PRACTICAL WIRELESS

MAY 1972

20p

Extra Inside

8 PAGES OF SEMICONDUCTOR DATA

The 'TEXAN'

20 + 20 WATT I.C. STEREO AMP

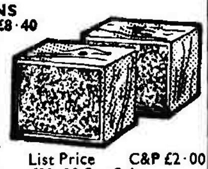
&

RADIO 2 ADD-A-VERTER

TREASURE TRACER MkII

FANTASTIC! WHARFEDALE

SPEAKER BARGAINS
DENTON 2 SAVE £8·40



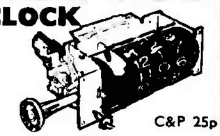
Sold in matched pairs. Each Denton contains an 8in. bass unit with 3in. pressure unit, coupled by a Wharfedale crossover network. Rated input: 18 watts maximum. Frequency response: 65-17,000 Hz. Impedance: 4/8 ohms. Cabinet 9¾in. x 14in. x 8½in.

List Price **£39·90 Per Pair** C&P £2·00
LASKY'S PRICE £31·00

	List Price	Lasky's Price	C&P
LINTON 2 Pair	£49·90	£38·75	£2
TRITON 3 Pair	£65·00	£51·50	£2
MELTON 2 each	£35·00	£25·50	£1
DOVEDALE 3 each	£45·00	£33·00	£1
ROSEDALE each	£65·00	£50·00	£1
UNIT 3 each	£12·50	£9·50	50p
UNIT 4 each	£18·00	£12·50	50p
UNIT 5 each	£26·00	£18·50	50p

DIGITAL CLOCK SCOOP

EXCLUSIVELY FROM LASKYS



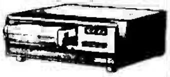
The lock measures 4¾ W x 1¾ H x 3¾ D (overall from front of drum to back of switch). SPEC.: 210/240V a.c. 50Hz operation; switch rating 250V, 3A. Complete with instructions. **HUNDREDS OF APPLICATIONS COMPLETE WITH KNOBS. FEATURES: ● MAINS OPERATION ● 12-HOUR ALARM ● AUTO "SLEEP" SWITCH ● HOURS, MINUTES AND SECONDS READ-OFF ● FORWARD AND BACKWARD TIME ADJUSTMENT ● SILENT OPERATION ● SHOCK AND VIBRATION PROOF ● BUILT IN ALARM BUZZER**

C&P 25p

SPECIAL QUOTES FOR QUANTITIES **LASKYS PRICE £6·50**

BSR TD8S

8 TRACK STEREO CARTRIDGE PLAYER



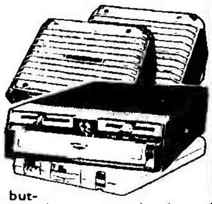
The unit is switched on and off by the insertion of the cartridge; The TD8S is suitable for use with most modern stereo amplifiers and delivers a pre-amp output of 125mW. Power requirements: 210/250V AC, 50Hz. Frequency response: 50Hz-10KHz. 4 pole dynamically balanced synchronous motor maintains unwavering speed accuracy - independent of mains fluctuations. Compact in size the TD8S is housed in black and woodgrain plastic cabinet. Size: 8½(W) x 3¾(H) x 10½(D) in.

C&P 35p

List Price £24·20 **LASKYS PRICE £17·95**

BELTEX 8 TRACK

Stereo car Player



Accepts all standard pre-recorded 8 track stereo cartridges and other features include automatic head cleaner, channel select and channel repeat push buttons, slider type volume and tone controls, channel balance control. Tech spec. max output 10W (5 watts per channel), frequency response 50Hz-10kHz. Output imp. 4 ohms. size 4½(W) x 1⅞(H) x 6½(D) in. Operates on 12V DC negative earth systems. Beautifully styled with black ivory and chrome trim finish.

BELTEK C5700 complete with mounting brackets and 8-track pre-recorded demonstration cartridge £23·50

BELTEK C5700 with pair SP24 speakers C&P 25p each **£29·00**

Beltek SP24 speakers are available perfectly matching the C5700 in performance and finish specially designed for optimum performance in heavily damped car interior. Size: 7½in(W) x 6in(D) x 4½in. rear, 2½in front (H). Comp with connecting leads. **£7·95** Pair

TM-1 TEST METER

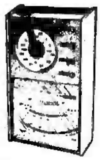
1000 ohms/volt

Lasky's new look top value TM-1 is a really tiny pocket multimeter providing "big" meter accuracy and performance. Precision movement calibrated to +3% of full scale. Click stop range selection switch. Beautifully designed and made impact resistant black case with white and metalic red/green figuring. Ohms zero adjustment. 1000's IN USE. SIZE ONLY 2$\frac{7}{16}$x3$\frac{11}{16}$x1$\frac{1}{16}$ ● DC/V: 0–10–50–250–1000 at 1K/ohms/V. ● AC/V: 0–10–50–250–1000 at 1K/ohms/V. ● DC Current: 0–1mA, 100mA. ● Resistance: 0–150K ohms. ● Decibels: -10 + 22dB. ● Complete with test leads.

LASKYS PRICE £1.85 C.&P. 15p

TM-5 TEST METER

5000 ohms/volt



Another pocket multimeter from Lasky's. The "slimline" impact resistant case – size 4½in x 2½in x 1¼in fitted with extra large 2½in square meter. Readability is superior on all low ranges, making this an excellent instrument for servicing transistorised equipment. Zero ohms adjustment. Buff finish with crystal clear meter cover. ● DC/V: 3–15–150–300–1,200 at 5K ohms/V. ● AC/V: 6–30–300–600 at 2·5K/ohms/V. ● DC Current: 0–300μA, 0–300mA. ● Resistance: 0–10K/ohms, 0–1M/ohms. ● Decibels: -10dB to 16dB. ● Complete with test leads, battery and instructions

LASKYS PRICE £2.55 C.&.P 35p

BSR McDONALD MP60

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

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BSR McDONALD UNITS & PACKAGES

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610	14·50	18·75	23·00	22·25	25·50
510	12·10	16·50	18·85	20·00	22·85
310	9·75	14·00	16·50	17·25	20·25
210 Complete with plinth, cover & BSR cartridge					
MP.60 TPD2 Styrene base				17·50	21·00

FANTAVOX CAR RADIO

W1/700 MW/LW

A new two waveband all transistor car radio that covers full medium and long wavebands with slide switch wave change. Large easy to grip controls. Illuminated dial with "easy to read" lining scale. Externally adjustable aerial trimmer ensures maximum output. Powerful output stage gives perfect reproduction through either one or two speakers. Operates on all 12 volt D.C. system. Negative or positive earth. Standard size 6½in (W) x 4½in (D) x 2in (H). Black with chrome trim. Complete with speaker, baffle, leads, mounting brackets and instructions. Fully guaranteed. Complete with speaker, baffle & mounting bracket.

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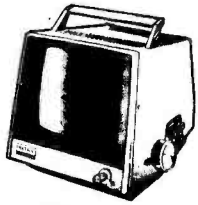
SONY TV SCOOP

TV-720UK—the world in 7"



This miniature portable TV can be operated by household current, rechargeable power pack or 12V car/boat battery. The special anti-glare screen gives a perfect picture even in sunlight. Attractively finished in ebony and chrome. Here's a portable companion that brings you a world of viewing wherever you are. Brief Spec. ● Screen size 7in. measured diagonally. ● System: 625 UHF. ● Antenna system: Built-in loop aerial. External 300 and 75 ohm switchable. ● 23 transistors, 15 diodes, 3 thermistors, 1 EHT rectifier (selenium). ● Power source: AC 240V, 50Hz; DC 12V. ● Power consumption: AC17W, DC 11W. ● Dimensions: 9in. x 9$\frac{7}{16}$ in. x 11½in. ● Weight: 8lb. 13oz. ● Accessories: Earphone, loop aerial; polishing cloth.

List Price £59·75 C.&.P. £1·50 **LASKYS PRICE £42·00**

CAR RADIOS FROM PHILIPS

MODEL RN 214/15

RN214 is a triumph of micro-miniaturisation. So compact and light, mounted on its spindles only, it needs no real support. The RN214 can be fixed quickly and easily. **Spec:** Power supply: 13 volt D.C. negative earth operation only. Power output: 5 watts. Wave ranges: Medium wave: 185m-586m (1622-512kHz). Long wave: 1030m-2000m (290-150 kHz). Intermediate frequency: 470kHz. Size: 7in x 1·6in x 3·6in. **EN8893/05 general purpose mounting kit with loudspeaker £2·70 extra.**

List Price £19·25 **LASKYS PRICE £15·50** C.&P. 25p

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The RN314 gives you big sound because of the high sensitivity from the tuned RF stage. Due to its compact size it can be mounted without any rear support. Spec: power supply: 12V DC neg earth only. Power output: 5 watts RMS. Wave ranges: Medium 185m-585m (1622-512kHz): Long 1030m-2000m (290–150kHz). Intermediate frequency: 470kHz. Size: 7in x 1·6in x 3·6in. **EN8893/05 general purpose mounting kit with loudspeaker £2·70 extra.**

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High quality transistorised and ultra compact Shortwave Converter for use with any suitable MW(AM) Car Radio. Self powered for use on 12V positive or negative earth systems. The model 2649 is simply connected to the radio via the aerial socket and provides shortwave covering in 9 push button selected band spread ranges (13, 16, 19, 25, 31, 41, 49, 60 & 90 M) combined with the normal radio tuning to give full cover from 3·2MHz–21·75 MHz. On/off switch and by-pass switch for normal M.W. radio use. Complete with mounting bracket fitting and alignment instructions. Black hammer crackle finished case—size: 6(W) x 1½(H) x 3½(D) in. C.&.P. 20p.

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WHARFEDALE UNIT 3	£18·50	A
WHARFEDALE UNIT 4	£24·50	B
WHARFEDALE UNIT 5	£35·00	C
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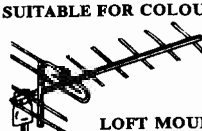

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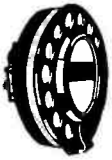

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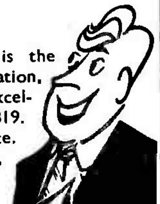

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2 x Duo Type III speakers	£32·00+£3 p&p
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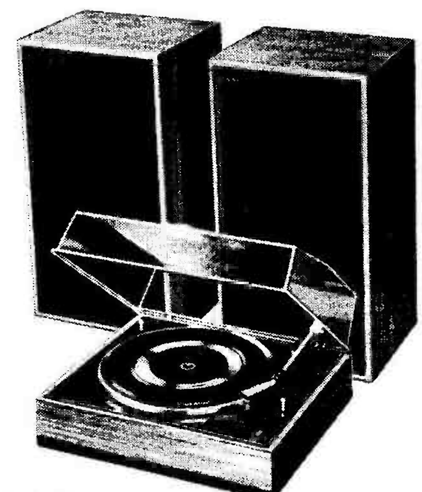
SPECIFICATION R101
14 watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within ±1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB to −17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to −12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max) R101—P.U.1 and radio—65dB. P.U.2 −58dB. **R100** same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. *Cross talk* better than −35dB on all inputs. *Overload characteristics* better than 26dB on all inputs. Size approx 13¾" x 9" x 3¾".



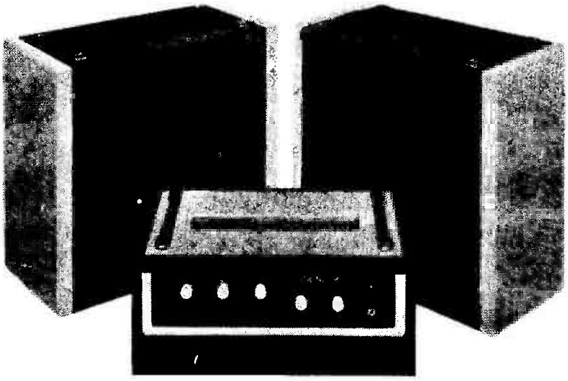
Goods not despatched outside U.K.

RTVC

Radio and TV Components (Acton) Ltd., 21c High Street, Acton, London W3 6NG, 323 Edgware Road, London, W2. Mail orders to Acton. Terms C.W.O. *All enquiries S.A.E.*

SOUND 50

50 WATT AMPLIFIER & SPEAKER SYSTEM



The Sound Fifty valve amplifier and speakers are sturdily constructed with smart housings and thoroughly tested electronics. They are designed to last—to withstand the knocks and bumps of life on the road. Built for the small and medium sized gig, they are easy to handle and quick to set up and can be relied upon to come over with all the quality and power you need.

Output Power: 45 watts R.M.S. (Sine wave drive). **Frequency response:** −3dB points 30Hz at 18KHz. **Total distortion:** less than 2% at rated output. **Signal to noise ratio:** better than 60dB.
Speaker Impedance: 3, 8 or 15 ohms. **Bass Control Range:** ± 13dB at 60Hz. **Treble Control Range:** ± 12dB at 10KHz. **Inputs:** 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K.
To protect the output valves, the incorporated fail safe circuit will enable the amplifier to be used at half power.
SPEAKERS! Size 20" × 20" × 10" incorporating 12" heavy duty 25 watt high flux, quality loudspeaker with cast frame. Cabinets attractively finished in two tone colour scheme—Black and grey.

COMPLETE SYSTEM Sound 50 amp and 2 speakers **£50** Plus £6 P. & P.

or available separately. Amplifier £28.50 plus £1.50 P. & P. Speakers £12.50 each plus £2.25 P. & P.

TOURIST MK3 CAR RADIO

ALL TRANSISTOR

Beautifully designed to blend with the interiors of all cars. Permeability tuning and long wave loading coils ensure excellent tracking, sensitivity and selectivity on both wave bands. R.F. sensitivity at 1MHz is better than 8 micro volts. Power output into 3 ohm speaker is 3 watts. Pre-aligned I.F. module and tuner together with comprehensive instructions guarantees success first time. 12 volts negative or positive earth. Size 7in x 2in x 4½in deep.

SET OF PARTS

£6.30 plus P. & P. 50p.

Circuit diagram 13p. Free with parts Speaker, baffle and fixing kit £1·25 extra plus 25p. p. & p. Postage free when ordered with parts.

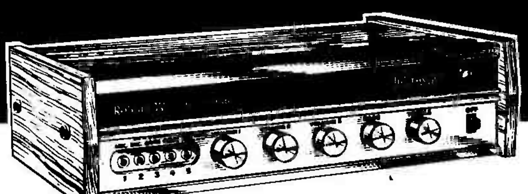
CONTINENTAL 4 TRACK, 3 SPEED TAPE DECK

with high impedance heads

R.C. 74 tape deck. Three speeds—7½, 3¾ and 1⅞ ips. 4-track record/playback head. Plus 4-track erase head. Positive pressure pad system. Takes any tape spool up to and including 7". The R.C. 74 is driven by a powerful 200/250V 50-cycle A.C. motor. A heavy, accurately balanced, flywheel brings wow and flutter levels down to approx. 0.3% total at 3¾ and 7½ ips. Fast rewind in both directions.
Controls couldn't be simpler! Just five push buttons that interlock to cut out accidental tape damage. Efficient servo-action type braking. Easy drop-in tape loading.
The R.C. 74 comes with an attractive moulded deck cover, which has positions for tone and volume controls. The unit is built into a rigid die-cast frame, and overall size of the whole unit is 12⅞ × 11⅛ × 6 inches. Every single deck fully tested before dispatch. Spools not supplied.

£15·00. Plus 75p P. & P.

RELIANT mk. IV



Provides a high standard of sound reproduction, with full mixing facilities. Its versatility makes it suitable for: Discotheque, P.A., Home Entertainment Applications, etc.

- ★ **Five Electronically Mixed Inputs**
- ★ **Three Individual Mixing Controls**
- ★ **Separate base and treble controls common to all five inputs**
- ★ **Mixer employing F.E.T. (Field Effect Transistor)**
- ★ **Solid State Circuitry** ★ **Attractive Styling**

£9.50 plus P. & P. 60p

INPUTS:—1. Crystal Mic or Guitar 9mV. 2. Moving coil Mic or Guitar 8mV. Inputs 3, 4 & 5 are suitable for a wide range of medium output equipment (Gram. Tuner, Monitor, Organ, etc.). All 250mV sensitivity.
CONTROLS:—3 Volume controls. Bass control range : 13db @ 60Hz. Treble control range ±12db @ 15KHz. Separate ON/OFF Switch. Neon Indicator.
POWER OUTPUT:—12 Watts R.M.S. into 3 to 4 ohms speaker
SIGNAL/NOISE:—Better than −60db on inputs 3, 4 and 5 & −50db on 1 & 2
SUPPLY:—220 - 250 AC Mains. **SIZE:**—12½" x 6" x 3½"

DUETTO mk. II I.C.

STEREO AMPLIFIER

Sophisticated styling combined with up-to-date electronics means Hi-Fi. This is what the Duetto Mk.II offers at a realistic price. Mullard built stereo pre-amplifier/tone control module and the highly efficient I.C. monolithic power chips ensure: reliability, very low distortion at all power levels, correct operation in all ambient temperatures, full power over the audio spectrum etc.

