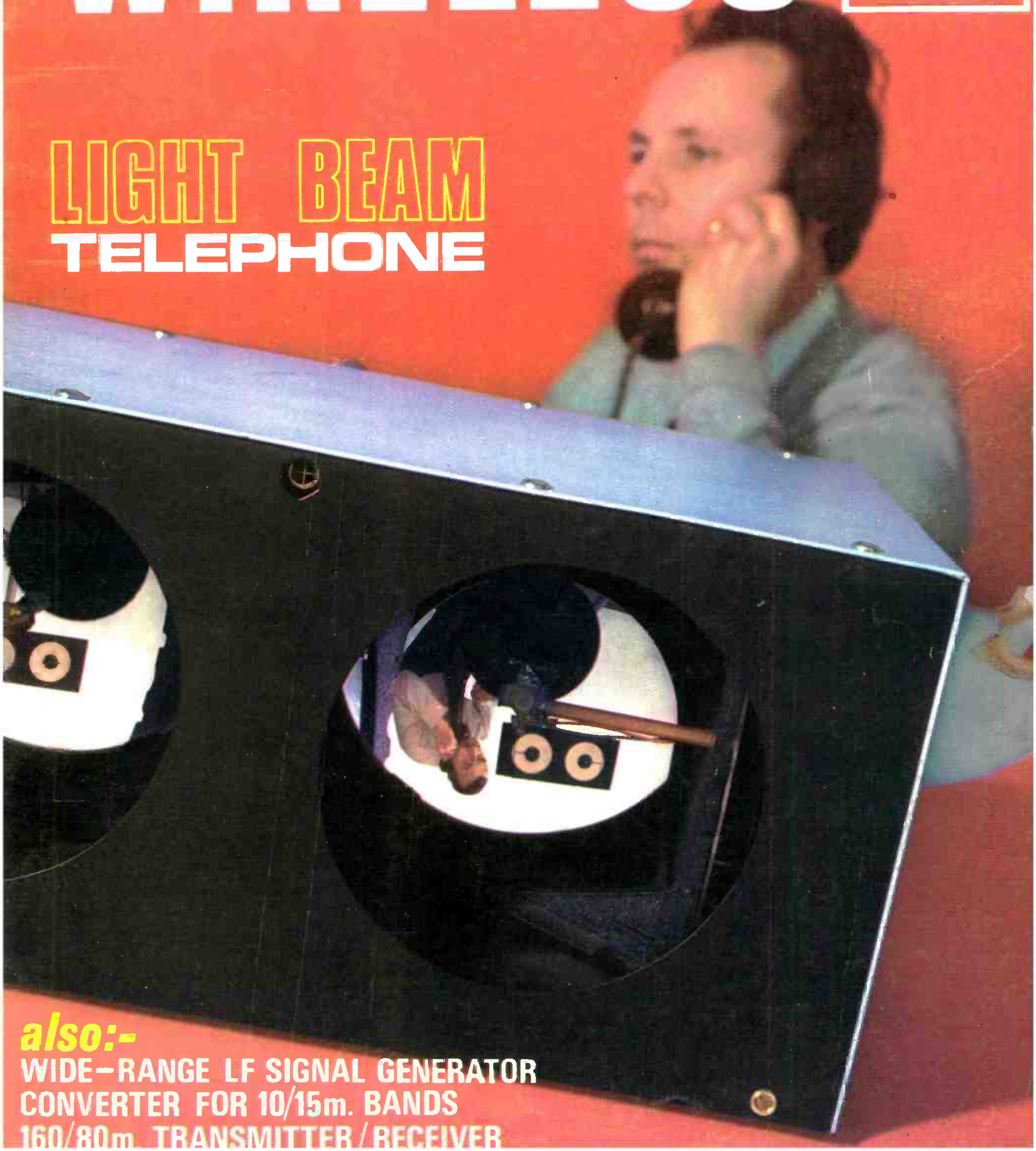
PRACTICAL WIRELESS

JUNE 1970

3/6



LIGHT BEAM TELEPHONE

also:-

WIDE-RANGE LF SIGNAL GENERATOR
CONVERTER FOR 10/15m. BANDS
160/80m. TRANSMITTER/RECEIVER

COMPLETE STEREO SYSTEM

FOR ONLY 39 GNS

CARRIAGE 35/-

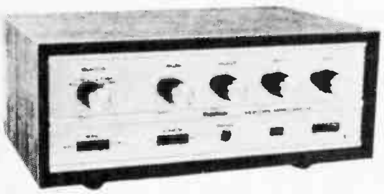
PREMIER STEREO SYSTEM "ONE" Consists of an all transistor stereo amplifier. Garrard 2025 T/C auto manual record player unit fitted stereo mono cartridge and mounted in teak finish plinth with perspex cover and two matching teak finish loudspeaker systems. Absolutely complete and supplied ready to plug in and play. The 10 transistor amplifier has an output of 5 watts per channel with inputs for pick-up, tape and tuner also tape output socket. Controls: Bass, Treble, Volume, Balance, Selector, Power on off, stereo mono switch. Brushed aluminium front panel Black metal case with teakwood ends: Size 12 × 5½ × 3½in. high (Amplifier available separately if required £14.19.6. Carr. 7/6.)

PREMIER STEREO SYSTEM "TWO"

As system 'ONE' above but with Garrard SP25.

PREMIER PRICE **45 Gns.** Carr. 35/-

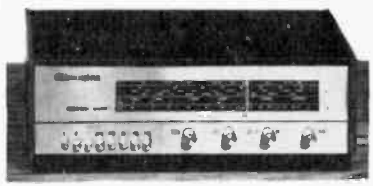
TELETON SAQ203E STEREO AMPLIFIER



A small but powerful amplifier designed for stereo hi-fi reproduction. 10 watts per channel music power. Inputs for Gram (Magnetic and Crystal), Tuner and Auxiliary. Tape Record output. Controls: Volume, Balance, Bass, Treble, Stereo/Mono slide switch. Stereo headphone socket. Attractive oiled walnut cabinet with brushed aluminium front panel. List Price £28.7.0

OUR PRICE **22 Gns.** P. & P. 10/-

ALBA UA100D ALL TRANSISTOR STEREO TUNER AMPLIFIER



Covers Long, Medium and Short Waves plus VHF/FM with built in stereo decoder and A.F.C. Output 15 watts r.m.s. per channel into 8 ohms (distortion less than 0·3%). Response 20Hz–20kHz. Inputs for Magnetic and ceramic p.u. and Tape. Tape outlet socket. Tuning, Volume, Bass, Treble and Balance controls. Push button selector. Black leatherette top, teak ends and brushed aluminium front panel.

PREMIER PRICE **£67.11.6** Carriage 12/6.

"NOVA" 505 STEREO AMPLIFIER

A superb stereo amplifier offering every facility for the hi-fi enthusiast. Output 5 watts per channel. Frequency response 40-20,000 Hz ± 3dB. Inputs for radio, P.U. Ceramic, P.U. Magnetic Tape. Separate bass and treble controls. Volume and Balance controls, Mono Stereo Switch. Also features headphone socket and tape output. Teak case with attractive illuminated front panel. Size 14¼ × 9½ × 3½in. A.C. 200/250V.

WONDERFUL VALUE AT ONLY **18 Gns.** Carr. 10/-.

PREMIER STEREO SYSTEM "FOUR"

Teleton SAQ203E Amplifier (as above)	£23.2.0
Garrard SP25	£11.19.6
Shure M3D	£6.19.6
Teak base and cover	£5.10.0
Pair of Hi-Fi Enclosures fitted E.M.I. Speakers	£26.5.0
Total cost if purchased separately	£73.16.0

PREMIER PRICE **65 Gns.** Carr. 35/-

PREMIER STEREO SYSTEM "FIVE"

Alba UA100D Tuner/Amplifier	£67.11.6
Garrard SP25	£11.19.6
Shure M3D	£6.19.6
Teak base and cover	£5.10.0
Pair of Hi-Fi Enclosures fitted E.M.I. Speakers	£26.5.0
Total cost if purchased separately	£118.5.6

PREMIER PRICE **£110** Carr. 35/-.

PREMIER STEREO SYSTEM "THREE"

Nova 505 Amplifier (as above)	£18.18.0
Garrard SP25	£11.19.6
Sonotone 9TAHCD	£2.15.0
Teak base and cover	£5.10.0
Pair of Hi-Fi Enclosures fitted E.M.I. Speakers	£26.5.0
Total cost if purchased separately	£65.7.6

PREMIER PRICE **55 Gns.** Carr. 35/-

VERITAS V-149 MIXER

Battery operated 4-channel audio mixer providing four separate inputs. Size 6 × 3 × 2in. suitable for crystal microphone low impedance microphone, with transformer, radio, tape, etc. Max. input 1·5v. Max. output 2·5v. Gain 6 dB. Standard jack plug socket inputs, phonoplugs output. Attractive teak wood grain finish case.

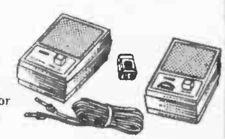
MONO MODEL **59/6** STEREO MODEL **69/6** P. & P. 2/6.

VERITAS V-313 TAPE HEAD DEFLUXER

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

34/6 P. & P. 1/6.

TWO STATION TRANSISTOR INTERCOMS.



Complete with battery and 50ft. connecting wire. Compact size, two way call system. Ideal for home office, factory, etc.

65/- P. & P. 4/-.

"VERITONE" RECORDING TAPE

SPECIALLY MANUFACTURED IN U.S.A. FROM EXTRA STRONG PRE-STRETCHED MATERIAL. THE QUALITY IS UNEQUALLED. TENSILISED to ensure the most permanent base. Highly resistant to breakage, moisture, heat, cold or humidity. High polished splice free finish. Smooth output throughout the entire audio range. Double wrapped–attractively boxed.

LP3	3″	250′	P.V.C.	5/6	LP6	5¾″	1200′	P.V.C.	12/6
TT3	3″	450′	POLYESTER	7/6	DT6	5¾″	1800′	POLYESTER	22/6
DT3	3¼″	600′	POLYESTER	11/6	TT6	5¾″	2400′	POLYESTER	37/6
SP5	5″	600′	P.V.C.	8/6	SP7	7″	1200′	P.V.C.	12/6
LP5	5″	900′	P.V.C.	10/–	LP7	7″	1800′	P.V.C.	15/–
DT5	5″	1200′	POLYESTER	15/–	DT7	7″	2400′	POLYESTER	25/–
					TT7	7″	3600′	POLYESTER	50/–

TAPE SPOOLS 3″ 1/-, 5″, 5¾″, 7″ 1/9.
Post and Packing 3″ 1/-, 5″, 5¾″, 1/6, 7″ 2/-. (3 reels and over Post Free).

TAPE CASSETTES

C60 (60 min.) 7/6 THREE FOR 21/-
C90 (90 min.) 12/6 THREE FOR 36/-
C120 (120 min.) 17/6 THREE FOR 51/-
P. & P. 1/-.

CASSETTE HEAD CLEANER

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

11/6 P. & P. 1/-.

PREMIER RADIO

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

OXFORD ST. 23 TOTTENHAM COURT RD. DOMINION

Laskys

SCOOP Garrard 3000

CUSTOM UNIT *BY FAMOUS BRITISH MANUFACTURER*

A deluxe custom styled and built record player unit made by world famous British manufacturer. The unit incorporates the renowned Garrard 3000 four speed autochanger with lightweight tubular pick-up arm **FITTED WITH SONOTONE 9TA STEREO CARTRIDGE with diamond stylus.** The beautifully made plinth is finished in richly figured teak veneer with tinted perspex panels in the lid and with attractive charcoal grey "mirror" insert panel on front. All metal trim parts are satin chrome. Blackleather grain underside. The lid allows the player to operate fully automatically when closed and has snap action "stay" when raised. Mains socket and 5 pin DIN audio output socket are at rear. Overall size $15\frac{3}{4} \times 7\frac{3}{4} \times 14$in.

LASKY'S SPECIAL PRICE £16.15.0 Post 15/

AUDIO-TECHNICA

SPECIAL OFFER

AT-35X Stereo magnetic cartridge with elliptical diamond stylus. Frequency response 20–25 kHz ±2 dB. Channel separation 30 dB. Output 5mV. **List Price £24.4.9.**

LASKY'S PRICE £17.10.0 Post Free

Also available AT-35 stereo magnetic cartridges with either 0·5 or 0·7 mil diamond stylus assemblies. List Price £18.10.0.

Lasky's Price £13.10.0. Post Free.

AT-33 Stereo magnetic cart.—frequency response 20–20 kHz with 0·7 mil diamond stylus. Output 5mV. List £10.14.3.

LASKY'S PRICE £7.19.6

ADC 40 PRECISION PICK–UP ARM

The ADC 40 Mk II is a complete low inertia arm with side thrust compensator and anti-drag lead out arrangement. Single-thrust ball bearings used at four points. Accurately machined walnut non-resonant arm. Adjustable counter-weight. Plug-in head shell accomodates nearly all cartridges. Easy installations. Built-in arm rest. Arm length $10\frac{5}{8}$ in. overall. Pivot to stylus tip 9 in. Rear overhang $1\frac{3}{4}$ in.

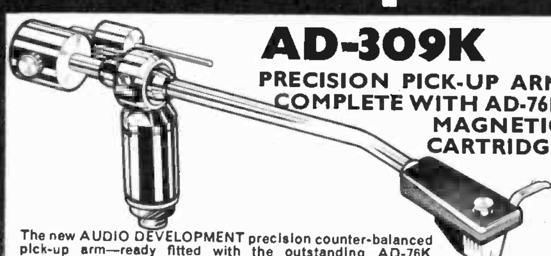
List Price £19.1.6

LASKY'S PRICE £8.19.6 Post 3/6

Audio Development

AD-309K

PRECISION PICK-UP ARM COMPLETE WITH AD-76K MAGNETIC CARTRIDGE



The new AUDIO DEVELOPMENT precision counter-balanced pick-up arm—ready fitted with the outstanding AD-76K magnetic cartridge is constructed of brass throughout, heavily chrome-plated; uses needle and miniature ballrace bearings; both coarse and fine balance adjustment is provided. The fixed head has standard $\frac{1}{2}$in. mounting centres and is finished in black enamel with chrome lifting spur. Completely wired, with all fixing nuts and washers. Arm rest also supplied. Tech. details: Overall length 285mm.; needle to pivot length 223mm.; offset angle 24°; overhang 10mm. Requires single $\frac{7}{16}$in. dia. mounting hole.

LASKY'S PRICE **£9.19.6** Post 3/6

AUDIO DEVELOPMENT AD-76K

Stereo magnetic cartridge with diamond stylus
Frequency response 20-20,000Hz. 5mV output.
Replacement diamond stylus Model JS P1 38/6

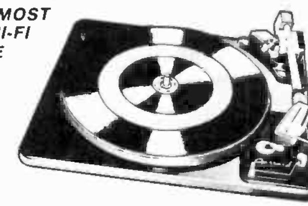
90/- Post Free

Garrard

SP.25 Mk II

FROM STOCK

THE U.K.'s MOST POPULAR HI-FI TURNTABLE



4-speed single record playing deck features include: heavy precision-built turntable, pick-up arm bias compensation, calibrated stylus-force adjustment, cueing device. After play, the arm automatically rises, returns to rest and switches off motor. Finish: dark green polychromatic and silver.

LASKY'S PRICE £11.19.6

SP. 25 Mk.11 with A.D.76K Stereo Magnetic Cartridge £15 10 0

OTHER GARRARD UNITS FROM STOCK

AUTOCHANGERS

SL72B	£25 0 0	**SL65B**	£15 19 6
2025TC with stereo cartridge	£8 17 6	**1025** with stereo cartridge	£6 19 6
3000 complete with 9TAHC stereo cartridge	£9 19 6	**SL95B**	£40 0 0
		SL75B	£32 0 0

SINGLE PLAYERS

AP 75, £16.10.0 AP75 with AD76K mag. cart., **£21.10.0. 401** Transcription Unit, **£28.0.0**

BASES AND COVERS FOR GARRARD UNITS

Type **WB1** and **WB5** for models 2025TC.3000, SL65B 1025, SP25 Mk II **Price WB1** £3.16.6. **WB5** £5.12.6. Type **WB4** for models SL72B, SL75B, SL95B **Price £5.12.6. Perspex covers:** **SPC1** for WB1, £3.14.1. **SPC4** for **WB4** and **WB5** (allows unit to be played with the cover in place)—price **£4.8.0.**

PACKAGE DEALS

AP75 complete with **AD76K** Stereo magnetic cartridge, teak plinth and perspex cover **£30.0.0** Post 10/–

SP25 Mk II complete with **AD76K** cartridge, teak plinth and perspex cover **£19.0.0** Post 7/6

1025 complete with **J2105** stereo ceramic cart., teak plinth and perspex cover **£11.19.6** Post 7/6

Post on Garrard units: 8/– extra—except AP75, SL75B, SL95B and 401 7/6 extra. Post on bases and covers 5/– extra.

SPECIAL OFFER—BSRUA-15

4 speed autochangers with modified tubular tone arm. Comp. with stereo cart. **£46.19.6** Post 5/-

SKYROVER MkII

COMMUNICATION RECEIVER

A short wave receiver, exclusive to Lasky's, at a real economy price. Four valve line up using one each 6BE6, 6BA6, 6AV6 and 6AR5 valves, gives highly sensitive reception and powerful gain. Switch selected SW frequency range cover: 1·5 to 30 MHz in three separate band-spread ranges and full AM medium waveband cover in one range 550-1,600KHz. Reduction drive tuning with hair line cursor. Controls include volume on/off BFO, Band selector. Power-on indicator lamp. External antenna connections and mains fuse at rear. Internal speaker plus standard 5mm jack socket for phones on front. For 220/240V a.c. mains operation. Strong metal cabinet finished in grey crackle with anodised silver front panel. Size $9\frac{1}{2} \times 5\frac{3}{4} \times 5\frac{1}{2}$in. Complete with mains lead and full instructions.

THE IDEAL BEGINNERS RECEIVER

LASKY'S PRICE ONLY **£13.13.0** Post 5/–

Audio Tronics 70

The 1970 edition of Lasky's famous Audio-Tronics catalogue is now available—FREE on request. The 28 tabloid pages—many in full colour are packed with 1000's of items from the largest stocks in Great Britain of everything for the Radio and Hi-Fi enthusiast. Electronics Hobbyist, Servicemen and Communications Ham. Over half the pages are devoted exclusively to every aspect of Hi-Fi (including Lasky's budget Stereo Systems and Package Deals). Tape recording and Audio accessories. All the goods shown are available from any of our branches or by Mail Order to any address in the U.K. or Overseas—bringing the benefits of shopping at Lasky's to you in the comfort of your home. **plus Lasky's amazing money saving vouchers worth over £25 0s. 0.**

SEND TODAY

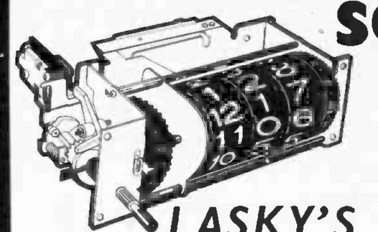
Send: Your name, address and 2/0 for the post only and inclusion of your name on our regular mailing list

THIS MONTHS

VOUCHER WORTH 40/-!

JUST ARRIVED

DIGITAL CLOCK SCOOP!



LASKY'S FIRST AGAIN!

- MADE ESPECIALLY FOR LASKY'S BY FAMOUS MAKER
- MAINS OPERATION
- 12 HOUR ALARM
- AUTO "SLEEP" SWITCH
- HOURS, MINUTES AND SECONDS READ-OFF
- FORWARD AND BACKWARD TIME ADJUSTMENT
- SHOCK AND VIBRATION PROOF
- BUILT IN ALARM BUZZER
- SILENT OPERATION SYNCHRONUS MOTOR

This unique DIGITAL CLOCK is now available **EXCLUSIVELY FROM LASKY'S** in chassis form for you to mount in any housing that you choose. All settings are achieved by two dual-concentric controls at the front including: ON-OFF-AUTO and AUTO ALARM, "sleep" switch, 10 minute division "click" set alarm (up to 12 hour delay), time adjustment. Ultra simple mechanism and high quality manufacture guarantee reliable operation and long life. The sleep switch will automatically turn off any appliance—radio, TV, light etc. at any pre-set time up to 60 min. and in conjunction with the AUTO setting will switch on the appliance again next morning. The clock measures 4⅝W x 1⅞H x 3⅞D (overall from front of drum to back of switch). SPEC: 210/240V AC, 50Hz operation; switch rating 250V. 3A. Complete with instructions. **HUNDREDS OF APPLICATIONS FOR THE ELECTRONICS HOBBYSIT.**

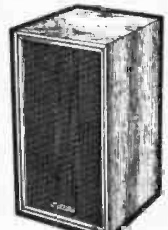
LASKY'S PRICE **£6.19.6** POST 3/6

SPECIAL QUOTATIONS FOR QUANTITIES

EXCLUSIVE

FOSTER "Criterion" MkII

HIGH FIDELITY BOOKSHELF SPEAKER

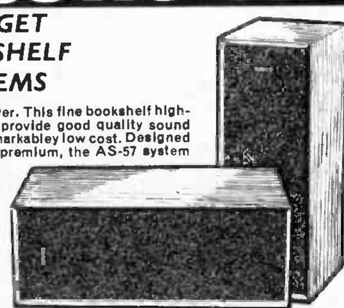


Another high quality bookshelf system from Foster. The "Criterion" MkII is a sealed infinate baffle type enclosure using 5½in. bass/mid-range woofer with rolled cloth edge and a 2½in. HF cone type tweeter. The compact cabinet is constructed of ½in. laminate with handsome oiled walnut veneer finish and black woven acoustic gauze—front panel with satin chrome edge insert. SPEC: Frequency range 90-20,000Hz. Power Handling 10 watts. Impedance 8 ohms. HF cross-over. Screw Tag connections at rear. Size 12½ x 7½ x 6½in. The performance of the "Criterion" is superior to many larger and more expensive units and at Lasky's exclusive price offers absolutely unbeatable value.

LASKY'S PRICE **£9.10.0** *or 2 for* **£17.10.0** Post 1—7/6 2—10/-

SONICS AS-57

ELEGANT BUDGET PRICED BOOKSHELF SPEAKER SYSTEMS



The AS-57 is a real space saver. This fine bookshelf high-fidelity speaker system will provide good quality sound anywhere in your home at remarkabley low cost. Designed for use where space is at a premium, the AS-57 system is ideal for the small apartment or isolated area. The special high efficiency 5 x 7in. full range speaker has a frequency range of 70–18,000 Hz with a peak handling capacity of 10 watts. Imp. 8 ohms. Finish: oiled walnut. Size: 5½ x 15½ x 8½in.

LASKY'S PRICE **£15 per PAIR** Post 10/-

COLOUR + SOUND

DJ LIGHT CONTROL UNITS

These two psychedelic light control units may be fed from the speaker output of the Amplifier although drawing virtually no signal themselves, they are suitable for connection across a 60 watt max. amplifier. The signal is fed to a thyristor light control unit. (In the case of the DJ30L, the signal is split 3 ways, bass, middle, and top, to independent thyristor circuits). Independent intensity controls and lights-on over-ride switches are provided. Outputs are to 5A 2 pin sockets on the back of the instrument. Main on/off switches and pilot lights are provided. Specs: DJ10L. Single channel thyristor control. 1000 watts max. light output. Input level equivalent to 60 watts RMS into 15 ohms, or similar voltage. 220-250V, 50-60 Hz. Size 6 x 6 x 5½in. DJ30L 3 channel thyristor control (built-in cross-over). 1000 Watts max. light output. Per channel (de-rate to 600 watts per channel when all three channels are used simultaneously) 220/250V, 50-60 Hz. Size 6 x 10 x 5½in. Complete with instructions. Both units are panel mounting with brushed aluminium front panel.

DJ 10L **£19.10.0** Post 3/6

DJ 30L **£37.10.0** Post 5/-

NEW EAGLE LIGHT CONTROL UNIT NOW AVAILABLE £11.19.6 Post 3/6

NEW BRANCH

We have pleasure in announcing the opening of yet another Lasky's Audio, Electronics and Hi-Fi Centre— **109 FLEET STREET, E.C.4.**

Here you will find the customarily wide range of everything for the audio, Hi-Fi and tape recording enthusiast, electronics hobbyist and communications ham. An especially comprehensive range of high fidelity equipment is presented for easy comparison. *We look forward to welcoming you at our newest city branch.*

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FABULOUS VALUE

TRANSISTORISED STEREO HI-FI RECORD PLAYER

Build your own Hi-Fi Record Player with the Serenade fully transistorised amplifier which comes complete with 2-10" x 6" speakers and the latest BSR 4 Speed Stereo/Mono Record Changer.
Advanced solid state amplifier only 4½" deep, 14 transistors plus 4 diodes, separate Bass and Treble – 10 watts total power. Frequency response 50-15,000 c/s.
EASY TO INSTALL
NO TECHNICAL KNOWLEDGE REQUIRED

Only **28** Gns. + P&P 17/6

Credit terms available, first monthly payment £3.6.2 followed by 9 monthly payments of £3.6.2. (Total "Credit Sale" Price £33.1.8). Send £4.3.8 today.

FANTASTIC BARGAIN OFFER!

"TRANSCONTINENTAL"
FULLY TRANSISTORISED STEREOPHONIC RADIOGRAM CHASSIS

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

10 Watts Total output
17 Transistors & 10 diodes **£36.10.0** P&P 17/6

EASILY FITTED NO TECHNICAL KNOWLEDGE NECESSARY

Credit Terms available. First monthly payment £4.2.2 followed by 9 monthly payments of £4.2.2. (Total "Credit Sale" Price £41.1.8.) Send £4.19.8 today.

Callers Welcome

POST THIS COUPON NOW!

PLEASE SEND ME FREE DETAILS OF YOUR RANGE

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Address ....

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Kinver for Components

SILICON TRANSISTORS FOR HIGH QUALITY EQUIPMENT

BC107	3/3	BD123	24/3	TIP32A	23/–	2N3055	15/9
BC108	3/–	BDY20	24/3	TI844	1/9	2N3702	3/6
BC109	3/3	BF184	7/6	TI849	2/6	2N3703	3/3
BC158	7/6	BF194	7/–	TI850	3/9	2N3704	3/9
BC182L	3/2	BFX29	10/4	2N696	4/9	2N3705	3/4
BC183L	2/5	BFX84	6/8	2N697	5/–	2N3707	4/–
BC184L	3/2	BFX85	8/8	2N706	3/3	2N3708	2/5
BC212L	3/9	BFY50	5/–	2N1132	10/9	2N3819	9/–
BC213L	3/9	BFY51	4/6	2N2906	13/–	2N3820	18/9
BC214L	4/–	BFY52	5/–	2N2924	4/4	2N3826	5/11
BCY70	5/4	BSY95A	3/11	2N2925	5/3	2N4058	4/6
BCY71	10/4	MJ481	27/3	2N2926	3/–	2N4059	3/5
BCY72	4/6	MJ491	32/11	2N3053	6/8	2N5457	9/9
BD121	17/3	TIP31A	17/–				

1 WATT AMPLIFIER MODULE TYPE PCM1

This amplifier unit is a printed circuit module incorporating the popular and well tried PA234 i.c. amplifier. The unit is a complete AUDIO AMPLIFIER and requires no external components, you simply connect an 18 volt power supply and a 15 or 16 ohm speaker or head phone, even the supply smoothing capacitor and the output capacitor are included! The overall dimensions, including capacitors are 2½" x 3" x ⅝". The input for 1 watt output at 1kHz is typically 300mV into 100 kohms.
This unit is available at only 36/– net complete with descriptive leaflet or 70/– net per pair. Send for free leaflet.

ELECTRONIC COMPONENTS IN THE WEST MIDLANDS

A wide range of components are available from stock for CALLERS, including the following:
RESISTORS (includes 5% ½ watt, High stabs at only 2d. each in 100+ quantities of MIXED values of your choice in the E 12 series from 10 ohm to 10 Mohm)
CAPACITORS (includes Polyesters, polystyrene, metallised film, miniature electrolytics, silver micas). SEMICONDUCTORS, (includes Integrated circuits, transistors, diodes, rectifiers).
PLUS ALL the usual components such as plugs & sockets, pots, Veroboard, etc.

WE ARE AN INTERNATIONAL RECTIFIER SEMICONDUCTOR CENTRE

Mail order, 1/6 P & P per order inland, Overseas at cost. min. 10/–. Open 9.00 a.m. to 12.50 p.m. 2.00 p.m. to 5.00 p.m. Weekdays, 9.00 p.m. to 12.50 p.m. Saturdays. Please note, we will be closed for annual holiday from June 1 to June 6 inclusive.

Kinver ELECTRONICS LTD
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STOURBRIDGE WORCS
Telephone: KINVER 2099

Peerless

PEERLESS FABRIKKERNE A/S
COPENHAGEN · DENMARK

HIGH FIDELITY LOUDSPEAKER KIT SYSTEMS FOR THE HOME CONSTRUCTOR

KIT 2-8
Max. Power Input .... 10 watts.
Frequency Range .... 50-18,000 Hz in 0.57 cu. ft cabinet.
Woofer .... B 65 W.
Tweeter .... MT 25 HFC
Cross-over Frequency .... 4000 Hz.
Delivered with components for dividing network and drawing for cabinet.
Price .... **£6-14-0** incl. tax.

KIT 3-25
Max. Power Input .... 25 watts.
Frequency Range .... 40-18,000 Hz in 3½ cu. ft. cabinet.
Woofer .... CM 120 W.
Mid-range .... G 50 MRC.
Tweeter .... MT 20 HFC
Cross-over Frequencies 750 & 4000 Hz.
Delivered with ready-wired cross-over network and cabinet leaflet.
Price **£15-17-6**

KIT 3-15
Max. Power Input .... 15 watts.
Frequency Range .. 45-18 000 Hz in 1.06 cu. ft. cabinet.
Woofer .... P 825 W.
Mid-range .... GT 50 MRC
Tweeter .... MT 20 HFC
Cross-over Frequencies 750 & 4000 Hz.
Delivered with components for dividing network and cabinet leaflet.
Price .... **£12-9-5** incl. tax.

KIT 20-2
Max. Power Input .... 30 watts.
Frequency Range .... 40-20,000 Hz in 0.7 cu. ft. cabinet.
Woofer .... L 825 WG.
Tweeter .... MT 225 HFC
Cross-over Frequency .. 2500 Hz.
Delivered with ready-wired cross-over network and cabinet handbook.
Price .... **£12-12-6** incl. tax.

KIT 3-25

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GOODMANS Maxamp	£54 0 0	£44 19 6
LEAK Stereo 30 Plus	£53 0 0	£43 19 6
LEAK Stereo 30 Plus in teak case	£59 10 0	£47 19 6
LEAK Stereo 70	£65 0 0	£53 19 6
LEAK Stereo 70 in teak case	£71 10 0	£57 19 6
LINEAR LT.66	£18 18 0	£15 19 6
PHILIPS RH 591	£73 0 0	£56 1 6
PHILIPS RH 590	£49 0 0	£37 12 6
PHILIPS RH 580	£26 0 0	£19 19 6
PHILIPS 580	£26 0 0	£19 19 6
PHILIPS 590	£49 0 0	£37 12 6
PHILIPS 591	£73 0 0	£55 19 6
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QUAD 303 Main Amplifier	£55 0 0	£47 19 6
ROGERS Ravensbourne	£59 10 0	£48 19 6
ROGERS Ravensbourne in teak case	£64 0 0	£52 13 6
ROGERS Ravensbrook	£44 0 0	£36 19 6
ROGERS Ravensbrook in teak case	£49 0 0	£38 19 6
ROGERS Ravensbrook (Chassis)	£45 0 2	£39 19 6
ROGERS Ravensbrook (Chassis) in teak case	£51 5 3	£42 19 6
SINCLAIR 2000	£30 9 0	£24 19 6
TELETON 203E	£28 7 6	£21 15 6
TRUVOX TSA.200	£54 12 0	£35 19 6
TUNERS		
ARENA F211 with decoder	£39 10 0	£33 19 6
ARMSTRONG 523 AM/FM	£52 9 0	£44 19 6
ARMSTRONG 524 FM	£40 4 6	£34 19 6
ARMSTRONG M8 decoder	£9 10 0	£7 19 6
DULCI FMT.7 FM	£22 1 0	£17 19 6
DULCI FMT.7S Stereo	£31 0 0	£25 5 0
GOODMANS stereomax	£82 10 5	£71 19 6
LEAK Troughline with MPX	£51 10 6	£39 19 6
LEAK Stereofetic Chassis	£59 18 0	£51 19 6
LEAK Stereofetic in teak case	£67 3 6	£57 10 0
PHILIPS RH 690	£39 0 0	£33 2 6
PHILIPS 690	£39 0 0	£32 19 6
QUAD Stereo FM	£51 0 0	£39 19 6
ROGERS Ravensbourne Tuner with Decoder	£61 17 9	£52 12 6
SINCLAIR 2000	£26 14 6	£19 4 6
TRUVOX FM 200/IC with decoder	£60 11 10	£39 19 6
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ARENA 2400 with MPX	£90 6 0	£69 19 6
ARENA 2600 Stereo AM/FM with MPX	£111 6 0	£94 0 0
ARENA 2700 Stereo FM with MPX decoder	£105 0 0	£85 0 0
ARENA T1500F with MPX	£72 9 0	£59 19 6
ARENA T9000 with MPX	£303 9 0	£258 0 0
ARMSTRONG 525	£87 16 9	£66 19 6
ARMSTRONG 526	£98 15 6	£79 19 6
ARMSTRONG 127	£43 19 9	£37 19 6
(Teak Case for 127)	£3 17 0	£3 10 0
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GOODMAN 3000 suite	£140 9 0	£117 0 0
WYNDSOR System	£59 19 6	£49 19 6
VIDEORAMA	£42 19 6	£35 0 0
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Goldring 800H	£10 13 9	£8 10 6

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Goldring 800 Super E	£26 0 1	£20 15 0
Goldring G850	£6 10 0	£5 10 0
Goldring CS90 Stereo Ceramic Cartridge	£5 4 0	£4 3 0
Goldring CS91/E	£7 16 1	£6 4 6
Pickering V15 AC2	£8 8 0	£6 19 6
Ortofon SL 15E	£29 12 11	£23 12 11
Ortofon 2X 15K	£7 0 0	£5 5 4
Shure M3DM	£7 8 3	£6 8 3
Shure N3D	£5 11 2	£4 8 8
Shure M31E	£12 19 5	£10 6 0
Shure N31E	£9 5 3	£7 8 6
Shure M32E	£12 0 11	£9 12 0
Shure N32E	£8 6 9	£6 13 0
Shure M32-3	£11 2 4	£8 17 6
Shure N32-3	£6 9 8	£5 3 6
Shure M44-5	£11 2 4	£8 17 6
Shure N44-5	£7 8 3	£6 8 3
Shure M44-7	£10 3 10	£8 5 0
Shure N44-7	£6 9 8	£5 3 6
Shure M44-C	£10 3 10	£8 5 0
Shure N44-C	£6 9 8	£5 3 6
Shure M44E	£14 16 6	£11 16 6
Shure N44E	£10 3 10	£8 5 0
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Shure N55E	£11 2 4	£8 17 6
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Shure N75G	£9 5 3	£8 17 6
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PHILIPS 228	£19 19 6	£16 19 6
PHILIPS GA 146	£29 19 6	£24 19 6
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ARENA HT 7	£19 19 0	£17 0 0
ARENA HT 10	£22 1 0	£18 19 6
ARENA HT 20	£32 11 0	£26 19 6
ARENA HT 26	£78 15 0	£65 19 6
B & W DM3	£63 0 0	£53 6 0
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DULCI AS 3	£8 8 0	£6 19 6
GOODMANS Majesta	£57 0 0	£48 19 6
GOODMANS Maxim	£20 7 9	£15 19 6

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Rosedale	£59 10 0	£48 19 6
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Goodmans ARU 172	£3 17 8	£2 18 6
Goodmans Trebax 100	£7 9 0	£5 11 6
Goodmans Trebax 5K/20KL	£8 8 0	£6 6 0
Goodmans Midax	£11 4 0	£8 8 0
Goodmans Attenuator	£3 1 4	£2 6 0
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Goodmans Crossover Networks XO/950	£6 7 9	£4 15 9
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Wharfedale 8" Bronze/RS/DD	£4 8 0	£3 13 6
Wharfedale Super 8/RS/DD	£7 12 0	£6 6 0
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AKAI 1800	£158 0 0	£133 0 0
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NKT449	8/6
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NKT452	7/6
NKT453	6/-
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NKT677	5/-
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OA5	3/-
OA7	4/-

OA9	3/-
OA10	4/-
OA47	2/-
OA70	2/-
OA71	2/-
OA73	2/-
OA74	2/-
OA79	2/-
OA81	2/-
OA85	2/6
OA86	4/-
OA90	2/-
OA91	1/6
OA95	1/6
OA200	1/9
OA202	2/-
OA210	6/-
OA211	9/6
OAZ200	11/-
OAZ201	10/-
OAZ202	8/6
OAZ203	8/6
OAZ204	8/6
OAZ205	8/6
OAZ206	8/6
OAZ207	9/6
OAZ208	6/6
OAZ209	6/6
OAZ210	6/6
OAZ211	6/6
OAZ212	6/6
OAZ213	9/6
OAZ222	9/6
OAZ223	9/6
OAZ229	9/6
OAZ231	9/6
OAZ238	9/6
OAZ241	4/6
OAZ223	7/6
OAZ224	7/6
OAZ225	7/6
OAZ228	7/6
OAZ234	7/6
OAZ242	4/6
OAZ244	4/6
OAZ245	4/6
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OAZ247	4/6
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OAZ291	7/6
OAZ292	7/6
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OC29	12/6
OC35	10/-
OC36	12/6
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OC42	6/-
OC43	8/-
OC44	4/-
OC44M	4/-
OC45	3/6
OC45M	3/6
OC46	5/6
OC57	12/-
OC58	12/-
OC59	13/-
OC70	3/-
OC71	3/-
OC72	5/-
OC73	6/-
OC74	6/-
OC75	5/-
OC76	5/-
OC77	8/-
OC78	5/-
OC78D	2/6
OC79	4/6
OC81	5/-
OC81D	4/-
OC81M	5/-
OC81DM	3/-
OC81Z	7/6
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NEW! roamer eight mkI

WITH VARIABLE TONE CONTROL

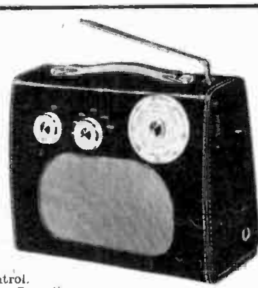
7 Tunable Wavebands: Medium Wave 1, Medium Wave 2, Long Wave, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for Medium and Long Waves. Five section 22in. chrome plated Telescopic aerial for Short Waves can be angled and rotated for maximum performance. Push pull output using 600 mW transistors.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

Total Building Costs **£6.19.6**

P & P 7/6.

