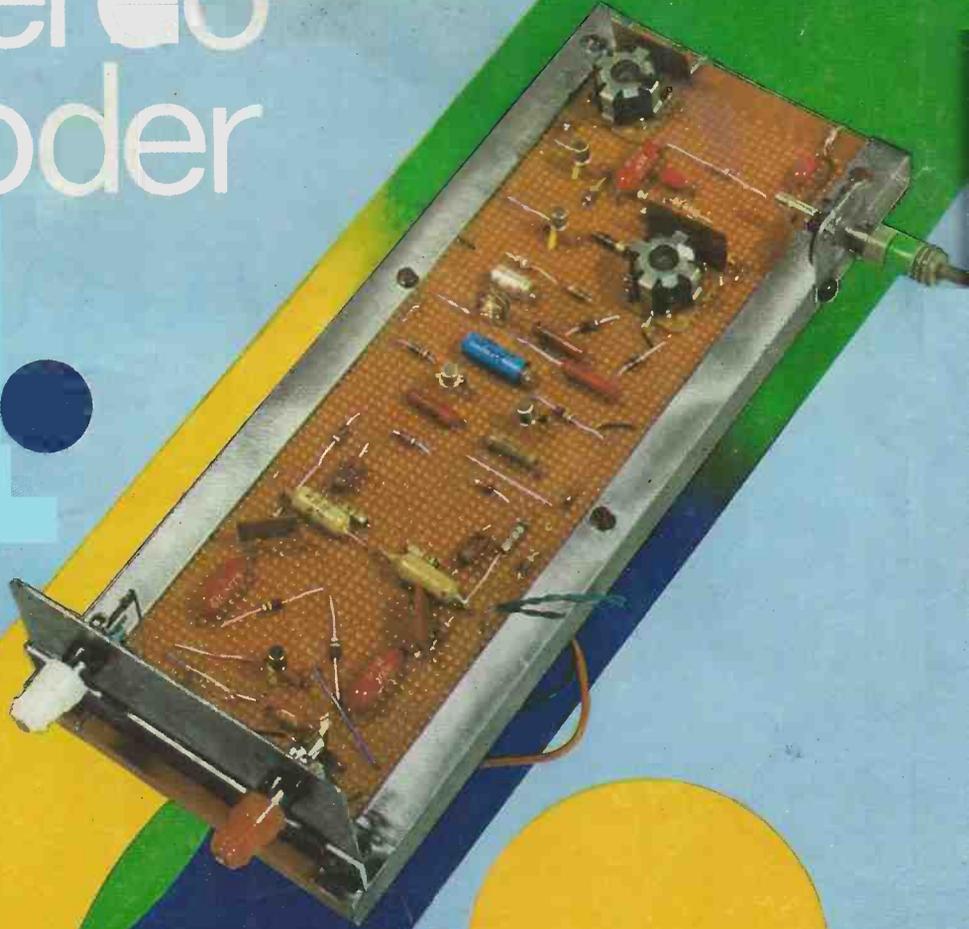


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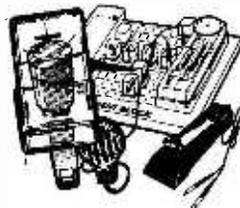
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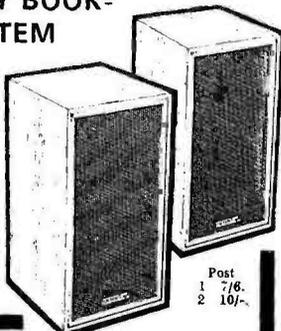
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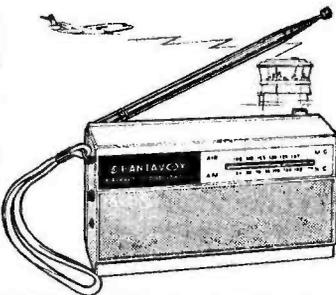
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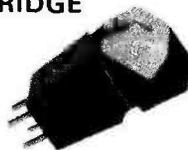
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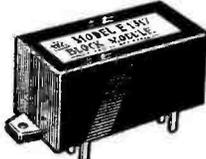
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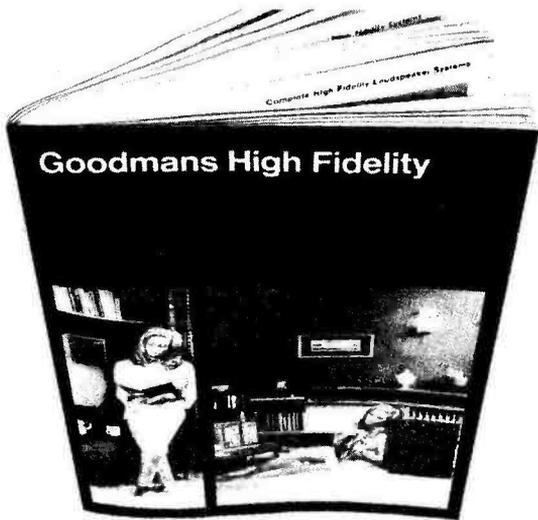
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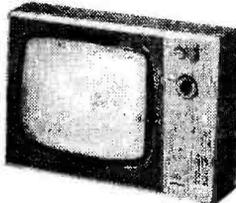
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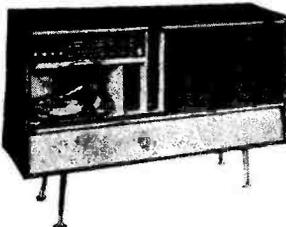
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VHF MOBILE TX/RX. Miniature valve xtal controlled transceiver with 12 volt transistorised power unit. Internal speaker. Double conversion receiver easily modified to tuneable. Ideal for 4 metres. £9.10.0 plus 27/6 carriage.

MODULATION TRANSFORMERS.

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60 UNTESTED DIODES 2/6

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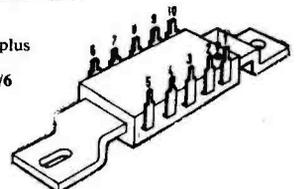
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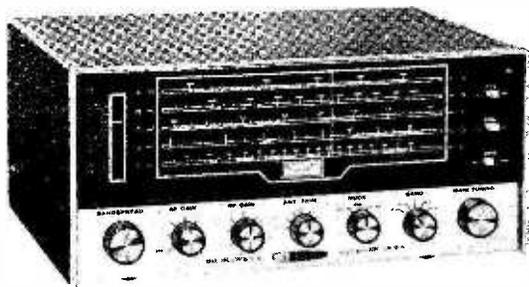


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GR-54

DELUXE 5 BAND SHORTWAVE RECEIVER GR-54

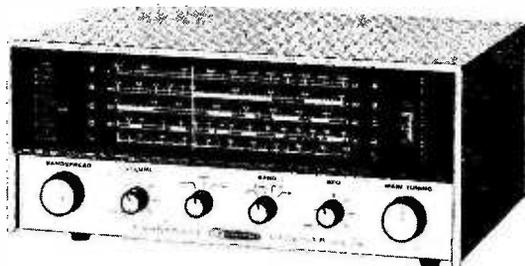
This receiver offers exceptional performance and many special features at such a low price. It covers 2MHz to 40MHz plus 550KHz to 1550KHz AM broadcast band and 150KHz to 420KHz aeronautical and radio navigation band. Receives AM/CW/SSB, 6 x 4in. PM speaker and sleek, "low-boy" styling. Operates on 115-230V 50Hz AC.

Kit K/GR-54 £48.16.0. Carr. 9/-

LOW COST 4 BAND SHORTWAVE RECEIVER GR-64

Makes an ideal present for the youngster. It has high performance features plus world-wide reception, shipping, aircraft, radio amateurs plus the popular medium broadcast band. It covers 1MHz to 30MHz plus 550KHz to 1620KHz AM, with sleek "low-boy" styling, operates on 115-250V 50Hz AC.

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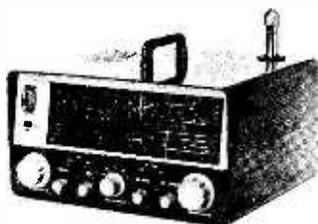


GR-64

GENERAL COVER- AGE RECEIVER GC-1U

A welcome traveller wherever you go! Covers 580 to 1550 KHz and to 40MHz in 5 bands with calibrated bandspread scales for 80, 40, 20, 15 and 10 metre amateur bands. Completely solid state and self contained for portability. Operates on two internal PP6 batteries (not supplied) or 230V AC with a suitable power supply.

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AMATEUR BANDS RECEIVER RA-1

Unequaled value for the radio amateur. Covers 160 to 10 metres. High quality lattice crystal filter for optimum communications selectivity. Optional 100KHz crystal calibrator plugs in inside receiver. 8 valve and 2 diode circuit. Operates on 115, 200-250V AC, 50Hz.

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A Super-regenerative
Receiver designed expressly
for reception on the v.h.f.
aircraft band—108 to
140 MHz

2-TRANSISTOR CONVERTER
FOR 10 METRES

SUPPRESSED—ZERO
VOLTMETER
AUTOMATIC
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RADIO CONSTRUCTOR

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100 amp series prices

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Midget Electrolytic Conds. Wire Ends

At 6d. each		
0.8µF	25 volt	
4µF	150 volt	
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At 9d. each		
2µF	350 volt	
4µF	12 volt	
8µF	12 volt	
16µF	16 volt	
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125µF	4 volt	
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16µF	250 volt	
50µF	10 volt	
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100µF	25 volt	
200µF	10 volt	
320µF	10 volt	

Crystal Diodes—6 for 2/6 (7d.).

Additional Transistors—AF147 and AF150, 24v. Larger envelope, 4 leads, collective current 10mA, gain 70—4/- each. AF149—gain 225—4/6 each.

Also 8µF 350V 1/2, 25µF 25V 1/8 and 50µF 50V 1/8. Other electrolytics in current list.

Postage, Packing and Insurance all above 1/- up to 11, 12 and over charges paid.

2 GANG VAR. CONDENSER: Mod., air-spaced, .0005 ea. sec. 5/- (1/-).

THREE GANG, 7/6 (1/-).

300-500 TRANSFORMERS: Output (3Ω for OC72 etc.) 2/6. Driver 2/8 (up to six, 1/-).

MULTIMETER: 2000Ω Ω/V D.C., 10,000 Ω/V A.C. 0-5/25/50/250/500/1K volts D.C.

0-10/50/100/500/1K volts A.C. ● 0-50µA/2.5mA/250mA D.C. ● 0-6KΩ/6M meg Ω

● 10µF—001mf/1mf. ● —20 to +22dB. ● Complete with test leads and instructions.

● Over-load protected 1969 model with every refinement. 24.7.6 (2/6). JUNIOR MODEL

at 4/8 (3/6) 1000Ω/V described in free list.

SOLDERING IRON. Slim Mod. British High speed, 8 1/2in., all parts replaceable, fully

guaranteed for professional, radio and general D.I.Y. use. 13/6 (1/6).

DIAMOND BEZEL REPLACEMENTS for BSR, TC8LP, 7C3/8, and TC8LP/STEREO:

COLLARO "O"; RONETTE RF40LP; GARRARD GC2LP and GC3LP; ACOS GP65/67;

all at 7/6 each (1/-). ACOS GP91 ST/1P; BSR ST4 and ST9; SONOTONE ST4 and

ST4HC, PHILIPS AG3306, 3060 (3063, 3066, 3301, 3302, 3304) state whether long or

short type, all at 13/6 (1/-).

SAPPHIRE all the above 7/6 types only, also ACOS GP37 at 3/8 each (1/-). ACOS GP91

at 6/8 (1/-). No other types at present and no 75 rpm available in any type.

PICK-UP CARTRIDGES: all fitted Styl and Standard fittings. Mono GP76/7, 13/6 ●

Stereo Compatible—Mono which also plays Stereo records monaurally with min. wear,

GP91/80, 19/6. ● Latest Stereo GP98, 23/- ● Ceramic Stereo, top quality for expensive

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FP3 ELIMINATOR (A.C.) 17/6. (1/6) TWO STATION TRANS. INTER-OOM. Excellent

alarm. Instant, easy fitting with leads, plugs and battery. All you require 52/6 (3/-).

TRANSISTORED AMPLIFIERS, 3 watt, 5V operation, 45/6 (1/8); 7 1/2 watt, 6 trans.

24V operation, 67/6 (2/6).

Extra High Torque MINI-MOTOR, 4 1/2 to 12V, 1 1/2 in. 5/- (1/-), 9,000 r.p.m.

SUBSTITUTION BOXES, Capacitance 24/9 (1/6). Resistance 32/6 (1/8). Both full range and

complete. Full details in list.

TEST PRODS: Flexible, unbreakable 24" Red and Black leads, thin 4 1/2" prods, 1 1/2" plugs

4/8 (1/-). Plated (Green, Blue, 6d. each, 5d. each, 1/-). ● 1 1/2" 6d. (5/-).

RECORDING TAPE: Finest quality British Mylar. STANDARD: 5in. 600ft. 7/8, 5/1in.

850ft. 3/8, 7in. 1200ft. 11/8. LONG PLAY 5in. 900ft. 10/-, 5 1/2in. 1200ft. 11/8, 7in. 1800ft.

18/- (1/3 reel). Still the finest quality and value obtainable.

MICROPHONES—CRYSTAL, MIC91, Desk, 16/8; MIC45, curved hand grip 17/8; Stick

"80" 20/8; Stick "39" 26/8 (1/6 each type). Cream plastic hand type 7/8, or with "strut"

stand, switch and 2 leads with 2 1/2 and 3 1/2 plugs 11/-, Lapel (for hand) with clip 6/8 (1/-).

Machined metal tool steel stick type with neck cord and adaptor to fit standard floor stands,

25/- (1/6). DYNAMIC: Cream hand/table 15/8 (1/6). MS10 50K Ω, 3 1/2 x 3 1/2 in. with Base

Adaptor and Neck Cord 37/6 (2/6). MS11, similar, but fixed on flexible Swan neck to switch-

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fine quality 6 1/2 x 2 1/4". 25.9.6 (1/-).

CARDIOM DYNAMIC ORBITAL-DIRECTIONAL: Two highly successful mikes "SQUAIRE"

204, 55.10.0. "BALL" type, 209, with built-in vol. control, switch 50K/600 ohms imp.,

25.17.6 (either type 5/-). Full details in list.

MICROPHONE INSERTS: Diameter 1.75in. or 0.9in. either size 5/6 (1/-).

SPEAKERS: 12in. round, fitted Tweeter, W, 3 or 15 Ω (state which), 35/6 (5/6); 2 1/2in. 3 Ω

6/8 (1/-); 6 x 4 heavy duty 3 Ω 14/6 (3/6) or for Stereo 34/6 pair (charges paid);

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excellent, 5/6 (charges paid). HEADPHONES High Res. 3000 Ω ea. earpiece 18/6 (1/6);

Stereo Dyn 8-16 Ω, 68/- (2/-). EARPIECES with lead etc., Min. Plug Magnetic 1/6;

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AERIALS, Car Types: Telescopic, vandal proof, locks retracted, 2 keys and all fittings,

32/6 (2/6). Motor driven, 12V, 5 section, complete 47.10.0 (5/-).

FOR ALL PORTABLES and P.M. SETS, 7-section 55-32in. No swivel, screw hole in base,

6/6. ● 10-section 6 1/2-47in., no swivel, screw hole in base, 12/6. DISAPPEARING 8 section,

swivel fixing assembly, 6 1/2-33in 10/-, New 6 section 5 1/2-26 1/2in, screw hole in base, no swivel

4/-, (1/- all sizes).

SWITCHES: Standard toggle, metal, 250V 2A. One hole fixing: SPST 2/2, SPDT 2/8.

DPST 3/-, DPDT 3/8, 5 section type, 300mA, 12V, 12V 1/6 each, 3rd DPDT 3 way, centre

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Switches etc. in list.

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MAINS NEON TESTER: Fly leads 2/-, Pocket screwdriver type 3/6. PLUGS: Std. Jack,

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6d. (all above, 1/- up to three). CONNECTING WIRE: 5 coils asstd. cns. each 5/6. Solid

Core 2/6. Flexible 3/-, Super thin for transistor wiring etc. 3/- (1/- all types per 5 coils).

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Both flexible, screened and sheathed. ● FEEDER CABLE: Twin r.f. bal. "Hg. 8", 80 Ω

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R.F. INDICATOR, 5-Band, with meter antenna, monitoring crystal earpiece etc., 48/6

(1/8). Details in list.

RETRACTABLE FLEXIBLE LEADS. Space saving 'Curly', many uses in car and home:

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CURRENT LIST: Sent with all orders or free for s.a.c. details of cable, croc. clips and leads,

Continental din plugs for Grundig, Telefunken equipment, etc., diags. plugs and sockets,

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LIND-AIR "COMPACT" HI-FI STEREO SYSTEM

LIMITED PERIOD ONLY



39½ Gns
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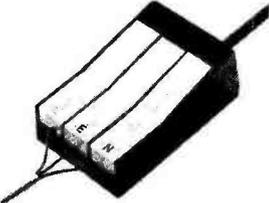
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Big sound at low cost! 6 watt r.m.s. per channel. Controls: Bass, Treble, Volume, Balance, Function selector, Mono/Stereo switch, Tape record outlet, Inputs for Tape replay/Tuner. Headphone facility. Beautiful teak case with matched loudspeakers. Garrard Autochanger unit fitted Stereo Cartridge.

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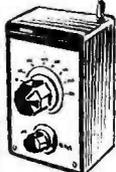


One mains "Keynector" instantly and safely connects electrical appliances to mains supply without the use of a plug. A number of appliances may be used simultaneously up to the full 13 amp rating of this device. A red light glows when "live". The "Keynector" is fused and has its own robust switch which is interlocked to prevent connections when "live". *Invaluable to handymen, electricians, demonstrators etc.*

39/6 P. & P. 3/-

VHF AIRCRAFT BAND CONVERTOR.

When placed within line of a MW band radio full coverage of VHF Aircraft Band 108-135 Mc/s. can be obtained. All transistor, 9v battery operation. Fully tunable 18in. x 7 section telescopic aerial. Size 4 x 2 1/2 x 1 1/2in. 79/6. P. & P. 3/6.



MODEL MAKER'S MOTOR No. 16RN. Voltage 11.5v. Current 400mA. Torque 12g-cm. Body size 1 1/2" long x 1 1/2" dia. Shaft 3/16" long x 1/16" dia. Ideal for small models and toys. 5/6 each.

P. & P. 1/3. 3 for 15/- P. & P. 2/6.



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With soft rubber earpieces. Impedance 8-16 ohms. Frequency response 25-13,000cps. With lead and stereo plug. Only 59/6. P. & P. 3/6.

NEW STEREO/MONO HEADPHONES

SD11-7. Soft rubber earpieces with slide switch for mono/stereo listening and ind. vol. controls. Impedance 8-16 ohm. Freq. response 25-16,000 cps. With lead and stereo plug. 36.6/0. P. & P. 3/6.



SINCLAIR IC-10 INTEGRATED CIRCUIT



10 watt Amplifier. Size only 1 x 0.4 x 0.2in. A true hi-fi amplifier complete with manual giving details of a wide range of applications and instructions. Guaranteed 5 years. ONLY 59/6. P. & P. 1/6.

SPECIAL TRANSFORMER FOR OPERATING SINCLAIR IC-10 from A.C. mains 230/250v. Output 13v. at 0.5 amp. 12/6. P. & P. 2/6.

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BRITISH MADE. TOP QUALITY			
J1001	3"	Long Play PVC	220ft. 5/8
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J1004	5"	Double Play Poly	1200ft. 15/-
J1005	5 1/2"	Long Play PVC	1200ft. 12/6
J1006	5 1/2"	Double Play Poly	1800ft. 28/6
J1007	7"	Standard Play PVC	1200ft. 12/6
J1008	7"	Long Play PVC	1800ft. 17/6
J1009	7"	Double Play Poly	2400ft. 25/-
J1010	7"	Triple Play Poly	3600ft. 50/-



Special Lind-air Offer!

Teleton SAQ203
Transistor Stereo Amplifier
List Price £28.7.0.
OUR PRICE 22 Gns

One of the most popular models from the fabulous Teleton range. Incorporates 16 transistors and diodes producing superb quality hi-fi. 10 watts per channel music power. Inputs for Gram (Magnetic and Crystal), Tuner and Auxiliary. Tape Record output. Controls: Volume, Balance, Bass, Treble. Housed in attractive oiled walnut cabinet with brushed aluminum front panel.

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AUTO WOUND TRANSFORMERS

All Winding Voltage Ratings and Tapping 0-115-200-220-240v except MT113-0-115-210-240v.

Model	Power	Size	Wgt	Price	P&P
MT113	20W	Size 2 1/2 x 1 1/2 x 1 1/2 in.	Wgt 1 1/2oz	Price 12/6	P&P 2/6
MT14	75W	Size 2 1/2 x 2 1/2 in.	Wgt 1 1/2 lb 14oz	Price 21/6	P&P 4/6
MT4	150W	Size 3 1/2 x 2 1/2 x 3 in.	Wgt 3 1/2 lb	Price 33/-	P&P 6/-
MT65	200W	Size 3 1/2 x 4 1/2 x 4 in.	Wgt 4 1/2 lb	Price 39/6	P&P 6/-
MT66	300W	Size 4 x 4 x 3 1/2 in.	Wgt 6 1/2 lb	Price 58/4	P&P 9/-
MT110	400W	Size 4 1/2 x 4 1/2 x 4 in.	Wgt 11 1/2 lb	Price 85/-	P&P 10/-
MT67	500W	Size 5 1/2 x 4 x 4 in.	Wgt 12 1/2 lb	Price 89/-	P&P 10/6
MT83	750W	Size 4 1/2 x 5 1/2 x 3 1/2 in.	Wgt 13 1/2 lb	Price 95/7	P&P 10/6
MT84	1000W	Size 4 1/2 x 5 1/2 x 3 1/2 in.	Wgt 18 1/2 lb	Price 142/2	Carr. ex.
MT93	1500W	Size 5 1/2 x 6 1/2 x 6 1/2 in.	Wgt 28 1/2 lb	Price 170/6	Carr. ex.
MT94	1750W	Size 5 1/2 x 6 1/2 x 6 1/2 in.	Wgt 31 1/2 lb	Price 185/-	Carr. ex.
MT95	2000W	Size 7 x 6 1/2 x 8 1/2 in.	Wgt 40 lb	Price 211/2	Carr. ex.
MT73	3000W	Size 6 1/2 x 7 1/2 x 8 1/2 in.	Wgt 45 1/2 lb	Price 300/-	Carr. ex.

LOW VOLTAGE 12 VOLT RANGE

Model	Primary	Secondary	Wgt	Price	P&P
MT111	0-5 Amp	Size 3 x 2 x 1 1/2 in.	Wgt 1 1/2 lb	Price 15/3	P&P 2/6
MT71	2 Amp	Size 2 1/2 x 2 1/2 x 2 in.	Wgt 1 1/2 lb	Price 19/-	P&P 3/9
MT69	4 Amp	Size 3 1/2 x 2 1/2 x 2 in.	Wgt 2 1/2 lb	Price 28/-	P&P 6/-
MT70	6 Amp	Size 4 x 3 x 2 1/2 in.	Wgt 3 1/2 lb	Price 39/-	P&P 6/-
MT72	10 Amp	Size 3 1/2 x 4 1/2 x 4 in.	Wgt 6 1/2 lb	Price 51/-	P&P 9/-
MT115	20 Amp	Size 4 1/2 x 4 1/2 x 4 in.	Wgt 11 1/2 lb	Price 95/-	P&P 9/-
MT187	30 Amp	Size 5 1/2 x 4 1/2 x 4 in.	Wgt 16 1/2 lb	Price 180/-	P&P 13/6

Other ranges available as November. Send for complete Lists

TTC.G1001 MULTITESTER in leather case.

Overload protection. 20,000 opr. AC volts 10, 50, 250, 1,000v. DC volts 5-25, 125, 500, 2500v. D.C. Current 0-50µA, 0-250mA Resistance 0-60K, 0-5 Megohms. Decibels -20 to +22dB. Size of meter 4 1/2 x 3 1/2 x 1 1/2 in. 85/- P. & P. 3/6.

SHIRA 6SD MULTI-TESTER 69,000 o.p.v.

DC voltage: 0-50-500-2500-500-2-5K (20,000 ohms per volt). AC Voltage: 10-50-100-500-1000 volts (10,000 ohms per volt). DC Current: 0-50µA, 0-2-5mA, 0-250mA. Resistance: 0-5K, 0-5 Megohms. Decibels: -20 to +22dB. Size 4 1/2 x 3 1/2 x 1 1/2 in. 71/- P. & P. 3/6

8-DEC BREAD BOARD

British Made. Solderless breadboard panels, for fast reliable component connections. Single 12vDC. One 8-12vDC with Control Panel, Jig and Accessories for solderless connections to controls, etc., with booklet "Projects on 8-DeC" giving construction details for a variety of circuits. 29/6. P. & P. 2/6.

GARRARD DECKS

4-DeC KIT: Four 8-DeCs with two Control Panels, Jigs and Accessories and the booklet "Projects on 8-DeC" all contained in a strong attractive plastic case. Ideal for the professional user. 25.17.6. P. & P. 3/6.

SRP22 less cartridge.

1025 Stereo/Mono with cart. £26.19.6
2025 Stereo/Mono with cart. £27.19.6
3000S Stereo/Mono with cart. £29.19.6
3000D Stereo/Mono with cart. £10.19.6
SP25 less cartridge £11.19.6
SP25 with Decca Deram cart. £17. 4.6
S155 less cartridge £11.19.6
S155 with Decca Deram cart. £17.4.6
S165 less cartridge £11.9.6
Covers for above £2.19.6
Bases for above £2.10.0
AP75 less cartridge £18.18.0
S175 less cartridge £28.7.0
S185 less cartridge £38.19.6
Bases for above £4.19.6

SPECIAL OFFER!

SP25 less cart., with base £13. 2.6
P. & P. Decks 12/6, Cover 4/6, Base 4/6.
P. & P. Deck/Cover/Base 17/-

MINIATURE SOLDERING IRON

British made and designed for use with transistor circuitry but ideal for many other uses. AC 240v. 18 watt. Length 7 7/8 in. 1/2 in. slide on bit. Price 32/6 P. & P. 2/-

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

Type 1 SPECIFICATION:—

Impedance 10 ohms. It incorporates Goodmans high flux 6" x 4" speaker and 2½" tweeter. Teak finish 12" x 6½" x 5½". 4 guineas each. 7/6d. p. & p. Type 2 as type 1. Size 17½" x 10½" x 6½". Incorporating 10½" x 6½" bass unit and 2½" tweeter. 3 ohms impedance 5½ guineas plus 7/6 p. & p.

Garrard Changers from £7.19.6d. p. & p. 7/6d.
Cover and Teak finish Plinth £4.15.0d. 7/6d. p. & p.

The items illustrated can be purchased together for 28 gns.

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

SPECIFICATION:—

R.M.S. power output: 3 watts per channel into 10 ohms speakers

INPUT SENSITIVITY: Suitable for medium or high output crystal cartridges and tuners. Cross-talk better than 30dB at 1 Kc/s.

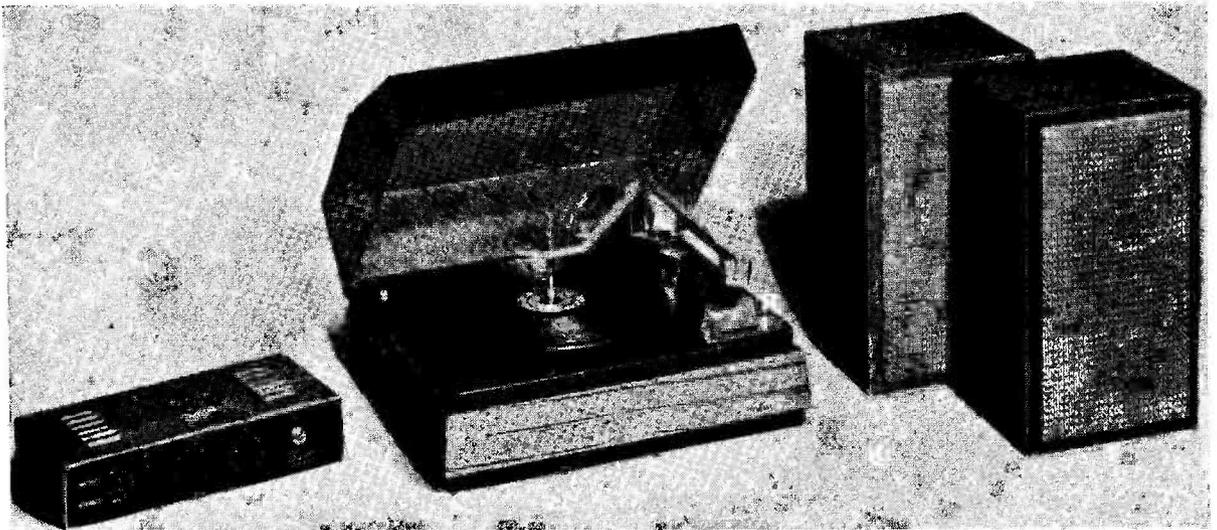
CONTROLS: 4-position selector switch (2 pos. mono and 2 pos. stereo) dual ganged volume control.

TONE CONTROL: Treble lift and cut. Separate on/off switch. A preset balance control.

Duetto

Integrated Transistor Stereo Amplifier

9 GNS.
plus 7/6d.
p. & p.



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

The Classic

8½ Gns. plus 7/6 p. & p.

Controls: Selector switch Tape speed equalisation switch (3½ and 7½ i.p.s.). Volume. Treble. Bass. 2 position scratch filter and 2 position rumble filter.

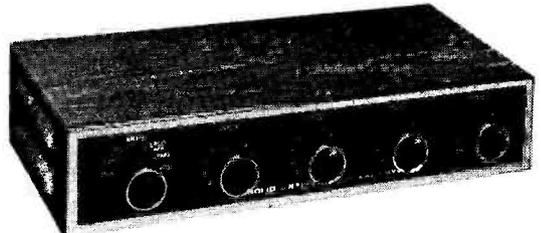
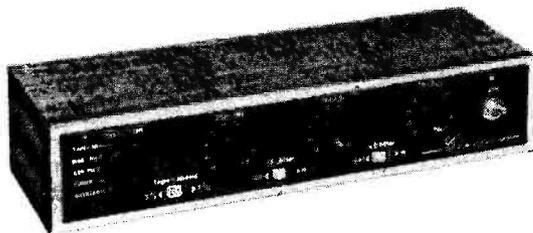
Specification: Sensitivities for 10 watt output at 1KHz into 3 ohms. Tape head: 3mV (at 331 p.s.). Mag. P.U.: 2mV. Cer. P.U.: 80 mV. Tuner: 100mV. Aux.: 100mV. Tape/Rec. output: Equalisation for each input is correct to within ±2dB (R.I. A. A.) from 20Hz to 20KHz. Tone control range: Bass ±13dB at 60Hz. Treble ±14dB at 15KHz. Total distortion: (for 10 watt output) <1.5%. Signal noise: <-60dB. A.C. mains 200-250v. Built and tested. Size 12½in. long, 4½in. deep, 2½in. high. Teak finished case.

The Viscount

13½ Gns. plus 7/6 p. & p.

Integrated High Fidelity Transistor Stereo Amplifier. Specification—Output: 10 watts per channel into 3 to 4 ohms speakers (20 watts monaural). Input: 6 position rotary selector switch (3 pos. mono and 3 pos. stereo), P.U., Tuner, Tape and Tape Rec. out. Sensitivities: All Inputs 100mV into 1-8M ohm. Frequency Response: 40Hz-20KHz ±2dB. Tone Controls: Separate bass and treble controls; treble, 13dB lift and cut (at 15KHz); Bass, 15dB lift and 25dB cut (at 60Hz). Volume Controls: Separate for each channel. A.C. Mains Input: 200-240V, 50-60Hz. Size, 12½" x 6" x 2½" in teak finished case. Built and tested.

VISCOUNT MARK II for use with magnetic pick-ups specification as above. Fully equalised for magnetic pick-ups. Suitable for cartridges with minimum output of 4mV/cm/sec. at 1kc. Input impedance 47k. 15 gns. plus 7/6 p. & p.



SPECIAL OFFER!

Complete stereo system comprising BALFOUR 4-speed autoplayer with stereo head, 2 Duo speaker systems, size 12in. x 6½in. x 5½in. Plinth (less cover) and the DUETTO stereo amplifier. All above items

19 Gns. plus 20/- p. & p.

Also see opposite page



The ELEGANT SEVEN Mk. III (350mW Output)

7 transistor fully tunable M.W.-L.W. portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back protected for footproof construction. MAINS POWER PACK KIT: 9/8 extra.

Circuit 2/6
FREE WITH PARTS.

Price £4.9.6 plus 7/6 P. & P.

The DORSET (600mW Output)

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

Price £5.5.0 plus 7/6 P. & P.

MAINS POWER PACK KIT: 9/8 extra



Circuit 2/6
FREE WITH PARTS.



EXTRACTOR FAN

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

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

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

Specifications: Power Output (into 3 ohms speaker) 10 watts. Sensitivity (for rated output): 1mV into 3K ohms (0.33 microamp). Total Distortion at 1KHz at 5 watts, 0-35%, at rated output 1-5%. Frequency Response: Minus 3dB points 20Hz and 40KHz. Speaker: 3-4 ohms (3-15 ohms may be used). Supply voltage: 24V. D.C. at 800mA (6-24V. may be used).

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

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

Power Supplies for the X101:
P101 M (for mono) 35/- plus 4/6 p. & p.
P101 S (for stereo) 42/8 plus 4/6 p. & p.



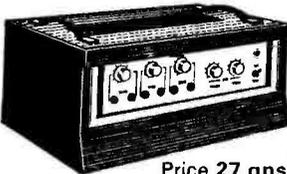
CAR TRANSISTOR IGNITION SYSTEM

by famous manufacturer

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

Price £4.19.6 plus 5/- P. & P.

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



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

TECHNICAL SPECIFICATIONS
3 electronically mixed channels, with 2 inputs per channel, enables the use of 6 separate instruments at the same time. The volume controls for each channel are located directly above the corresponding input sockets. **SENSITIVITIES AND INPUT IMPEDANCES.** Channels 1 & 2 4mV at 470K. These 2 channels (4 inputs) are suitable for microphone or guitars.

Channels 3 & 4 300mV at 1m. Suitable for most high output instruments (gram, tuner, organ etc.). Input sensitivity relative to 10w output. **TONE CONTROLS ARE COMMON TO ALL INPUTS.** Bass Boost +12dB at 60 Hz. Bass Cut -13dB at 60 Hz. Treble Boost +11dB at 15 KHz. Treble Cut -12dB at 15 KHz. With bass and treble controls central -3dB points are 30 Hz and 20 KHz. **POWER OUTPUT:** For speech and music 50 watts rms. 100 watts peak. For sustained music 45 watts rms. 90 watts peak. For sine wave 38-5 watts rms. Nearly 80 watts peak. Total distortion at rated output 3-2% at 1KHz. Total distortion at 20 watts 0-15% at 1KHz. Output to match into 8 or 15 ohms speaker system. **NEGATIVE FEEDBACK** 20dB at 1 KHz. **SIGNAL TO NOISE RATIO** 60dB. **MAINS VOLTAGES** adjustable from 200-250V. A.C. 50-60 Hz. A protective fuse is located at the rear of unit. Output impedance 3, 8 and 15 ohms.

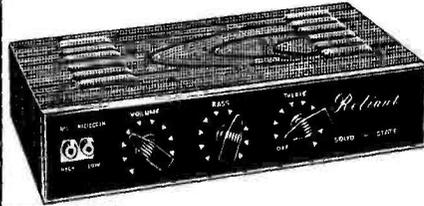
B.S.R. TD-2 TAPE DECK

Takes 5 1/2 in. spools, fitted with B.S.R. 1 Track Heads. Size 13 1/2 in. long by 8 1/2 in. wide. Price £8.19.6 plus 7/6 P. & P.

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

The RELIANT

SOLID STATE
GENERAL
PURPOSE
AMPLIFIER



SPECIFICATIONS

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

RELIANT Mk. I

As above less teak case
5 1/2 gns. plus 7/6 P. & P.

RELIANT Mk. II

In teak finished case.
6 1/2 gns. plus 7/6 P. & P.

RECORD PLAYER SNIP A.C. Mains 240V

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



ONLY £5.19.6 plus 7/6 P. & P.



POCKET MULTI-METER

Size 3 1/2 x 2 1/4 x 1 1/2 in. Meter size 2 1/4 x 1 1/2 in. Sensitivity 1,000 O.P.V. on both A.C. and D.C. volts. 0-15, 0-150, 0-1,000 D.C. current 0-150mA. Resistance 0-100KΩ. Complete with test leads, battery and full instructions.

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

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

STEREO PRE-AMPLIFIER

Inputs—6 position rotary switch (3 position mono, 3 position stereo). Tuner 150mW into 600Ω. Magnetic pick-up fully equalised and suitable for magnetic cartridges with minimising output of 4mV/cm/sec. Load 47k. Ceramic pickup 150mV into 600Ω. Sensitivities taken for 200mV output. Controls—separate volume controls for each channel. Twin ganged bass, 12dB lift and 15dB cut at 60c/s. Twin ganged treble, 10dB lift and 15dB cut at 10k/s. Voltage required 23-30V DC at 5mA. Size 12 1/4 x 3 1/2 x 2 1/2 in. In teak finished case, complete with front panel and knobs. Built and tested.

£7.7.0 plus 5/- P. & P.

CYLDON 2 TRANSISTOR U.H.F. TUNER

Brand new. Complete with circuit diagram.
Price £2.10.0 plus 1/- P. & P.

THREE-IN-ONE HI-FI 10 WATT SPEAKER

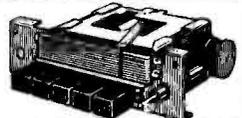
A complete Loud Speaker system on one frame, combining three matched ceramic magnet speakers with a low loss crossover network. Peak handling power 10 watts. Impedance 15 ohms. Flux density 11,000 gauss. Resonance 40-60 c/s. Frequency range 50c/s to 20Kc/s. Size 13 1/4 x 8 1/2 x 4 1/2 in. By famous manufacturer.

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

Similar speaker to the above without tweeters in 3 and 15 ohms 44/8 plus 5/- p. & p.