Inputs : P.U. 150mV. @ 2·2 Meg (for cer. cartridge)
Auxiliary 100mV. @ 1 Meg (for radio, tape etc.)
Outputs : 5 watts rms per channel into 8–15Ω speakers. Switched stereo headphone socket with power correction.
Controls : Mono/stereo switch, selector switch, treble, bass, volume, balance and on/off switch. Neon indicator.
Tone Controls : Treble ±14db @ 15KHz
Bass ±14db @ 60Hz
Power Bandwidth : ±2db 20Hz–25KHz Size 12½" × 6" × 3½"

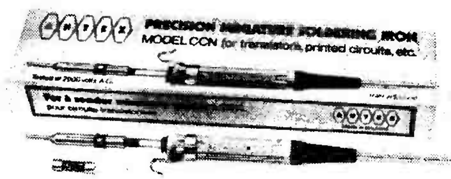
£10.50
plus P. & P. 60p

R T V C
See opposite page for addresses

CN.240/2 Miniature soldering iron 15 watt 240 volts, fitted with nickel plated 3/32" bit and packed in transparent display box. Also available for 220 volts. **Price £1.70**

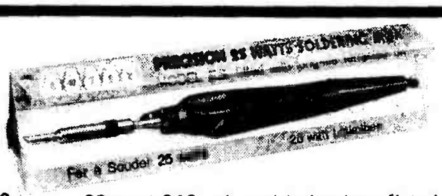
CN.240 Miniature soldering iron 15 watt 240 volts, fitted with iron coated 3/32" bit. Up to 18 interchangeable spare bits obtainable. This iron can also be supplied for 220, 110, 50 or 24 volts. **Price £1.70**

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



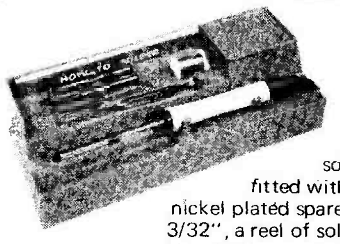
CCN.240 New model 15 watt 240 volts miniature soldering iron with ceramic shaft to ensure perfect insulation (4,000 v A.C.). Will solder live transistors in perfect safety: fitted with 3/32" iron coated bit. Spare bits 1/8" 3/16" and ¼" available. Can also be supplied for 220 volts. **Price £1.80**

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



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

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



SK.1 SOLDERING KIT

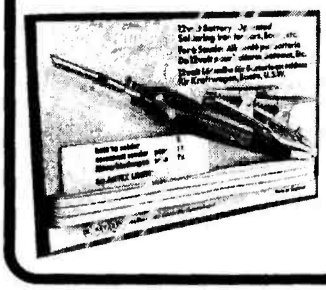
The kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, heat sink, cleaning pad, stand and booklet "How to Solder". Also available for 220 volts.

Price £2.75

SK. 2 SOLDERING KIT

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

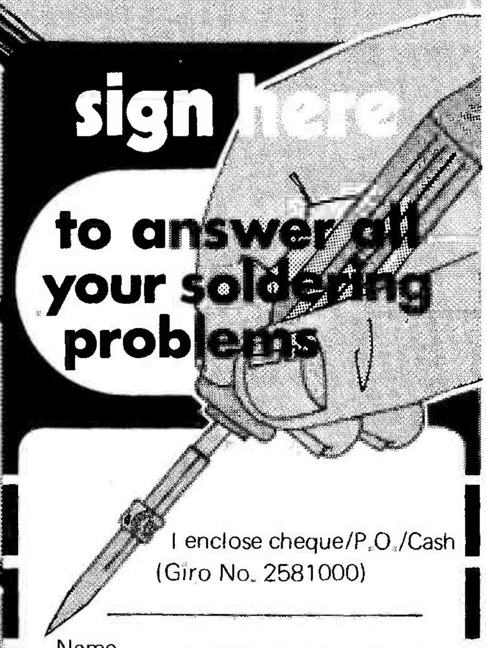
Price £2.40.



MES. 12

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

Price £1.95.



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Build yourself a TRANSISTOR RADIO

NEW! ROAMER 10 WITH VHF INCLUDING AIRCRAFT

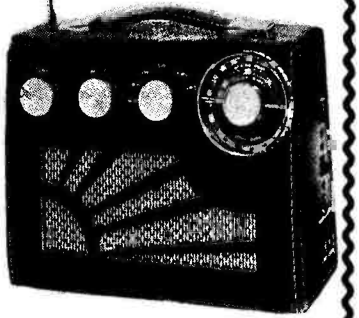
10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND. VHF AND LOCAL STATIONS AND AIRCRAFT BAND

Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mw Transistors. Car Aerial and Tape Record Sockets. Switched Earpiece Socket complete with Earpiece. 10 Transistors plus 3 Diodes. 8" × 2½" Speaker. Air Spaced ganged Tuning Condenser with VHF section. Volume on/off, Wave Change and Tone Control. Attractive Case in black with silver blocking. Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts).

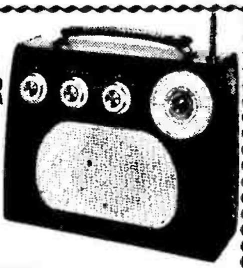
Total building cost **£8·50**

P. P. & Ins. 50p

(Overseas P. & P. £1)



ROAMER EIGHT Mk I

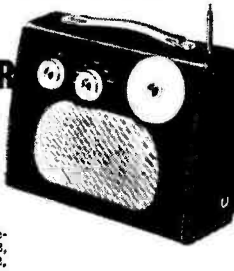


NOW WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. Switched earpiece socket complete with earpiece. 8 transistors plus 3 diodes. 8" × 2½" Speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans 25p (FREE with parts).

Total building cost **£6·98** P. P. & Ins. 41p.
(Overseas P. & P. £1)

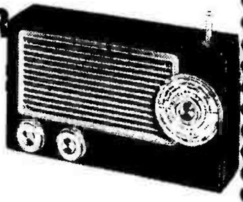
ROAMER SEVEN MK IV



7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes, including Micro-Alloy R.F. Transistors. 8" × 2½" speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 15p (FREE with parts). Earpiece with plug and switched socket for private listening, 30p extra.

Total building costs **£5·98** P. P.& Ins. 41p.
(Overseas P. & P. £1)

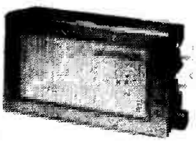
ROAMER SIX



6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra M.W. band for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Easy build plans and parts price list 15p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£3·98** P. P. & Ins. 26p
(Overseas P. & P. £1)

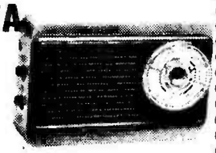
POCKET FIVE



3 Tunable Wavebands: MW, LW, Trawler Band 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. Attractive black and gold case. Size 5½ × 1½ × 3½in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£2·23** P. P. & Ins. 21p
(Overseas P. & P. 63p)

TRANSONA FIVE

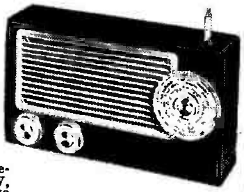


5 TRANSISTORS AND 2 DIODES

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial. tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6½ × 4½ × 1½in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£2·50** P. P. & Ins. 22p
(Overseas P. & P. 63p)

TRANS EIGHT



8 TRANSISTORS and 3 DIODES

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£4·48** P. P. & Ins. 31p
(Overseas P. & P. £1)

NEW! "EDU-KIT"

BUILD RADIOS, AMPLIFIERS, ETC., FROM EASY STAGE DIAGRAMS. FIVE UNITS INCLUDING MASTER UNIT TO CONSTRUCT.

COMPONENTS INCLUDE: Tuning Condenser: 2 Volume Controls: 2 Slider Switches: 4"×2½" Speaker: Terminal Strip: Ferrite Rod Aerial: 3 Plugs and Sockets: Battery Clips: 4 Tag Boards: Balanced Armature Unit: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ½" Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction.

All parts including Case and Plans **£5·50** P. P. & Ins. 31p
Overseas P. & P. £1)

FULL AFTER SALES SERVICE
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I enclose £.................... please send items marked

ROAMER TEN	☐	ROAMER SEVEN	☐
ROAMER EIGHT	☐	TRANS EIGHT	☐
TRANSONA FIVE	☐	ROAMER SIX	☐
POCKET FIVE	☐	EDU-KIT	☐

Parts price list and plans for ....

Name ....

Address ....

....

PW41

NEW LOW

COMET
HI-FI DISCOUNT WAREHOUSES

STEREO AMPLIFIERS	Rec. Retail Price	Comet Price
ALBA UA 700	34·50	23·95
ALPHA 212 By Highgate	36·75	27·95
AMSTRAD Stereo 8000 Mk 2	27·95	16·90
AMSTRAD I.C. 2000	42·95	27·95
ARMSTRONG 521	59·00	42·95
DULCI 207	26·00	16·95
OULCI 207M	32·00	19·50
FERROGRAPH F307 Mk. II (cased)	64·00	46·95
FERROGRAPH F307 MII (Metal case)	60·00	42·95
GOODMANS Maxamp	54·00	34·95
LEAK Delta 30 (cased)	65·00	48·50
LEAK Dolta 70 (cased)	79·50	58·95
METROSOUND ST20E	39·50	25·95
METROSOUND ST60	70·00	49·95
PHILIPS RH 591	79·00	56·95
PHILIPS RH 590	52·00	37·95
PHILIPS RH 580	29·00	19·95
PIONEER SA500A	53·62	38·95
PIONEER SA600	83·75	59·95
PIONEER SA700	97·97	66·95
PIONEER SA800	109·21	75·95
PIONEER SA900	133·83	93·95
PIONEER SA1000	137·56	95·95
PIONEER Reverberation 202W	46·35	30·95
RANK Rotel 210	34·90	24·95
RANK Rotel 310	47·50	31·50
RANK Rotel 610	74·50	48·95
ROGERS Ravensbourne	59·50	42·50
ROGERS Ravensbourne (cased)	64·00	46·95
ROGERS Ravensbrook Mk. II	47·50	34·50
ROGERS Ravensbrook (cased) Mk.II	52·50	38·50
SINCLAIR 2000	35·00	23·50
SINCLAIR Project 60/2 x Z30/PZ5	23·90	15·95
SINCLAIR PROJECT 60/2 x Z50/ PZ8/trans	34·86	23·25
SINCLAIR PROJECT 605	29·95	21·95
SINCLAIR AFU	5·95	4·45
SINCLAIR Neoteric	61·95	42·95
SINCLAIR 3000	45·00	30·95
TELETON SAQ 206	32·50	18·25
TELETON 307	30·00	19·95
VOLTEX 100w. Stereo Discotheque, 8 electronically mixed inputs	185·00	139·00
WHARFEDALE Linton Amplifier	60·00	42·50

All take both ceramic and magnetic cartridges.

TUNERS	Rec. Retail Price	Comet Price
*ARMSTRONG 523 AM/FM	54·22	41·50
*ARMSTRONG 524 FM	42·17	32·50
ARMSTRONG M8 Decoder	9·50	7·50
*DULCI FMT.7 FM	25·10	17·95
DULCI FMT.7S Stereo	33·79	24·95
GOODMANS Stereomax	80·07	47·95
LEAK Delta FM	75·00	58·50
LEAK Delta AM/FM	89·50	68·95
PHILIPS RH 690	45·30	34·95
PHILIPS RH 691	85·80	69·95
PIONEER TX500 AM/FM	66·09	53·95
PIONEER TX900 AM/FM	147·15	116·00
RANK ROTEL 320	54·94	39·95
ROGERS Ravensbourne chassis	59·63	45·50
ROGERS Ravensbourne in teak case	64·45	48·95
ROGERS Ravensbrook chassis	43·37	34·95
ROGERS Ravensbrook (cased)	49·39	38·95
SINCLAIR 2000	45·00	34·95
SINCLAIR 3000	45·00	34·95
SINCLAIR Project 60 tuner (stereo)	25·00	19·25
TELETON GT 101	43·93	30·50

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

TUNER/AMPLIFIERS	Rec. Retail Price	Comet Price
AKAI AA 8500	235·00	182·95
AKAI 6600	149·50	114·95
AKAI 6300	129·50	94·50
AKAI 6200	89·50	73·95
ARENA 2600	111·30	89·95
ARENA T9000	303·45	285·00
ARMSTRONG M8 Decoder	9·50	7·50
ARMSTRONG 525	92·77	69·95
ARMSTRONG 526	105·72	79·95
GOODMANS Module 80, 35w. RMS	91·59	68·50
GOODMANS Module 80 Compact	165·00	129·00
GOODMANS Module 110 FM/MW/ LW/SW 100W RMS	135·00	108·00
LEAK Delta 75	165·00	128·95
MIDLAND 19/542	49·56	37·50
PHILIPS RH 790	134·00	77·95
PIONEER SX770 AM/FM	139·23	109·95
PIONEER SX990 AM/FM	167·83	129·95
PIONEER 440	104·18	82·95
ROGERS Ravensbrook Chassis	99·39	81·95
ROGERS Ravensbrook (cased)	108·43	87·95
ROTEL RX150	69·90	53·50
TANDBERG 1171	110·00	82·50
TANDBERG TR200	99·00	82·95
TELETON F2000	51·50	28·50
TELETON 10AT1 150w. RMS	160·00	94·00
TELETON TFS50	79·65	53·95
TELETON TFS50 LA MW/LW/FM	86·64	61·95
TELETON CR55	125·26	61·95
WHARFEDALE 100-1	139·00	92·95

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

CARTRIDGES	Rec. Retail Price	Comet Price
AUDIO TECHNICA AT66	6·47	4·50
GOLDRING G850	6·27	3·95
GOLDRING G800	12·55	5·95
GOLDRING G800E	18·16	10·45
GOLDRING G800 Super E	25·10	14·75
*GOLDRING CS90 Stereo	5·02	4·25
*GOLDRING CS91/E	7·53	6·35
EMPIRE 1000ZE/X	60·34	46·95
EMPIRE 999VE/X	43·01	33·95
EMPIRE 999TE/X	25·09	19·95
EMPIRE 999SE/X	20·31	15·95
EMPIRE 999E/X	15·89	12·30
EMPIRE 999/X	12·55	8·85
EMPIRE 909E/X	12·36	9·60
EMPIRE 909/X	9·26	7·25
EMPIRE 90EE/X	9·56	7·50
ORBIT Magnetic NM 22	Special Price	2·90
ORTOFON SL15E	28·62	22·95
ORTOFON 2 X 15K Transformer	7·00	4·95
ORTOFON M15E	29·08	23·50
SHURE M3DM	6·10	4·25
SHURE M31E	11·63	8·69
SHURE M32E	10·73	8·00
SHURE M32-3	9·84	7·80
SHURE M44-5	8·30	5·75
SHURE M44-7	7·90	5·50
SHURE M-44C	7·90	5·50
SHURE M44E	8·60	5·95
SHURE M55E	9·70	6·75
SHURE M75G	14·70	9·95
SHURE M75-6	13·60	8·45
SHURE M75EJ	15·40	10·75
SHURE M75E	19·00	12·95
SHURE M75E/95G	20·80	14·95
SHURE V15-11	39·40	27·50

Starred cartridges above are ceramic. All others are magnetic.

PICKUP ARMS	Rec. Retail Price	Comet Price
GOLDRING Lenco 75	13·98	9·50
GOLDRING Lenco L69	10·04	6·50
SME 3009 with S2 Shell	33·26	24·90
SME 3012 with S2 Shell	35·42	26·45

TURNTABLES

The following Turntables are complete with base, plinth, perspex cover and cartridge. Fully wired and ready for use. All at special prices.

GARRARD SP25 Mk III with Goldring G.800 Special Price £18·90
GARRARD SP25 Mk III with Shure M.44/7 Special Price £20·95
GARRARD AP76 with Goldring G800 Special Price £29·90
GARRARD AP76 with Shure M55E Special Price £33·95
GARRARD AP76 with Shure M75EJ Special Price £35·95
GARRARD 2025 with Sonotone 9TAHC Special Price £13·90
GOLDRING 705/P with G850 £26·00 £10·95
GOLDRING GL75 with G800 Special Price £40·95
THORENS 150 AB complete with TX11 cover Shure M55E cartridge £64·83 £49·95.

	Rec. Retail Price	Comet Price
GARRARD SP25 Mk III	15·85	9·95
GARRARD SL65 B	20·48	13·40
GARRARD SL95 B	49·23	32·90
GARRARD 401	39·26	27·40
GARRARD SL72 B	31·83	23·90
GARRARD Zero 100	56·25	42·95
GARRARD Zero 100S	51·75	41·95
GARRARD WB4 base Mk IIZ to fit Zero 100 & Zero 100S	6·40	4·95
Base and Cover to fit GARRARD SP25, SL55, SL65B	Special Price	3·60
GARRARD 40B	13·34	10·95
GARRARD AP76	27·85	18·85
GOLDRING GL69 Mk.II	27·60	18·95
GOLDRING GL69P Mk. II	36·21	26·95
GOLDRING GL75	40·15	28·95
GOLDRING GL75P	48·76	35·95
GOLDRING Covers for 69P and 72P	4·48	3·75
Cover tor 75P Deluxe	5·02	3·95
GOLDRING C99—plinth and cover for G99	11·05	9·75
GOLDRING G99	26·89	19·90
GOLDRING G101P	28·68	22·95
GOLDRING GL72 Chassis	28·68	22·95
GOLDRING GL72P	37·29	29·95
GOLDRING GL85	62·74	47·95
GOLDRING GL85P	72·78	55·95
GOODMANS 3025	37·74	19·95
LEAK Delta	69·50	59·95
McDONALD MP 60	15·20	10·70
McDONALD 610	19·28	14·50
McDONALD HT 70	21·22	15·45
McDONALD HT70 inc. plinth & cov.	30·68	22·25
Base and Cover for MP 60 and 610	Special Price	4·25
PHILIPS 202 Electronic	66·50	52·95
PHILIPS 308 transcription unit complete with base and cover	37·60	28·95
PIONEER PL12A with base & cover	48.34	36·25
THORENS TX25 cover	8·52	6·60
THORENS TD125	76·03	59·45
THORENS TD125AB	115·57	93·95
THORENS TD150 Mk. II	34·67	28·75
THORENS TD150A Mk. II	44·40	34·25
THORENS TD150AB Mk. II	48·05	38·95
THORENS TX11 Cover	4·26	3·75
WHARFEDALE Linton with base and cover and Shure M44/7 cartridge	35·00	27·95

