the leads to the function switch are kept short, and the high- and low-signal areas are separated.

Chassis details

The chassis is a standard size 8 x 5 x 2 in., and although constructed in the standard way is mounted in the recorder on its side, presenting one long side as the control panel. When fitted into the cabinet the underside of the chassis is exposed by removing a side panel of the cabinet. There was no intention to make the amplifier compact since this greatly complicates wiring, but the final layout is, even so, not spread out. Since the layout is designed to make working on it easy there are no interconnecting plugs and the wires to the deck switch are permanent.

Before construction begins the chassis must be drilled. The common sizes used in construction are used and only a B9A chassis punch is needed. The oblong holes to expose the magic-eye and for the input/output sockets can be drilled out and filed quite easily. The hole to take the wires to the switch needs to be fairly large since through it are carried four screened wires and three others. The hole to take the mains to the on/off switch and back to the motor also needs to be fairly large. All holes in the chassis should be protected by grommets. The drilling details are shown in Fig 9. H.T. smoothing capacitors are often a nuisance to mount, but paxolin adaptors to mount these in the same way as a valve base are readily available. All holes should be countersunk, especially on the control panel side.



The amplifier chassis is mounted beside the deck.

Construction

Once the chassis has been drilled the major components may be mounted leaving the mains transformer until last; to put it on first makes the chassis rather heavy and thus harder to handle. Note that the valve base for V1 should be the type to take a screening can. The h.t. rectifier is the only component mounted on the side of the chassis and this, being contact cooled, should be securely bolted using countersunk screws to keep the outside of the chassis flush. The audio sockets are mounted from underneath. Care should be taken to ensure that a plug will fit on to these since a clearance is necessary around the socket for the plug earth contact. Solder tags should be fitted at the same time as the main components to save effort later on.

The valve bases should be orientated as shown since the combination of this and the tagboard is designed for the shortest possible leads.

The volume and tone controls and the deck motor on/off switch may be mounted with the contacts facing the open side. A piece of wire should be soldered connecting their cases to earth to ensure they are properly at earth potential. The motor on/off switch used in the prototype is of the rotary kind and makes the final appearance more attractive,

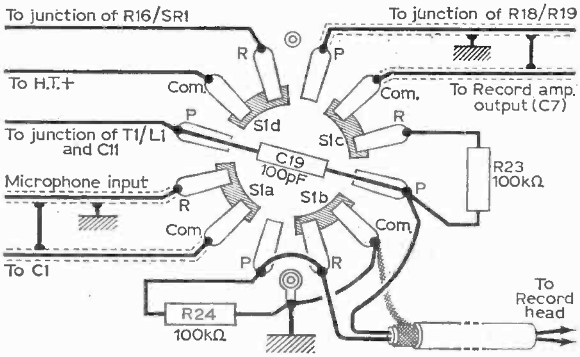
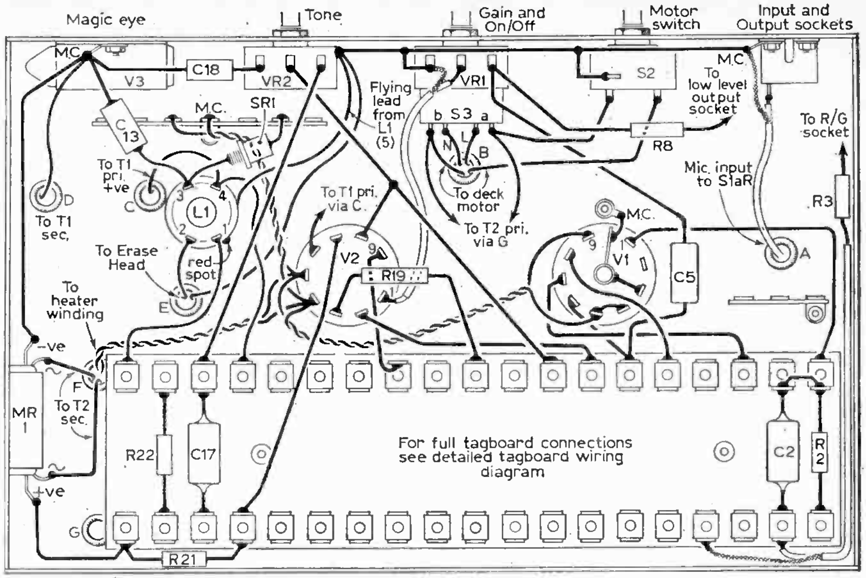


Fig. 4: Wiring to the record/playback switch S1.

but there is no reason why an on/off toggle switch need not be used.

The magic-eye should next be fitted. The DM70 has no valve base and is supplied with long leads. To mount this valve a small aluminium bracket, shown in Fig. 8, is needed. This curls around the back of the valve and pushes it on to the control panel where the cutout will stop it from sliding. The leads from the valve should be covered and soldered to the small 7-way tagstrip as shown in Fig. 8. Once this is completed the magic-eye and the tagstrip can be fitted.

Wiring can now begin. The mains lead is soldered to the double-pole on/off switch on the volume control, the other section



Note :– tags marked 'M.C.' are earthing connections to chassis

Fig. 5: Under view of amplifier chassis, showing wiring to main components. R19 should be mounted as closely to V2 pin 3 as possible.

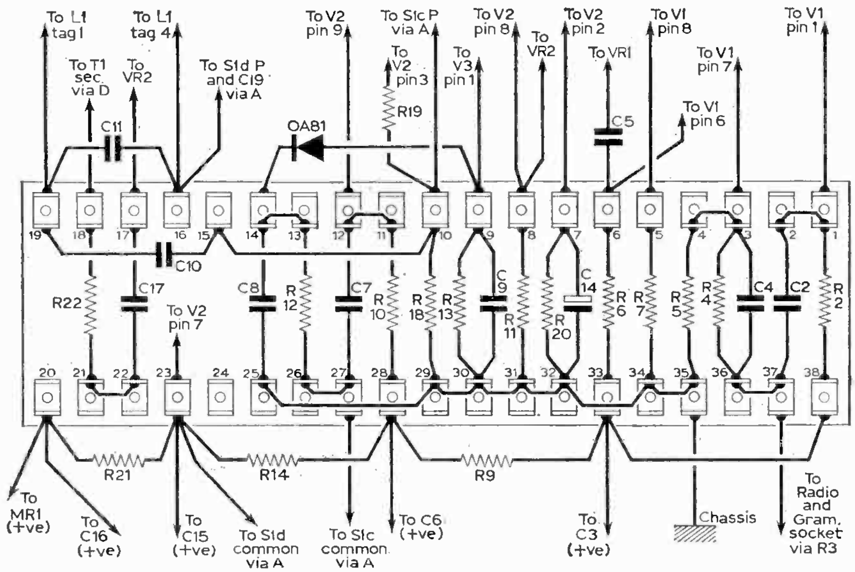


Fig. 6: Wiring of the main tagboard.

switch out through the same hole. The secondary of the mains transformer is taken to the rectifier contacts marked either a.c. or ~. The heater supply is connected to pins 4 and 5 of V2, and from here a parallel connection should be taken to the magic-eye tagboard already fitted and another parallel connection to pins 5 and 9 of V1, pin 4 also being connected to pin 5. One side of the heater line is earthed on to the magic-eye tagboard. Heater wires should be twisted together and laid close to the chassis to avoid hum. Only one other thing need now be done before the main tagboard is fitted. This is the small 3-way tagstrip

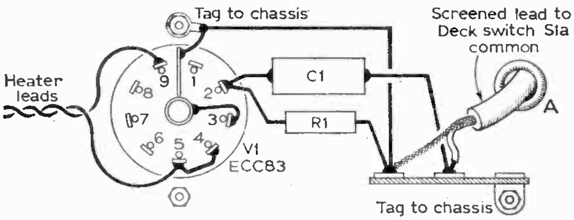


Fig. 7: Wiring to V1a grid tagstrip.

of the switch going to the primary of the mains transformer and to one contact of the motor switch. The mains lead to the motor is taken from the other contact of the motor switch and the double-pole

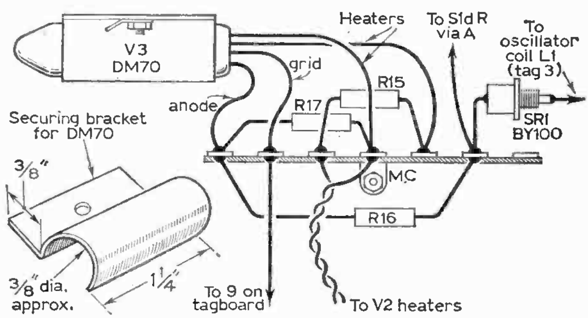


Fig. 8: Magic-eye tagstrip wiring and securing bracket details.

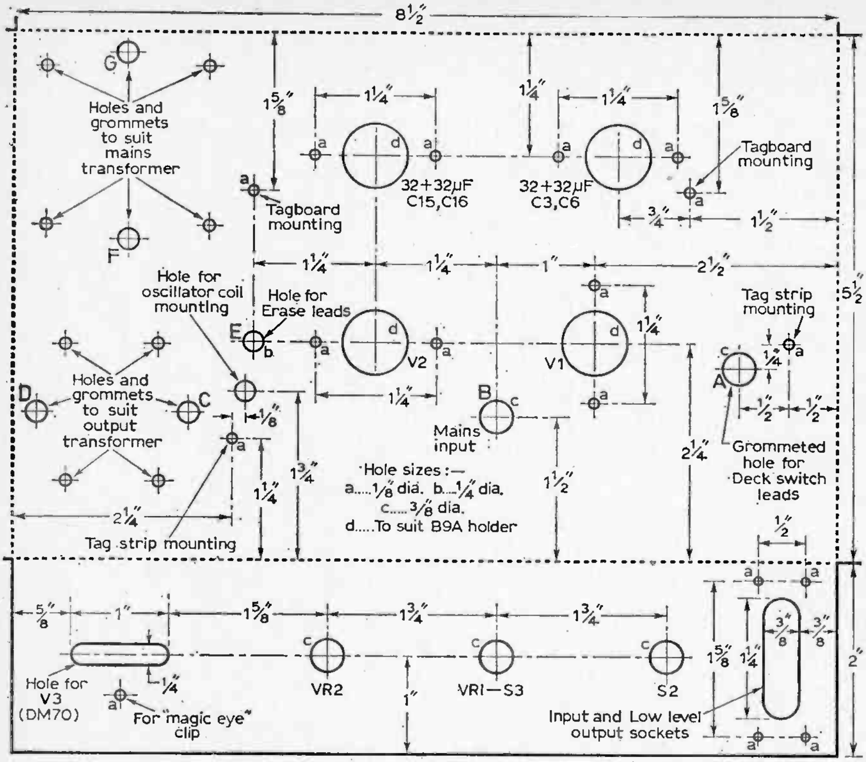


Fig. 9: Chassis dimensions and drilling details, viewed from above.

for the grid of V1A. This part of the circuit is very liable to hum pickup and the wires must be kept as short as possible, with C1 and R1 soldered right on to pin 2 of V1.

The tagboard may now be made. This is a 19-way strip and is available as standard. It will fit on to two 1½in. 4BA screws, which should be sited as shown. The screws must be locked by a nut with a further nut about ½in. from the top for the tagboard to rest upon.

The wiring of the tagboard needs no explanation except that it will save considerable time later on if the wires which will be used for interconnection are fitted on at the same time as the components. Their lengths need only be approximate. The tagboard is shown in Fig. 6.

This completed, the first wires to fix are those for the smoothing capacitors. This must be done before the tagboard is bolted down since they become concealed under it. The longer wires from the tagboard can be fed through the appropriate grommet holes. The oscillator coil should now be mounted. The type suggested is easily mounted having its own plastic nut! The adjustable core in the oscillator coil should be set approximately in the centre of the windings.

The interconnecting wiring should then be started. This is perfectly straightforward. The only wires which should not be connected at this stage are those to the output transformer secondary.

The amplifier is now nearly complete. The only component not covered above is the 0·001μF capacitor across the primary connections of the output transformer.

The switch wafer should now be wired. Three components are mounted on this for convenience. There should be four screened wires and three others to this. The earth contact should only be made through one of the screens to avoid earth loops. Wiring for this is shown in Fig. 4.

Testing

The amplifier is now ready for testing once the loudspeaker has been connected to the secondary of the output transformer. The switch wafer should be put in the record position and a microphone plugged in. In this position the magic-eye should glow, the speaker should be quiet, the wires to the erase head should read approximately 50V a.c., and on speaking into the mic. and turning the volume control up the green line on the magic-eye should shorten.

When the wafer is switched to the playback position the speaker will be on. The magic-eye should not glow. In practice the magic-eye may glow but will be very much dimmer: this is because of the extremely low h.t. that is needed for this valve so that even the reverse current through the rectifier is enough to produce slight glow—how much depends on the actual rectifier used.

The microphone is inoperative in this position so for testing purposes a signal must be inserted into the high-level input. In this way the recorder acts as an ordinary amplifier. The tone control may be tested after the wires to the secondary of the output transformer are connected. If the amplifier howls the leads should be reversed.

Before the recorder heads are connected it is wise to ensure that there is no voltage on the wires to the record/playback head. Testing should then go ahead in the normal way.

The record/playback head could well be not truly vertical. If this is the case the recorder will play back perfectly tapes recorded on it but other tapes will seriously lack top. It is as well to adjust this before the recorder is used seriously. The easiest

—*continued on page 925*

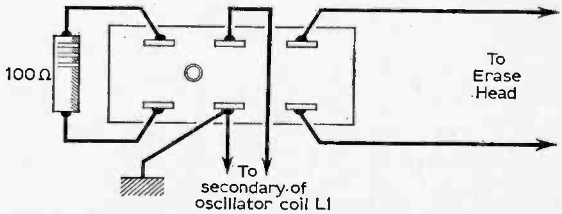


Fig. 10: A superimpose facility can be simply added by incorporating a double-pole changeover switch wired as shown.

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times GMT
Frequencies in kc/s

THE BROADCAST BANDS by CHRISTOPHER DANPURE

ONCE again spring is upon us, and with it come the best conditions of the year in my opinion for DX-ing. During March '67 I received *Radio New Zealand, Radio Free Korea,* and *Voice of Free China,* plus *Radio Australia* on the 19m.b. at 0100 GMT. During March '68 you should be able to hear those small and hard to hear stations which during other seasons are practically impossible to receive. At the same time as the general high frequency bands are giving good DX, so should the Tropical Bands of 60, 75, 90 and 125m.b.'s. through the night for the stations in the South and South-West from Europe.

South Africa: During daylight hours listen on 25 and 21Mc/s bands and for evening listening 17, 15, 11 and 9Mc/s, which should last through the night together with 7 and 6Mc/s.

West Africa: Again the same as South Africa, daylight hours on 25 and 21Mc/s, then 17, 15, 11Mc/s and night hours on 9, 7, 6 and 5Mc/s.

East Africa: From 0600–2000 listen on 25, 21 and 17Mc/s, early evening add 15Mc/s, for night hours 11, 9, 7, 6Mc/s, but between 0400–0600 GMT there will only be 15 and 17Mc/s.

South Asia: From 0600–1600 GMT 25, 21, 17 and 15Mc/s will give best results, 1600–2000 17, 15, 11 and 9Mc/s; 2000–0200 11, 9, 7, 6 and 4Mc/s; 0200–0400 GMT 9 and 11Mc/s.

South East Asia: The bands will open at 0600 on 21 and 25Mc/s, 1000 onwards add 17, then through the afternoon up until 1800 GMT the 15, 11 and 9Mc/s bands will give best results, for evening listening 11, 9, 7 and 6Mc/s, the bands will be closed for this area between 0000–0600 GMT.

Pacific Area: The bands will be closed during the period 1000–2000 GMT then 17 and 15Mc/s, 0400 onwards add 11Mc/s then after 0800 GMT add 9Mc/s.

Australia via Asia: After 0600 GMT on 21Mc/s, after 1000 add 17Mc/s, 21Mc/s closes at 1400 GMT, during the afternoon add 15, 11 and 9Mc/s, 17Mc/s closes at 1600 GMT, the bands will be closed to this area between 2200–0600 GMT.

North and South America: Bands are all open, after 1000 GMT generally 25, 21 and 17Mc/s, afternoons add 15Mc/s, evenings on 21, 17 and 15Mc/s, night hours on 11, 9, 7 and 6Mc/s.

Those were the propagation forecasts for March 1968. Now on to this month's DX-tips, the deadline for the June issue is March 20th, so all your loggings for inclusion in that issue must be in by March 20th.

ATLANTIC

BBC relay station on Ascension Island evening transmissions are now as follows:

English, French and Haussa to Africa 1645–1815 15,105, 9,600; 1815–1830 15,105; 1830–2000 15,105, 9,580; 2000–2015, 9580; 2015–2145 9,580, 7,240.

A World Service to Africa 1645–2145 15,400, 11,820.

Spanish and Portuguese to Latin America 2200–0415 15,180, 11,820.

World Service to Latin America 2200–0415 15,140, 11,865.

ASIA

Israel: *Kol Israel* is now on the following schedule 1600–1630 Yiddish, 1630–1700 Persian, 1700–1735 Russian, 1735–1745 Hungarian, 1745–1800 Hungarian, 1800–1815 Ladino, 1815–1830 Mugrabit, 1830–1900 Yiddish, 1900–1930 Hebrew, 1930–2000 Russian, 2015–2030 English, 2045–2115 French, 2115–2130 English, 2145–2200 Russian, all on 9,725, 9,625, 9,009.

Japan: *Radio Japan* has the following transmissions to Europe 0700–0830 in German, French, Italian, English and Swedish on 17,825, 15,135; 1930-2100 languages as at 0700, on 11,965 and 9,700; 0100–1130 general service in English and Japanese on 15,300, 1200–2130 general service in English and Japanese on 9,560; 2200–0030 general service in English and Japanese on 9,700.

AFRICA

Ghana: The External Service of *Radio Ghana* transmits in English to Europe from 2045-2215 on 9,545.

South Africa: The All Night Service of *Radio South Africa* has been heard with strong signals here in Europe from 2200–0300 on 6,150 and 4,945.

NORTH AMERICA

Canada: *Radio Canada* will have the following alterations for March–May 1968 transmissions. From 1832–1958 to Africa in English and French on 21,595, 17,820 and 15,320; 2001–2150 to Europe in French and English on 17,820, 15,320 and 11,720 to the Americas from 2300–0045 in English, Portuguese and Spanish on 15,190, 11,945 and 9,625.

SOUTH AMERICA

Venezuela: *Radio Yaracuy* has been heard with good signals on 4,940 after 0200.

EUROPE

Switzerland: Mr. Andrew Givens informs me that the tests from committee of Red Cross in Geneva for March are on the 18th, 20th and 22nd at 0600–0700, 1130–1230, 1700–1800 and 2300–2400 on 7,210.

Until next month Good DX-ing and 73's.

FIRST my thanks to all those who sent in a log this month. My "in" tray sagged under the weight and it has been very difficult to select the ones to print. There seems to be the usual controversy of which bands are dead and which aren't. Some claimed that twenty was literally hibernating while others promptly supplied logs of juicy DX-type callsigns heard on this very same band. Conditions are rather patchy at present, so if the band seems a bit quiet one week, have a listen throughout the month, you'd be surprised what's about.

Congratulations to **Dale Harvey** on getting his ticket, call to listen for is G3XBY. **R. King** (Yorks), informs of a source of DX information given out on 80 metres by ON4UN and LA5KG. Regular bulletins given out on Mondays and Thursdays at 2100 GMT on 3·785Mc/s. Richard says that ON4UN also runs a European DX net on 80 which now has around 80-90 members.

Want to log some real exotic callsigns easily? Good, follow these instructions carefully and rich harvests of goodies shall verily be thine. Tune the receiver to 28Mc/s and peak everything up. Now tune down to 27-27·3Mc/s and tune round very carefully. Yes, it's the dreaded Citizens' Band again. Callsigns like Batman and Robin; Rattlesnake (heard him last year); Red Fox and Old Brown Hog are quite common. Now that Ten metres is climbing back to the top, the signals from 27Mc/s will be easier to receive.

Topband fans will remember GM3SVK recently heard working as G3SVK/A from Rutland on s.s.b. At the time of writing, rumours inform that a DX-pedition to the Orkneys is on. Anyone hear the station?

TWENTY METRES

Pleasing to report that the famed "Henbry Ears" were at it again last month. A huge pile of logs for this band and all showing some very fb DX about.

David Henbry (Sussex), HA500, 7ft. vertical at 30ft., claims rough approximations of sine waves emanating from the following—CE3NL, CR4BC, CX2CR, CX9AAF, EL2EL, FG7XT, FR7ZN, HL9KR, HZ7KO, KG6IF (Marcus Island), KV4CF, PZ1BF, PZ1BW, TI2XL, UL7LA, VE8MD, VK9OM (New Guinea Territory), VP2LA (St. Lucia), VP2SAB (St. Vincent), VP5AA, VP6AO, VP6GN, VP8HZ, VP8IU, YJ8BW, ZD7DI, ZD7KH, ZE6JN, ZP3AL, 3V8BZ, 4U1ITU, 5H3JL, 6W8BM, 7Q7PBD, 8P6AH (New prefix for Barbados), 8R1S, 9L1DW, 9Y4LP. Think I'll flog my receiver and run a long phone lead down to Sussex.

R. Walters (Derbyshire), Eddystone 358, 120ft. long wire rescued these from 20—AP2SM, CE3ZN, CR6CE, CX2WY, DU1FF, EA6OJ, FP8DM, FR7ZD, HI2JP, JA1CIB, KR6NA, KZ5DA, LU3BU, MP4DNG, OA2EH, OY2YA, PY7GV, TA9DJ, TG7WH, TZ1BW, VE2MI, VE6BL, VE7AON, VE8JY, VK1QM, VK2CV, VK3CP, VK4GI, VK5FO, VK6EI, VK7QP, VK9MV, VP1BY, VP8JD, VQ8AU, VR2EK, W1—Ø, XE1CW, YV5ANE, ZB2A, ZD7DI, ZL1AF, ZL4DMA, ZM7AE (Tokelau Is.), ZS6DM, 5A1KA, 5U1JL, 9K2MO, 9V1OR, 9Y4AR. Another phone lead to Derbyshire too!