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Push Button Tuning Heart
This PRESTOLOCK 5 station Push-Button Tuner Heart with Manual Over-ride is an ideal basis for a quality AM car radio. Size 6 1/2 x 4 x 2".
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Input 250 volts. OUTPUT (All RMS values) 4 windings of 11.6 volts connected in series total 46 volts at 4.5 amps (conservatively rated). The following combinations may be used.
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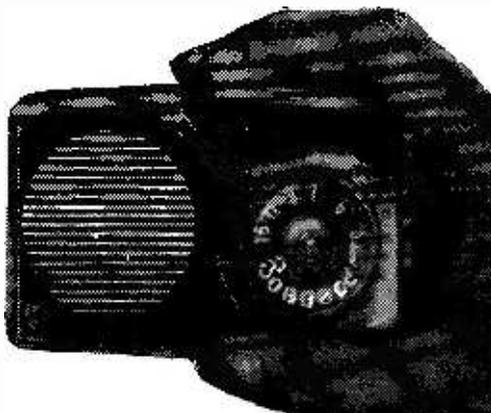
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rejects, no manufacturers' seconds", and uses "Ever Ready" battery. **FOR 59/6**
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ALL LOUDSPEAKER... DEMAND
—D. IT MUST GIVE GOOD RECEPTION IN DIFFICULT AREAS... DEMAND—E. IT MUST WORK ON ITS OWN INTERNAL FERRITE ROD AERIAL... ETC. ETC.
ANSWER—The Apollo "6" does all this—and much more!
REVOLUTIONARY SILICON PLANAR EPOXY CIRCUIT DESIGN



CONTAINS FEATURES THAT CAN'T BE BOUGHT IN READY MADE SETS—AT ANY PRICE

- receives medium wave & trawler broadcasts.
 - every component brand new—no surplus rejects or "seconds".
 - uses latest Silicon Planar Epitaxial Epoxy transistors.
 - six stage stable reflex—2 R.F., 1 Diode demodulation, 3 A.F.
 - simplified illustrated plans.
 - from parts to programmes in an evening
- ... PLUS MANY MORE!

No soldering iron is necessary and you don't have to have a magnifying glass and a pair of tweezers. **DEMAND—B. IT SHOULD WORK FIRST TIME... ANSWER**—Apollo "6" uses latest rugged Silicon Transistor Circuitry and every single transistor, diode, capacitor, resistor, inductance etc. is brand new and fully tested—no surplus parts, no manufacturers

Apollo "6" will probably be bang up-to-date well into the seventies! It bristles with latest technical innovations. Six stage stable reflex N.P.N. and P.N.P. circuit consisting of 2 Radio Frequency stages, 1 Diode demodulation stage and 3 Audio Frequency stages. Uses latest Silicon Planar Epitaxial Epoxy transistors (similar to types used in America's Space

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Project). The first two transistors give amplification of 100 to 400 each, (at only 100 Microamps collector current approx). Output transistor gives amplification

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Listen to the thrilling sound of an SOS at sea—tune in to a world you've never heard before... **NOTE**. Because members of our own Staff (and their friends) are enthusiastic and have already bought Apollo "6" parts we know demand will be enormous. **DON'T DELAY—SEND FOR YOURS NOW**, send 59/6+3/6 P. & P. for all parts, illustrated plans, personal listening earpiece etc. (all parts can be bought separately) **MONEY BACK GUARANTEE** (see panel).

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Provides three separate switched output voltages 6v., 7½v. and 9v. DC. Attractive case with indicator light, mains lead output socket, plug and lead. Size 4½ x 3½ x 2½ in. (Extra lead with DIN plug for Cassette Recorders 7/6)



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M44C		£12.19.5	£9.9.0
M44E		£17.8.4	£13.19.6
M55E		£20.15.1	£15.15.0
M75-6		£17.8.4	£13.19.6
M75E		£25.18.10	£21.0.0

	AUDIO TECHNICA	List Price	Premier Price
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A.T.7S stereo		£22.0.0	£15.0.0
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Post and Packing 1/6 each

"NOVA" TRANSISTOR STEREO AMPLIFIER

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



WONDERFUL VALUE
AT 25 Gns. Carr. 10/-

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RONETTE 106 (Stereo)	£1.15.0
RONETTE 106 (Stereo)	£1.15.0

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



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

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



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

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Size 17 1/2 x 10 x 7 1/2 in. Ideal for above speakers £5.10.0, p. & p. 10/-.



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Designed to the highest possible standard. Fitted 2 1/2" speaker units with soft padded ear muffs. Adjustable headband. 8 ohm impedance. Complete with 6ft. lead and stereo jack plug.
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SPECIALLY MANUFACTURED IN U.S.A. FROM EXTRA STRONG PRE-STRETCHED MATERIAL. THE QUALITY IS UNEQUALLED.

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

LP3 3" 250' P.V.C.	5/8	LP6 6 1/2" 1200' P.V.C.	12/8
TP2 3" 450' POLYESTER	7/6	DT6 6 1/2" 1800' POLYESTER	22/8
DT3 3 1/2" 600' POLYESTER	11/8	TP8 8 1/2" 2400' POLYESTER	37/8
SP5 5" 800' P.V.C.	8/6	SP7 7" 1200' P.V.C.	12/6
LP5 5" 900' P.V.C.	10/-	DT7 7" 2400' POLYESTER	25/-
TP5 5" 1200' POLYESTER	15/-	TT7 7" 3600' POLYESTER	50/-

TAPE SPOOLS 3" 1/-, 5", 5 1/2", 7" 1/8, TAPE CASES 5", 7" 2/6.
Post and Packing 3" 1/-, 5", 5 1/2" 1/6, 7" 2/- (3 reels and over Post Free).

SAVE NEARLY £5!

Premier Stereo System with "Nova" 10 watt Stereo Amplifier as above. 45 Gns. Carr. 35/-.

VERITAS V-149 MIXER

Battery operated 4-channel audio mixer providing four separate inputs. Size 6 x 3 x 2 1/2 in. suitable for crystal microphone, low impedance microphone with transformer, radio, tape, etc. Max. input 1.5v. Max. output 2.5v. Gain 6 dB. Standard jack plug socket input, phono plug output. Attractive teak wood grain finish case.



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

VERITAS V-313 TAPE HEAD DEFLUXER

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



SPECIAL BARGAIN OFFER

B.S.R. UAT5 RECORD PLAYER UNIT COMPLETE WITH TEAK PLINTH. 4 speeds. Automatic or Manual operation. Low mass arm with cue and pause lever, bias compensator, stylus pressure adjuster, etc. Complete with B.S.R. G1 Stereo Cartridge. Original Price £25.18.8.



Our Price 14 Gns. Carr. 10/6



WELLER "EXPERT" SOLDER GUN. Saves time and simplifies soldering in the home and service dept. Two position trigger gives instant dual heat. 100/140 watt. 240 volt A.C. 67/6 P. & P. 2/-.



POCKET SIZE MULTI-TESTER With wide angle, jewelled meter movement, ceramic long-life, low-loss switching, tough impact resisting case. Sensitivity 20,000 ohms/volt D.C. 10,000 ohms/volt A.C. 18 Ranges: 0.5-25-50-250-500-2500 volts D.C. 0-10-50-100-500-1000 volts A.C. 0-50µA-0.5 mA-250 mA D.C. 0-600 ohms-4 megohms 10µ mf-0-001 mfd-1 mfd. -20 to +22dB. Complete battery, test lead and instructions. £4.19.6 P. & P. 3/6.

TWO STATION TRANSISTOR INTERCOMS

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



FOUR STATION INTERCOM. Master unit and 3 slaves. Ideal for office and home. Complete with battery and connecting wire £7.10.6 P. & P. 5/6.

"PREMIER" TAPE CASSETTES



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

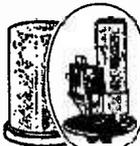
P. & P. 1/-.



CASSETTE HEAD CLEANER

Removes unwanted deposits from delicate tape heads. Fits all cassette recorders. 11/6 P. & P. 1/-.

CAR LIGHT FLASHERS



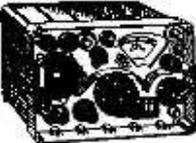
Heavy duty light flasher employs a condenser discharge principle operating on electro mechanical relay. (As inset). Housed in strong plastic case. Flashing rate between 60-120 per minute. 12V DC operation. Maximum load 6 amps. Size 2-11/16in. dia. x 4in. Supplied brand new at a fraction of original cost.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

HAMMARLUND SP600JX COMMUNICATION RECEIVER

540 Kc/s-54 Mc/s in 6 bands. Few only. \$100 each.

R209 MK II COMMUNICATION RECEIVER

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



TYPE 13A DOUBLE BEAM OSCILLOSCOPES

An excellent general purpose D/B oscilloscope. T.B. 2 cps-760 Kc/s. Bandwidth 5-6 Mc/s. Sensitivity 32mV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. \$22.10.0. Or complete with all accessories, probe, leads, lid, etc. \$25. Carriage 30/-.



MARCONI T/44/TF956

AF Absorption Wattmeter
1 μA/watt to 6 watts.
\$20. Carr. 10/-

SOLARTRON CD-1016 OSCILLOSCOPE

Double beam. D.C. To 5 Mc/s. Excellent condition. \$25 each. Carr. 20/-.

GEARED MAINS MOTORS

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

SOLARTRON CD.711S.2 OSCILLOSCOPES

Double beam. D.C. to 9Mc/s. Perfect order. \$25. Carr. 50/-.

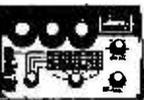
TO-2 PORTABLE OSCILLOSCOPE

A general purpose low cost economy oscilloscope for everyday use. Y amp. Bandwidth 2 C/Ps-1 mHz. Input imp. 2 meg Ω 25pF. Illuminated scale. 2in. tube. 115 x 180 x 230mm. Weight 8lb. 220/240V. a.c. Supplied brand new with handbook. \$22.10.0. Carr. 10/-.



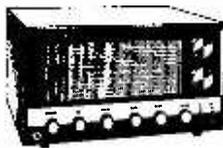
TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE

A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 10-11.1 meg Ω 6 Ranges ±1%. L1 μ H H 111 HENRYS 6 Ranges -2%. C. 10pF ±1110mPd. 6 TURNS RATIO 1:1/1000-1:1100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case. Size 7 1/2 x 5 x 2in. \$20. P. & P. 5/-.



UNR-30 4-BAND COMMUNICATION RECEIVER

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



LAFAYETTE SOLID STATE H800 RECEIVER
5 BAND AM/OW/SSB AMATEUR AND SHORT WAVE 150 Kc/s-400 Kc/s and 550 Kc/s-30 Mc/s F E T front end • 2 mechanical filters • Huge dial • Product detector • Variable BFO • Noise limiter • 8 meter • 24in Bandspread • 230V. A.C./12V. D.C. neg. earth operation • RF gain control. Size 15in. x 9 1/2in. x 8 1/2in. Weight 13 lbs. EXCEPTIONAL VALUE. \$45. Carr. 10/-, S.A.E. for full details.



TRIO COMMUNICATION RECEIVER MODEL 9R-59DE

4 band receiver covering 500 Kc/s to 30 Mc/s continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit, 4/8 ohm output and phone jack. SSB-CW • ANL • Variable BFO • 8 meter • Sep. bandspread dial • 12.455 Kc/s • Audio output 1 1/2 W. • Variable RF and AF gain controls. 115/250V. A.C. Mains. Beautifully designed. Size: 7 x 15 x 10in. With instruction manual and service data. \$42, carriage paid. **TRIO COMMUNICATION TYPE HEADPHONES.** Normally \$5.19.6. OUR PRICE \$3.15.0 if purchased with above receiver.

TRIO JR-500SE 10-80 Metre AMATEUR RECEIVER

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

TRIO TS 510 AMATEUR TRANSCEIVER with speaker and mains P.S.U.

\$212. IN STOCK!



RCA COMMUNICATIONS RECEIVERS AR88D

Latest release by ministry BRAND NEW in original cases. 110-250V. A.C. operation. Frequency in 6 Bands. 535 Kc/s-32 Mc/s continuous. Output impedance 2-5-600 ohms. Incorporating crystal filter, noise limiter, variable BFO, variable selectivity, etc. Price \$27.10.0. Carr. \$2.



LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER

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



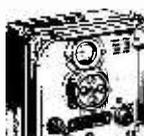
CLASS D WAVEMETERS

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



CRYSTAL CALIBRATORS No. 10

Small portable crystal controlled wavemeter. Size 7 x 7 1/2 x 4in. Frequency range 500 Kc/s-10 Mc/s (up to 30 Mc/s on harmonics). Calibrated dial. Power requirements 300V. D.C. 15mA and 12V. D.C. 0.3A. Excellent condition. \$9/8. Carr. 7/6.



CLASS D WAVEMETERS No. 2
Crystal controlled. 1-2-19 Mc/s. Mains or 12V. D.C. operation. Complete with calibration charts. Excellent condition. \$12.10.0. Carr. 30/-.



CLEAR PLASTIC PANEL METERS

First grade quality Moving Coil panel meters. Type MR 38P. 1 1/2in. square fronts.

500-0-500 μA	\$27/6	50mA	\$27/6	150V. D.C.	\$27/6
1mA	\$27/6	100mA	\$27/6	300V. D.C.	\$27/6
1-0-1mA	\$27/6	150mA	\$27/6	500V. D.C.	\$27/6
2mA	\$27/6	200mA	\$27/6	750V. D.C.	\$27/6
5mA	\$27/6	300mA	\$27/6	15V. A.C.	\$27/6
10mA	\$27/6	500mA	\$27/6	50V. A.C.	\$27/6
750mA	\$27/6	10V. D.C.	\$27/6	150V. A.C.	\$27/6
1 amp	\$27/6	30V. D.C.	\$27/6	300V. A.C.	\$27/6
2 amp	\$27/6	20V. D.C.	\$27/6	500V. A.C.	\$27/6
5 amp	\$27/6	100V. D.C.	\$27/6	8 meter 1mA 38P-VU meter	\$27/6
20mA	\$27/6				

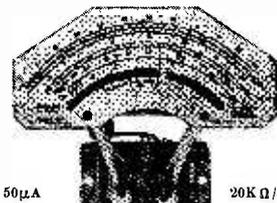
FULL RANGE OF OTHER SIZES IN STOCK. SEND S.A.E. FOR LEAFLET

Variable Voltage TRANSFORMERS

Brand new, guaranteed and carriage paid. High quality construction. Input 230V. 50-60 cycles. Output full variable from 0-250 volts. Bulk quantities available. 1 amp - \$5.10.0; 2.5 amp - \$8.15.0; 5 amp - \$9.15.0; 8 amp - \$14.10.0; 10 amp - \$18.10.0; 12 amp - \$21.0.0; 20 amp - \$27.0.0.



AVOMETER MOVEMENTS



50 μA 20K Ω/V

Spare movements for Model 8 or 9. (Fitted with Model 9 scale) or basis for any multi-meter. Brand New & Boxed. 99/6. P. & P. 3/6.

TE-40 HIGH SENSITIVITY A.C. VOLTMETER

10 meg. input 10 ranges: 0.1/0.03/1/5/10/30/100/300V. R.N.S. 4cps. 1-2 Mc/s. Decibels -40 to +60dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. \$17.10.0. Carr. 5/-.



LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

Frequency 0-20 Kc/s. on 2 ranges. Output 500 Ω or 5k Ω. Operation 200/250V. A.C. Supplied in perfect order. \$18.10.0. Carr. 10/-.

TE-65 VALVE VOLTMETER

High quality instrument with 28 ranges. D.C. volts 1.5-1,500V. A.C. volts 1.5-1,500V. Resistance up to 1,000 megohms. 200/240V. A.C. operation. Complete with probe and instructions. \$17.10.0. P. & P. 6/- Additional probes available: R.F. 35/-, H.V. 42/6.

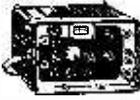


COSSOR 1049 DOUBLE BEAM OSCILLOSCOPES

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

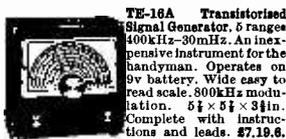
AM/FM SIGNAL GENERATORS

Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20-80 Mc/s. AM CW/FM. Incorporates precision dial, level meter, precision attenuator 1μV-100mV. Operation from 12 volt D.C. or 0/110/200/250 volt A.C. Size 12 x 8 1/2 x 9in. Supplied in brand new condition complete with all connectors fully tested. \$45. Carr. 20/-.



EDDYSTONE VHF RECEIVERS

Model 770R. 19-165 Mc/s. Excellent condition. \$150.



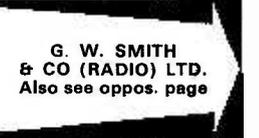
TE-18A Transistorised Signal Generator. 5 ranges 400KHz-30mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide easy to read scale. 300kHz modulation. 5 1/2 x 5 1/2 x 3 1/2in. Complete with instructions and leads. \$7.19.6. P. & P. 4/-.

FIELD TELEPHONES TYPE L

Generator ringing, metal cases. Operates from two 1.5V batteries (not supplied). Excellent condition. \$4.10.0 per pair. Carr. 10/-.

AUTO TRANSFORMERS

0/115/230V. Step up or step down. Fully shrouded. 150 W. \$1.12.6. P. & P. 3/6. 300 W. \$2.7.6. P. & P. 4/6. 500 W. \$4.10.0. P. & P. 6/6. 1,000 W. \$7.18.6. P. & P. 7/6. 1,500 W. \$7.18.6. P. & P. 8/6. 7,500 W. \$15.10.0. P. & P. 20/-.



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

ARF-100 COMBINED AF-RD SIGNAL GENERATOR



A.F. SINE WAVE
20-200,000 c/s.
Square wave 20-30,000 c/s. O/P.
HIGH IMP. 21V.
P/600Ω 3.8V. P/P.
TF 100 Kc/s-300 Kc/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. £20.0.0. Carr. 7/6.

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 Kc/s-260 Mc/s on 4 bands.



Directly calibrated Variable R.F. attenuator. Operation 200/240V. A.C. Brand new with instructions. £18.0.0. P. & P. 7/6, S.A.E. for details.

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

TE22 SINE SQUARE WAVE AUDIO GENERATORS



Size: 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, £18.10.0. Carr. 7/6.

MARCONI TF148E DISTORTION FACTOR METERS. Excellent condition. Fully tested. £20. Carr. 15/.

LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYSER

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



MODEL ZQM TRANSISTOR CHECKER

It has the fullest capacity for checking on A, B and Ic. Equally adaptable for checking diodes, etc. Spec.: A: 0.7-0.9967. B: 5-200. Ic: 0-50 microamps. 0-5mA. A.C. Resistance for diode 200Ω-1MΩ. Supplied complete with instructions, battery and lead. £5.10.6. P. & P. 2/6



ADVANCE TEST EQUIPMENT

Brand new and boxed in original sealed cartons. **VM.76 VALVE VOLTMETER.** R.F. measurements in excess of 100 Mc/s and D.C. measurements up to 100V with accuracy of +2% D.C. range 300 MV to 1 KV. A.C. range 300 MV to 100 V RMS. Resistance 0.2-500 MΩ. Price £72. **VM.79 UHF MILLIVOLT METER.** Transistorised. A.C. range 10 MV-3 V. D.C. current range 0.1μA-3 mA. Resistance 1 ohm-10 megohms. Price £125. **HIS-140 AUDIO SIGNAL GENERATOR.** 15 c/s-50 Kc/s. Sine or square wave. Price £30. **J1B AUDIO SIGNAL GENERATOR.** 15 c/s-50 Kc/s. Price £30. **TT18 TRANSISTOR TESTER.** £37.10.0. Carriage 10/- per item.

SOLARTRON MONITOR OSCILLOSCOPE TYPE 101

An extremely high quality oscilloscope with time base of 10μ/sec to 20m/sec. Internal V. amplifier. Separate mains power supply 200V/250V. Supplied in excellent condition with cables, probe, etc., as received from Ministry. £8.19.8, carriage 30/-.

HOSIDEN DHO4S 2-WAY STEREO HEADSETS



Each headphone contains a 2 1/2" woofer and a 3/4" tweeter. Built in individual level controls. 8Ω Imp. 25-18,000Ω/s with cable and stereo plug. £5.19.6. P. & P. 2/6.

Latest Catalogue

The latest edition giving full details of a comprehensive range of HI FI EQUIPMENT, COMPONENTS, TEST EQUIPMENT and COMMUNICATIONS EQUIPMENT. Nearly 200 pages fully illustrated and detailing thousands of items - many at bargain prices. FREE DISCOUNT COUPONS. VALUE 10/-



SEND NOW - ONLY 7/6 P&PH

GARRARD

FULL CURRENT RANGE OFFERED BRAND NEW AND GUARANTEED AT FANTASTIC SAVINGS

- *SRP22 Stereo £5.10.6
- *1025 Mono £7.10.0
- *1025 Stereo £7.15.0
- *2025 Stereo £7.19.8
- *2025T/C £1.75
- *3000 Stereo £9.19.8
- *SP25 MK II £11.19.8
- *8L55 £11.19.8
- *A70 MK II £12.10.0
- *A780 MK II £13. 5.0
- *8L65 £14.14.0
- *475 £17.17.0
- *8175 £28. 7. 8
- *8175 £28.10.0
- *8195 £35. 0.0



Carriage/insurance 7/6 extra any model. WB4 Bases £3.19.8. Perspex covers £3.10.0. *Special offer base and cover available for these models at £4.15.0. Carr. 5/-. Full range of Garrard accessories available.

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 complementary metal case. Size 10 1/2 x 9 1/2 x 7 1/8". Operation 115/230V. A.C. £28. Carriage 7/6.

MULTIMETERS for EVERY purpose!

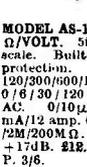
TE-51. NEW 20,000Ω/VOLT MULTIMETER with overload protection and mirror scale. 0.6/60/120/1,200v. A.C. 0.3/30/60/300/600/3,000v. D.C. 0-60μA/12/300mA. D.C. 0/60KΩ meg. ohm. 92/6. P. & P. 2/6.



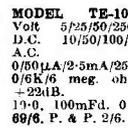
TE-900 20,000Ω/VOLT GIANT MULTIMETER mirror scale and overload protection. 6in. full view meter. 3 colour scale. 0.2/5/10/250/1,000/5,000 v. A.C. 0.25/12.5/10/80/250/1,000/5,000v. D.C. 0.5/0.5μA/110/100/1500 mA/10 amp. D.C. 0.25/250/250 MEG. OHM. £15. P. & P. 5/.



MODEL AS-100D. 100KΩ/VOLT. 5in. mirror scale. Built-in meter protection. 0.3/12/60/120/300/600/1,200v DC. 0.6/30/120/300/600v A.C. 0.10μA/6/60/300 mA/12 amp. 0.2K/200K Ω/2M/200MΩ. -20 to +17dB. £12.10.0. P. & P. 3/6.



MODEL TE-10A 30kΩ/VOLT 5/25/50/250/500/2,500v. D.C. 10/50/100/500/1,000 v. A.C. 0.60μA/2.5mA/250mA. D.C. 0/6KΩ/6 meg. ohm. -20 to +25dB. 19-0. 100mFd. 0.100-0.1mFd. 69/6. P. & P. 2/6.



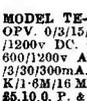
MODEL TE-90 50,000 Ω/V mirror scale overload protection 0.3/12/60/300/600/1200 v. DC. 0.6/30/120/300/600mA. DC. 16K/160K/1.6/16meg Ω. -20 to +63dB. £7.10.0. P. & P. 3/-.



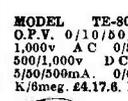
LAFAYETTE 57 Range Super 50kΩ/volt Multi-meter. D.C. volts 12mV-1000V. A.C. volts 1.5V-1000V. D.C. current 25μA-10 amp. Ohms 0-10 megΩ dB -20 to +81 dB. Overload protection. £12.10.0. Carr. 3/6.



MODEL TE-70. 30,000 Ω/V. 0.3/15/60/300/600/1200v DC. 0.6/30/120/600/1200v AC. 0.3/30μA/3/30/300mA. 0.16K/160 K/1.6/16 Meg. Ω. £5.10.0. P. & P. 3/-.



MODEL TE-80. 90,000 Ω.P.V. 0.3/10/50/100/500/1,000v AC 0.5/25/50/250/500/1,000v DC. 0-50μA. 5/50/500mA. 0.6K/60K/600 K/8meg. £4.17.8. P. & P. 3/-.



MODEL PT-34. 1,000 Ω.P.V. 0.10/50/250/500/1,000v AC and DC. 0.1/100/500mA DC. 0/100K Ω. 39/8. P. & P. 1/6.



MODEL TE-12 20,000 Ω.P.V. 0.0-0.6/30/120/600/1,200/500/1,000v. D.C. 0.6/30/120/600/1,200v. A.C. 0.60μA/6/60/600mA. 0.6K/600K/6Meg. 69. Meg. Ω. 50P. 0.2mFd. £5.19.8. P. & P. 3/6.



★ TRANSISTORISED FM TUNER ★



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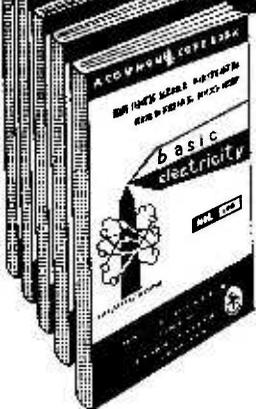
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★ Goldring Transcription Turntable on Plinth
★ Shure or Goldring Magnetic Pick-up Cartridge
★ Super 30 Amplifier in veneered housing
★ Pair of Stanway II Loudspeaker Units
Special total price. Four fully wired units ready to "plug-in". Carr. 30/-.
86 Gns.
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AUDIOTRINE HIGH FIDELITY LOUSPEAKERS



Heavy construction. Latest high efficiency ceramic magnets. Treated Cone surround for low fundamental resonance. "D" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 15 ohms. Please state choice. Exceptional performance at low cost.

Prices include carriage.
HF100D 10" 15W £25.15.0
HF510L 5" 10W 57/9 HF120 12" 15W 79/9
HF801D 8" 8W 59/9 HF120D 12" 15W 89/9
HF811D 8" 10W 4 gns. HF125 12" 15W 25.5.0
HF126D 10" 10W 65/- HF126D 12" 15W 25.5.0

HIGH FIDELITY LOUSPEAKER UNITS
Cabinets latest style Satin Teak or Afrormosia veneer. Acoustically lined or filled woollen damping. Ported where appropriate, credit terms available

DORCHESTER Size 16 x 11 x 9in. Appr. Range 45-15,000 c.p.s. Rating 8-10 watts. Fitted High Flux 13 x 8in. Dual Cone spkr. Imp. 3 or 15 ohms **£8.19.9**

STANWAY II Size 20x10x9in. Rating 10 watts. Incorporating with rubber cone surround and 11,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 35-20,000 c.p.s. Imp. 15 ohms. **16 Gns.**

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14" deep, 11" high. Cut for TA12, Super 15, Super 30 and other amplifiers. 'Roll over' transp. plastic cover. Satin Teak or Afrormosia veneer finish **8 Gns.**

MOTOR BOARDS cut for Garrard 12/9
Turntables and many other units. Price

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

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High Grade Components.
Specifications comparable with units costing considerably more.

TRANSISTORS 9 high quality types in each channel.

OUTPUT 10 Watts R.M.S. continuous into 15Ω (per channel). 15 Watts R.M.S. continuous into 3Ω.

INPUT SENSITIVITIES Mag. P.U. 4 mV. Ceramic P.U. 35 mV. Tape Amp. 400 mV. Aux. 100 mV. Mic. 5 mV. Tape Head 2.5 mV.

FREQUENCY RESPONSE ± 2 dB. 10-20,000 c.p.s.

TREBLE CONTROL +17 dB to -14 dB at 10 Kc/s.

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HUM LEVEL -80 dB.

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Total cost of parts with detailed wiring diagrams & instructions. Inc. Carr. **14 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.**

30 WATT OUTPUT

★ Garrard SP25 Mk II Turntable on Plinth
★ Goldring CS90 Ceramic P.U. Cartridge with diamond stylus
★ Super 30 amplifier in veneered housing
★ Pair Stanway II Loudspeaker Units
Four fully wired units ready to "plug-in" Special total price **76 Gns.** Carr. 30/-

13 WATT OUTPUT

★ Garrard SP25 Mk II 4 sp. player unit on plinth
★ Goldring CS90 Ceramic P.U. Cartridge
★ TA12 Amplifier in veneered housing
★ Pair of Dorchester Loudspeaker Units. Special total price. Carr. 25/-
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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) 30mV (2) 50mV (3) 100mV (4) 2mV. Output rating I.H.F.M. ★ Handsome brushed silver finish Facia and Knobs. Complete kit of parts with full wiring diagrams & instructions. Factory built with 12½ Gns. mth gntee **16 GNS** or Deposit **£5.2.6** and 9 mthly pymts **£1/6** (Total **£19.6.0**) Or in Teak or Afrormosia veneer housing **19½ Gns.** Dep. **£5.10.6** and 9 mthly pymts **39/-**. (Total **£23.1.8**)



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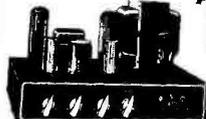
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DEMONSTRATIONS AT ALL BRANCHES

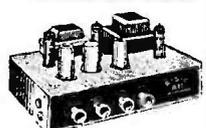


R.S.G. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER



Highly sensitive. Push-Pull high output. With Pre-amp/Tone Control Stages. Performance figures of factory built units: Hum level -70dB. Frequency response 3dB 30-20,000c/s. Sectionally wound output transformer. All high grade components. Valves EP86, EP86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 36 mV. Suitable for high impedance microphones, Crystals or Ceramic P.U.s. 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 spkrs. Complete kit of parts with point-to-point wiring diagrams and manual. **15 Gns.** Carr. 10/-
Twin-handled perforated cover 27/8. Supplied factory built with EL34 output valves. 12 months' guarantee for 18 Gns. TERMS: Deposit £6.3.0 and 9 monthly payments of 34/- (Total £21.9.0). 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 3 valves. ECC83, ECL86, E281. High quality sectionally wound output transformer. IND. BASS AND TREBLE CONTROLS. Frequency response +3dB 30-20,000 c/s. Hum level -80dB. SENSITIVITY 40 millivolts. For Crystals or Ceramic P.U.s. High Impedance Output for 3 and 15 ohm spkrs. SAE for leaflet. Complete kit. **9 1/2 Gns.** Full instructions and point-to-point wiring diagrams. Carr 11/8 (or factory built 12 Gns.). Twin handled metal cover 27/8. TERMS ON ASSEMBLED UNITS: Deposit 99/8 and 9 monthly payments of 23/- (Total £15.6.8)

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



An exceptionally powerful high quality all-purpose unit for lead, rhythm, bass guitar, melists, gram, radio, tape.
★ Two extra heavy duty 12in. Loudspeakers.
★ Four Jack inputs and two Volume Controls for simultaneous use of up to four pick-ups or "mikes". Bass and Treble controls.
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£100 100 watt peak output with Pr. speaker columns and a Bass Unit (Six 12" and Two 15" Spkrs). 99/- gns

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All all-day battery eliminator. Size 5 1/2 x 4 1/2 in. approx. Completely replaces batteries supplying 1.5v. and 90v. where A.C. mains 200/250v. 50c/s is available. Complete kit with diagram 52/8 or assembled 3 Gns

SELENIUM RECTIFIERS F.W. (Bridged)
All 6/12v. D.C. output. Max. A.C. input 18v. Ia. 4/3. 2a. 6/11. 3a. 9/8. 4a. 12/9. 5a. 15/9.

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Complete kit of parts with Ammeter and Circuit. Both models with variable charge rate selector.
4 amp 49/9 **6 amp 69/9**
All types 200-250v. A.C. Mains. Built 10/- extra.

14 WATT HI-FI AMPLIFIERS High sensitivity. Two separate inputs. Two vol. controls for mixing purposes. Separate Bass and Treble Controls. Valves ECC83, ECL86, ECL86, E280. Output for 15 ohm Loudspeakers. 200-250v. 50 c.p.s. A.C. mains operation. Size approx. 8 x 8 x 6in. Factory built and fully guaranteed. Limited number to clear at **£7-19-11** Carr. 10/-



FANE POP 30c LOUDSPEAKERS



12in. 8-15Ω 25 watts R.M.S. **£5.19.9**
continuous. Dual cone. Carr. free

R.S.C. COLUMN SPEAKERS Covered in two-tone Rexine/Vynair. ideal for vocalists and Public Address. 15 ohm matching. C57 15 watts inc. five 7 x 4in. speakers 27.19.11.
TYPE C488 30 WATTS. Fitted four 8in. high flux 8 watt speakers. Overall size approx. 42 x 10 x 5in. Or deposit 67/- and 9 monthly pmts 34/9 (Total £18.19.9) Carr. 10/-.
TYPE C485, 50 WATTS. Fitted four 12in x 1,000 line 15 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/- Or Deposit 25.17.8 and 9 monthly payments of 54/6 (Total £30.7.0).

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For Guitar, Vocal or Instrumental Group
A 2 or 4 input, 2 vol. control Hi-Fi unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/gold perspex fascia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. Deposit 5 gns. and Carr. 15/- 9 monthly payments of 39/8 (Total 22 gns). **19 Gns.** Carr. 12/6



F.A.L. 'Phase Fifty' PUBLIC ADDRESS AMPLIFIER

Solid State Circuitry. 50 Watts Peak Output. 3 separately controlled inputs for mixing purposes. Separate Bass and Treble Controls. Output for loudspeakers 3-30 ohms. Suitable for Dynamic, Ribbon or Crystal Mikes. For Clubs, Theatres, Restaurants, Hotels, Schools, etc. For Vocal or Instrumental Groups. Send S.A.E. for leaflet. only **29 GNS.**

HIGH QUALITY LOUDSPEAKERS

In Teak or Afrormosia veneered Cabinets
L13 13" x 8" 10 Watt L12 12"
10,000 lines **£4.19.9** 20 Watt 10,000 lines **£8.19.9**
3or 15ohms. Carr 7/6 15 ohms. Carr 8/9



FANE ULTRA HIGH POWER LOUDSPEAKERS

All power ratings are R.M.S. continuous. 2 year guarantee. High Flux 14,000 line ceramic magnets. Heavy cast chassis.

'POP' 100 18" 100 Watt **21 GNS.** Carr. free
'POP' 60 15" 60 Watt **12 GNS.** Carr. free
'POP' 50 12" 50 Watt **10 GNS.** Carr. free

POWER PACK KIT

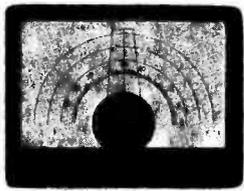
Consisting of Mains transformer, Metal Rectifier, Electrolytics, smoothing choke, chassis and circuit. 200/250v. A.C. mains. Output 250v. 60mA 8.3v. 2a. Supplied with case in lieu of chassis 32/11. Or assembled 44/- **28/11**

MINI-8 HI-FI Loudspeaker Units Special Offer

Teak or Afrormosia veneered cabinet, size approx. 10 1/2 x 6 1/2 x 7 1/2 in. Peak power handling 8 watts 3-5 ohms. Inc. Carr. **69/11**

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PRACTICAL WIRELESS

VOL 45 NO 8

Issue 754

DECEMBER 1969

TOPIC OF THE MONTH

Regarding Rallies

NOW that the season's spate of mobile rallies is over, it seems in retrospect that there is a large scope for improvement. While admitting that some rallies are parochial and others organised on a grander scale, thus providing a desirable degree of difference, it seems to us that more cohesion would not come amiss.

A central organising body would overcome many of the current defects. Such a body would provide maximum publicity, select the most suitable dates, avoid clashing of events, maintain a better standard and ensure that the calendar contained everything from small local events to large National Mobile Rallies. Events could be arranged to take place in the right part of the country at the right time.

We would like to see more co-operation between clubs in a particular area who could get together as a group and put on a really impressive show, not just a village fête in the back-of-beyond. We would like to see adequate signposting: G3JDG once described the signposts for the Harlow rally as "sweetpapers hidden in hedges", and even this was perhaps too charitable. An organising body could take care of these things and perhaps arrange for commercial organisations to sponsor certain events; for example, if one of the motoring organisations (RAC or AA) is convinced of a large turn-out, its support in signposting can be relied on.

And the tightening up of rally programmes would ensure that they were planned with a bit more imagination. At the moment too much is left to chance and it seems to have escaped many clubs that a rally is partly a family affair. All too often the YLs, XYLs and sprigs sit in cars, bored stiff, waiting for the time to go home. We want more efforts like the Woburn Abbey rally where there is plenty to amuse the family as well as the enthusiast. We would like to see more rallies coupled with open days of suitable establishments—the Services, industry and broadcasting. As for a central co-ordinating body, our national society is the natural choice, so how about it RSGB?

W. N. STEVENS—*Editor*.

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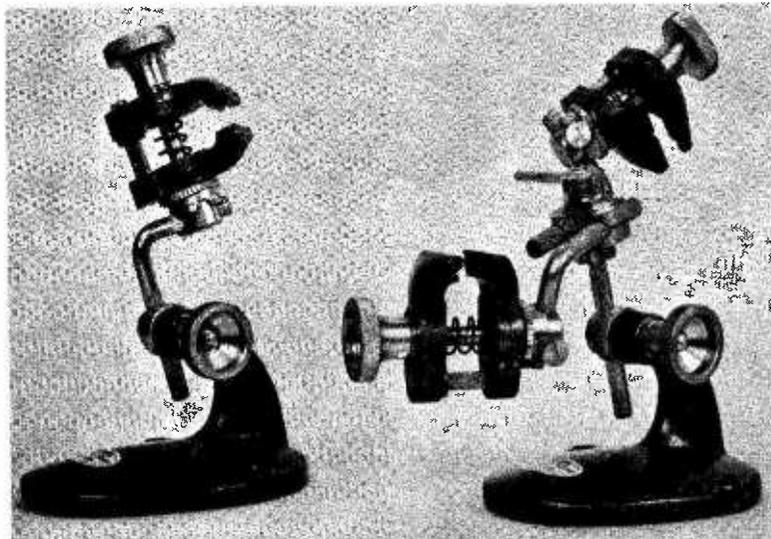
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JANUARY ISSUE WILL BE PUBLISHED
ON DECEMBER 5th

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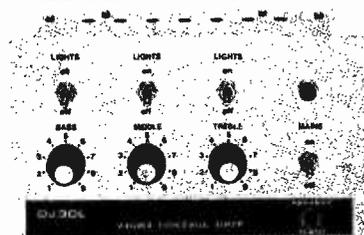
NEWS AND COMMENT...

THE THIRD HAND



We are informed by the Coventry Movement Co. Ltd. that they are the manufacturers of the "Multi-Mini" universal vice and stand. This is an ideal device for holding a printed circuit board or components when soldering is taking place. In fact it acts as the "third hand" that many of us wish we had when we are constructing. Price of the Multi-Mini Universal Vice and Stand is 67s. 6d. There is also a model called the Multi-Mini Twin which is basically the same but has an extra set of jaws. Price of this model is £5 18s. It should be possible to obtain both these units at tool stores but should difficulty be experienced, the manufacturers will be pleased to supply direct for a P.P. charge of 3s. extra on each model. *The Coventry Movement Co. Ltd., Burnsall Road, Coventry. Tel: OC03 74364.*

LIGHTING UNITS



The DJ.10L (£19 10s.) and the DJ.30L (£37 10s.) are light control units. Both units feature dual input sockets for front or rear connections, plus an override switch so that the lights may be left permanently on. Cabinets are made for panel mounting.

DJ.10L makes lights flash on and off with the music; DJ.30L is however a more sophisticated unit with three channels which enable bass, middle and treble frequencies from the amplifier to be operated individually as required. The maximum wattage that each channel will take is 1,000W in the "flashing

lights" position or 600W in the "lights on" position with all three channels working simultaneously. *D. J. Electronics (Hackney) Ltd., 170 Albion Road, London, N.16.*

APAE moves Exhibition to London

It has been found necessary to find a suitable venue to house more exhibitors in larger stands and easier access for visitors from home and abroad for the Assoc. of Public Address Engineers' Exhibition.