SPEAKERS	Rec. Retail Price	Comet Price
ARENA HT 227 (pair)	42·00	26·95
AKAI SW 155	59·50	39·95
B & W Model 70	159·50	111·95
B & W DM3	63·00	47·95
B. and W DM1 (per pair)	76·94	60·95
CELESTION Ditton 120 (per pair)	57·70	43·95
CELESTION Ditton 15	38·47	27·25
CELESTION Ditton 25	65·00	44·50
CELESTION Ditton 44	54·00	39·50
GOODMANS Minister (per pair)	48·20	34·95
GOODMANS Havant (per pair)	56·00	43·95
GOODMANS Magister	62·50	39·50
GOODMANS Double Maxim	33·00	25·75
GOODMANS Mezzo 3	34·00	22·75
GOODMANS Magnum K2	44·00	29·75
GOODMANS Dimension 8	69·00	47·95
GOODMANS DIN 20NT kit	12·54	9·95
KELETRON KN400 2-speaker System (pair)	16·10	12·75
KN600 3-speaker System (pair)	26·86	18·95
KN800 3-speaker System	15·90	10·95
KN1100 4-speaker System	20·40	14·95
KN1600 3-speaker System	25·20	16·95
KN2100 3-speaker System	30·60	20·95
LEAK 150 (per pair)	49·90	37·95
LEAK 250 (per pair)	65·00	47·50
LEAK 600	49·50	34·50
METROSOUND HFS 103 (pair)	30·05	23·95
METROSOUND 202	21·50	15·25
METROSOUND Duplex 15	32·00	23·95
METROSOUND Duplex 25	52·00	36·95
PHILIPS RH 411 (pair)	21·20	16·95
PHILIPS RH 481 (pair)	21·20	16·95
PHILIPS RH 482 (per pair)	34·70	28·95
PHILIPS 496	38·00	30·95
SINCLAIR Q16	8·95	6·90
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TANDBERG Tan 12 teak (pair)	52·00	44·95

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Rosedale	65·00	44·95
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Unit 4 Speaker Kit	18·00	12·25
Unit 5 Speaker Kit	26·00	17·95
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GOODMANS Axiom 201	14·45	10·95
GOODMANS Axiom 401	17·86	12·25
GOODMANS Twin Axiom 10	9·86	7·25
GOODMANS Audiom 8P	5·35	3·95
GOODMANS Audiom 10P	5·83	4·50
GOODMANS Audiom 12P	12·37	9·25
GOODMANS Audiom 15P	20·00	14·75
GOODMANS Audiom 18P	34·00	24·50
GOODMANS ARU172	4·50	3·20
GOODMANS Trebax 100	8·60	5·25
GOODMANS Axent 100	6·90	4·95
GOODMANS Midax 650	12·95	8·95
GOODMANS Attenuator	3·55	2·50
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GOODMANS Crossover Networks XO/5000	2·65	1·95
WHARFEDALE 8in.Bronze/RS/DD	4·82	3·45
WHARFEDALE Super 8/RS/DD	8·19	6·70
WHARFEDALE Super 10/RS/DD	11·20	10·50
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AMSTRAD Stereo 1000	48·00	34·95
DANSETTE Consort Stereo	33·74	29·95
DECCA Sound 613	70·14	55·95
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FERGUSON 3451 with radio	99·50	79·95
FIDELITY UA2 Music Master	44·50	34·95
FIDELITY UA1 Music Master with radio	107·00	81·95
GOODMANS Module 80 Compact System FM/35W.R.M.S. (less L/S)	165·00	129·00
H.M.V. 2404/5/6 with radio	198·00	153·00
HMV 2452	65·65	51·95
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MURPHY 902 Studio 1, AM/VHF Radio	86·84	69·95
MARCONI 4452	76·00	57·95
PHILCO Ford M1500	99·93	68·50
PHILIPS 808	96·05	75·95
PHILIPS 580/481/105	71·00	55·95
PHILIPS GF 823	47·80	35·95
PHILIPS GF 824	67·10	50·95
PHILIPS RF 833	67·10	51·95
PHILIPS GF 834	86·40	65·95
PYE Black Box Unit Stereo 1022	93·45	69·95
RIGONDA Party Time	27·50	21·95
STEEPLETONE Stereo system	41·75	33·95
TELETON STP 8-track Stereo System	54·75	47·00
ULTRA 6026	37·10	30·95
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AKAI 1720L 4-track Stereo	89·91	67·95
AKAI 4000D 4-track stereo deck	96·38	61·95
AKAI CR80D 8-track stereo tape deck	87·50	59·95

	Rec. Retail Price	Comet Price
AKAI CR80 8-track stereo recorder	109·50	75·95
AKAI X200D	162·52	103·00
AKAI 1800SD	180·71	105·00
AKAI 2000SD	297·50	229·00
AKAI GXC 40D Cassette Tape Deck	94·95	69·95
AKAI GXC 40 Cassette recorder	115·00	85·95
BUSH Discassette DC70	21·19	16·95
BUSH TP60 Cassette tape recorder	28·38	23·95
BUSH TP 66 Batt./Mains Cassette Recorder	28·95	22·75
BUSH TP70 Cassette, battery/mains tape recorder	28·91	23·50
FERGUSON 3245 Twin track	36·70	26·95
FERGUSON 3246 4-track	42·55	31·95
FERGUSON 3247 4-track	47·95	35·95
FERGUSON 3248 4-track	53·75	40·95
FERGUSON 3252 4-track	100·52	79·95
FERGUSON 3253	43·55	33·50
FERGUSON 3258 4-track	72·40	55·95
FERROGRAPH 702 2-track tape deck	220·22	175·00
FERROGRAPH 704/W 4-track tape deck	220·22	175·00
FERROGRAPH 722	256·52	195·00
FERROGRAPH 724	256·52	195·00
GRUNDIG C200 De Luxe Cassette	38·45	28·95
GRUNDIG TK 121 twin track	57·90	40·95
GRUNDIG TK 141 4-track	63·90	46·95
GRUNDIG TK 146 4-track Auto	68·90	51·50
GRUNDIG TK 147 4-track Auto	95·75	73·95
GRUNDIG C410 Cassette recorder	43·70	33·95
PHILIPS 2202 cassette	23·50	18·95
PHILIPS 2204 cassette, battery/mains	29·95	23·50
PHILIPS R.R. 392 MW/VHF Radio and Cassette Recorder	49·95	37·50
PHILIPS 3302 cassette	20·05	16·95
PHILIPS 4307 4-track	50·00	34·95
PHILIPS 4308 De luxe 4-track	58·40	42·50
PHILIPS 4404 4-track stereo recorder	91·70	67·95
PHILIPS 4407 4-track stereo recorder	111·50	83·95
PHILIPS 4500 4-track stereo tape deck	127·70	93·95
PHILIPS 4408 4-track stereo	134·20	102·95
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PYE 351 Battery/Mains Cassette	23·90	18·95
PYE 9109 cassette	20·95	18·95
PYE 9116 Stereo cassette	68·00	52·95
TANDBERG 1841 4-track stereo tape deck	68·00	49·95
TANDBERG 3021X twin track stereo	107·00	82·95
TANDBERG 3041X 4-track stereo	107·00	82·95
TANDBERG 4021X twin track stereo	174·00	139·00
TANDBERG 4041X 4-track stereo	174·00	139·00
TANDBERG 6041X 4-track stereo	188·00	149·00
TANDBERG 6021X twin track stereo	188·00	149·00
TELETON TC110 cassette battery/mains	26·79	18·95
WHARFEDALE Dolby DC9 cassette stereo tape deck	110·00	89·95
BASES AND COVERS		
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GARRARD WB4 Base	5·49	4·75
GARRARD SPC1 Cover	3·60	2·95
GARRARD SPC4 Cover	4·27	2·75
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THORENS TD 150AB Mk. II with TX11 dust cover, SHURE M55E Cartridge, LEAK Delta 70 Amplifier, 2 Wharfedale Dovedale 3 Speakers	234·33	175·95
TELETON STP 801 Stereo 8 track tape Audio system complete with speakers	54·75	47·00
GARRARD AP76 with base cover and Shure M55E cartridge Arena 2600 AM/FM and SW Tuner/Amp and 2 Goodmans Mezzo III speakers	229·43	148·00
GOLDRING GL75 complete with base and cover, G800 Cartridge, Wharfedale 100-1 Tuner/Amp and 2 Wharfedale Dovedale III speakers	294·79	189·00
GOODMANS Module 80 Tuner/Amplifier, Garrard AP76 Turntable with Goldring G800 Cartridge and 2 Goodmans Minister Speakers	189·95	132·95
GOLDRING 705P Turntable fully wired, complete with Goldring 850 Cartridge, Amstrad stereo 8000 amplifier and 2 Metrosound 103 speakers	81·00	49·95
METROSOUND 448 8-track stereo play-back unit complete with 2 HFS 103 Speakers	83·56	70·95
LINTON System with Wharfedale Linton Amplifier, Linton Turntable with Shure M47 Cartridge and pair of Linton Mk II Speakers	144·90	107·95
ALBA UA 700 Amplifier Garrard SP25 with G800 cartridge including base, plinth and cover and pair of Arena speakers	110·85	67·95
AMSTRAD 8000 Mk. II Amplifier, Garrard SP25 with G800 cartridge including base, plinth and cover and pair of Voltex speakers	82·45	49·95
PHILIPS 308 Transcription Turntable, complete with plinth, base and cover and fitted with Empire 909E/X cartridge, Rank Rotel 310 Amplifier and pair of Wharfedale Triton Speakers	169·63	106·95

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200	0·05	0·09	0·06	0·14	0·20	0·24	1·00
400	0·06	0·13	0·07	0·20	0·27	0·37	1·25
600	0·07	0·16	0·10	0·23	0·34	0·45	1·85
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T5	8	2G382T	OC82
T6	8	2G344B	OC44
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U38	20 Fast switching sil. trans. NPN, 400Mc/s 2N3011	0·50
U39	30 RF germ. PNP trans. 2N1303 5 TO-5	0·50
U40	10 Dual trans. 6 lead TO-5 2N2060	0·50
U41	25 RF germ. trans. TO-1 OC45 NKT72	0·50
U42	10 VHF germ. PNP trans. TO-1 NKT667, AF117	0·50
U43	25 Sil. trans. plastic TO-18 A.F. BC113/114	0·50
U44	20 Sil. trans. plastic TO-5 BC115/116	0·50
U45	7 3A SCR's TO-66 up to 600 Piv.	1·00

Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

POWER TRANSISTOR BONANZA!

GENERAL PURPOSE GERM. PNP
Coded GP100. BRAND NEW TO-3 CASE. POSS. REPLACE.:—OC25-28-29-30-35-36. NKT 401-403-404-405-406-430-451-452-453. TI3027-3028, 2N250A, 2N456A-457A-458A, 2N511 A & B. 2G220-222, ETC. VCBO 80V VCEO 50V IC 10A PT. 30 WATTS Hfe 30-170.

PRICE	1-24	25-99	100 up
	43p each	**40p** each	**36p** each

SILICON High Voltage 250V NPN TO-3 case. G.P. Switching & Amplifier Applications. Brand new Coded R 2400 VCBO 250/VCEO 100/IC 6A/30 Watts. HFE type 20/fT 5MHZ.
OUR PRICE EACH:

1-24	25-99	100 up
50p	**45p**	**40p**

2N3055
115 WATT SIL POWER NPN
63p EACH

EX-STOCK TYPE EACH AS PRICED

OC20 **50p**	OC28 **40p**	AD149 **43p**	BD131 **70p**	BD139 **75p**
OC22 **30p**	OC29 **40p**	AL102 **85p**	BD132 **80p**	BD140 **85p**
OC23 **38p**	OC35 **33p**	AL103 **85p**	BD135 **70p**	BD155 **75p**
OC24 **45p**	OC36 **40p**	BD121 **60p**	BD136 **80p**	BU105 **£3**
OC25 **25p**	AD140 **40p**	BD123 **75p**	BD137 **70p**	2N3054 **45p**
OC26 **25p**	AD142 **40p**	BD124 **70p**	BD138 **80p**	

AD161 *NPN*
AD162 *PNP*
M/P COMP
GERM TRANS.
OUR LOWEST PRICE OF **68p** *PER PAIR*

SILICON 50 WATTS MATCHED NPN/PNP
BIP 19 NPN TO-3 Plastic.
BIP 20 PNP. Brand new.
VCBO 100/VCEO 50/IC 10A. HFE type 100/ft 3mHZ.
OUR PRICE PER PAIR:

1-24 prs.	25-99 prs.	100 prs.
60p	**55p**	**50p**

GENERAL PURPOSE NPN SILICON SWITCHING TRANS. TO-18 SIM. TO 2N706/8, BSY27/28/95A. All usable devices no open or short circuits. ALSO AVAILABLE in PNP Sim. to 2N2906, BCY70. When ordering please state preference NPN or PNP.

		£p			
20	For	0·50	100	For	1·75
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			1000	For	13·00

OUR STOCKS of individual devices are now too numerous to mention in this Advertisement. Send S.A.E. for our listing of over **1,000 Semiconductors.** All available **Ex-Stock** at very competitive prices.

RTL MICROLOGIC CIRCUITS

	Price each		
Epoxy TO-5 case	1-24	25-99	100 up
uL900 Buffer	**35p**	**33p**	**27p**
uL914 Dual 2I/p gate	**35p**	**33p**	**27p**
uL923 J-K flip-flop	**50p**	**47p**	**45p**

Date and Circuits Booklet for IC's Price 7p.

NEW QUALITY TESTED PAKS

Pak	Description	Price £p
Q1	20 Red spot trans. PNP AF	0·50
Q2	16 White spot R.F. trans. PNP	0·50
Q3	4 OC77 type trans.	0·50
Q4	6 Matched trans. OC44/45/81/81D	0·50
Q5	4 OC75 transistors	0·50
Q6	4 OC72 transistors	0·50
Q7	4 AC128 trans. PNP high gain	0·50
Q8	4 AC126 trans. PNP	0·50
Q9	7 OC81 type trans.	0·50
Q10	7 OC71 type trans.	0·50
Q11	2 AC127/128 comp. pairs PNP/NPN	0·50
Q12	3 AF116 type trans.	0·50
Q13	3 AF117 type trans.	0·50
Q14	3 OC171 H.F. type trans.	0·50
Q15	5 2N2926 sil. epoxy trans.	0·50
Q16	2 GET880 low noise germ. trans.	0·50
Q17	3 NPN 1 ST141 & 2 ST140	0·50
Q18	4 Madt's 2 MAT 100 & 2 MAT 120	0·50
Q19	3 Madt's 2 MAT 101 & 1 MAT 121	0·50
Q20	4 OC44 germ. trans. A.F.	0·50
Q21	3 AC127 NPN germ. trans.	0·50
Q22	20 NKT trans. A.F. R.F. coded	0·50
Q23	10 OA202 sil. diodes sub-min.	0·50
Q24	8 OA81 diodes	0·50
Q25	6 IN914 sil. diodes 75PIV 75mA	0·50
Q26	8 OA95 germ. diodes sub-min. IN69	0·50
Q27	2 10A 600PIV sil. rects. 1S45R	0·50
Q28	2 Sil. power rects. BYZ13	0·50
Q29	4 Sil. trans. 2 × 2N696, 1 × 2N697, 1 × 2N698	0·50
Q30	7 Sil. switch trans. 2N706 PNP	0·50
Q31	6 Sil. switch trans. 2N708 NPN	0·50
Q32	3 PNP sil. trans. 2 × 2N1131, 1 × 2N1132	0·50
Q33	3 Sil. NPN trans. 2N1711	0·50
Q34	7 Sil. NPN trans. 2N2369, 500MHZ	0·50
Q35	3 Sil. PNP TO-5 2 × 2N2904 & 1 x 2905	0·50
Q36	7 2N3646 TO-18 plastic 300MH2 NPN	0·50
Q37	3 2N3053 NPN sil. trans	0·50
Q38	7 PNP trans. 4 x 2N3703, 3 × 2N3702	0·50
Q39	7 NPN trans. 4×2N3704, 3×2N3705	0·50
Q40	7 NPN amp. 4×2N3707, 3×3N3708.	0·50
Q41	3 Plastic NPN TO-18 2N3904	0·50
Q42	6 NPN trans. 2N5172	0·50
Q43	7 BC107 NPN trans.	0·50
Q44	7 NPN trans. 4 × BC108, 3 × BC109	0·50
Q45	3 BC113 NPN TO-18 trans	0·50
Q46	3 BC115 NPN TO-5 trans.	0·50
Q47	6 NPN high gain 3×BC167, 3×BC168	0·50
Q48	4 BCY70 NPN trans. TO-18	0·50
Q49	4 NPN trans. 2×BFY51, 2×BFY52	0·50
Q50	7 BSY28 NPN switch TO-18	0·50
Q51	7 BSY95A NPN trans. 300MH2	0·50
Q52	8 BY100 type sil. rect.	1·00
Q53	25 Sil. & germ. trans. mixed all marked new	1·50

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2N3819	**35p**
2N3820	**50p**
2N3821	**35p**
2N3823	**30p**
2N5458	**50p**
2N5459	**40p**
BFW 10	**40p**
MPF105	**40p**

PHOTO TRANS.

OCP71 Type. **43p**

SILICON PHOTO TRANSISTOR. TO-18 Lens end NPN Sim. to BP×25 and P21. BRAND NEW. Full data available. Fully guaranteed.

Qty.	1-24	25-99	100 up
Price each	**45p**	**40p**	**35p**

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14 and 16 Lead Sockets for use with Dual-in-Line Integrated Circuits

	Price each		
Order No.	1-24	25-99	100 up
TSO 14 pin type	**30p**	**27p**	**25p**
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-the lowest prices!