Martin Pasek (Notts), HRO, 180ft. long wire, is 13 years old. Persistence on 20 s.s.b. brought rewards from —CT1AV, PZ1AC, VK2AHT, VK3BK, VK4NP, VK5MS, VK7DK, VP2AA, VP7MS, ZL4BC.

D. Higgins (Lanarkshire), KT340, 40ft. end fed indoors, all 20 s.s.b.—CR4BC, CR6CN, EA9EG, GC2LV, HR1KA, HS2AK, HV3SJ, HZ4PY, K5EIH, LX1WR, PY2PE, PZ1AC, SV1BV, TF2WKW, TI2JIC, VE8ML, VO1FU, VK3HW, VK5HV, VK6FC, VQ9DH, VU2VKZ, W5TTY, W7UMJ, YV5LA, ZB2A, ZS2MI (Marion Is.), ZS6BFP, 3A2CP, 5Z4AA, 7X2ED, 9L1BW, 9Y4VT. Daniel queries QQ7A claiming to be on Ganzo Island. He's not on my list—neither is the island.

TEN METRES

C. Bradshaw (Lincs), HRO, dipole at 25ft. logged—JA3CWM, K1BHK, UA3KHD, VE1ANJ, VE2LXZ, W1LMW, W4BG, WØELC, ZE2KL, 9H1AG, 9H1AY all on a.m.

R. Dinning (Ayrshire), HA350, PR3OX preselector, 20 metre dipole, all s.s.b.—CE3TB, CR6DX, CR7DS, CX9PP, ET3REL, HC2OA, HR1DX, K4IIF/P/KV4, KZ5MB, OD5BZ, PJ4AC, TI2CAP, VK6CF, VK6LF, VP6RD, VU2JM, XE1PY, YO9CN, ZC4RB, ZD7DE, ZE7JZ, ZS1JU, 3A2CB, 5N2AAF, 5Z4KN, 9H1AC, 9J2DT, 9L1GQ, 9Y4LR, W1—Ø.

WHERE AND WHEN

Many listeners write in with queries based on where and when can I hear it, the "it" varying from letter to letter. The following snippets of gossip, picked up from varying but reliable sources, are offered because they answer the most commonly received queries.

A Countries List can be obtained from the R.S.G.B. Also, the R.S.G.B. Bulletin published monthly, contains propagation predictions for the h.f. bands—where and when the bands will be open etc. Slow morse transmissions are on most nights on 160 metres (topband) and sent out by G stations in various parts of Britain.

The Dutch station PAØAA transmits on Friday evenings with news in English at 1915-1930 and 2115-2130. This station also sends slow morse on the same evening at 1930-2000, and for the more advanced c.w. enthusiasts from 2000 to 2030. Why not listen for him this Friday on 3·60Mc/s? All things considered, perhaps the best "standard" to check your crystal calibrators and frequency meters against is the BBC station at Droitwich. It radiates on 200kc/s and is accurate within 5 parts in 10^{10} of absolute which is pretty accurate by any reckoning. G3JDG is on mainly on topband at present. I will QSL with pleasure providing the report is useful and not just the usual "heard you 5 and 7 etc., please QSL".

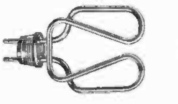
NEWS AND CONTESTS

Three contests this month all very different from each other. March 2—3, BARTG contest for the teleprinter types; March 2—3, 2 Metre Open Contest; March 9—10, BERU Contest, this is a 3·5—28Mc/s c.w. contest in which contestants try to contact as many British Empire stations as possible.

Multi Purpose Neon Test Unit

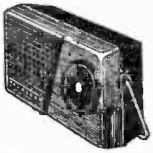
Robust, useful and instructive—tests insulation—capacity—continuity—resistor—volume controls—also acts as signal injector and L.T. fault finder—kit comprises neon indicator—4-way wafer switch—ebonite tubes—resistors-condensers—terminals, etc. with diagram only 9/6, plus 2/- post and insurance.

KETTLE ELEMENT



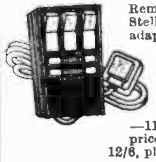
Made by famous "Best" company, suitable for most kettles. 1⅞in. dia. hole. 1500 watts. 230/250v. Normally 30/- each. Our Price 15/- each, plus 2/6 P. & P.

NO SOLDERING POCKET 3



Lots of fun to build and good results when finished—complete kit with detailed instructions and crystal earpiece (batteries 1/2 extra) £5 value only 19/6 plus 3/- post and insurance.

ARMCHAIR CONTROL UNIT



Remote Controller for Philips, Stella and Cossor TV sets but adaptable to most others, and to model control. Comprises three rock switches, two variable resistances and component including Mullard OA81—Knobs—10 way plug—11ft. 7 way cable, etc. List price £3.3.0, yours for only 12/6, plus 2/- post and insurance.

SILICON RECTIFIERS

Tested and guaranteed.

750mA	100v.	1/3	1 Amp.	100v.	3/-
	200v.	1/6		200v.	4/-
	400v.	3/6		400v.	6/-
3A	100v.	3/6			
	200v.	5/-	10 Amp.	100v.	9/6
	400v.	7/6		200v.	12/6
	600v.	9/6		400v.	14/6

Sub-miniature glass encased—only approx. ⅜in. long wire ended.
400mA, 50v. 1/6   100v. 2/6   200v 4/6.

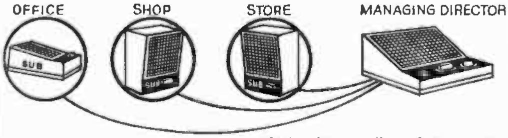
GARRARD AUTO RECORD PLAYER Model 2000

This is one of the latest products of the World's most experienced maker of fine record reproducers. Its superior features include—automatic playing of up to 8 mixed size records—stopping and starting without rejecting—manual playing—pick-up pivots to give low stylus pressure—large diameter turn-table for max. stability adjustments include pick-up height—pick-up dropping position and stylus pressure. Size is 13½ x 11⅝in. clearance 4⅜in. above, 2¼in. below. Supplied complete with mounting template and service sheet. Offered this month at the Special Snip price of £6.19.6 plus 7/6 carriage and insurance.

SOLID STATE IGNITION

Big things are claimed of Electronic ignition systems and if you would like to try for yourself a circuit was described in *Practical Electronics* (Sept., 1966). This requires a silicon controlled rectifier, four transistors and other components available as a kit. Price £6.15.0, post free.

INTERCOM BARGAIN

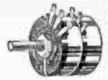


Will save time and improve efficiency. Ideal in home—office—shop—surgery. etc. Complete outfit comprises Master unit and three substations each of which can call the master and have full two-way working. No wiring problems as subs fitted with 60ft. twin flex and they plug into sockets. Also included is packet of staples—and battery. Nothing else to buy—£4.19.6, plus 4/6 post and insurance.

HURSEAL AUTOMATIC TIME SWITCH

12 hour. 15A to control heating, lighting, radio, immersion heaters etc. Regular price £4/4/-. Limited quantity 39/6. P. & P. 3/-.

GANGED POTS

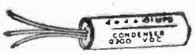


Standard type and size with good length of spindle—made by Morganite. List price is 10/- each but if you act quickly you can have them at 12/- doz. (or 1/6 each if less than doz.). Following values in stock all "lin"—10K + 10K—100K + 100K—500K + 500K all new and unused. Post 2/9 on 1st doz. then 1/- per doz. 6 doz. or more post free.

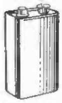
SIMMERSTAT

TYX–FL and TYX–F. Both popular types fitted to many cookers. Suitable for 230/240v. up to 15 amps. Handy device to have around the workshop. 12/6 each.

SUPPRESSOR CONDENSER



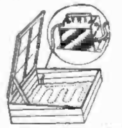
Stop your drill or other appliances interfering with you or your neighbours' radio or television. Simple instructions given, 1/6 each, 12/- doz.



PP3 Eliminator. Play your pocket radio from the mains! Save £s. Complete component kit comprises 4 rectifiers—mains dropper resistances, smoothing condenser and instructions. Only 6/6 plus 1/- post.

Be first this year

SEED AND PLANT RAISING



Soil heating wire and transformer. Suitable for standard size garden frame. 19/6 plus 3/6 post and ins.

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

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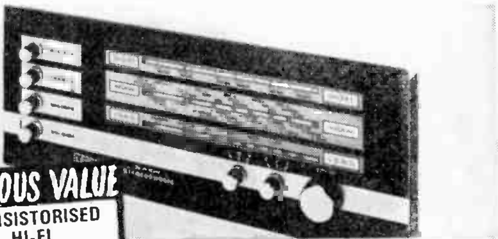

FABULOUS VALUE

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Build your own Hi-Fi Record Player with the Serenade fully transistorised amplifier which comes complete with 2-10″ x 6″ speakers and the latest BSR 4 Speed Stereo/Mono Record Changer.

Advanced solid state amplifier only 4½″ deep, 14 transistors plus 4 diodes, separate Bass and Treble—10 watts total power. Frequency response 50-15,000 c/s.

EASY TO INSTALL
NO TECHNICAL KNOWLEDGE REQUIRED

ONLY **26** GNS. + P&P 17/6

H.P. terms available. Deposit £6:16:6d and 12 monthly payments of 38/5d (Total H.P. £29:17:6d). Send £7:14:0d today.

FANTASTIC BARGAIN OFFER!

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FULLY TRANSISTORISED STEREOPHONIC RADIOGRAM CHASSIS

Complete with 2-10″ x 6″ speakers and the latest BSR Mono/Stereo Record Changer—a complete radiogram at half normal price ONLY

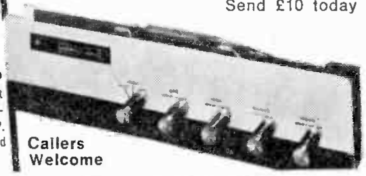
10 Watts Total output
17 Transistors & 10 diodes

34½ GNS. P&P 17/6

EASILY FITTED NO TECHNICAL KNOWLEDGE NECESSARY

H.P. available £9:2:6d deposit plus 18 monthly payments of £1:15:9d (Total H.P. £41:6:0).

Send £10 today



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AC107	3/6
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OC22-25	5/-
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OC44-45	1/9
OC71-81	1/6
OC72-75	2/6
OC81D-82D	2/3
OC82	2/6
OC140	5/-
OC170	2/6
OC171	3/6
OC201	7/6
ORP12-60	8/6
OCP71	8/6
OA5-10	1/9
OA47	2/-
OA70	1/3
OA79	1/9
OA81-85	1/6
OA91	1/3
OA95	1/9
OA200	3/-
OA202	3/6
2N696-7	5/-
2N706	3/6
2N708	5/-
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2N2646	15/-
2N2712	5/6
2N2929	3/6

Devices previously advertised still available

Minimum Order 10/-. CASH WITH ORDER PLEASE. Add 1/- postage and packing per Order. GUARANTEED by return postal service. Overseas add extra for Air Mail.

KING OF THE PAKS "TOP TWENTY"

Unequalled Value and Quality

all at **10/-** per pak

BRAND NEW—UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED in Every Pak, or money back

120	Glass Sub-min G. Purpose GERM. DIODES
60	Mixed GERM. TRANS. AF/RF
75	Germ. Diodes GOLD BONDED
40	TRANSISTORS Like OC81, AC128
60	200mA Sub-min SIL. DIODES
40	SIL. PLANAR TRANS. NPN BSY95A, 2N706
16	SIL. RECTS. Top Hat 750mA
50	SIL. PLANAR DIODES 250mA OA200/202
20	Mixed Volts 1 Watt ZENER DIODES
30	PNP-NPN SIL. TRANS. OC200/2S104
150	Mixed SIL. and GERM. DIODES
10	3 Amp SIL. RECTS. Stud Type
30	SIL. NPN TRANS. Like BC108
12	1·5 Amp SIL. RECTS. Top Hat
30	AF. GERM. ALLOY TRANS. 2G300 Series
10	1 Amp Glass min. SIL. RECTS. High Volts
30	MADT's Like MAT Series TRANS. PNP
20	GERM. 1 Amp RECTS. GJN Series
25	300 M/Cs NPN SIL. TRANS. 2N708, BSY27
30	FAST SWITCHING SIL. DIODES IN14 Micro

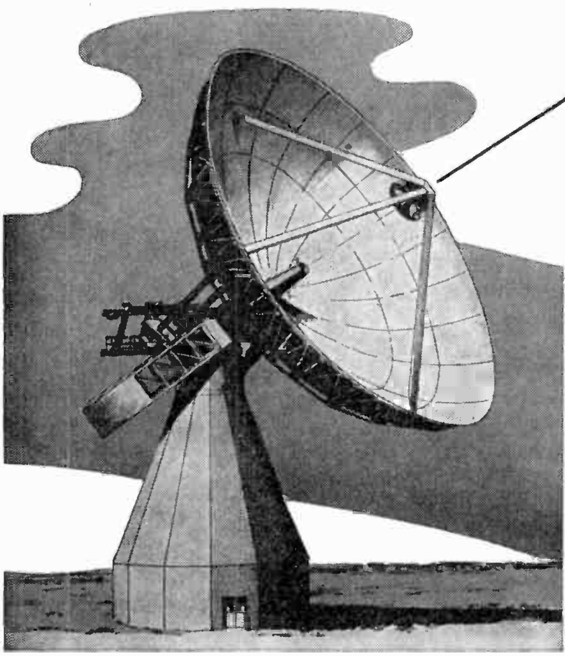
Code No's mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

SATELLITE EARTH TERMINALS

THE first two satellite earth stations for public service to be owned and operated by Cable and Wireless Ltd., will, it is claimed, be operational in May 1969. The contracts are being placed with the Marconi Company Ltd,, for the supply and construction of these two stations which are to be sited at Bahrain and Hong Kong. The value of the basic contracts is £2,115,000.

Each station will have facilities for transmitting up to four carrier signals and the reception of up to 32. Each of these carriers may have a capacity of 24, 60 or 132 separate communication channels.

The dish aerials are 90ft. in diameter in the form of a parabolic reflector constructed from a mild



steel backing structure and covered with an aluminium alloy skin, 0·080in. thick and adjusted to a surface accuracy of better than ±0·040in. The Hong Kong terminal will be able to withstand typhoon conditions and will be capable of operating in gales up to 70 miles per hour, and when parked, with the dish pointing vertically upwards, it will withstand 210-mile-per-hour winds.

The signals received from space arrive at the aerial at a power of a tenth of one million millionth of a watt. Initial amplification takes place in receiver components contained in helium vapour at a temperature of the order of 250deg. below zero. In this environment, signals are amplified with the minimum of interference from the background electrical noise inherent in any conducting material, and which is temperature dependent. The transmitting valve is designed to provide peak saturation at 12kW level, although operationally a figure lower than this will normally be employed. Two travelling wave tubes are used, Marconi believe that the travelling wave tube is more reliable than klystrons in this application and it has the advantage of requiring no mechanical tuning.

The t.w.t.s. are connected in series, each stage having a gain of approximately 30dB throughout the entire civil satellite transmission band of 5,925 Mc/s to 6,425Mc/s. These are capable of multiple carrier transmission.

Cross modulation problems arising due to multicarrier work, have been completely eliminated by maintaining the linearity of the power amplification system. Simple, but effective, auto-level control units are employed by which each radiated carrier is maintained within ¼dB. This is achieved using variable ferrite attenuators in the waveguide feeds.

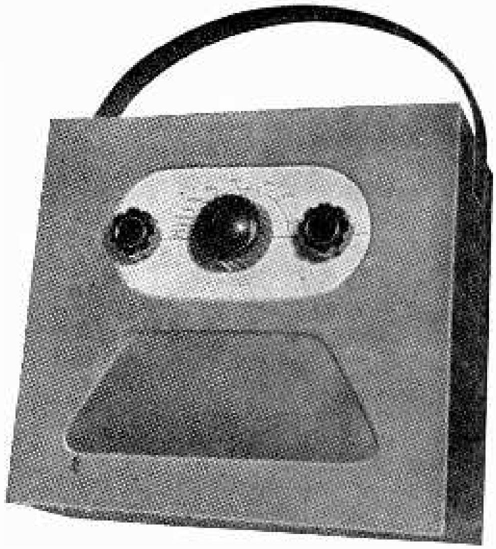
Radio energy is fed to the dish from the feed point (in the feed once), by the well-known Cassegrain principle, the secondary reflector for which is a 7ft. hyperboloid at approximately 30ft. from the apex of the dish. Radio energy from the satellite follows a reciprocal path to the feed point where a diplexer separates the transmitted and received signals.

Signals from the ground are transferred to one or two carriers which are then multiplied up to their final frequencies in the 6,000 Mc/s frequency band when they are finally amplified through a wideband (500Mc/s) travelling wave tube to approximately 3kW and then fed to the aerial.

Signals for the Hong Kong station from the satellite may be comprised initially of up to eight carriers within a 500Mc/s bandwidth in the 4,000Mc/s frequency band. These signals have a very low power of about −180dBW or 10 watts and are amplified by high sensitivity, low-noise, cooled parametric amplifiers. Each carrier is then separated and converted down to its original frequency band and those channels destined for the earth station are extracted. They are then recombined in a form suitable for use on the SHF radio link.

The tower is approximately 40ft. high and the overall maximum height of the structure is 82ft, in the zenith position. The aerial has full steerability which means it can follow satellites in any orbit. The axes on which the dish is mounted are in an azimuth/elevation configuration, being driven about each axis by two 5h.p. d.c. electric motors. These are controlled by the servo-system which may in turn be controlled either manually from the station console or automatically by error signals which are a measure of the amount by which the aerial is pointing off target. This is sensed by the rotating tracking system and a special tracking receiver which operates at the beacon frequency originated in the satellite especially for tracking. A facility which can be added later is for the aerial to follow a prearranged track derived from a computer. ■

THE Simple six



R. F. GRAHAM

THIS unit is basically a slightly simplified but fully efficient receiver for medium waves only, to which various additions can be made. This allows the receiver to be finished and checked in working order as quickly as possible, and it may be retained or modified later. There are also easy circuit checks which can be made as wiring proceeds.

Figure 1 is the circuit, and since aerial/oscillator-coil alignment is frequently a source of lost sensitivity, a fixed oscillator "trimmer" C4 is employed in conjunction with a variable aerial trimmer VC1. It is only necessary to peak VC1 somewhere throughout its swing for maximum volume. This proves quite useful, since with pre-set trimming exact alignment throughout the whole tuning range is not easily achieved. By having medium-wave coverage only, the difficulties sometimes encountered by the inexperienced, in wiring and aligning a 2-band aerial/oscillator circuit, are avoided.

A single intermediate frequency stage, with double-tuned i.f.t., and followed by a transistor emitter detector, provides enough selectivity and sensitivity for all normal purposes. As this type of detector is not often seen, it should be mentioned that although the OC71 is an audio type transistor its emitter-base junction is satisfactory for detection. Resistor R4 from the positive line, and R5/R7 in series from the detector stage collector, supply the AF117 base, and increase positive bias with strong signals for automatic volume control.

The audio amplifier/driver and push-pull output circuit is very straightforward and other audio and output transistors should be satisfactory, if to hand (OC71—2xOC72; OC81D—2xOC81, etc). The values of R14 and R15 may then have to be changed, as explained later.

PANEL CONSTRUCTION

The complete receiver (including speaker) is built on a paxolin panel $5\frac{1}{2}$in. high and 6in. wide, with components on the back and wiring on the front. A support allows this panel to stand upright, enabling the receiver to be checked and tested with all connections and components accessible. After-

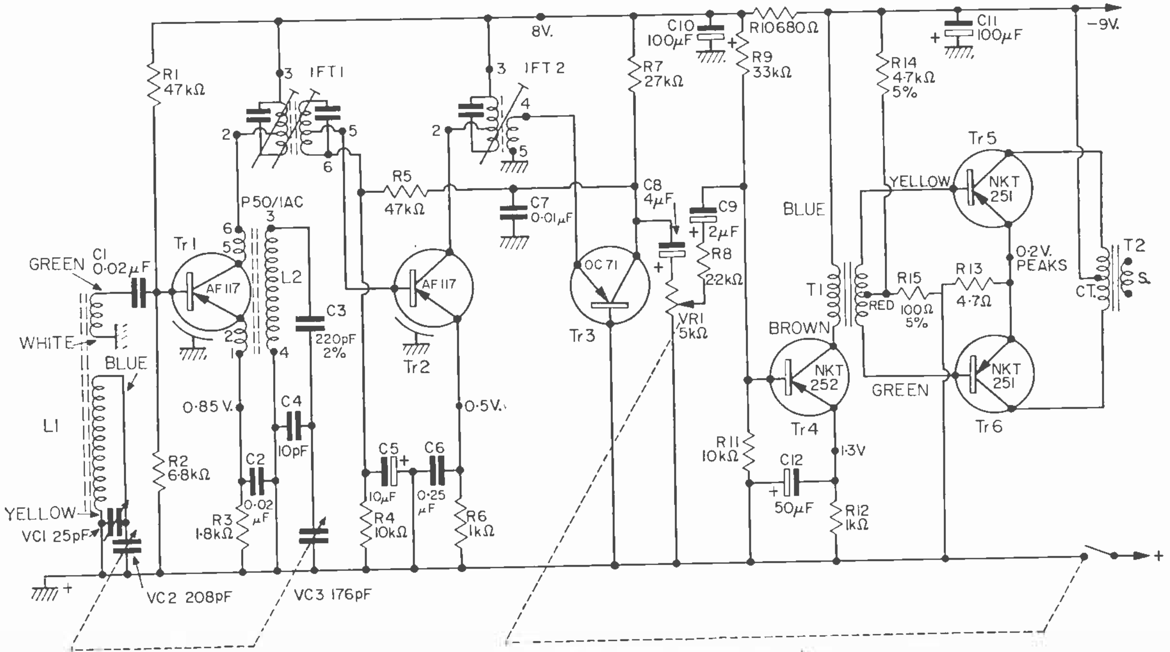


Fig. 1: Basic circuit of the Simple Six m.w. receiver.

wards, it is inserted as a single unit into a cabinet. If a suitable case is to hand, it should be possible to change dimensions to fit. A different speaker would be satisfactory but would probably influence the size of cabinet practical.