The exhibition will be known as "Sound '70 International" and will take place at Camden Town Hall, opposite St. Pancras Station in Euston Road, London N.W.1 from 10th—12th March, 1970, 10 a.m.—5.30 p.m. daily. As in other years stress will be made on the educational theme as well as being a selling and viewing exhibition. Various lectures will take place during the show. The sponsor is the Association of Public Address Engineers.

"SEMICONDUCTOR DEVICES"

The third booklet in the series of "minibooks" published by the Mullard Educational Service is entitled *Semiconductor Devices*. It is intended as an introduction to the subject which, being treated non-mathematically, should be easily understood by anyone with a basic knowledge of electronics.

The booklet starts with a description of germanium and silicon and shows how they can be made into n- or p-type material by the addition of minute amounts of other elements. Explanations are given of the action of the p-n junction in a diode and the p-n-p or n-p-n arrangement in a transistor. The current-amplifying property of a transistor is explained and several basic transistor circuits are included.

The booklet then describes briefly how various transistors are constructed and has a section on transistor characteristics. In the final section other solid-state devices, such as phototransistors, thyristors, thermistors, f.e.t.s., and Gunn "diodes", are outlined. The booklet ends with a short description of integrated circuits.

Semiconductor Devices should be of interest to all students, and apprentices as well as lecturers and teachers of electronics in schools, technical colleges and other training establishments. Priced at 5s. (including packing and postage), it can be obtained from the *Mullard Educational Service, Mullard House, Torrington Place, London, W.C.1*. Cash should accompany orders.

RAILWAYMEN'S RADIO CLUB

I am a licensed Radio Amateur working for the railway at the town of Eastleigh which is 7 miles north of Southampton. I am trying to form a radio club of railwaymen but they are very hard to contact because of shifts etc.

If railwaymen in the Basingstoke, Fareham, Eastleigh, Southampton and Bournemouth areas would contact me, we may well be able to get a club going. *R. Mannion, G3XFD, 23 Marston Road, Thornhill, Southampton, Hants. Tel: West End 3851.*

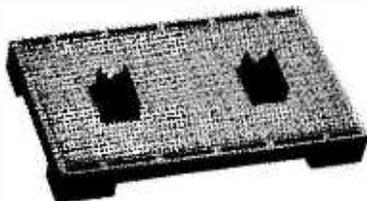
NEWS AND COMMENT...

BBC SCHOLARSHIP

The Engineering Division maintains six research scholars at United Kingdom universities, and is awarding one scholarship this year. The scholarships are intended to provide the opportunity for selected honours graduates to work for a higher degree, the subject chosen for post-graduate study being with in those fields of physics or engineering which have an application to radio or television broadcasting.

Mr. P. A. Ratliff graduated with first-class honours in electronic engineering from the University of Birmingham in June this year. He has been awarded a three-year BBC Research Scholarship to undertake research in the Department of Electronic and Electrical Engineering, University of Birmingham, under Professor D. G. Tucker, D.Sc., F.I.E.E. The subject of Mr. Ratliff's study is "an aerial system designed to combat multipath fading in VHF mobile communications, using existing AM receivers", and his supervisor will be Professor E. D. R. Shearman, B.Sc., F.I.E.E.

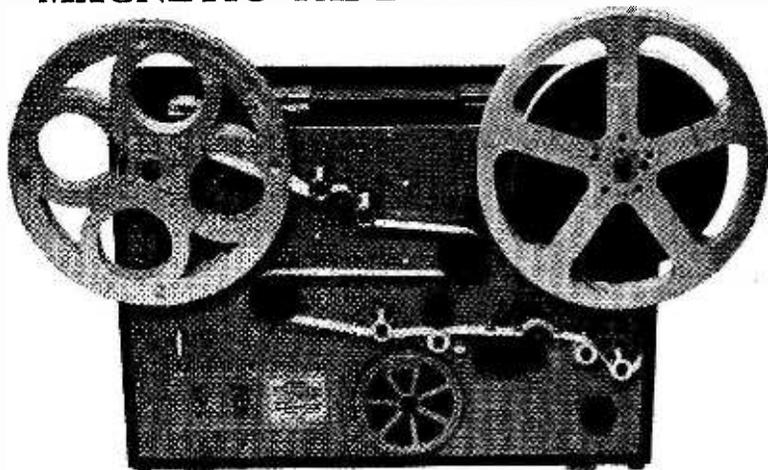
IC Breadboards from SDC



S.D.C. Products (Electronics) Ltd. now have in their range of modular solderless breadboarding systems, two new DeCs specifically designed to accommodate integrated circuits as well as modern short-lead discrete components and to have an increased contact capability—208 contact points per DeC—as compared with the original S-DeC which is of more limited capacity.

The new μ -DeCs, primarily for integrated circuits, can accommodate two 16-lead DIL stations or four 10-lead TO5 stations. The new T-DeCs, primarily for discrete components, can also accommodate one DIL station or two TO5 stations. *S.D.C. Products (Electronics) Ltd., 34 Arkwright, Astmoor Industrial Estate, Runcorn, Cheshire.*

MAGNETIC TAPE ON CINE FILM



Supersound Electronic Products announce their new powered film striper. This is a machine that puts a piece of magnetic tape 0.0315in. (standard-8 film) or 0.026in. (super-8) down the side of the film so that a soundtrack can be recorded. The new striper incorporates a footage counter and a power rewind which enables the film to be quickly rewound after it has been striped with tape. Models are available for super/standard-8 (dual gauge), 16mm., and 9.5mm. The 8mm. version (see picture) has a total film capacity of 800ft. and the price for a kit which consists: Striping machine, 800ft. of Superstripe magnetic tape, 1oz. bottle of adhesive, 1oz. bottle of film cleaner and full operating instructions, is £40.

Less sophisticated models are available for £12 10s. and £13 11s. For further details, contact: *Supersound Electronic Products, 114 Mount Pleasant Road, Hastings, Sussex. Tel. Hastings 5647.*

SPRAY-ON POWER

Gould Ionics, an American company, have developed a "spray-on" battery. It can be sprayed on to a printed circuit board in thicknesses down to one-thousandth of an inch. It is also possible to re-charge it!

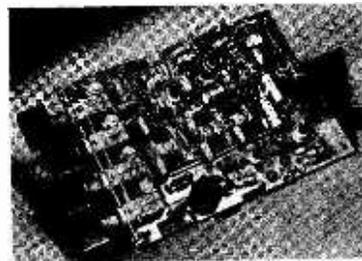
It is formed by first spraying on a silver-carbon electrolyte anode, then a rubidium-silver-iodine electrolyte. After this a specially developed iodine-free cathode is fitted.

A 3-cell 1.5V battery, three-hundredths of an inch thick has been sprayed on to a camera flash tube, illustrating one usage.

The absence of iodine in the cathode is important as it is the diffusion of iodine that shortens the life of other batteries. Current is at the moment limited to 200 μ A per square centimetre.

Another future application is where a new battery can be selectively sprayed on different portions of a circuit board providing miniaturised isolated power supplies.

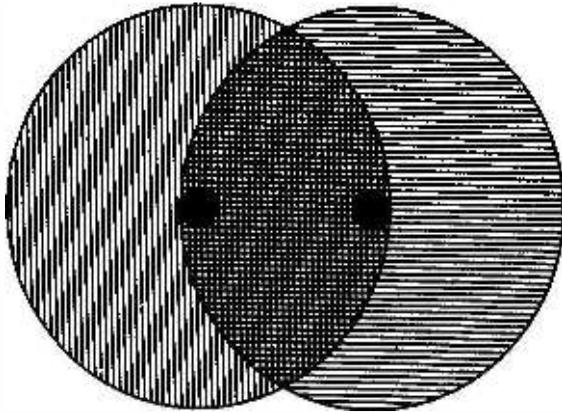
IC FM TUNER KIT



We now show a photograph of the IC FM Tuner kit mentioned first in News and Comment October 1969 issue. The kit sells at £9 19s. 6d. plus 5s. complete with drilled and tinned printed circuit board, fully illustrated booklet and all necessary components.

GOLDRING SERVICE AND SPARES

The service and spares department of the Goldring Manufacturing Co. (Great Britain) Ltd., 486-488 High Road, Leytonstone, London, E.11 now has a new telephone number 01-539-4208.



Part 1

a stereo decoder

F.C. JUDD

STEREOPHONIC f.m. transmissions are at present available to listeners in the UK service areas of the BBC transmitters located at Wrotham, Sutton Coldfield, Holme Moss and Swingate and certain of their relay stations. In order to hear these programmes "stereophonically" a v.h.f./f.m. receiver with a special "decoder" is necessary as the BBC use the "pilot tone" stereo transmission system commonly employed by many European, American, Canadian and Japanese broadcasters. In this system the left- and right-hand channels are "encoded" at the transmitter by a multiplexing process and transmitted on a common frequency. The signals for the respective channels are "decoded", after detection at the receiver. The system is compatible, which means that receivers without a decoder will receive and produce a "monophonic" version of the stereo transmission. An adapted receiver, i.e., one with a decoder will automatically receive and produce a monophonic output from a monophonic transmission and/or a stereophonic output from a stereophonic transmission.

Monophonic transmission of stereo (left- and right-hand channels) involves only adding the signals of the two channels which can be transmitted and

received in the normal way. For stereo reception however, additional information is necessary in order to separate the left- and right-hand channels. In the system employed by the BBC (the Zenith-G.E. system) the additional information consists of a difference signal—left minus right—which is transmitted as the upper and lower sidebands of a 38kHz sub-carrier. The sub-carrier itself is totally suppressed. To ensure synchronisation between the receiver "decoder" and the transmitter "encoder", a low level synchronising signal of 19kHz, the pilot tone, is also transmitted.

Circuit for a decoder

The circuit described in this article can be used with almost any f.m. tuner with a transistor or valve discriminator. The circuit is due to Mullard Limited (Central Technical Services) and the writer is indebted to both Mullard Limited and the BBC for permission to quote from their respective publications.

In the decoder circuit shown in Fig. 1 the pilot tone is extracted from the multiplex input by means of a 19kHz tuned circuit (L1/C2) immediately fol-

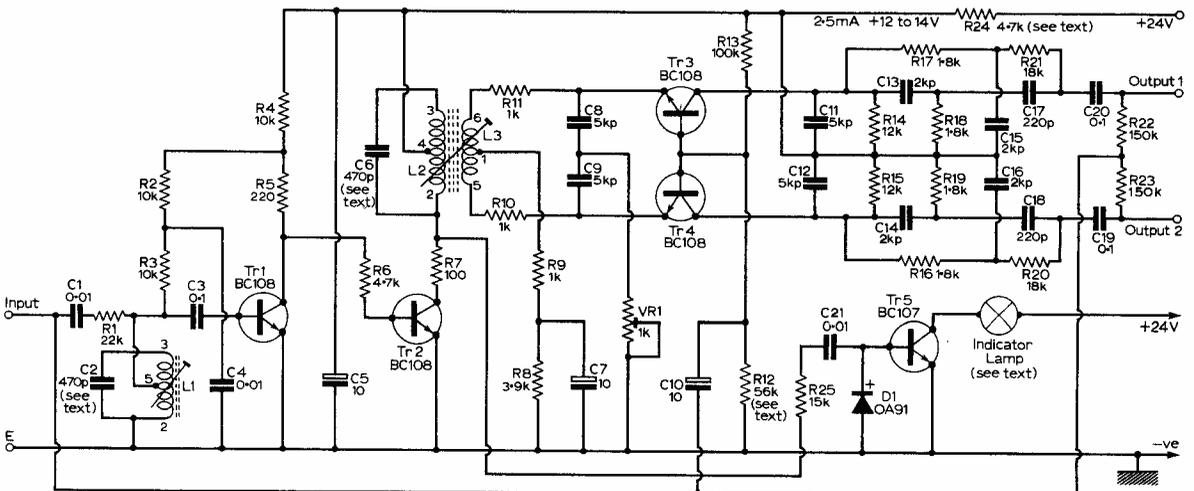
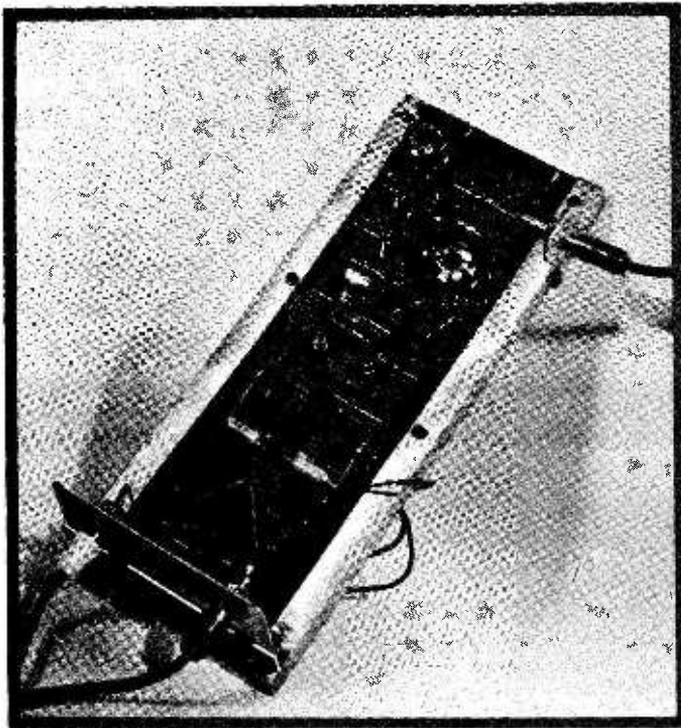


Fig. 1: Circuit diagram of the stereo decoder.



The author's completed decoder.

lowing the discriminator output. The pilot tone is then amplified by Tr1 and applied to the base of Tr2 which is biased to operate in class B condition, i.e., only the positive half-cycles of the pilot tone are amplified. The distorted waveform resulting from this form of amplification is rich in second harmonic content (38kHz) which is extracted by means of a tuned circuit (L2/C6) in the collector of Tr2. Note that the peak-to-peak amplitude of the 38kHz signal between the collector end of the coil and the tapping (pin 4) is limited to approximately twice the supply voltage. Hence its amplitude is constant once a certain input level has been exceeded.

The centre tapped secondary (L3) applies antiphase switching signals to the emitters of Tr3 and Tr4 whilst the complete multiplex information is applied

to the bases. With this arrangement, synchronous detection to obtain the difference signal, together with matrixing of the sum and difference signals occurs, and the now separated left- and right-hand signals appear respectively at the collectors of Tr3 and Tr4. However, with a simple decoder operating as described, only a limited separation is obtained. The circuit of Fig. 1 contains additional arrangements to improve separation which is done by introducing a controlled amount of crosstalk into the two outputs and in antiphase to the inherent crosstalk.

Although conventional de-emphasis occurs in the collector circuits of Tr3 and Tr4 this is insufficient to remove the 38kHz waveform from the output. Any strong residual 38kHz signals could produce distortion in a following audio amplifier or produce spurious whistles on a tape recording by beating with the bias oscillator in the tape recorder. Parallel-T filters are therefore included to reduce the 38kHz signal at the decoder outputs to a more or less negligible amount.

In the absence of a 38kHz switching waveform, i.e., during monophonic transmissions, the switching transistors Tr3 and Tr4 are biased to operate in class A and any signal applied to their bases is reproduced at their collectors. The circuit is therefore compatible and requires no switching from stereo to mono operation.

Indicator lamp

Stereo transmissions are directly indicated by means of a lamp which lights when the 19kHz pilot tone is present in the transmission. The signal for driving the stereo indicator lamp is actually taken from the 38kHz output at the junction of R7 and L2 in the collector circuit of Tr2. This signal allows Tr5 to conduct and pass sufficient current (20 to 30mA) to light the lamp in its collector circuit. Note that the h.t. voltage required to operate the stereo indicator lamp is 24V assuming the use of a 24V 20mA lamp as originally specified for the Mullard circuit. The decoder itself requires an h.t. rail of only 12 to 14V and could be run from this potential if the indicator circuit and its lamp is omitted. The indicator light is however a valuable asset to reception and to the alignment of the decoder and is therefore best retained.

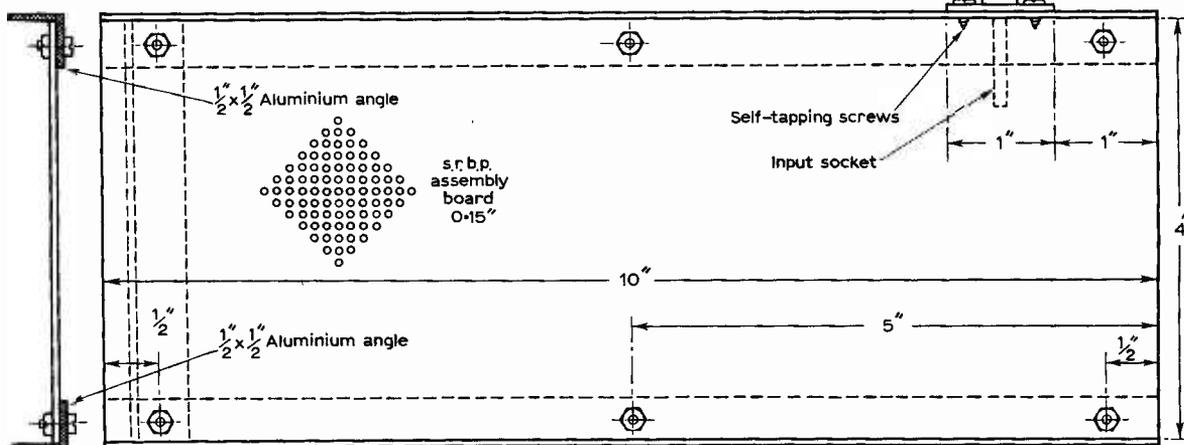


Fig. 2: Assembly board and support rails.

be little trouble with hum pick-up but precautions should be taken by keeping the unit away from leads carrying mains voltages and from large mains transformers.

As shown in Fig. 2 the s.r.b.p. perforated assembly board is mounted on $\frac{1}{2} \times \frac{1}{2}$ inch aluminium angle which gives support to the board and could be used for mounting purposes. Attached to one end of the board as in Fig. 3a is the output socket panel, also mounted on $\frac{1}{2} \times \frac{1}{2}$ inch aluminium angle as in Fig. 3b. The input socket panel (Fig. 4) is mounted directly on one side of the main assembly as shown in Fig. 2.

The component layout for use with Mullard decoder coils type WF2949 (19kHz—L1) and WF2951 (38kHz—L2/3) is shown in Fig. 5. Note that the pin connections are as seen when looking at the base of the coils (through the board) and as also shown in Fig. 6. The reference as to orientation on the board itself is the earthing tag pin 8. Note that these coils cannot be obtained direct from Mullard Limited, but are available from Gurneys Radio Limited, 91 The Broadway, Southall, Middlesex. Those who decide to use the alternative coils by Henry's Radio Limited, 303 Edgware Road, London, W.2, should use the layout and wiring shown in Fig. 7 and then continue as in Fig. 5. The Henry's decoder coils which are known by frequency, i.e., 19kHz and 38kHz respectively, are identical to the other coils in characteristics but the pin connections are as shown in Fig. 6. If these coils are used the reference for orientation is the earthing tag on the metal clamp.

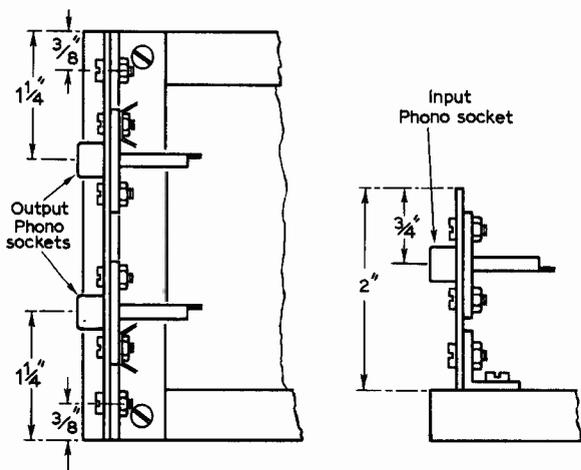


Fig. 3a: (above left) Output socket assembly.

Fig. 3b: (above) Input socket assembly.

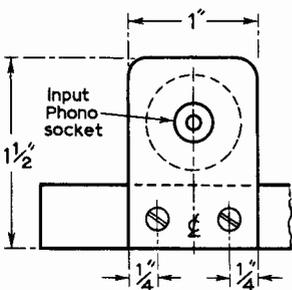


Fig. 4: (left) Input socket panel.

Construction

The entire decoder (except the power supply) could no doubt be accommodated as a much smaller assembly board than that shown in Fig. 2. The use of a fairly large board makes layout a little easier and in fact by extending the length of the board the small 24V power supply might also be included as well. No details for a box of any kind have been given as constructors may wish to mount the unit in some existing form of cabinet perhaps containing the f.m. tuner and amplifier. So long as the input and output leads are screened there should

Power supply

A circuit for a suitable 24V power supply is shown in Fig. 8 and a schematic for assembly in Fig. 9. As previously mentioned the power supply could be assembled on an extension of the main component board or separately on a small chassis of its own.

When assembly has been completed preliminary tests should be made. Check the h.t. current at the point marked X in the circuit Fig. 1. This should be approximately 2.5mA if the h.t. is 12 to 14V and in this case no alteration to the value of R24

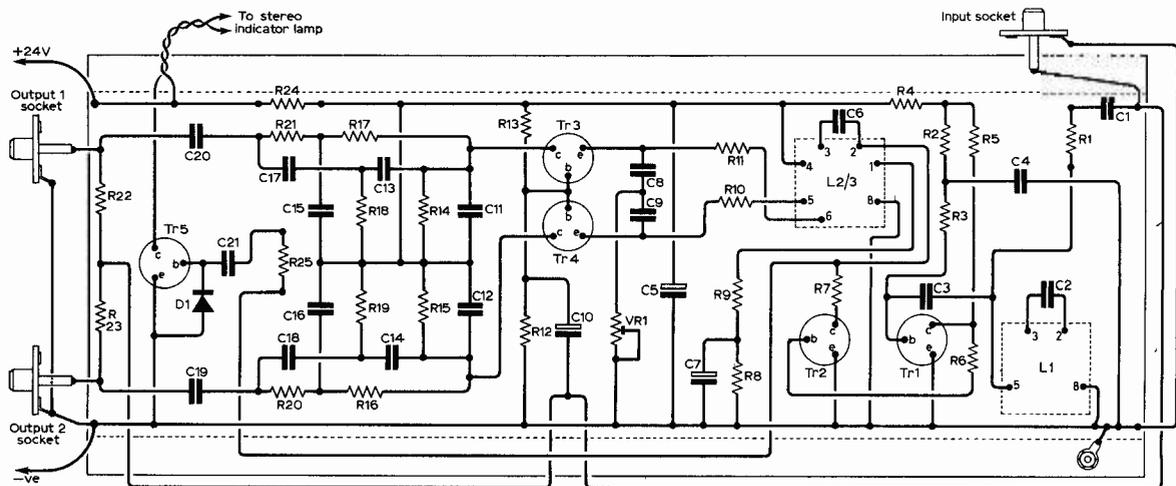


Fig. 5: Wiring and layout of decoder (Mullard Coils).

(4.7k Ω) should be necessary. If an audio generator capable of providing a sine-wave output of approximately 50mV at 19kHz is available, a preliminary tuning check on L1 and L2/3 can be carried out. Couple the generator to the input of the decoder and on tuning the coils with the integral tuning slugs, it should be possible to light the stereo indicator lamp. If an r.m.s. reading valve or transistor voltmeter is available further checks can be made as follows. With approximately 50mV of 19kHz signal at the input of the decoder the r.m.s. voltage of the 38kHz signal between the junction of R7 and L2 and earth should be around 4V. The signal at either side of L3 to earth should be approximately 400mV. If an oscilloscope is available examination of the waveforms at the input and at the junction of R7 and L2 should show whether or not the 38kHz signal is being developed.

★ components list

Resistors:

R1 22k Ω	R10 1k Ω	R19 1.8k Ω
R2 10k Ω	R11 1k Ω	R20 18k Ω
R3 10k Ω	R12 56k Ω	R21 18k Ω
R4 10k Ω	R13 100k Ω	R22 150k Ω
R5 220 Ω	R14 12k Ω	R23 150k Ω
R6 4.7k Ω	R15 12k Ω	R24 4.7k Ω
R7 100 Ω	R16 1.8k Ω	R25 15k
R8 3.9k Ω	R17 1.8k Ω	
R9 1k Ω	R18 1.8k Ω	

Potentiometer:

VR1 1k Ω

Capacitors:

C1 0.01 μ F	C12 0.005 μ F
C2 470pF (s.m.)	C13 0.002 μ F
C3 0.1 μ F	C14 0.002 μ F
C4 0.01 μ F	C15 0.002 μ F
C5 10 μ F Elec. 25V	C16 0.002 μ F
C6 470pF (s.m.)	C17 220pF (s.m.)
C7 10 μ F Elec. 25V	C18 220pF (s.m.)
C8 0.005 μ F	C19 0.1 μ F
C9 0.005 μ F	C20 0.1 μ F
C10 10 μ F Elec. 25V	C21 0.01 μ F
C11 0.005 μ F	

Transistors:

Tr1	Mullard BC108
Tr2	
Tr3	
Tr4	Mullard BC107
Tr5	

Diode:

D1 Mullard OA91

Coils:

- L1 19kHz—Henry's Radio or Mullard WF2949—Gurneys Radio
- L2 38kHz—Henry's Radio or Mullard WF2951—Gurneys Radio

Miscellaneous:

Indicator lamp 24V 20/30mA; 3 single phono sockets; perforated s.r.b.p. assembly board; $\frac{1}{2} \times \frac{1}{2}$ aluminium angle etc.

Power supply:

Transformer T1 (Henry's Radio CT1) Pri 230V with tapped secondary for 15 to 18V.
 Rectifier MR1 Contact cooled type 1H3
 Capacitor C1 Elec. 2500 μ F 30V working

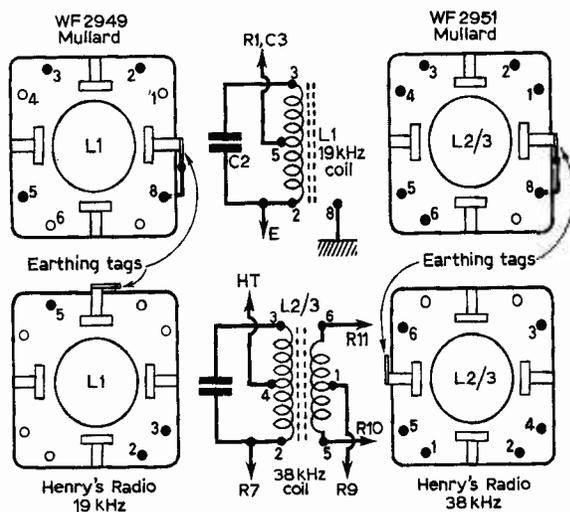


Fig. 6: Outlines and connections of available coils.

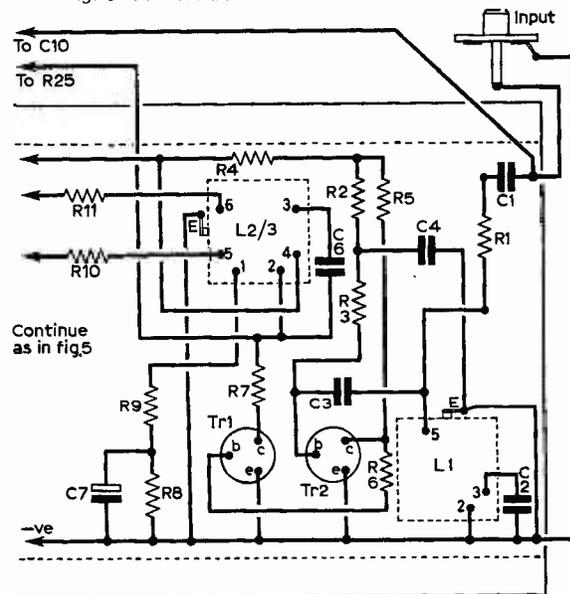


Fig. 7: Coil wiring for Henry's Radio decoder coils.

Coupling to an F.M. tuner output

The input impedance of the decoder is approximately 15k Ω and it may be fed directly from a transistor discriminator capable of providing a loaded output with a peak-to-peak amplitude of approximately 750mV. The decoder may also be fed from a valve discriminator in which case the output will probably have to be attenuated by a series resistor and shunt capacitor. This arrangement not only provides the correct input level at all multiplex frequencies but also reduces the discriminator loading to an acceptable value. The series resistor may be between 3.3k Ω and 33k Ω and the capacitor around 300pF. As an example, a resistor of 15k Ω shunted by 300pF was found just about right when the decoder was operated from a Heathkit (valve) f.m. tuner.

The actual point of signal take off from the tuner

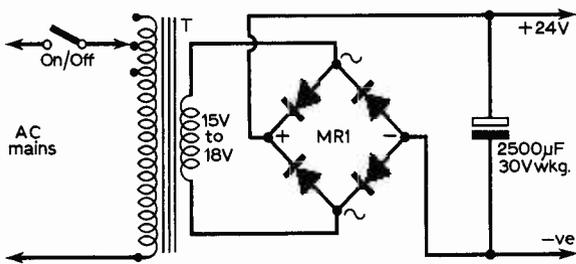


Fig. 8: Circuit of the power supply.

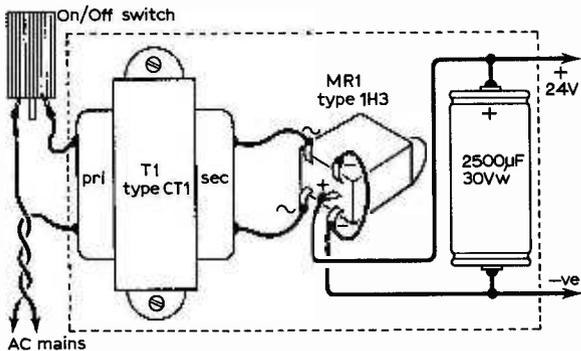


Fig. 9: Power supply assembly details.

is best made directly at the output from the discriminator circuit, i.e., before the de-emphasis network which should be disconnected. The circuit of Fig. 10 is the discriminator of a Heathkit tuner used for subjective testing of the decoder and is typical of those employed in f.m. tuners using valves. The circuit of Fig. 11 shows the discriminator of a transistorised tuner and again is typical of those at present in use.

Alignment of the decoder

For initial alignment any stereo transmission can be used and the procedure is as follows. Connect a potentiometer of at least 50kΩ across the discriminator output and connect the decoder input to the slider of the potentiometer which should now be set to maximum value. Tune the receiver to a stereo broadcast (Radio 3) and carefully and slowly adjust the 19kHz and 38kHz coil slugs for maximum brightness of the stereo indicator lamp. (The preliminary test with an audio-signal generator mentioned earlier should have produced the same result, i.e., maximum brilliance of the indicator lamp.) Next adjust the potentiometer until the lamp just glows and then re-set the coil slugs again to produce maximum brightness. Repeat this procedure until any further adjustment of the slugs produces no further increase in brightness. The two coils are now reasonably well aligned. should the slugs fail to tune the coils sharply at approximately their mid-position of travel it may be necessary to alter the value of C2 and/or C6, as the case may be, to 390pF.

When this alignment procedure has been completed disconnect the potentiometer, re-connect the decoder to the discriminator output and adjust the pre-set control VR1 (1kΩ) to its mid-position, i.e., slider halfway round. The decoder should now give a reasonable degree of separation but should now be finally aligned with the help of the BBC test tone

transmissions which are transmitted every Wednesday and Saturday at 11.30 p.m. (2330 hrs.) on Radio 3 v.h.f./f.m. Full details of the various tests can be obtained free by writing to the BBC Engineering Information Department, Broadcasting House, London, W1A 1AA. Ask for: *Information Sheet No. 1605(2) May 1969 Stereophonic Broadcasting, Test Tone Transmission.*

The test tone transmissions will facilitate identification of the left- and right-hand channels which should be done with the decoder output connected to the stereo amplifier. Now, when the left-hand channel only is being transmitted disconnect the left-hand amplifier channel and adjust the 38kHz tuning slug very slowly **anti-clockwise** (as viewed from the top of the coil) until the output from the right-hand loudspeaker is at minimum. Anti-clockwise rotation of the slug is necessary because a false minimum will be obtained with clockwise rotation.

Next re-connect the left-hand amplifier channel and when the right-hand channel only is being transmitted disconnect the right-hand amplifier channel and adjust the preset (VR1) to produce minimum output from the left-hand loudspeaker. Reconnect the right-hand amplifier for normal stereo and note that the stereo indicator light will have been on as during any stereo transmission. It does not glow during monophonic transmission.

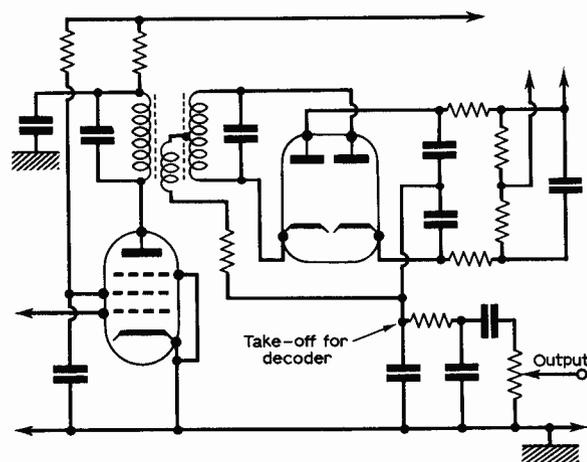


Fig. 10: Typical discriminator output (valved tuners).

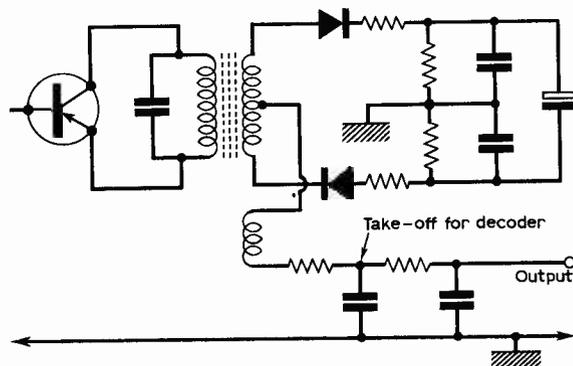


Fig. 11: Typical discriminator output (transistorised tuners).

Performance

The decoder, exactly as per the circuit in Fig. 1, was tested with both valve and transistor f.m. tuners. It was aligned as described above on BBC transmissions and by means of special laboratory stereo test equipment. The performance was quite in accordance with the Mullard specification. Channel separation is around 30dB and the decoder has a good signal-to-noise performance. It is worth noting however, that as the signal-to-noise ratio of a stereo broadcast is slightly lower than that of a monophonic broadcast a good f.m. aerial should be used to maintain the best reception signal-to-noise level. The average audio signal output per channel is around 400 to 500mV and should be more than sufficient for the "tuner" input on stereo amplifiers. The impedance of the amplifier inputs should preferably be not less than 50k Ω .

The following BBC Engineering Information Sheets may also be of interest to those contemplating stereo broadcast reception: *Information Sheet 1603 (6) April, 1969—Stereophonic Broadcasting. Information Sheet 1102(4) May, 1969—VHF Radio Receiving Aerials. Stereo Q and A*—This leaflet deals generally with stereo broadcast reception and can be obtained, as the other leaflets, free of charge from the BBC Engineering Information Department at the address previously given. ■

PRACTICAL TELEVISION *in the DECEMBER issue*

★ LINEAR TIMEBASES

Generating a linear scanning waveform is not simple. The basic waveform produced by the charge or discharge of a capacitor is exponential. A number of intriguing circuits have been devised at various times to overcome this basic deficiency and in the December issue we shall start to examine timebase circuits such as the bootstrap, Miller, transitron, phantatron and sanatron.

★ TEST EQUIPMENT LIMITATIONS

A meter never lies—but do you know how to interpret readings correctly? The basic limitations of commonly used test equipment are explained to enable you to avoid the pitfalls caused by misunderstood readings.

★ TV FILTERING CIRCUITS

Filters are found throughout television circuits, in the power supplies, i.f. sections, a.g.c. feeds and so on. This aspect of television receiver circuitry is highlighted with explanations of how filters act and the different types used, including those found in the chrominance sections of colour receivers.

★ SERVICING THE THORN 1400 CHASSIS

The Thorn/BRC 1400 chassis has been used in a very large number of models from 1967 to the present time. L. Lawry-Johns takes a look at this chassis and the common faults associated with it.

**PLUS ALL THE REGULAR FEATURES
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NOVEMBER 21st

THE MW COLUMN

CONDITIONS on the medium waves have been good throughout the summer in spite of occasional fadeouts. Johannesburg 1286 was logged on the 22nd June by Glyn Morgan of Tredegar. A good effort Glyn, not many of us have heard this one. Latin American reception was excellent in June and July. Brazilians such as PRA3 860, PRF4 940, PRE8 980 all in Rio de Janeiro and PRB9 1000, PRG9 1100 in Sao Paulo were particularly prominent just before sunrise. Reception of the West Coast of the United States came on 1st September at 0431 hrs. GMT when the writer logged KOMO 1000 in Seattle. The following morning KFBK 1530 Sacramento, California was heard as a background to WCKY by a DXer in Cumberland.

Ramadan starts on 11th November this year. During this four week period many radio stations in the Arab world remain on the air all night, providing the DXer with the opportunity to log countries that otherwise would rarely be heard. Among the more prominent signals are Morocco on 593 and 837 (Oujda), 611 (Sebaa Aïoun), 935 (Agadir), 1115 and 1232 (Tangier); Algeria with 529 (Constantine), 548 (Oran), 890 and 980 (Algiers); Tunisia on 629 and 962 (Tunis); Egypt with 557 and 773 (Cairo), 620 (Batra). More difficult countries are Libya 674 (Benghazi), 1052 (Tripoli); Saudi Arabia 588 and 647 (Riyadh), 602 and 723 (Jeddah); Jordan 800 (Amman); Syria 566, 665 and 785 (Damascus), 746 (Aleppo); Lebanon 836 (Beirut); Iraq 760 and 908 (Baghdad); Kuwait 1345; Iran 777 (Zahadan), 1390 (Ahwaz). The late evening onwards is the time to look for these stations.

It is now generally agreed that the sunspot maximum has been passed, so we can look forward to a steady improvement on the medium waves possibly with some DX from the Far East. There are two periods of the day for FE reception in the UK. The first is in the afternoon in winter, an hour or so before sunset. Stations to look for include the *Voice of America* stations in Okinawa on 1178kHz and in the Philippines on 920 (Malolos) and 1140 (Poro). The programmes from these stations are mainly in Far East languages but station identification is usually in English on the hour and half-hour. Okinawa can be heard behind Horby Sweden when conditions are good, sometimes with news in English. The second period occurs after midnight when *All India Radio* is often heard on 1070kHz (Rajkot). Others to look for are Jullender 710, Lucknow 910, Delhi 1020, Bikanar 1330. *A.I.R.* Rajkot has a news bulletin in English at 0110 hrs. GMT which helps with identification. Do not be misled if you hear Indian music on 760kHz, it will be from ZFY in Guyana. There is a large Indian population in this South American country and *Radio Demerara* carries special programmes for them.

The new BBC relay station in Masirah Island has been heard on 1410kHz with sign off at 2115 hrs. GMT. This station is a replacement for Perim Island which was part of the Aden Protectorate. Masirah relays the BBC World Service.