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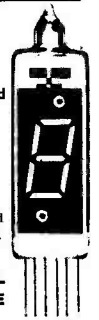
Check our 74 Series List before you buy any I.C's. Our prices are the lowest possible. All devices ex-stock. Full spec. guaranteed

BI-PAK Order No.	Price and qty. prices 1-24 £p	25-99 £p	100 up £p
BP00=SN7400	0·15	0·14	0·12
BP01=SN7401	0·15	0·14	0·12
BP02=SN7402	0·15	0·14	0·12
BP03=SN7403	0·15	0·14	0·12
BP04=SN7404	0·15	0·14	0·12
BP05=SN7405	0·15	0·14	0·12
BP07=SN7407	0·18	0·17	0·16
BP08=SN7408	0·18	0·17	0·16
BP09=SN7409	0·18	0·17	0·16
BP10=SN7410	0·15	0·14	0·12
BP13=SN7413	0·29	0·26	0·24
BP16=SN7416	0·43	0·40	0·38
BP17=SN7417	0·43	0·40	0·38
BP20=SN7420	0·15	0·14	0·12
BP30=SN7430	0·15	0·14	0·12
BP40=SN7440	0·15	0·14	0·12
BP41=SN7441	0·67	0·64	0·58
BP42=SN7442	0·67	0·64	0·58
BP43=SN7443	1·95	1·85	1·75
BP44=SN7444	1·95	1·85	1·75
BP45=SN7445	1·95	1·85	1·75
BP46=SN7446	0·97	0·94	0·88
BP47=SN7447	0·97	0·94	0·88
BP48=SN7448	0·97	0·94	0·88
BP50=SN7450	0·15	0·14	0·12
BP51=SN7451	0·15	0·14	0·12
BP53=SN7453	0·15	0·14	0·12
BP54=SN7454	0·15	0·14	0·12
BP60=SN7460	0·15	0·14	0·12
BP70=SN7470	0·29	0·26	0·24
BP72=SN7472	0·29	0·26	0·24
BP73=SN7473	0·37	0·35	0·32
BP74=SN7474	0·37	0·35	0·32
BP75=SN7475	0·47	0·45	0·42
BP76=SN7476	0·43	0·40	0·38
BP80=SN7480	0·67	0·64	0·58
BP81=SN7481	0·97	0·94	0·88
BP82=SN7482	0·97	0·94	0·88
BP83=SN7483	1·10	1·05	0·95

BI-PAK Order No.	Price and qty. prices 1-24 £p	25-99 £p	100 up £p
BP86=SN7486	0·32	0·30	0·28
BP90=SN7490	0·67	0·64	0·58
BP91=SN7491AN	0·87	0·84	0·78
BP92=SN7492	0·67	0·64	0·58
BP93=SN7493	0·67	0·64	0·58
BP94=SN7494	0·77	0·74	0·68
BP95=SN7495	0·77	0·74	0·68
BP96=SN7496	0·77	0·74	0·68
BP100=SN74100	1·75	1·65	1·55
BP104=SN74104	0·97	0·94	0·88
BP105=SN74105	0·97	0·94	0·88
BP107=SN74107	0·40	0·38	0·36
BP110=SN74110	0·55	0·53	0·50
BP111=SN74111	1·25	1·15	1·00
BP118=SN74118	1·00	0·95	0·90
BP119=SN74119	1·35	1·25	1·10
BP121=SN74121	0·67	0·64	0·58
BP141=SN74141	0·67	0·64	0·58
BP145=SN74145	1·50	1·40	1·30
BP150=SN74150	1·80	1·70	1·60
BP151=SN74151	1·00	0·95	0·90
BP153=SN74153	1·20	1·10	0·95
BP154=SN74154	1·80	1·70	1·60
BP155=SN74155	1·40	1·30	1·20
BP156=SN74156	1·40	1·30	1·20
BP160=SN74160	1·80	1·70	1·60
BP161=SN74161	1·80	1·70	1·60
BP164=SN74164	2·00	1·90	1·80
BP165=SN74165	2·00	1·90	1·80
BP181=SN74181	2·75	2·60	2·40
BP182=SN74182	0·97	0·94	0·88
BP190=SN74190	3·50	3·25	3·00
BP191=SN74191	3·50	3·25	3·00
BP192=SN74192	2·10	1·95	1·75
BP193=SN74193	2·10	1·95	1·75
BP195=SN74195	1·10	1·05	0·95
BP196=SN74196	1·80	1·70	1·60
BP197=SN74197	1·80	1·70	1·60
BP198=SN74198	5·50	5·00	4·00
BP199=SN74199	5·50	5·00	4·00

PRICE-MIX. Devices may be mixed to qualify for quantity prices.
PRICES for quantities in excess of 500 pieces mixed, on application.
Owing to the ever increasing range of TTL 74 Series, please check with us for supplies of any devices not listed above, as it is probably now in stock. WARE 3442.

NUMERICAL INDICATOR TUBE Type GR116



Cold Cathode gas-filled side-viewing numerals (0–9) and Decimal Point.

COLOUR : Neon Red.

DATA : Anode supply voltage 175 min Vdc.
Cathode current : 14mA dc. Nom

Ideal for use in constructing Digital Clocks, Desk Calculators etc., and many products described in this magazine. We recommend use of BP41 or BP141 to drive this tube.

Full data available on request.

ACTUAL SIZE

PRICE 1-5 £1·55. 6-25 £1·40

BRAND NEW LINEAR I.C's—FULL SPEC.

Type No.	Case	Leads	Description	Price 1-24	25-99	100 up
BP 201C—SL201C	TO-5	8	G.P. Amp	63p	53p	45p
BP 701C—SL701C	TO-5	8	OP Amp	63p	50p	45p
BP 702C—SL702C	TO-5	8	OP Amp Direct OP	63p	50p	45p
BP 702—72702	D.I.L.	14	G.P. OP Amp Wide Band)	53p	45p	40p
BP 709—72709	D.I.L.	14	High OP Amp	53p	45p	40p
BP 709P—µA709C	TO-5	8	High Gain OP Amp	58p	45p	40p
BP 710—72710	D.I.L.	14	Differential comparator	53p	45p	40p
BP 711—µA711	TO-5	10	Dual comparator	58p	50p	45p
BP 741—72741	D.I.L.	14	High Gain OP Amp (Protected)	75p	60p	50p
µA 703C—µA703C	TO-5	6	R.F.—I.F. Amp	43p	35p	27p
TAA 263—	TO-72	4	A.F. Amp	70p	60p	55p
TAA 293—	TO-74	10	G.P. Amp	90p	75p	70p
TAA 350	TO5	8	Wide band limiting amplifier	170p	158p	150p

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Especially designed by S.G.S. incorporating their proven Linear I.C. Audio Amp. TA/621 providing unlimited applications for the enthusiast in the construction of radios, record players, Audio and Stereo units. Also ideal for intercom systems, monitoring applications and phone answering machines.

OTHER USES : *portable applications where supply rails as low as 9V are of prime importance.*

- **Sensitivity 40 mV for 1 watt. VOLTAGE GAIN 40dB but can be varied up to 73dB for some applications.**
- **Signal to Noise Ratio 86dB.**
- **Frequency response better than 50 Hz to 25 KHz for – 3dB.**
- **Normal supply Voltage 9-24V.**
- **Suitable for 8-16 OHM Loads.**
- **Overall Size 2" × 3" × 1".**
- **Typical Total Harmonic distortion at 1 watt less than 1%.**

***Supply voltage (Vs) = 24V 15ohm load.**
Module Tested and Guaranteed.

Quantity	1-9	10-25
Price each	£2·63	£2·38

Larger quantities quoted on request.

Full hook-up diagrams and complete technical data supplied free with each module or available separately at 10p each.

NOTE THESE PRICES!

I.C's DTL 930 SERIES LOGIC

Type No.	Function	Price 1-24	25-99	100 up
BP930	Expandable duel 4-input NAND	12p	11p	10p
BP932	Expandable dual 4-input NAND buffer	13p	12p	11p
BP933	Dual 4-input expander	13p	12p	11p
BP935	Expandable Hex Inverter	13p	12p	11p
BP936	Hex Inverter	13p	12p	11p
BP944	Dual 4-input NAND expandable buffer without pull-up	13p	12p	11p
BP945	Master-slave JK or RS	25p	24p	22p
RP946	Quad, 2 input NAND	12p	11p	10p
BP948	Master-slave JK or RS	25p	24p	22p
BP951	Monostable	65p	60p	55p
BP962	Triple 3 input NAND	12p	11p	10p
BP9093	Dual Master-slave JK with separate clock	40p	38p	35p
BP9094	Dual Master-slave JK with separate clock	40p	38p	35p
BP9097	Dual Master-slave JK with Common Clock	40p	38p	35p
BP9099	Dual Master-slave JK Common Clock	40p	38p	35p

Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

DTL & TTL INTEGRATED CIRCUITS

Manufacturers' "Fall outs"—out of spec. devices including functional units and part function but classed as out of spec. from the manufacturers' very rigid specifications. Ideal for learning about I.C's and experimental work.

Pak No.		Pak No.	
UIC930 = 12 × µA 930	50p	UIC948 = 8 × µA 948	50p
UIC932 = 12 × µA 932	50p	UIC951 = 5 × µA 951	50p
UIC933 = 12 × µA 933	50p	UIC961 = 12 × µA 961	50p
UIC935 = 12 × µA 935	50p	UIC9093 = 5 × µA 9093	50p
UIC936 = 12 × µA 936	50p	UIC9094 = 5 × µA 9094	50p
UIC944 = 12 × µA 944	50p	UIC9097 = 5 × µA 9097	50p
UIC945 = 8 × µA 945	50p	UIC9099 = 5 × µA 9099	50p
UIC946 = 12 × µA 946	50p	UICX9 25 Assorted 930 Series	£1·50

Packs cannot be split but 25 Assorted Pieces (our mix) is available as Pack UICX9
Data Booklet available for the BP930 Series, PRICE 13p

UIC00 = 12 × 7400N	50p	UIC46 = 5 × 7446N	50p	UIC81 = 5 × 7481N	50p
UIC01 = 12 × 7401N	50p	UIC47 = 5 × 7447N	50p	UIC82 = 5 × 7482N	50p
UIC02 = 12 × 7402N	50p	UIC48 = 5 × 7448N	50p	UIC83 = 5 × 7483N	50p
UIC03 = 12 × 7303N	50p	UIC50 = 12 × 7450N	50p	UIC86 = 5 × 7486N	50p
UIC04 = 12 × 7404N	50p	UIC51 = 12 × 7451N	50p	UIC90 = 5 × 7490N	50p
UIC05 = 12 × 7405N	50p	UIC53 = 12 × 7453N	50p	UIC91 = 5 × 7491N	50p
UIC10 = 12 × 7410N	50p	UIC54 = 12 × 7454N	50p	UIC92 = 5 × 7492N	50p
UIC13 = 8 × 7413N	50p	UIC60 = 12 × 7460N	50p	UIC93 = 5 × 7493N	50p
UIC20 = 12 × 7420N	50p	UIC70 = 8 × 7470N	50p	UIC94 = 5 × 7494N	50p
UIC40 = 12 × 7440N	50p	UIC72 = 8 × 7472N	50p	UIC95 = 5 × 7495N	50p
UIC41 = 5 × 7441AN	50p	UIC73 = 8 × 7473N	50p	UIC96 = 5 × 7496N	50p
UIC42 = 5 × 7442N	50p	UIC74 = 8 × 7474N	50p	UIC121 = 5 × 74121N	50p
UIC43 = 5 × 7443N	50p	UIC75 = 8 × 7475N	50p	UICX1 = 25 × Asst'd 74's	£1·50
UIC44 = 5 × 7444N	50p	UIC76 = 8 × 7476N	50p		
UIC45 = 5 × 7445N	50p	UIC80 = 5 × 7480N	50p		

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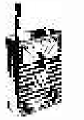
FIND BURIED TREASURE!
Transistorised Treasure Locator

This fully portable transistorised metal locator detects and tracks down buried metal objects—it signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. **FINDS GOLD, SILVER, COINS, JEWELLERY, ARCHAEOLOGICAL PIECES ETC. ETC.** *Extremely sensitive, will signal presence of certain objects buried several feet below ground* No knowledge of radio or electronics required. *Can be built with ease in one short evening by anybody from nine years of age upwards*, with the clear, easy to follow, step-by-step, fully illustrated instructions—Uses standard PP3 battery. No soldering necessary. Kit includes nuts, screws, wire, etc. **ONLY £2·85** + 25p p. & p. (Sectional handle as illustrated 95p extra). Parts available separately. Made up looks worth £15!

ONLY £2·85

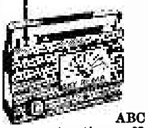
Eavesdrop on the exciting world of Aircraft Communications
V.H.F. AIRCRAFT BAND CONVERTOR

ONLY £2·85



Listen in to **AIR-LINES, PRIVATE PLANES, JETPLANES.** *Eavesdrop on exciting cross talk between pilots, ground approach control, airport tower, Hear for yourself the disciplined voices hiding tenseness on talk downs.* Be with them when they have to take nerve ripping decisions in emergencies—Tune into the international distress frequency. Covers the aircraft frequency band including **HEATHROW, GATWICK, LUTON, RINGWAY, PRESTWICK, ETC. ETC. CLEAR AS A BELL.** This fantastic fully transistorised instrument *can be built by anyone over nine in under two hours.* No soldering necessary. Fully illustrated simple instructions take you step-by-step. Uses standard PP3 battery. All you do is extend rod aerial, place close to any ordinary medium wave radio (even tiny portables). **NO CONNECTIONS WHATEVER NEEDED.** SEND ONLY £2·85 + 20p p. & p. for kit including case, nuts, screws, wire, etc. etc. (parts available separately).

SHORTWAVE TRANSISTOR RADIO



only **£2·75**

Anyone from 9 years up can follow the step-by-step, easy as ABC fully illustrated instructions. No soldering necessary. 76 stations logged on rod aerial in 30 mins.—**Russia, Africa, USA, Switzerland, etc.** Experience thrills of world wide news, sport, music, etc. Eavesdrop on unusual broadcasts. Uses PP3 battery. Size only 3" x 4¾" x 1⅜" Only £2·75 + 20p p. & p. Kit includes cabinet, screws, instructions, etc. (Parts available separately).

INGENIOUS ELECTRONIC SLEEP INDUCER

ONLY £3·25

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

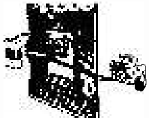
ELECTRONIC ORGAN

ONLY £3·25

Don't confuse with ordinary electronic organs that simply blow air over mouth-organ type reeds etc. Fully transistorised. **SELF CONTAINED LOUDSPEAKER.** *Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night", play "Auld Lang Syne" etc. etc.* You have the thrill and excitement of building it together with the pleasure of playing a real, live, portable electronic organ. **NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED.** No soldering necessary, Simple as ABC to make. *Anyone over nine years can build it easily in one short evening following the fully illustrated step-by-step, simple instructions.* **ONLY £3·25** + 25p p. & p. for kit, including case, nuts, screws, simple instructions, etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

Find buried treasure with this READY BUILT & TESTED
TREASURE LOCATOR MODULE

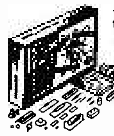
ONLY £4·95



FULLY TRANSISTORISED PRINTED CIRCUIT METAL DETECTOR MODULE. *Ready built and tested*—just plug in a PP3 battery and 'phones and it's working. Put it in a case, screw a handle on and **YOU HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20!** Extremely sensitive—penetrates through earth, sand, rock, water, etc.—EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC. Signals exact location by "beep" pitch increasing as you near buried metallic objects. *So sensitive it will detect certain objects buried* **SEVERAL FEET BELOW GROUND!** GIVES CLEAR SIGNAL ON ONE COIN! £4·95 + 30p carr. etc. (High quality Danish Stethoscope headphones £2·75 extra if required.) **EXAMINE AT HOME FOR 7 DAYS. YOUR MONEY REFUNDED IN FULL IF NOT 100% DELIGHTED.**

BUILD 5 RADIO AND ELECTRONIC PROJECTS

only **£2·45**



Amazing Radio Construction set! Become a radio expert for £1·97. A complete Home Radio Course. No experience needed. Parts including simple instructions for each design. Illustrated step-by-step plans, all transistors, loudspeaker, personal phone, knobs, screws, etc. all you need. Presentation box 45p extra as illus. (if required) (parts available separately) no soldering necessary. **Send £2·45** + 20p p. & p.

SOOTHE YOUR NERVES, RELAX WITH THIS AMAZING
RELAXATRON

Only £2·75

CUTS OUT NOISE POLLUTION—SOOTHES YOUR NERVES! Don't underestimate the uses of this fantastic new design—the RELAXATRON is basically a pink noise generator. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. For instance, many people find a rainstorm mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops!—a well known type of pink noise. IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron. Once used you will never want to be without it—TAKE IT ANYWHERE. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life). **CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE** using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones. Components, nuts, screws, wire, etc. no soldering. £2·75 + 25p p. & p. *Parts available separately*

CONCORD ELECTRONICS LTD. (PW5U) **8 Westbourne Grove, London, W.2.** *Callers welcome 9 a.m.–6 p.m. Inc. Saturday*

M. & B. COMPONENTS (LEEDS) LTD.

(INCORPORATING M. & B. RADIO)

PO Box 125, 38 BRIDGE END, LEEDS 1 Telephone 0532-35649

NEW RETAIL PREMISES NOW OPEN IN BISHOPGATE STREET. Near City Station. Everything for the HAM. Give us a call, G8BUU at your service.

PYE AM25B VANGUARDS. 12v Boot mounting radio-telephones. 20 watts RF output from QQV03/20A. High-band and low-band in stock. Ideal for 2 or 4 metre mobile operation. Less mike, control box and Speaker. **£20 each plus 90p carr. UK.**

BRAND NEW SIFAM. 2¼ sq 25–0–25μA meters. **ONLY 95p each plus 10p carr. UK.**

RCA POWER TRANSISTORS TYPE 2N3773 on hefty heat sink. Ideal for high power Amps. **60p each or £1 a pair plus 10p carr. UK.**

9 TRANSISTOR 455 Kc/s IF STRIPS. Ideal basis for Receiver. **ONLY £1·20 inc. carr. UK.**

EX-GPO TELEPHONES. Used but in working condition. Ideal for intercoms. **TWO for £2 inc. carr. UK.**

QQVO3-10. Ex equipment. **THREE for £1 plus 10p carr. UK.**

BRAND NEW CR300 RECEIVERS. **£25 inc. carr. UK.**

EDDYSTONE 770U Mk II RECEIVERS. **As new £120**

STRONG ETCHING FLUID. ½ Pint Plastic Bottles. **40p each plus 10p carr. UK.**

BRAND NEW 2¼ sq 500μA METERS. ONLY £1·20 plus 10p carr. UK.