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

roamer seven mkIV



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

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

NEW! trans eight

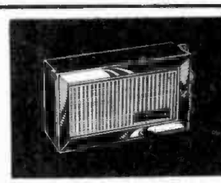
SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case in black with red grille and cream knobs and dial with polished brass inserts. Size 9 x 5½ x 2⅝in. approx. Tunable on Medium and Long Waves, three Short Waves and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. Eight improved type transistors plus 3 diodes. Push pull output. Ample power to drive a larger speaker. Parts price list and easy build plans 5/- (FREE with parts). Earpiece with switched socket for private listening 5/- extra.

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

pocket five

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER

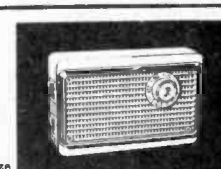


Attractive black and gold case. Size 5¼ x 1¼ x 3½in. Tunable over both Medium and Long Waves with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Easy build plans and parts price list 1/6 (FREE with parts).

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

transona five

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER AND EARPIECE

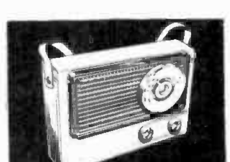


Attractive case with red speaker grille. Size 6¾ x 4¾ x 1½in. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker also Personal Earpiece with switched socket for private listening. Easy build plans and parts price list 1/6 (FREE with parts).

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

roamer six

SIX WAVEBAND PORTABLE WITH 3in. SPEAKER



Attractive case with gilt fittings. Size 7¼ x 5¼ x 1¾in. Tunable on Medium and Long waves, two short waves, Trawler Band Plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short waves. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors etc. (Carrying strap 1/6 extra). Easy build plans and parts price list 2/-. (FREE with parts).

Total building costs **79/6** P. & P. 4/6

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POCKET FIVE	☐	ROAMER SIX	☐

Parts price list and plans for ....

Name ....

Address ....

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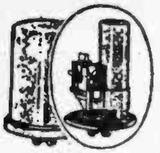
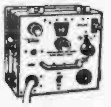
CAR LIGHT FLASHERS



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

CLASS D WAVEMETERS



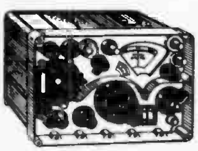
A crystal controlled heterodyne frequency meter covering 1·7-8 Mc/s. Operation on 6 volts D.C. Ideal for amateur use. Available in good used condition. £5.19.6. Carr. 7/6. Or brand new with accessories. £7.19.6. Carr. 7/6.

CLASS D WAVEMETERS No. 2

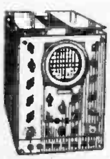
Crystal controlled. 1·2-19 Mc/s. Mains or 12V. D.C. operation. Complete with calibration charts. Excellent condition. £12.10.0. Carr. 30/-.

R209 MK II COMMUNICATION RECEIVER

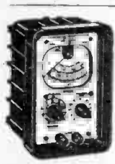
11 valve high grade communication receiver suitable for tropical use. 1·20 Mc/s on 4 bands. AM/CW/FM operation. Incorporates precision vernier driver, B.F.O., aerial trimmer, internal speaker and 12v. D.C. internal power supply. Supplied in excellent condition, fully tested and checked £15.0.0. Carr.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



TYPE 13A DOUBLE BEAM OSCILLOSCOPES



An excellent general purpose D/B oscilloscope. T.B. 2 cps-750 Kc/s. Bandwidth 5.5 Mc/s. Sensitivity 33mV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. £22.10.0. Or complete with all accessories, probe, leads, lid, etc. £25. Carriage 30/-.



MARCONI T/44/TF956

AF Absorption Wattmeter

1 μ/watt to 6 watts.

£20. Carr. 10/-.

SOLARTRON CD 711S2

Double Beam Oscilloscopes

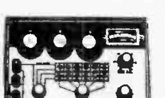
D.C. to 9 Mc/s. Perfect order £65. Carr. 50/-

(Few available less C.R.T.) £25 Carr. 50/-

TO-3 PORTABLE OSCILLOSCOPE

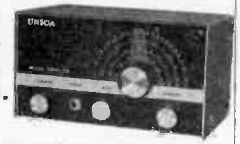
3in. tube. Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps-1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1.5 cps -800KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps-300 KHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½ lb. 220/240V. A.C. Supplied brand new with handbook. £37.10.0. Carr. 10/-.

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



A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 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. 5/-.

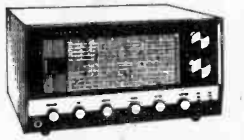
UNR-30 4-BAND COMMUNICATION RECEIVER



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

TRIO JR.310 New Amateur Band 10-80 Metre Receiver in stock. £77.10.0.

LAFAYETTE SOLID STATE HA600 RECEIVER



5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE 150 Kc/s-400 Kc/s and 550 Kc/s-30 Mc/s F E T front end ● 2 mechanical filters ● Huge dial ● Product detector ● Variable BFO ● Noise limiter ● S meter ● 24in Bandspread ● 230V. A.C./12V. D.C. neg. earth operation ● RF gain control. Size 15in. × 9½in. × 8½in. Weight 18 lbs. EXCEPTIONAL VALUE. £45. Carr. 10/-. S.A.E. for full details.

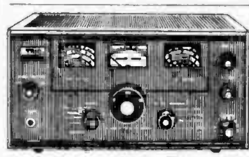
LAFAYETTE HA-800 SOLID STATE AMATEUR COMMUNICATION RECEIVER

Six bands 3·5-4, 7-7·3, 14-14·35, 21-21·45, 28-29·7, 50-54Mc/s. Dual conversion on all bands. 2 × 455 Kc/s mechanical filters. FET front end. product detector, variable BFO. 100Kc/s crystal calibrator. 'S' Meter. Huge slide rule dial. Operation 230V AC or 12V DC. Size 15 × 9½ × 8½in. Complete with instruction manual. £57.10.0 Carr. Paid. 100Kc/s crystal 39/6 extra.

UR-1A SOLID STATE COMMUNICATION RECEIVER

4 bands covering 550 Kc/s—30 mc/s continuous. Special features are use of FET transistors. S meter, built in speaker and telescopic aerial, variable BFO for SSB reception, noise limiter, bandspread control, sensitivity control. Output for low impedance headphones. Operation 220/240 volt A.C. or 12 volt D.C. Size 12¾in. × 4½in. × 7in. Excellent value. ONLY £24. Carr. 7/6.

TRIO COMMUNICATION RECEIVER MODEL 9R-59DE

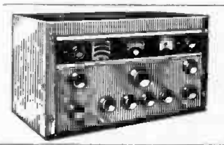


4 band receiver covering 550 Kc/s to 30 Mc/s continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit, 4/8 ohm output and phone jack. SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. bandspread dial ● IF 455 Kc/s ● Audio output 1.5 W. ● Variable RF and AF gain controls. 115/250V. A.C. Mains. Beautifully designed. Size: 7 × 15 × 10in. With instruction manual and service data. £42, carriage paid. TRIO COMMUNICATION TYPE HEADPHONES. Normally £5.19.6. OUR PRICE £3.15.0 if purchased with above reciever.

TRIO JR. 500SE 10-80 Metre Receiver £69.10.0

TRIO TS 510 AMATEUR TRANSCEIVER with speaker and mains P.S.U. £180 IN STOCK!

RCA COMMUNICATIONS RECEIVERS AR88D



Latest release by ministry BRAND NEW in original cases. 110-250v. A.C. operation. Frequency in 6 Bands. 535 Kc/s—32 Mc/s continuous. Output impedance 2·5-600 ohms. Incorporating crystal filter, noise limiter, variable BFO, variable selectivity, etc. Price £65.0.0. Carr. £2.

LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER

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

TELETON CR-10T AM/FM STEREO TUNER AMPLIFIER

A new model from Teleton. 31 solid state devices. 4 + 4 watt output. Inputs for ceramic/crystal cartridge. Frequency range AM 540-1600KHz FM 88-108MHz. Automatic FM Stereo reception. Stereo Indicator. Controls: Tuning, function selector, Tone and R & L volume controls. AFC switch. Stereo headphone socket. Size 13¾" × 3½" × 9¼" approx. PRICE £34.0.0. Carr. 7/6.

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	1-0-1mA 27/6	150mA 27/6	500V. D.C. 27/6
	2mA 27/6	200mA 27/6	750V. D.C. 27/6
	5mA 27/6	300mA 27/6	15V. A.C. 27/6
50μA 40/-	10mA 27/6	500mA 27/6	50V. A.C. 27/6
50-0-50μA 37/6	750mA 27/6	3V. D.C. 27/6	150V. A.C. 27/6
100μA 37/6	1 amp 27/6	10V. D.C. 27/6	300V. A.C. 27/6
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500μA 40/-	20mA 27/6	100V. D.C. 27/6	VU meter 42/-

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Brand new, guaranteed and carriage paid.
High quality construction. Input 230V. 50-60 cycles.
Output full variable from 0-260 volts. Bulk quantities available.
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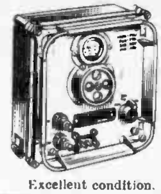
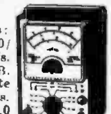
8 amp.—£14.10.0; 10 amp.—£18.10.0; 12 amp—£21.0.0;
20 amp.—£37.0.0.

CRYSTAL CALIBRATORS NO. 10



Small portable crystal controlled wavemeter. Size 7 × 7½ × 4in. Frequency range 500 Kc/s-10 Mc/s (up to 30 Mc/s on harmonics). Calibrated dial. Power requirements 300V. D.C. 15mA and 12V. D.C. 0.3A. Excellent condition. 89/6. Carr. 7/6.

TE-40 HIGH SENSITIVITY A.C. VOLTMETER

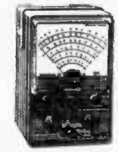


10 meg. input 10 ranges: ·01/·003/·1/·3/1/3/10/30/100/300V. R.N.S. 4cps.-1·2 Mc/s. Decibels -40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. £17.10.0 Carr. 5/-.

LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

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

TE-65 VALVE VOLTMETER



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

COSSOR 1049 DOUBLE BEAM OSCILLOSCOPES

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

AM/FM SIGNAL GENERATORS

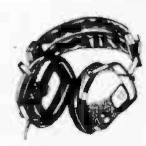
Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20-80 Mc/s. AM CW/FM. Incorporates precision dial, level meter, precision attenuator 1μV-100mV. Operation from 12 volt D.C. or 0/110/200/250 volt A.C. Size 12 × 8½ × 9in. Supplied in brand new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

EDDYSTONE VHF RECEIVERS Model 770R. 19-165 Mc/s. Excellent condition. £150.

PLESSEY SL.403A 3 watt Integrated Amplifier Circuit 49/6. Post paid.

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 × 5¾ × 3¼in. Complete with instructions and leads. £7.19.6. P. & P. 4/-.

HOSIDEN DH-08S DE-LUXE STEREO HEADPHONES



Features unique mechanical 2 way units and fitted adjustable level controls. 8 ohm impedance. 20-20,000cps. Complete with spring lead & stereo jack plug £7.19.6. P. & P. 2/6.

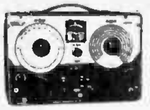
AUTO TRANSFORMERS

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

150 W.	£2. 2.6.	P. & P. 3/6.
300 W.	£2.19.6.	P. & P. 4/6.
500 W.	£4.10.0.	P. & P. 6/6.
1,000 W.	£6.10.0.	P. & P. 7/6.
1,500 W.	£7.19.6.	P. & P. 8/6.
7,500 W.	£15.10.0.	P. & P. 20/-.

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

ARF-100 COMBINED AF-RD SIGNAL GENERATOR



A.F. SINE WAVE 20 – 200,000 c/s. Square wave 20–30,000 c/s. O/P. HIGH IMP. 21V. P/P600 Ω 3.8V. P/P TF 100 Kc/s–300 Mc/s. Variable R.F. attenuation int/ext. modulation. Incorporates dual purpose meter to monitor AF output and % mod. on R.F. 220/240V. A.C. £32.10.0. Carr. 7/6.

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 Kc/s–260 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator. Operation 200/240V. A.C. Brand new with instructions. £15.0.0. P. & P. 7/6, S.A.E. for details.

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

TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20c/s to 200 Kc/s on 4 bands. Square: 20c/s to 30Kc/s. Output impedance 5,000 ohms. 200/250V. A.C. Supplied brand new and guaranteed with instruction manual and leads. £16.10.0. Carr. 7/6.

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

LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYSER

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

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. £22.10.0. Carr. 10/-.

ADVANCE TEST EQUIPMENT

Brand new and boxed in original sealed cartons

J1B. AUDIO SIGNAL GENERATOR. 15 c/s to 50 Kc/s. Sine wave. Output 600 ohms or 5 ohms £30.0.0.

VM79. UHF MILLIVOLT METER. 100 Kc/s to 1,000 Mc/s. AC. 10mV to 3v. DC. 10 mV to 3v. Current 0.01 uA to 0.3 mA. Resistance 1 ohm to 10 megohm. £125.0.0.

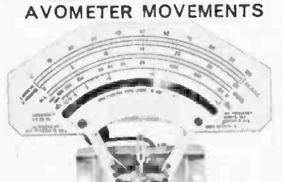
TT18. TRANSISTOR TESTER. Full range of facilities for testing PNP or NPN transistors in or out of circuit. £37.10.0.

Carriage 10/– per item.

HOSIDEN DH04S 2-WAY STEREO HEADSETS

Each headphone contains a 2½in. woofer and a ⅞in. tweeter. Built in individual level controls. 8 Ω imp. 25–18,000c/s with cable and stereo plug. £5.19.6. P. & P. 2/6.

AVOMETER MOVEMENTS



50µA 20K Ω/V

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

Latest Catalogue

The latest edition giving full details of a comprehensive range of HI FI EQUIPMENT, COMPONENTS, TEST EQUIPMENT and COMMUNICATIONS EQUIPMENT.... Over 230 pages, fully illustrated and detailing thousands of items—many at bargain prices. FREE DISCOUNT COUPONS VALUE 10/-.

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GARRARD

FULL CURRENT RANGE OFFERED BRAND NEW AT FANTASTIC SAVINGS

1025 stereo	£7.19.6	AP75	£16.19.6
2025T/C stereo	£9.17.6	SL75	£25.19.6
3000 stereo	£9.19.6	SL75B	£28.0.0
SP25 Mk II	£11.9.6	SL95B	£35.0.0
SL55	£11.12.6	A70/11	£11.19.6
SL65B	£14.19.6	401	£25.0.0
SL72B	£25.0.0		

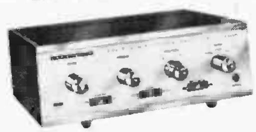
SL55 with Sonotone 9TAHCD £12.10.0

Carriage 7/6 extra each item.

TEAK PLINTHS & PERSPEX COVERS

1. For SP25, SL65, SL55, 3000, 2025 T/C 2025, 1000. £4.10.0
2. For AP75, SL75, SL95 £5.19.6.
3. For SP25 etc. to operate with lid in place £5.19.6. Carriage 7/6 extra each type. Full range of Garrard accessories available.

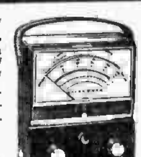
LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER



19 transistors, 8 diodes, 1HF music power, 30W at 8 Ω. Response 30–20,000 ± 2dB at 1W. Distortion 1% or less. Inputs 3mV and 250mV. Output 3–16 Ω. Separate L and R. volume controls. Treble and bass control. Stereo phone jack. Brushed aluminium, gold anodised extruded front panel with complementary metal case. Size 10½ × 3 9/16 × 7 13/16in. Operation 115/230V. A.C. £24. Carriage 7/6.

MULTIMETERS *for EVERY purpose!*

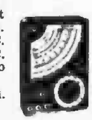
TE-51. NEW 20,000 Ω/VOLT MULTIMETER with overload protection and mirror scale. 0/6/60/120/1,200v. A.C. 0/3/30/60/300/600/3,000v. D.C. 0.60µA/12/300mA. D.C. 0/60K/6 meg. ohm. 92/6. P. & P. 2/6.



TE-900 20,000 Ω/VOLT GIANT MULTIMETER mirror scale and overload protection. 6in. full view meter. 2 colour scale. 0/2.5/10/250/1,000/5,000 v. A.C. 0/25/12.5/10/50/250/1,000/5,000v. D.C. 0/50µA/110/100/500mA/10 amp. D.C. 02K/200K/20 MEG. OHM. £15. P. & P. 5/-.

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

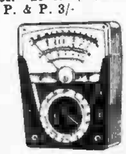
MODEL TE-10A. 20k Ω/Volt 5/25/50/250/500/2,500v. D.C. 10/50/100/500/1,000 v. A.C. 0/50µA/2.5mA/250mA D.C. 0/6K/6 meg. ohm. –20 to +22dB. 10.0, 100mFd. 0.100-0.1mFd. 69/6. P. & P. 2/6.



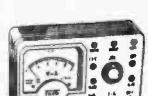
MODEL TE-90 50,000 OPV mirror scale overload protection 0/3/12/60/300/600/1200v. D.C. 0/6/30/120/300/1200v. D.C. .03/6/60/600 mA. D.C. 16K/160K/1.6/16meg Ω. -20 to +63dB: £7.10.0. P. & P. 3/-

LAFEYETTE 57 Range Super 50k Ω/volt Multimeter' D.C. volts 12 mV —1000V. A.C. volts 1.5V —1000V. D.C. current 25µA–10 amp. Ohms 0–10meg Ω dB –20 to +81 dB. Overload protection. £12.10.0. Carr. 3/6.

MODEL TE-70. 30,000 OPV. 0/3/15/60/300/600/1200v D.C. 0/6/30/120/600/1200v A.C. 0/30µA/3/30/300mA. 0/16K/160 K/1.6M/16 Meg. Ω £5.10.0. P. & P. 3/-.



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



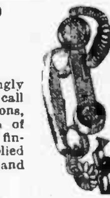
MODEL PT-34. 1,000 OPV. 0/10/50/250/500/1,000v AC and D.C. 0/1/100/500mA D.C. 0/100K Ω. 39/6. P. & P. 1/6.

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. £5.19.6. P. & P. 3/6.

★ TRANSISTORISED FM TUNER ★

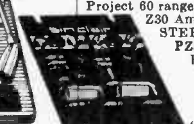
6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6 × 4 × 2½in 3 I. F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88–108Mc/s Ready built ready for use. Fantastic value for money. £6.7.6. P. & P. 2/6. Stereo multiplex adaptors 99/6.

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM



Operative over amazingly long distances. Separate call and press to talk buttons, 2-wire connection. 1000's of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets. £6.19.6. P. & P. 3/6.

SINCLAIR EQUIPMENT



Project 60 range of new models now in stock

Z30 Amplifier	89/6
STEREO 60 Control Unit	£9.19.6
PZ5 Power Supply	£4.19.6
PZ6 Power Supply	£7.19.6
Q16 Speakers	£8.19.6

All Post Paid

SPECIAL PACKAGE OFFER !

2 × Z30 Amplifiers/ Stereo 60 and PZ5 Power Supply £19. Carr. 7/6 or with 2 × Q16 Speakers £35 Carr. 7/6

Micromatic Radio Kit	49/6
Micromatic Radio Built	59/6
SINCLAIR IC/10 IN STOCK	59/6
2000 Amplifier	£23.10.0 Carr. 7/6
Neoteric Amplifier	£42.10.0 Carr. 7/6

ECHO HS-606 STEREO HEADPHONES

Wonderfully comfortable. Lightweight adjustable vinyl headband. 6ft. cable and stereo jack plug. 25–17,000 cps. 8 ohm imp. 67/6 P. & P. 2/6.

TE111. DECADE RESISTANCE ATTENUATOR

Variable range 0–111dB. Connections, Unbalanced T and Bridge T. Impedance 600 Ω range (0.1dB × 10) + (1dB × 10) + 10 + 20 + 30 + 40dB. Frequency: d.c. to 200kHz (–3dB). Accuracy: 0.05dB. +Indication dB × 0.01. Maximum input less than 4W (50V). Built in 600 Ω load resistance with internal/external switch. Brand new £27.10.0. P. & P. 5/–.

RECORDING HEADS

COSMOCORD ½-track heads. High imp. record/playback 65/–. Low imp. erase 20/–. **MARRIOTT** ½-track heads. High imp. record/playback 65/–. Low imp. erase 20/–. Post extra.

AMERICAN TAPE

First grade quality American tapes. Brand new. Discount on quantities.

3in. 225ft. L.P. acetate	3/6
3¼in. 600ft. T.P. mylar	10/–
5in. 600ft. std. plastic	8/6
5in. 900ft. L.P. acetate	10/–
5in. 1,200ft. D.P. mylar	15/–
5¾in. 1,200ft. L.P. acetate	12/6
5¾in. 1,200ft. L.P. mylar	16/–
5¾in. 1,800ft. D.P. mylar	22/6
5¾in. 2,400ft. T.P. mylar	39/6
7in. 1,200ft. std. acetate	12/6
7in. 1,800ft. L.P. acetate	15/–
7in. 1,800ft. L.P. mylar	20/–
7in. 2,400ft. D.P. mylar	25/–
7in. 3,600ft. T.P. mylar	45/–

Postage 2/–. Over £3 post paid.

TAPE CASSETTES

Top quality in plastic library boxes.
C60 60 min 8/6, 3 for 24/6
C90 90 min 12/6, 3 for 36/-
C120 120 min 15/–, 3 for 43/6
Cassette Head Cleaner 11/3. *Post Extra.*

G.W.SMITH & CO.(RADIO) LTD

All Mail Orders to—
147, Church Street, London, W.2
Tel: 01-262 6562
(Trade supplied)

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34, LISLE STREET, LONDON, W.C.2 Tel: 01-437 9155
311, EDGWARE ROAD, LONDON, W.2 Tel: 01-262 0387
OPEN 9-6 MONDAY TO SATURDAY (EDGWARE ROAD ½ DAY THURSDAY)

PRACTICAL WIRELESS

VOL 46 NO 2
Issue 760

JUNE 1970

TOPIC OF THE MONTH

LO, HI or MID?

FOR a good many years, a number of people (including the present writer) have argued the case for establishing a British standard for hi-fi equipment. Nothing, however, has been done in this direction in the UK and manufacturers wishing to put a label on their audio products are forced to quote the German DIN specifications.

The trouble is that progress has caught up with, and passed, requirements so that to many enthusiasts the fact that a piece of equipment meets the DIN45 500 specification is not so much a guarantee of high qualtiy but rather an assurance that the equipment is not of low quality. The DIN specifications were drawn up several years ago and while they may have been adequate at the time are now sadly out of date as a criteria of top quality audio. Today they could reasonably be interpreted as being the minimum requirement of anything with any pretensions to quality and that any equipment below this specification is poor indeed.

This, of course, is the result of technical progress made in the past few years, and it leaves open to question current terminology. With the advent of really high quality audio equipment, the term "hi-fi" became part of the language, with inferior products dismissed contemptuously as "lo-fi" and other similar derisory terms. Around "hi-fi" grew up a certain mystique, which was encouraged not only by elements in the manufacturing world but by purist audio enthusiasts. The term became, as it were, the "in" thing.

But this barrier (which is based partly on snobbery) is becoming dissipated, due mainly to the vast improvements made in ordinary "domestic" audio equipment, which, once far removed from the real high quality equipment, has placed good quality sound reproduction within reach of most families. In other words, the gap in narrowing. And this has lead to another frightful term, unfortunately gaining favour, namely "mid-fi".

So, what is the answer? The DIN45 500 standard (once hi-fi) is nowadays reckoned to be mid-fi by British thinking. The mid-fi of today, equivalent to the hi-fi of yesterday, will no doubt be the lo-fi of tomorrow. Do we abandon all labels, or set up a British audio standard which is subject to revision every few years? Or do we forget the whole mess and just sit back and enjoy listening to music?

W. N. STEVENS—*Editor.*

JULY ISSUE WILL BE PUBLISHED ON JUNE 5

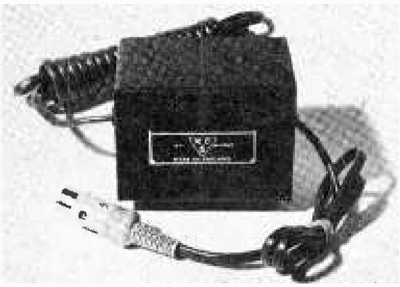
NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

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

Eliminators



Recently announced by *RCS Products Ltd., 11 Oliver Road, Walthamstow, London, E.17,* is a unit which enables a cassette tape recorder or portable radio to be used from a car battery supply. It is said to be particularly useful to people who have to make "notes" whilst driving or to people who want to just listen to music. Operating from the car supply it is possible to turn the volume up fully without any drain on a recorder's internal batteries.

Units can be supplied to deliver 6V, 7·5V or 9V. When ordering, the manufacturers ask if readers will state the make of recorder or radio and type of plug required on the unit lead. Price is 35s. plus 2s 6d. p.p.

Mini Space Dishes

GEC-AEI (Electronics) have been awarded a substantial contract by the Ministry of Defence (Navy), for the development of a small shipborne satellite communications terminal (SCOT) to operate through the Skynet system, and provide secure communication links between small ocean-going warships and the U.K. The dish aerial, only $3\frac{1}{2}$ feet in diameter, will be the smallest ever used in satellite communications.

While designed as part of the Skynet system, SCOT will be capable of operation through the American Defence Communication Satellite system should the need arise. More significantly, terminals as small, reliable and cheap as these could open the way for a large expansion in satellite communications for other purposes, both military and civil. SCOT is seen to have a considerable export potential.

Police Equipment

The police forces of three of the states of the Federal Republic of Germany have recently installed fingerprint facsimile transmission equipment manufactured by Muirhead Limited of Beckenham, Kent.

Fingerprint photographs can now be transmitted within minutes between the Bundeskriminalamt in Wiesbaden and the Landeskriminalaemter in Dusseldorf (Nordrhine/Westphalia), Stuttgart (Wuttenburg), and Hannover over normal telephone lines.

With this equipment a fingerprint picture 8 inches square when scanned at a density of 7·54 lines/mm (190 lines/inch) can be transmitted with extremely high definition in 14 minutes. The picture received is fully processed inside the receiver.

Dynatron Phones

Dynatron Radio Limited feel confident that the use of high quality Stereo Headphones for personal listening will very soon become as popular here in the U.K. as they have been for some time past in the U.S.A., Canada and Scandinavia, and accordingly have equipped their range of radiograms and audio separates for 1970/71 with a jack socket to enable every item in their range to have stereo headphones connected.

The quality of sound obtainable through their new Stereo Headphones type S.P.2 which are suitable for use with their range of products is said to be quite equal to high quality Stereo Loudspeaker Systems. Price is £7 10s.

Bedfast Club

Would readers of Practical Wireless like to help in the good work done by the Radio Amateur Invalid & Bedfast Club?

They would be grateful for any foreign stamps, which will be sorted and packeted and sold at the International Radio Engineering and Communications Exhibition to be held in London later this year, all proceeds going to R.A.I.B.C. funds.

Stamps need not be soaked off, but should have their backing paper cut to leave a generous margin on all sides. The address to which they should be sent is:

Allan Herridge, G3IDG, 96 George Street, Basingstoke, Hants.

Should there be a large response, it may not be possible to acknowledge individually, but donors may rest assured that all offerings, whether large or small, will be equally appreciated.

Readers may also be interested to know that the Bedfast Club, founded in 1954, now has 365 disabled licensed amateur and short-wave listener members in 12 countries.

Low-cost scope

Mitre Electronic Products of 22 Powis Terrace, London. W.11, have introduced a new oscilloscope type EA0669-2 at only £29 15s. 0d. Features include: $2\frac{3}{4}$in. diameter tube; d.c. to 100kHz Y-amplifier bandwidth; calibrated Y attenuator giving deflection sensitivities of 100mV/cm., 250mV/cm., 1V/cm., 2·5V/cm., 10V/cm., and 25V/cm.; a.c. or d.c. input coupling; automatically synchronised timebase with four ranges (plus off) from 100mS/cm. to 10μS/cm.

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

Receiver Kit

The GR-78 General coverage Receiver recently announced by Heath Company provides a.m., c.w. and s.s.b. coverage from 190kHz to 30MHz in six switch-selected bands. The all solid-state circuit employs Field Effect Transistors in the r.f. section and four ceramic i.f. filters. The ceramic i.f. filters eliminate the need for alignment. Built-in bandspread tuning can be calibrated for either the short-wave broadcast or amateur radio bands, and a switchable 500kHz crystal calibrator insures accurate dial calibration.

This receiver comes complete with a rechargeable nickel-cadmium battery pack with a built-in charging circuit. Wiring options permit operation from either 120 or 240V a.c., and 12V d.c. This receiver incorporates switched a.v.c. and an automatic noise limiter. Additional features include headphone jack, built-in speaker, external antenna terminals, receiver muting for use with a transmitter and a front panel relative signal strength meter.

Styled in Heath charcoal wrinkle finish with grey, black and chrome accents, the unit measures only 4⅝in. H × 11⅞in. W × 8⅝ in. D and weighs only 11lbs. The Kit GR-78 costs £68 18s. *Daystrom Ltd., Heathkit Division, Gloucester. Telephone 0GL2 29451.*

Price changes

The prices in the Codar Radio advertisement on page 53 of the May issue are incorrect. The following are the revised prices: **T28** £16 10s., carriage 4s. 6d. **CR45** ready built £13 10s., carriage 10s. **Preselector PR30** £6 10s., carriage 4s. 6d. **PR30X** £8 10s., carriage 4s. 6d. **Mini Clipper** 55s., carriage 3s.

Chesterfield R.S.

The above Society met at its Headquarters at Hunloke Adult Education Centre, off Derby Road, on the 11th February. Twenty members were present and after the conclusion of the normal business, two extremely interesting films were shown from the Mullard Film Library, entitled: "Mirror in the Sky" and "Girdle round the Earth."

Other events have included a talk on colour television on the 11th March by Mr A. Barsby and a talk and demonstration on transistor principles by Mr G. C. Oxley on the 25th March.

P.C. Boards

Cirkitrite Ltd. have achieved a breakthrough in printed circuit design by developing a process by which electrically conductive patterns can be produced by direct application of a special pen to selected areas.

A Cirkitrite "pen" containing a special chemical is applied directly to specially prepared materials which are subsequently immersed in a metal reducing solution. Since the chemical provides a catalytic surface to the selected areas only, the chemical reduction of metal is confined to those areas—even when the whole material is immersed in the reducing solution. In this way an electrically conductive pattern can be drawn directly on to the substrate without the necessity for etching or removing conductive material from unrequired areas.

Further details may be obtained from *Cirkitrite Limited, c/o Haven Green, Ealing, London, W.5.*

Engineer appointment

Phil Keene (44) at present an Engineer at the BBC's studios in Glasgow, has been appointed Engineer for BBC Radio Derby.

Mr Keene joined the BBC in December 1941 as an Engineering trainee in London. For the past eighteen years he has lived and worked in Glasgow.

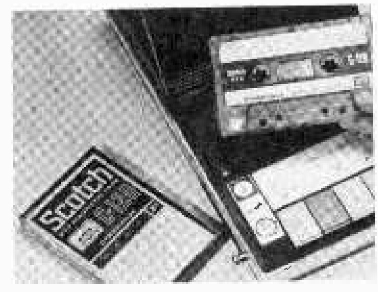
Thanet R.S.

Meetings of the above Society are held at Hilderstone House, Broadstairs each Friday at 7.30 p.m. except when the South East UHF/VHF Group hold their meetings. Further gen from *Dick Trull, G3RAD, 1 Approach Road, Broadstairs, Kent.*

2-hour Cassette

The range of Scotch magnetic tape cassettes has been expanded to include a two-hour version. A feature of this new Philips-compatible cassette—the Scotch C-120—is an improved shim material which offers reliability while eliminating tape binding and jamming.

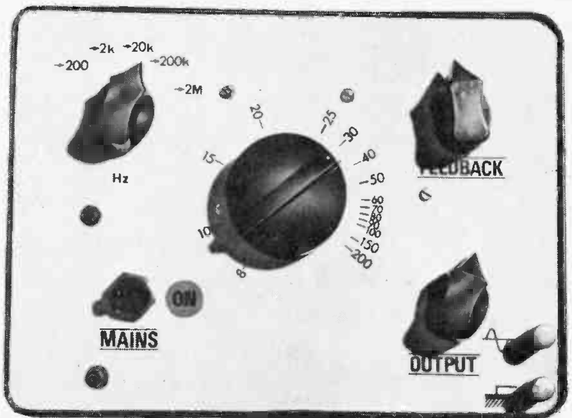
The Scotch C-120 cassette, which retails at a recommended price of 33s. 6d., utilises Scotch Dynarange low-noise magnetic tape, which provides good high-frequency response while offering complete compatibility with slow (1⅞ i.p.s.) recording speed. As with the other cassettes in the range (the Scotch C-60 which gives 60 minutes recording and the Scotch C-90 giving 90 minutes) the new cassette is supplied in a durable hinged plastic case designed to protect the tape and provide easy storage.



A WIDE-RANGE L.F. SIGNAL GENERATOR

THE SIGNAL GENERATOR to be described is a sine-wave oscillator employing a Wien bridge feedback network, and the frequency coverage is from 15Hz to 1·5MHz in five ranges. The circuit uses the minimum of components consistent with reliable operation, and is easy to build and use. However, it is as well to say right away that if a really good output waveform is required, high quality components *must* be used throughout, particularly in the case of the ganged tuning potentiometers. The theoretical harmonic distortion of the instrument is under 1 per cent.

If the constructor needs only a general-purpose signal generator, and does not, for instance, wish to make distortion measurements on audio amplifiers, economies can be made. Using readily available components, an inexpensive dependable instrument can still be built.



T. J. MELVILLE

Operation

The theoretical operation of the system is illustrated in Fig. 1. In its most elementary form, the oscillator is an amplifier with a resistance—capacitance network providing positive feedback between output and input. R-C networks are, of course, frequency selective; so the amount of feedback available reaches a peak at one particular frequency (f). If the gain of the amplifier, and hence the positive feedback, were not controlled in some way, the waveform of the oscillations would be an indescribable monstrosity, with only peaks in amplitude corresponding to f. Very careful regulation of the amplifier's gain is therefore essential, and so a negative feedback loop is added to the circuit.

This loop cuts the gain of the amplifier down to the point where oscillation can only just be sustained; thus regeneration can only occur at f, the frequency at which the Wien bridge permits the maximum amount of positive feedback, and the output is a sine wave.

