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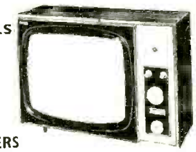

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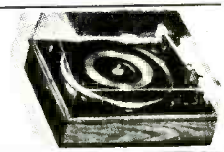

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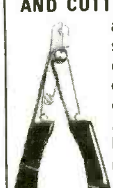

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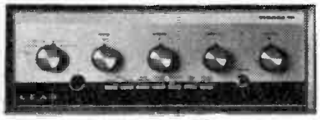
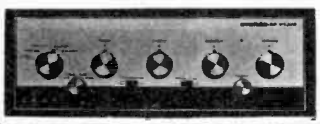


Leak Stereo 70 amplifier (cased only)—Power output (both channels linewave driven): 35 watts r.m.s. each channel into 3 ohm. loudspeakers. Total harmonic distortion: 0·1% for all power levels up to 25 watts r.m.s. each channel at 1KHz into 8 ohm loudspeakers. Crosstalk: between left and right channels—50dB up to 1KHz and —30dB at 10KHz. Dimensions: 13in (W.) × 4¾in. (H.) × 9¾in. (D.). LIST PRICE £75·00 **LASKY'S PRICE £55·00. Carriage £1·00.**

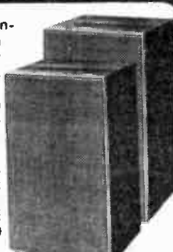
Leak Stereofetic FM tuner:—Frequency range: 87-108mHz. Frequency response: ± 1dB 40Hz to 15kHz. Frequency drift: Less than 25KHz without A.F.C. Sensitivity: 2½ microvolts for 3dB signal/noise. Output impedance: 200 ohms. Distortion: less than 0·5% for full deviation, i.e.: less than ½% for average modulation. Signal/Noise: 60dB A.M. suppression: 50dB. Dimensions (cased) 12in. (W.) × 4¾in. (H.) × 9¾in. (D.) chassis 11½in. (W.) × 4½in. (H.) × 7¾in. (D.)
CASED LIST PRICE £69·80, **LASKY'S PRICE £45·00**
CHASSIS LIST PRICE £64·03, **LASKY'S PRICE £39·50. Carriage £1·00 on chassis or cased model.**



Leak Stereo 30 Plus amplifier (cased only)—Power outputs (both channels sinewave driven) 15 watts r.m.s. each channel into 8 ohms loudspeakers. Music power outputs 20 watts r.m.s. each channel into 8 ohm loudspeakers. Total Harmonic distortion 0·1% for all power levels up to 10 watts r.m.s. each channel at 1KHz into 8 ohm loudspeakers. Crosstalk: between left and right channels: —50dB up to 1KHz and —30dB at 10KHz. Dimensions: 13in. (W.) × 4¾in. (H.) × 9¾in. (D.). LIST PRICE £62·50 **LASKY'S PRICE £45·00. Carriage £1·00.**

Leak Truspeed Transcription Turntable Mk. III— A low speed (250 r.p.m.) synchronous 12-pole hysterisis motor (100–130V., or 200–250V., 15 mwA), gives constant turntable speed independent of mains voltage fluctuations. Speeds: 33⅓ r.p.m. and 45 r.p.m. Wow: Less than 0·15%. Flutter: Less than 0·02%. Frequency range: 20Hz–20KHz. Stereo separation: better than 25dB at 1KHz. Dimensions: 12⅞in. × 15¾in. × 7½in. inc. cover. Complete with arm, teak base and tinted perspex cover and Shure M75/6 cartridge. Made to sell for £69·50. **LASKY'S PRICE £47·50. Carriage £1·50.**

Leak 200 speaker system—A Stainless Steel woven mesh grille cloth for maximum acoustic transparency and an attractive teak cabinet finished off with aluminium trim all round housed a 3 speaker system worthy of LEAK's name. Impedance: 8 ohms nominal. Frequency response: 60Hz to 18KHz. Power handling capacity 18 watts r.m.s. Resonance of bass unit (free air): 45Hz. Finish: Teak. Dimensions: 15¾in. × 10in. × 8½in. LIST PRICE £49·90. **LASKY'S PRICE £31·50** (pair). **Carriage. £2·00**



fantastic LEAK packages

Package 1
Stereo 30 Plus (cased) .... £62·50
Stereofetic (chassis) .... £64·03
Total Rec. Retail Price .... £126·53
LASKY'S PRICE £84. C. & P. £1·50

Package 2
Stereo 70 (cased) .... £75·00
Stereofetic (chassis) .... £64·03
Total Rec. Retail Price .... £139·03
LASKY'S PRICE £94. C. & P. £1·50

Package A
LEAK ST 30 Plus (cased) .... £62·50
LEAK 200 Spks. (pr.) .... £49·90
LEAK Truspeed T/T system .... £69·50
Total Rec. Retail Price .... £181·90
LASKY'S PRICE £120. C. & P. £2·00

Package B
LEAK ST 70 (cased) .... £75·00
LEAK 200 Spks. (pr.) .... £49·90
LEAK Truspeed T/T system .... £69·50
Total Rec. Retail Price .... £194·40
LASKY'S PRICE £130. C. & P. £2·00

Package C
LEAK ST 30 Plus (cased) .... £62·50
LEAK Stereofetic (cased) .... £69·80
LEAK 200 Spks. (pr.) .... £49·90
LEAK Truspeed T/T system .... £69·50
Total Rec. Retail Price .... £251·70
LASKY'S PRICE £160. C. & P. £3·00

Package D
LEAK ST 70 (cased) .... £75·00
LEAK Stereofetic (cased) .... £69·80
LEAK 200 Spks. (pr.) .... £49·90
LEAK Truspeed T/T system .... £69·50
Total Rec. Retail Price .... £264·20
LASKY'S PRICE £170. C. & P. £3·00

Package E
LEAK ST 30 Plus (cased) .... £62·50
Wharfedale Denton Spks. (pr.) .... £39·90
BSR McDonald MP60 .... £15·20
Lasky's base and cover .... £4·75
AD76K magnetic cartridge .... £4·35
Total Rec. Retail Price .... £126·70
LASKY'S PRICE £92. C. & P. £2·00

Package F
LEAK ST70 .... £75·00
Wharfedale Triton Spks. (pr.) .... £59·90
Garrard AP76 .... £27·85
Garrard base and cover .... £9·75
Shure N44/E magnetic cartridge .... £11·63
Total Rec. Retail Price .... £184·13
LASKY'S PRICE £129. C. & P. £3·00

Package G
LEAK ST30 Plus (cased) .... £62·50
Lasky's Criterian Mk. X Spks. .... £25·00
BSR McDonald MP60 .... £15·20
Lasky's base and cover .... £4·75
AD76K magnetic cartridge .... £4·35
Total Rec. Retail Price .... £111·80
LASKY'S PRICE £85. C. & P. £2·00

Package H
LEAK ST 70 (cased) .... £75·00
LEAK Stereofetic (cased) .... £69·80
LEAK Truspeed T/T system .... £69·50
LEAK 600 spks. (pr.) .... £99·00
Total Rec. Retail Price .... £313·30
LASKY'S PRICE £225. C. & P. £4·00

These are only a few of our package bargains incorporating LEAK equipment, many more can be arranged. If none of the packages here suit you please send us details of your requirements and we will be pleased to quote.

SUPER SONY SCOOP!

DIGITAL CLOCK RADIO 8FC-59WA

SAVE £12·19

Sony's elegantly designed digital alarm clock radio. The digital clock shows you the time minute by minute with matchless accuracy, and once set the Digimatic will wake you up at the same time every morning without having to be re-set. The radio section features Sony's unique sleep button, you fall gently to sleep lulled by the sweet tone of the radio, which switches itself off at a pre-determined time. Available in either black, red or white. Frequency range 530-1,605KHz (AM): 87-108MHz (FM). Uses 8 transistors and 8 semi-conductors, built-in ferrite aerial and $3\frac{1}{8}$" loudspeaker. Power requirements: 230v AC 50Hz. Dimensions: $12\frac{3}{4}$" × $3\frac{7}{8}$" × $5\frac{1}{8}$".

List Price £28·94 **LASKY'S PRICE £16·75** Post 25p

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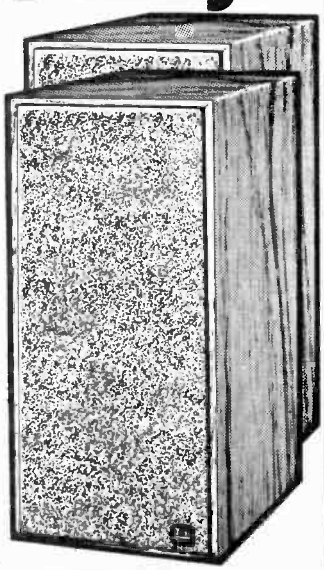
NEW from Laskys

Criterion Mk X



Because of the increasing demand for inexpensive, high quality bookshelf speakers, we have seen fit to introduce the Criterion Mk. X bookshelf system. The speaker is a sealed infinite baffle type enclosure using 8in. woofer, a 5in. mid. range and $2\frac{1}{2}$in. tweeter. The compact cabinet is in oiled walnut and black woven speaker grille cloth. Frequency response 40Hz — 20KHz. Power handling capacity: Max. 20 watts. Impedance: 8 ohms. The Criterion is fitted with two types of speaker lead connections—screw terminal or phono. Size: $18\frac{3}{4}$in. (H.) × $9\frac{7}{8}$in. (W.) × $9\frac{7}{8}$in. (D.). Operational horizontally or vertically.

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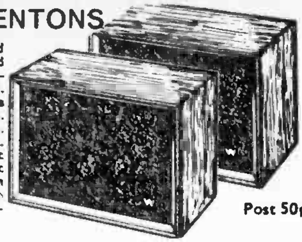
SUPER SPEAKER BARGAINS

WHARFEDALE DENTONS

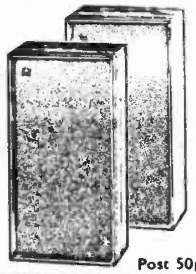


A compact system sold in matched pairs for a perfectly balanced stereo system. Each Denton contains an 8in. bass unit with 3in. pressure unit, coupled by a Wharfedale crossover network. Rated input: 15 watts maximum. Frequency response: 65–17,000Hz. Impedance: 4/8 ohms. Cabinet 9¾in. x 14in. x 8¼in. These most attractive units are available in oiled teak, and are small enough to blend in with most surroundings.

Post 50p

LIST PRICE £39·90 **£29·00** Teak

WHARFEDALE TRITONS



A new and exciting addition to the Wharfedale range, this three speaker system will satisfy the most ardent Hi-Fi enthusiast. Shelf or floor standing—hand finished in oiled teak. Frequency response 55–22,000Hz. C.A.B. Dome pressure unit. Bass unit 8in. Midrange unit 5in. Treble unit 2in. impedance 8 ohms. Size 21½in. x 9¾in. x 9in.

LIST PRICE £59·90

LASKY'S PRICE **£39·00** Teak

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7in.	RT.22	Standard play, 1,200ft. Acetate	63p
7in.	RT.10	Standard play, 1,200ft. Mylar	83p
7in.	RT.12	Long play, 1,800ft. Mylar	95p
7in.	RT.13	Double play, 2,400ft. Mylar	£1·25
7in.	RT.11	Long play, 1,800ft. Acetate	75p
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BATTERY/MAINS

A combined battery and mains portable of exceptionally attractive design. Housed in a leatherette covered case, size 8½in. x 5¼in. x 3¼in., fitted with an 8-section external telescopic aerial for FM and internal ferrite rod for MW wave bands, and clear easy-to-read dial with logging scale. Wave band coverage is FM 88-108MHz, AM 535-1,600KHz. A highly selective circuit using 9 transistors and 9 semi-conductors operating from either 4 x 1·5 volt torch batteries or direct from 230 volts 50Hz AC house mains, from a built-in mains unit. A socket is fitted for a personal earphone. Easy-to-use silver colour knobs, with "woodgrain" panel enhances the appearance of this fine radio.

LASKY'S PRICE **£9·95** Post 15p

BSR McDONALD MP60

High precision low-mass counterbalanced pick-up arm, heavy balanced turntable. Simple to operate controls, viscous cueing device, slide in cartridge carrier, 4 pole motor.

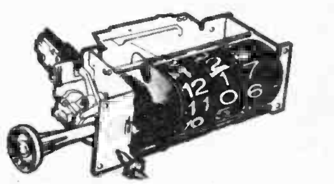
LASKY'S PRICE **£12·50** Post 35p

BSR McDONALD UNITS & PACKAGES

A. Chassis only. B. Complete with Lasky's plinth and cover. C. Complete with Lasky's plinth, cover and AD76K cartridge. D. Comp. wired on BSR plinth with cover. E. As D plus AD76K cartridge.

MODEL	A	B	E	D	E
MP.60	11·20	15·50	19·00	19·25	22·00
HT.70	15·90	20·00	23·50	24·50	27·00
610	14·50	18·57	22·00	23·00	25·50
510	12·10	16·50	19·85	20·00	22·85
310	9·75	14·00	17·25	17·90	20·25
210					9·95
MP.60 TPD2 Styrene base				18·00	21·00

DIGITAL CLOCK SCOOP



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EXCLUSIVELY FROM LASKY'S for you to mount into any housing. The clock measures 4¾ W x 1¾ H x 3¾ D (overall from front of drum to back of switch). SPEC.: 210/240V a.c., 50Hz operation; switch rating 250V, 3A. Complete with instructions. HUNDREDS OF APPLICATIONS. COMPLETE WITH KNOBS.

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GARRARD PACKAGES

Post on packages 50p

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Garrard SP25 Mk. III, AD76K cart. and Lasky's plinth and cover... ...	£20
Garrard SP25 Mk. III. Micro M2100/e cart. and Lasky's plinth and cover	£25

TRIO HS.1 & HS.2 STEREO HEADPHONE BARGAINS

Models HS-1 and HS-2. Both these sets by TRIO offer really superb stereo reproduction in a lightweight, fully adjustable headset designed for optimum comfort. Listening fatigue is unknown with TRIO headphones. Brief spec. both models: Input imp. 8Ω nominal (matching 4 to 8Ω); max. input 0·5W; frequency response 20–19 kHz; output sensitivity at 1mW input; HS-1 118 dB, HS-2 111 dB; weight 0·66lbs. Identical in appearance—both models are finished in ivory with contrasting foam filled ear pads and head band.

LIST PRICE £8·40 LIST PRICE £6·75

HS.1 **£5** HS.2 **£4** Post 18p

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Type	Singles	5	10	20
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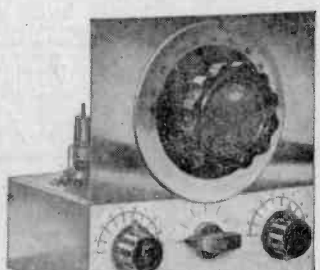

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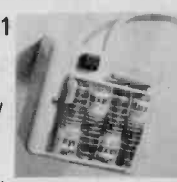

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TREASURE LOCATOR TRANSISTORISED

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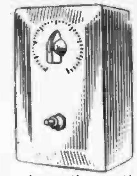

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CUTS OUT NOISE POLLUTION—SOOTHES YOUR NERVES! Don't underestimate the uses of this fantastic new design—the **RELAXATRON** is basically a pink noise generator based on avalanche operated transistors. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. For instance, many people find a rainstorm mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops!—a well known type of pink noise. *A group of Dentists have experimented on patients with this pink noise*—**NO ANESTHETICS WERE USED!** The noise ostensibly created a most definite reaction on these patients nervous systems with the results that their pain systems were blocked. **IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX**—then build this fantastic Relaxatron. Once used you will never want to be without it—use this amazing pink noise generator whenever you feel uneasy, can't relax or wish to concentrate. **TAKE IT ANYWHERE,** pocket sized. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life) **CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE** using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones, Components, Nuts, Screws, Wire, etc. etc. no soldering. Send only £2·25 + 25p (45/- + 5/-) p. & p. parts available separately.)

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INGENIOUS ELECTRONIC SLEEP INDUCER

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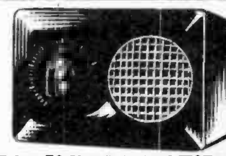

CAN'T SLEEP AT NIGHTS? DO YOU WAKE UP IN THE NIGHT AND CAN'T GET OFF TO SLEEP AGAIN? WOULD YOU LIKE TO BE GENTLY SOOTHED OFF TO SATISFYING SLEEP EVERY NIGHT? Then build this ingenious electronic sleep inducer. *It even stops by itself so you don't have to worry about it being on all night!* The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sounds gradually become less and less—until they eventually cease altogether, *the effect it has on people is amazingly very similar to hypnosis.* A control is provided for adjusting the length of times etc., all transistor, can be built by anyone over 12 years of age in about two hours. No knowledge of electronics or radio needed. Extremely simple, easy-to-follow, step-by-step, fully illustrated instructions included. *No soldering necessary.* Works off standard batteries—extremely economical. Size only 3" x 4¾" x 1¾"—take it anywhere. **All parts including case, loudspeaker, components, nuts, wire, screws, etc. etc. THERE WILL BE A GREAT DEMAND FOR THIS UNIQUE NEW DESIGN—SEND NOW £2·75 + 25p (55/- + 5/-) p. & p.** (parts available separately).

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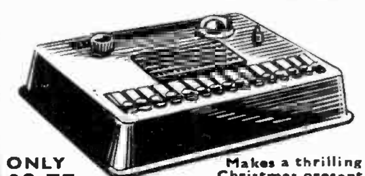

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Can be built in one evening

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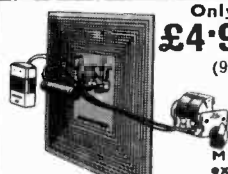

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BRAND NEW FULLY TRANSISTORISED PRINTED CIRCUIT METAL DETECTOR MODULE *Ready built and tested*—just plug in a PP3 battery and 'phones and it's working. Put it in a case, screw a handle on and **YOU HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20!** Extremely sensitive—penetrates through earth, sand, rock, wood, dirt, water, etc.—**EASILY LOCATES COINS, GOLD, SILVER, WATCHES, JEWELLERY, NUGGETS, METALLIC ORE, HISTORICAL RELICS, BURIED PIPES, KEYS, NAIL-IN-TREES, ETC., ETC.** Signals exact location by "beep" pitch increasing as you near buried metallic objects. **PRINTED CIRCUIT SEARCH COIL** *so stable and sensitive it will detect certain objects buried* **SEVERAL FEET BELOW GROUND! GIVES CLEAR SIGNAL ON ONE COIN!** *You could even pay for your holidays with two or three days electronic beachcombing—it's almost like having a licence to print money!* Unclaimed treasure now exceeds the combined wealth of all nations. **ORDER NOW WHILE PRESENT STOCKS LAST—TREMENDOUS DEMAND EXPECTED AT THIS REMARKABLY LOW PRICE. DEMONSTRATIONS DAILY. ORDERS DESPATCHED IN STRICT ROTATION. SEND NOW £4·95 + 30p carr.** (99/- + 6/-) etc. (High quality Danish Stethoscope headphones £2·75 (55/-) extra if required).

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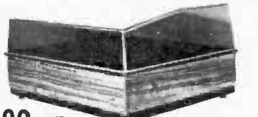

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12AU6	·20	DK32	·33	EF183	·28	PCF80	·28	U50	·26	OC45	·12
12AU7	·20	DK91	·28	EF184	·31	PCF82	·31	U52	·31	OC71	·12
12AX7	·22	DK92	·38	EH90	·37	PCF86	·45	U78	·24	OC72	·12
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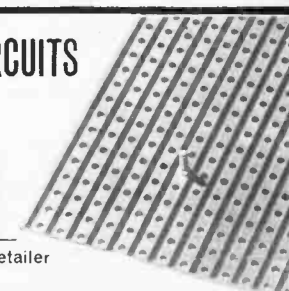

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9 Vol Gramophone Unit. Collaro battery operated with pick up on unit plate. 4 speed auto-stop turnover cartridge. Price **£2·50** plus 40p post and insurance.
Buy Time Slot Meter. Made by Sangamo Weston. 3 types—one for each coin, 2½p, 5p or 10p. Price **£1·75p** each plus 25p post and insurance.
Photo Electric Kit. Contains photo cell, relay, transistor and all parts to make light operated switch. Originally £2 Limited quantity to clear. **£1·25p** plus 20p post and ins.
Desk/Hand Mike. Made by Acos. Crystal insert in neat plastic case which opens at right angles for desk or opens completely for hand holding. Good general purpose mike. Price **85p** each.
Printed Circuit Kits. Hagato Pk. 3 facilities in kit form include printing, etching, resist removal, polishing and complete manufacture of printed sets to own specifications. Price **£1·25** + 20p.
4 Station Transistorised Intercom. Solid state three transistor printed cct. master and 3 sub station push button/press talk system. 200mW output complete with installation accessories and 9v. Everready power pack approx. dimensions. Master 4½ × 1½ × 3½ in. Sub station 3 × 1¾ × 4 in. Price **£3·50**+20p.
Laboratory Instruments. For horizontal use in strong black reinforced bakelite cases with screw down terminals especially suitable for experiments and demonstrations. All have precision meters (manufacturers quoted accuracy of better than 1·5%). Following available:
D.C. Voltmeter 0–300.v **f.s.d.** moving coil mirror scale meter size approx. 5 × 4½ × 1½ in. Price **£1·75.**
D.C. Voltmeter 0–30v. f.s.d. moving coil mirror scale met r. Size approx. 5 × 4½ × 1½ in. Price **£1·75.**
AC/DC Milliameters 3 range, moving iron mirror scale meter. Range selection 25, 50 and 100mA by selection switch mirror scale (coil resistance marked) size. 7½ × 5 × 3½ in. type 35999/1. Price **£9·75.**
Micrometer 100 micro amps, moving coil mirror scale precision meter (coil resistance marked) size, 5 × 4½ × 2½ in. type M/109/1 Price **£3.**
Galvometer 20-0-20 f.s.d. moving coil precision laboratory instrument of extremely high sensitivity (3 × 10·7 A per division), Size approx 6½ × 2½ × 2in. Price **£5.**
Acos. 'G' Meters. For use with Acos transducers and accelerometers or others of any make provided they have a sensitivity of not less than 17·5mV. per ·g' and a linear output over the frequency range under investigation.
This is a precision instrument. It measures ·g' in three steps, 0-10, 0-100 and 0-1000 directly on a large clear meter scale 0-1. We have two models. Standard Model (ID001). Price **£12** and: Auto cutout model (ID001) which has an inbuilt circuit with relay to trip the external circuit (trip level is adjustable by a control which is virtually linear with the meter scale). The trip load may be up 2a. Once the circuit has been tripped it can be restored by a reset button. Price of this model is **£18.** Please note also we have Acos Transducers ref. no. ID1001 in stock. Price **£4** each.
Parmeko Neptune Series C. Core Transformers. These transformers are beautifully made, steel encased, stove enamelled black, upright mounting. All have normal 50cps. primary 230/240v. with primary screen and are new and unused. Small quantities only of each type available as follows:
Model 6000/79. 275-0-275v. at 330mA, and 6·3v. at 4·6a. Price **£4·50:** 50p post.
Model 6000/71-290-215-0-215-290 at 125mA. and 2 at 6·3v. 6a. Price **£4·50.** 40p post.
Model 49. 250v. at 10mA. 6·3v. at 3a., 5v. at 0·75a. Price **£2** + 30p. post.
Model 47. 620-0-620 at 9mA. 4v. at 1A. Price **£4·50** + 40p post.
Parmeko Neptune C., Core Chokes. These are encased and match the transformer above.
Model 6000/73 4H at 560mA. **£2·50** + 40p post.
Model 55. 10H at 1mA. **£2·50** + 40p post.
Model 49. 10H at 70mA. **£1·50** + 30p post.
Model 69. 10H at 110mA. Price **£2** + 40p post.
Fuse Holders. Heavy duty type B.S.S. 88 440. Reyrolle power fuse holders. English Electric type S.100.1, ex. equipment. Price **50p.**
Fuses. H.R.C. 100A 160A. type EA . . . Eng. Electric 100A. 160A. type 84TF . . . Kantark **60** A., new all at **25p** each.
Electronic Car Ignition. In addition to the kits or 12v. cars we can also supply systems for 6v. cars. These are not kits but made up and read. to work. Price **£5·50.** + 30p post.
Carbon Resistors. We are now stocking these in a big way and will be pleased to quote special prices to quantity buyers. Made by Erie, Morganite or Dubiliar.

	Price per each			
	1-9	10-99	x100-999	1,000up
¼ Watt	1p	8p	6p	5p
1 Watt	2p	18p	15p	125p
2 Watt	4p	32p	30p	275p

Special Resistor Assortment Offer (1). 100 × ¼ watt resistors made up of 2 each of 50 different values fairly evenly spaced between 1 ohms and 10 megs. Price **50p**
Special Resistor Assortment Offer (2) 1,000 × ¼ watt resistors made up of 20 each of 50 different values fairly evenly spaced between 1 ohms and 20 megs. Price **£4.**
Special Resistor Assortment Offer (3) As offer 1 but 1 watt. Price **£1.**
Special Resistor Assortment Offer (4). As offer 2 but 1 watt. Price **£3.**
12 Way Sub-Miniature Multi-core Cable 7·0076 copper cores each core P.V.C. insulated and of different colour. P.V.C. covered overall and approx. 3/16in. thick. Price **20p** per yard.

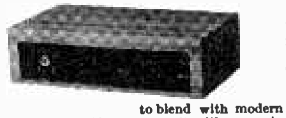
MICROSONIC KEYCHAIN RADIO

7 transistor Keychain Radio in very pretty case, size 2¾×2¼×1½in.—complete with soft leather zipped bag. 7 transistor, ferrite rod. Loudspeaker.
In transit from the East these sets suffered corrosion as the batteries were left in them but when this corrosion is cleared away they should work—offered without guarantee except that they are new. Price only **£1·25** less batteries plus **18p.** post 6 for **£7** post free. Pair of rechargeable batteries and charger **85p.**

24-HOUR TIME SWITCH

Made by Smiths, these are AC mains operated, NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. 2 completely adjustable time periods per 24 hours, 5 amp changeover contacts will switch circuit on or off during these periods. **£2·50** post and ins. 23p. Additional time contacts **50p** pair

THE FULL-FI STEREO SIX



The amplifier sensation of the year

You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal cabinet elegantly styled in simulated teak finished to blend with modern furnishings, this amplifier uses an integrated solid state circuit with an output power of 6 watts R.M.S. split over the two channels. The amplifier is ideal for use with normal pick-ups and tuners, it has a double wound mains transformer and ganged volume and tone controls—also switching for Mono to Stereo, tuner or pick-up. Other controls include "treble lift and cut", "balance" and separate mains on/off switch. UNREPEATABLE PRICE is **£9** plus 38p post and insurance.

THIS MONTH'S SNIP

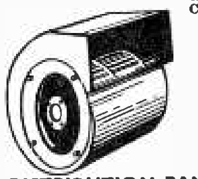
POCKET CIRCUIT TESTER

Test continuity for any low resistance circuit, house wiring, car electrics. Tests polarity of diodes and rectifiers. Also ideal size for conversion to signal injector (circuit supplied) **30p** or 2 for **50p** Post paid.

TANGENTIAL HEATER UNITS

This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing **£15** and more. We have a few only. Comprises motor, impeller, 2kW. element and 1kW. element allowing switching 1, 2 and 3kW. and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need control switch. **£3·50.** 2kW. Model as above except 2 kilowatts **£2·50.** Don't miss this. Control Switch **35p.** P. & P. 40p.

CENTRIFUGAL FAN



Mains operated, turbo-blower type. Pressed steel Housing contains motor and aluminium impeller. Motor is 1/10th hp giving considerable air flow but virtually no noise. Approx. dimensions 10½" wide by 12" dia. Outlet into trunking 10½" × 4½". **£4·95** + **£1.**

DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work. **£2** less plug **£2·25** with fitted 13 amp plug; **£2·40** with fitted 15 amp plug, plus **23p** P. & I.

CAPACITOR DISCHARGE CAR IGNITION

This system which has proved to be amazingly efficient and reliable was first described in the Wireless World about a year ago. We can supply kit of parts for improved and even more efficient version, price **£4·95.** When ordering please state whether for positive or negative systems. Plus 30p post.

15 WATT 12in. HI-FI SPEAKER

15 WATT 12in HI-FI SPEAKER. 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 and public address. Handling 15W R.M.S.—Cone moulded fibre—Freq. response 30 10,000 c.p.s.—specify 3 or 15 ohms. Chassis diam. 12in—12¾in over mounting lugs. Overall height 5½in. A £10 speaker offered this month for **£3·75** plus 30p. post and ins.

2 OCTAVE MINI ORGAN

As featured in this issue. Send S.A.E. for list of parts.

Snap Action Slide Switch. Rated 5a. 240v. Made by Arrow. Type fitted in the handles of electric drills, vacuums, etc. **5p** each, 10 for **45p.**
Numicator Tubes. For digital instruments, counters timers, clocks, etc. Hi-vac XN, 3. Price **£1·45** each. 10 for **£13.**
Pressure Switch. Containing a 15 amp. change over switch operated by a diaphram which in turn is operated by air pressure through a small metal tube. The operating pressure is adjustable but is set to operate in approx. 10 in. of water. These are quite low pressure devices and can in fact be operated simply by blowing into the inlet tube. Original use was for washing machines to turn off water when tub has reached correct level but no doubt has many other applications. **50p** each. 10 for **£4·50.**
Papst Miniature Extractor Fans. Beautifully made as are all papst motors. Intended for cooling computers but suitable for any equipment. Size 4¾in. square and 1½in. thick. Price **£2** each. Post and insurance 20p.
Commutator Motor. Small. Size approx. 3in. plus 1in. of shaft. 3in. high × 1¾in. wide, but high speed and very powerful. These motors operate from the mains. Are particularly useful as they can be speed controlled by our thyristor kit or by variable resistor. **£1** each.
Auto Light Kit. The circuit for this appeared in *Practical Wireless*, October issue. It is a simple circuit but has many uses: Parking light, porch light, etc. Uses light cell and two transistors. Complete kit, no case **95p.** Suitable case **20p.**
Charger Kit. Comprises of 3 amp. transformer, 5 amp. rectifier and a pair of hefty crocodile clips. With wiring diagram. **£1·40** plus 20p post and insurance.
24 hr. Clock Switch. In metal case with 13 amp. socket Smiths movement, 2 ons and 2 offs per 24 hours. Very neatly made and finished. Original retail price **£7** each. Few only, new and perfect. **£4.00** each.
P.E. Gemini Amplifier. This amplifier is a 30 × 30 watt stereo amplifier and pre-amplifier of exceptionally high performance. The performance is certainly equal to anything one can buy no matter what the cost. The P.E. Gemini has been designed for both hi-fi applications and for use with discotheques and forthis reason,has a microphone input that can be mixed with any other input. The amplifier is designed and is thus capable of driving two Quad electrostatic speakers and is thus capable of driving any other speakers, provided they are of the correct impedance. We offer the complete kit cabinets at **£45.** Price list including reprint of data. **55p** post paid.
Neon Indicator Lamps. With amber lens, standard type with built in resistor for mains. **10p** each. 10 for **90p.**
Condensers. Another addition to our range. 500uF at 50v. **15p** each. 10 for **£1.25.**
Thermistor Bead Type. For instruments, medical applications, etc. ITT No. GL23, **75p** each. 10 for **£6·75.**
3 Core Mains Leads. Special offer this month is a 6ft. lead with 23/36 cores and coloured according to the new code i.e. Brown—live; Yellow/Green—earth; Blue—neutral. Price **6p** each or 10 for **50p.**

P.W. Constructor Projects

As described in this and past issues. We can probably supply components. Send S.A.E. for list, naming project.

TREASURE TRACER

Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless August issue. **£2·95** plus 20p post and insurance.

MAINS RELAY BARGAIN

Special this month are some single, double and treble pole changeover relays. Contacts rated at 15 amps. Operating coil wound for 240V A.C. Good British Make. Ex-unused equipment. Size approx. 1½" × 1".
Open construction

Single pole	**25p** each	10 for **£2·25**
Treble pole	**40p** each	10 for **£3·6**

Flex Connector

A quick way to connect equipment to the mains safely and firmly—L., N. and E. coded to new colour scheme; disconnection by plugs prevents accidental switching on: has sockets which allow insertion of meter without disconnection cable inlets firmly hold one hair wire on up to four 7.029 cables. **85p** each

THYRISTOR LIGHT DIMMER

For any lamp up to 200 watt. Mounted on switch plate to fit in place of standard switch. Virtually no radio interferences. Price **£1·99** plus 20p post and insurance.

Where postage is not stated then orders over £5 are post free. Below £5 add 20p. Semi-conductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

J. BULL (ELECTRICAL) LTD.

Dept. P.W. 7, Park Street, Croydon CRO 1YD

JUST BEGINNING?

Then try out

8-Watt, 10-Transistor Stereo Amplifier R.137

ROC price £10.50

Separate tone and volume controls for each channel,inputs for turntable (ceramic cartridge),tuner and tape.Attractive black crackle finish with brushed aluminium front.Frequency response:70-20,000 Hz ±3dB.Output: 4 watts per channel @ 8 ohms.Inputs:Phono 80mV; tuner/aux 80mV.

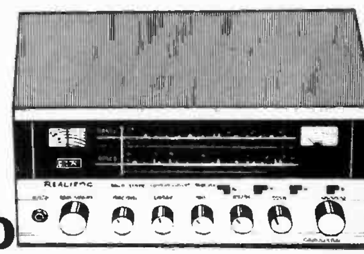
Normal retail price : £14·70

World wide reception

Professional Solid-state, Four-band Communications Receiver R.135

Fully transistorised with continuous coverage from 555K Hz to 30 M Hz in four bands (with illuminated bandspread for 160-10 metres).Incorporates internal speaker,automatic noise limiter, SSB/AM/CW switch,AVC switch,S Meter,Receive and Standby switch,external socket for headphone or speaker,bandspread control,BFO control,on/off/AF gain,band selector,antenna trimmer and RF gain.Runs off 240 v AC,batteries or any 12 v DC negative ground source.Frequency ranges (in mHz):Band A, 535-1·6;B,1·55-4·5;C,4·5-13;D,13-30.Sensitivity:0·5µV @ 30mHz. Bandspread:10-160 metres.

Normal retail price : £65·00



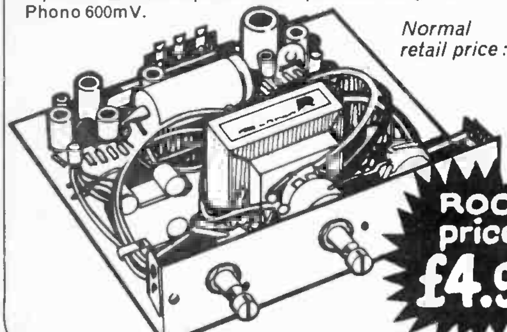
ROC price: £45.00

FIRST STEP TO STEREO!

5-Watt Transistor Stereo Amplifier Chassis R.123

Completely self-contained,fully transistorised,mains-powered (240vAC) amplifier,needing only cabinet and knobs.Ideal for adapting mono players to stereo.Frequency response:40-17,000 Hz ±3dB.Output:2·5 watts per channel @ 8 ohms.Input: Phono 600mV.

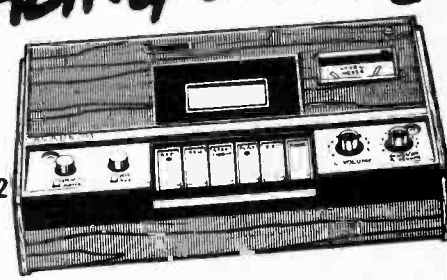
Normal retail price : £7·30



ROC price £4.95

AMAZING OFFER!

Stereo Cassette Tape Unit R.142



Complete stereo record and playback unit with line and microphone inputs. Fitted with tape counter,separate pause control,recording level metres for each channel,pop-up cassette ejection.Supplied complete with two pencil microphones.Wow & flutter better than 0·3%, frequency response 100-10,000 Hz.Tape speed:1⅞ IPS,4·75 CMS.Rewind time: Better than 60 sec (C.60 cassette).

Normal retail price : £65·00

ROC Price £49.50

SOUNDS SENSATIONAL

AM/FM/MPX Stereo Tuner Amplifier R.124

A top quality amplifier with facility for receiving stereo broadcasts. Separate bass and treble controls,automatic frequency response,stereo headphone socket,output power:8 watts.FM frequency range 88-108 M Hz;AM frequency range 535-1605 K Hz. Inputs for turntable (ceramic cartridge) and tape.Frequency response:50-10,000 Hz ±3dB.Output:4 watts per channel @ 8 ohms.Inputs:Phono 200mV,tape 100mV.FM:Sensitivity 20µV, stereo separation 26dB,image rejection 55dB.AM:Sensitivity 300µV.

Normal retail price : £42·00 **ROC price: £29.95**

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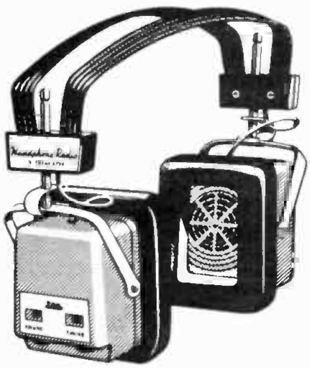
Every piece of electronic or audio-equipment we sell is built to our specifications.It comes complete with a Guarantee.And it's tested before it leaves us.

We bend over backwards in our advertising to make sure everything we say is factually accurate. But,buying mail-order,even though you're buying from us,we accept you could still end up with a piece of equipment that's not exactly what you wanted.And we think that's unfair.

FANTASTIC BARGAIN



Headphone Radio R.143

For completely private listening without the distortion of the ordinary earphone adaptor. Battery operated; PP3. Fully transistorised. Frequency range: 535-1600 K Hz, Medium Wave Band. Maximum output: 300mW.

ROC price £6.90

Normal retail price: £9·40

STEREO headphones

only £2.40

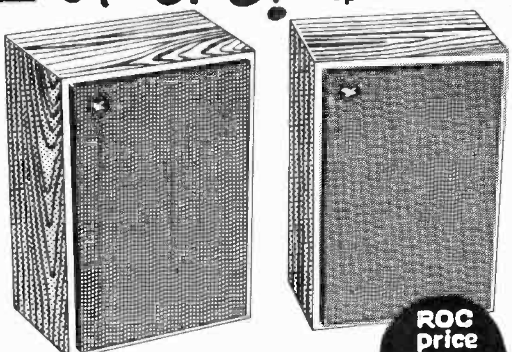
Stereo Headphones R.328

Light and comfortable, with a frequency response of 30-15,000 Hz for real listening pleasure. Complete with jack plug. Impedance 8-16 ohms.

Normal retail price: £2·95

2 for the price of one!

Matched Stereo Speakers R.446



ROC price £16.40

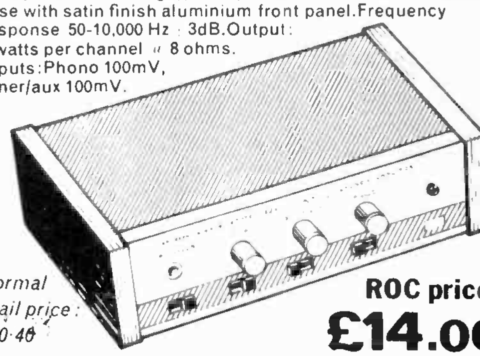
Heavily lagged teak finish cabinets each with large dual cone base unit and separate tweeter. Power handling: 10 watts peak; frequency range: 40-18,000 Hz, impedance: 8 ohms. Size 14 x 8¾ x 6¼.

Normal retail price: £19·60

Don't read this!

10-watt Transistor Stereo Amplifier R.136

Ganged volume, balance and tone controls. Inputs for turntable (ceramic cartridge), tuner (see R.134) or tape. Oiled walnut case with satin finish aluminium front panel. Frequency response 50-10,000 Hz ± 3dB. Output: 5 watts per channel @ 8 ohms. Inputs: Phono 100mV, tuner/aux 100mV.



Normal retail price: £20·40

ROC price: £14.00

The Perfect match!

AM/FM/MPX Stereo Tuner R.134

Matching unit to the R.136 amplifier. Covers AM and FM tuning bands with automatic stereo signal light. FM frequency range: 88-108mHz; AM frequency range: 535-1605kHz. FM: Sensitivity 5μV, stereo separation 25dB @ 1kHz, image rejection 50dB. AM: Sensitivity 250μV.

ROC price £22

Normal retail price: £28·60

pay for your mistakes

So we've got a proposition for you.
If you buy a piece of Roc equipment, and it's not quite what you expected, send it back within seven days, and as long as it's as good as new we'll give you your money back. O.K?

Return of post mail-order service; orders over £10 post free, (U.K. only) add 25p for p & p to orders under £10. HP terms available.

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THE RADIO CONSTRUCTOR

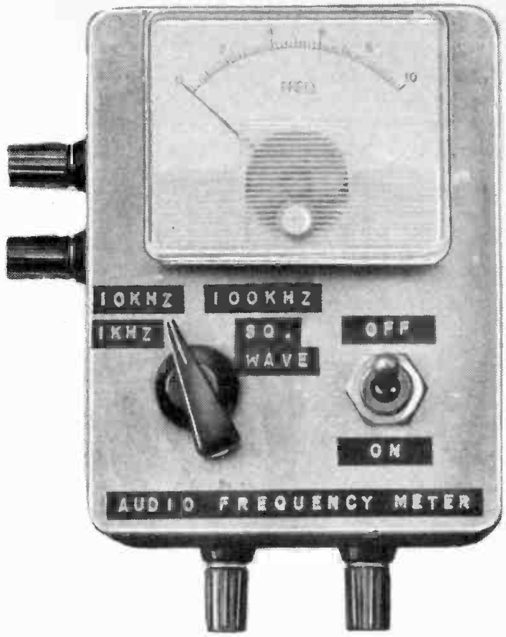
NOVEMBER ISSUE

features

AUDIO FREQUENCY METER

by J. T. Neill

Part one of a two part article describing a compact frequency meter, with analogue display, working at audio frequencies and employing an integrated circuit for ease of construction.



Also featured

THE "DROITWICH" CAR RADIO

by Sir Douglas Hall, K.C.M.G.

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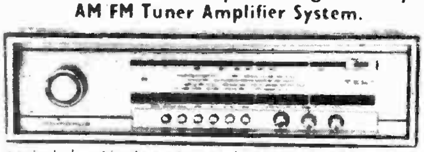
FANTASTIC BARGAIN OFFER!

TRANSEUROPEAN

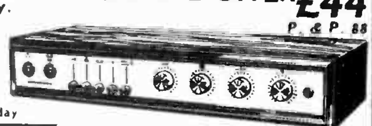
Transistorised Stereophonic High Fidelity AM FM Tuner Amplifier System.



This system includes this elegantly styled solid state Teak finished cabinet tuner/amplifier. Covering VHF/FM. Short, medium and long wavebands. The latest 4 Speed B.S.R. Mono/Stereo record changer with 2-10in. x 6in matching elliptical speakers. **A complete Hi-Fi Stereo Radiogram at less than half normal price.**
Easily fitted no technical knowledge necessary.

SPECIAL OFFER £44
P. & P. 88

Credit Terms available. First monthly payment of £5·83 followed by 9 monthly payments of £4·95. Total Credit Sale Price £49·50. Send £5·83 today



FABULOUS VALUE

Hi-Fi stereo at a new low. System Ten-Ten; 4 speed BSR autochanger with cue and pause control plus solid state amplifier, 20 watt total output Frequency response 20-20,000 Hz. enclosures—100% complete,

ONLY £4·93 DOWN

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ASE20	£7·50	A
AKG		
K60	£11·50	A
K180	£23·00	B
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DT800/K100	£11·00	A
DT109/K109	£19·00	A
DT480	£22·00	B
DT485	£27·00	B
CLARK		
300	£7·50	A
100	£18·00	B
EAGLE		
SE60	£7·50	A
SE80	£13·50	A
SE100	£14·50	A
HOSIDEN		
DH 02S	£2·25	A
HOWLAND WEST		
NIKKO 3S	£4·00	A
NIKKO 4SV	£6·50	A
NIKKO 4ST	£7·00	A
NIKKO 8S	£11·00	A
NIKKO 77S	£12·50	A
KOSS		
K711 (DEVILS)	£8·00	A
K6	£9·50	A
K6LC	£11·00	A
KO727	£12·50	A
PRO 4AA	£22·00	B
ESP 6	£35·50	B
ESP 9	£54·00	B

MIDLAND		
SA700	£3·00	A
PWB		
NSE (Electrostatic)	£31·00	B
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SE 2P	£5·50	A
SE 30	£10·50	A
RODGERS		
RAVENSBROOK	£13·75	A
ROTEL		
RH600	£5·00	A
RH711	£8·00	A
SANSUI		
SS2	£6·25	A
SS20	£14·50	A
SENNHEISSER		
HD414	£8·00	A
STAX		
SR3/SRD5	£38·00	B
TELETON		
SH301	£3·25	A
SH 307	£4·25	A
TOSHIBA		
HR80	£4·75	A
WHARFEDALE		
DD1	£9·50	A

DELIVERY CHARGES
A .. 30p
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Examples of Speaker prices below, *delivered free*. Many more makes available please telephone or write for quotation.

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KITS	
UNIT 3	£20·50
UNIT 4	£26·50
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FULLY TESTED AND MARKED

	£p		£p
AC107	0·15	OC170	0·23
AC126	0·13	OC171	0·23
AC127	0·17	OC200	0·25
AC128	0·13	OC201	0·25
AC176	0·25	2G301	0·13
ACY17	0·15	2G303	0·13
AF239	0·37	2N711	0·50
AF186	0·50	2N1302-3	0·20
AF139	0·37	2N1304-5	0·25
BC154	0·25	2N1306-7	0·30
BC171 = BC107	0·13	2N1308-9	0·35
BC172 = BC108	0·13	2N3819FET	0·45
BF194	0·15	**Power Transistors**	
BF274	0·15		
BFY50	0·20	OC20	0·50
BSY25	0·57	OC23	0·30
BSY26	0·13	OC25	0·25
BSY27	0·13	OC26	0·25
BSY28	0·13	OC28	0·30
BSY29	0·13	OC35	0·25
BSY95A	0·15	OC36	0·37
OC41	0·13	AD149	0·30
OC44	0·13	AUY10	1·25
OC45	0·13	2S034	0·25
OC71	0·13	2N3055	0·63
OC72	0·13		
OC73	0·17	**Diodes**	
OC81	0·13	AAY42	0·10
OC81D	0·13	OA95	0·19
OC83	0·20	OA79	0·09
OC139	0·13	OA81	0·09
OC140	0·17	IN9114	0·07

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Quantity	*1–10*	*10–50*	*50+*
BB105 Varicap Diodes	10p	8p	6p
OC71 or 72 Fully Tested Unmarked	5p	5p	4p
Matched Sets 1–OC44 and 2–OC45's. Per Set.	25p	20p	15p
Matched Sets of OC45's 1st and 2nd IF	15p	12p	10p
OA47 Gold-Bonded Diodes. Marked and Tested	3p	3p	2p
1-watt Zener Diodes 7·5, 24, 27, 30, 36, 43 Volts	5p	4p	3p
10-watt Zener Diodes 5·1, 8·2, 11, 13, 16, 24, 30, 100 Volts	20p	17p	15p
Micro Switches, S/P, C/O	25p	20p	15p
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SL403D Audio Amp., 3-Watts	2·00	1·95	1·80
709C Linear Opp. Amp.	50p	40p	35p
Gates, Factory Marked and Tested by A.E.I.	25p	22p	20p
J. K. Flip-Flops Factory. Marked and Tested by A.E.I.	40p	35p	30p
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This field effect transistor is the 2N3823 in a plastic encapsulation, coded as 3823E. It is also an excellent replacement for the 2N3819.

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H6	40	250mW. Zener Diodes DO-7 Min. Glass Type	50p
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H15	30	Top Hat Silicon Rectifiers, 750mA. Mixed volts	50p
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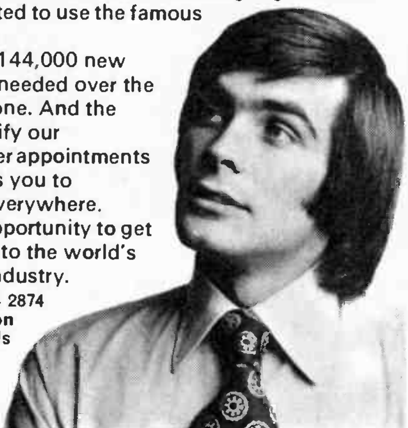

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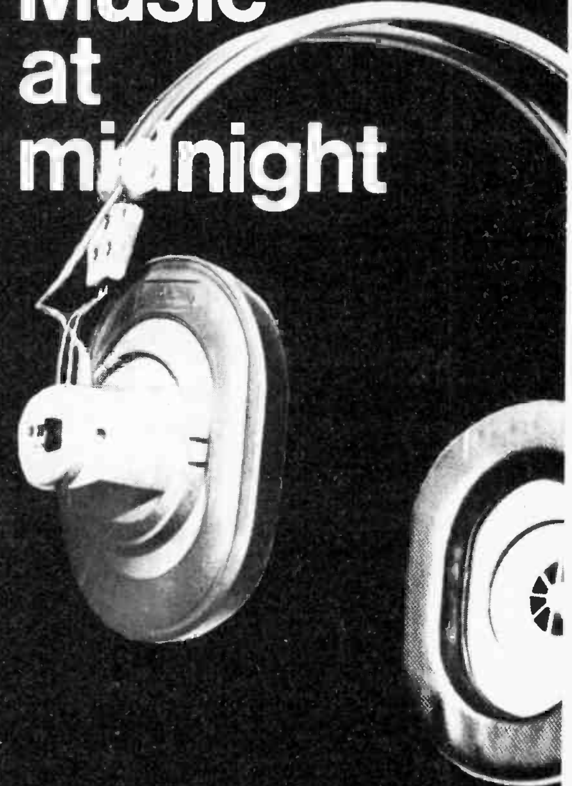
Music at midnight



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SUPER 30 MkIII HI-FI STEREO AMPLIFIER

Only high grade components by leading manufacturers.
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Carr. 65p

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Dep. £5·75 and 9 monthly payments £3·50 (Total £37·25)
Or FACTORY BUILT in cabinet as illustrated Dep. £6 and 9 monthly payments £3·86 (Total £40·74) **£36·75**

PRINTED CIRCUITRY, TWENTY SILICON TRANSISTORS. FOUR DIODES, FOUR RECTIFIERS.
TECHNICAL DETAILS (Applying to each channel where appropriate)
CONTROLS: PUSH-BUTTON SELECTOR (1) Disc (2) Radio (3) Tape (4) Mono L (5) Mono R (6) SPEAKER DIS. (7) Mains on/off. Bass, Treble, and Balance. Plus Ceramic/Mag P.U. Switch.
OUTPUT: 15 watts R.M.S. (Continuous) into 8 ohms. 10 watts R.M.S. (Continuous) into 15 ohms.

★ SATIN SILVER METAL FACIA with black lettering. Black edged knobs with bright silver centres.
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WE RECOMMEND USE WITH THE BEST ANCILLARY EQUIPMENT THAT CAN BE AFFORDED.

HUM & NOISE—75dB Min. Vol.—65dB Full Vol. **HARMONIC DISTORTION** 0·1% at 1000 Hz 10 Watts
FREQUENCY RESPONSE: −3dB 7Hz to 70KHz
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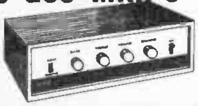
BASS CONTROL: +17dB to −16dB at 40Hz **CROSS TALK**—58dB
SENSITIVITIES: Disc Mag. 2·5mV. Ceramic 35mV. Radio 120mV. Tape 120mV.
REAR PANEL SOCKETS ARE FOR 3 PAIRS OF INPUTS (1) P.U. (2) Radio. (3) Tape Amp. Plus pair for tape recorder signal take off and 2 pairs for speaker connections.

RSC G66 MkII 6+6 Watt HIGH QUALITY STEREO AMPLIFIER



Individual Ganged Controls. Bass, Treble, Volume and Balance. Printed circuit construction employing 10 Transistors plus Diodes. Output rating I.H.F.M. Frequency range 20–20,000 c.p.s. Bass Control ± 12dB. Treble Control ±13db. Selector switch for P.U. or Tape/Radio. For loudspeaker output impedances of 3 to 15 ohms. For standard 200–250v A.C. mains operation. Attractive Black and Silver finished metal facia plate and matching control knobs.
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R.S.C. TA12 MKIII 6·5 + 6·5 WATT STEREO AMPLIFIER

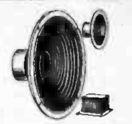
FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION
HIGH FIDELITY OUTPUT OF 6·5 WATTS PER CHANNEL

Designed for optimum performance with any crystal or ceramic Gram. P.U. cartridge. Radio tuner, Tape recorder 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 20-20,000 c.p.s. −2dB ★ Harmonic Distortion 0·3% at 1,000 c.p.s. Hum and Noise − 70dB ★ Sensitivities (1) 50mV (2) 400mV (3) 100mV. Output rating I.H.F.M. ★ Handsome finish Facia plate & Knobs.
COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS. **£15·50** Carr. 40p. Factory built with 12 mths guarantee **£19·50** or Dep. £3 and 9 mthly pymts £2·15 (Total £22·35). Or in Teak veneer housing **£23** Dep. £3 & 9 mthly payments £2·55 (Total £25·95). Send S.A.E. for leaflet

FANE 807 HIGH FIDELITY LOUDSPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Gauss 10.000. Impedance 3 or 8-15 Ω. STATE WHEN ORDERING **£3·50**

AUDIOTRINE HI-FI SPEAKER SYSTEMS

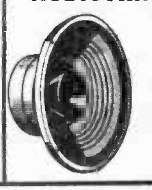


Consisting of matched 12in. 11,000 line 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **£5·75**
OR SENIOR 15 WATT INC. £6·75 Carr. 30p
HF126 15,000 LINE SPEAKER carr. 35p

HI-FI SPEAKER ENCLOSURES

Modern design. Teak veneer finish. Acoustically lined. All sizes approx. Carr. 30p. per enclosure
JE8 Size 16 x 11 x 9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi 'speaker. **£5·35**
SE8 For optimum performance with any 8in. Hi-Fi 'speaker. Size 22 x 15 x 9in. Ported **£6·47**
SE10 For outstanding results with 10in. Hi-Fi 'spkr Size 24x15x10in. P'td. **£6·74**
SE12 For excint prfmnce with 12in. Hi-Fi speaker and Tweeter. Size 25 x 16 x 10½in. **£7·87**

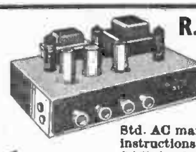
AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS



Heavy construction. Latest high efficiency ceramic magnets. Treated Cone surround. "D" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 8-15 ohms. PLEASE STATE CHOICE. Exceptional performance at low cost.

HF801D	8"	8W £2·71	HF120D	12"	15W £4·75
HF102D	10"	10W £33·40	HF126	12"	15W £5·50
HF120	12"	15W £4·25	HF126D	12"	15W £5·90

R.S.C. A11 HI-FI 12-14 WATT AMPLIFIER



PUSH-PULL OUTPUT. Two input sockets with sep. vol. controls for mixing. High sensitivity, 5 valves. Bass and treble controls. Response ± 3dB 30-20,000 c/s. Hum level −60dB. Sensitivity 40 millivolts. For Crystal or Ceramic PUs. High Impedance "mikes". For Musical Instruments etc.
Std. AC mains. For 3 & 15 ohm spkrs. Complete kit. Full instructions and point-to-point wiring diagrams. Carr. 60p **£10·50**
SAE for leaflet. Twin handled metal cover £1.75
Factory built £14.75 or Dep. £3 and 9 mthly pymnts of £1.60 (Total £17.40.)

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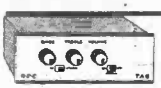
Teak Finish Matching Pairs **£36·75** PAIR carr. £1

ALL RSC UNITS MANUFACTURED TO EXACTING SPECIFICATIONS

★ **DEMONSTRATION FACILITIES AT ALL BRANCHES**

R.S.C. TA6 6 Watt HI-FI SOLID STATE AMPLIFIER



200-250v. AC mains operated. Frequency Response 30-20,000 c.p.s. −2dB. Harmonic Distortion 0.3% at 1,000 c.p.s. Separate Bass and Treble 'lift' and 'cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm spkrs. Max. sensitivity 5mV. Output rating I.H.F.M. Fully enclosed enamelled case, 9¾ × 2¾ × 5¾in. Attractive brushed silver finish facia plate 10¼ × 3¼in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. **£7·50** Carr. 40p
OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE **£9·75**

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Superior Solid Natural Wood Construction

for Record Playing units, cut for Garrard 1025, 2025, 3000, AT60, SP25 etc. £3·15
WITH TRANSPARENT PLASTIC COVER £6·30

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Four fully wired units ready to 'plug in'.
★ SUPER 30 AMPLIFIER (15 + 15 watt) in veneered housing
★ GARRARD SP25 MK III Turntable on Plinth with cover
★ GOLDRING CS90 Ceramic Pick-up Cartridge with diamond stylus
★ PAIR OF STANWAY II Speaker Units

Special Total Price **£79·80** Carr. £1·50

Terms: Deposit £12 and 9 monthly payments £8·55 (Total £88·95).

★ Super 30 Amplifier (15 + 15 watt) in veneered housing
★ Goldring GL69 II Transcription Turntable on Plinth as illustrated
★ Goldring Magnetic P.U. Cartridge.
★ Pair of Stanway II speaker units.

Special Total Price **£96·75** Carr. £1·50

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ATTRACTIVE TEAK OR AFRORMOSIA VENEERED CABINETS AND PLINTHS

Matching as recommended for optimum performance. Send S.A.E. for coloured brochure showing other money-saving offers. Package prices apply providing all individual units are purchased from any branch within 3 months. See leaflet.

★ TA12 AMPLIFIER 6·5 + 6·5 watt in veneered housing
★ GARRARD SP25 MK III Player unit on Plinth
★ GOLDRING CS90 Ceramic P.U. Cartridge with diamond stylus
★ PAIR OF DORCHESTER Loudspeaker Units

Special Total Price **£58**

Or Deposit £7·15 and 9 monthly payments £6·35 (Total £64·30). Carr. £1·25

Trans. Plastic Cover £3·15 extra.

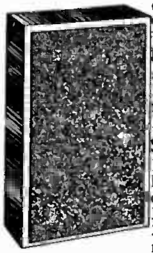
PACKAGE AS ABOVE but with Garrard 3000 Autochanger and Sonotone 9TA Ceramic Cartridge in lieu of SP25 and CS90 **£51·75**

Carr. £1·25

Or Deposit £6 and 9 monthly payments £5·70 (Total £57·30)

Trans. Plastic cover £3·15 extra.

HIGH FIDELITY SPEAKER UNITS



Cabinets latest style Satin Teak veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.

DORCHESTER (Illustrated) Size 16×11×9in. appr. Range 45-15,000 c.p.s. Rating 8-10 watts. Fitted High flux 13×8in. Dual Cone speaker. Imp. 3 or 15 ohms. **£9·45** Carr. 40p.

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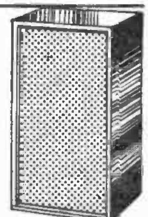
'YORK' HIGH FIDELITY 3 SPEAKER SYSTEM

★ Moderate size only 25×14×10in.
★ Response 30-20,000 c.p.s. Impedance 15 ohms
★ Performance comparable with units costing considerably more.

Consists of (1) 12in. 15 watt Bass unit with cast chassis. Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system (3) 8×5in. high flux middle range speaker. (4) High efficiency tweeter. (5) Appropriate quantity acoustic damping material. (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions. Terms: Dep. £4·50 and 9 monthly payments £2·25 (Total £24·75).



COMPLETE KIT **£22** Carr. 63p

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AUDIOTRINE A55 HIGH QUALITY STEREO SYSTEM

5 + 5 WATT OUTPUT
Garrard 5200 Changer with low mass pick-up arm and Stereo Cartridge. Controls: TREBLE, BASS, VOLUME, STEREO, BALANCE. Operation on 200-250v. A.C. mains. Output rating I.H.F.M. Luxurious Teak Veneer Finished Cabinets. Transparent plastic (tinted) cover included for main unit. Silver finished facia plate and matching control knobs.