Send SAE for full list with many bargains of general interest.

JERMYN
50p BARGAIN PACKS

All fully coded, all from well-known manufacturers and now available, while stocks last, at better than bulk-buyer's prices! Cash with order only.

1N4148 (=1N914)	Signal Diode	18 for 50p
1N5060 (=A14D)	1 Amp Rectifier 400V avalanche protected	7 for 50p
2N2923	NPN Silicon Transistor hfe 90–180 (25v)	7 for 50p
2N2926 (Red)	NPN Silicon Transistor hfe 55–110	8 for 50p
2N3391A	Si NPN Hi Gain (250–500) low noise transistor	3 for 50p
2N3402	Medium power (driver) 900mw 25v Hfe 75–225	6 for 50p
C6U	1.6 amp general purpose 25v SCR in T05 case	3 for 50p

Post and packing 10p for 1 or 2 packs; 3 packs or more post free.

Order any quantity, till sold (but we regret packs cannot be subdivided).

Star Bargain Sprague (Pirgo) Triacs PTA08S (6 amp 400v) 48p each

P.O. or Cheque payable Jermyn Industries, Vestry Estate, Sevenoaks, Kent.

RSC HIGH-FIDELITY STEREO PACKAGE OFFERS

Four fully wired units ready to 'plug in'.
- ★ SUPER 30 AMPLIFIER (15 + 15 watt) in veneered housing
- ★ GARRARD SP25 MK III Turntable on Plinth with cover
- ★ GOLDRING G850 Magnetic P.U. cartridge with diamond stylus
- ★ PAIR OF STANWAY II Speaker Units

Special Total Price **£87·75** Carr. £1·50

Terms: Deposit £13 and 9 monthly payments £9·35 (Total £97·15).

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

Special Total Price **£99·75** Carr. £1·50

Terms: Deposit £15 and 9 monthly payments £10·60 (Total £110·40).

ATTRACTIVE TEAK OR AFRORMOSIA VENEERED CABINETS AND PLINTHS
Send S.A.E. for coloured brochure showing other money saving offers.

Matching as recommended for optimum performance. Package prices apply providing all individual units are purchased from any branch within 3 months. See leaflet.

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

Special Total Price **£59**

Or Deposit £9 and 9 monthly payments £6·25 (Total £65·25). Carr. £1·25

Trans. Plastic Cover £3·15 extra.

PACKAGE AS ABOVE but with Garrard 3000 Autochanger and Sonotone 9TA Ceramic Cartridge in lieu of SP25 and CS90 Carr. £1·25 **£51·75**

Or Deposit £8 and 9 monthly payments £5·58 (Total £58·22)

Trans. Plastic cover £3·15 extra.

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

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

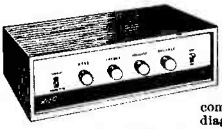
COMPLETE KIT **£23** Carr. 65p

Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system (3) 8×5in. high flux middle range speaker. (4) High efficiency tweeter. (5) Appropriate quantity acoustic damping material. (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions. Terms: Dep. £4·60 and 9 monthly payments £2·47 (Total £26·83).

DEMONSTRATIONS AT ALL BRANCHES

RSC G66 MkII 6+6 WATT high quality STEREO AMPLIFIER

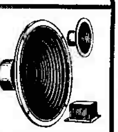
Individual Ganged Controls: Bass, Treble, Volume and Balance. Printed circuit construction employing 10 Transistors plus Diodes. Output rating I.H.F.M. Frequency range 20–20,000 c.p.s. Bass Control ± 12db. Treble Control ± 13db. Selector switch for P.U. or Tape/Radio. For loudspeaker output impedances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



COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and comprehensive wiring diagram and instructions **£11·50** Carr. 40p

Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £14·99 or dep. £2·20 and 9 monthly payments £1·70 (Total £17·50).

AUDIOTRINE HI-FI SPEAKER SYSTEMS



Consisting of matched 12in. 11,000 line 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **£5·95** Carr. 30p

OR SENIOR 15 WATT INCLUDING HF126 15,000 LINE SPEAKER **£6·95** Carr. 35p

AUDIOTRINE HIGH FIDELITY SPEAKERS

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

HF808T	8"	10W	£2·88	HF120D	12"	15W	£4·75
HF102D	10"	10W	£3·40	HF126	12"	15W	£5·50
HF120	12"	15W	£4·25	HF126D	12"	15W	£5·90

FANE 807 HIGH FIDELITY SPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 3 or 8-15 Ω. STATE WHEN ORDERING **£3·85**

HIGH FIDELITY LOUDSPEAKER UNITS

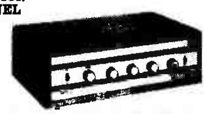
Cabinets latest style Satin Teak veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.

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

STANWAY II Size 20×10¾×9¾in. approx. Rating 10 watts. Inc. 13×8in. speaker with highly flexible cone surround, long throw voice coil and 10,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 35-20,000 c.p.s. Imp. 8 ohms. Gives smooth realistic sound output. **See 'package offers' for illustration** **£17·85**

R.S.C. TA12 MKIII 6·5+6·5 WATT STEREO AMPLIFIER

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



Designed for optimum performance with any crystal or ceramic Gram. P.U. cartridge, Radio tuner, Tape recorder etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3-15 ohms ★ For 200-250v. A.C. mains ★ Frequency Response 20-20,000 c.p.s. −2dB ★ Harmonic Distortion 0·3% at 1,000 c.p.s. Hum and Noise −70dB ★ Sensitivities (1) 50mV (2) 400mV (3) 100mV. Output rating I.H.F.M. ★ Handsome finish Facia plate & Knobs.

COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS. £15·50 Carr. 40p. **Factory built with 12 mths. guarantee £19·50**

Deposit £3 and 9 mthly pymts £2·15 (Total £22·35). Or in Teak veneer housing **£23** Dep. £3 & 9 mthly payments £2·55 (Total £25·95). Send S.A.E. for leaflet.

HI-FI SPEAKER ENCLOSURES MODERN DESIGN

Teak veneer finish. Acoustically lined. All sizes approx.
Carr. 30p. per enclosure.

JE8 Size 16×11×9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi speaker. **£5·35**

SE8 For optimum performance with any 8in. Hi-Fi speaker. Size 22×15×9in Ported. **£6·47**

SE10 For outstanding results with 10in. Hi-Fi spkr. Size 24×15×10in. P'td. **£6·74**

SE12 For exclnt prfmnce with 12in Hi-Fi speaker and Tweeter. Size 25×16×10½in. **£7·87**

R.S.C. BATTERY/MAINS CONVERSION UNITS

TYPE BM1. An all-dry battery eliminator. Size 5¼×4¼×2in. approx. Completely replaces batteries supplying 1·5v and 90v, to battery radio where A.C. mains 200/250v. 50c/s is available.

COMPLETE KIT WITH DIAGRAM **£3·25** ASSEMBLED READY FOR USE **£3·75**

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

200-250v. AC mains operated. Frequency Response 30-20,000 c.p.s. −2dB. Harmonic Distortion 0·3% at 1,000 c.p.s. Separate Bass and Treble 'lift and cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm spkrs. Max. sensitivity 5mV Output rating I.H.F.M. Fully enclosed enamelled case, 9¼×2¾×5¼in. Attractive brushed silver finish facia plate 10¾×3¼in. and matching knobs.

Complete kit of parts with full wiring diagrams and instructions. **£7·50** Carr. 40p.

OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE £9·75

R.S.C. MkIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

A COMPLETELY NEW DESIGN FURTHER IMPROVED IN BOTH APPEARANCE and PERFORMANCE. REPRESENTING VALUE FAR HIGHER THAN THE PRICES SUGGEST.

Only high grade components by leading manufacturers.
COMPLETE KIT OF PARTS **£25** Carr. 65p

Or **FACTORY BUILT** with 12 months guarantee. Dep. £5·75 and 9 monthly payments £3·50 (Total £37·25.) **£33·75**

Or **FACTORY BUILT** in cabinet as illustrated. Dep. £7 and 9 monthly payments £3·99 (Total £42·91) **£38·75**

PRINTED CIRCUITRY
TWENTY SILICON TRANSISTORS.
FOUR DIODES.
FOUR RECTIFIERS

- ★ **SATIN SILVER METAL FACIA** with black lettering. Black edged knobs with bright silver centres.
- ★ **PUSH-BUTTON SELECTOR SWITCHING**
- ★ **NEON INDICATOR**
- ★ **JACK SOCKET FOR HEADPHONES**
- ★ **CABINETED MODEL VENEERED IN SATIN TEAK. SUITABLE FOR ANY MODERN PICK-UP CARTRIDGE CERAMIC or MAGNETIC, REGARDLESS OF PRICE. WE RECOMMEND USE WITH THE BEST ANCILLARY EQUIPMENT THAT CAN BE AFFORDED.**

TECHNICAL DETAILS (Applying to each channel where appropriate)

CONTROLS: PUSH-BUTTON SELECTOR (1) Disc (2) Radio (3) Tape (4) Mono L (5) Mono R (6) SPEAKER DIS. (7) Mains on/off. Bass, Treble and Balance. Plus Ceramic Mag P.U. Switch.

OUTPUT: 15 watts R.M.S. (Continuous) into 8 ohms. 10 watts R.M.S. (Continuous) into 15 ohms.
HUM & NOISE —75dB Min. Vol. —65dB Full Vol. **HARMONIC DISTORTION** 0·1% at 1000 Hz 10 Watts
FREQUENCY RESPONSE: —3dB 7Hz to 70kHz
TREBLE CONTROL: +16dB to —12dB at 14kHz
BASS CONTROL: +17dB to —16dB at 40Hz
CROSS TALK —58dB
SENSITIVITIES: Disc Mag. 2·5 mV. Ceramic 35mV. Radio 120mV. Tape 120mV.
REAR PANEL SOCKETS ARE FOR 3 PAIRS OF INPUTS (1) P.U. (2) Radio. (3) Tape Amp. Plus pair for tape recorder signal take off and 2 pairs for speaker connections.

RSC DISCOTHEQUE EQUIPMENT

50 WATT SPEAKER

100 WATT AMPLIFIER

50 WATT SPEAKER

HEADPHONES MICROPHONE

TWIN TURNTABLE WITH PRE-AMP

SEND S.A.E. FOR DISCO LEAFLET

SAVINGS ON PACKAGE OFFER

All units available separately
(1) FAL FG1/2A Console
(2) 100W Power Amplifier
(3) Pair High Quality Headphones
(4) Matching Microphone fitted to Headphones
(5) Pair 50W Speakers black rexine covered Size approx. 18"×18"×8"

TOTAL COST OF ALL ILLUSTRATED UNITS Carr. £2·50 **£139·75**
Terms: Deposit £30 and 18 monthly payments of £7·50 (Total £165)

FAL

F.G.1/2A DISCO CONSOLE

Incorporating twin Garrard SP25 Mk.III turntables and Sonotone 9TAHC Ceramic Cartridges with diamond styli. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Rexine covered Cabinet with lid. **£69**
Carr. £1·25
Carrying straps £1·25 extra if required.
Terms: Deposit £15 and 9 monthly payments of £6·75 (Total £75·75)

R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

All types 15 Ohms covered in Rexine and Vynair
TYPE C4100 IS ALSO SUITABLE FOR BASS GUITAR OR ELECTRONIC ORGAN

TYPE C48S 25-30 WATTS
Fitted four 8" high flux 8 watt speakers Overall size approx. 48×10×5in. **£17·75**
Terms: Dep £3 and 9 monthly payments £2 (Total £21) Carr. 50p.

TYPE C412S 50 WATTS
Fitted four 12" 11,000 line 15 watt speakers: Overall size approx. 56×14×9in Terms: Dep. £4 and 9 monthly payments £3·37 (Total £34·33) Carr. 75p **£31**

TYPE C4100 100 WATTS inc. four 12" 50 watt speakers for conservative rating. Extra heavy construction. Size approx. 58×16×10" Acoustically filled and pressurised. Terms: Dep. £11 and 9 mthly. pyts. £6·75 (Total £71.75). **£65** Carr. £1

FANE ULTRA HIGH POWER LOUDSPEAKERS

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

'POP' 100
18" 100 Watt
14,000 gauss
8/15Ω
£22·95
Dep: £6 and 9 mthly payments £2·20 (Total £25·80)

'POP' 60
15" 60 Watt
14,000 gauss
8/15Ω
£12·90
Dep. £3·30 and 9 monthly payments. £1·30 (Total £15).

'POP' 50
12" 50 Watt
13,000 gauss
15Ω **£10·90**
Dep £2 and 9 monthly payments £1·20 (Total £12·80)
PAIR SUITABLE ALL PURPOSES

FOR BASS GUITAR, ELECT. ORGAN, ETC.

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

Highly sensitive. Push-Pull high output, Hum level −70dB. Response ±3dB 30-20,000 c/s. All high grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Contrrols. Sensitivity 36 millivolts. For High Impedance microphones. For Clubs, Schools, Theatres, Dance Halls, Outdoor Functions, etc. For Electronic Organ, Guitar, String Bass, etc. Gram, Radio or Tape. Two separate inputs with vol. controls permit such as "mike" and Pick-up etc. to be used for mixing purposes, 200-250v. 50 c/s A.C. mains. For 3 and 15 ohm speakers. Complete Kit of parts with wiring diagram and instructions. Twin-handled perforated cover £1·90. Or factory built with EL34 output valves and 12 months' guarantee for £19·75 **£15·75** Carr. 65p
TERMS: Deposit £4 and 9 monthly payments of £2·10 (Total £22·90). Send S.A.E. for leaflet.

FANE LOUDSPEAKERS 'POP' 25/2 12 in. 25 WATT

Dual Cone 15 Ω (for uses other than Bass Guitar or Electronic Organ). **£6·75** Carr. free or Dep. £1 and 9 mthly payments 75p (Total £7·75).

GROUP/DISCO EQUIPMENT PACKAGE OFFERS

F.A.L. PHASE 50 MK.III AMPLIFIER £34·95
PR. FANE POP 25/2 25W L/SPEAKERS £13·50
£48·45
Terms: Deposit £6.50 and 9 monthly payments of £4.72 (Total £48.98)
PACKAGE PRICE **£45** carr. £1

F.A.L. PHASE 50 MK.III AMPLIFIER £34·95
PR. FANE POP 50 L/SPEAKERS £21·80
£56·75
Terms: Deposit £10 and 9 monthly payments of £5·25 (Total £57.25)
PACKAGE PRICE **£52** carr. £1

F.A.L. PHASE 100 AMPLIFIER £61·95
PR. L125 50W L/S in cabinets £67·00
£128·95
Terms: Deposit £23 and 9 monthly payments of £12·50 (Total £135·50)
PACKAGE PRICE **£123** carr. £2·50

F.A.L. PHASE 100 AMPLIFIER £61·95
4 FANE POP 50 L/SPEAKERS £43·60
£105·55
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250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a. £2·20
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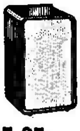

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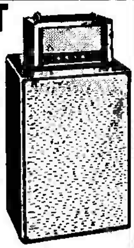

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PRACTICAL WIRELESS

VOL 48 NO 1
Issue 783

MAY 1972

Up for the Cup!

AT this time of year, all sorts of people are getting worked up on the outcome of *that* sporting event soon to take place in Wembley Stadium. In between bouts of waving their favours and whirling their rattles, the staff of P.W. have found themselves involved in the fate of another, though less spectacular, silver cup. They have been judging nominations for the P.W. Designer's Trophy for 1971.

In 1970 we launched *Project Autumn*, in which readers were invited to send in original articles on constructional projects within a specified period, the winner being the author of the work considered by the judges to be the best submitted. It was decided, however, to amend the rules slightly for the 1971 Trophy. Entries would be judged not in manuscript form but would be drawn from material actually published between the July 1971 and March 1972 issues.

Nominations would be judged, as before, on originality, ingenuity, construction, presentation, technical accuracy and other associated factors. However, under the revised arrangement, a new factor could be brought into play—call it 'workability', or Factor X. This allows the judges to take into consideration the trouble (or lack of it) in passing the articles through the editorial mill and noting any shortcomings not obvious in manuscript form. This permits a much fairer and realistic assessment to be made. The final results will be published in the next issue.

Although last year's crop of entries brought some new names to the pages of P.W., this year we want to see more and more! It has been suggested that the relative newcomer to technical writing has little chance when in competition with the regular and more experienced authors. There may, of course, be an element of truth in this, because on balance the "published" writer is experienced enough to have learned what is likely to be accepted for publication. On the other hand, P.W. has published many articles by new authors, sometimes at their first attempt.

However, in order to show faith in our stated objective of encouraging new writers, it has been decided that for the 1972 Cup *only writers who have never previously had articles published in P.W. will be eligible.* Describing the théory, construction and use of a piece of equipment can be a revealing exercise in testing the author's grasp of a subject (and the gaps in his knowledge), with the added incentive of some financial gain and, perhaps, a little glory! Full details next month.

So, keep those articles rolling—you may have just what we have been looking for and (who knows?) you may even win a cup!

W. N. STEVENS—*Editor.*

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

SPECIAL FEATURE

Part 8 of "Transistor Circuitry for Beginners" is held over.

JUNE ISSUE WILL BE PUBLISHED ON MAY 5th

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

Pacemakers

With surgical care, an electronic module for a long-lived heart pacemaker is assembled at Raytheon Company's Industrial Components Operation at Quincy, Mass. Aerospace reliability techniques are employed in the manufacture of the new devices to pace the beat of a human heart. The new medical aids will be powered by nuclear energy giving them a life expectancy of 10 years instead of two as presently experienced with units powered by mercury batteries. Raytheon is building the modules for ARCO Nuclear of Apollo, Pa., a wholly-owned subsidiary of Atlantic Richfield. The experimental programme is sponsored by the Atomic Energy Commission.

About 50,000 persons now depend upon pacemakers. It is estimated that an additional 5,000 to 10,000 will join their ranks annually as the reliability and longevity of the device is increased.