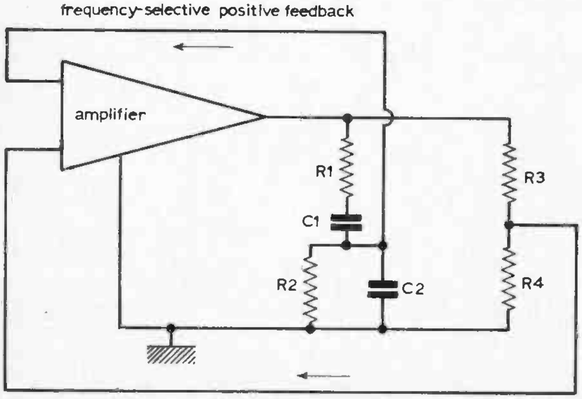


Fig 1: Block diagram of Wien bridge oscillator.

In a circuit such as this, it is usual to make the components in the two halves of the Wien bridge of equal value, to simplify design calculations, and to enable variable tuning to be employed. Therefore, $R = R1 = R2$, $C = C1 = C2$ and the frequency of oscillation is calculated from the formula $f = \frac{1}{2\pi CR}$ the units being hertz, farads and ohms. Varying either C or R alters the frequency, and in this design, C is varied decade-fashion to provide "coarse" tuning for the instrument, and R is varied by potentiometers for the "fine" tuning.

In Fig. 1, R3 and R4 constitute a potential divider between the amplifier's output and earth. An accurately determined portion of the output voltage is fed back to the input from this, but in reverse phase. Consequently, the gain of the amplifier is drastically reduced. Given that C1=C2 and R1=R2, the forward gain has to be cut to times 3.

The amplifier used in the signal generator is a simple two-stage circuit. The first stage comprises Tr1 and Tr2 (of Fig. 2) connected as a Darlington pair and has a high input impedance. This has to be high to prevent the lowish impedance of the bridge from being shunted. The second stage is a common-emitter amplifier with a small collector load to provide a low output impedance.

Practical details

Since the gain requirement is so low, a wide range of bipolar transistors can be used in this circuit, germanium or silicon, npn or pnp. (Note: if pnp types are used, the power supply lines and electrolytic capacitors will need to be reversed in Figs. 2 and 4).

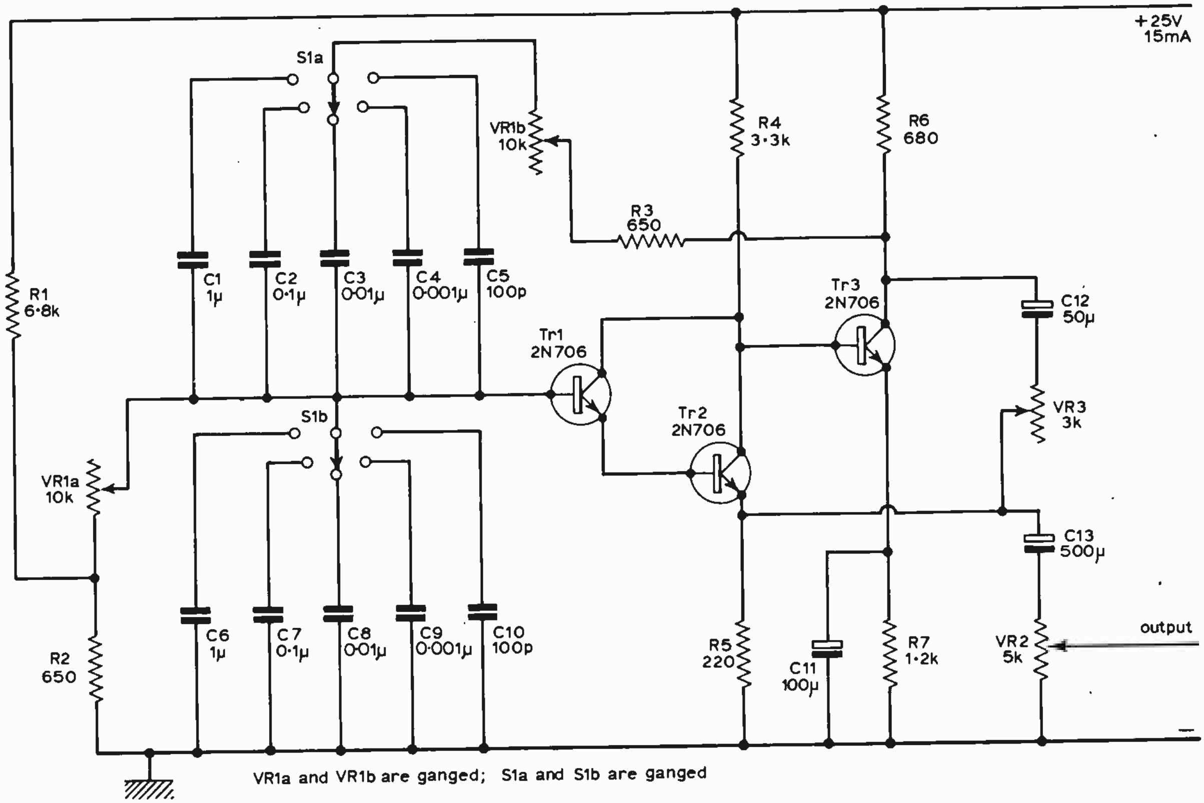


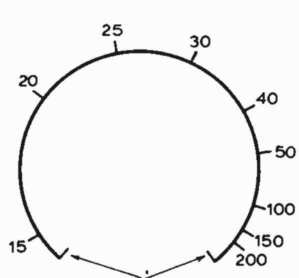
Fig. 2: Circuit of signal generator based on Wien bridge oscillator.

However, if the instrument is required to operate on the top range, transistors with a high cut-off frequency are essential. The types specified have an F_T of 200MHz, which enables the scale calibration to remain unchanged for all ranges. If poorer devices were used (eg. F_T about 10MHz) a modified scale would be needed for the 1·5MHz range at least.

After extensive experimenting, the author finally opted for "untested" 2N706's, which, at a few pence each, are the most economical choice. Silicon planar transistors with their low leakage (Icbo) offer the further advantage that the operation of the instrument is substantially unaffected by large changes in supply voltage or ambient temperature.

To move on to the actual circuit diagram (Fig.2), R3 and VR1b correspond to R1 in Fig.1, and R2 and VR1a to R2,; C1-5 of Fig.2 are C1 of Fig.1, and C6-10 are C2. From the formula quoted above, the theoretical range of the instrument is 14·950Hz to 2·453MHz, but as should be clear from Fig. 3,

Fig. 3: Typical dial calibration showing cramping at top end of scale when using linear-track potentiometers.



the scale above the 150 mark is too cramped for accurate calibration. Consequently, the nominal top frequency of the instrument is taken to be 1·5MHz.

The scale follows a more or less logarithmic course, and this admittedly unfortunate fact is principally due to the use of linear-track potentiometers for VR1. Anti-log types would improve the situation considerably, if reliably matched anti-log, or indeed matched log pots were available. The so-called logarithmic carbon pots that are offered by retailers are, of course, nothing of the sort. They merely have their track divided into two, one part being low-resistance and linear, and the other high-resistance and linear. To try and use a "matched" ganged pair of these in the present application is definitely not possible.

Ganged carbon pots usually claim to be matched to within 2dB, a figure which appears admirably low, but to the author at least, an unqualified decibel rating is more or less meaningless. He can only assume 2dB matching means a mismatch of up to +25%, −20%. From tests made on such components, however, this would appear to be a too pessimistic view.

Figure 3 illustrates the behaviour of VR1 in the prototype, which does, in fact, use a ganged carbon pot, and this probably makes the calibration more "logarithmic" than it should be. For the best possible results, ganged wire-wound potentiometers must be used. Suitable types are available from Colvern Ltd, Spring Gardens, Romford, Essex.

Negative feedback is derived from the collector of Tr3 and taken to the emitter of Tr2 via the potential divider comprising VR3 and R5+VR2 (=R3 and R4 of Fig.1). VR3 varies the amount of feedback applied, so that the user can obtain the best waveform from the oscillator at any frequency. With VR3 at minimum resistance, the forward gain will be too low for oscillation to commence. The user should back off the control just to the point where it does occur.

The typical output level with VR3 correctly set and with VR2 at maximum is around 700mV, but variations of up to 10% can be expected due to mismatching in the bridge and the reduced efficiency of the amplifier at extreme frequencies.

At this point, the author must introduce Fig.4. This is a modified version of the original circuit employing a thermistor to give automatic gain control. It is ideal for those who do not like having an excess of knobs to twiddle, and who want a constant 1V output (VR2 can then be accurately calibrated). But the use of a thermistor has disadvantages. First, its dual roles of giving a constant output voltage and regulating the gain of the amplifier are not necessarily compatible. Consequently, the hi-fi constructor is advised to retain VR3 to get the best waveform, and not to worry too much about the output voltage.

The maximum dissipation of the only thermistor suitable is 3mW, with means that the careless must be *very* careful with their soldering irons and heat sinks. Also, its purchase would almost double the cost of the instrument. If the thermistor is to be used, a small pre-set potentiometer (about 1kΩ) may have to be wired in series or parallel with it (experimenting will decide which) in order to get the best results. Once adjusted, this potentiometer should of course be left alone, since continued twiddling would invalidate the use of the thermistor in the first place.

Using the Frequency Meter

The capacitors C1-10 should be close-tolerance types, and can be checked with the frequency meter described in PW May 1970, even if the signal generator to be used for the testing signal is the present design and still under construction. Although the output waveform will doubtless be rather nasty, the signal generator will function with capacitors that are quite badly mismatched. By judicious manipulation of VR1 and the f.s.d. pre-set control in the frequency meter, a considerable overlap of ranges is possible.

If, for example, two 0·1μF ±20% capacitors are temporarily wired in for C2 and C7 in the signal generator (and if oscillation occurs), 1μF, 0·1μF and 0·01μF capacitors can be accurately checked with the frequency meter. As the latter does not contain a 100pF capacitor, two of these will need to be purchased.

If the constructor has already built the frequency meter, calibration of the scale for VR1 is no problem at all: some might not consider it even necessary. There is surely nothing more tedious than inscribing scales and dials, especially if they are cramped at one end. This constructor for one invariably gets an acute attack of Calibrator's Cramp! On the prototype of the signal generator, only one scale was found to be necessary, calibration for the bottom range being correct for the top range. Though as the latter (if included) cannot be checked against the frequency meter, a radio set should be called into use.

Construction

The instrument must be housed in a metal case or box, and screened leads used for output connections. The reason for this is simply to avoid r.f. radiation from the instrument. Readers may well think that operating the oscillator at 1kHz, say, is unlikely to interfere with anyone's radio reception. It won't, as long as the output waveform is kept sinusoidal.

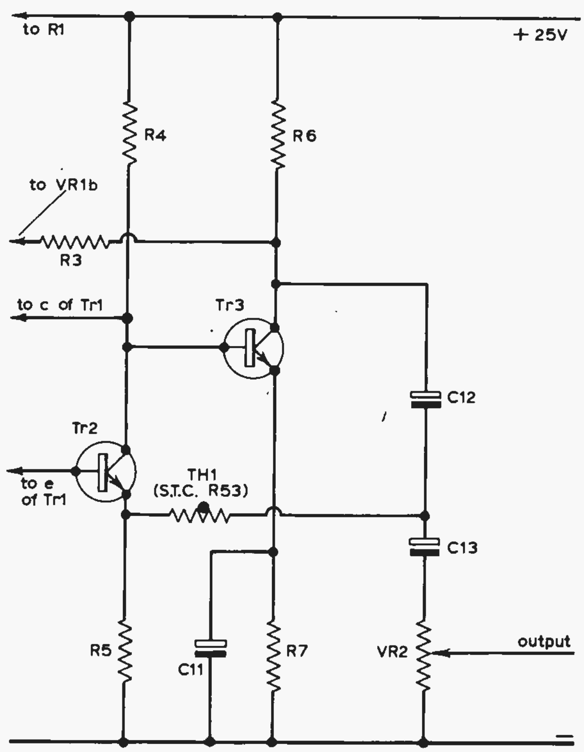


Fig. 4: Modified circuit using a thermistor to provide a.g.c.

Most of the components are accommodated (vertically) on a Veroboard module. (See Figs.5 and 6). Layout is not critical, though wiring between the module and the other bits and pieces should be short, direct and rigid to minimise stray capacitances.

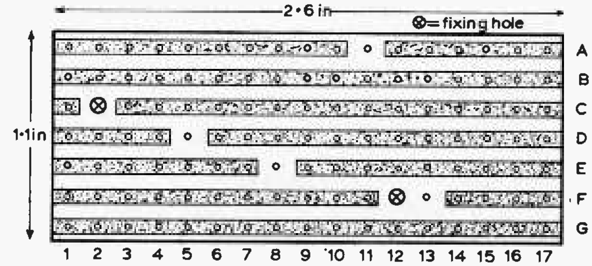


Fig. 5: Circuit board shown actual size.

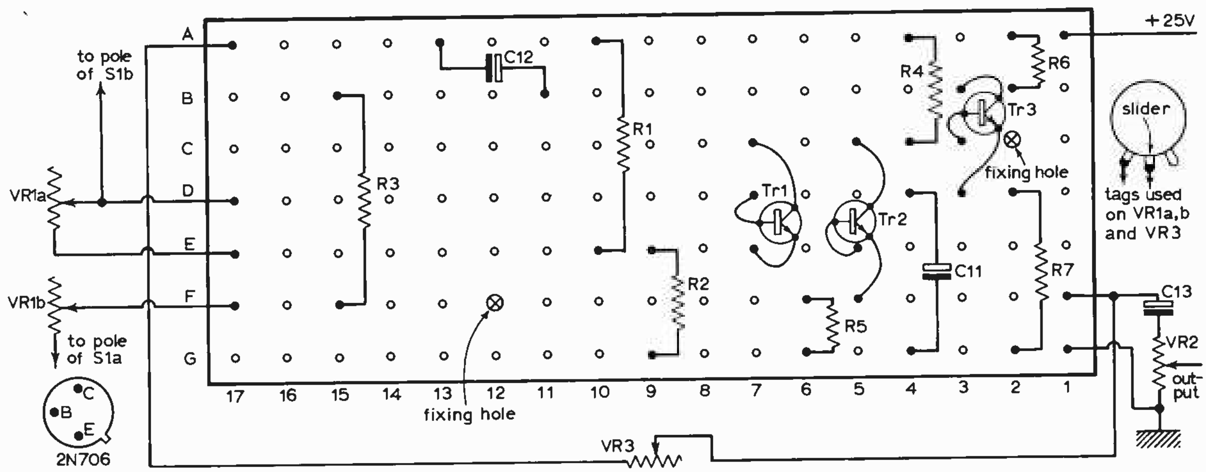


Fig. 6: Enlarged view of circuit board showing location of components.

This is particularly important if the top range is to be included. The tuning capacitors C1-10 are mounted on a group board, and this should have more than the required minimum of ten parallel pairs of tags, to allow room for padding capacitors, if necessary.

Power supply

Figure 7 illustrates a suitable power supply for mains operation of the instrument. There is a lot to be said for powering the equipment from batteries if this is feasible, since a ripple-free supply is essential. However, the power needed is at least 20V at 15mA, so readers may consider a mains supply more practicable.

★ components list

Resistors

R1	6·8kΩ	VR1a/b	10kΩ linear ganged
R2, 3	650Ω±1%	VR2	5kΩ linear
R4	3·3kΩ	*VR3	3kΩ linear
R5	220Ω		
R6	680Ω		
R7	1·2kΩ		

Capacitors

C1-10 see Table 1
C11 100μF 6V electrolytic
C12 50μF 25V electrolytic
C13 500μF 3V electrolytic

Semi-conductors

Tr1, 2, 3 2N706

Miscellaneous

*TH1 Thermistor type R53 (Fig. 3: only)
Veroboard, 2 pole 5 way switch, metal case, insulated terminals, group board for C1-20.

Power Supply

*Transformer 18-25V at 20mA *see text
*Capacitor 2000μF 25V
*Four silicon diodes 50 p.i.v. 50mA(OA200, OA202)
On-off switch, group board for diodes.

Table 1

Values for C1-10 (all ±1%) and ranges covered

C1, C6=1μF	15—150Hz
C2, C7=0·1μF	150Hz—1·5kHz
C3, C8=0·01μF	1·5—15kHz
C4, C9=0·001μF	15—150kHz
C5, C10=100pF	150kHz—1·5MHz

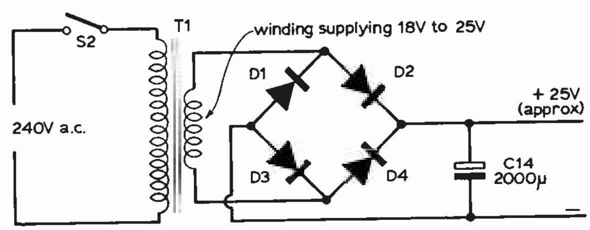


Fig. 7: Circuit of suggested power supply unit.

The mains transformer and smoothing capacitor will need to be of modest dimensions if they are to be housed in the same portable case as the rest of the circuitry. The author in fact used a miniature 120V transformer, with a 12kΩ resistor as a voltage dropper (on the mains side), and certainly a resistor of this size helps the smoothing considerably.

If miniature silicon diodes such as the OA200 (or "untested" equivalents) are used for the rectifiers, it should be noted that they have a high forward resistance at 15mA or so, compared to the more orthodox types of rectifier diodes. Consequently, if one's transformer gives out 25V a.c., the output from the rectifier bridge will still be only 25-30V d.c. (It should be about 36V with a large capacitance reservoir). The maximum operating voltage of the signal generator is about 30V, but the rating of the smoothing capacitor will normally limit this to 25V.

The author used a box 9 x 6½ x 1½in to house his instrument. A large front panel area is needed, if the controls are to be comfortably spaced out, and the depth will largely be determined by the size of the mains transformer or battery used. ■

I.C. OF THE MONTH

L.A.J. IRELAND

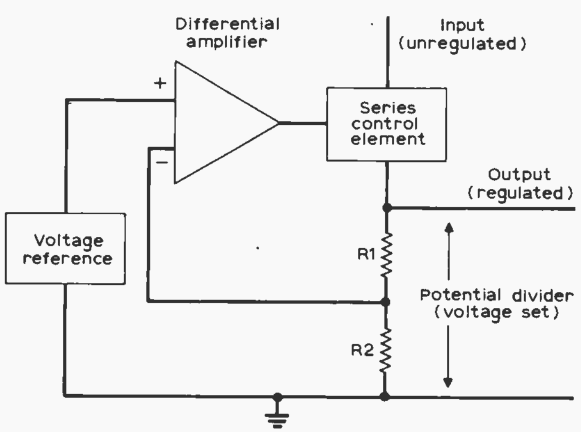
Number 8

LM100 Voltage Regulator

A FEATURE of the present phase of integrated circuit development is the increasing number of special-purpose linear units becoming available, and this month one such application is discussed, the question of precision voltage regulators.

Here the close matched characteristics of monolithic active elements is particularly useful. Operation is by comparison of the voltage delivered to the load at any instant with a stabilised reference voltage, with any deviation being amplified and applied to the actual regulating element.

In a given case this may be either a series or parallel element: the former procedure places the control transistor in series with the load, so that its d.c. resistance (dependent on the bias applied by the deviation amplifier) forms a potential divider, together with the load, across the unregulated supply voltage, while the latter method divides the output current between the load and a transistor in parallel with it, the transistor being biased so that the total current drawn remains constant despite fluctuations of the load.



Block diagram of a series regulator.

The standard voltage regulator is the National Semiconductors type LM100. This is a "positive" regulator, in that the negative line is common to both the input (unregulated) and output circuits. It can accept an input voltage of up to 40V and provide an output of from 2 to 30V, the precise value being determined by a potential divider across the regulated output which supplies the comparison signal to match the fixed reference voltage.

"Line regulation," that is, the variation of output voltage as the input unregulated voltage fluctuates, is better than 0·05% per volt, while load regulation, or the variation in voltage as the current drawn from the regulator changes from its minimum to its maximum limit, is 0·1%. Further, a current limiting feature is built in, so that the circuit is self-protecting against output short circuits.

The only obvious limitation on the usefulness of this device is the low value of permitted output current which can be drawn from the regulated output, 12 mA. This is due to the fact that a high current transistor requires a relatively large junction area, while in the LM100 the whole circuit occupies a chip of silicon only 38 mils. square. However, if the output of the circuit is used as the base current of an external discrete transistor, a current of 200mA. is available, or even several amps. if a power transistor is used.

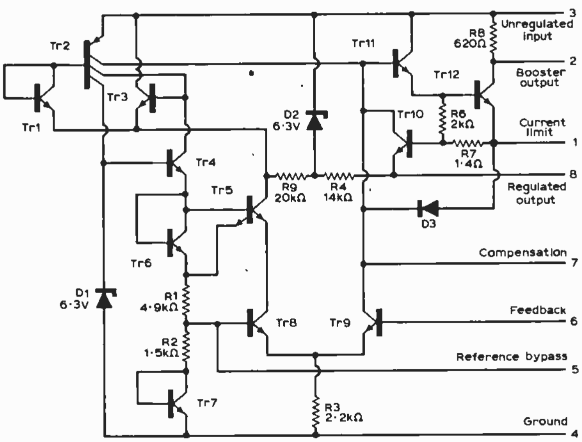
Operation of the LM100

Now to examine the actual device and its application in detail. In use, the reference voltage is compared with a fraction of the output voltage; therefore to allow the maximum range of permissible output voltages, the reference should be as low as possible. Further, on the stability of the reference depends the maintenance of the preset output voltage as temperature drift occurs.

In the LM100 the basic reference is provided by the zener D1; 6·3 volts appears across this element when supplied with current from the constant current source Q2. However, it has a positive temperature drift, amounting to 7mV/°C at the output of the emitter follower buffer transistor. This is compensated for by the negative drift of Q7, so that the definitive reference voltage of approx. 1·8V at the junction of R1 and R2 is stable to within 0·3% over an extended temperature range (−55°C to +125°C).

The deviation or error amplifier is basically a single stage differential pair (Q8 and Q9) followed by a Darlington output circuit, Q11 and Q12. If, however, an external transistor with a higher current rating is to be employed, access to the collector of Q12 is provided to supply the base drive, with R8 already in place to act as an emitter-base resistor for the transistor; when used "straight" pins 2 and 3 are shorted, eliminating this resistor from the circuit.

Q10 is responsible for the current-limiting function. At a level determined by an external resistor, Q10 is biased on, reducing the drive to Q11 of the Darlington pair. The emitter-base voltage of Q12 also affects the bias of Q10, and with the difference in temperature drift between these two transistors due to the difference in current density in their emitter junctions, the current limit for operation of Q10 drops as the temperature rises.

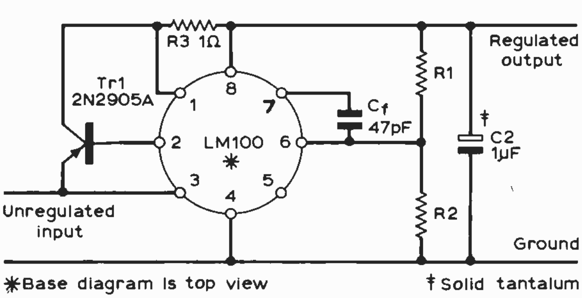


Complete circuit of the LM100.

The amateur will probably prefer to use the commercial variant of the LM100 circuit, having little need for the extended temperature range which can be traded off against unit cost. The LM200 operates from −25° up to +85°C and cheaper still is the LM300, further restricted in temperature and also in input voltage (30 rather than 40). However, all three have the same internal layout, and the degree of regulation achieved is similar.

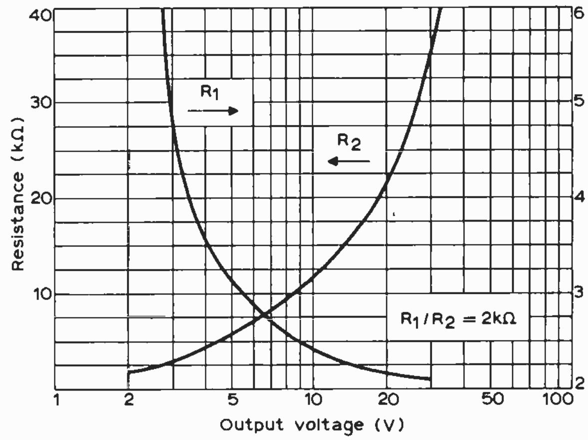
Applications

As for amateur applications, two will be mentioned to indicate possibilities. Standard transistor radios, tape recorders, etc. have a current consumption dependent on audio output level, since they commonly employ a class B arrangement. Should it be desired to operate such a device from, say, a 12 volt car battery, a simple dropper resistor in series



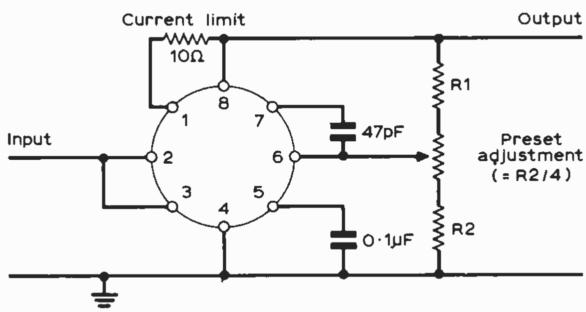
With an external transistor stabilised outputs up to 200mA can be obtained.

would not provide the 6 or 9 volts required, as by Ohm's law the voltage drop would be current dependent.



Optimum values of R1/R2 as a function of the output voltage.

An LM100 type regulator, however, with a suitable external transistor, would be ideal as a source of stabilised d.c. for such a load. In another field, every constructor has at some time desired a variable d.c. power supply unit to replace batteries when experimenting or developing transistor circuits. If pin 6 is supplied from the slider of a 50kΩ potentiometer, an LM100 is a very fine continuously variable power supply; further, with the current limit facility, should there be a fault in the experimental circuit no excessive current can be drawn, so that not only is the regulator protected, but also the equipment under test.



Circuit to provide a continuously variable output.

Already, too, there is news of improved regulator circuits on the way, which will not require external transistors to carry a useful current; G.E. (U.S.A.) are working on a PA264 with a 5 watt capability, similar in appearance to the PA246 audio amplifier already mentioned in these pages. Motorola are introducing an MC1461 with a reported 10 watt dissipation, in a new can with integral heat sink; and from National a negative regulator (LM104) is expected. So perhaps in the future a return to this month's theme will be called for; meanwhile the "simple" positive regulator can be usefully investigated and applied.

The LM300 can be obtained from the Semiconductor Marketing Co. Ltd., 140 High St., Egham, Surrey. ■

TAKE 20

JULIAN ANDERSON

No. 14
RECORD PLAYER AMPLIFIER

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

THERE must be many constructors who have purchased record players and have added ready built amplifiers to these. Our project for this month is for such an amplifier for those who may wish to build their own and save money. Although designed for use with a record player, the amplifier has, of course, uses in several other fields. It is extremely simple and should be very quickly built and this, together with the fact that it should cost well under 20s., makes it an ideal project for the raw beginner.

There should be no problem in obtaining the components from almost any supplier, though by shopping around it is usually possible to save quite a bit.

Output from the amplifier is about 750mW, which is of course very small by current standards, but this sort of volume is more than adequate for normal use. The quality is very acceptable and although far from being in the Hi-Fi category, it is unlikely to be the main cause of poor quality when used with a cheap record player using a crystal pickup on 45 r.p.m. discs. It should be the ideal companion for one of the cheap battery operated turntables.

THE CIRCUIT

Crystal pickups have a high output but also have a high impedance and for best matching should be connected to a load of at least 500kΩ. VR1, nominally 1MΩ, could in fact be any value between 500kΩ and 2MΩ. Although the volume control presents a high impedance to the pickup, the amplifier has a very much lower impedance input and it will be seen that when the volume control is at maximum the input impedance of the first stage causes a mismatch. In fact in this position the tone *does* alter because of this. However this is not objectionable and while theoretically it is bad practice, it has been left like this for simplicity.

C1, 0·5µF is rather lower than one would expect to see but in the protoype no improvement was gained by increasing the value.

Tr1 acts as a straightforward amplifier with R1 providing the base bias and R2 acting as the collector load. We have made considerable use of the transistor used here, the BC169C, in previous circuits and will do so in future. It is a plastic encapsulated, high gain, low noise silicon transistor costing around 2s 6d. (It has two further features to recommend it, neither of which are made use of in this circuit, of handling an appreciable collector current and having a high frequency cut-off). In this circuit we are using it for its high gain.

Tr2 is a germanium PNP type power transistor and in the circuit is "inverted" so to speak. The base is

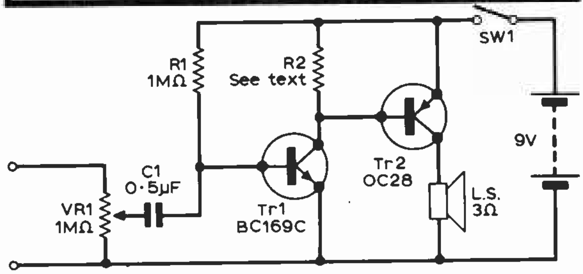


Fig. 1: The circuit of the record player amplifier. In the prototype R2 was 39Ω.

★ components list

R1	1MΩ 10%, ¼ watt
R2	39Ω 10%, ¼ watt, see text
VR1	1MΩ log. pot. with switch.
C1	0·5µF
Trl	BC169C
Tr2	OC28
L.S.	3Ω type, 6in. diameter or larger.
Battery	9V, PP9 etc.

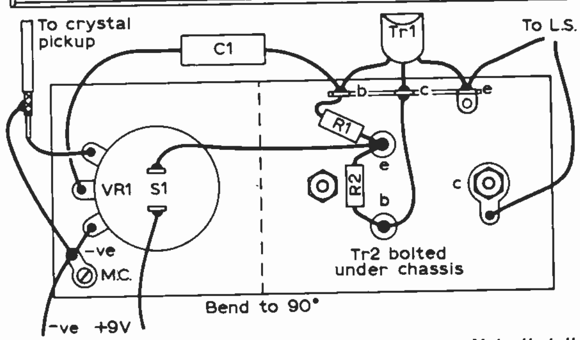


Fig. 2: The layout on a small aluminium chassis. Note that the power transistor, Tr2, should be insulated from the chassis in the usual way.

directly coupled to the collector of Tr1 and the loudspeaker acts as the collector load.

The value of R2 is critical for it sets the quiescent current through Tr2. If its value is high excessive current is drawn leading to short battery life; if too low it causes "clipping" and severe distortion. Its value should be chosen so that it is the lowest that does not cause clipping on maximum output on the peaks of the signal. In the prototype 39Ω was the final value chosen but in earlier mock-ups it was 56Ω and 100Ω. One could use a preset here but trial and error selection is just as good. If one has a testmeter it will be found that the quiescent current is around 30mA using the best value.

Since the quiescent current for Tr2 is passing through the speech coil of the loudspeaker it is important that a decent sized one is used. Speakers under about 6in. diameter will sound dreadful operated from this amplifier as the biased speech coil causes it to operate at an unfavourable point; this effect is not noticeable on larger diameters. ■

GOING HI-FI

R. HINDLE

THERE is a minimum specification that should be met before the tag Hi-Fi is attached to an installation but there are often signs of misuse of the term and there is no widely accepted definition. Specifications can be in technical terms such as power output, degree of distortion, frequency range and so on but, although these factors are important, they cannot tell the whole story because, firstly, they do not cover the whole chain of reproduction; and, secondly, the environment (e.g., the type of room and its furnishings) has a profound effect on the result.

The overall system involves one or more sources of signal—a radio tuner, a record player or a tape deck, or a combination of those—an amplifier and a speaker system. Maybe present needs are thought not to call for equipment capable of stereo reproduction (resulting in doubling up the amplifier and speaker systems) to qualify as Hi-Fi, but the time when this must be insisted upon is surely coming.

The Hi-Fi enthusiast is also unlikely to accept into his world any equipment built as a single unit; he has good reasons for his belief that high fidelity in reproduction can be achieved only by the use of speakers separate from other equipment.

COMPARING EQUIPMENT

The usual advice given to purchasers of Hi-Fi equipment is to go where they can hear comparisons between a wide range of models. This is good theoretical advice but it is not really practicable. This is because it is quite impossible to carry in one's mind a sufficient impression of successive permutations and combinations of equipment for the mutual comparison to be valid. Even if this were not so it would not be possible to make a reliable, final choice without taking into account the environment, so that the ultimate tests would have to be made in the user's own room.

Is the equipment, in fact, to be stereo or mono? The answer these days surely must be stereo; even though the full aim may not be realised immediately and the intention is to reproduce in mono for the time being everything to be bought at this time must be suitable for a stereo ensemble.

INPUTS

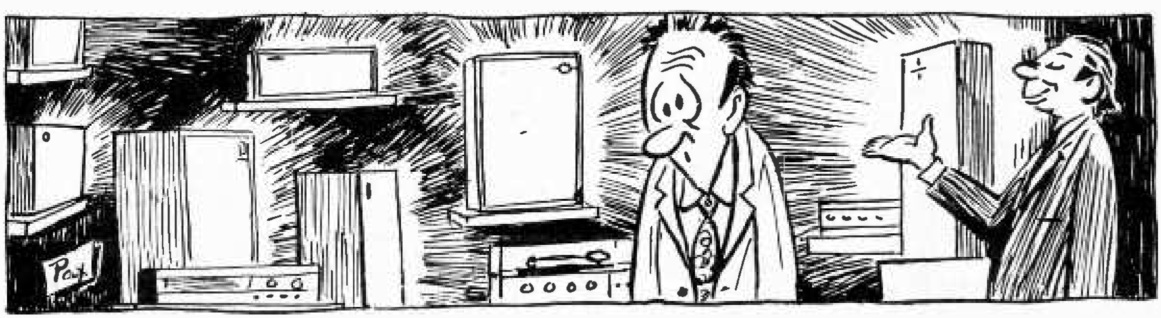
Next, specify all the input sources that are likely to be needed, not just now but during the lifetime of the equipment. Almost certainly there will be a record player, perhaps in the first place using a cheaper, ceramic cartridge but later to acquire a more expensive cartridge which will not only give a much smaller signal but will also have a different characteristic.

So the amplifier must have two suitable input facilities if it is intended to progress from a cheaper to a more expensive cartridge. Typical input sensitivities looked for would be around:—

100/200mV for ceramic cartridges
2/4mV for magnetic cartridges.

A stereo cartridge in either variety would be chosen. This will play either mono or stereo records but the mono cartridge would not deal with stereo records.

There is also likely to be a need to budget for a radio tuner (typically giving 200mV). Perhaps also a tape deck is to be used. In practice it is extremely unlikely that a modern amplifier will be deficient in these input facilities or in the provision of the necessary equalisation circuits to compensate for standard characteristics now adopted for the input signals. Not all operate equally well with regard to the input overload characteristic and this is very significant. The input sensitivity previously referred to indicates the input signal to give rated output, and if there is more input signal than rated the volume control can be set lower so that the output circuits are not overloaded. However, the volume control is unlikely to be in the input circuit itself but will follow the low noise first stage and consequently its adjustment cannot prevent the input stage from overloading.



" go where they can hear comparisons "

Having determined the input characteristics needed, any amplifier unsuitable on this account can be rejected on the basis of considering the technical specifications given in the manufacturer's literature and in technical reviews. The rest can be surveyed without further consideration of input requirements and demonstrations can be taken using a single, high quality input device—probably a pickup cartridge because of the ease and speed with which a range of different sounds can be demonstrated using records.

THE BUDGET

There is the question of cost and it is pointless to produce a short list of possibles only to find that none can be fitted into one's budget, though most people finish up by paying more than they had originally intended. If a complete outfit is to be purchased about a third of the total money available should be spent on the amplifier and about another third on the speakers, leaving a third for a motor, pickup arm and cartridge; the proportion will change if a tuner or tape deck is also to be included.

The important consideration is that the quality of the various units should be compatible. However, it is perhaps worth bearing in mind that amplifier design is probably nearer perfection than other links in the chain and a good choice now is going to be acceptable for a long time.

POWER OUTPUT

Power output from the amplifier is worthy of thought. Advertisements give one the impression that power needs are increasing all the time and figures up to hundreds of watts are seen. But first make sure that the watts are genuine. Only ratings of continuous sine wave output (or so called r.m.s.) should be accepted for comparison and if interesting amplifiers are not specified in this way (read the small print to make sure), ask for a conversion of the specification provided into continuous sine wave form.

Practically the whole of one's listening is done at the level of a fraction of a watt, so why bother about high output? The truth is that it is not so important as one might imagine, but it does come into its own on the occasional peaks that contribute so much to the overall satisfaction derived from listening to music.

Probably many people can get by with some 3 to 4 watts per channel, but musically it is unlikely to be satisfying. Ten watts per channel will be a great improvement and most people will be content. An increase to 20/25 watts per channel will be worth while, but it is doubtful whether any further increase will be an advantage in most cases.

Speakers vary in acoustic efficiency and therefore have a bearing on power output needed. The smaller units are less efficient and need more power input for a given noise but are rated at lower maximum power input than the larger more efficient speakers. The larger units are commonly rated at 25 watts and if fed by power up to their full rating will give a very healthy volume.