CHARLES MOLLOY

Useful Tips

Having read the article in the October issue of PRACTICAL WIRELESS, "Printed Circuit Design", I would like to point out two labour-saving tips.

First of all, having established the final design this can indeed be transferred to the copper laminate board by means of carbon paper, but I have found from practical experience that Sello-tape masking can be omitted. Provided one has a fairly steady hand the outline of the design can be painted with a small paint brush using nail varnish. After etching, nail varnish remover can be used. Secondly, I am doubtful whether the best solution to feedback path problems really is a link wire. For v.h.f. work, for instance, the mechanical nature (and capacitive effect) of such a dodge could result in instability. Better to puzzle the link out in the design and remember the copper laminate path need only be, say, $\frac{1}{4}$ in. wide. This is probably narrow enough to pass between two adjacent paths.—**D. M. Aldridge** (Co. Durham).

When is a dB not a dB?

Mr. Mitchell made some valid points, "Ex-Meter" October PRACTICAL WIRELESS, but the actual situation is even worse. The idea of using an S scale for signal reports, stands or falls on using a standard number of dB's per S point. This is not done in practice. "Home-brew" apart, manufacturers use various ratios for their meter calibration, some use 3dB per point, others use 6dB's per point, while the "cheap" receivers use almost anything. In such circumstances, S reports can be meaningless for any real useful purpose. For example, a station requires a report on an aerial's efficiency, two other stations reply. One says "S9 here O.M.", the second says "S6 here". O.K. so far, but! the first station's meter is calibrated at 3dB per point, while the second is 6dB per point. So we have the position where the "S9" is actually 27dB, while the "S6" is 36dB. What a hopeless situation and of harm to the experimenting station's

efforts. However, a meter can be of great help when used purely as a "comparative indicator" during experiments. If the meter is set to mid-scale (whatever type of calibration is used) on the signal any change in level can be observed and reported as a *percentage* of the original reading. A much more helpful report than "slavish" S reports. Decremental modulation and comparison between the side-bands on a.m. is observable, plus other effects, using a meter. So if one wishes to be of help, do use a meter, but allow for its drawbacks in practice, the average S meter is only useful for comparative reports and nothing more.—**M. J. Shepherd** (Essex).

Beware!!

Regular readers of your magazine will certainly be wary of purchasing semiconductors "on the cheap" if good results are expected, but there would appear to be no guarantee of quality even when full prices are paid to some well-known suppliers. On several occasions I have dismissed the odd "dud" when only a couple of shillings has been involved, but I have recently come unstuck to the tune of nearly £3 and am fast losing confidence in ordering semiconductors by post. In this instance, the semiconductors involved were some fairly expensive power transistors for use in a well-known Hi-fi audio amplifier circuit. They have a trade-mark with which I was not familiar, and were found to have most undesirable characteristics in use. Each transistor, for instance, had a very high value of I_{ceo} of the order of hundreds of milliamps with only low V_{ce} , so what with the live open-circuit the core-temperature rose to very high values. On replacing these transistors with others bearing a well-known trade-mark, the circuit functioned perfectly. The supplier disclaimed liability, stating that as far as he was concerned, the transistors were "to spec." Which spec., though? I have therefore paid out nearly £3 for some TO3, can electric fires—if this had been all that I

required I could have searched for a hefty valve from the junk-box!

Manufacturers and distributors naturally cannot supply small quantities to the constructor, and the local shop cannot be expected to stock every obscure semiconductor, but how can the constructor obtain semiconductors through the post with confidence? The only answer would seem to be to persuade reputable suppliers to advertise the manufacturer's name against each semiconductor, as is indeed already done by some suppliers, so that the constructor knows exactly what device he can expect to receive.—**D. J. Farman**, G3TWZ (Middlesex).

[I agree with you that the subject you mention could be aired.

With regard to particular cases, I would like you to understand that should you have this sort of trouble with the advertisers of PRACTICAL WIRELESS we are always ready to take up the matter on behalf of a reader, providing that we have full details fairly quickly. In this way, we have been able to obtain satisfaction in a number of instances where a reader has had a poor deal from the advertisers. Perhaps you would bear this in mind for the future.—Editor]

PSST! WANNA BUY PRACTICAL WIRELESS?

We received a letter recently from F. Laverty, BRS 23419, enclosing a cutting from his local paper the *Luton, Beds. Saturday Telegraph*. It read: "The scene: One of those little shops that sell lots of girlie magazines, in a Luton side-street. It's fairly filled with goggle-eyed males.

Enter a chap who walks up and murmurs something to the proprietor.

The proprietor draws himself up to his full height and says firmly—and loudly—"We don't sell THAT sort of book here, sir!"

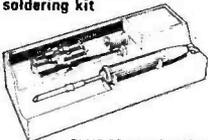
Exit rather abashed gent, while the other customers look at each other wondering what exotic sins they might be missing.

The magazine he asked for? PRACTICAL WIRELESS."

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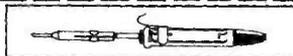


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0B2 5/9	6P8G 1/9	12AV6 5/8	150C2 20/9	EAS0 12/6	EL81 8/9	PC97 8/6	UAF42 9/6	W63 10/8	ASV28 6/6	OA9 2/6
0C3 4/8	6P8M 1/9	12AV7 5/8	301 20/9	EAT6 13/9	EL83 6/9	PC90 8/3	UB41 6/6	W76 5/9	ASV29 10/9	OA10 8/6
1A3 4/8	6P12 3/3	12AX7 4/8	302 16/6	EABC80 6/9	EL84 4/6	PC84 6/9	UBC41 7/9	W77 2/6	BI181 10/9	OA47 2/9
1A5 5/9	6P13 3/6	12AY7 9/8	303 15/9	EAC9 3/9	EL85 7/6	PC85 6/9	UBC81 7/9	W81M 6/9	BA102 9/9	OA70 3/9
14GT7 7/9	6P15 9/6	12BA6 5/9	305 16/6	EAF42 8/9	EL86 8/9	PC88 9/9	UBF80 5/9	W101 88/2	BA115 2/8	OA73 3/9
1C1 5/6	6P18 7/6	12BE6 5/9	306 13/9	EB34 7/6	EL91 8/6	PC89 9/9	UBF99 5/9	W107 7/9	BA116 9/9	OA79 1/9
1C2 7/9	6P23 13/3	12BH7 6/9	807 11/9	EB41 4/6	EL95 5/6	PC189 9/9	UBL21 9/9	W729 10/9	BA129 2/6	OA81 1/9
1C3 7/9	6P24 11/9	12EL 17/9	956 2/9	EB91 2/3	EM71 14/9	PCF86 6/6	UC24 5/6	X24 16/6	BC10 5/9	OA85 1/6
1C5 4/9	6P25 11/9	12F5GT 2/8	1821 10/9	EBC41 8/6	EM80 5/9	PCF89 6/9	UC28 8/9	X41 10/9	BC210 5/9	OA86 4/6
1D3 6/9	6P28 10/6	12J7GT 4/8	6763 10/9	EBC51 5/9	EM81 9/9	PCF84 8/9	UC35 8/9	X61 5/6	BCX12 5/9	OA89 2/6
1D6 3/9	6P32 3/9	12K3 10/9	6060 5/8	EBC90 4/6	EM84 6/9	PCF86 9/9	UCF80 3/8	X63 5/6	BCY33 5/9	OA91 1/9
1FP1 9/9	6S6G 2/6	12K7GT 5/9	7193 10/9	EBC91 5/6	EM85 11/9	PCF80013/6	UCH21 9/9	X64 12/6	BCY34 4/6	OA182 2/9
1FP9 3/6	6H6GT 1/9	12Q7GT 4/6	7475 4/9	EBF80 4/6	EM87 7/9	PCF801 3/6	UCH42 9/9	X65 5/6	BCY38 5/9	OA200 1/9
1G6 6/9	6J5G 3/9	12SA7GT9/8	A1834 20/9	EBF83 8/9	EY1 6/9	PCF802 9/9	UCH81 6/9	X66 7/6	BCY39 4/6	OA202 2/9
1H5GT 7/9	6J5GT 4/9	12SC7 4/9	AC2P2	EBF89 6/9	EY81 7/9	PCF805 8/9	UCL82 7/9	X101 28/1	BCZ11 8/6	OA210 3/6
1L4 2/6	6J6 3/9	12SG7 3/9	AC2P1	EBL21 11/9	EY83 8/6	PCF80611/6	UC188 10/9	X109 28/6	BC107 4/9	OA211 13/8
1LD5 5/6	6J7G 4/9	12SH7 3/9	AC2P1N	EC53 5/9	EY86 6/9	PCF80811/6	UCF84 8/9	X119 8/6	BC108 3/6	OA22012/8
1LNG6 7/9	6K7G 6/8	12SK7 4/9	AC6P4N	EC64 6/9	EY86 6/9	PCF81 9/9	UCF42 9/9	X179 5/6	BC113 5/6	OA221 10/8
1PI 7/9	6K7GT 4/8	12RK7 4/8	AC6P4N (5)	EC70 4/9	EY87 6/9	PCF82 7/9	UCF80 6/9	Z63 4/9	BC115 3/9	OA2202 9/9
1PI0 4/9	6K8G 3/9	12RGT7GT7/8	AC6P4N (5)	EC86 12/6	EY88 7/6	PCF83 9/9	UCF85 6/9	Z77 8/3	BC116 5/9	OA2203 9/9
1PI1 5/6	6K8GT 7/9	13D1 5/9	AC/CPEN (7)	EC88 12/9	EY91 3/9	PCF84 7/6	UCF86 9/9	Z152 8/6	BC118 4/6	OA2204 9/9
1R5 5/6	6L1 19/6	13D3 9/9	AC/CPEN (7)	EC92 6/8	EZ35 5/6	PCF85 8/3	UCF89 6/3	Z329 13/6	BC119 6/9	OA2205 9/9
1R4 4/9	6L6GT 7/9	14H7 9/6	AC/HTP11/6	EC93 15/6	EZ40 7/6	PCF86 15/6	UCF92 6/6	Z49 13/3	BCF50 4/6	OA2206 9/9
1R3 3/9	6L7 18/6	14S7 15/6	AC/HTP11/6	EC93 28/1	EZ40 7/6	PCF88 15/6	UL46 12/6	Z729 6/6	BFY51 4/6	OA2207 10/8
1T4 5/9	6L15 5/9	18 18/6	AC/CPY210/6	EC94 29/6	EZ41 4/6	PCF80015/6	UM80 6/6	Z749 13/3	BFY52 4/6	OA2210 7/9
1U4 2/9	6L19 19/6	19H1 40/9	ARF3 7/9	EC94 29/6	EZ41 4/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY54 5/6	OA2213 7/9
1U5 6/9	6LD20 8/6	20D1 13/9	AT21 2/8	EC94 29/6	EZ90 3/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY59 5/6	OA222418/8
2A7 12/6	6N7GT 6/6	20D1 13/9	AZ1 8/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY63 4/6	OC23 28/9
2D13L 7/9	6P1 12/9	20D1 13/9	AZ1 8/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY64 5/6	OC25 5/9
2D21 6/9	6P25 12/9	20P1 17/6	B36 4/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY65 5/6	OC25 5/9
2X2 4/9	6P26 12/9	20P1 17/6	B36 4/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY66 5/6	OC25 5/9
3A4 3/6	6P28 25/9	20P3 18/6	B36 4/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY67 5/6	OC25 5/9
3A5 10/6	6Q7G 6/9	20P4 18/6	CL503 10/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY68 5/6	OC25 5/9
3B7 5/9	6Q7GT 8/6	20P5 18/6	CL503 10/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY69 5/6	OC25 5/9
3D6 3/9	6R7G 7/9	25L6G 5/6	CL38 18/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY70 5/6	OC25 5/9
3Q4 6/8	6R7M 11/9	25Y6 6/9	CV6 10/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY71 5/6	OC25 5/9
3Q5GT 6/9	6S4GT 7/9	25Y6 6/9	CV6 10/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY72 5/6	OC25 5/9
3R4 4/9	6S4 7/9	25Z4G 9/9	CV271 12/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY73 5/6	OC25 5/9
3V4 5/6	6S4GT 6/6	25Z5 7/9	CV428 19/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY74 5/6	OC25 5/9
4D1 3/9	6S7G 6/9	25Z6G 8/6	EY1 10/4	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY75 5/6	OC25 5/9
5R4G 8/9	6H7 3/9	30C1 8/6	CV1C 10/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY76 5/6	OC25 5/9
5U4G 4/9	6H7 3/9	30C1 8/6	CV1C 10/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY77 5/6	OC25 5/9
5U4G 4/9	6H7 3/9	30C1 8/6	CV1C 10/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY78 5/6	OC25 5/9
6A5 3/6	6V6GT 6/9	30C1 8/6	CV1C 10/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY79 5/6	OC25 5/9
6A7 3/6	6X 3/6	30L15 12/6	DD4 10/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY80 5/6	OC25 5/9
6AK5 8/6	6X5GT 5/9	30L17 12/6	DF33 7/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY81 5/6	OC25 5/9
6AK6 6/9	6Y6G 8/9	30P4 12/6	DF72 30/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY82 5/6	OC25 5/9
6AK8 6/9	6Y7G 12/6	30P4MMR	DF96 8/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY83 5/6	OC25 5/9
6AL5 2/3	7A 12/6	30P12 13/9	DF97 10/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY84 5/6	OC25 5/9
6AM5 2/6	7AN7 6/9	30P19 12/6	DH30 15/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY85 5/6	OC25 5/9
6AM6 3/6	7B6 10/9	30P19 12/6	DH30 15/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY86 5/6	OC25 5/9
6AQ5 4/9	7B7 7/9	30P15 15/6	DH63 6/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY87 5/6	OC25 5/9
6AR6 8/9	7C6 6/9	30P13 13/9	DH76 4/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY88 5/6	OC25 5/9
6AT6 4/9	7D6 12/6	30P14 12/6	DH76 4/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY89 5/6	OC25 5/9
6B7 4/9	7D7 12/6	30P15 15/6	DH81 10/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY90 5/6	OC25 5/9
6AV6 5/6	7H6 5/6	35A3 9/9	DH101 25/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY91 5/6	OC25 5/9
6BE6 2/6	7R7 12/6	35A5 15/6	DH107	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY92 5/6	OC25 5/9
6BA9 4/6	7V7 5/9	35D5 12/6		EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY93 5/6	OC25 5/9
6BE6 4/6	7Y4 6/6	35LGT 8/9		EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY94 5/6	OC25 5/9
6CG6 20/8	7Z4 4/6	35W4 4/6		EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY95 5/6	OC25 5/9
6BEH 7/6	8P3W6	38L 10/9	DK91 5/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY96 5/6	OC25 5/9
6BJ6 6/9	9D7 9/9	35Z4GT 4/9	DK92 7/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY97 5/6	OC25 5/9
6BQ5 4/6	10C1 12/6	35ZGT 6/9	DK96 7/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY98 5/6	OC25 5/9
6BQ7A 7/9	10C2 10/9	42 10/9	DL33 6/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY99 5/6	OC25 5/9
6BR7 8/6	10D1 8/9	42 10/9	DL35 4/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY00 5/6	OC25 5/9
6BR8 8/9	10D2 14/7	50B5 6/9	DL37 15/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY01 5/6	OC25 5/9
6BR7 12/6	10P1 15/6	50C5 8/3	DL75 30/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY02 5/6	OC25 5/9
6BW6 12/6	10F9 9/9	50CDG6C41/9	DL92 4/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY03 5/6	OC25 5/9
6BW7 11/9	10F18 7/6	50LGT 9/9	DL94 5/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY04 5/6	OC25 5/9
6BX6 4/6	10LD3 7/6	52K 14/6	DL96 7/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY05 5/6	OC25 5/9
6BZ6 6/9	10L11 11/9	58K 14/6	DL97 10/9	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY06 5/6	OC25 5/9
6CGT 6/9	10P14 12/6	7 6/6	DM71 7/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY07 5/6	OC25 5/9
6CE 3/9	10P14 12/6	7 6/6	DM71 7/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY08 5/6	OC25 5/9
6C9 11/9	10P18 6/6	78 4/9	DW43508/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY09 5/6	OC25 5/9
6CD6G 19/6	12A6 3/6	85A2 8/6	DW43508/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY10 5/6	OC25 5/9
6CH6 6/9	12AC6 7/6	90AG 67/6	DY86 5/6	EC98 2/8	FC4 12/6	PCF8015/6	UM80 6/6	Z759 45/9	BFY11 5/6	OC25 5/9
6CH7 6/9	12AD6 6/9	90AV 67/6	DY86 5/6	EC98 2						

SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times in GMT • Frequencies in kHz

THE BROADCAST BANDS

Malcolm Connah

THE beginner to the hobby of short wave listening is possibly not aware of all the interesting and useful information that he can obtain to help him to progress in the hobby. The information which follows is intended to help him gain experience but should also prove useful to the experienced DXer.

Radio Nederland has a DX Information Service which publishes many data sheets and offers courses on practically every aspect of the hobby. Although the service is free of charge I usually include an IRC and/or a reception report to promote friendly relations with the station. For further information write to: DX Information Service, c/o Radio Nederland, P.O. Box 222, Hilversum, Holland.

The World Radio-Television Handbook Co. Ltd. of Sundvej 6, 2900 Hellerup, Denmark publishes several books which are of interest to the SWL. The first of these is the *World Radio-Television Handbook (WRTH)*, this indispensable volume contains full details of every radio and television station in the world. Each entry gives details of the equipment used by the station, a full programme schedule and the address to which reports should be sent. Everyone with an interest in short wave radio should own a copy of this book.

The same company also publishes *How to Listen to the World* which, like *WRTH*, appears yearly. The recently published 1969/70 edition contains a wealth of information for both the beginner and the experienced listener. The following selection of chapter titles should give some indication of the scope of this excellent little book: Physics of the Ionosphere; Interference; Fading; How to Measure Frequencies and Calibrate Receivers; The Crystal Calibrator; How to report to Stations; Tape Recording of Reports; Listening to: Asia and the Pacific, The Far East, Africa, Latin America; Languages in International Radio; Sunspot Information and many other interesting chapters. The book is written by an international team of well-known DXers who each write on their own specialised topics.

Another way of obtaining information and gaining experience in the hobby is by joining one of the established DX clubs. The monthly magazines produced by these clubs will keep you informed on the latest news and enable you to compare your results with those of other SWLs. Most clubs also offer certificates in recognition of various achievements and organise regular competitions for their members. Two of the best-known British based clubs are: The International Short Wave League (ISWL), 60 White Street, Derby, DE3 1HA, and The World DX Club (WDXC), 16 Ena Avenue, Neath, Glamorgan, Wales.

PROPAGATION FORECAST

The predicted smoothed sunspot number for the month of November is 93 (Switzerland Calling) which

leads me to make these predictions of the most suitable megahertz bands for the month: Europe 4MHz; North America 11-25MHz; South America 15-25MHz; Africa 9-17MHz; Asia 9 and 11MHz and Oceania 9 and 11 MHz.

AFRICA

United Arab Republic: The European Service of *Radio Cairo* has dropped the two usual frequencies of 9475 and 12005 and is now using 9740. The times of the broadcasts are unaltered, German can be heard at 2030 and English at 2145.

ASIA

Ceylon: The Commercial Service of *Radio Ceylon*, which broadcasts in English, has replaced 15230 with 15120 for all its broadcasts. The Home Service now starts fifteen minutes earlier at 0100 on 5020.

Vietnam: A schedule just received from the *Voice of Vietnam* in Hanoi gives these details of the English programmes broadcast by the station. Frequencies used are given as 7380, 7416, 9840, 10224 and 15018. The times of the broadcasts are 0500, 1000, 1300, 1530, 2000 and 2300, 0830 (except Sundays).

EUROPE

Albania: *Radio Tirana* has introduced the following English programmes: 0030 on 49m. and 41m.; 0100 on 42m. and 31m.; 0230 and 0330 on 49m. and 41m.; 1100 on 31m. and 25m.; 0630, 1630, 1830, 2030 and 2200 on 42m. and 31m. No details of exact frequencies have yet been given but the usual frequencies for this station are: 5950, 6200, 7070, 7300, 9370, 9500, 11840 and 11870.

Armenia: A schedule received from Yerevan gives the news that they have forsaken their usual frequencies of 6155, 7185, 7200 and 9540 and are using unspecified frequencies in the 16 and 19 metre bands for the broadcasts to Europe.

Norway: The latest schedule received from *Radio Norway* gives the following details of programmes in English:

Sundays 0800-0830 on 15345, 21655, 21730, 25730, 25900; 1200-1230 on 7240, 17825, 21655, 25730, 25900; 1400-1430 on 17825, 21655, 21730, 25730, 25900; 1600-1630 on 17825, 21655, 21730, 25730, 25900; 1800-1830 on 15345, 21655, 21730, 25730, 25900; 2000-2030 on 15345, 21670, 21655, 21730, 25730; 2200-2230 on 15345, 17795, 17825, 21655.

Mondays 0000-0030 on 11735, 11850, 15345; 0200-0230 on 11735, 11850, 11860; 0400-0430 on 9550, 9645, 15345.

Well, that's the lot for another month except to remind you to send in your reports and suggestions. 73's and good DX until next time.

THE AMATEUR BANDS

David Gibson, G3JDG

ONCE again your scribe, one Hippie Gibson, is putting quill to parchment to keep you all fully informed about everything which hasn't happened during the month. For the first time in many moons, the postbag has had that sparse, undernourished appearance. O.K., so the "Let's all hate Gibbie" month is over, now how about some logs, just to show there's no hard feeling?

There should be no great shortage of DX to listen in to on the h.f. end this month as things are considerably better than the summer. This applies particularly to 20 metres which is almost a 24-hour band these days and carries most of the DX signals.

Down a few kHz on 15, the DX has been quite good with best times to listen from 0600 to 1800. By the time you read this it will in all probability have moved on, so try 0730-1900 or perhaps a little later.

Ten metres should provide something from Oceana, probably some good sigs from VK, although this will be at a price of poor reception from Canada.

Again, as king winter approaches and G3JDG gets his comms out of pawn, the l.f. bands should improve. Don't neglect 40 metres, there's some very good DX about, it just needs a little patience.

Eighty and topband will be improving fast. This could be a good time to have a crack at listening for topband nets. See how many "local" nets you can log and how far they are from you. Mobile stations on topband seem to become quite rare birds during the colder months and many would doubtless appreciate a decent report on their sigs. A good report though, not just the "heard you five and seven, please QSL" type.

Speaking of the winter months, now is the time to think about some constructional projects to keep you all out of mischief during the dark evenings. An a.t.u. (aerial tuner unit) is well worth while. You could look back through all those back issues of P.W. and find something of interest, perhaps a pre-amp or an outboard "S" meter? A grid dip oscillator is an invaluable asset to any s.w.l. or amateur, and circuitry for this has appeared in the magazine from time to time.

For those who are interested purely in logging callsigns and getting a long, long list of countries heard, a good time to listen is during contests. During most contests, the callsign is just about all you get anyway. The VK/ZL Oceana DX contest was a good example. There's nearly always two dates for this type of contest, one for c.w. and one for phone, so you can take your pick. It's nearly always easier to bag the goodies on c.w. so if you can't read Morse, how about learning this winter, then you'll be ready for next year? Incidentally, most radio clubs run Morse sessions and there's always slow c.w. signals on topband put out by RSGB members on a rota basis just for the beginner who wants to learn c.w.

In reply to the many queries about callsigns. You can obtain a list of all the different countries and their callsigns from the RSGB, 35 Doughty Street, London, W.C.1. Just send a 9d. stamp or P.O.

An item of interest to constructors is the TAD 100. This is an IC (integrated circuit) which has the

frequency changer, i.f., detector, and audio all on the one chip. Your scribe is trying to get further details and I'll pass on the gen when it arrives. Incidentally, speaking of ICs, an American company has achieved a packing density of 240,000 components to the square inch on a single chip. Admittedly this is only in the laboratory, but it makes you think doesn't it? Perhaps the time will come when you will send the specifications for your ideal receiver to a manufacturer with a ten bob postal order, and receive per return a one-inch slice with it all on, you'll just have to find a dial!

Passing on to the mail this month. **Jim Baker** (Liverpool) writes to say that there's a new ZL on 80 metres. The callsign is ZL4NM or NH (sri OM ur wrtg nt gud) and he lurks on 3.8kHz plus or minus a few kHz using s.s.b. with an FT100. His name is Pat, and he's a Liverpudlian (licensed readers call "CQ Whack") and he's looking for contacts in the UK. S.W.Ls who want a card should send their own card, together with an s.a.e., to Jim Baker at 86 Max Road, Liverpool, Lancs., L14 4BJ. See if you can hear the ZL first!

Stephen Randall is very nearly 14 years old and has managed to wrap his digits around a Trio 9R-59DE. The antenna is a 110ft. long wire, and 20 produced—CT1WB, DK1CQ, HV3SJ, JX1OM, LA8TM, UL7SG, VK3AXQ, VK3MO, VP8RCF, W4YNX. Stephen lives in Hendon, London.

Normally I don't print lists of G calls heard unless short skip conditions are proving interesting. But when you get up to 2 metres, G calls are not too easy to come by over long distances.

J. Simons (Dudley, Worcs.), has an 8 over 8 antenna, (cor, think of the size of one of those on 20), feeding a homebrew preamp and converter. This supplies the AR88 as a tuneable i.f. from 24-26MHz. On 2, John raised—G15ALP, E17AF, E15BH, G18AYZ/P, GM3TGL/P (at Kirkcudbright), G3KDG (Devon), G3GJY/P, G8BGR/P, G8APV/P, G3TAB/P, G3PXF/P (Westmorland), G3WSC/P, G2JF, GD3VXX, GW3NWR/P, GW3UCB/P, GW3ILO, GW3NUE/P.

Philip Batt (Littleborough, Lancs.), has a PCR3. The antenna is 22ft. bare copper wire on two masts at 15ft., with a 58ft. down lead. Twenty metres produced—CE3FZ, CR6QX, CT1BD, G2MJ, HBØXB, HP1XAJ, HR1KS, K6MHO, K6AFT, K6SA, OA6S, TIIECE, TI2CEF, UG6AW, VK2ATT, VK3AM, VK4CK, VK7CR, VK9FW.

Fifteen proved fruitful for Philip too—CE1EF, EA8EG, FØQR/M, HBØAA, IS1DMN, HL2IX (Korea), JA1BAC, JA2GQF, JA3JMC, JA4SNM, JA5DRJ, JA7GHM, JA8DEL, JH1GJF, KZ4VA, KP4DCR, KR6EX, LU1DAB, MP4BHL, OD5BCV, OHØAS, OX2BBA, PY6TP, TF3SB, VK2RV, VS6AD, VS9MB, W6MSM, YV3KT, ZE3RK, 3V8AA, 4X4AM, 9H1BH, 9M2DQ, 9G1GB.

A few contests and happenings in November which are worth a listen. 3rd November, 2 metre s.s.b. contest; 8th-9th, 40 metre phone contest; 15th-16th, topband contest, go on, have a listen; 29th-30th, CQ world-wide DX contest but it's c.w. only. Start those Morse classes now and you can listen next year!

There are two early ones in December. These are 6th-7th December, CHC international DX contest (c.w.); and 7th, 4 metre contest (c.w.).

All logs to the home QTH please before the 18th of the month. 5 Edward Close, St. Albans Herts.

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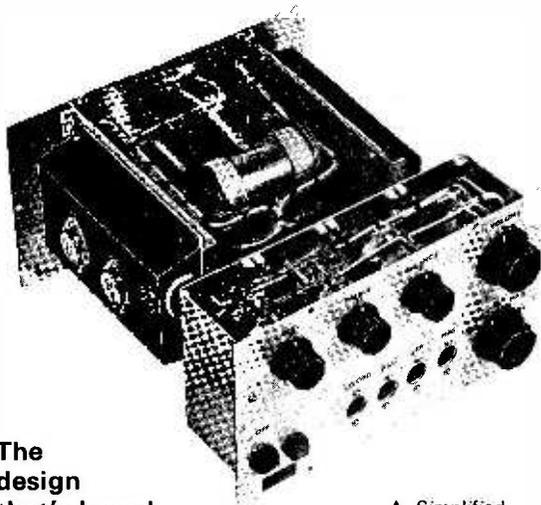
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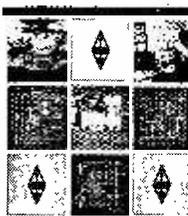
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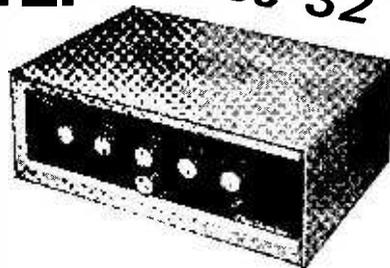
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A PEDAL STEEL GUITAR

Part 2

F.C. JUDD

As mentioned in part 1 the production and assembly of the special roller bridge and pedal mechanism calls for fairly accurate work although apart from the usual metal working tools, the writer used only an electric bench drill. Before embarking on the bridge and pedal mechanism however, all the woodwork, i.e., the making of the console and the guitar body should be completed. The tuning pegs do not have to be made of course and these can be purchased from Cyril Proctor, 180 Town Street, Leeds, Yorks. These are known as single geared pegs and cost £2 for a set of eight but make sure that 4 left-hand and 4 right-hand pegs are ordered. The same firm can also supply the plastic fret board which should be ordered as follows: 25in. scale—24 frets for 8 string guitar and the price is 25s. The special 8 string H.G. magnetic pick-up type 2A with adjustable poles is also available from Cyril Proctor and costs £4 5s.

The raw materials required for the bridge and pedal mechanism are $\frac{1}{2}$ in. thick brass for the lever rollers etc., $\frac{1}{16}$ in. thick mild steel, $\frac{3}{16}$ in. and

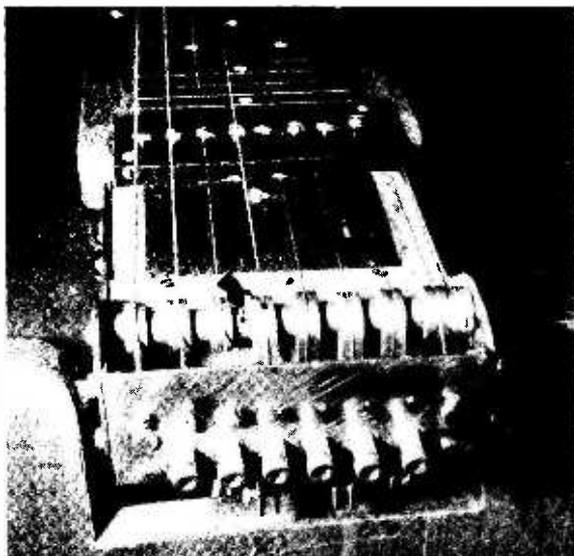
$\frac{1}{4}$ in. diameter mild steel rod, $\frac{1}{4}$ in. diameter silver steel rod and $\frac{1}{4}$ in. and $\frac{1}{2}$ in. square section mild steel tube which is for the tie across the bottom of the console between the left- and right-hand sides and the pedals. This tie-bar also serves as a stop for the foot pedals (see Fig. 6 part 1). The remainder of the materials are the 2BA Allen head screws and the compression springs for the lever roller stops and sundry 4 and 6BA screws and nuts as indicated in the various diagrams.

The Roller Bridge

This consists of a square U-shaped framework which is screwed on to the tail of the guitar body as shown in Fig. 7A (part 1) and in the photograph in this article. It carries the $\frac{1}{4}$ in. diameter spindle on which the circular rollers and lever rollers are mounted together with the spacers. Six "stop" screws have been provided so that lever rollers can be used for strings other than those indicated for the E6th tuning as given in part 1. Strings which run over the circular rollers are secured to the bridge frame at the rear. Strings controlled by the pedals are anchored directly to the lever rollers.

Details for making the bridge frame are given in Figs. 9A, B, C, D and E. Note the small caps which are used to retain the roller spindle in the frame. The six 2BA Allen screws, each 1in. long act as the rear stops for the lever rollers. The compression springs should be about $\frac{3}{8}$ to $\frac{1}{2}$ in. long and are fitted to prevent the screws turning of their own accord. Although only two stop screws are used for the tuning given in part 1 it is worth fitting all six so that either of the strings 7 to 2 could be used with the pedals if required. Before drilling and tapping the holes for these screws secure the $\frac{1}{2}$ in. thick brass block to the rear plate of the bridge frame. The tapped holes go right through this as per Figs. 9D and 9E.

The spindle for the rollers and lever rollers is $\frac{1}{4}$ in. diameter silver steel cut to fit exactly within the frame but flush with the outer surfaces. The spindle is held in by means of the retaining caps as per Fig. 9E. Next come the plain circular rollers which can be made from $\frac{1}{4}$ in. diameter brass rod and cut, drilled and grooved as in Fig. 10B. The



(A): The Roller Bridge.

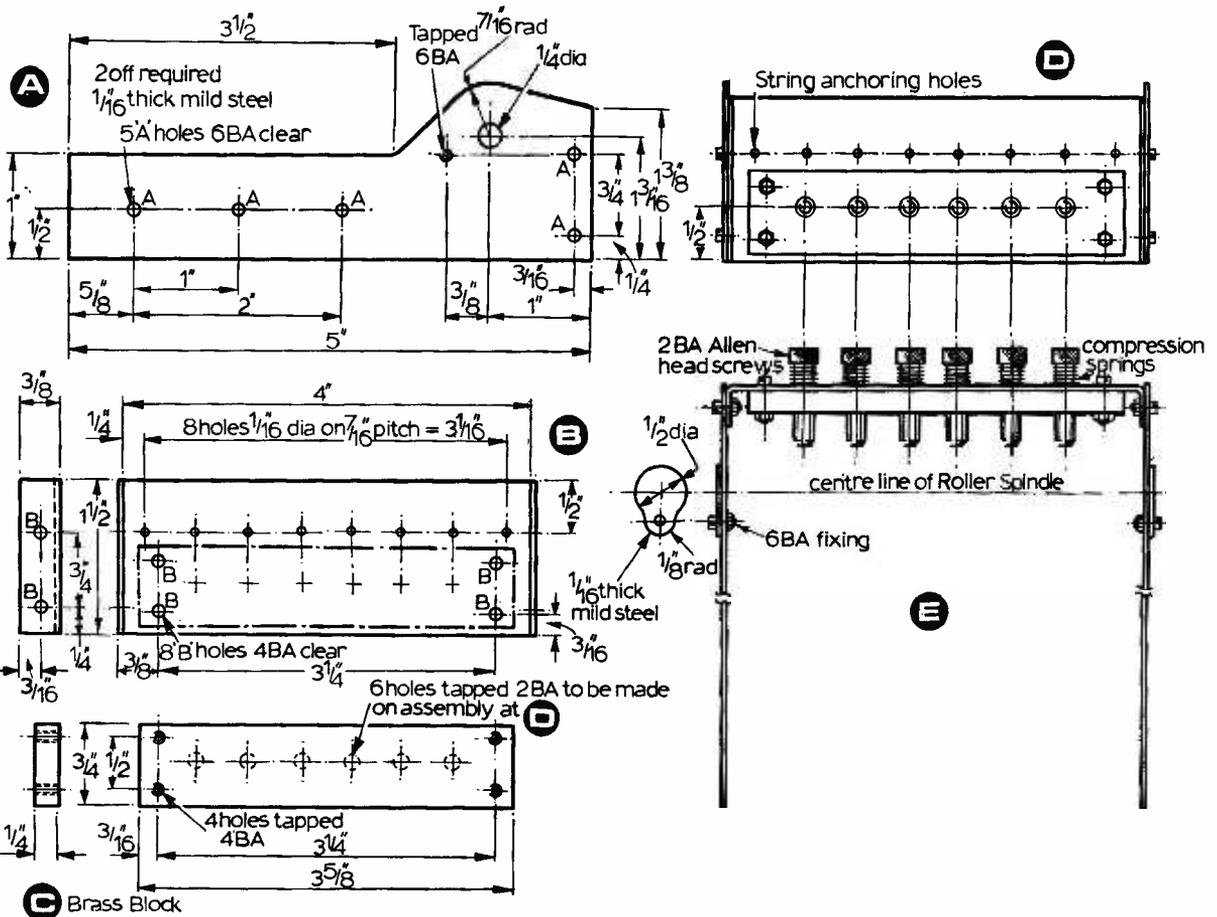
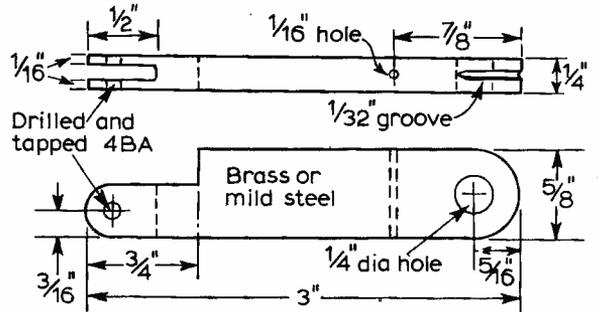
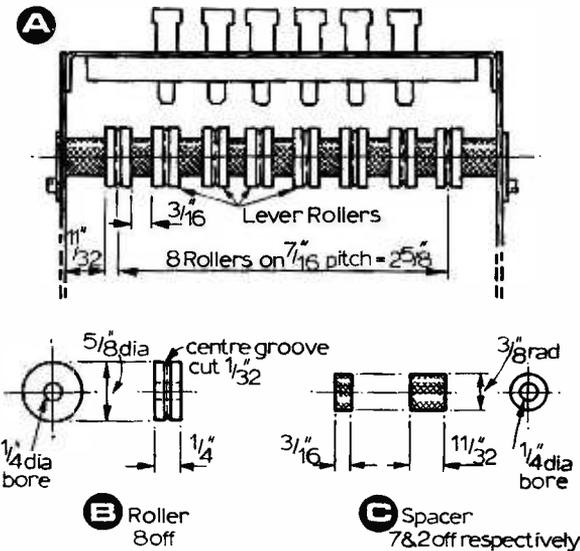


Fig. 9 (above): (A) Side of frame—two required. (B), (C) Tail plate assembly. (D) Holes for the 2BA Allen screws drilled and tapped after brass block is fitted as in (C). (E) Final assembly of the roller bridge frame. Note retaining caps for roller spindle.

Fig. 10 (below): Details of rollers and assembly of rollers and lever rollers in the bridge frame.

Fig. 11 (right): Dimensions for the lever rollers.



spacers are cut from 3/8 in. diameter brass tube with a 1/4 in. diameter inner bore. Details for these and the two end spacers are given in Fig. 10C.

Next come the lever rollers and although only two are required for a two pedal system it is worth making and fitting four as shown for possible future use with an alternative tuning. These are made from 3/8 in. thick brass as shown in Fig. 11. Note that they are grooved around the circular portion of the top to hold the strings in place. The action of these lever rollers and the method of securing the string to the lever is shown in Fig. 12. The stop screws are set so as to allow only sufficient movement of the lever roller to tension or de-tension the string by an amount required to raise or lower its pitch according to the tuning required. The adjustment available with the stop screws should allow the lever enough movement to raise or lower the string pitch by

more than a whole tone. The final adjustment of the stops is of course made in conjunction with the movement of the pedal rods and the pedals.