Figure 2 is the panel and components seen from behind. The best method is to cut the speaker opening and other large holes first. A number of lines lightly scribed on the paxolin will act as guides for the numerous small holes, which can be made with a $\frac{1}{16}$in. or slightly larger drill. If one or two of these are missed, they can be made later. Components are put on the panel as wiring proceeds, and after drilling. As resistor values are important, the colour coding can be checked against the components list. Do not bend the wires sharply against the body of a resistor or capacitor.

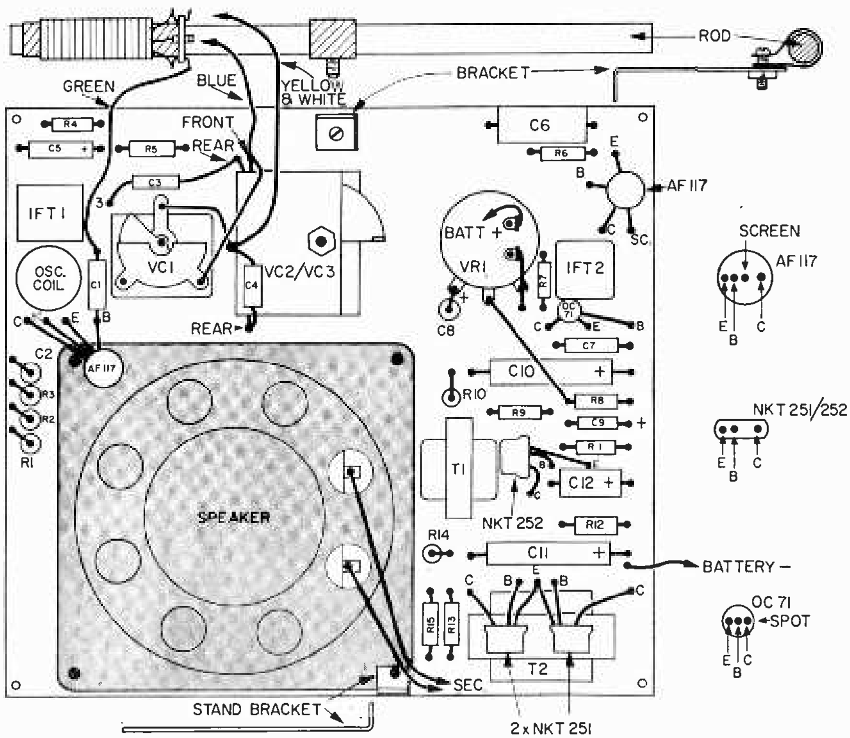


Fig. 2: Layout of components on top of the chassis.

Drilling positions for the oscillator coil and i.f.t. pins can be located by pushing a small piece of paper against the pins, holding the paper on the paxolin, and marking through with a pointed tool. Afterwards, drill so that these components fit easily.

PREPARING THE TRANSISTORS

Care should be taken that emitter, base and collector leads are correctly connected. The AF117 transistors also have shield leads. It is not easy to see all transistor leads once the transistors are in place. To simplify identification, it is useful to put short pieces of coloured sleeving on some leads enabling each transistor wire to be readily identified. Half-inch lengths of 1mm. red sleeving were put on AF117 and OC71 collector leads, with black sleeving for bases, and yellow for emitters. The audio amplifier transistors have sleeving on base and collector leads only.

FRONT PANEL WIRING

In many places the wire ends of resistors or other parts will reach. Elsewhere, thin tinned-copper or copper wire (about 26s.w.g.) can be used, with insulated sleeving where needed. It is helpful to put red sleeving on the positive or "earth" line connections. and black sleeving on the battery negative circuit wires. If each lead and joint is marked with a coloured pencil as completed, there is little chance of overlooking any connections.

The oscillator coil has a spot between pins 1 and 6, and must be placed as shown. The i.f.t. pins are identified by their positions and spacing. Tags through small holes hold the screening cans, and these tags are connected to the positive or earth line. Pins 1 and 4 of the 1st i.f.t. are not used neither is pin 1 of the 2nd i.f.t.

A tag under one 4BA screw earths the frame of the ganged capacitor. A small ball drive could be fixed to a short-spindle capacitor without drive. A 208/176pF capacitor without integral reduction drive gives similar results, but the drive simplifies tuning.

All connections should be soldered rapidly, with a hot, clean iron. Prolonged heating may damage components, especially transistors. Lengths of thin flex are soldered on for battery connections, red for positive and black for negative. The correct type of battery clips should be added. The battery must never exceed 9V and must always be connected with correct polarity.

FERRITE AERIAL

The ferrite aerial is mounted by cutting a piece of aluminium about ½in. x 2in. long and bending a ¼in. flange on one end. Drill this and bolt it to the paxolin above the ganged capacitor. The other end is drilled for a bolt which passes also through a loop of insulated material round the ferrite rod. The ferrite winding has coloured markings near its tags, and connections are short pieces of thin flex.

Other medium wave ferrite aerials for 208pF capacitor, should be satisfactory. Some, as made for OC44 and similar transistors, may have slightly too many turns on the base coupling winding. If so, this section is easily modified by removing turns. With the AF117, four or five turns should be satisfactory. The oscillator coil and i.f.t's should be as for the transistors shown, components for OC45 and similar transistors being unsuitable.

A quick check of direct current working conditions will usually show that no serious defect is present, such as wrongly connected transistors. A meter placed in series with one battery connection should indicate a current of about 10-12mA with no signal, or with low volume. With average good volume, current peaks rise to 25mA or more. Using a 10,000 ohms per volt meter, emitter supply point voltages were as in Fig. 1. These can vary slightly without a fault being present, due to individual variation in resistors and transistors but a large difference in voltages indicates a fault. A high voltage shows the transistor concerned is passing excess current, so its base supply circuit and connections need checking. A very low emitter voltage, or absence of voltage, shows little or no emitter current, probably due to a fault in collector or base circuit. Voltages are measured from the "earth" or battery positive line. The i.f. amplifier emitter voltage should fall slightly as a fairly strong signal is tuned in.

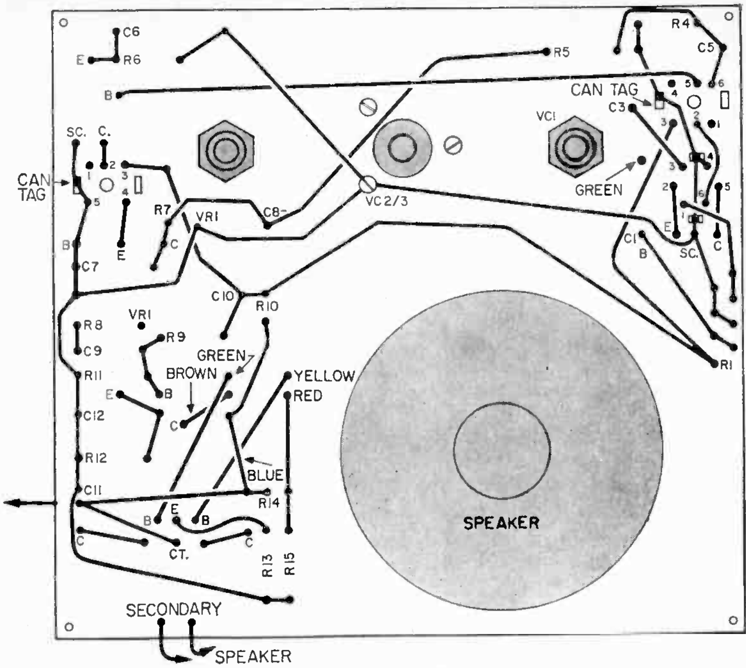


Fig. 3: Wiring beneath chassis of major components.

ALIGNMENT

Accurately tune in a weak signal, and if necessary adjust the two cores of i.f.t.1, and the single core of i.f.t.2, for best volume. With a stronger signal this corresponds to minimum voltage reading across R6.

In the original model, aerial alignment and coverage was correct with the aerial winding former flush with the end of the ferrite rod. Provided VC1 peaks for maximum volume somewhere throughout its swing (not fully open or fully closed) maximum sensitivity is obtained. Should VC1 need to be progressively closed when tuning to lower frequencies by closing VC2/VC3, push the winding slightly further along the rod, or unscrew the oscillator coil core slightly. Should VC1 need opening slightly for best results when VC2/VC3 is closed, move the winding towards the end of the rod, or screw the oscillator coil core in a little. In this way the need to adjust VC1 throughout the tuning range is reduced.

CABINET DETAILS

The cabinet was made from $\frac{3}{16}$in. plywood. Edges are sanded, adhesive placed on meeting surfaces and parts held with small panel pins. Afterwards, edges are sanded as needed, dust cleaned off, and the exterior covered with one of the plastic or similar materials used for such purposes. Speaker gauze is glued behind the speaker opening, and the control spindles either project through holes, or have a small sub-panel which comes behind an aperture, as preferred.

A PP9 or other non-midget battery is most suitable. If this goes behind the receiver, as in the original, the cabinet needs to be at least $3\frac{1}{4}$in. deep inside. Should a cabinet be to hand in which the battery can stand besides the receiver, a depth of $2\frac{1}{2}$in. is sufficient.

The NKT252 driver transistor normally furnishes adequate power for driving headphones. Figure 4 introduces the phones between collector and transformer. This gives excellent results with a medium or high impedance personal phone, or complete headset (the latter is more comfortable for long periods).

If a 50Ω or other quite low impedance personal phone is to hand, this is better in parallel with the transformer primary (brown to blue). The jack should then be of the type which does not short when the plug is removed.

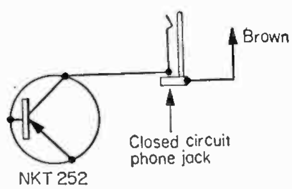


Fig. 4: Adding a phone jack.

If the speaker is to be silenced completely, opening contacts on the jack are needed to interrupt the speaker circuit. Should greater volume be required, it is in order to work phones from the output stage.

An external aerial may be needed when screening and rotation (as in a vehicle) makes the ferrite aerial unsatisfactory, or for longer distance reception. The actual external aerial may be a self-supporting telescopic type screwed to the cabinet, a vehicle aerial or a short wire. Figure 5 shows a satisfactory method of coupling. About 40 turns of

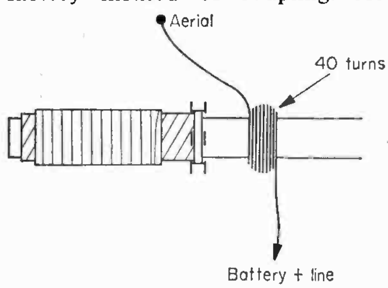


Fig. 5: Adding an extra winding on the ferrite rod aerial enabling an external aerial to be used.

32s.w.g. or other thin insulated wire are wound near the medium-wave coil. One end of this new winding is connected to a socket, terminal, or the telescopic aerial, the other end being connected to the receiver "earth" line.

Coverage around 1,500 metres can be obtained, with good results, by capacitor loading of the aerial and oscillator windings, Fig. 7. This requires a 3-point switch, open for medium waves, and closed for 1,500 metres. A midget switch can be accommodated near the ganged tuning capacitor. With the switch closed, 1,500 metres should be found at about half capacity of VC2/VC3. The 500pF trimmer is then adjusted for best volume. Should full long-wave tuning be required, a dual-wave ferrite aerial is necessary, with switching and capacitor values as shown by its maker.

TONE CONTROL

Small transistor receivers sometimes have a simple two-position tone control with "high" or normal reproduction, and a top-cut optional setting. The latter is sometimes useful also in reducing high-pitched heterodynes. A satisfactory circuit, requiring 0·05μF capacitor, and on/off or two-way switch, is shown in Fig. 6. The capacitor value may be modified to give the "tone" required.

The automatic volume control circuit is quite effective, but cannot reduce overloading in the presence of very strong signals. To overcome this, a damping diode is added in some receivers, and can be included as in Fig. 8.

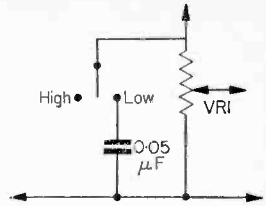


Fig. 6: A suitable tone control switch.

Diode D1 is an OA79 or similar type, and is arranged so that it only conducts with very strong signals, damping the circuit so that gain is reduced. The performance of the circuit is readily checked by disconnecting one end of D1. Results should be as before. When D1 is connected, reception of weak and moderate signals should be as before, but the volume of a strong local station should be much less than originally.

BIAS RESISTORS

Most small audio transistors are suitable in the NKT252 driver position with resistor values shown, but correct push-pull operation of the output stage depends on R14 and R15. A meter placed between the output transformer centre-tap and negative line

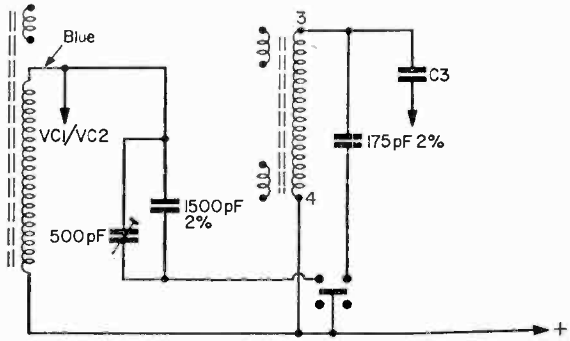
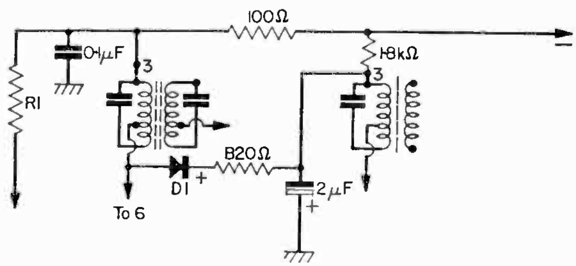


Fig. 7 (above): Modifications for long wave reception.

Fig. 8 (below): Fitting a damping diode to improve a.g.c. action.



should show about 4mA, with no signal. If the output pair bases are too negative, current will be much higher. But if the bases are too positive, current is low and distortion likely, therefore R14 or R15 may be modified, if necessary. Reducing R15 (or increasing R14) reduces collector current. Slightly raising the value of R15 increases current. So in this way most output transistors of somewhat similar type to those listed can be arranged to give satisfactory results.

The above receiver offers an uncomplicated approach to a superhet receiver. It can be constructed in its simplest form, as per Fig. 1, or the various modifications added. Needless to reiterate the necessity of checking all wiring, particularly transistors, diodes and battery polarity before switching on. ■

★ components list

Resistors: (all 10% except where marked)

R1	47kΩ	R9	33kΩ
R2	6·8kΩ	R10	680Ω
R3	1·8kΩ	R11	10kΩ
R4	10kΩ	R12	1kΩ
R5	47kΩ	R13	4·7Ω
R6	1kΩ	R14	4·7Ω 5%
R7	27kΩ	R15	100Ω 5%
R8	2·2kΩ	VR1	5kΩ log. pot with switch

Capacitors:

C1	0·02μF	C8	4μF 6V
C2	0·02μF	C9	2μF 6V
C3	220pF 2%	C10	100μF 12V
C4	10pF	C11	100μF 12V
C5	10μF 6V	C12	50μF 6V
C6	0·25μF	VC1	25pF air spaced variable
C7	0·01μF	VC2/3	Jackson 208/176pF

Semiconductors:

Tr1	AF117	Mullard
Tr2	AF117	Mullard
Tr3	OC71	Mullard
Tr4	NKT252	Newmarket
Tr5	NKT251	Newmarket
Tr6	NKT251	Newmarket

Inductances:

L1	RA2W	Weyrad
L2	P50/1AC	Weyrad
IFT1	IFT18/465	Denco
IFT2	IFT14/465	Denco
T1	QXD1	Osmor
T2	QXO2	Osmor

Miscellaneous:

Loudspeaker—2/3Ω; paxolin sheet; knobs; wire; Solder; 9V battery; battery clips, etc.

repairing radio

★ The first series ran from April–September 1967 and dealt with valve circuits. We now begin the second series, concentrating on transistor equipment. As before, the writing, will be handled by Gordon J. King (basic fault finding) and H. W. Hellyer (servicing procedures, workshop practice, etc). G. J. King sets the ball rolling . . .

WHILE millions of valve radio sets are still in use, almost all domestic electronic equipment now being made contains transistors. Although transistors operate quite differently from valves, their circuits closely resemble those of valve equipment and it is not difficult to identify the various transistor stages if one is conversant with the stages in valve sets.

The major difference between valve and transistor circuits lies in the value of the components connected to the transistor electrodes and conveying the signals to and from the various stages. For example, a coupling capacitor in a valve a.f. amplifier may be about 0·1μF, while in a comparable transistor stage it would be about 5μF—sometimes greater. The main reason for this is that while valves run at relatively high voltage and low current, transistors run at low voltage and relatively high current. To take an example, a valve audio amplifier (output stage) may operate with 300V on its anode and pass, say, 80mA while a similar stage using a large transistor may have about 24V on its collector and pass up to 500mA.

This does not apply on the same scale to small-signal transistors of the kind used as r.f. and i.f. amplifiers and a.f. voltage amplifiers, for on these the collector may run at less than 9V and sometimes in the order of microamperes. Nevertheless, ordinary transistors are generally referred to as *current-operated* devices (the term *device* is common in semiconductor parlance) and valves as *voltage-operated*. To some extent this relates to the input signal, for valves require virtually no input signal *current*, just a signal voltage from a high impedance circuit, and transistors require the reverse in general. That is, a signal current from a low impedance circuit and little *voltage*.

It is sometimes useful to compare transistors with valves in terms of the device proper. Take a triode valve for instance. We all know that this has an anode, a grid and cathode and that the cathode temperature is raised by a heater. When the cathode is heated electrons are so to speak "boiled off" its surface and, being negative, are attracted to the positive anode, via the grid. The anode, of course, is connected to h.t. positive and the cathode to h.t. negative.

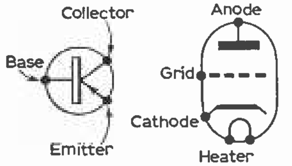


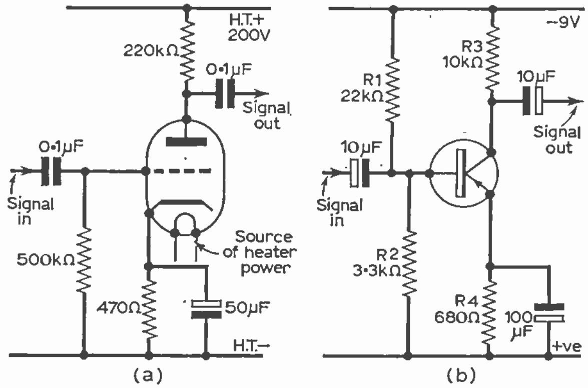
Fig. 1 (left): P-n-p transistor symbol compared with a triode valve.

Fig. 2 (right): P-n-p transistor amplifier (b) compared with triode valve amplifier (a).

These electrodes operate in the vacuum of the valve envelope and the electrons travel from cathode to anode, through the grid, with very little hindrance from gas molecules. Since a flow of electrons represents a flow of electric current—the conventional flow of current being opposite to electron flow—anode current flows from anode to cathode. The amount of current is governed by the quantity of electrons available at the hot cathode and by the anode voltage. The current rises as the anode voltage is increased up to a point called "saturation", where all the cathode electrons are being absorbed by the anode and where further increases in voltage fail to produce corresponding current increases.

The grid is a mesh through which the electrons can pass, but by making this negative some of the cathode electrons fail to get through it (from the law that negative repels negative) and the anode current is thus reduced. The anode current can, therefore, be varied by adjusting the amount of negative potential on the grid. Most of us know these things anyway, but it is just as well to have them in mind when we look at the transistor, for then we may not be amazed to find only a few volts on the collector of a transistor each time we test in transistor sets!

Figure 1 compares the transistor with the triode valve. The transistor also has three electrodes as shown by its symbol and these are the collector, emitter and base, roughly equivalent to the valve's anode, cathode and grid. This comparison, however, cannot be taken too far, and it is sometimes desirable to look upon the transistor without basing its action on the valve at all. In this series of articles, however, we are graduating as it were from valve circuits to transistor circuits, and will thus adopt the valve/transistor analogy as far as possible.



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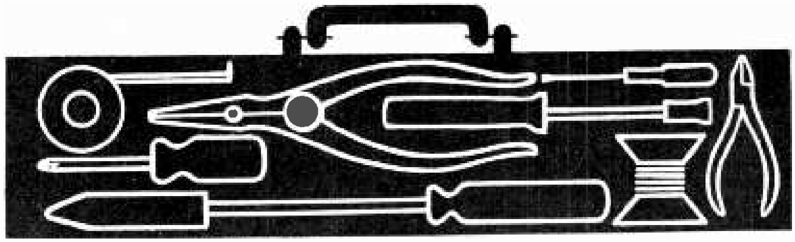


EQUIVALENT CIRCUITS

Figure 2 shows at (a) the elementary feeds in circuit to the electrodes of a valve with component values and at (b) the equivalent transistor circuit. These are both a.f. amplifiers, and the difference in component values is highlighted. There are pretty well the same number of components used in both circuits, but the base of the transistor circuit is fed from a potential-divider, R1, R2, from across the power supply. Some transistor stages may have only a single, higher value resistor to the supply line from the base, depending on the nature of the circuit and the type of transistor used. Note that the signal is applied to the transistor base and taken from the collector and that electrolytic coupling capacitors are used instead of the ordinary, non-electrolytic, far lower value couplers in the valve circuit.