It is not necessary to be overstrict in comparing amplifier peak output ratings with speaker power ratings—the figures need not necessarily be identical. Speakers with a higher rating than the amplifier are obviously acceptable and even if they have a somewhat lower rating it need be no cause for concern. Speaker impedance varies as frequency varies and so matching to amplifiers is not an exact science.

However, one should choose speakers with a nominal impedance equal to that specified by the makers of the amplifier. This impedance is commonly 8 ohms with modern transistor amplifiers but there are variations, for instance 16 ohms as commonly used for valve amplifiers. If an amplifier is to be bought for use with existing speakers and if perhaps the preferred amplifier specifies an impedance differing from that of the speakers caution is called for.

Small increments in power output are quite unnoticeable. An increase from, say, 10 to 12 watts (other things, and particularly distortions, being equal) will be pointless. Increases by a factor 2 are necessary to make an impression of greater power.

DISTORTION

Having dealt with input and output, what goes on in the middle? In the process there will be the inevitable production of distortion and this is specified in relation to output. For modern amplifiers a total harmonic distortion at full rated output of 1% is mediocre; the better amplifiers will have a figure of 0·1% or less. Since the greater part of one's listening time involves output at a fraction of a watt, distortion at these low levels can be very annoying.

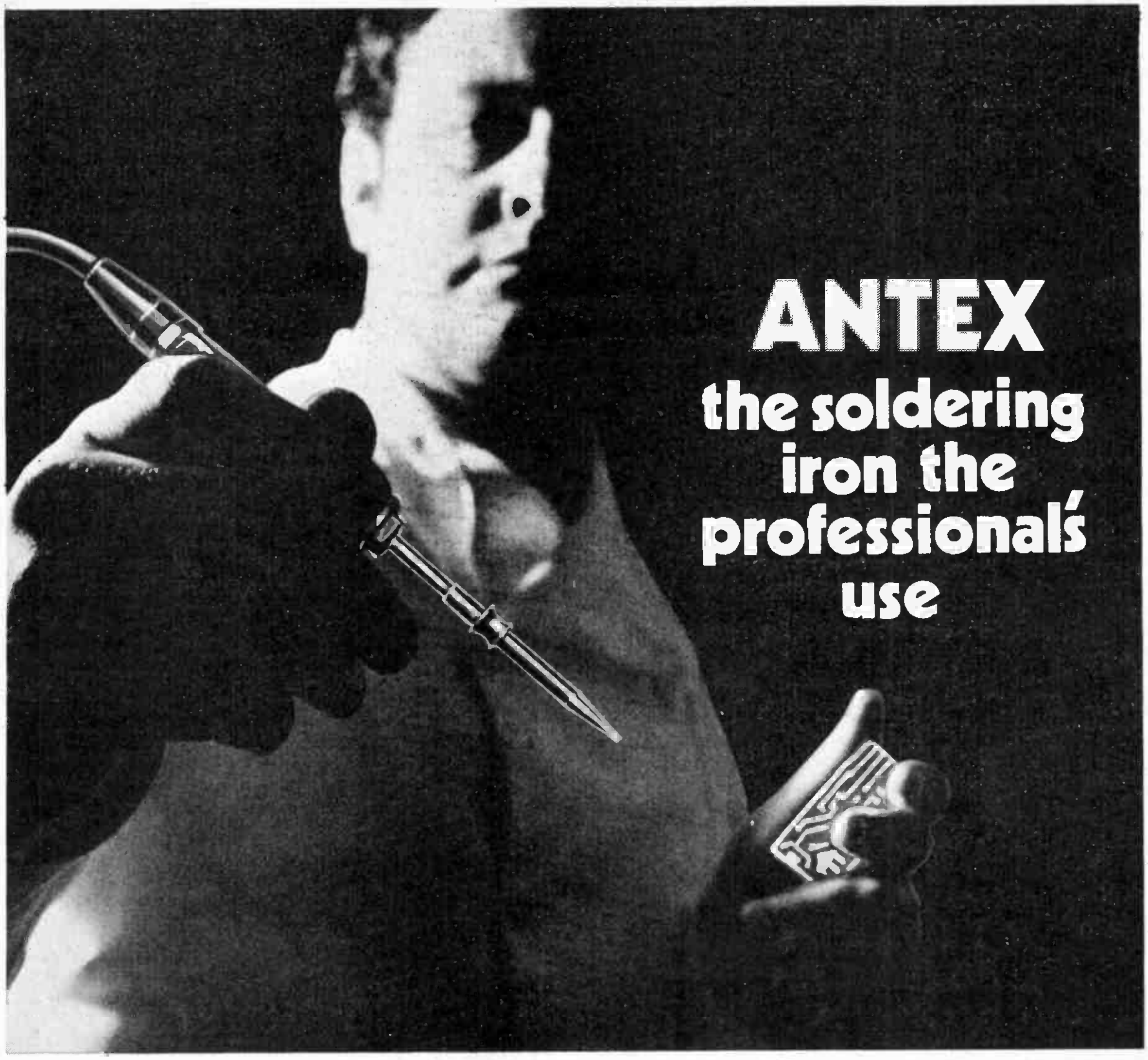
The intending purchaser should look for a specification of low level distortion, ideally in the form of a graph or a statement covering a range of output levels rather than a specification at a single output level. The surest way of avoiding this unpleasant rise in distortion at lower outputs is to use Class A output in which case there is an intrinsic fall in distortion at lower levels; such amplifiers sound distinctly better than most and are as good as the best of Class B amplifiers.

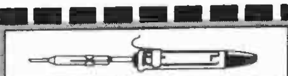
Frequency response is unlikely to be inadequate in these days. It should, and generally does, extend from below 40Hz to above 20kHz without significant deviation from level response. However, this is usually measured at comparatively low power levels and it is important to know if the frequency range is held at higher powers—this is often called the power bandwidth. A satisfying statement by the makers of a well-known amplifier is "Frequency response maintained up to full power (25Hz—25kHz ±0·5dB)."

CONTROLS

Finally the controls provided should be considered. There must be an input selector for the various inputs chosen. A switch is needed to ring the changes between stereo and mono, in the latter case permitting either left hand or right hand input to be used or for the two to be combined into a single signal. Volume, bass and treble tone controls are needed in each channel for stereo—ganged controls with single knobs are preferred and this makes a balance control essential.

—continued on page 150





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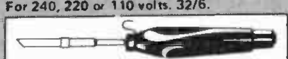

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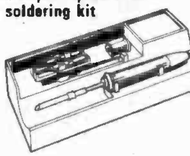

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U52	5/6
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U78	4/3
U107	18/3
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U153	5/3
U154	5/3
U191	12/6
U192	5/3
U193	6/9
U251	14/6
U281	8/-
U282	8/-
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AA120	3/-
AA129	3/-
AAZ13	3/6
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AC113	5/-
AC114	8/-
AC154	5/-
AC156	4/-
AC157	5/-
AC165	5/-
AC166	5/-
AC167	12/-
AC168	7/6
AC169	6/6
AC176	11/-
AC177	5/6
ACY17	8/-
ACY18	3/8
ACY19	3/9
ACY20	3/6
ACY21	3/9
ACY22	3/6
ACY28	4/-
AD140	7/6
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AF102	18/-
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AF114	4/-
AF115	4/3
AF117	4/6
AF119	3/-
AF121	6/-
AF124	7/6
AF126	5/-
AF139	13/-
AF178	13/6
AF179	13/6
AF180	9/6
AF181	14/-
AF186	11/-
AF239	7/6
ASY27	8/6
ASY28	6/6
ASY29	10/-
B1181	10/-
BA102	9/-
BA115	2/8
BA116	5/-
BA129	2/6
BA130	2/-
BCY10	5/-
BCY12	5/-
BCY33	5/-
BCY34	4/6
BCY38	5/-
BCY39	4/6
BCZ11	3/6
BC107	4/-
BC108	3/6
BC113	5/-
BC115	3/-
BC116	5/-
BC118	4/6
BD119	9/-
BFY50	4/-
BFY51	4/-
BFY52	4/6
BF154	5/-
BF159	5/-
BF163	4/-
BF173	7/6
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BF181	8/-
BF185	8/-
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BY101	3/-
BY105	3/6
BY114	3/6
BY126	3/-
BY127	3/6
BYY23	30/-
BYZ10	5/-
BYZ11	5/-
BYZ12	5/-
BYZ13	5/-
BYZ15	35/
OG12E	4/-
OG64H	4/-
FSY11A	4/6
FSY28A	4/6
GD4	6/6
GD5	5/6
GD6	5/6
GD8	4/-
GD9	4/-
GD10	4/-
GD11	4/-
GD12	4/-
GD14	10/-
GD15	8/-
GD16	4/-
GET103	4/-
GET105	18/-
GET113	4/-
GET115	17/-
GET116	6/6
GET118	4/-
GET119	4/-
GET573	7/6
GET587	8/6
GET872	19/-
GET873	3/-
GET882	10/-
GET887	4/6
GET889	4/6
GET890	4/6
GET896	4/6
GET897	4/6
GET898	4/6
GEX13	3/6
GEX35	4/6
GEX36	10/-
GEX45	6/6
GT3	5/-
M1	2/10
M3	2/10
MAT100	7/9
MAT101	8/6
MAT120	7/9
MAT121	8/6
OA5	5/6
OA9	2/6
OA10	8/6
OA47	2/-
OA70	3/-
OA73	3/-
OA79	1/9
OA81	1/9
OA85	1/6
OA86	4/-
OA90	2/6
OA91	1/9
OA95	1/9
OA200	1/-
OA202	2/-
OA210	9/6
OA211	13/6
OAZ200	12/-
OAZ201	10/6
OAZ202	9/-
OAZ203	9/6
OAZ204	9/-
OAZ205	9/-
OAZ206	9/-
OAZ207	10/6
OAZ210	7/-
OAZ213	7/-
OAZ224	16/6
OC19	25/-
OC22	5/-
OC23	5/-
OC24	5/-
OC25	5/-
OC26	5/-
OC28	9/-
OC29	9/-
OC35	7/6
OC36	7/6
OC38	8/6
OC41	10/-
OC42	12/6
OC43	23/6
OC44	2/-
OC44PM	8/3
OC45	2/-
OC45M	8/-
OC46	3/-
OC65	22/6
OC70	2/3
OC71	2/-
OC72	2/-
OC73	16/-
OC74	2/6
OC75	2/-
OC76	2/6
OC78	3/-
OC78D	3/-
OC79	3/-
OC81D	2/-
OC81M	5/-
OC82	2/3
OC82D	2/3
OC83	2/-
OC84	3/-
OC123	4/6
OC139	4/6
OC140	19/-
OC169	3/6
OC172	4/-
OC200	4/4
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SUMS plus CIRCUITS equals UNDERSTANDING

PART 3

LESLIE MOORE

TRIGONOMETRY

FOR a full understanding of circuit operation and relevant mathematical treatment, a few trigonometrical exercises should be dealt with, so a few simple definitions are required for further work. Consider the right angled triangle shown in Fig. 3.1.

Definitions of trigonometrical ratios are:—

Sine of angle A $= \frac{a}{c}$ (written as sinA).

Cosine of angle A $= \frac{b}{c}$ (written as cosA).

Tangent of angle A $= \frac{a}{b}$ (written as tanA).

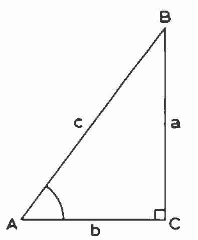


Fig. 3.1.

These relationships are valid only for right angled triangles. The sinusoidal waveforms discussed in the last article are in fact graphs of angle sines against angle, and as trigonometrical tables exist which give us angles for given sines, cosines and tangents, the above relationships are of importance.

Further information of use to us in given in Pythagoras' Theorem which states that for a right angled triangle:

$c^2 = b^2 + a^2$ (with reference to fig. 3.1.)
e.g. when $a = 4$, $b = 3$.

$$c^2 = 4^2 + 3^2 = 16 + 9 = 25$$

$$c = \sqrt{25} = 5$$

In this particular case:

$$\text{Sin A} = \frac{4}{5} = 0{\cdot}8$$

$$\text{Cos A} = \frac{3}{5} = 0{\cdot}6$$

$$\text{Tan A} = \frac{4}{3} = 1{\cdot}33$$

The size of angle A can be found from any of the trigonometrical tables mentioned. In this case angle A = 53° 8′ (53 degrees 8 minutes).

These few facts are of use in determining out of phase angles in a.c. circuits as will be seen later.

Sinusoidal waves

The sine wave is the basic alternating waveform we use. Figure 3.2 shows one cycle of a waveform and indicated are several values of importance.

1. R.M.S. or root mean square value is the voltage/current normally quoted. This is the value which must be used for determining power in a circuit.
2. Average value is the mathematical average of the waveform obtained by dividing the waveform's bounded area by its base length.
3. Peak value which should be known when considering electronic circuitry so that "bottoming" of a transistor and exceeding diode peak-inverse voltage limits may be avoided.
4. Peak-peak value, twice the peak value, is used when determining useful amplifier gain graphically.

The base of a waveform can be graduated in units of time or angle. e.g. A frequency of 1Hz will have a waveform of 1 second periodic time. One complete cycle which occurs in the periodic time, can also be considered as 360° of angular rotation. From this consideration waveform amplitudes may be obtained for each angle using sinusoidal tables.

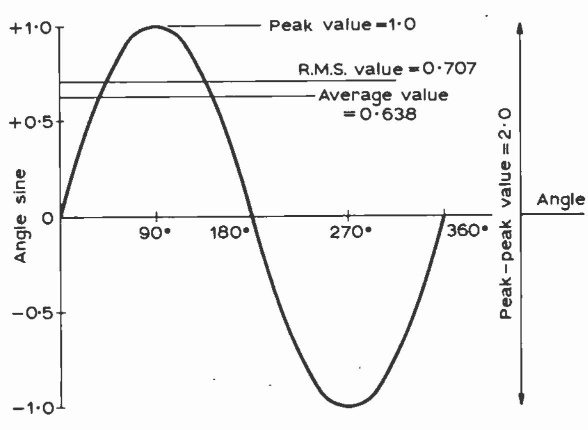


Fig. 3.2: Typical sine wave and four methods of defining its value.

Reactive Components

Inductive and capacitive components have "reactance" in a.c. circuits and it is the reactance value which gives us most useful information.

Capacitance is the property which exists between two conducting surfaces held apart by an insulating material or "dielectric".

The value of capacitive reactance is determined by the formula:

$$Xc = \frac{1}{2\pi fC}\Omega$$

where f = frequency in Hz.
C = capacitance in Farads.
Xc = capacitive reactance in ohms.

A capacitor in an a.c. circuit has the effect of producing a current out of phase with the applied voltage. Figure 3.3 gives an example. Values of current and voltage can be calculated using Ohm's law, however, phase change should be taken into account.

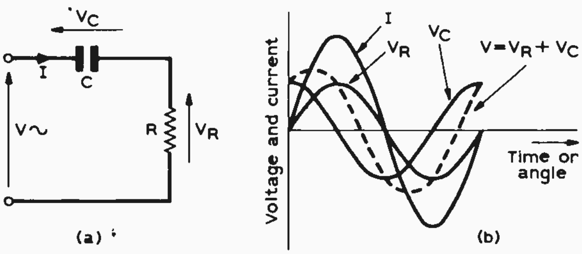


Fig. 3.3a: CR series circuit.
3.3b: Voltage and current wave forms.

Inductance is due to the build up of magnetic fields around a coil of wire. An alternating current in the coil produces an alternating magnetic field which tries to oppose the flow of current. This opposition to current flow is termed inductive reactance and is determined from the formula:

$$X_L = 2\pi fL \ \Omega$$

where L is the inductance in henries
X_L is the inductive reactance in ohms.

Inductance in an a.c. circuit gives a phase shift in the opposite direction to that of capacitance. This is demonstrated in Fig. 3.4.

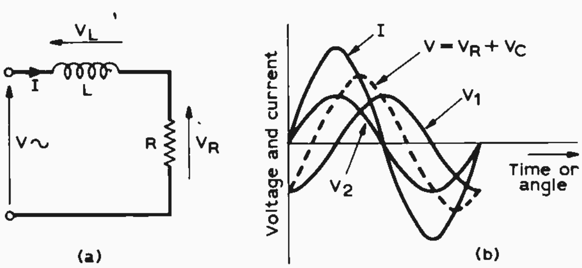


Fig. 3.4a: LR series circuit.
3.4b: Voltage and current waveforms.

Calculation of phase angle

Phase angle is determined from resistive and reactive values in a circuit. This can be most easily demonstrated by representing voltage drops by the method of vectors.

Only resistive components in an a.c. circuit will consume power, therefore they are known as "real" components. Reactive components, however, absorb no power and are known as "imaginary" components.

Vector representation utilises real and imaginary components as different axis on a graph, each current, voltage, or impedance being represented as a single straight line. Purely real components are drawn along the horizontal axis and purely reactive components are drawn along the vertical axis. Any component which is not purely reactive or resistive is drawn at a relevant angle to the horizontal plane.

The representative straight lines, known as vectors, are drawn to scale, e.g. 1 inch represents 1 volt in magnitude. It should be noted that all vectors should represent the same type of component value, rms values are normally used.

Figure 3.5 (a) shows a CR circuit with all voltages and current marked. A vector diagram for this circuit has been constructed in Fig. 3.5 (b).

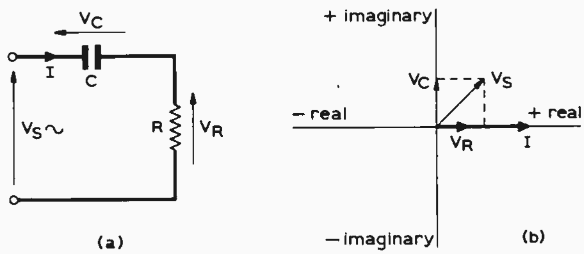


Fig. 3.5a: CR series circuit.
3.5b: Vector diagram for CR circuit.

Supply current to a series circuit is common to both R and C components and therefore taken as reference vector. Resistive volt drops are in phase with current, hence V_R is a real component. Voltage across a capacitor is out of phase with current by 90°, and as current reaches a maximum value 90° after the voltage, voltage is shown on the plus reactive scale.

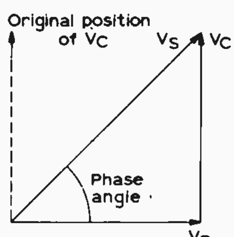


Fig. 3.6.

Supply voltage to the circuit can now be determined by adding resistive and reactive volt drops vectorially.

The reconstruction of the voltage vectors in Fig. 3.6 and as can easily be seen, supply voltage and its angle with supply current can be measured.

Having drawn the diagram, from comparison with the introduction of this article, we can determine a method for calculating phase angle and supply voltage.

Tangent of the phase angle is given by the ratio $\frac{V_C}{V_R}$, and by Ohm's law:

$$V_C = I_S X_C \text{ and } V_R = I_S R$$

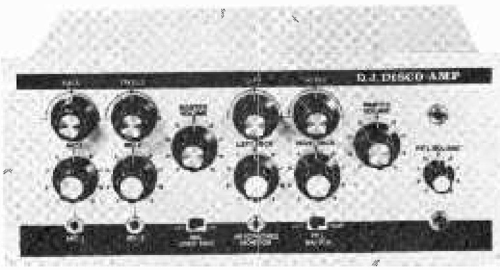
Tangent of phase angle (often written as $\tan\phi$) is given by:

$$\tan\phi = \frac{I_S X_C}{I_S R} = \frac{X_C}{R}$$

Phase angle can be obtained accurately directly from trigonometrical tables.

DISCOSOUND

DJ DISCO-AMP



The DJ Disco-amp has been designed specifically for use with discotheques and has many exclusive features not normally found on P.A. amplifiers. The unit will be of use to the professional D.J. as well as in clubs and mobile discotheques.

The pre-amp section features independent inputs and volume controls for two mics with separate bass, treble and master volume. plus two independent inputs and volume controls for turntables. again with separate bass, treble and master volume controls.

A complete Pre-fade listen (P.F.L.) cueing monitor section is also featured with separate input for headphones (either stereo or mono) with an independent volume control for headphone monitoring. and a P.F.L. switch, so that either turntable can be monitored for accurate cueing up of records. A mic over-ride switch is also added which cuts the music volume by half so that mic announcements may be made over the music without altering the volume controls.

The power amplifier section has an output of 70 watts R.M.S. into 8 ohms and has elaborate protection against thermal. short or open circuit. The unit is designed for panel mounting.

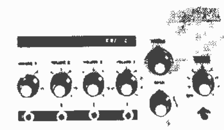
SPECIFICATION

Output power	70 watts R.M.S. ± 1db at 8 ohms.
Frequency response	30-20,000 Hz ± 3 db.
Harmonic distortion	Less than 1% at full output.
Signal/noise ratio	Better than − 65db.
Speaker impedance	8-16 ohms.
Headphone impedance	8-16 ohms.
Bass control	Variable 20 db at 100 Hz.
Treble control	Variable 20db at 10 kHz.
Inputs:	Miç 1 & 2 5 mV at 50 K ohms.
turntable	1 & 2 100mV at 1 meg ohm.

50 ohm or 600 ohm mic inputs may be ordered at extra cost. Size: Front Panel 16½" x 7". Cut out 15½" x 6". Fuses: A.C. 1.5 amp (B.S.) mounted on back panel.

PRICE £85.0.0 inc. P & P.

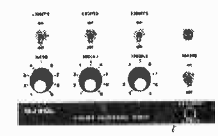
DISCOSOUND PRE-4



This is a four channel fully mixable pre-amp, with separate treble, bass and master volume controls. and is completely self powered. All four inputs are by standard jack socket on the front panel with the addition of inputs 3 and 4 being duplicated on the back panel, with two paralleled outputs also featured for versatility in use.
Frequency response: 30-20,000 HZ± 3db.
Signal/Noise Ratio: −65db.
Size: front panel 12¼ × 5¼ cut out required 11¼ × 4¼.
Completely built and tested.

PRICE £18.0.0 inc. P & P.

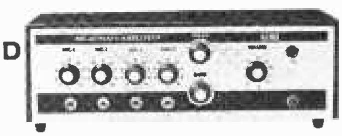
DJ 30L PSYCHEDELIC LIGHT CONTROL UNIT



3 channel light control unit that handles up to 1,000 watts per channel. Separate bass, middle and treble controls for full frequency separation.
Completely built and tested

PRICE £37.10.0 inc. P & P.

DJ 70S INTEGRATED MIXER-AMPLIFIER



One of the finest units available on the market today. regardless of price. The front end of the unit consists of a four channel mixer with separate inputs and volume controls. plus a separate bass. treble and master volume control. One of the main features of this remarkable amplifier is its elaborate protection against short and open circuit and we can guarantee that it is virtually indestructable. Allied to this is its very high power output (70 watts R.M.S.) a frequency response (30-20,000 Hz ± 3db) that is superb, and distortion that is well below 1% even at full output. The unit is suitable for use with discotheques. groups. P.A.. clubs etc., or anywhere that high quality high output is required. Size: 15¼in × 5in × 6in.

PRICE £55.0.0 inc. P & P.

Also available DJ105S 30 watt P.A. Amplifier. Similar specification to above.

PRICE £35.0.0 inc. P & P.

DISCOSOUND 70 MAIN AMPLIFIER

A 70 watts RMS (8 Ohms) High Fidelity power Amplifier which utilises all silicon transistors of modular construction and features full automatic overload protection against short or open circuits. Frequency response: 20-20,000 Hz ± 2db. The High output is ideally suited for discotheques, groups, clubs, etc., or anywhere where reliability and quality are required. This unit is the companion model for use with our control pre-amp Discosound PRE-4, or can be used with any other high quality pre-amp control unit.
Size: 7" × 9" × 6".
Completely built and tested on steel Chassis.

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It is now also obvious that supply voltage magnitude can be determined using Pythagoras' theorem.

then $V_S^2 = V_C^2 + V_R^2$

therefore $V_S^2 = I_S^2 X_C^2 + I_S^2 R^2$

therefore $V_S = \sqrt{I_S^2 X_C^2 + I_S^2 R^2}$

$= I_S \sqrt{X_C^2 + R^2}$

The term $\sqrt{X_C^2 + R^2}$ is the circuit impedance, Z.

It seems then, that by using a few simple calculations useful information may be obtained for resistive-reactive networks. Unfortunately not all circuits are quite so simple to work with and other techniques have been utilised to handle them.

j Notation

Complicated vector diagrams can be solved by a series of small calculations which take up time.

j notation can be used to represent vectors mathematically and so eliminate some of the more tedious work.

The vector diagram axis of real and imaginary terms is used. Positive and negative real axis are graduated with real numbers whereas positive and negative imaginary axis terms are prefixed with +j and −j terms.

Although j has the meaning of a vector of unity magnitude at 90° from the reference, j also has the numerical value of being the square root of −1.

The following table lists vector positions in terms of j.

Angle	0° or 360°	90°	180°	270° or −90°
j notation	$(j)^\circ = 1$ or $j^4 = 1$	j	$j^2 = -1$	$j^3 = -j$

Any vector lying at some angle between axis has two components, real and imaginary. Figure 3.7 shows a vector which can be written as 2 + j1.

There are a few rules which should be obeyed when manipulating j items, but these are best demonstrated in an example.

Figure 3.8 shows a parallel circuit. Circuit impedance in j items is given by:—

$$Z = \frac{-jX_C(R + jX_L)}{R - jX_C + jX_L}$$

$$= \frac{X_C X_L - jX_C R}{R + j(X_L - X_C)}$$

If $R = 10\,\Omega$, $X_L = 5\,\Omega$, $X_C = 10\,\Omega$

$$\text{then } Z = \frac{50 - j50}{10 + j5}\,\Omega$$

This term is rather cumbersome, so to produce an impedance term which can be easily handled the lower term of the fraction (or denominator) must be made into a real number. This is done simply by multiplying both numerator and denominator by a term which contains the denominator's real part and the opposite sign of its imaginary part.

$$Z = \frac{50 - j50}{10 + j5} \cdot \frac{10 - j5}{10 - j5}$$

$$= \frac{500 - j250 - j500 - 250}{100 - j50 + 50 + 25}$$

$$= \frac{250 - j750}{125}$$

$$= 2 - j6\,\Omega$$

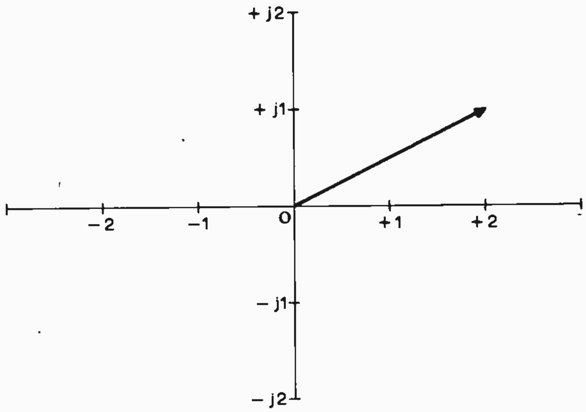


Fig. 3.7: Relating vectors to j notation.

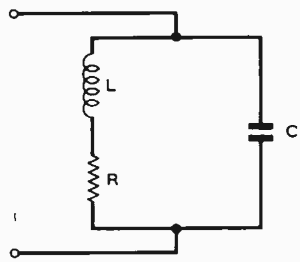


Fig. 3.8: Parallel tuned circuit to demonstrate use of j notation.

Polar Representation

A further method of representing vectors can often prove useful, especially when vectors are to be multiplied or divided. This involves representing each vector by its magnitude and angle.

e.g. (I) $A \underline{|X}$; (II) $B \underline{|Y}$; (III) $C \underline{|Z}$

where A, B and C are the vector magnitudes (or lengths) and X, Y and Z are the vectors' angles.

Rules for multiplying are:

Multiply magnitudes and add angles.

Rules for dividing are:

Divide magnitudes and subtract angles. (It should be noted that we cannot add and subtract vectors when represented by their polar forms.)

Conversions from j notation to polar form are often made necessary. Suppose the term D + jE is to be converted to $A \underline{|X}$. Using rules duscussed previously, $A^2 = D^2 + E^2$.

$$A = \sqrt{D^2 + E^2}$$

$\tan X = \dfrac{E}{D}$, therefore angle X, can be obtained from trigonometrical tables.

Applications

Numerous applications for this type of calculation include the determination of lower and upper half power points of amplifiers, calculations involving filter networks and attenuators, determination of oscillator operating frequency and accurate measuring bridge calculations.

Application of some of the theorems mentioned here will be discussed later in the series.

TO BE CONTINUED

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times in GMT • Frequencies in kHz

THE BROADCAST BANDS

Malcolm Connah

THE FIRST report this month is another excellent one from **Geoffrey Gilham,** ISWL G-10056, of London S.E.12. Goeff's equipment includes an Eddystone EC10 and a TRIO 9R59D.

4820 *HRVC,* Honduras with classical music at 0215.

4940 *R. Yaracuy,* Venezuela with Ident. at 0227

4960 *R. Sucre,* Venezuela with news at 0200

5020 *Trans. Caldas,* Colombia at 0704

9560 *R. Australia* with DX News at 0730

11650 *R. Pakistan,* Dacca at 1500

11920 *Abidjan,* Ivory Coast with Eng. news at 1830

15105 *BBC,* Ascension Island relay, Ident. at 0915

15365 *RNE,* Canary Islands with Ident. at 0105

Chris Stacey of Tunbridge Wells has a Lafayette HA-700 with a Joystick antenna and A.T.U. and he sent me the following log:

7295 *Athens,* Greece at 1412-1445

7306 *Polish Pathfinders* at 1530-1555

9009 *Israel Broadcasting Auth.* at 2045-2127

17810 *R. Nederland,* Bonaire in Dutch at 1955-030

Roy Patrick of Derby has an impressive line-up of equipment including an Eddystone 840, Hallicrafters S×24, Codar Preselector and various aerials and seems to have been concentrating on Middle-Eastern stations:

7155 *R. Amman,* Jordan in English at 2015

9667 *R. Damascus,* Syria in English at 2030-2100

17820 *R. Ankara,* Turkey in English at 1415

Roy also reports that *Radio Iran* will have a 250kW shortwave transmitter on the air very soon.

T. R. McKirdy, ISWL GM-13209, of Hamilton used a TRIO 9R59D, RF Preselector and a 66ft dipole at 18ft to send in a log which included:

5975 *VOA,* Okinawa with Science of Medicine at 0240

6050 *HCJB,* Ecuador with Religious Service at 0930

9630 *CBC,* Canada with Ident, in English at 1615

11720 *VOA* Tangier with 'Jazz Hour' at 2340

15040 *R. Peking* with news in English at 0000

21535 *NHK,* Japan in English at 0820.

Ray Hounslow of Carlton near Bedford has a Hallicrafters S-76 and sent in the following items:

The *Windward Islands Broadcasting Service (WIBS)* transmits with a power of 5kW at 0245-0315 on a frequency of 11970. The QSL card is a bit drab but it is worth the effort.

The *Broadcasting Service of the Kingdom of Saudi Arabia* uses 11855 at 0615-0645 with a power of 50kW.

John W. Smith of Anstruther, Fife has, once again, made good use of his Eddystone 840C and Joystick to hear several interesting stations:

6255 *Schulungssender des Osterreicheschen Bundesheeres* at 1830-1900

15080 *All India Radio* at 1850

15155 *R. Dif. de Sao Paulo,* Brazil at 2145

15155 *ELWA,* Liberia sign off at 2230

15160 *R. Ankara,* Turkey at 2210

15370 *R. Tamois and Tupi,* Brazil (33443) at 2200

21455 *Voice of Nigeria* (44444) at 0705

John also reports that a new QSL card will be issued to mark the 25th anniversary of the International Service of *CBC,* Canada.

Africa

Malagasy Republic: According to a recent schedule from the IV network of *R.T.V. Malagasy* there is a programme in English on Tuesdays, Thursdays and Saturdays and in French on Mondays at 1700-1715. The programme, titled "QSL Service," is followed by a musical programme until close down at 1730 on 17730 with a power of 100kW.

Asia

Afghanistan: *Radio Afghanistan,* Kabul broadcasts in German at 1730 and English at 1800 on new frequencies of 9530 and 11790.

Ceylon: The Commercial Service of *Radio Ceylon* in English now starts at 0100 on frequencies of 9720 and 15120.

Indonesia: The *Voice of Indonesia* is now using the frequency of 11710 and broadcasts news in English to the United Kingdom at 1915.

Philippines: *Radio Veritas,* Manila is broadcasting test transmissions on 15170 and 11830 from 0530 to 0630 and from 1100 to 1400.

South America

British Honduras: *Radio Belize* has increased power from one to five kilowatts on its shortwave channel of 3300 and broadcasts until close down at 0600.

Ecuador: A note received from *HCJB,* Quito says that in order to receive a QSL from them the following details *must* be given:— date, time, frequency in MHz (only 5kHz variance is allowable and metre band only is not acceptable), name of programme and items that would identify the programme. If an airmail reply is required three International Reply Coupons must be enclosed.

El Salvador: *YSS, Radio Nacional,* El Salvador is to broadcast in English and French. The programmes will be transmitted Monday to Saturday at 0300-0330 and on Sunday at 0030-0100 and consist of news items in Spanish, French and English. The frequent cies used will be 5980 and 9555.

All reports, preferably in frequency order, should arrive at 58 Kensington Gardens, Cranbrook, Ilford, Essex by the 17th of each month.

THE AMATEUR BANDS

David Gibson, G3JDG

EVEN listeners with cloth ears must have had themselves a ball this past month. All bands from 1·8MHz to 144MHz have been humming and, judging by the logs received, plus the remarks accompanying them, the resultant happy lug-holes are in a state of high jubilation.

L. Bunnewell (Norwich) claims that there is no achievement in receiving DX if you use a commercial receiver, and that it is the receiver and not the operator which should get due credit. (How many photographers do you know who make their own cameras, OM?) Any readers agree with this, or have any other ideas?

D. Henbry (Sussex), KW77, 7ft. vertical at 30ft. is back in the r.f. saddle again and sends in a fantastic all-band log. Down among the spurious and curious on 80 metres his ears beheld the wonders of: CN8HL, CR4BC, CR4BB, CT2AP, HC2GG, HK3WO, HP1JC, HS5ABD, KZ5AE, KZ5NR, MP4BFO, TI9CF (Cocos Is.), VP5NB, VP5TH, VP7NY, VS6DO, W5JV, W9FIU/KS4, WA1AIM/VO2, XE1CE, XE1KS, YV4UA, ZM1BAZ, ZM2GL, ZL2BCG, ZL4NH, 3A2MJC, 4X4UF, 9L1RP, 9Y4MM. (Cor! It's better than my log for 20 metres.)

On 40 metres David logged: CE3RR, CO2DC, CO2FA, CP1GN, EA8BZ, HBØLL, HI7CAF, HK1BWC, HT1HF, KZ5NR, OA4NLA, PY7PYQ, PZ1AH, TF5TP, TG8IA, TI2CAP, VP2VI, VP9GE, XE1BR, YV4CH, ZL3JC, 4X4KT.

D. Isaac (S. Wales), 9R-59DE, 60ft. end fed, caught this bunch red-handed on 80 as they crossed the Welsh border: CT2AT, HC2GG, HK3WO, K3UZE, K5KLA, K8UDI, KP4CL, OA4NLA, PY7VIZ, VE3TC, W2JKI, W3GM, W4BVV, W5IOU, W5QWF, XE1CE, XE2IH, YV4UA, YV5TS, ZL4NH, ZM3GQ, ZM3LE, 4X4UF.

J. Moore (Leicester), CR100/2, 60ft. end fed, reports happenings on the lower frequencies. 160—EI4AN, GI3TLT, GM3LIB, GM3NVU. 80—CT2AK, HV3SJ, K1BXI, KP4CL, VO1DE, W1CBU, WA1JFX, W2NIN, XE1KS, YV5BTS, ZC4CV. 40—K2BQI, PY7BFN, W2IUY, WA2BVU, W3ZKH/P/3, ZM3RK, 6W8DY. All this lot on s.s.b.

An urgent message for the chemistry master at Sir Thomas Rich's School, Gloucester. Messrs. **Anderson, Davies** and **Apperley** are holding sneaky listening sessions on your HRO plus 80ft. end fed. On 15 metres this trio logged: CN8HD, EP2EX, G3CGD, VE3ACD, W6ARJ, W6NWU, W8LIC, W9KHW, YA1HD, YT2FVW, 3Z6AAT, 4X4DK, 4Z4BG, 9H1BI. Well done lads—back to the tuck shop.