Readers may by now be wondering why such a complicated mechanism is necessary merely to raise or lower the pitch of a guitar string by a semitone or so. Why not for instance, use a conventional bridge and simply apply pressure to the strings

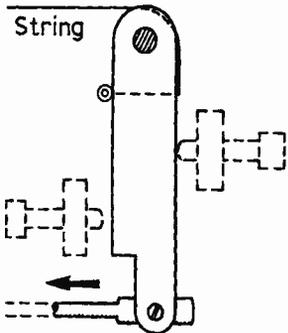


Fig. 12: Lever roller action. Note method of anchoring guitar string.

between the bridge and the tailpiece? This has been tried and rejected for the simple reason that strings continually tensioned and de-tensioned across the edge of a bridge very quickly break. The method described in these articles is basically the same as that developed for commercially-made instruments now on the market and overcomes this problem.

Next comes the making and fitting of the forward stop screw assembly shown in Fig. 13A and which must be fitted underneath the tail end of the guitar as in Fig. 13B and before the roller bridge is fitted. This consists of a piece of $\frac{3}{4}$ in. aluminium angle to which is bolted the $\frac{1}{4}$ in. thick brass block that carries the stop screws. A piece of $\frac{1}{2} \times \frac{1}{2}$ in. aluminium angle is fitted across the top of the tail end of the guitar above the stop screw assembly as in Fig. 13B

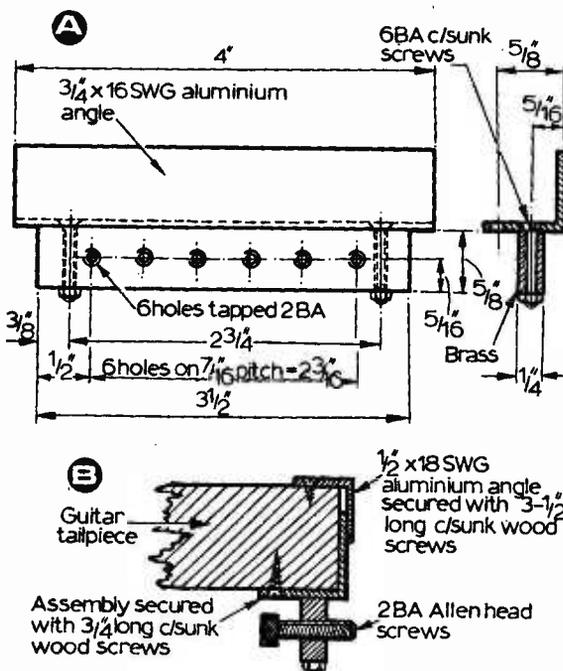


Fig. 13: Details of the forward stop bar fitted beneath the tail end of the guitar body.

and which is also shown in Fig. 7A part 1 and marked "Z". Additional guidance as to the function of the forward stop screw assembly is shown in Fig. 14. It will be seen that the lever rollers come forward to meet the lower stop screws and in the opposite direction to meet the higher rear stop screws. The overall movement of the lever rollers should not be more than one-eighth to three-sixteenths of an inch for a pitch change of a semitone up or down.

The Pedal Mechanism

Schematic diagrams showing the whole mechanism between the lever rollers and the pedals are given in Figs. 2 and 3 of part 1. The mechanism is a system of rods and levers which is shown in greater detail in Fig. 15. The lever assembly is situated underneath the top of the console a little to the left of midway between the two sides. This assembly consists of a mild steel plate on which are mounted

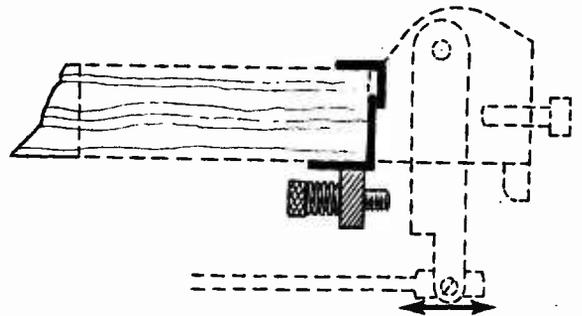


Fig. 14: Position of forward stop bar relative to the bridge frame and lever rollers.

the levers and spindles as shown in Fig. 16A. However, let us return to Fig. 15 for a moment. This shows the de-tensioning system which operates as follows. The $\frac{1}{4}$ in. diameter rod attached to the roller lever is also bolted to the lever marked "A" and a large tension spring is connected between this and the left-hand side of the cabinet via a piece of steel wire (piano wire). The large spring holds the lever roller against the forward stop screw as shown in the diagram, the tension of the spring being sufficient to overcome the normal tuning tension of the guitar string. When the pedal is pressed, lever "B" actuates lever "A" via the connecting spindle which now moves to the right. This allows the lever roller to move over to the rear stop thus *reducing* the pitch to which the guitar string is tuned. The other pedal produces the reverse of this action, i.e., when the lever "D" is actuated by the pedal then lever "C" moves to the left and pulls its lever roller toward a forward stop screw thus *raising* the pitch to which the string is tuned. A side view of the lever assembly is shown in Fig. 17. Note that the levers A, B, C and D as in Figs. 16A and 17 must be bolted directly to the spindles so that no slipping occurs.

The Foot Pedals

The dimensions for the pedals and pedal bearings are given in Figs. 18A, B, C and D. The pedal bar is made from $\frac{1}{2}$ in. square mild steel tube which is

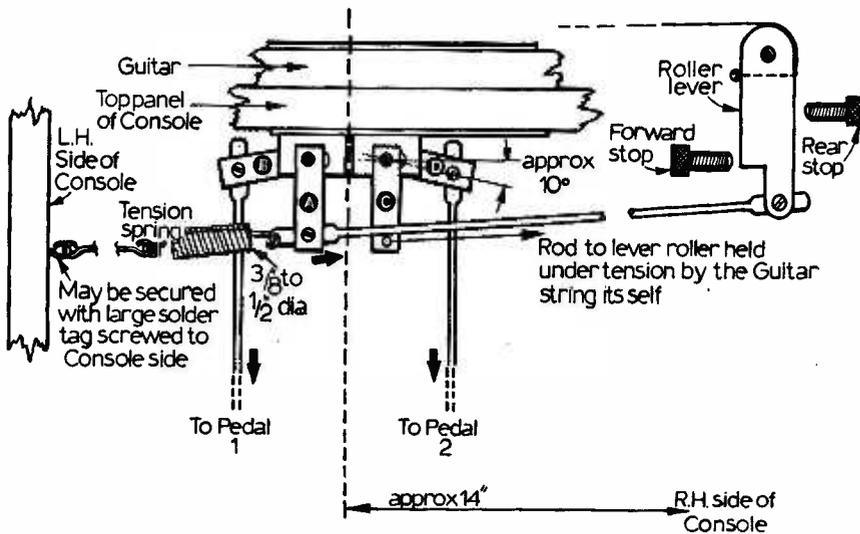


Fig. 15 (above): The action of the lever roller and pedal coupling mechanism situated beneath the top of the consol. Arrows show movement of rods when pedal 1 is pressed. Text explains mechanism.

Fig. 16 (below): Coupling mechanism between lever rollers and pedals.

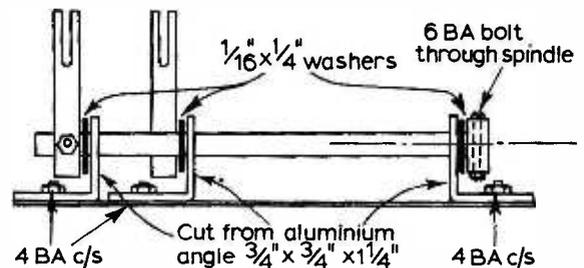
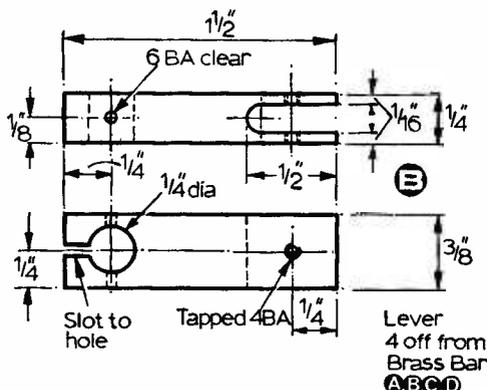
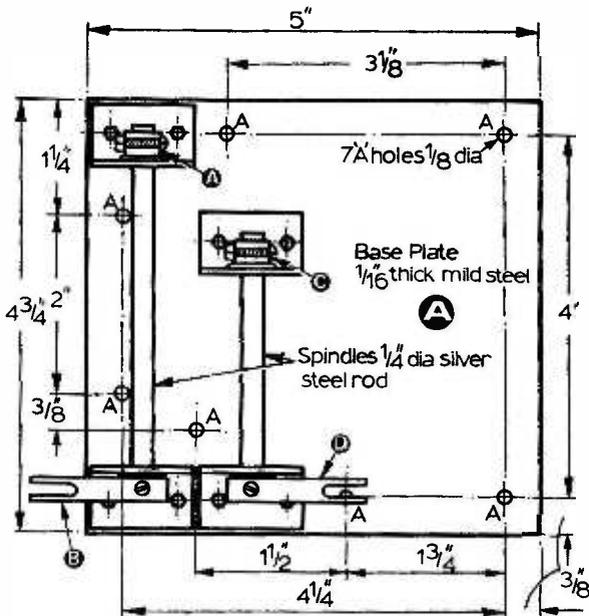


Fig. 17: Side view of mechanism shown in Fig. 9A.

attached to its bearing (Fig. 18B) by a $\frac{1}{4}$ in. diameter spindle. The spindle is cut so that about one-sixteenth of an inch projects either side. The ends are lightly hammered to prevent the spindle coming out. Make sure that the pedal has free movement but as little side play as possible. The control rod from the lever assembly is attached to the pedal as shown in Fig. 18C and D. Note the use of a felt washer above the pedal bar and the $\frac{1}{4}$ in. sleeve below. The size of the foot plate and the length of the pedal bar can be adjusted a little for comfort in playing, otherwise

the dimensions given should be used. The foot plate need only be about $1\frac{1}{2}$ in. wide and 3in. long. Two pedals and bearings are of course required and they should be mounted directly below and in line with the levers to which they are attached. No measurements have been given for this as the positioning is best done experimentally. However, for correct up and down movement of the pedals the bearing spindle should be at a point about 2in. above the bottom of the lower backboard. The pedals should slope gently to the tie-bar.

Connecting Rods

Finally comes the connecting rods between the lever rollers on the guitar bridge assembly and the pedal levers under the console top and between these and the foot pedals. The rods from the lever rollers may be made from $\frac{1}{4}$ in. diameter mild steel and those to the pedals of $\frac{3}{16}$ in. diameter. The overall length of each rod is best determined experimentally but for guidance here are the lengths of the rods as on the writer's prototype pedal guitar. The de-tensioning rod between its lever roller and lever "A" (as in Fig. 15) is approximately 16in. long. The rods to pedals from levers "B" and "D" (as in Fig. 15) are both approximately 27in. long. The "flats" at each end of the rods are produced by heating and hammering and the holes through these flats as in Fig. 19 should provide more than ample adjustment when the mechanism is finally aligned.

As pointed out previously a pedal guitar using the basic control mechanism as described in these articles could of course be built to accommodate more pedals, alternative tuning with 8 or 12 strings or even with twin necks. The roller bridge system is however, the only satisfactory method of tensioning and de-tensioning guitar strings by means of foot pedals.

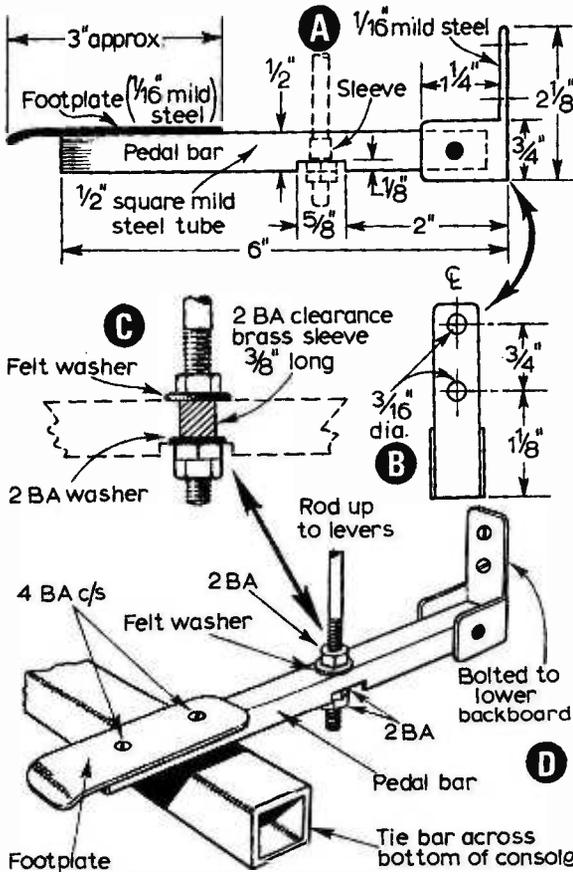


Fig. 18: Dimensions and assembly of foot pedals.

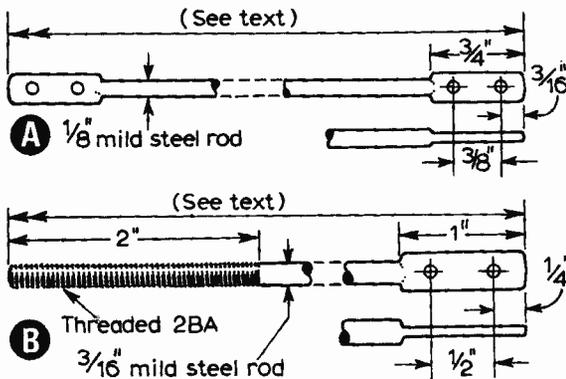


Fig. 19: Coupling rods. (A), to lever rollers. (B), to pedals.

The final part of this article, next month, will deal with the alignment of the pedal mechanism, the circuit for the tone control preamplifier and a pedal volume control.

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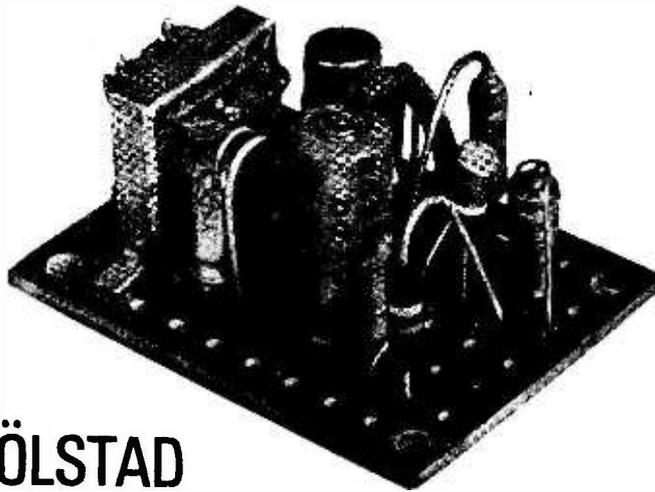
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MINIATURE audio amplifier

T. BÖLSTAD



THE amplifier described in this article is a very simple unit, which is very easy to build. It is thus well suited for the beginner, but it may also be of interest to the more experienced constructor as it may be used for a variety of purposes. It consists of three inexpensive transistors and a handful of other small components and can be built for under £1.

Audio amplifiers of this type are usually operating in class B push pull, since class B output stages require very little quiescent current (i.e. under no signal conditions), and since their efficiency is near 80% under signal conditions. However, such an output stage requires matched transistors, which are relatively critical on the biasing circuit, and the beginner may find it difficult to construct a class B push pull output stage with a minimum of harmonic distortion. Class B stages also require a reasonably constant voltage supply, so that the voltage will stay constant when the current in the stage increases with increasing output signal.

The output stage of this particular amplifier operates in class A, which means that the current through the output transistor is constant, whether there is a signal output or not. If a battery is used, this is of course not very economical, but if one uses a mains supply, the constant current drain is not a serious drawback, even if the amplifier is left on for several days. Its power consumption is so small that its existence will not be detected in the electricity bill! However, the maximum efficiency of a class A output stage is only 50%, compared to the 80% for the class B push pull stage, but when one considers the low initial cost of a single class A output stage, its distortionless output, and its non-critical construction, it is well worth using this type of output in a small amplifier.

THE CIRCUIT

The schematic diagram of the basic amplifier is shown in Fig. 1. The amplifier is designed around three inexpensive silicon transistors, which may be obtained very cheaply indeed from advertisers in this magazine, and it will give a low distortion output power of approximately 80-100mW. The current drain is approximately 40 to 50mA from a 6V supply. The frequency response is from 200c/s to above the audible frequency spectrum, but its lower limit may be improved by increasing the values of C1 and C3.

As the transistors used have negligible leakage

currents, very simple biasing techniques have been employed. Tr1 has the input signal applied to its base, via C1, and it is biased by means of a single resistor, R1, giving both d.c. and a.c. feedback. Tr1 acts as a common emitter voltage amplifier and the signal voltage developing across its collector load R2 is coupled via C3 to Tr2. Tr2 acts as a common collector (also known as an emitter follower) amplifier, and its bias is derived from the two resistors R3 and R5. It will thus have a high input impedance so

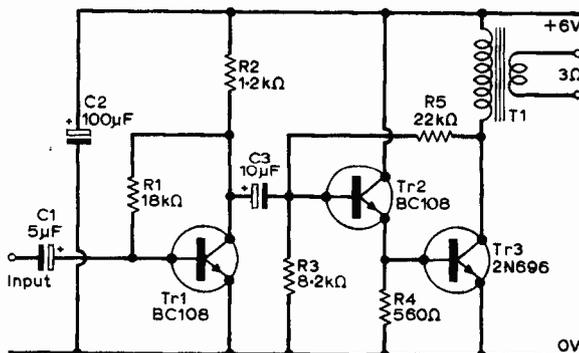


Fig. 1: The circuit of the transistor amplifier

★ components list

Resistors:

R1	18kΩ	R4	560Ω
R2	1.2kΩ	R5	22kΩ
R3	8.2kΩ		

All ½-watt miniature types, 10% tolerance.

Capacitors:

C1	5µF 6V—see text	C3	10µF 6V—see text
C2	100µF 15V		

Transistors:

Tr1	BC 108 or equivalent
Tr2	BC 108 or equivalent
Tr3	2N696

Miscellaneous:

Output transformer, 9:1 ratio (Radiospares T/T4, available from retail suppliers); Veroboard 2½ x 1½ in., 0.15in. matrix; 3Ω loudspeaker.

as not to decrease the effective a.c. load of the first stage, and a low output impedance to match the input impedance of Tr3, which is of the order of 40Ω. As in all emitter followers, the voltage gain is approximately unity.

The output stage consists of a 2N696, which is a medium power transistor. It is directly coupled to the emitter of the previous stage, thus avoiding a coupling capacitor, and at the same time provides the bias for the base. A small output transformer acts as the collector load of Tr3, matching the output to a 3Ω speaker. The feedback resistor is connected to the collector of the output stage, and thus both negative a.c. and d.c. feedback are applied. The d.c. feedback stabilises the d.c. conditions of the output stage, and the a.c. feedback improves the quality.

The output transformer has a turns ratio of approximately 9:1 to achieve the best possible matching, and the Radiospares T/T4 is suitable for this purpose. The output quality is remarkably good, considering the simplicity of the circuit, and the power delivered to the speaker is quite sufficient for most purposes.

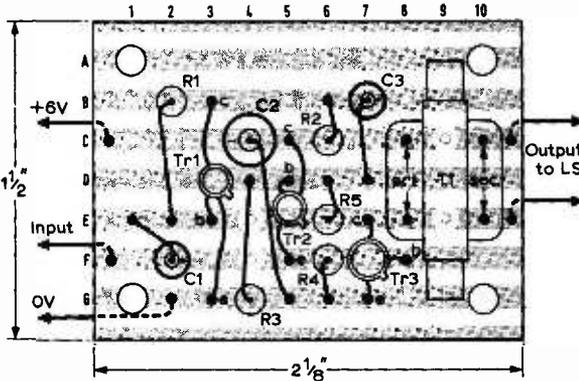


Fig. 2: The component layout on the Veroboard.

CONSTRUCTION

The amplifier is built on a small piece of Veroboard, of $2\frac{1}{8} \times 1\frac{1}{2}$ in., as shown in Fig. 2 and the photograph. The connecting pins of the transformer must be bent slightly to fit it into the board, otherwise there is nothing special about the Veroboard construction. All components are mounted vertically, which allows the amplifier to be a very compact unit. A hole is drilled in each corner for fixing the board into a box etc.

No heatsink is required for Tr3, even if its temperature rises slightly above room temperature. The power dissipation of the output transistor is held at a level well below the permissible amount, and besides, silicon transistors may be operated at higher junction temperatures than germanium ones.

APPLICATION

It should not be difficult to find uses for this little device. It can be used for a gramophone amplifier (the larger the speaker, the better the output quality) or incorporated in a small receiver system, since its sensitivity is of the order of 1mV for full output. However, it was originally designed for home communication purposes.

Figure 3 shows a simple baby alarm system, using the amplifier together with a medium impedance dynamic microphone (1-3kΩ), and a logarithmic

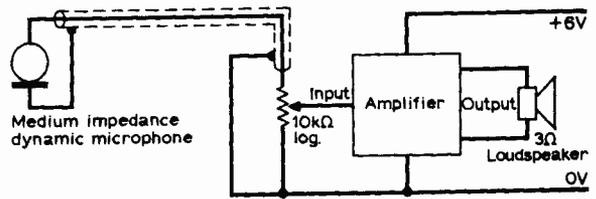


Fig. 3: Connecting the amplifier as a baby alarm.

potentiometer connected as a volume control across the input. The output is taken to a 3Ω loudspeaker. In this and the following examples, the mains power supply shown in Fig. 4 is highly recommended, as it would be much more economical to use than conventional dry batteries. It consists of a standard 6.3V heater transformer and a conventional full wave rectifying bridge. The output voltage is dropped slightly across the 10Ω resistor and then smoothed in the large electrolytic capacitor. The 10kΩ resistor connected across the output simply acts as a bleeder, so that a higher voltage will not build up across the storage capacitor when no load is connected to the supply. The maximum current drain is approximately 50mA.

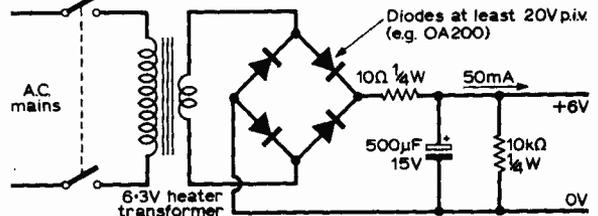


Fig. 4: A mains power supply for the amplifier.

As an alternative to the baby alarm just described, the circuit in Fig. 5 can be used. Here, the microphone has been replaced by a small speaker with a matching transformer, to match the low impedance of the speaker to that of the amplifier input. Since the input

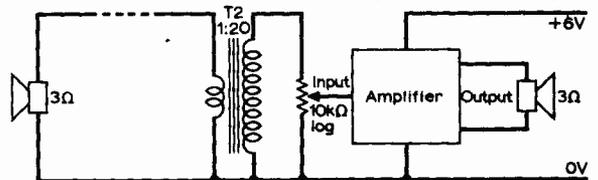


Fig. 5: Using a small speaker as a microphone.

impedance of the amplifier is around 1.2kΩ, a transformer with turns ratio of 1:20 is needed (e.g. Repanco type TT52). By arranging a simple switching system, as shown in Fig. 6, the baby alarm is

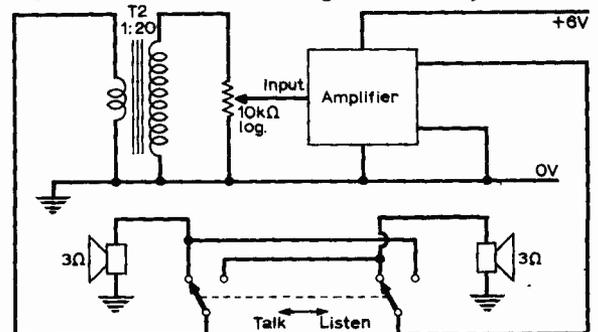


Fig. 6: Schematic of the amplifier used as an intercom.

—continued on page 598



INJECTRACE

TWO of the most useful pieces of test gear, for both the serviceman and the amateur constructor are a signal source and a signal tracer. The project described here combines both these functions in an inside jacket pocket sized case, $7 \times 1 \times \frac{1}{8}$ in. It generates a very wide band signal from about 1kHz to over 200MHz in the inject mode, heaving out a pretty powerful signal. In the trace mode it will detect a.f. and r.f. up to very high frequencies and is sensitive enough to hear local stations when connected to a short length of wire. Switching between the two functions is automatic; in the normal mode it acts as an injector producing a 1kHz squarewave but as soon as the earpiece is plugged in it becomes a tracer, the earphone itself acting as the switch.

The Injectrace is built into a Wisdom toothbrush case which is strongly built and exactly the right size. Including toothbrush this costs 2s. 6d. (3s. 6d. for bristle!)—not a bad price for a custom size case (never mind the toothbrush). Standard components are used throughout and the metalwork requires only metal cutters, a few drills and a pair of pliers.

The Circuit

Most readers will be familiar with the straightforward amplifier circuit, that is, R-C coupled. When the earphone is plugged in it is connected to the collector of Tr2 via C3 (see Fig. 1). The connection feeding back to the base of Tr1 is broken while the earphone is connected.

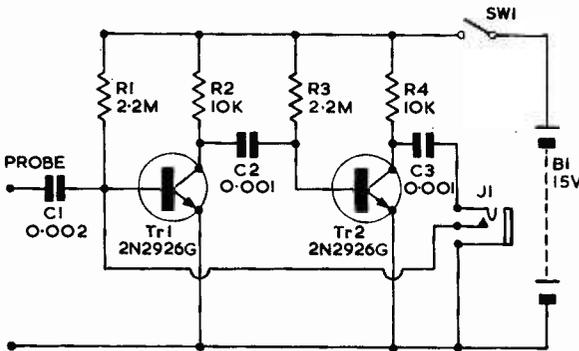


Fig. 1: The Injectrace signal injector and tracer. Functions are changed merely by plugging in the earphone.

When the earphone is removed C3 connects to the base of Tr1 forming a multivibrator working at about 1kHz fundamental. However this waveform takes the shape of a square and as we know

HAL MOORSHEAD



this is full of harmonics. Due to biasing conditions etc. (the reasons will be described later) the rise time is fairly slow but the cut-off is very sharp. In fact the unit will radiate frequencies well into TV Band III (about 200MHz) but above this the transistor is approaching cut-off.

In its trace mode the deliberate distortion enables the Injectrace to detect r.f. signals. There is always detection in an amplifier which is non-linear; although this distorts a.f. signals we will generally be trying to trace a signal rather than judge for quality.

The very high gain of the transistors used and the high frequency response built in can lead to problems. If a crystal earpiece is used this will not damp the output and stray capacitance can cause the circuit to oscillate. Although this will not generally matter (you can still hear your input and the frequency will normally be outside the audio range) this can be overcome by using a 250Ω earpiece which mismatches the output and consequently reduces the gain. The commoner 8Ω earpieces will do but the sensitivity is considerably reduced.

Construction

Having a circuit as described is of little use unless it is housed in a robust container of convenient size. A lot of thought was put into the general construction and other layouts were tried but the one shown here is the best from several points of view. All the components are fixed to a $\frac{1}{8}$ in. strip of 16s.w.g. aluminium bent as shown. The problem of battery housing and rigid construction are overcome using this method. About the only battery

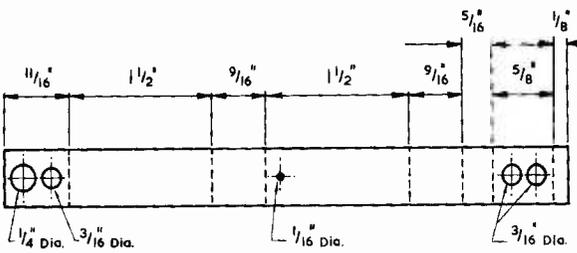


Fig. 2: The aluminium "chassis".

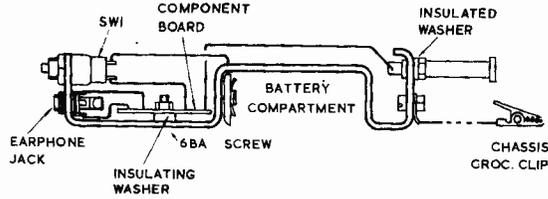
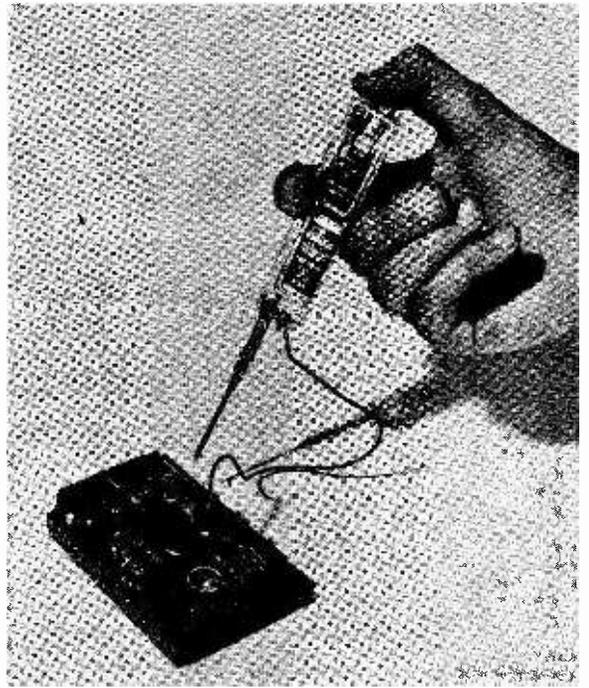


Fig. 3: Layout of the major components, which also shows how the strip is bent.

suitable is the Ever Ready B154 which is not fitted with clip battery terminals but with "domes" for pressure contact.

One of these domes, the negative, presses against the aluminium chassis strip while the other presses against the female connection of a PP3 battery clip. Plastic covered clips of this type are widely available and by cutting off the male section, spreading the contacts of the female connector and feeding the wire through a small hole drilled in the chassis, a good spring contact will be made.

The miniature push-button switch and the earphone socket are mounted on the end plate. Care should be taken as there is precious little room and also because of this a 2.5mm. socket should be used for the earphone.

The active components are mounted on a small piece of 0.1in. matrix Veroboard 9 × 5 holes, the centre hole being drilled out for mounting. The mounting screw for the Veroboard is countersunk

using a plastic washer of the type used for mounting power transistors.

To increase the versatility of the Injectrace it was required that three different probes should be used and to facilitate this the probes are plugged in. One probe should be straightforward as illustrated, another fitted with a 0.01μF 500V capacitor for valved or other high voltage equipment and another probe fitted with a 5.6MΩ resistor for use with high level inputs that would otherwise overload the amplifier in the trace mode. These probes are all soldered to banana plugs which fit into a socket fitted to the front of the unit.

Because of the large diameter of the screws on

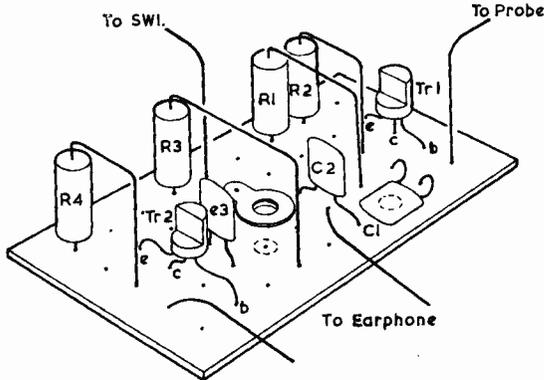


Fig. 4: The circuit panel, showing where components are mounted.

through the chassis and an insulating washer should be fitted to space the underside of the component board away from the chassis. The chassis itself is the negative connection and contact is made to the board by fitting a solder tag underneath the securing nut with a wire from the tag to the negative strip on the board.

The probe itself is connected to the front panel and this of course is insulated from the chassis

★ components list

Resistors:

R1 2.2MΩ ¼ watt	R4 10kΩ ½ watt
R2 10kΩ ½ watt	R5 5.6MΩ 1 watt
R3 2.2MΩ ¼ watt	(for attenuating probe)
All 10% tolerance.	

Capacitors:

C1 0.002μF Mylar Film	C4 0.01 500V
C2 0.001μF Mylar Film	Silvered Mica
C3 0.001μF Mylar Film	(for high voltage probe)

Semiconductors:

Tr1 2N2926G

Tr2 2N2926G

Miscellaneous:

B154 15V battery; 0.1in. matrix Veroboard, 9 × 5 holes; 2.5mm. earphone socket; 250Ω earphone with 2.5mm. jack; miniature push-button switch; plastic toothbrush case—see text; socket; three banana plugs; aluminium strip; PP3 battery connector; small crocodile clip; nuts and bolts, etc.

such plugs there is a problem in insulating them from the chassis and to overcome this a 6BA nut was soldered to the base of the socket which in turn fitted on to the insulated 6BA screw on the front of the Injectrace.

The earthing connection is taken from a solder tag fitted underneath the probe, the illustrations show this clearly. A small crocodile clip makes the best type of connection and about 9in. of wire should be about right.

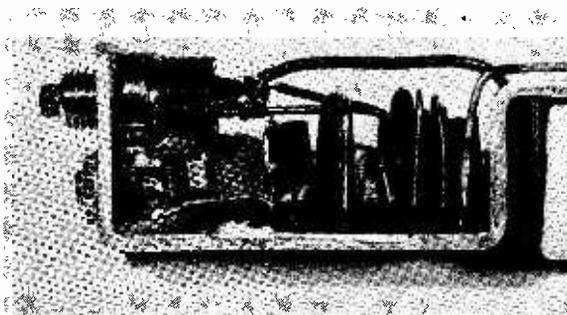
Once the wiring-up of the unit has been completed it should be slipped into the case and holes marked and drilled in the back to line up with the push-button switch and the earphone socket.

The chassis is held into the case by leaving the nut of the push-button switch off while the chassis is being fitted and screwing it on when it protrudes through the back of the case.

One point must be made regarding the switch. These are Japanese imports and are widely available in two forms, both suitable, however the plastic part through which the contacts protrude is very soft and will very easily melt and shift the contacts making the switch useless unless great care is taken when soldering.

Uses

Once built the Injectrace will prove invaluable and it should not be too long before isolating a



fault in a piece of equipment becomes second nature.

Take for example a transistor superhet radio—and there must be few of us who haven't been called upon to fix one.

First eliminate the two commonest faults—flat or low battery and dirty earphone switch. These are by far the easiest things to check and account for a huge proportion of faults. If both these points are O.K. all the rest can be done with the Injectrace.

Inject at the slider of the volume control; if the signal is heard the fault will lie in the r.f./i.f. section. If not, it will probably lie in the amplifier. Working either forwards or backwards through the circuit injecting or tracing will be very simple and the fault will be easily found. ■

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We would like to draw readers' attention to the fact that the BLUEPRINT SERVICE has been discontinued and therefore no further BLUEPRINTS are available.

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MINIATURE AUDIO AMPLIFIER

—continued from page 595

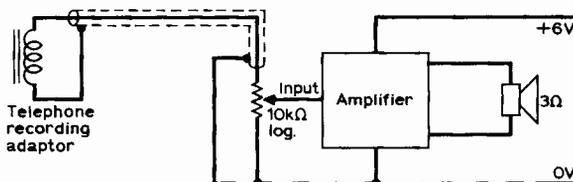


Fig. 7: Connections for use as a telephone amplifier.

converted into a two-way intercom system. If one uses this system, a separate calling system could be built using buzzers and push buttons.

Finally, the circuit of a telephone amplifier is given in Fig. 7. A telephone recording adaptor (which is readily obtained from advertisers in this magazine, e.g. Henry's Radio) is connected via the volume control to the input of the amplifier. It connects the telephone inductively to the amplifier so that a telephone conversation may be heard by a third person. The adaptor is fitted with a rubber sucker which is pressed on to the telephone in a position so as to give maximum volume.

This simple amplifier has been a satisfactory (and inexpensive) solution to the author's home communication problem. The devices which were built gave very good results; they had sensitivity enough to pick up weak sounds and voices from sources situated several yards away from the microphone/speaker, and the output volumes were in excess of most commercial intercom. systems. ■

practically wireless commentary by HENRY

The Chips
are down

FOLLOWING our Editor's September comments, I could have entitled this piece "Third time lucky". Allow me to repeat—for the benefit of those in whose minds the successive editorials do not burn—the gist of the message.

"During the heyday of the valve era, designers, constructors, equipment makers and service engineers were plagued with the vast proliferation of valve types . . . complete listing became well-nigh impossible due to sheer numbers. With the advent of transistors it seemed that a new era of rationalisation was dawning . . . it was inconceivable that the same mistakes would be made . . ."

BUT

"There must be tens of thousands of types in the catalogues . . . there has been little attempt to rationalise the type numbering system. At this stage of the game it is too late to remedy matters."

His nibs went on to say that we were on the threshold of another major opportunity for industry to work together. But our Editor must have felt the vain optimism of his hopes, for he warned that unless industry could prevent itself—lemming fashion—from making the same mistakes the third time, a situation even more chaotic would result. ". . . we are all set to be overwhelmed by an avalanche of IC devices within

the next few years." The small boy's dream, buried 'neath a mountain of chips!

The chip invasion is with us. The recent torrodero laughingly called a Radio Show slipped a number of IC devices into its offerings, and such was the obsession of reporters suffering from incipient chomatomania that the infiltrators disembarked from their coloured Trojan horses and are entering our lives unseen.

Readers of our sister journal, *Practical Television*, are already being brainwashed. A series of articles by E. J. Hoare entitled *Chips with Everything*, which got itself front-page billing, no less, sets out to describe the design, development and application of integrated circuits in detail. It is thoroughly recommended reading.

Trouble with the IC label always seems to me the use some equipment makers put that hard-worked word *integrated* to. In grammar as atrocious as my last sentence they pad out their advertising with "integrated for utmost efficiency" items. These reveal themselves to be no more than the familiar units packed into one case.

At this year's Radio Shows we saw a 9×5×3in. stereo radio with separate dinky loudspeakers. Rather like matching matchboxes—and not an IC in sight, as far as we could gather. Presumably this trend to miniaturisation will bypass the ultimate status symbol, the super-gram. Yet we may find a large central box with dummy dial and turntable, and the IC hiding behind the aerial plug.

On the grounds of reliability, chips have more flavour. But we remember being told just this when transistors came to town. IC design demands a multi-terminal connection to a printed circuit panel with a few discreet components scattered around. Capacitors cannot be formed to any size because of sheer physical limitations, and resistors that



Too many eggs in one basket.

must dissipate some power are also doomed to the fringes. The result will probably be a few more expensive breakdowns, where a ninepenny component will require replacement of the whole panel willy-nilly. There is a disadvantage, as Mr. Hoare has said, of having too many eggs in one basket.

One of the present limitations to the IC is the physical size. Power dissipation is limited to about a quarter-watt. About 20 volts for the "high tension" line is the modern extreme and the feedback problems at high frequency make high-gain circuits an untenable proposition.