PAIR OF LOUDSPEAKER UNITS incorporating high flux 8in. 5in. speaker. Size approx. 13 × 7¾ × 8¾ins.

PRICE COMPLETE ONLY **£42** Carr. £1·25

Terms: Deposit £5·50 and 9 monthly payments £4·50 (Total £46)

A REALLY SURPRISING STANDARD OF QUALITY IS OBTAINED FROM THIS COMPACT LOW PRICED SYSTEM

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FULLY GUARANTEED. Impregnated and Interleaved where necessary

Primaries 200-250v. 50c/s. Screened

MIDGET CLAMPED TYPE 2¼×2¼×2¼in.
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FULLY SHROUDED UPRIGHT MOUNTING
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Types 6.3v. 1.5a. 49p; 6.3v. 2a. 54p; 6.3v. 3a. 76p; 6.3v. 6a. £1·30; 12v. 1a. 55p; 12v. 3a. or 24v. 1.5a £1·85; 0.9-18v. 1½a. £1·10; 0-12-25-42v. 2a. £1·76

CHARGER TRANSFORMERS 0-9-15v. 1½a. 99p; 2½a. £1·10; 3a. £1·25; 5a. £1·45; 6a. £1·65; 8a. £2·00

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Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω 50p
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TYPE BM1. An all-dry battery eliminator. Size 5½ × 4½ × 2in. approx. Completely replaces batteries supplying 1·5v. and 90v. where A.C. mains 200/250v. 50c/s is available.

Complete kit with diagram. **£3** Assembled ready for use **£3·50**

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F.W. (Bridged)
All 6/12v. D.C. Output. Max. A.C. Input 18v 1a. 25p, 2a 35p, 3a. 50p, 4a. 65p, 6a. 80p.

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TWIN TURNTABLE UNIT WITH MONITORING FACILITIES

HI-FI CENTRES LTD.

SEPARATE VOLUME CONTROLS
PLUS TREBLE & BASS CONTROLS
MICROPHONE SOCKET WITH
ASSOCIATED SWITCH & VOL. CONTROL

FAL DISCOTHEQUE CONSOLE FG 1/2 £65

Carr. £1·25

Terms: Deposit £11 and 9 monthly payments of £6·70 (Total £71·80)

SEND S.A.E. FOR LEAFLET

Incorporating twin Garrard SP25 Mk. III turntables and Goldring CS90 Ceramic Cartridges with diamond stylii.

Size approx. 36" × 6¼" × 15"

Black Rexine covered Cabinet with lid.

RSC BASS REGENT 50 WATT AMPLIFIER

A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape. Peak Output rating. Loudspeaker unit optional horizontal or vertical mounting.

★ Two extra heavy duty 12in. Loudspeakers.

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£60

Carr. £1·50

30 WATT HI-FI AMPLIFIER

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 P.V.C. facia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. Terms: Deposit £3·70 and 9 monthly payments of £2·10 (Total £22·60).

ONLY **£19·95**

Carr. 65p

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(1) FAL FG1/2 Console
(2) 100W Power Amplifier
(3) Pair High quality Headphones
(4) Matching Microphone fitted to H/phones
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TOTAL COST OF ALL ILLUSTRATED UNITS **£132**

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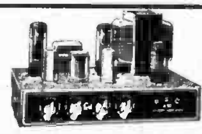
F.A.L. PHASE 50 Mk.II AMPLIFIER PAIR FANE POP 25/2 25W L/SPEAKERS.	Terms: Deposit £5·50 and 9 monthly payments of £4·72 (Total £47·98).	PACKAGE PRICE **£44** carr. £1
F.A.L. PHASE 50 Mk.II AMPLIFIER PAIR FANE POP 50 L/SPEAKERS OR PAIR L12/25 Cabineted Speakers.	Terms: Deposit £10·50 and 9 monthly payments of £5 (Total £55·50)	PACKAGE PRICE **£49·50** carr. £1
F.A.L. PHASE 100 AMPLIFIER PAIR L125 50W L/S in cabinets.	Terms: Deposit £25 and 9 monthly payments of £11·62 (Total £129·58).	PACKAGE PRICE **£118** carr. £1·50
F.A.L. PHASE 100 AMPLIFIER 4 FANE POP 50 L/SPEAKERS.	Terms: Deposit £15 and 9 monthly payments of £10·52 (Total £109·50).	PACKAGE PRICE **£99** carr. £1·50

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



Highly sensitive. Push-Pull high output, Hum level—70dB. Response ±3dB 30-20,000 c/s. All high grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 36 millivolts. For High Impedance microphones. For Clubs, Schools, Theatres, Dance Halls, Outdoor Functions, etc. For Electronic Organ, Guitar, String Bass, etc. Gram, Radio or Tape. Two separate inputs with vol. controls permit such as "mike" and Pick-up etc. to be used for mixing purposes, 200-250 v. 50 c/s A.C mains. For 3 and 15 ohm speakers. Complete Kit of parts with wiring diagram and instructions. Twin-handled perforated cover £1.90 Or factory built with EL34 output valves and 12 months' guarantee for £19·75

£15·75

Carr. 65 p

TERMS: Deposit £4 and 9 monthly payments of £2·10 (Total £22·90). Send S.A.E. for leaflet.

MINIMUM 12 MONTHS GUARANTEE, LABOUR & MATERIALS (Excl. Valves) ON ADVERTISED GOODS

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PHASE 50 MkII FAL PHASE 100

50W AMPLIFIER OUTPUT

50 Watts (Music)
40 ,, R.M.S. (Cont.)
100 ,, (Peak)

£33·50

Carr. 65p

Terms: Deposit £6 and 9 monthly payments £3·50. Total £37·50.

100W AMPLIFIER OUTPUT

100 Watts (MUSIC)
70 ,, R.M.S. (Cont.)
I.H.M.F. Output rating.

£61·95

Carr. 75p

Terms: Deposit £12 and 9 monthly payments £6·25. Total £68·25.

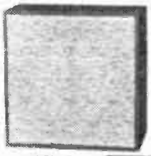
SOLID STATE, ALL SILICON TRANSISTORS ★ Protective circuitry in case of overload or short circuiting of output. ★ Frequency Range 30-20,000 c.p.s. ★ 4 Separately controlled inputs for mixing; plus master volume control. ★ Individual Bass and Treble Controls. ★ Suitable for any loudspeaker combination between 3 & 30 ohms. ★ Cabinet covered in black rexine. Brushed silver finish metal facia, with black lettering. Matching control knobs. For Clubs, Discotheques, Hotels, Restaurants, Schools, Theatres, etc. For Vocal & Instrumental Groups, Gram., Radio or Tape. Send S.A.E. for leaflets.

RSC CABINET LOUDSPEAKERS

L13 8-10 WATTS

Incorporating high flux 13" × 8" 8-10 watt loudspeaker. Available with 3 or 15 ohm. impedance. (State when ordering.) Cabinet finished in Teak or Afrormosia Veneer.

£5·25 (Carr. 37½p)



L12/25 25 WATTS

12" 25 watt heavy duty loudspeaker. Impedance 15 ohms. 18" × 18" × 8" approx. Veneered or Rexine/Vynair finish. Suitable small Discotheques, Clubs, Schools etc., etc..

Terms: Deposit £3 and 9 monthly payments £1 (Total £12)

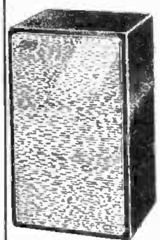
£10·50 (Carr. 45p).

B4/100 100 WATTS

Fitted four extra heavy duty 12" 14,000 Gauss 50 watt speakers for conservative rating of 100 watts. Impedance 15 ohms. Cabinet in ¾" chipboard with centre reinforcement back to front. Rexine/Vynair covered. Acoustically filled and pressurised 27" × 27" × 14" approx. Ideal for base guitar or Electronic organ. Or Deposit £8 and 9 monthly payments £5·90 (Total £61·10).

£55 (Carr. £1·50)

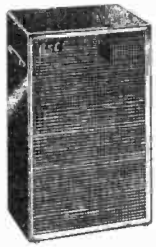
L125 50 WATTS



Incorporating two 12" 50 watt 14,000 Gauss extra heavy duty loudspeakers for conservative rating of 50 watts. Impedance 8-15 ohms. Sturdy pressurised cabinet in ¾" chipboard. Rexine Vynair Covered 31" × 20" × 16" approx. Suitable Vocal or Instrumental Groups. Bass Guitar or Electronic Organ, etc. For use in Discotheques, Clubs, etc.

£31 (Carr. £1·50)

Or Deposit £4 and 9 monthly payments £3·35 (Total £34·15).



FAL DUO/100

Employing two FANE 'CRESCENDO 12' 100 watt, super efficient, high flux, high power, full range speakers. Gauss 20,000. ULTRA HIGH SENSITIVITY. **Ideal for Vocalists and Instrumental Groups.**

Frequency Range 30—16,000 c.p.s. Impedance 8 ohms.

Cabinet constructed in heavy ¾" Chipboard and covered in black Rexine and pleasing shade of Vynair with aluminium trim. Attractive design.

Size 30" × 19½" × 15½" approx.

Conservatively rated at 100 watts.

£63 (Carriage £1·50)

Terms: Deposit £9 and 9 monthly payments of £6·70 (Total Credit Price £69·30)

ALL FANE LOUDSPEAKERS GUARANTEED 2 YEARS

FANE 'POP' 25/2 LOUDSPEAKERS

12in. 25 Watt Dual Cone 15Ω (for uses other than Base Guitar or Electronic Organ), or Dep. £1 and 9 mthly payments 75p (Total £7·75).

£6·75 Carr. free

RSC COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

All types 15 Ohms covered in Rexine and Vynair

TYPE C4100 IS ALSO SUITABLE FOR BASS GUITAR OR ELECTRONIC ORGAN

C48S 25-30 WATTS

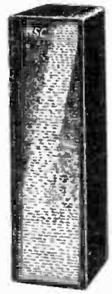
Fitted four 8" high flux 8 watt speakers. Overall size approx 48" × 10" × 5". Terms: Dep £3 and 9 monthly payments £2 (Total £21)

£17·75 Carr 50p

C412S 50 WATTS

Fitted four 12" 11,000 line 15 watt speakers: Overall size approx 56" × 14" × 9". Terms: Dep. £4 and 9 monthly payments £3 (Total £31)

£27·50 Carr 75p



C4/100 100W

inc. four 12" 50 watt speakers for conservative rating. Extra heavy construction. Size approx 58" × 16" × 10" Acoustically filled and pressurised. Terms: Dep. £7·50 and 9 monthly payments £5·45 (Total £56·55) Carr. £1

ONLY **£50·50**

Recommended for DISCOTHEQUES, or INSTRUMENTAL GROUPS.

FANE ULTRA HIGH POWER LOUDSPEAKERS

All power ratings are R.M.S. continuous. 2 YEARS' GUARANTEE High flux ceramic magnets, Heavy cast chassis. All carr. free.

18" 'POP' 100

RATING 100 WATTS R.M.S. 14,000 gauss 8/15Ω

£22·50 Dep. £6 and 9 monthly payments £2·15. Total £25·35

15" 'POP' 60

RATING 60 WATTS R.M.S. 14,000 gauss 8/15Ω

£12·90 Dep. £3·30 and 9 monthly payments £1·30 (Total £15).

FOR BASS GUITAR, ELECTRONIC ORGAN, ETC.

12" 'POP' 50

RATING 50 WATTS R.M.S. 13,000 gauss 15Ω

£10·50 Dep. £2 and 9 monthly payments £1·15. Total £12·35

Pair suitable all purposes

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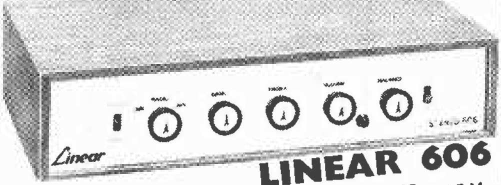

LINEAR 606

6+6 WATTS I.H.F.M.

Recommended Retail Price

£22·50

0-200-230-250v. 50 Hz A.C. mains operation. Inputs for magnetic or Ceramic Pickup, Tape or Radio Tuner.

TECHNICAL DETAILS

Bass Control ± 12 dB at 40 Hz.

Treble Control ± 12 dB at 14 KHz.

Sensitivities Mag. P.U. 3·5 m.v. into 47K ohm R.I.A.A. Ceramic P.U. 35 m.v. into 100K ohm. Tape Amp. 100 m.v. into 100K.

Radio Tuner 400 m.v. into 400K ohm, Crosstalk 53 dB.

Hum and Noise −75 dB min. vol. −65 dB max. vol.

Total Harmonic Distortion 0·1 per cent at 1 watt into 15 ohms.

★ Individual Bass and Treble Controls.
★ Frequency Response ± 1½ dB 27 Hz to 65 KHz.
★ Outputs for 3-15 ohm Speakers.
★ Stereo/Mono Switch.
★ Input Selector Switch.
★ Solid State Circuitry.
★ Attractive silver finished metal facia and matching control knobs.

LINEAR 505 5+5 WATTS

★ A modestly priced solid state unit.
★ The Silver Facia with black lettering enhanced by matching control knobs, provides a high standard of appearance.
★ Suitable for crystal or ceramic Gram. Pick-up cartridges, and Radio input.
★ A wide range of tone variation is provided by the separate Bass and Treble 'lift' and 'cut' controls.
★ A selector switch permits instantaneous selection of Gram. or Radio.
★ Speaker impedances between 3 and 15 ohms are suitable.

TECHNICAL DETAILS

Frequency Range 20 Hz to 20 KHz

Output (per channel) 4 watts I.H.F.M.

Bass Control ± 12 dB at 60 Hz

Treble Control ± 14 dB. at 14 KHz.

PRINTED CIRCUIT CONSTRUCTION EMPLOYING 10 TRANSISTORS

Recommended Retail Price

£17·50

0-200-250v. 50 Hz A.C. mains operation

Wholesale and Retail enquires to the Manufacturers

ALL LINEAR AMPLIFIERS GUARANTEED FOR 12 MONTHS

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This Capacitor-discharge Electronic ignition system was recently described in Practical Wireless and has proved extremely popular. We are able to offer the kit in two forms: the Standard kit containing the electronic components only, enabling the customer to tailor these to his own layout, or the De-luxe version containing a ready-drilled roller-trimmed printed circuit board and fully machined die-cast case with electrical connection block. Each kit is supplied with a custom wound transformer, first-grade components and full construction details. Suitable for 12V. systems only, pos. or neg. earth. All components available separately. Case size 4¾" x 3¼" x 2" Complete assembly and wiring manual 25p, refundable on purchase of kit.

Price :	Standard kit	..	£7·25 post free
	De-luxe	.. ..	£8·75 post free

Trade enquiries invited. Mail order only.

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WALSALL, STAFFS. WS1 1UZ
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£7.25

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

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No batteries—no wires. Just plug in the mains for instant two-way, loud and clear communication. On off switch and volume control. Price £14.40 P. & P. £0.55

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Transistor TELEPHONE AMPLIFIER

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

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U.H.F. T.V. AERIALS

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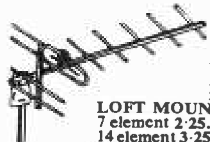

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SHURE 31E	£9·00
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GARRARD SL75B	£24·00
GARRARD 401	£26·00
GARRARD SL95B	£32·00
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GOLDRING GL75	£28·00
GOLDRING GL69	£20·00
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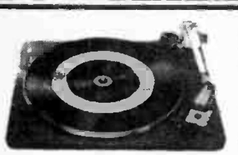

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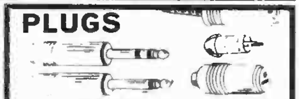

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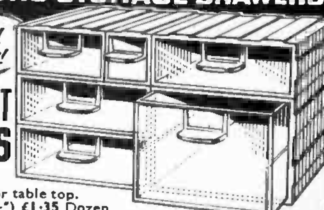

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ALPHA 212 By Highgate	36·75	24·95
AMSTRAD Stereo 8000 Mk 2	27·95	17·95
AMSTRAD I.C. 2000	42·95	27·95
ARMSTRONG 521	59·00	41·75
DULCI 207M	32·00	19·95
FERROGRAPH F307 Mk. II (cased)	64·00	45·95
FERROGRAPH F307 Mk2 metalcase	60·00	42·95
GOODMANS Maxamp	54·00	37·95
LEAK Delta 30 (cased)	65·00	51·95
LEAK Delta 70 (cased)	79·50	63·95
METROSOUND ST20E	39·50	27·95
PHILIPS RH 591	79·00	54·95
PHILIPS RH 590	52·00	36·95
PHILIPS RH 580	29·00	19·95
PIONEER SA500	62·10	41·95
PIONEER SA700	98·00	67·95
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PIONEER Reverberation	45·50	31·95
REVERBERATION 202W	46·35	33·95
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RANK Rotel 610	69·00	49·95
ROGERS Ravensbourne	59·50	42·95
ROGERS Ravensbourne (cased)	64·00	47·95
ROGERS Ravensbrook Mk. II	47·50	36·96
ROGERS Ravensbrook (cased) Mk.II	52·50	39·95
SINCLAIR 2000	35·00	23·75
SINCLAIR Project 60/2 x Z30/PZ5	23·90	15·95
SINCLAIR PROJECT 60/2 x Z50/PZ8/trans	34·86	23·25
SINCLAIR PROJECT 605	29·95	21·95
SINCLAIR AFU	5·95	4·45
SINCLAIR Neoteric	61·95	43·95
SINCLAIR 3000	45·00	31·50
TELETON SAQ 206	32·50	18·95
TELETON GA101	37·50	28·50
VOLTEX 100w. Stereo Discotheque, 8 electronically mixed inputs	185·00	139·00
WHARFEDALE Linton	60·00	47·95

All the above take both ceramic and magnetic cartridges.

TUNERS	Rec. Retail Price	Comet Price
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*ARMSTRONG 524 FM	42·17	30·95
ARMSTRONG M8 Decoder	9·50	7·70
*DULCI FMT.7 FM	25·10	19·95
DULCI FMT.7S Stereo	33·79	27·25
GOODMANS Stereomax	80·07	47·95
LEAK Delta FM	75·00	58·95
LEAK Delta AM/FM	89·50	69·50
PHILIPS RH 690	45·30	36·50
PHILIPS RH 691	85·80	69·95
PIONEER TX500 AM/FM	75·95	61·50
PIONEER TX900 AM/FM	147·15	118·00
RANK ROTEL 320	49·99	39·95
ROGERS Ravensbourne chassis	59·63	46·95
ROGERS Ravensbrook	43·37	34·95
ROGERS Ravensbrook (cased)	49·39	38·95
ROGERS Ravensbourne in teak case	64·45	48·95
SINCLAIR 2000	45·00	34·95
SINCLAIR project 60 tuner (stereo)	25·00	19·95
TELETON GT 101	43·93	30·95

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

TUNER/AMPLIFIERS	Rec. Retail Price	Comet Price
AKAI AA 8500	221·85	175·00
AKAI 6600	137·34	108·00
AKAI 6300	128·85	99·95
AKAI 6200	91·56	71·95
ARENA 2400	90·30	69·95
ARENA 2600	111·30	69·95
ARENA 2700	88·63	73·95
ARENA T9000	303·45	285·00
ARMSTRONG M8 Decoder	9·50	7·70
ARMSTRONG 525	88·55	69·95
ARMSTRONG 526	105·72	79·95
GOODMANS Mod. 80, 35w. R.M.S.	91·59	68·95
GOODMANS Model 110 FM/MW/LW/SW 100W R.M.S.	135·00	108·00
LEAK Delta 75	165·00	139·95
MIDLAND 19/542	49·56	37·50
PHILIPS 882 with stereo cassette recorder	96·50	76·95
PHILIPS RH 790	134·00	79·95
PIONEER SX770 AM/FM	159·79	125·95
PIONEER SX990 AM/FM	192·61	148·95
PIONEER 440	119·62	95·00
ROGERS Ravensbrook Chassis	99·39	81·95
ROGERS Ravensbrook (cased)	108·43	89·95
TANDBERG 1171 comp. with decoder	110·00	91·95
TANDBERG TR200 without decoder	99·00	82·95
*TELETON F2000	51·50	28·95
TELETON 7AT20	119·75	69·95
TELETON 10AT1 150w. RMS	160·00	94·00
TELETON TFS50	79·65	52·95
TELETON TFS50 LA MW/LW/FM	86·64	60·95
TELETON CR55	125·26	74·95
WHARFEDALE 100-1	139·00	89·95

All the above Tuners and Tuner/Amplifiers take both ceramic and magnetic cartridges except Teleton F2000 which takes ceramic only. All include MPX Stereo Decoder with the exception of Armstrong where decoder is extra as listed.

CARTRIDGES	Rec. Retail Price	Comet Price
GOLDRING 800	12·55	6·75
GOLDRING 800E	18·16	10·50
GOLDRING 800 Super E	25·10	15·95
*GOLDRING CS90 Stereo	5·02	4·10
*GOLDRING CS91/E	7·53	6·00
GOLDRING G850	6·27	3·95
EMPIRE 1000ZE/X	60·34	51·25
EMPIRE 999VE/X	43·00	34·95
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EMPIRE 999SE/X	20·31	16·95
EMPIRE 999E/X	15·89	12·50
EMPIRE 999/X	12·55	10·25
EMPIRE 909E/X	12·37	9·95
EMPIRE 909/X	9·26	7·75
EMPIRE 90EE/X	9·56	7·95
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ORTOFON 2 X 15K Transformer	7·00	4·95
ORTOFON M15E	29·08	23·50
SHURE M3DM	7·16	4·50
SHURE M31E	11·63	8·70
SHURE M32E	10·73	8·05
SHURE M32-3	9·84	7·80
SHURE M44-5	10·73	7·19
SHURE M44-7	9·84	7·15
SHURE M-44C	9·84	7·15
SHURE M44E	11·63	7·50
SHURE M55E	12·52	8·95
SHURE M75G	16·99	13·75
SHURE M75-6	16·10	12·45
SHURE M75EJ	18·78	14·95
SHURE M75E	20·57	12·95
SHURE V15-11	39·35	27·95
SHURE V15-11-7	37·56	27·95

Starred cartridges above are ceramic. All others are magnetic.

PICKUP ARMS	Rec. Retail Price	Comet Price
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GOLDRING Lenco L69	10·04	6·50
SME 3009 with S2 Shell	33·26	24·95
SME 3012 with S2 Shell	35·42	26·45

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GOLDRING 705/P with G850 Special Price £14·50
GOLDRING GL75 with G800 Special Price £39·95
GOODMANS 3025 with G800 Special Price £21·95

	Rec. Retail Price	Comet Price
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GARRARD SL65 B	20·48	13·45
GARRARD SL95 B	49·23	32·95
GARRARD 401	39·26	27·45
GARRARD SL72 B	31·83	23·95
GARRARD Zero 100A	56·25	42·95
GARRARD Zero 100S	51·75	41·95
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GARRARD AP76	27·85	18·90
GOLDRING GL69 Mk. II	27·60	19·50
GOLDRING GL69P Mk. II	36·21	26·95
GOLDRING GL75	40·15	28·95
GOLDRING GL75P	48·76	35·95
GOLDRING Covers for 69P and 75P	4·48	3·30
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GOLDRING G99	26·89	19·95
GOODMANS 3025	37·74	21·95
McDONALD MP 60	15·20	10·95
McDONALD 610	19·28	14·50
McDONALD HT 70	21·22	17·50
McDONALD HT70 inc. plinth & cov.	30·68	24·95
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PHILIPS GA146	30·35	23·95
PHILIPS 202 Electronic	66·50	49·95
PHILIPS 308 transcription unit complete with base and cover	37·60	29·95
PIONEER PL12A with base & cover	48·34	36·95
THORENS TX25 cover	8·52	6·95
THORENS TD125	76·03	58·95
THORENS TD125AB	115·57	94·50
THORENS TD150A Mk. II	44·40	34·50
THORENS TD150AB Mk. II	48·05	40·25
THORENS TX11 Cover	4·26	3·50
WHARFEDALE Linton	35·00	28·95

SPEAKERS	Rec. Retail Price	Comet Price
B & W Model 70	159·50	114·95
B & W DM3	63·00	48·40
B & W DM1	38·47	31·95
CELESTION Ditton 120	28·85	22·95
CELESTION Ditton 15	38·47	31·95
CELESTION Ditton 25	65·00	46·95
GOODMANS Minister	24·10	17·45
GOODMANS Havant	28·00	21·95
GOODMANS Magister	62·50	41·95
GOODMANS Double Maxim	33·00	25·95
GOODMANS Mezzo 3	34·00	22·95
GOODMANS Magnum K2	44·00	29·95
GOODMANS Dimension 8	69·00	49·95
GOODMANS din 20NT kit	12·54	9·95
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KELETRON KN400 2-speaker System (pair)	16·10	12·95
KN600 3-speaker System (pair)	26·86	18·95
KN800 3-speaker System	15·90	10·95
KN1100 4-speaker System	20·40	14·20
KN1600 3-speaker System	25·20	16·95
KN2100 3-speaker System	30·60	20·95
LEAK 200	30·19	18·45
LEAK 300	39·33	23·95
LEAK 600	49·50	35·95
LOWTHER Acousta (with PM6)	52·50	45·50
LOWTHER Acousta (with PM7)	65·00	54·00
LOWTHER Ideal Baffle	37·50	32·00
METROSOUND HFS103 (pair)	30·05	19·95
METROSOUND 202	21·50	15·95
PHILIPS RH481	10·60	8·45
PHILIPS RH482	17·35	14·45
SINCLAIR Q16	8·95	6·20
STE-MA 400	24·00	16·95
TANDBERG TAN 7	28·00	23·95
TANDBERG TAN 11	19·00	16·25
TANDBERG TAN 15	45·00	35·95
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Denton Mark II	19·95	15·95
Linton Mark II	24·95	19·95
Melton Mark II	35·00	27·95
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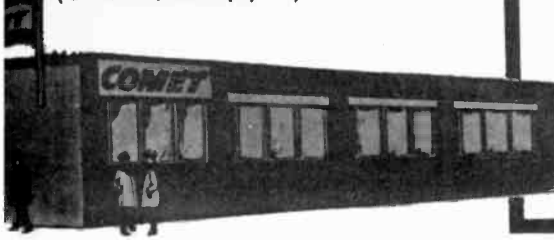

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GOODMANS Attenuator	3·55	2·25
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GOODMANS Crossover Networks XO/950	7·40	5·50
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WHARFEDALE Super 8/RS/DD	8·19	6·75
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ALBA UA662	60·32	46·95
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DECCA Sound 614	66·55	54·95
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DECCA Compact 3	119·56	103·95
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CN.240 Miniature soldering iron 15 watt 240 volts, fitted with iron coated 3/32" bit. Up to 18 interchangeable spare bits obtainable. This iron can also be supplied for 220, 110, 50 or 24 volts. **Price £1.70**

G.240 Miniature soldering iron 18 watt 240 volts extensively used by H.M. Forces. Suitable for high speed soldering and fitted with iron coated 3/32" bit. Also available for 220 volts. Spare bits 1/8", 3/16" and ¼" are obtainable. **Price £1.83.**

CCN.240 New model 15 watt 240 volts miniature soldering iron with ceramic shaft to ensure perfect insulation (4,000 v A.C.). Will solder live transistors in perfect safety: fitted with 3/32" iron coated bit. Spare bits 1/8" 3/16" and ¼" available. Can also be supplied for 220 volts. **Price £1.80**

CCN.240/7 The same soldering iron fitted with our new 7-star high efficiency bit for very high speed soldering The triple-coated bits are iron, nickel and chromium plated. **Price £1.95**

E.240 20 watt 240 volts soldering iron fitted with ¼" iron coated bit. Spare bits 3/32", 1/8" and 3/16" available. Can also be supplied for 220 and 110 volts. **Price £1.80.**

ES.240 25 watt 240 volts soldering iron fitted with 1/8" Iron coated bit and packed in a transparent display box. Spare bits 3/32", 3/16" and ½" available. Can also be supplied for 220 and 110 volts. **Price £1.83**

SK.1 SOLDERING KIT

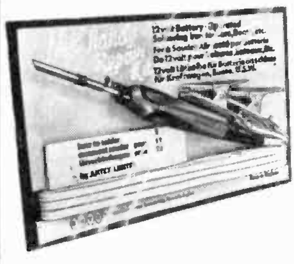
The kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, heat sink, cleaning pad, stand and booklet "How to Solder". Also available for 220 volts.

Price £2.75

SK. 2 SOLDERING KIT

This kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, Heat Sink, 1 amp fuse and booklet "How to Solder".

Price £2.40.



MES. 12

A battery operated 12 volts 25 watt soldering iron complete with 15' lead, two crocodile clips for connection to car battery and a booklet "How to Solder" packed in a strong plastic wallet.

Price £1.95.

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PW12

PRACTICAL WIRELESS

VOL 47 NO 8

Issue 778

DECEMBER 1971

But Why?

ONE of the most difficult tasks to face a technical journalist is to write an article for the absolute beginner. It is comparatively easy to prepare something for the advanced reader, for the author is aiming at those generally a little below his own standard. An article beamed at middle-of-the-road readers is, perhaps, the least troublesome because the author does not have to dwell on fundamentals or to go too deeply into advanced theory.

But the snags come when a writer has to do something for "the beginner"—a term full of pitfalls, for there are various degrees of that species. The main difficulty for the writer is to put himself in the position of his potential readership and to anticipate questions which might arise in the mind of a newcomer to the subject. A point which is to the author perfectly obvious may cause a beginner to feel perplexed and form questions in his mind. Taken to its extreme, the author must, as far as possible, assume that the newcomer knows virtually nothing—an impossibility in practical terms, for some sort of mental line has to be drawn.

In P.W., we have to cater for all grades of experience. In general, a constructional article is geared to provide sufficient information for a constructor who has reached a stage at which he should reasonably be expected to be able to tackle the particular project. Since levels vary so widely, some readers complain that articles are too elementary while others think they are too advanced. This is the perpetual dilemma of trying to please everyone!

We do feel, however, that it is not a bad thing to err on the side of simplicity, for if the beginner is the one who wants to ask the most questions it is obvious that he is the one who needs greater attention. This is one reason why we have periodic bursts of special features for the beginner, such as the new series on transistor circuitry started in October and the extra 8-page supplement included with this issue aimed at providing some basic guidance on the main components likely to be encountered by the home constructor.

Author Hellyer said in the October issue, " . . . any beginner worth his salt is going to say 'But Why???' We would go further, for the path of progress of *any* enthusiast will be travelled faster if he makes a point of always asking 'But Why?'—and finding the answer—when confronted with an aspect not fully understood.

W. N. STEVENS—*Editor*.

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

SPECIAL FEATURE

JANUARY ISSUE WILL BE PUBLISHED ON DECEMBER 3rd

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

BSR Transcription

BSR's new unit, the McDonald 810, priced at £45·51 for the basic unit, was shown at the Audio Fair for the first time. Features include push button operation, a pitch control for absolute accuracy of turntable speed and a virtual friction free pick up arm movement which is gyroscopically controlled with a concentric gimbal mount.

Twelve months ago, BSR Limited launched the BSR McDonald consumer range. The 810 is the culmination of design expertise and production efficiency which has successfully produced in succession the wide selling MP 60 and HT 70 units.

The technical data for the 810 is impressive. It is a two speed player, $33\frac{1}{3}$ and 45 rpm, utilising as its heart a 4 pole dynamically balanced synchronous motor driving a $7\frac{1}{4}$lb. diecast balanced turntable. A stroboscopic centre plate when coupled with the pitch control ensures absolute turntable accuracy. A low mass pick up arm, over $8\frac{1}{2}$in. in length has less than 0·5° per inch tracking error.

Although primarily a single play unit, versatility comes with an interchangeable umbrella spindle giving true automatic function if required.

"Sonex 72"

The Third International Exhibition of Audio Equipment, operated by British Audio Promotions Ltd, on behalf of the members of The Federation of British Audio will be mounted at the Skyway Hotel, Bath Road, Hayes, Middx (near London Airport) over the period from Wednesday, March 22, 1972, to Sunday, March 26, 1972.

Hacker RP73

This newly-designed successor to the famous Hacker Autocrat RP33 home/car portable radio incorporates an integrated circuit and ceramic filter in its design.

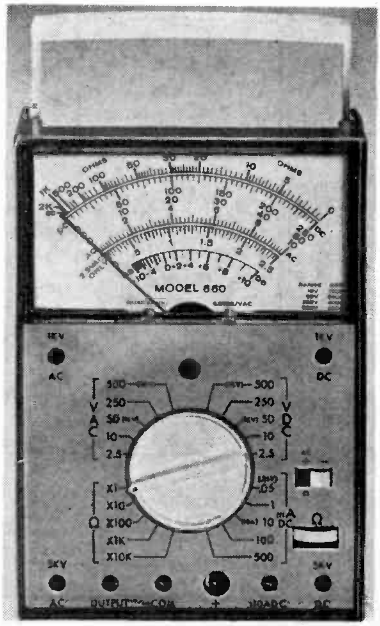
In common with its predecessor the Autocrat Mark 2 Model RP73 offers extreme portability for use in the home, and a special change-over aerial circuit for interference-free reception in a car. Price is £25·25 including Purchase Tax. *Hacker Radio Ltd, Norreys Drive, Cox Green, Maidenhead, Berks.*

Meteronic Scope

The MSB 101 oscilloscope has a bandwidth of d.c.-8MHz; vertical sensitivity of 100mV/cm-50V/cm; sweep speed range of 100nSec/cm-150mSec/cm; and a unique signal locking circuit which by means of a single control enables the user to select through 'Free Run', 'Internal Signal Sync' to 'Triggered.' Also provided is switch slope selection. Fibreglass P.C. boards are fitted as standard. The MSB 101 size is 8 x 6 x 4in. and weighs 5lb. Price: £69. *Meteronic, 114/116 Shipbourne Road, Tonbridge, Kent. Tel. Tonbridge 61448.*

Daystrom Throw It Around

Daystrom has introduced a 660 series drop-proofed multimeter. These precision meters are warranted to operate within specification after being dropped from a height of five feet. The meter mechanism floats inside a sealed, high-impact plastic case. These multimeters also have temperature compensation, with shielded and electrically protected meter movement. The meter maintains accuracy in extreme environments and will not be damaged if, as sometimes happens, the user accidentally connects it to a high voltage source. Daystrom salesmen sometimes demonstrate the 660 series by throwing the meter on the customer's floor. So far, customers have had a worse shock than the meter! So, if you feel like chucking a £29·85 meter about, contact *Daystrom (Schlumberger), Bristol Road, Gloucester GL2 6EE.*



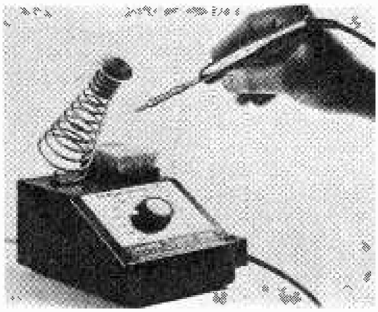
NEWS... NEWS... NEWS...

Litesold System

The Litesold ETC/1 Soldering System consists of a lightweight soldering iron which is fed from a solid state power/control unit giving fully automatic electronic control of the temperature of the front of the bit.

Operating temperature is fully adjustable by means of a calibrated dial on the power unit over a wide range from 150/400°C. Thus there is no need to change bits for different settings which can be altered and read-off instantly.

The most important feature is the total avoidance of electrical disturbance and R.F.I. generation

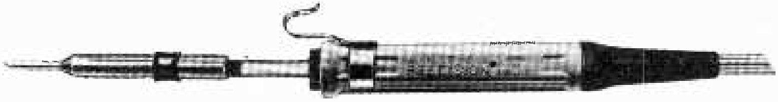


by the control unit which allows the iron to be used on ultra-sensitive equipment and components.

The plug-in soldering iron contains no control components except the temperature sensor and is as cheap and simple to repair as an ordinary iron.

Long-life bits slip over the heating element and are available in a range of tip sizes. Price is £19·80. *Light Soldering Developments Ltd., 28 Sydenham Road, Croydon, CR9 2LL.*

A New Iron From Antex



The element of this new Antex soldering iron is totally enclosed within a ceramic shaft. (Aluminium oxide.)

Near perfect insulation has been achieved; as a result there is no measurable leakage and live transistors can be soldered without risk of damage.

The 15 watt element generates a temperature of up to 450°C. at the tip to facilitate high speed soldering. A choice of four iron coated bits and one special bit plated with iron, nickel and chrome is available: all designed to ensure long bit-life.

The complete iron has passed a test of 4,000 volts a.c. and each production model is tested at 2,000 volts a.c. Further details from: *Antex Limited, Mayflower House, Plymouth, Devon.*

Eagle International

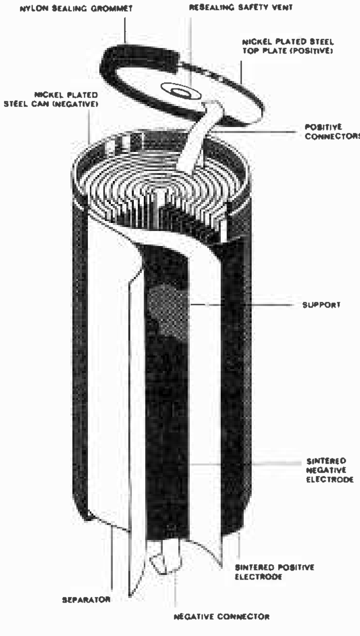
Eagle International will add a quadraphonic synthesiser to its range in January 1972. Designated AA10, it enables a conventional stereo system to be turned into a quadraphonic system by dividing the 2-channel output from a stereo amplifier into 3 or 4 channels based on sum and difference signals.

Ever Ready Co's Rechargeable Cells

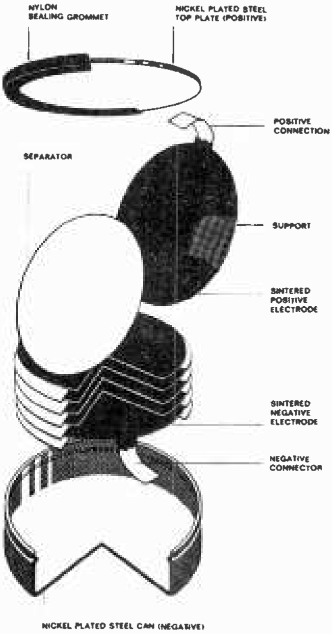
These cells, marketed by the Ever Ready Co. are sealed Nickel Cadmium types and have been used for some time now as the rechargeable power units in small portable appliances where the charging unit is integral. Now they are available to the home constructor and prices vary with quantity and capacity but typically a U2 size replacement would cost something over £2 for a single cell but would be proportionately reduced for larger quantities.

Button cells are more normally supplied as higher voltage prepacked batteries and typically a 4·8V 550mAh battery as used in radio controlled models, would cost around £3·30.

Cells and battery packs are available direct from the manufacturer and the smaller button cell packs from reputable suppliers to the radio controlled model field. *The Ever Ready Company (Gt. Britain) Ltd., Special Battery Division, Hockley, Essex.*



TYPICAL CYLINDRICAL CELL CONSTRUCTION



TYPICAL BUTTON CELL CONSTRUCTION

9 BAND SHORT WAVE RADIO

R. F. GRAHAM

ANY means of spreading the great number of short wave transmissions which can be heard over an increased tuning range is helpful, simplifying and easing tuning. When several ranges are needed it becomes difficult to use separate inductors for each range, involving a large number of coils, with all the associated switching.

In the receiver described here, only two coils are required band-changing being achieved by bringing in pairs of fixed capacitors. This breaks up the full tuning range into a number of smaller divisions.

CIRCUIT

Fig. 1 is the mixer stage circuit the wiring being very much simplified by using this switching arrangement. L1 is the aerial coil, tuned by VC1, and L2 the oscillator coil, tuned by VC2. VC1 and VC2 are sections of a small ganged capacitor, operated through a cord drive.

The 2-pole 9-way rotary switch S2/S3 selects the required band. With the switch in position 1, VC1/2 alone are in use, for the highest frequency band. When the switch is in position 2, C2 and C10 are in circuit. Each of these capacitors is 50pF, so the next range runs on from the frequency reached when S2/3 was in position 1, and VC1/2 fully closed. In a similar manner, position 3 of the switch brings in C3 and C11, each of 100pF. The next lower frequency band employs C4 and C12, each of 150pF, with the switch in position 4. This continues for the nine ranges, each pair of capacitors being 50pF larger in value than the previous pair.

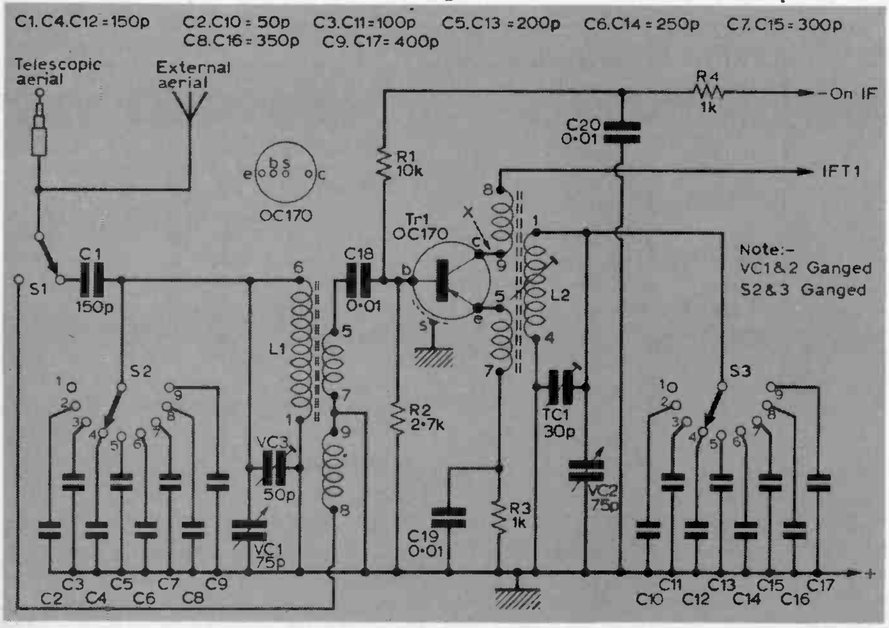
VC1/2 has a swing of a little over 50pF, so that ranges overlap. VC3 is a panel trimmer, which can be set for best volume on any band, or when altering the aerial. S1 is an aerial switch, used for the attached telescopic aerial or an external aerial.

The capacitors C2 to C9 for the aerial circuit, and C10 to C17 for the oscillator, are 1% or 2% silver-mica, and any variation in the exact capacitances of the components used is easily cancelled out by VC3.

IF AMPLIFIER

A conventional high gain intermediate frequency amplifier is used, Fig. 2. This has two double-tuned i.f.t.'s, and one single tuned i.f.t. resulting in good selectivity.

The i.f. amplifier is wired as a separate unit, on



The complete circuit of the 9 Band Receiver is made up of Fig. 1, (left) mixer stage; Fig. 2, i.f. stages and Fig. 3 the audio output stage. The constructor only need assemble the mixer and i.f. stages since the audio stage is a packaged module.

a small insulated board. Input from the mixer stage is to pin 2 of i.f.t.1 and audio output is from D1 and C26. VR1 is the usual audio volume control.

AUDIO AMPLIFIER

This provides high gain and 330mW output into a 15 ohm speaker. Fig. 3 is the circuit and Tr4 is the first a.f. amplifier stage, stabilised by R14. Output from Tr4 collector is via C30 to the base of Tr5, which with Tr6 forms a Darlington pair driver for the output transistors Tr7 and Tr8. These form a push-pull complementary-symmetry stage, working in Class B, with diode D2 for thermal stabilisation. Feedback through R17 maintains operating conditions for the four directly-coupled transistors Tr5 to Tr8.

This circuit has plenty of amplification and volume. In order to simplify construction of the whole receiver, the audio amplifier is obtained as a printed circuit package, ready for use, and incorporating matched transistors.

A is the common positive line, and D the negative line. Point C is for audio input. The resistor R13 is included in the amplifier. R12, which is in series with R13, was found to be necessary for stable working in this particular receiver.

Leads from D (battery negative line) and E run to the 15 ohm speaker. The circuit is of the transformerless type and a speaker of other than 15 ohm impedance should not be used.

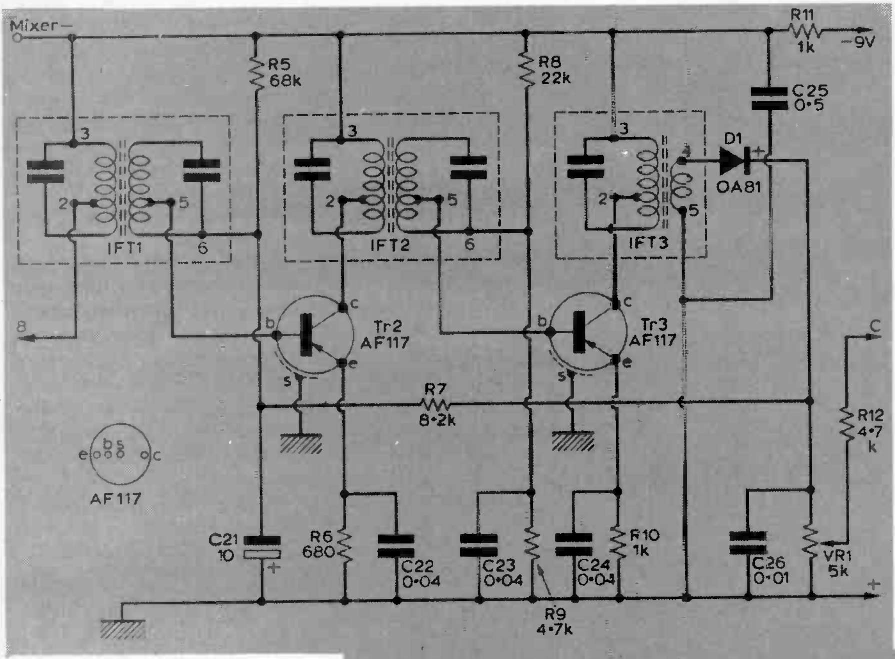


Fig. 2. The circuit of the i.f. stages, constructed as a separate unit on a paxolin panel (See Fig. 6). The input comes from pin 8 on L2 in the mixer stage.

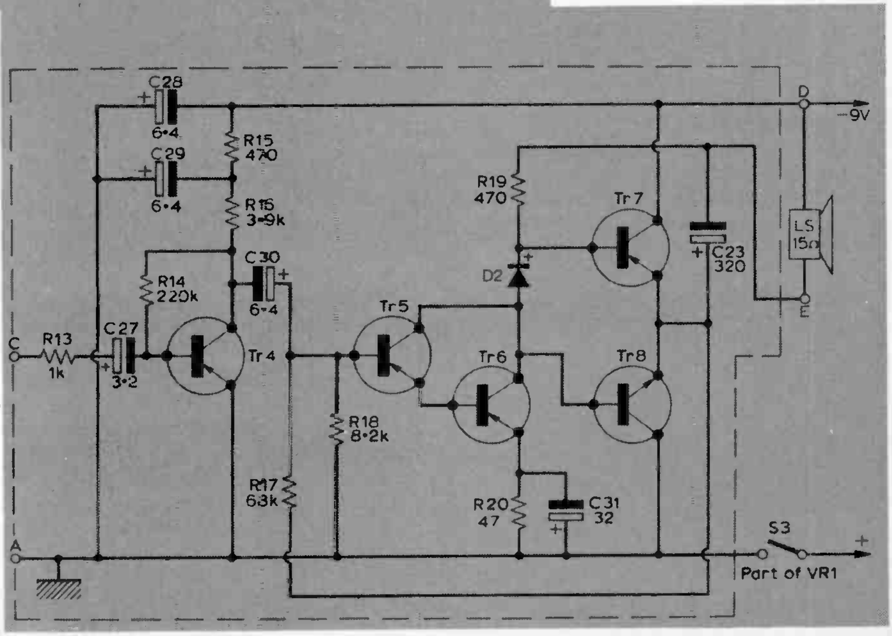


Fig. 3. Since the audio stages are contained within a packaged module this circuit of the 5 transistor unit is given for interest only. Input from the i.f. assembly goes to pin C, the loudspeaker to pins D and E and the earth line to the on/off switch S3. (Note: C23 should read C32.)

MIXER STAGE ASSEMBLY

A 10in. x 4in. flanged plate (universal chassis member) serves as panel for the controls and the top of the case. The controls are placed 1in. from the bottom of this plate, VC3 and the cord drive spindle being $1\frac{3}{4}$in. from the plate ends and S2/3 and VR1 equally spaced between these.

VC1/2 is fixed as in Fig. 4 so that the top of the drum is about $\frac{1}{8}$in. below the top of the plate. One pulley is above the cord drive spindle, to keep the cord parallel with the plate. The second pulley guides the cord clear of the bushes of S2/3 and VR1. The pulleys are on bolts fixed with lock nuts to the plate. The cord is given one complete turn round the drive spindle, then passes round the wheels and

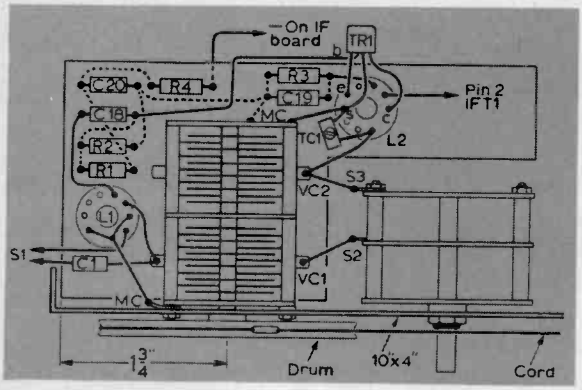


Fig. 4. Layout of the mixer assembly built on an aluminium plate.

drum. It is taken through the drum slot, and tied so that it is under tension from the spring.

Fig. 4 shows wiring, etc., for this stage. L1, L2 and the other items are mounted on a piece of paxolin 5in. x $2\frac{1}{2}$in., which has a cut-out section to clear S2/3. VC1/2 is bolted to the 10in. x 4in. plate, and the paxolin is in turn bolted to the underside of the ganged capacitor. Additional support is given by a bracket attached to the paxolin and rear of the 9-way switch.

Transistor Tr1 has three leads soldered directly

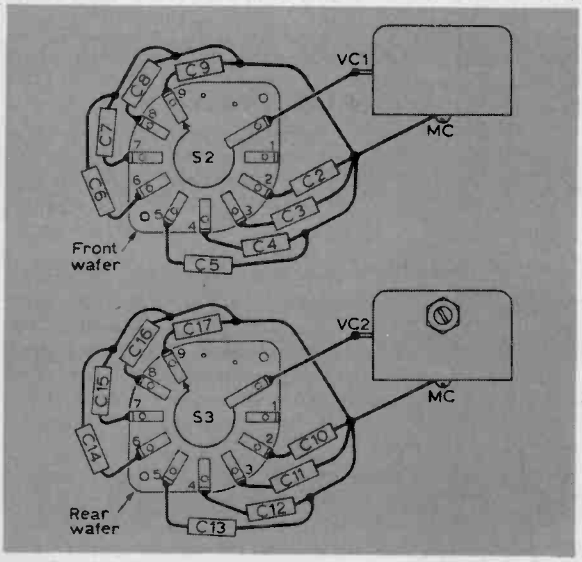


Fig. 5. Details of the wiring of the bandswitch S2/S3.

★ components list

Resistors:

R1	10kΩ	R5	68kΩ	R9	4·7kΩ
R2	2·7kΩ	R6	680Ω	R10	1kΩ
R3	1kΩ	R7	8·2kΩ	R11	1kΩ
R4	1kΩ	R8	22kΩ	R12	4·7kΩ

All $\frac{1}{4}$W 10%.

VR1 5kΩ potentiometer, log, with switch (S3).

Capacitors:

C1	150pF	C10	50pF	C19	0·01μF
C2	50pF	C11	100pF	C20	0·01μF
C3	100pF	C12	150pF	C21	10μF 6V
C4	150pF	C13	200pF	C22	0·04μF
C5	200pF	C14	250pF	C23	0·04μF
C6	250pF	C15	300pF	C24	0·04μF
C7	300pF	C16	350pF	C25	0·5μF
C8	350pF	C17	400pF	C26	0·01μF
C9	400pF	C18	0·01μF		

Capacitors C1 to C17 inc. are 1% or 2% silver mica.

VC1/2 2 gang, 75 + 75 pF approx. See text.
VC3 50pF air-spaced variable.
TC1 30pF pre-set.

Semiconductors:

Tr1	OC170	Tr3	AF117
Tr2	AF117	D1	OA81

Inductors:

IFT1	IFT18/465 (Denco)	L1	Range 4 Blue (Transistor)
IFT2	IFT18/465 (Denco)		
IFT3	IFT14/465 (Denco)	L2	Range 4 Red (Transistor)

Audio Amplifier:

PC3 Packaged circuit (Newmarket).

Miscellaneous:

Cabinet: 2 off, 10in. x 4in. Universal chassis flanged member (Home Radio). 2 off, $7\frac{1}{2}$in x $4\frac{1}{2}$in. plywood. 2 off, 10in x 7in. hardboard.
Tuning drive: Drum, $2\frac{3}{4}$in. dia., DL34 drive spindle, spring, cord, pulleys (Home Radio).
Speaker, 7in. x $3\frac{1}{2}$in., 15Ω. Telescopic aerial.
Aerial socket, knobs, rubber feet.

to the pins of L2. The base lead B is extended by soldering on connecting wire, to run to C18. Connections in this stage should be reasonably short and direct. R3, C19 and C20 are wired to a tag under the paxolin, in contact with the metal frame of VC1/2.

VC3 is mounted directly under VC1/2 and is connected in parallel with it by short leads.

The bandswitch occupies the position shown in Fig. 4, and is wired as in Fig. 5. The switch has separate single-pole 9-way wafers connected directly to VC1 and VC2 by short leads. No extra connection is made to position 1. Position 2 has the pair of capacitors C2 and C10 (50pF each). Position 3 has equal capacitors C3 and C11 (100pF each), and so on.

The capacitors are best arranged to lie partly over the wafers, in the manner giving shortest leads to a stout wire which returns to the frame tag of the ganged capacitor.

GANGED CAPACITOR BAND SWITCH

S2/3 introduces fixed capacitor increments of 50pF at each position. There is a certain amount of stray circuit capacitance, to which is added the minimum capacitance of VC1/2. This means that a ganged capacitor having a maximum capacitance of 50pF each section is not quite sufficient and results in small gaps in the tuning range.

A ganged capacitor with a capacitance swing of just over 50pF (say from 10pF to 70pF) would be ideal. To obtain a little overlap, and allow for variations of C2 to C17, the nearest standard value is 75pF, which is satisfactory.

When this tuning arrangement was first used, a 2 x 100pF capacitor was fitted and some plates pulled off, but this resulted in too many being removed. A new capacitor thus had to be fitted. Caution is therefore required, if a capacitor is modified in this way. With a 2-gang 100pF capacitor, the effective value can be reduced to about 75pF by placing a 300pF fixed capacitor (silver mica) in series with each section. The lead from L1 to VC1 must then run over VC1 so that it can join the lead from S2.

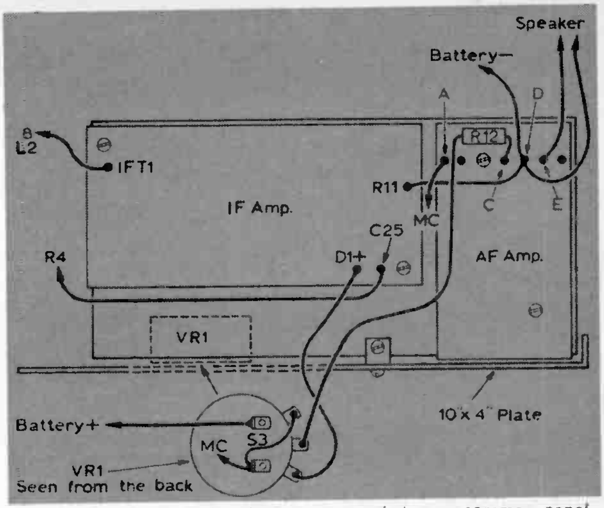


Fig. 7. The i.f. and audio stages are mounted on a common panel.

IF AMPLIFIER ASSEMBLY

This is assembled and wired on a paxolin panel $3\frac{3}{4}$in. x $1\frac{3}{4}$in. All components are mounted on one side and wiring is on the reverse, as in Fig. 6. Note that the different spacing of the pins of the i.f.t.'s enable these to be identified. Remember to drill holes for adjustment of the cores.

Small holes are drilled for the leads of the other components. Note the polarity of C21 and diode D1. Connections underneath are made by bending over the wires and snipping off the ends and by using thin connecting wire where required. Insulated sleeving is put on all leads where necessary. Two bolts holding the tags MC, locked on, will mount the finished amplifier and provide a positive return circuit.

Solder a lead to pin 2 of i.f.t.1. This is later soldered to pin 8 of the oscillator coil L2.

Take a black lead from R11, to use as negative. Solder a wire to the junction of R11 and C25, as shown, which will later run to R4. The remaining external connection is from R7, C26 and D1, and goes to the volume control VR1.

Both i.f. and a.f. amplifiers are mounted on a piece of paxolin $5\frac{1}{2}$in. x $2\frac{1}{2}$in. which is supported by the bracket mentioned earlier, and by a further bracket bolted to the 10in. x 4in. aluminium plate. Extra nuts are put on the bolts holding the tags MC, Fig. 6. The bolts pass through the $5\frac{1}{2}$in. x $2\frac{1}{2}$in. paxolin. Further tags are then put on fixed with nuts. The tags are wired to the volume control and metal plate (positive line).

The audio amplifier package is mounted in a similar way, Fig. 7. R12 is soldered to point C. A black lead for battery negative is taken to point D, and white leads for speaker connections to points D and E. A red lead from point A runs to the positive line at VR1 and the on-off switch.

ALIGNMENT

The complete assembly on the 10in. x 4in. flanged plate is aligned and tested before fitting it in the cabinet. A speaker of the correct type (15 ohms) must be connected.

The five cores of the i.f.t.'s are rotated with a suitable tool, such as the Denco TT5, for best results. A weak signal is most suitable from a signal generator, or from a transmission, a short wire aerial being temporarily

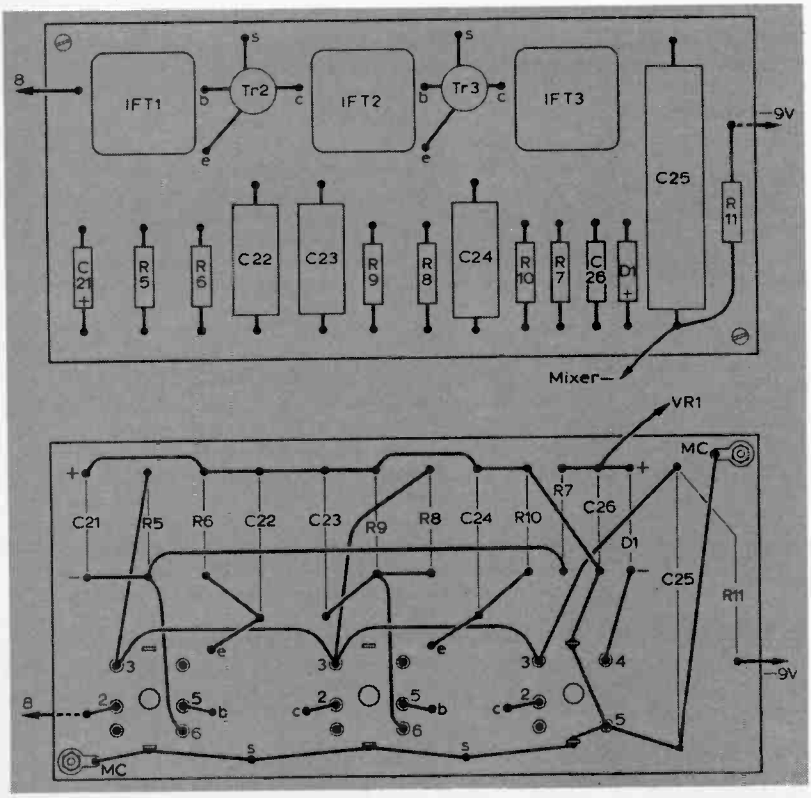


Fig. 6. Layout and wiring diagram of the i.f. assembly built on a paxolin panel, $3\frac{3}{4}$in x $1\frac{3}{4}$in.

connected to tag 8 of L1. VR1 should be near maximum volume, but a strong signal should be avoided because the automatic gain control circuit will then make critical adjustment of the cores difficult.