D. Robbins (Warks), CR70A, 60ft end fed, got these on s.s.b with the help of his b.f.o.: AX4PX, CN8HD, CR4BB, ET3USA, G3RTU/4X4, IS1LMN, JA6JNQ, JA6KCY, JX3MN, LU9DZ, PY7AF, VS6DA, VS6BE, ZC4HS, ZD9BM (Tristan da Cunha), ZL3BJ, ZS6AO, 5H3JR, 5H3KJ/A (Zanzibar), 9E3USA, 9G1GD. All these on 15 metres. On 20 s.s.b.—AX6RU, CE6DP, CP1GT, FP8CSV, HI8UD, HV3SJ (Vatican), JX3MN, JX4DN, JW3XK, KL7EBK, KP4FS, KZ5EK, LU1DM, DU6DLN, LU8AFB, LU9DDH, MP4QBK, PY4ATG, PY6AG, PZ1AP, TI9CF, TR8DG, VK3MO, VP2AA, VP2GLE, YV1ABO, ZP5AA, 4U1ITU, 5Z4LW, 8R1U, 9L1RP, 9Y4MM, 9Y4PL.

T. Maxwell (Lanarkshire), CR70A, 18ft. end fed sent a thin slip of paper with a fat log. Fifteen s.s.b.: CT1GD, EA6BJ, ET3REL, HPØLL, HR2HHP, JAØENB, JA3TXN, JA8AHH, JR1DQH, JW1CI, KZ5MP, OD5GD, PAØWEJ/SM/MM, SVØWP, VE5MW, VE6AJS, WB6UZF, YO9CN, ZM2NY, ZS6RO, 4U1ITU, 4X4RW, 6Y5ET, 7P8AB, 9Q5NW, 9U5CR.

K. Webb (Bucks), CR45, 12ft. whip antenna, says Vive la t.r.f. and promptly shows what can be heard. His log for 15 reads: AX3AKP, EA6BN, EA8FS, FP8CT, HR2WTA, JX3MN, KL7YM, KP4BBK, KR6HS, KV4GN, LU8FLO, PY2PA, SV1AR, VE1FN, VEØNA, VP2VI, VK3ZL.

A. Markham (Essex), 9R-59DE, 33ft. end fed, received these on 10 metres: AX3ACR, AX6BDO, AX6NM, HK5NE, JA1LBR, KH6QR, KZ5KZ, VE6UM, YV5CIL, ZE3JO, ZE4JG, 6Y5GB, 9J2PU, 9Q5RH.

A. Crooks (Leicester), RA1, PR30, 45ft. end fed logged FM7WR (Martinique) on 10 metres a.m. On s.s.b., Andy logged: CE3RR, CE8AA, CR7GC, CR7IK, EP2BI, HR1EMM, K6QVT, KP4ZC, LU2DAW, MP4QBK, OA4J, PY3APH, PY8JL, RA1AKZ (U.S.S.R.), SV1DA, VE2DMG, VE6AJD, VE6ANO, VP7DL, VP8KD, VP8KL, VU2OLK, W5RMC, W6GU, W7KPK, WØDQQ, WA6FQY, WA6UAG, WB6SMG, XW8BP, ZE1BS, ZP5OJ, 5N2AAF, 7Q7LZ, 9G1GD, 9H1BX, 9J2WS.

J. Stevenson (Surrey) is working on a collapsible 3-element 2 metre beam which can be dragged off the roof and hidden under the bed when the landlord is in. Mind how you turn over in bed OM, or you'll get more dB's than you bargained for. John has constructed the CQ-2 with certain modifications. His present antenna is a simple dipole made from 14 s.w.g. wire and he reports many fairly local signals. His main criticism of 2 metres is the overall standard of modulation. "Class C a.f. stages don't do much for R5 copy", he says. (Down you mutinous G8's.)

G. Richards (Isle of Wight) says, "Tell L. Coombs that I have declared war on him". Glyn has a 4 over 4 slot-fed yagi, JXK converter into a Mohican receiver tuning 28-30MHz. Stations in the 70-110 mile range received on 144MHz include—GW8ASA, GW3MFY, G2JF, G2DRT. From further afield—G3EGK (Leicester) and G6CW (Nottingham) both on s.s.b.

N. Richardson (Bucks), 5-element yagi (hand-rotated), Garex converter, PR30 plus CR70A as tuneable i.f. Nicholas reports some good openings and his log includes signals from—G2DQI, G2MR, G2BVW, G3HRH, G3KPB, G3MJW, G3NJV, G3RJC, G3SLJ, G8LT, G8ASR/A, G8BBB, G8BSH, G8BIC/P, G8CAF, G8CLX.

Goings on in May include: May 2nd. - 3rd., 144MHz contest; 10th., Ealing and District A.R. Mobile Rally at Hanwell, London, W. 7.; 17th. D/F event at Grimsby; 17th., Northern Mobile Rally; 30th., and 31st., 70cm. contest; June 6th., and 7th., National Field Day.

Please remember that logs must reach me by the 18th. of the month and should be in alphabetical order. Several logs received last month arrived on the 20th. and were too late to be included. Summer is aerial weather so how about trying a new aerial this year and let me know how you get on?

AERIALS FOR MOBILES

F. JUDD G2BCX

Continued from last month

Matching the Aerial to the Transmitter

One of the problems which many mobile operators find difficult to overcome is that of matching the aerial to the transmitter which is most important if maximum power is to be transferred into the aerial. As all loaded aerials for the h.f. bands are resonant to a quarter-wavelength they are current fed. A ten watt transmitter should put at least 0.3 to 0.4A into the aerial. However, this is only a rough guide and the aerial resonance should be adjusted until no further increase in aerial current can be obtained. There is also the problem of maintaining resonance over the whole of the band and which is closely bound with matching. The transmitter output must in the first instance be of low impedance, i.e., from a pi-network or link coil coupling. From here the aerial can be fed by a co-axial cable of 70 to 80Ω impedance. Unfortunately the feed impedance of loaded aerials is usually much lower than that of a full quarter-wave aerial and because of their low efficiency accurate matching is important.

A simple method is that shown in Fig. 11 which can be adapted to all the h.f. bands. The method provides not only accurate matching but also allows the aerial to be set to resonance over the band. The total amount of inductance in series with the feed to the aerial itself must be sufficient to maintain resonance at the lowest working frequency. As the sections of inductance are switched out the aerial will resonate at higher frequencies. Some operators use a coil with a sliding contact but these are difficult to obtain and/or make. Normally a mobile operator will work over a fairly narrow frequency band to avoid constant retuning of the aerial. Another method of tuning the aerial so as to be able to cover the whole band is to use a ferrite slug as illustrated in Fig. 12. The aerial and the matching inductance should be adjusted to resonate at the high frequency end of the band. Resonance at the lower frequencies is obtained by sliding the ferrite further into the coil. This method should only be used for the lower frequency bands of 1·8 and 3·5MHz.

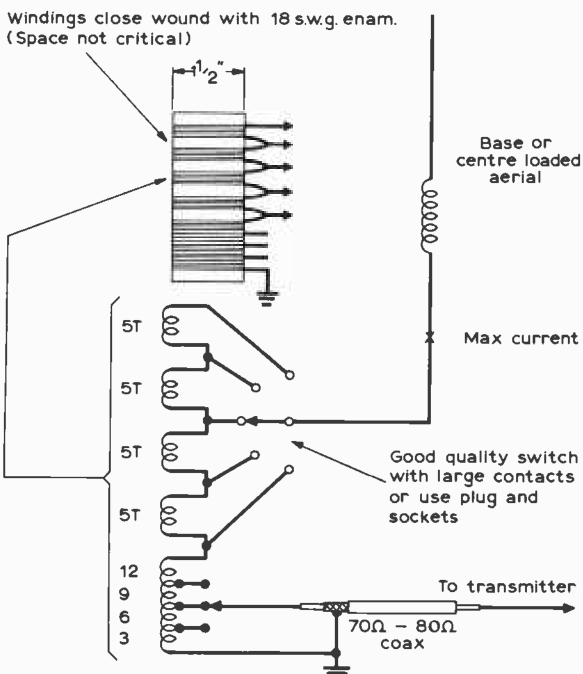


Fig. 11: Wide range matching system.

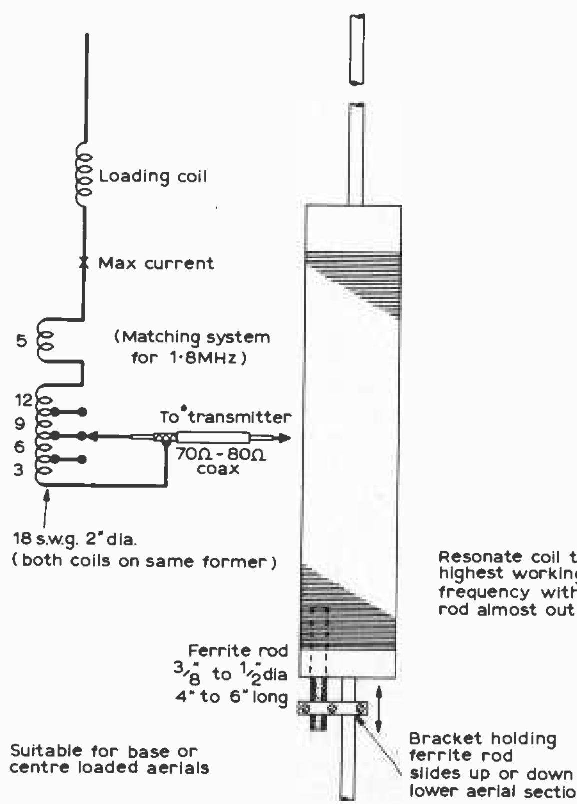


Fig. 12: Ferrite rod system for the l.f. bands

Capacity Hats

The capacity hat is rarely used now for low frequency aerials since it would have to be fairly large to produce any worthwhile reduction in coil inductance. Capacitive elements above the loading coil can, however, be used to tune the aerial to resonance over an appreciable proportion of the low frequency bands 1·8 and 3·5MHz. A fairly simple arrangement is shown in Fig. 13 and consists of two rods, one fixed and one moveable. Each rod should be about 12 in. long and ⅛in. diameter brass or copper. When the two rods are in line the capacity is minimum and as they are spread apart to form a 'V' the capacity increases. Both rods are in contact with the whip section above the coil and with each other.

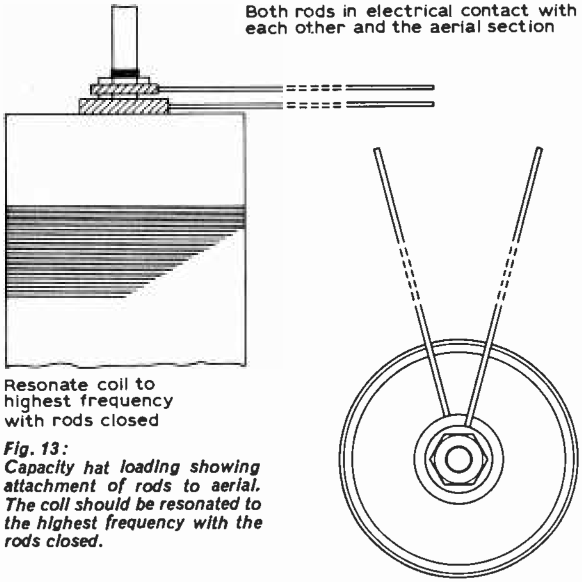


Fig. 13: Capacity hat loading showing attachment of rods to aerial. The coil should be resonated to the highest frequency with the rods closed.

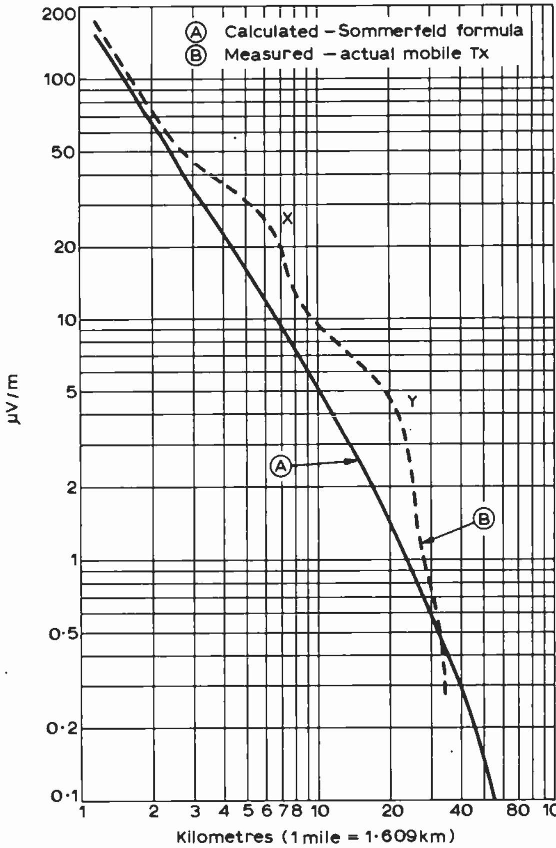


Fig. 14: Ground wave measurements on 1.8MHz.

Ground Wave Field Strength at 1·8MHz

The most popular amateur band for mobile operation is 1·8MHz on which propagation is predominantly ground wave. Field strength is therefore very much influenced by the ground over which the wave travels and particularly by built up areas. In open flat country transmitting ranges of up to 100 miles are possible but in rolling country this can soon be reduced to 30 miles or so. In heavily built up areas the range may well be limited to 10 miles or less. This is assuming a reasonably efficient mobile aerial, a transmitter input power of around 10 watts and that the receiving station also has a good aerial. Mobile to mobile ranges will normally be much less. A few years ago the writer carried out a series of field strength/distance checks with a 1·8MHz mobile transmitter (1). These were made over fairly flat country and compared favourably with field strength/distance calculated by the Sommerfeld formula.

The calculated and measured field strengths/distance are given in Fig. 14. The small increases in measured signal strength at X and Y were due to an increase in the height of the ground over which the mobile station was travelling.

(1) *Ground Wave Propagation at 1·8MHz by F. C. Judd, A.Inst.E. R.S.G.B. Bulletin, December, 1960.* ■

A LIGHT BEAM TELEPHONE

J. THORNTON LAWRENCE

The light beam telephone provides a convenient method of short range point-to-point communication, without the use of wires, which does not involve transmission and reception on frequencies requiring a Post and Telecommunications Licence.

Basically, the transmitter consists of a lamp which is amplitude (brightness) modulated by the voice signal to be transmitted. The lamp is mounted in an optical system, so as to produce a parallel beam of light, which is directed at the receiver. The receiver consists of a phototransistor mounted in a similar optical system to the transmitter.

The resultant audio frequency currents in the phototransistor, produced by the received light, are amplified to a level suitable to operate an earphone. By using a transmitter and receiver at both ends, a two way speech link may be established.

Technical Considerations

When the light source consists of a filament lamp, the thermal inertia, i.e. the time taken for the filament temperature to follow rapid changes of the applied current, causes the higher audio frequencies to be severely attenuated. To counteract this effect it is necessary to provide frequency compensation in the amplifier circuits, having an opposite characteristic which rises at the higher audio frequencies, in an attempt to produce a relatively level response.

The compensation is done in the coupling and de-coupling circuits in the transmitter and at the receiver. The effect is to produce an overall frequency response which is within 3dB over the range, 300-3000Hz, normally required for good voice communication.

Circuit Description

The circuit of the transmitter is shown in Fig. 1. The direct energising current for the carbon microphone M1 is provided by R1. The resultant a.f. signal voltage developed across R1 is coupled by C1 to the base of Tr1. Tr1 and Tr2 are connected as a 'Darlington pair' with the transmitter lamp LP1 connected in the collector circuit. R2, R3 and VR1 provide an adjustable potential divider which enables the operating current of Tr1 and Tr2 to be varied, so that the brightness of the transmitter lamp may be set to the level which gives the best modulation characteristics.

The necessary rising high frequency response is provided by the time constant of the coupling capacitor C1 and the potential divider resistors, and by negative current feedback at low frequencies by C2 and R5. H.T. line de-coupling is provided by C3.

In the receiver, Fig. 2., a.f. signals are developed across R7, the collector load resistor of the phototransistor Tr3. The signals are coupled via C4 to the base of Tr4. Tr4 and Tr5 comprise a direct coupled

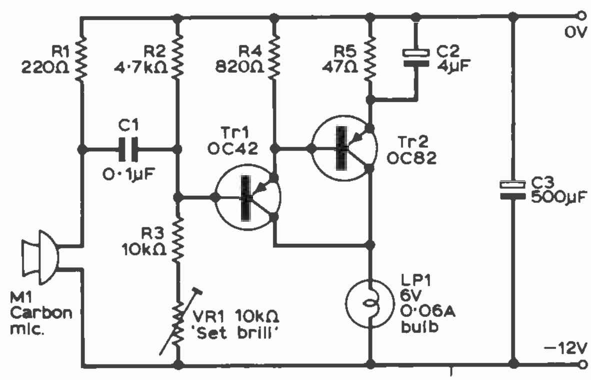


Fig. 1: Circuit of transmitter.

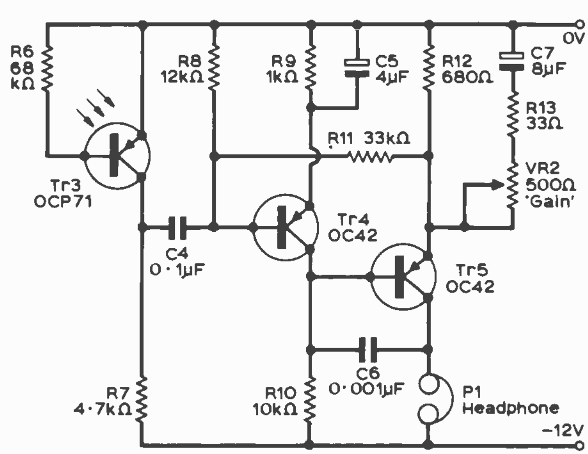
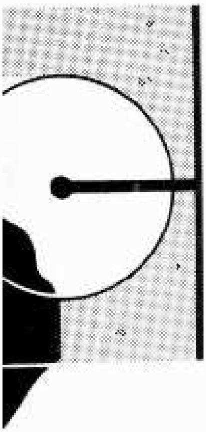
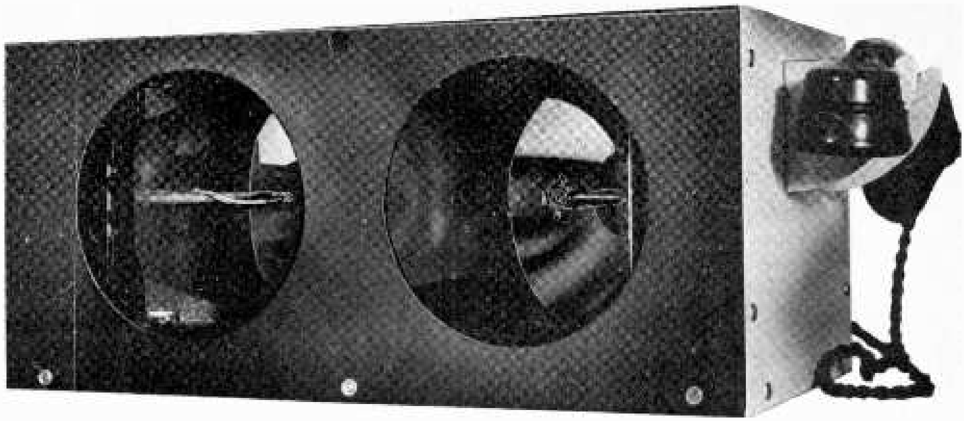


Fig. 2: Circuit of receiver.





amplifier. D.C. stabilisation of the operating conditions is provided by current shunt feedback from R11 and R8 to the base of Tr4. A rising high frequency response is produced by C4 and R7 also by C5 and R9.

For good signal to noise ratio the rising high frequency response has to be restricted to the required passband, this is done by C6 which provides voltage shunt feedback to reduce the gain of Tr5 at frequencies beyond about 8kHz.

Amplified a.f. currents in the collector circuit of Tr5 are fed to the earphone in the telephone handset. An a.f. gain control is provided by VR2 which forms part of the a.f. feedback loop with R11 to the base of Tr4. The overall measured frequency response is shown in Fig. 3.

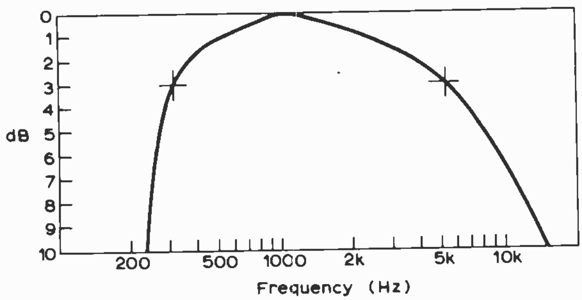


Fig. 3: Frequency response of receiver.

The Optical System

A number of experimenters have used different types of optical systems having varying beam widths and efficiencies. For the best results it is important to have a parallel beam of light from the transmitter to the receiver. The optics required to produce a near-parallel beam would normally be quite expensive.

The optics used in this system are built from four Mullard optical projector units, salvaged from old projection-type television receivers, such as Decca 1000, Ferranti 20T4, Peto Scott 169 and Philips 1700A series etc.

The Mullard optical unit contains a precision concave mirror, which is part of the Schmidt optical system and capable of giving a remarkably parallel beam of light. The focal length of the concave mirror is about 9·5 cms giving an equivalent aperture of about f1·8. The lamp in the transmitter is positioned so that its filament is at the focal point of the mirror and at the receiver a similar arrangement has the phototransistor at the focal point.

Construction

Construction of the unit is not critical, and the layout shown in the photographs is just one possible arrangement. Each Mullard optical unit frame is stripped of all hardware except the concave mirror and its fixing clips. Two units are bolted together feet-to-feet with an aluminium plate sandwiched between, to act as an optical screen. Aluminium plates are also fitted over the aperture left by removing the corrector lens.

The transmitter lamp and the receiver phototransistor are mounted on suitable brackets at the focal point of the mirror (about 9·5 cms out from the centre). Due to the very narrow beam width that can be obtained it is essential to have an optical sight attached to the units to facilitate correct alignment of both stations.

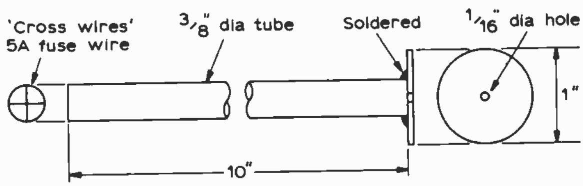


Fig. 4: Constructional details of optical sight.

The construction of the sight is shown in Fig. 4 and consists of a brass tube with a small aperture at the eye end and cross-wires at the remote end. The sight is attached by clips at the top junction of the optical unit feet and is packed into its correct position as described in the setting-up instructions.

The optical units may conveniently be bolted to a baseboard and the complete light beam telephone may be cased-in to prevent accidental damage to the components and to afford some protection against direct sunlight and the weather, when used for portable work outdoors.

Modified Construction

The original set of Light Beam Telephones were built some years ago and since that time, it has become increasingly difficult to obtain redundant Mullard optical units.

A very satisfactory alternative to the Mullard unit is the metal reflector from a car headlamp. This type of reflector can be found on most pre-1955 British cars and on current production cars of Continental manufacture. One of the easiest headlamps to modify are those found on Volkswagen vans. The reflector is readily removable and has an excellent lampholder on which the lamp or phototransistor can be mounted. These and similar types can be purchased from most car breakers for about 10s each.

It may be possible to use headlamps with surface silvered glass reflectors, but the front glass would have to be removed to avoid diffusion of the beam.

A suitable mounting arrangement is shown in Fig. 5. Here the reflector is mounted on the front panel by three long 4BA screws. The reflector has clearance holes drilled in its edge at 120 degree spacing and corresponding holes are drilled in the front panel. The long screws pass through the front panel, through three compression springs, through the reflector and are held in place by three 4BA nuts which wedge in the return flange of the reflector. The screws are tightened sufficiently to compress the springs and adjustment of elevation and bearing can be made from the front of the unit by adjusting the appropriate screws.

The phototransistor or lamp is mounted on short support rods of 18 s.w.g. tinned copper wire which are soldered to the lampholder contacts. This enables the original terminals to be used for connections.

The setting up instructions for the lamp and phototransistor in the Mullard unit apply similarly to the car headlamp reflectors. However, the fact that the reflectors can be tilted individually means that the sights on both units should be aligned on each other first, then the reflectors adjusted for correct alignment of the beams.

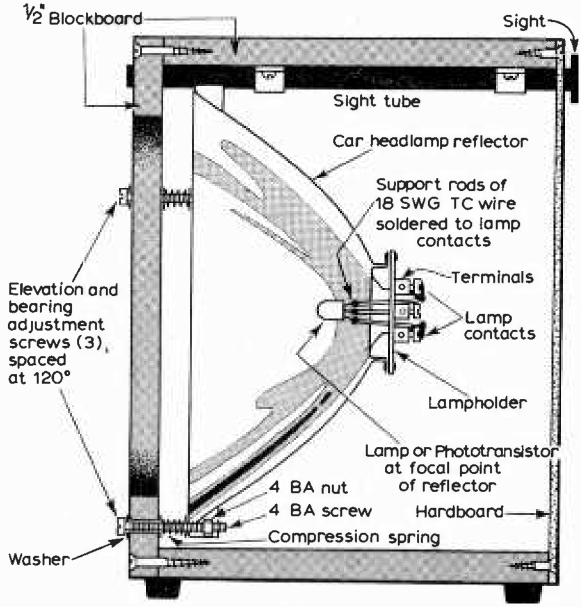
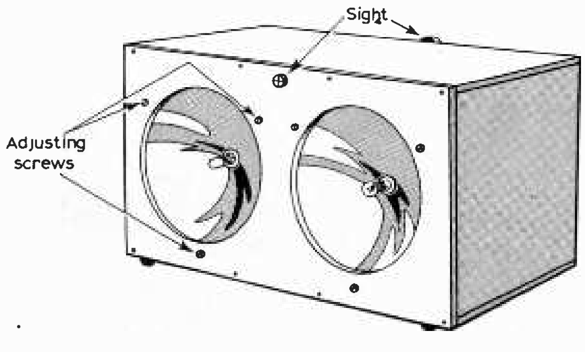


Fig. 5: Alternative construction using headlamp mirrors.



General view of modified unit.

★ components list (for one unit only)

Resistors

R1	220Ω	
R2	4·7kΩ	
R3	10kΩ	
R4	820Ω	
R5	47Ω	
R6	68kΩ	
R7	4·7kΩ	
R8	12kΩ	All ½ watt 10% carbon
R9	1kΩ	
R10	10kΩ	
R11	33kΩ	
R12	680Ω	
R13	33Ω	
VR1	10kΩ preset	
VR2	500Ω variable	

Capacitors

C1	0·1μF	125V	Paper/polyester
C2	4μF	15V	Electrolytic
C3	500μF	15V	Electrolytic
C4	0·1μF	125V	Paper/polyester
C5	4μF	15V	Electrolytic
C6	0·001μF	125V	Paper/polyester

Semiconductors

Tr1	OC42	Mullard or 2N1303 T.I.
Tr2	OC82	Mullard
Tr3	OCP71	Mullard
Tr4	OC42	Mullard or 2N1303 T.I.
Tr5	OC42	Mullard or 2N1303 T.I.

Miscellaneous

M1 and P1 Standard telephone handset.
LP1 6V 0·06 amp m.e.s. pilot lamp.
2 Mullard optical units (see text)
Miscellaneous screws, nuts, aluminium plates, lampholder etc.

Circuit Board

The photographs show a prototype unit in which the transmitter and the receiver units were constructed on separate circuit boards.

In the final version the two boards were combined on a single board consisting of a piece of Veroboard 5¼ x 2⅜in. of 0·15x0·15in. matrix.

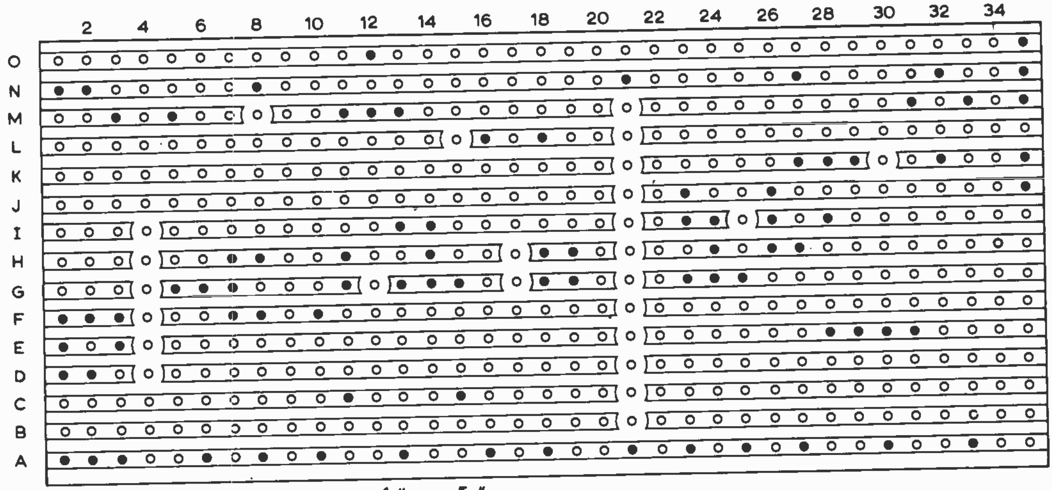
The board contains all the components with the exception of the gain control, the lamp and the phototransistor.

Details of the circuit board are given in Figs. 6 and 7. The board should be mounted as close to the phototransistor as possible in order to reduce the lead lengths. The gain control is mounted at the rear of the chassis at the same end as the circuit board.

Setting up

The easiest way to adjust and align the units is to set them up at each end of a fairly long room or corridor, facing each other, parallel and level.

Set the 'SET BRILL' control on one unit for near maximum brightness of the lamp and fix a piece of white paper over the opposite receiver unit aperture.



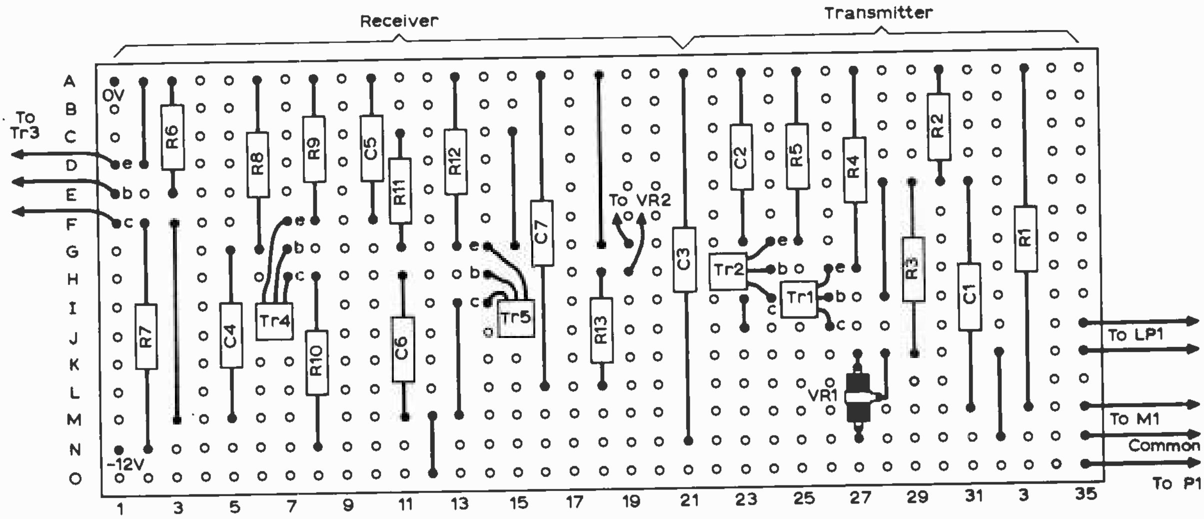
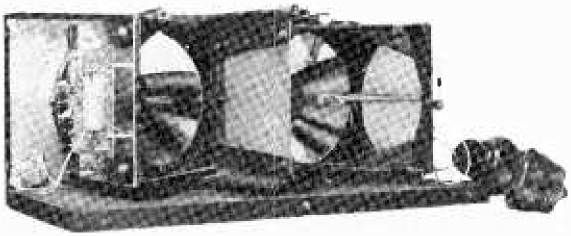
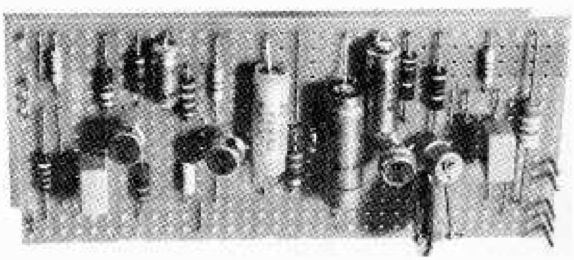


Fig. 6: Basic circuit board for combined transmitter and receiver.
Fig. 7: bottom: Top of board showing component layout.



View of prototype unit showing receiver circuit board.



Completed circuit board. Compare with Fig. 7.

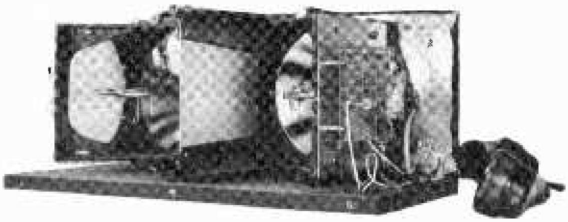
Darken the room or corridor and adjust the position of the transmitter lamp to obtain an even parallel beam, focussed on the paper and centred on the axis of the receiver optical unit. Remove the paper and adjust the position of the phototransistor for maximum illumination of its sensitive area.

Re-set the 'SET BRILL' control on the transmitter for about half full brightness and with a sound signal, e.g. voice or 'ticking clock', check the control setting for best modulation. If necessary make a final adjustment to the phototransistor position to give maximum audio volume.

The setting-up procedure for the other channel should now be carried out, but care should be taken not to move either unit or the original alignment will be upset. When both channels are fully operational, the optical sights on each unit should be aligned by packing the sight within its fixing clip so that the cross-wire on each is correctly sighted on the end of the sight of the other unit.

Operation

A range of several hundred feet should be obtained under normal daylight conditions, providing the sun is not shining directly into either receiver unit. An extended front cowl will normally overcome this problem, if it arises.



View from transmitter end of prototype unit.

At night the range will be increased to several hundred yards or more in very dark conditions. The gain control may be adjusted to suit the particular operating conditions.

Note

The concave mirrors are surface silvered and care should be taken to avoid damaging or marking the surface. If the mirror requires cleaning, this may be done by very gentle rubbing with a small pad of cotton wool slightly moistened with Stergene, diluted in accordance with the maker's instructions for cleaning glass.

Other sources of suitable reflectors, in order of suitability, include Aldis signalling lamps, aircraft runway landing lights, and projector lamphouse reflectors. The successful operation of the system depends on having a well focussed beam and good alignment.

Finally, should it be found necessary to use headlamp reflectors great care must be taken in removing any front glass to avoid injury to the hands. If necessary wrap the reflector unit in a cloth and then tap the glass gently with a hammer until it breaks. ■

THE MW COLUMN

WEST AFRICAN stations are usually at their best at this time of year. Listen from sunset onwards, preferably using a loop aerial since DX is to the south while any interference will probably be from the east. Conakry 1403kHz is invariably a good signal after 2300 hrs GMT—it was logged in Germany recently on a transistor portable! Listen for French announcements and African style music and singing. Dakar 746kHz in Senegal also signs off at midnight and has similar programming. Try after Sottons goes off the air at 2300 hrs (except on Saturdays). More difficult stations from this area include ELBC 629kHz in Monrovia Liberia which signs off at 0045 hrs with announcements in English; *Radio Abidjan* 1240kHz in the Ivory Coast in French; CQA 759kHz on the Portuguese island of Sao Tome in the Gulf of Guinea. Further south in Angola, CR6RZ on 1088kHz is sometimes heard in Portuguese after BBC4 on the same channel finishes for the night. Among easier stations in the north are *Radio Sahara* 656kHz in Spanish Sahara with close-down at midnight and Tenerife 620kHz in the Canary Islands which signs off at 0100 hrs. *The Voice of Morocco* 1232kHz in Tangiers is usually strong and can be heard quite late in the evening, broadcasting in Arabic or French.

The continued improvement in conditions on the medium waves since the maximum of the current sunspot cycle is illustrated in an interesting letter from Chris Pearson of Bolton Lancashire. Chris made his first attempt at MW DX on the 13th and 14th February using a domestic receiver and a 60ft aerial. During the period 2300 to 0130 GMT he logged CFCY 630kHz in Charlottetown Prince Edward Island; *WOR* 710 in New York City; *CHER* 950 Sydney Nova Scotia; *WINS* 1010 N.Y.C.; *CBA* 1070 Sackville New Brunswick; *WBAL* 1090 Baltimore; *WCAU* 1210 in Philadelphia; *WGAR* 1220 Cleveland. A very good beginning Chris. North American stations can still be heard from 0230 GMT until sunrise in May.