Mr. Regan, Raytheon's marketing manager, said the electronic circuitry of contemporary pacemakers outlasts the present mercury power sources but with the shift to nuclear energy and its 10-year life, the circuitry had to be upgraded. He said Raytheon had been selected for the task because of the company's experience and expertise in the manufacturing of sophisticated electronic modules. The company's performance with the ultra-reliability of the Apollo programme and compliance with NASA reliability standards were important factors in the selection, he said.

"Radio Ear"

The present generation of mankind may be able to tune in on intelligent civilisations beyond Earth, if Congress appropriates the money to start building the VLA, America's proposed superpowerful radio observatory.

The National Science Foundation, under whose aegis the radiotelescope would be designed and constructed, said that an array of aerials resembling the giant "dishes" used to track spacecraft, would be set up in geometric patterns to pick up and focus signals emanating from the edge of the universe, 13,000 to 16,000 million light years away. The pattern would be an extension of the interferometer technique (placing aerials in a row or at right angles to one another) already widely used in radio-astronomy to enhance the strength of incoming radio signals.

A specific location has not yet been chosen for the new telescope, but it would be built in a pattern some 24 miles long at a high-altitude site in the south-western part of the United States, well away from earth-generated background noise.

It is likely that any new very large aerial would be used, at least part time, in "passive listening" for radio signals from other civilisations which many scientists believe must inhabit planetary systems around distant stars.

Atlantic Lock Out!!!

Mr. S. Valentine recently wrote to tell us of an amusing incident which occurred when he was doing a bit of S.W. listening one day.

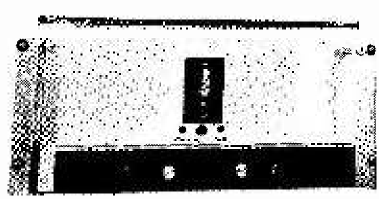
He was tuned in to a QSO between two amateurs—one in the U.S.A. and the other in Scunthorpe. The American asked the "G3" to "let his wife in as it was raining outside." On hearing this, the Englishman was most astonished and enquired what was going on.

It transpired that the English lady of the house had allowed the door to lock behind her, and not being able to make her husband hear her, had contacted one of his pals to get on the air to the American to tell her husband to unlock the door!

1,000W Amp

Crown International of Elkhart Ind. have announced a new high power amplifier capable of providing 1,000 watts r.m.s. into a 4 ohms load. Available from Macinnes Laboratories in the U.K. the M600, is d.c.-coupled throughout although a front panel switch provides for an a.c.-coupled input if required. Power bandwidth at the 1,000 watts level is ±1dB from d.c. to 20kHz and THD at this level is below 0·1% throughout the frequency range. At 600 watts THD is below 0·05%. The intermodulation distortion is better than 0·1% at all levels from 0·01 watt to 1,000 watts, and the damping factor is greater than 200 from d.c. to 20kHz. Hum and noise are at least 110dB below 600 watts level. The M600 is equipped with its own two speed fan for cooling and on the rear panel is a switch offering six positions of operating modes. Weight is 80lb., and price inclusive of import duty, is £730.

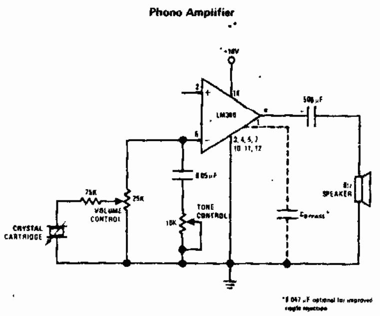
Macinnes Laboratories Ltd., 71 Oakley Road, Chinnor, Oxon. Tel. Kingston Blount 52061.



The M600 amplifier

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

LM380 I.C.



D.T.V. Group Limited announce the LM380 audio power amplifier. The output has both short circuit current limiting and thermal overload current limiting to insure safe operation. Supply Voltage is 22V. Peak Current is 1·3A. Power output is 2W and input voltage is ±0·5V. Storage Temperature is −65°C to 150°C and Operating Temperature 0°C to 70°C. Lead Temperature (Soldering, 10 sec) 300°C. Price is £1·37½ +10p postage and packing. *D.T.V. Group Limited, 126 Hamilton Road, West Norwood, London, S.E.27.*

Gas Radio

Reader R. Jenkins has told us of a Mr. Jack Hickson who has a Gas-Powered radio.

The radio at Mr. Hickson's home in Hadnock Road, Monmouth, takes its power from a thermo-electric generator which has gas burners. Electricity is generated by heating of copper plates. The generator charges a battery off which the 33-year-old radio is run.

The generator supplies enough electricity to charge accumulator batteries or even a car battery.

The generator was made in 1938 by a Yorkshire firm specially for providing power for battery radios.

But for gas board engineers carrying out North Sea conversion it was something they had never encountered before. They had to take the generator to Cardiff and it took them about a week to change the burners and adapt it for North Sea gas.

Audio Fair

Exhibitors at last year's International Audio Festival & Fair asked for more space in the 1972 show. In order to accommodate them, the organizers have arranged to move the Festival from the Empire Hall to the Grand Hall, Olympia, which will provide an additional 74,000 sq. ft. of space.

The 1972 Audio Fair, sponsored by the Sunday Mirror, will be held from October 23 to 28. It will allow the public to listen to the products of the world's leading manufacturers of sound reproduction equipment, specialist Hi-Fi, and a comprehensive display of accessories.

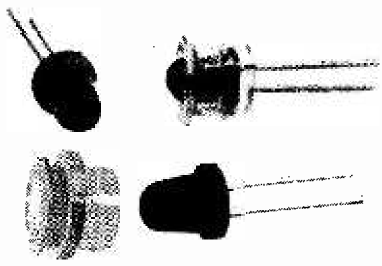
There will be many special attractions, including more than 75 specially constructed Audio Studios, and a Hi-Fi Theatre offering a daily programme of lectures and concerts.

GaAs Light

GaAs Light indicates the state of p.n.p. or n.p.n. logic systems capable of driving at say 15mA at 1·6V or over. For the brightest display 40mA is recommended. The intensity is acceptable at only 10mA. The advantage of these lamps is the low cost (95p) and higher reliability.

Due to the low current and voltage requirement of small battery operated equipment it is now possible to run these GaAs lamps in series with the electronics, so reducing the indicating power to only 16mW. This power is therefore less than the power wasted by even a very small equipment being inadvertently left on. *West Hyde Developments Limited, Ryefield Crescent, Northwood Hills, Northwood, Middx., HA6 1NN.*

Led Lamps



Guest International announce the availability of a new range of solid state lamps using Gallium Arsenide Phosphide Diodes. The lamps are encapsulated in two main forms of package—one with a glass to metal seal and the other a moulded plastic case. Both employ a lens in front of the actual diode to alter the characteristics of the light emission, one type diffuses the light, whilst the other produces a point source each available in different colourations. The lamps combine extremely long life with very efficient operation making them ideal for use as panel lights or status indicators in modern equipment. There are currently 5 versions in the range given the generic title RED LIT series and luminosities as high as 2000FtL at 50mA are offered. *Guest International Limited, Nicholas House, Brigstock Road, Thornton Heath, Surrey, CR4 7JA.*

Philips Booklet

Philips have published a colour booklet entitled "All about Tape and Cassette recording". The booklet, which sets out the origins of tape recording and describes how magnetic tape works, is available to schools and students on request.

It has been published primarily as further study material for project work.

25,000 copies of the booklet have been printed and copies can be obtained from the *Publicity Department, Philips Electrical Ltd., ELA Division, Century House, Shaftesbury Avenue, WC2H 8AS.*

THE PW TREASURE TRACER Mk II

HALVOR MOORSHEAD

The original Treasure Tracer, described in P.W., August 1971, was a very popular feature, judging by your letters and reports from components stockists. Few readers had difficulty in either building or using the metal locator. This article describes an improved version of this project.

SINCE the orginal Treasure Tracer was built and described in this magazine, development work has continued. The author's own success with the prototype and the enthusiasm of readers has resulted in a considerable amount of experimenting and this article describes the improvements that have been made.

It has not been assumed that all readers will have seen the original article; for this reason much of the information given last time is repeated. This article should enable the new reader to build the project as described as well as enabling the reader who built up the original circuit to up-date his Treasure Tracer. To make matters simpler for these people, the original case has been retained with relatively few changes.

The cost of the original was not high but in fact the component cost for the Mark II will probably be marginally less, though the mechanical and construction side may cost more. The total cost for the Treasure Tracer Mk II should be something under £5 though this will vary depending on source of supply.

For those who did not see the original article, the principle of operation will be briefly described.

The circuit works in exactly the same way as the original. Two low frequency r.f. oscillators are arranged to beat together. One of these oscillators makes use of a tuned circuit working inside the case; we shall call this the reference oscillator. In operation this remains at one frequency though this is adjustable for "tuning up".

The second oscillator, working at essentially the same frequency, also makes use of a tuned circuit but in this case the inductor is external and becomes the "business end" of the circuit. We shall call this the search coil and the search oscillator.

If a small part of each of these oscillators is mixed together they will beat with each other. If the difference in frequency is small, this beat note will fall in the audio range. If the reference oscillator is working at say 130kHz and the search oscillator is at 131kHz, a beat note equivalent to that difference will be produced, in this case 1kHz; this audio signal can be amplified and fed to the speaker.

Now the search oscillator makes use of an external coil and if certain materials, especially metals, are brought into the vicinity of this coil, these will alter the value of the coil inductance, which in turn will alter the frequency of oscillation.

A better known example of this change of inductance is the ferrite rod aerial. By moving the coil along the rod the inductance is changed; this is of course done every time a superhet is aligned. A ferrite rod will roughly double the inductance of a coil. Far smaller changes in inductance take place in a metal locator—usually fractions of one percent —but because of the frequency used and the fact that it is compared to a standard frequency, the changes in the *audio* note will be considerable. Taking the frequency actually used in this circuit, a 0·1 per cent increase (or decrease) in the inductance will result in a 130Hz change in the audio note.

It would be possible to have both frequencies fixed at say a difference of 100Hz but there are so many factors that effect the frequency that it is easier to arrange for one of the oscillators to be adjustable in order that they can be brought close together.

In this circuit we are changing the frequency of the reference oscillator though it could just as well have been the search oscillator.

The original Treasure Tracer, described in the August 1971 issue. The text mentions several improvements that have been made, both to the circuit and the construction. The heading photograph shows the Mark II in operation.

MODIFICATIONS

In the light of experience and bearing in mind the comments of readers, the following modifications have been made to the prototype:

1. The original Treasure Tracer was not mechanically balanced. It was held at the end of the handle and while this worked quite well, it became very tiring to hold during long searches. The Mark II is balanced as can be seen from the photograph; it is easier and more comfortable to hold and there is no hand strain even after several hours.
2. The output volume was felt by some readers to be too low. In many cases this could have been due to inefficient operation of the particular transistors used as the output of the prototype was found to be quite adequate. Even so, the sound level available in the Mark II has been increased and since this could be annoying in certain locations at maximum volume, a volume control has been included. To save extra drilling etc., the on-off switch (a miniature slide type in the prototype) is incorporated with the volume control.
3. The stability of the prototype left a little to be desired. Touching the metal case or the wires running from the search coil to the case caused a change in frequency. This was not too serious in practice once one got used to it but several changes have been made to the construction of the Mark II to improve the stability.
4. The construction of the search coil has been changed to make the windings much more rigid; this has proved to be much better than the principle originally employed. In addition the weight of the "head" has been reduced and this again helps with the balance.
5. Overseas readers (who account for a proportion of the magazine's readership) sometimes had difficulty in obtaining certain parts. This has been borne in mind and the parts should be available world-wide except for one component and the construction of this is described later.
6. Improvements have been made to the oscillator circuits. In the Mark I a Hartley oscillator and a Blocking oscillator were used for the search and reference oscillators respectively. Both of these have been changed to the more stable (and slightly simpler) Colpitt's type. In addition to these advantages, the search coil is now only a single winding (it was tapped in the Mark I) as is the coil used for the reference oscillator. This simplifies construction and reduces the cost slightly.

In addition to the above points a considerable number of other experiments have been tried but have not been incorporated for various reasons. For those who wish to experiment further, these are mentioned; they may give certain leads and possibly prevent the reader following fruitless paths.

The best frequency for operation was carefully investigated. Although the regulations limit operation below 150kHz, experiments were carried out at six widely differing frequencies and the results compared. Since for a given percentage change in inductance there will be a much larger change in the audio frequency using higher r.f. frequencies, it would appear that operating at say 2MHz would be better. In practice other factors start to come into it and ground capacity effects become serious. Bringing the coil towards plain earth causes a considerable change in frequency and even fitting a Faraday Shield only improved this slightly. About six different frequencies were tried but the only result was a confirmation that the original 130kHz or thereabouts is the best. Ground capacity effects are negligible and, although a Faraday shield was tried, this made no improvement and so has not been incorporated.

A meter was tried as the sensing indicator. Although a workable circuit was developed, it was found to be far less sensitive than the ears and very difficult to use. There was also considerable difficulty in filtering out all the r.f. before applying this to the frequency counting circuit. For this reason details are not included.

Several experiments were made with different diameters of search coil. A clear rule seems to apply here. The larger the diameter of the coil, the greater the depth of penetration for large objects *but* at the same time the larger coils were less sensitive to small objects close by.

There is certainly room for experiment here. As long as the inductance of the coil remains the same, it doesn't matter at all what size it is, it could be 1in. or 3ft. in diameter. The 6in. used here is the best compromise for general purposes; it is good for coins and not too bad for large objects reasonably close by. For those who are prepared to take the trouble, it should be possible to arrange for the coils to be changed depending on the nature of the search.

As a general guide the same length of wire should be used whatever the diameter of the coil, that is about 92ft. of wire. This is only a guide and turns may have to be added or taken off, to allow the frequency to be brought into the right range.

Encapsulating the coil in epoxy resin was tried and although this was an improvement over the Mark I as it prevented movement and consequent frequency changes, it did not help with the Mark II and only added to the weight of the search coil head.

THE CIRCUIT

The complete circuit is shown in Fig. 1. Tr1 and the components surrounding it form the search coil oscillator and, as can be seen, this connects to the search coil via a coaxial cable. Tr2 and the associated components form the reference oscillator, L2 being a long-wave winding (an inductance of just over 2mH) but fitted with a ferrite slug (not normally supplied). The one used in the prototype is primarily intended as a crystal set coil; a medium wave winding is also fitted but this is ignored.

This oscillator is adjustable by varying VC1 which is a 750pF compression trimmer and the combination of the variable core in the coil and VC1 enables this tuned circuit to be varied over a considerable range. Even if the search coil oscillator is way off the intended frequency it will be possible to tune the reference oscillator to it.

From the collectors of both oscillator transistors low value capacitors C6 and C7 feed to the detector diode which, being a silicon type, requires a standing d.c. bais provided by R5. The output from this is fed to the volume control VR1 and is smoothed by C8 which removes nearly all the r.f. component. The output of the volume control feeds to the simple amplifier which uses Tr3 and Tr4. R6 has not been given a value as it should be selected individually; its value will depend on the actual transistors used. For initial setting up a 22kΩ resistor may be used,

★ components list

Resistors

R1	470kΩ	R5	120kΩ
R2	10kΩ	R6	See text
R3	470kΩ	R7	270kΩ
R4	10kΩ	R8	39Ω

All resistors ⅛W, 5% types.
VR1 10kΩ log pot with switch

Capacitors

C1 2,000pF ceramic or polystyrene
C2 2,000pF ceramic or polystyrene
C3 0·05µF ceramic or mylar
C4 3,300pF ceramic or polystyrene
C5 0·05µF ceramic or mylar
C6 27pF polystyrene or mica
C7 27pF polystyrene or mica
C8 3,300pF ceramic or polystyrene
C9 0·1µF ceramic or mylar
C10 30µF 10V electrolytic
C11 50µF 10V electrolytic

Semiconductors

Tr1	2N2926	Tr4	BC109 or 2N2926
Tr2	2N2926	D1	1N914
Tr3	2N2926		

(Note that any colour of the 2N2926 can be used but the "G" or green is best for Tr3 and Tr4)

Miscellaneous

L1 See text and Fig. 2
L2 Repanco Crystal Set Coil Type DRX1. This must be fitted with a ferrox tuning slug which is not provided.
T1 Transistor output transformer, Type LT700 or similar—see text.
L.S. Miniature 8Ω loudspeaker—see text
Earphone jack, 3·5mm type with break switch; Battery, PP3, 9V; Case, 6¾ × 2¾ × 1⅞in. in aluminium (available from H. L. Smith Ltd., 287/9 Edgware Road, London W.2, price 60p including postage); Coax cable; Connecting block; Aluminium (or copper) tube, 5ft; Plywood for former.

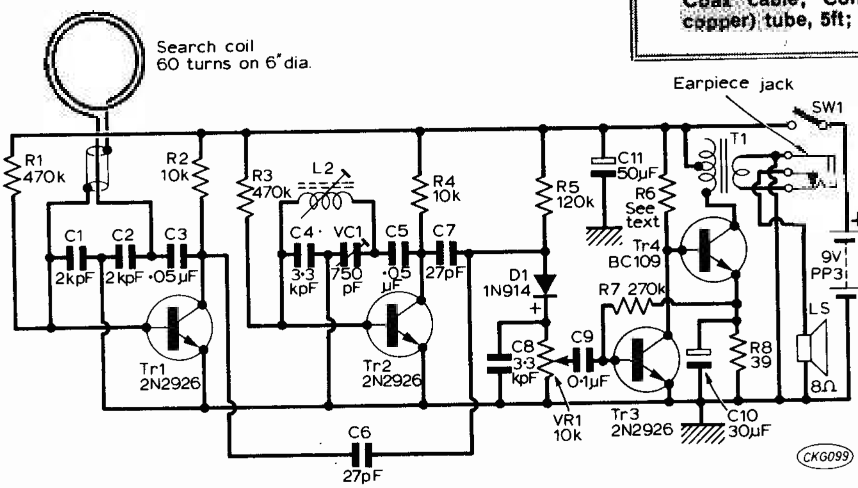


Fig. 1: The complete circuit of the Mark II. Although very similar to the original as far as operation is concerned, this is more stable and has a greater output.

this will certainly work. Once operation of the main stages has been established, the correct value should be found by experiment. It should be chosen for maximum output compatible with reasonable current consumption (under 20mA).