While a valve works in a vacuum, a transistor works within a germanium or silicon crystal. The crystal is made "pure" to start with and then controlled impurities are added to give it semiconductor characteristics: it is then neither a pure conductor nor a pure insulator. The transistor is formed of two junctions, called the emitter junction and the collector junction, with the base element being common to both junctions. Various techniques are employed during the manufacture of transistors to diffuse the two junctions into the common base electrode or, in some transistors, to diffuse base and emitter regions into a crystal forming the collector, and the semiconductor characteristics of the three "electrodes" are different. It is not intended in this basically "servicing" series to investigate the deeper principles of transistors. Indeed, this would demand a series of its own. Nevertheless, something must be known about how transistors work to enable us to develop a logical approach to servicing.

CURRENT CARRIERS

Transistors, like valves, use electrons as current carriers, and the number of carriers available depends on the nature and amount of impurity diffused into the pure crystal. In other words, the pure crystal of a transistor can be looked upon as the vacuum of a thermionic valve and the impurities present as the potential source of carriers. Of course, electrical energy must be fed into the device to cause the available carriers to move and constitute a flow of electricity, but energy is not required to create the carriers as it is in a valve where it is used to heat the cathode. This is a major saving in transistor equipment as can well be imagined.

All conductors of electricity contain so-called free or mobile electrons, so there is no point in making transistors just to get ordinary current conduction. Instead, the design is such that the current carriers can be moved between junctions in a very controlled manner.

At this stage, however, it must be mentioned that transistors are said to have *positive* current carriers in addition to the *negative* ones of the electrons themselves. These positive carriers are called *holes*. They are created in the basic crystal by including an impurity which gives the electrode a *deficiency* of electrons. This makes spaces or holes in the basic structure for electrons to fill. And this is, in fact, what happens. Electrons from another part of the transistor move in and fill the holes in an orderly manner, and the effect is that the holes move in the opposite direction to the movement of the electrons which jump from one hole to the next. It should be noted, however, that there are always fewer electrons than holes in this particular type of semiconductor, called p-type (p standing for *positive* holes).

We shall not be surprised to learn that there is also an n-type semiconductor. This is created by the addition of an impurity to the pure crystal that gives *electrons* for conduction. The number of electrons produced depends on the nature and quantity of the impurity. The n in n-type, of course, stands for *negative*—negative electrons.

P-N AND N-P JUNCTIONS

The transistor drawn in Fig. 2(b) has p-type semiconductor for its collector and emitter and n-type for its base, and for this reason is called a p-n-p transistor. It is symbolised by the arrow on its emitter pointing towards the base. Its complement is the n-p-n transistor having n-type semiconductor for its collector and emitter and p-type for its base. This type is symbolised by the arrow on the emitter pointing *away* from the base, as shown in Fig. 3.

The transistor junctions are thus either p-n or n-p. Now, when two types of semiconductor are brought together as a junction there occurs an initial balance of internal charge, as it were, and a potential barrier forms at the junction which may be broken down by a voltage applied in one polarity across the junction or reinforced when the polarity of the applied voltage is reversed. Thus, one way round current flows easily and the other way it is considerably restricted. This gives the well-known junction rectifier effect.

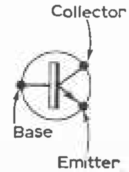


Fig 3 Symbol of n-p-n transistor.

In practice, the emitter junction is biased for ease of current flow, called the forward direction, while the collector junction is biased the other way round, called the reverse direction where there is very little or no current flow. Looking at Fig. 2(b), therefore, we see that the base is set by R1, R2 to a potential well below −9V, that the collector is connected to the −9V line through the collector load R3 and that the emitter is connected to zero volts (i.e., the positive side of the supply). This means that the collector is negative with respect to base and that the emitter is positive with respect to base. This puts a little forward current in the emitter junction and biases the collector junction the reverse way.

BASE BIAS

The current flowing into the base circuit due to forward current flow in the emitter junction is called the base current, and this current is fundamental to the transistor effect proper. At this stage, however, it must not be assumed that the base current is equal to the emitter current. This is certainly not the case because the emitter current comprises not only the base current but also the collector current when the transistor effect occurs, as we shall see.

We can say, therefore, that the base of a p-n-p transistor is biased negatively with respect to the emitter, and since the emitter is roughly the equivalent of the valve's cathode and has holes (being p-type) to provide conduction it can be considered as injecting holes into the base. Remember, though, that this happens only when the base is biased negatively with respect to the emitter.

The holes diffuse through the base and are then accepted by the collector which, as we have seen, is connected to a negative supply (positive holes being attracted by a negative charge). Thus in spite of the collector junction being connected for reverse conduction to the supply, collector current flows when base current is flowing due to the holes from the emitter. This collector current flows through the collector load R3 in Fig. 2(b) and also through the emitter resistor R4 which, as we have just seen, also passes the base current. The current in R4, then, is equal to the collector current due to the transistor effect plus the base current due to forward current in the emitter junction. It is important that these aspects are perfectly clear.

An n-p-n transistor works in a similar manner, but this time the emitter is n-type and electrons flow from it into the base and are attracted by the collector which, for n-p-n transistors, is connected to supply positive. The base of this kind of transistor is also biased positively (with respect to the emitter) for forward current in the emitter junction to get the transistor effect.

Normal collector current thus flows only when there is base current. When there is no base current there is no ordinary collector current. However, a very sensitive current meter connected in the collector circuit would record a small current which is the reverse current in the collector junction. As the base current is increased, so the collector current rises to a saturation value, as with a valve, and the value of this is determined by the collector voltage and the type of transistor. There is also a limit to the base current that the transistor will handle, above which the emitter junction dissipation is exceeded, eventually destroying the junction and ruining the transistor.

LEAKAGE CURRENT

While the reverse collector junction current is normally very small (a matter of microamperes), as just mentioned, this current can rise and add substantially to the transistor effect collector current with increase in temperature of the junction. This is called *leakage current*, and large transistors limit this current by various counteracting circuit measures and by the use of a transistor *heatsink*, the purpose of which is to drain away the heat developed in the junction by normal electrical power dissipation. By these means leakage current rise is effectively inhibited. Without them, however, the transistor could quickly run into damaging overload because junction heat causes greater power dissipation and more heat and greater than ever power dissipation, more heat and so on . . . Soon the junction power dissipation is seriously exceeded and the junction fuses. This effect is called thermal runaway.

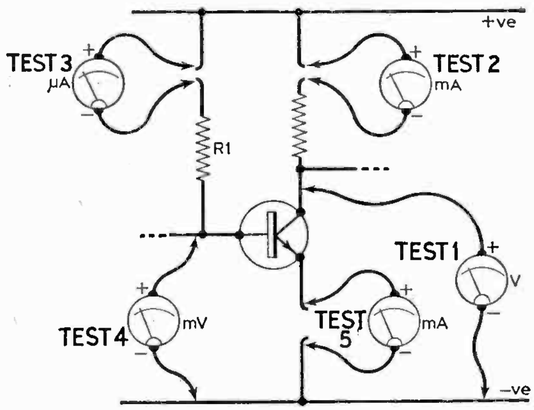


Fig. 4: Tests in a transistor stage These are fully explained in the text.

We now know sufficient to look at the voltages and currents in a basic transistor circuit. Such is shown in Fig. 4, using an n-p-n transistor for a change. It will be seen that the current measurements are taken by breaking the feeds to the electrodes, and it must be assumed that if these current meters are not connected (when voltages are measured, for instance), the breaks in the circuits where they are introduced are joined across. This is necessary to keep the stage working correctly when the current meters are disconnected, since it is unlikely that the experimenter (or technician, for that matter) would have enough instruments at his disposal to meter the various sections of the circuit simultaneously as in Fig. 4.

BASIC TESTS

Test 1 represents a basic measurement—collector voltage. If the transistor is passing no collector current for some reason or other, then this test would indicate almost the full positive supply voltage. The actual reading is governed by the sensitivity of the voltmeter used for the test and by the value of the collector load resistor, and to avoid bad error due to the meter one with a sensitivity of at least 10,000 ohms/volt should be used, preferably 20,000Ω/V.

When the transistor is taking current a low resistance occurs between the collector and emitter and

★ FAULT FINDING CHART No 1

The fault finding chart presented with this issue is in the form of a family tree diagram of symptoms. Starting at the "root", select the appropriate main fault box then proceed along the "branches" to find the more detailed symptom. At each relevant point will be found one or more Key Numbers.

★ ***A second chart will be given away free with the next issue and from this the Key Numbers will be related to particular receiver sections and components likely to have caused the fault.*** ★

The two charts together will form a comprehensive guide to logical 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.

the collector voltage could be almost zero. The effect is that almost all the supply voltage is developed across the collector load resistor, and the meter is reading effectively across an almost short-circuit. When transistors are used as switches this represents the transistor "on" position, instigated by a fairly large "switch-on" bias applied to the base. Conversely, the "switch-off" condition occurs when there is no base bias or when the base is reverse biased. Collector current, as we have just seen, is then zero and collector voltage maximum.

Test 2 represents the basic measurement of collector current. With the base bias removed there is no ordinary transistor effect and any current read on Test 2 is collector leakage current. Base current in Fig. 4 is applied through the single resistor R1, and the value of this resistor governs the amount of current flowing. A very much lower resistance than R1 is seen looking into the base due to forward conduction of the emitter junction, which means that the base current is closely equal to the current in R1 given by Ohm's law. That is, the voltage at the top of the resistor divided by its value. The current is in μA when the resistance is in megohms. Thus if the voltage is say 10V and the resistance 0·1MΩ the base current is close to 100μA.

A meter connected as for Test 3 reads base current, but here a very sensitive current meter is needed which will indicate microamperes over a fair deflection of the pointer. Test 2, of course, is in mA (except for leakage current which, we hope, would be in microamperes) and most testmeters will read this sort of current magnitude. Technicians do not generally attempt to read base current direct, but if necessary calculate it by using Ohm's law in conjunction with the base resistor value and the supply voltage, as just explained, but this can be complicated when a base potential-divider as in Fig. 2(b) is adopted.

Test 4, for base voltage, also demands a very sensitive voltmeter, with 100mV full-scale deflection or thereabouts. It is a waste of time to connect a meter with, say, a full-scale deflection of 5V to measure base voltage, since when the correct base current is flowing the base voltage (relative to emitter) is often little more than 50mV, sometimes less than this.

Test 5, giving emitter current, is one of the most popular tests since any ordinary milliammeter can be used and because the emitter is often in the "earthy" side of the circuit so far as signal is concerned. In the circuit of Fig. 4 the emitter current is equal to the collector current *plus* the base current.

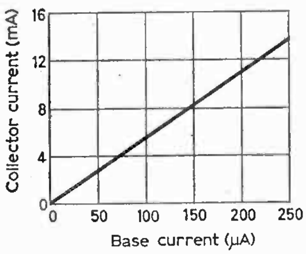


Fig. 5: Transfer characteristic of small-signal common-emitter stage.

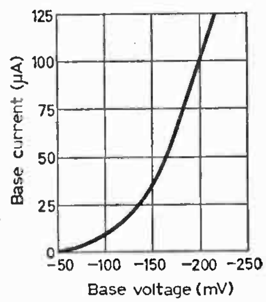


Fig. 6: Input characteristic in common-emitter stage (in at base).

The curve in Fig. 5 is called the *transfer characteristic* when the transistor is connected so that its emitter, as in the circuits so far given (Figs. 2 and 4), is common to both the input and output signals. This is called the *common-emitter* configuration. This shows clearly how the collector current (in mA) rises when the base current (in μA) is increased. The curve in Fig. 6 is called the *input characteristic* with the transistor connected in the same way and shows how the base current rises as the base voltage is increased. Input characteristics are essentially non-linear due to the rectifier action of the emitter junction. In practical circuits the design has to "swamp" this non-linearity to avoid input distortion.

Both of these curves are for small-signal transistors; larger transistors have correspondingly larger currents and voltages.

TRANSISTOR CIRCUIT MODES

As with valves, transistors can be connected differently, giving the common-base and common-collector connections, akin respectively to the valve earthed-grid and cathode-follower circuits. These stages, found in all kinds of transistor equipment, are shown in Fig. 7, (a) the common-base circuit with input to emitter and output from collector, and (b) the common-collector, or emitter-follower circuit as it is sometimes called, with input to base and output from the emitter.

For the sake of variety, circuit (a) is arranged with an n-p-n transistor, requiring a positive collector and base and negative emitter, and circuit (b) with a p-n-p transistor requiring a negative collector and base and positive emitter. Whatever the configuration, the electrode potentials must always suit the type of transistor used in this way.

Now a word or two about these three basic circuits. There are five main characteristics to be considered in each case. These are (i) input impedance, (ii) output impedance, (iii) current gain, (iv) voltage gain and (v) phase shift. In each case there is also a power gain which is the product of the voltage and current gains. The common-emitter has medium input and output impedances, high voltage and current gains (giving a very high power gain) and reverses the phase of the signal between input and output. The common-base has low input impedance, high output impedance, less than unity current gain, high voltage gain (giving a fair power gain) and zero phase reversal. The common-collector has high input impedance, low output impedance, high current gain, less than unity voltage gain (giving a fair power gain) and zero phase reversal.

The configurations are often mixed in commercial circuits to facilitate matching one stage to another with the least reduction in overall gain. Also p-n-p transistors are often mixed with n-p-n types in so-called complementary circuits, especially in audio amplifiers, and to allow direct-coupling (without a capacitor) from one stage to another, having in mind the required supply polarities.

GAIN FACTORS

However, before we look at this kind of coupling, let us see how a transistor provides gain. Since a transistor is basically a current amplifier its basic gain parameter is *current gain*. In the common-emitter configuration this is given by the collector current divided by the base current. From Fig. 5 we see that a collector current of 8mA is achieved when the base current is about $150\mu A$. Thus, by dividing $8{,}000\mu A$ by $150\mu A$ we get a current gain factor of a little over 53 times. Here we have considered direct-current, and the gain factor is modified when the base and collector currents are superimposed with a.c. signal, due to impedance and reactive effects coming into play when a.c. signal voltages and currents are applied to the transistor. The signal feed circuits and components to and from the transistor can also influence the a.c. gain. Current gain in the common-emitter mode if often symbolised by alpha dash (α^1) or beta (β).

Current gain in the common-base mode is the

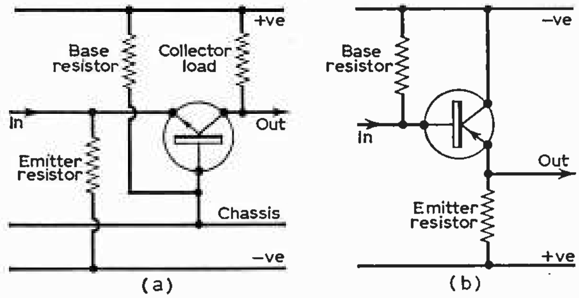


Fig. 7: Common-base stage (a) and common-collector stage (b).

collector current divided by the emitter current. We have seen that the emitter current is greater than the collector current, since it is equal to the collector current *plus* the base current. The common-base current gain, therefore, is less than unity, and is symbolised by plain alpha (α).

Voltage gain is given because the voltage drop across the collector load resistor due to the signal current in the collector is greater than the signal voltage applied to the input of the transistor to obtain the required change in emitter junction current. The collector junction has a relatively high impedance because it is biased for reverse conduction, while the emitter junction has a low impedance because it is biased for forward conduction. This means that the collector load resistor can be much higher than the transistor input impedance, and since the voltage at the collector junction is also higher than that at the emitter junction substantial voltage gains can be yielded by transistor amplifiers. The common-collector circuit, owing to its low output impedance, is the only configuration that has less than unity voltage gain, as we have seen. The power gain is a product of the current and voltage gains, and as one is high even when the other is less than unity, a transistor circuit always yields a power gain. The common-emitter circuit has high voltage and current gains, and thus has the highest power gain of all configurations.

D.C. STABILISATION

Figure 8 shows two techniques used for combating thermal runaway and for bias stabilisation. In (a) an increase in collector current due to leakage current resulting from temperature rise produces an increased voltage drop across the collector load R2. This reduces the voltage at the collector, and since it is from this point that the base bias resistor R1 picks up its potential, the base bias is also reduced, thereby pulling back the collector current. There is a limit to this simple kind of stabilisation, for if the total collector current is pulled down too far by the base current being reduced when collector leakage current rises the transistor would cut off.

Circuit (b) is more efficient and will be found in the majority of receiver stages. Here the base current is set by the potential-divider R1, R2 and to some extent by the collector current flowing through the emitter resistor R3. Should the collector current rise due to leakage current increase the voltage across R3 will also rise and this is reflected at the base as a *fall* in negative bias (remember this is a p-n-p transistor), thereby pulling back the collector current due to the ordinary transistor effect. The same arrangements are also used with n-p-n transistors.

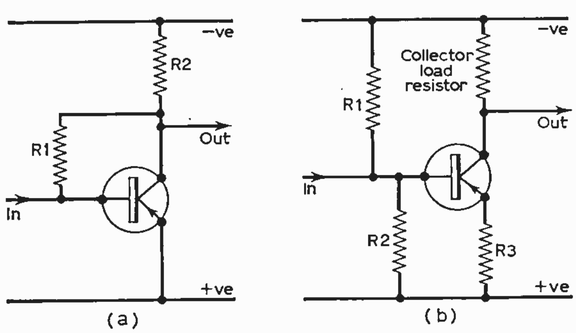
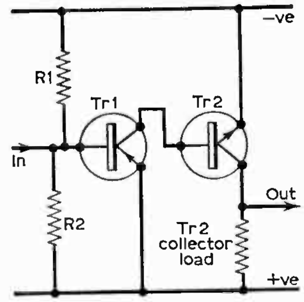


Fig. 8: Two types of d.c. stabilisation.

Figure 9 shows how a p-n-p transistor can be directly coupled to an n-p-n transistor. Here the base bias for Tr1 is set by the potential-divider R1, R2, as in the circuit of Fig. 8(b), and the collector of this transistor is loaded, not by a resistor, but by the emitter-base junction of Tr2. Thus Tr2 base current constitutes Tr1 collector current. The output signal is then taken from the collector of Tr2. Both stages are in the common-emitter mode. Complementary stages of this kind are now commonly used in the audio circuits of radio sets and amplifiers.

We have now sufficient information to get to grips with most transistor servicing problems, but first one or two hints and tips.



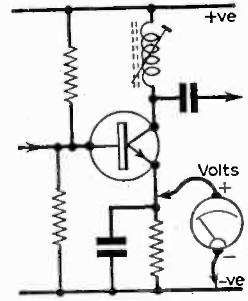


Fig. 9 (left): Direct-coupling between two complementary transistors.

Fig. 10 (right): The current can be assessed by measuring the voltage across a resistor and then dividing this by the value of the resistor (see text).

CURRENT CHECKS WITHOUT TEARS

It is often extremely difficult in miniature transistor equipment to disconnect a resistor or transistor electrode, especially on a flimsy printed circuit board, to connect a current meter. The best plan is to measure the voltage across a resistor in the circuit carrying the current, and then work out the current by Ohm's law, using the value of the resistor in the calculation.

As an illustration, take the set-up in Fig. 10. Here the emitter current can be computed by connecting a voltmeter across the emitter resistor and then dividing the voltage measured by the value of the resistor. To get the answer in milliamperes, the value of the resistor in kilohms (thousands of ohms) should be divided by the voltage. For example, 3V measured across 1·5k would indicate a current of 2mA. Easy! Current in any part of the circuit can be likewise assessed without breaking any wires.

Now a word or two about the testmeter. This, as we have already noted, should have as high a sensitivity as possible—not less than 10,000 ohms/volt if possible. If current *is* measured by breaking a circuit, then the current meter should not have too great a resistance, for this will be put in circuit and upset the normal operation. A multirange testmeter is ideal, but this should have the lowest possible reading ranges (i.e., full-scale current and voltage); but this, of course, will be related to the meter's sensitivity.

Although transistors are very reliable devices when properly used, they will quickly go faulty if wrongly connected or subjected to voltage and current surges or excessive heat from the soldering iron.

SOME DON'TS

The following "don'ts" given by Mullard are well worth keeping in mind. Don't short-circuit the lead-outs—easy to do accidentally with a screwdriver. Don't solder when the set is switched on: short-circuits and surges can easily occur. Don't use an unearthed soldering iron as the insulation between the element and the bit may break down and the bit become "live". Don't change components when the set is switched on, as surges large enough to destroy transistors can be created. Don't use a soldering iron without a heat-shunt: transistors and associated miniature components can be damaged by excessive heating. Don't connect the battery of a set incorrectly as reverse polarity can permanently affect the characteristics of transistors. Don't make resistance measurements and continuity tests with an ohmmeter giving an output voltage of more than 1·5V. Don't connect transistors the wrong way round in circuit as the characteristics may be permanently altered. Don't bend the lead-outs nearer than 1·5mm. from the seal, otherwise the seal may be damaged. Don't damage the light-proofing, as light can affect the currents inside a transistor.

TO BE CONTINUED

THE RHODIAN TAPE RECORDER

—continued from page 908

method is to borrow a tape recorded on a high-quality machine or a pre-recorded tape. The two screws holding the record/playback head should then be adjusted to give an output with the most treble.

For those wishing to have superimpose facilities all that is necessary is a small slide switch which cuts off the erase current and shunts a 100-ohm resistor across the secondary of the oscillator coil. There is just room to mount this on the control panel between the magic-eye and the end of the panel. The wiring for this is shown in Fig. 10.

Cabinet

The cabinet used is very easy to build and provides storage for the mains lead, the microphone, a radio connecting lead and a couple of boxes of tape. In the prototype the long sides have the strength and are made from 12 mm. (½in.) plywood, the short sides and base being made from 6mm. (¼in.) plywood. The deck rests on two battens which are sunk into the long sides, one of which is drilled out to provide ventilation for the amplifier. With modern resin wood glues only glueing and pinning is necessary for a strong cabinet.

Covering the cabinet is a matter of personal choice—the author used rexine but the contact adhesive plastic sheets are easy to use and give a pleasant appearance. One final touch is to use attractive control knobs and, using a bronze aerosol spray, to cover over the inevitable scratches etc. on the control panel. To discourage tamperers the author never labels controls, but this can be done very neatly by using the press-on sticky letters available from many stationers.