Once the i.f.t. cores have been correctly peaked for best sensitivity, they should be left alone. A meter placed in one battery lead should show a current of under 15mA with weak signals, rising to peaks of 50mA or more with signals giving good volume.

The cores of L1 and L2 are then rotated until about $^3/_8$in. of threaded brass projects. Set VC3 and TC1 at about half capacitance. Open VC1/2, set the bandswitch at Position 1, and rotate TC1 as necessary to tune to about 15MHz.

Leave VC3 and TC1, switch to Position 9, and close VC1/2. Rotate the core of L2 as necessary to tune to approximately 3·6MHz. Switch to Position 8, tune in a transmission, and rotate the core of L1 for best results.

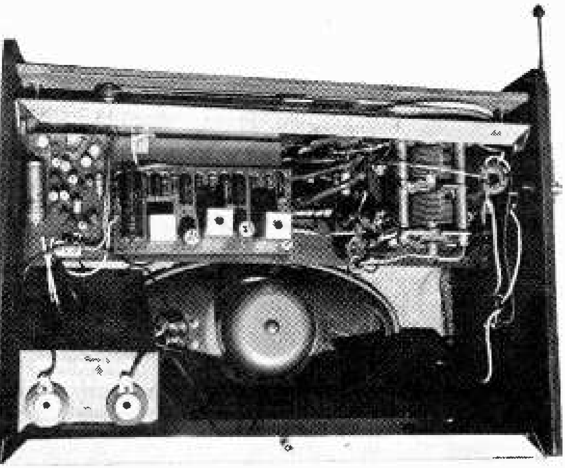
It should then be found that with the bandswitch in any position, and a transmission tuned in, VC3 can be peaked for best reception. Should VC3 need to be either fully open or fully closed with the switch in Positions 1 or 2, re-adjust TC1 as required. If VC3 is either fully open or fully closed to give best results with the switch in positions near the low frequency end of the coverage provided (especially Position 8 or 9) then the core of L1 needs slight re-adjustment to avoid this.

It should be found that VC3 generally only needs one adjustment for each band and that often even this will not be necessary. VC3 can be peaked up for best reception of weak signals at any time, when changing the aerial, or switching S1.

If it is found that almost uninterrupted whistles arise at the extreme h.f. end of the coverage provided, include a resistor at X in Fig. 1, between collector and pin 9 of L2. Its value should be the lowest which prevents oscillation and will generally be around 47 ohms to 470 ohms or so. This depends on the individual transistor and other factors.

CABINET ASSEMBLY

Fig. 8 will help to clarify assembly of the case. Cut two pieces of hardboard 10in. x 7in. and with a pad saw or keyhole saw cut a hole to match the speaker cone. Clean up all edges with glasspaper and wipe off any dust. Fabric is then stretched over the hardboard, brought round the edges, and glued on the inside.



A view inside the 'works' shows the three units forming the complete receiver.

The sides are 3-ply, each $7^1/_2$in x $4^1/_2$in., sanded and varnished. The 10in x 4 in. flanged plate forming the case bottom is placed on a flat surface, and the sides are positioned as in Fig. 8. Mark through the flange holes, drill the sides to match, and fix them with bolts.

Drill the hardboard front for speaker and front flange, and bolt this as in Fig. 8, with the speaker in position.

The receiver panel should then be finished. Cut a piece of plywood or other thin wood about 5in. x 2in. and fix this with small screws through the 10in x 4in. plate, to bring the tuning scale about level with the drive cord. Clip a small piece of tinplate on the cord, and solder a straight wire pointer on this, so that it moves along the scale.

A piece of perspex is cut 10in. x 4in., and drilled to match the four control spindles and for 6BA bolts in line with the four holes which are in the universal chassis flanged plate. A piece of coloured card is also cut this size, and a window about $5^1/_4$in. x $1^1/_4$in. is cut in it with a sharp blade, to lie over the tuning scale.

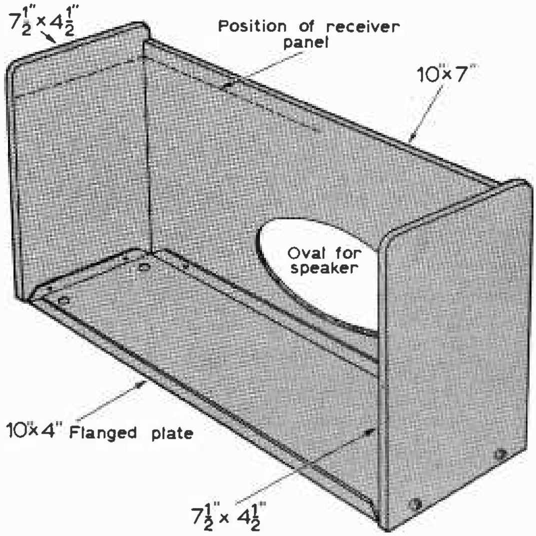


Fig. 8. Details of the construction of the receiver cabinet.

Four 1in. long 6BA bolts are put through the holes in the perspex and card. A washer and nut is put on each bolt, and the nuts are tightened. An extra nut is then put on each bolt, and the whole is fixed in place with further nuts behind the flanged plate. The nuts are adjusted to give about $^1/_2$in. clearance, to take the drum, cord and pointer.

The assembly is then put in the top of the case, so that the flanged plate is about $^1/_2$in. down, as in Fig. 8, and the perspex is flush with the case front. Drilling positions are then marked through the holes punched in the flanges. The sides are drilled, and the receiver bolted in place. The receiver case front is also bolted to the front flange of the 10in. x 4in. plate.

—continued on page 738

BUDGET HIGH-FIDELITY STEREO SYSTEMS

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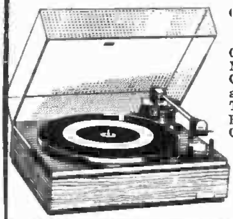

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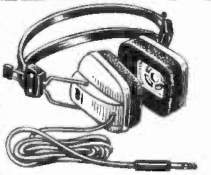

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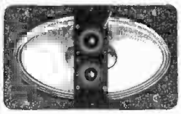

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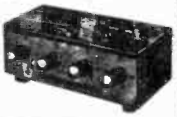

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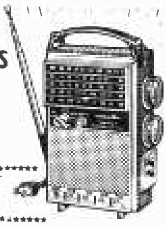

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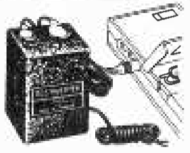

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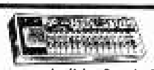

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Three pairs of sockets for the regulated output have been provided to enable the power supply to supply several loads with the minimum of inconvenience. These outputs have been left floating and a separate earth socket provided such that the supply can be connected to give a positive output with respect to earth or a negative output with respect to earth. The negative output of the 45V supply is connected in common with the negative output of the regulated supply.

Variable current limiting from 0·2A to 1A is included making the power supply particularly suitable for development work and also giving it protection from short-circuit surges.

Principle

The principle of negative feedback is used in systems where accurate control is required. The system could be a positional servo as used in rudder control of a model aircraft, speed control of an electric motor, temperature control of a blast furnace or cooker or as in this example, voltage stabilisation. In each case a sample is taken of the final output, a comparison made with some reference, then corrective adjustments made to reduce the error.

The block diagram of Fig. 1 illustrates the principle of voltage control where the controlling device is in series with the output current. The output is monitored by a sampler and the sample voltage compared to a reference voltage by a differential amplifier.

The differential amplifier amplifies the difference such as to starve the output stage of base current if the sample voltage is greater than the reference. As a transistor is basically a current amplifying device complete control of the output current can be achieved by controlling the base current of the current output transistor.

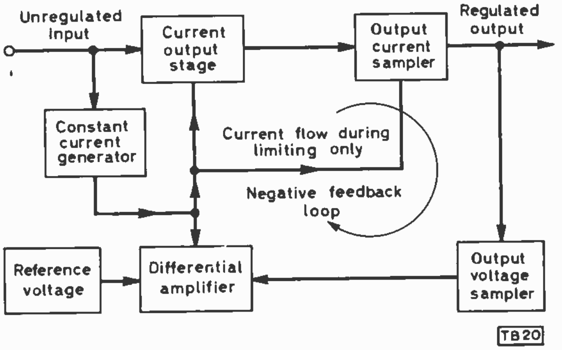

Fig. 1: Block diagram showing function of stages in the power unit.

Current Output Stage

Transistors are current amplifying devices and in general the more current they are capable of handling the less gain they have. A power transistor capable of passing 1A can have a typical β (current gain) of only 10 which would mean that the base current would still be rather high for the differential amplifier to handle, being in the region of 100mA. The current output stage is simply a configuration of two transistors, Tr3 and Tr4, Fig. 2, to give high output current capability with high current gain.

Constant Current Generator

The output current of this circuit, Tr2, is constant and sufficient to supply the maximum base current of the current output stage with a little extra for the differential amplifier.

The circuit uses the principle that as the base-emitter junction of a transistor is a forward biased diode then it will present a low voltage drop (0·7V in the case of silicon transistors). The zener diode potential will therefore be applied almost completely across R6. The resulting current through R6:—

$$I=(V_z-0\cdot7)/R6$$

will pass through the transistor without loading the zener diode.

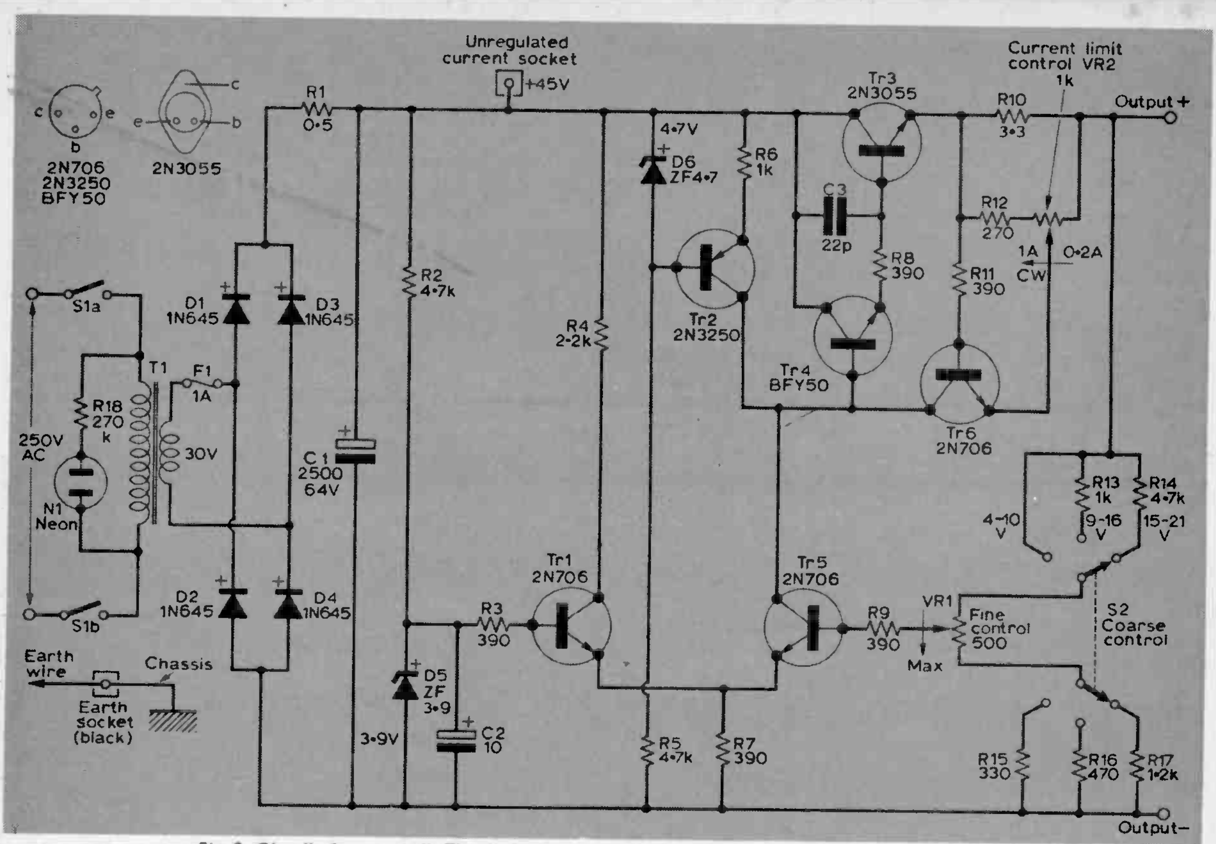

Fig. 2. Circuit of power unit. The diodes D1-4 may be replaced by a single bridge rectifier unit.

Bias current for the zener diode will be supplied by R6. A constant current output of 4mA was sufficient to supply the output stage and the differential amplifier.

Differential Amplifier

The differential amplifier, Tr1 and Tr6, is coupled to the base current circuitry of the current output stage. It takes current surplus to that required to maintain the correct amount of output current.

The amplifier amplifies the difference between its two inputs hence the term "differential amplifier." In this case it is used as a current control device.

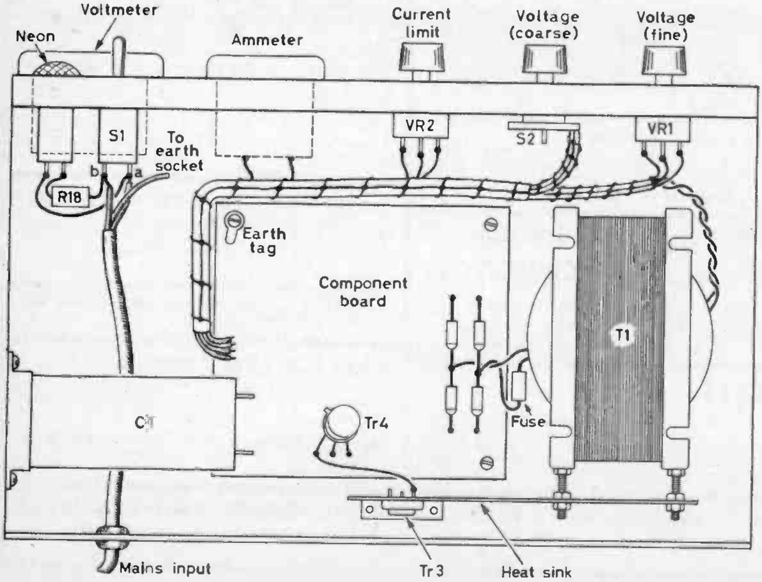

Fig. 3. Layout of unit constructed by the author. See Fig. 4: for details of the component board.

Reference Voltage

This is obtained from a zener diode, D5, an attempt being made to keep the diode current constant by connecting a capacitor across it. This is necessary as low wattage zener diodes have a high series internal resistance resulting in their output voltage varying with current.

The regulated output voltage of the power supply would normally be preferred to supply bias current to the zener but as this will be switched over wide ranges in this case, bias current has been supplied from the unregulated input through a 4·7kΩ resistor R2 giving a bias current of 10mA.

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1N5402	28p	AC187K	17p	BF115	23p
1844	9p	ACY17	31p	BF167	18p
18940	5p	ACY18	19p	BF173	19p
2N696	17p	ACY19	23p	BF177	25p
2N697	18p	ACY20	20p	BF194	14p
2N706	12p	ACY21	21p	BF195	15p
2N930	29p	ACY22	21p	BF254	14p
2N1132	29p	ACY39	63p	BF255	15p
2N1302	19p	ACY40	17p	BFX29	31p
2N1303	19p	ACY41	18p	BFX84	25p
2N1304	26p	ACY44	31p	BFX85	32p
2N1305	26p	AD142	50p	BFX87	29p
2N1306	33p	AD149	58p	BFX88	26p
2N1307	33p	AD150	50p	BFY50	23p
2N1309	36p	AD161	33p	BFY51	20p
2N1613	23p	AD162	36p	BFY52	23p
2N1711	26p	AF114	24p	BSX20	16p
2N1893	54p	AF115	24p	BY164	45p
2N2147	95p	AF116	22p	BY238	18p
2N2218	34p	AF117	22p	BYX38-300	38p
2N2218A	44p	AF118	82p	BYX38-300R	38p
2N2219	38p	AF124	24p	C407	17p
2N2270	62p	AF125	24p	C762	19p
2N2369A	19p	AF126	22p	EA403	10p
2N2483	35p	AF127	22p	EB383	10p
2N2484	42p	AF139	33p	EC401	18p
2N2646	47p	AF239	36p	EC402	17p
2N2904	38p	ASY26	27p	NKT211	25p
2N2905	44p	ASY27	36p	NKT212	25p
2N2905A	47p	ASY28	27p	NKT213	25p
2N2924	20p	ASY29	36p	NKT214	23p
2N2925	22p	AU111	97p	NKT217	50p
2N2926	11p	B30C250	24p	NKT261	21p
2N3053	27p	B1912	66p	NKT271	18p
2N3054	60p	B5041	72p	NKT274	18p
2N3702	13p	BA102	25p	NKT403	65p
2N3703	13p	BA130	22p	NKT405	79p
2N3704	13p	BA145	27p	NKT613F	30p
2N3705	13p	BA156	13p	NKT674F	24p
2N3706	13p	BB103/B	16p	OA47	8p
2N3708	10p	BB103/G	16p	OA90	6p
2N3709	11p	BC108	11p	OA91	5p
2N3710	13p	BC109	12p	OA95	6p
2N3711	13p	BC122	21p	OA200	9p
2N3794	15p	BC125	15p	OA202	10p
2N3819	23p	BC126	22p	OC19	50p
2N3820	53p	BC140	30p	OC25	42p
2N3904	35p	BC147	10p	OC29	76p
2N3906	35p	BC148	9p	OC35	60p
2N4036	55p	BC149	10p	OC36	65p
2N4058	13p	BC153	19p	OC41	42p
2N4059	10p	BC169	11p	OC44	42p
2N4060	11p	BC177	14p	OC70	21p
2N4061	11p	BC178	13p	OC71	38p
2N4124	18p	BC179	14p	OC75	40p
2N4126	27p	BC182L	11p	OC81	25p
2N4284	15p	BC183L	10p	OC81D	25p
2N4286	15p	BC184L	11p	OC83	25p
2N4289	15p	BC186	42p	OC84	25p
2N4291	15p	BC212L	16p	P346A	26p
2N4410	24p	BC213L	16p	S2CN1	10p
2N4991	62p	BC214L	16p	SD1	10p
2N5062	61p	BC257	9p	SD4	12p
2N5457	49p	BC259	9p	V763	28p
2N5459	49p	BC267	17p	W106B1	45p
40250	71p	BC268	15p	W02	40p
40251	89p	BC269	17p	WP02	95p
40361	55p	BC300	49p	ZTX300	14p
40362	68p	BC301	37p	ZTX301	16p
40602	52p	BC303	60p	ZTX302	22p
AC107	46p	BCY30	60p	ZTX303	22p
AC126	20p	BCY31	75p	ZTX304	27p
AC127	20p	BCY70	18p	ZTX330	23p
AC128	20p	BCY71	33p	ZTX331	27p
AC141H	34p	BCY72	15p	ZTX500	18p
AC141HK	37p	BD130	50p		

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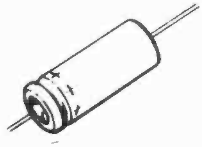

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C	1/20W	5%	82-220K	E12	9	8	7
C	1/8W	5%	4·7-470K	E24	1	0·8	0·7
C	1/4W	10%	4·7-10M	E12	1	0·8	0·7
C	1/2W	5%	4·7-10M	E24	1·2	1	0·9
C	1W	5%	4·7-10M	E12	2·5	2	1·9
MO	1/2W	2%	10-1M	E24	4	3·5	3
WW	1W	10% ± 1/20 Ω	0·22-3·9	E12	7	7	6
WW	3W	5%	12-10K	E12	7	7	6
WW	7W	5%	12-10K	E12	9	9	8

Codes : C = carbon film high stability low noise
MO = metal oxide Electrosil TR5 ultra low noise
WW = wire wound Plessey

Values :
E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades
E24: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 72, 91 and their decades.
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0·33, 0·39, 9p, 0·47, 10p, 0·56, 13p, 0·68, 15p.

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Manufacturer's prices increase roughly by 20% on these on pages 51, 52 and 53 since printing our catalogue. S-DeC £1·44, Four pack £5·10, DeCSTOR pack £2·88. T-Dec, may be temperature-cycled (208 points), £2·88. μDecA, £3·18, μDecB, £5·94. Also I.C. carriers.

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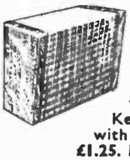

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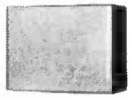

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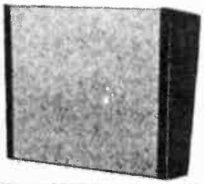

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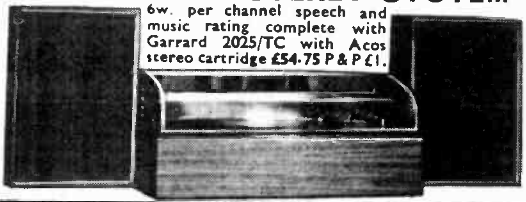

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EBF89	12½p	PCF82	12½p	6F23	20p
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ECC82	12½p	PL81	17½p	20P3	10p
ECC83	12½p	PY81	7½p	20D1	10p
ECL80	7½p	PY33	17½p	30P4	20p
EF80	7½p	PY82	7½p	30P12	20p
EF91	4p	PL82	7½p	30FL1	20p
EY86	20p	PL83	7½p	6/30L2	20p
		PCL84	12½p		

Output Sampler

The resistor chain is strapped across the output voltage and the tapping point will always be at 3·9V. There are three separate resistor chains in order to reduce the sensitivity of VR1.

It is worth mentioning that the output of this power supply can never be less than the reference voltage generated by D5. If 3·9V is not low enough then a 2·7V zener may be used for D5 and if necessary, the sampling chain recalculated.

Construction

Not much information need be given on the construction of this unit since much will depend upon the dimensions of the components used. Fig. 4 shows the layout of the component board and the interconnections with the remaining components.

Fig. 3 illustrates the general layout of the power unit as built by the author. Note that the transistor case of Tr3 forms the collector connection and must be insulated from the heat sink with the mica insulation kit generally supplied with the transistor. Check after assembling the transistor and heat sink that there is no conducting path between the transistor case and the heat sink.

The heat sink used here is made from aluminium sheet $4\frac{1}{2} \times 2\frac{3}{4}$in. bolted to the main chassis.

It is worth adding that where wire-wound resistors are used there is always a tendency for oscillation to occur. These resistors, from the nature of their construction, are slightly inductive. Often this effect can be corrected by the addition of a small capacitor of 20 to 100pF coupled across the resistor to tune out the effect of the inductance. ■

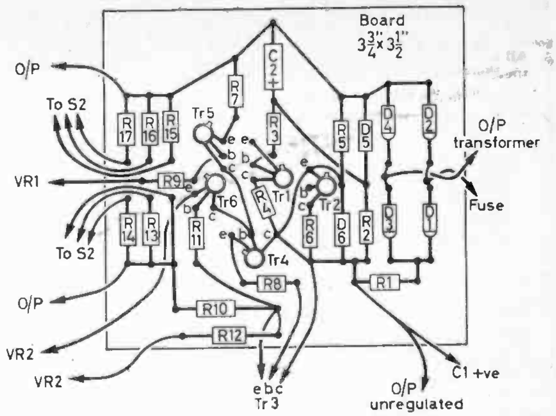

Fig. 4 : Layout of component board.

★ components list

Resistors

R1	0·5Ω	R7	390Ω	R13	1kΩ
R2	4·7kΩ	R8	390Ω	R14	4·7kΩ
R3	390Ω	R9	390Ω	R15	330Ω
R4	2·2kΩ	R10	3·3Ω3W	R16	470Ω
R5	4·7kΩ	R11	390Ω	R17	1·2kΩ
R6	1kΩ	R12	270Ω	R18	270kΩ

All resistors except R10 are ½W
VR1 500Ω linear carbon pot
VR2 1kΩ linear carbon pot

Capacitors

C1 2500μF 64V C2 10μF 25V
C3 22pF polystyrene

Semiconductors

Tr1 2N706 or BC107, 2N930 or 2N2484
Tr2 2N3250 or BCY30, 31, 32 or 2N3250
Tr3 2N3055 or BDY 38, with insulating washer etc.
Tr4 BFY50 or 2N1711, 1613 or BFY51
Tr5 2N706 or BC107, 2N930 or 2N2484
Tr6 2N706 or BC107, 2N930 or 2N2484

D1	1N645	D4	1N645
D2	1N645	D5	ZF3·9 (400mW)
D3	1N645	D6	ZF4·7 (400mW)

Miscellaneous

Transformer 30V 2A (Type MT3AT). S1, 2 pole 2 way toggle switch. S2, 4 pole 3 way, make before break wafer switch, used as 2 pole 3 way. Sockets, red (4), black (5). Neon lamp, Q1332 (Bulgin) or equivalent; some equivalents have built-in resistor —if so delete R18. Fuse holder with 1A fuse. Veroboard, plain, 3½ x 3½ in., 0·1 in. matrix. Aluminium chassis, 10½ x 9 in., panel 12 x 9 in., heat sink 4½ x 2¾ in. Voltmeter 20V, ammeter 1A, if required.

TELEVISION

DECEMBER ISSUE

A CLOSER LOOK AT PAL
The basic principles of the PAL system are now generally understood. There is however a good deal more than meets the eye to the system. So this month we are starting a new series in which we shall be investigating the system in greater detail than previously. The account will be descriptive, not a fog of formulae!

CONSTRUCTORS' CIRCUITS
This month we turn to the line timebase. A choice of transistor or valve line oscillator circuits, both with flywheel synchronisation, and a line output stage with optional stabilisation and optional solid-state e.h.t. and boost rectifier circuits is given.

THE TELDEC SYSTEM
With the first demonstration of the Teldec system in colour at the recent international Berlin Radio Exhibition this remarkable disc videorecording system is again in the news. A full account of the mechanics of the system.

RUSSIAN TV RECEIVERS
There are many novel and unusual features in the Temp single-standard receivers manufactured in the USSR and now being widely distributed in the UK. For example, an external definition control varies the vision i.f. response by means of a varicap diode, the line blocking oscillator transformer has an adjustable feed-in point for optimum a.f.c., automatic brightness control is incorporated in the video output stage and amplified negative feedback is used in the field output stage. We are taking a detailed look at this interesting chassis.

PLUS ALL THE REGULAR FEATURES

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deliberate effort has to be made to roll-off this response to avoid r.f. pickup in the high gain amplifier and also to prevent the bias oscillator signal from being a problem.

It should be pointed out that this circuit is only suitable for the Marriott XRP18 or XRP36 record playback heads and the XES11 erase head. The amplifier will play back from other heads but, on record, other heads need much higher bias voltages than this circuit will produce.

All the transistors specified are common types and inexpensive and the total cost of the semiconductors is unlikely to be more than about £1·50 including the output pair.

The circuit is very largely based on one published by Mullard's and no originality is claimed. There are however certain differences incorporated for various reasons.

The switching necessary in a tape recorder circuit tends to make the understanding of the circuit difficult and so Fig. 1 shows the effective circuit on playback. Fig. 2 shows it in on record. The component numbers are shown and if the values given in the main circuit are used these will work perfectly well by themselves without switching if for instance only a tape playback amplifier is needed.

PLAYBACK

From Fig. 1 it will be seen that Tr1 and Tr2 are coupled as a pretty conventional preamplifier to boost the signal from the tape head. R7, the emitter resistor of Tr2, is not decoupled, this provides a measure of feedback to the whole stage as the bias

Transistor TAPE RECORDER

W. LANGLEY

In January we published full details for a stereo tape recorder and at the time we promised an article describing a mono version. The amplifier described here can be used with any type of tape deck, though the tape heads specified must be used.

THE design of a transistor tape recorder has its own special problems. High gain is necessary since the output from a tape head on playback is very low but at the other end, in the circuits feeding the loudspeaker, high currents are passed and it is vital to ensure that earth loops do not create instability. Readers who wish to build this circuit should not deviate from the general layout unless they are absolutely certain that they know exactly what they are doing.

The problems of earth loops are not helped by the necessity for including fairly complex switching to alter the function of the amplifier from record to playback. An early prototype of this project was violently unstable due to the voltage drop in only a 2in. length of wire; this may give some indication of how important careful layout is.

Care has also to be taken in another field. Modern transistors of the type used here have frequency responses reaching to several Megahertz and a

to Tr1 is taken from the emitter of Tr2 via R5. This feedback improves the stability of the amplifier. C3, a low value capacitor, has little effect at audio frequencies but effectively cuts out the r.f. signals, which may have been picked up, from later stages. Tone control is achieved by coupling feedback from Tr2 collector to Tr1 emitter via C6 and VR2. To

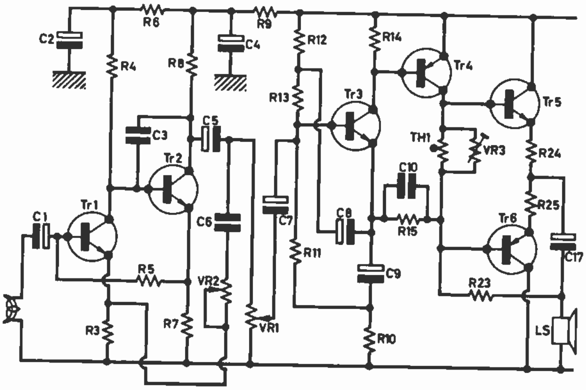

Fig. 1: The effective circuit on playback.

ensure quiet and stable operation, the supply to Tr1 collector must be adequately decoupled, this being achieved through R6 and C2.

After the volume control, the output is fed to a fairly conventional transformerless complementary pair output stage. It is d.c. coupled throughout with a variety of feedback and stability circuits. Conventional connections would take the junction of C10-R15 to the junction of R24 and R25 instead of the base of Tr6; the reason for deviating from this will become apparent from the record stage.

TH1, a VA1077 32Ω thermistor, holds the bases of the output pair close together, as far as potential is concerned, while the trimmer VR3 linearises the operation and sets the output current. R10 applies a degree of negative feedback to the first part of the output stage.

RECORD

On record the input to Tr1 is connected to the input sockets, the first of which is unattenuated, the second which is severely attenuated for inputs of up to 2V. The input impedance of both is fairly high, about 100kΩ.

The preamplifier and the first two stages of the main amplifier operate identically except that the tone control is disconnected and the volume control becomes the record level control. TH1 and VR3 are included but in fact their low value means that they can be ignored in the record position; R16 goes directly to chassis and acts as the collector load. Output to the tape head is taken from the collector of Tr4 (effective) via C11, C12 and R21. The VU meter is connected via R22, the actual value of which should be selected later.

In the record mode, transistors Tr5 and Tr6 are coupled as an oscillator with the erase head, the potential divider chain R17, R18, R19 and R20 providing the correct bias voltages. This arrangement

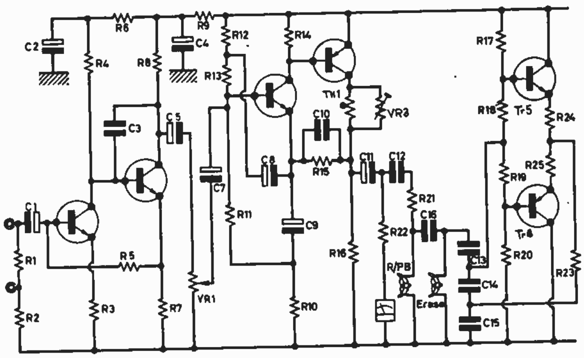

Fig. 2: The effective circuit on record.

gives a high voltage swing across the erase head. The a.c. bias necessary for correct operation is applied to the record head via C16.

SWITCHING

To alter the function of the amplifier from record to playback an eight-pole, two-way switch is needed. The various functions can be studied in the complete circuit diagram shown in Fig. 3. The VU meter is only operational on record and serves as a level indicator.

The type of switch used is not important but may be hard to obtain. That used in the prototype is made up from "Make-a-Switch" parts with two six-pole, two-way wafers.

EQUALISATION

For the best signal-to-noise ratio, on record, treble boost should be applied to the signal and on playback, bass boost should be applied. In fact these tend to be self-cancelling if a slightly worse signal-to-noise ratio can be accepted (and it is only very slight with

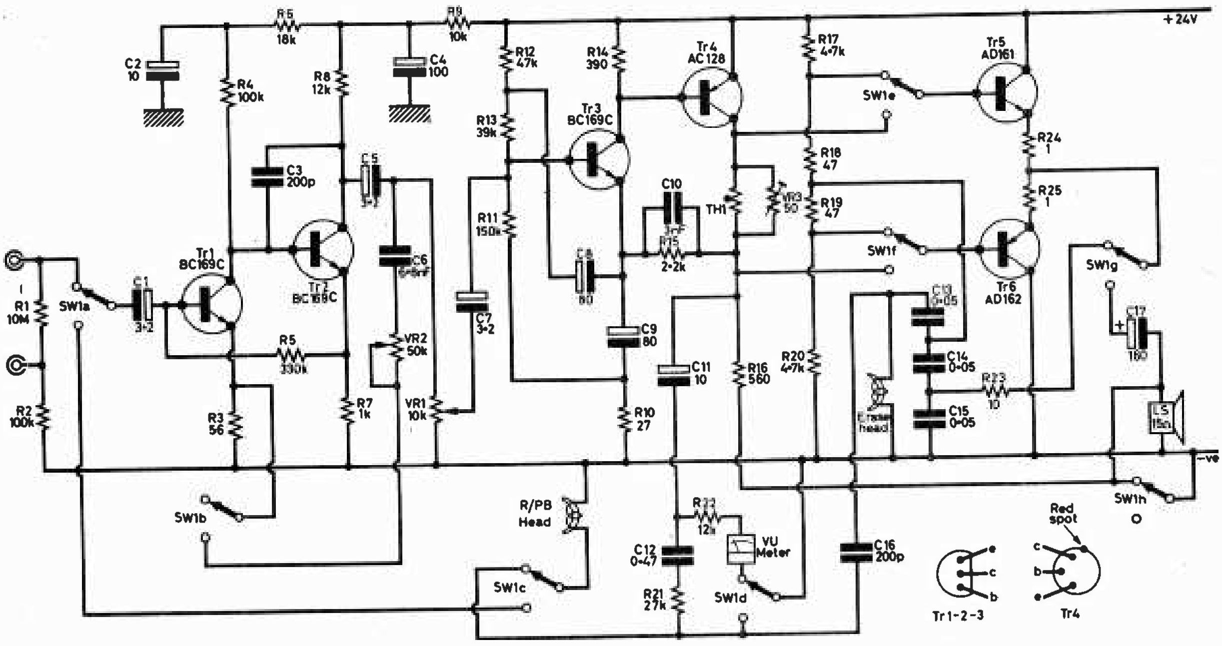

Fig. 3: The complete circuit. SW1 is shown in the record position. The connections for Tr5 and Tr6 are shown in Fig. 6.

modern tape). The author has a number of professionally recorded tapes and recordings, made without equalisation using this amplifier, were hardly different from these. On playback the tone control gives a wide control over the frequency response and this compensates somewhat for the lack of equalisation.

HEAD SWITCHING

The tape heads specified are both four-track and it is of course necessary to switch from one to the other. This is simply accomplished by fitting a slide switch near the heads, the siting will depend on the deck used. Alternatively, this switch could be incorporated on the main chassis.

★ components list

Resistors

R1	10MΩ ¼W	R10	27Ω	R19	47Ω
R2	100kΩ	R11	150kΩ	R20	4·7kΩ
R3	56Ω	R12	47kΩ	R21	27kΩ
R4	100kΩ	R13	39kΩ	R22	12kΩ
R5	330kΩ	R14	390Ω	R23	10Ω
R6	18kΩ	R15	2·2kΩ	R24	1Ω 1W
R7	1kΩ	R16	560Ω ½W	R25	1Ω 1W
R8	12kΩ	R17	4·7kΩ		
R9	10kΩ	R18	47Ω		

All ¼W, 5% except where stated

VR1 10kΩ log. pot with double pole switch
VR2 50kΩ lin. pot
VR3 50Ω (47Ω) skeleton preset

Capacitors

C1	3·2μF 25V	C7	3·2μF 25V	C13	0·05μF
C2	10μF 25V	C8	80μF 25V	C14	0·05μF
C3	200pF	C9	80μF 25V	C15	0·05μF
C4	100μF 25V	C10	3nF (3,000pF)	C16	200pF
C5	3·2μF			C17	160μF 25V
C6	6·8nF (6,800pF)	C11	10μF 25V		
		C12	0·47μF		

Semiconductors

Tr1	BC169C	Tr4	AC128
Tr2	BC169C	Tr5	AD161 } matched pair
Tr3	BC169C	Tr6	AD162 } matched pair

Miscellaneous

TH1, VA1077 32Ω thermistor; L.S., 15Ω loudspeaker; SW1—see text; Veroboard—see text; DIN input sockets (2 off) and extension L.S. socket; VU meter; Aluminium chassis—see text.

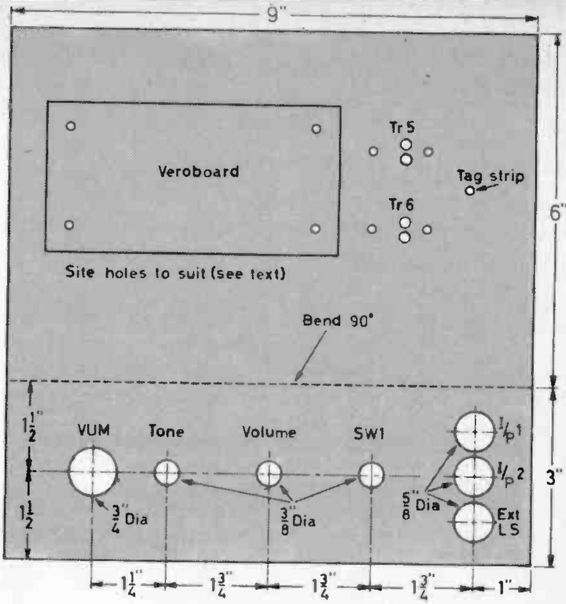

Fig. 4: Details of the metalwork.

CONSTRUCTION

A very simple chassis arrangement is used for the amplifier, the dimensions are shown in Fig. 4. The input sockets and loudspeaker socket are at one end with the VU meter at the other; the function switch, the volume control and the tone control lie in between. The majority of the components are mounted on a piece of Veroboard 5in.×2½in. (a standard size). Four holes are drilled in this for later mounting to the chassis.

The power transistors, AD161 and AD162, need to be heat-sunk and these are fitted at one end of the Veroboard near the switch. A small tag-strip holds the large capacitor C17 and acts as an anchoring point for the output pair emitter resistors, R24 and R25. R1 and R2 are mounted directly on the input sockets.

Building the Veroboard panel should be straightforward, the layout is shown in Fig. 5. The necessary connections to the board are made with Veropins at

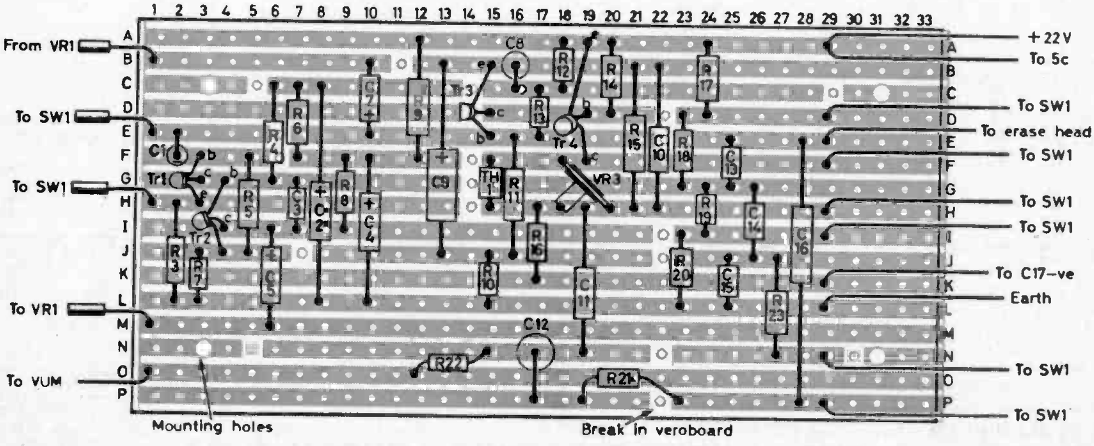

Fig. 5: The main component layout on Veroboard.

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2N2217	27½p
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OC170	30p
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OC202	75p
OC203	42½p
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SN7401	0·20	0·18	SN7437	0·64	0·06	SN7473	0·43	0·41
SN7402	0·20	0·18	SN7438	0·64	0·60	SN7474	0·43	0·41
SN7403	0·20	0·18	SN7440	0·23	0·21	SN7475	0·45	0·44
SN7405	0·20	0·18	SN7441AN	0·87	0·83	SN7476	0·45	0·44
SN7406	0·80	0·75	SN7442	0·85	0·81	SN7480	0·70	0·65
SN7407	0·20	0·18	SN7443	2·86	2·70	SN7481	1·40	1·38
SN7408	0·20	0·18	SN7444	2·86	2·70	SN7482	0·87	0·82
SN7409	0·20	0·18	SN7445	2·50	2·40	SN7483	0·87	0·82
SN7410	0·20	0·18	SN7446	1·00	0·95	SN7484	2·00	1·85
SN7411	0·23	0·21	SN7447	1·00	0·95	SN7485	3·62	3·40
SN7412	0·48	0·46	SN7448	1·00	0·95	SN7486	0·33	0·30
SN7413	0·40	0·38	SN7449	1·00	0·95	SN7490	0·87	0·84
SN7420	0·20	0·18	SN7450	0·20	0·18	SN7491AN	1·21	1·10
SN7423	0·51	0·47	SN7451	0·20	0·18	SN7492	0·87	0·84
SN7427	0·48	0·45	SN7453	0·20	0·18	SN7493	0·87	0·84
SN7428	0·80	0·75	SN7454	0·20	0·18	SN7494	0·87	0·84
SN7430	0·23	0·15	SN7460	0·20	0·18	SN7495	0·87	0·84
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SILICON RECTIFIERS

PIV	50	100	200	400	600	800	1000	1200
1A	10p	12½p	15p	16p	17½p	19p	20p	—
3A	15p	—	—	22½p	—	30p	—	—
6A	—	—	25p	30p	32½p	35p	—	—
10A	—	52½p	57½p	65p	77½p	86½p	97½p	£1·25
17A	—	57½p	62½p	77½p	90p	97½p	£1·20	£1·57½
35A	—	80p	90p	£1·00	£1·25	£1·50	£2·50	—

1 amp and 3 amp are plastic encapsulation.

DIODES & RECTIFIERS

IN34A	10p	AA119	10p	BAX16	12½p	BYZ13	25p
IN914	07½p	AA129	10p	BAY18	17½p	FST3/4	22½p
IN916	07½p	AAZ13	10p	BAY31	07½p	OA5	17½p
IN4007	22½p	AAZ15	12½p	BAY38	25p	OA10	22½p
IS44	10p	AAZ17	12½p	BY100	17½p	OA9	10p
IS113	15p	BA100	15p	BY103	22½p	OA47	07½p
IS120	15p	BA102	22½p	BY122	47½p	OA70	07½p
IS121	17½p	BA110	32½p	BY124	15p	OA73	10p
IS130	12½p	BA114	22½p	BY126	15p	OA79	09p
IS131	12½p	BA115	07½p	BY127	17½p	OA81	07½p
IS132	15p	BA141	32½p	BY164	57½p	OA85	07½p
IS920	07½p	BA142	32½p	BYX10	22½p	OA90	07½p
IS922	07½p	BA144	12½p	BYZ10	35p	OA91	07½p
IS923	07½p	BA145	20p	BYZ11	32½p	OA95	07½p
IS940	07½p	BA154	12½p	BYZ12	30p	OA200	10p
		BAX13	12½p			OA202	10p

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SC50D	£2·05	40512	£1·45

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A.	PIV		A.	PIV	
1	100	47½p	4	50	60p
1.4	140	52½p	4	100	70p
2	50	55p	4	400	95p
2	200	70p	5	50	62½p
2	400	80p	6	200	87½p
			4	400	£1·12½

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PIV	50	100	200	300	400
1A	25p	27½p	37½p	40p	47½p
4A	47½p	55p	57½p	—	77½p
5A	—	55p	65p	—	90p
7A	—	55p	65p	—	97½p

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1·5µF	21p
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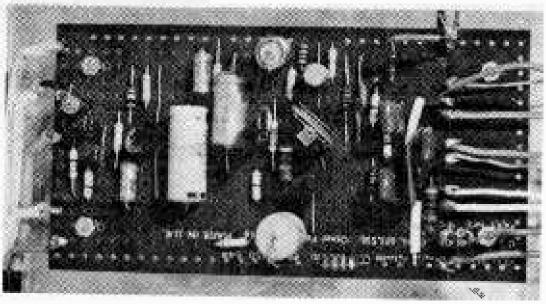


The Veroboard panel—compare this with Fig. 5.

both ends of the board and much work will be saved later if these are fitted at the same time as the main components and soldered in.

There are a number of breaks in the copper conducting strip and these are shown clearly on the diagram.

There is a reasonable amount of room on the board but care should be taken to ensure that extra large components are not selected. The $\frac{1}{8}$W resistors specified will fit neatly as shown. The skeleton preset VR3 will also fit neatly into 0·15in. matrix Veroboard if fitted at an angle as shown.

Naturally the output transistors have to be insulated from the chassis and this applies to Tr6 as well, even though the collector is at chassis potential. It is this sort of thing that can cause earth loop problems.

One connection on the small tag strip is the common earthing point and all wires which carry any appreciable current are earthed directly to this. A second earthing point is on the input DIN sockets but as these wires are taking no current to speak of, no problem arises. When finally connected to the tape deck, be sure that the metal body of the deck is connected to the main earthing point of the amplifier. Certain wires need to be screened, these are indicated on the diagrams.

The switch wiring is shown in Fig. 7. A logical sequency in wiring this up is essential. It is easier to mount the completed Veroboard panel and the other components to the chassis and then proceed with the wiring. A heavy gauge piece of copper wire can be mounted alongside the switch to act as an earth bus bar, this being connected to the common earth point. If the tape deck used has incorporated switch wafers these could be used but this entails a lot of additional wire and could result in instability.

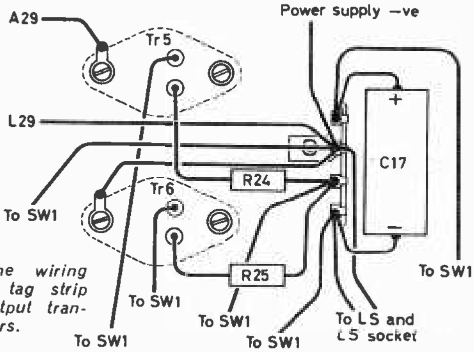
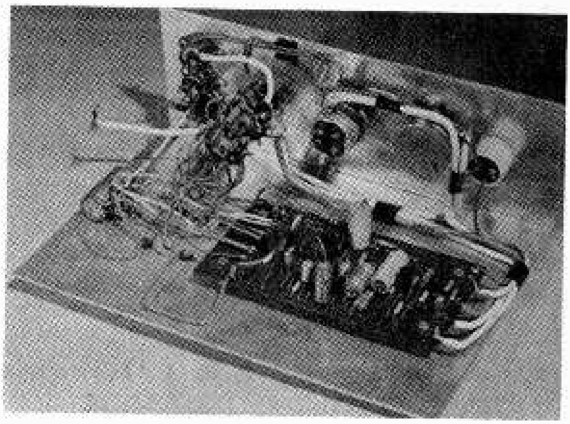


Fig. 6: The wiring around the tag strip and the output transistors.



Rear view of the completed prototype

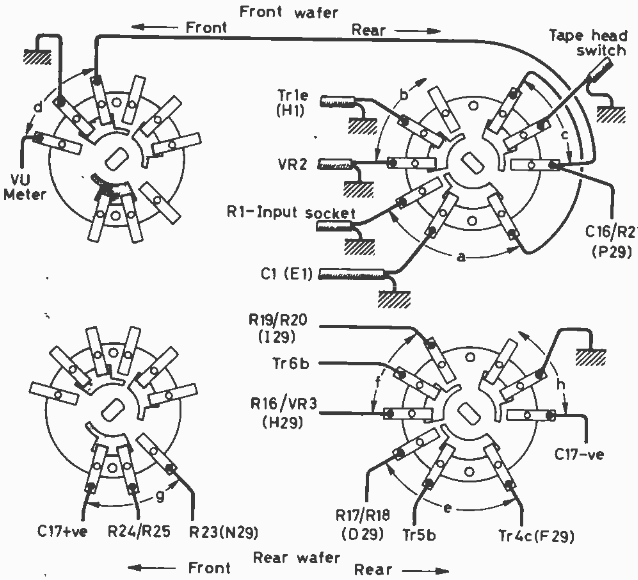


Fig. 7: The record/playback switch wiring.

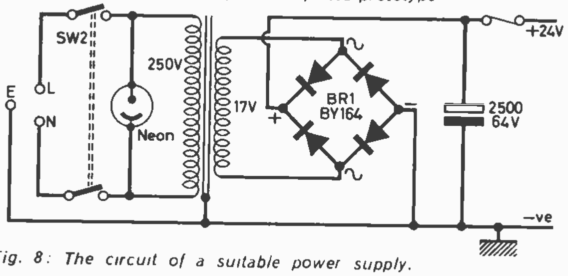


Fig. 8: The circuit of a suitable power supply.

The power supply should be built separately and fixed some distance both from the main amplifier and the tape heads to avoid hum induction. The circuit for a suitable power supply is shown in Fig. 8.

There are only two items that need to be set up. One is VR3; for this a meter should be inserted in the emitter leads of one of the output pair and the quiescent current should be adjusted, using VR3, to read about 20mA. The value of the resistor feeding the VU meter has to be found by trial and error. In use the correct recording level can be found simply by listening for high level distortion caused by over modulation of the tape. When the correct level has been found, the resistor R22 should be selected to read zero level on peaks. ■

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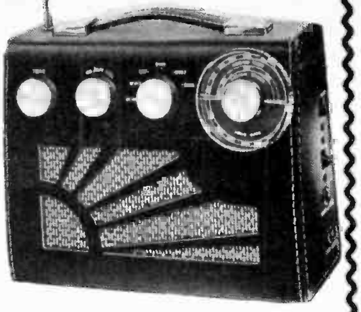

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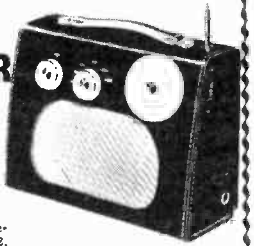

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes, including Micro-Alloy R.F. Transistors. 7 × 4in. P.M. speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 15p (FREE with parts). Earpiece with plug and switched socket for private listening, 30p extra.

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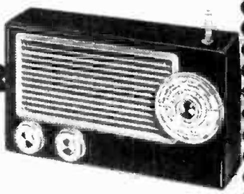

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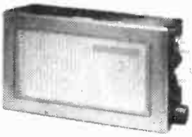

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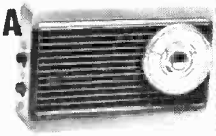

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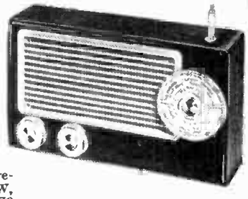

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2¾in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

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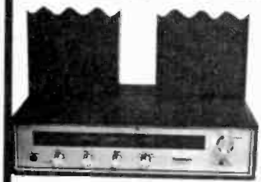

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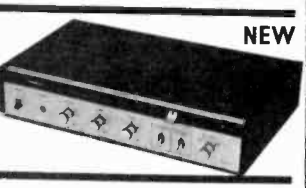

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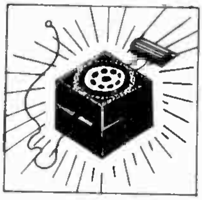

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COMPREHENSIVE MULTI-BAND RECEIVER

F. G. RAYER G3OGR

PART 2

RF AMPLIFIER

The circuit for this stage is shown in Fig. 5. The 6BA6 is to the right of the ganged capacitor, Fig. 3, and L1 is to the left, near the panel. In Fig. 5, L1 is a "Blue" coil, and L2 the existing mixer "Yellow" coil.

Leads run from VC6 and VC7 through the chassis as in Fig. 3. The aerial trimmer VC8 is fixed to the panel in the position shown in Fig. 4, near the holder for L1. Arrange the valve and coil holders to allow short leads, with separation of grid and anode circuits, and earth the central spigot of the valve-holder to the chassis.

The primary of L2 was originally earthed. Pin 8 is now disconnected from the chassis and wired to C1, Fig. 4, shown as C4 in the r.f. stage circuit Fig. 5. Pin 9 is disconnected from the aerial socket and connected to pin 5, V1, Fig. 5.

A piece of co-axial cable is now used for the aerial circuit. Its inner conductor runs from the aerial socket to pin 8 of L1. The outer conductor is connected to the earth socket, chassis, and also to the chassis near L1.

Add the r.f. gain control in the position shown, and disconnect R7 of the i.f. amplifier from the chassis, wiring it to VR1 and R4, Fig. 5.

RF AMPLIFIER ALIGNMENT

Insert a set of three coils. VC8 should peak quite sharply near the h.f. end of each band, unless the aerial is very long. Adjust the core of L1, in the way already described for L2, so that little or no adjustment of VC8 is required near the l.f. end of the band.

There is no loss of efficiency if VC8 and VC3 can both be used to peak up signals throughout each band, and are not fully open or fully closed. But correct adjustment of the cores will make it unnecessary to adjust these trimmers frequently, except to peak up weak signals, or when changing the aerial or coils.

When dealing with the highest frequency range, note that it is possible to tune L1 or L2 to the wrong side of the oscillator frequency, at the h.f. end of the band. This effect is possible when trimming any circuit of this type, with an i.f. near 465kHz. L1 and L2 should be tuned l.f. of the oscillator frequency, and the second channel, or unwanted response, will be about 930kHz h.f. of this, and will be found as a weaker signal, if a generator is used for alignment.

On the lower frequencies it is not possible to set L1 or L2 to the wrong side of the oscillator frequency.

CARRIER OSCILLATOR/PRODUCT DETECTOR

Fig. 6 shows the circuit of these sections. The product detector V1 occupies the position near the last i.f.t. as in Fig. 3. The carrier oscillator is constructed completely in the box which is later bolted to the left of the chassis, Fig. 3. It is possible to use the carrier oscillator for the reception of both c.w. and s.s.b. using the diode detector D1 but reception is much improved by switching it out and bringing in the product detector V1.

The 3-way rotary switch controls operation of the receiver. Section S1 allows the diode detector D1 to supply signals for a.m. reception, or switches to C5 for s.s.b., c.w. and "Calibrate." Section S1b applies h.t. to both stages in the s.s.b./c.w. and "Calibrate" positions.

A 7×2in "universal chassis" flanged side is taken and its flanges cut away 2in from each end. It is then given right-angle bends 2in from each end, to make an open box 2in high, 3in wide, and 2in deep. A plate 3×2in is cut and bolted to the front flanges.

The valveholder and CO coil are located as in Fig. 3, and all components in the box in Fig. 6 are assembled and wired, with tag strips to anchor h.t. circuits and other

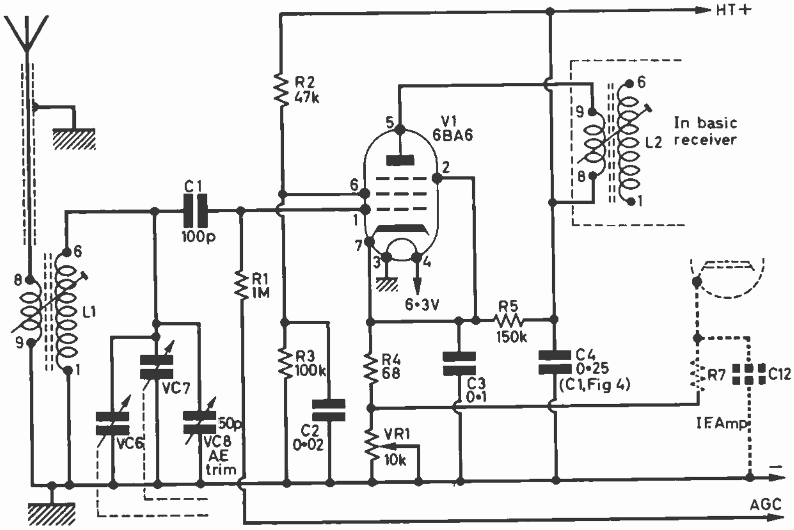


Fig. 5: Circuit of the r.f. amplifier, to give increased sensitivity.

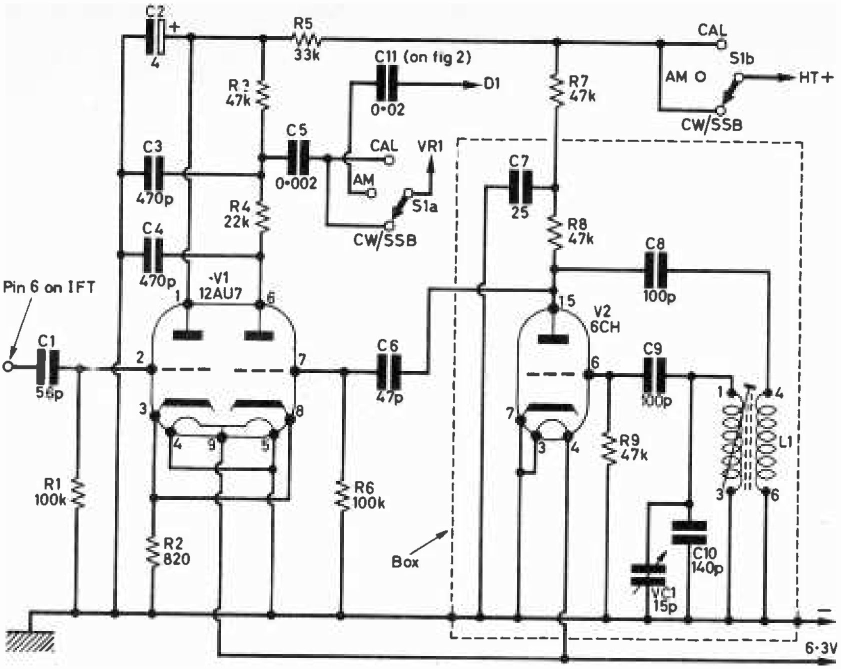


Fig. 6: Circuit of the carrier oscillator and product detector to permit reception of s.s.b. and c.w. signals.

components. A blue lead is run out from pin 4 for heater, a yellow lead from tag 1 for C6, and a red lead from C7 for h.t. circuits.

A back plate 3×2in with a ½in flange to bolt to the chassis is bent up, or cut from a spare 3in wide "universal chassis" member. It is drilled so that it can be attached to the back of the CO box with four self-tapping screws into the flanges of the latter.

The CO box is placed so that the bush and spindle of VC1, Fig. 6, project through a clearance hole in the receiver panel. It is fixed here by two bolts through the lower flanges of the box and chassis. The back plate described is then screwed on from behind, and is bolted to the receiver chassis.

When VC1 is half closed the knob pointer or mark should be vertical.

The function switch is put in the position shown, and h.t. and heater circuits connected.

Most of the small components for the product detector are supported by the valveholder pins, and an adacent tag strip. The lead from C5 to S1 runs against the chassis. Keep grid circuits away from leads carrying heater current.