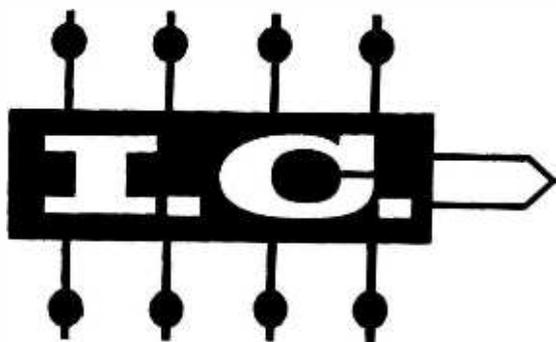
So, if we want to avoid overcooking our chips, we shall have to be content with small-signal, low-frequency circuits, such as i.f. stages, TV sync separators, a.g.c. and a.f.c. amplifiers and discriminators.

Power stages are taboo—as yet. (We need the saving phase because, remember? it was not so long ago that the line output stage of a television receiver simply *had* to be a valve. Nowadays a couple of BU105 transistors handle the power for a colour TV line output section with no more than a gentle blush.)

No, we shan't be saying "Goodbye Mr. Chips" for a long, long time, lemming-like proliferation notwithstanding.



Disembarked from their Trojan horses.



OF THE MONTH

L.A.J. IRELAND

Number 2

The CA3028 used as a S.W. Converter

INTEGRATED circuits have by now fairly well established themselves in many branches of amateur electronics. The cost of these devices is continually decreasing and in some cases use of an i.c. can work out to be cheaper than its discrete counterparts. Moreover due to their compactness and ruggedness they lend themselves especially for use in equipment where reliability is important

since they are not easily damaged. This article describes the use of an R.C.A. CA3028 i.c. in a 1.6MHz short wave converter.

Figure 1 shows the theoretical circuit of the CA3028. As can be seen from the diagram a great number of access points to the unit are available and this makes it particularly useful. The designers intended the unit to be used in either the cascode or differential mode but in the present design each transistor will be used to perform a different function thereby utilising all the advantages afforded by the i.c.

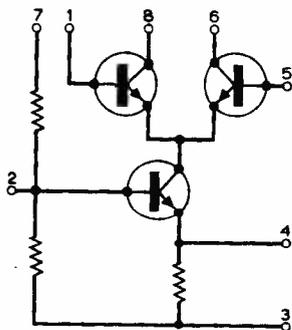


Fig. 1: The integrated circuit under review this month is the CA3028 manufactured by R.C.A. The theoretical circuit, containing three transistor elements, is shown alongside.

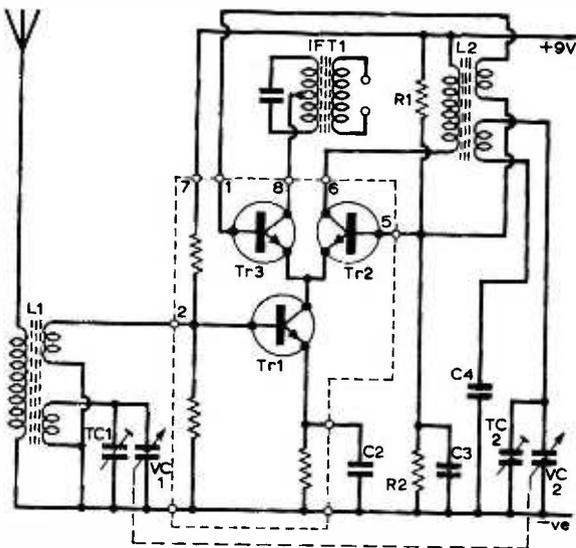


Fig. 2: The CA3028 can be used as a combined r.f. amplifier, mixer and oscillator in a receiver front-end. This particular circuit is for a short-wave tuner to go ahead of a medium-wave receiver.

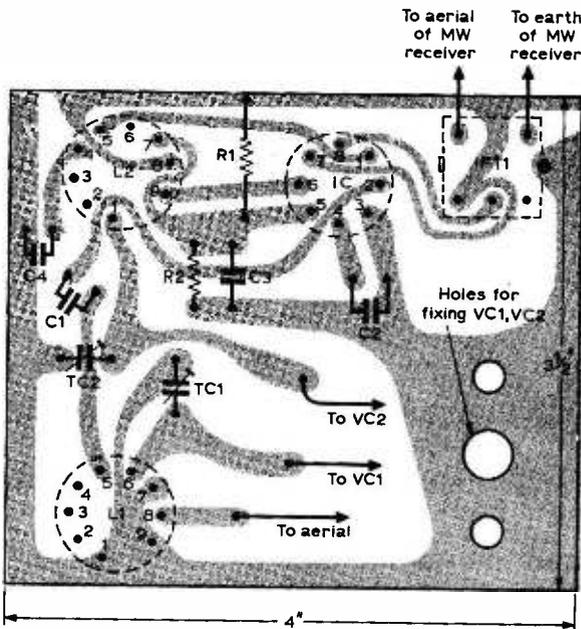


Fig. 3: The printed-circuit layout for Fig. 2, seen from the copper side.

The complete circuit diagram of the converter is shown in Fig. 2. The r.f. signal from the tuned circuit is fed to the base of Tr1 operating as an r.f. amplifier in the common emitter mode. Tr2 oscillates at a frequency determined by L2 and VC2 with regeneration provided by the coupling winding from the base of Tr3, which in addition provides the

LOW COST valve amplifier

R. J. WINFROW

WITH the current trend towards complicated transistor Hi-Fi amplifiers and preamplifiers, it is often forgotten that very good quality can be obtained from fairly simple, low cost valve amplifiers. The amplifier described here is a two valve one giving very acceptable quality at a cost of under £6.

The Circuit

The input is fed directly to the tone and volume control stage and although this is a passive network, gives wide control over the tone. The output from this is fed to the first valve, EF86, which is a high

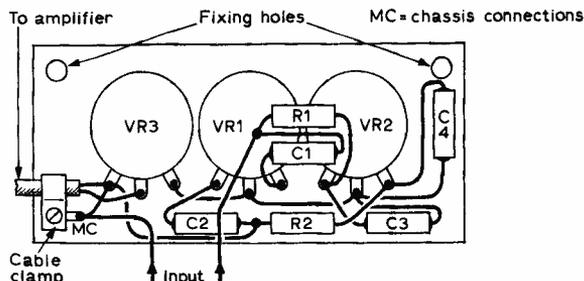


Fig. 2: The wiring of the tone control panel.

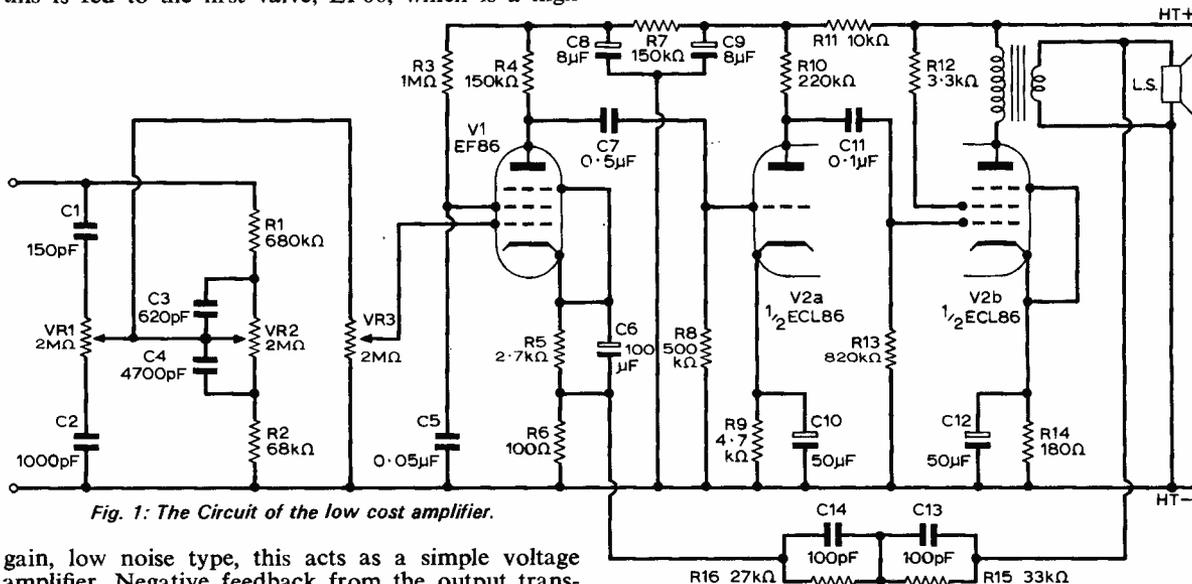


Fig. 1: The Circuit of the low cost amplifier.

gain, low noise type, this acts as a simple voltage amplifier. Negative feedback from the output transformer is fed to the cathode of this stage which makes use of extra gain by improving the overall quality.

The output of the first stage is fed to the triode section of the ECL86 which further amplifies the signal and applies this to the grid of the output section in the same valve which applies the signal to the output transformer in the anode circuit.

The only component that is critical with regard to quality is the output transformer, the difference between a good one and a small cheap one is tremendous. Any good transformer having a primary impedance of about 8kΩ will do.

Because of the high gain of the EF86, care should be exercised in the layout of the components. The main sources of noise in an amplifier are the components associated with this valve and if good noise figures are wanted R3, R4, R5 and R6 should be high stability types. The unscreened lead to the grid of the first valve should be kept as short as possible.

All the main components are mounted on a chassis

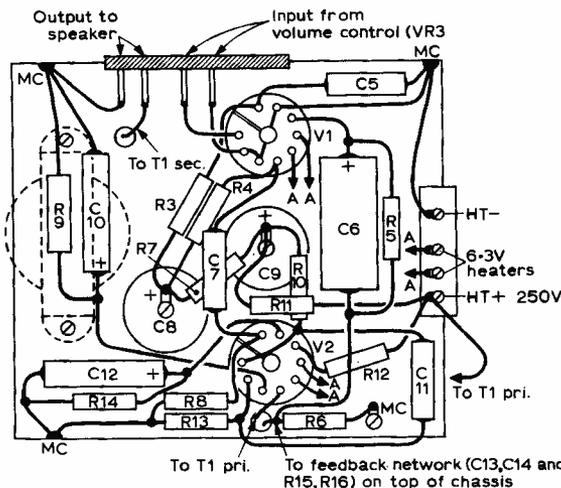


Fig. 3: The under chassis wiring.

— continued on page 618

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16	32	150	9d.			54	500	8	6d.		
17	64	2.5	3d.			55	64	275	1/3		
18	100/200/200/50	275	7/6			56	25	6	3d.		
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21	24	275	1/-			59	400	30	1/6		
22	10	25	3d.			60	500	4	3d.		
23	125	2.5	3d.			61	150	30	1/6		
24	2	150	3d.			62	64/32/8	275	2/6		
25	16/32	350	2/6			63	200	275	2/6		
26	32	275	1/6			64	40	6.4	3d.		
27	350	12	6d.			65	50	25	6d.		
28	75/75/75/75	150	2/6			66	250	50	1/9		
29		20	3d.			67	8	6	3d.		
30	12.5	40	9d.			68	100/100/50	275	5/-		
31	640	2.5	3/1.			69	50/50/50	350	4/-		
32	3,000	35	7/6			70	40/40/20	275	2/-		
33	3,000	15	3/-			71	400	6.4	3d.		
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36 ohms	1.8 k ohm	7.5 k ohm	43 k ohm	430 k ohm	5.1 meg ohm
47 ohms	2.2 k ohm	10 k ohm	47 k ohm	470 k ohm	6.2 meg ohm
91 ohms	2.4 k ohm	16 k ohm	51 k ohm	560 k ohm	7.5 meg ohm
220 ohms	3.3 k ohm	18 k ohm	62 k ohm	620 k ohm	8.2 meg ohm
470 ohms	3.6 k ohm	22 k ohm	75 k ohm	75 k ohm	1.2 meg ohm
550 ohms	4 k ohm	24 k ohm	82 k ohm	82 k ohm	1.5 meg ohm
750 ohms	4.7 k ohm	27 k ohm	91 k ohm	91 k ohm	10 meg ohm

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4.7 pf	22 pf	72 pf	170 pf	600 pf	2,200 pf
5 pf	25 pf	80 pf	180 pf	680 pf	2,500 pf
6 pf	27 pf	82 pf	180 pf	800 pf	2,700 pf
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TAKE 20

JULIAN ANDERSON

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

THERE are on the market several types of intercom costing upwards of £2 10s., and there is no doubt that many readers could find a use for one, but doubt whether even this expenditure would be justified. The unit described here comes within our 20s. limit and this expenditure may make it a viable proposition. It can easily be used as a baby alarm—it is certainly sensitive enough—merely by switching one of the units on permanently.

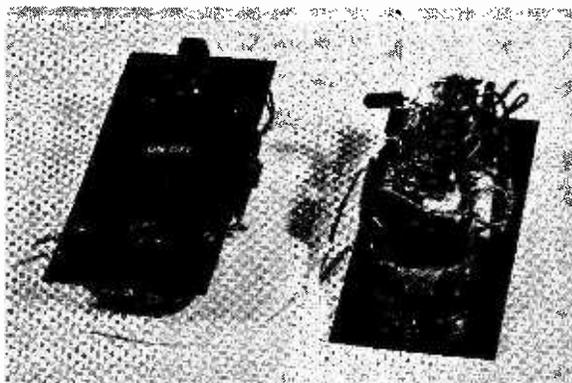
Most of the commercially available units are arranged so that first a signal button is pressed and the unit is then switched on and the volume level set. Also nearly all of them can be used for "spying", that is, switching on by the master activates the slave microphone so that the master can eavesdrop.

The unit described here is not fitted with a buzzer as calling over the unit is usually enough to draw the attention of the distant party. It cannot be used for eavesdropping (an undesirable, "Big Brother" type feature) and thus its installation can cause no offence. Since no volume control is fitted (this is really unnecessary for this type of equipment) only one control is made by either end to activate the unit.

The Circuit

The basis of the intercom is a simple amplifier which boosts the "microphone" output to feed a speaker. To make the project simpler and cheaper we use balanced armature earpieces which, by being switched, serve both functions as microphone and

No. 8 INTERCOM



The two intercom stations.

loudspeaker. These balanced armature earpieces are really marvellous pieces of design. They are extremely sensitive, have a perfect impedance for transformerless transistor work and are very cheap—mine cost me 2s., unfortunately from a retailer who doesn't do mail order. After the *Take 20* Electronic Organ I had a number of letters asking where to obtain these and I understand that they are no longer made and are in short supply. However, some are still available from various retailers, but this will not help those who can't obtain them. Eighty-ohm loudspeakers can be used in their place and these, even if a little more expensive and taking us over the 20s. limit, are available.

The amplifier is slightly unusual and is an alternative to the one described in *Take 20* No. 1 as a very simple Lo-Fi (I imagine that's the opposite of Hi-Fi!) sensitive a.f. amplifier. It uses a p-n-p and an n-p-n transistor and is R-C coupled. The switching is straightforward; two batteries are used, one each in the master and slave section. This is done purely to enable a three-wire rather than a four-wire connector to be used.

In the normal position (as shown in Fig. 1) no current is drawn and the switch on the master is set to receive calls from the slave. The only thing the slave has to do is apply battery voltage to the master by making SW2.

When the master makes a call the output from the amplifier is fed to the slave loudspeaker, its own loudspeaker is switched to the input, becoming the microphone, and the slave's microphone becomes the loudspeaker switched to the output of the amplifier. The master unit will, of course, override the slave.

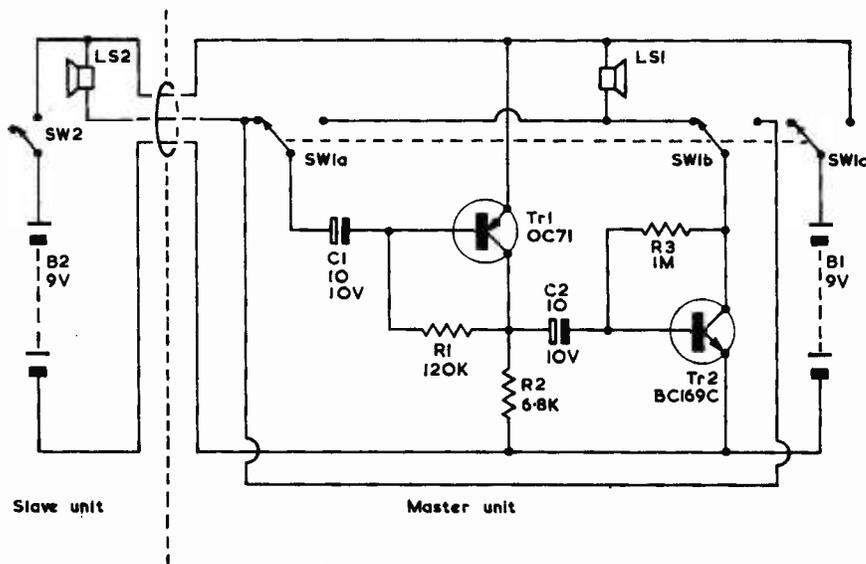


Fig. 1: Intercom theoretical circuitry.

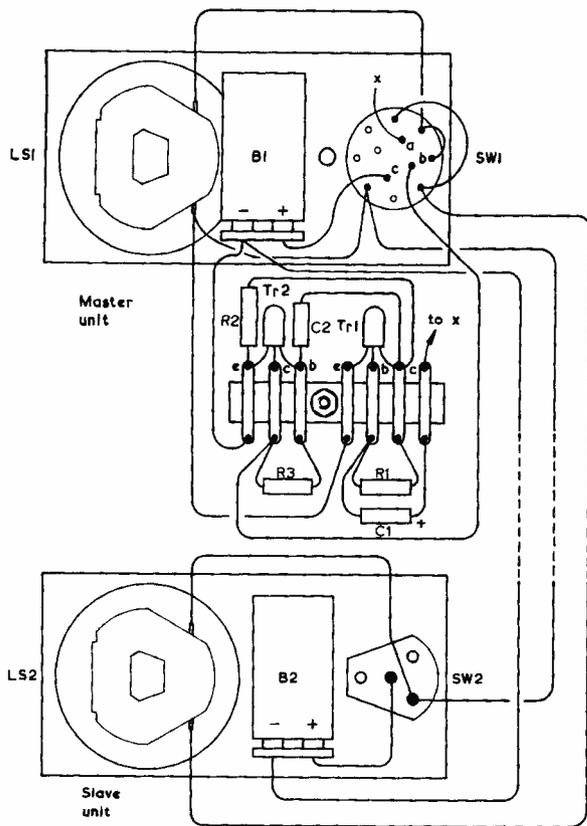


Fig. 2: Component layout and wiring details

★ components list

R1	120kΩ ¼W miniature	3d.
R2	6.8kΩ ¼W miniature	3d.
R3	1MΩ ¼W miniature	3d.
C1, C2	10µF 10V	2s. 0d.
Tr1	OC71 or equivalent	1s. 6d.
Tr2	BC169C or equiv.	2s. 3d.
SW1	three-pole, two-way	3s. 0d.
SW2	one-pole, two-way	2s. 0d.
LS1, LS2	balanced armature earpieces	4s. 0d.
Miscellaneous:		
	Paxolin boards, tagstrip battery clips	3s. 0d.
		18s. 6d.

Construction

Both the sections are built on Paxolin panels about 4½×2½in. and all the components, including the battery, are mounted on this; the layout is by no means critical and the drawing is self-explanatory (see Fig. 2).

Although it may be better if press button switches were used, these are not readily available and are rather dear compared with the rotary switches used here. Also, using rotary switches enables either of these units to be switched on permanently for use as a baby alarm.

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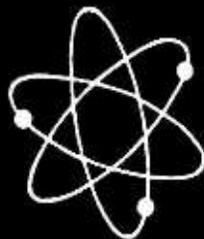
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DESIGNING CLASS "A" TRANSISTOR OUTPUT STAGES

C. R. BOGGIS, M.A.P.A.E.

THE purpose of this article is to show that it is possible to design an output stage operating in the class "A" mode, with very little involved mathematics. The design procedure is based on several "rules of thumb" and the assumption that the losses are negligible.

A power amplifier designed by this method will prove to be a viable proposition, and gives the added satisfaction of being able to say "I designed and built it myself". For simplicity of design the input to the amplifier is transformer coupled, see Fig. 1.

First we decide on the output power required and the supply voltage that is available. We then choose a transistor capable of meeting the specification. In this example, the required power is 2 watts and the power supply is to be a fully-charged car battery, the voltage of which will be about 14.5 volts.

A transistor which will more than "fit the bill" is type OC35, which is, incidentally, readily available on the surplus market. Ignoring any losses, the power required (P_o) is equal to the peak collector current (I_c) times the peak collector voltage (V_c), each divided by the square root of 2 to obtain r.m.s. values.

The peak collector current can be determined thus:

$$P_o = \frac{V_c}{\sqrt{2}} \times \frac{I_c}{\sqrt{2}} \quad \therefore I_c = P_o(\sqrt{2}) \times \frac{\sqrt{2}}{V_c}$$

Substituting our requirements this becomes:

$$= 2\sqrt{2} \times \frac{\sqrt{2}}{14.5} = 278\text{mA, or approx. } 300\text{mA.}$$

In class "A", the d.c. collector current and the peak collector current are similar, and can be considered equal. Thus the collector voltage and current are 14.5 volts and 0.3 amps respectively. The voltage drop across R_e is usually around 0.6 volts in power output stages. This value is calculated from: $R_e = \frac{V}{I_e}$ where V equals 0.6 volts, and I_e is considered equal to I_c , which is equal to 0.3 amps. Thus here $R_e=2$ ohms.

The voltage from base to earth is equal to the base-emitter voltage (V_{be}) of the transistor (normally 0.6 volts in silicon, 0.4 volts in germanium transistors) plus the voltage drop across R_e , in this case 0.6V. The voltage across R_2 is therefore 1V. By "rule of thumb" R_2 is made equal to R_e times 10, or 20 ohms (use preferred value 22 ohms). Thus the current through R_2 is equal to the voltage across R_2 divided by R_2 , which equals in this example 45mA.

The current through R_1 can be considered equal, since the base current is very small in comparison with the bleed current through resistors R_1 and R_2 .

$$\text{Thus } R_1 = \frac{14.5-1}{45\text{mA}} = 320 \text{ ohms (use 330 ohms). (The$$

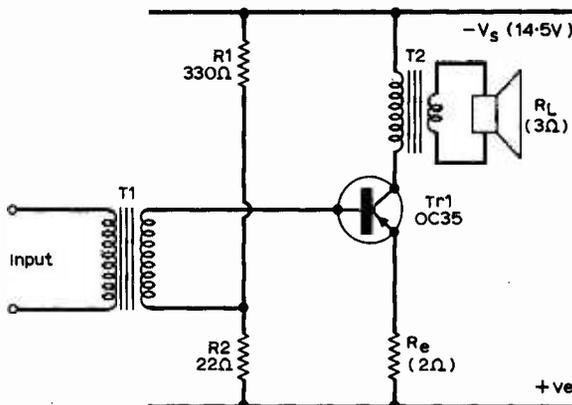


Fig. 1: The circuit referred to in the text.

voltage drop across T_1 can be ignored, the d.c. resistance being very small.)

The output transformer requirements are calculated from the a.c. voltages and currents in the circuit. The peak collector voltage swing that can be utilised before "clipping" occurs is approximately 90% of the supply voltage, or 13 volts in this example.

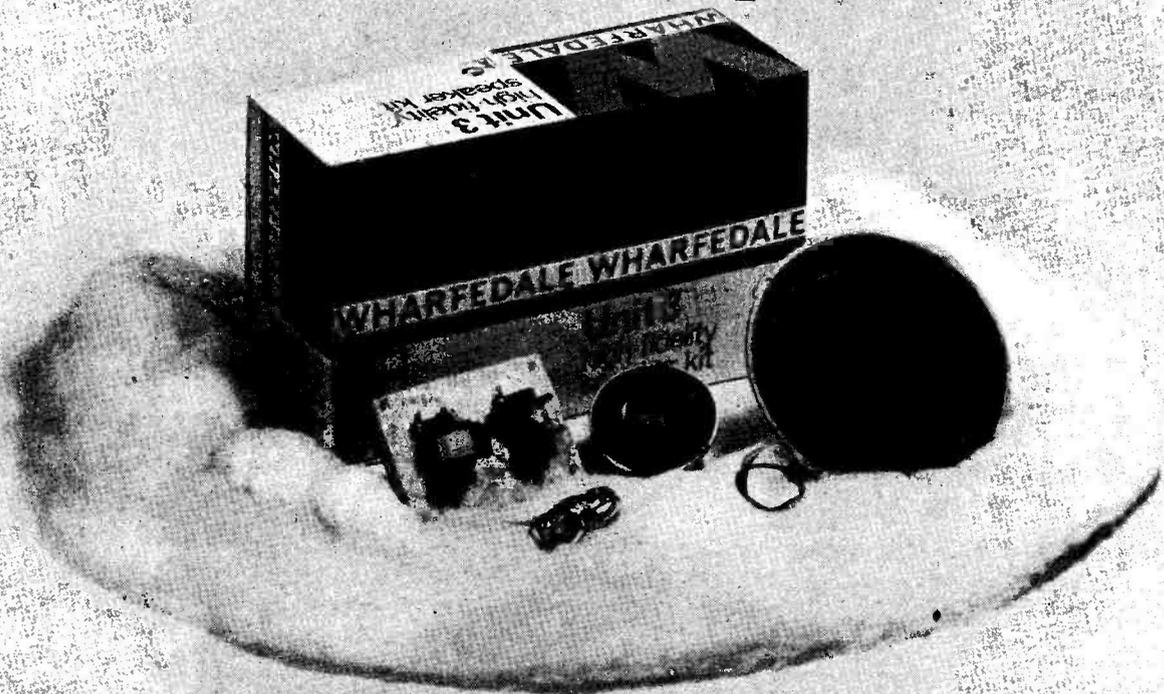
The peak collector current swing available is, as previously stated, 300mA. The collector load should thus be 13 volts divided by 300mA or approx. 43 ohms in this case. The transformer should match this impedance to the actual load impedance used. A 3 ohm loud-speaker is to be the load here, thus the impedance ratio should be 43:3 ohms or the turns/voltage ratio should be $\sqrt{(43:3)}$ or 3.8:1.

The total input power that is required to drive the stage to full output is the voltage needed across T_1 secondary times the current. This current is equal to the base current required. This is determined from the transistor characteristics, being the value of peak collector current divided by the β value for the transistor at that current. Here, β is equal to the range 25-75 for an OC35. Choosing the mean, 50, and from previously calculated collector current 300mA, drive signal required is 0.3A divided by 50, which equals 6mA peak, or 4.2mA r.m.s.

The peak input a.c. voltage is nearly equal to the sum of the base-emitter voltage, plus the voltage across R_e , plus the peak a.c. voltage across R_2 ($6\text{mA} \times 22$ ohms).

Thus, in this case, the drive voltage required is equal to 1.132V peak ($0.4\text{V} + 0.6\text{V} + 0.132\text{V}$) or 0.8 volts r.m.s. The total a.c. power required is thus 0.8 volts times 4.2mA, or 3.4mW. The input impedance is 0.8 volts divided by 4.2mA, that is about 200 ohms. T_1 should be designed to match this impedance to the optimum load for the preceding stage. This can be designed along the same lines as the power amplifier discussed in this article.

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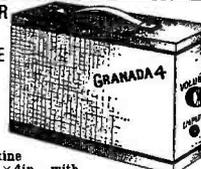
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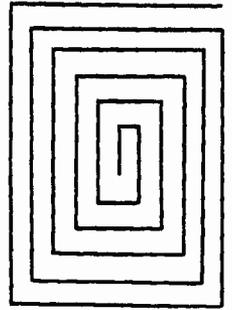
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BASIC SEMICONDUCTOR TECHNOLOGY

PART SEVEN



by M.F. DOCKER, M.Sc.

IN the last two parts the operation of the minority carrier transistor was explained. These devices depend on the injection of carriers into a base region across which they diffuse towards the collector. They can thus be thought of as charge controlled devices. Shockley and his colleagues discovered these devices in 1948. They had been trying to make an amplifying device, though of a different type to that they found. Their idea had been to find a device whose conductivity was altered by changing the voltage applied to a separate electrode. They were looking in fact for a field controlled device which would not depend on the injection of minority carriers for its operation but rather on the regulation of the current carried by the majority carriers by a field in the device. It would thus be a majority carrier device and because the current would be carried by only one type of carrier it would be "unipolar".

However because of the rather poor specimens of semiconducting material which were then available Shockley had very little success. It was not until 1958 that the first field effect transistor was produced, by a French firm under the name Technetron. This was not a commercial device and it was not until 1962 that an American firm produced the first commercial f.e.t., priced at about 50s.

The first f.e.t. devices were junction field effect transistors, or j.u.f.e.t.s. Later a superior device became available, the metal oxide field effect transistor or m.o.s.t. This latter device has an insulated gate electrode and is sometimes called an insulated gate field effect transistor or in short an i.g.f.e.t.

Junction Field Effect Transistors

Before describing the method of operation of the junction field effect transistor it is perhaps best to describe its construction. The simplest geometrical arrangement is that shown in Fig. 1. It consists of an n-type slice of silicon into which a heavily doped p-type layer is diffused to form the gate of the transistor. Contacts are provided at either end of the slice by n⁺ diffusion, giving ohmic contacts which are called the source and drain terminals. Practical devices are constructed by a double diffusion process. A p-type substrate is used and an n-type channel region diffused into it. A second diffusion of p-type material then forms the gate region. Such a structure is shown in Fig. 2.

Returning to the simple structure shown in Fig. 1 it will be seen that if the gate electrode is made negative with respect to the source the junction will be reverse biased. Consequently a depletion layer will extend into the n-type silicon. If at the same time a voltage is applied between the source and drain electrodes a current will flow through the channel of n-type silicon. By definition the source terminal is that from which

the current carriers originate and the drain terminal is the one to which they go.

Junction f.e.t. Characteristics

In this example the source is the negative terminal and the drain is positive, thus there is a potential drop between these electrodes. Near the source the reverse bias across the junction will be essentially the same as the gate to source voltage, V_{gs} , but nearer the drain the reverse bias is greater because of the voltage drop across the drain to source channel region. The result of this is that the channel available for conduction is reduced in

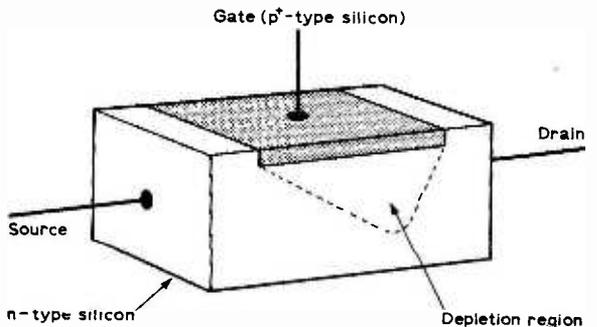
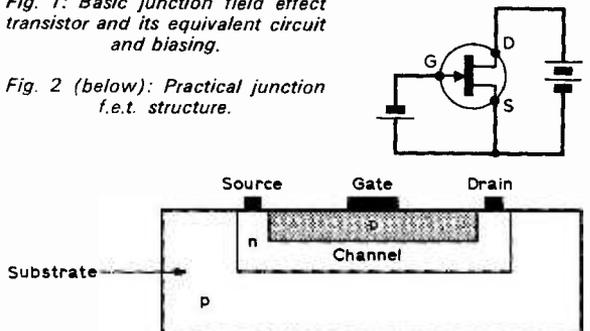


Fig. 1: Basic junction field effect transistor and its equivalent circuit and biasing.

Fig. 2 (below): Practical junction f.e.t. structure.



width so that the resistance between the source and drain electrodes is increased as the drain current increases. Eventually, the channel is reduced to such a width that further increase in the drain to source voltage produces no increase in the drain current. Of course the channel is never completely closed as this would lead to zero drain current, with a resultant fall in the potential drop between the drain and source and a widening of the channel once more. The voltage at the gate which produces an essentially constant drain current is called the pinch off voltage, V_p . This depends very much on the construction of the device and at present most of the commercially available field effect transistors have a large spread in their pinch off voltages.

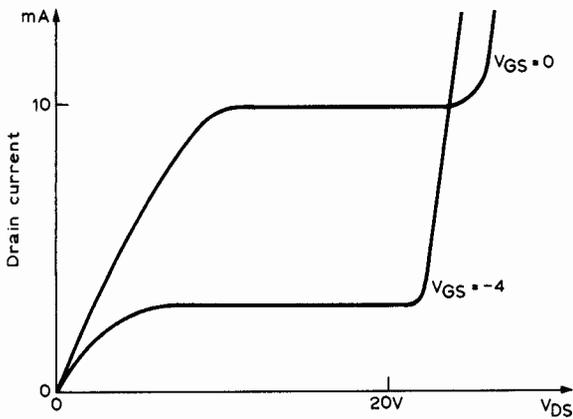


Fig. 3: Curves showing variation in drain current with drain voltage for different gate voltages.

From the characteristic curve shown in Fig. 3 it is seen that at high drain to source voltages the drain current suddenly increases. This is because of our old friend the avalanche effect. The large voltage is in effect in series with the reverse voltage across the gate junction and produces avalanching in this region. This effect sets a limit to the maximum voltage that can be applied to the f.e.t. either directly to the gate or via the drain supply.

It is possible to make both n- and p-channel junction field effect devices. The n-channel device gives a decreased drain current if the gate is made negative whilst p-channel device gives a decreased drain current if the gate is made positive.

Insulated Gate Field Effect Transistors

A later addition to the range of the majority carrier devices was the insulated gate field effect transistor. Although the input resistance of the gate electrode of the junction f.e.t. is high, often being of the order of $100M\Omega$, that of the i.g.f.e.t. is often up to $10^{14}\Omega$ or $100MM\Omega$. This is of course of immense value in high input impedance instruments used in laboratories and for circuits requiring low loading of previous stages.

The insulated gate field effect transistor, or metal oxide silicon transistor as it is more usually called, is made by diffusing into a p-type substrate two heavily doped n^+ regions which act as source and drain electrodes, being separated by perhaps 1 mil. A layer of silicon oxide is then grown over the top of the device and two holes are etched in this to enable metal contacts to be attached to the source and drain. A further layer of metal is attached to the oxide over the region between the source and drain as seen in Fig. 4: this becomes the gate terminal of the complete device.

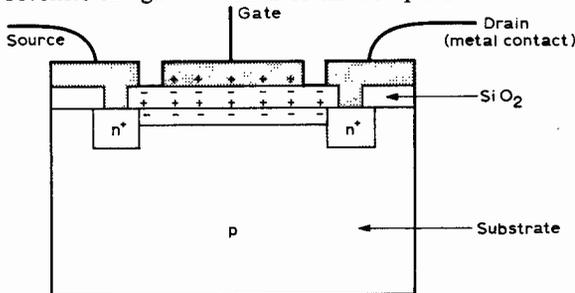


Fig. 4: Structure of an enhancement-mode insulated gate field effect transistor.

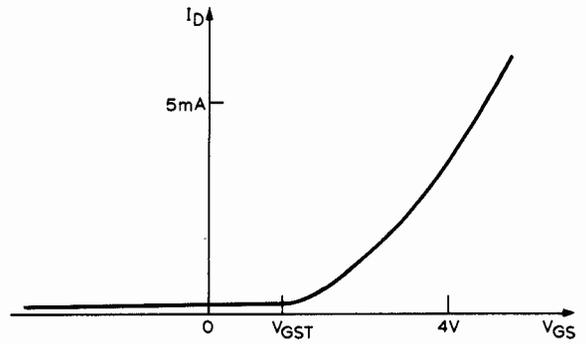


Fig. 5: Enhancement-mode insulated gate field effect transistor characteristic curve.

The operation of the m.o.s.t. is explained quite easily by considering the arrangement of Fig. 4. If the gate is made positive with respect to the substrate an electric field will be developed and will induce charges on the surface of the semiconductor. Since the field is directed into the surface negative charges will be induced by the force acting on the atoms in the semiconductor. In this way a layer of negative charge is produced between the source and drain, which results in a decreased source to drain resistance and an increase in the drain current.

Enhancement Mode Operation

The layer of induced charge is called an inversion layer because the charge carrier is of opposite type to that in the bulk of the semiconductor. This arrangement is called the enhancement type of m.o.s.t. as the conductivity of the channel is enhanced by application of the gate potential. It is characterised by the fact that very little current flows through the channel when there is no field at the gate. A curve showing the relationship between the drain current and the gate voltage of a typical m.o.s.t. of the enhancement type is shown in Fig. 5. It is seen that only a very small current flows through the device until a gate threshold voltage V_{gst} is reached. This threshold voltage varies from device to device and is the voltage required to produce the inversion charge layer.

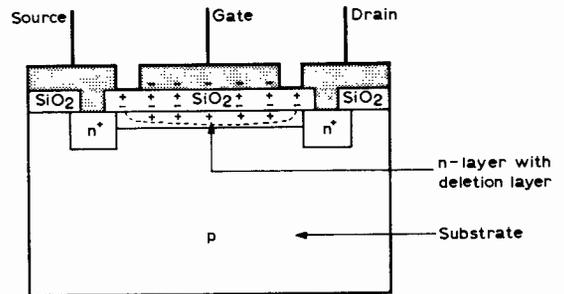


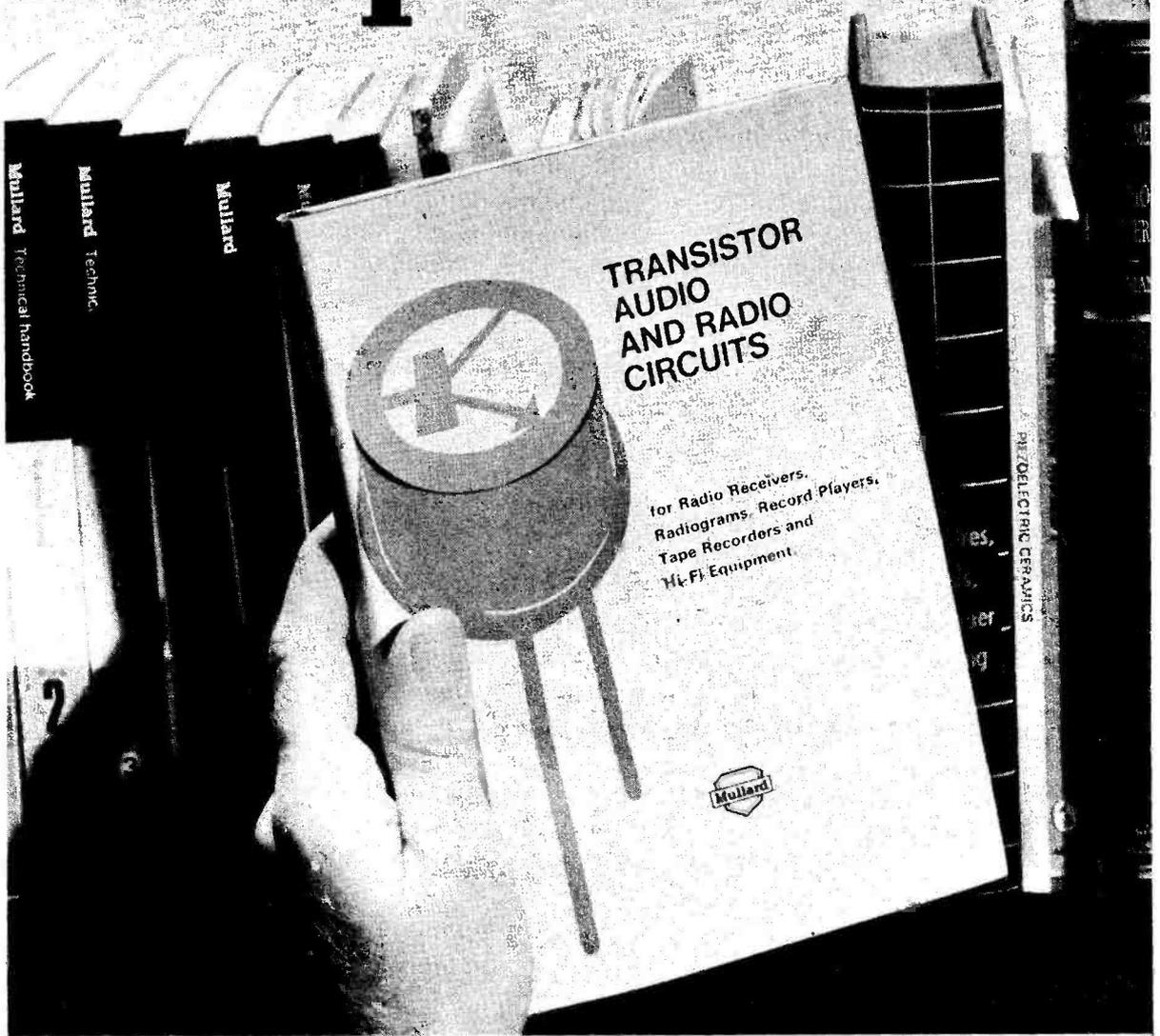
Fig. 6: Depletion-mode i.g.f.e.t. construction.