Sunset is a profitable time for the MW DXer. Before European QRM becomes too troublesome it is often possible to pick-out quite rare stations. Khania 1511kHz in Crete is one that has been logged at sunset during May. Although part of Greece, Crete is generally regarded as a separate country for DX purposes. Another 'DX Country' in this area is Rhodes in the Dodecanese Islands. In spite of QRM the *VOA Rhodes* on 1259kHz is occasionally logged. From the Persian Gulf the BBC Eastern Relay, *Radio Mazirah* 1410kHz in Sharjah, Trucial Oman, was heard regularly last summer in Arabic and Hindi up to sign off at 2115hrs. Further east, Urumchi 1525kHz in the Sinkiang Province of Western China beams programmes westward and can be heard quite clearly during the evening in Russian, in spite of jamming. Urumchi is one of a small number of high power MW stations intended for other than domestic or medium range reception; it's power is believed to be in the region of 2000kW.

CHARLES MOLLOY

SUPERCONDUCTIVITY

I. R. SINCLAIR

OF all the surprising effects which research in physics has uncovered in the 20th century, effects which include transistor action, lasers, parametric amplification and many others which have affected communications, one of the strangest to influence electronics must be superconductivity. It had, of course, been known that all good conductors decreased in resistance as they were cooled, and also that, contrary to what might be expected, the resistance then became constant for most materials at low temperatures.

By "low" in this context, we mean temperatures at which most gases are frozen solid, and to measure such temperatures we use a scale of temperature called the Kelvin or Absolute scale. We shall have to become used to this scale, as it is now internationally recognised as a standard, and will soon be the only scale of temperature taught in schools. The familiar term "degree" will disappear, to be replaced by the "Kelvin," and the temperature of "nought" Kelvin will be the absolute zero of temperature.

There are no temperatures below zero on the Kelvin scale, as we have very convincing evidence that it is impossible to have colder temperatures, and in practice we can only approach to within a few hundredths of a Kelvin to zero temperature. The zero of the Kelvin scale is at $-273{\cdot}16°$ on the Celcius (often wrongly called Centigrade, even by the BBC) scale on which water freezes at 0° and boils at 100°.

On the Kelvin scale, water freezes at 273·16°K, oxygen at 91°K and nitrogen at 79°K. Incidentally, if you think that this is another new fangled continental measurement, the scale was originated by Lord Kelvin in 1854, and has been in use since that time.

Research

By 1933, it was known that certain metals, in particular lead and tin, showed a sudden drop in resistance at temperatures of only a few Kelvin. Such temperatures could only be attained in baths of liquid helium, which is the last gas still to be liquid as the temperature approaches absolute zero, and the discovery must have seemed to readers of the newspapers of the time (if they troubled to report it) a useless piece of pure research with no practical significance.

It has great significance now. When lead is cooled, the resistance starts to fall very noticeably at about 7°K and by the time 4°K has been reached, the boiling temperature of liquid helium, the resistance of the lead is only a millionth of a millionth (10^{-12}) of its value at the freezing point of water. The **transition temperature** at which such metals suddenly drop in resistance varies from one metal to another; for tin it is 3·7°K, for mercury it is 4·1°K, and so on.

Much of the work which has been done on superconductivity has been aimed at finding alloys whose transition temperatures are higher than those of pure metals; the highest known at the time of writing is about 22°K. There is even a faint prospect of finding non-metallic substances which may be superconducting at ordinary room temperatures.

The Superconductivity State

To form any idea about what happens when materials become superconducting, we must use the modern theory of solids (see "The Solid State" in *Practical Wireless*, December 1968 and January 1969). This theory pictures a solid as an arrangement of positively charged nuclei surrounded by electrons of various energies arranged in groups or **bands.** The transfer of electrons from one band to a higher energy band can be arranged by providing the electrons with energy in the form of heat, light, or other radiation, sufficient to cause the transfer.

In many substances there are gaps between the bands, meaning that no electron can ever have values of energy corresponding to the gaps. If these gaps are wide, the transfer of electrons may never take place under any conditions which we can arrange, if the gaps are narrow, the transfer may be easy.

Insulators are materials whose highest energy band in use is filled with electrons, and whose next empty band is a large energy gap away. Insulators become conducting only at very high temperatures when some electrons transfer to the empty band and become free to move from the region of one nucleus to others.

Semiconductors have a smaller band gap, so that conductivity increases rapidly as the material is heated because of the easy transfer of electrons into a vacant band, leaving behind holes which can also act as conductors. Metals have overlapping bands, and electrons can move easily at normal temperatures. In this case the effect of heating is to move too many electrons into higher band regions, so causing what amounts to a traffic jam and **raising** resistance.

If we could examine an atom of a substance, we might find that the energies of the electrons were carefully graded in steps of energy which formed into bands only when atoms were forced to live close together, as when a gas is condensed into a solid. In each step of energy, a maximum of two electrons can only ever be found, distinguished from each other by their "spin," that is they appear to spin in opposite directions.

We should not take this too literally, because we cannot observe this spin, nor can we imagine any axis around which an electron should be spinning, but there is a sound basis for the idea of electron spin, not least in the explanation of magnetism, and spin is as good an idea as any to describe the difference between electrons which appear to be identical in every other respect.

As a metal is cooled, electrons of opposite spin in different energy levels appear to team up to form pairs (called Cooper Pairs) which have **identical** energy values, a situation which never exists at higher temperatures. These pairs with identical energy values stay together and move together without any interference from the rest of the particles forming the material.

An Analogy

The nearest thing which we know to this in everyday electronics is series resonance. Suppose we call an inductor a "resistor with clockwise spin"—expressing the idea that the voltage across the inductor is 90° ahead of the current through it. Since the voltage across a capacitor is 90° behind the current through it, we could call a capacitor a "resistor with anti-clockwise spin," and we might not be surprised if we found that the combination of an inductor and a capacitor had, under certain circumstances of energy (frequency) practically no resistance.

We cannot press this similarity very far, however, for nothing in electronics prepares us for the idea that all pairs of electrons will have the same energy and will move together. It is as if tuning one resonant circuit in a vast tuned amplifier caused all the other circuits to come into resonance at the same time.

The idea is not entirely unfamiliar, because the action of a laser depends on electrons moving from one energy level to another in a large number of atoms together. In the laser, however, the "sync. pulse" which causes the electrons to move in step is the light ray travelling to and fro along the laser tube or rod; in the superconductor, the "sync. pulse" seems to be the vibrations (called **phonons**) of the nuclei of the atoms of the solid which in certain substances reach the correct frequency for stimulating the pairing of electrons at the transition temperature.

When a substance becomes superconducting, an energy gap appears which did not previously exist in the substance, and the paired electrons are all in a band which is just below this gap. If the paired superconducting electrons are given enough energy to travel across this gap into another energy band, they can no longer contribute to superconduction, and they "unpair" rapidly.

If enough energy is put in, by heating above the transition temperature, or by the application of strong magnetic fields, then the energy gap disappears and superconduction stops.

The ability of superconduction to be switched on and off in this way is the principle behind the use of superconducting wire in computer memories. For some other purposes, the destruction of superconductivity by magnetic fields is a disadvantage, and alloys have been developed (for winding electromagnets) in which the magnetic field for the breakdown of superconductivity is very large.

The Josephson Effect

We have seen that superconducting electron pairs cause other electron pairs to move in the same way and have the same energies. The situation is similar to the hypothetical case of a set of oscillators being brought to the same frequency by a sync. pulse applied to one oscillator, the others being very closely coupled.

We know also that if the coupling between the oscillators in our imaginary case were made loose, it would be most unlikely that they would pull into line so willingly, but what happens when we loosen the coupling between electrons in a superconductor?

The way in which we can do this is by inserting an insulator between two portions of superconductor. If the insulator is "thick" to the extent of several thousand atoms, then the conditions existing in one superconductor have no relation to the conditions existing in the superconductor on the other side of the insulator; there is no synchronisation.

If, on the other hand, the insulator is very thin, perhaps one or two atoms in extent, the superconductivity is unaffected by the insulator. We say that the superconducting electrons have tunnelled through the insulator, implying that there has been a superconducting current in an insulator.

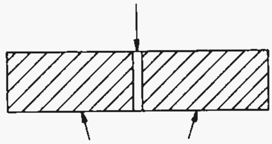


Fig. 1: The Josephson Junction

The effects which can be produced in these sandwich constructions of superconductor-insulator-superconductor (Fig.1) were discovered by a research student, B. D. Josephson, in 1962. He found that the current flowing in an insulator-superconductor junction, now called a Josephson Junction, was expressed by a comparatively simple formula which involved the steady voltage across the junction, the alternating voltage applied, the frequency of this alternating current, the charge on the superconducting electron pair, and a well known constant called Planck's Constant which appears in any description of energy levels, and can be crudely described as being the atom of energy.

We can obtain several solutions to the Josephson equation by filling in values for the voltages which we can adjust. If, for example, we have no voltages, direct or alternating, across the junction, the equation predicts a steady flow of current. Such a current, flowing without an applied voltage is a superconducting current, and shows that the junction is behaving as a superconductor.

If a steady voltage only is applied, the solution of the equation is now an oscillating current whose frequency is equal to 483·6MHz for every microvolt applied. This appears to be a very simple way of generating very high frequencies, with the frequency easily varied by varying the voltage applied.

When alternating voltage alone is applied to the junction, the results are not particularly interesting, a current at the applied frequency; but when both alternating and direct voltage are applied **together,** the output is a direct current whose amplitude is proportional to the frequency of the alternating voltage, plus a series of harmonics of the alternating voltage. This implies that a Josephson Junction can be used as a detector, even at extremely high frequencies.

Superconductivity Switches

Up until now, switching with superconductor materials has been done by the principle mentioned earlier that the superconducting state can be destroyed by added energy. It turns out, however, that a Josephson Junction is much easier to switch. At low currents, the junction is superconducting and has zero voltage across it, at higher currents the junction conducts by electron tunnelling and has about 1mV across it.

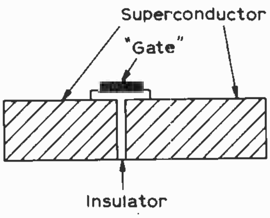


Fig. 2: Josephson Junction with gate.

Adding a third electrode, a strip of lead carrying a control current, makes a more satisfactory arrangement similar in construction to a mosfet (Fig.2). A flip-flop has already been constructed (Ref.1) which has a switching time of less than 0·8ns (1000ns$=1\mu$s).

The Future

To my mind, the whole future of the Josephson Junction depends on the achievement of superconductivity at higher temperatures. The use of any device which depends on supplies of liquid helium for its operation is inevitably going to be restricted to applications for which absolutely nothing else will do.

If we reach the stage where the developments in superconductive materials and the developments in electrical cooling (by Peltier-Thomson junctions) overlap in their temperature range, then the Josephson Junction may suddenly become the big growth industry in electronics. Until then we only watch and wait.

References:

1. *Matisoo, J., "The Tunnelling Cryotron," Proc. Inst. Elect. Electronics Engrs. 1967, 55. pp 172-180.*
2. *Solymar, L., "Josephson Junctions," "Electronics & Power," Aug. 1968, p. 316.*

MAINS connector

B. HUNTER

WHEN setting up a workshop, the author was careful to provide mains sockets for all the common types of plugs in use so that plugs would not have to be changed on apparatus being serviced. This method worked well until equipment arrived without plugs or when testing newly constructed apparatus which did not yet have a plug. Fitting plugs was time consuming and so some method of connecting the bare wires to the mains was desired so the author decided to construct the mains connector described here. Using this, apparatus without plugs may be quickly connected to the mains and the bare wires are completely covered and safe.

The connector consists of a base to which three crocodile clips are fixed. These clips are connected to the mains supply and provide *Live, Neutral* and *Earth* connection to the wires from the apparatus. The clips are completely covered by the top and sides of the connector so that the user is protected from electric shock whilst the unit is closed. It seemed a pretty safe bet that at some time or other, the user would open the top whilst the unit was still live and possibly receive quite a shock, so a means of cutting off the supply when the unit was opened was required. The simple addition of a micro-switch provided this facility. The micro-switch is in the live side of the mains, the normally open contacts being used so that the switch is closed when the top of the unit is closed.

A mains neon may be fitted if thought necessary, and by adding the neon after the micro-switch, a visual indication of the unit switching off when the top is opened is obtained. This is an added safety feature in the unlikely event of the micro-switch failing to break the supply.

The unit was constructed from $\frac{1}{4}$in. Perspex which was glued together with 'Araldite'. The size of the unit is, of course, in no way important. The sizes given in Fig. 1 may be changed to suit individual taste.

The bolts in the crocodile clips should be removed and the end of the clip shown in Fig. 2 should be broken off. The clips are held to the base by bolts which fit through the holes shown in Fig. 1. These holes should be countersunk so that the heads of the bolts sit well below the surface of the perspex. The clips are screwed to the base with countersunk bolts, solder tags being fitted underneath the clips. The clips are already tapped for 6BA bolts, so it is not necessary to use nuts on the bolts. When the clips are tightened, the heads of the counter-sunk bolts should be completely covered with 'Araldite' because these are connected to the mains when in use.

The sides are cut out as in Fig. 1, slots being filed as in the diagram to accommodate the wires. The sides are then glued to the top so that they are out of the way when the unit is opened.

The micro-switch should be bolted to one of the sides so that the switch operates just as the top is

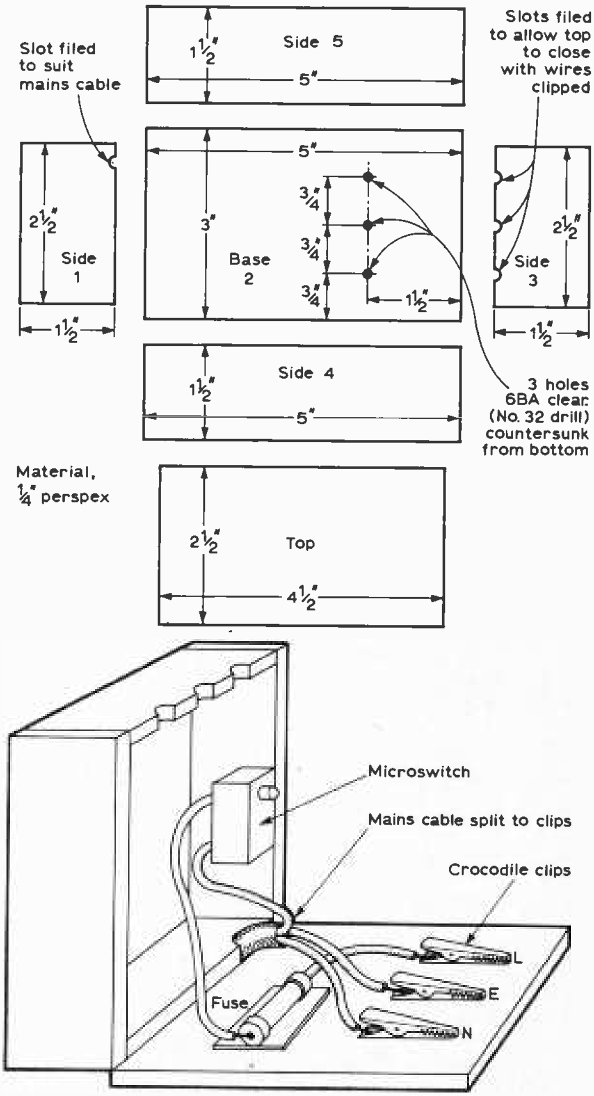


Fig. 1 : The constructional details of the mains connector.

opened. It is best to construct the box then fit the switch so that the position of it can be adjusted for correct operation. If the unit is fitted with a 13 amp plug, this will already be fused, but it is a good idea to fit one inside the unit for ease of replacement.

When the glue on the sides has set (up to 3 days—see instructions on Araldite packet), a hinge should be fitted on side 1 and the base 2.

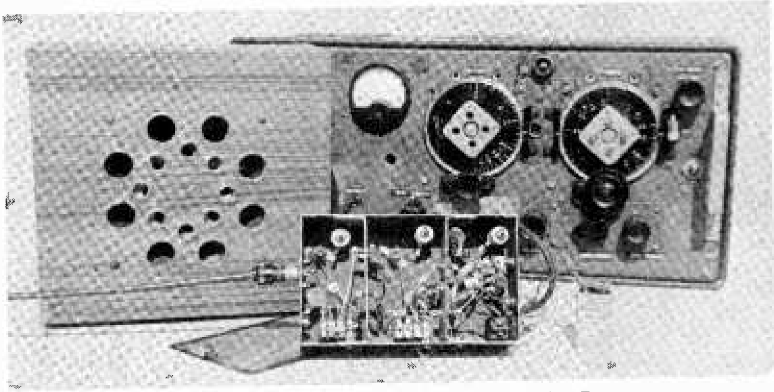
When the plastic work is complete, the three-core mains cable should be fitted through the slot in side 1 and held in place with a cable clip. The black (neutral) lead from the mains cable should go to the

—*continued on page 141*

10 OR 15 METRE CONVERTER

C. DRINKWATER

THERE are many good receivers in use which do not cover the 15 and 10 metre bands, and this article is intended to provide a relatively cheap unit which is both useful to the more experienced and instructional to the beginner. The tuning depends upon the main set, and bandspread or a good length of tuning scale is needed for the 2·5—3·5MHz i.f. No crystal or tuning gang is employed in the converter, and it is suggested that the beginner start with the 15 metre version to gain experience, before tackling the 10 metre version.



The underside of the completed Converter.

The omission of crystal control does cause oscillator drift, but this was not found troublesome, even for s.s.b. once the unit has settled down after switching on. Results obtained have been surprisingly good, and it is recommended that the beginner should read and act upon one of the many articles covering aerials although an unmatched long wire will work quite well. Ten metres is more prone to ignition interference, and if the location is near a busy road the answer is a good aerial or a limiter on the main set, or both in a particularly bad spot.

The circuit

R.F. is tuned by L2/TC1, coupled to the base of amplifier Tr1 by L3, aerial coupling by L1. Output is coupled to mixer stage by L4, tuned by L5/TC2, and coupled to Tr2 by L6. Tr3 is a Colpitts circuit—h.f.c., C8, L8, TC3 with C9 to base—operated above signal frequency, and coupled via L7 to mixer Tr2 emitter. As the oscillator is at a fixed frequency, a variable i.f. is obtained via C5; e.g. on 15 metres, 24·5MHz will mix with an incoming signal of 21·0MHz to give an i.f. of 3·5MHz, signal of 21·5MHz will give i.f. of 3·0MHz etc. On 10 metres, 31·5MHz with 28·0MHz gives 3·5MHz i.f., with 28·5MHz gives 3·0MHz, etc. It will be found that the tunable i.f. range extends beyond 2·5-3·5MHz, but results may be erratic due to the fixed front end.

It is desirable to fit a lid to the box to minimize breakthrough of local TV or v.h.f. stations, and to prevent the local oscillator from interfering with domestic TV. Note the position of C7 in Fig. 2 to prevent radiation from the battery leads. The battery was fitted externally to avoid disturbing the wiring accidentally, and to reduce the effects of changing characteristics. The battery life should be extremely long since little current is drawn.

The h.f.c. used was the "56UH" type found in common use on those computer panels which most good "junk-shops" seem to have. Note the use of AF115 transistors for 15 metres, and AF114 for 10 metres. These will in fact work either way round, but it was found to be more stable and with better gain if used as indicated. If used transistors are to be fitted, be certain that they are of known good quality. Many fruitless hours can be spent when all that is wrong is a transistor of unknown response failing at these higher frequencies.

Cx is only to bring the oscillator into the range required, and if it is over 5pF it will probably be better to rewind the coil, although it can be as much as 10pF. Usually the ends of the coil have come away in fitting and as this will cause a weaker oscillator, it is better to rewind.

Construction

The original was made in a box of heavy-gauge tinplate, soldered at all edges, but the second unit was constructed in a die cast box, easily obtained although the screens had to be made—see Fig. 2 for dimensions. Rubber sleeves were used to deaden any vibration on the leads passing to other compartments, as a tendency was found for the unit to be microphonic. Drill the ⅛in. holes for these at a depth of ¼in., two in each screen, and a larger one for the battery leads. Apply a little Bostik or Evo-Stik to the sleeves and push them in and allow to set. A short length of 18-gauge tinned copper wire is then carefully pushed through and the ends formed into a tight loop to form an anchoring point for the various components either side. Drill the larger holes for the co-ax. input and output sockets switch S1 and the smaller holes for mounting the trimmer capacitors and fit these components.

If it is possible to get enough heat from the soldering iron without over-heating everything else, it is better to solder all points marked MC to the chassis direct. Solder tags can be used, but fit a non-slip washer on the screw first, then fix the tag on a

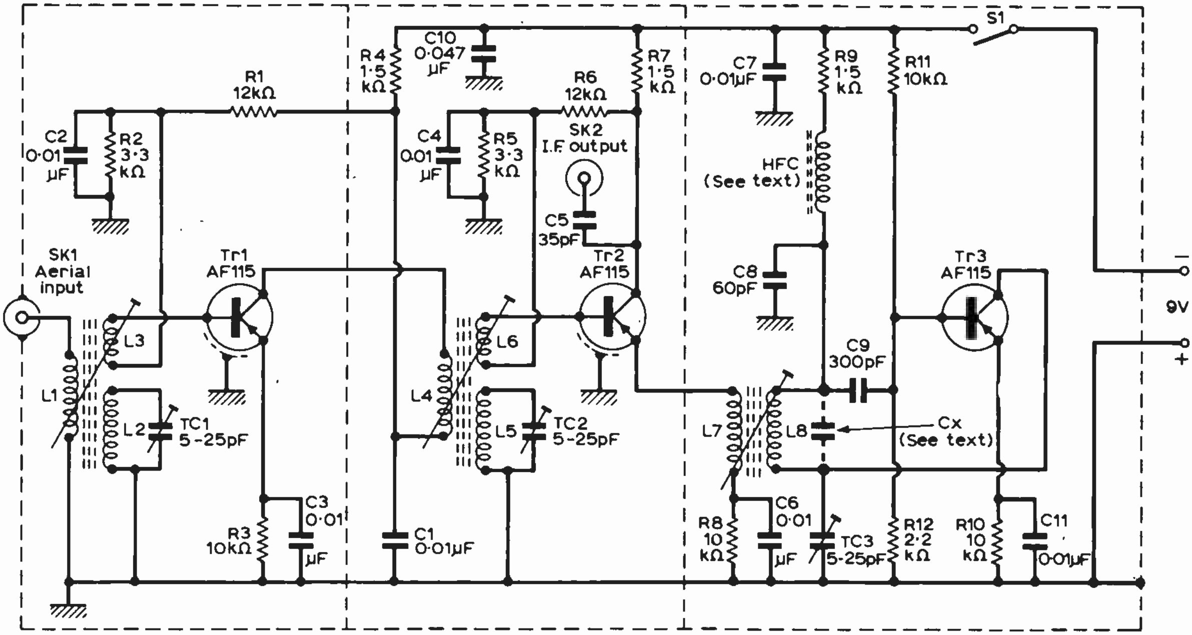


Fig. 1: The circuit of the converter. Coil winding details are given below.

cleaned surface as tightly as possible, bending up the end to allow the wire to be pushed through for soldering. It is important that these are good chassis contacts.

Fit the four-way tag strips about half the depth of the box to allow room for the transistors to be fitted last of all. Fix the coils to the chassis and wire in all components. Some of the components are intended to be self supporting, a check with Fig. 2 will show which. Keep the leads as short as possible, and stick to the layout as near as components will allow, particularly in the oscillator section as this affects frequency. If a lid is fitted drill holes to allow access to the coils and trimmers, as the lid causes a considerable shift in frequency when in place.

Check wiring carefully on completion, make sure transistors are fitted correctly before fitting battery, and ensure battery positive is connected to chassis.

Alignment without signal generator

Switch on main set and tune to 3·0MHz, connect aerial and connect converter. Set dust cores extending half-way out and trimmers halfway open. Swing main set tuning for some indication of life. The aim is to get the band central on 3·0MHz i.f., this can be done if care is taken. The newcomer at this point needs some information on what he is listening for; briefly, once the amateurs can be heard, the "Calling CQ on 10" etc., will soon establish where you are. The bands consist of amateur a.m., amateur s.s.b., commercial a.m., with various c.w., telegraphy, etc., to either side. If you hear the "Citizens-Band" you are too low for ten metres, they are around 27·0MHz and you should be around 28·0MHz.

Centre up the band by means of the oscillator trimmer capacitor adjusting the dust core on the 15 metre version until the right spot is found. Do this slowly, as little movement shifts the frequency a lot. Peak up L5 and L2 at this point, re-adjusting L8 to keep the band central on 3·0MHz until no improvement can be made. Tune to a signal on 2·5MHz i.f. and adjust TC2, TC1, but do not adjust the oscillator.

Remember, the 10 metre band is liable to fold up

COIL DATA AND CONSTRUCTION

Coil	Turns 10metres	Turns 15metres	Positioning	Wire
L2	10	13	Wind on first, close wound	22 gauge enam.
L1	3	4	Over L2 opposite direction	22 gauge DCC
L3	1½	2½	Over L1 lower end, same direction as L2	22 gauge enam.
L5	9½	12	as L2	as L2
L4	3	4	as L1	as L1
L6	1½	2½	as L3	as L3
L7	4	5	For 10 metres, wind L8 on dust core, with L7 over and opposite. For 15 metres, wind L8 on former first, with L7 over and opposite direction	22 gauge DCC
L8	8	11		22 gauge enam.

Use ¼in. x ¾in. plastic formers with ⅜in. long dust cores with fine thread; be sure they are h.f. type. Use quick setting cement; hold in jig while setting. Wind coils tightly. Keep ends straight and do not allow them to open out when fitting.

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Specification

POWER OUTPUT 70 watts RMS ±1 db at 8 OHMS.
FREQUENCY RESPONSE 20–20,000 HZ ±1 db.
SIGNAL/NOISE RATIO—70 db at full output.
HARMONIC DISTORTION less than 5% at full output.
INPUT SENSITIVITY 700 mV at 20–30 K OHMS.
SIZE 7" · 9" · 6¼".
A.C. FUSE 1·5 amps (British Standard).

Recommended Retail Price £35.0.0.

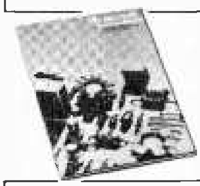
Mainline Pre-4 mixer pre-amp control unit

The MAINLINE Pre-4 is a high quality control unit, which has been designed specifically for use where mixing facilities are essential, and features many facilities not normally found on control units of this type.
The unit has four individual inputs each with its own gain control, plus separate bass, treble and master volume controls, for versatility in use. Inputs 3 and 4 are duplicated on the back panel so that if the unit is panel mounted the two auxiliary inputs (which are suitable for P.U. Tuners, Tape-recorders, etc.) may be connected from the rear. As the Pre-4 is self-powered it can be used with any other Power Amplifier, but has been designed basically as the control unit for our MAINLINE 70AB Amplifier Module.

Specification

INPUTS VOL. 1 8 mV at 50K OHMS (mic).
VOL. 2 8 mV at 50K OHMS (mic).
VOL. 3 50 mV at 500K OHMS (aux).
VOL. 4 50 mV at 500K OHMS (aux).
50 OHM and 600 OHM Mic inputs may be ordered at £2.0.0. extra per Input.
1 or 2 meg OHM aux inputs may be ordered at no extra cost.
FREQUENCY RESPONSE 30–20,000 HZ ±3 db.
SIGNAL/NOISE RATIO Better than – 65 db.
HARMONIC DISTORTION Less than 5% at 1 volt.
BASS Continuously variable 20 db at 100 HZ.
TREBLE Continuously variable 30 db at 10 KHZ.
SIZE 12¼" × 6" × 4¼".
CUT OUT REQUIRED 11¼" × 5".
FUSE 60 ma internally mounted.

Recommended Retail Price £24.0.0.



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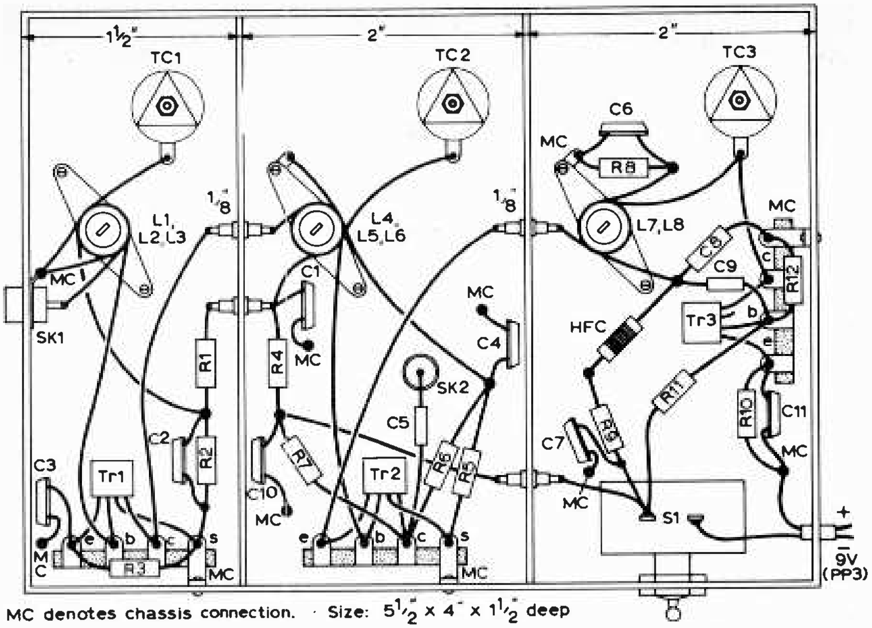

MC denotes chassis connection. · Size: $5\frac{1}{2}" \times 4" \times 1\frac{1}{2}"$ deep

Fig. 2: The component layout.

over L2, adjust L5 for maximum whilst re-adjusting TC3. Adjust L2,, reducing signal by removing loop until no further gain is obtained. Set main tuning to 2·5MHz and feed in 22·0MHz via loop to L2, adjust signal generator if needed to final signal, peak up TC2 and TC1.

10-Metre version. L8 is not adjustable. Using TC3, adjust to receive 28·5MHz on 3·0MHz main tuning, coupling as for 15 metre version, and adjusting L5, L2. Set to receive 29·0 MHz, around 2·5MHz on main tuning, peak up on TC2, TC1. If Cx is needed, see end of circuit description, it should not be more than 10pF. ■

much quicker than the 15 metre band, and good DX is more likely to occur during daylight. On 15 it does continue for several hours after sunset, with s.s.b. coming in from the daylight side.

Alignment using a signal generator

15-Metre version. Set main tuning at 3·0MHz i.f., feed in 21·5MHz via an one turn loop fitted to the test lead held over L5. Adjust L8 and TC3 together, a little at a time until signal is heard. Place loop

★ components list

Resistors

R1	12kΩ	R7	1.5kΩ
R2	3.3kΩ	R8	10kΩ
R3	10kΩ	R9	1.5kΩ
R4	1.5kΩ	R10	10kΩ
R5	3.3kΩ	R11	10kΩ
R6	12kΩ	R12	2.2kΩ

All resistors ¼W, 10% types.

Capacitors:

C1 0.01μF disc ceramic	C6 0.01μF disc ceramic
C2 0.01μF disc ceramic	C7 0.01μF disc ceramic
C3 0.01μF disc ceramic	C8 60pF silver mica
C4 0.01μF disc ceramic	C9 300pF silver mica
C5 35pF ceramic	C10 0.047 disc ceramic

Cx—see text.
TC1, TC2, TC3—5–25pF concentric trimmers.

Miscellaneous

Tr1, Tr2, Tr3: AF115 for 15 metres, AF114 for 10 metres; coils—see data box; coil formers; 3 off 4-way tag strips; on-off switch; metal chassis; 2 off co-ax sockets, etc.

Mains Connector

—continued from page 136

crocodile clip on the left, and the green (earth) lead should go to the middle clip. The red (live) lead should go first through the micro-switch then the fuse and on to the right-hand crocodile clip. The fuse-holder may be fitted in any convenient position inside the unit. A fuse-holder as used in television and radio sets should be used, indeed the one used in the authors unit was stripped from an old set.

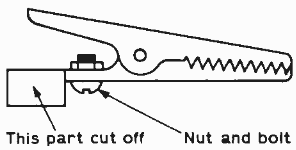

Fig. 2: The modification to the crocodile clips.

As was stated earlier, a mains neon may be fitted in any convenient position and should be wired between the live and neutral clips.

A 5 amp fuse should be the largest that should be required in the unit. If the workshop mains fuses are 5 amp then the fuse in the unit should be smaller so that this fuse will blow before the main fuse. The three crocodile clips should have identifying letters beside them so that confusion as to which clip is which does not arise. These letters (L, N, E) may be painted on, or 'Instant Lettering' may be used, the latter giving a neater appearance.

The author's model was made from perspex because some scrap perspex was available, but there is no reason why wood or any other insulating material should not be used, providing it has physical strength. Although Araldite was used for bonding the perspex together, perspex cement might possibly make a neater job.

The unit has been in use for some months now and has proved extremely useful by eliminating the annoyance of fitting plugs. ■

practically wireless commentary by HENRY

No. 69 Sin of Omission

Opulent brochures given away to small boys.

ONCE upon a time—oh, long before *then*—manufacturers of 'wireless' equipment took great pride in not only making a good product but also a good 'image' by which to foster its sales. Slogans abounded. Individual makes were as instantly recognisable by their style as by their name. And there was a similar sense of company pride about the brochures and handbooks that accompanied the equipment.

In the springtime turnout that Mrs. Henry employs to remind the rest of the menage of her superiority, we came across some of these old handbooks and nostalgically leafed through them. What struck us immediately was not the amount of information they contrived to pack into the board-like pages but the significance of the technical data they had left out.

Wavebands were mentioned—in metres of course, and only occasionally in cycles. Hertz hadn't come along then. Now and again a power output figure would be quoted. One took it for granted, these being British and the need for dissimilation not yet having arisen, that these watts were r.m.s. It was never manifest.

Curiously, although practically every radio set on the market used one of three distinct intermediate frequencies (more by convention than agreement), the i.f. was almost always stated. It was one of the things that the user could do little about, but we presumed that some advertising mogul had opined that this pearl of wisdom gave comfort and all his rivals followed suit.

After which it comes as no surprise to read in a recent audio publication that the HMV 'little dog' has been adopted by several different countries.

The ironic comment on that is that the dog was a bitch and the original gramophone that the artist painted was a cylinder type, not the better-known horn. Anyway, says Joe, the animal should have been a cat, which does appear to make much more note of recorded sound.

But it is not my intention to knock the advertising boys—this time. Henry is more concerned with the omission of vital information from these 'come-on' compilations. Technical data, mostly.

Quite often, we are called upon to match odd pieces of equipment—some, very odd—and have recourse to the precious 'user's handbook' for connections, impedances and sensitivities. Said user may have bought an amplifier or tape recorder and now wishes to record the rumblings of his ancient radiogram and perhaps replay the recordings through its massive 'super-mellow' loudspeakers.

"What sort of microphone should I buy...?

Can we find the notes we want in that lavish publication? Can we heck! Connections may be given, but impedances are never more than 'high' or 'medium' and sensitivity quotes are as elusive as the Greek calends. This is so commonly the case that we are nowadays resigned to 'suck-it-and-see', more scientifically known as 'empirical performance testing.'

As a variant on this theme, we have to answer off-the-cuff telephone enquiries. 'What sort of microphone do you think I should buy to play my Whizzispool?' cries the distraught owner. We are expected to know, and this is one reason that the files of service information are right there above the head of the bloke who answers the workshop phone. (And sometimes on it when he pulls too desperately).

But whoever is responsible for the compilation of the average service sheet does not live in Kedar's tents. He believes that the buyer of product X is never going to purchase anything from maker Y. It is inevitably taken for granted that matching of items from X's stable will be in order, so nobody bothers to quote the figures, on the circuit diagram or on the specification sheet that accompanies it.

We could name at least five firms with this obnoxious sin of omission, and yet three of them publish opulent sales brochures, given away to small boys at exhibitions, that contain all this and much besides.

Not British companies—oh no! These are either too good, or so completely out of touch that their service data is a smudged sheet of blotting paper with half the components wrongly rated. At least, you know where you are with them. Up the creek, oarless. The culprits are Continental and Japanese organisations whose determined efforts to improve their 'image' make the effusions of their advertising almost believable.