After connecting C1 re-align the last i.f.t. in the way explained. Tune in any transmission, with the switch at the "AM" position and place VC1 in the central position, as mentioned earlier.

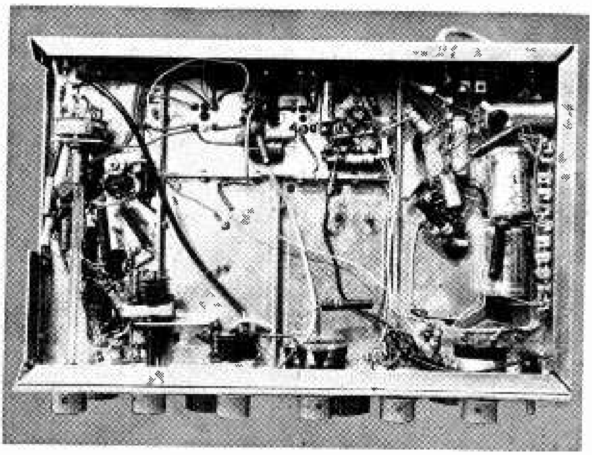
Switch to SSB/CW and rotate the core of the CO coil until a strong heterodyne is produced. This is an audio tone which falls in frequency as the correct core position is reached. Passing this position results in the tone beginning again and rising in frequency. The correct core setting is the central, zero beat setting. An audio tone which rises in pitch can then be produced by rotating VC1 either way.

When receiving s.s.b. the carrier oscillator has to replace the suppressed carrier, being adjusted slightly one way or the other, as necessary by VC1. The sideband normally employed depends on the amateur band in use, but the adjustment of VC1 will soon become clear.

For c.w. reception, use VC1 to obtain the most suitable pitch, placing the CO either above or below the c.w. as found to give least interference.

CRYSTAL FILTER

This incorporates an extra stage of i.f. amplification, 3-position selectivity switch, and variable phasing control using the circuit in Fig. 7. It provides



This photograph of the underneath of the receiver can be compared with Fig. 4 (Part 1).

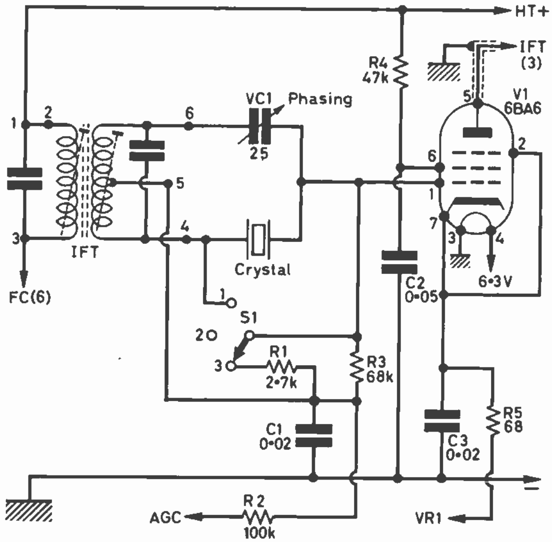


Fig. 7: For increased gain and selectivity this crystal filter unit can be fitted.

★ components list

RF STAGE:—

R1 1MΩ ½W R3 100kΩ ½W R5 150kΩ 1W
R2 47kΩ 1W R4 68Ω ½W All 10% tolerance

VR1 10kΩ wire wound potentiometer, linear.

C1 100pF SM C3 0·1μF
C2 0·02μF disc C4 (C1, Fig. 4)
VC6 Front section of bandset capacitor
VC7 Front section of bandspread capacitor
VC8 50pF variable

L1 From basic receiver (L2)
L2 Miniature plug-in coils (Denco 'Yellow' Ranges 2, 3, 4 and 5)

Miscellaneous:
V1, 6BA6. Valveholders B7G (1) with screen, B9A (1).

CARRIER OSC/P. DETECTOR:

R1 100kΩ ½W R4 22kΩ ½W R7 47kΩ ½W
R2 820Ω ½W R5 33kΩ 1W R8 47kΩ ½W
R3 47kΩ ½W R6 100kΩ ½W R9 47kΩ ½W

C1 56pF SM C6 47pF SM
C2 4μF 350V C7 0·25μF 350V
C3 470pF C8 100μF SM
C4 470pF C9 100pF SM
C5 2000pF C10 140pF SM
VC1 15pF variable

V1 12AU7 V2 6C4

Miscellaneous:
Valveholders, B9A (1), B7G (1) with screen. S1a/b/c 3 pole 3 way wafer switch (S1c is for crystal marker). Universal chassis flanged members 7×2in (1) 4×3in (Home Radio). L1, BFO2/465 (Denco).

CRYSTAL FILTER:

R1 2·7kΩ W R3 68kΩ ½W R5 68Ω ½W
R2 100kΩ ½W R4 47kΩ ½W

C1 0·02μF C2 0·05μF C3 0·02μF
VC1 25pF variable

Miscellaneous:
V1, 6BA6. Crystal, 465kHz (see text). IFT, IFT11/465/CT (Denco). S1, 1 pole 3 way wafer switch. Valveholder B7G and screen. Bushes (2) DL52C, couplings (2) DL60, ¼in dia. polystyrene rod (Denco). Universal chassis side 7×2in (1), 4×3in (1) (Home Radio).

CRYSTAL MARKER:

R1 470kΩ ½W R3 100kΩ ½W
R2 10kΩ ½W R4 22kΩ ½W

C1 220pF SM C3 0·02μF disc
C2 0·02μF disc C4 100pF SM
VC1 100pF variable

Miscellaneous:
Crystal, 1MHz. Valve, EF91. Valveholder, B7G. Universal chassis side 4×3in (Home Radio). Crystal holder.

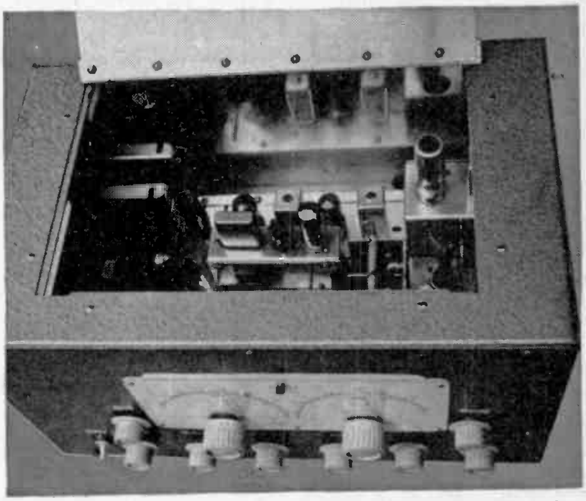
additional gain, and a very great increase in selectivity.

The i.f.t. has a centre-tapped secondary, and VC1 can be adjusted to balance stray capacitance in the crystal and wiring, or to give a rejection notch either side of the crystal frequency. With the switch in position 1, the crystal is out of circuit, and selectivity is that provided by the three i.f.t.'s. With position 2, the crystal is in use working into the relatively high impedance of R3. For position 3, the crystal provides maximum selectivity. Position 1 is suitable for general reception and position 2 is used for other signals except when severe interference from adjacent transmissions is troublesome.

A 3×2×2in box is made in the same way as described for the carrier oscillator. The circuit in Fig. 7 is built entirely in this box, which is then bolted to the chassis, and closed by a plate fixed to the back with self-tapping screws.

The i.f. transformer is situated above a hole in the main chassis, so that its lower core can be adjusted.

VC1 must be insulated from the front of the box, and it is also mounted so as to avoid unnecessary



stray capacitance to the metal. This was done by punching a 1in hole in the box and bolting a $\frac{1}{16}$in strip of paxolin across inside, with a hole to take the capacitor bush. The spindle is extended by using a small coupling and length of ¼in diameter insulated rod, which runs through a bush at the panel.

The 3-way switch is situated immediately under the box, on a chassis bracket and an extension spindle is also fitted.

The exact frequency of the crystal is not too important, provided it falls near the frequency of the i.f.t.'s (465kHz). A 464kHz surplus crystal was used and a 455kHz crystal, available as a spare for a well-known communications receiver, also tried. No difficulty arose in adjusting the i.f.t.'s to 455kHz.

A wire-ended crystal can be supported between pin 4 and VC1. Other crystals may need fixing to an insulated strip or bracket.

Coloured leads pass down through the chassis to identify heater and other circuits. R2 runs to the common a.g.c. line. R5 is connected to the r.f. gain control, which now adjusts the bias of all i.f. stages.

RF leakage round the filter will degrade the very high selectivity so the lead from the f.c. anode to i.f.t. primary is screened from the valveholder right up to the pin of the i.f.t. The anode lead of V1, Fig. 7, is similarly screened.

ALIGNMENT WITH FILTER

Alignment should be checked with a meter, such as used earlier when adjusting the i.f.t. cores. A multi-range meter clipped in to read cathode current of one of the stages receiving a.g.c. is suitable, adjustments being directed towards securing minimum current.

Set the phasing control about half open and the selectivity switch at 1. Tune in a strong transmission. Switch to position 2 and tune slowly across the signal, observing the tuning meter. There will probably be one normal response on the meter, observed as a steady rise and fall while tuning through the signal. A second response should be found, very much sharper, and probably giving only a small dip on the meter. This is the crystal frequency. Leave the tuning at this frequency, and adjust all the i.f.t. cores for best results (lowest meter reading). Switching from 1 to 2 and tuning should show that the i.f.t.'s are now virtually on the crystal frequency.

The phasing control is now adjusted slowly to find the exact point where selectivity is greatest and the response peak (or meter movement) approximately symmetrical a each side of the signal. Repeat this with the switch at 3, and adjust all the i.f.t. cores slightly, if necessary, with a signal tuned in precisely. Adjust the pointer of the phasing control so that it is vertical without moving the control itself.

With the switch at 2 or 3, slight adjustments of VC1 one way or the other will produce a rejection notch which can be moved across the i.f. passband. This should be found to eliminate any interfering signal which is so near the wanted signal that it produces a heterodyne.

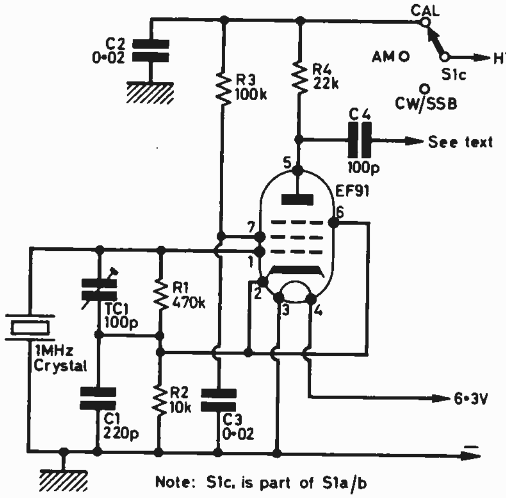


Fig. 8: As a finishing touch this 1MHz crystal marker will provide calibration points throughout the range of the receiver.

CRYSTAL MARKER

Fig. 8 is the circuit of the harmonic marker, which provides crystal-controlled "pips" from 1MHz to 30MHz. TC1 allows a slight shift in crystal frequency, so that the unit can be set to zero beat with MSF on 5MHz. HT is applied to the EF91 only when the function switch is in the "Calibrate" position.

The marker is assembled on a sub-chassis which is 1¾in. high, 4in. wide, and 1¼in. deep made from a single "universal chassis" member 4×3in cut to leave two pieces, one 4×1¾in and the other 4×1¼in. The flange of the smaller piece is bolted to the straight edge of the larger piece, which can later be attached to the chassis by its flange. After wiring, it is bolted 3½in from the rear edge of the chassis, behind the bandspread capacitor.

The EF91, TC1, and crystal holder are mounted in line on the top of the sub-chassis with TC1 insulated from the metal. This may be done by punching a hole which adequately clears the bush, and using two washers of 1/16in paxolin.

A small tag strip anchors C2, R3 and R4, and a flexible lead to pass to the function switch. C4 is similarly anchored, and a rigid insulated wire a few inches long is soldered here and runs near the ganged tuning capacitor. This was found to give adequate coupling into the receiver.

A blue lead from pin 4 passes to the heater circuit. The chassis return is formed by bolting the marker to the receiver chassis.

Initially place TC1 about half closed. With the function switch at "Calibrate" the 5th harmonic at 5MHz can be located with the appropriate coils in place. Switch off the marker and tune in MSF, which will probably be found on almost exactly the same frequency. If necessary, TC1 is rotated so that the marker harmonic is on the same frequency. Turning TC1 either way from this position will cause a flutter, rising to a low pitched growl or audio tone, the correct setting for VC1 being the central, zero position.

The marker can be used for calibration, enabling the 1MHz tuning points to be marked in, from 1MHz to 30MHz.

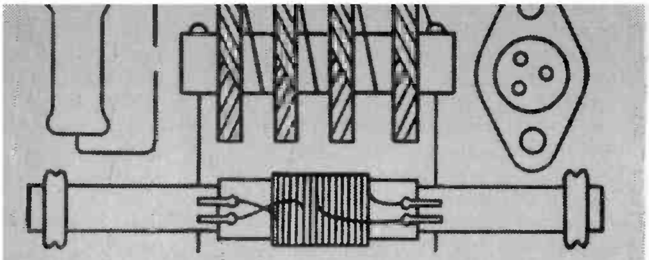
It also allows exact positioning of the bandset capacitor, so that frequencies in a narrow band can be read with the bandspread tuner. To do this, turn the bandspread pointer to the nearest MHz reading, and adjust the bandset capacitor for zero beat. This assures exact reading on the bandspread dial, which is not possible if the bandset capacitor is adjusted visually. This procedure is used at 4MHz, 7MHz, 14MHz, 21MHz and 28MHz, for the 80, 40, 20, 15 and 10 metre amateur bands.

GENERAL NOTES

A piece of thin perspex 8¼×3½in is used to cover the scales, held with chrome bolts. The perspex was held slightly clear of the panel by ½in wide strips of card at the bottom and each side. This allows slightly thinner card to be slid in, so that a separate pair of scales can be used with each set af coils. There is sufficient space to take all the four ranges on a single permanent card, if preferred.

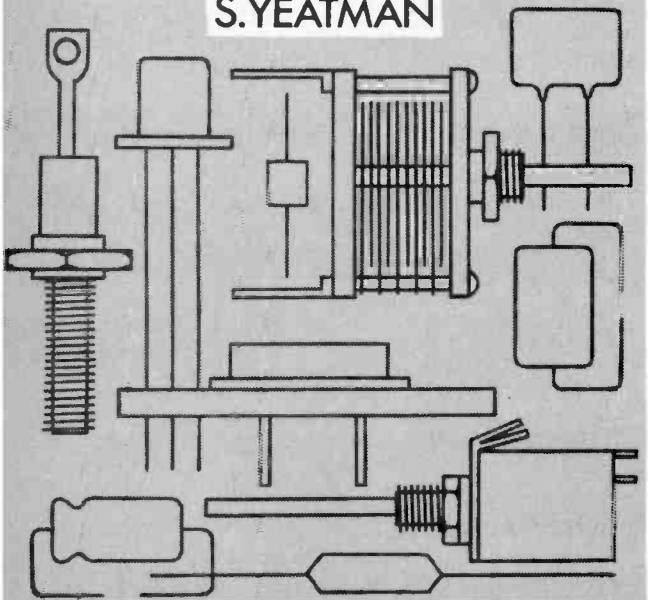
The case top was cut to give an opening lid about 11½×7in. A line scribed ¾in from the back, 1½in from the front, and 1¾in from each side. A small drill is used to start a metal saw, to remove this piece. Strips about 1in wide are bolted on inside the cabinet, for the piece removed to close upon, and it is secured along the back with a piano type hinge.

Several ½in holes are punched in the case bottom, and along the back, for ventilation. Openings 3½×1½in are cut for the aerial and other connections and the mains cord. This can be done by punching pairs of 1½in diameter holes, and sawing between them. ■



COMPONENTS DICTIONARY

S. YEATMAN



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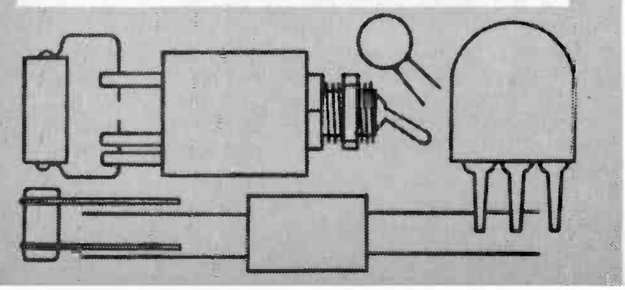
DECEMBER 1971



This dictionary has been compiled to assist the reader in identifying the more common components that he will come across when constructing electronic equipment. It will also enable him to choose the correct component for a particular purpose.

AERIALS, ferrite

Ferrite rod aerials are universal in transistor radios and many other receivers, obviating the need for an external aerial. Inductors suitable for the medium and/or long wave ranges are wound on formers on a flat slab or round rod of ferrite material, the formers being movable on the rod for alignment purposes. These inductors take the place of the conventional inductors in the input circuit of the first stage of the receiver.

Ferrite rod aerials have very pronounced directional characteristics having minimum pick-up off the ends of the rod and maximum pick-up at right angles to the line of the rod. This feature can be used to increase the strength of a signal or to null out an interfering signal if its direction is substantially different to that of the wanted signal.

Ferrite aerials are obtainable for use in either valve or transistor circuits.

CAPACITORS, fixed

Any two metal objects (plates) separated by an insulator (dielectric) possess capacitance, or the ability to hold an electrical charge. Introduction of a solid dielectric in place of air increases the value of a capacitor by several times.

Practical Units: The microfarad (μF) and the picofarad (pF$=1/1{,}000{,}000\mu$F).

Electrolytic capacitors basically consist of two lengths of metal foil separated by a length of insulating material, the whole rolled up and sealed in a tubular container. During the process an electrolyte is introduced often in the form of a jelly. The foil may be aluminium or tantalum which may be etched in order to increase the effective area and thus the capacitance. The insulating material will be as thin as possible consistent with the working voltage of the capacitor. All these measures are aimed at getting the maximum capacitance into the minimum of space.

Electrolytic capacitors are generally polarised, one side (or electrode) always being connected to the positive side of the supply and the other electrode to negative. Generally, the outer case, usually of aluminium, is connected to the negative side although occasionally it is isolated. If the voltage is applied in reverse polarity the capacitor will almost certainly be badly damaged. Plus and minus signs or red and black markings are usually boldly marked on polarised electrolytic capacitors.

It should be noted that non-polarised electrolytics are

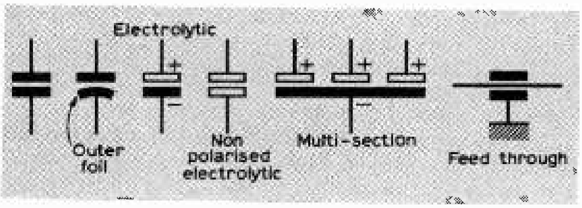
COMPONENTS DICTIONARY

also obtainable but they are the exception rather than the rule. Electrolytic capacitors with as many as four sections are available such as 8+8+16+16μF usually with a common negative connection, with the one unit being used for smoothing and decoupling purposes. Values of electrolytic capacitors range from 0·25μF to 10000μF at working voltages from 2·5V to 600V. Tolerances on nominal capacity are not "symmetrical" as with resistors (±5%) but may be given as "−10% +50%" or "−10% +100%".

Electrolytic capacitors are used in electronic equipment for smoothing purposes in mains rectifier circuits and as decoupling capacitors on h.t. and cathode circuits in valve radios, amplifiers etc. and as decoupling and coupling components in transistorised equipment.

Fixed Capacitors (non-electrolytic) have several different forms of construction, each with its own special characteristics, which must be taken into account when selecting a capacitor for a particular application, so each type will be described separately.

Silver Mica capacitors are considered very stable with a low temperature co-efficient and thus eminently suitable for use in tuned circuits. The working voltage is generally 350V and capacity tolerance 1 or 2% with values available from 2·2 to 12000pF (0·012μF).



Polystyrene capacitors are cylindrical in form with the plastic film forming the dielectric. Possessing high insulation resistance, stability is fair and a negative temperature co-efficient makes these capacitors suitable for temperature compensation purposes in oscillator circuits. Also suitable for coupling and decoupling at radio frequencies. Capacitances available from 2·2pF to 0·1μF with tolerances of 2½ to 5% and working voltages of 125V or 250V.

Polyester capacitors are also tubular, the dielectric this time being polyester plastic foil, again providing high insulation resistance and thus much superior to paper insulation in every respect. Stability is good and performance at r.f. fair. These capacitors can be used to replace paper ones in all non-critical applications. The range of capacitance is 0·01μF to 0·5μF with a tolerance of 10% and working voltages of 125V or 250V.

Polycarbonate capacitors are somewhat similar to paper capacitors in performance, having poor stability and only fair capabilities from the point of view of r.f. performance.

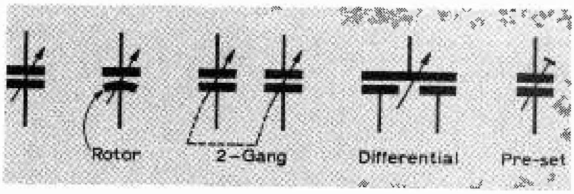
Ceramic, tubular capacitors have good stability characteristics together with known temperature coefficients which may be positive or negative and sometimes included in the colour code marking. Hence these capacitors may be used to effect temperature compensation of tuned circuits with a fair amount of precision. Care must be taken not to confuse these capacitors with the ceramic "High K" types which have a very high temperature co-efficient and are not particularly stable, being more suited for use as r.f. coupling and bypass capacitors. See table for colour coding.

CAPACITORS, variable

Variable capacitors, like their fixed counterparts, come in a wide variety of sizes and values from the simplest two plate (vane) trimmer to the multi-section tuning capacitor with a total of perhaps 120 vanes.

The moving plates or rotor are usually electrically part of the capacitor framework, the fixed vanes or stator being mounted in the framework on ceramic stand-off insulators to ensure minimum losses. Capacitors intended for use in oscillator circuits, where stability is most important, will have a rotor bearing at each end of the framework while a single front bearing is adequate for other uses.

The spacing between the vanes may only be a few thousandths of an inch in the case of miniature variable capacitors such as are used in transistor radios while those used in small transmitters may have an air gap of a ¼in. depending upon the d.c. and r.f. voltages existing across the capacitor. In the process of miniaturisation the air dielectric is replaced by a plastic film considerably reducing the physical size of the unit for a given capacitance.



Ganged capacitors may have several sections mounted on a common spindle often with an end section of lower capacitance than the others, for use in the oscillator circuit of a superhet receiver. Each section will have a built-in compression type trimmer for alignment purposes. These trimmers are not generally shown on circuit diagrams. Typical values for a two-gang unit are 176pF+208pF and, for a four-gang unit, 15pF+15pF+500pF+500pF, the latter being intended for use in an a.m./f.m. receiver.

Differential capacitors have two stators arranged about a common rotor so that the capacitance of one is increasing while decreasing on the other, being, in effect, a capacitative potentiometer.

The "law" of a capacitor relates the change in capacity with angular movement of the rotor, common ones being SLF (straight line frequency) and SLW (straight line wavelength). In each case the dial calibration will be approximately linear. The law is determined by the shape of the rotor vanes.

It is possible to obtain capacitors with integral slow-motion gearing obviating the need for a separate dial mechanism.

Trimmer capacitors are generally similar in construction to variable capacitors except that the spindle is short and slotted to take a screwdriver. Air spaced trimmers are not generally available in values greater than 150pF. Ceramic trimmers are two plate capacitors with the plates in the form of silver deposited on the ceramic base and ceramic disc rotor. The maximum value of this type of trimmer is mostly under 50pF.

Compression type trimmers utilise mica or plastic film for the dielectric between a stack of plates the capacity being adjusted by means of a central screw altering the pressure on the plates. The minimum capacitance of this type of trimmer tends to be high but the maximum capacitance can be as much as 2000pF. Typical ranges are 10–80pF and 500–2000pF. These trimmers are commonly known as "padders" and are mainly used in the oscillator circuit of receivers.

CIRCUIT BOARDS

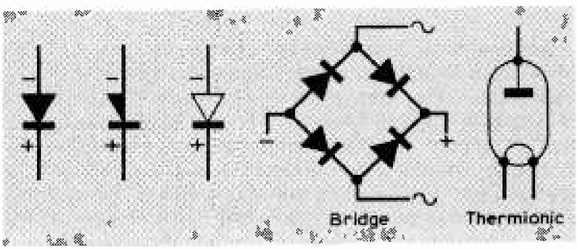
These are flat boards of insulating material on which components may be mounted and wired together to form electronic circuits. The insulation may be s.r.b.p. (synthetic resin bonded paper) or fibreglass. Boards may have the circuit printed on one side by depositing copper by chemical means, the components being interconnected with the circuit through small holes in the board. Copper clad boards having one side covered in copper can be used to form printed circuit boards by etching away the unwanted copper.

Other boards (Veroboard) have a series of copper strips on one side with a matrix of holes, usually of 0·10″ or 0·15″ spacing, along the strips thus enabling components to be wired between the strips to form a circuit. Plain Veroboard is also available having the matrix of holes but no copper strips. Special pins are used with this board to which components and wiring may be connected.

Edge connector sockets can be fitted to electronic equipment enabling circuit boards to be rapidly inserted or removed for servicing.

DIODES

A diode is a simple rectifier capable of passing current essentially in one direction only and hence may be used to rectify a.c.



Thermionic diodes consist of a filament or heater, constituting the cathode, surrounded by a metal cylinder or anode, all enclosed in an evacuated glass envelope. The diode may be a single unit or one or more may be incorporated with a triode or other valve. Power rectifiers consisting of two diodes, often with a common heater, are used in radio receivers and similar equipment to provide d.c. from an a.c. supply. Thermionic diodes or rectifiers are rapidly being replaced by silicon diodes which do not require a heater and are more efficient.

Semiconductor diodes are generally of silicon or germanium with a point contact or a junction of semiconductor materials. The smallest, a fraction of an inch long, are used for signal rectification and similar small signal purposes while the largest used in power supplies can pass several hundred amperes. Vast quantities of s.c. diodes are used in computers as high speed switches usually as part of integrated circuits. In a silicon diode the resistance in the forward direction is very low and high in the reverse direction. In a germanium diode the resistance in the reverse direction is appreciably lower than that of a silicon diode.

Semiconductor diodes are marked with a spot or a band or a plus sign indicating the end of the diode that will show a positive voltage when an a.c. voltage is applied to the diode. This end corresponds to the cathode in a thermionic rectifier.

A characteristic of diodes, quoted in maker's data, is the "peak inverse voltage" (PIV). This is the maximum peak voltage allowable across the diode during the non-conducting part of its operating cycle. In practice the p.i.v. will vary between 1·4 and 2·8 times the applied r.m.s. voltage depending upon the type of rectifier circuit employed.

INDUCTORS

While a straight wire possesses "inductance" the value of this inductance will be considerably increased if the wire is formed into a coil or inductor. An iron dust core inserted into the inductor will further increase this inductance.

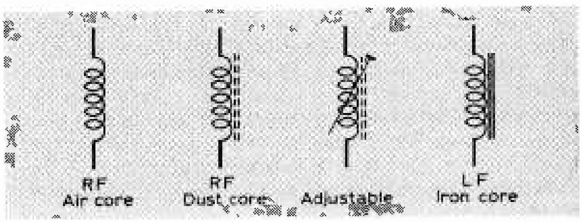
Practical Units: The henry (H), the millihenry (mH=1/1000H) and the microhenry (μH=1/1,000,000H).

LF Inductors, or chokes, are a single winding on an insulating former having a laminated core (see Transformers). The inductance will range from one or two henrys to around 50 henrys or so. These chokes offer high impedance to low frequencies and are used in audio amplifiers and filters, loudspeaker networks and as smoothing chokes in mains rectifier circuits.

RF Inductors, or coils, have a single winding, either layer or pile wound, on a low-loss former and may include an adjustable iron dust core for varying the inductance. If the coil is wound with heavy gauge wire the turns may be self-supporting. Windings of comparatively few turns may be added to the inductor to couple it to other circuits or to provide a feedback winding for use in oscillators.

Such inductors, with associated tuning capacitors, are found in r.f. amplifier, mixer and oscillator stages of receivers as well as in transmitters and signal generators and other test equipment. Although they are usually permanently wired into circuit they can be obtained mounted on a plug-in base for rapid coil changing.

The "goodness" or "Q" of an inductor may be enhanced by enclosing it in a ferrite "pot" with or without an adjustable iron dust core.



RF Chokes are inductors having a single winding, sometimes on a ferrite core, and of sufficiently large inductance to present a high impedance to specified radio frequencies. The winding may also be in the form of several separated pile wound sections in order to reduce the self-capacitance of the choke.

Values of inductance range from a few microhenrys for v.h.f. work to 30 millihenrys for the lower radio frequencies.

INTEGRATED CIRCUITS

The integrated circuit is produced by methods similar to those used in transistor manufacture and combines a number of discrete components on the one silicon chip. Apart from the transistors or diodes, resistors, capacitors

COMPONENTS DICTIONARY

and inductors can be formed as well as the necessary interconnections.

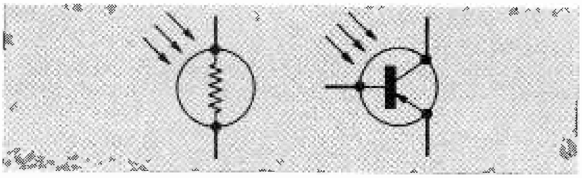
Linear i.c.'s include wideband, audio and operational amplifiers while digital i.c.'s are used in frequency counters, digital clocks, computers etc.

Integrated circuits may be encapsulated or mounted in metal cases. Lead-out wires or tags enable the device to be directly wired into a circuit board or plugged into a suitable holder.

PHOTOCONDUCTIVE CELLS

These devices are sensitive to light, either producing a voltage when subjected to sunlight as in the case of selenium and silicon photocells, or varying their internal resistance as with cadmium sulphide photocells. The latter are also known as light-dependent resistors (LDR).

The silicon and selenium cells will deliver enough power to operate a transistorised radio or even a small electric motor, a single silicon cell providing nearly half a volt at a current of 15mA.



With LDR's the effect of the varying resistance with changes of incident light can be amplified and used to actuate an alarm or counter or similar device. A typical LDR is the ORP12 which has a "dark resistance" of several megohms falling to a few hundred ohms with full illumination.

RESISTORS, fixed

Every electrical circuit possesses "resistance" which limits the current flowing in the circuit. Resistors of known value are used to introduce resistance into circuits, usually to a pre-arranged design.

Practical Units: The ohm (Ω), kilohm (kΩ=1000Ω) and the megohm (MΩ=1,000,000Ω).

Fixed resistors (carbon) are moulded from a special carbon composition, the connections to the resistor being in the form of wire ends. Resistors are given a wattage rating by the makers which represents the maximum power that the resistor may safely dissipate. Wattages generally available range from $\frac{1}{8}$ watt to 2 watts in values from 1 ohm to 22 megohms.

The tolerances available on the nominal value are usually plus or minus (±) 5 and 10% although 20% was common in the recent past.

The stability of composition resistors is poor but their performance at radio frequencies can be considered fair while their change of value with change in temperature (temp. co-efficient) is poor being about ten times worse than a wire-wound resistor. Such resistors should only be used in non-critical applications.

High wattage carbon resistors, 25W or more, are often used as non-inductive loads for transmitters and amplifiers although they are somewhat difficult to obtain. Constructors can improvise by series/paralleling lower wattage resistors until the required value is obtained.

Fixed resistors (metal oxide/carbon film) are formed by deposition on to a ceramic tube or rod, their main advantage being that of high stability. Tolerances are generally 1 or 2%.

Their performance at r.f. is good although care should be taken in using them at v.h.f. or u.h.f. since the metal film is often in the form of a spiral which can introduce appreciable inductance at these frequencies. These resistors are particularly suitable for audio amplifiers and circuits where a low noise level is essential.

Fixed resistors (wire-wound) are composed of a layer of resistance wire on a ceramic tube or rod, with clips or wire ends, and generally having a coating of vitreous enamel or something similar. Some versions have one or more movable clips so that intermediate values of resistance can be had.

Wire-wound resistors must not be used in r.f. circuits since by the very nature of their construction they are highly inductive. Those with special windings and termed "non-inductive" should also be treated with some suspicion at r.f. On the credit side these resistors have a very low noise characteristic and low temperature co-efficient compared to carbon resistors.

Wire-wound resistors are available to the constructor in ratings from 1W to around 50W and in values from 0·22Ω to 100kΩ usually with a tolerance of 5%. Mains "dropper" resistors are a special breed of wire-wound resistor used in transformerless radios and TV sets and fitted in series with the valve heater chain. They may have adjustable clips or tapped sections.

Resistor values, for carbon resistors, are indicated by a colour coding, details of which are given in the accompanying table. If a tip or spot colour appears to be missing it can be assumed to have the same colour as the body of the resistor. For example, a resistor which is red all over has a value of 2·2kΩ and one with an orange body and a yellow spot only is 330kΩ.

The actual values of resistors in common use conform to the "E12 Series" of twelve values and their decades (see table) but there is also the "E24 Series" with a further twelve values intermediate with the E12 series. These are: 1·1, 1·3, 1·6, 2·0, 2·4, 3·0, 3·6, 4·3, 5·1, 6·2, 7·5 and 9·1 and their decades.

Wirewound resistors usually have their value marked in plain numbers.

RESISTORS, variable

Like fixed resistors, these use either carbon composition or resistance wire for the resistance element. The moving arm or rotor moves over the element thus enabling any value between virtually zero and the value of the variable resistor to be selected. The rotor spindle is extended to take a control knob where frequent adjustment is required, such as with a volume control, or may be short and slotted for adjustment with a screwdriver as a preset control. Potentiometer or "pot" is the general name given to such variable resistors.

Carbon potentiometers have a moulded composition track or a carbon deposit on an insulating ring. The rotor contact, generally with two or more "fingers" to ensure continuous pressure on the track, is usually isolated from the spindle.

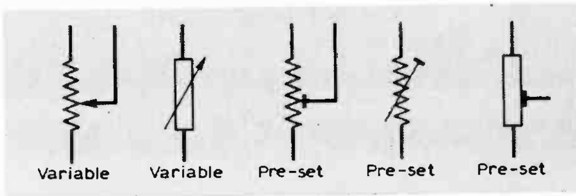
The amount of resistance in circuit relative to the angular movement of the rotor constitutes the "law" of the potentiometer. If equal resistance change results from equal angular movement of the rotor the potentiometer is said to be "linear". If the change is logarithmic the potentiometer is "log" law. If checked on a test meter such a potentiometer would show little change in resistance at the beginning of the movement (clockwise) and a very rapid change towards the end of the movement. An "anti-log" potentiometer will show the reverse effect.

Log potentiometers are generally used as volumes controls on radios and audio amplifiers since the human ear responds to sound levels on a logarithmic basis. Such a volume control will appear to give equal changes in sound level for equal movement of the control.

Potentiometers can be obtained ganged together with a common spindle or with concentric spindles for independent operation. On stereo amplifiers ganged potentiometers are used for volume controls, filter adjustments, balancing and similar circuits where both amplifiers must be adjusted simultaneously. It is common practice to fit a volume control with a single or double pole mains on/off switch operated by the rotor of the potentiometer at the beginning of its travel.

Values of carbon potentiometers go from around 100Ω to about 2MΩ. Wattage ratings are not always quoted since these controls are not usually called upon to pass any appreciable current.

Pre-set carbon potentiometers may be of completely enclosed construction or open skeleton type. The latter generally have wire lead-outs or tags suitable for direct mounting on circuit boards.



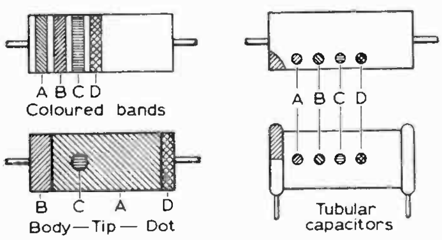
Wirewound potentiometers are similar in most respects to the carbon ones except that the resistance element consists of resistance wire wound on to a flat insulating strip which is then formed into a ring, the rotor generally moving round one edge of the ring.

Values of these potentiometers of interest to the constructor run from 10Ω to 100kΩ in ratings from 1 to 3W. Again, mains on/off switches can be fitted if required.

Precision wirewound potentiometers have the winding in helical form needing perhaps ten or more turns of the control spindle to cover the whole winding. A turns counter is fitted to the spindle. Preset wirewound potentiometers for use on circuit boards have a straight winding with a sliding contact operated by a screw thread, the whole enclosed in a plastic moulding. For use in adverse conditions of dirt or moisture both carbon and wirewound potentiometers can be had as hermetically sealed units.

SWITCHES

The simplest device for making or breaking a circuit is the on/off switch and from this devolves a multiplicity of types.



COLOUR CODE FOR CAPACITORS AND RESISTORS

	First Figure 'A'	Sec'd Figure 'B'	Multiplier 'C'		Tolerance 'D'		
			Resistors	Caps pF	Res	Ceramic Capacitors to 10pF	Ceramic Capacitors over 10pF
Black	—	0	1	1	—	2pF	±20%
Brown	1	1	10	10	±1%	0·1pF	±1%
Red	2	2	100	100	±2%	—	±2%
Orange	3	3	1,000	1,000	—	—	±2-%
Yellow	4	4	10,000	10,000	—	—	—
Green	5	5	100,000	—	—	0·5pF	±5%
Blue	6	6	1,000,000	—	—	—	—
Violet	7	7	10,000,000	—	—	—	—
Grey	8	8	100,000,000	0·01μF	—	0·25pF	—
White	9	9	1,000,000,000	0·1μF	—	1pF	±10%
No colour	—	—	—	—	±20%	—	—
Silver	—	—	—	—	±10%	—	—
Gold	—	—	—	—	±5%	—	—

A salmon-pink fifth ring or body colour denotes a Grade 1 high-stability composition resistor. There are variations in the code for capacitors other than ceramic tubular types.

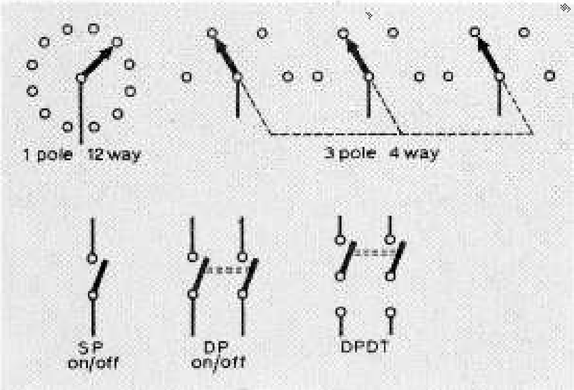
The "preferred" series of values is as follows:—1·0 1·2 1·5 1·8 2·2 2·7 3·3 3·9 4·7 5·6 6·8 8·2 and their decades.

COMPONENTS DICTIONARY

Toggle switches have a laminated or moulded body with a metal or insulated dolly or operating lever. Switch contact combinations include single pole, single throw, (s.p.s.t.), double pole, single or double throw (d.p.s.t. and d.p.d.t.) and double pole change-over. Some types are obtainable with a centre off position. The dolly may be slotted for operation from a cam on an associated control. Other variations include biasing in one position, terminal or tag connections and instrument type toggles which are designed to have very low contact resistance for instrument use.

The ordinary toggle is designed to carry 3A at 250V a.c. with other ratings up to 10A.

Other switches performing the same function as toggle switches include rotary toggle switches, miniature slide switches and press button switches although these are generally s.p.s.t. only.



Microswitches are button operated switches capable of operation with pressures as low as 1 ounce usually by means of a lever or similar attachment. Contact arrangements are fairly simple, on/off or s.p.d.t. the contacts themselves handling 6A at 12V a.c. or 3A at 250V a.c. although models are obtainable for up to 10A.

Wafer rotary switches consist of a flat ring of paxolin insulating material with fixed contacts riveted around the periphery. A disc in the centre of the ring carries the rotor contacts, the disc being rotated by a spindle attached to an index plate. The maximum number of fixed contacts is generally 12 with a maximum of four on the rotor giving various combinations such as 1 pole, 12 way to 4 pole, 3 way.

Since the wafers are very thin several may be mounted on one spindle, sometimes with metal screens between sections to reduce unwanted coupling. These switches are widely used as wavechange switches on radios, audio filters and tone control circuits as well as in meters and test equipment.

Mains switches are available for use with wafer switch assemblies since the wafers themselves should not be used for this purpose. The contacts are not designed to carry any appreciable current. Wafers in ceramic or other low-loss materials are available for switching r.f. circuits. The switches can be bought as complete units or the individual wafers and parts obtained and assembled to suit particular requirements.

THERMISTORS

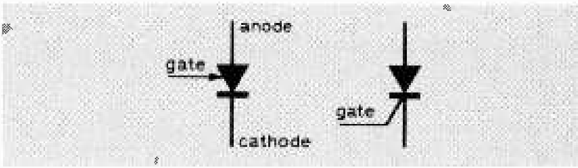
Thermistors are a special kind of resistor having a pronounced negative temperature co-efficient. They are used in circuits, such as valve heater chains, to restrict initial current surges when first switching on. The initial high resistance of the thermistor drops logarithmically as the protected device warms up.

The thermistor is also used to protect photo flood lamps from current surges and in temperature sensitive fire alarm systems. Audio signal generators and oscillators utilise the thermistor in feedback circuits to provide a constant output. Bead type thermistors are used in these circuits since their reaction time to current changes is comparatively short. Bead types can also be employed in measuring r.f. power especially at very high frequencies.

Thermistors in general use have current ratings ranging from 2mA to 2A.

THYRISTORS

Also known as silicon controlled rectifiers (SCR) the thyristor is basically a silicon diode rectifier with an additional electrode or "gate" which is used to control the current flowing through the thyristor. A pulse applied to the gate can switch the thyristor on or off. Once the thyristor is conducting a minimum current is required to maintain conduction.

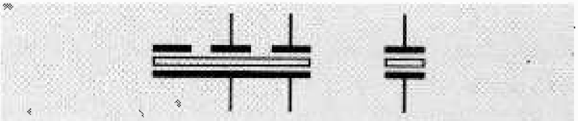


Thyristors used by the constructor will have current ratings between 1 and 10A and peak voltage ratings up to 600V. The p.i.v. figure required for a particular application will be approximately 1½ times the applied r.m.s. voltage.

The gate trigger circuit will need to provide a voltage of the order of 3V at a current of up to 20mA. Small current thyristors are generally contained in a TO5 type metal case with wire lead-outs while the larger thyristors have a stud mounting and tag connectors.

TRANSFILTERS

Transfilters are ceramic filters having somewhat similar characteristics to those of the conventional i.f. transformer. Several transfilters may be combined with capacitors to provide specified bandpass filter features. Several types of transfilter are available around 455kHz as well as for 10·7MHz for use in the i.f. stages of f.m. receivers. Since transfilters do not require any alignment in a receiver they are gradually replacing the tuned i.f. transformers in commercial receivers.

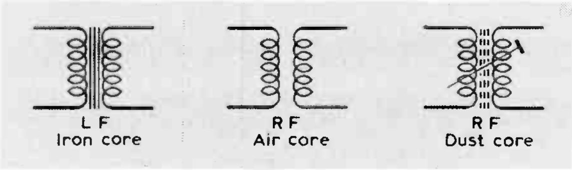


TRANSFORMERS

Basically two coils coupled together so that an alternating current in one coil, the primary, will induce an alternating current in the second coil, the secondary. The ratio of the input voltage, producing the current in the primary, to the voltage at the secondary is directly proportional to the turns ratio of the two coils.

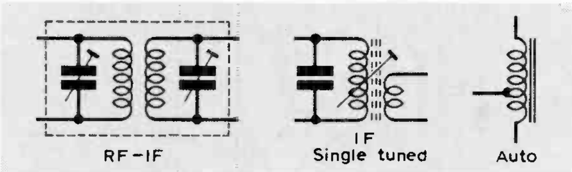
In this way the transformer can be used to match one impedance to another.

LF Transformers are wound on a laminated core of ferromagnetic material, the laminations being electrically insulated from each other. Mains transformers may have extra windings for valve heaters, pilot lamps etc. as well as taps on the primary winding to accommodate variations in mains supply voltages.

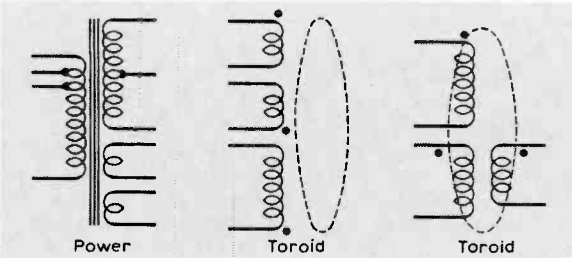


RF Transformers have coils wound in layer or pile-wound form, or air-spaced, on insulating formers often with iron dust cores or slugs to enable each winding to be separately tuned.

IF Transformers are similar to r.f. transformers, being designed to work at the fixed intermediate frequency in superhet receivers, usually between 450 to 475kHz or around 1·6MHz. As well as dust cores each winding generally has a fixed capacitor across it in order to obtain the optimum inductance to capacitance ratio.



Autotransformers have a single tapped winding the ratio of the turns each side of the tap providing the required transformation ratio. One winding may be common to both circuits providing an alternative ratio. Note that an autotransformer does not provide the isolation obtainable with a double wound transformer. A common form of autotransformer is the *Variac* used for compensating changes in mains supply voltages.



Toroid transformers have the windings wound on an annular ferrite core. The separate wires comprising the windings are laid or twisted together and then wound round the ferrite ring. On the circuit symbol the start of each winding is marked with a dot to assist in identification.

TRANSISTORS

The transistor is a three electrode semiconductor device capable of amplifying an electrical signal. The semiconductor materials used in making transistors are either silicon or germanium although there are others such as selenium.

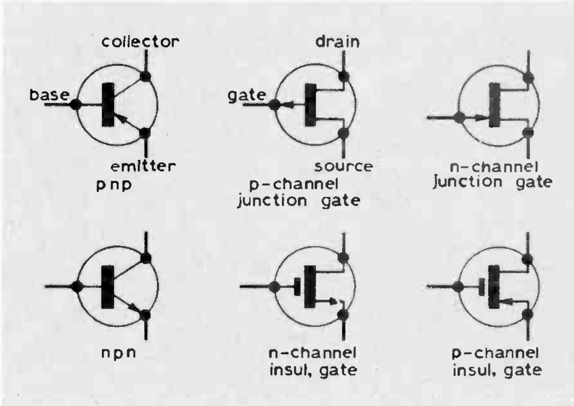
The pure silicon or germanium is treated with either of two impurities in minute quantities to produce 'p' and 'n' type silicon and germanium. A junction of silicon p and n material will show a high resistance in one direction and a low resistance in the other thus forming a diode. A germanium diode similarly formed will not show such a wide change in resistance.

A p-n-p transistor is formed from a thin slice of n material sandwiched between two pieces of p material, the slice being known as the base and the p material as the emitter and collector respectively. An n-p-n transistor has a slice of p material between two pieces of n material.

With an n-p-n transistor the emitter voltage must always be negative with respect to the collector and the emitter of a p-n-p transistor positive with respect to the collector. N-P-N and p-n-p transistors can have very similar characteristics in which case they are said to be "complementary".

Many different processes are used in the manufacture of transistors producing devices of widely varying characteristics and types:

Alloy transistors were among the earliest types produced. The germanium alloy transistors are cheap to produce but do not have a very good performance at high frequencies. They are widely used as power transistors since their low resistance permits the maximum current to be passed at low voltages. Silicon alloy transistors are used mainly because of their ability to operate at high temperatures.



Alloy-diffused transistors have improved performance with a cut-off frequency of the order of 100MHz and being cheap to produce are widely used in radio receivers.

Mesa transistors with a cut-off frequency of over 1000MHz are among the best at high frequencies.

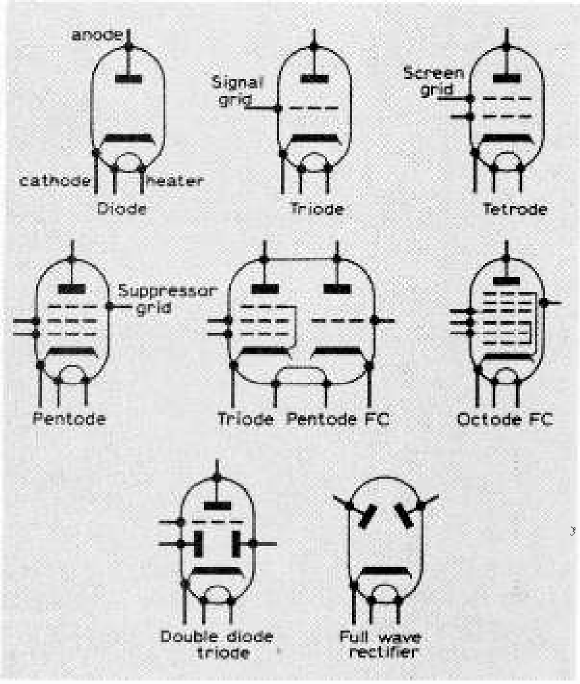
Planar and epitaxial planar transistors have been developed to reduce the collector leakage current and also to include a shield to reduce the capacitance existing between the collector and base electrodes.

Field effect transistors are unipolar as distinct from those listed above which are bi-polar. F.E.T.'s are more akin to the thermionic valve than any previous transistors. While bi-polar transistors are essentially current operated devices and have a low input resistance f.e.t.'s are voltage controlled and consequently have a very high input resistance. The controlling "gate" may be either a junction type (j.u.g.f.e.t.) or insulated type gate (i.g.f.e.t.) either type being obtainable as p-channel or n-channel f.e.t. The i.g.f.e.t. is also known as the metal oxide silicon f.e.t. (m.o.s.f.e.t.).

COMPONENTS DICTIONARY

VALVES

Thermionic valves contain a filament or heater/cathode which emits electrons, with one or more other electrodes. all contained in an evacuated glass envelope. The four basic types of valve are the diode, triode, tetrode/pentode and frequency changer or mixer.



The Diode comprises the cathode and a metal plate or cylinder called the anode. Small single or double diode units are used for signal rectification in detectors and a.g.c. circuits. Larger single or double units are employed in half and full wave power rectifier circuits. A special use for diodes is in the line scanning circuits of TV sets where they are known as "efficiency diodes".

One or more diodes are frequently found in a common structure with triodes and pentodes where they are associated with the signal circuits.

The Triode has a wire mesh, the signal grid, placed between the cathode and the anode. A negative voltage on the grid controls the anode current enabling the triode to be used as an a.f. amplifier or oscillator at a.f. or r.f. A triode is commonly incorporated with a pentode where it acts as a preamplifier.

The Tetrode has a second grid placed between the signal grid and the anode. This "screen grid" reduces inter-electrode capacitance and overcomes a deficiency of the triode known as the "space charge effect".

The Pentode has yet another grid, the suppressor grid, between the screen grid and the anode, which eliminates the kink in the characteristic curve of the tetrode caused by secondary emission. In "beam" tetrodes this third grid is omitted but its effect is simulated by the careful placement of the anode with respect to the other electrodes. Tetrodes and pentodes are used for both r.f. and a.f. work.

Frequency changers, or mixers, are used in superhets to produce the intermediate frequency (i.f.) from the input signal and the local oscillator signal. The mixer valve takes the form of a pentode or tetrode with additional grids to which these signals are applied. Some frequency changers incorporate a separate triode for the local oscillator feeding internally or externally into the mixer section.

Battery type valves have 1·4V filaments for operation from a single cell, taking a current of 25 or 50mA. The maximum anode voltage is generally 90V. Valves fed from a mains supply may have 6·3V heaters which are connected in parallel each heater taking anything from 200 to 600mA. Dual section valves sometimes have heaters with a centre tap allowing operation in series on 12·6V or in parallel on 6·3V.

Other mains operated valves have the heaters in series based on a common current of 100, 150 or 300mA with individual heater voltages of 4 up to 50V. In a.c./d.c. receivers and TV sets the heater chain may be connected across the mains, the difference between the sum of the heater voltages and the mains voltage being taken up by a "dropper" resistor (see Resistors, fixed).

VARICAP DIODES

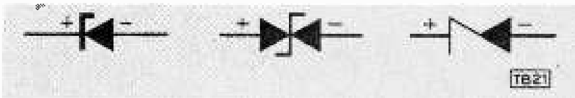
Varicap Diodes, sometimes known as varactors, are similar to semiconductor p-n junction diodes in that the capacity existing between the regions varies with the applied reverse voltage. Varicap diodes provide known changes of capacity over a given range of reverse voltage, typically 50 to 10pF for a range of 1 to 20 volts.

These diodes can thus be used to tune r.f. circuits by means of a potentiometer controlling the applied reverse voltage. They are useful up to frequencies of several hundred MHz and are currently being employed commercially in v.h.f. receivers and t.v. tuners.

ZENER DIODES

The zener diode is a semiconductor diode which breaks down and conducts when a voltage applied in the reverse direction reaches a predetermined value. The action is somewhat similar to that of a gas filled voltage stabiliser.

The external circuitry of a zener diode must be designed so that its rated power dissipation is not exceeded.

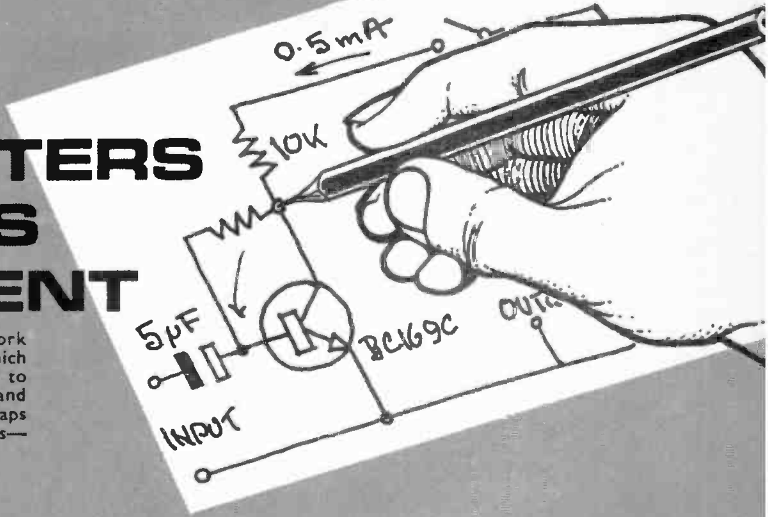


Zener diodes of interest to the constructor are available with nominal zener voltages ranging from 2·4V to 200V with tolerances from 5 to 20% and dissipations from 200mW to 20W. These diodes are used as voltage stabilisers, voltage reference sources, limiters etc.

The end of a zener diode intended to be connected to the positive side of a supply is usually marked with a spot or band or a plus sign.

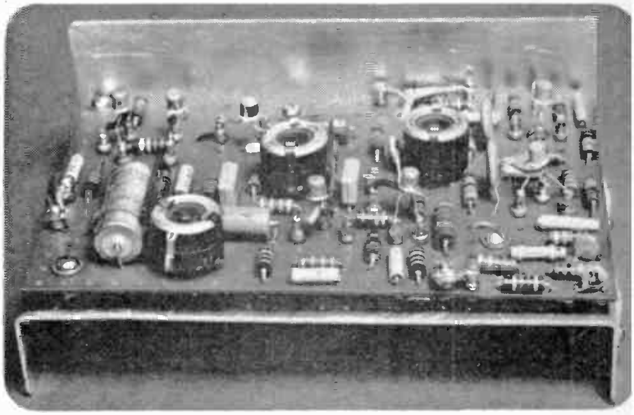
IN NEXT MONTH'S PRACTICAL WIRELESS

EXTRA EXPERIMENTERS CIRCUITS SUPPLEMENT



Here is a mine of information for anyone who can work from a circuit. Feast your eyes on some of the items which are included: several audio amps, ranging from 50mW to 10W; radio circuits from a crystal set to an all band receiver—plus test gear, novelty circuits, etc., etc. Heaps of circuits with all the necessary information and notes—you'll want to keep it for years!

stereo decoder



Most of us have been endowed with two ears; why? Surely because we were meant to listen to stereo! Plans are being made by the BBC to increase their output of stereo material and you'll soon want to fit a decoder to your f.m. set if you haven't one already. Why not settle for our high quality design—complete with easy-to-follow plans.

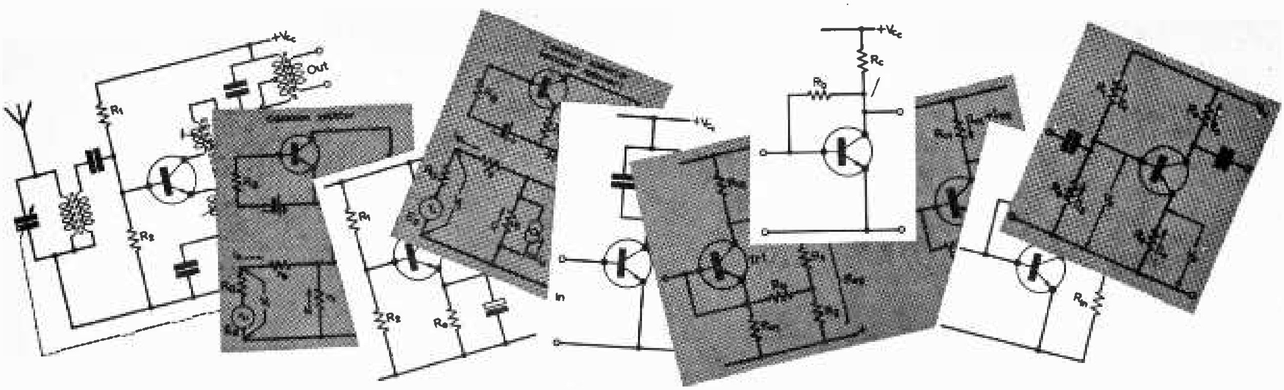
Sound operated flash

Just think of the photographs you could take if you could freeze an action for a split second. Now you can. Our sound operated flash trigger unit enables anyone to take highly original shots for a very small outlay and with no additional expensive equipment. This circuit, which is highly sensitive and ultra-reliable, uses three transistors and an SCR.

AF/RF Mini-probe

This fist-full of probe uses just two transistors and is completely portable. Typical receiver and audio amplifier circuits are illustrated with invaluable hints and tips on how to go about trouble-shooting that faulty set.

ALL IN THE JANUARY ISSUE ON SALE DEC. 3rd.



TRANSISTOR CIRCUITRY for beginners

PART 3

H.W.HELLYER

Circuits and Parameters

That ugly word 'parameters' frightens many newcomers—and really, it need not, for it is only the guideline along which we can walk as we follow the curious path of transistor development. There have to be some hard-and-fast rules, and these are the parameters.

Transistors can be of p.n.p. or n.p.n configuration, the essential difference, in practice, being polarity of the supply voltage. The three basic modes are common-base, common emitter and common-collector. The last is more conveniently referred to as emitter follower, for reasons we shall explain. Some of our circuits show p.n.p. transistors, some n.p.n.—we must get it into our heads at the outset that the essential difference is polarity, and this makes it easy to combine the two types in one circuit.

The common-base circuit is a good introduction to transistor technology. Here, a small change in emitter current brings about a small change in collector current. The ratio between the two is the current transfer ratio, alpha (α).

$$\text{In symbolic form: } \alpha = \frac{\delta I_C}{\delta I_E}$$

where delta (δ) denotes change, in this case, increase. In some formulae, the symbol $\triangle$ may be used instead of δ.

Figures for alpha are very near, but not quite, unity. For a germanium device, typically 0·98.

Take Fig. 9, a proving circuit to demonstrate the above formula. Here we have a common-base transistor connected so that the emitter current flows, around 0·5mA. Voltage V_E establishes this. The emitter junction for an average transistor will be around 100 ohms. The collector current, I_C, flowing through the load R_L, will be slightly lower than the emitter current. Between base and emitter—the base being earthed, or common, a 1·5 volt battery biases the emitter positively.