Depletion Mode Operation

A second type of insulated gate f.e.t. exists, called a depletion type device. This has an n-type layer diffused into the region between the source and drain as can be seen in Fig. 6. Consequently a considerable current flows through the device when there is zero applied gate voltage because of the conductivity of this channel. However if the gate is made negative relative to the

continued on page 622

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P. & P. 7/6



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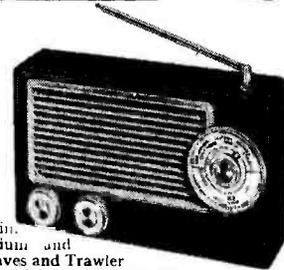
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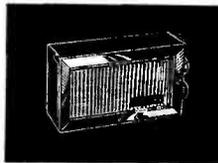
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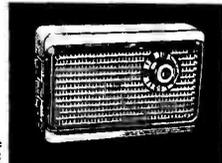
44/6

P. & P.
3/6

transona five

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AND TRAWLER BAND (to 50
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WITH SPEAKER AND EARPIECE

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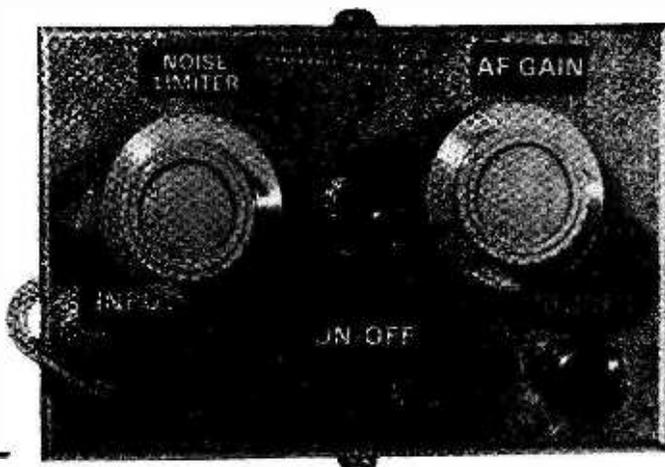
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AUDIO NOISE LIMITER

M. WALLIS



ANYONE who has tried DXing will know that one of the limitations on receiving those prized stations is the background noise, static etc. Frequently one can hear a station below this noise but it cannot be identified for sure because it is swamped by the noise level, and of course increasing the volume doesn't help.

Others may be interested in very old 78r.p.m. records, some of which have a very low modulation level compared with the inevitable scratches; here the audio limiter will work well, although it is primarily designed for radio use, fitting between the phone output socket and the headphones.

Most good communication receivers are fitted with a noise limiter which automatically adjusts itself to limit just above the level of the incoming signal. There is however a strong disadvantage in this system; the limiter will only cut signals above the average and of course the noise itself contributes to that average. Such a limiter, in heavy noise conditions, will limit the peaks of the noise

rather than that of the signal. Simpler non-automatic noise limiters do not suffer from this, but since they cannot be controlled are virtually ineffective on weak signals.

The unit described here not only overcomes these problems but requires no modification to the set; it is a self-powered unit which is fitted between the set and the headphones. It doesn't matter whether the phones' take-off point is immediately after the volume control or across the loudspeaker, it will work equally well on both.

In addition to acting as a limiter in the normal manner it is also extremely effective at reducing the effects of side-band splash caused either by a close adjacent transmission or cross-modulation within the receiver itself. The unit can be adjusted so that the wanted signal is at comfortable listening level and the splash only reaching that level at a maximum. In addition treble cut is incorporated in the circuit making this even less objectionable.

As well as doing all the above it provides audio gain—useful when the audio stages are working flat out and the signal is still too quiet. It has another advantage over more conventional diode type clippers in that it “rounds off” the clipped signal rather than converting it into a sort of square wave which is heard as a nasty “rasping” sound. The same circuit can be used as a speech compressor for transmitters and similar equipment.

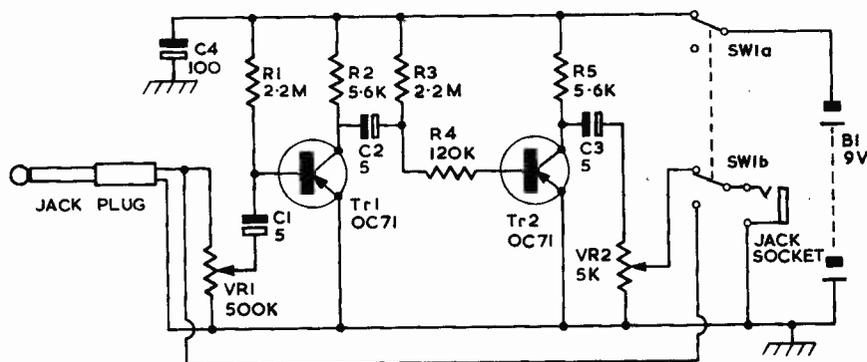


Fig. 1: The audio noise limiter using transistors biased almost to cut-off for clipping noise.

★ components list

Resistors:

R1, 3	2.2MΩ	VR1	500kΩ log.
R2, 5	5.6kΩ	VR2	5kΩ log.
R4	120kΩ		

Capacitors

C1, 2, 3 5μF, 12V

Transistors

Tr1, 2 OC71

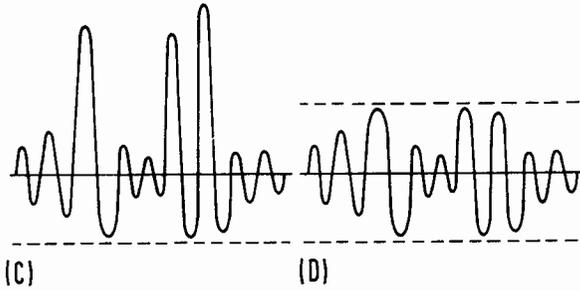
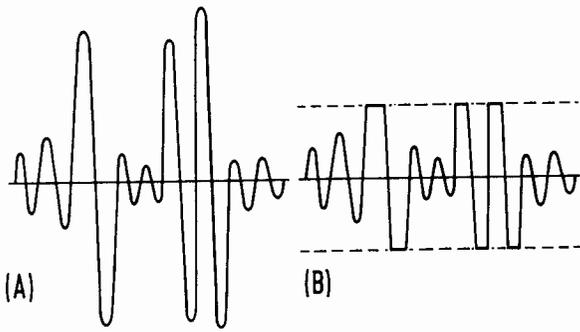
Miscellaneous

SW1 2 pole, 2 way slide switch. Phone jack; 9V battery, knobs, chassis/case, Veroboard, rubber grommet, soldering tags.

The Circuit

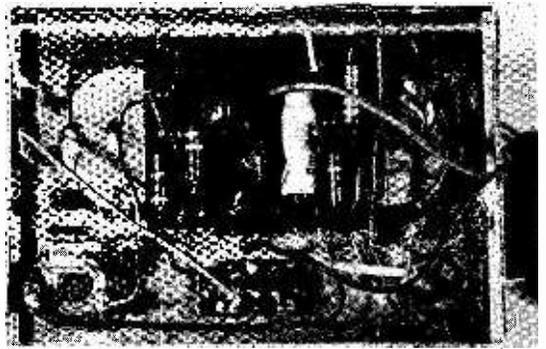
The output from the receiver is connected across VR1, a 500kΩ potentiometer. Its high value prevents it loading previous stages in certain types of radios, at the same time this value works perfectly well for all inputs. (It may be found that with VR1 at its maximum setting the input impedance of the transistor loads previous stages on certain radios. This will not generally matter as the control will rarely be on maximum but can be overcome by fitting a 47kΩ resistor between the input and the top of VR1.)

The signal is fed to the base of Tr1 via C1 which acts



(A) A typical incoming audio signal with noise peaks apparent. (B) A diode type noise limiter will clip the peaks squarely, causing splatter. (C) The first stage of the audio limiter (Fig. 1) will clip and round off the lower peaks. (D) TR2 completes the process by flattening the upper peaks.

as a d.c. blocking capacitor. Tr1 is biased by R1, 2.2MΩ; in small signal conditions this acts as a linear amplifier but with high level signals the positive peaks will bias Tr1 towards cut-off. Phase inversion takes place in Tr1 since it is arranged as a common-emitter amplifier and the signal is fed via C2 to the junction of R3 and R4. R3, 2.2MΩ provides the bias for Tr2 while



The rear view of the limiter.

R4 attenuates the signal so that the cut-off points will be the same as for Tr1.

Negative peaks were unaffected by Tr1 but after inversion they become positive peaks and are limited by Tr2. The output from Tr2 is taken via C3 to the top of VR2 which acts as a straightforward volume control. This is necessary as the level at which it is required to limit is not necessarily the level at which you want to listen.

SW1 in the *on* position as shown in Fig. 1 provides battery power to the unit and also the headphones to the output of the limiter. In the *off* position the battery is disconnected and the phones taken directly to the input, making the limiter inoperative. This enables the limiter to be permanently connected and makes for easy comparison between the corrected and uncorrected signal.

Construction

The prototype was built into a small aluminium case, 4 × 2½ × 2in., which was supplied with a flanged lid. These small instrument cases are fairly widely available but if difficulty is experienced a small aluminium case can be made up or another type of box (even plastic) used. All the components are mounted on the lid as shown in the photograph. The two transistors and associated components are mounted on a small piece of Veroboard 13 × 9 holes.

The centre hole of the board is drilled out to take a 4BA screw and six adjacent holes should have the copper strip removed as shown in Fig. 2. The board itself is mounted behind the two variable resistors on a 1½in. screw and held by a couple of 4BA nuts. A solder tag should be fitted under the top nut and a wire from this taken to the positive strip. Apart from the above points construction is perfectly straightforward if Fig. 2 is carefully followed.

Usage

After checking that all wiring etc. is correct, with the slide switch in the *off* position, plug the unit into the radio and the phones into the unit. Set the volume of the radio to a comfortable level. Now switch the unit on and adjust VR1 to a level just below a point where rasping is heard and distortion is not noticeable. Above this point the limiter is overloaded and the transistors are completely cut off. Next set VR2 to a comfortable listening level. VR1 and VR2 will have to be set for each signal heard but a considerable improvement will be heard between the unit inserted and out of circuit. A little practice to achieve the best balance between receiver volume, limiting level and output level is needed but after this it should be invaluable for DX listening. ■

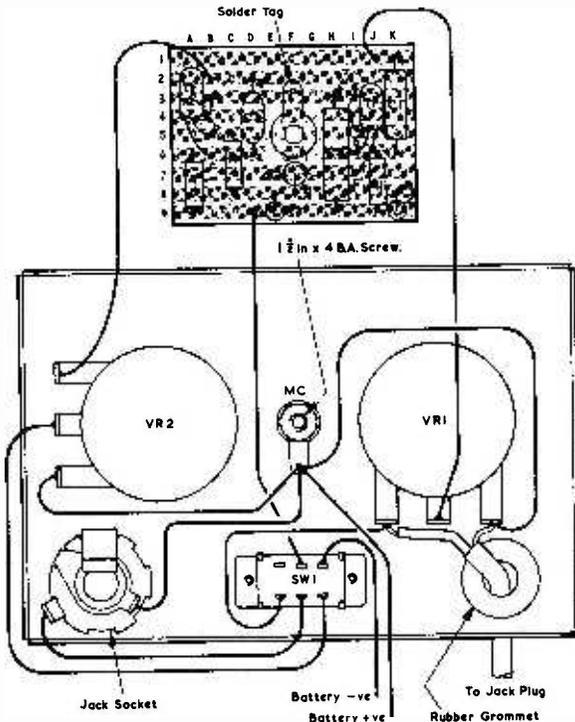


Fig. 2: The rear view chassis layout and component grouping on the Veroboard. The soldering tag connects to F1.

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Communications Receiver 540-10 metres



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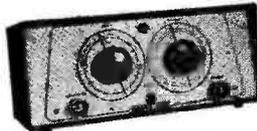
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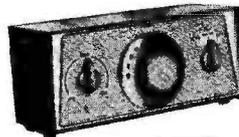
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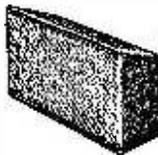
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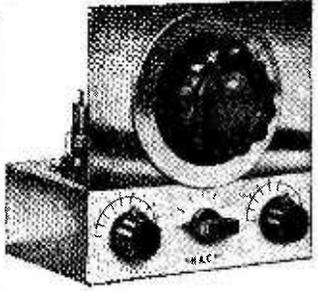
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P.W. GUIDE TO COMPONENTS

PART 12

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

BOTH germanium and silicon diffused diodes are available but due to the greater operating temperature and low reverse leakage of silicon devices they have virtually eliminated germanium diodes for power rectification. Diffused diodes are capable of passing high currents and can be made to close tolerances to give the required reverse characteristics. They are robust and reliable and therefore ideal for general purpose applications.

A further increase in robustness is obtained in the glass encapsulation by using a technique of inserting molybdenum blocks between the junction and the lead-out wires. These blocks match the glass and metal temperature coefficients and thus remove the requirement for the "S"-shaped connection. Such devices are sometimes referred to as "whiskerless diffused diodes" and despite the construction are obtainable at prices between 2s. and 5s. each.

Avalanche Diodes

The avalanche diode is a development of the diffused construction which considerably reduces failures due to reverse voltage transients. To enhance the avalanche breakdown protection the periphery of the diffused junction is chamfered to a fairly critical angle. The slice is then cleaned and the edge treated with varnish or resin.

The chamfering affects the edge irregularities and properties. During transient switch-off the current flows mainly in the periphery of the junction and as a result this technique enables the diode to withstand greater transients. The avalanche rectifier is therefore particularly suitable for applications in which transients are likely to be encountered—such as high-speed power switching. It must be remembered however that the avalanche diode does not have a higher frequency response than the normal diffused

rectifier and is only suitable for power switching below 20kHz before derating for switching losses is necessary.

A development which does lead to an increased working frequency is the addition of gold to the diffused junction. The gold reduces the recombination time of the charges within the junction on switch-off and considerably reduces the switch-off time. Most fast switching rectifiers operating with up to 50kHz squarewaves utilise this modified construction.

Gold-Bonded Diodes

Signal diodes which utilise this addition of gold are referred to as gold-bonded diodes and are available in both silicon and germanium materials. As they are manufactured to give increased frequency of operation germanium is often used and germanium gold-bonded diodes have high frequency characteristics closely approaching those of the point contact diode.

Planar Epitaxial Diodes

Another form of construction which has resulted in increased switching speeds is the planar epitaxial construction. This method of forming the junction utilises silicon dioxide as a masking layer and a photographic etching technique: it is explained fully in other parts in this series. The encapsulation for signal diodes is usually glass as shown in Fig. 8 but plastic encapsulations are now appearing with a resultant reduction in cost.

Planar diodes are reliable and are used in high-speed switching circuits such as computers. Several power rectifiers are now available with this form of construction which gives increased switching performance, although at the present time they are considerably more expensive than diffused rectifiers.

Bridges and Assemblies

The general use in industrial and commercial applications of plastic encapsulation has led to the introduction of diode rectifier assemblies encapsulated in plastics. These assemblies are available in various forms of which the bridge rectifier and centre tapped transformer rectifier configurations shown in Fig. 10 are the most popular. Individual rectifiers, signal diodes and zener diodes are all now available in plastic encapsulations at a considerable saving in cost.

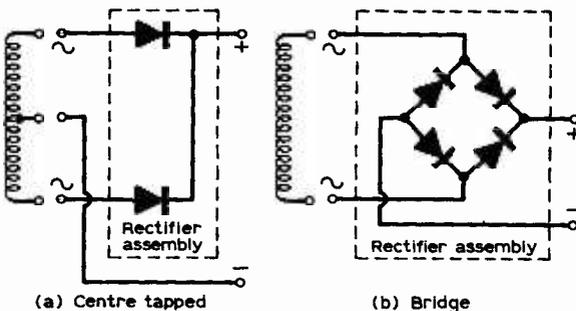


Fig. 10: Basic rectifier assemblies.

Table 4: General comparison of available diodes

Construction	Material	Typical parameters			Encapsulation	Cost	Application
		Maximum forward current	Average reverse current	Reverse voltage			
Point contact	Germanium	50mA	10-500 μ A	30-150V	glass	1s. to 5s.	V.H.F. signal diode
Gold bonded	Germanium	100mA	7-200 μ A	30-150V	glass	1s. 1d. to 5s.	V.H.F. signal diode
Junction	Germanium Silicon	1A 1A	1-100 μ A 0.01-1 μ A	100-800V 100-800V	} glass, metal and plastic	3s. to 10s. 2s. to 10s.	} general purpose
Whiskerless diffused	Silicon	200mA	0.01-1 μ A	50-200V		glass	
Diffusion	Silicon	>250A	0.01-100 μ A	100-1,200V	metal and plastic	see table 1	General purpose and rectification
Planar	Silicon	100mA and 10A	0.001-1 μ A	25-800V	glass, metal and plastic	1s. to £1 £2 upward	Signal Power rectification h.f.
Avalanche diffused	Silicon	>50A	0.01-100 μ A	200-1200V	metal and plastic	10s. upward	Switching and rectification with transients
Bridges	Silicon	>10A	0.01-100 μ A	100-1000V	metal but mainly plastic	11s. to £20	Transformer power rectification

Figure 11 illustrates two bridge encapsulations primarily intended for use as rectifier bridges. Figure 11(a) shows a 1.8A silicon rectifier bridge which can be wired directly to a printed circuit without the necessity of a heatsink. Figure 11(b) shows a 10A silicon rectifier bridge which can be bolted to a heat-sink. Both are considerably smaller than general attempts to mount four diodes to give the same performance.

Conclusion

Table 4 summarises the main methods of construction, their parameters, cost and uses. This should not be regarded as absolute in any parameter or statement but just a typical device range of the

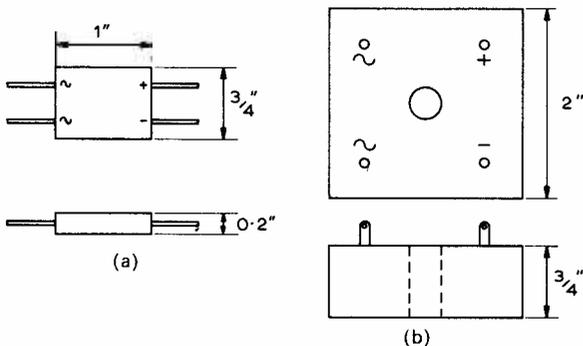


Fig. 11: (a) 1.8A and (b) 10A bridge encapsulations.

particular construction. There are many hundreds of different device types and this article will have served its purpose if the search for a required diode is reduced to a given form of construction.

TO BE CONTINUED

LOW COST VALVE AMPLIFIER

- continued from page 602

★ **components list**

Resistors:

- R1 680k Ω
- R2 68k Ω
- R3 1M Ω high-stab.
- R4 150k Ω high-stab.
- R5 2.7k Ω high-stab.
- R6 100 Ω high-stab.
- R7 150k Ω
- R8 560k Ω
- All 10% 1/4 watt except where stated.
- R9 4.7k Ω
- R10 220k Ω
- R11 10k Ω
- R12 3.3k Ω 1 watt
- R13 820k Ω
- R14 180 Ω 2 watt
- R15 33k Ω
- R16 27k Ω

Capacitors:

- C1 150pF
- C2 1000pF
- C3 620pF
- C4 4700pF
- C5 0.05 μ F 150V
- C6 100 μ F 25V
- C7 0.5 μ F 150V
- C8, C9 8 μ F 350V
- C10 50 μ F 25V
- C11 0.1 μ F 150V
- C12 50 μ F 25V
- C13 100pF
- C14 100pF

Miscellaneous:

- VR1, VR2, VR3 2M Ω log pots.
- V1 EF86
- V2 ECL86

Metal chassis, metal panel (see text); Output transformer (see text); Two B9A valve bases, Suitable power supply.

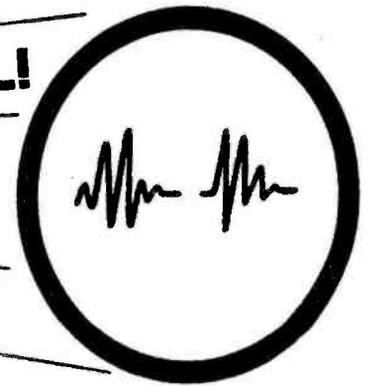
about 6 x 6 x 2 1/2 ins., and the controls on a panel 6 x 2 1/2. No details are given for a power supply as any capable of giving between 200V. and 350V. at 75mA and 6.3V. 1.5A. will do.

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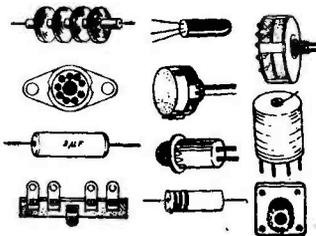
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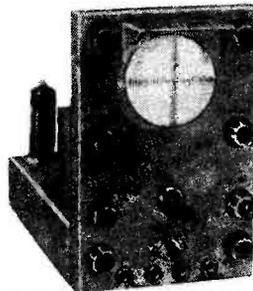
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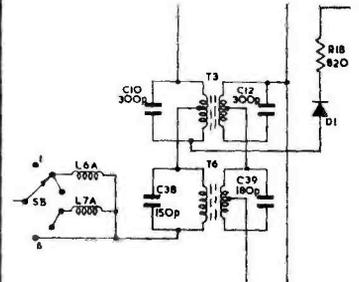


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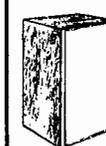
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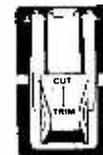
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L.C. MEASUREMENTS

W.D. WATKINS

THIS article is intended to help those constructors and experimenters who like myself have been frustrated in attempting to decide which, out of a number of capacitors or inductors, is the one with the required value. A bridge is undoubtedly the quickest, and possibly the best method, but values may be easily determined by another method employing a grid dip oscillator (g.d.o.), a calibrated capacitor and a coil of an arbitrary value.

The method used is simplicity itself. If the coil is connected across the calibrated capacitor, which should be adjusted to somewhere near its maximum capacitance the combination will resonate at some particular frequency which is determined by use of the grid dip oscillator, with as loose a coupling as possible to prevent "pulling" of the oscillator frequency. The unknown capacitor is now connected across the combination in parallel, and the variable capacitor is reduced in value until the combination once again resonates at the same frequency. Now, since the frequencies are the same, and the coil is the same, the total capacitance must also be the same as before. Thus it must be obvious that the variable capacitor has been decreased in value by an amount which is equal to the value of the unknown capacitor. The value of this is, therefore, simply the difference between the two readings on the calibrated capacitor.

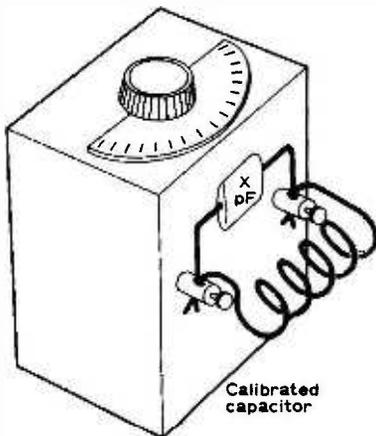


Fig. 1: By placing a G.D.O. near the tuned circuit using the calibrated capacitor, unknown capacitors and inductors are quickly measured.

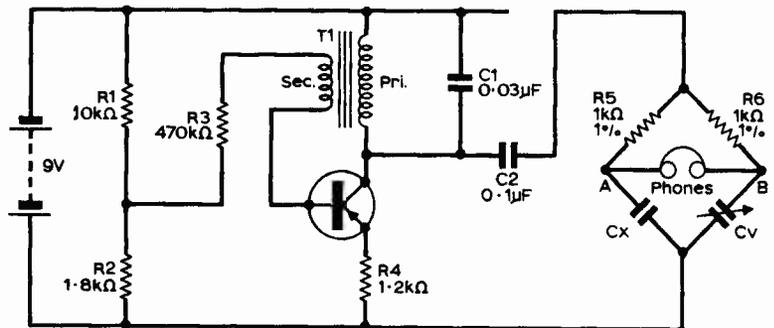
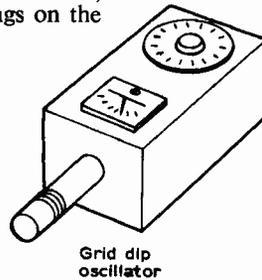


Fig. 2: The circuit used for accurately calibrating the capacitor, shown as Cv above.

The method used in the determination of inductance is slightly different, inasmuch as it involves a small amount of calculation. The unknown inductor is connected as before, across the calibrated capacitor, and the resonant frequency is determined with the grid dip oscillator. The value is now calculated using the formula:

$$f = \frac{1}{2\pi\sqrt{L.C.}}$$

Where f is the measured resonant frequency in Hz, L is the inductance in Henrys, C is the capacitance in Farads.

CONSTRUCTION AND CALIBRATION

The variable capacitor to be employed should be beyond reproach, in that it should be free from any backlash or play in the bearings. Attention to these details will contribute to the final accuracy and quality of the capacitor. The most useful value to use is in the region of 200pF, since this will enable small increments of capacitance to be read off with ease. Larger values may be made up by adding good quality capacitors of known value in parallel. Direct calibration may be used where the actual value of capacitance is marked for each division on the scale, or a calibration graph may be drawn where the angle of rotation of the cursor is plotted against capacitance. The latter is the better method, since a good graph will avoid any errors which may be made in drawing in the individual points using direct calibration. Another advantage is that scales and knobs are available already marked in degrees.

Calibration may be carried out, either by the easiest method of borrowing a bridge from an affluent friend, or a simple bridge may be made up for the purpose. The circuit shown in Fig. 2 will serve.

The oscillator is a simple feedback type which has a frequency of about 1kHz, but if an oscillator is already available with a higher frequency, then it may be used, provided it operates in audible frequency range.

The bridge section uses headphones for detection. The resistors R5 and R6 should be close tolerance high stability types and, for Cx, a number of close tolerance, silvered mica capacitors, with values ranging up to near the maximum value of the capacitor to be calibrated. Where a graph is to be drawn, a smaller number of fixed value capacitors will be required, since the number of points needed in order to draw the graph is less than the number required to give individual points for direct calibration.

When the bridge is at balance, the voltage at point A, equals the voltage

at point B. Therefore, the potential difference across C_x and C_v must be equal. Thus since the values of the resistors are the same with equal potential differences across each, it will follow that the values of capacitors C_x and C_v will be the same. The balance condition for the bridge is, of course, that at which a null point is detected in the phones.

No dimensions in relation to the actual construction are offered, as the types of capacitor available will differ in physical size. The best type to use is one providing a linear relationship between capacitance and angle of rotation.

For the case, plywood or aluminium is suitable, but the terminals should be mounted on a panel of paxolin or synthetic resin-bonded paper in order to minimise losses. For this reason also, it is best not to place the terminals too close together; a separation of about two inches is suitable, whilst bearing in mind the lengths of the wire leads on components which may have to be connected across.

The capacitor terminals should be brought out through the same side of the case as that upon which the capacitor itself is mounted. This will minimise upsetting of the calibration should the case have to be opened for any reason. For ease of dial positioning, a reduction drive should be fitted, which, needless to say, must be free from backlash.

As a final note the constructor will find this simple unit of great value, and apart from the previously mentioned uses, it will be found most useful in a number of other ways which include: frequency comparison, calibration, as a bridge component, etc. ■

its conductivity. A curve showing the variation of drain current with the gate voltage is shown in Fig. 7, where the regions of enhancement and depletion operation are shown. In most applications the substrate is connected to the source terminal. However it can also be used as a second gate terminal.

Because of the very high input impedance of the m.o.s.t. the gate is capable of storing a very small quantity of charge for a long time. This is useful when it is required to measure the voltage of a small capacitor. However it also means that if the gate is left open-circuited small charges induced on it from external static electricity can build up large voltages which are capable of puncturing the very thin insulating layer between the gate and channel. In order to avoid this it is necessary to keep an external short between the gate and source. This is provided by the manufacturers and should not be removed until the device is wired into the circuit. A second method of avoiding this danger is adopted in some devices. This involves a diode built into the device across the vulnerable leads. The breakdown voltage of the diode is arranged to be less than that of the m.o.s.t. so that irreparable damage is not done to the device if an excessive voltage is applied. However this reduces the input impedance of the device which is not therefore suitable for use in very high impedance circuits.

Advantages of f.e.t.s.

The main advantages of field effect transistors over conventional bipolar transistors are as follows:

- (1) They have in general very high input impedances; in the case of the m.o.s.t. this can reach $10^{14}\Omega$. This makes them very useful for measuring voltages from very high impedance sources in such applications as pH measurement, measurement of very small charges etc.
- (2) Except at low frequencies they are much quieter than valves or bipolar transistors. This makes them more suitable for low level amplification where noise is especially important.
- (3) Since they do not rely on the diffusion of minority carriers across a potential barrier—as the bipolar transistor does—they are far more stable with respect to temperature than the conventional transistor.
- (4) The input signal to the gate terminal is measured in volts rather than the millivolts commonly applied to minority carrier devices. This leads to their use in applications where higher voltages are involved, such as high level logic circuits. They can even be used in valve circuits, forming hybrid arrangements, providing the correct voltages are applied to them.
- (5) Lastly but perhaps of most importance there is no offset voltage in their drain current versus drain voltage characteristic so that they are ideally suited for use as analogue switches and in chopper circuits for amplifying small d.c. voltages.

It would appear that these devices are always better than bipolar transistors. However they do have some disadvantages. For example they have a smaller gain-bandwidth product than the normal transistor, and as a switch they have a much greater "on" resistance than the bipolar device does, amounting to several hundred ohms.

TO BE CONTINUED

BASIC SEMICONDUCTOR TECHNOLOGY

—continued from page 610

source, an induced positive charge appears on the surface of the n-type channel layer and as this is composed of relatively immobile charges the conductivity of the channel is decreased. Because the device relies on the reduction in the number of charge carriers as the gate voltage is increased it is called a depletion m.o.s.t. A maximum value of gate voltage which can be applied to this device is set by the field required to reduce the drain current to a negligible value.

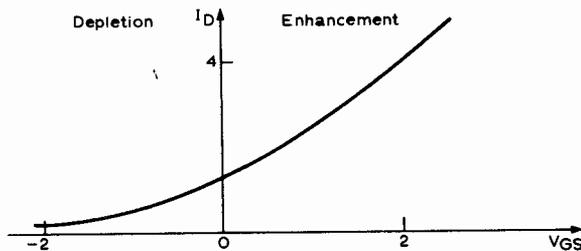


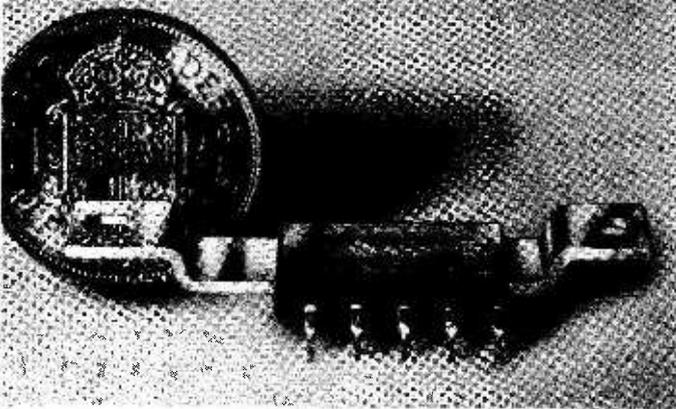
Fig. 7: Curve of drain current against gate voltage for a depletion mode i.g.f.e.t.

This very same device can also be used in the enhancement mode by making the gate positive with respect to the source. In this situation negative charges are induced on the surface of the channel which increase

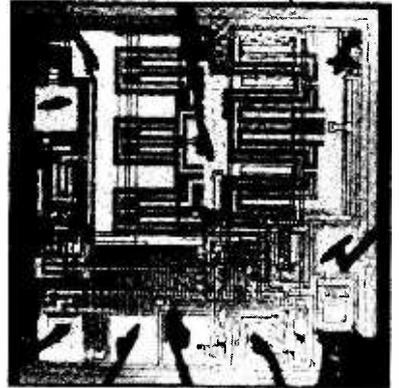
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the world's most advanced high fidelity amplifier

The Sinclair IC-10 is the world's first monolithic integrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself, a chip of silicon only a twentieth of an inch square by a hundredth of an inch thick, has an output of 5 watts R.M.S. (10 watts peak). It contains 13 transistors (including two power types), 2 diodes, 1 zenor diode and 18 resistors, formed simultaneously in the silicon by a series of diffusions. The chip is encapsulated in a solid plastic package which holds the metal heat sink and connecting pins. This exciting device is not only more rugged and reliable than any previous amplifier, it also has considerable performance advantages. The most important are complete freedom from thermal runaway due to the close thermal coupling between the output transistors and the bias diodes and very low level of distortion.

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

■ SPECIFICATIONS

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

■ CIRCUIT DESCRIPTION

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

■ APPLICATIONS

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

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IC.10 *with IC.10
manual and
5 year guar-
antee* **59/6**

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NEW

25 WATTS (50 WATTS PEAK)

HIGH-FIDELITY POWER AMPLIFIER



Z.30

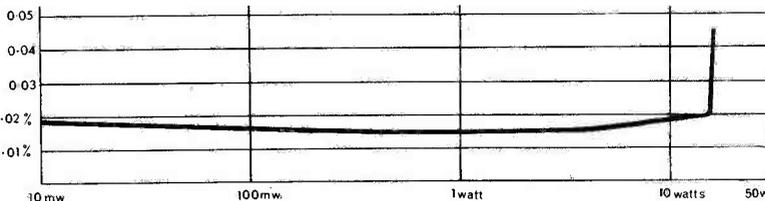
THE WORLD'S LOWEST DISTORTION HIGH FIDELITY AMPLIFIER.

For four years, the Sinclair Z.12 dominated the constructor world, being the best selling unit of its kind this side of the Atlantic. Excellent as it was, the new Sinclair Z.30 is still better. Half the size of the Z.12, it has more than twice the power, very much greater gain and a level of distortion 50 times lower. This incredible figure results from using over 60dB of negative feed back with a constant current load to the driver stage obtained by incorporating a two transistor circuit in place of the more usual boot-strapping. 9 silicon epitaxial planar transistors are used to provide enormous power (up to 20 watts RMS continuous sine wave, 40 watts peak). The circuitry of this marvellous amplifier allows it to be operated from any voltage from 8 to 35 to perfection.

At all output levels, distortion is only 0.02%. This puts true laboratory standards into the hands of every user of a Z.30. Two Z.30s and a new Stereo Sixty will make a stereo assembly of such perfection that it could not be bettered in its class no matter how much you spent. But the Z.30 has an enormous variety of applications, particularly where quality, precision and reliability are essential. Yet this brilliant new Sinclair design costs not a penny more than its famous predecessor.

APPLICATIONS

Hi-fi amplifier; car radio amplifier; record player amplifier fed directly from pick-up; intercom; electronic music and instruments; P.A.; laboratory work, etc. Full details for these and many other applications are given in the manual supplied with the Z.30.



SPECIFICATIONS

Power output: 15 watts R.M.S. into 8 ohms using a 35 volt supply; 20 watts R.M.S. into 3 ohms using a 30 volt supply.

Output: Class AB.

Frequency response: 30 to 300,000Hz \pm 1dB.

Distortion: 0.02% total harmonic distortion at full output into 8 ohms and at all lower output levels.

Signal-to-noise ratio: better than 70dB unweighted.

Input sensitivity: 250mV into 100 Kohms.

Damping factor: > 500.

Loudspeaker impedances: 3 to 15 ohms.

Power requirements: From 8 to 35V. d.c. (The Z.30 will operate ideally from batteries if required).

Size: $3\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$ inches.

Built, tested and guaranteed with circuits and instructions manual

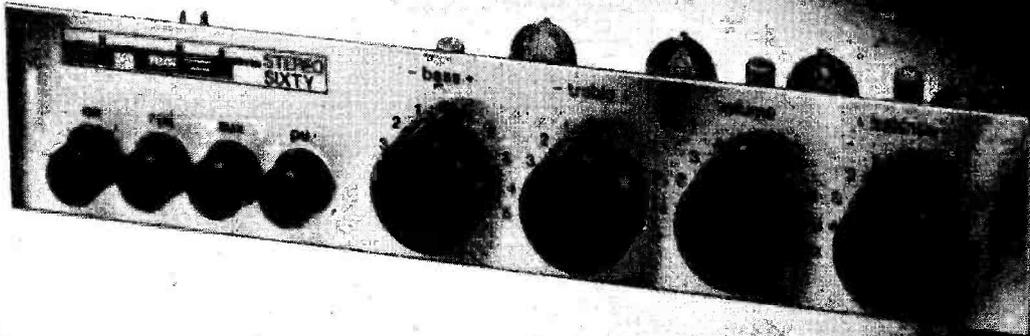
89/6

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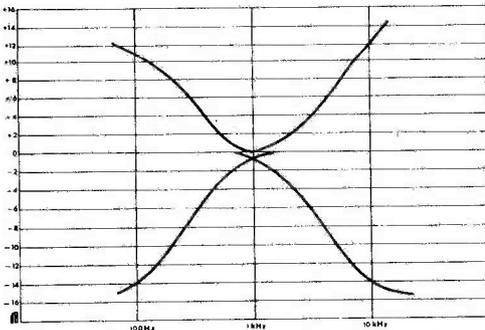
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NEW



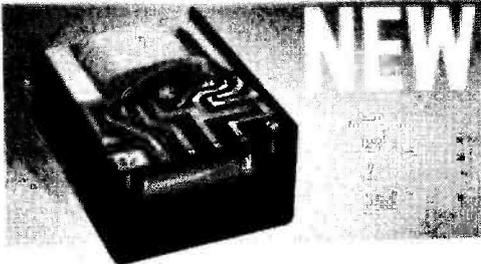
STEREO SIXTY P.W. AMP & TONE CONTROL UNIT



Curves to show bass and treble cut and boost

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This attractive and completely new unit is intended for use with two new Z.30 amplifiers to provide the finest possible standards of stereo reproduction. Four press buttons and four rotary controls are used to provide on-off, three input selectors and Volume, Bass cut/boost, Treble cut/boost and Stereo balance. The on-off button also switches the power amplifiers. The front panel in brushed aluminium is flush mounted to the cabinet front, it being necessary only to drill holes to accommodate the controls. Rear adjustable brackets hold the chassis tight to the cabinet. The very latest ganged rotary controls are used to afford compactness and extra long working life free from noise.