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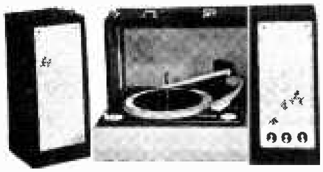

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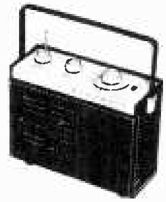

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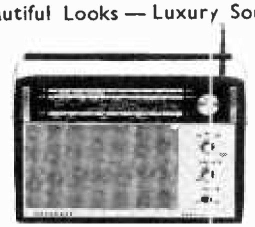

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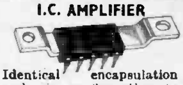

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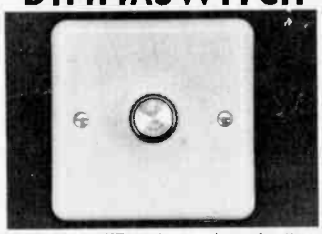

The DIMMASWITCH is an electronic dimmer capable of controlling from 40–600 watts of incandescent lighting at mains voltages from 200/250V at 50 Hz. The DIMMASWITCH has the same dimensions (3⅜"x3⅜") as a standard switch and is intended as an alternative fitting, finished in ivory, with a contrasting control knob.

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F.G.RAYER G3OGR

for the LF BANDS

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Fig.1 is the complete circuit, and brief notes on the function of each stage will make its working clear.

Circuit

Transmitter RF Section. V1 is a Vackar type v.f.o. tuned by VC1 and covering 1·8-2·0MHz. The voltage regulator VR provides 150V for V1 and the screen grid of the buffer V2. L2 is broadly resonant, and V2 drives the power amplifier V3, the test point 'G' being provided to check grid current. The p.a. tank coil L3, with tuning and loading capacitors, allows V3 to be matched to most ordinary aerials.

Audio and Modulator Section. V4A/V4B is a high-gain microphone amplifier giving full modulation from a crystal microphone V5 with the primary of transformer T1 provides anode and screen modulation of V3. When receiving V5 drives the loadspeaker.

Receiver RF Section. V6 is a tuned r.f. amplifier, followed by the mixer V7. V8 is the i.f. amplifier, a diode giving detection and AGC bias for all stages. VR1 is the receiver r.f. gain, and VR2 the audio gain control.

Power Supply. This delivers about 120mA at 300V on 'transmit', reduced to 220V on 'receive'. It is not absolutely necessary that the voltage is reduced when receiving, but this was found helpful in obtaining cooler running over long periods by avoiding the heat of series dropping resistors.

Switching

Change-over of all required circuits is achieved with a 2-way 8-pole rotary switch. It is possible to change some circuits slightly so that fewer poles are needed, as described later. The functions of each pole are given below, and this should be checked when wiring.

Section 1: In the 'transmit' position T this applies h.t. to v.f.o. V1, and the buffer V2. In the 'receive' position R, h.t. is taken to r.f. mixer and i.f. stages, V6, V7 and V8.

Section 2 and 3. These contacts allow the same meter to be used to show PA anode current and to operate as a dip type tuning meter on reception. Section 2 supplies h.t. to either the p.a. anode, or to the receiver. Section 3 takes h.t. directly from the h.t. line, via S1, for reception, or from the modulator V5 for transmission. The main advantage of this method is that a 50mA meter can be used for both functions without any shunts having to be made up.

Section 4. On transmit this switches the aerial to the p.a. tank circuit L3 and to the receiver aerial coil L4 on receive.

Section 5. On transmit input to V5 is from the microphone amplifier V4B and from the receiver gain control VR2 on receive.

Section 6. This connects the anode of V5 to the anode (via meter) and screen grid circuits of V3 to modulate the latter when transmitting.

Section 7. This closes only on receive to bring in the speaker.

Section 8. This opens during reception converting the power supply to choke input to reduce the h.t. voltage without resorting to dropping resistors.

Net. This switch is temporarily closed while receiving to put h.t. on the v.f.o. and buffer stages so that the v.f.o. can be tuned to the frequency on which transmission will be wanted. Stray r.f. coupling into the receiving operates the tuning meter thus indicating when the v.f.o. and receiver are tuned to the same frequency.

It may be found more convenient to make this switch a spring loaded one rather than a toggle switch.

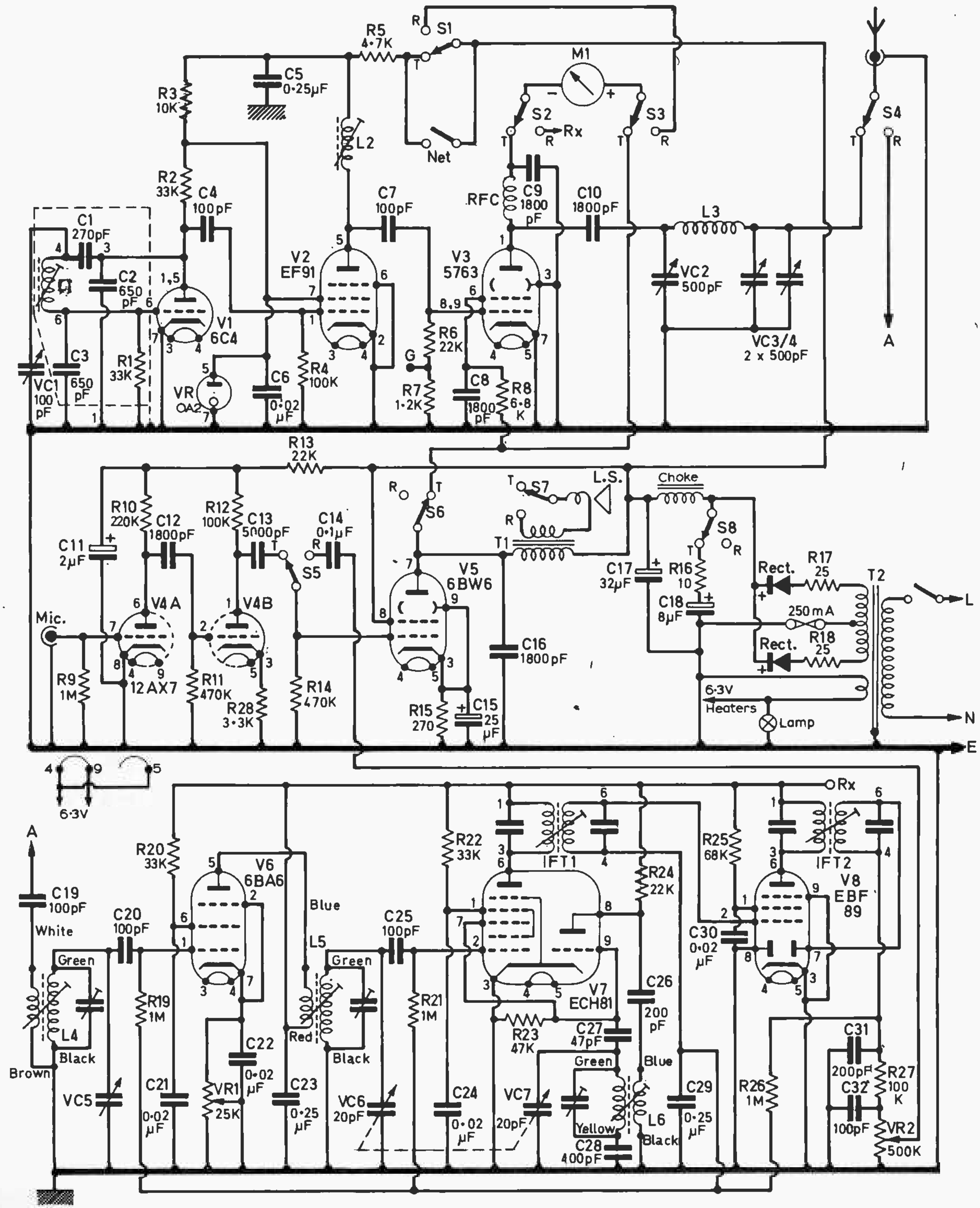

Fig. 1: Complete circuit diagram of the transmitter/receiver and power supply.

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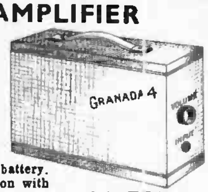

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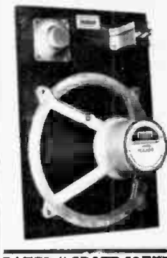

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12in 25 watt **6gns.**	12in 35 watt **8½gns.**	15in 50 watt **18gns.**

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SPECIAL OFFER! 80 ohm. 2½in, 2¾in. dia.; 35 ohm, 3 in. 25 ohm, 3in. dia.; 6 × 4in; 8 × 3in; 8 × 5in. 15 ohm, 7 × 4in; 8 × 5in. 3 ohm, 2¾in, 3in, 5in, 5 × 3in, 7 × 4in. **17/6** EACH TYPE
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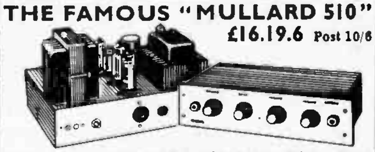

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Practical Radio Inside Out	4/6
Supersensitive Transistor Pocket Radio	3/6
Radio Valve Guide, Books 2, 3, or 4 ea. 5/- No. 5 ea.	6/-
T.V. Fault Finding 405/625 lines	8/6
Shortwave Transistor Receivers	5/-
Transistor Communication Sets	6/-
Sub-Miniature Transistor Receivers	5/-
Wireless World Radio Valve Data	10/-
International Radio Stations Guide	2/6
Transistor Circuits for Radio Controlled Models	7/6
Valves, Transistors and Diodes equivalents Manual	10/6

3 Inch MOVING COIL METERS BRITISH MADE

Various calibrations/movements. 500 Microamp; 1 Milliamp; 50-0-50 Microamp. etc. S.A.E. for list. **37/6**

MAINS ELECTRIC MOTORS

(120v. or 240v. AC). Size 2½ × 2½ × 1½in. Clockwise 1,200 r.p.m. off load. Heavy duty 4 pole 50mA. Spindle ⅛ × 3/20. BARGAIN PRICE **17/6** EACH Post 2/6 3 for 50/-; 6 for 90/-.

Minimum Post and Packing 2/6. RETURN OF POST DESPATCH. HI-FI STOCKISTS. CUSTOMERS FREE CAR PARK. CALLERS WELCOME.

RADIO COMPONENT SPECIALISTS 337 WHITEHORSE ROAD, WEST CROYDON

Open 9-6 p.m. (Wednesdays 9-1 p.m., Saturdays 9-5 p.m.)

List 1/-. **Written guarantee with every purchase.** *(Export: Remit cash and extra postage.) Buses 133, 68 pass door. S.R. Stn. Selhurst.* **Tel. 01-684-1665**

Alternative Switching

Switching as in Fig.1 was completely satisfactory, but as the circuit lends itself to changes, to use items to hand, or for experiment, it is worth noting other ways in which change-over from transmit to receive can be arranged.

If a small matching transformer is used with the speaker, S7 is unnecessary since S6 can transfer to the matching transformer primary on receive. This dispenses with one switch pole.

S8 may be eliminated by using capacitor input in the usual way, a 4·7kΩ 5W resistor then being placed in series with the h.t. supply to V6, V7, and V8.

By not switching the meter to indicate tuning on receive eliminates the need for S2 and S3. A 'tuning eye' operated from the a.g.c. line could be incorporated in the receiver section. It is then possible to utilise a 4-pole switch only—S1, S4, S5 and S6 to perform all the necessary switching functions.

After calibration a piece of perspex 7½ x 2½in. is bolted over the scale.

VC6/VC7 tunes mixer and oscillator circuits. VC5 tunes the aerial circuit only but space was left for a 3-gang capacitor to tune aerial, mixer and oscillator, with VC5 as an aerial trimmer, but this was not found necessary.

The meter is immediately above VC1. VC2 and VC3/VC4 were fixed to a flanged plate bolted to the chassis to avoid bolts in the panel. If these capacitors have feet they can be fixed to the chassis instead.

The r.f. choke, C9 and C10 are supported on a tag strip, and a lead passes down through a hole close to pin 1 of V3. L3 is 65 turns of 22swg enam. wire, layer wound on a 1in. dia. paxolin tube. The tube is bolted to a strip of paxolin 1¾x½in. fixed to the frame of VC2.

The loudspeaker is bolted to a piece of 3-ply wood about 6x7in. This is spaced from the chassis side by a strip of wood. When the chassis is in its

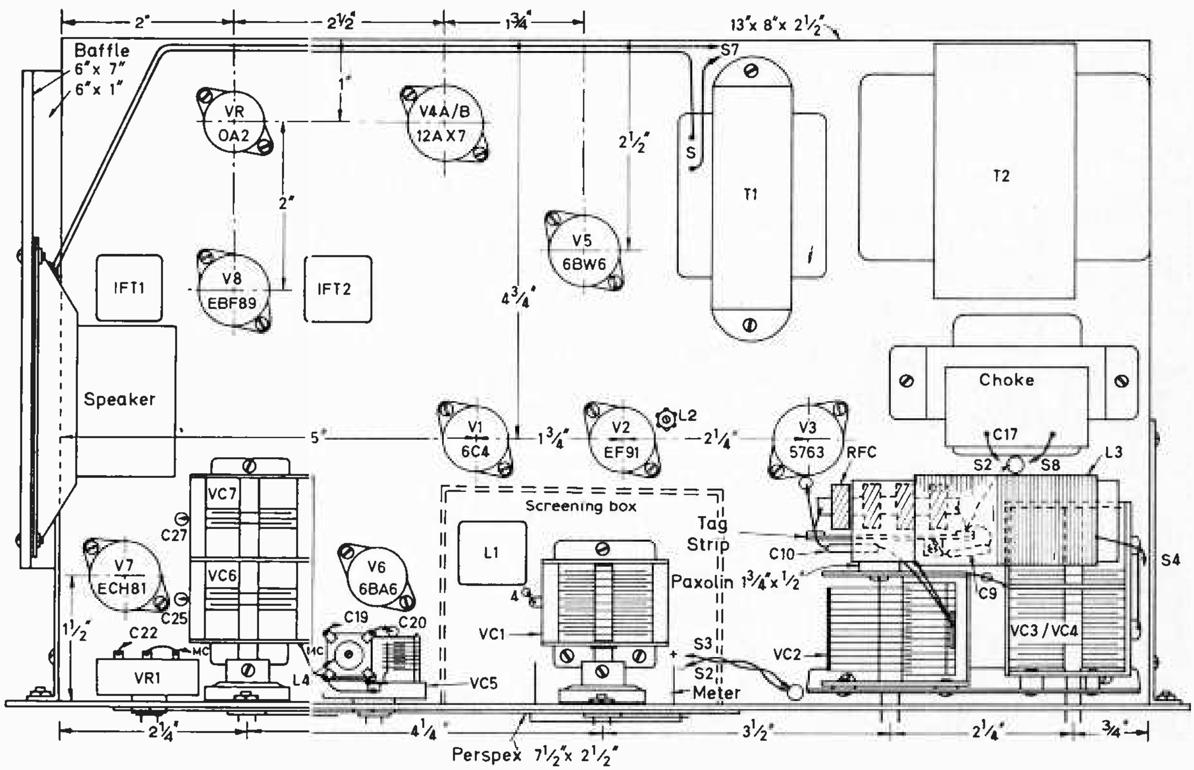


Fig. 2: Top of chassis showing location of major components.

Construction

Fig.2 shows dimensions, and positions of the valveholders and major components. Holes for the valveholders are readily made with a chassis punch, ⅝in. dia. for the B7G holders, and ¾in. for B9A holders.

The panel is bolted to the chassis flanges, and also to side brackets bolted to the chassis. The two ball drives are fitted in holes aligned with the spindles of VC1 and VC6/7. The type of drive having a flange allows a perspex cursor to be fitted with 8ba screws, or a stiff wire pointer can be soldered or screwed on. The scales are stout paper or thin card.

cabinet, the speaker locates behind rows of holes in the cabinet side.

Adjustment

Variable Frequency Oscillator. The coil-can L1 in Fig.2 also contains C1, C2, C3 and R1, forming a temperature compensated v.f.o. unit. This part of the circuit is completed by the leads to the numbered pins and VC1. For Top Band use it is only necessary to adjust the core of L1 until VC1 gives 1·8-2·0MHz coverage, with a little to spare at the ends of the scale.

★ sectional components list ★

RF Section

L1, C1, C2, C3, R1 incorporated in VFO2 coil (Electroniques).
C4 100pF mica
C5 0·25μF 350V
C6 0·02μF 500V disc ceramic
C7 100pF mica
C8 1800pF 1kV disc ceramic
C9 " " " "
C10 " " " "
VC1 100pF air spaced variable
VC2 500pF " " "
VC3/4 2x500pF or similar ganged capacitor

R2	33kΩ 1W	R6	22kΩ 1W
R3	10kΩ 3W	R7	1·2kΩ ½W
R4	100kΩ ½W	R8	6·8kΩ 2W
R5	4·7kΩ 2W		

L2 Denco "Blue" Range 2
L3 65 turns 22 s.w.g. enam. on 1in. former
V1 6C4. B7G holder with shield
V2 EF91. " " " "
V3 5763. B9A holder
VR OA2 voltage regulator. B7G holder
RFC 2·6mH 60mA RF choke

Audio Section

C11	2μF 350V	C14	0·01μF 150V
C12	1800pF disc ceramic	C15	25μF 25V
C13	5000pF mica	C16	1800pF 1kV disc ceramic

R9	1MΩ ½W	R13	22kΩ ½W
R10	220kΩ ½W	R14	470kΩ ½W
R11	470kΩ ½W	R15	270Ω 1W
R12	100kΩ ½W	R28	3·3k ½W

V4A/V4B 12AX7 B9A holder with shield
V5 6BW6 B9A holder
T1 80-100mA type pentode matching transformer
Speaker: WB 2/3 ohm 3½in. or similar

Power Supply

Choke Parmeko 120mA 5H
R16 10Ω 1W
R17 25Ω 1W
R18 25Ω 1W
C17 32μF 450V
C18 8μF 450V
Rectifiers, 2xSE-05
250mA fuse and holder
T2 Parmeko P2931, 250/0/250V 150mA, 6·3V 4A

Receiver Section

C19	100pF mica	C26	200pF mica
C20	100pF "	C27	47pF mica
C21	0·02μF 500V disc ceramic	C28	400pF silver mica (padder)
C22	0·02μF disc ceramic	C29	0·25μF 150V
		C30	0·02μF 500V disc ceramic
C23	0·25μF 350V		
C24	0·02μF 500V disc ceramic	C31	200pF mica
		C32	100pF mica
C25	100pF mica		

R19	1MΩ ½W	R24	22kΩ 1W
R20	33kΩ 1W	R25	68kΩ 1W
R21	1MΩ ½W	R26	1MΩ ½W
R22	33kΩ 1W	R27	100kΩ ½W
R23	47kΩ ½W		

VR1	25kΩ linear pot	V7	ECH81 B9A holder
VR2	500kΩ log pot	V8	EBF89 B9A holder
V6	6BA6 B7G holder		

L4 1·8MHz bandspread aerial coil } Types 1·8/46 Electroniques
L5 " " mixer "
L6 " " osc. "

1FT1/2 Denco 1FT11/465
VC5 50pF air spaced tuning
VC6/7 2-gang 20pF or similar

Miscellaneous

Metal cabinet with panel 15x9x8in. (H. L. Smith & Co., 287/9 Edgware Road, W.2.)
13x8x2½in. chassis Type 1 "
Pair 4in.Type C panel brackets "
50mA miniature meter: 8-pole 2-way rotary switch: Two DL50A ball drives with flange for pointer (Home Radio, Mitcham): Two co-axial sockets: (Microphone and aerial). Knobs, etc. Panel fitting lamp holder. 6·3V lamp. 2-SPST toggle switches.

Regulator VR. This provides 150V for V1 and the screen grid of V2 with the power supply as given. If a 250v or similar supply is to be utilised, and VR fails to strike when switching to transmit, R3 can be reduced to about 6·8kΩ or R5 to 2·2kΩ.

Buffer-amplifier. The anode coil L2 of V2 is a medium-wave type broadcast band coil, with primary removed. Due to the low parallel capacitance, this can be tuned to about 160 metres. When first setting up the transmitter, connect a milliampmeter between test point G and chassis with positive to chassis. Set the v.f.o. to about 1·9MHz and adjust the core of L2 for maximum grid current. This should be about 3mA, falling off only slightly towards 1·8MHz and 2·0MHz. R7 is included so that grid current can be measured without disconnecting R6.

RF Power Amplifier. The supply is 300V, so an anode current of 30mA on the panel meter represents an input of 9 watts. If the equipment is later used on 80m, the current can be 40mA, or about 12 watts.

TO BE CONTINUED

Going HI-FI *—continued from page 116*

A bass filter might be needed to suppress rumble from the motor and treble filters can help to take roughness and background noise out of reproduction and these should be provided with switches to bring them in and out at will.

Loudness controls are controversial. These vary the frequency response with sound volume to counteract the variations in sensitivity of the ear to different frequencies at different volume levels. However, a switch separate from the volume control, to reduce volume and adjust tone appropriately (sometimes called a "quiet" switch) is most useful.

If a cheaper cartridge is to be used for the time being it would be as well to include this in the demonstration and if at all possible the demonstration should take place in one's own home. At least, by eliminating most of available equipment from individual consideration on the lines given above, the demonstration required has been reduced to manageable proportions with reasonable hope of a conclusive result. ■

MINIATURE WAFER SWITCHES

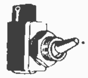
2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at 3/6 each. 36/- dozen, your assortment.

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

MICRO SWITCH

5 amp. changover contacts, 1/9 each, 18/- doz. 15 amp Model 2/- each or 21/- doz.

TOGGLE SWITCH



3 amp 250v. with fixing ring. 1/6 each, 15/- doz.

CONSTRUCTORS PARCEL

1. Plessey miniature 2 gang tuning condensor with built in trimmers and wave gang switch. 2. Ferrite slab aerial with coils to suit the above tuning condensor. 3. Circuit diagram giving all component values for 6 transistor circuit covering full medium wave and the long wave band around Radio 2. The three items for only 7/6d which is half of the price of the tuning condenser alone.

10 AMP 24V BATTERY CHARGER

Ideal unit for garage, boat station etc. £22.10.0d. each plus carriage and cost.

BEHIND THE EAR DEAF-AID

Made by a very famous maker. Thoroughly overhauled, cleaned and re-conditioned. Guaranteed 6 months. Regular price around £50. Our price £10.

ISOLATION TRANSFORMERS 200-250 Mains

A must if you work on mains equipment. Prevents accidents and shocks even in damp conditions. Input and output separately screened by connection block. 100 watt £3.10.0. 250 watt £5.

SLOW MOTION DRIVES

For coupling to tuning condensers etc. One end ¼in. shaft, the other end fits to a ¼in. shaft with grub screws. Price 4/6 each 48/- dozen.

LARGE PANEL MOUNTING MOVING COIL METERS

Size 5in. x 4in. Centre zero 200-0-200 micro amp made by Sangamo Weston. Regular price probably £8. Our price 59/6. ditto but 100-0-100 79/6.

A.C. Ammeter 0-5 amps. flush mounting—moving iron. Ex equipment but guaranteed perfect 29/6.

CIRCUIT BOARDS

Heavy copper on 3/32 paxolin sheet ideal for making power packs etc. as sheet is very strong and thick enough to allow copper to be cut away with hacksaw blade. 5in. x 5in. 1/6 each. 15in. x 5in. 4/6d. each.

6KVA Auto-transformer in ventilated sheet steel case—tapped 110v-140v-170v-200v-230v. Ex equipment but guaranteed perfect £19.10.0. carriage at cost.

PP3 BATTERY ELIMINATOR

Run your small transistor radio from the mains—full wave circuit—made up ready to wire into your set and adjustable high or low current. 8/6 each.

REED SWITCHES

Glass encased, switches operated by external magnet—gold welded contacts. We can now offer 3 types:
Miniature. 1in. long × approximately ⅛in. diameter. Will make and break up to ½A up to 300 volts. Price 2/6 each. 24/- dozen.
Standard. 2in long × 3/16in. diameter. This will break currents of up to 1A, voltages up to 250 volts. Price 2/- each. 18/- per dozen.
Flat. Flat type, 2in. long, just over 1/16in. thick, approximately ¼in. wide. The Standard Type flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1 amp 200 volts. Price 6/- each. £3 per dozen.
Small ceramic magnets to operate these reed switches 1/9 each. 18/- dozen.

0.005mFd TUNING CONDENSER

Proved design. Ideal for straight or reflex circuits 2/6 each, 24/- doz.

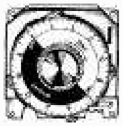
SUB-MINIATURE MOVING COIL MICROPHONE

as used in behind the ear deaf aids
Acts also as earphone size only ½in. × ⅜in. × ⅛in. Regular price probably £3 or more. Our price 19/6. Note these are ex-equipment but if not in perfect working order they will be exchanged.

INTEGRATED CIRCUIT BARGAIN

A parcel of integrated circuits made by the famous Plessey Company. A once-in-a-lifetime offer of Micro-electronic devices well below cost of manufacture. The parcel contains 5 ICs all new and perfect, first-grade device, definitely not substandard or seconds. The ICs are all single silicon chip General Purpose Amplifiers. Regular price of which is well over £1 each. Full circuit details of the ICs are included and in addition you will receive a list of 50 different ICs available at bargain prices 5/- upwards with circuits and technical data of each. Complete parcel only £1 post paid; or List and all data 10/- post free. Credited when you order IC's value of 30/- and upwards.

24 HOUR TIME SWITCH



Mains operated. Adjustable Contacts give 2 on/offs per 24 hours. Contracts rated 15 amps, repeating mechanism so ideal for shop window control, or to switch hall lights (anti-burglar precaution) while you are on holiday. Made by the famous Smiths Company. This month only 39/6 with Perspex cover, plus 3/6 postage and insurance, a real snip which should not be missed.

DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp sockets and on/off switch with neon warning light (in metal box). Takes standard 13 amp fused plugs Supplied complete with 7 feet of heavy cable.
39/6 wired up, ready to work plus 4/6 post & insurance.
5 amp model 34/6 plus 4/6 p. & i.
15 amp model 45/- plus 4/6 p. & i.

THIS MONTHS SNIP

REPAIRABLE RADIOS

7 transistor Key chain Radio in very pretty case, size 2½ x 2¼ x 1¼in.—complete with soft leather zipped bag. Specification:—Circuit: 7 transistor superheterodyne. Frequency range: 530 to 1600 Kc/s. Sensitivity: 5 mv/m. Intermediate frequency: 465 Kc/s or 455 Kc/s. Power output: 40mW. Antenna: ferrite rod. Loudspeaker: Permanent magnet type.
These radios require attention. Circuit diagram is not available. Price only 24/6 plus 2/6 post and insurance rechargeable batteries 8/6 post.
Plug in mains charger 12/6.

VARIAC CONTROLLERS

With these you can vary the voltage applied to your circuit from zero to full mains without generating undue heat. One obvious application therefore is to dim lighting. We offer a range of these, ex-equipment but little used and in every way as good as new. Any not so, will be exchanged or cash refunded.
2 amp £4.19.6. 6 amp £9.10.0. 8 amp £12.19.6. 10 a,mp £15.19.6.

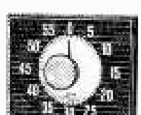
15, 30 & 100 WATT HI-FI SPEAKERS

FULL FI 12 INCH LOUDSPEAKER. This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi load and Rhythm Guitar and public address. Flux Density 11,000 gauss—Total Flux 44,000 Maxwells—Power Handling 15 watts R.M.S. Cone Moulded fibre—Freq. response 30-10,000 c.p.s.—Specify 3 or 15 ohms—Mains resonance 60 c.p.s.—Chassis Diam. 12in.—12⅜in. over mounting lugs—Baffle hole 11in. Diam.—Mounting holes 4, holes—¼in. diam. on pitch circle 11⅝in. diam.—Overall height 5½in. A £6 speaker offered for only £3.19.6 plus 7/6 p. & p. Don't miss this offer. 15in. 25 watt £7.19.6 18in. 100 watt £19.10.0.

THE 5-5 WATT STEREO AMPLIFIER

Made by one of our most famous makers for a de-luxe player. This amplifier has a quality of reproduction much better than average. Using a total 16 transistors and a generously sized mains power pack. Controls include bass, terbile, balance and volume. Suitable for 8-16 ohms impedance speakers with crossovers for tweeter mid-range and bass thus giving option of 1, 2 or 3 speakers per channel. Offered at about one third of its original price only £9.19.6d. plus 6/6d post and insurance.

1 HOUR MINUTE TIMER



Made by famous Smiths company, these have a large clear dial, size 4¼ x 3¾, which can be set in minutes up to 1 hour. After preset period the bell rings. Ideal for processing, a memory jogger or, by adding simple lever, would operate micro-switch 22/6.

A.C. Condensers—these make good voltage droppers for working low voltage appliances from AC mains—the big advantage being there is no heat. Also useful in power factor correction, motor starting and in DC circuits where reverse voltage is encountered.

1.5 mfd 400v 3/6	5 mfd 570v 9/6	12 mfd 250v 11/6
2 mfd 440v 4/6	6.25 mfd 250v 8/6	15 mfd 250v 13/6
3.4 mfd 440v 6/6	8 mfd 250v 9/6	20 mfd 275v 16/6
3.5 mfd 250v 5/6	8 mfd 440v 11/6	

Gro-lux Lighting. Special tubes give light rich in U.V. and other rays necessary for plants and fish kept indoors away from natural sunlight. 12in. 8 watt tube 23/6—control kit comprising choke and starter—tube ends and clips—starter holder and diagram 19/6—post and insurance 3/6 on either or 4/6 on both items.

VARYLITE

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

Where postage is not stated then orders over £5 are post free. Below £5 add 2/. S.A.E. with enquiries please.

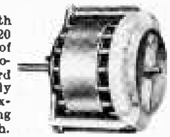
NEED A SPECIAL SWITCH

Double Leaf Contact. Very slight pressure closes both contacts, 1/3 each, 12/- doz. Plastic push-rod suitable for operating, 1/- each, 9/- doz.

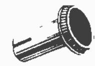
50-Way Connector Block. Heavy duty block, size 24in. x 2¼in. x 1¾in. approximately. Each of the 50 ways has a multi cable inlet and outlet designed for easy connection. Also, each way has 2 test sockets and a disconnecting plug. Ideal for inserting ammeter or other device without breaking circuit, offered at 69/6 each, which is only a fraction of the regular price, postage and insurance 5/6.

Under-floor Heating Cable. 200ft, lengths, suitable for dissipating 1,000 watts at 80 volts. Join three in series to make a 240 volt mains operated element of 3kW. Price 20/- per length, 4/6 post on any quantity.

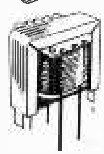
3-Core Leads. Heavy duty 23/36, average length 5ft. 10/- per dozen lengths, plus 4/6 P. & I.



Papst Motors. Est. 1/40th h.p. Made for 110-120 volt working, but two of these work ideally together off our standard 240 volt mains. A really beautiful motor, extremely quite running and reversible. 30/- each.



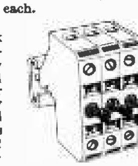
Instrument Knobs. ⅞in. dia. head with ⅜in. shank for flatted ¼in. spindle, 9d. each, 8/- dozen. Ditto but with metal disc, 1/- each, 11/- dozen.



Midget Output Transformer. Ratio 140:1. Size approx. 1in. x ⅞in. x ⅞in. primary impedance 450 Ω. Connection by flying leads. 4/6 each 48/- doz.

Midget Output Transformer. Ratio 80:1. Size approx. 1⅛in. x 1in. x ⅞in. Primary imepdance 132 Ω. Printed circuit board connection. 5/6 each. £3 doz.

4-Gang Air Spaced Tuning Condenser for AM/FM circuits. AM rf section 200 pf osc section 80 pf both with trimmers.—FM rf section 9.5 pf osc section 11.2 pf—integral slow-motion drive 9/6 each.



Mains 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. 12/6 each

DRILL CONTROLLER

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

ELECTRIC CLOCK WITH 25 AMP SWITCH

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

MAINS TRANSISTOR POWER PACK

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

ELECTRONICS (CROYDON) LTD

Dept. PW, 266 London Rd., Croydon CPO-2TH
Also 102/3 Tamworth Road, Croydon

P.W. GUIDE TO COMPONENTS

PART 18

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

INTEGRATED CIRCUITS

(continued)

Linear I.C.'s

THE term linear integrated circuit is applied to all non-digital devices. Originally they were d.c. amplifier circuits used in analogue computers for differentiation, integration etc., and were consequently required to have precise and linear characteristics. Now the term is used loosely and includes many specialist devices.

The d.c. amplifiers produced utilise fully the advantages of matched pair operation in long tail pair circuits. Again in order to minimise resistive elements active constant current generators are used. Consequently the amplifiers—such as the operational amplifier shown in Fig. 18—are extremely stable in terms of temperature and drift. This basic configuration is used for many applications such as a.f., i.f., r.f. and wideband amplifiers.

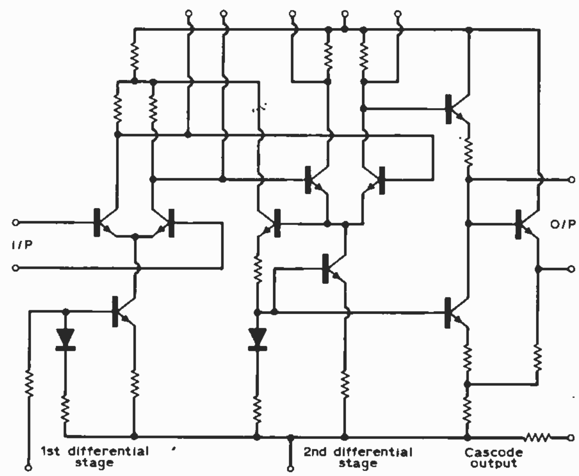


Fig. 18: Typical linear integrated circuit.

Special Circuits

Many specialist circuits are now available such as audio amplifiers, power control circuits, motor control circuits, i.f. strips and complete receiver circuits which only require the addition of tuned circuits and controls. Most of these circuits are the control devices for power stages and are rarely designed as complete devices. The power limitations restrict the output stages, although 5W audio amplifiers are available in integrated circuit form. Table 2 gives a list of some of the devices available together with costs, parameters and applications.

Summary and Future Trends

We have seen how integrated circuits are fabricated and investigated some of their advantages and disadvantages. Perhaps the greatest advantage is reliability and simplicity of design. When using circuit blocks, design time is reduced and all the layout and interaction difficulties solved. They are still new and consequently the full potential has yet to be realised. Undoubtably the very basis of electronics will change through the widespread use of integrated circuits since multi-element, complex devices will become feasible and perhaps commonplace. Undoubtably as the range widens designers will increasingly operate simply as systems engineers, building circuits with integrated circuit "bricks". It is because they are the devices of the future that it is important they are understood, just as it is important to be aware of the many devices which are available.

With this final article the series "PW Guide to Components" comes to an end. The series which began in December 1968 has covered the whole range of components used in the field of electronics from simple resistors to the latest in integrated circuits. It is hoped that the series has proved of some worth to our readers. ■

Table 2: Parameter and Cost of Some Linear Integrated Circuits

Device, designation and circuit function		*Parameters*	*Cost*	*Supplier*
Operational amplifier:	High gain, linear d.c. amplifier for critical applications	Open loop V gain 3,000 to 75,000 Zin 15 kΩ to 2MΩ Common mode rejection 75-100dB	50/– to £5 upwards to £25	Most
Wideband Amplifier:	Wideband d.c. and video amplifiers	Frequency d.c. to 2 or 5MHz Power gain about 50dB Signal to noise about 70dB Power output about ½W	20/– to 50/– upwards to £10	Most
R.F. amplifiers:	R.F. and I.F. amplification	Voltage gain about 25dB Frequency d.c. to 40MHz	30/– to 50/– upwards to £17	Most
I.F. Amplifiers:	A.M. and F.M. I.F. amplifiers and discriminators	Voltage gain 60-70dB at 4·5 MHz Noise figure about 8·5dB A.F. output level about 200mV	12/6 to 30/–	Most
Audio amplifiers:	Direct low output to speakers or to drive p.a. stage	Voltage gain about 20-50 Power output about 0·5-5W Bandwidth about 500 KHz	£2 to £6	Most
Pre-amplifiers:	Low level audio stages, f.e.t. input	Bandwidth from 20Hz—10kHz to d.c.—500kHz	12/6 to 30/– upwards to £15	Most
Differential amplifiers:	General purpose with Darlington input stages and cascode output	Differential voltage gain 60-150 Bandwidth d.c. to 0·2 up to 2MHz	30/– to 50/– upwards to £10	Most
Diode and transistor Arrays:	General purpose circuits with matched diodes or transistors	Signal diodes 1·8pF, 0·73V Transistors VcE. about 15V Icmax about 50mA hFE about 60	Approx. 20/–	Most
Receiver semiconductors:	All semiconductors in receiver or transmitter; a.m. or f.m., and i.f. and 10MHz amplifier	R.F. range 10-30MHz I.F. 100-500kHz Amp. gain 50dB	Approx. 50/–	Mullard
Optoelectronic amplifier:	Gallium arsenide diode and photodiode interface	Computer and communications	—	T.I.
Phase control:	Module for controlling phase switching of triacs and thyristors	Gate current 2A peak Supply 8·5V Input—feedback or manual	Approx. £4	G.E.
Voltage regulator:	Error amplifiers for controlling d.c. power supplies	D.C. voltages to 15V direct	20/– to £5	Most
Zero switch module:	Thyristor and triac controller switching at zero volts only	Zero line voltage sensing, output to 15A, 240V triac	Approx. £5	G.E.
Complementary unijunction:	Monolithic complement of p-emitter unijunction	Frequency 100kHz Stability + 0·6% Voltage (Vbb) 30V max.	Approx. 30/–	G.E.