In operation the TD2 deck tends to vibrate a bit and to overcome this noise the author mounted the deck on two strips of expanded rubber between the deck and mounting battens. This reduced considerably the noise of the motor. ■

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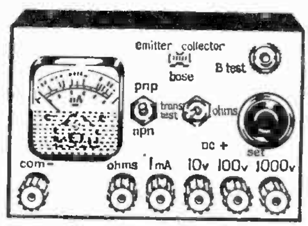

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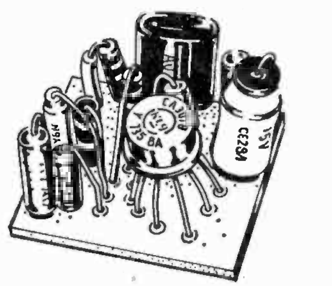

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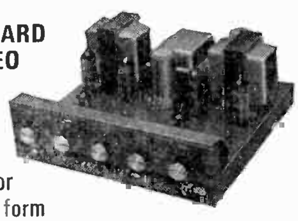

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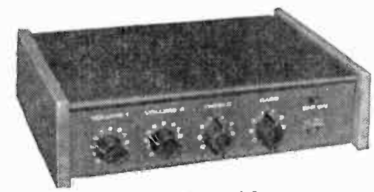

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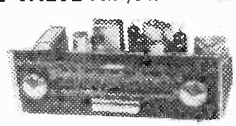

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PART 3

H.T. KITCHEN

ONCE the two units have been checked for correct operation individually they can be assembled on to the front panel and the rest of the wiring completed when this has been checked, the unit can be considered for alignment.

For this purpose the use of another audio oscillator that is known to be accurate will simplify and speed up the process of calibration, but it is not absolutely essential. The use of an oscilloscope is essential and it must be equipped with a timebase that will not drift over the period of time it will take to calibrate the equipment under discussion. Also required are an a.c. voltmeter capable of reading 1V r.m.s. accurately, and a d.c. voltmeter (20kΩ/volt minimum) capable of reading up to 10V. Preparations for calibration are simple, for the oscillator does not require any warming-up period. It should however be switched on for a few minutes prior to calibration, whilst a generous warming-up period say half an hour, should be allowed for the oscilloscope. VR8 should be set fully anti-clockwise to insert its maximum resistance into circuit whilst VR3 should also be fully anti-clockwise so that C13 is out of circuit. Both output controls should be set for maximum with S3 in the INT position. S4 can then be switched to Monitor Battery and the supply voltage monitored by the d.c. voltmeter set to its 10V range. VR8 should now be rotated until this meter reads 9V and the scale reading on the equipments meter noted.

S4 is then rotated to Monitor Output and the a.c. voltmeter and oscilloscope are connected to the output. VR3 is then slowy increased until the a.c. voltmeter reads 1V precisely, at which point the reading on the equipments meter should be noted. On the prototype R18 was selected so that the meter read mid scale, which of course corresponded to half the full scale reading. It would no doubt be possible to calibrate the meter specially so that it indicated a wide range of output voltages and in some cases this might prove useful.

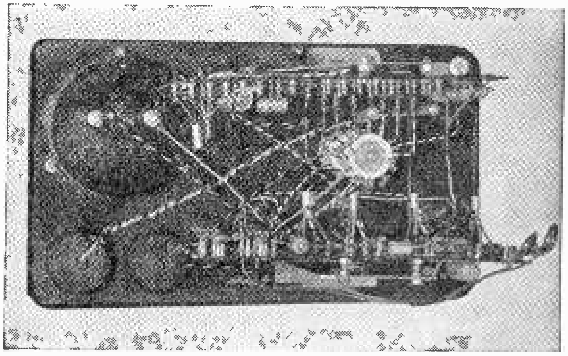
FREQUENCY CALIBRATION

Having calibrated the supply and output voltages, attention can now be turned to frequency calibrations. The oscilloscope must of course possess means of connecting the 50c/s mains, at a suitable amplitude, to the timebase amplifier or X plates in order to make use of Lissajous' figures for comparing the mains frequency against the unknown frequency from the oscillator which is set to range 1 (20c/s to 200c/s) and fed into the oscilloscope's vertical or Y input.

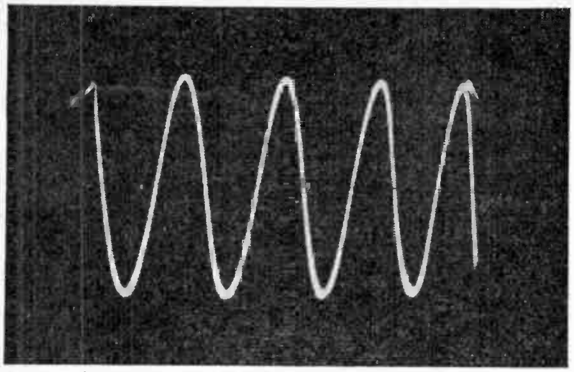
VR1 is then rotated until the oscilloscope displays a full circle which means that the oscillator frequency is equal to the mains frequency of 50c/s. Rotating anti-clockwise should display Lissajous' figures corresponding to 25c/s but it is doubtful if the next "full" figure corresponding to $16\frac{2}{3}$c/s will be obtained. VR1 should now be rotated clockwise and Lissajous' figures obtained at 100c/s, 150c/s and 200c/s. When the 200cs/ point is found VR4 should be rotated until the meter reads full scale. The scale linearity can now be checked by reducing the frequency and checking if the meter and oscilloscope agree at the 150c/s, 100c/s, 50c/s and 25c/s points.

It is possible that due to component tolerances the 200c/s point may not be reached at the clockwise position of VR1 or the 25c/s position at the anti-clockwise position. If 200c/s cannot be reached it indicates that the two 1μF capacitors C1 C5 are high in value and alternative components will have to be tried until 200c/s can be obtained. The effect of reducing R3 in value or removing it from circuit altogether could be tried but as this will affect all four ranges, it should be left until the remaining ranges have been checked for bandwidth. Should the clockwise position of VR1 cause the oscillator frequency to exceed 200c/s by any great extent it will be found that the low frequency end will not tune as low as 20c/s. This is due to C1 C5 being low in capacity and the effect of bridging them with other capacitors could be tried until it is possible to tune the desired bandwidth.

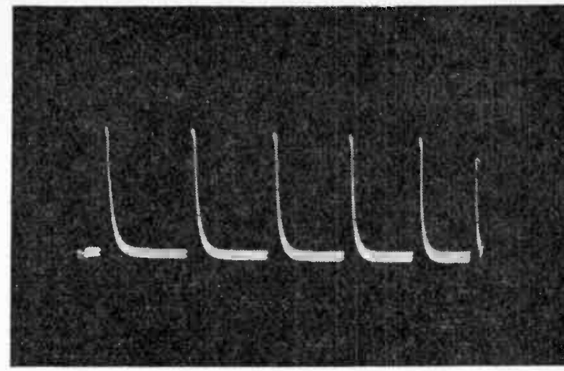
Range 2, 200c/s to 2kc/s, is next to be calibrated and in order to do so the 200c/s point should be located on range 1. The 50c/s feed to the oscilloscope's horizontal section should now be removed the oscilloscope restored to normal working order. Using the very minimum of sync or no sync at all, the coarse and fine timebase controls are adjusted to display exactly one full cycle on the c.r.t. at which point both the timebase oscillator and the audio oscillator are working at the same frequency. Without altering the oscilloscope's controls, the



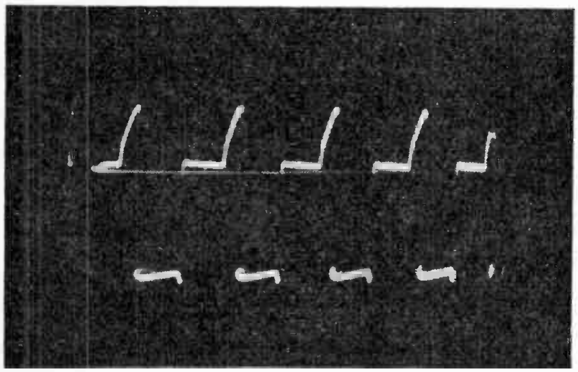
Internal view of the completed instrument.



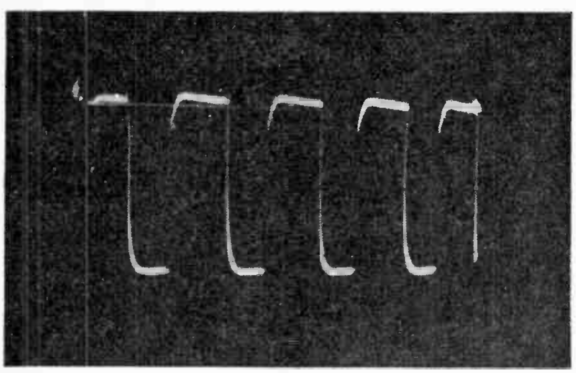
Input waveform of 1V r.m.s. 10 kc/s to Tr5 base.



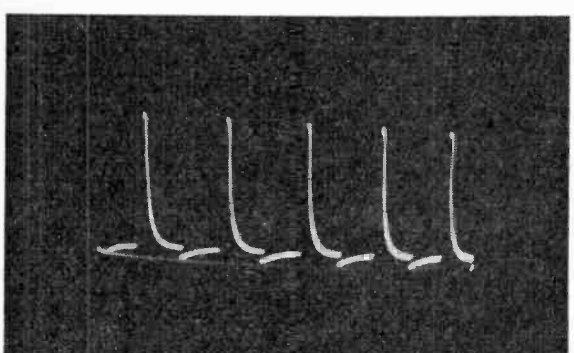
Across the meter (M1) terminals (oscilloscope y-attenuator was adjusted to equalise amplitude of all waveforms displayed).



Signal as it appears at Tr7 base.



At the collector of Tr8.



The same signal at the junction of D5/D6.

oscillator is now switched to range 2 and VR1 is rotated anti-clockwise until the oscilloscope again displays one full cycle, showing that the 200c/s point of range 2 (this should be towards the extreme anti-clockwise travel of VR1) has been reached. VR1 is now rotated clockwise again until the oscilloscope displays full cycles, 3, 4, 5 and up to a maximum of 10 full cycles. The oscillator frequency is equal to the timebase frequency of 200c/s multiplied by the number of cycles displayed. Thus 3 cycles corresponds to an oscillator frequency of 600c/s, and so on, up to the 10 cycles displayed which correspond to an oscillator frequency of 2kc/s, at which point VR5 is adjusted to make the meter read full scale.

Range 3 is calibrated in the same fashion by making the oscilloscope display one full cycle at the top (2kc/s) end of range 2, switching to range 3 and locating the bottom end frequency of 2kc/s. VR1 is then rotated to display 2, 3, 4—10 cycles to find the top limit of 20kc/s at which point VR6 is adjusted to make the meter read full scale.

Range 4 is calibrated in exactly the same manner and VR7 is adjusted to make the meter read full scale.

Although this method of calibrating an audio oscillator does not appear to be well known, it does possess the merit of simplicity and requires nothing more elaborate than an oscilloscope and the 50c/s mains. It is also capable, given an oscilloscope with a stable timebase and of course methodical working, of surprisingly accurate results.

During frequency calibration, minimum sync should be used to prevent the timebase being "pulled" into step with the signal from the audio oscillator. Whilst errors so caused might cancel out if the frequency "pulled" the timebase a different way each time it is also quite possible that it would be pulled the same way every time. Such errors would be additive, resulting in an unacceptably large error by the time the 200kc/s point was calibrated.

Should the frequency coverage of any range fall outside the desired bandwidth corrective measures will prove necessary. If the bandwidth is above the required limits it will be necessary to increase the capacity of whichever pair of capacitors out of C1 to C8 is concerned. Should the bandwidth fall below the desired limits the capacity of the affected pair is too high and will require reducing until the desired limits are reached. ■

LETTERS...

They're certainly not incompetent

With reference to Mr. M. Fisher's letter (P.W. January) in which, as a part-time commercial operator, he objects, maybe correctly, to the term "button pusher". But he then goes on to cast doubt upon the competency of Amateurs to work a net. I wonder if he has ever listened to the Radio Amateurs' Emergency Network when holding an exercise or during a real emergency. If any mistakes are made there then a life may be at stake. He might also try listening to the nets on 80m. sometime, most of which are conducted in a very orderly fashion. The fact that he complains of the poor amateurs in his district suggests that he should buy a more sensitive receiver and listen to those in other districts.

O.K. then Mr. Fisher, maybe we shouldn't call you "button pushers" but please don't call Amateurs incompetent, many of whom may hold technical qualifications far above you or me.—**P. R. Bennett, ORS29462** *(R.A.F. Gatow, BFPO45).*

Quick P.C.'s

May I offer the suggestion that constructors can produce a circuit board quickly from copper laminate board by cutting through the copper with a sharp knife and peeling away the unrequired copper. This method is very quick and changes can easily be made during construction. An alternative method which I also use is to saw the copper only into a series of small squares and then join these together as required. — **H. R. Vaughan-Williams, B.Sc.** *(Cardiff).*

5W Amplifier mods

By inserting a 390Ω resistor in series with the 100Ω preset pot., the bias between the bases of Tr2 and Tr3 is increased, giving correct currents and no crossover distortion. The best answer would probably be to use a preset of about 1kΩ, which would better accommodate different supply voltages.—**W. Wright** (*East Lothian, Scotland*).

They're all E.A.R.S.

On behalf of the Exeter Amateur Radio Society I am writing to request a small space in your most excellent journal to show that Exeter still has a thriving club, and there must be many of your readers who would like to know of our existence.

The A.G.M. was recently held and new officers were elected to the committee. New ideas will be developed, interesting talks and demonstrations are being arranged, and a new drive for increased membership is being made.

Meetings are held on the first Tuesday in each month at the George and Dragon (hall at rear), Blackboy Road, Exeter, commencing at 1930 hrs (7.30 p.m.) and a hearty welcome is extended to Transmitting and Short Wave Listeners, Junior and Senior, in fact to all interested in Amateur Radio.—**Gordon Wheatcroft, G3HMY,** Hon. Sec. (27 *Lower Wear Road, Countess Wear, Exeter, Devon*).

Comment on "Questions Answered"

Could I be allowed to comment on the item "Tape Recorder Whistle" in "Your Questions Answered" column? (February P.W.).

Having built a recorder a few years ago everything went well until the double-triode oscillator valve went low. A new valve was obtained and plugged in and Hey presto! The finest whistle you ever did hear!

A bias trap was the answer; an 800pF preset in parallel with a coil wound on a ferrite pot core. This combination was connected in series with the lead from feed resistor to the recording head.

It took many hours to find the correct number of turns to tune the circuit to the oscillator frequency as even a few turns makes all the difference. However it certainly stopped the bias getting into the amplifier and cured the whistle.

The preset was adjusted to give nil voltage at the junction of the feed resistor and bias trap to earth on the a.c. range of a normal multimeter. — **K. A. Le Lievre** (*Southampton*).

Word of praise

I greatly appreciate the F.M. Switched Tuner, by Mr. W. Groome, with its cheap and easily obtained parts.

However, I now find, to be on the ball, that it is necessary to tune to a.m. on the long wave.

May I beg of you to get Mr. Groome to arrange for his tuner to switch the four programmes, for, to be perfectly honest, I have no desire to improvise on the work of such a competent man.

As a reader of all your electronic publications for over 40 years, I am delighted to note the more professional background of articles. I would, however, love to see more technical data included with circuits, also voltages for servicing at a later date.—**Ivor Dee** *(London, S.E.12).*

A winner

"World Radio Club", the programme for radio amateurs and DXers in the BBC World Service for overseas listeners offered an annual subscription from a selection of British magazines on radio communication, as prizes in their latest competition. The competition called for geographical information on the beam from London to Melbourne. Two of the prizewinners selected PRACTICAL WIRELESS as their choice of prize; one from South Australia, and one from Germany.—**John G. Pitman**, *Producer "World Radio Club". (B.B.C., London, W.C.2).*

Local club offers help

We like the sentiments expressed by D. J. Tivey in his letter to you published in your December issue. Our commiserations are due to a keen enthusiast who has struggled with the Morse code for nine years. May his local Society offer him some help? In addition to our R.S.G.B. Slow Morse transmissions, five periods per week, we can put morse on tape to suit the individual and also give him personal tuition.

One of the many benefits of membership of our Society is the receipt of our monthly newsletter.—**M. Clift, G3UNV** *(Ashford, Middlesex).*

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S.T.C. 1 watt Zener diodes. 2·4v: 2·7v: 3·0v: 3·6v: 4·3v: 13v: 16v: 18v: 30v. All 3/6d. each.

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THE 'CLUBMAN'

J. THORNTON-LAWRENCE GW3JGA

continued from the March issue

THE Clubman Mk III is a further development of the Mk II version, previously described, and includes an r.f. amplifier stage employing Field Effect Transistors. The circuit is shown in Fig. 26. The r.f. amplifier stage has several important functions to perform, these may be summarised as follows:

1—Increase sensitivity.
2—Increase signal to noise ratio.
3—Increase second channel rejection.
4—Reduce cross-modulation.
5—Provide variable gain.
6—Be suitable for operation with a direction finding aerial.

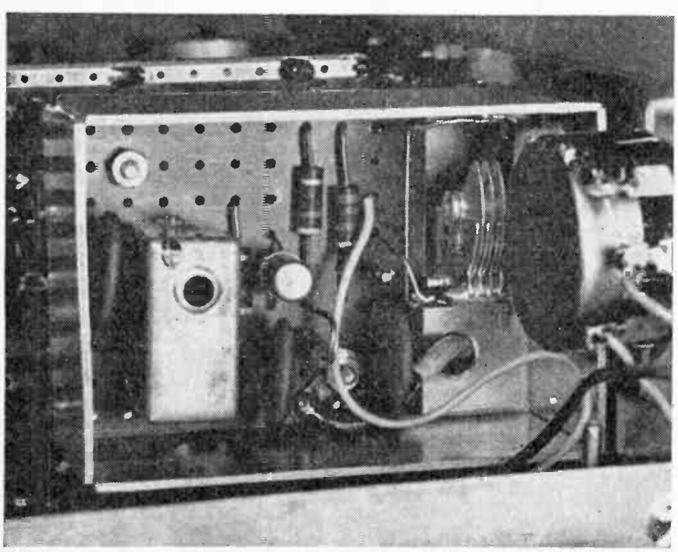
The addition of a conventional transistor r.f. amplifier stage will provide 1, 2 and 3, but is unsuitable when used as a variable gain amplifier, due to the large amount of cross-modulation caused by the transistor in the presence of adjacent strong signals. The use of a d.f. aerial would be complicated by the necessity of providing a base coupling winding.

An r.f. amplifier stage which satisfies all the above requirements is formed by using two F.E.T.'s in a cascode circuit. The F.E.T. provides adequate gain and has a lower noise figure than a conventional transistor, it has excellent cross-modulation characteristics with variable gain, and the circuit has the high input impedance required to suit a d.f. aerial.

To those who are familiar with television receiver tuners, the circuit has many similarities with the conventional valve cascode circuit using a double triode, where one section is used in an earthed cathode configuration and the other in earthed grid. The source, gate and drain of the F.E.T. may be considered to be equivalent to the cathode, grid and anode of the valve.

The prices of F.E.T.'s have fallen dramatically in the last year and the types chosen for the r.f. stage are Motorola type MPF102.

The MPF102 is an N-channel type and is operated with the drain positive with respect to the source and the gate biased negatively.



View of the b.f.o. section, described last month.

Circuit Description

The circuit has been drawn the correct way up to convey the method of circuit operation as an r.f. amplifier, but it will be noted that it is upside down for the d.c. conditions, in that Tr7 drain goes to chassis through L7 and that Tr8 gate is returned to −9 volts via R25, and Tr8 source to −9 volts via the r.f. gain control, VR1. R.F. signals are passed through the aerial coupling coil L1 to the input tuned circuit, L2 and VC4. L3 is not used.

Signals appearing across L2 are passed to Tr8 gate via C22. Tr8 source is earthed to r.f. by C24. Resultant signal currents in Tr8 drain are passed directly to Tr7 source. Tr7 gate is earthed to r.f. by C23. Signal currents appearing in Tr7 drain are passed through the coupling coil L7 to the tuned winding L8 and to the frequency changer base coupling winding, L9.

D.C. biasing for Tr8 is provided by the voltage drop across R28 in the source. Tr8 gate is taken to −9 volts by R25 and the gate bias is varied by VR1, the r.f. gain control. An increase of gate bias voltage causes the current through Tr8 and Tr7 to decrease, and as the mutual conductance of the F.E.T. is dependent on source current, a reduction of the gain of the stage is effected.

Due to the wide variation in the characteristics of F.E.T.'s of the same make and type, a pre-set control, VR3, is included in series with VR1 to enable the bias voltage produced by the r.f. gain control to be set so as to cut off Tr8 completely at the minimum position. Biasing for Tr7 gate is provided by the potential divider R26 and R27.

Construction

The aerial coil L1, 2 and 3, is installed in the position shown in Fig. 29, using a B9A valveholder and the screening can is fitted by the method suggested by Denco in their coil leaflet.

The tuning capacitor VC4 is mounted on bracket B and installed in the position shown. A spindle coupler enables an extension spindle to pass through the front panel to form the "Peak AE" Control. The wiring of the r.f. amplifier stage, as shown in Fig. 27, is accomplished by using two 4-way tagstrips cut from Radiospares mounting (tag) strips (28-way) and by using three unused tags (2, 3 and 4) on the aerial coil "valveholder". The r.f. coil L7, 8 and 9, is plugged into the holder previously occupied by the aerial coil.

It is recommended that the interconnecting wiring be done first, including the connections to VR1, as shown in Fig. 28. The capacitors and resistors may be fitted next and finally the F.E.T.'s. F.E.T.'s are easily damaged by the capacitive voltage existing on some soldering irons and so it is important that the soldering iron is earthed and that a heat shunt is used when soldering. The receiver chassis should not be connected to any other equipment when soldering in the F.E.T.'s.