Some readers had difficulty in obtaining the high impedance speakers used in the Mark I and for this reason the Mark II uses a standard 8Ω miniature loudspeaker. This necessitates using a transistor output transformer. Normally only push-pull types are available, that means that the primary is centre tapped, in this case only one half of the primary winding is used. The use of earphones is also easier as the impedance of 8Ω is far more common than the 80Ω used in the Mark I. For those who have high impedance speakers (anything from 35Ω to 80Ω) these can be used, in which case they go directly between the collector of Tr4 and the positive line. The fitting of an earphone socket for this will have to be worked out if required. R6 will be a different value if a high impedance speaker is used.

The whole circuit is operated by a PP3, 9V battery which will last a considerable while. The current consumption will depend on the value of R6 but will probably lie in the range 10-20mA.

For those who have the original Treasure Tracer article, it will be seen that although very similar in many aspects, this circuit is rather simpler as well as being a bit better. The choice of a BC109 transistor for Tr4 rather than the 2N2926 used previously is not important and a 2N2926 can be used here if required.

CONSTRUCTION

The construction of the Treasure Tracer Mark II can be regarded in two distinct sections; the electronics and the mechanics. It does not matter which is tackled first.

The search coil is wound on a wooden former cut from a piece of ¼in. (6mm) plywood, see Fig. 2. This is circular in shape with a cut-out to reduce the weight although this is optional; it is a simple matter with a fret-saw or jig-saw but difficult otherwise. A groove should be cut into the edge of this circle to hold the wires. Many methods can be used to do this, the simplest way is to spin it in an electric drill and use a rasp to cut the groove. The search coil need not even be round, it could be square or triangular and many other methods of construction can be employed but the described shape has proved very successful. When this groove has been cut, two very small holes should be drilled diagonally from the groove to the top of the former as shown. Where these emerge, a connecting block can be screwed on to act as the winding anchoring point. Sixty turns in all are required; these should be neat and taut and once finished a band of tape can be wound around as shown in the photograph. An alternative would be to saturate the windings with a glue to hold them firmly in place. By sinking the windings in a groove they are protected to a considerable extent.

The handle of the device is made from aluminium tubing which is available from a number of sources. If difficulty is experienced in obtaining this it can be made from copper tubing with the same diameter, a plumber should be able to supply a suitable length. Five feet was found to be about the right length but this will depend on the height of the user.

The handle is fitted to the search coil former with a simple bracket, bolt and wing-nut as shown in Fig. 2. The connecting wire from the search coil to

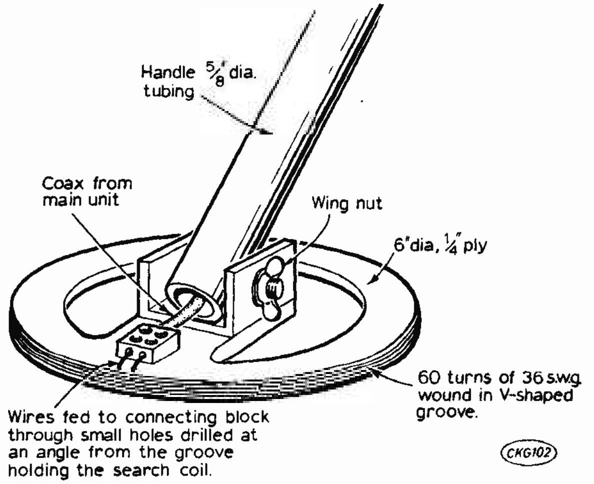
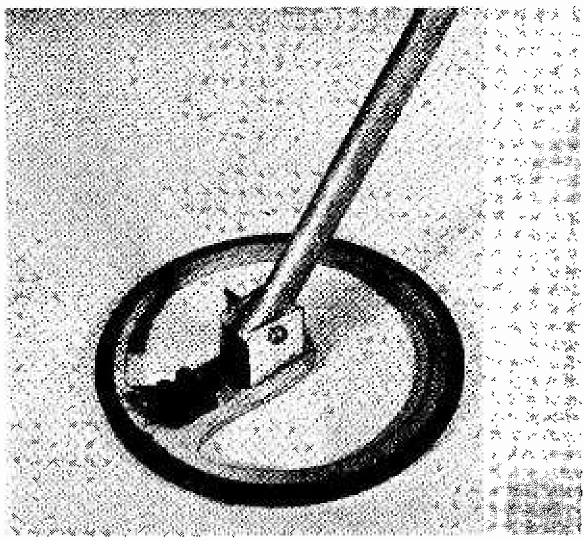


Fig. 2: The construction of the search coil. This design has been found to be excellent but as long as the inductance of the coil remains the same, any arrangement may be used.



A photograph of the search coil used in the Mark II.

the main circuit is a coax cable running up the tube. At the lower end this is fitted to the connecting block. The use of coax ensures that there will not be loose wires flopping about inside and that the capacity will remain constant. Coax is more rigid than twin wires and is also better for that reason.

The electronics is built into a aluminium case, available from the suppliers mentioned in the components list. This will have to be drilled to take the speaker and various other fittings. A drilling diagram is not shown as the siting will depend on the components used and in any case the siting is fairly obvious. A series of small holes can be drilled for the speaker or a large hole (1½in. diameter at least) which can be fitted with some form of grille.

The majority of the components are mounted on a piece of Veroboard and the layout of this is shown in Fig. 3. Veropins are used for all the take-off points as this leads to a nice, neat appearance. The coil L2 is mounted directly onto the board as shown. Four corner mounting holes should be drilled for later fitting.

A number of breaks are needed in the copper strip of the Veroboard and these are indicated in Fig. 3. There is nothing complex about the wiring. R6, which will have to be found by experiment, has plenty of room around it. The easiest way of experimenting with this is to initially wire in the recommended 22kΩ resistor with fairly long leads. Once the general operation has been established this can be cut out leaving wires sticking out. These can form the anchoring point for the replacement.

Figure 4 shows the remainder of the wiring and also the anchoring of the coax cable from the search coil. All connecting points are coded with letters and no difficulty should be experienced in this part of the construction.

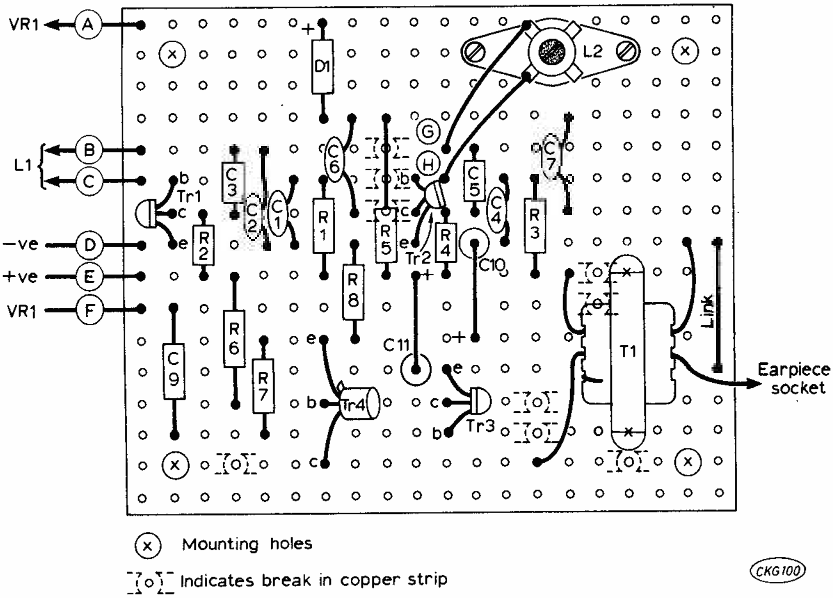


Fig. 3: The components layout on Veroboard. Veropins should be inserted at the points marked A to H.

TESTING

Once completed the unit can be tested. If all is well there will be a slight noise from the speaker which will be increased greatly by dabbing a finger onto the VR1 contact which runs to point A on the board. Set VC1 to roughly half compression and adjust the core of L2. A strong whistle should be heard at one point and this will be found to be tuneable by VC1 as well. Other lower level whistles may be heard, these are due to the oscillators beating with radio stations. In some cases it is possible to make the unit operate using only these but it will not be nearly as loud or as good. The level of the main beat note will be much louder and cannot be missed.

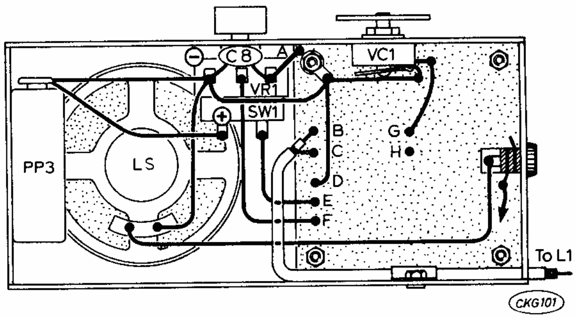
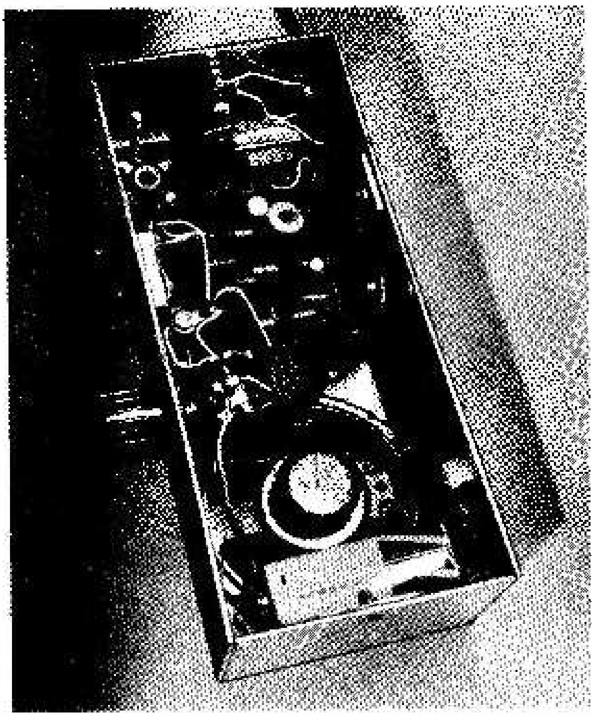


Fig. 4: The wiring inside the case. VC1 must be sited so that it does not foul the coil L2.

Once the beat note has been established, the Treasure Tracer is ready for use. We have deliberately avoided making any claims about the depth to which it will find objects. Commercial models frequently make wild claims which cannot be substantiated and we do not want to follow this example.

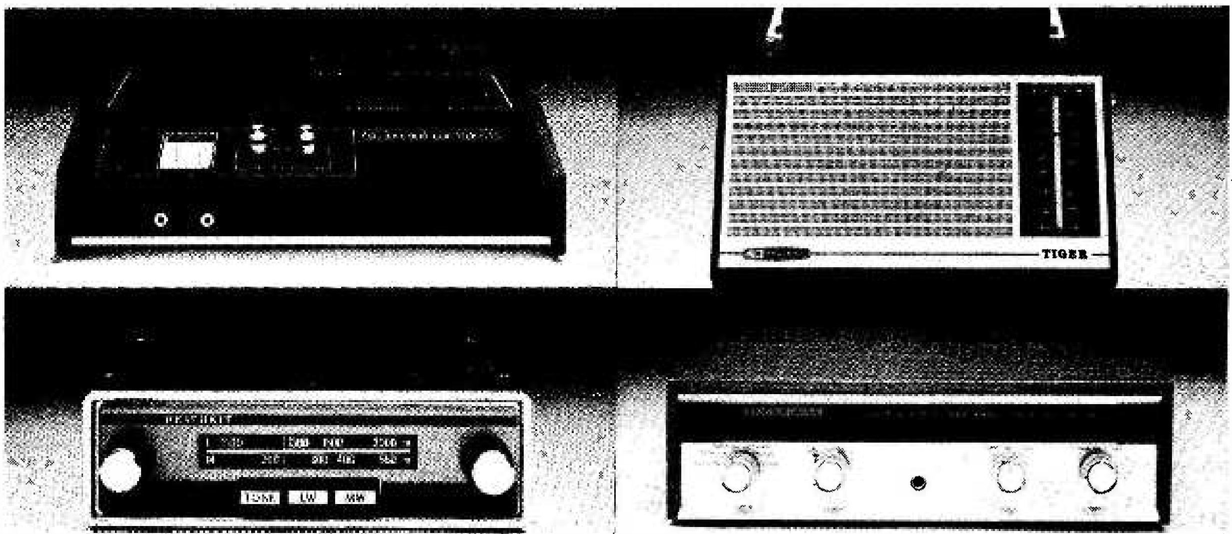


An internal view of the Treasure Tracer Mark II.

To conform with the Wireless Telegraphy Act (1949) a licence is required to use the Treasure Tracer described here.

Under Section 1(1) (Pipe Finder Licence) the band 16 to 150kHz can be used for equipment of this type.

A licence for five years costs 75p and can be applied for on a form obtainable from the Ministry of Posts and Telecommunications, Waterloo Bridge House, Waterloo Road, London S.E.1.



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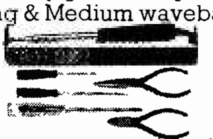

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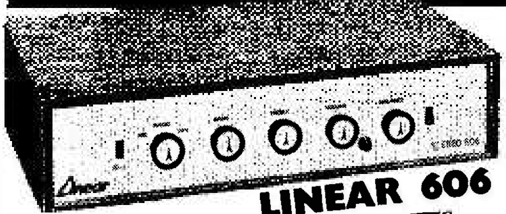


LINEAR 606

6+6 WATTS

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

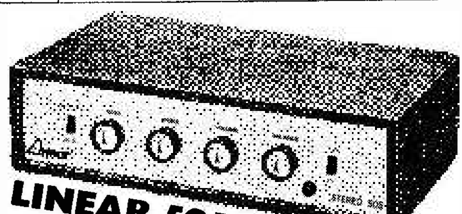
Recommended Retail Price

£22·50

TECHNICAL DETAILS

Bass Control ± 12 dB at 40 Hz.
Treble Control ± 12 dB at 14 KHz.
Sensitivities Mag. P.U. 3·5 m.v. into 47K ohm R.I.A.A. Ceramic P.U. 35 m.v. into 100K ohm. Tape Amp. 100 m.v. into 100K. Radio Tuher 400 m.v. into 400K ohm,
Crosstalk 53 dB.
Hum and Noise −75 dB min. vol.—65 dB max. vol.
Total Harmonic Distortion 0·1% at 1watt into 15 ohms.
Output (per channel) 6·5 watts I.H.F.M.

- ★ Individual Bass and Treble Controls.
- ★ Frequency Response ± 1½ dB 20 Hz to 65 KHz.
- ★ Outputs for Speaker impedances between 3 and 15 ohms.
- ★ Stereo/Mono Switch.
- ★ Input Selector Switch.
- ★ Solid State Circuitry.
- ★ Attractive silver finished metal facia and matching control knobs.



LINEAR 505

5+5 WATTS

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

TECHNICAL DETAILS

Frequency Range 20 Hz to 20 KHz
Output (per channel) 5 watts I.H.F.M.
Bass Control ± 12 dB at 60 Hz.
Treble Control ± 14 dB. at 14 KHz.

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Recommended Retail Price

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

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6F32	25
6G6	25
6H6	23
6J5M	50
6J5G	20
6J5GT	30

6J6	20
6J7M	45
6J7G	30
6J7GT	45
6K6GT	60
6K7M	35
6K7G	35
6K7GT	35
6K8M	60
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AC128	20
ACY20	20
ACY39	50
AD140	50

AD149	50
AD161	37
AF115	25
AF117	25
ASY26	25
BC107	10
BC108	10
BC109	10

BC169C	15
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BFY50	22
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GET882	25
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MJE3055	87
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NKT214	15

NKT223	33
NKT251	24
NKT713	25
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OA71	10
OA81	08
OA85	12
OA91	07
OA211	30

OAZ201	50
OAZ207	47
OAZ210	32
OAZ222	45
OAZ224	45
OAZ241	22
OAZ242	23
OAZ246	23

OC35	50
OC44	17
OC45	12
OC57	60
OC58	60
OC59	65
OC71	12
OC72	20
OC81	20

OC81D	20
OC82	25
OC82D	20
OC84	25
OC170	25
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DEPTH OF OPERATION

In the original article we showed exactly what we found and at what depths. Generally speaking coins can be detected at ranges of up to 4 or 5in. but this also depends on the size. Large objects can be detected at distances up to about a foot but the sensitivity falls off considerably over that distance.

Do no expect to become an expert as soon as you start to use the Treasure Tracer. The Mark II is considerably more stable than the Mark I and there will be fewer false signals; even so it takes an appreciable amount of practice before the small changes in the audio frequency are noticed. This point cannot be over-emphasised.

Using the Mark II one person was able to locate a $\frac{1}{2}$p coin at 4in. every time, while another, who had never tried it before, had difficulty in finding a 50p coin at 2in. This illustrates the importance of practice.

The beat note is adjustable for either a rise or fall in frequency when a metal object is approached. The author prefers a falling note but this is only personal preference. It is usually better to work with a low frequency audio note—say 100Hz—as a 50Hz change at this frequency is very noticeable; at 1kHz the same change would not be so obvious.

FREQUENCY LOCKING

If the two notes are very close together, the two oscillators will lock together. The Mark II is slightly better than the Mark I in this respect and reducing the value of C6 and C7 will lower this locking frequency even further but no advantage was found in bringing it much lower. The prototype Mark II locked at about 20Hz.

VC1 has considerable range and it has been found better to arrange for it to be used at near maximum compression, compensating for this by readjusting the core of L2. This prevents a change in frequency due to the leaves of VC1 moving which they tend to do when there is little compression. A possible improvement would be to replace VC1 with a much lower value—say around 100pF (compression trimmers in this range are available) and to wire fixed capacitors in parallel with it to obtain the correct value. This will mean that VC1 will have a narrower range, but still around the correct frequency, at the same time as reducing the likelihood of instability.