The input voltage, V_{IN}, depends on the setting of the variable resistance, R_{IN}, which has a further 1·5 volt battery across it, again biasing the emitter positively. The proportion of voltage across the base/emitter junction aided by the position of R_{IN} in series with V_E represents the increase δI_E.

The emitter junction resistance of a typical small signal transistor is about 100 ohms, and let us suppose that the load resistor is 10000 ohms. Thus the change at the input is 10μA through a resistance of 100 ohms, but the change at the output is 9·8μA through a resistor of 10000 ohms. The result, from Ohm's Law, is a voltage change across R_L of 98mV for a change in voltage at the input of 1mV. This gives us a voltage gain of 98 times in spite of a slight loss of current flowing out through the base contact.

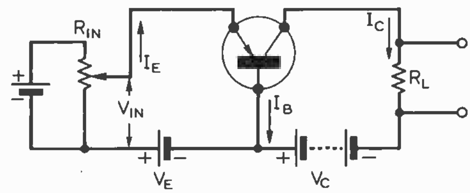


Fig. 9: The common-base circuit arranged to demonstrate change in emitter current causing change in collector current.

With the more frequently used common-emitter circuit, the current transfer ratio is the ratio of current change at the base to current change at the collector, and is designated β (beta) (or sometimes α'). These parameters, β and α, are mathematically related, the relationships, for those wishing to look further into this being:

$$\beta = \frac{\alpha}{(1-\alpha)} \text{ and } \alpha = \frac{\beta}{(1+\beta)}$$

The figures quoted by manufacturers are for small-signal operation unless otherwise stated.

Another commonly seen transistor parameter is the transition frequency, designated f_T. This is the frequency at which the common-emitter current gain falls to unity, and gives an indication of the frequency limits of the transistor.

Hybrid Parameters

Hybrid parameters are widely used in the semiconductor industry to specify transistor characteristics. They are a set of resistance, admittance and voltage and current ratios for given conditions (hence the term hybrid). In the case of the common-emitter circuit these h parameters are:

h_{ie}:— input resistance, common emitter, output short-circuited.
h_{re}:— reverse voltage feedback ratio, common emitter, input open circuit.
h_{fe}:— forward current gain, common emitter, output short-circuited.
h_{oe}:— output admittance, common emitter, input open circuit.

If one group of parameters is known, for one circuit configuration, it is possible to work out the others. In practice, however, such information is more useful to the designer than to the engineer or constructor, who chooses replacement transistors on more empirical lines than a comparison of detailed parameters.

Characteristics of Basic Configurations

Approximate characteristics of the three basic circuit configurations are summarised in Table 1. These must be taken as a guide only, not as accurate conditions for a particular transistor. The table indicates the orders of magnitude of the main parameters with the three configurations: actual figures will of course vary considerably with different types of transistor.

TABLE 1 Features of Circuit Configurations for Comparison

Characteristic	Common Base	Common Emitter	Common Collector
Input to	Emitter	Base	Base
Output from	Collector	Collector	Emitter
Current Gain	Less than unity	About 50	About 50
Voltage Gain	High (approx. 250)	High (approx. 250)	Low (approx. 1)
Input Impedance	Low (200Ω)	Medium (1000Ω)	High (100kΩ)
Output Impedance	High (200kΩ)	Medium (40kΩ)	Low (1000Ω)
Power Gain	Medium (30dB)	High (40dB)	Low (16dB)
H.F. Response (Power ... 3dB down)	High (400kHz)	Low (12kHz)	Dependent on source and load resistances
Phase Shift	0°—Output and input in phase	180° (inverse)	0° (in phase)

It will be noted that the details given in Table 1 include power gain and phase shift, the latter stated to show the effect of the different configurations on the polarity of the signal. This last factor is too often overlooked when experiments are made. Another important factor, not given in the table, but necessary for the designer, is the comparison of collector leakage current with the three configurations: except in the common base configuration, this is dependent on the resistance in the base circuit.

Output Characteristics

As can be seen from the output characteristic set of curves of Fig. 10, circuit configuration makes quite a difference to collector voltage and current relationships (compare these characteristics with the basic pn junction characteristic shown in Fig. 6, Part 1). When considering the choice of a replacement transistor or working out a design it is necessary to take a set of output characteristics, i.e., a family of curves for different base currents—and plot a **load line** as shown in Fig. 11. It can be seen that with a common emitter circuit when the base current is zero the voltage between emitter and collector is almost the full supply volts, i.e. collector current is very small. (It is actually the reverse leakage current of the collector junction.)

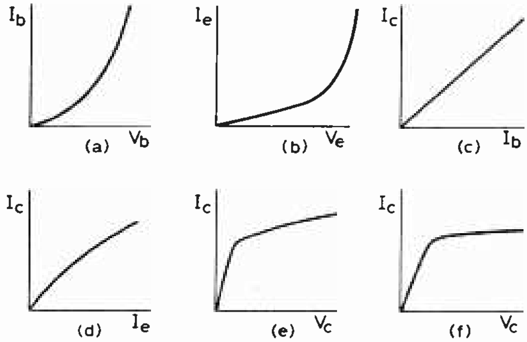


Fig. 10: Typical characteristics showing how circuit configuration drastically alters collector voltage and current relationships.

Increasing base current causes an increase of collector current; the voltage across the load resistance increases and the voltage across the transistor decreases. Eventually, as the base current is increased to a state when the collector current causes a voltage across the load almost equal to the supply

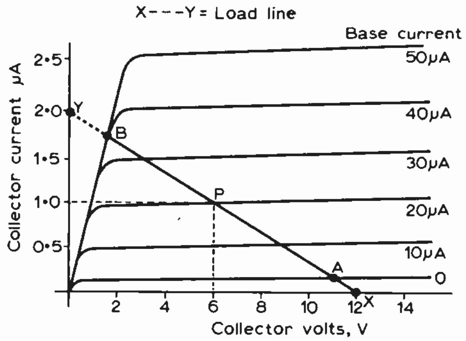


Fig. 11: Constructing a load line for a transistor gives its case history for design purposes.

voltage, the voltage across the transistor drops to practically zero. Any increase of base current beyond this point gives no further increase in collector current—the transistor is saturated. This, for a transistor of given characteristics, is at point B in Fig. 11. The load line, drawn through points X to Y passes through this point B. Point X is the maximum supply voltage and point Y the current resulting from dividing the supply voltage by the load resistance. In the example, a supply voltage of 12 volts and a load resistor of 6000 ohms gives a collector current at Y of 2 mA.

From this load line, the transistor operating point can be chosen by adjusting the base current to a value between the two extremes of A and B. The best choice is midway along the load line, i.e. at P, where collector current is 1mA and collector volts 6. Since the current gain of our example is 50, the base current must be adjusted for 20μA. This will allow an input signal for linear amplification to produce a base current variation of $\pm 20\mu$A, giving a collector current variation of almost $\pm$1mA between saturation and cut-off (at upper and lower ends of the curve respectively).

Correct choice of operating point is important; input and output impedances of a common emitter amplifier stage vary with collector current and so performance depends on the value of the d.c. collector current.

Bias Stabilisation

To set the operating point, a simple method is to arrange that a d.c. base current flows which (when multiplied by the current gain of the particular transistor) gives the required value of collector current. A resistor from the negative supply to the base provides this, but is not really effective, because of collector leakage current and variation with temperature change. For stable operation, bias stabilisation is required, and the two circuits of Fig. 12 are methods of ensuring this.

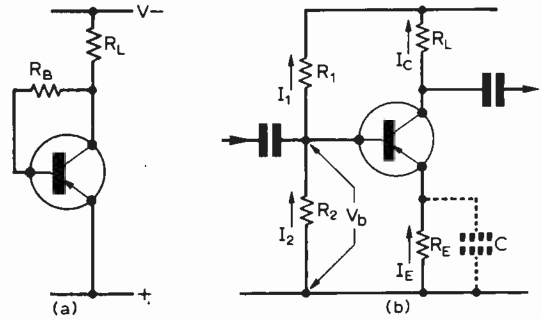


Fig. 12(a): Base bias current feedback and (b) voltage bias.

In Fig. 12(a) a resistor R_B is coupled back from collector to base so that if the collector current increases, collector voltage falls and this fall is reflected back to base via R_B, reducing base current. This tends to reduce collector current and oppose the change. However, this method does not allow control with zero base current and slight variations between transistors do not allow replacements to be made without reconsideration of the value of R_B. A further point is that a.c. negative feedback is introduced by this method, and this may not be wanted. Splitting the bias resistor and bypassing the centre point to chassis with a suitable capacitor can reduce this feedback.

A better method is shown in Fig. 12(b). The bias voltage V_b applied to the base is obtained from a potentiometer R1 and R2 across the supply. A further resistor R_E is put in the emitter circuit. The voltage across R_E is equal to V_b less the voltage dropped across the emitter-base junction of the transistor. If V_b is made large with respect to this junction voltage, the emitter current will depend only on V_b and R_E. Thus if V_b is held constant, I_E and therefore I_C will be independent of temperature and transistor gain.

A comparatively low value of R2 will not cause a significant change in V_b. Actual values can be seen in later circuits, and it will be noted that R1 is four or five times the value of R2. R_E depends on the transistor to be employed, and it will usually be bypassed by a large value capacitor (C, shown dotted) to avoid loss of gain with an a.c. signal.

Practical Circuits

Two low frequency amplifier circuits using this method of base bias stabilisation are depicted in Fig. 13. In the first, transformer coupling is used between stages, and in the second RC coupling is employed (note the polarity of the electrolytic coupling capacitors: in p.n.p. transistor circuits the succeeding base will generally be positive with respect to the preceding collector). Because a more precise impedance match between stages can be made with a transformer, and thus the greatest energy transfer effected, this type of coupling is widely used.

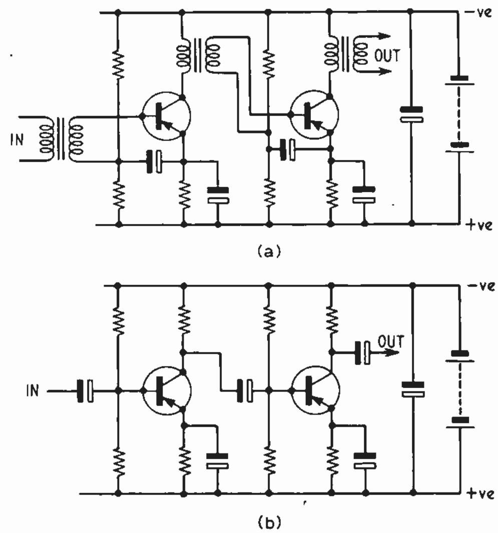


Fig. 13: Circuits demonstrating base bias voltage stabilisation, (a) transformer coupling and (b) RC coupling.

As with valve-operated receivers intermediate frequency stages use transformer coupling, with the windings tuned to the appropriate frequency, as we shall see later. But for audiofrequency purposes coupling transformers are not so economical as resistor-capacitor combinations, and some efficiency is sacrificed to save costs.

Having laid the ground and, it is hoped, taken some of the fearsomeness from formulae, we shall proceed to a breakdown of some of the circuitry likely to be met in radio and audio gear, with a few notes on constructing both the simple circuits themselves in practical form and test devices that can help us handle transistors with more confidence.

TO BE CONTINUED

We regret that, due to shortage of space, several regular features have had to be held over. These will be resumed as soon as possible.

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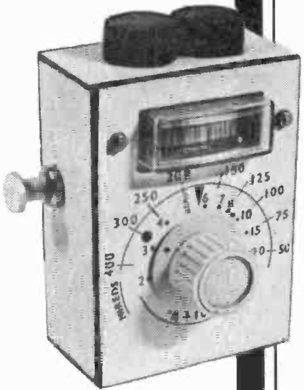

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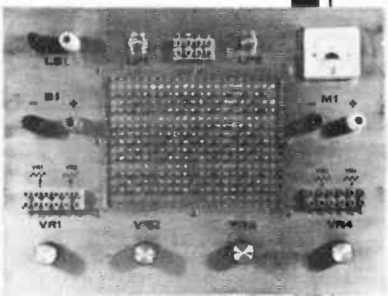

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PART 3

MODULAR AUDIO MIXING SYSTEM

F.C.JUDD

The Modular Audio Mixing System is designed to allow any combination of signals to be mixed. The previous two parts have described some of the preamp. circuits and this final part concludes these and describes the final mixing and level monitoring arrangement

MICROPHONE PREAMP (MIC Hi ZT)

This circuit shown in Fig. 19 is for microphones with built-in transformers or can be used with a microphone transformer at the input. The input impedance is about 100kΩ and is suitable for microphone transformer secondaries, usually classified as medium to high impedance. The amplifier is a direct coupled BC109 pair with d.c. stabilization and negative feedback between the output and the emitter of Tr1 to set the gain. The circuit board layout is given in Fig. 20.

PREAMP FOR CRYSTAL PICK-UPS

The requirements are a high input impedance and a sensitivity between 500mV and 1V r.m.s. The large value series resistor and emitter follower input provide the high impedance input and the gain, and therefore input sensitivity, is set by negative feedback from the amplifier (Tr2) output to the circuit input. The nominal input sensitivity is 850mV. The output network VR1 and R10 is again as common to all the preamplifiers. The circuit board layout is given in Fig. 22.

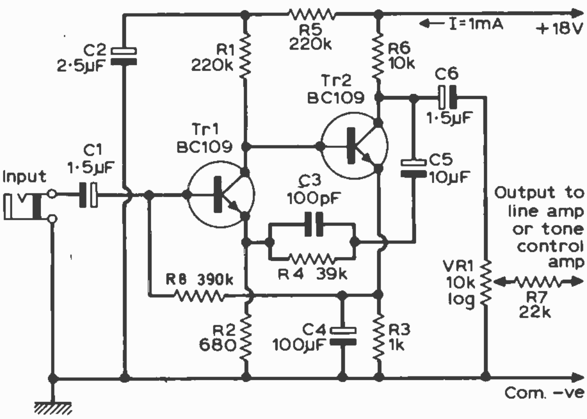


Fig. 19: Circuit of the preamplifier for use with microphones with built-in transformers.

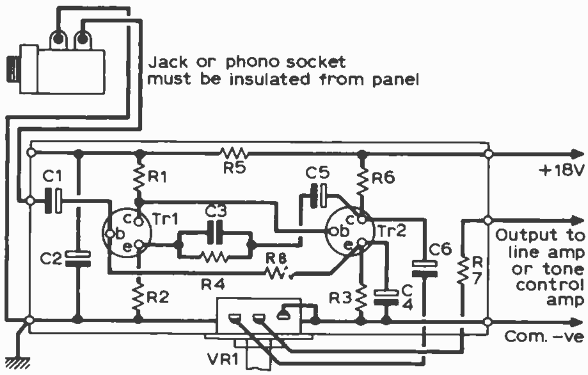


Fig. 20: Layout for the circuit shown in Fig. 19.

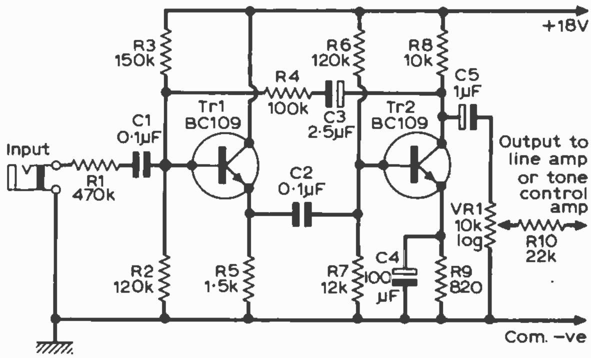


Fig. 21: Preamp. circuit for use with high output crystal pickups.

PREAMPLIFIER FOR GUITAR (G)

Some guitar pick-up units have a high output and

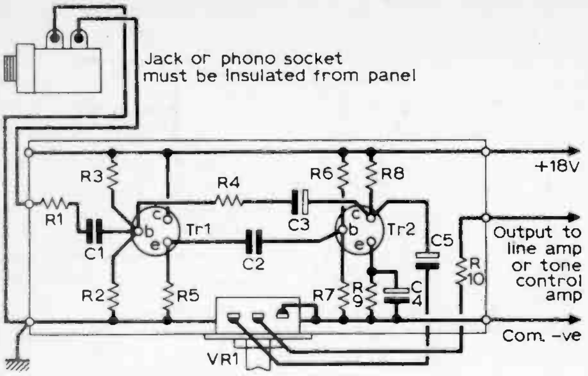


Fig. 22: Layout for the crystal pickup preamplifier.

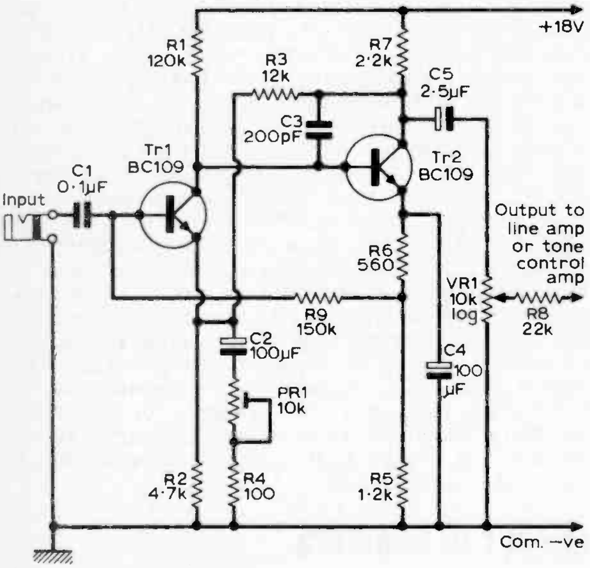


Fig. 23: The preamplifier circuit for use with low output guitar pickups.

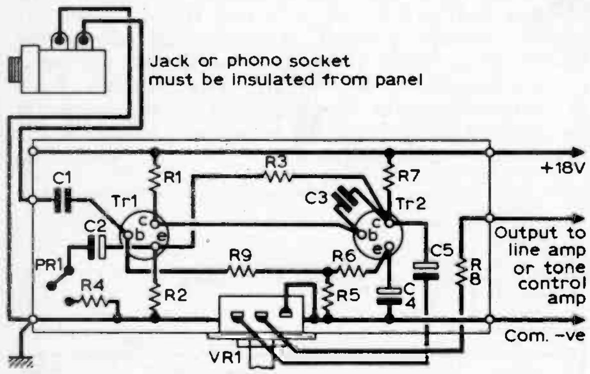


Fig. 24: The component layout for the guitar pickup preamplifier.

these could be connected to a line level input which, in conjunction with the line amplifier, has an input sensitivity of approximately 200mV. Low output, medium impedance guitar pick-ups may provide signal levels from around 20mV to perhaps 100mV and require some amplification. The circuit given in Fig. 23 is quite a conventional arrangement originally due to Mullards and has provision for setting the overall gain from about 12 to 40dB. This is controlled by PR1 which sets the amount of negative feedback between Tr2 collector and Tr1 emitter. With PR1 at maximum resistance the gain will be at 12 to 13dB and about 40dB with PR1 at minimum. The input impedance is typically 100kΩ and suitable for the majority of medium to high impedance guitar pick-ups. PR1 should be adjusted so as to provide not more than the requisite 100mV or so output between R8 and earth with VR1 at maximum. The circuit board layout is given in Fig. 24.

★ components list

Mic Pre-amp (Mic Hi ZT)

Tr1, Tr2		BC109
VR1	10kΩ	Carbon log. pot.

Resistors

R1	220kΩ	R5	220kΩ
R2	680Ω	R6	10kΩ
R3	1kΩ	R7	22kΩ
R4	39kΩ	R8	390kΩ

All ¼W, 10% types

Capacitors

C1	1·5μF	25V	C4	100μF	25V
C2	2·5μF	25V	C5	10μF	25V
C3	100pF		C6	1·5μF	25V

Crystal p.u. Pre-amp (P.U. Xtal)

Tr1, Tr2	BC109	
VR1	10kΩ	Carbon log. pot.

Resistors

R1	470kΩ	R5	1·5kΩ	R9	820Ω
R2	120kΩ	R6	120kΩ	R10	22kΩ
R3	150kΩ	R7	12kΩ		
R4	100kΩ	R8	10kΩ		

All ¼W, 10% types

Capacitors

C1	0·1μF		C4	100μF	25V
C2	0·1μF		C5	1μF	25V
C3	2·5μF	25V			

Guitar Pre-amp

Tr1, Tr2		BC109
VR1	10kΩ	Carbon log. pot.
PR1	10kΩ	Carbon preset

Resistors

R1	120kΩ	R4	100Ω	R7	2·2kΩ
R2	4·7kΩ	R5	1·2kΩ	R8	22kΩ
R3	12kΩ	R6	560Ω	R9	150kΩ

All ¼W, 10% types

Capacitors

C1	0·1μF		C4	100μF	25V
C2	100μF	25V	C5	2·5μF	25V
C3	200pF				

Line Input

VR1	10kΩ	carbon log. pot.
R1	22kΩ (¼W, 10% type)	

VU Meter

Type V403	Henry's Radio

Insulated input jack or phono sockets as required.

LINE LEVEL SIGNAL INPUTS

Line level usually refers to signals of over 100mV or so which are linear i.e., requiring no equalization and no preamplification other than that necessary to bring the level to the requirements of the system output, in this case to a uniform 1V r.m.s. As no preamplifier is required, line level signals, such as from a radio tuner, tape recorder external amplifier output, etc., could be coupled directly to the line amplifier but as the outputs from other sources i.e., preamplifiers and/or other line inputs are also to be connected, the passive mixing component must be included to prevent any one signal source loading the others. Line level inputs are therefore connected to the line amplifier via a gain control and series resistor (22kΩ) in the same way as the output from each preamplifier is connected. This method is commonly used in signal mixing circuits so that any one signal source can be controlled independently of any other. The series passive component has been made high (22kΩ) compared with the gain controls, each of which are 10kΩ. The insertion loss is a little higher but the higher value series resistor ensures complete fadeout of the signal when a gain control is at minimum and that no loading is imposed on other mixing circuits. The circuit for the line inputs, as

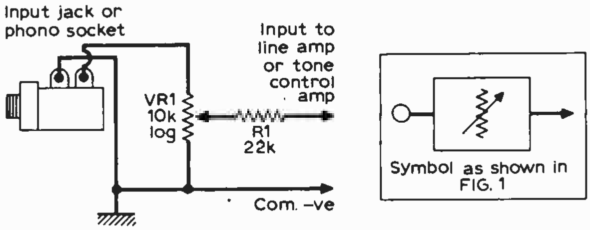


Fig. 25: The resistive arrangement for the line inputs.

shown in Fig. 25 consists simply of the gain control and series resistor. Up to half a dozen line inputs can be used but more than this number could cause loading. If say, four or five preamplifiers were used, then the number of line inputs should be limited to three or four. Much the same applies to the total number of preamplifiers e.g., six should be about the limit with two line inputs.

VU LEVEL METERS

VU meters with built-in rectifiers are readily available and most of these will read well over full scale with a 1V r.m.s. signal. This allows a VU meter to be connected across the line amplifier output with a series variable resistor so that the meter can be adjusted for a maximum signal indication of 1V r.m.s. equals 0dB. The meter could also be adjusted to read in conjunction with a tape recorder level meter in cases where the mixer is remote from the recorder. The connection is simple enough as shown in Fig. 26 but note that the meter must be one with a built-in rectifier and provide full scale deflection for at least 600mV of signal.

GENERAL APPLICATIONS

As already mentioned in Part 1, the various preamplifiers, tone control unit and line amplifier can be connected together to provide signal mixing facilities for sound recording, public address and

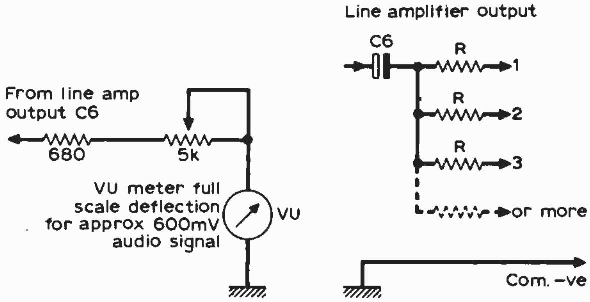
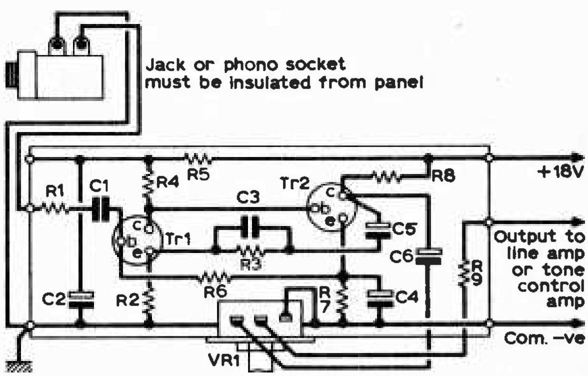


Fig. 26: (left) The VU meter arrangement.
Fig. 27: (right) The arrangement for feeding more than one amplifier.

discotheque or music amplification systems. The high signal output of around 1V r.m.s. is sufficient to directly drive many power amplifier modules now available so in fact a complete multi-channel amplifier system is perfectly feasible. The various combinations given in the block diagram in Part 1 are but a few of the possibilities and any combination can be extended for stereo operation simply by duplication. For stereo mixing systems ganged gain and tone controls are not necessary, in fact separate controls are advisable, as they allow much more control over stereo balance. The output from the line amplifier can be coupled to more than one amplifier or tape recorder simultaneously or for example to a tape recorder and an amplifier for simultaneous recording and monitoring. As the input impedance of external equipment may vary, external equipment connections should be made via series resistors as shown in Fig. 27. Normally each resistor can be 47kΩ but this may be reduced to as little as 10kΩ if the higher value reduces the output signal too much as it may do if external equipment has a very low input impedance.

LAYOUT IN CABINETS

The photos shown in the previous parts are of a small mixing system which would be ideal for tape recording enthusiasts and, as can be seen, each of the preamplifiers are simply mounted side by side. The built-in screens prevent crosstalk and shield the boards from hum pick-up. Nevertheless a metal cabinet should be used for any system derived from the various modules. The mains power supply should be situated away from the preamps and preferably in a screened compartment. ■



Last month's Fig. 12 (page 619) showed the incorrect layout. The correct layout for the crystal mic. preamp. circuit is shown above.

2-Octave Miniature Organ

F. C. JUDD **PART 2**

THE completed keyboard is mounted in a tilted position as in Fig. 9b on a hardboard base that fits into the top of the organ. This base also carries the circuit board and battery etc. The piece of hardboard is cut as in Fig. 9a and the keyboard mounted as in Fig. 9b so that the keys themselves are level. It is important that when the completed keyboard is fitted in the top of the case that the front of the keys are aligned with the top of the upper front panel as shown in Fig. 9c and also in Fig. 10 so that when a key is depressed the top does not come below the upper edge of the panel. When the keyboard has been correctly aligned it can be secured in the organ cabinet.

The lid of the organ is made up as shown in Fig. 11 and in the photo. Appropriate dimensions for the lid are best derived from the inside measurements of the top of the case and the height of the keys but the lid must be made so that the centre portion drops directly behind the black keys. The whole of the lid is hinged on the rail at the rear of the cabinet. Figure 11 also shows more detail concerned with the expression pedal system. Ensure that when the lid is closed down it does not foul the keys and that all the keys can be depressed and will return to their rest position.

At this stage the painting might well be done but first the keyboard and the main front panel should be removed. If a music stand is to be included this should be fitted and can be made from a piece of hardboard about 12 x 7in. attached to the lid by a

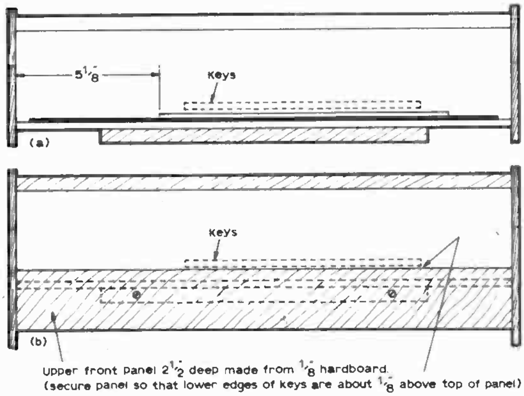


Fig. 10: A front view of the keyboard mounting and the siting of the upper front panel.

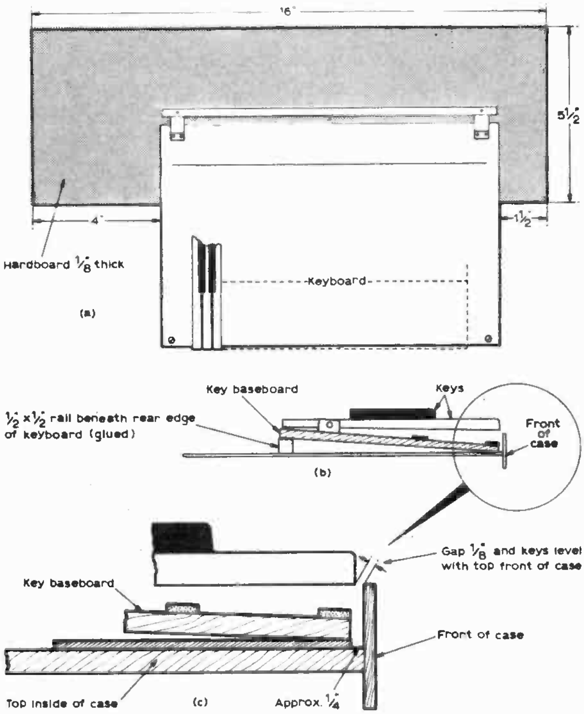


Fig. 9: Details of the keyboard mounting.

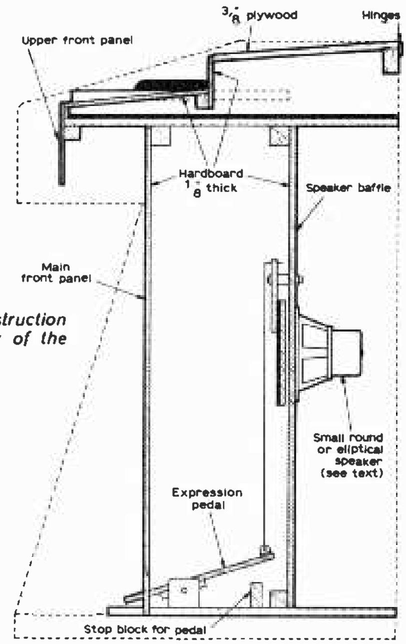
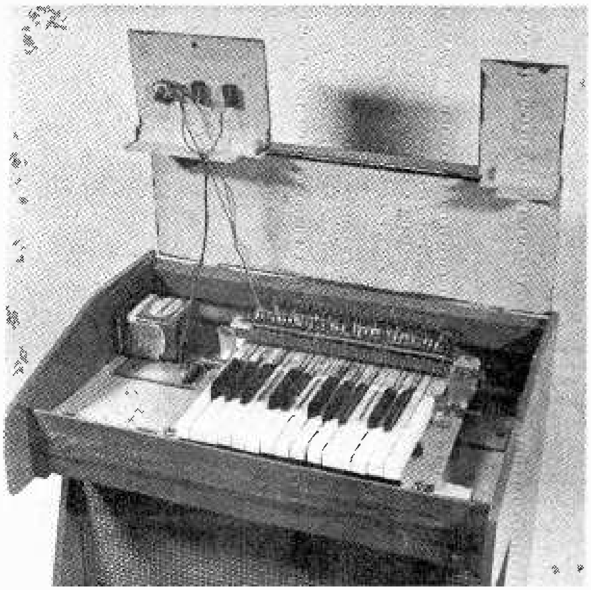
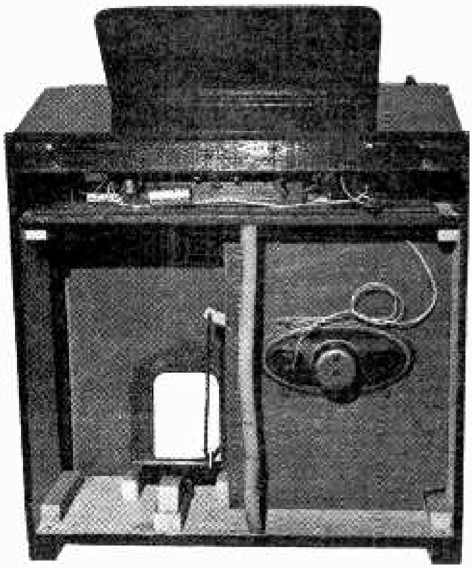


Fig. 11: The lid construction and a cut-away view of the expression pedal.



A view of the keyboard with the lid raised.



A rear view of the completed project with the back removed.

short length of ½ x ½in. batten. The original organ was finished with a bright red gloss paint over an undercoat of emulsion paint.

When the decor is complete the loudspeaker can be installed and the expression pedal (if used) adjusted. The on/off, vibrato and voice switches can be fitted to the left hand portion of the lid and a back cover made up of hardboard to close in the rear of the organ. Two small wood blocks should be fitted inside, one either side of the keyboard, and flush with the upper front panel. These act as stops when the lid is closed down and take a screw through each side of the lid so that it can be secured against opening by small hands. These blocks are just visible in the photograph.

The component board is mounted just behind the key contact frame as shown last month — and allows for convenient short connections between the tuning pre-sets and the key contact wires. A rear view of the completed organ with the circuit board in position is shown.

TUNING

First adjust all the pre-sets, including PR1, to midway travel and set S1, the vibrato switch, and S2, the voice switch, so that both are open. Tuning is best done with a piano and should be commenced with the pre-set for the F key (No. 25) at midway. Now tune the F note to pitch at 698·4Hz with PR1, the initial pitch control. The remainder of the pre-sets from E No. 24 down to F No. 1 at 174·6Hz can now all be tuned one after the other.

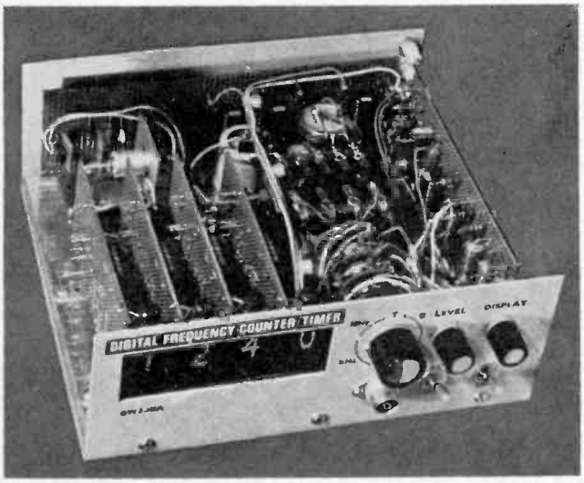
The vibrato should produce a pleasant pitch variation, not too pronounced, at about 6 to 8Hz. The intensity of the vibrato can be increased by reducing R14 to 100kΩ or decreased by making R14 about 150kΩ. The vibrato frequency can be altered by slightly increasing or decreasing the value of R2. With the voice switch S2 closed, the tone should be flutelike and somewhat softer.

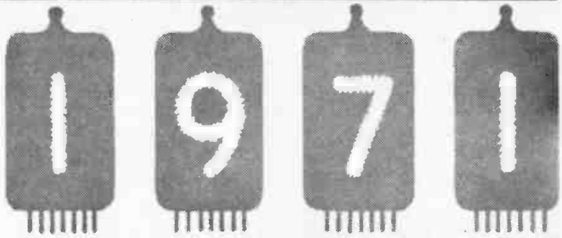
The expression pedal will reduce the sound level somewhat but if moved up and down quickly whilst a note is sustained will produce a pronounced "wah-wah" effect which will no doubt intrigue the junior player.

The organ will stay in good tune for a long time, or until the battery voltage falls and the two octave range allows for the playing of a wide range of tunes. Like the author's grandson who has become the final owner of the prototype, any youngster will get a great deal of enjoyment from it.

In the circuit of the 2-octave miniature organ published last month (Fig. 1, page 594) there is an error in the multi-vibrator circuit. C6 should connect between the collector of Tr2 and the base of Tr3 and not between the bases as shown. In Fig. 2 the resistor next to R1 should read R14 and not R13 as shown. ■

DIGITAL FREQUENCY COUNTER/TIMER





J. THORNTON-LAWRENCE GW3JGA

PART 4 *(continued from the November issue)*

Frequency measurement is the primary purpose of the instrument and although, on low and medium frequency signals of a reasonable amplitude, it is sufficient to connect the signal and read away, better results may be obtained particularly on the higher frequencies if the controls are set correctly.

It should be remembered that the purpose of the input clipping stage is to provide, from the input signal, a clean squarewave suitable for driving the signal gate and decade counters.

With the input switch in the "AC" position the input a.c. signal can be "slid up and down" the input characteristic of Tr1 by rotating the LEVEL control, so that symmetrical clipping takes place.

The smaller the input signal and the higher the input frequency the more important it is to set the LEVEL control correctly.

With the signal applied to the input and the function control set to a low frequency range, the LEVEL control should be carefully rotated from one end to the other and the range noted over which a steady reading is obtained. The correct setting is in the centre of this range (see Fig. 19).

The actual physical position of the control depends to a large extent on the individual characteristics of Tr1. (It may be possible to substitute other types of f.e.t. in place of the 2N3823 but the spread of characteristics may make the LEVEL control inoperative.)

It is assumed that normally the signal to be measured will be clean and free from hum and noise. However, if a large amount of hum (mains ripple) is present on the signal to be measured this may cause errors due to the clipper stage being saturated for periods of the hum waveform, as shown in Fig. 20.

A solution to this problem is to use a simple high pass filter, as shown, which will effectively remove the low frequencies whilst allowing the r.f. signal to pass through.

Assuming that the LEVEL control has been set to its optimum position, the function switch should then be rotated to a position where the first digit of the displayed reading appears on the left hand tube.

Suppose that a signal of 7·054321MHz is being measured, the reading of frequency should be 7·054MHz. Setting the function switch to the highest frequency range will cause a reading of 07·05MHz to be displayed and obviously the frequency is not being measured as accurately as it can be.

Conversely, by moving the function switch the other way to a lower frequency range, the 7 disappears off to the left and a reading of 0543 is displayed.

This procedure may be repeated until in the Hz position the reading will be 4321, the right hand figure indicating cycles per second and the left hand figure indicating kHz.

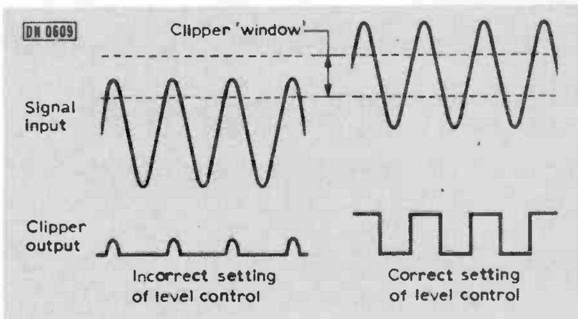


Fig. 19 : Waveforms showing correct and incorrect settings of the LEVEL control.

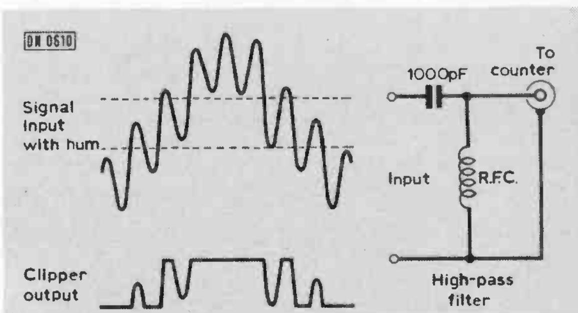


Fig. 20 : Effects of hum and noise on the input signal. A simple high pass filter is shown on the right.

This is a useful facility for measuring small changes in frequency, e.g. checking variable frequency oscillators, frequency modulation systems, and monitoring the frequency of a signal generator when aligning the i.f. stages of a receiver and checking crystal filters.

It is important to remember that whilst this measurement gives very high discrimination it is only a relative measurement of frequency and is not an absolute measurement to this accuracy. The stability of the internal crystal oscillator is insufficient for this to be so.

Calibration Outputs

The 100kHz, 10kHz and 1kHz outputs at the rear of the instrument may be used for calibrating receivers. This can be done by loosely coupling the appropriate output to the input of the receiver. A series coupling capacitor and resistor of about 1,000pF in series with 1kΩ should be used as each output is directly connected to the divider circuits and an accidental short to earth or worse still to a high voltage would upset the operation of the divider and may cause permanent damage.

Time and Period Measurement

The simplest time measurement for the instrument to make is in measuring the time of one cycle of a repetitive waveform. This is useful for frequencies below 100Hz as greater accuracy can be obtained.

On the time ranges of the instrument, the counting is initiated by the negative going part of a signal and stopped by the next negative going signal. The operation on various waveforms is shown in Fig. 21a, b and c.

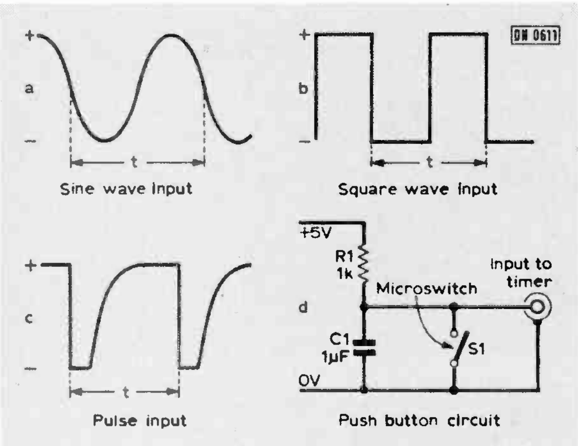


Fig. 21: Operation of various timing waveforms. Circuit on the right provides a fast negative going pulse when S1 is closed.

For the timing of events, as an electronic stop watch, it is necessary to provide a circuit which will generate a fast negative going pulse when a button is pressed. A suitable circuit is shown in Fig. 21d.

The 1μF capacitor C1 is normally charged to +5volts through R1. When the microswitch is pressed a sharp negative going voltage step is produced which starts the timer counting time. The switch is released and R1 recharges C1. When the switch is pressed for the second time the negative pulse stops the count and the total time between the two operations is displayed in mS or seconds depending on the setting of the function switch. The purpose of C1 is to prevent the contact bounce in S1 from causing false triggering of the instrument.

For automatic operation, two photocells may be used and a suitable circuit for timing the duration between two events is shown in Fig. 22.

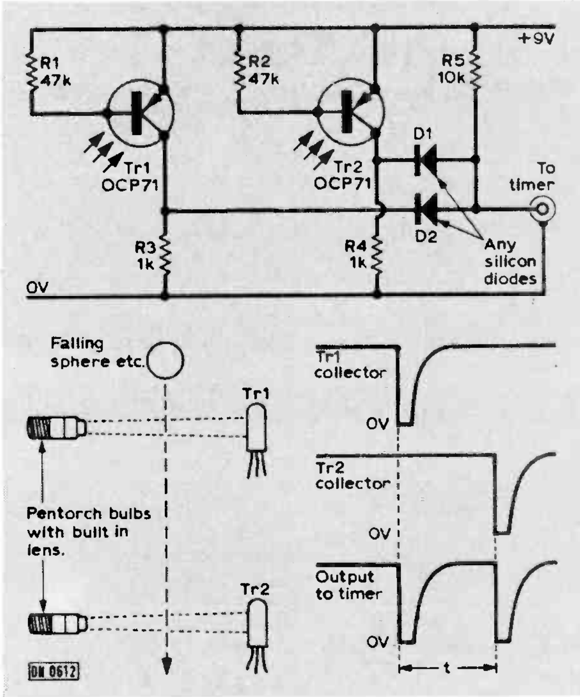


Fig. 22: Circuit shown above is suitable for automatically timing the duration between two events.

An extension of this system with more powerful light sources may be used for race timing, horse trial events, etc.

In the above applications of start-stop pulses it is suggested that the input switch is set to the "AC" position and that the LEVEL control is adjusted to the position which gives reliable operation, this is usually slightly higher (clockwise) than the centre operating point used in frequency measurements.

Very Low Frequency Input Signals

For very low frequency signals where the input coupling capacitor may attenuate the signal severely the input switch may be used in the "DC" position. This may result in the LEVEL control having little or no effect. However, if the input signal has an amplitude of about 10 volts peak to peak about earth potential, reliable operation of the instrument should be obtained.

The integrated circuits used in the Digital Frequency Counter Timer are the 74 series of TTL (Transistor-Transistor Logic) in the 14 and 16 pin DIL (dual in line) package. The device operates from a supply of +5 volts (4·5V min., 5·5V max.).

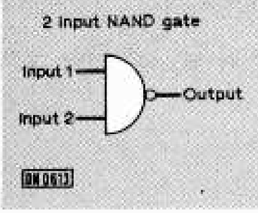
In the operation of the logic only two states are possible, 0 and 1.

logic 0="low" =less than +0·8volts.

logic 1="high" =greater than +2·0volts.

7400N Quadruple 2 Input Nand Gate

This device contains four separate identical two input NAND (NOT AND) gates, as shown in Fig. 23.



Truth table

Input 1	Input 2	Output
Low	Low	High
High	Low	High
Low	High	High
High	High	Low

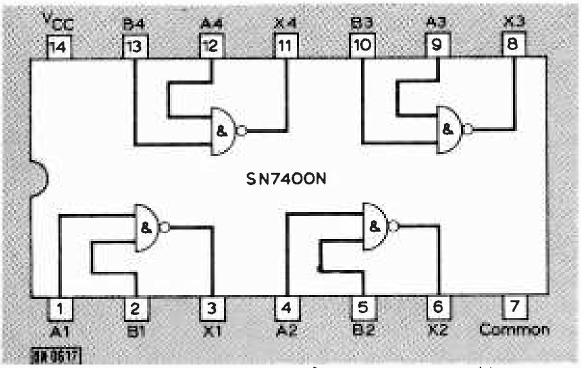
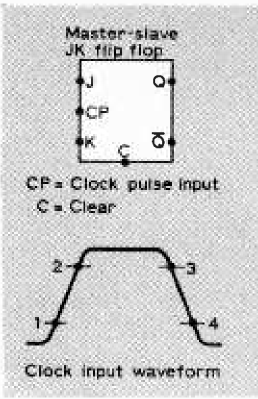


Fig. 23: SN7400N integrated circuit and truth table.

Each gate has two inputs and one output and the operation is shown in the truth table. It can be seen that only when input 1 AND input 2 are high will the output NOT be high, i.e. low. In the circuit of the instrument some gates are shown with only one input and here the other input is left disconnected. This is equivalent to connecting it to a high input. In this condition the gate becomes an invertor, the output condition is the inverse of the input.

7473N Dual Master-Slave J.K. Flip Flops

The SN7473N contains two Master-Slave J.K. Flip Flops, each flip flop contains a large number of gates all internally connected to form a bi-stable or flip-flop in which the state of the outputs for specific input conditions is clearly defined. This is shown in the truth table in Fig. 24. What this means is that if J and K are both low, no change takes place during the clock pulse. But if K is high and J is low the clock pulse will cause Q to go low and conversely if J is high and K is low the clock pulse will cause Q to go high. And finally if J and K are both high Q will change state at each appearance of the clock pulse. With J and K both high the circuit makes a divide by two divider stage, the output from Q being half the frequency applied to CP.



Truth table

t_n		t_n+1
J	K	Q
Low	Low	Q_n
Low	High	Low
High	Low	High
High	High	$\bar{Q}_n$

t_n = bit time before clock pulse
t_n+1 = bit time after clock pulse

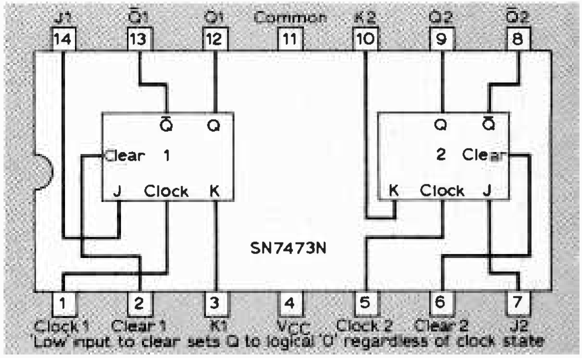


Fig. 24 : SN7473N integrated circuit and truth table. The sequence of operation relative to the clock waveform is also shown.

In the master-slave JK flip flop, the input to the master section is controlled by gates operated by the clock pulse. The clock pulse also regulates the state of more gates which connect the master and slave sections. The sequence of operation, relative to the clock waveform shown in Fig. 24, is as follows:

1. Isolate slave from master.
2. Enter JK input information into master.
3. Disable input gates.
4. Transfer information from master to slave.

The input C is a direct clear input which restores Q to low irrespective of any other input signals./ opposite logic condition to Q.
instrument is in storing information and transferring this on the application of a pulse to the clock pulse
$\bar{Q}$ is the reciprocal of Q and always has the
The use of the Master-Slave JK Flip Flop in the input.

7490N Decade Counter

The SN7490N contains 4 flip-flops and 3 gates forming a divide by 2 stage and a divide by 5 stage.

When used as a binary coded decimal counter, the signal input goes to the divide by 2 stage and from the output of this to the divide by 5 stage. The binary coded decimal output is then available as shown in Fig. 25.

When used as a frequency divider, as in the Crystal Oscillator divider panel, it is more convenient to feed the signal into the divide by 5 stage first and then the divide by 2 stage, this ensures a 1:1 square wave output which has certain advantages when used as a calibrator output. The other arrangement

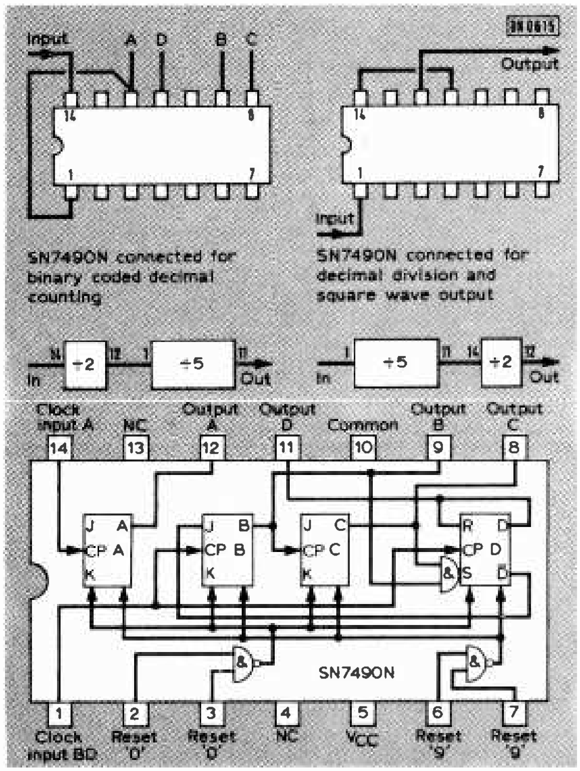


Fig. 25 : SN7490N integrated circuit used as a binary coded decimal counter.

will of course also divide by 10 but the output waveform is far from symmetrical. The SN7490N has input connections for resetting to "9" or "0" and in the instrument only the reset to "0" is used.

74141N B.C.D. to Decimal Decoder Driver

This device contains a complex arrangement of gates terminating in ten high voltage transistors for driving the numeral indicator tube. The operation of this device was illustrated in Part II of this series (Fig. 9, page 480, October 1971 issue).

A number of queries have been received regarding the use of a SN7441AN device in place of the SN74141N. The SN7441AN was in fact used in the prototype and whilst a number of these functioned satisfactorily a few gave trouble by loading the decade counter excessively and causing an incorrect count.

The SN74141N is an improved version of the original SN7441AN. ■

B.B.C. RADIO LONDON

Sunday, November 7th at 3 p.m. on 95·3 MHz.

"Don't call us 'hams'!"

featuring radio amateurs of London, with Sylvia Margolis, past P.R.O. of the Radio Society of Great Britain

CHARLES MOLLOY

THE Medium Wave Column

ONE of the attractions of medium wave DXing is its unpredictability, a feature which is very apparent when the listener searches for North American DX. Although reception conditions can vary considerably from night to night, there is also a long term trend which follows the sunspot cycle; the best medium wave DX occurring in years of low sunspot activity. We are now well past the maximum of the current sunspot cycle and can expect an all-round improvement in long range reception on m.w.

Last month it was suggested that the newcomer to MW DXing should listen on 1070kHz after 2300hrs for the Canadian CBA located at Moncton, New Brunswick. Other North Americans that are frequently heard in this country during the early part of the night are CNB 640kHz in St. John's, Newfoundland; WNBC 660kHz in New York City; WABC 770 also in NYC; WHDH 850 in Boston; CBH 860 in Halifax, Nova Scotia; WABI 910 in Bangor, Maine; CJCH 920 Halifax, N.S.; CJON 930 St. John's; CHER 950 Sydney, N.S.; WINS 1010 NYC; WBZ 1030 Boston; WBT 1010 Charlotte, North Carolina. An unusual catch is Radio St. Pierre 1375kHz situated at St. Pierre, the capital of the French islands of St. Pierre et Miquelon, located to the south of Newfoundland. When conditions are favourable R. St. Pierre will cause a heterodyne on Lille 1376kHz before the latter closes down for the night at 2300hrs.

Harold Emblem, of Mirfield, Yorkshire, has received a verification from the new station at Kinshasha (692kHz). This is a difficult country to verify and the address for reception reports is Chef des Services Techniques, Radiodiffusion Nationale Congolaise, Kinshasha, Republique Democratique du Congo.

Reception of Far Eastern medium wave stations is possible in the U.K. during the afternoon in winter time. Stations fade-in about one hour before sunset and are audible either until they sign-off or they become submerged in interference from Europeans, which increases as darkness approaches. The 1,000kW All India Radio outlet at Calcutta on 1130kHz which broadcasts in English from 1530 until 1600hrs was heard frequently last winter. It is easy to pass over this station as it suffers from slow cyclic fading, so it is worth while pausing on the frequency for a few minutes. The Voice of America, Okinawa 1178kHz is another megawatter that is often heard in this country, usually as a background to the Swedish broadcaster on the same channel. Programmes from Okinawa are in local languages but identification is on the hour and half hour usually in English and is accompanied by the Yankee Doodle signature tune. Sign-off is at 1700hrs. Peking has been logged on 1,000kHz, 1230kHz and 1290kHz; Taiwan (Formosa) has been heard on 750kHz and 1200kHz with programmes of westernised Chinese music while Kabul, Afghanistan 1280kHz is a regular until close down at 1830hrs.

Reports to 132 Segars Lane, Southport PR8 3JG.

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz • Times in GMT

DURING the past few months I have received many letters asking the correct way of converting metres into kilohertz. It would appear that many readers have receivers which are calibrated in metres only.

The conversion is performed as follows: In order to obtain the frequency in kHz divide 300,000 by the wavelength in metres. This formula also works in reverse, that is: wavelength in metres can be obtained by dividing 300,000 by the frequency in kHz.

The first report this month comes from **Paul Benton** of Hednesford who has an Astrad-Nova receiver. Paul's aerial system consists of a 75 foot long-wire, a 14-element television aerial and a copper grid. Items from his log include:

4783 *Radio Mali*, in French at 2145.
4800 *Radio Lara*, Venezuela, music at 2330.
4900 *R. Juventud*, Venezuela, music at 0000.
4900 *R. Conakry*, Guinea, news in French at 2300.
4940 *R. Abidjan*, Ivory Coast, French at 2250.
5015 *Windward Islands B.S.*, English at 2345.
5035 *R. Bangui*, Cent. Afr. Rep., English at 2045.
5047 *R. Lome*, Togo, African music at 2100.
11652 *R. Pakistan*, Karachi in English at 2030.
11815 *HCJB, Quito*, Ecuador in English at 0040.
11855 *Saudi Arabia* in English at 0430.

Stephen John Mathews of Hull has a new receiver, the Trio 9R-59DS, but having broken his leg playing football he has to be content with his 90 foot loft aerial instead of the new one which he was going to erect. The combination yielded some interesting stations including:

2326 *S. African B.C.* in English at 0030.
4777 *R.T. Gabonaise* in French at 0000.
4800 *R. Lara*, Venezuela in Spanish at 0400.
4880 *R. Universo*, Venezuela, Spanish at 0045.
4955 *R. Nacional*, Colombia in Spanish at 0315.
5960 *Voz de Angola* in Portuguese at 2015.
15170 *ELWA, Liberia* in French at 2020.
15200 *NBC, Lagos*, Nigeria, English at 1830.
15280 *4VEH, Haiti* in English from 2330 to 0200.
15415 *FEBA, Seychelles*, testing at 1855.
15485 *R. Portugal Libre*, clandestine at 1922.

Peter Reed of Brighton has used his R1155N receiver in conjunction with his Joystick antenna to log some interesting stations which include:

3380 *Malawi B.C.* in English at 2000.
4805 *Voice of Kenya*, Nairobi, 1800-1845.
4875 *R. La Cruz del Sur*, Bolivia, Spanish at 1100.
5040 *R. Burma* noted at 1445.
9520 *R. La Cronica*, Peru, Eng. and Sp. at 1200.
11825 *Papeete, Tahiti* in French at 0755.
21685 *Kuwait B.S.* in Arabic at 1300-1330.

Ross Pullen of Crawley has sent in a log which includes the following interesting stations:

5970 *R. El Sol*, Peru in Spanish at 0200.
9670 *Saudi Arabia* in Arabic at 2215.
9725 *R. Burma* in English at 0700.
11715 *R. Republik Indonesia* in English at 0900.
11875 *R. dif. Nacional*, Nicaragua at 0200.

Julian V. Moss of Rayleigh, Essex has just purchased a Meridian receiver and a 50 foot long-wire enabling him to hear:

6050 *HCJB, Quito*, Ecuador in German at 0615.
6080 *R. Berlin Int.* in French at 2100.
7280 *R. Berlin Int.* in English at 2045.
9530 *AIR, Delhi* in English at 2100.
9550 *R. Warsaw*, Poland in English at 2030.
9700 *R. Sofia*, Bulgaria in English at 1935.
9765 *Deutschewelle* in English at 2150.
11620 *AIR, Delhi* in English at 2030.
11672 *R. Pakistan*, news in English at 1900.
11700 *R. Kiev*, Ukraine in English at 1945.
11740 *R. Australia* in English at 1610.
11755 *Finnish B.C.* in English at 1000.
11765 *R. Australia* in English at 0800.
11800 *RAI*, Rome in English at 1940.
11910 *Radio Budapest* in German at 2010.

Fred Wall of Walthamstow, London E.17 used his homebrew 4-valve superhet and a 20 foot long-wire aerial to hear the following stations:

7290 *TWR, Monte Carlo* at 1600.
9555 *Finnish B.C.* at 1815.
9620 *R. Belgrade*, Yugoslavia, English at 1942.
11745 *HCJB, Quito*, Ecuador at 0015.
11765 *R. Australia* with news at 0900.
11790 *R. Afghanistan*, news in English at 1800.
15345 *Kuwait B.S.* with news at 1830.
17820 *RSA, S. Africa* with news at 1845.
21640 *NHK, Japan* with music at 1518.
25900 *R. Norway* in Eng./Nor. at 1820.

Robert C. Hanstock of Sheffield has a Colombia 5-valve superhet and a 50 foot long-wire which enabled him to hear:

5980 *RSA, S. Africa* in English at 1815.
7205 *R. Australia* in English at 1600.
9010 *R. Peking* in English at 2045.
9740 *Radio Portugal* in French at 0700.

Robert also reports that Radio Nederland is to open a new relay station at Tananarive, Malagasy in November. Programmes will be beamed to Africa and S. Asia. The station will also be changing the frequencies of its evening transmission in English to Europe; the new frequencies being 17830, 6085 and 6020 from 1830 to 1950.

D. A. Hairon of St. Clement, Jersey is now using a 100 foot long-wire with his other equipment and reports hearing:

9740 *R. Cairo* in English, 2245-2300.
11730 *R. Nederland*, Bonaire in Eng. at 0630.
11795 *R. Nacional*, Rio de Janeiro at 0055.
11865 *R. Clube*, Brazil at 0200.
21705 *R. Mexico* in Spanish at 2205.