Testing and Alignment

To repeat the usual warning, double check all connections before switching on, particularly to the F.E.T.'s.

With the aerial coil moved to its new position and the new r.f. coil inserted in its place, it is now necessary to realign the frequency changer stage in the manner described for the Mk II receiver, but substituting L8 for L3 in the alignment instructions. The signal generator should be connected across L7 for this operation.

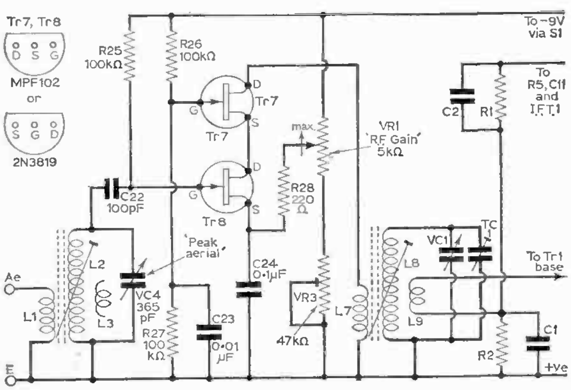


Fig. 26: Circuit of the F.E.T. r.f. stage, Mk III Clubman.

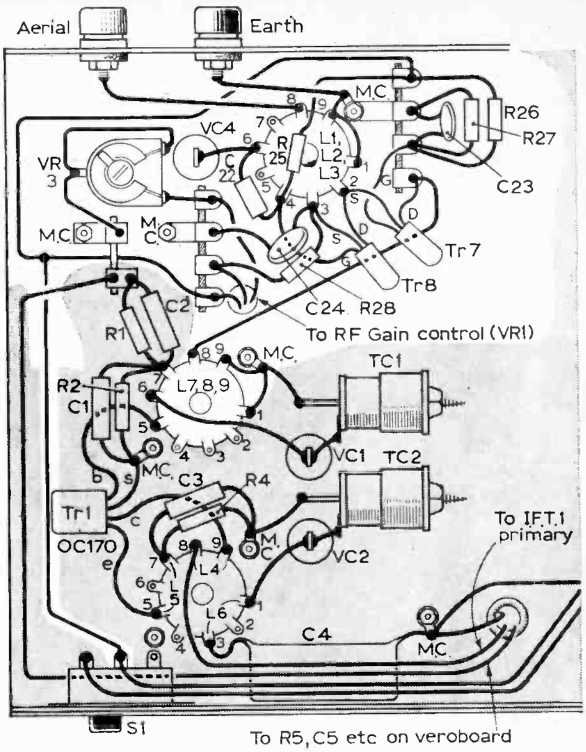


Fig. 27: Wiring diagram of the r.f. stage. The additional wiring and components are shown unshaded.

★ components list

Note: All components listed for the Mk II receiver are required for the Mk III receiver, the additional items required are listed below.

Resistors:
(Carbon ¼ watt, 10%)

R25 100kΩ   R27 100kΩ
R26 100kΩ   R28 220Ω

Potentiometers:

VR3 47kΩ miniature pre-set

Capacitors:

C22 100pF ceramic
C23 0·01μF 20V } disc ceramic
C24 0·1μF 20V }

Variable Capacitors:

VC4 365pF single gang, type 01. Jackson Bros.

Semiconductors:

Tr7 MPF102*   Tr8 MPF102*

Coil:

L7, 8 and 9 r.f. coil. 3T Yellow. Denco

Miscellaneous:

B9A valveholder, tagstrip, spindle coupler, spindle, knob, etc.

* Alternative type for the Motorola MPF102, is the Texas, 2N3819.

CONVECTOR HEATER

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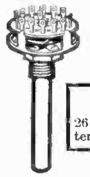

4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole, 6 way—1 pole, 12 way. All at 3/6 each, 36/- dozen, your assortment.

WATERPROOF HEATING ELEMENT
26 yards length 70W. Self-regulating temperature control. 10/- post free.

See in the Dark INFRA-RED BINOCULARS

These infra-red binoculars when fed from a high voltage source will enable objects to be seen in the dark, provided the objects are in the rays of an infra-red beam. Each eye tube contains a complete optical lens system as well as the infra-red cell. These optical systems can be used as lenses for TV cameras— light cells, etc. (details supplied). The binoculars form part of the Army night driving (Tabby equipment). They are unused and believed to be in good working order but sold without a guarantee. Price **£3.17.6**, plus 10/- carr. and ins. Handbook 2/6.

SPECIAL BARGAINS

50 ohm 50 watt Wire Wound Pot-meters, 8/6 each.
1 Meg Miniature. Pot-meter Morganite standard ¼in. spindle 1/- each, 9/- per dozen.
1 Meg Miniature. Pot-meter Morganite preset screwdriver control. **9d.** each. 8/- per dozen.
Pre-Set 100K by Welwyn with intrical bakelite knob, 1/- each. 9/- per dozen.
100K Pot-Meter. Miniature type with double pole switch and standard ¼in. spindle, by Morganite. 2/- each. 18/- per dozen.
Blanketstat Glass. Enclosed, normally closed. Circuit will open should blanket overheat. **4/6** each.
Thermal Relay. Can be used to delay the supply of HT while heaters warm up, or will enable 15amp. loads to be controlled by miniature switches or relays. Regular list price over £2, price **7/6** each.
Siemens High Speed Relay. Twin 1000 ohm coils. Platinum points changeover contacts—Ex equipment. **8/6** each.
Toggle Switch Bargain. 10 amp. 250 v. normal one hole fitting. **2/9** each, or 30/- per doz.
Electric Lock. 24 v. coil, but rewindable to other voltages, **4/6** each.
Compression Trimmers. Twin 100 pF 1/- each, 9/- per dozen.
Precision Wheatstone Bridge. Opportunity to build cheaply. 100K wire wound pot. 15 w. rating, only 5/-.
Sheet Paxolin. Ideal for transistor projects. 12 panels each 5in. x 8in., 5/-.
3in. PM Loudspeaker. 3 ohm. **12/6**. 80 ohm. **13/6**.
Transistor Ferrite Slab Aerial with medium and long wave coils. **7/6** each.
Slide Switch. Sub miniature double pole changeover. 2/- each. 18/- per dozen.
Vacuum Cleaner Flex. Non-kinkable ribbed rubber most pliable but very tough. 24/36 Cores. Normally, 1/9 per yard, offered at £3 per 100 yard coil, post and insurance 8/6.
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Telescopic Aerial for radio or transmitter, chrome plated, 6 section extends from 7¼in. to 47in., **7/6** each, **£4** per dozen.
Midget Neons for mains indicators, etc., 1/3 each or 12/- dozen.
Midget Relay twin 250 ohm coils, size approx. 1¼in. x 1in. x 1in. 4 pairs change over contacts, **7/6** each.

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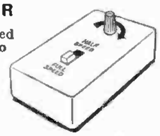

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions **19/6**, plus 2/6 post and insurance. Or available made up **32/6**. Plus 2/6 post.

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It's partly built
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- 7 Transistors, superhet circuit.
- Two-tone Cabinet, size 11 x 8 x 3in.
- All circuit requirements—Push-pull output—A.V.C. and feed back, etc.
- Printed circuit board all wired only connections e.g. to Volume control W.C. Switch and Tuning Condenser.
- Pre-aligned IF stages complete with full instructions. Price only **£4.9.6** plus 6/6 post and insurance.

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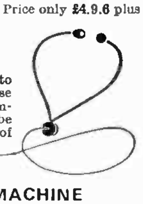
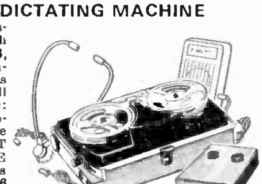


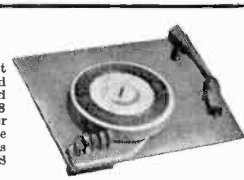
Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece **29/6**—twin stetoset instead of earpiece 7/6 extra—post and ins., 2/9.

CASSETTE LOADED DICTATING MACHINE



Battery operated and with all accessories. Really fantastic offer a British made £31 outfit for only **£6.19.6**, brilliantly designed for speed and efficiency—cassette takes normal spools drops in and out for easy loading—all normal functions—accessories include: stethoscopic earpiece—crystal microphone has on/off switch—telephone pick-up—tape reference pad—DON'T MISS THIS UNREPEATABLE OFFER—SEND TODAY **£6.19.6** plus 7/6 post and insurance. Footswitch **18/6** extra. Spare Cassettes at **7/6** each, three for **£1**.

THE 'TECHNICAL' RECORD PLAYER



4 speed, gram. motor with lightweight pick up, motor electronically balanced and free from wow and flutter. Speed change by push button—16, 33, 45, 78 r.p.m. Price **39/6**. Two valve amplifier **32/6**. Elliptical speaker **9/6**. Cartridge extra, mono 10/6; stereo, 15/- plus 4/6 post and insurance. DON'T MISS THIS TERRIFIC BARGAIN.

OZONE AIR CONDITIONER

For removing smells and generally improving oppressive atmosphere. In neat hammer finish box. Uses Philips ozone lamp and mains unit. Lamp easily replaceable. Only 39/6 plus 6/6 carr. and ins.

TUBULAR HEATERS

New and unused made by G.E.C.—rated at 60 watts per ft.—these are ideal in airing cupboards, bedrooms, offices, stores, greenhouses, etc., curtains or papers can touch them without fear of scorching or fire. Supplied complete with fixing brackets and available in the following sizes. Prices which are about ¼ of list price include carriage by B.R.S. 10ft. 36/-; 12ft. 42/-.

Be first this year! SEED AND PLANT RAISING

Soil heating wire and transformer. Suitable for standard size garden frame. Post and ins. 3/6. **19/6**

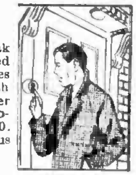
FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15-20 w. **19/6**. Kit B—30-40 w. **17/6**. Kit C—80 w. **17/6**. Kit D—125 w. **22/-**. Kit E—65 w. **19/6**. Kit MF1 is for 6in., 9in. and 12in. miniature tubes **19/6**. Postage on Kits A and B 4/6 for one or two kits then 1/6 for each two kits ordered. Kits C. D and E 4/6 on first kit then 3/6 for each kit ordered. Kit MF1 3/6 on first kit then 3/6 on each two kits ordered.

MAINS TRANSISTOR POWER PACK

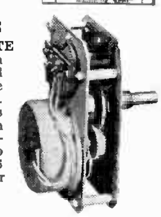
Designed to operate transistor sets and amplifiers Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only **16/6**, plus 3/6 postage.

DOOR INTERCOM



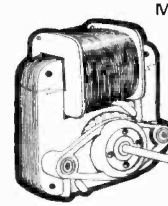
Know who is calling and speak to them without leaving bed or chair. Outfit comprises microphone with call push button connectors and master inter-com. Simply plugs together. Originally sold at £10. Special snip price 79/6, plus 3/6 postage.

GEARED MOTOR



HALF REV. PER MINUTE
Made by famous Smith Electric, mains operated and quite powerful. Size 3¼ × 2¼ x 1½in. deep. Secondary use as process timer. Internal switch can be made to break circuit within a period up to 2 mins. 17/6. P. & P. 2/6 unless ordered with other goods.

MAINS MOTOR



Precision made — as used in record decks and tape recorders —ideal also for extractor fan-blower, heater, etc. New and perfect. Snip at **9/6**. Postage 3/- for first one then 1/- for each one ordered. 12 and over post free.

RELAY SWITCHES. These enable micro switches, delicate thermostats or other low current devices to control up to 30 amps—ideal to switch thermal storage heaters—motors, etc., made by the famous A.E.I. group these are listed at **£25** each—you can buy if you hurry at a very keen price of **39/6** each and we will include diagrams and data. Mounted on panel size approximately 6 × 7 × 2in. deep.

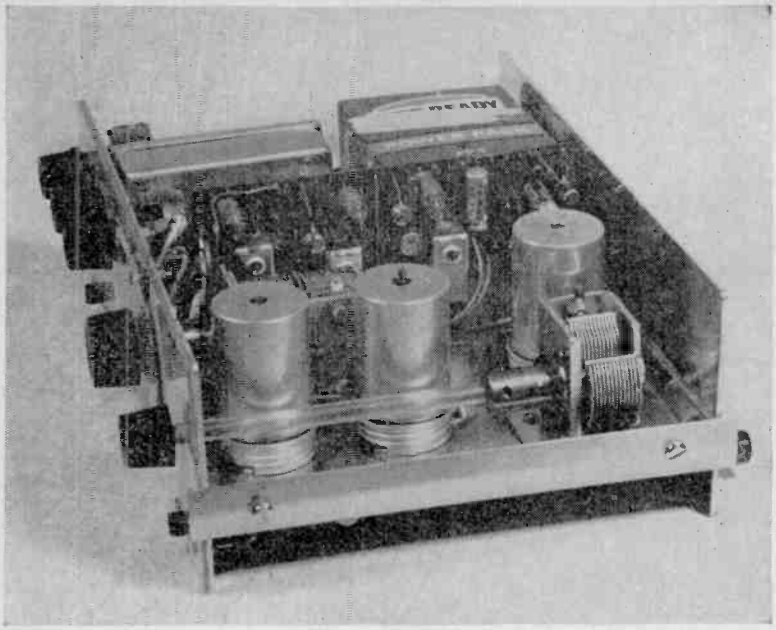
ALL PRICES GREATLY REDUCED

Type No.	*Price*	*Type No.*	*Price*	*Type No.*	*Price*
2N1727	15/-	OA5	5/-	OC72	3/-
2N1728	10/-	OA10	6/-	OC75	3/-
2N1742	25/-	OA47	3/-	OC76	3/-
2N1747	25/-	OA70	2/-	OC77	7/-
2N1748	10/-	OA79	2/6	OC78	3/-
AC107	9/-	OA81	2/6	OC78D	3/-
AC127	4/-	OA85	2/6	OC81	3/-
ACY17	8/6	OA90	2/6	OC81D	3/-
ACY18	5/6	OA91	2/6	OC82	3/-
ACY19	6/6	OA200	3/3	OC82D	3/-
ACY20	5/6	OA202	4/3	OC83	4/-
ACY21	6/-	OC20	12/6	OC84	4/6
ACY22	4/6	OC22	10/-	OC139	8/6
AF114	4/-	OC23	8/-	OC140	12/6
AF115	4/-	OC24	15/-	OC170	5/-
AF116	4/-	OC25	8/-	OC171	4/-
AF117	4/-	OC26	7/6	OC200	9/-
AF118	4/-	OC28	8/-	OC201	12/6
AF139	12/6	OC29	17/6	OC202	13/6
AF186	17/6	OC35	10/-	OC203	12/6
AFZ12	15/-	OC36	15/-	OCP71	15/-
ASZ21	15/-	OC38	12/6	ORP12	8/6
BC107	14/6	OC42	6/6	ORP60	10/-
BY100	4/6	OC44	3/-	SBO78	6/6
BYZ13	7/6	OC45	3/-	SB305	8/6
MAT100	6/6				
MAT101	7/6	OC46	3/-	SB251	10/-
MAT120	6/6	OC70	3/-	ST140	3/-
MAT121	6/6	OC71	3/-	ST141	4/6

P.O. Type Relay. Twin 200 ohm coils, size approx. 3in. x 2in. x ¾in. 4 pairs changeover contacts, 8/6 each.
1000W Fire Spiral replacement for most fires, 1/3 each, 12/- dozen.

ELECTRONICS (CROYDON) LIMITED

(Dept. P. W.) 102/3 TAMWORTH RD., CROYDON, SURREY *(Opp. W. Croydon Stn.)*
also at **266 LONDON ROAD, CROYDON, SURREY** *S.A.E. with enquiries please*



View of Mk. III Clubman. The "peak aerial" capacitor VC4 can be seen in the foreground.

Having completed the alignment of the frequency changer stage, alignment of the r.f. amplifier should be carried out as follows:

1—Set VC4 to maximum capacity (fully meshed).

2—Set r.f. gain control, VR1, to maximum gain (clockwise).

3—Connect the signal generator to the earth and aerial terminal via a dummy aerial or a 470Ω resistor.

4—Set the signal generator to 1·6Mc/s and tune in the signal.

5—Adjust the aerial coil core L2, for maximum output, reducing the signal generator output as necessary to avoid overloading.

The receiver has an exceptionally high sensitivity and even with the output controls of the signal generator at zero, it may not be possible to reduce the signal sufficiently. In this case the signal generator may be loosely coupled to the receiver by laying the output lead near, but not connected to, the receiver aerial terminal. This completes the alignment of the r.f. amplifier stage.

Tune in a signal of medium strength of 1·8Mc/s and adjust VC4 to peak up the signal to a maximum. Set the r.f. gain control VR1 to minimum and adjust VR3 so that the received signal just disappears. This setting should allow the r.f. gain control to operate smoothy from zero to maximum.

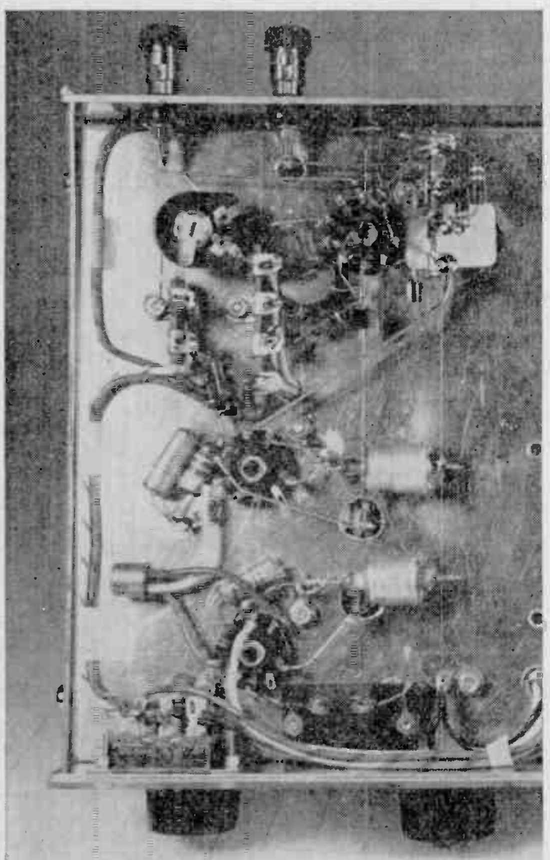
With an aerial and earth connected to the receiver, tuning should be carried out in the normal way and the "Peak AE" control adjusted for best results when the desired signal is tuned in.

The performance of the receiver when fully aligned is given below.

Sensitivity.	1·8Mc/s	less than 1μV
	5·0Mc/s	less than 1μV

(For 5μW output, 6dB s/n ratio, input signal modulated 30%.)

Selectivity.	3dB down	6kc/s
	20dB down	25kc/s



Underside chassis view of the r.f., mixer/oscillator section.

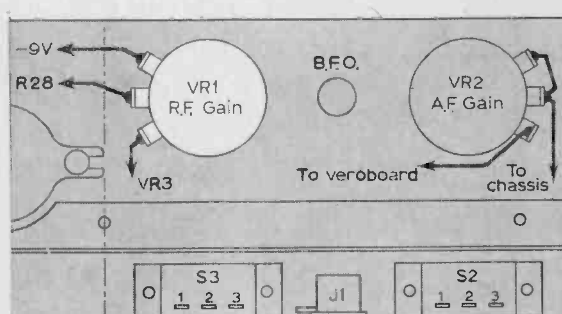


Fig. 28: Alterations to VR1, the r.f. gain control.

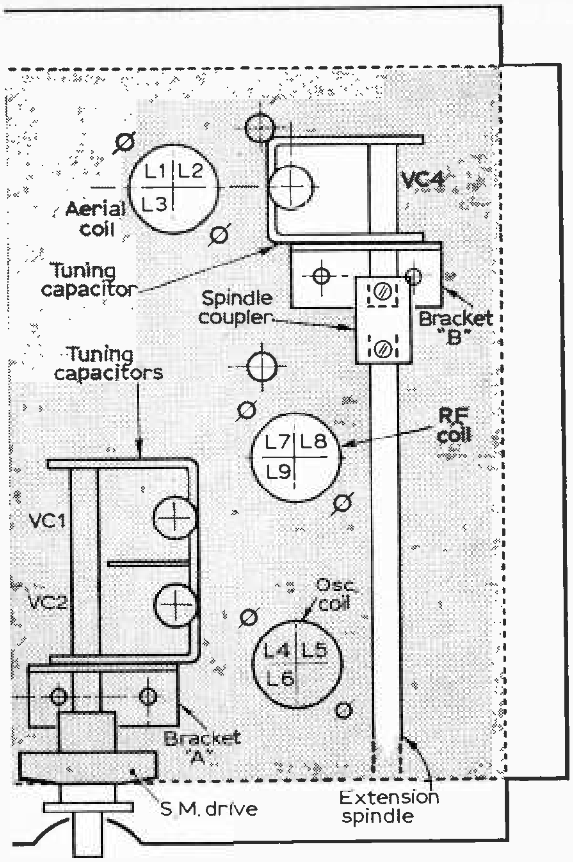


Fig. 29: Diagram showing position of r.f. and aerial coils also mounting of VC4.

Voltage Table

VR1 at maximum gain (clockwise)
20,000 ohms/V meter, 10 volt range.

	Tr7	Tr8
Source	−4·3V	−8·5V
Gate	−3·5V*	−7·5V**
Drain	0	−4·3V

* —4·5V using valve voltmeter.
**—8·9V using valve voltmeter.

Author's note :

The author has drawn our attention to a small number of errors, that have appeared in the CLUBMAN series.

1. Page 673. Components list. Resistors are all ½ watt rating.
2. Page 675. Fig. 6. Left hand side of chassis dimension given as 7in. should be 6in.
3. Page 735. Fig. 16. Tr1 (OC170) screen and base connections transposed.
4. Page 826. To avoid confusion with the wiring of S1 in other diagrams, ignore the numbering of S1 (1–2) in Fig. 18.