BLUEPRINT SERVICE

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

QUERY COUPON

This coupon is available until 5th June 1970 and must accompany all queries in accordance with the rules of our Query Service.

PRACTICAL WIRELESS, JUNE 1970

Published approximately on the 7th of each month by IPC Magazines Limited, Fleetway House, Farringdon Street, London, E.C.4. Tel: 01-236 8080. Printed in England by Index Printers, Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/sia) Ltd.; South Africa—Central News Agency Ltd.; Rhodesia and Zambia—Kingston Ltd.; East Africa—Stationery and Office Supplies Ltd. Subscription rate (including postage): For one year to any part of the world £2 5s 0d.

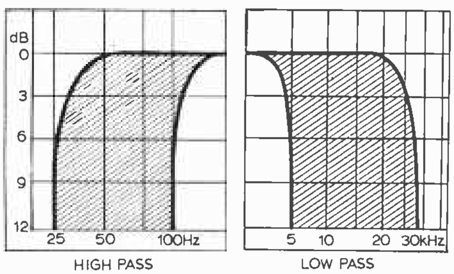
New for Project 60

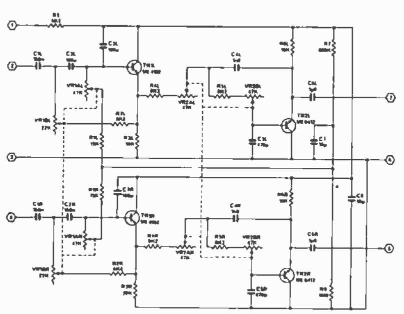
Active Filter Unit

The Sinclair Active Filter Unit is a new addition to our Project 60 range of high fidelity modules and is designed to complement the other modules in the range. Its performance is such, however, that users of other amplifier systems might well consider adding it to their assemblies.

The purpose of a filter unit is to reject frequencies above (scratch) or below (rumble) a specific cut off frequency when these frequencies contain unwanted interference. The Sinclair A.F.U. is unique in that the cut off frequency is continuously variable for both the scratch and rumble units and, as the attenuation in the rejection band is rapid (12dB per octave), the removal of interference can be achieved with less loss of the wanted signal than has previously been possible.

Each channel of the A.F.U. has an overall gain of unity and, as the imput impedance is high and the output impedance is low, it may be connected between the pre-amplifier and power amplifier sections of any amplifier. Both amplitude and phase distortion have been made quite negligible by the careful design and the large amount of negative feedback employed.





Specifications

Designed for connection between the Stereo 60 pre-amplifier and two Z-30 or Z-50 power amplifiers.
Employs two Sallen & Key type active filter stages, the first being a rumble (high pass) filter and the second a scratch (low pass) filter. The two stages use complementary transistors to minimise distortion.
Supply voltage 15 to 35V Current 3mA max.
Gain at 1kHz, filters flat 0.98 (—0.2dB)
H.F. cut off (—3dB) variable from 28kHz to 5kHz
H.F. filter slope 12dB/octave
L.F. cut off (—3dB) variable from 25Hz to 100Hz
L.F. filter slope 12dB/octave
Distortion at 1kHz (35v supply) 0.02% at rated output (250mV R.M.S.)
Frequency response, flat position, 35Hz to 20kHz—1dB
25Hz to 28kHz—3dB

Built, tested and guaranteed **£5.19.6**

Z-50 FORTY WATT R.M.S. (80 WATT PEAK) HIGH FIDELITY POWER AMPLIFIER

The Z-50 has been designed for applications requiring higher output power than the Z-30. The maximum supply voltage is raised to 50 Volts and the output power is **40 watts continuous R.M.S. in to 3 or 4 ohms and 30 watts continuous into 8 ohms.** The Z-50 is otherwise identical to the Z-30 in design and specification, the increased power being obtained by using much higher current power transistors used well within their rated limits.

The Z-50 is, of course, compatible with the other Project 60 modules, such as the Stereo 60, and since the price is only 20/- higher than that of the Z-30, customers may like to consider the advantages of buying two Z-50's for their systems now in case higher power is required later.

Where the full output power is not required the Z-50 may be used with the PZ-5 or PZ-6 but for the full output power the PZ-8 should be used. This unit is a stabilised power supply providing 45 volts at up to 3 amps. It is supplied without mains transformer as it is designed for use with a readily available "Radiospares" unit.

SINCLAIR
Z-50

Z-50 built, tested and guaranteed **£5.9.6** *PZ-8* **£5.19.6**

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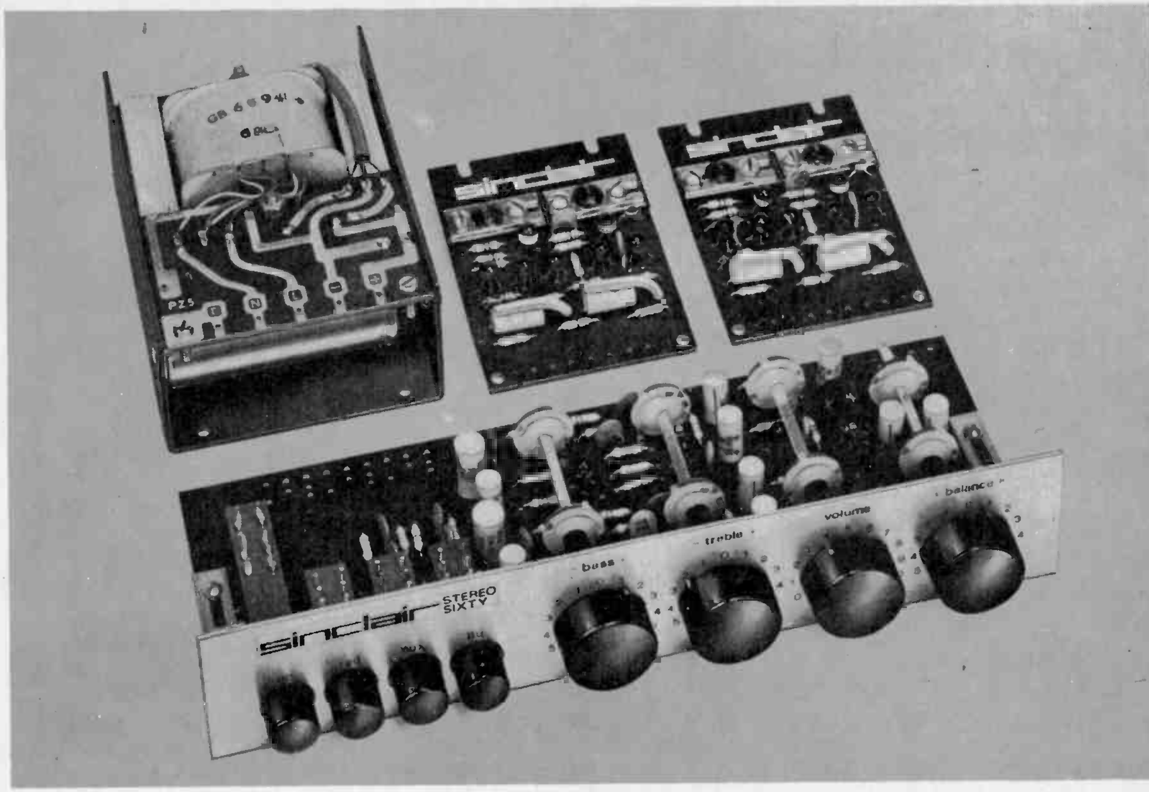

Project 60 an exciting alternative

It is not likely that anyone purchasing an amplifier today would have difficulty in finding one that met all his requirements, although the price might not be as low as could be wished. But one's needs can change, also the technically correct amplifier may be physically inconvenient. If there is an amplifier available, of the right size and price, to meet all your needs for the foreseeable future, then that is your best buy. If not, we offer a possibility which we believe to be an exciting alternative approach. That alternative is **Project 60**.

Project 60 now comprises a range of modules which connect together simply to form a complete stereo amplifier with really excellent performance. So good, in fact, that only 2 or 3 amplifiers in the world can compare in overall performance. Now with the addition of three new modules to the range, the constructor has choice of assemblies with either 20 or 40 watts output per channel, with or without filter facilities.

The modules now are: **1**. The Z-30 and Z-50 high gain power amplifiers, each of which is an immensely flexible unit in its own right. 2. The Stereo 60 pre-amplifier and control unit. 3. The Active Filter unit with both high and low audio frequency cut—offs. **4**. The PZ-5 and PZ-6 power supplies. A complete system could comprise, for example, two Z-30's, one Stereo-60, and a PZ-5. The P-Z6 is stabilised and should be used where the highest possible continuous sine wave rating is required. An A.F.U. may be added later. In a normal domestic application, there will be no significant difference between using PZ-5 or PZ-6 unless loudspeakers of very low efficiency are being used, in which case the PZ-6 will be required. For assemblies using two Z-50's there is the new PZ-8 stabilised supply unit to ensure maximum performance from these amplifiers.

All you need to assemble your Project 60 system is a screwdriver and soldering iron. No technical skill or knowledge whatsoever is required and, in the unlikely event of you hitting a problem, our customer service and advice department will put the matter right promptly and willingly. Project 60 modules have been carefully designed to fit into virtually all modern plinth or cabinets and only holes need be drilled into the wood of the plinth to mount the control unit. Any slight slip here will be covered by the aluminium front panel of the Stereo 60. The Project 60 manual gives all the buildings and operating instructions you can possibly want, clearly and concisely. Perhaps the greatest beauty of the system is that it is not only flexible now but will remain so in the future as the latest additions to the range show. A stereo F.M. tuner is next to come. These and all other modules we introduce will be compatible with those already available and may be added to your system at any time. And because Sinclair are the largest producers of constructor modules in Europe, Project 60 prices are remarkably low.

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Z.30 TWENTY WATT R.M.S. (40 WATT PEAK) HIGH FIDELITY POWER AMPLIFIER

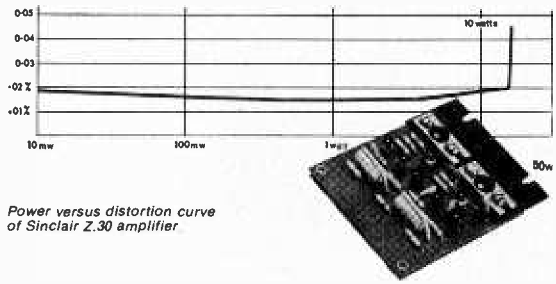
The Z.30 is a complete power amplifier of very advanced design employing 9 silicon epitaxial planar transistors. Total harmonic distortion is incredibly low being only 0.02% at full output and all lower outputs. As far as we know, no other high fidelity amplifier made can match this specification, no matter what the price. Thus you can be utterly certain that your Project 60 system will do full justice to your other equipment however good it may be. The Z.30 is unique in that it will operate perfectly, without adjustment, from any power supply from 8 to 35 volts. It also has sufficient gain to operate directly from a crystal pickup. So in addition to its use in a high fidelity system you can use a Z.30 to advantage in your car or a battery operated gramophone for your children, for example. These, and many other applications of the Z.30 are covered in the manual of circuits and instructions supplied with every Z.30 high fidelity power amplifier.

SPECIFICATIONS

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

Frequency response:	30 to 300,000 Hz ± 1dB.
Distortion:	0.02% total harmonic distortion at full output into 8 ohms and at all lower output levels.
Signal-to-noise ratio:	better than 70dB unweighted.
Input sensitivity:	250mV into 100Kohms.
Damping factor:	>500.
Loudspeaker impedances:	3 to 15 ohms.
Power requirements:	From 8 to 35 V.d.c.(The Z.30 will operate ideally from batteries if required.)
Size:	3½ × 2¼ × ½ inches.

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



Power versus distortion curve of Sinclair Z.30 amplifier

Z.30
Built, tested and guaranteed, with circuits and instructions manual

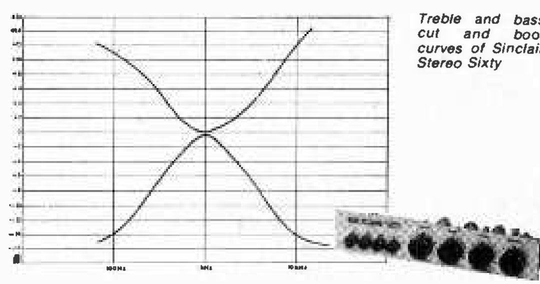
89/6

STEREO 60 PRE-AMPLIFIER AND CONTROL UNIT

The Stereo 60 is a stereo preamplifier and control unit designed for the Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout and great attention has been paid to achieving a really high signal-to-noise ratio and excellent tracking between the two channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs. The tone controls are also very carefully designed and tested.

SPECIFICATIONS

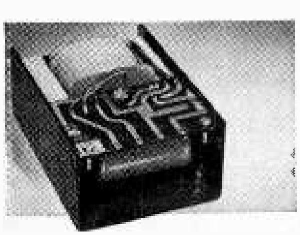
- Input sensitivities—Radio—up to 3mV Magnetic Pickup—3mV: correct to R.I.A.A. curve ± 1dB; 20 to 25,000 Hz. Ceramic Pickup—up to 3mV: Auxiliary—up to 3mV.
- Output—250mV
- Signal-to-noise ratio—better than U0dB.
- Channel matching—within 1dB.
- Tone controls—TREBLE + 15 to − 15dB. at 10 KHz: BASS + 15 to − 15dB at 100Hz.
- Power consumption 5mA.
- Front panel—brushed aluminium with black knobs and controls.
- Size 8¼ × 4 ins.



Treble and bass cut and boost curves of Sinclair Stereo Sixty

Ready for immediate installation **£9. 19s. 6d.**

SINCLAIR MAINS POWER SUPPLY UNITS



PZ-5 *30 volts unstabilised—sufficient to drive two Z.30's and a Stereo 60 for the majority of domestic applications.* **£4.19.6**

PZ-6 *35 volts stabilised—ideal for driving two Z.30's and a Stereo 60 when very low efficiency speakers are employed.* **£7.19.6**

PZ-8 *45 volts power supply unit for use with Z.50 amplifiers (less mains transformer)* **£5.19.6**

BUILDING A PROJECT 60 ASSEMBLY

The illustration here shows quite clearly how easily Project 60 can be contained in one of today's slim, modern plinths. Very little space is required to house these Sinclair units, and within the space of the motor plinth, you can install a stereo amplifier of the very highest quality. If, for example you have already put together an assembly as illustrated here, adding the Active Filter Unit would be very easy.

IC.10 MICROMATIC AND Q.16. *Please see next page*

GUARANTEE

If at any time within 3 months of purchasing Project 60 modules 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 services thereafter. No charge for postage by surface mail. Air-mail charged at cost.

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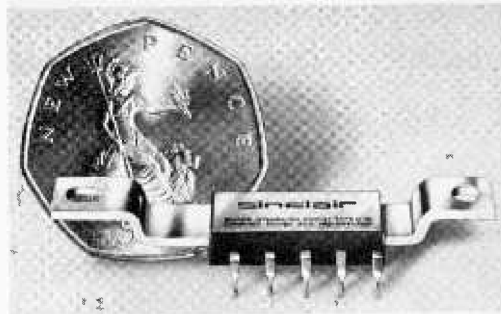
PW 670

SINCLAIR IC.10

MONOLITHIC INTEGRATED CIRCUIT
HI-FI AMPLIFIER COMBINED WITH PRE-AMP



The Sinclair IC-10 is the world's first monolithic integrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself, a chip of silicon only a twentieth of an inch square by one hundredth of an inch thick, has 5 watts R.M.S. output (10w. peak). It contains 13 transistors (including two power types), 2 diodes, 1 zener diode and 18 resistors, formed simultaneously in the silicon by a series of diffusions. The chip is encapsulated in a solid plastic package which holds the metal heat sink and connecting pins. This device is more rugged and reliable than any previous amplifier and has considerable performance advantages. The most important are complete freedom from thermal runaway and very low level of distortion.

The IC-10 is primarily intended as a full performance high fidelity power and pre-amplifier, for which application it only requires the addition tone and volume control network and a battery or mains power supply. The IC-10 may be used simply in many other applications including car radios, electronic organs, servo amplifiers (it is d.c. coupled throughout). Stabilised power supply, oscillator, etc. The pre-amp section can be used as R.F. or I.F. amplifier. We give a full guarantee on every IC-10 knowing that every unit will work as perfectly as the original and do so for a lifetime.

SPECIFICATIONS

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

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

With comprehensive manual of circuits & instructions Post free. **59/6**

SINCLAIR MICROMATIC

A powerful high quality radio smaller than a matchbox

In kit complete with earpiece, case, instructions and solder in fitted pack.

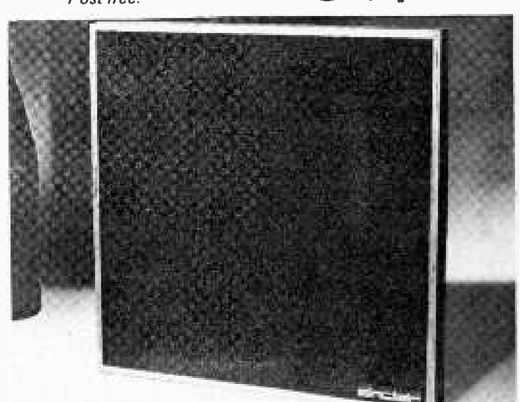
49/6

Ready built, tested and guaranteed, with earpiece.

59/6

Mallory Mercury Cell, RM675 (Two needed) 2/9 each.

Considerably smaller than an ordinary box of matches, this is a multi-stage A.M. receiver with remarkable standards of selectivity, power and quality. Powerful A.G.C. counteract fading from distant stations: bandspread at higher frequencies makes reception of Radio 1 easy at all times. Venier type tuning and self-contained special ferrite rod aerial makes station separation easy. The plug-in matching high quality magnetic earpiece ensure wonderful reproduction of speech and music. Everything including the batteries is contained within the attractively designed black and aluminium case. Whether you build your Micromatic or buy it ready built and tested, you will find it as easy to take with you as your wristwatch, and dependable under the severest listening conditions.



Q.16 an outstandingly fine loudspeaker

Developed on entirely original design principles, this compact, beautifully styled shelf-speaker accepts up to 14 watts R.M.S. loading at 8Ω. Frequency response 60—16,000 Hz. Size 9¾" square x 4¾" deep, on plinth. Teak surround, with all-over cellular foam front and special seamless sealed sound chamber.

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Sinclair Project 60—see previous three pages

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AC128	2/6	OC201	7/-
AC176	5/-	2G301	2/6
ACY17	3/-	2G303	2/6
AF114	4/-	2N1302-3	4/-
AF115	3/6	2N1304-5	5/-
AF116	3/6	2N1306-7	6/-
AF117	3/6	2N1308-9	9/-
AF239	12/6	2N3819 FET.	9/-
AF186	10/-	2N3844A	5/-
AF139	10/-	Power	
BFY50	4/-	Transistors	
BSY25	7/6	OC20	10/-
BSY26	3/-	OC23	10/-
BSY27	3/-	OC25	8/-
BSY28	3/-	OC26	5/-
BSY29	3/-	OC28	7/6
BSY95A	3/-	OC35	5/-
OC41	2/6	OC36	7/6
OC44	2/6	AD149	10/-
OC45	2/6	AUY 10	30/-
OC71	2/6	2N3055	15/-
OC72	2/6	2S034	10/-
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B80	8	Dual Trans. Matched O/P pairs NPN. Sil. in TO-5 can.	10/-
B82	10	OC45., OC81D and OC81 Trans Mullard glass type.	10/-
B83	200	Trans. Makers rejects. NPN/PNP, Sil. and Germ.	10/-
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202.	10/-
B66	150	High quality Germ. Diodes. Min. glass type.	10/-
B86	50	Sil. Diodes sub. min. IN914 and IN916 types.	10/-
B87	100	Germ. PNP Trans. equiv. to OC44, OC45, OC81, etc.	10/-
B88	50	Sil. Trans. NPN, PNP, equivalent to OC200/1, 2N706A, BSY95A, etc.	10/-
B60	10	7 Watt Zener Diodes. Mixed voltages.	10/-
H5	16	1 Amp. Plastic Diodes, 50-1,000 Volts. 6 large, 10 small	10/-
H6	40	250mW. Zener Diodes DO-7 min. Glass Type. AV. 40% Good.	10/-

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B96	5	2N3136 PNP Sil. Trans. TO-18, HFE 100-300 I.C. 600mA. 200MHz.	10/-
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B99	200	Capacitors, Electrolytics, paper silver mica, etc. Post and packing, this Pak 2/6.	10/-
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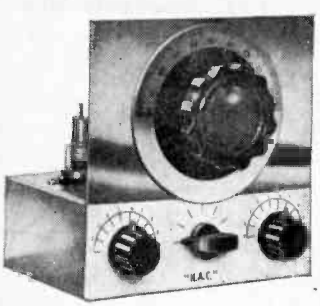

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Solve your communication problems with this 4-Station Transistor Intercom system (1 master and 3 Subs), in de-luxe plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs and Subs to Master. Ideally suitable for Business, Surgery,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

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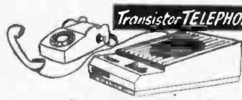
Transistor TELEPHONE AMPLIFIER



59/6

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57/6 P. & P. 2/6

(Extra lead with DIN plug for Cassette Recorders 7/6)

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for transistor equipment using 7½v. Complete with DIN plug for power socket. Can also be supplied for a 6-volt output complete with suitable plug. (State make, model and voltage required.)

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Code	Power	Tolerance	Range	Values available	1 to 9	10 to 99	100 up
					SEE NOTE BELOW		
C	1/20W	5%	82 Ω–220K Ω	E12	18	16	15
C	1/8W	5%	4·7 Ω–330K Ω	E24	2·5	2	1·75
C	1/4W	10%	4·7 Ω–10M Ω	E12	2·5	2	1·75
C	1/2W	5%	4·7 Ω–10M Ω	E24	3	2·5	2·25
MO	1/2W	2%	1·0 Ω–1M Ω	E24	9	8	7
C	1W	10%	4·2 Ω–10M Ω	E12	6	5	4·5
WW	1W	10% +1/20 Ω	0·22 Ω–3·3 Ω	E12	15d all quantities		
WW	3W	5%	12 Ω–10K Ω	E12	15d all quantities		
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Codes: C = carbon film, high stability, low noise.
MO = metal oxide, Electrosil TR5, ultra low noise.
WW = wire wound, Plessey.

Values: E12 denotes series: 1, 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.
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Dual gang linear: 4K7, 10K, 22K etc. to 1M Ω	,, 8/6
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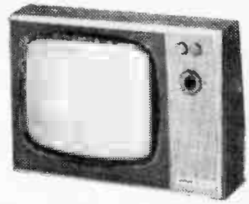

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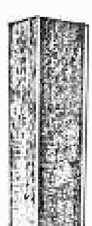

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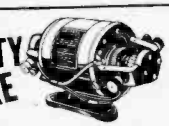

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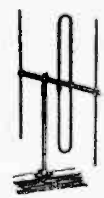

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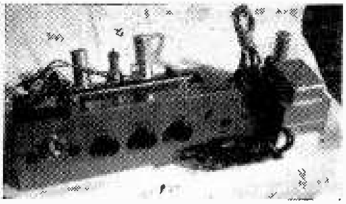
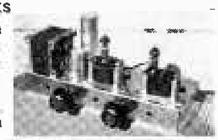


Chassis 12½ x 5½ x 4½in. high. Plastic front panel finished in Black and "Silver". 200-250 A.C. Record/Playback amp. switch; Off/On-Tone. Vol./Mc.; Vol./Gram; Mic. Input; Gram. Input; Valves 6BR7; 12AX7; EM84; EL84 and EZ80. Separate Output Transformer (Already wired to amp). PRICE £12 (10/- P. & P.). 3-ohm speaker 7" x 4" 16/- extra.

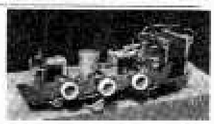
STEREO AMPLIFIER type HV—2 x 3 Watts



Fully built. On off. sep. vol. and tone each channel 12 × 4½ × 6in. high. EZ80. 2 × ECL86: for 3 ohm speakers, double wound main trans: fixing flanges and base plate, suitable for crystal cart, tuner etc. £6.10.0 (8/- p. × p.)

Superior version — separate base, treble & vol each channel with mono/stereo switch 15/- extra

STEREO AMPLIFIER type RC— 2 x 3 Watts



Fully built. 2 × UCL82, metal rect; ganged vol. and tone cont; on-off. balance. 11 × 3½ × 4in high. Double wound mains trans. with supporting brackets. For 3-ohm speakers. £6 (8/- p. & p.).

MONO GRAM CHASSIS 3 WATT

3 Wave band long-med-short. Gram., 200-250v AC Ferrite aerial. Chassis 13 × 7 × 5in. Dial 13 × 4in. Double wound mains transformer 5 valves ECH81 EF89, EBC81, EL84, EZ80. Price £10.12.6. (7/6 p. & p.) Output trans. for 3-ohm speaker.

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ECC189	11/-
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EL81	10/-
EL83	8/3
EL84	5/-
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EL360	23/-
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ELL80	15/-
EM34	16/-
EM71	12/6
EM80	8/-
EM81	8/6
EM84	7/6
EM87	11/-
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EY51	8/-
EY80	9/-
EY81	8/-
EY83	11/-
EY86	8/-
EY87	8/6
EY88	8/6
EZ35	5/6
EZ40	9/-
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EZ81	5/6
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GY501	16/-
GZ30	7/6
GZ31	6/-
GZ32	9/6
GZ33	16/-
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HABC80	8/6
HBC90	5/-
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HF93	6/6
HF94	5/6
HK90	6/6
HL92	7/-
HL94	8/-
KT66	27/6
KT88	33/-
N78	21/-
PABC80	8/-
PC86	11/6
PC88	13/-
PC97	8/6
PC900	9/6
PCC84	7/-
PCC85	8/-
PCC88	12/-
PCC89	10/6
PCC189	11/-
PCC805	17/-
PCC806	17/-
PCE800	15/-
PCF80	6/6
PCF82	6/9
PCF84	9/-
PCF87	16/-
PCF800	15/-
PCF801	10/-
PCF802	10/-
PCF805	15/-
PCF806	13/-
PCF808	15/6
PCH200	14/-
PCL81	10/-
PCL82	7/9
PCL83	13/-
PCL84	8/9
PCL85	9/6
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PF818	17/-
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PL36	11/-
PL81	9/6
PL82	9/-
PL83	8/-
PL84	7/-
PL302	15/-
PL500	15/-
PL504	16/-
PL508	17/6
PL509	30/-
PL801	16/-
PL802	14/-
PM84	9/-
PY31	5/-
PY33	12/6
PY80	6/6
PY81	6/-
PY82	6/-
PY83	7/6
PY88	8/-
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U37	30/-
U50	6/-
U52	6/-
U76	5/-
U78	5/-
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U281	8/-
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UCC85	8/-
UCF80	10/6
UCH21	11/-
UCH42	13/-
UCH43	12/6
UCH81	6/6
UCL81	11/-
UCL82	7/-
UCL83	12/-
UF9	11/-
UF11	10/-
UF41	10/-
UF42	12/-
UF43	11/-
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UF89	7/-
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UM84	4/-
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VR150/30	6/6
VU39A	10/-
VU111	10/-
VU120	15/-
VU133	10/-
W729	12/-
Z309	10/-
Z329	17/-
Z803U	17/6

TRANSISTORS

Quantity prices quoted on request

Type	Price	Type	Price	Type	Price
2N404	3/6	2N3710	3/-	BCY39	5/-
2N410	3/6	2N3819	12/-	BCY72	3/10
2N412	3/6	2N3906	6/-	BCZ11	7/6
2N444A	5/-	AC113	3/-	BD121	18/-
2N696	4/6	AC125	6/6	BC123	25/-
2N697	4/6	AC126	5/-	BF167	5/-
2N698	8/6	AC127	5/6	BC173	6/-
2N705	15/-	AC128	4/6	BF181	6/-
2N706	3/-	AC153	5/-	BF184	7/6
2N708	3/6	AC154	3/-	BF194	3/6
2N753	4/9	AC157	4/-	BF195	3/-
2N929	6/-	AC169	2/-	BF196	4/6
2N930	6/8	AC176	6/9	BF197	4/6
2N987	6/6	ACY17	6/-	BFX88	5/4
2N1131	8/6	ACY18	4/-	BFY17	8/6
2N1132	9/6	ACY19	4/9	BFY18	5/-
2N1301	7/-	ACY20	4/-	BFY19	5/-
2N1302	7/-	ACY21	3/11	BFY50	5/-
2N1304	4/6	ACY22	2/8	BFY51	4/6
2N1305	4/6	AD140	16/-	BFY52	4/10
2N1306	5/-	AD149	12/6	BSY26	5/-
2N1307	6/-	AD161	9/-	BSY27	5/6
2N1308	7/6	AD162	9/-	BSY28	5/-
2N1309	9/6	AD102	15/6	BSY65	4/6
2N1756	15/-	AF114	6/-	BSY95A	3/9
2N2147	14/9	AF115	6/-	OC16	15/-
2N2160	23/-	AF116	5/6	OC22	13/-
2N2217	6/6	AF117	4/6	OC23	12/6
2N2218	7/9	AF118	10/-	OC24	15/-
2N2219	8/6	AF125	6/-	OC25	7/6
2N2369A	4/6	AF126	5/3	OC26	6/-
2N2477	12/6	AF127	5/3	OC28	14/6
2N2646	12/6	AF178	12/6	OC29	14/9
2N2905	10/-	AF186	11/-	OC30	15/-
2N2923	3/-	AF239	10/-	OC35	11/3
2N2924	3/-	AFY19	22/6	OC36	12/6
2N2926'b'	3/-	AFZ11	9/-	OC42	6/6
2N2926'r'	3/-	ASY26	6/-	OC44	4/-
2N2926'o'	3/-	ASY27	6/6	OC45	3/6
2N2926'y'	3/-	ASY28	6/6	OC71	3/6
2N2926'g'	5/6	ASY29	6/-	OC72	5/-
2N3053	6/3	ASY54	6/-	OC73	7/6
2N3055	15/-	ASY73	10/-	OC75	5/-
2N3133	7/-	ASY74	16/-	OC76	5/-
2N3134	8/6	ASY77	7/-	OC78	5/-
2N3391	4/-	ASY82	4/-	OC78D	3/3
2N3392	3/2	ASY86	4/6	OC81	4/6
2N3393	2/6	BC107	3/-	OC81D	3/-
2N3394	2/6	BC108	3/-	OC83	4/6
2N3395	3/6	BC109	4/-	OC84	5/-
2N3402	5/-	BC113	8/6	OC139	7/6
2N3403	5/-	BC118	8/6	OC140	9/6
2N3404	6/6	BC147	4/6	OC170	5/-
2N3414	4/-	BC148	3/3	OC171	5/6
2N3415	4/3	BC149	3/6	OC200	4/4
2N3416	4/6	BC152	3/2	OC201	10/-
2N3417	5/2	BC175	5/6	OC202	13/-
2N3702	4/6	BCY30	7/-	OC203	6/3
2N3703	3/10	BCY31	5/-	OC204	6/-
2N3704	5/6	BCY33	5/-	OC205	23/-
2N3707	4/-	BCY34	5/-	OC206	14/-
2N3709	3/5				

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WIRE ENDED

Type	p.i.v.	Current	Price
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IN5399	1000p.i.v.	1.5A	4/6
IN5408	1000p.i.v.	3A	6/3
IS113	400p.i.v.	400mA	4/6
IS115	600p.i.v.	400mA	7/6
BY127	600p.i.v.	1A	3/6
BY130equivalent(Y1928)	450p.i.v.	800mA	1/6
D226B	400p.i.v.	300mA	2/9
D226V	300p.i.v.	300mA	2/6

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Type	p.i.v.	Current	Price
D242	100p.i.v.	10A	6/-
KD202A	50p.i.v.	3A	5/-
KD202B	50p.i.v.	1A	3/-
KD202D	200p.i.v.	3A	6/-
KD202E	200p.i.v.	1A	3/6
KD202G	100p.i.v.	1A	3/3
KD2021	300p.i.v.	1A	3/8
KD202V	100p.i.v.	3A	5/-

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TYPE MF16

D.C. voltage range:
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A.C. voltage range:
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D.C. current range:
500μ-10-100mA.
Resistance ranges: 100MΩ-1MΩ. The meter is also calibrated for capacity and output level measurements. Sensitivity 2000Ω/V. Accuracy ± 2.5% for D.C. and ± 4% for A.C. measurements.

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101DV	600v FSD, Basic movement 1mA	77/-
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120DA	250 microamps	65/-
120DA	10 amps with internal shunt	60/-
	3" × 2½" face	
70DA	250 microamps	54/-
70DA	600 microamps	49/-
70DA	250 mA	46/-
70DA-	600 mA	46/-
70DV	150v	82/-

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CA3005 RF Amplifier with 100mc/s bandwidth. Max. dissipation 26mW. For use as RF amplifier, balanced mixer, product detector or self-oscillating mixer 27/-

CA3012 wide Band Amplifier (up to 20mc/s), suitable as IF Amplifier for VHF/FM receivers 22/-

CA3020 General Purpose Audio Amplifier of 550mW output 30/-

CA3036 Buffer amplifier consisting of two 'super-alpha' pair of transistors suitable for stereo pick-up systems 19/-
The above four I.C's are in TO5 encapsulation.

CA3052 Four-in-one 42/-

PA222 Audio Amplifier providing a max. output of 1·2 watts 65/-

PA234 Audio Amplifier providing a max. output of 1 watt 27/6

PA237 2 watts Audio Amplifier 40/-
The above three I.C's are in epoxy moulded double four-in-line package.

MC1709CG General Purpose operational amplifier in TO-99 case 40/-

TAA263 3-stage direct coupled amplifier for use from DC to 600kc/s; 70mW dissipation. Output 10mW into 150 Ω load 15/-

TAA293 3-stage amplifier with connection brought out to the individual leads. Bandwidth 600kc/s. 160mW dissipation. Output 10mW into 150 Ω load 20/-

TAA320 MOST input stage followed by a bi-polar transistor stage. 200mW dissipation 13/-

TAD100 Integrated AM receiver circuit containing *all* active components, except output stage, required to build a complete receiver 45/-

SL403A 3 watts Audio Amplifier into 7·5 Ω Loudspeaker. Operating voltage 18V. Overvoltage protection 49/6

Data sheets are available for all the above I.C's.

Please note that certain external components like resistors, capacitors, etc. are required to build complete amplifiers. Circuit details are supplied free of charge with amplifiers, but are charge at 1/- each if supplied separately.

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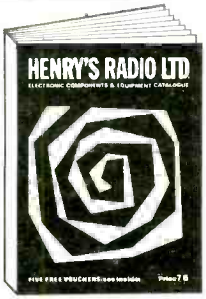

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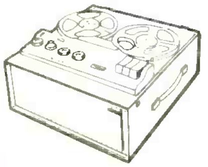

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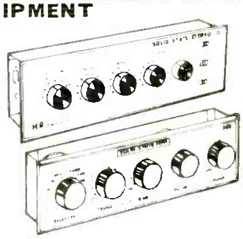

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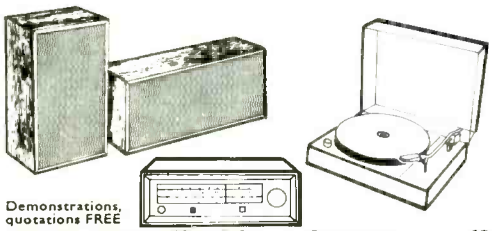

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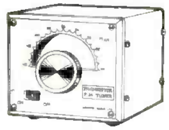

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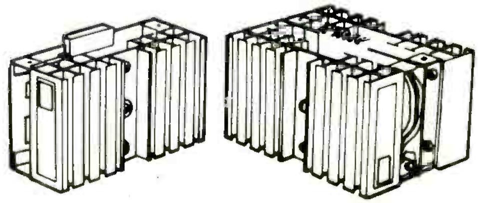

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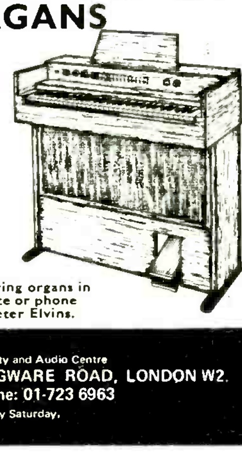

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