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

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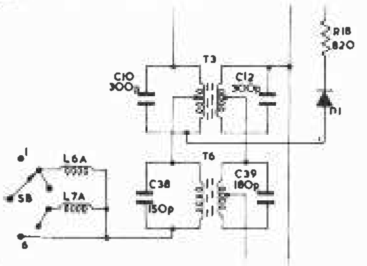

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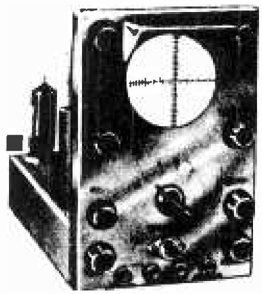

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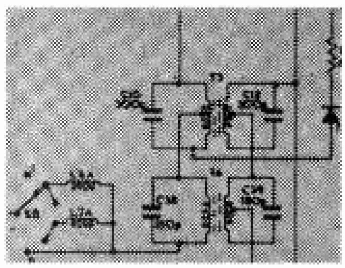

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ON THE SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

FIRST letter out of the hat this month is from **Peter Short** (ZS2HT). He remarks on comments made in an earlier Amateur Bands regarding ZS1MH. Peter says that the latter station has managed over 1,000 contacts on 3·5MHz notching up 115 countries. Gear is a KW Atlanta and a G8KW antenna at 175ft. Apparently ZS1MH will be using a 66ft. loaded vertical early next year and has plans to have a 2-element beam for 3·5MHz up by next March. Peter says also that there is intense ZS activity on both 3·5 and 7MHz between 0400 and 0600 g.m.t. Listen 7090 to 7100kHz and from 3730kHz upwards.

A shout from **Des Walsh** (EI5CD) of Co. Tipperary. He asks for s.w.l's who can QRX on 2 metres to listen out for his a.m./f.m. sigs on the following freqs.: 144·7, 144·9, 145·35 and 145·96. Des runs 8W output to a 6-over-6 and is on most weekends beaming eastwards.

The aerial is 67ft. wrapped neatly around a first floor flat in Cambridge. The receiver is a "modded" HRO-MX and the log from **M. Wallace** is for 3·5MHz s.s.b.; HA0KHT, WA8OBG, ZB2CC, ZL3LE, ZL4JW.

Listen after 0100 b.s.t. around 7·2MHz for KP4GL who m.c's the Caribbean net, advises **Paul Edwards** (Penge). Paul's antenna is 120ft. "bent round the garden" and the Rx is a homebrew 1-V-1. Log for 7MHz reads; CN8HD, CT1GQ, CT2AK, EA7EU, FM7WN, K4UAS, KP4DHD, KP4GL, KZ5JF, PJ2CW, PY3APH, PY7BIH, VP7DL, W1YNQ, W2RGV, W3LTU, WA2BVU/4X, YV1BI, YV5BPG, ZL2BT, 4Z4JT, 8P6AJ.

John Brockett (Hemel Hempstead) has a homebrew transistor superhet which is working on 160 and 80 metres. Best on 160 to date is GM3SVK/A in the Shetlands. On 80, John bagged many EUs plus JY9DX, OD5BA, VE1OW, VO1FG, 3V8ZK and 5H3LV.

Peter West (Leigh, Lancs), reckons midnight to 0700 for 7MHz DX. Proof of the pudding comes from Peter's log for that band gained with the aid of a TCS-9 receiver and 132ft. end-fed (all s.s.b.); CM3LN, EA3LP, EA6BH, K4ELK, K4PTK, PY2ASY, PY7AJB, PZ1CV, W1EEF, W2BMK, W3WGH, W4CVS, YV4BE.

Talk about DX logs, I gotta DX letter. Epistle from **Karl Muller** of Mbabane, Swaziland, uses a Philips domestic portable and the oscillating detector of a homebrew t.r.f. as a b.f.o. Karl stalks 40 metres with this little lot and reports squeaks of activity from: CR7FM, CR7BN, DK2EQ, DJ9JF, EI8H, ET3ZU/A, G8NV (that's DX to Karl!), GM3JDR, HA3GR, HB9AGN, IT9FG, JA0BCO, JA1BK, JA2BUX, JA3LU, JA4IWD, JA5BLH/MM, JA6FT, JA7DCK, JA9YBA, JH1EDB, JW1EE, K4THA, K6DC, K6DV, KH6RS, LZ1KVV, OK2BM, OH5UQ, SM5EXE, thousands of "U" stations.

David Lawley (Gravesend) CR100, a wide variety of antennas, has been doing a spot of all-band listening. Topband log includes; GI3ZIA, GM3WDF and GW3UMB. Up to 3·5MHz and a QRX revealed; CT1BT, EI3S, GC3MDX, OY7JD, PY7AF, VO1FX, VO1FG and YK1AA. On 40 metres, David's best were; OZ9HG (Langeland Island) and TI2IT.

Without doubt the award for the best kept log of the year goes to **Adrian Barnes** of Abingdon, Berks. This was laid out neatly and ledgibly in columns making it easy to read. All the information was included; callsign, mode, frequency, date, time, country etc. No local stations were listed, no Eu stations either, just some 175 DX stations. A sample from this superb 14MHz s.s.b. log reads; AP2AD, CE3FM, CN8BB, CP1BG, CR5SP, CT1BT, EL2BA, EP2JA, ET3ZU, HC1M, HI1AGS, JY9DK, KH6CD, KP4FS, KZ5JW, LU2AGE, OA1BU, OA6BGI, PJ0PM, PY2FIQ, TI2FKB, VA2UN (special station in Montreal), fourteen VEs, VK1BT, VK2APK, VK3BCM, VK4CZ, VK4PV/P, VK5GX, VK6OV, VK7RX, VK9CD, seventy Ws, XE1IIJ, YB5BFK, YN2OM, YV1ACI/P5, YV4YC, YV5CKR, YV6EE, ZA2BE, ZB2A, ZC4LC, ZE1CW, ZL2BGV, ZL3GO, ZL4AW, 3A0FX, 3V8ZK, 4X4JL, 4Z4DZ, 5Z4LW, 6Y5GA, 7X2BK, 9H1BG, 9M2LP, 9Q5RN, 9V1QJ, 9Y4CP.

Irwin Brown (Co. Antrim), has a JR-310 and a dipole at 30ft. Log of s.s.b. from 14MHz which was heard in the Emerald Isle includes; AP5HQ, EA6BM/M, ET3ZU/A, HI8LA, VE1CW/M, VQ9YL, YA2DD, YB3AAY, ZK1CD, ZM7AG, 5K5LR, 5Z5KL.

Philip Cross (Preston) has an HRO-MX and a dipole cut for 14MHz. Log of s.s.b. reads; CN8GC, CR5SP, CR6IC, ET3ZU/A, FP9AR/M, HP9ARZ, HV3SJ, JA6YUV, JX1AK, JY1, LU2ECO, M1B, MP4TDM, OD5GC, PZ1DR, VQ9XX, VP9BN, ZE1CY, ZS3KC, 3A2CP, 3V8ZK, 7X2BK, 7Z3AB, 9K2BG, 9J2ED, 9X5AA, 9Y4VV.

"I'm now working hard trying to learn c.w," says **Alan Smith** (Nelson). "Good lad," says **David Gibson** (Harpenden). Alan uses a Koyo KTR 1662 receiver and 25ft. of wire. Not an elaborate set up, but enough to hear some 14MHz s.s.b. from; EA6BU, HC1KH, HK3BN, KZ5IK, KP4BJD, PJ9AD, PZ1AY, VE3CNE, YB5FB, YV5AXT, 6Y5SR, 9Y4VV.

An ECC83 and ECL82 (leaky grid detector and a.f. amp), is the homebrew receiver of **John Runchman** (South Norwood). On 20 metres, with the aid of a dipole, John bagged; HK3UY, sixteen Ks, LU4ECO, PY2CAQ, VE1IJ, VP2LY, thirty Ws, YN1ABD, YV4UA, ZP5AN, ZL3AA, 4X4AE, 4Z4QAM, 6Y5GA, 9H1M, which is pretty good going for two valves.

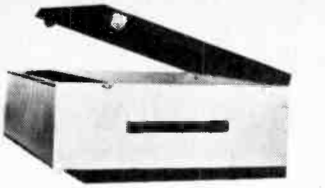
P. Harris (Surbiton) RA-1, dipole, got these on 28MHz; LU3DTV, LU6DRB, PY2HT.

Goings on for contest-types at this time of the year includes: November 6-7, 144/432MHz c.w. contest; 6-7, 40 metre phone contest; 6-8, CHC/FHC phone/c.w. contest; 13-14, topband contest; 14, OK contest; 27-28, CQ WW d.x. c.w. contest. December 5, 2 metre contest.

Logs, in alphabetical order please, to arrive by the 15th of the month to:

12 Cross Way, Harpenden, Herts.

PHILIPS PORTABLE PLAYER CABINET



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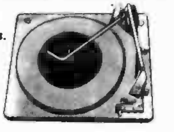
STEREO AND MONO



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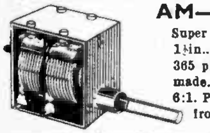

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16/450V	15p	1000/50V	47p	32+32/250V	18p
32/450V	20p	8+8/450V	18p	32+32/450V	33p
25/25V	10p	8+16/450V	20p	350+50/325V	50p
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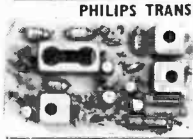

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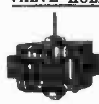

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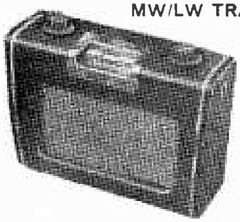

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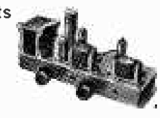

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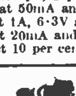

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Electronic Vandals

As an amateur archaeologist and also as a reader of your journal for nearly 20 years, I would like to applaud your editorial on "Electronic Vandals."

We as archaeologists do not want to deprive folk of their pleasures, but in return we ask that they in turn do not deprive us of vital information.

A coin or a metal brooch, so badly corroded as to be almost worthless as a coin may, in expert hands of conservationists at museums, tell us the date when Roman forces were active in a fort or when a Roman villa was last occupied.

We may have worked for many years patiently working out the size, shape and function of a structure; but if our dating evidence has been removed all our work becomes fruitless.

If some of your readers honestly wish to help in furthering human knowledge then I suggest they contact their local archaeological society through their museum. It may be that they would be grateful for their help. Please remember that archaeology is a study of people and not a treasure hunt. —**J. L. Cole,** *(Sutton Coldfield).*

Beginners' Licence

Although there are many Amateurs, who have worked hard to acquire their radio licence, and are now fully fledged Amateurs, I fail to see why the G.P.O. have, as yet, not introduced a "beginners'" licence. Such a licence could not fail to please all, as it would undoubtedly benefit the amateur radio movement, would encourage enthusiastic people to join, and would not clash with the activities of the fully licensed Amateur.

I feel that a "beginners" licence is necessary as there are lots of potential Amateurs, who either don't have the facilities or don't have the time. I am sixteen years old, a keen SWL, but am in the middle of my 'O' Levels, and I will be continuing my studies for the next two years, and have therefore no time with which to study for the R.A.E. I am sure that there are many others, who are in a similar position. A limited licence would sow a good grounding and this would enable one to acquire a licence at a later date.

Such a licence could be based on the following terms, and conditions:

(1) A written exam comprising:
  (a) Section one of the present exam;
  (b) Frequency control and measurement;
  (c) Interference, the causes and suppression of it;
  (d) Full operating procedure (this should relieve many qualified "Hams");

(2) The G.P.O. morse test;

(3) (a) Only able to use a small allotted section of the band;
  (b) Limited to two watts power output;
  (c) C.W. transmission only;
  (d) The allocation of a "beginners" prefix.

These conditions would, by their very nature, urge the willing and genuine Amateur on to the full licence while the lazy, and unenthusiastic would fall by the wayside.—**M. S. Lerner,** *(Hendon, London).*

Take—20 Dollars

Recently I started to construct one of the "Take 20" projects and I was horrified at some of the local prices for parts. These prices may be of interest to you: 5μF 12V capacitor, 20 cents; 1·5MΩ ¼W resistor 10 cents; BC109 transistor, $1·85c; BC169C transistor $2·25c. Ten New Zealand cents is equal to 5p.

It is actually cheaper to have these parts air-freighted from Britain than to buy them from the local shop.—**K. B. Moore** *(Tokoroa, New Zealand).*

A Protest

Radio components are clearly inferior to the previous designed ones, when silk covered windings of transformers were impregnated with quality varnish. Modern methods use enamelled wire impregnated with wax resulting in what I think is an inferior component which cannot be relied upon.

Oil insulated windings are inferior, especially when mains voltages are used in primary windings of transformers. Enamelled wires are clearly inferior and unreliable. More so when wax impregnated.

We are progressing in the wrong direction. When will the proven system return, so that quality returns? I refer to transformers only but other components are quite often just as bad.—**R. Wibberley,** *Nottingham.*

Such a D.I.N.

I would like to say a few words, aimed at manufacturers and suppliers: Now that "D.I.N." connectors are becoming more popular and standard on most equipment nowadays, how about making 5-core cables readily available, and 4-core individually screened cables at least available, if not readily available?—**R. Williams** *(St. Albans, Herts)*

Treasure Traced

We have been using a metal locator manufactured by a well-known company for some time now and recently our Town Hall called upon us to help search for a very expensive diamond and sapphire ring which had been lost on the beach.

We tried a manufactured metal locator which proved useless near salt. When we used the P.W. Treasure Tracer, we found the ring after one hour. The P.W. locator was not affected by water at all and the ring was in salt water when located.

This was the first time we had put the P.W. Treasure Tracer to work and since the ring we located was worth about £200 it proves how good it is. Needless to say, the lady to whom the ring belonged is very grateful and I hope other readers will have as much success.

The cost to build the Treasure Tracer is so low for such performance that the P.W. circuitry gives.

I must add that we also found about a dozen coins before finding the ring.—**R. Miller** *(Brightlingsea, Essex).*

SERVICING

AN INTRODUCTION TO FAULT-FINDING

PART 7 **G. J. KING**

GORDON KING CONTINUES THE SERIES DISCUSSING TUNER-AMPLIFIERS AND THEIR PROBLEMS, PICKUPS AND THEIR ASSOCIATED CORRECTION NETWORKS AND ENDS WITH A BRIEF RESUME OF HI-FI AMPLIFIER SPECIFICATIONS.

I want to begin this month with the hi-fi type of radio receiver, called the tuner-amplifier. This is an integration of a stereo (two channel) amplifier and a radio receiver always tuning the f.m. band (Band II) and sometimes a.m. bands as well, and invariably embodying a stereo decoder. This type of equipment is ousting the ordinary radiogram in certain areas of application, for, coupled to a pair of good speaker systems and a record playing unit the tuner-amplifier constitutes the 'heart' of a music system of significantly greater quality potential than the average radiogram.

Real hi-fi radio reproduction is not possible from the a.m. bands owing to the necessary restriction of the i.f. passband to avoid interference between adjacent stations. Sadly, even such passband restriction is unable to keep unwanted stations from the wanted in the medium waveband after dark, and as a consequence we get an annoying background of whistles and monkey chatter. Moreover, the passband restriction deletes the higher-order sidebands of the modulated signal and hence impairs the treble output.

With f.m. things are not like this because in Band II each channel is allotted 200 kHz of 'elbow room', thereby permitting full expansion of all the sidebands without restriction.

The f.m. system has attractive attributes over and above the a.m. system, including enhanced signal-to-noise performance, the ability to reject a.m. signals and interference and a parameter known as the 'capture ratio'.

The capture ratio stems from the nature of f.m. demodulation and from the amplitude limiting engineered into the i.f. channel of the receiver. It means that when two signals are present in the same channel (or close together in the receiver's passband) the weaker one is almost completely rejected and only the stronger of the two gives an output, free from interference.

A capture ratio of two or three decibels ensures that a co-channel signal is muted when the wanted signal is only about 10dB above it. Nothing like this degree of rejection is possible on a.m. All this boils down to the fact that the f.m. radio system is truly hi-fi, and that a.m. cannot be regarded in this light at all.

DEVELOPMENTS

Contemporary radio tuners and the tuner sections of tuner-amplifiers are fast taking in the latest devices, including field effect transistors (f.e.t's.), integrated circuits (i.c's.), crystal and ceramic i.f. filters supplementing the bandpass transformer couplings. F.e.t's. are used mostly in the front-end as the r.f. amplifier and, sometimes, the mixer (with a bipolar local oscillator). Since their transfer characteristics exhibit second-order components they yield fewer third-order intermodulation components at high signal level than bipolar counterparts, whose characteristics contain an abundance of third-order components.

This means that unwanted spurious signals are minimised, particularly at locations close to a powerful station group. They also provide other attributes, including relatively low noise working and good 'mixing' properties. Thus a tuner section (f.m.) containing an f.e.t. r.f. amplifier and an f.e.t. mixer is likely to out-perform an 'equivalent' incorporating bipolar devices in these stages under a wide range of operating conditions.

THIRD ORDER INTERMODULATION

One problem with simple f.m. front-ends is third-order intermodulation when operated in a strong, locally derived signal field. One symptom of this is a spurious signal at Radio 3 frequency (from $f_2+f_4-f_3$, where f_2, f_3 and f_4 are the frequencies of Radios 2, 3 and 4 respectively). This can result in 'burbles' and similar sort of interference on Radio 3, and possibly 'birdies' inteference when Radio 3 is stereo encoded.

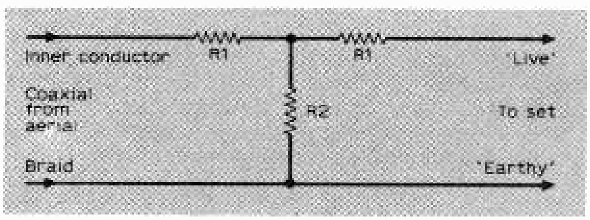


Fig. 1: Simple attenuator for reducing intermodulation problems.

SPECIAL PURCHASE!

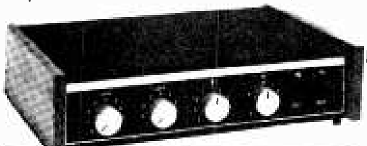
BRAND NEW FM MULTIPLEX STEREO DECODERS
Manufactured by **PHILIPS**. Size 2"×3¼"×1". All transistor 24v. at 6 mA. Supplied pre-aligned with full circuit diagram and connection detials. **£4 each Post Free**

LEAK MK I TRANSCRIPTION PICK-UP ARMS
Using the world famous gimbal pivot system. Complete but less pick up head. **£2·50** P. & P. 20p

INPUT MATCHING TRANSFORMER
Beautifully made in heavy Mu-metal cylindrical case for minimum hum pick-up. Size 1¾" high×1½" dia. Ratio 150 : 1 approx. Especially suitable for matching dynamic or ribbon mikes or pick up from low to high impedance or vice versa. **75p each Post Free**

BLACK ANODISED 16g. ALUMINIUM HEAT SINKS
For TO3, complete with mica's & bushes. Size 2½"×3" approx. **25p pair** P. & P. 5p.

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



NEW IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED PRINTED CIRCUIT BOARD FOR EASY CONSTRUCTION

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Output stage for any speakers from 5 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board, attractive front panel, knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1.0 amp. Overall Size 12"w. x 8"d. x 2½"h.
Fully detailed 7 page construction manual and parts list free with kit or send 18p plus large S.A.E.

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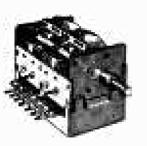
All Transistor F.M. tuner head with twin A.M. Gang incorporated. Beautifully engineered with precision geared reduction drive. FM RF Transistor, oscillator/Mixer and first I.F. stage (10.7 Mc/s output) with optional AFC connection. Built on printed circuit panel and fully screened. Extremely stable over range 88-108Mc/s. Brand new and pre-aligned. Size 2½"h x 1¾"w x 2½"d. For 6v D.C. at 2.8mA. A.M. Gang fitted with trimmers which can be connected to standard A.M. aerial and oscillator circuits if required. LIMITED NUMBER. Only **£2.25** post free. Connection details supplied.



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A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. Ready built and tested. PRICE **£3·75** P. & P. 40p
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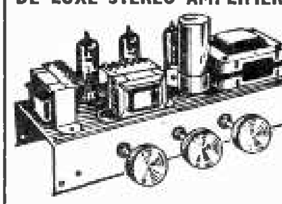
DE LUXE STEREO AMPLIFIER



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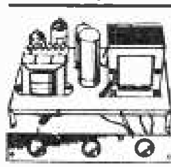

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½" w. × 4" d. × 4½" h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£4·75.** P. & P. 35p.

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6BR7	.79
6BR8	.63

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6CB6A	.26
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6DE7	.50
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6EW6	.55
6F1	.59
6F6	.63
6F6G	.25
6F13	.33
6F14	.42
6F18	.45
6F23	.68
6F24	.68
6F25	.54
6F28	.60
6F32	.15
6GH8A	.50
6GK5	.50
6GU7	.50
6H6GT	.15
6J5G	.19
6J5GT	.29
6J6	.18
6J7G	.24
6J7GT	.38
6JU8A	.50
6K7G	.10
6K7GT	.23
6K8G	.16
6L1	.98
6L6GT	.39
6L7GT	.38
6L18	.44
6L19	1.38
6LD20	.48
6N7GT	.40
6Q7	.43
6Q7G	.27

6R7	.55
6R7G	.35
6SA7GT	.35
6SA7M	.35
6SC7GT	.33
6SG7GT	.33
6SH7	.53
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6SQ7GT	.38
6V6G	.17
6V6GT	.30
6X4	.20
6X5GT	.25
7A7	.88
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7B7	.32
7C6	.30
7H7	.28
7R7	.65
7Z4	.50
9D7	.78
10C2	.49
10DE7	.50
10F9	.45
10F18	.35
10LD11	.53
10P13	.54
10P14	1.08
12A6	.63
12AC6	.40
12AD6	.40
12AE6	.48
12AT6	.23
12AT7	.16
12AU6	.21
12AU7	.19
12AV6	.28
12AX7	.22
12BA6	.30
12BE6	.30
12BH7	.27
12E1	.85
12J7GT	.33
12K5	.50
12K7GT	.34
12Q7GT	.28
12SA7GT	.40

12SC7	.35
12SG7	.23
12SH7	.15
12SJ7	.23
12SK7	.24
12SQ7GT	.50
13D3	.45
14S7	.75
19AQ5	.24
19G6	.50
20D4	1.05
20F2	.65
20L1	.98
20P1	.50
20P3	.79
20P4	.89
20P5	1.00
25A6G	.29
25L6G	.20
25Y5	.38
25Y5G	.43
25Z4G	.28
25Z5	.40
25Z6G	.43
30A5	.44
30C1	.28
30C15	.60
30C17	.77
30C18	.60
30F5	.65
30FL1	.60
30FL2	.60
30FL12	.69
30FL14	.68
30L1	.29
30L15	.58
30L17	.67
30P4MR	.95
30P12	.69
30P19/30P4	.58
30PL1	.59
30PL13	.75
30PL14	.65
30PL15	.87
35A3	.48
35L6GT	.42
35W4	.23
35Z4GT	.24

35Z5GT	.30
50EH5	.55
50L6GT	.45
85A2	.43
90C1	.59
150B2	.58
807	.59
5702	.80
5763	.50
AC2/PEN	.98
AC2/PEN/DD	.98
AC6PEN	.38
AC/PEN(7)	.98
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AC/TP	.98
AL60	.78
ATP4	.12
AZ1	.40
AZ31	.46
AZ41	.53
CL33	.90
CY1C	.53
CY31	.31
DAF91	.20
DAF96	.33
DF91	.14
DF96	.34
DH76	.28
DK40	.55
DK92	.35
DK96	.35
DL96	.35
DM70	.30
DM71	.38
DY86/7	.24
DY802	.35
E80F	1.20
E83F	1.20
E88CC	.60
E92CC	.40
E180F	.90
E182CC	1.00
E1148	.53
EA50	.18
EA76	.88
EABC80	.30
EAC91	.38

EAF42	.48
EB34	.20
EB91	.10
EBC41	.48
EBC81	.29
EBC91	.28
EBF80	.30
EBF83	.38
EBF89	.27
EBL21	.60
EC86	.59
EC88	.59
EC92	.34
ECC32	1.50
ECC33	1.50
ECC40	.60
ECC81	.16
ECC82	.19
ECC83	.22
ECC84	.28
ECC85	.24
ECC86	.40
ECC88	.35
ECC189	.48
ECC804	.55
ECC807	1.70
ECF80	.27
ECF82	.26
ECF86	.64
ECF804	2.10
ECH21	.63
ECH42	.60
ECH81	.27
ECH83	.39
ECH84	.34
ECL80	.30
ECL82	.30
ECL83	.52
ECL84	.54
ECL85	.54
ECL86	.35
EF22	.63
EF36	.33
EF37A	.45
EF39	.40
EF40	.49
EF41	.58
EF42	.33
EF54	.98
EF73	75

EF80	.22
EF83	.48
EF85	.26
EF86	.29
EF89	.23
EF91	.17
EF92	.35
EF97	.55
EF98	.65
EF183	.26
EF184	29
EH90	.36
EL32	.18
EL34	.44
EL35	1.00
EL36	.49
EL37	.74
EL42	.53
EL81	.50
EL83	.38
EL84	.22
EL85	.40
EL86	.38
EL91	.23
EL95	.32
EM80	.38
EM81	.39
EM83	.75
EM84	.31
EM87	.35
EY51	.33
EY81	.35
EY83	.54
EY84	.50
EY87/6	.30
EY88	.40
EY91	.53
EZ40	.40
EZ41	.42
EZ80	.21
EZ81	.22
EZ90	.20
FW4/500	.75
FW4/800	.75
GZ30	.34
GZ32	.41
GZ33	.70
GZ34	.48
GZ37	.67
HABC80	.44
HL23DD	.40

HL41DD	.98
HL42DD	.50
HN309	1.40
HVR2	.53
HVR2A	.53
KT2	.25
KT8	1.75
KT44	1.00
KT66	.80
KT81	2.00
KTW61	.63
KTW62	.63
KTW63	.50
MHLD6	.75
N78	2.05
N308	.95
N339	.44
P61	.44
PABC80	.33
PC86	.47
PC88	.47
PC95	.53
PC97	.36
PC900	.32
PCC84	.29
PCC85	.26
PCC88	.41
PCC89	.45
PCC189	.48
PCF80	.28
PCF82	.30
PCF84	.40
PCF86	.44
PCF200	.67
PCF801	.29
PCF802	.40
PCF805	.60
PCF806	.57
PCF808	.68
PCH200	.62
PCL82	.32
PCL83	.58
PCL84	.34
PCL805/85	.40
PCL86	.38
PCL88	.65
PD500	1.44
PEN4DD	1.38
PEN36C	.75

PEN45DD	.75
PEN46	.20
PEN453DD	.98
PENDD-4020	.88
PFL200	.52
PL36	.47
PL81	.44
PL81A	.48
PL82	.30
PL83	.32
PL84	.30
PL504/500	.62
PL505	1.30
PL508	.90
PL509	1.30
PL802	.75
PM84	.34
PX4	1.16
PX25	.98
PY33/2	.50
PY80	.33
PY81	.24
PY82	.24
PY83	.26
PY88	.32
PY500	.95
PY800	.33
PY801	.33
PZ30	.48
QQV03/10	1.20
QS95/10	.49
QV04/7	.63
R10	.75
R11	.98
R16	1.75
R17	.88
R19	.30
SP42	.75
SP61	.33
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TH233	.98
TP2620	.98
UABC80	.30
UAF42	.49
UBC41	.45
UBC81	.40

UBF80	.30
UBF89	.30
UBL21	.55
UC92	.35
UCC84	.33
UCC85	.34
UCF80	.33
UCH21	.60
UCH42	.60
UCH81	.30
UCL82	.33
UCL83	.48
UF41	.50
UF42	.60
UF80	.35
UF85	.34
UF86	.63
UF89	.27
UL41	.54
UL84	.31
UM80	.33
UY1N	.50
UY41	.38
UY85	.25
U10	.45
U12/14	.38
U18/20	.75
U19	1.73
U22	.39
U25	.64
U26	.56
U45	.78
U191	.58
U251	.65
U281	.40
U282	.40
U301	40
U403	.33
U404	.38
U801	.93
U4020	.38
VP23	.40
VP41	.38
VT61A	.35
VU111	.44
VU120	.60
VU120A	.60
VU133	.35
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W107	.50
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AA120	.15
AA129	.15
AAZ13	.18
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AC113	.25
AC127	.17
AC128	.20
AC154	.25
AC156	.20
AC157	.25
AC166	.25
AC168	.38
AC176	.55
AC177	.28
ACY17	.25
ACY18	.20
ACY19	.19
ACY20	.18
ACY21	.19
ACY22	.15
ACY28	.18
AD140	.36
AD149	.50
AD161	.45
AD162	.45
ADT140	.63
AF102	.90
AF106	.50
AF114	.25
AF115	.15
AF117	.19
AF121	.30
AF124	.25
AF126	.18
AF139	.65
AF178	.68
AF180	.48
AF186	.55
AF239	.38
BA102	.45
BA115	.14
BA116	.25
BA129	.13
BA130	.10
BA153	.15
BC107	.13

BC108	.13
BC113	.25
BC115	.15
BC116	.25
BC118	.23
BCY10	.45
BCY12	.50
BCY33	.20
BCY38	.23
BCZ11	.38
BF158	.29
BF159	.25
BF163	.20
BF173	.38
BF180	.30
BF181	.40
BF185	.40
BF194	.15
BFY50	.23
BFY51	.19
BFY52	.20
BY100	.18
BY105	.18
BY114	.18
BY126	.15
BY127	.18
BYZ10	.25
BYZ11	.25
BYZ12	.25
BYZ13	.25
CG12E	.20
FSY11A	.23
FSY41A	.23
GD9	.20
GET113	.20
GET116	.40
GET118	.20
GET119	.20
GET573	.38
GET587	.43
GET873	.15
GET887	.23
GET897	.23
GET898	.23
M1	.15
M3	.15
OA5	.28
OA9	.13
OA10	.43
OA47	.10
OA70	.15

OA73	.15
OA79	.09
OA81	.09
OA85	.08
OA90	.13
OA91	.09
OA95	.09
OA200	.09
OA202	.10
OC22	.38
OC23	.38
OC24	.38
OC25	.38
OC26	.24
OC28	.60
OC29	.63
OC35	.32
OC36	.43
OC42	.63
OC43	1.18
OC44	.10
OC45	.11
OC46	.15
OC70	.13
OC71	.11
OC72	.11
OC74	.23
OC75	.11
OC76	.15
OC77	.27
OC78	.15
OC78D	.15
OC81	.11
OC81D	.11
OC82	.11
OC82D	.11
OC83	.20
OC84	.24
OC123	.23
OC139	.23
OC140	.95
OC169	.23
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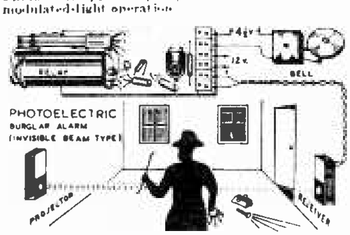

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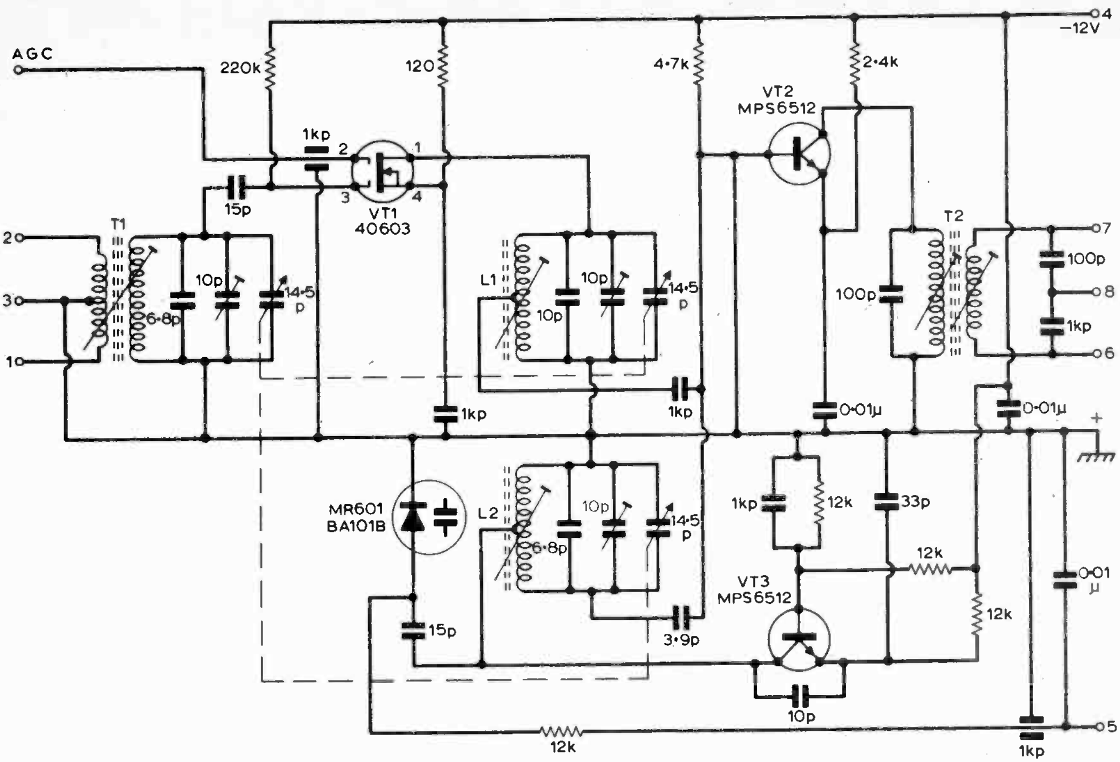

Fig. 2: Circuit of the "front-end" of a typical British tuner-amplifier.

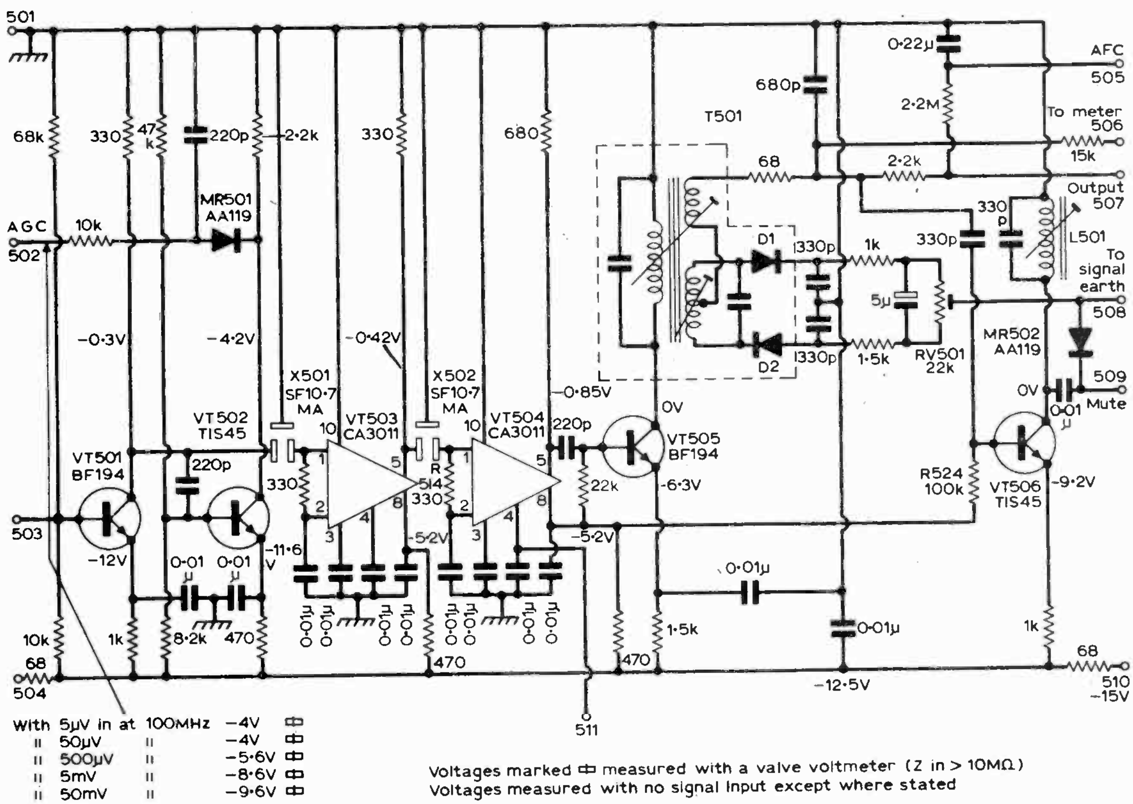

Fig. 3: The f.m. i.f. channel of the tuner-amplifier shown above.

One solution lies in attenuating the signal from the aerial to the set. Belling Lee make plug-in attenuators over a range of values; alternatively a simple resistive pad can be made up as shown in Fig. 1.

FM FRONT-END

The f.m. front-end of a typical British tuner-amplifier is shown in Fig. 2. Here VT1 is a dual-gate f.e.t. with the input signal applied to one gate and an a.g.c. potential to the other. The mixer is bipolar VT2 and the local oscillator bipolar VT3.

Aerial coupling is by T1 primary, and since this is centre-tapped 300 ohms balanced feeder can be connected across terminals 1-2 or 75 ohms coaxial (unbalanced) across 2-3. Not all input circuits permit this dual mode of feeder connection, and if the design is essentially for 300 ohms balanced (or 240 ohms European DIN) the best coupling from coaxial is obtained through a 'balun' transformer.

A.f.c. is applied to the local oscillator from a varactor diode (MR601), and this receives its control bias from the f.m. detector. The varactor is in parallel with the oscillator tuned circuit, so the frequency of this is altered by the control bias which appears in appropriate polarity from the f.m. detector when the tuned carrier is displaced from the centre of the i.f. passband.

The i.f. signal is developed across T2, and is coupled to the f.m. i.f. channel from the capacitance tap on circuit No. 8.

FM IF CHANNEL

The f.m. i.f. channel is shown in Fig. 3, and the input goes to circuit No. 503 and thence to the base of VT501.

The channel includes two ceramic filters of the kind already mentioned (X501/X502) and a couple of i.c's. (VT503/VT504). The ceramic filters take the place of the usual i.f. transformers and because they exhibit steeply rising and falling response sides extremely good i.f. selectivity is secured. The only alignment required is of the ratio detector transformer T501.

The i.f. signal at VT501 collector is fed to the first filter and from this to the first i.c. The second filter couples the two i.c's., while VT505 bipolar transistor drives the ratio detector, composed of diodes D1/D2, etc. This circuit is balanced, and preset RV501 allows this to be optimised, one mode for adjustment being for the least response to an a.m. signal.

It will be noticed that the ratio detector yields potential for the tuning meter as well as for the varactor diode on circuits 506 and 505 respectively. Demodulated audio (or multiplex signal in the case of stereo) from circuit 507 is coupled to the stereo decoder.

VT506 is concerned with the muting, etc., while VT502 amplifies i.f. signal at VT501 collector and passes it to the rectifier MR501. The resulting filtered d.c. constitutes the a.g.c. potential for the f.e.t. r.f. amplifier (Fig. 2).

FAULT FINDING

Fault finding in a circuit of this kind is best carried out by feeding a modulated 10·7MHz (or a signal at the i.f.) into the strip, starting at the final transistor (VT505 in this case), then working forward until the point of inactivity is located.

To find the actual component which is in trouble, after locating the faulty area or stage, might well require the testing of voltages, etc. at the electrodes of the various devices, and to help in this respect the voltage references in Fig. 3 have been retained.

Servicing of f.m. front-ends is not recommended—apart, possibly, from the replacement of transistors—and trouble in this area is best left to the maker or distributor to clear. This applies to professional service organisations as well as to the amateur repairer.

A word about the replacement of f.e.t's. would not be amiss. The insulated gate types in particular are vulnerable to static discharges, and when making a replacement always retain the shorting clip (fitted by the maker) until the device has been completely soldered into the circuit.

From the testing, adjusting and servicing aspects, the BBC's stereo test sequence at the close-down of Radio 3 can be of a great help in determining such parameters as stereo separation (e.g., degree of crosstalk), signal-to-noise, frequency response, etc.

SOURCE INPUTS

When a radio tuner is used with a hi-fi amplifier a 'flat' response is required since the de-emphasis is performed in the tuner. Inputs with 'flat' responses thus include radio, high-level tape replay and auxiliary. If an amplifier is equipped with an input for the signal direct from a tape head, then equalisation will be included to cater for the replay response. The only equalising then required is that pertaining to the gramophone pickup, and a good starting point is the pickup (cartridge) itself.

PICKUPS

There are two versions. One the magnetic which works rather like a generator, and the piezo, using either a natural crystal or processed ceramic, which works on the transducer principle.

When a gramophone record is made the modulation is imparted to the groove from a cutting head via a special electrical filter having a specific

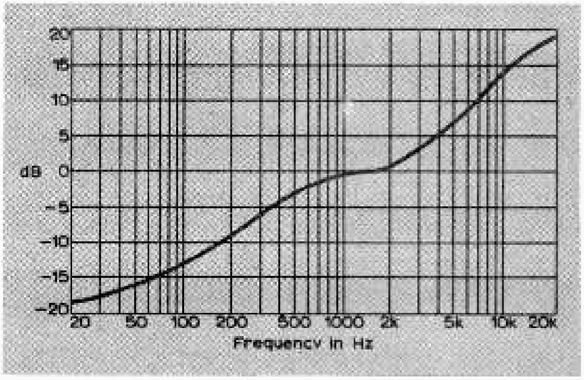

Fig. 4: Graph showing the standard RIAA recording characteristic

recording characteristic. The bass end of the spectrum is attenuated and the treble end is boosted. On replay, therefore, the bass needs to be boosted and the treble attenuated to secure a 'flat' audio output.

The standard recording characteristic is given in Fig. 4. This has an 'average' slope of about 4dB/

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5¾in.	900ft.	52p	5¾in.	1,200ft.	65p
7in.	1,200ft.	62½p	7in.	1,800ft.	92½p
Double Play			**Triple Play**		
3in.	300ft.	20p	4in.	900ft.	65p
4in.	600ft.	40p	5in.	1,800ft.	£1·12½
5in.	1,200ft.	75p	5¾in.	2,400ft.	£1·70
5¾in.	1,800ft.	95p	7in.	3,600ft.	£2·40
7in.	2,400ft.	£1·35	**Quadruple Play**		
			3in.	600ft.	42½p

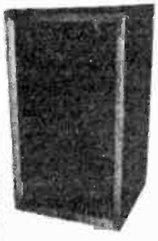
Postage 5p reel.

Post Free less 5% on three reels.

Quantity and Trade enquiries invited.

NOTE. *Large tape stocks at all branches.*

Introducing The New JASON "ALPHA" Loudspeaker Enclosure.



Incorporating the famous EMI "450" set consisting of a 13×8in. bass unit with a high flux ceramic magnet, 2 tweeters and crossover. 20 watt peak handling power (10 watts RMS).

Heavy duty 16mm infinite baffle case in superb quality genuine golden teak veneers with solid mahogany contrasting leading edges. High quality foam loaded cloth fret. Acoustically loaded "Jason" rotating badge in genuine gold leaf for horizontal or vertical operation. Size 19in.×10in.×10½in. Weight 16lbs. A price break through at only

Carriage etc. 50p singly. Carriage free in pairs. **£12·50** each

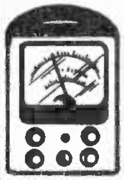
JASON SENIOR 20W ENCLOSURE. As above but with super heavy duty bass unit with 3·6lb magnet in Magnadur II material with 1·5in speech coil and super tweeter giving frequency range of 20–20,000Hz. Standard 8Ω impedance in beautifully finished heavy teak veneers. Size 12¼×12×23in. 20 Watts RMS, 40 watts peak.

At a super keen price **£18** or **£35** a pair carriage and ins. 62½p for 1 or 2.

PLINTHS & COVERS

for Garrard (all take current models except heavy transcription types) Beautiful heavy solid perspex top with "stereo" badge high quality base with solid wood sides machined ready for R/P deck to drop in without any further work. Terrific value at only **£3·75** complete. Carr. & Insurance 40p.

KG-620 4½" VTVM KIT ★ NEW!

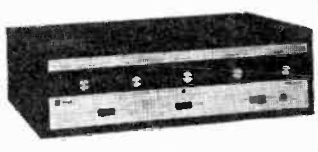


SPECIFICATIONS

Ranges: *0-1·5-5-15-50-150-500-1,500V full scale; with optional High-Voltage Probe, to 25,000V.*
Accuracy: *±3% Of full scale reading.*
Input Resistance: *11 megohms (1 meg in probe) up to 1,500V.*
Ranges (rms): *0-1·5-5-15-50-150-500-1,590V full scale (p-p); 0-4·2-14-42-140-420-1,400-4,200V full scale.*
Decibels: *−10 to +65 in 7 ranges.*
Response: *±1dB, 30Hz to 3MHz: ±3dB, 30Hz to 5MHz; with optional H.F. Probe, to 250MHz.*
Accuracy: *±5% of full scale reading.*
Ranges: *0-1,000-10,000-100,000 ohms; 0-1-10-100-1,000 megohms.*
Centre Scales: *10, 100, 1,000, 10,000, 100,000 ohms; 1 and 10 megohms.*
Battery: *1½V size U2.*

Recommended List Price £18·27½: **£9·95** Assembled Price **£12·90** (RR Price £30)

KG-865 50 Watt Stereo Amplifier Chassis



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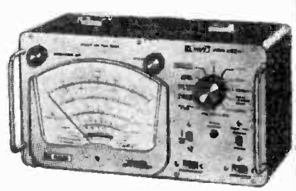
Output: *50W IHF, 25W per channel; 34W continuous sine wave* ● **Response:** *±1dB, 18 to 30,000Hz* ● **Output Impedances:** *4 through 16 ohms, plus stereo headphones* ● **IM Distortion:** *under 1% at 60Hz and 7,000Hz mixed 4 : 1 at rated power* ● **Input Sensitivity.** *Magnetic Phono, 5mV; Tuner and Auxiliary, 500mV* ● **Power Requirement:** *230–250V, 50Hz a.c.* **Rec. List Price £51·00**

Our Price £29

KG-375 Deluxe Solid-State Auto Analyser

Tune-up and trouble-shoot any car, perform actual road tests

It's several testers in one . . . do all this



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Complete with 8-page booklet, circuits and data **£1·50** ea.

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10 watt	ZS series	+40p	37p	35p	30p	25p

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SC35B	200	3 amps	85p
SC35D	400	3 amps	90p
SC40A	100	6 amps	90p
SC40B	200	6 amps	£1·05
SC40D	400	6 amps	£1·00
SC45A	100	10 amps	£1·05
SC45B	200	10 amps	£1·15
SC45D	400	10 amps	£1·25
SC50A	100	15 amps	£1·35
SC50B	200	15 amps	£1·45
SC50D	400	15 amps	£1·75
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DIAC SD2			25p

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Type	P.I.V.	1-49	50+	100+	500+	1000+
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IN4002	100	7p	6p	5p	4½p	4p
IN4003	200	8p	7p	6p	5p	4½p
IN4004	400	8p	7p	6p	5p	4½p
IN4005	600	10p	9p	8p	7p	6p
IN4006	800	12p	10p	9p	8p	7p
IN4007	1000	15p	12p	10p	9p	8p

BRIDGE RECTIFIERS

Miniature Potted Silicon ½" × ½" × ½"

Type	P.I.V.	Current	1-12	Type	P.I.V.	Current	1-12
1002	100	2a	55p	4004	400	4a	75p
2002	200	2a	65p	6004	600	4a	80p
4002	400	2a	75p	1006	100	6a	70p
6002	600	2a	80p	2006	200	6a	75p
1004	100	4a	65p	4006	400	6a	£1·00
2004	200	4a	70p	6006	600	6a	£1·10

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100 + 18p
500 + 15p
1000 + 13p

BY127 Mullard 15p
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100 + 10p
500 + 9p
1000 + 8p

OC35 Mullard 50p
25 + 45p
100 + 40p
500 + 35p
1000 + 30p

2N2926 Green 10p
25 + 9p
100 + 8p
500 + 6p
1000 + 5p

BC107 All Makes 10p
25 + 8p
100 + 7p
500 + 6p
1000 + 5p

2N3055 Fairchild 75p
25 + 65p
100 + 50p
500 + 40p
1000 + 35p

BYZ13 Mullard 25p
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OA202 10p
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500 + 6p
1000 + 5p

OC28 Mullard 60p
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100 + 50p
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1000 + 40p

2N3819 Texas 35p
25 + 30p
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500 + 20p
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octave, but the RIAA equalising, as it is called, is very carefully engineered into the magnetic pickup input circuits of hi-fi amplifiers and good quality radiograms, etc., so that the response is exactly the reciprocal of that shown in Fig. 4. The net result is that a 'flat' output from the preamplifier which, of course, is the signal requirement of the control section and power amplifiers.

Now, it is the **velocity** of the imparted modulation which follows Fig. 4 curve, and because magnetic pickups yield an output proportional to the velocity of stylus deflection the output from the pickup applied to the equalised preamplifier is thus after the style of that in Fig. 4. Hence the reciprocal equalisation just referred to.

A piezo pickup, on the other hand, produces an output which is proportional to the **amplitude** of stylus deflection (not velocity). This implies that a piezo pickup playing a record cut to the standard RIAA response produces an almost 'flat' output **without** equalisation.

All piezo cartridges need to be loaded into a very high resistance of not less than 1MΩ and for the best results and to secure full advantage of the inbuilt equalisation and thus obtain a 'flat' output from a disc recorded to the RIAA standard.

A magnetic cartridge (whose source is inductive), however, is commonly designed to work best into a load of round 50kΩ. If it is loaded lower the treble tends to fall, while too high a loading can lift the treble end of the spectrum and incite undue 'ringing'. Conversely, a piezo cartridge (because its source is capacitive) exhibits falling bass and rising treble when loaded into a resistance significantly below 1MΩ or so.

The signal yield from a piezo cartridge, even when loaded low, is significantly in excess of that from a magnetic cartridge when playing modulation of a given velocity. This means, therefore, that the piezo signal might well have to be attenuated before being fed to the magnetic input, to avoid preamplifier overload.

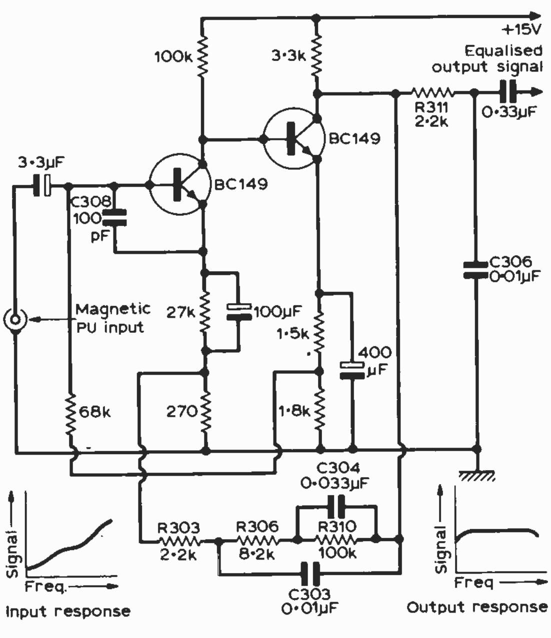


Fig. 5: Circuit of a pre-amplifier incorporating RIAA equalisation.

The peaks of signal can be clipped when the pickup signal veers towards the overload level. However, when an 'equalising' pad is included a degree of attenuation is automatic, so additional attenuation may not be necessary.

RIAA EQUALISED PREAMPLIFIER

Shown in Fig. 5 is the circuit of a fairly conventional RIAA equalised preamplifier. It is common to employ two transistors, at least, and in the circuit shown, R306/R310/C303/C304 network provides the frequency selective network, giving the necessary response characteristic inversely to correspond with the recording characteristic (Fig. 4). The overall effect is that the feedback increases with rising frequency and decreases with reducing frequency, thereby giving the required treble cut and bass boost.

R303 provides a 'flat' control of gain, and in some amplifiers the frequency selective network is switched out of circuit when the programme input signal requires a 'flat' response, a resistor such as R303 then being used to provide the appropriate input sensitivity voltage. Stereo equipment embodies two such preamplifiers, one for each channel.

The RC network C306/R311 provides a low-pass characteristic, preventing the response from extending too far above the audio spectrum. The 100pF capacitor (C308) connected directly across the base/emitter electrodes of the input transistor cuts the input response to radio frequencies and thus prevents the breakthrough of radio and television interference during low-level record replay.

RADIO/TV BREAKTHROUGH

Not all amplifiers are equipped with radio and TV filtering like this, and since the response of transistor stages can embrace the radio and TV spectrums, a symptom becoming increasingly common is, in fact, radio and TV breakthrough. This mostly happens when the equipment is switched to magnetic pickup and when it is operated relatively close to a powerful radio or TV station. It is encouraged by (i) the high sensitivity of the amplifier under this mode of operation and (ii) the relative ease at which the RIAA preamplifier can be pushed into non-linearity.

A filter which nearly always clears the trouble is given in Fig. 6. The circuit to the base should be broken and the 2·2kΩ resistor inserted in series.

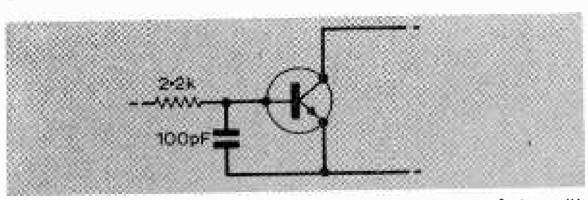


Fig. 6: A simple filter to prevent radio and TV signals interfering with audio amplifiers.

while the 100pF capacitor should be connected right across the base/emitter electrodes, as close as possible to the input transistor. Both channels should be so treated.

The RIAA preamplifier signals can get into trouble so if one channel of a stereo amplifier appears to be lacking in bass, with excessive treble output, when operating from a magnetic cartridge, then attention should be given to the preamplifier department of the affected channel. Excessive noise on the magnetic input is commonly caused by a defective preamplifier transistor or a 'noisy' collector resistor.

HI-FI SPECS

It is impossible to detail all the specifications relating to hi-fi equipment (further information on this score is given in **"Tuners and Amplifiers"** by John Earl, published by Fountain Press), but comment on a few of the more important ones would not be amiss.

Power Capacity. This is the maximum power that an audio section is capable of delivering with both channels running, the **maximum** being defined either to the level of sinewave clipping or to a specified value of distortion when the output is loaded by pure resistance of appropriate value in place of the speaker. The 'standard frequency' is 1kHz, but to obtain the **power bandwidth** the measurement is repeated at low and high frequencies.

Standard Output Power. This is 50mW (17dB/mW). However, in some instances values of 500mW (27dB/mW) and 5mW (7dB/mW) might be used, but the power to which any parameter (such as sensitivity) refers should be stated in the specification.

Input Sensitivity Voltage. This is the input signal at 1kHz required to yield the rated output power when the volume control is fully advanced, all filters 'out' and tone controls 'flat'.

Signal/Noise Ratio. This refers to the voltage due to components of hum and noise across the output load in terms of dB ratio to the rated output power and within the full noise bandwidth of the equipment. The volume control is generally fully advanced and the selected source input is either short-circuit or open-circuit (the former preferred since it avoids the pickup of spurious hum and noise components).

A ratio of 60dB, for example, implies that the **power** of the summed hum and noise in the output load is one million times below the full power of the amplifier.

Total Harmonic Distortion (THD). This is commonly measured through a distortion factor meter, in which a very sharply tuned filter 'notches out' the fundamental frequency, leaving only the harmonic components.

Intermodulation Distortion (IMD). Like THD, IMD is a function of amplifier non-linearity. This is commonly measured in terms of the amplitude of intermodulation components resulting from the introduction of two signals to the amplifier, so as to produce sum and difference frequencies.

S/N Ratio (FM). This refers to hum and noise relative to a stated modulation level (100% or 30%). Measurement is similar to that of S/N ratio of an amplifier, and the usable sensitivity of an f.m. tuner is commonly given as the input required for a S/N ratio of 45dB.

Owing to the wider passband involved and the action of decoding, a stereo receiver has a S/N performance below that on mono, particularly at the lower signal input levels, which is the reason why stereo receivers should always be operated with the best possible f.m. aerial system, consistent with the location and prevailing signal field on Radio 3.

END OF SERIES

NINE BAND RECEIVER—*continued from page 690*

AERIALS

The telescopic type aerial has a bracket, so that it can be bolted directly on the left hand side of the case, about 1in. from the back. An insulated socket is fitted on the side of the case for an external aerial. Many transmissions can be received at ample volume with the telescopic aerial alone but an external aerial will greatly improve the reception of weak signals.

DIAL SCALE

Because each of the nine bands covers a relatively small frequency range, the main tuning scale is fitted with a card marked 0 to 50.

The bandswitch has nine positions, and the card scale under it has ten frequency markings. The bandswitch pointer comes to rest **between** these markings, which thus show the approximate frequency coverage of that particular range. For example, if the pointer rests between 4·6 and 5·0, the range is 4·6-5·0MHz, while if it is between 5·0 and 5·6 the range is 5·0-5·6MHz, covered with the normal tuning control.

The full markings are as follows: 3·6—3·8—4·3—4·6—5·0—5·6—6·3—7·4—10—15. This scale is best put under the perspex. ■

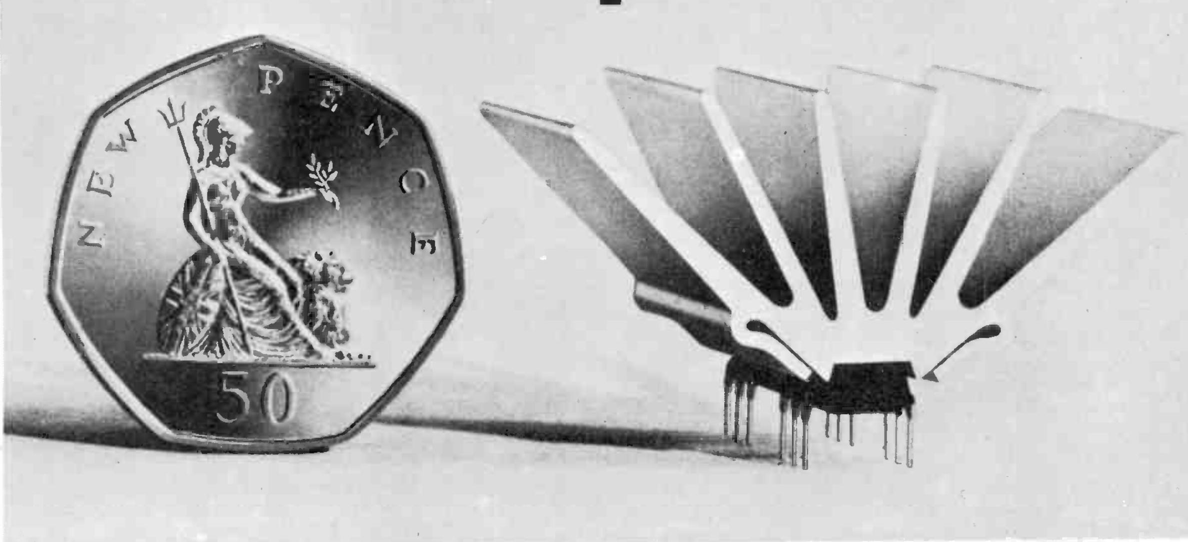
MAXWELL

by G8DSH

"—a bit of a mismatch somewhere!"

new

Super IC-12



High fidelity Monolithic Integrated Circuit Amplifier

Two years ago Sinclair Radionics announced the World's first monolithic integrated circuit Hi-Fi amplifier, the IC.10. Now we are delighted to be able to introduce its successor, the Super IC.12. This 22 transistor unit has all the virtues of the original IC.10 plus the following advantages:

1. Higher power.
2. Fewer external components.
3. Lower quiescent consumption.
4. Compatible with Project 60 modules.
5. Specially designed built-in heat sink. No other heat sink needed.
6. Full output into 3, 4, 5 or 8 ohms.
7. Works on any voltage from 6 to 28 volts without adjustment.
8. NEW 22 transistor circuit.