TO BE CONTINUED

THE MW COLUMN

CONDITIONS have not been very good of late, although there have been one or two very good days. Asia has been extremely poor and there have been many completely dead days. Despite the general depression, some good things have been heard.

Glyn Morgan reports Cairo and Canary Islands (both on 620, separated by loop); ELBC Liberia very good on 630; Godhaven, Greenland good on 650; Hofn, Iceland good after midnight on 655; an unidentified Arabic station on 1057 at 2300 (could be Tetuan on new frequency); Conakry, Guinea on 1403 at 2320.

M. Stephenson is a newcomer to MW DX and his log will interest others just starting up. It includes the following USA and Canadian stations—CBA 1070, CJON St. John's (930), CHER Sydney (950), CBH Halifax (860), CBN St. John's (640), CKBW Bridgewater (1000), CBD St. John's (1110), WOR New York (710), WINS NY (1010), WINZ Miami (940), WITC Hartford (1080), WNEW (1130), WHDH Boston (850). He also heard PJB Bonaire on 800 and *Radio Demerara,* Guyana on 760.

Some of those picked up by myself recently include VOCM St. John's (590), CKCM Grand Falls (620), CJOX Grand Bank (710), São Tomé (good signal on 759), WGY Schenectady (810), HJED *La Voz de Rio Cauca* (820), HJKC *Nuevo Mundo* (very good on 850), WHOA San Juan P.R. (870), XEW Mexico City (900), YVRQ *Radio Aeropuerto* (910), WTRY Troy (980), WCFL Chicago (1000, mixed with *XEOY Radio Mil*), KDKA Pittsburg (1020), WBZ Boston (1030), KMOX St. Louis (poor on 1120), HJCT *La Voz de la Costa* (1190), YVOZ *Radio Tiempo* (1200), WEZE Boston (1260), CKEC New Glasgow (1320), WAVY Portsmouth (1350). The three most outstanding signals heard here recently have been Godhaven (Greenland) on 650 around 0100, Hofn (Iceland) after midnight on 665 and CR6RZ heard most nights after BBC closedown on 1088. At odd times these stations were all heard at extremely high strength.

India/Pakistan, for the last few years heard on frequent occasions from 0030 onwards, has been poorly received this season. Reports have come in of reception of Indore (650), Hyderabad (1060) and Lahore (620), together with Lucknow on 910 (a new frequency), and Rajkot (now on 1070 from 910) but the almost nightly appearances of the last few years seems to be literally a thing of the past.

The Madeira station on 1331, mentioned last month, has now moved to 1421. The station at Riyadh, Saudi Arabia, on 647 is said to be 1200kW. ELBC Monrovia is said to have moved from 650 to 630. More high power in the Middle East—Beirut is to operate a 3000kW station any time now; Kuwait is due on 539 with 750kW. And talking of high power, the West Chinese station at Urumchi on 1525 is said to have a power of 2000kW, but its beam into USSR pushes this up to an e.r.p. of 8000kW!

With CR6RZ in Angola being so well heard, and other Southern African stations being logged this year, keep an ear open for *Radio Pax,* Mozambique, which has a new station operating on 1295 with 20/50kW.

ALISTAIR WOODLAND

practically wireless commentary by HENRY

No. 43

Tolerably So

In the columns of the *Sunday Times* I came across the statement *"The answer lies somewhere between the two figures . . . the 75 per cent claimed by Steinbeck . . . the 2·6 per thousand troops admitted by the US State Department."*

The subject does not really matter. What *does* interest this observer is the generous margin of tolerance allowed by the writer of the article. 2·6 per thousand, according to my reckoning, and even without the aid of Mr. Kampel's slide rule, comes to 0·26 per cent.

This is the sort of tolerance factor that Mrs. Henry employs. *"Do you like my hat? Only two pounds"* may be taken to mean it cost something like £2 18s. 11d. On the other hand, she will gaily tell her friends that it set her back three pounds—*"Well, so it was—nearly."* It is that "nearly" that contains the crux of the matter.

This has been brought home to me rather forcibly in recent weeks. Our firm has been buying new instruments, including a quite costly wow and flutter meter. Henry had fun, running the proverbial rule over a wide range of gramophone decks and tape recorder mechanisms. The results would have surprised anyone except a hardened service mechanic. Divergences such as the *Sunday Times* tolerance limits were chicken feed to the happy gentlemen who write those beautiful sales brochures.

'Do you like my new hat?"

The better mechanics were very good, and the cheaper ones were horrid. But in most cases, when the measured figures were beyond the tolerance of even the modest commercial standards, one's ears had *already* informed us that something was amiss. The wow attributable to a tape recorder capstan lies in the region of 2-10c/s and this is precisely the region in which those deceitful flappers that hold our hats up are most sensitive to speed fluctuations. Which explains why we squirm when someone replays a piano piece on some tape recorders yet tolerate worse technical variations from a gramophone record.

An eccentric disc at 33⅓ r.p.m. will produce a wow once in three seconds (roughly—don't argue, be tolerant!). Similarly, motor flutter, allowing the motor to be the usual kind that revolves at 3,000 r.p.m., can give a varying drive at about 50c/s. The point is that the measurements can be similar on all three sources of annoyance, but the subjective effect is very different. Because of our non-linear hearing, there is as much as a 12dB difference in the amount of variation above and below that sensitive range needed to produce the same distress. Hence the "weighting factor" that we so often see quoted.

We learn to be tolerant, applying our own physical correction factors as we go along. But it seems funny to the boffin when one of us at the bench sweats over a simple calculation to determine what value component to replace when he, the long-headed one, has used an approximation of quite daring breadth in the original design.

In a recent article by Rex Baldock in *Hi-Fi News*, entitled "Approximations", he gives some fascinating figures, for example on that hardy constant "pi". Remember how our old mentors insisted on four decimal places?

A piano piece on some tape recorders.

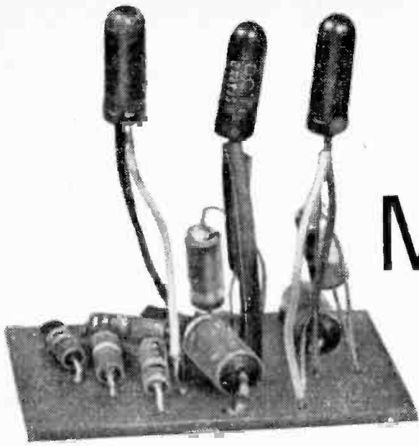
(3·1416 please, none of your old twenty-two upon seven.) But as Mr. B says, the use of 22/7 is only 1 part in 3,000 larger than a true value of π to *five* decimal places. Even the use of 10 for π^2 is only a 1 per cent error.

Also, note that pi-cubed, which bothers so many trigonometry students, is only 1 part in nearly 5,000 too low if we use 31 instead of 31·006. How much closer do you want to get?

Remember those comfortable words next time you are ferreting through the spares box for exactly the right component to complete that PW project.

It is obvious that some so-called designers have eschewed all calculations and proceeded along what might euphemistically be called "empirical" lines. One imagines them tangling up a brainstormed circuit and muttering: *"Let's try a diode there and see what happens,"* or *"Bung another resistor in—we've got plently."* And then when some production wallah stalks into the development den and rebuilds the horror to suit the factory system, and mischievously hides all the vital parts under screens and wiring harnesses, the poor mechanic is going to need more than tolerance to sort out subsequent faults.

Then is the time for a bit of the old "give and take".



EXPERIMENTAL Microphone Preamp

A.J. Garratt-Reed

THIS unit was originally built to feed the main amplifier enabling a Collins T.C.S. transmitter to be modulated by a cheap Japanese crystal insert microphone. However, it has proved equally suitable for use as a pre-amp with a main power amplifier as a public address system, and the prototype has been used on a number of occasions (with a good quality mike) at dances at a local club.

CIRCUITRY

The circuit is shown in Fig. 1, but it is worthwhile looking at the design considerations. A crystal microphone behaves like a voltage source in series with a capacitor of about 5,000pF. If such a source is fed into a resistive load low frequencies are attenuated and the output falls to half its maximum when the frequency f is of such a value that the load R is numerically equal to $\frac{1}{2\pi fC}$, C being the series capacity. Now amateurs normally find it unnecessary to transmit audio frequencies below 300c/s, so putting this number into the formula we find R is 110kΩ. This cut-off, while making the pre-amp of little value to a singer, makes no difference to an announcer as no significant amount of information is carried by the low frequencies in speech. Evidence suggests that speech is *more* audible over interference when these low notes are removed!

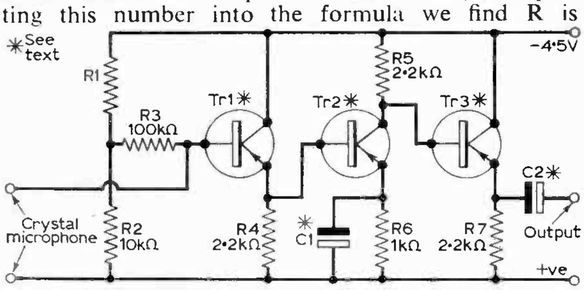


Fig. 1: Circuit of the preamp.

INPUT IMPEDANCE

The input impedance of a transistor amplifier consists of two parts, the impedance of the transistor itself and the resistance of the bias chain. As the effects of the bias network can be almost completely eliminated we will discuss the transistor first, and assume that it contributes all the input impedance, which is entirely resistive. If Re is the emitter resistor of an emitter follower, then the input impedance is approximately Re x β where β is the current gain of the transistor in the common emitter mode. This is usually about 50 with normal transistors. Hence to make the input impedance 110kΩ, Re must be 2·2kΩ. This is R4 in Fig. 1.

BIAS

The bias chain shown has an impedance of about 100kΩ, which, together with the 110kΩ of the transistor, gives a total input impedance of the amplifier of 55kΩ. As mentioned above, the impedance of the bias chain can be eliminated, but in trials, it was found to make little difference. However, as only one component is involved, readers may like to experiment. This process, called bootstrapping, consists of connecting a capacitor (try 25μF 6V) with its positive end to the emitter of Tr1 and its negative end to the junction of R1, R2 and R3. We will see later that a value of 2·2kΩ or R4 is suitable from the d.c. bias point of view.

The output voltage from an emitter follower is very nearly equal to the input voltage, hence in our case, about 10mV. This feeds the base to Tr2, which has an input impedance of about 2kΩ. Hence the a.c. base current is about 0·005mA. If this transistor also has a β of 50, the alternating collector current will be 0·25mA. Across a load of 2·2kΩ this gives an output voltage of about half a volt. (This is so because the collector impedance of the transistor Tr2 and the input impedance of Tr3 are both much higher than 2kΩ). This output is ample to drive most audio power amplifiers, and the third stage, another emitter follower, is not strictly necessary for this purpose. However, the output impedance of about 2kΩ was too high to drive the transmitter, so the third stage was added. It is useful in that it makes the pre-amp more versatile and helps to reduce hum. The output impedance is about 40Ω.

D.C. ASPECT

The pre-amp now works for a.c. but we must still consider the d.c. aspect. Direct coupling was chosen to minimise the number of components, so the d.c. conditions of the amplifier as a whole must be considered. The amplifier transistor Tr2 is the most critical, and this dictates the operating conditions of the other two. A collector current of 1mA was chosen for Tr2 as a compromise between low noise and high gain. The voltage drop across R5 is thus 2·2 volts. If the supply is 4·5 volts, and we allow 1·3 volts across the transistor (this is not a lot but is enough) then the emitter must be 1 volt

above earth. This means that the emitter resistor is 1kΩ. Its by-pass capacitor need only be 6 volt working, and at least 25μF. In a germanium transistor, there is a voltage of about 0·2V between the emitter and base, so the base of Tr2 is 1·2 volts to earth. This is also the potential at the emitter of Tr1, so the current in R4 is about 0·5mA, which is perfectly suitable. The base of Tr1 is 1·4 volts above the earth line. Very little current flows in R3, but as R3 is so large, in order to keep up the input impedance, there is still an appreciable voltage drop of the order of 1 volt. Thus R1 and R2 must be approximately equal. As we said before, the collector of Tr2 is 2·3 volts above earth, so the emitter of Tr3 is about 2 volts above earth. Allowing 1mA to flow in this emitter circuit dictates a value of 2·2kΩ for R7. To set the bias, R2 is set at 10kΩ, and R1 is altered until the voltage as measured on a high resistance voltmeter across R7 is within ¼V either way of 2V. If germanium transistors are used, start off with R1 at 15kΩ, but if silicon devices, which have a larger emitter-base voltage, are used, R1 will be smaller, and 10kΩ could be tried as a start.

Almost any small-signal amplifier transistors should work, silicon or germanium but silicon ones tend to be quieter. The prototype has run perfectly with OC71's and with 2N2926's. The OC71's tend to hiss, and it was a little more critical adjusting the bias on the 2N2926's (Silicon n-p-n transistors). OC44's or 45's should work, as should almost any tran-

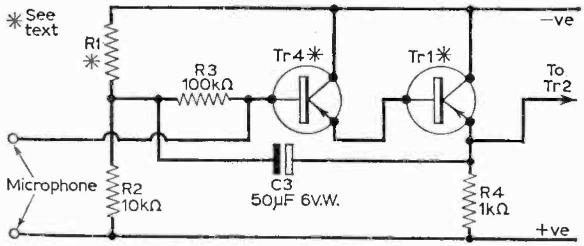


Fig. 2: Adding another transistor to improve response.

sistor which is used in circuits published in this magazine. The three transistors need not be the same type, but must all be either p-n-p or n-p-n. Figure 1 shows the circuit for p-n-p's, but the only difference for n-p-n's is that the capacitors are connected the opposite way round, and the battery polarity is reversed.

The value of C2 depends on several things. If the main amplifier is transistorised, then C2 must be at least 25μF, but if a valve amplifier is being fed, things are different. If only a short screened lead connects the pre-amp to the main amplifier, 0·1μF will suffice for C2, but for good hum elimination 10μF or more is recommended. In these conditions, if a short lead connects the pre-amp to the main

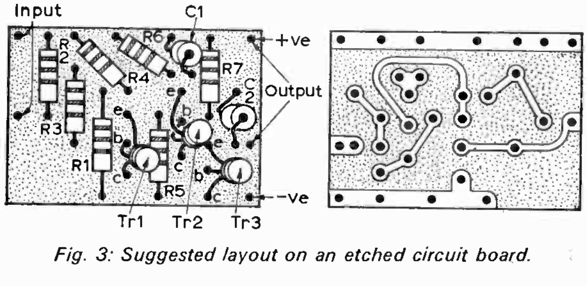


Fig. 3: Suggested layout on an etched circuit board.

★ components list

Resistors:		Capacitors:
R1	See text	See text
R2	10kΩ	
R3	100kΩ	**Semiconductors:**
R4	2·2kΩ	See text.
R5	2·2kΩ	
R6	1kΩ	
R7	2·2kΩ	

Components for Figure 2:

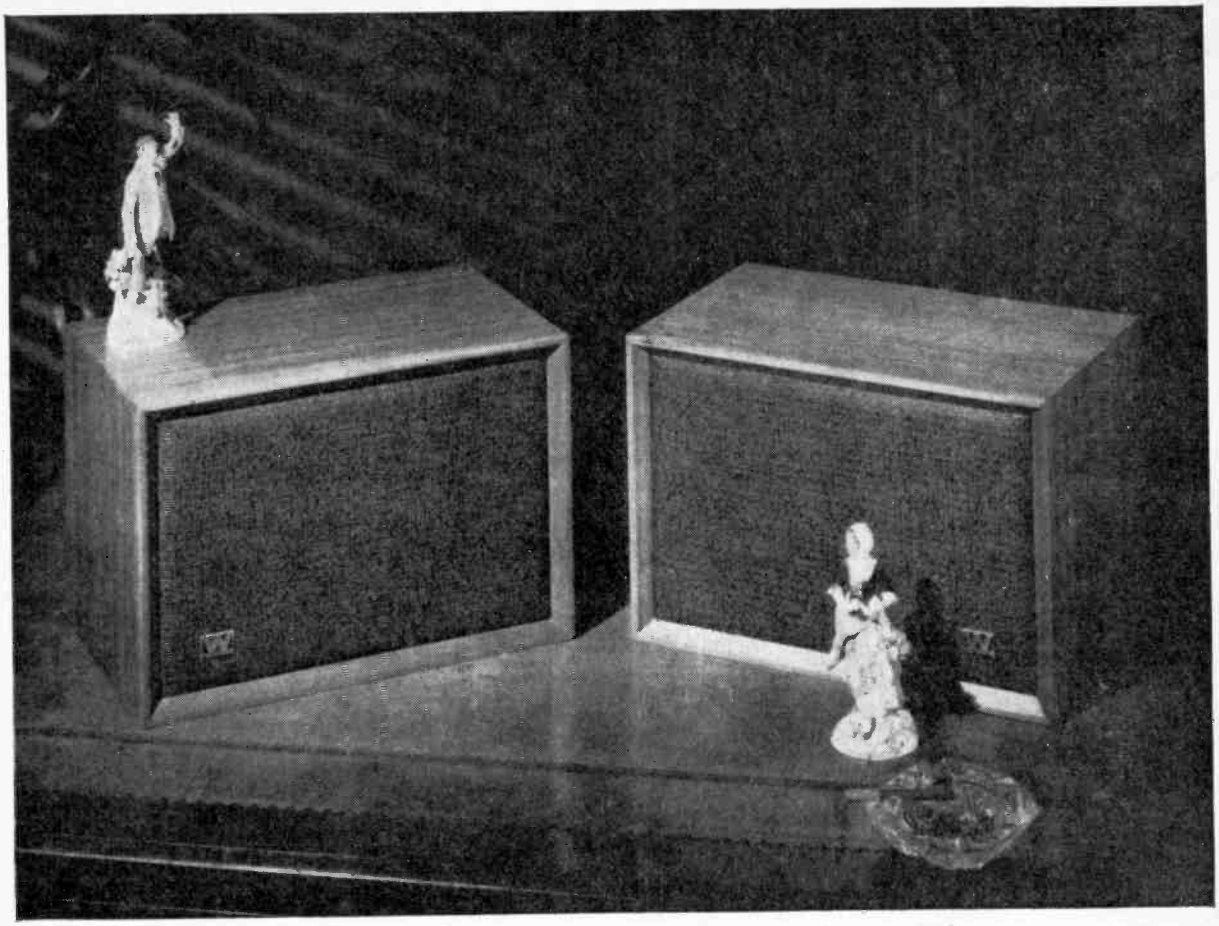
Resistors:		Capacitors:
R1	See text	C3 50μF 6V
R2	10kΩ	
R3	100kΩ	**Semiconductors:**
R4	1kΩ	Tr1, Tr4 See text

amp, then it need not be screened at all, but twin lighting flex will suffice! The lead connecting the microphone to the pre-amp must be screened, and should be as short as practicable, not more than a few yards. If a long lead must be used, for instance with a "roving mike" then the person with the microphone can carry the pre-amp in his pocket, as the lead from the pre-amp to the main amplifier can be many dozens of yards.

CONSTRUCTION

The construction is left to the reader, as it is very simple and in no way critical. The final version of the prototype was built on a printed circuit etched by ferric chloride from an off-cut of copper laminated board about 1½ by 2in. Nail varnish was used for masking, and cellulose paint thinner to remove the varnish. The holes were drilled with a 3/64th in. drill.

In order to increase the low frequency capabilities of the circuit, thus making it suitable for singing, it is necessary to modify the first stage, incorporating a fourth transistor, Tr4, as shown in Fig. 2. This circuit is known as the super-alpha pair, which should work, but has not been tried. Resistor R4 should be about 1kΩ, and Tr4 must be a low noise type. If several transistors are to hand it would be worthwhile experimenting to find the quietest combination. R1 should be adjusted as for the three transistor circuit. ■



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One Watt Power Output. Portable Cabinet size 12 × 4 × 9in. fitted 7 × 4in. Speaker. Volume Control, Standard Jack Socket. Uses PP9 Battery. Will increase volume and performance of Transistor Radios, Record Players, Tape Recorders, etc. Ideal for Guitar practice. Worth Double!

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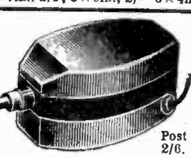

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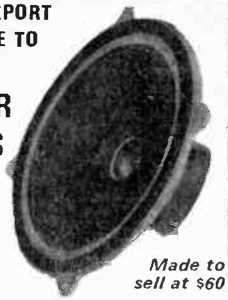

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HIGH STABILITY. ½ w. 1% 10 ohms to 10 meg., 2/-.
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5 watt	0.5 to 8.2 ohm 3 w.	1/6
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15 watt	10 ohms to 6,800 ohms	2/-

10K, 15K, 20K, 25K, 68K, 10W. 3/-

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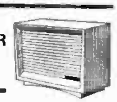

Black plastic cabinet, 20ft. lead and adaptors. For any radio, intercom, tape recorder, etc. 3 to 15 ohm. Size: 7¼" x 5¼" x 3". POST 2/6 **30/-**

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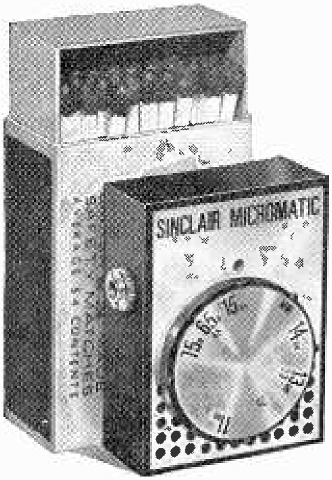
The world's smallest radio



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The ultimate in personal listening, the Micromatic is as easy to have with you as your wristwatch. It has enormous power and range, and the magnetic earpiece now supplied assures marvellous quality. Hear how Radio 1 and other stations simply pour in. Build it yourself or buy your Micromatic ready built. This is the set you will never be without once you hear it for yourself.