The Stereo-60 may also be used with 2 IC-10's or any other high performance amplifiers.

SPECIFICATIONS

- Input sensitivities—Radio—up to 3mV
Magnetic Pickup—3mV; correct to R.I.A.A. curve ± 1 dB; 20 to 25,000 Hz.
Ceramic Pickup—up to 3mV; Auxiliary—up to 3mV.
- Output—1 volt.
- Signal-to-noise ratio—better than 70dB.
- Channel matching—within 1dB
- Tone Controls—TREBLE ± 15 to -15 dB at 10kHz. BASS ± 15 to -15 dB at 100Hz.
- Power consumption 5mA.
- Front panel—brushed aluminium with black knobs and controls.
- Size $8\frac{1}{2} \times 1\frac{1}{2} \times 4$ ins.

PZ.5 POWER SUPPLY UNIT

A new heavy duty mains power supply unit designed specially to drive two Z.30s and a Stereo Sixty. New compact design.

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Q.16 Loudspeaker and Micromatic on next page.

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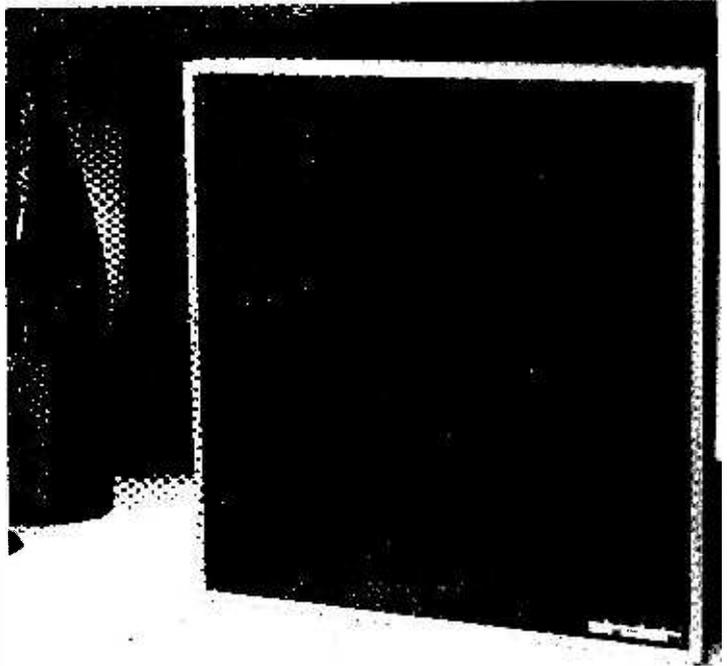
PW.1269

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Q.16

new elegance in an outstanding loudspeaker

All the superb features which went to make the Sinclair Q.14 have been incorporated in the new Q.16 which gives an exciting new opportunity for you to match your Sinclair equipment with modern decor. Employing the same well proven acoustic system in which materials, processing and styling are used in such a radical and successful departure from conventional design, the new Q.16 presents an entirely new appearance with its attractive teak surround and all-over special cellular foam front chosen as much for its appearance as for its ability to pass all audio frequencies without loss. The Q.16 is compact and slim. Its new styling makes it eminently suitable for shelf mounting, but it is no less versatile than its famous predecessor. Listen to a pair of Q.16s in stereo and marvel at the standards of quality and clarity they give.



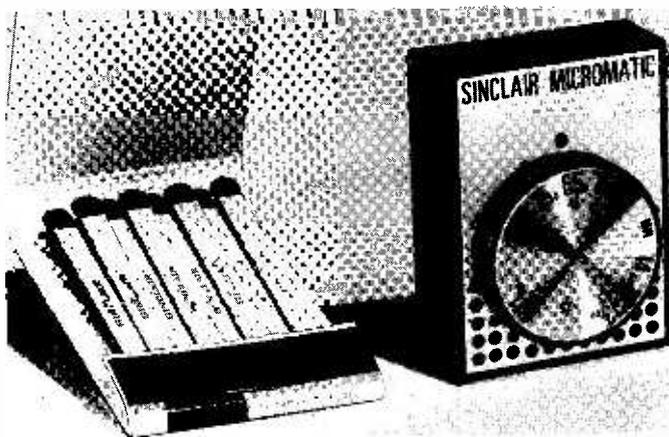
The Q.16 will handle loading up to 14 watts R.M.S. and presents an 8 ohm impedance to the amplifier output. Frequency response extends from 60 to 16,000Hz with exceptional smoothness. A specially designed driver system is used in a sealed and contoured pressure chamber to ensure good response at all frequencies. Size: 9 $\frac{1}{2}$ " square \times 4 $\frac{1}{2}$ " deep from front to back.

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SINCLAIR MICROMATIC

The world's most successful miniature radio



SPECIFICATIONS—Size: 1 $\frac{13}{16}$ " \times 1 $\frac{7}{16}$ " \times $\frac{1}{2}$ " (46 \times 33 \times 13mm). **Weight incl. batteries:** 1 oz. (28.35gm) approx. **Tuning:** Medium wave band with bandspread at higher frequency end. **Earpiece:** Magnetic type. **Case:** Black plastic with anodized aluminium front panel, spun aluminium dial.

Complete kit incl. earpiece, case, solder and instructions in fitted pack. **49/6**

Plus 11d. P.T. surcharge Ready built, tested and guaranteed, with earpiece. **59/6**

Plus 1/1d. P.T. surcharge Mallory Mercury Cell RM675 (2 req.) 2/9 each

Considerably smaller than an ordinary box of matches, this is a multi-stage A.M. receiver meticulously designed to provide remarkable standards of selectivity, power and quality. Powerful A.G.C. is incorporated to counteract fading from distant stations; bandspread at higher frequencies makes reception of Radio 1 easy at all times. Vernier type tuning plus the directional properties of the self-contained special ferrite rod aerial makes station separation much easier than with many larger sets. The plug-in magnetic earpiece which matches exactly with the output provides wonderful standards of reproduction.

Everything including the batteries is contained within the attractively designed case. Whether you build your Micromatic or buy it ready built and tested, you will find it as easy to take with you as your wrist-watch, and dependable under the severest listening conditions.

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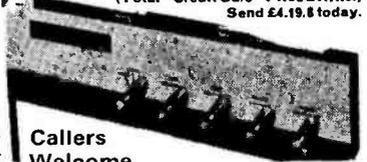
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18025	3/1	2N2923	4/1	AD148	11/6	BD147	10/6	MPF103	7/6
18113	3/1	2N2924	4/1	AD161	7/6	BF167	7/6	MPF104	7/6
18120	2/6	2N2925	3/6	AD162	7/6	BF173	7/6	MPF105	7/6
18121	2/6	2N2926	6/1	AF114	5/1	BF180	7/1	NKT0018	3/6
18130	2/6	Green	3/1	AF116	5/1	BF181	6/6	NKT216	7/6
18131	2/6	Yellow	2/6	AF117	5/1	BF184	7/6	NKT217	7/6
18132	2/6	Orange	3/6	AF118	13/6	BF194	5/1	NKT261	4/1
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2G303	4/1	2N3055	15/1	AF127	3/6	BFX30	9/6	NKT272	5/1
2G371	3/1	2N3702	3/6	AF129	7/6	BFX35	19/6	NKT274	4/1
2N2696	4/6	2N3703	4/6	AF181	8/6	BFX43	8/6	NKT275	4/1
2N2697	5/1	2N3704	4/6	AF186	11/1	BFX44	3/6	NKT281	5/6
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2N3040	6/6	2N4106	3/6	BC164	3/6	BX860	3/6	OC92	4/6
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2N3045	6/6	2N4111	3/6	BC169	3/6	BX865	3/6	OC97	4/6
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2N3050	6/6	2N4116	3/6	BC174	3/6	BX870	3/6	OC102	4/6
2N3051	6/6	2N4117	3/6	BC175	3/6	BX871	3/6	OC103	4/6
2N3052	6/6	2N4118	3/6	BC176	3/6	BX872	3/6	OC104	4/6
2N3053	6/6	2N4119	3/6	BC177	3/6	BX873	3/6	OC105	4/6
2N3054	6/6	2N4120	3/6	BC178	3/6	BX874	3/6	OC106	4/6
2N3055	6/6	2N4121	3/6	BC179	3/6	BX875	3/6	OC107	4/6
2N3056	6/6	2N4122	3/6	BC180	3/6	BX876	3/6	OC108	4/6
2N3057	6/6	2N4123	3/6	BC181	3/6	BX877	3/6	OC109	4/6
2N3058	6/6	2N4124	3/6	BC182	3/6	BX878	3/6	OC110	4/6
2N3059	6/6	2N4125	3/6	BC183	3/6	BX879	3/6	OC111	4/6
2N3060	6/6	2N4126	3/6	BC184	3/6	BX880	3/6	OC112	4/6
2N3061	6/6	2N4127	3/6	BC185	3/6	BX881	3/6	OC113	4/6
2N3062	6/6	2N4128	3/6	BC186	3/6	BX882	3/6	OC114	4/6
2N3063	6/6	2N4129	3/6	BC187	3/6	BX883	3/6	OC115	4/6
2N3064	6/6	2N4130	3/6	BC188	3/6	BX884	3/6	OC116	4/6
2N3065	6/6	2N4131	3/6	BC189	3/6	BX885	3/6	OC117	4/6
2N3066	6/6	2N4132	3/6	BC190	3/6	BX886	3/6	OC118	4/6
2N3067	6/6	2N4133	3/6	BC191	3/6	BX887	3/6	OC119	4/6
2N3068	6/6	2N4134	3/6	BC192	3/6	BX888	3/6	OC120	4/6
2N3069	6/6	2N4135	3/6	BC193	3/6	BX889	3/6	OC121	4/6
2N3070	6/6	2N4136	3/6	BC194	3/6	BX890	3/6	OC122	4/6
2N3071	6/6	2N4137	3/6	BC195	3/6	BX891	3/6	OC123	4/6
2N3072	6/6	2N4138	3/6	BC196	3/6	BX892	3/6	OC124	4/6
2N3073	6/6	2N4139	3/6	BC197	3/6	BX893	3/6	OC125	4/6
2N3074	6/6	2N4140	3/6	BC198	3/6	BX894	3/6	OC126	4/6
2N3075	6/6	2N4141	3/6	BC199	3/6	BX895	3/6	OC127	4/6
2N3076	6/6	2N4142	3/6	BC200	3/6	BX896	3/6	OC128	4/6
2N3077	6/6	2N4143	3/6	BC201	3/6	BX897	3/6	OC129	4/6
2N3078	6/6	2N4144	3/6	BC202	3/6	BX898	3/6	OC130	4/6
2N3079	6/6	2N4145	3/6	BC203	3/6	BX899	3/6	OC131	4/6
2N3080	6/6	2N4146	3/6	BC204	3/6	BX900	3/6	OC132	4/6
2N3081	6/6	2N4147	3/6	BC205	3/6	BX901	3/6	OC133	4/6
2N3082	6/6	2N4148	3/6	BC206	3/6	BX902	3/6	OC134	4/6
2N3083	6/6	2N4149	3/6	BC207	3/6	BX903	3/6	OC135	4/6
2N3084	6/6	2N4150	3/6	BC208	3/6	BX904	3/6	OC136	4/6
2N3085	6/6	2N4151	3/6	BC209	3/6	BX905	3/6	OC137	4/6
2N3086	6/6	2N4152	3/6	BC210	3/6	BX906	3/6	OC138	4/6
2N3087	6/6	2N4153	3/6	BC211	3/6	BX907	3/6	OC139	4/6
2N3088	6/6	2N4154	3/6	BC212	3/6	BX908	3/6	OC140	4/6
2N3089	6/6	2N4155	3/6	BC213	3/6	BX909	3/6	OC141	4/6
2N3090	6/6	2N4156	3/6	BC214	3/6	BX910	3/6	OC142	4/6
2N3091	6/6	2N4157	3/6	BC215	3/6	BX911	3/6	OC143	4/6
2N3092	6/6	2N4158	3/6	BC216	3/6	BX912	3/6	OC144	4/6
2N3093	6/6	2N4159	3/6	BC217	3/6	BX913	3/6	OC145	4/6
2N3094	6/6	2N4160	3/6	BC218	3/6	BX914	3/6	OC146	4/6
2N3095	6/6	2N4161	3/6	BC219	3/6	BX915	3/6	OC147	4/6
2N3096	6/6	2N4162	3/6	BC220	3/6	BX916	3/6		



MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at 8/6 each. 30/- dozen, your assortment

WATERPROOF HEATING ELEMENT

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

A Micro Meter bargain. Limited quantity only, centre zero 50-0-50 micrometers. This is a Weston Meter enclosed in clear perspex case for flush mounting. Dial size approximately 2 1/2 in. wide. The scale is not engraved but has a red part in the centre and a green part to the left of centre. Scale could be cleaned off and re-written to suit your particular requirements. Regular price probably over £5 each, our price 29/6 each.

Battery Record Player. Made by Collaro. This is made up on a unit plate with speed selector and pick-up. The turntable is a heavy one and measures approximately 9 1/2 in. Pick-up is fitted with the famous "Studio" cartridge. Price 69/6, postage and insurance 6/6.

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

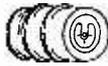
85 Watt Tubular Element. Very well made unit. The element is wound on a porcelain former then encased in a brass tube terminated with beaded leads 12 in. long. Normal mains voltage. Price 5/- each or 54/- per doz.

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

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

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

1/40th h.p. Motor. Made by the French (Cassor) Company. This is an excellent totally enclosed motor, powerful enough to operate small lathe, drilling machine, washing machine, etc. It's speed is 1,450 r.p.m. Made to take normal 50 cycle, 220/230 volt mains, totally enclosed, size 2 1/2 x 3 1/2 in. with 1 1/2 in. of 1/2 in. spindle. Price 19/6 plus 4/6 postage and insurance.



NICAD RECHARGEABLE BATTERIES

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

ELECTRIC CLOCK WITH 25 AMP SWITCH

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

INDICATOR LAMP

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

BECKASTAT

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

SOLDER GUN

A must for every busy man. Gives almost instant heat, also illuminates job. 100 watt 220/240v. 39/6 (saves you over 30/-), post & ins. 4/6. BIG JOB 250 watt model 99/6 (saves you over £5.10.0), post & ins. 6/6.

FLEX BARGAINS

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

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

10 Amp 3 Core Non-kink Flex. As above but cores are 25/0076 Copper. Normal price 2/6 per yd. 100 yd. coil £2.10.0, or cut to your length 1/9 yd. coil 2/7.10.0. As above, but 2 Cores each 20/0076 as used for Vacuum Cleaners, Electric Blankets, etc. 39/6 100 yd. coil. 70/0076 Triple Core P.V.C. covered, circular, normally sold at 1/6 yd. Our price 100 yd. coil £3.19.8. Post and insurance 6/6.



ELECTRIC TIME SWITCH

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

STEREO CABINET

Size 25in. x 14in. x 9 1/2 in deep—speaker compartment each end. Centre portion with record lid and removable bottom has platform for autochanger and room for amplifier. Two tone (red and grey) rexine covered but loud speaker ends need metal grilles. With handle and clips, 22/6. Carriage and packing 15/-.



'GLADIATOR' 2 WAVE BAND TRANSISTOR RADIO

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



CONTROL DRILL SPEEDS

DRILL CONTROLLER

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. 19/6 plus 3/6 post and insurance. Made up model 37/6 plus 2/6 p. & p.



TANGENTIAL HEATER UNIT



THIS MONTH'S SNIP

Winter is coming but set today and you won't dismay. This heater unit is the very latest type, most efficient and quiet running. Is as fitted in Hoover and blower heaters costing 415 and more. We have a few only. Units complete, wired ready to fit into cases i.e. motor impeller, 3 kw, heater switching 1, 2 and 3 kw, with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only needs on/off switch. 79/6, postage & insurance 6/6. Don't miss this.

3 STAGE PERMEABILITY TUNER

This Tuner is a precision instrument made by the famous "Clydon" Company for the equally famous Radiomobile Car Radio. It is a 3 stage tuner (3m) range of longwave coils available as an extra if required with a frequency coverage 1620 Kc/s-525 Kc/s and intended to operate with an I.F. value of 470 Kc/s. Extremely compact (size only 2 1/2 x 2 1/2 in. thick) with reduction gear for fine tuning. Snip price this month 12/6, with circuit of front end suitable for car radio or as a general purpose tuner for use with Amplifier. Post Free.

DISTRIBUTION PANELS

Just what you need for work bench or lab. 13 x 13 amp sockets in metal box to take standard 13 amp fused plugs. Supplied complete with 6 feet of heavy cable and 13 amp plug. Similar advertised at 25. Our price 39/6, +4/6 P & I.

VARYLITE

Will dim incandescent lighting up to 600 watts from full brilliance to out. Fitted on M.K. flush plate, same size and fixing as standard wall switch so may be fitted in place of this. Also fits in surface. Price complete in heavy plastic box with control knob £3.19.8.

BUY TIME SLOT METERS

If you hire out equipment such as TV sets by the hour then these slot meters are what you require. We have 3 types, £3. an hour, 1 1/2 an hour and 1 1/2 an hour. Brand new. Made by the famous Weston Company. Price £3.19.8, postage and insurance 6/6.

THERMOSTAT WITH PROBE

This has a sensor attached to a 15A switch by a 1 1/2 in. length of flexible capillary tubing—control range is 20°F to 160°F so it is suitable to control soil heating and liquid heating especially when in buckets or portable vessels as the sensor can be raised out and lowered into the vessel. This thermostat could also be used to sound a bell or other alarm when critical temp. is reached in stack or heap subject to spontaneous combustion or if liquid is being heated by gas or other means not controllable by the switch. Made by the famous Teddington Co., we offer these at 12/6 each. Postage and insurance 2/9.

HI FI BARGAIN

FULL F1 12 INCH LOUDSPEAKER. It is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi Band and Rhythm Guitar and total address. Flux Density 11,000 gauss—Total Flux 44,000 Maxwells—Power Handling 16 watts R.M.S. Cone Moulded fibre—Freq. response 30-10,000 c.p.s.—specify 3 or 15 ohms—Mains resonance 60 c.p.s.—Chassis Diam. 12in.—12in. on mounting lugs—Baffle hole 11in. Diam.—Mounting holes 4, holes —1 1/2 in. diam. on pitch circle 11 1/2 in. diam.—Overall height 6 1/2 in. A 48 speaker offered for only £3.8.6 plus 7/6 p. & p. Don't miss this offer. 15in. 50 watt £7.19.8. 18in. 100 watt £24.10.0.

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

REED SWITCHES

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

Miniature. 1in. long x approximately 1/4 in. diameter. Will make and break up to 1/2 amp up to 300 volts. Price 2/6 each, 24/- dozen.

Standard 2in. long x 5/16in. diameter. This will break currents of up to 1 amp, voltages up to 250 volts. Price 2/- each, 18/- per dozen.

Flat. Flat type, 2in. long, just over 1/16in. thick, approximately 1/4 in. wide. The Standard Type flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1 amp, 200 volts. Price 6/- each, 48/- per dozen.

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

ROTISSERIE MOTOR

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

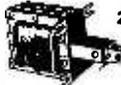
EXTRACTOR FAN

Cleans the air at the rate of 10,000 cubic ft. per hour. At great grime and cooking smells before they dirty decorations. Suitable for kitchens, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 6in. casing with 5 1/2 in. fan blades. Suitable wherever it is necessary to move air fast. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector and fixing brackets. 39/6 +6/6 post and ins.



230 VOLT SOLENOID

1/2 in. stroke. Size 2 1/2 in. x 2 1/2 in. x 1 1/2 in. 14/6, postage 2/9.



FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-sealed, mostly resting on Kit A—15-20 w. 19/6, Kit B—30-40w. 19/6, Kit C—50 w. 19/6, Kit E—65 w. 19/6, Kit MFI is for 6in., 9in., and 12in. miniature tubes, 19/6. Postage on Kits A and B 4/6 for one or two kits then 4/6 for each two kits ordered. Kits C, D and E 4/6 on first kit then 3/6 for each kit ordered. Kit MFI 3/6 on first kit then 3/6 on each two kits ordered.

DEAC RECHARGEABLE BATTERY

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

MAINS TRANSFORMER SNIP

Making a power pack for amplifier or other equipment? These transformers have normal mains primaries (230/240v.) and isolated secondaries two types (1) 12v. 500mA at 8/6; (2) 15v. 600 mA at 8/6.

THERMOSTATS

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

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

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

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

Type "F". Glass encased for controlling the temp. of liquid—particularly those in glass tanks, vats or sinks—thermostats is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developers and chemical baths of all types. Adjustable over range 50° to 150°F. Price 18/6 plus 2/- post and insurance.

ELECTRONICS (CROYDON) LTD

Dept PW 266 London Road, Croydon CRO-2TH
Also 102/3 Tamworth Road, Croydon

Sonotone 9TA and 9TA/HC. Diamond Cartridge brand new, boxed in manufacturers' carton 49/6 plus 2/6 p/p. Acos GP 91-1 and GP 91-3 stereo compatible cartridges, new in sealed manufacturers' cartons 22/6 plus 2/6 p/p.

BASF TAPE 25% OFF

5in. 600ft. 14/- 900ft. 19/- 1200ft. 30/-
 5½in. 900ft. 19/- 1200ft. 24/- 1800ft. 39/-
 7in. 1200ft. 24/- 1800ft. 35/- 2400ft. 57/-
 P/P 2/- per reel—over £5 FREE

SPECIAL PURCHASE

12in. 15 watt HI-FI LOUDSPEAKERS

Made by famous British manufacturer to very high standards, heavy duty cast chassis, twin cone construction, smooth extended range, with very low level of distortion.—Response 35-17,500Hz.—impedance 15 ohms—flux, 11,000 gauss.

WALDON PRICE 97/6 each plus 6/6 P. & P.

E.M.I. HI-FI SPEAKERS

SET 450: 13 x 8 with two built-in tweeters and cross-over unit. Our Price 69/6 3 or 15 ohm, 10W, 40-13,000Hz.

SET 850: 6½in. bass plus 3½in. tweeter and cross-over unit. 8 ohm, 10W, 65-20,000Hz. 79/6

SET 250: 5in. heavy duty bass plus 3in. tweeter and cross-over unit. 8 ohm, 6W, 80-20,000Hz. 65/-

Add 5/6 p/p for each speaker set.

TRIO Stereo Moving Magnet Cartridge Model AD76K. Diamond Stereo LP Stylus. Frequency response 20-20,000c/s output. 7mV tracking pressure 2 grammes ± 0.5 gm. Fully guaranteed. Price 85/- p/p free.

GARRARD UNITS

	£	s	d
SP25 Mk. II	11	9	6
AP75	17	19	6
SL65	14	9	6
*3500	11	9	6

*Denotes including Sonotone 9TA-Stereo/Diamond Cartridge. Elegantly styled plinth and cover to suit the above units. From 5 gns. Please add 10/- p/p each on all above items.

SPEAKER ENCLOSURES

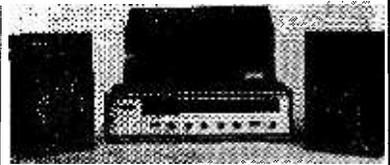
Designed to accept the full range of E.M.I. loudspeakers. Beautifully styled in teak.

Prices from **89/6** each.

25 WATT GROUP SPEAKERS

Guitar group 25. 12in. round, heavy duty cone, with solid aluminium chassis, 15 ohms imp. 12,000 gauss. Response 30-10,000c/s. OUR SPECIAL PRICE

£5.9.6 plus 6/6 P. & P.



The greatest budget system available today—can't be beaten—price or quality anywhere—look at these great features—then compare:

Teleton FZ000 Mk. II. Tuner amp. Latest version with all the new features. Tuning indicator—fused circuit protection, AM-FM fitted multiplex, A.F.C. 2 x 5 watts per channel. A truly outstanding unit. £ 43 s 1 d 8

Garrard 3500 (Auto/single). Latest in the great new Garrard range, provides facilities and controls that are usually found only on much more expensive units. 13 11 0

Teleton SA1003 matching speaker systems. 10 0 0

Sonotone 9TA stereo cartridge with diamond styli—a perfect match. 4 2 0

Plinth/Cover elegantly styled. 7 0 0

Plugs and Leads all supplied. 1 5 0

Normal Retail Price £78 19 8

Exclusively offered by **WALDON 63 gns** + 25/- at the remarkably low price of **63 gns** Carr.

All items may be purchased separately.

WALDON ELECTRONICS, 707 Blackburn Road, Bolton, Lancs. Bolton 54280

PLEASE ENCLOSE 2/- IN STAMPS WITH ENQUIRIES



RANGE OF SOLID STATE A.C. MAINS AMPLIFIERS

Employing only high grade components and transistors.



LT55 6 WATT AMPLIFIER

A HIGH FIDELITY UNIT PROVIDING EXCELLENT RESULTS AT MODEST OUTPUT LEVELS.

Sensitivity 5 mv (max).
 Frequency Response 30-20,000 cps—2dB
 Harmonic Distortion 0.5% at 1,000 cps
 Output for 3-8-15 ohm Loudspeakers.
 Input Sockets for "Mike," Gram and Radio Tuner/Tape Recorder.

Recommended **£10**

Retail price
 Size 9½ x 2½ x 5½in.
 Controls (5) Volume, Bass, Treble, Mains Switch, Input Selector Switch.

LT66 12 WATT STEREO AMPLIFIER

A TWIN CHANNEL VERSION OF THE LT55 PROVIDING UP TO 6 WATTS HIGH FIDELITY OUTPUT ON EACH CHANNEL.

Switched Input Facilities
 Socket (1) Tape or crystal PU
 (2) Radio Tuner (3) Ceramic PU Microphone.

Controls (6) Volume, Bass, Treble, Balance, Mains Switch, Input Selector Switch, Stereo/Mono Switch.

Facia Plate Rigid Perspex with black/silver background and matching black edged knobs with spun silver centres.



Recommended Retail price **18 gns**
 Size 12 x 3½ x 6in.

If required an attractive wood cabinet with veneer finish can be supplied for any model. Prices from **70s.**

Please send a stamped addressed envelope for full details of above units, also TUNER/AMPLIFIERS STEREO and MONO

AVAILABLE FROM YOUR LOCAL HI-FI DEALER

Wholesale and Retail enquiries to:

LINEAR PRODUCTS LTD, Electron Works, Armley, Leeds

WIRECOMP ELECTRONICS

LONDON'S LEADING BARGAIN SPECIALISTS FOR THE RADIO • HI-FI & ELECTRONICS ENTHUSIAST

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AT GIVE AWAY PRICES!

100's of component bargains from our easy to see and choose from self service racks.

100's OF OLD TYPE VALVES — from 2/- each

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Huge stocks of shop soiled and reconditioned second hand radios, record players, tape recorders, etc.

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DUXFORD ELECTRONICS

ELECTROLYTIC CAPACITORS (Mullard)—10% to + 50%.

Working Voltage (V)—Capacitance (μF)					Price each	10 off	25 off	100 off
4V	6.4V	10V	16V	25V	40V	64V		
8	6.4	4	2.5	1.6	1	0.64	1/4	12/4
32	25	16	10	6.4	4	2.5	1/2	10/6
64	50	32	20	12.5	8	5	1/2	10/4
125	100	64	40	25	16	10	1/-	8/9
250	200	125	80	50	32	20	1/1	9/6
400	320	200	125	80	50	32	1/2	10/4
800	640	400	250	160	100	64	1/6	13/4
1250	1000	640	400	250	160	100	2/-	18/10
2000	1600	1000	640	400	250	160	2/6	22/3
3200	2500	1600	1000	640	400	250	3/-	26/9
				800	500	320	5/3	46/6
				1250	800	500	6/6	57/6
				2000	1250	800	8/-	71/4
				4000	2500	1600	12/6	91/6
				6400	4000	2500	15/-	133/4

POLYESTER CAPACITORS (Mullard)

Tubular, 10%, 160V:
Prices per Capacitance value (μF)

each	10 off	25 off	100 off
0.01, 0.015, 0.022, 0.033, 0.047, 0.068	7d.	5/1	10/11
0.1	7d.	5/8	11/10
0.15	8d.	6/6	13/6
0.22	9d.	6/8	14/3
0.33	11d.	7/6	16/6
0.47	1/-	8/2	17/9
0.68	1/3	10/11	23/3
1.0	1/6	13/2	28/1
	2/3	19/7	42/3
	2/8	23/4	48/9

Tubular, 10%, 400V:
Prices per Capacitance value (μF)

each	10 off	25 off	100 off
0.001, 0.0015, 0.0022, 0.0033, 0.0047, 0.0068, 0.01, 0.015, 0.022, 0.033, 0.047, 0.068	6d.	4/5	9/9
0.1	6d.	4/6	9/10
0.15	7d.	5/1	10/11
0.22	7d.	5/2	11/10
0.33	7d.	5/3	12/-
0.47	8d.	5/8	12/7
0.68	9d.	6/7	14/5
1.0	11d.	7/8	16/7
	11d.	8/-	17/2
	1/2	10/3	22/-
	1/6	14/3	28/5
	2/3	19/7	42/3
	2/8	23/4	48/9

Modular, metallised, P.C. mounting, 250V:
Prices per Capacitance value (μF)

each	10 off	25 off	100 off
0.01, 0.015, 0.022, 0.033, 0.047, 0.068	7d.	5/2	11/3
0.1	7d.	5/4	11/9
0.15	8d.	5/11	12/10
0.22	9d.	6/7	14/1
0.33	9d.	6/9	14/9
0.47	11d.	8/2	18/-
0.68	1/-	8/9	18/11
1.0	1/5	12/6	27/-
	1/8	14/8	31/9
	2/3	19/10	43/2
	2/9	23/8	49/8

CAPACITORS
Subminiature Polyester film, Modular for P.C. mounting. Hard epoxy resin encapsulation. Radial leads. ±10% tolerance. 100 Volt Working. Prices—per Capacitance value (μF)

each	10 off	25 off	100 off
0.001, 0.002, 0.005, 0.01, 0.02, 0.05, 0.1, 0.2	6d.	4/3	8/4
	8d.	6/-	12/6
	10d.	7/1	15/6
	1/2	10/-	20/10

Polyethylene film, Tubular, Axial leads. Unencapsulated. ±5% or ±1% tolerance. 160 Volt Working. Prices—per Capacitance value (μF)

each	10 off	25 off	100 off
10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82, 100, 120, 180, 220, 270, 330, 390, 470, 560, 680, 820, 1,000, 1,500, 2,200, 3,300, 4,700, 5,600, 6,800, 8,200, 10,000, 15,000, 22,000	5d.	3/7	7/9
	6d.	4/-	8/8
	7d.	5/-	10/10
	8d.	6/-	13/-
	9d.	6/9	18/-

POTENTIOMETERS (Carbon)
Miniature, fully enclosed, rear tags, carbon brush wiper. Long life, low noise. Body dia. 3/16 in. Spindle, 1/16 in. ±W at 70°C. ±20% below 1M, ±30% over 1M. Lin. 100 ohms to 10 Megohms. Log. 5 Kohms to 5 Megohms. Prices—per ohmic value

each	10 off	25 off	100 off
2/-	18/4	41/8	150/-

GANGED STEREO POTENTIOMETERS (Carbon)
±W at 70°C. Long Spindle. Logarithmic and Linear: 5k+5k to 1M+1M. Prices—per ohmic value

each	10 off	25 off	100 off
8/-	70/-	162/6	575/-

SKELETON PRE-SET POTENTIOMETERS (Carbon)

High quality pre-sets suitable for printed circuit boards of 0.1in. P.C.M. 100 ohms to 5 Megohms (Linear only). Miniature: 0.3W at 70°C. ±20% below 1M, ±30% above 1M. Horizontal (0.7in. × 0.4in. P.C.M.) or Vertical (0.4in. × 0.2in. P.C.M.). Subminiature: 0.1W at 70°C. ±20% below 2.5M, ±30% above.

Prices—per ohmic value

each	10 off	25 off	100 off
Miniature (0.3W)	1/-	8/9	18/9
Subminiature (0.1W)	10d.	7/1	14/7

RESISTORS

High stability, carbon film, low noise. Capless construction, molecular termination bonding.

Dimensions (mm.): Body: 1/8W: 8 × 2.8

1/4W: 10 × 4.3

Leads: 35

10% ranges; 10 Ohms to 10 Megohms (E12 Renard Series).

5% ranges; 4.7 Ohms to 1 Megohm (E24 Renard Series).

Prices—per Ohmic value.

each	10 off	25 off	100 off
1/8W 10%	2d.	1/6	3/3
1/8W 5%	2d.	1/9	3/8
1/4W 10%	2d.	1/9	3/8
1/4W 5%	3d.	2/-	4/-

SEMICONDUCTORS

Type	1 off	10 off	25 off	100 off	Type	1 off	10 off	25 off	100 off
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AC127	2/6	18/9	45/-	166/3	OA81	2/-	15/-	36/-	133/4
AC128	2/6	18/9	45/-	166/3	OA202	2/-	15/-	36/-	133/4
AD140	8/-	60/-	144/-	533/4	OC23	7/4	58/8	132/-	497/8
AD149	9/-	67/6	162/-	600/-	OC25	6/-	45/-	108/-	399/-
AF115	2/6	18/9	45/-	166/3	OC28	9/-	67/6	162/-	598/6
AF116	2/6	18/9	45/-	166/3	OC35	6/-	45/-	108/-	399/-
AF117	2/6	18/9	45/-	166/3	OC44	3/-	22/6	54/-	199/6
BC107	3/6	26/3	63/-	232/9	OC45	2/6	18/9	45/-	166/3
BC108	3/-	22/6	54/-	199/6	OC71	2/-	15/-	36/-	133/4
BC109	3/6	26/3	63/-	232/9	OC72	2/6	18/9	45/-	166/3
BY234	2/9	24/3	52/4	177/-	OC75	2/4	17/6	42/-	155/4
BY235	3/-	26/3	56/3	187/6	OC81	2/-	15/-	36/-	133/4
BY236	3/3	28/8	61/9	208/4	OC81D	2/4	17/6	42/-	155/4
BY237	3/6	30/8	65/6	218/9	OC82D	2/4	17/6	42/-	155/4
BY238	3/9	34/4	71/6	227/6	OC139	3/4	25/-	60/-	221/8
BYZ10	6/-	45/-	108/-	399/-	OC170	2/6	18/9	45/-	166/3
BYZ11	5/4	40/-	96/-	354/8	OC171	2/6	18/9	45/-	166/3
BYZ12	4/8	35/-	84/-	310/4	2N2926	2/8	20/-	48/-	177/4
BYZ13	4/-	30/-	72/-	266/-	(Green)				

Thyristors (5 amp)—Stud mounting.

P.I.V.	1 off	10 off	25 off	100 off
100	8/-	60/-	144/-	532/-
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400	15/-	112/6	270/-	997/-

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3 1/2 × 3 1/2 in.	3/11	35/10	80/9		3 1/2 × 3 1/2 in.	4/6	43/4	100/-	
3 1/2 × 5 in.	5/6	50/-	114/7		3 1/2 × 5 in.	5/6	48/4	111/5	

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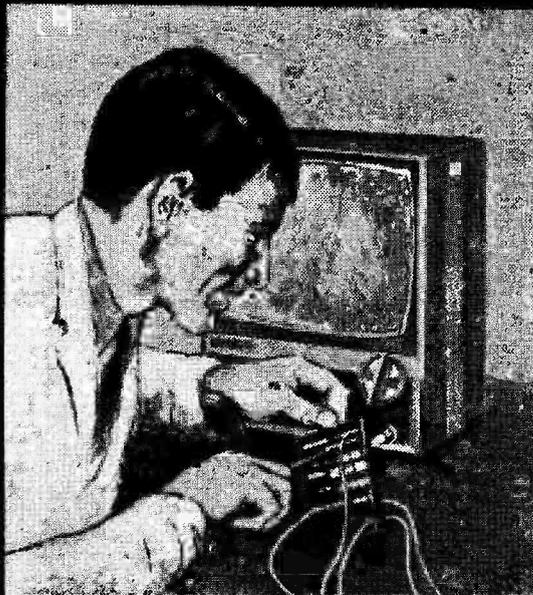
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6X4	4/8	B729	12/6	ECL86	3/-	PC89	10/6	U78	4/8	OC28	2/6
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7B7	7/-	CL33	18/6	EF39	4/9	PCF80	6/6	U183	8/6	OC45	2/3
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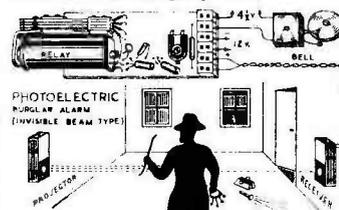
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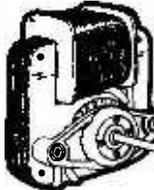
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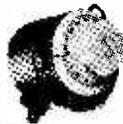
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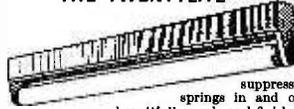


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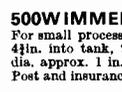
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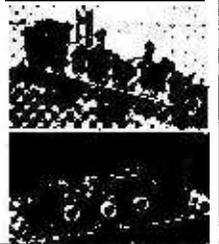
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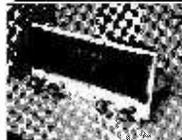


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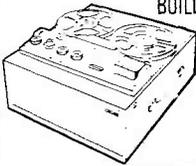
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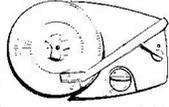
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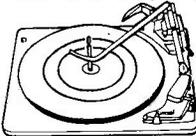


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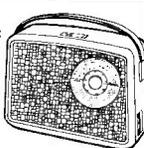


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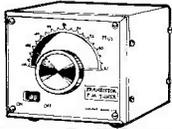
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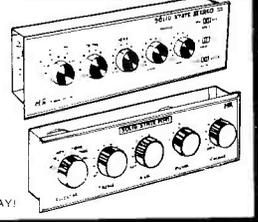
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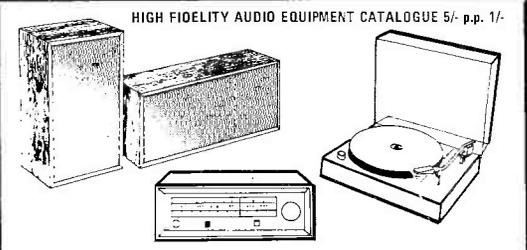
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