SINCLAIR GENERAL GUARANTEE
Should you not be completely satisfield with your purchase when you receive it from us, return the goods without delay and your money will be refunded in full, including cost of return postage, at once and without question. Full service facilities are available to all Sinclair customers.

Output power 6 watts RMS continuous (12 watts peak).

Frequency Response 5 Hz to 100KHz $\pm$ 1 dB.

Total Harmonic Distortion Less than 1%. (Typical 0.1%) at all output powers and all frequencies in the audio band.

Load Impedance 3 to 15 ohms.

Power Gain 90dB (1,000,000,000 times) after feedback.

Supply Voltage 6 to 28 volts (Sinclair PZ-5 or PZ-6 power supplies ideal).

Size 22 x 45 x 28 mm including pins and heat sink.

Input Impedance 250 Kohms nominal.

Quiescent current 8mA at 28 volts.

With the addition of only a very few external resistors and capacitors the Super IC.12 makes a complete high fidelity audio amplifier suitable for use with pick-up, F.M. tuner etc. Alternatively, for more elaborate systems, modules in the Project-60 range such as the Stereo 60 and A.F.U. may be added. The comprehensive manual supplied with each unit gives full circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include car radios, oscillators etc. The very low quiescent consumption makes the Super IC.12 ideal for battery operation.

Price, inc. FREE printed circuit board for mounting.

£2.98 Post free

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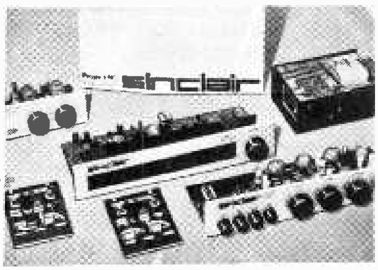
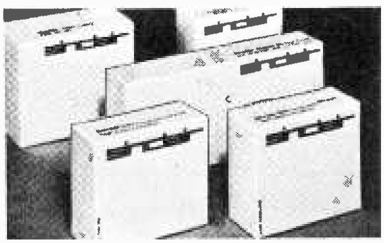
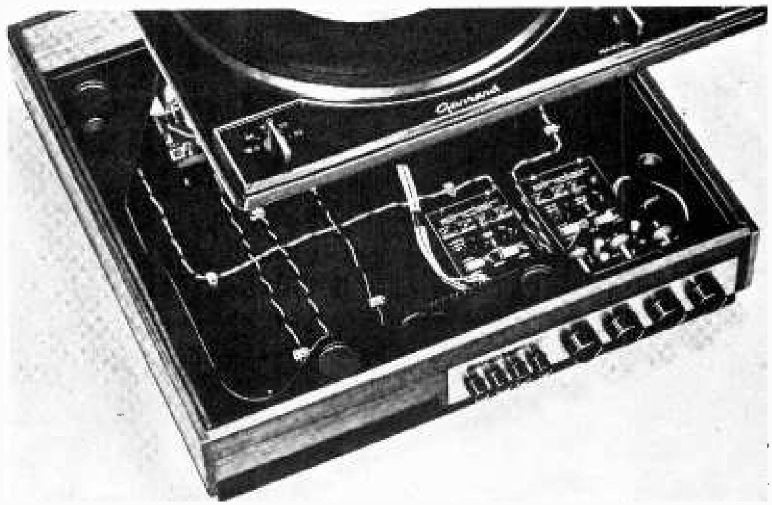
Sinclair Project 60

The World's leading range of high fidelity modules







New!

Project 605

The easy way to buy and build Project 60

Project 605 is one pack containing: one PZ5, two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules. Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting.

Complete Project 605 pack with comprehensive manual, post free **£29.95**

All you need for a superb 30 watt high fidelity stereo amplifier.

Project 60 offers more advantage to the constructor and user of high fidelity equipment than any other system in the world.
Performance characteristics are so good they hold their own with any other available system irrespective of price or size.
Project 60 modules are more versatile – using them you can have anything from a simple record player or car radio amplifier to a sophisticated and powerful stereo tuner-amplifier. Either power amplifier can be used in a wide variety of applications as well as high fidelity. The Stereo 60 pre-amplifier control unit may also be used with any other power amplifier system, as can the AFU filter unit. The stereo FM tuner operates on the unique phase lock loop principle to provide the best ever standards of sensitivity and audio quality. Project 60 modules are very easily connected together by following the 48 page manual supplied free with all Project 60 equipment. The modules are great space savers too and are sold individually boxed in distinctive white and black cartons. With all these wonderful advantages, there remains the most attractive of all – price. When you choose Project 60 you know you are going to get the best high fidelity in the world, yet thanks to Sinclair's vast manufacturing resources (the largest in Europe) prices are fantastically low and everything you buy is covered by the famous Sinclair guarantee of reliability and satisfaction.

Typical Project 60 applications

System	The Units to use	together with	Cost of Units
Simple battery record player	**Z.30**	Crystal P.U., 12V battery volume control	**£4.48**
Mains powered record player	**Z.30, PZ.5**	Crystal or ceramic P.U. volume control etc.	**£9.45**
20 + 20 W. stereo amplifier for most needs	**2 x Z.30s, Stereo 60, PZ.5**	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	**£23.90**
20 + 20 W. stereo amplifier with high. performance spkrs.	**2 x Z.30s, Stereo 60, PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	**£26.90**
40 + 40 W. R.M.S. de-luxe stereo amplifier	**2 x Z.50s, Stereo 60 PZ.8, mains trsfrmr**	As above	**£34.88**
Indoor P.A.	**Z.50, PZ.8, mains transformer**	Mic., guitar, speakers, etc., controls	**£19.43**

F.M. Stereo Tuner **(£25)** & A.F.U. Filter Unit **(£5.98)** may be added as required.

Sinclair Radionics Limited, London Road,
St. Ives, Huntingdonshire PE17 4HJ.
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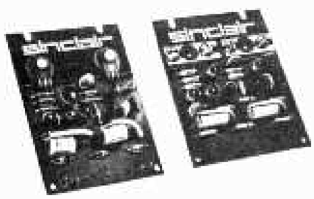
from a simple amplifier to a complete stereo tuner amplifier with Project 60 modules

Z.30 & Z.50 power amplifiers



The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at full output and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and may be used with other units in the Project 60 range equally well.

SPECIFICATIONS ***(Z.50 units are interchangeable with Z.30s in all applications).***
Power Outputs
Z.30 15 watts R.M.S. into 8 ohms using 35 volts: 20 watts R.M.S. into 3 ohms using 30 volts.
Z.50 40 watts R.M.S. into 3 ohms using 40 volts: 30 watts R.M.S. into 8 ohms using 50 volts.
Frequency response: 30 to 300,000Hz ±1dB.
Distortion: 0.02% into 8 ohms.
Signal to noise ratio: better than 70dB unweighted.
Input sensitivity: 250mV into 100 Kohms.
For speakers from 3 to 15 ohms impedance.
Size: 14 x 80 x 57 mm.

Z.30
Built, tested and guaranteed with circuits and instructions manual. **£4.48**

Z.50
Built, tested and guaranteed with circuits and instructions manual. **£5.48**

Power Supply Units

PZ.5

PZ.8

Designed special for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stabilised supply is essential.

PZ.5 *30 volts unstabilised* **£4.98**
PZ.6 *35 volts stabilised* **£7.98**
PZ.8 *45 volts stabilised (less mains transformer)* **£7.98**
PZ.8 *mains transformer* **£5.98**

The Sinclair Guarantee

If within 3 months of purchasing Project 60 modules directly from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost.

Project 60 Stereo F.M. Tuner

First in the world to use the phase lock loop principle

The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other original features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and squelch circuit for silent tuning between stations. Good reception is possible in difficult areas, and often a few inches of wire are enough for an aerial. In terms of a high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically as the tuning control is rotated, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with any other high fidelity system.

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. **Tuning range:** 87.5 to 108 MHz. **Capture ratio:** 1.5dB. **Sensitivity:** 2µV for 30dB quieting: 7µV for lock-in over full deviation. **Squelch level:** 20µV. **A.F.C. range:** ±200 KHz. **Signal to noise ratio:** >65dB. **Audio frequency response:** 10 Hz – 15 KHz (±1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2µV. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. **Operating voltage:** 25-30 VDC. **Indicators:** Power on/tuning/stereo.
Size: 93 x 40 x 207 mm.

Built and tested. Post free. **£25**

Stereo 60 Pre-amp/control unit

Designed for Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout, achieving a really high signal-to-noise ratio and excellent tracking between channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs.

SPECIFICATIONS—Input sensitivities: Radio – up to 3mV. Mag. p.u. 3mV: correct to R.I.A.A curve ±1dB: 20 to 25,000 Hz. Ceramic p.u. – up to 3mV: Aux – up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE + 15 to —15dB at 10 KHz: BASS ∓ 15 to —15dB at 100Hz. **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.
Built tested and guaranteed. **£9.98**

A.F.U. High & Low Pass Filter Unit

For use between Stereo 60 unit and two Z.30s or Z.50s, and is easily mounted. It is unique in that the cut-off frequencies are continuously variable, and as attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is suitable for use with any other amplifier system. Two filter stages – rumble (high pass) and scratch (low pass). Supply voltage – 15 to 35V. Current – 3mA. H.F. cut-off (–3dB) variable from 28KHz to 5KHz. L.F. cut-off (–3dB) variable from 25Hz to 100Hz. Distortion at 1KHz (35V. supply (0.02% at rated output. **Size:** 66 x 40 x 90 mm. *Built tested and guaranteed.* **£5.98**

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PW 12

Sinclair Q16/Micromatic

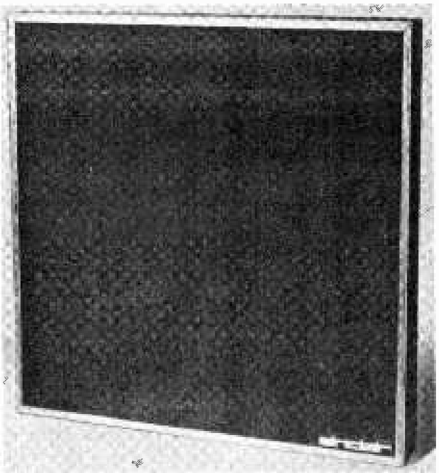
Q16 High fidelity loudspeaker

The Q16 employs the well proven acoustic principles specially developed by Sinclair in which a special driver assembly is meticulously matched to the characteristics of the uniquely designed cabinet. In reviewing this exclusive Sinclair design, technical journals have justly compared the Q16 with much more expensive loudspeakers. Its shape enables the Q16 to be positioned and matched to its environment to much better effect than is the case with conventionally styled enclosures. A solid teak surround with a special all-over cellular foam front is used as much for appearance as its ability to pass all audio frequencies without loss.

This elegantly designed shelf mounting speaker brings genuine high fidelity within reach of every music lover.

Specifications:

Construction: Special sealed seamless sound or pressure chamber with internal baffle.
Loading: up to 14 watts RMS.
Input Impedance: 8 ohms.
Frequency response: From 60 to 16,000 Hz. confirmed by independently plotted B and K curve.
Driver unit: Special high compliance unit having massive ceramic magnet of 11,000 gauss, aluminium speech coil and special cone suspension for excellent transient response.
Size and styling: $9\frac{3}{4}$ in. square on face x $4\frac{3}{4}$ in. deep with neat pedestal base. Black all over cellular foam front with natural solid teak surround.
Price £8.98.



Britain's smallest radio

Considerably smaller than an ordinary box of matches, this is a multi-stage AM receiver brilliantly designed to provide remarkable standards of selectivity, power and quality for its size. Powerful AGC counteracts fading from distant stations; bandspread at higher frequencies makes reception of Radio 1 easy. The plug-in magnetic earpiece provided, matches the Micromatic's output to give wonderful standards of reproduction. Everything including the special ferrite rod aerial and batteries is contained within the minute attractively designed case. Whether you build a Micromatic kit or buy this amazing receiver 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.

Specifications:

Size: 36 x 33 x 13 mm (1.8 x 1.3 x 0.5 in.)
Weight: including batteries, 28.4 gm (1 oz.)
Case: Black plastic with anodised aluminium front panel and spun aluminium dial.
Tuning: medium wave band with bandspread at higher frequencies (550 to 1,600 KHz).
Earpiece: Magnetic type.
On/off switching: By inserting and withdrawing earpiece plug.
Kit in pack with earpiece, case, instructions and solder **£2.48.**
Ready built, tested and guaranteed, with earpiece **£2.98.**
Two Mallory Mercury batteries type RM675 required from radio shops, chemists, etc.

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Please send ____________________

for which I enclose cash/cheque/money order

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PW1271

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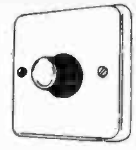
CRESCENT RADIO LTD

MAIL ORDER DEPARTMENT
No.11 Mayes Rd., London, N22 6TL

LIGHT DIMMER

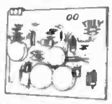


The unit comes complete with MK Ivory Front Plate and Control Knob, when used in place of Light Switch it will control your room lighting from off to full brightness. Power—up to 300 watts interference suppressed.
£2·75 P. & P. 8p

CHROMOSONIC SOUND OPERATED LIGHT DISPLAY

This compact unit (size 8½" × 5½" × 3" high) is connected directly across the speaker output of an amplifier, it will than convert audio signals into a spectacular three colour light display (500 watts light output each colour). Send S.A.E. for further details or call in at any branch for demonstration.
£18·50 P. & P. 36p

BARGAIN COMPUTER BUMPER BOARDS

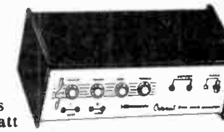


Many Resistors, Condensers, Diodes and Transistors (minimum of 4 transistors on each board).
5 BOARDS FOR 120p. Post Free.

SOLID STATE BLOCK MODULES

Phono pre-amp E1311 input 100k: gain 28dB max out 3 volt: max input 50mV. Tape pre-amp as above E1313. Power amp E1314 input 1,000 ohms gain 20dB 300mW. Organ tone osc E1315 tone freq. 200-1k. Hz output 80mW. All above modules 9 volt. Dual flasher E1318 flash time 1-4 secs power 6 volt. Lamp 6v 150mA. All at £1.25 P. & P. 10p

100 WATT HIGH POWER AMPLIFIER



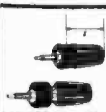
- In excess of 100 watt peak output
- Open and short circuit proof
- Sensitivity 10mV for full output
- Frequency Response 10-25,000Hz
- Safe with all loudspeaker systems 4 to 16 ohms
- Silicon transistors used throughout
- F.E.T. Front end

Send S.A.E. for further details.

▲ **£42·00** If purchased with light unit above **£40·00**
Post and Insurance £1·00.

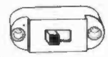
GUARANTEED 12 MONTHS

BLACK TERMINALS



Length as indicated 1 inch
10p per pair P. & P. 3p.

D.P.D.T. SLIDE SWITCH



SIZE
1½ ins long ⅜ wide
13p each 3p Postage

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Primary 220, 250 v. fused. Secondary 220 v. at 50mA, 6·3v. at 1 amp. Overall size 2½" x 2" x 2½" high. **63p** each. P. & P. 15p.

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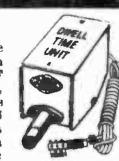
COMPONENT CENTRE

8 x 6 Printed circuit board	10p	each
By100 Type rectifier 800 Piv 750 mA	16p	,,
4 Pin transistor holders	3p	,,
2½ 8 ohm speaker	33p	,,
U2 Battery holders	5p	,,
10OHM W/W Pots	13p	,,
OC81 Heat clips (double)	3p	,,
Tape rev counters	25p	,,
1,500mF 150v DC 4" x 2" dia approx	40p	,,
Flex connector 2amp approx non-reversible Ideal for loudspeaker connections	8p	,,
2½ 80 ohm Speaker	38p	,,

Please include Post & Packing
Send S.A.E. for return of post quote of your electronic project.

DWELL TIME UNIT



These small units contain the following components: 700 ohm DPDT relay with base, 1μF 250v. paper, 0·01μF 400v. paper, 50μF 35v. electrolytic, 3 diodes OC200 transistor, a 2N2926 type transistor unmarked, a skeleton pre-set pot, 4 pin din plug & skt., 4 foot of 4 core screen. All housed in a small neat metal box. Can be made into many timing devices. **43p** P. & P. 8p

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100	0·25	0·33	0·53	0·58	0·63	1·40
200	0·35	0·37	0·57	0·61	0·75	1·60
400	0·43	0·47	0·67	0·75	0·93	1·75
600	0·53	0·57	0·77	0·97	1·25	—
800	0·63	0·70	0·90	1·20	1·50	4·00

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PIV	300mA	750mA	1A	1·5A	3A	10A	30A
	£p	£p	£p	£p	£p	£p	£p
50	0·04	0·05	0·05	0·07	0·14	0·21	0·47
100	0·04	0·06	0·05	0·13	0·16	0·23	0·75
200	0·05	0·09	0·06	0·14	0·20	0·24	1·00
400	0·06	0·13	0·07	0·20	0·27	0·37	1·25
600	0·07	0·16	0·10	0·23	0·34	0·45	1·85
800	0·10	0·17	0·13	0·25	0·37	0·55	2·00
1000	0·11	0·25	0·15	0·30	0·46	0·63	2·50
1200	—	0·33	—	0·33	0·57	0·75	—

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	£p	£p	£p
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200	0·70	0·90	1·25
400	0·90	1·00	1·60

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Full Tested 1,000 .. 9·00
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T4	8	2G381A	OC81
T5	8	2G382T	OC82
T6	8	2G344A	OC44
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U8	50 Sil. planar diodes 250mA, OA/200/202	0·50
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U11	30 PNP silicon planar transistors TO-5 sim. 2N1132	0·50
U13	30 PNP-NPN sil. transistors OC200 & 28104	0·50
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U31	20 Sil. Planar NPN trans. low noise amp 2N3707	0·50
U32	25 Zener diodes 400mW D07 case mixed volts, 3–18	0·50
U33	15 Plastic case 1 amp silicon rectifiers IN4000 series	0·50
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U41	25 RF germ. trans. TO-1 OC45 NKT72	0·50
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Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

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Q30	7 Sil. switch trans. 2N706 NPN	0·50
Q31	6 Sil. switch trans. 2N708 NPN	0·50
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Q33	3 Sil. NPN trans. 2N1711	0·50
Q34	7 Sil. NPN trans. 2N2369, 500MHZ	0·50
Q35	3 Sil. PNP TO-5 2 × 2N2904 & 1 × 2905	0·50
Q36	7 2N3646 TO-18 plastic 300MH2 NPN	0·50
Q37	3 2N3053 NPN sil. trans.	0·50
Q38	7 PNP trans. 4 × 2N3703, 3 × 2N3702	0·50
Q39	7 NPN trans. 4 × 2N3704, 3 × 2N3705	0·50
Q40	7 NPN amp. 4 × 2N3707, 3 × 3N3708.	0·50
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Q42	6 NPN trans. 2N5172	0·50
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Q45	3 BC113 NPN TO-18 trans.	0·50
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Q48	4 BCY70 NPN trans. TO-18	0·50
Q49	4 NPN trans. 2 × BFY51, 2 × BFY52	0·50
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BP02 = 7402	Quad 2-input pos. NOR gates	0·15	0·14	0·12
BP03 = 7403	Quad 2-input pos. NAND gates (with open collector output)	0·15	0·14	0·12
BP04 = 7404	Hex Inverters	0·15	0·14	0·12
BP05 = 7405	Hex Inverter (with open-collector output)	0·15	0·14	0·12
BP10 = 7410	Triple 3-input pos. NAND gates	0·15	0·14	0·12
BP13 = 7413	Dual 4-input Schmitt trigger	0·29	0·26	0·24
BP20 = 7420	Dual 4-input pos. NAND gates	0·15	0·14	0·12
BP30 = 7430	8-input pos. NAND gates	0·15	0·14	0·12
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BP72 = 7472	Master slave J-K flip-flop	0·29	0·26	0·24
BP73 = 7473	Dual Master slave J-K flip-flop	0·37	0·35	0·32
BP74 = 7474	Dual D type flip-flop	0·37	0·35	0·32
BP75 = 7475	Quad latch	0·47	0·45	0·42
BP76 = 7476	Dual J-K with pre-set and clear	0·43	0·40	0·38
BP80 = 7480	Gated full adders	0·67	0·64	0·58
BP81 = 7481	16-bit read/write memory	0·97	0·94	0·88
BP82 = 7482	2-bit binary full adders	0·97	0·94	0·88
BP83 = 7483	Quad full adder	1·10	1·05	0·95
BP86 = 7486	Quad 2-input exclusive NOR gates	0·32	0·30	0·28
BP90 = 7490	BCD decade counter	0·67	0·64	0·58
BP91 = 7491	8-bit shift registers	0·87	0·84	0·78
BP92 = 7492	Divide-by-twelve counters	0·67	0·64	0·58
BP93 = 7493	4-bit binary counters	0·67	0·64	0·58
BP94 = 7494	Dual entry 4-bit shift register	0·77	0·74	0·68
BP95 = 7495	4-bit up-down shift register	0·77	0·74	0·68
BP96 = 7496	5-bit parallel in parallel out shift-register	0·77	0·74	0·68
BP100 = 74100	8-bit bistable latches	1·75	1·65	1·55
BP104 = 74104	Single J-K flip-flop equivalent 9000 series	0·97	9·94	0·88
BP105 = 74105	Single J-K flip flop equivalent 9001 series	0·97	0·94	0·88
BP107 = 74107	Dual Master slave flip-flops	0·40	0·38	0·36
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BP119 = 74119	Hex set-reset latches. 24-pin	1·35	1·25	1·10
BP121 = 74121	Monostable multivibrators	0·67	0·64	0·58
BP141 = 74141	BCD-to-decimal decoder/driver	0·67	0·64	0·58
BP145 = 74145	BCD-to-decimal decoder/driver O/C	1·50	1·40	1·30
BP150 = 74150	16-bit data selector	1·80	1·70	1·60
BP151 = 74151	8-bit data selectors (with strobe)	1·00	0·95	0·90
BP153 = 74153	Dual 4-line-to-1-line data	1·20	1·10	0·95
BP154 = 74154	4- to 16-line decoder	1·80	1·70	1·60
BP155 = 74155	Dual 2- to 4-line decoder	1·40	1·30	1·20
BP156 = 74156	Dual 2- to 4-line decoder O/C	1·40	1·30	1·20
BP160 = 74160	Sync. decade counter	1·80	1·70	1·60
BP161 = 74161	Sync. 4-bit binary counter	1·80	1·70	1·60
BP190 = 74190	Sync. up-down BCD counter	3·50	3·25	3·00
BP191 = 74191	Sync. binary up-down counter (single clock line)	3·50	3·25	3·00
BP192 = 74192	Sync. up-down decade counter	2·10	1·95	1·75
BP193 = 74193	Sync. binary up-down counter (tow clock lines)	2·10	1·95	1·75
BP196 = 74196	Pre-setable 50MHz decade counter	1·80	1·70	1·60
BP197 = 74197	Pre-setable 50MHz binary counter	1·80	1·70	1·60
BP198 = 74198	8-bit parallel L-R shift register	5·50	5·00	4·00
BP199 = 74199	8-bit parallel access shift register	5·50	5·00	4·00

Devices may be mixed to qualify for quantity price. Larger quantities—prices on application (TTL 74 Series only).
Data is available for the above series of I.C's in booklet form. Price 13p.

TTL INTEGRATED CIRCUITS

Manufacturers' "Fall outs"—out of spec. devices including functional units and part function but classed as out of spec. from the manufacturers' very rigid specifications. Ideal for learning about I.C's and experimental work.

PAK No.		PAK No.		PAK No.	
UIC00 = 12 × 7400N	50p	UIC42 = 5 × 7450N	50p	UIC80 = 5 × 7480N	50p
UIC01 = 12 × 7401N	50p	UIC50 = 12 × 7450N	50p	UIC82 = 5 × 7482N	50p
UIC02 = 12 × 7402N	50p	UIC51 = 12 × 7451N	50p	UIC83 = 5 × 7483N	50p
UIC03 = 12 × 7403N	50p	UIC60 = 12 × 7460N	50p	UIC86 = 5 × 7486N	50p
UIC04 = 12 × 7404N	50p	UIC70 = 8 × 7470N	50p	UIC90 = 5 × 7490N	50p
UIC05 = 12 × 7495N	50p	UIC72 = 8 × 7472N	50p	UIC92 = 5 × 7492N	50p
UIC10 = 12 × 7410N	50p	UIC73 = 8 × 7473N	50p	UIC93 = 5 × 7493N	50p
UIC20 = 12 × 7420N	50p	UIC74 = 8 × 7474N	50p	UIC94 = 5 × 7494N	50p
UIC40 = 12 × 7440N	50p	UIC75 = 8 × 7475N	50p	UIC95 = 5 × 7495N	50p
UIC41 = 5 × 7441AN	50p	UIC76 = 8 × 7476N	50p	UIC96 = 5 × 7496N	50p

UICX1 = 25 × Asst'd 74's £1·50

Paks cannot be split but 20 assorted pieces (our mix) is available as PAK UICX1
Every PAK carries out BI-PAK Satisfaction or money back GUARANTEE.

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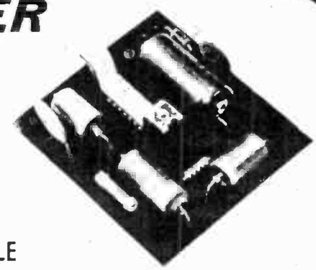

THE NEW **S.G.S.** EA 1000 AUDIO AMPLIFIER MODULE

***GUARANTEED NOT LESS THAN 3 WATTS RMS**

Especially designed by S.G.S. incorporating their proven Linear I.C. Audio Amp. TA/621 providing unlimited applications for the enthusiast in the construction of radios, record players, Audio and Stereo units. Also ideal for intercom systems, monitoring applications and phone answering machines. OTHER USES: *portable applications where supply rails as low as 9V are of prime importance.*

- **Sensitivity 40 mV for 1 watt VOLTAGE GAIN 40dB but can be varied up to 73dB for some applications.**
- **Signal to Noise Ratio 86dB.**
- **Frequency response better than 50 Hz to 25 KHz for −3dB.**
- **Normal supply Voltage 9-24V.**
- **Suitable for 8-16 OHM Loads.**
- **Overall Size 2″ × 3″ × ⅜″.**
- **Typical Total Harmonic distortion at 1 watt less than 1%.**

****Supply voltage (Vs) = 24V 15ohm load.***

Module Tested and Guaranteed

Quantity	1-9	10-25
Price each	£2·63	£2·28

Larger quantities quoted on request

Full hook-up diagrams and complete technical data supplied free with each module or available separately at 10p each.

ROCK BOTTOM PRICES—CAN'T BE BEATEN!

LOGIC DTL 930 SERIES IC's

Type No.	Function	Price 1–24	25–99	100 up
BP930	Expandable dual 4-input NAND	12p	11p	10p
BP932	Expandable dual 4-input NAND buffer	13p	12p	11p
BP933	Dual 4-input expander	13p	12p	11p
BP935	Expandable Hex Inverter	13p	12p	11p
BP936	Hex Inverter	13p	12p	11p
BP944	Dual 4-input NAND expandable buffer without pull-up	13p	12p	11p
BP945	Master-slave JK or RS	25p	24p	22p
BP946	Quad, 2-input NAND	12p	11p	10p
BP948	Master-slave JK or RS	25p	24p	22p
BP951	Monostable	65p	60p	55p
BP962	Triple 3-input NAND	12p	11p	10p
BP9093	Dual Master-slave JK with separate clock	40p	38p	35p
BP9094	Dual Master-slave JK with separate clock	40p	38p	35p
BP9097	Dual Master-slave JK with Common Clock	40p	38p	35p
BP9099	Dual Master-slave JK Common Clock	40p	38p	35p

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

BRAND NEW LINEAR I.C's—FULL SPEC.

Type No.	Case	Leads	Description	Price 1–24	25–99	100 up
BP 201C—SL201C	TO-5	8	G.P. Amp	63p	53p	45p
BP 701C—SL701C	TO-5	8	OP Amp	63p	50p	45p
BP 702C—SL702C	TO-5	8	OP Amp Direct OP	63p	50p	45p
BP 702—72702	D.I.L.	14	G.P. OP Amp (Wide Band)	53p	45p	40p
BP 709 —72709	D.I.L.	14	High OP Amp	53p	45p	40p
BP 709P—μA709C	TO-5	8	High Gain OP Amp	53p	45p	40p
BP 711—μA711	TO-5	10	Dual comparator	58p	50p	45p
BP 741 —72741	D.I.L.	14	High Gain OP Amp (Protected)	75p	60p	50p
μA 703C—μA703C	TO-5	6	R.F.-I.F. Amp	43p	35p	27p
TAA 263—	TO-72	4	A.F. Amp	70p	60p	55p
TAA 293—	TO-74	10	G.P. Amp	90p	75p	70p

All prices quoted in new pence *Giro No. 388-7006*
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Postage and packing add 7p. Overseas add extra for airmail. Minimum order 50p. Cash with order please.

Guaranteed Satisfaction or Money Back

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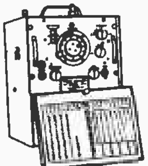
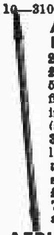


BEST OFFER YET!
FAMOUS BC.221 FREQUENCY METER
125 KHz—20 MHz. Complete with valves, crystal and charts. ONLY £13·50. Carr. £1·50
Less charts £8, carriage £1·5. Less charts & crystal £5, carriage £1·50.

CRYSTAL CALIBRATOR

No. 10 Crystal controlled heterodyne wave-meter covering 500 KHz—10 MHz (Harmonics up to 30 MHz). Power required 300V. D.C. 15mA. 12v. 0·3A. D.C. Test equipment for 62TM/RC.
ONLY £4·25. P. & p. 50p.
FEW ONLY—No. 62 TM/RC 1·5—10 MHz £17·50. Carr. £2.

MARCONI 801A SIGNAL GENERATOR
10—310 MHz. In original transit case. £45. Carr. £2·50.



AERIAL MAST EQUIPMENT
20' TELESCOPIC MASTS £3·75. Carr. £1.
5' 2" Extension Sections to fit bottom of above mast to increase height. £1·25 each (any number supplied).
35' MAST (7—5' 2" interlocking sections) with base plate and 12 nylon guys with semi-auto tensioner. £22·50. Carr. £2·50.
70' MAST. Ditto.16 guys, block and tackle. £45. Carr. £2·75.

AERIAL RODS 3ft.
Screw-in 1" dia. sections. Brand New, green finish. Suitable for many other uses. 10 for £2. Carr. 50p. 25 for £5. Carr. Paid.

R.F. ANTENNA TUNER (A.T.U.)
Cylinder design 10" x 4½". Precision calibrated scale. Suitable for tuning most aerials for increased signal strength. A must for serious operators for RC or TM. Full instructions.
ONLY £1·75. P. & p. 25p.

R.F. ANTENNA TUNER (A.T.U.) OPEN TYPE
Mounted on ceramic former and feet.

"Roller Coaster" design 16 G silver or silver plated wheel traversing on wire on ceramic former. Will handle considerable R.F.
In original packing. As used with No. 53 Transmitter.
ONLY £2·50. P. & P. 50p.

No. 19 SET TRANSMITTER RECEIVER
Rebuilt. Complete station with PSU, Cables, Mic, Aerial, etc. £22·50. Carr. £3.

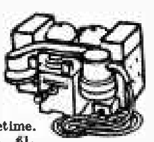
No. 19 SET 500uA METERS
Scaled 0–600 and 0–15V. Brand new, boxed £1·25 Post Paid. (Quantity prices on request.)

R.F. AMPLIFIER. To increase output of No. 19 Set.
ONLY £3·75. Carr. £1·25.
Instruction Book for RF Amp. 37½p Post Paid.

ALL No. 19 SPARES IN STOCK
Complete instruction book with circuits for No. 19 Equipment. 37½p Post Paid.

HEAVY DUTY BATTERIES
New in metal cases with carrying handles.
6v. 85 AH 13" x 9¼" x 7" £3·25. Carr. £1·25

LIQUID PRISMATIC COMPASSES
2" diameter £7·50, p. & p. 25p



FAMOUS TELE 'F' FIELD TELEPHONES
Suitable for Farms, Building Sites etc. Communication up to 5 miles or more. Rugged construction, will last a lifetime.
ONLY £5·75 PAIR. Carr. £1.
(Twin telephone wire for above available—ask for price.)
Many other Ex-Govt. Surplus Equipment items in stock. Receivers etc. in small quantities too numerous to mention. Enquiries invited. LIST 25p Post Paid. (Refundable against purchases over £3.)
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SUB MIN CROC CLIPS. Red or Black, insulated 4p. Min. quantity. 6 pp. 3p.

GARRARD MAG TAPE DECKS: 1⅞ips. 50v solenoid operated brakes. etc. Mains voltage motors £7·50 each. pp £1·23.

4½" PLANNAIR FANS. Complete, capacitor, ex-equip. 2,800 r.p.m. £3·50, pp 40p.

ELECTRIC MOTORS. HOOVER OR CROMPTON PARKINSON.

⅛ h.p.	1,440 r.p.m.	£3·75	pp £1·00
⅓ h.p.	1,425 r.p.m.	£6·75	pp £1·25
⅙ h.p.	1,440 r.p.m.	£2·25	pp 75p

AUDIO CONNECTORS

3 pin Din Plug	13p	each
5 pin Din Plug A type, B type	15p	,,
2 pin Din Speaker Plug	10p	,,
3 pin Din Line Socket	13p	,,
3·5mm Jack Plug Screened	10p	,,
Standard Jack Plug	10p	,,
Screened Standard Jack Plugs	15p	,,
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B.S.R. MINI AUTO-CHANGER. Mono Cartridge £4·75 pp 30p.

PHONO PLUGS: Red or Black 3p each.

MAINS NEONS. Red or Green. Size: ¼" × 1¼" 15p, pp 3p.

LEVER ACTION P.O.1000 TYPE SWITCHES. Lock 4-pole changeover 15p, pp 3p. (ex-equip.)

SCREENED PHONO LEADS 46" long, 15p. pp 3p.

PIEZO DYNAMIC MICROPHONE 50k Ω £1·00 pp 8p.

MULLARD SCREW TERMINAL CAP 4,500uf 64v 50p pp 13p.

BELLING LEE 1·5 amp in-line rubber covered interference suppressor 25p pp 8p.

SOLENOIDS 12 VOLT PULL ACTION 2" × 1" × ½" 40p pp 8p.

STC SEALED RELAYS DOUBLE POLE CHANGEOVER 48v 2500 Ex-equip. 15p pp 5p.

SIEMENS MINIATURE RELAY. Double pole changeover dust cover/base 48v 2500 50p pp 5p new.

STC MINIATURE RELAY 280 Ω Perspex Cover 6-15v new, 35p pp 5p.

GARDNER'S POTTED TRANSFORMER 0-250v Input: 18v 500m/n 50v 150 m/a, 6v 250 m/a Output. Size 3" × 2¼" × 2¼", £1·00. pp 20p. Ex equip tested.

TELESCOPIC AERIALS Chromed 7" closed 28" extended 6 section ball jointed base 23p pp 8p new.

MULLARD 4 DM 160 INDICATORS in plastic holder/cover ex-equip. size approx. 1½" × 1½" × ½" 35p pp 8p.

PRINTED CIRCUIT BOARD/19 ACY 19's 10 OA200 Diodes: 1 reed relay: 10 AZ 229 zenner ass. capacitor/resistors. Power supply 22v 250 m/A DC. Output 240v. AC £1 pp 20p ex-equip.

TOGGLE SWITCHES. Single pole Double Throw ex-equip. new condition. 50p doz. pp 13p.

FIBRE GLASS TAPE. 100 yd. roll: 3" 3½" wide £1 per roll pp 20p.

PAINTON PLUG SOCKETS Type 159 series working voltage 350v AC/DC current max. 3 amp AC/DC 7 pin plug & socket 50p pp 10p. 15 pin plug & socket £1 pp 10p.

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Ajacent Elstree Mainline Station
Tel: 01-953 6009.

NEW 8in. SPEAKERS 15 ohms 75p. p. & p. 10p.

BARGAIN PARCELS 14lb at £1·45 plus 32½p p.p.; 28lb at £2·75 plus 52½p p.p.; 56lb at £4·50 plus £1·25 p.p. Contain pots, Res, Valves, Diodes, Tagboards, Chassis, Valve-holders, etc. Good value save £££s. Lucky Dip Service.

FANTASTIC BARGAIN. New 6 inch tubes. E450 4/B/16 4VH, medium Persistance, green. Ideal scope tube. List price £5. Our price £1·40 carriage paid.

500 μ AMP METERS. Approx. 1½" on panel with plug and switch ex new equip. 75p p. & p. paid.

NEW HEAVY COAX CABLE dia. ⅜" 70 ohms approx. 50ft. lengths £1·40, p. & p. 30p. 100 ft. lengths £2·70. p. & p. 50p.

VHF AERIAL TUNING UNITS consisting of the following: 1–1½" 500 micro/ampmeter. 1 small 2-gang 75 PF capacitor. 1 various large wattage resistors for dummy load. Pair gears B.N.C. type sockets. Will tune 10 mtrs. with 25/30 watts R.F. input. Size only 5½" × 4½" × 5". Sealed. Price £1·87½ p.p. 25p

CRYSTALS AS NEW: Hc 6u. 5,345; 5,030; 5,005; 4,945; 4,875; 4,840; 4,795; 4,580; 4,660; 4,520; 4,510; 2,300; 2,295 Kc/s. 50p each plus 8p. p.p.

SCOOP PURCHASE OF BRAND NEW CARBON RESISTORS. 10% tolerance ¼ & ½ watt. Preferred values in packets of 10. Our price 50p per 100, 95p per 200, £1·35 per 300, 500 at £2·12½. Our selection. p.p. 8p per 100 and 2½p per extra 100.

TRIMMER BARGAINS. These are 10PF sub-min. air-spaced trimmers on board with min. wire ended Xtal. Brand new. No details; Contents 12 trimmers, some ceramic caps. Xtal frequency 3RD overtone 249 mc/s–250 Mc/s, 255 Mc/s. No choice.
Trimmers without Xtal—60p per doz. plus 17½p p.p.
Trimmers with Xtal—75p per doz. plus 17½p p.p.
Also 20 PF min. brand new air spaced.
50p per doz. plus 17½p p.p.

ANY HEIGHT AERIAL TUBULAR SECTIONS ½" dia x 3 ft. long. Brass screw in type, copper coated and painted. Good condition. 20p, p. & p. 5p each. Minimum order 10.

BRAND NEW HARTLEY OSCILLOSCOPES CT316 in original packing. Band width up to 5 Mc/s. Mains supply. Price £40, p. & p. £1·50p.

AERIALS NEW CONDITION. Whip type 4ft. 25p, 11ft. 70p, 14ft. 77½p. Used condition 4ft 20p, 14ft. 62½p. All collapsible type. P. & p. 4ft. 10p, rest at 17½p. Bases for above 25p, p.p. 12½p. New matching unit coax connection for above 30p, p.p. 5p.

Huge release of valves for the 62 set TX/RX. In original rubber packing consisting of QV04/7 × 61M, ARP12 etc, 10 valves in all at the bargain price as seen
87½p plus 17½p p.p.

R209. Set of valves 62½p. p.p. 25p.

New Headphone and Mike rubber muff type. Low impedance. 97½p, p. & p. 17½p.

NEW AERIAL WIRE ON BOARDS 7/22 UNCOVERED. 75ft, 40p, 90ft, 47½p. 100ft 55p, 150ft, 75p. 180ft, 95p, 250ft, £1·30p, p & p 20p.

Headphones, ex Gov. DLR No. 5 low impedance. New 87½p 17½p p.p. Used condition 62½p 17½p p.p.

MUIRHEAD DECADE A.F. SIGNAL GENERATOR.
This precision instrument can be used:
1. To Measure Gain up to 50 dbs.
2. To Measure Loss up to 45 dbs.
3. To compare Power levels (A.F.).
4. As an Audio Frequency Generator covering 100 Hz to 41 kHz. With a dial setting accuracy of ±0·5 Hz. Output :—1 M/W into 600 SL. Complete with mains power unit. Tested. Good Condition. £12, p. & p. 75p.

ENCLOSED AERIAL RELAY COIL. Res. 700 ohms approx. 25 watts RF BNC outlet, working voltage 12v. 75p, p. & p. 10p. £1 with BNC plugs.

Also ⅜" 75 ohm Coax in 50ft coils with BNC plugs good condition. price £1 + 30p. p.p.

2 BNC plugs on short length coax cable large size low loss plugs 30p + 5p, p.p.

NEW BOXED AMP METERS 1½" 20-0-20 dc. 65p. p. & p. 5p.

C.W.O. CARRIAGE CHARGES MAINLAND ONLY

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Radio Dept.,
HIGH STREET, CHESLYN HAY,
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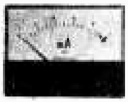
SEW PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES, ETC.

● LOW COST ● QUICK DELIVERY ● OVER 200 RANGES IN STOCK ● OTHER RANGES TO ORDER

NEW "SEW" DESIGNS!

CLEAR PLASTIC METERS

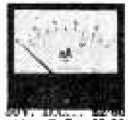


TYPE SW.100
100 x 80 mm.

50µA	£2·60	20V. D.C. ..	£3·10
50–0–50µA	£3·45	50V. D.C. ..	£3·10
100µA	£3·20	300V. D.C.	£3·10
100–0–100µA	£3·45	1 amp. D.C.	£3·10
500µA	£2·85	5 amp. D.C.	£3·10
1mA	£3·10	300V. A.C.	£3·10
		VU Meter..	£3·75

BAKELITE PANEL METERS

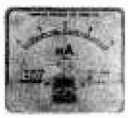
TYPE S-80
80 mm.
square fronts



50µA	£3·20	300V. D.C.	£2·60
50–0–50µA	£3·10	1 amp. D.C.	£2·60
100µA	£2·75	5 amp. D.C.	£2·60
100–0–100µA	£3·10	300V. A.C.	£2·60
500µA	£3·00	VU Meter..	£3·37
1mA	£2·60		
20V. D.C...	£2·60		

"SEW" CLEAR PLASTIC METERS

Type MR.85P. 4½in. × 4¾in. fronts.



50µA	£3·60	50mA	£2·80
50–0–50µA	£3·10	100mA	£2·80
100µA	£3·10	500mA	£2·80
100–0–100µA	£3·00	1 amp.	£2·80
200µA	£3·00	5 amp.	£2·80
500µA	£2·90	15 amp.....	£2·80
500–0–500µA	£2·80	30 amp.....	£2·90
1mA	£2·80	20V. D.C...	£2·80
1–0–1mA ..	£2·80	50V. D.C...	£2·80
5mA	£2·80	150V. D.C.	£2·80
10mA	£2·80	300V. D.C.	£2·80
		15V. A.C...	£2·80
		300V. A.C.	£2·80
		S Meter 1mA	£2·87
		VU Meter..	£3·60
		1 amp. A.C.*	£2·80
		5 amp. A.C.*	£2·80
		10 amp. A.C.*	£2·80
		20 amp. A.C.*	£2·80
		30 amp. A.C.*	£2·80

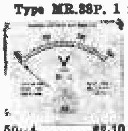
Type MR.52P. 2½in. square fronts.

50µA	£3·10	10V. D.C. ..	£2·00
50–0–50µA	£2·60	20V. D.C. ..	£2·00
100µA	£2·60	50V. D.C. ..	£2·00
100–0–100µA	£2·50	300V. D.C.	£2·00
500µA	£2·30	15V. A.C. ..	£2·10
1mA	£2·00	300V. A.C.	£2·10
5mA	£2·00	S Meter 1mA	£2·10
10mA	£2·00	VU Meter ..	£2·20
50mA	£2·00	1 amp. A.C.*	£2·00
100mA	£2·00	5 amp. A.C.*	£2·00
500mA	£2·00	10 amp. A.C.*	£2·00
1 amp.	£2·00	20 amp. A.C.*	£2·00
5 amp.	£2·00	30 amp. A.C.*	£2·00

Type MR.65P. 3½in. × 3¼in. fronts.

50µA	£3·37	10V. D.C. ..	£2·20
50–0–50µA	£2·75	20V. D.C. ..	£2·20
100µA	£2·75	50V. D.C. ..	£2·20
100–0–100µA	£2·65	150V.D.C. ..	£2·20
200µA	£2·65	300V. D.C.	£2·20
500µA	£2·40	15V. A.C. ..	£2·30
500–0–500µA	£2·20	50V. A.C. ..	£2·30
1mA	£2·20	150V. A.C.	£2·30
5mA	£2·20	300V. A.C.	£2·30
10mA	£2·20	500V. A.C.	£2·30
50mA	£2·20	S Meter 1mA	£2·37
100mA	£2·20	VU Meter..	£2·37
500mA	£2·20	50mA A.C.*	£2·20
1 amp.	£2·20	100mA A.C.*	£2·20
5 amp.	£2·20	200mA A.C.*	£2·20
10 amp.	£2·20	500mA A.C.*	£2·20
15 amp.	£2·20	1 amp. A.C.*	£2·20
20 amp.	£2·20	5 amp. A.C.*	£2·20
30 amp.	£2·30	10 amp. A.C.*	£2·20
50 amp.	£2·50	20 amp. A.C.*	£2·20
5V. D.C. ..	£2·20	30 amp. A.C.*	£2·20

Type MR.38P. 1 21/32in. square fronts.



50µA	£2·10	200mA	£1·60
50–0–50µA	£1·90	300mA	£1·60
100µA	£1·90	500mA	£1·60
100–0–100µA	£1·75	750mA	£1·60
200µA	£1·75	1 amp.	£1·60
500µA	£1·65	2 amp.	£1·60
500–0–500µA	£1·60	5 amp.	£1·60
1mA	£1·60	10 amp. ..	£1·60
1–0–1mA ..	£1·60	3V. D.C. ...	£1·60
2mA	£1·60	10V. D.C. ..	£1·60
5mA	£1·60	15V. D.C. ..	£1·60
10mA	£1·60	20V. D.C. ..	£1·60
20mA	£1·60	100V. D.C.	£1·60
50mA	£1·60	150V. D.C.	£1·60
100mA	£1·60	300V. D.C.	£1·60
150mA	£1·60	500V. D.C.	£1·60
		750V. D.C.	£1·60
		15V. A.C. ..	£1·70
		50V. A.C. ..	£1·70
		150V. A.C.	£1·70
		300V. A.C.	£1·70
		500V. A.C.	£1·70
		S Meter 1mA	£1·70
		VU Meter..	£2·10

Type MR.45P. 2in. square fronts.

50µA	£2·25	5 amp.	£1·70
50–0–50µA	£2·10	10V. D.C. ..	£1·50
100µA	£2·10	20V. D.C. ..	£1·50
100–0–100µA	£1·87	50V. D.C. ..	£1·50
200µA	£1·87	300V. D.C.	£1·50
500µA	£1·75	15V. A.C. ..	£1·80
500–0–500µA	£1·70	300V. A.C.	£1·80
1mA	£1·70	S Meter 1mA	£1·85
5mA	£1·70	VU Meter..	£2·25
10mA	£1·70	1 amp. A.C.*	£1·70
50mA	£1·70	5 amp. A.C.*	£1·70
100mA	£1·70	10 amp. A.C.*	£1·70
500mA	£1·70	20 amp. A.C.*	£1·70
1 amp	£1·70	30 amp. A.C.*	£1·70

"SEW" BAKELITE PANEL METERS

Type MR.65. 3½in. square fronts.

		500mA	£1·90
		1 amp.	£1·90
		5 amp.	£1·90
		15 amp.....	£1·90
		30 amp.....	£1·90
		50 amp.....	£1·90
		5V. D.C. ..	£1·90
		10V. D.C. ..	£1·90
		20V. D.C. ..	£1·90
		50V. D.C. ..	£1·90
		150V. D.C.	£1·90
		300V. D.C.	£1·90
25µA	£3·50	30V. A.C.*	£1·95
50µA	£2·75	50V. A.C.*	£1·95
50–0–50µA	£2·35	150V. A.C.*	£1·95
100µA	£2·35	300V. A.C.*	£1·95
100–0–100µA	£2·25	500mA A.C.*	£1·95
500µA	£2·20	1 amp. A.C.*	£1·95
1mA	£1·90	5 amp. A.C.*	£1·95
1–0–1mA ..	£1·90	10 amp. A.C.*	£1·95
5mA	£1·90	20 amp. A.C.*	£1·95
10mA	£1·90	30 amp. A.C.*	£1·95
50mA	£1·90	50 amp. A.C.*	£1·95
100mA	£1·90	VU Meter ..	£3·10

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Type ED.107. Size overall 100mm × 90mm × 108mm. A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

50µA	£5·00	20V d.c.	£4·40
100µA	£4·65	50V d.c.	£4·40
1mA	£4·40	300V d.c. ...	£4·40
50-0-50µA ...	£4·65		
1-0-1mA	£4·40	Dual range	
1A d.c.	£4·40	500mA/5A d.c.	£4·65
5A d.c.	£4·40	5V/50V d.c...	£4·65
10V d.c.	£4·40		

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Type PE.70. 3 17/32in. × 1 15/32in. × 2¾ in. deep.

50µA	£3·10	500µA	£2·75
50–0–50µA	£3·00	1mA	£2·45
100µA	£3·00	300V. A.C.	£2·45
100–0–100µA	£2·90	VU Meter..	£3·40
200µA	£2·90		

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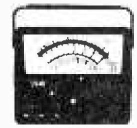
ROUND SCALE TYPE PENCIL TESTER MODEL TS.68

Completely portable, simple to use pocket sized tester. Ranges 0/3/30/300V AC and DC at 2,000 o.p.v. Resistance 0-20K ohms. ONLY £1·97 P. & P. 13p.

MODEL TE-90 50,000 O.P.V. Mirror scale, overload protection. 0/3/12/60/300/600/1,200 v. D.C. 0/6/30/120/300/1,200 v. A.C. .03/6/60/600mA. D.C. 16K/160K/1.6/16 MEGΩ. −20 to +63 db. £7·50. P. & P. 15p.

SKYWOOD SW-500



50KΩ/Volt. Mirror scale DC Volts 0.6/3/12/30/300/600. DC Current 20uA/6/600mA Resistance 10K/100K/1 Meg/10 Meg. Decibels — 20 to +57 db. £7·50. P. & P. 15p.

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Features A.C. current ranges. 20,000 o.p.v.
0/·5/2·5/10/50/250/500 1000 V DC.
0/2·5/10/50/250/500/1000 V AC.
0/50uA/1/10/100MA/1/10 Amp DC.
0/100MA/1/10 Amp AC
0/5K/50K/500K/5MEG/50MEG.
− 20 + 62 db.
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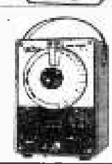
Full capabilities for measuring A, B and ICO. NPN or PNP. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads. £6·97½. P. & P. 15p.

AG76 AUDIO GENERATOR



Portable, mains operated
Sine wave 20 to 200,000 Hz.
Square wave 20 to 30,000 Hz.
Output voltage Sine 17V P/P. Square 21V P/P.
Distortion less than 1%.
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Accurate wide range signal generator covering 120 Kc/s–500 Mc/s on 6 bands. Directly calibrated Variable R.F attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions. £15. Carr. 37½p. Size 140 × 215 × 170 mm.

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New high quality portable instrument. Sine 1 Hz to 100 KHz. Square 20 Hz to 20 KHz. Output max + 10 dB (10 K ohms). Operation 220/240v. A.C. Size 215mm x 150mm x 120mm.
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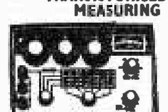
MW1-6 60mm square £3·97½
MW1-8 80mm square £4·97½
P. & P. extra

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



A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω–11·1 megΩ 6 Ranges ±1% L.1 µ H - 111 HENRYS 6 Ranges 2 = % C.10pF ± 1110mFd. 6 Ranges ±2%. TURNS RATIO 1:1/1000–1:11100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100µA. Meter indication. Attractive 2 tone metal case. Size 7¾ × 5 × 2in. £20. P. & P. 25p

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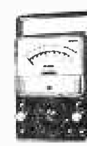
20,000 O.P.V. overload protection.
0/3/30/60/300/600/3000 V DC.
0/6/60/120/600/1200 V AC.
0/60uA/12/300 MA. DC.
0/60K/6MEG.
- 20 + 63 db
£4·50, P. & P. 15p.

MODEL TE-12

20,000 O.P.V. 0/0.6/6/30/120/600/1,200/3,000/6,000v. D.C. 0/6/30/120/600/1,200v. A.C. 0/60µA/6/60/600mA. 0/6K/600K/6Meg./60 Meg. Ω 50pF. 0.2mFd. £5·97½. P. & P. 17½p.

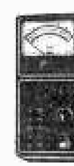
TMK MODEL TW-50K 46 ranges, mirror scale, 50K/Vol. D.C. 5K /Volt A.C. D.C.: Volts ·125, ·25, 1·25, 2·5, 5, 10. 25, 50, 125, 250, 500, 1000V. A.C. Volts: 1·5, 3, 5, 10, 25. 50, 125. 250, 500, 1000V. D.C. Current: 25, 50uA, 2·5, 5, 25. 50, 250, 500mA, 5, 10 amp, Resistance: 10K, 100K, 1 MEG, 10 MEGΩ. Decibels: −20 to +81·5 dB. £8·50. P. & P. 17½p

HT100B4 MULTI-METER



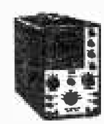
Features A.C. current ranges. 100,000 o.p.v. Mirror Scale, Overload protection.
0/·5/2·5/10/50/250/500/1000 V DC.
0/2·5/10/50/250/1000 V AC.
0/10/250uA/2·5/25/250 MA/10 Amp DC.
10 Amp AC.
0/20K/200K/2MEG/20 MEG.
- 20 + 62 db.
£12·50, P. & P. 25p.

RUSSIAN 22 RANGE MULTIMETER



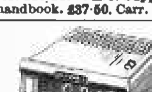
Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2·5/10/50/250/500/1000v D.C. 2·5/10/50/250/500/100v/ AC. DC Current 100 wA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3M Ω. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE £5·97 P. & P. 25p.

TO-3 PORTABLE OSCILLOSCOPE



3in. tube. Y amp. Sensitivity 0·1v p·p/CM. Bandwidth 1·5 cps–1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p·p/CM. Bandwidth 1.5 cps –800KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps–300 KHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½ lb. 220/240V. A.C. Supplied brand new with handbook. £37·50. Carr. 50p

HONEYWELL DIGITAL VOLTMETER VT.100



Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt, current and ohms with optional plug in cards. Specification: Accuracy: ± 0.2, ± 1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1·999) Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100v. D.C. Input: Fully floating (3 poles). Input power: 110-230v. A.C. 50/60 cycles. Overall size: 5¾in. x 2 13/16in. x 8 3/16in.