- $1\frac{4}{5}'' \times 1^{3}/_{10}'' \times \frac{1}{2}''$
- **Tunes over medium waveband**
- **Slow motion tuning control**
- **Aluminium front panel and dial**
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Complete kit including magnetic earpiece and instructions

49/6

Ready built with magnetic earpiece

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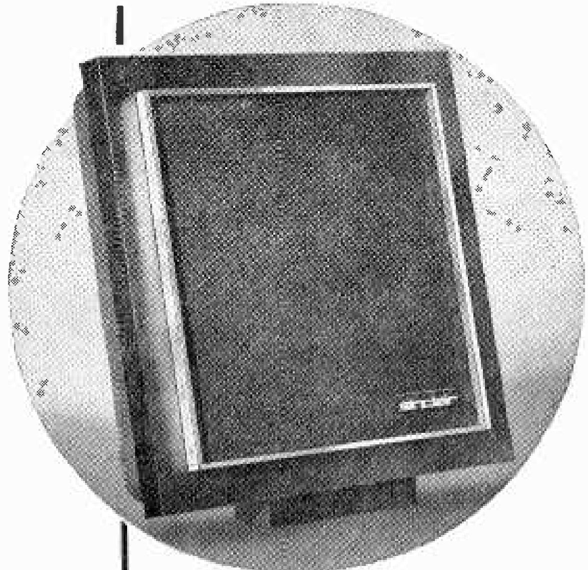
Mallory Mercury Cell RM.675 (2 needed) ea. 2/9



SINCLAIR Q.14 LOUDSPEAKER

BRILLIANTLY EFFICIENT
... especially in stereo

When Sinclair Radionics decided to design and manufacture a new loudspeaker, it was required from the start that its performance should be worthy of today's best high fidelity standards and be so reasonably priced that the greatest numbers could afford it. By using ultra-low resonant materials to form its acoustically contoured housing, outstandingly brilliant performance resulted. Furthermore, the unusual form of the Q.14 meant it could be used as a free-standing shelf speaker, as a wall-corner sound radiator or flush mounted singly or in multiple units on a flat surface such as a wall. The correctness of the design of the Q.14 has amply proven itself since within a few months of its introduction, it is already amongst the four most demanded loudspeakers irrespective of price. Independent laboratory tests have already shown that the Q.14 has amazingly good performance characteristics. As a judge of good sound yourself, your ear will confirm this instantly. At its price, there is nothing to stop you changing to Sinclair at once.

- Size $9\frac{3}{4}$in. x $9\frac{3}{4}$in. x $4\frac{3}{4}$in. deep plus detachable base
- 15 ohms impedance
- Up to 14 watts loading
- Smooth response between 60 and 16,000 Hz
- British manufacture

The Q.14 is finished in matt black with solid aluminium bar embellishment on the front. Supplied in strong fitted carton and sent post free under money back guarantee if you are not satisfied.

£6.19.6

IDEAL WITH Z.12 HI-FI SYSTEMS

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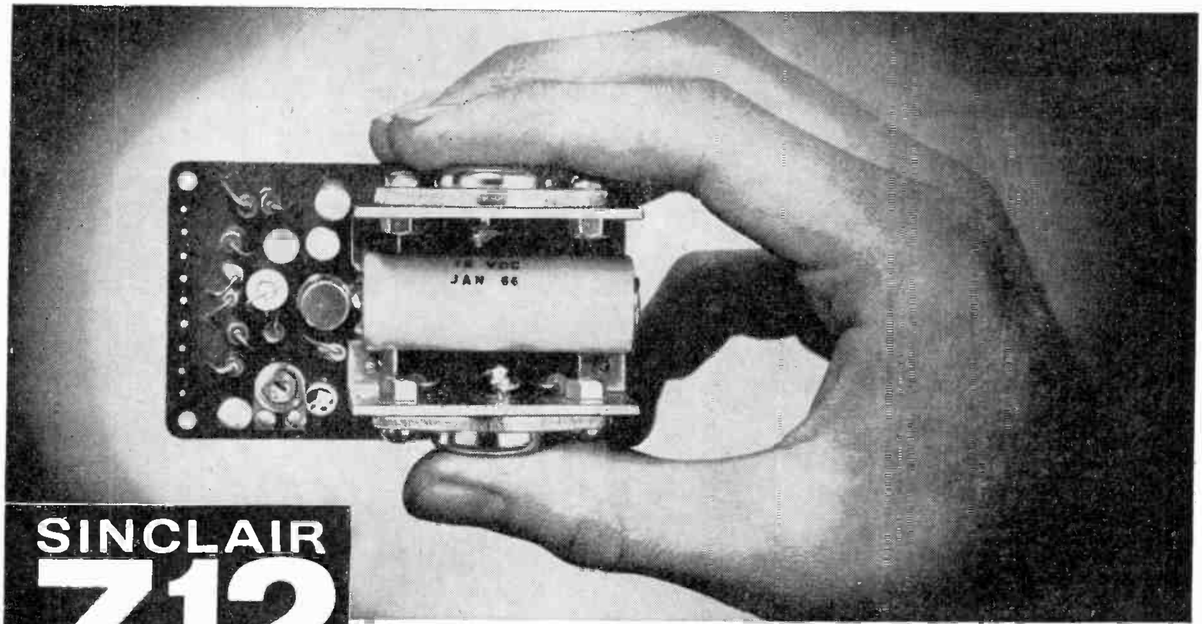

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COMBINED 12 WATT HI-FI AMP AND PRE-AMP

UNCHALLENGED LEADER IN ITS FIELD

No constructor's transistor amplifier has ever achieved such successes as the Sinclair Z.12. It favours the user in so many ways—with fantastic power-to-size ratio, with far greater adaptability, with freedom to operate it from batteries or mains power supply unit (the new PZ.4 is ideal for this) with the opportunity to obtain superb stereo reproduction for very little outlay. Countless thousands of Z.12s are in use throughout the world—in hi-fi installations, electronic guitars and organs, P.A. installations, intercom systems etc. This true 12 watt amplifier is supplied ready built, tested and guaranteed together with the Z.12 manual which details control circuits enabling you to match the Z.12 to your precise requirements. For complete listening satisfaction, use your Z.12 system with Q.14 loudspeakers. It assures superb quality with substantial saving in outlay.

- 3″ x 1¾″ x 1¼″
- Class B Ultralinear output
- 15–50,000 Hz ± 1dB
- Suitable for 3, 5, 8 or 15Ω speakers. Two 3-ohm speakers may be used in parallel.
- Input—2mV into 2kΩ
- Output—12 watt, R.M.S. continuous sine wave (24 w peak)

"I made this (Z.12) stereo record player for my work as hospital chaplain and it has been a great success."
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"The Z.12 and Q.14 live up to your high standard. I could spend pages praising these products."
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Ready built, tested and guaranteed. **89/6**

SINCLAIR STEREO 25

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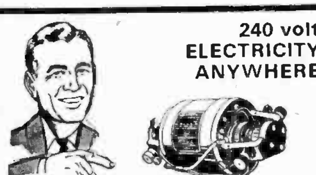

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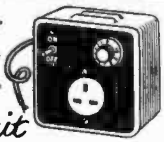

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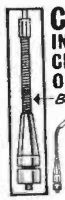

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8¼"	6⅞"		17	9	1	1	6	1	5	0
10¼"	7⅞"	1	3	0	1	8	0	1	11	9
12¼"	3⅞"		17	9	1	1	9	1	4	9
12¼"	5⅞"	1	2	3	1	7	0	1	10	6
12¼"	8⅞"	1	8	9	1	14	6	1	18	9
14¼"	3⅞"	1	0	6	1	5	0	1	7	3
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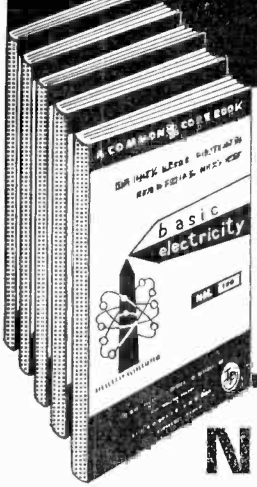

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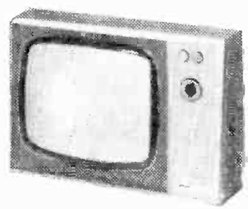

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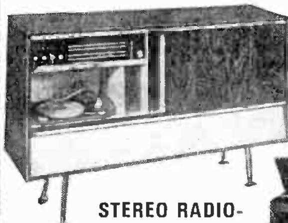

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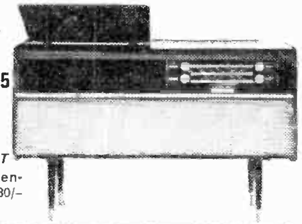

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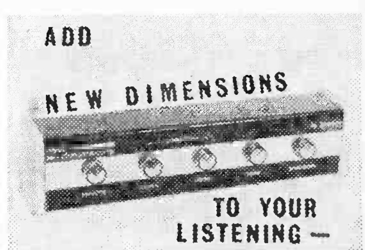

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1,000µF, 70v	3/2	250/250, 325v	4/–	1,000µF, 15v	1/6
100/200, 275v	3/2	2000/2000, 25v	4/6	1,000µF, 18v	1/–
100/200/200/50, 275v	4/–	250µF, 50v	10d.	500µF, 15v	10d.
3,000µF, 35v	3/9				

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
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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
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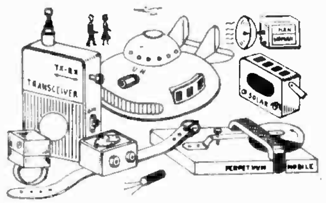

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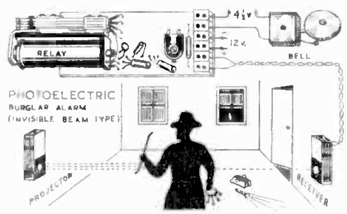

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30FL12	17/-	931A	65/-	DL95	7/-	ECC189	11/-
30FL13	8/-	955	3/-	DL96	7/-	ECC804	12/6
30FL14	14/-	991	7/-	DM70	5/6	ECC807	13/6
30L1	5/6	5654	9/-	DM71	6/-	ECF80	6/6
30L15	15/-	5670	10/-	DM160	8/-	ECF82	6/6
30L17	15/-	6146	27/6	DY30	8/-	ECF83	12/-
30P16	7/-	6360	25/-	DY80	7/-	ECF86	9/6
30P18	6/-	6939	40/-	DY86	6/-	ECF200	13/-
30P19	14/-	7199	15/-	DY87	6/6	ECF201	13/-
30PL1	16/-	7360	30/-	DY802	9/-	ECH21	9/6
30PL13	16/-	7586	22/6	E88CC	12/6	ECH35	11/-
30P14	16/-	7895	22/6	E180F	17/6	ECH42	10/-
35D5	12/-	9002	5/6	EABC80	6/6	ECH81	5/3
35L6GT	8/-	9003	9/-	EAF42	8/6	ECH83	7/6
35W4	4/6	A2293	18/-	EB91	3/-	ECH84	9/-
35Z3	10/-	AR8	6/-	EBC33	7/-	ECL80	7/-
35Z4GT	8/6	ARP12	4/6	EBC41	8/7	ECL81	7/6
35Z5GT	6/-	AT825	9/-	EBC81	6/-	ECL82	6/-
50C5	6/-	AZ11	7/6	EBC90	4/6	ECL83	9/6
50CD6G	27/6	AZ31	9/-	EBC91	5/-	ECL84	11/-
50L6GT	7/6	CBL1	15/-	EBF80	7/6	ECL85	10/6
52KU	7/-	CBL31	15/-	EBF83	8/-	ECL86	8/-
53KU	12/6	CCH35	9/-	EBF89	6/6	EF9	8/-
58CG	45/-	CY1	8/-	EBL1	14/-	EF36	5/-
		CY31	7/-	EBL31	22/6	EF37A	8/-

EF39	6/-	EZ90	4/-	PCL86	8/-	U26	14/-
EF40	8/6	FW4/800	10/-	PCL88	16/-	U33	26/-
EF41	8/6	G810H	40/-	PCL800	16/-	U76	4/-
EF42	11/-	G847X	12/-	PCL801	16/-	U81	10/-
EF80	4/6	GTE175M	12/-	PEN4DD	6/-	U191	14/-
EF83	9/6	GZ30	7/-	PEN45	6/6	U281	8/-
EF85	6/6	GZ31	5/-	PEN45DD	12/-	U282	8/-
EF86	6/-	GZ32	10/-	PEN46	6/-	U301	11/-
EF89	5/6	GZ33	12/6	PEN220A	7/-	U404	5/-
EF92	4/-	GZ34	10/-	PEN383	9/-	U801	17/-
EF93	4/-	GZ37	12/6	PEN384	7/-	UABC80	5/3
EF94	5/-	HABC80	8/-	PEN453DD	10/-	UAF41	9/-
EF95	5/-	HBC90	4/6	PENDD 402	10/-	UAF42	9/-
EF96	2/6	HBC91	5/6	PF86	10/-	UB41	10/-
EF98	10/-	HF93	6/-	PF818	14/-	UBC41	7/-
EF183	6/-	HF94	5/-	PFL200	13/6	UBC81	8/-
EF184	6/-	HL42DD	8/-	PL36	9/-	UBF80	6/6
EF804	20/-	HL92	6/-	PL81	7/-	UBF89	7/-
EF811	14/-	HL94	7/-	PL82	7/-	UBL21	10/-
EF812	14/-	KT66	19/-	PL83	6/6	UC92	6/-
EH90	7/-	KT88	27/6	PL84	6/-	UCC84	9/-
EL34	9/6	PABC80	7/6	PL302	14/-	UCC85	6/6
EL35	9/6	PC86	10/6	PL500	13/6	UCF80	9/6
EL36	8/6	PC88	10/6	PL504	14/-	UCH21	9/6
EL38	22/6	PC95	6/6	PL801	13/-	UCH42	9/-
EL41	8/6	PC97	7/6	PM84	8/-	UCH43	8/-
EL42	9/6	PC900	8/6	PX4	20/-	UCH81	6/3
EL81	9/-	PCC84	5/6	PX25	15/-	UCL81	9/-
EL82	8/-	PCC85	7/-	PY31	5/-	UCL82	7/3
EL83	6/6	PCC88	11/-	PY32	8/6	UCL83	9/-
EL84	4/6	PCC89	10/6	PY80	5/6	UF9	10/-
EL85	7/6	PCC189	11/-	PY81	5/6	UF41	9/-
EL86	8/-	PCC805	15/-	PY82	5/-	UF42	9/-
EL90	5/6	PCC806	15/-	PY83	5/6	UF43	8/-
EL95	5/-	PCE800	15/-	PY88	7/6	UF80	6/6
EL360	22/-	PCF80	6/3	PY301	14/-	UF85	7/3
EL821	8/-	PCF82	6/-	PY800	9/-	UF86	9/-
EL822	17/-	PCF84	8/-	PY801	9/-	UF89	7/-
ELL80	13/-	PCF86	8/-	PZ30	7/-	UL41	8/6
EM34	13/-	PCF87	14/6	QQV02-6	40/-	UL84	6/6
EM71	12/6	PCF800	13/6	QQV03-10	25/-	UM4	10/-
EM80	7/-	PCF801	9/-	R17	8/-	UM80	5/-
EM81	6/9	PCF802	9/-	R18	9/6	UU5	8/-
EM84	7/-	PCF805	14/-	8D6	12/-	UU8	7/-
EM85	11/-	PCF806	12/-	TH233	7/-	UU9	7/6
EM87	10/-	PCF808	13/-	TH2321	7/-	UU10	8/-
EN91	5/6	PCH200	12/-	TT21	35/-	UY1N	9/-
EY51	7/-	PCL80	15/-	U12/14	8/-	UY21	9/-
EY70	10/-	PCL81	9/-	U18/20	10/-	UY41	6/6
EY80	8/-	PCL82	7/-	U19	40/-	UY82	9/6
EY81	7/-	PCL83	8/6	U20	10/-	UY85	6/-
EY83	9/-	PCL84	7/6	U21	7/-	VU39A	8/-
EY84	9/6	PCL85	8/6	U22	6/-	VU111	7/6
EY86	6/6			U25	14/-	VU120A	12/-
EY87	8/-					VU133	7/-
EY88	8/6					Z719	4/6
EZ35	5/-					Z729	6/-
EZ40	7/6					Z759	24/-
EZ41	8/-					Z803U	15/-
EZ80	5/-						
EZ81	5/-						

TRANSISTORS

OC16	20/-	OC141	12/6	AF124	7/6	MAT101	8/6
OC23	12/6	OC170	5/-	AF125	6/6	MAT120	7/9
OC24	15/-	OC171	6/-	AF126	6/-	MAT121	8/6
OC25	7/6	OC200	7/6	AF127	6/-	V30/30P	20/-
OC26	6/-	OC201	10/-	AF178	12/6	2G309	5/-
OC28	12/6	OC202	13/-	AF186	17/6	2G371A or B	3/-
OC29	14/9	OC203	10/6	AFY19	22/6	2G381	3/6
OC35	13/-	OC204	12/6	AFZ11	17/-	2G403	3/6
OC36	12/6	OC205	15/-	AFZ12	10/-	2N410	3/6
OC42	5/-	OC206	22/6	ASY26	6/6	2N412	3/6
OC43	9/-	AC107	10/-	ASY28	6/6	2N696	7/-
OC44	4/-	AC125	6/6	ASZ20	7/6	2N697	7/6
OC45	3/6	AC126	6/6	ASZ21	12/6	2N706	3/4
OC58	12/6	AC127	7/6	BC107	7/6	2N753	6/6
OC70	4/-	AC128	6/6	BCY30	7/-	2N1132	37/-
OC71	3/6	AC176	7/6	BCY33	7/6	2N1304	6/-
OC72	5/-	ACY17	8/6	BCZ11	10/-	2N1756	15/-
OC73	7/6	ACY18	5/6	BFY50	8/6	2N2068	20/-
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/-
OC81D	3/-	AF102	18/-	GET113	4/-	2S012	140/-
OC83	5/-	AF114	6/6	GET114	4/-	2S018	60/-
OC84	5/-	AF115	6/-	GET115	8/6	2S103	25/-
OC122	12/6	AF116	6/6	GET116	10/-	2S104	15/-
OC139	7/6	AF117	5/-	GET872	6/-		
OC140	9/6	AF118	10/-	GET875	6/-		

COMPLEMENTARY PAIRS (PNP/NPN)
AC128/AC176 (Germanium) 13/-; 2N697/2N1132 (Silicon) 27/-; ASY26/ASY28 (Germanium) 12/-.

SPECIAL OFFER OF TRANSISTORS

AM/FM and SW KIT comprising two AF125 (mixer/oscillator), two AF126 (IF), one AC126 (audio) and two AC128 (push/pull output). 21/- post paid.
GERMANIUM GENERAL PURPOSE. 2G371A or B, 2G381. 25/- per doz. assorted.

25 WATT SOLDERING IRONS

200-250 watt exceptionally well made lightweight soldering irons with polished wooden handles and chromium plated body. Angle bit of sufficient length for long life. No breakable plastics used in construction. PRICE 16/- (P.P. 2/-). Spare, bits 1/9. Spare elements 3/6.

THYRISTORS

3/40, 400 p.i.v. 3 amp, stud mounted, Gate voltage 3·0v. at 20mA max	7/6
BLUE SPOT, 200 p.i.v. 5 amp, stud mounted. Gate voltage 3·25v. at 120mA max	12/6
GREEN SPOT, 400 p.i.v. 5 amp, stud mounted. Gate voltage 3·25v. at 120mA max	17/6

AVALANCHE SILICON RECTIFIERS

Type RAS508AF, 960 p.i.v. at 6 amps. max., stud mounted 10/6

FOR P.W. CLUBMAN RECEIVER

One each OC170, OC45, OC71. Two OA81 and TC1, TC2 Trimmers (3-30pF Beehive), 19/-, post free.

DRY REED INSERTS

Glass dry reed inserts approx. ¼in. dia. x 1in. long with axial leads. One "make" contact of 100mA capacity at 50V. Can be operated by permanent magnet or 30-50 Amp-turns relay coils. PRICE 18/- per doz. post free.

TEXAS SILICON FULL-WAVE BRIDGE RECTIFIERS
1B20K10 100 piv, 2 amps, dimensions 1·4 x1·4x·6in. 25/-
1B40K10 100 piv, 4 amps, dimensions 1·4x1·4x·6in. 30/-
1B100M10 100 piv, 10 amps, dimensions 2¼x2¼x1in. 85/-.
Postage 1/6 per rectifier.

MOVING COIL METERS

We announce the introduction of a range of first quality moving coil meters with 1.5% accuracy. Meters are available in 3in. round flange, and 3in. and 4½in. square flanges. Please write for illustrated leaflets.

SILICON POWER RECTIFIERS

BY100, 700 p.i.v., 450mA, W.E.	4/6
BYZ10, 800 p.i.v., 6 Amps, S.M.	9/-
BYZ12, 400 p.i.v., 6 Amps, S.M.	5/-
BYZ13, 200 p.i.v., 6 Amps., S.M.	7/6
BYZ19, as BYZ13 but stud negative	7/6
DD000, 50 p.i.v., 500mA, W.E.	3/-
DD006, 400 p.i.v., 500mA, W.E.	6/6
DD058, 800 p.w., 500mA, W.E.	7/6

Note: W.E.—Wire Ended; S.M.—Stud Mounted.

GERMANIUM POINT CONTACT DIODES

OA5, 100 piv/115 mA	3/-
OA6, 60 piv/115 mA Gold Bonded	4/-
OA79, 30 piv/35 mA, 40 mc/s	2/3
OA81, 115 piv/60mA, High Back Resistance	2/-
OA95, 90 piv/50 mA subminiature	2/-

25% discount for orders of 24 or more of each type.

Our new (1967/68) price list of Valves, Tubes and Semiconductors is now ready. In addition to listing prices of some 2,300 types it is a useful reference work giving: Valve and Tube Equivalents, Specification of Microwave Tubes, Cathode Ray Tubes and Semiconductors. Send S.A.E. (Quarto) now to get your copy free of charge.

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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/-
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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 5th April, 1968 and must accompany all queries in accordance with the rules of our Query Service.

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