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2N708	12p
2N709	45p
2N718	25p
2N718A	30p
2N726	25p
2N727	25p
2N914	17p
2N916	17p
2N918	30p
2N929	22p
2N930	20p
2N937	52p
2N1090	22p
2N1091	22p
2N1131	25p
2N1132	25p
2N1302	17p
2N1303	17p
2N1304	22p
2N1305	22p
2N1306	25p
2N1307	25p
2N1308	25p
2N1309	25p
2N1507	17p
2N1613	20p
2N1631	35p
2N1632	30p
2N1637	30p
2N1638	27p
2N1639	27p
2N1701	162p
2N1711	24p
2N1889	32p
2N1893	37p
2N2147	72p
2N2160	57p
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2N2614	30p
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2N2906A	25p
2N2907	23p
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2N2924	15p
2N2925	15p
2N2926G	12p
2N2926O	12p
2N2926Y	12p
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2N3014	25p
2N3053	20p
2N3054	49p
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2N3136	25p
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2N3711	10p
2N3713	187p
2N3714	200p
2N3715	220p
2N3716	285p
2N3773	240p
2N3791	275p
2N3819	34p
2N3820	55p
2N3823	50p
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2N5172	12p
2N5174	52p
2N5175	52p
2N5176	46p
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2N5246	42p
2N5249	67p
2N5265	325p
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2N5307	37p
2N5308	37p
2N5309	62p
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2S104	25p
2S301	50p
2S302	50p
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2S304	75p
2S501	32p
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2S503	27p
3N83	40p
3N128	70p
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3N143	67p
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40348	52p
40360	40p
40361	40p
40362	50p
40370	32p
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40407	40p
40408	62p
40409	55p
40410	62p
40412	55p
40467A	57p
40468A	35p
40528	72p
40600	57p
40603	50p
AC107	30p
AC126	20p
AC127	24p
AC128	20p
AC151	18p
AC152	22p
AC154	22p
AC176	20p
AC187	25p
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ACY20	20p
ACY21	20p
ACY22	10p
ACY28	17p
ACY39	47p
ACY40	14p
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ACY44	25p
AD140	47p
AD149	47p
AD150	62p
AD161	35p
AD162	35p
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AF115	25p
AF116	25p
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AF124	22p
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AF126	16p
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BC183	9p
BC183L	9p
BC184	11p
BC184L	11p
BC186	25p
BC187	27p
BC212L	12p
BC213L	12p
BC214L	15p
BCY10	27p
BCY30	30p
BCY31	40p
BCY32	60p
BCY33	30p
BCY34	35p
BCY38	45p
BCY39	60p
BCY40	50p
BCY41	15p
BCY42	15p
BCY43	15p
BCY54	20p
BCY58	22p
BCY59	22p
BCY60	97p
BCY70	15p
BCY71	20p
BCY72	15p
BCY78	30p
BCY79	30p
BCZ10	27p
BCZ11	40p
BD112	50p
BD116	112p
BD121	65p
BD123	80p
BD124	75p
BD131	75p
BD132	80p
BDY10	125p
BDY20	105p
BDY61	125p
BDY62	100p
BF115	25p
BF117	47p
BF152	28p
BF154	20p
BF158	15p
BF159	35p
BF163	35p
BF167	25p
BF170	33p
BF173	30p
BF177	30p
BF178	35p
BF179	35p
BF180	35p
BF181	35p
BF182	35p
BF184	30p
BF185	20p
BF194	15p
BF195	15p
BF196	15p
BF197	15p
BF198	25p
BF200	35p
BF224	14p
BF225	19p
BF237	22p
BF238	22p
BF244	32p
BFW61	47p
BFW87	25p
BFW88	23p
BFW89	20p
BFW90	22p
BFW91	20p
BFX12	22p
BFX13	22p
BFX29	25p
BFX30	25p
BFX37	30p
BFX44	37p
BFX68	67p
BFX84	25p
BFX85	30p
BFX86	25p
BFX87	25p
BFX88	20p
BFX89	62p
BFX93A	70p
BFY11	42p
BFY18	25p
BFY19	25p
BFY21	42p
BFY24	45p
BFY29	40p
BFY30	40p
BFY41	50p
BFY43	62p
BFY50	20p
BFY51	20p
BFY52	20p
BFY53	15p
BFY56A	57p
BFY76	42p
BFY77	57p
BFY90	65p
BSX19	17p
BSX20	15p
BSX21	20p
BSX26	45p
BSX27	47p
BSX28	32p
BSX60	82p
BSX61	62p
BSX76	15p
BSX77	20p
BSX78	25p
BSY24	15p
BSY25	15p
BSY26	17p
BSY27	15p
BSY28	17p
BSY29	17p
BSY32	25p
BSY36	25p
BSY37	25p
BSY38	20p
BSY39	22p
BSY43	50p
BSY51	32p
BSY52	25p
BSY53	37p
BSY54	40p
BSY56	90p
BSY79	35p
BSY90	57p
BSY95A	12p
C424	15p
C450	15p
GET102	35p
GET113	25p
GET114	20p
GET118	20p
GET120	25p
GET873	12p
GET880	45p
GET887	15p
GET889	22p
GET890	22p
GET896	22p
GET897	22p
GET898	22p
MAT100	25p
MAT101	25p
MAT120	25p
MAT121	25p
MJ400	107p
MJ420	80p
MJ421	80p
MJ430	102p
MJ440	95p
MJ480	97p
MJ481	125p
MJ490	100p
MJ491	137p
MJE340	50p
MJE370	80p
MJE371	80p
MJE520	75p
MJE521	70p
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MPF103	35p
MPF104	37p
MPF105	37p
MPS3638	32p
NKT124	42p
NKT125	27p
NKT126	27p
NKT128	27p
NKT135	27p
NKT137	32p
NKT210	30p
NKT211	30p
NKT212	30p
NKT213	30p
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NKT215	22p
NKT216	35p
NKT217	40p
NKT219	30p
NKT223	27p
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NKT237	35p
NKT238	25p
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NKT264	20p
NKT271	20p
NKT262	20p
NKT274	20p
NKT275	20p
NKT278	25p
NKT281	27p
NKT401	87p
NKT402	90p
MKT403	75p
NKT404	55p
NKT405	75p
NKT406	62p
NKT451	62p
NKT452	62p
NKT453	47p
NKT713	20p
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NKT734	27p
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NKT773	25p
NKT781	30p
OC16	50p
OC19	37p
OC20	85p
OC22	50p
OC23	60p
OC24	60p
OC25	40p
OC26	25p
OC28	60p
OC29	60p
OC35	50p
OC36	60p
OC41	22p
OC42	40p
OC44	15p
OC45	12p
OC46	15p
OC70	15p
OC71	12p
OC72	12p
OC73	30p
OC74	30p
OC75	25p
OC76	25p
OC77	40p
OC78	20p
OC81	20p
OC81D	20p
OC82	25p
OC82D	15p
OC83	25p
OC84	25p
OC139	25p
OC140	40p
OC170	25p
OC171	30p
OC200	40p
OC201	75p
OC202	80p
OC203	40p
OC204	40p
OC205	75p
OC206	95p
OC207	75p
OCP71	42p
ORP12	50p
ORP60	40p
ORP61	42p
P346A	22p
ST140	15p
ST141	20p
TI834	62p
TI843	40p
TI844	12p
TI845	12p
TI846	12p
TI847	12p
TI848	12p
TI849	12p
TI850	12p
TI851	10p
TI852	11p
TI853	22p
XB112	20p
XC141	35p
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CA3029A	165p
CA3030	137p
CA3035	122p
CA3036	72p
CA3039	82p
CA3041	109p
CA3042	109p
CA3043	187p
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CA3054	109p
CA3055	240p
CA3059	165p
CA3064	120p
FCH101	85p
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FCH121	105p
FCH131	50p
FCH141	105p
FCH151	105p
FCH161	50p
FCH171	105p
FCH181	105p
FCH191	105p
FCH201	130p
FCH211	130p
FCH221	130p
FCH231	150p
FCJ101	160p
FCJ111	150p
FCJ121	275p
FCJ131	275p
FCJ141	525p
FCJ201	100p
FCJ211	275p
FCK101	430p
FCL101	230p
FCY101	102p
FJH101	25p
FJH111	70p
FJH121	25p
FJH131	25p
FJH141	25p
FJH151	25p
FJH161	70p
FJH171	25p
FJH181	25p
FJH221	25p
FJH231	25p
FJH241	25p
FJH251	25p
FJJ101	50p
FJJ111	50p
FJJ121	60p
FJJ131	60p
FJJ141	125p
FJJ181	75p
FJJ191	65p
FJJ211	125p
FJJ251	125p
FJL101	125p
FJY101	25p
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SN7401	20p
SN7402	20p
SN7403	20p
SN7404	20p
SN7405	20p
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SN7409	20p
SN7410	20p
SN7411	23p
SN7413	30p
SN7420	20p
SN7430	20p
SN7440	20p
SN7441AN	75p
SN7442	75p
SN7446	100p
SN7447	135p
SN7448	125p
SN7450	20p
SN7451	20p
SN7453	20p
SN7454	20p
SN7460	20p
SN7472	30p
SN7473	40p
SN7474	40p
SN7475	45p
SN7476	45p
SN7483	87p
SN7486	33p
SN7490	87p
SN7492	87p
SN7493	87p
SN7495	87p
SN7496	87p
SN74107	52p
SN74153	140p
SN74154	220p
SN74160	180p
SN74161	260p
SN74164	220p
SN74165	225p
SN74192	175p
SN74193	175p
TAA241	162p
TAA242	425p
TAA243	150p
TAA263	75p
TAA293	97p
TAA300	175p
TAA310	125p
TAA320	72p
TAA350	175p
TAA435	147p
TAA521	132p
TAA522	360p
TAA530	495p
TAA811	445p
TAB101	97p
TAD100	150p
TAD110	150p
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UA703C	137p
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UA710C	125p
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UA730C	160p
UA741C	87p

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200 PIV 2A	65p
400 PIV 2A	75p
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400 PIV 4A	75p
50 PIV 6A	62p
100 PIV 6A	75p
200 PIV 6A	75p
400 PIV 6A	100p

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4003 200PIV	8p	10p	22p
4004 400PIV	8p	10p	25p
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4006 800PIV	12p	15p	27p
4007 1000PIV	15p	16p	30p

50 + less 15% 100 + less 20%

SILICON RECTIFIERS STUD MOUNTING

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100PIV	—	45p	50p	£1·22
200PIV	25p	50p	55p	£1·42
400PIV	30p	55p	62p	£1·77
600PIV	32p	60p	72p	£2·12
800PIV	35p	75p	87p	£2·47
1000PIV	40p	85p	£1·05	£2·77

50 + less 15% 100 + less 20%

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400MW	1·5 WATT	10 WATT
3·3-33 V	2·4—100	3·9—100V
10p each	25p each	40p each

25 + less 15% 100 + less 20%

TRANSISTOR DISCOUNTS:- 12 + 10%; 25 + 15%; 100 + 20% any one type. Postage on all Semi Conductors 7p extra.
S.A.E. FOR FULL LISTS.

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5V4	45p
5Y3	40p
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6AG7	40p
6AK5	35p
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6AL5	20p
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6AS6	40p
6AT6	35p
6AU6	25p
6AV6	30p
6BA6	25p
6BE6	30p
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6BR7	90p
6BR8	70p
6BW6	85p
6BW7	80p
6BZ6	40p
6C4	33p
6CD6	125p
6CL6	50p
6CW4	65p
6F1	62p
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6F13	45p
6F14	70p
6F15	65p
6F18	50p
6F23	85p
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6SJ7	40p
6SK7	40p
6SL7	35p
6SN7	35p
6SQ7	40p
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6V6GT	32p
6X4	35p
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25Z4	30p
25Z5	42p
25Z6	65p
30C15	80p
30C17	90p
30C18	80p
30F5	85p
30FL1	75p
30FL12	120p
30FL14	95p
30L15	85p
30L17	80p
30P12	80p
30P19	85p
30PL1	75p
30PL13	93p
30PL14	90p
35L6	50p
35W4	35p
35Z4	35p
35Z5	50p
50B5	50p
50C5	50p
80	55p
85A2	50p
807	50p
1625	50p
5763	70p
6146	160
AZ31	55p
CY31	35p
DAF91	30p
DAF96	45p
DF91	22p
DF96	45p
DK91	40p
DK92	55p
DK96	50p
DL92	35p
DL94	48p
DL96	45p
DM70	40p
DY86	32p
DY87	33p
E88CC	100p
E180F	100p
EABC80	35p
EAF42	35p
EB91	20p
EBC41	55p
EBC81	30p
EBF80	40p
EBF83	40p
EBF89	32p
EBL21	60p
EC86	60p
EC88	60p
ECC40	65p
ECC84	30p
ECC85	40p
ECC88	40p
ECF80	35p
ECF82	35p
ECF86	65p
ECH21	57p
ECH35	100p
ECH42	75p
ECH81	30p
ECH83	45p
ECL80	45p
ECL82	35p
ECL83	70p
ECL86	40p
EF37A	120p
EF39	50p
EF40	50p
EF41	65p
EF42	70p
EF80	25p
EF85	35p
EF86	30p
EF89	28p
EF91	30p
EF92	35p
EF183	35p
EF184	35p
EH90	40p
EL34	50p
EL33	£1·25
EL41	60p
EL42	65p
EL81	65p
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EM81	60p
EM84	35p
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EZ41	50p
EZ80	27p
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PC88	60p
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PC900	48p
PCC84	40p
PCC85	40p
PCC88	55p
PCC89	50p
PCC189	55p
PCF80	30p
PCF82	34p
PCF84	60p
PCF86	60p
PCF800	80p
PCF801	50p
PCF802	50p
PCF805	80p
PCF806	70p
PCF808	75p
PCL82	35p
PCL83	65p
PCL84	45p
PCL85	40p
PCL86	45p
PFL200	65p
PL36	55p
PL81	50p
PL82	45p
PL83	45p
PL84	40p
PL500	75p
PL504	80p
PY32	65p
PY33	63p
PY80	40p
PY81	30p
PY82	35p
PY83	38p
PY88	40p
PY800	40p
PY801	50p
U25	80p
U26	80p
U50	40p
U52	35p
U191	75p
U281	40p
U282	40p
U301	40p
U801	£1·80
UABC80	40p
UAF42	55p
UBC41	50p
UBC81	40p
UBF80	40p
UBF89	35p
UCC84	49p
UCC85	40p
UCF80	55p
UCH21	60p
UCH42	70p
UCH81	40p
UCL82	35p
UCL83	60p
UF41	60p
UF80	35p
UF85	40p
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AAZ15	10p
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BA144	12p
BA145	20p
BA154	12p
BAX13	12p
BAX16	7p
BAY31	7p
BAY38	15p
BY100	15p
BY103	22p
BY122	37p
BY124	15p
BY126	12p
BY127	15p
BY164	57p
BY210	35p
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BYZ12	30p
BYZ13	25p
BYZ16	40p
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OA6	12p
OA10	25p
OA9	10p
OA47	10p
OA70	10p
OA73	10p
OA79	10p
OA81	8p
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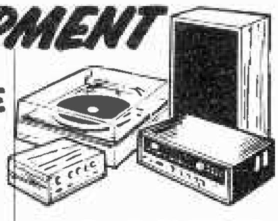
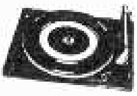


RECORD DECKS



B.S.R.

Mini Mono†	£4·97
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610	£14·65
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† Mono * Stereo Cartridge
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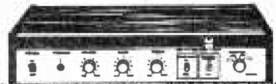
TELETON SAQ-206 STEREO AMPLIFIER



Latest exciting release. Brand new model. 6 + 6 watts rms. Inputs for mag. xtal, aux tape. Volume, bass, treble, sliding balance, scratch filter and loudness controls. List £32.50 OUR PRICE £17·50 Carr. 37p.

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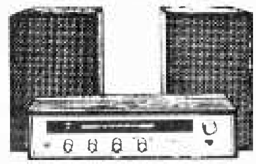

CR10T AM/FM STEREO TUNER AMPLIFIER WITH MATCHING PAIR OF SPEAKER SYSTEMS. Output 4 watts per channel. Excellent reception, AFC, built-in MPX. Cer/XTAL Input. Total List £50·25. OUR PRICE £22·75. Carr. 62½p.
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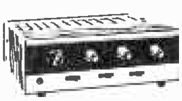

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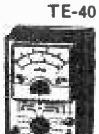
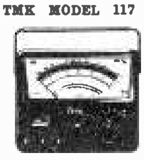
TE-40 HIGH SENSITIVITY A.C. VOLTMETER



10 meg. input 10 ranges: 01/·003/·1/·3/1/3/10/30/100/300V. R.M.S. 4cps.-1·2 Mc/s. Decibels −40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. £17·50. Carr. 25p.

TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER



Battery operated, 11 meg input, 26 ranges. Large 4½" mirror scale. Size 5¼" x 4½" x 2½". DC VOLTS 0 3–1200V. AC VOLTS 3 – 300V RMS. 8.0 – 800V P-P. DC CURRENT .12 – 12MA. Resistance up to 2000M ohm. Decibels – 20 to + 51 db Complete with leads/instructions. £17.50, P. & P. 20p.

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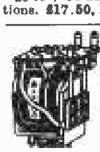

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Model 350. 13" x 8" with single tweeter/crossover. 20-20,000 Hz. 15 watt RMS. Available 8 or 15 ohms. £7·50 each. P. & P. 37p.
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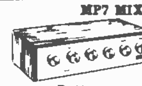
TE 1018 DE-LUXE MONO HIGH IMPEDANCE HEADSET

Sensitive, soft earpads, adjustable headband. Magnetic, impedance 2,600 ohms.
£1·97, P. & P. 15p.

MP7 MIXER PREAMPLIFIER



5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9¼" x 5" x 3". Inputs Mics: 3 x 3mV 50K : 2 x 3mV 600 ohm. Phono mag. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K.
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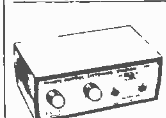
1021 STEREO LISTENING STATION



For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. 2 gain controls, speaker on-off slide switch, stereo headphone sockets. 6" x 4" x 2½". £2·25, P. & P. 15p.

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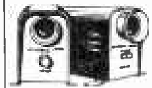
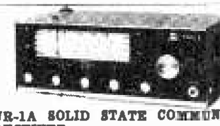
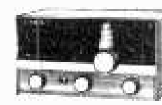


Inexpensive warning or counting system consisting of an enciter and relay unit. Relay unit has variable sensitivity control and switch for intermittent alarm operation. Enciter unit has removable infra red filter and A.C. outlet socket to operate bells, counters, etc. 240V AC. Complete with cables and instructions. £9.97, P. & P. 25p.



UR-1A SOLID STATE COMMUNICATION RECEIVER

4 Bands covering 550kc/s–30mc/s. FET, S Meter, Variable BFO for SSB, Built-in Speaker, Bandspread, Sensitivity Control. 220/240v. A.C. or 12v. D.C. 12¼" x 4½" x 7". Brand new with instructions. £25. Carr. 37½p.



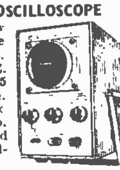
UNR-30 RECEIVER

4 Bands covering 550kc/s–30mc/s. B.F.O. Built-in Speaker 220/240v. A.C. Brand new with instructions. £15 75. Carr. 37½p.

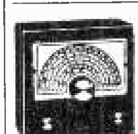
LAFAYETTE HA-600 SOLID STATE RECEIVER

General coverage 150–400kc/s, 550 kc/s–30mc/s. FET front end. 2 mech. filters, product detector, variable B.F.O., noise limiter. S. Meter, Bandspread. RF Gain. 15" x 9¼" x 8¼". 18 lbs. 220/240v. A.C. or 12v. D.C Brand new with instructions. £45. Carr. 50p.

TO-2 PORTABLE OSCILLOSCOPE



A general purpose low cost economy oscilloscope for everyday use. Y amp. Bandwidth 2 CPS–1 MHZ. Input imp. 2 meg Ω 25 P.F. Illuminated scale. 2in. tube. 115 × 180 × 230mm. Weight 8lb. 220/240 V a.c. Supplied brand new with handbook. £22.50. Carr. 50p.



TE-16A Transistorised Signal Generator. 5 ranges 400kHz—30mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide easy to read scale. 800kHz modulation. 5¼ × 5¼ × 3½in. Complete with instructions and leads. £7·97½. P. & P. 20p.

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5 MHz Pass Band. Separate Y1, Y2 amplifiers. Calibrated triggered sweep from ·2 sec to 100 milli sec/cm.
Supplied complete with all accessories and instructions £87. Carr. paid.

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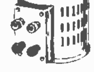

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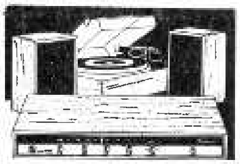

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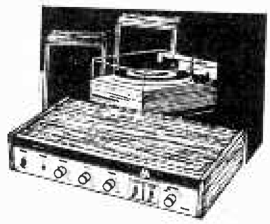

TELETON SAQ 206 STEREO AMPLIFIER
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Suggested System.
SAQ 206 Amplifier, SP25 III Plinth and Cover, G800 cartridge, pair large 3-way speaker system.
Our price **£59·95**
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1R4	0·35	6X5GT	0·35	EBC81	0·30	PCF87	0·85
1R5	0·35	6X8	0·55	EBF80	0·40	PCF801	0·50
1S4	0·27	6Y6G	0·65	EBF83	0·40	PCF802	0·50
1S5	0·25	7Y4	0·60	EBF89	0·30	PCF805	0·75
1T4	0·25	9BW6	0·50	EC53	0·50	PCF806	0·70
1U4	0·27	10C2	0·50	EC86	0·60	PCF808	0·75
1U5	0·50	10D1	0·50	EC88	0·60	PCH200	0·70
1V2	0·45	10D2	0·40	EC90	0·33	PCL81	0·50
1X2B	0·40	10F1	0·90	EC91	0·50	PCL82	0·35
2D21	0·35	10F9	0·50	EC92	0·35	PCL83	0·65
3A4	0·35	10F18	0·45	EC93	0·50	PCL84	0·45
3B28	2·15	10L1	0·45	EC8010	2·25	PCL85	0·40
3BP1	2·75	10LD11	0·60	ECC40	0·60	PCL86	0·45
3Q4	0·40	10P13	0·55	ECC81	0·33	PCL88	0·90
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5R4GY	0·60	12AC6	0·40	ECC84	0·30	PD500	1·50
5Y4G	0·33	12AL5	0·45	ECC85	0·40	PF86	0·60
5U4GB	0·42	12AQ5	0·43	ECC88	0·40	PF818	0·85
5V4G	0·42	12AT6	0·30	ECC89	0·50	PFL200	0·70
5Y3GT	0·32	12AT7	0·33	ECC91	0·20	PL33	0·35
5Z3	0·50	12AU6	0·30	ECC189	0·60	PL36	0·55
5Z4G	0·40	12AU7	0·30	ECF80	0·35	PL81	0·50
6/30L2	0·75	12AV6	0·33	ECF82	0·35	PL82	0·45
6AB4	0·35	12AV7	0·50	ECF86	0·65	PL83	0·45
6AF4A	0·50	12AX7	0·30	ECF804	1·50	PL84	0·40
6AG7	0·40	12AY7	0·70	ECH42	0·70	PL302	0·80
6AH6	0·50	12B44A	0·55	ECH81	0·30	PL504	0·80
6AJ8	0·30	12BA6	0·35	ECH83	0·40	PL508	0·90
6AK5	0·30	12BA7	0·35	ECH84	0·45	PL509	1·30
6AK6	0·57	12BE6	0·35	ECL80	0·40	PL801	0·80
6AL3	0·43	12BH7	0·40	ECL81	0·45	PM84	0·50
6AL5	0·20	12BY7	0·55	ECL82	0·35	PY31	0·80
6AM5	0·32	12K5	0·55	ECL83	0·65	PY33	0·63
6AM6	0·33	12K7GT	0·35	ECL84	0·55	PY80	0·35
6AQ5	0·35	12Q7G	0·30	ECL85	0·55	PY81	0·30
6AQ6	0·55	12SR7	0·35	ECL86	0·40	PY82	0·30
6AR5	0·35	14S7	0·80	ECLL800		PY83	0·38
6AR6	0·40	20D1	0·45		1·50	PY88	0·40
6AR11	1·25	20L1	1·10	EF37A	0·60	PY500	1·00
6AS5	0·35	20P1	0·50	EF39	0·40	PY800	0·50
6AS7G	0·80	20P4	1·10	EF40	0·50	PY801	0·50
6AT6	0·30	20P5	1·20	EF41	0·65	PZ30	0·35
6AU6	0·25	25C5	0·50	EF42	0·70	QQV2-6	2·15
6AV6	0·30	25L6GT	0·45	EF80	0·25	QQVO3-10	
6AW8A	0·55	25Z4G	0·30	EF83	0·55		1·25
6BA6	0·25	25Z6GT	0·65	EF85	0·35	QQV03-20A	
6BE6	0·30	30A5	0·45	EF86	0·30		5·25
6BF5	0·80	30AE3	0·40	EF89	0·28	QQV06-4A	
6BF6	0·50	30C1	0·30	EF91	0·33		5·50
6BH5	0·45	30C15	0·80	EF92	0·40	TT21	2·65
6BJ6	0·45	30C17	0·85	EF95	0·30	TT22	2·80
6BK7A	0·55	30C18	0·75	EF97	0·65	U18/20	0·75
6BN5	0·43	30F5	0·85	EF98	0·65	U25	0·75
6BN6	0·40	30FL1	0·70	EF183	0·30	U26	0·75
6BQ5	0·25	30FL12	0·93	EF184	0·35	U31	0·45
6BR8	0·65	30FL14	0·75	EF800	1·00	U37	1·50
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6C4	0·33	30PL1	0·70	EL37	1·25	U281	0·40
6C5GT	0·40	30PL13	0·93	EL41	0·55	U282	0·40
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6CD6GA	1·15	35A3	0·55	EL81	0·55	U403	0·50
6CG7	0·50	35A5	0·75	EL83	0·42	U404	0·40
6CH6	0·55	35B5	0·65	EL84	0·25	U801	1·00
6CL6	0·50	35C5	0·40	EL85	0·43	UABC80	0·35
6CW4	0·63	35D5	0·70	EL86	0·40	UAF41	0·50
6CY5	0·43	35L6GT	0·50	EL90	0·35	UAF42	0·55
6CY7	0·65	35W4	0·30	EL95	0·35	UBC41	0·50
6D3	0·45	35Z3	0·60	EL803	1·00	UBC81	0·40
6DC6	0·75	35Z4G	0·30	EL821	0·55	UBF80	0·40
6DK6	0·48	35Z5GT	0·40	EL822	0·90	UBF89	0·35
6DQ6B	0·63	50A5	0·70	ELL80	0·75	UBL1	0·50
6DS4	0·75	50B5	0·45	EM34	0·90	UBL21	0·60
6EA8	0·58	50C5	0·40	EM71	0·75	UC92	0·35
6EH7	0·30	50CD6G	1·65	EM80	0·40	UCC85	0·40
6EJ7	0·35	50L6GT	0·50	EM81	0·60	UCF80	0·55
6EW6	0·65	85A2	0·40	EM84	0·35	UCH21	0·60
6F1	0·70	90AG	2·40	EM85	1·00	UCH42	0·70
6F5	0·50	90AV	2·50	EM87	0·55	UCH43	0·75
6F6G	0·30	90C1	0·60	EN91	0·35	UCH81	0·35
6F11	0·38	90CV	1·25	EY51	0·40	UCL81	0·60
6F13	0·38	807	0·50	EY80	0·45	UCL82	0·35
6F14	0·65	813	3·75	EY81	0·40	UCL83	0·60
6F15	0·65	866A	0·75	EY83	0·55	UF41	0·60
6F18	0·45	5642	0·65	EY86	0·40	UF42	0·60
6F23	0·80	6080	1·50	EY87	0·43	UF43	0·60
6F24	0·75	6146	1·50	EY88	0·43	UF80	0·35
6F25	0·75	6360	1·25	EZ40	0·45	UF85	0·40
6F26	0·35	6870	2·50	EZ41	0·45	UF89	0·35
6F28	0·60	6939	2·15	EZ80	0·25	UL41	0·65
6J4	0·50	7199	0·75	EZ81	0·28	UL84	0·30
6J5GT	0·30	7360	1·80	GY501	0·80	UM84	0·20
6J7	0·45	7586	1·25	GZ30	0·40	UY1N	0·50
6K6GT	0·55	7895	1·25	GZ31	0·33	UY11	0·65
6K7	0·35	9002	0·35	GZ32	0·48	UY41	0·45
6K8G	0·35	9003	0·50	GZ33	0·70	UY82	0·50
6K25	0·75	AZ1	0·48	GZ34	0·60	UY85	0·30
6L6GT	0·45	AZ31	0·55	HABC80	0·40	W729	0·60
6L7	0·40	CBL1	0·80	HK90	0·35	Z759	1·85
6L18	0·45	CBL31	0·90	KT66	2·05	Z803U	0·90
6LD20	0·40	CY31	0·35	KT88	2·00		
6N7GT	0·40	DAF96	0·42	N78	1·45		
6P1	0·60	DF96	0·42	PABC80	0·40		
6P25	1·25	DK40	0·55	PC86	0·60		
6P28	0·65	DK92	0·50	PC88	0·60		
6Q7	0·40	DK96	0·42	PC97	0·50		
6SA7	0·40	DL96	0·42	PC900	0·48		
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1500 pF	630	25p
2200 pF	630	25p
3300 pF	630	25p
4700 pF	630	25p
6800 pF	630	25p
0·01 μF	630	27p
0·015 μF	630	29p
0·022 μF	630	29p
0·033 μF	630	33p
0·047 μF	630	40p
0·068 μF	630	42p
0·1 μF	630	50p
0·15 μF	630	56p
0·22 μF	630	67p
470 pF	1000	29p
680 pF	1000	29p
1000 pF	1000	25p
1500 pF	1000	25p
2200 pF	1000	27p

WIMA TROPYFOL

Capacitance	Working Voltage		Capacitance	Working Voltage	
47 pF	400	21p	0·022 μF	630	27p
68 pF	400	21p	0·033 μF	630	31p
100 pF	400	21p	0·047 μF	630	36p
150 pF	400	21p	1000 pF	1000	21p
220 pF	400	21p	1500 pF	1000	21p
330 pF	400	21p	2200 pF	1000	23p
470 pF	400	21p	3300 pF	1000	23p
0·01 μF	400	19p	4700 pF	1000	25p
0·015 μF	400	21p	6800 pF	1000	27p
0·022 μF	400	23p	0·01 μF	1000	27p
0·033 μF	400	23p	0·015 μF	1000	31p
0·047 μF	400	25p			
0·068 μF	400	27p			
0·1 μF	400	33p			
0·22 μF	400	46p			
1500 pF	630	21p			
2200 pF	630	21p			
3300 pF	630	21p			
4700 pF	630	21p			
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Garrard SP25 Mk. III with MAG. cart ridge plinth and cover	£23·00+£1·50 p&p
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SPECIFICATION R101
14 watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within ± 1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities; headphone socket, power out 250mW per channel. *Tone controls and filter characteristics*. Bass: +12dB to −17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to −12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max) R101—P.U.1 and radio—65dB. P.U.2. −58dB. **R100** same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. *Cross talk* better than −35dB on all inputs. *Overload characteristics* better than 26dB on all inputs. Size approx 13¾" x 9" x 3¾".

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Sound 50 amp and 2 speakers

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THE ELEGANT SEVEN Mk. III

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7 transistor fully-tunable M.W.—L.W. superhet portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction.
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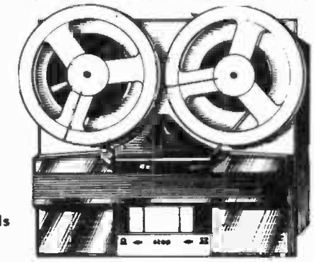

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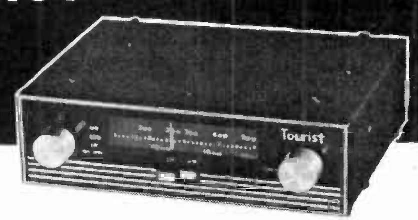

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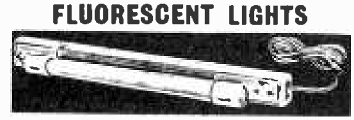

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3S4	·26	DK92	·37	EF183	·26	PL36	·47
3V4	·37	DK96	·36	EF184	28	PL81	·43
5Y3GT	·25	DL92	·26	EL33	·54	PL82	·29
6/3OL2	·53	DL94	·37	EL37	·75	PL83	·32
6AQ5	·21	DL96	·36	EL84	·22	PL84	·29
6BW7	·50	DY86	·24	EY51	·30	PL500	·62
6F1	·57	DY87	·24	EY86	·28	PL504	·62
6F23	·67	DY802	·30	EZ80	·20	PY81	·24
6F25	·55	EABC80	·30	EZ81	·21	PY82	·24
6SN7GT	·28	EB91	·10	KT61	·54	PY800	·32
25L6GT	·20	EBC33	·38	KT66	·75	PY801	·32
30C15	·56	EBF89	·27	N78	·85	R19	·29
30C18	·59	ECC81	·15	PC86	·45	U25	·63
30F5	·67	ECC82	·18	PC88	·45	U26	·55
30FL1	·59	ECC83	·21	PC900	·30	U191	·57
30FL14	·67	ECC85	·24	PCC84	·28	U251	·66
30L15	·56	ECF80	·26	PCC89	·43	U329	·65
30L17	·68	ECF82	·26	PCC189	·47	UBF89	·29
30P4	·56	ECH35	·27	PCF80	·27	UCC85	·34
30P19	·56	ECH81	·26	PCF86	·43	UCH81	·30
30PL1	·59	ECL80	·29	PCF801	·29	UCL82	·31
30PL13	·73	ECL82	·29	PCF802	·38	UCL83	·49
30PL14	·63	ECL86	·35	PCF805	·59	UF89	·28
DAF91	·21	EF39	·36	PCL82	·30	UL84	·29
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*Celestion Ditton 15/pr. ...	£76·94	**£60·00**
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*Goldring G850 Dia. ...	£6·27	**£4·00**
*Goldring G800 Dia. ...	£12·55	**£6·50**
*Shure M44.7 Dia.	£9·84	**£7·50**
*Goldring G800E Dia. ...	£18·16	**£11·00**
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*McDonald MP60	£15·20	**£11·20**
*Goldring GL69/2	£27·60	**£21·50**
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*Connoisseur BD2/SAU2 ...	£31·00	**£25·00**

	Rec. Retail	Our Price
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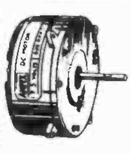

AMPEX 7·5v. **D.C. MOTOR.** This is an ultra-precision tape motor designed for use in the AMPEX model AG20 portable recorder. Torque 450GM/CM. Stall load at 500ma. Draws 60 ma on run. 600rpm +5% speed adjustment. Internal AF/RF suppression ⅛" dia. 1" spindle, motor 3" dia. 1⅝". Original cost £16·50. **Our** price **£4·25.** P. & P. 25p. Mu-metal enclosure available 75p each.

SYNCHRONOUS MOTORS. 220/380 v. 50/60 Hz. 250-300 rpm. 75p each.

MYCALEX MAINS. Shaded pole, 1425 rpm, 3/16" spindle. 2 for **£1·25.** Carriage Paid.

MAINS INDUCTION MOTOR. Open frame, 3/16" spindle, weight ¾ lb. Powerful. **88p** each. P. & P. 12p.

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"Parvalux" Reversible 100 RPM Geared Motor. Type S.D.14, 230/250v. A.C. 22 lb./in. ⅜" spindle. 1st class condition. **£7·50** each. P. & P. 50p. Also limited number only as above. **Brand New. £12·50** each. P. & P. 50p.

ELECTRO CONTROL (CHICAGO). Shaded pole 240v. 50 Hz. 200 rpm. 10lb. in. **£2·50**, P. & P. 25p.

MYCALEX. Open frame, shaded pole motors, 240v, 50 Hz. 7 rpm. 28 lb. in. 80 rpm. 12 lb. in, **£2·25** each. P. & P. 25p.

"CROUZET" TYPE 965. 115/240v. 50 Hz. 47/68 watts. 50 rpm. Stoutly constructed. Size: 2 11/16" dia. x 3⅜" long plus spindle 1" x ⅛" dia. Anti-clock. **£2·75.** P. & P. 25p.

TYPE 955. Same as above, but 3 rpm. **£3·00.** P. & P. 25p

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PAINTON BOURNS TRIMPOTS. 1k, 2k, 2·5k, 5k, 10k, 20k, 50k, 500k. Other Trimmer pots in stock. RIL 10k. MORGANITE 1k, MEC 200 Ω (tubular) 50Ω. Any 3 for **£1·10** carr. paid.

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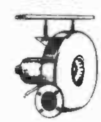
PRECISION FAN CO. (SMITHS INDUSTRIES) DOUBLE ENTRY CENTRIFUGAL FAN/BLOWER. This is a beautifully balanced particularly quiet running unit giving approx. 90 cubic ft./min. The motor is a 2 pole shaded pole Mycalex, drawing only 240ma on run. Weight 2¼ lbs. Sizes: case dia. 3·1 ins. width (case only) 3·125 ins. Width overall (inc. 5·25 ins. Aperture 3·125 ins. x 1·85 ins. Offered well below makers price at **£2·95.** P. & P. 25p.



Brand New "DISCUS" Centrifugal Blower by Watkins & Watson. 240v. 50 Hz. Powered by A.E.I. continuous rating 2850 rpm motor. Cowl diameter 10". Outlet flange 2" I.D. Coupling flange supplied. These superb precision units are ideally suited for **Organ construction.** Offered at approx. half makers price **£12·50.** Carriage £1·50.

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SYLVANIA MAGNETIC SWITCH—a magnetically activated switch operating in a vacuum. Switch speed —4ms, temperature —54 to +200°C. Silver contacts normally closed rated 3 amps. at 120v. 1·5 amp. at 240v. 4 for **£1**, or **£2·50** per doz. Special quotations for 100 or over.

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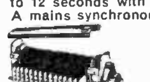
A bank of 15 micro-switches are each independently operated by 15 pairs of cams which in turn are individually adjustable to give switching periods of zero to 12 seconds with infinitely variable combinations. A mains synchronous motor drives the cam shaft at 1 rev. per 12 seconds (5 R.P.M.). Originally cost **£15·00** plus. Many applications such as lighting effects etc. New in original makers cartons. First class value at **£5·75** plus 25p. P. & P.



Special offer of AMPEX professional tape heads. mu-metal shrouded. (Designed for model AG20). Full track record, or playback, **£3·00.** Erase head **£2·00** Set of 3 with mounting bracket and cover **£7·50.** Half track record only, **£3·00** each. Carriage paid.

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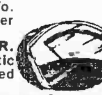

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1D5	40	6BH6	75	6J7G	30	7D5	55
1H5	50	6BJ6	50	6J7GT	45	7H7	35
IN5GT	55	6BQ7A	45	6K6GT	60	7R7	70
IR5	40	6BR7	90	6K7M	35	7S7	£2·25
1S4	30	6BR8	70	6K7G	20	7Y4	65
IS5	25	6BS7	£1·30	6K7GT	35	9BW6	50
IT4	30	6BW6	85	6K8M	60	10C2	50
3A4	40	6BW7	80	6K8G	40	10F1	75
3Q4	50	6C4	33	6K8GT	50	10F3	90
3Q5	50	6C5G	30	6K25	75	10F9	60
3S4	35	6C6	25	6L6G	45	10F18	50
3V4	48	6CD6G	£1·25	6L18	45	10LD11	65
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5U4G	35	6CW4	65	6Q7GT	43	11E3	£4·00
5V4G	45	6D6	25	6SA7M	40	12AT6	30
5Y3GT	32	6E5	60	6SC7M	75	12AT7	33
5Z4G	40	6F1	70	6SG7M	40	12AU6	35
6/30L2	80	6F5G	75	6SH7M	40	12AU7	30
6A7	75	6F6G	35	6SJ7GT	40	12AX7	30
6A8G	40	6F8G	35	6SK7GT	40	12BA6	40
6AK5	35	6F11	40	6SL7GT	35	12BE6	40
6AM5	35	6F13	45	6SN7GT	35	12C8GT	35
6AM6	33	6F14	70	6SQ7GT	40	12E1	£1·80
6AQ5	38	6F23	85	6U4GT	65	12J5GT	30
6AS7G	85	6F24	75	6U5G	40	12J7GT	50
6AT6	30	6F25	£1·00	6V6M	60	12K7GT	40
6AU6	25	6F28	65	6V6G	30	12K8GT	50
6B4G	£1·00	6F32	25	6V6GT	40	12Q7GT	40
6B8G	25	6G6	25	6X4	35	12SA7GT	40
		6H6	23	6X5G	35	12SG7	35
		6J5M	50	6X5GT	40	12SH7	35
		6J5G	20	7B6	70	12SJ7	40
		6J5GT	30	7B7	50	12SK7	50

Type	Price	Type	Price	Type	Price	Type	Price
12SR7	40	37	40	DAF91	30	EBL31	£1·50
14H7	50	42	50	DAF96	45	EC90	33
19AQ5	40	50B5	50	DCC90	£1·00	ECC81	33
20D1	50	50C5	50	DF33	48	ECC82	30
20F2	70	50CD6G	£1·20	DF70	45	ECC83	30
20L1	£1·10	50L6GT	55	DF91	30	ECC84	30
20P4	£1·10	75	50	DF92	20	ECC85	40
20P5	£1·20	78	45	DF96	45	ECC88	40
25A6	35	80	55	DH3-91	£6·00	ECH21	63
25L6GT	50	85A2	50	DH77	30	ECH35	£1·00
25Y5	60	150B2	60	DK32	40	ECH42	75
25Z4	45	150C4	60	DK91	40	ECH81	30
25Z5GT	50	801	50	DK92	50	ECH83	45
25Z6	65	807	50	DK96	50	ECL80	45
30C1	30	813USA	£3·75	DL66	£1·25	ECL82	35
30C15	80	866A	75	DL92	35	ECL83	70
30C17	90	954	60	DL93	40	ECL86	40
30C18	80	1625	40	DL94	48	ECLL800	£1·65
30F5	85	4022AR	£5·00	DL95	50	EF9	75
30FL1	75	5763	70	DL96	45	EF37A	£1·20
30FL12	£1·[illegible]0	7193	20	DM70	40	EF39	50
30FL14	85	7475	40	DY86	33	EF41	65
30L15	85	A61	48	DY87	33	EF50	25
30L17	80	ATP4	35	E88CC	65	EF80	25
30P4	£1·12	ATP5	60	EA50	20	EF85	35
30P12	80	ATP7	50	EABC80	35	EF86	30
30P19	85	AU2	£4·00	EAF42	55	EF89	28
30PL1	75	AU5	60	EB91	20	EF91	33
30PL13	93	AZ1	48	EBC33	50	EF92	35
30PL14	90	AZ31	55	EBC41	55	EF98	75
35A5	75	CBL31	£1·00	EBC90	35	EF183	30
35L6	50	CCH35	75	EBF80	40	EF184	35
35W4	35	CL33	£1·30	EBF83	40	EL32	30
35Z3	70	CY30	63	EBF89	30	EL33	£1·25
35Z4GT	50	CY31	43	EBL1	70	EL34	50
35Z5	40	DAC32	42	EBL21	60		

Type	Price	Type	Price	Type	Price	Type	Price
EL41	60	N78	£1·50	PL504	80	U404	60
EL42	65	N108	£1·50	PL508	90	U801	£1·18
EL84	25	OA2	38	PL509	£1·10	UABC80	40
EL95	35	OC3	38	PL802	95	UAF42	55
ELL80	£1·00	OZ4	40	PX4	£2·00	UBC41	50
EM34	90	PC86	60	PX25	£2·50	UBC81	40
EM80	45	PC88	60	PY33	63	UBF80	40
EM81	60	PC97	50	PY81	30	UBF89	35
EM84	35	PCC84	40	PY82	35	UCC84	43
EY51	40	PCC89	50	PY83	38	UCC85	40
EY86	40	PCC189	55	PY500	£1·00	UCF80	55
EZ35	40	PCF80	30	PY800	40	UCH42	70
EZ40	50	PCF82	35	PY801	50	UCH81	40
EZ41	50	PCF84	60	R2	60	UCL82	35
EZ80	28	PCF86	60	R19	40	UCL83	60
EZ81	28	PCF801	50	S130	£1·75	UF41	60
GY501	80	PCF802	50	SP4	50	UF89	40
GZ30	40	PCF805	80	SP41	60	UL41	65
GZ32	48	PCF806	70	SP61	75	UL84	40
GZ34	60	PCF808	85	STV280/80	£10·00	UM80	28
HN309	£1·50	PCL82	35	SU25	£1·00	UU6	£1·05
KT36	£1·00	PCL83	65	SU2150	75	UU7	£1·05
KT61	£1·25	PCL84	45	T41	£1·00	UU8	£1·05
KT66	£2·05	PCL85	40	TDD4	50	UU9	45
KT81	£1·75	PCL86	45	TH41	£1·75	UY21	50
KT81(7C5)	£1·13	PD500	£1·30	U10	60	UY41	48
KT88	£2·00	PENA4	£1·00	U14	60	UY85	40
KTW61	£1·00	PENB4	£1·00	U19	£3·00	VMP4G	85
KTZ41	45	PEN45	75	U25	80	VP4B	£1·25
ML4	88	PEN46	40	U26	80	VR105/30	38
ML6	40	PL36	55	U78	35	VR150/30	35
MSP4	50	PL81	50	U191	75	VU111	75
MU14	75	PL82	45	U251	80	VU120	£1·00
MX40	63	PL83	45	U301	63	VU508	£2·50
		PL84	40	U403	60	W81M	63
		PL500	80			Y63	50

Transistors

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
1N914	07	2N697	15	2N2218	20	2N4289	15	AD149	50	BC169C	15
1S113	25	2N706	10	2N2219	20	AAZ12	30	AD161	37	BFS98	28
1S202	23	2N1132	25	2N2369A	15	AC126	20	AF115	25	BFY50	22
2G302	22	2N1305	22	2N2646	45	AC127	25	AF117	25	BFY51	20
2G371	22	2N2147	75	2N2904	20	AC128	20	ASY26	25	BY100	15
2N404	20	2N2160	60	2N2926	10	ACY20	20	BC107	10	BZY88	15
				2N3055	75	ACY39	50	BC108	10	CRS1-40	47
				2N3702	10	AD140	50	BC109	10	DD003	15
				2N3819	35					GET102	30

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
GET882	25	NKT223	33	OAZ200	55	OC35	50	OC81D	20	ZS170	10
GJ7M	37	NKT251	24	OAZ201	50	OC44	17	OC82	25	ZS271	18
KS100A	25	NKT713	25	OAZ207	47	OC45	12	OC82D	20	ZTX107	15
MJE520	87	OA70	10	OAZ210	32	OC57	60	OC84	25	ZTX108	12
MJE2955	£1·37	OA71	10	OAZ222	45	OC58	80	OC170	25	ZTX300	12
MJE3055	87	OA81	08	OAZ224	45	OC59	65	OC171	30	ZTX304	25
NKT212	27	OA85	12	OAZ241	22	OC71	12	OC200	40	ZTX500	16
NKT214	15	OA91	07	OAZ242	23	OC72	20	OCP71	97	ZTX503	17
		OA211	30	OAZ246	23	OC81	20	ORP12	50	ZTX531	.25

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OC3	0.38
OD3	0.35
1B3GT	0.40
1L4	0.20
1R4	0.45
1R5	0.40
1S4	0.30
1S5	0.30
1T4	0.30
1U4	0.30
1U5	0.60
1V2	0.50
1X2B	0.50
2A3	0.50
2CW4	0.70
2D21	0.38
3A4	0.40
3BP1	3.00
3S4	0.35
3V4	0.48
5R4GY	0.75
5U4G	0.35
5V4G	0.45
5Y3GT	0.40
5Z3	0.60
5Z4G	0.40
6/30L2	0.80
6AB4	0.35
6AF4A	0.55
6AG5	0.22
6AG7	0.40
6AH6	0.50
6AJ8	0.30
6AK5	0.35
6AK6	0.60
6AL3	0.43
6AL5	0.20
6AM5	0.35
6AM6	0.33

6AQ5	0.38
6AQ6	0.65
6AR5	0.45
6AR6	0.55
6AR11	1.25
6AS5	0.45
6AS7G	0.85
6AT6	0.35
6AU6	0.25
6AV6	0.30
6AW8A	0.60
6AX4GTB	0.60
6AW8A	0.60
6BA6	0.25
6BE6	0.30
6BF5	1.00
6BF6	0.55
6BH6	0.75
6BJ6	0.50
6BK7A	0.60
6BN5	0.43
6BN6	0.45
6BQ5	0.25
6BR8	0.70
6BS7	1.30
6BW6	0.85
6BW7	0.80
6BX6	0.25
6BZ6	0.40
6C4	0.33
6C5GT	0.40
6CB6	0.35
6CD6GA	1.25
6CG7	0.55
6CH6	0.60
6CL6	0.55
6CW4	0.65
6CY5	0.45
6CY7	0.70
6D3	0.50
6DC6	0.80
6DK6	0.50
6DQ6B	0.70
6DS4	0.75

6EA8	0.60
6EH7	0.80
6EJ7	0.35
6EW6	0.70
6F1	0.75
6F5	0.75
6F6G	0.35
6F11	0.40
6F13	0.45
6F14	0.70
6F15	0.65
6F18	0.50
6F23	0.85
6F24	0.75
6F25	1.00
6F26	0.35
6F28	0.65
6GK6	0.60
6J4	0.50
6J5GT	0.30
6J6	0.20
6J7	0.45
6K6GT	0.60
6K7	0.35
6K8G	0.40
6K25	0.75
6L6GT	0.45
6L7	0.40
6L18	0.45
6LD20	0.50
6N7GT	0.45
6P1	0.60
6P28	0.65
6Q7	0.40
6SA7	0.40
6SG7	0.40
6SK7	0.40
6SL7GT	0.35
6SN7GT	0.35
6SQ7	0.40
6SR7	0.40
6T8	0.35
6U4GT	0.65
6U8A	0.40
6V6GT	0.40

6X4	0.35
6X5GT	0.40
6X8	0.60
6Y6G	0.70
7Y4	0.65
9BW6	0.60
10C2	0.50
10D1	0.55
10D2	0.50
10F1	0.75
10F9	0.60
10F18	0.50
10L1	0.50
10LD11	0.65
10P13	0.60
10P14	1.10
12AB5	0.70
12AC6	0.50
12AD6	0.55
12AE6	0.55
12AL5	0.50
12AQ5	0.50
12AT6	0.30
12AT7	0.35
12AU6	0.35
12AU7	0.30
12AV6	0.40
12AV7	0.65
12AX7	0.30
12AY7	0.75
12B4A	0.60
12BA6	0.40
12BA7	0.40
12BE6	0.40
12BH7	0.45
12BY7	0.60
12K5	0.70
12K7GT	0.40
12Q7GT	0.40
12SR7	0.40
20D1	0.50
20L1	1.10
20P1	0.50
20P4	1.10
20P5	1.20

25C5	0.50
25L6GT	0.50
25Z4G	0.30
25Z6GT	0.65
30A5	0.50
30AE3	0.40
30C1	0.80
30C15	0.80
30C17	0.90
30C18	0.80
30F5	0.85
30FL1	0.75
30FL12	1.20
30FL14	0.85
30L1	0.40
30L15	0.85
30L17	0.80
30P12	0.80
30P19	0.85
30PL1	0.75
30PL13	0.93
30PL14	0.90
35A3	0.55
35A5	0.75
35B5	0.65
35C5	0.50
35D5	0.75
35L6GT	0.50
35W4	0.35
35Z3	0.70
35Z4G	0.35
35Z5GT	0.60

50A5	0.75
50B5	0.50
50C5	0.50
50CD6G	1.20
50L6GT	0.55
85A2	0.50
90AG	2.40
90AV	2.50
90C1	0.65
90CV	2.40
807	0.50
813	3.75
866A	0.75
5642	0.70
6080	1.60
6146	1.60
6360	1.25
6939	2.25
7199	0.60
7360	2.00
7586	1.25
7895	1.25
9002	0.40
9003	0.50
AZ1	0.55
AZ31	0.55
CBL1	0.90
CBL31	1.00
CY31	0.35
DAF96	0.45
DF96	0.45
DK40	0.60

DK92	0.55
DL96	0.45
DM160	0.65
DY86	0.32
DY87	0.33
DY802	0.35
E88CC	0.65
E180F	1.00
E810F	2.90
EABC80	0.35
EAF42	0.55
EBC33	0.50
EBC41	0.55
EBC81	0.30
EBF80	0.40
EBF83	0.40
EBF89	0.30
EC53	0.50
EC86	0.60
EC88	0.60
EC90	0.33
EC91	0.60
EC92	0.35
EC93	0.55
EC8010	2.25
ECC40	0.65
ECC81	0.35
ECC82	0.30
ECC83	0.30
ECC84	0.30
ECC85	0.40
ECC88	0.40

ECC89	0.50
ECC91	0.20
ECC189	0.65
ECF80	0.35
ECF82	0.35
ECF86	0.65
ECF804	1.65
ECH42	0.75
ECH81	0.30
ECH83	0.45
ECH84	0.45
ECL80	0.45
ECL81	0.50
ECL82	0.35
ECL83	0.70
ECL84	0.55
ECL85	0.55
ECL86	0.40
ECLL800	1.65
EF40	0.50
EF41	0.65
EF42	0.70
EF80	0.25
EF83	0.55
EF85	0.35
EF86	0.30
EF89	0.28
EF91	0.33
EF92	0.35
EF95	0.35
EF97	0.65

EP98	0.65
EF183	0.30
EF184	0.35
EF800	1.00
EK90	0.30
EL33	1.25
EL34	0.50
EL36	0.50
EL37	1.60
EL41	0.60
EL42	0.65
EL81	0.55
EL83	0.42
EL84	0.25
EL85	0.43
EL86	0.40
EL90	0.38
EL95	0.35
EL821	0.60
EL822	1.30
ELL80	0.75
EM34	1.00
EM71	0.80
EM80	0.45
EM81	0.60
EM84	0.35
EM85	1.00
EM87	0.70
EN91	0.38
EY51	0.40
EY80	0.55
EY81	0.40
EY83	0.55
EY86	0.40
EY87	0.43
EY88	0.43
EZ40	0.50
EZ41	0.50
EZ80	0.27
EZ81	0.29
GY501	0.80
GZ30	0.40
GZ31	0.35
GZ32	0.48
GZ33	0.70

GZ34	0.60
HABC80	0.45
HK90	0.40
KT66	2.05
KT88	2.00
N78	1.50
PABC80	0.40
PC86	0.60
PC88	0.60
PC97	0.50
PC900	0.48
PABC80	0·40
PCC84	0.40
PCC85	0.40
PCC88	0.55
PCC89	0.55
PCC189	0.55
PCC805	0.85
PCC806	0.80
PCF80	0.30
PCF82	0.35
PCF84	0.60
PCF86	0.60
PCF87	0.90
PCF801	0.50
PCF802	0.50
PCF805	0.80
PCF806	0.70
PCF808	0.85
PCH200	0.70
PCL81	0.50
PCL82	0.35
PCL83	0.65
PCL84	0.45
PCL85	0.40
PCL86	0.45
PCL88	0.90
PCL800	0.93
PCL801	0.75
PD500	1.30
PF86	0.65
PF818	0.85
PFL200	0.65
PL33	0.35
PL36	0.55

PL81	0.50
PL82	0.45
PL83	0.45
PL84	0.40
PL302	0.85
PL504	0.80
PL508	0.90
PL509	1.10
PL801	0.80
PL802	0·95
PM84	0.60
PY31	0.30
PY33	0.63
PY80	0.40
PY81	0.30
PY82	0.35
PY83	0.38
PY88	0.40
PY500	1.00
PY800	0.40
PY801	0.50
PZ30	0.35
QQVO2-6	2.25
QQVO3-10	1.25
QQV03-20A	5.25
QQV06-40A	5.50
TT21	3.00
TT22	3.20
TY2-125	10.00
U18/20	0.75
U25	0.80
U26	0.80
U31	0.60
U37	2.10
U52	0.35
U76	0.35
U78	0.35
U191	0.75
U201	0.35
U281	0.40

U282	0.40
U301	0.40
U403	0.60
U404	0.60
U801	0.80
UABC80	0.40
UAF41	0.50
UAF42	0.55
UB41	0·60
UBC41	0.50
UBC81	0.40
UBF80	0.40
UBF89	0.35
UBL1	0.60
UBL21	0.65
UC92	0.40
UCC85	0.40
UCF80	0.55
UCH21	0.60
UCH42	0.70
UCH81	0.40
UCL81	0.60
UCL82	0.35
UCL83	0.60
UF9	0·60
UF11	0·50
UF41	0.60
UF42	0.60
UF43	0.60
UF80	0.35
UF85	0.40
UF89	0.40
UL41	0.65
UL84	0.40
UM84	0.25
UU8	0.60
UY1N	0.50
UY11	1.00
UY41	0.48
UY82	0.50
UY85	0.40
W729	0.75
Z759	2.00
Z803U	1.20

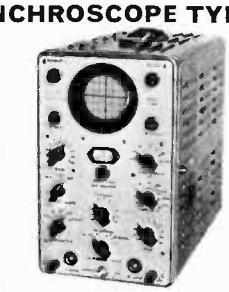
TRANSISTORS

2N696	0.17
2N697	0.17
2N698	0.30
2N705	0.70
2N706	0.10
2N708	0.15
2N753	0.25
2N929	0.22
2N930	0.25
2N987	0.30
2N1131	0.25
2N1132	0.25
2N1184	1.25
2N1301	0.40
2N1302	0.75
2N1304	0.25
2N1305	0.25
2N1306	0.25
2N1307	0.30
2N1308	0.25
2N1309	0.30
2N1613	0.22
2N1711	0.25
2N1756	0.75
2N2147	0.75
2N2160	0.65
2N2217	0.30
2N2218	0.30
2N2219	0.35
2N2369A	0.20
2N2477	0.65
2N2646	0.60
2N2905	0.35
2N2923	0.15
2N2924	0.15
2N2926	0.125
2N3053	0.25
2N3054	0.60
2N3055	0.75
2N3133	0.30
2N3134	0.30
2N3391	0.20
2N3392	0.15
2N3393	0.15
2N3394	0.15
2N3395	0.20
2N3402	0.15
2N3403	0.15
2N3404	0.35
2N3414	0.20
2N3415	0.15
2N3416	0.25
2N3417	0.25
2N3702	0.12
2N3703	0.12
2N3704	0.17
2N3707	0.15
2N3709	0.12
2N3710	0.12
2N3819	0.35
2N3906	0.20
2S702	0.50
2S746	0.25
AC113	0.15
AC125	0.30
AC126	0.20

AC127	0.20
AC128	0.15
AC132	0.35
AC153	0.20
AC154	0.15
AC157	0.20
AC169	0.10
AC176	0.25
AC187	0.30
AC188	0.30
ACY17	0.275
ACY18	0.20
ACY19	0.25
ACY20	0.20
ACY21	0.20
ACY22	0.15
AD140	0.50
AD149	0.50
AD161	0.35
AD162	0.35
ADZ11	1.25
ADZ12	1.25
AF114	0.20
AF115	0.20
AF116	0.20
AF117	0.20
AF118	0.45
AF125	0.25
AF127	0.20
AF180	0.35
AF181	0.35
AF186	0.40
AF239	0.40
AFZ11	0.45
ASY26	0.25
ASY27	0.30
ASY28	0.25
ASY29	0.30
ASY54	0.25
ASZ15	0.70
ASZ16	0.70
ASZ17	0.75
ASZ18	0.75
ASZ20	0.25
ASZ21	0.40
BC107	0.125
BC108	0.125
BC109	0.125
BC113	0.25
BC118	0.30
BC134	0.30
BC147	0.175
BC148	0.15
BC149	0.15
BC152	0.15
BC158	0.15
BC175	0.20
BC186	0.25
BCY30	0.25
BCY31	0.40
BCY33	0.25
BCY34	0.30
BCY72	0.20
BCZ10	0.30
BCZ11	0.40
BD121	0.65

BD123	0.80
BD131	0.85
BD132	0.85
BF115	0.20
BF167	0.18
BF173	0.20
BF179	0.30
BF180	0.35
BF181	0.25
BF184	0.25
BF185	0.20
BF194	0.15
BF195	0.15
BF196	0.20
BF197	0.20
BF200	0.35
BFW87	0.25
BFW88	0.23
BFW89	0.20
BFW91	0.20
BFX88	0.25
BFY17	0.40
BFY19	0.60
BFY50	0.25
BFY51	0.20
BFY52	0.25
BSY26	0.20
BSY27	0.20
BSY28	0.20
BSY65	0.20
BSY95A	0.15
OC16	0.50
OC22	0.50
OC23	0.60
OC24	0.60
OC25	0.35
OC26	0.25
OC28	0.60
OC29	0.60
OC30	0.75
OC35	0.50
OC36	0.60
OC42	0.20
OC44	0.20
OC45	0.15
OC70	0.10
OC71	0.12
OC72	0.25
OC73	0.30
OC75	0.20
OC76	0.20
OC78	0.25
OC78D	0.20
OC81	0.25
OC81D	0.15
OC83	0.20
OC139	0.30
OC140	0.35
OC141	0.60
OC170	0.25
OC171	0.25
OC200	0.30
OC202	0.65

SYNCHROSCOPE TYPE C1-5



3-in tube fitted with telescopic viewing hood, giving bright display in full daylight. Sensitivity 10mV/mm (narrow band) to 30mV/mm (wide band).
Bandwidth 10 c/s—10 mc/s. Triggered sweep pre-set at 1-2-5-10-30-100-300-1000-3000 μsec per stroke. Free-running time base 20 c/s to 2000kc/s with built-in crystal calibrator providing timing marks at .05-.2-1-5-20-100 μ sec + 5%.
Amptitude calibrator directly calibrated in volts.
Input attenuator 1-10-100.
Power supplies 127/230v AC.

PRICE £39.00. Packing and carriage 1.50

INTEGRATED CIRCUITS

TAA263 Direct coupled 3-stage amplifier up to 600kc. Supply voltage 6-8V output 10mW TO72 outline	0·75
TAA293. Medium frequency amplifier up to 600kc. Supply voltage 6V. output 10mW TO74 outline	0·95
TAA320. MOST stage followed by a bi-polar stage Gate-to-source voltage 9-14V. Power dissipation 200mW. TO18 outline	0·65
TAA570. Four-stage limiter-amplifier with F.M. quadrator detector and remote D.C. volume control facility. Nominal supply voltage 12V. TO74 outline	0·95
TAD100. AM receiver circuit containing all active components (except output stage) required to build a complete receiver	£1·95

PHOTO-EMISSIVE DEVICES

GAS Light emitting diode type MV10B	£1·05
Photo-transistor OCP71	0·90
Photo-conductive cell ORP12	0·50
Photo-conductive cell ORP60	0·50
Photo-conductive cell ORP61	0·32
Photo conductive cell ORP90	1·10
Photo-conductive cell ORP91	1·10
GAS Photocells 90AG	2·40
90CG	2·40
Vacuum Photocells 90AV	2·50
90CV	2·40

TWO NEW MULTIMETERS FROM RUSSIA

Type U4312 U4313

with AC current ranges

Type U4312—Low sensitivity instrument (667 o.p.v.) 1% accuracy on DC and 1·5% on AC. 9 current ranges on DC (300μA to 6A) and 8 current ranges on AC (1·5mA to 6A). 9 voltage ranges 0·3 to 900V AC/DC. Resistance 0·2 to 30k Ω. Mirror scale.

PRICE, complete with leads and steel carrying case £9.75

Type U4313—20.000 o.p.v. DC and 2,000 o.p.v. on AC. 8 DC current ranges 60μA to 1·5A. 6 AC current ranges 0·6 to 1·5A. 9 DC and AC voltage ranges 1·5–500V. Resistance ranges 0·5–500k Ω. Accuracy 1·5% DC and 2·5% AC. Mirror scale.
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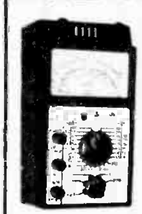

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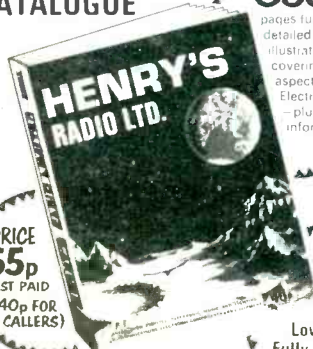

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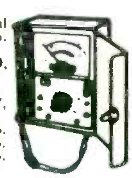

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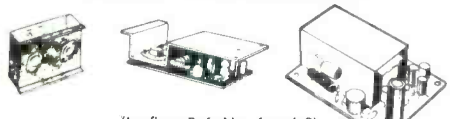

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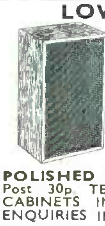

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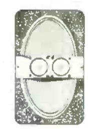

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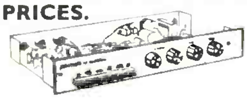

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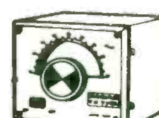

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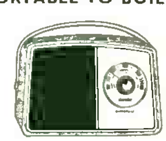

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