L2, as we have said, is a long-wave winding of a crystal set coil, the only modification being to fit a ferrite core (the former is already tapped to take this). It is possible, if tedious, to wind one's own coil on a $\frac{1}{4}$in. outside diameter former; 350 turns of fine wire (39s.w.g. is used by the makers) pile wound will give the correct inductance.

One point must be repeated from the previous article. Users of metal locators are not very popular with many archaeologists because of the highly irresponsible way in which some people use theirs. A local archaeological society may be happy to use your services under their supervision but others may not welcome you. *Note that there are heavy penalties for using such a device in areas scheduled as being of historical interest without permission.* ■

We regret that issues of Practical Wireless, August 1971, which described the Mark I are not available.

Electronotes..

S. GINSBERG

MANY people have expressed a mixture of interest and scepticism about the 50F (fifty Farad) "capacitors" which are contained within $\frac{1}{3}$rd of a cubic inch. These are manufactured by Gould Ionics in the U.S. and are marketed in the U.K. by Lyons Instruments at Hoddesdon. Note: the price of these units for one-off is around £25 each and the company may well only supply the professional user.

How does your radio shop test those transistor radios and televisions? Bet they have an engineer prodding about with a multimeter. Of course, knowing exactly where to prod and why is the most important part.

In industry, it would take far too long to do this on the end of a fast-moving production line so other techniques have had to be employed. Automated test gear is a highly sophisticated subject, but it is becoming more commonly employed.

One piece of gear which does this has been introduced by Honeywell Limited. Designated the "Swift" digital tester, it is a portable equipment and is so simple to operate that even an unskilled person can use it successfully. It can be used for testing digital printed circuit boards when they are fully assembled. Amazing thing is the speed at which the tests can be carried out. The equipment can test at the rate of a million tests every second which is just a trifle faster than the average service engineer. A p.c.b. with some 64 connectors may be plugged in and tested and should a fault arise, this is indicated by a light which shows at which end connector the fault is.

Cable-Scan is another useful little test gadget marketed by Thomas & Betts International Inc. located at Cowcross Street, London. Imagine you had a bundle of wires to sort out. Which are the signal wires, which are earth etc? Well, Cable-Scan will tell you.

A clever idea is that the operator wears a small wrist strap which provides a signal. This is then cunningly transmitted via the operator's fingers so that all he has to do is to touch the wires. A digital readout is provided so there is no chance of an operator making an error through having to write data down—he can see at a glance. Up to 200 signal input circuits are catered for which means that the operator can tackle a mighty big bunch of wires and sort them out without any trouble.

Before you think of rushing out and buying an automated tester and setting up in business as a lightning radio and t.v. repair enterprise, the cost of the Honeywell Swift equipment is around £900. But it is still cheap for large production runs.

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

The "colonials"

I am writing in hope that you may like to enlighten "us Colonials" about some of your circuits that you print in that great little magazine P.W.

We in Australia cannot obtain quite a few components that you use, mainly coils and substitute transistors. Wouldn't it be possible to give information on coils, such as diameter, turns, gauge of wire, etc.

There is another favour you can do for your readers, don't change P.W., it's O.K. as it is.—**R. C. Shambler,** *(Australia).*

Editor's Note:

It would not really be practical to give all the information on the coils specified in P.W. However the majority of the larger advertisers in this magazine will supply components to overseas readers and even air mail postage on small items such as coils and transistors is surprisingly inexpensive. (To Australia the air mail postage is often only twice that of internal British mail).

Cassette deck

I agree with V. C. Watts (Bath) "Cassette deck" March '72. I have tried many companies in search of a deck for a home-made system. The only firm I have discovered who at one time did sell decks (made by Philips) has now stopped and according to their letter did not think they would be able to sell them again. Perhaps these and other letters may stir the component firms into action.—**A. R. Knight,** *(Oxford).*

Ebuc oidar

Leafing through my March copy of *Practical Wireless* I chanced upon the article on the Cube Radio. On closer inspection, I found that the photograph on page 998, a general view of the completed receiver, was shown as a mirror image. The lettering on the battery and the position of VR1 show this. Is this because we have to use a battery providing positrons—the mirror—images of electrons?—**G. L. Manning,** *(Middlesex).*

Alice is not a member of our Staff—it's all done by mirrors—(Editor).

Tools for the job

The purpose of this letter is to comment on *"Who makes What?"* In Feb. issues's "Letters", as it has some bearing on my own experience, although with ancillary tools rather than radio parts.

Last May I got a kit for the "PW-12-12 Stereo", which is now, after some odd troubles working fantastically well. I was determined to get the tools for the job, which included special soldering irons and bits, the standard 'nipper' type of wire cutting pliers, and long nosed ordinary pliers, I was also determined to get British tools which I did; or thought I did. My comments hereunder refer to the pliers and wire nippers.

They were both on the modern type of display card, the long nosed pliers, with nicely red *painted* handles I saw were made in England. Quite a number of filing marks here and there on them, and a scratchless finish which looked like chrome plating. These nippers had the name in large headlines of the English company which 'made' them as I thought. A London firm. Surprisingly despite the perfect finish and insulated grip of the 'nippers' there was only 10% difference in the prices, and I thought that British tool makers at last were 'With it!'

When I got home I found that these perfect nippers were made in Japan, as quite properly announced in tiny print, *for* the English firm, and I felt aggrieved.

So I went to work on my Double-12 amplifier, and exactly a month later I found that the English made pliers had 1/16in lateral play at the plier points, showing either bad workmanship or bad material. After nine months the Japanese nippers are as when bought and when I'm sewing on a trouser button, I use them in preference to scissors to cut the cotton! Clean as a whistle.

I know this does not refer to radio parts, but such an experience reflects on all British products, and I wonder if this is the reason why it is now apparently expedient *not* to put the country of origin on the product. —**N. H. Hodgson,** *(Middlesex).*

CQ thanks

I should like to thank you for printing my problem in your C.Q. column. I have had several replies recently, including one offer from a Mr. Oldknow in Horsley, Woodhouse who is willing to turn a new pulley wheel from scratch on his lathe!—**W. R. Kennon,** *(Derbyshire).*

Dreams

I often dream of being a ship's radio operator between the spark-gap and the valve era, with big brass morse keys, large accumulator terminals, 4 pin valves and coils on 2in formers and not 1/4in. The transistor should never have been invented. Old and sentimental at 26 years of age!

Just in case I start a war as an inexperienced *nut* perhaps the following details provide my defence. My construction knowledge covers from a crystal receiver to a 9 valve communications receiver.

Operating experience—42,000 miles of travel.

Operating a.m., s.s.b., c.w. and RTTY links plus Australia with the armed forces, presently employed as GPO Telegraphist.

Transistors are too small and don't leave enough room for any serious experiments, I'll still keep buying old battery *valve* sets for 50p and £1 and re-making them until they run out of supply and then I'll take up fishing.—**W. D. Logan,** *(Hyde, Cheshire).*

Nuvistors

In "Letters" of March, Mr. K. Freeby remarks on the absence of information on nuvistors. I have a copy of Practical Television dated December 1962 in which there is an illustrated article by K. Royal entitled "Practical Nuvistor Circuits". Mr. Freeby may have this magazine if he requires it.—**N. A. Hodgson,** *(84 Lansbury Drive, Hayes, Middlesex).*

We would like to thank Mr. Hodgson for his kind offer and also to thank Mr. Laurence Mason who has kindly sent us some gen on nuvistor valves to pass on to Mr. Freeby—Editor.

MULTI-SPEED MOTOR

Six speeds are available 500, 850 and 1,100 r.p.m. and 8,000; 12,000 & 15,500 r.p.m. shaft is $\frac{1}{4}$ in. diameter 230/240v Its speed may be further controlled with the use of our Thyrister controller. Very powerful and useful motor size approx. 2 in. dia. × 5 in. long, Price **88p** plus 23p postage and insurance.

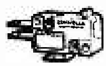
RESETTABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckoning your time at £1 per hour see how quickly our resettable fuse (auto circuit breaker) will pay for itself. Price only **£1** each or **£11** per dozen, specify 5, 10 or 15 amp—*simply fit in place of switch.*

MAINS TRANSISTOR POWER PACK

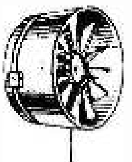
Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only **83p**, plus 20p postage.

MICRO SWITCH



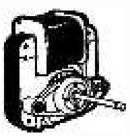
5 amp. changeover contacts, **9p** each, **£1** doz. 15 amp. Model **10p** each or **£1·05** doz.

EXTRACTOR FAN



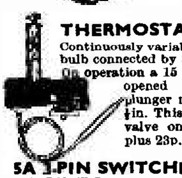
Cleans the air at the rate of 10,000 cubic ft. per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 5$\frac{1}{2}$" casing with 5$\frac{1}{2}$" fan blades. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector, and fixing brackets, **£2** plus 36p post and ins.

MAINS MOTOR



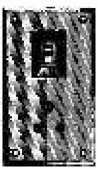
Precision made — as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at **50p**. Postage 15p for first one then 5p for each one ordered.

THERMOSTAT



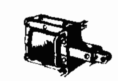
Continuously variable 30°-90°C. Has sensor bulb connected by 33in. of flexible tubing. On operation a 15 amp 250 volt switch is opened and in addition a plunger moves through approx. $\frac{1}{4}$in. This could be used to open valve on ventilator etc. **£1·50** plus 23p. p. & ins.

5A 3-PIN SWITCHED SOCKETS



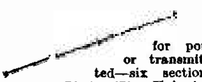
An excellent opportunity to make that bench dis board you have needed or to stock up for future jobs. This month we offer 6 British made (Hicraft) bakelite flush mounting shuttered switch sockets for only **50p** plus 18p post and insurance. (20 boxes post free.)

MAINS OPERATED SOLENOIDS



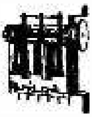
Model 772—small but powerful 1" pull—approx size 1$\frac{1}{4}$" x 1$\frac{1}{4}$" x 1$\frac{1}{4}$" **60p.**
Model 400/1 $\frac{1}{4}$" pull. Size 2$\frac{1}{4}$" x 2" x 1$\frac{3}{4}$" **75p.**
Model TT10 1$\frac{1}{2}$" pull Size 3" x 2$\frac{1}{2}$" x 2$\frac{1}{2}$"—**£1·80** plus 20p post and insurance.

TELESCOPIC AERIAL



for portable, car radio or transmitter. Chrome plated—six sections, extends from 7$\frac{1}{2}$ to 47in. Hole in bottom for 6BA screw, **38p**. KNUCKLED MODEL FOR F.M. **50p.**

3 STAGE PERMEABILITY TUNER

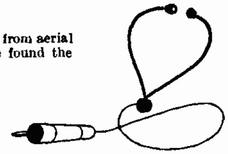


This Tuner is a precision instrument made by the famous 'Cyldon" Company for the equally famous Radiomobile Car Radio. It is a medium wave tuner (but set of longwave coils available, **25p** with a frequency coverage 1620 Kc/s-525 Kc/s and intended to operate with an I.F. value of 470 Kc/s. Extremely compact (size only 2$\frac{1}{2}$+2+$\frac{1}{2}$ins. thick) with reduction gear for fine tuning. Snip price this month **50p**, with circuit of front end suitable for car radio or as a general purpose tuner for use with Amplifier. Post free.

CAPACITOR DISCHARGE CAR IGNITION

This system which has proved to be amazingly efficient. We offer a kit of parts as PW circuit **£5·95** + 20p. De-luxe model with prepared circuit boards **£6·95.** When ordering please state whether for positive or negative systems. Also available, ready made ignition systems for 6v vehicles. **£5·25** plus 20p.

RADIO STETHOSCOPE



Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV amplifier, anything — complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. **£2**—twin stetho-set instead of earpiece **75p** extra—post and ins. 20p.

STANDARD WAFER SWITCHES

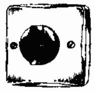
Standard size 1$\frac{1}{4}$ wafer—silver-plated 5-amp contaet standard $\frac{1}{4}$" spindle 2" long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10 way	12 way
1 pole	40p	40p	40p	40p	40p	40p	40p	40p	40p
2 poles	40p	40p	40p	40p	40p	40p	40p	70p	70p
3 poles	40p	40p	40p	40p	70p	70p	70p	95p	95p
4 poles	40p	40p	40p	70p	70p	70p	70p	£1·20	£1·20
5 poles	40p	40p	70p	70p	95p	95p	95p	£1·45	£1·45
6 poles	40p	70p	70p	70p	95p	95p	95p	£1·70	£1·70
7 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£1·95	£1·95
8 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£2·20	£2·20
9 poles	70p	70p	95p	95p	£1·45	£1·45	£1·45	£2·45	£2·45
10 poles	70p	70p	95p	£1·20	£1·45	£1·45	£1·45	£2·70	£2·70
11 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£2·95	£2·95
12 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£3·20	£3·20

THIS MONTH'S SNIP

1 Hour Minute Timer. Made by Smiths complete with control knob and calibrated dial. This months special bargain at **50p.** Useful in the Kitchen, Office and Darkroom, etc.

THYRISTOR LIGHT DIMMER



For any lamp up to 1kw. Mounted on switch plate to fit in place of standard switch. Virtually no radio interference. Price **£2·50**, plus 20p post and insurance.

MULLARD AUDIO AMPLIFIER MODULE

Uses 4 transistors, and has an output of 750mW into ohms speakers. Input suitable for crystal mic. or pick-up. 9 volt battery operated. Size 2" long × 1$\frac{1}{4}$" wide × 1" high. SPECIAL SNIP PRICE **60p** each. 10 for **£5.**

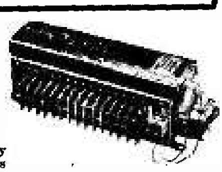
POCKET CIRCUIT TESTER

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

PW DIGITAL CLOCK

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

HONEYWELL PROGRAMMER

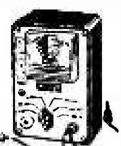


This is a drum type timing device, the drum being calibrated in equal divisions for switch setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 revs per min. Some of the many uses of this timer are Machinery control, Boiler firing, Dispensing and Vending machines, Display lighting animated and signs, Signalling, etc. Price from makers probably over £10 each. Special snip price **£5.75** plus 25p post and insurance. Don't miss this terrific bargain.

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 sub-standard or seconds. 4 of the ICs are single silicon chip GP amplifiers. The 5th is a monolithic NPN matched pair. Regular price of parcel well over **£5.** Full circuit details of the IC's are included and in addition you will receive a list of many different IC's available at bargain prices 25p upwards with circuits and technical data of each. Complete parcel only **£1** post paid. *DON'T MISS THIS TERRIFIC BARGAIN.*

BATTERY CONDITION TESTER



Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nicad—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace" "weak" or "good". The tester is complete in its case, size 3$\frac{1}{2}$" x 6$\frac{1}{2}$" x 2" with leads and prods. Price **£1·75** plus 20p postage.

Thermostat with Probe. Made by the famous Ranco Thermostat Co. Covers the range from approx. 0°-200°c variable by a control spindle, handles currents up to 16 amps. Length of capillery and sensor tube approx. 3' 6". These are ideal for ovens and as a general purpose thermostat. Price **50p** each or 10 for **£4·50.**
Small Tuning Condenser as fitted to many imported Japanese and Hong Kong radios. 2 gang about 200 pF per gang. Size approx. 1" by 1" with a $\frac{1}{4}$" diameter spindle with dust cover. **25p** each or 10 for **£2·25.**
Heat Sink. Small type as used with OC81, etc. Price **5p** each or 10 for **45p.**
High Voltage Condenser. ·265 mfd 1500v RMS which means that these have a D.C. rating of over 4000v. **75p** each or 10 for **£6·75.**
125w Starter. For 8' fluorescent tubes. Mazda 1$\frac{1}{4}$" cannister 4 pin base. Price **20p** each or 10 for **£1·80.**
IF Transformers. 465 K.C. double tuned and made for transistor circuits. **35p** per set of 3. 10 sets for **£3·15.**
Spectacle Frames (No lenses). With built-in hearing aids. The amplifier and battery being housed in the arms. Although these are complete hearing aids we are selling them purely for the sub miniature components they contain. We give no guarantee that they are in working order also these may be second hand. Price **£2·50 each.**
Giant Rev Counters. This is an 8" diameter moving coil meter with extra long (260°) pointer movement. 1mA full scale deflection. New and guaranteed perfect. Probably costing anything up to £20. Limited number only, our price **£5·50** each plus 40 p post and insurance.
Foot Switch. Twin levers each of which operates a 10 amp QMB change over switch. Price **90p each.**
9V Gram Unit. On unit plate with 33-45 change lever, complete with turntable, price **£2·25** each plus 20p post and insurance.
18 Way Plug and Socket. 15p per pair. 10 pairs for **£1·35.**
Programmers. 5 revs. per minute. Made by Magnetic Devices Ltd. The contacts may be set to trigger anywhere around the shaft, ideal for motivated lighting displays, sequential switching, etc. Drive motors are 200-240v 50 Hz. Model A has 5 change over contacts. Price **£1·50. Model B** has 11 change over contacts. Price **£2.**
Programmers. 6 revs. per minute. Similar to previous items but Swiss made and having 8 sets of change over contacts. Motor 200-240v 50 Hz. Price **£2·50** each.
Black Heat Elements. Copper clad $\frac{1}{4}$" tubular construction replacements in Tricity and many other cookers also suitable if connected in series to heat airing cupboards and for other low temperature applications. The following types are available.
900 W Model. 14" long × 1$\frac{1}{4}$" wide. Made by Backer. Price **75p** or 10 for **£6·75.**
2200 W Model. W shaped. 14$\frac{1}{2}$" long by 9" wide, **85p** each or 10 **£7·65.**
Radiant Cooker Rings. As fitted to Tricity and many other popular cookers. We have two types. These are copper clad $\frac{1}{4}$" tubular construction. Both models having an external diameter of 6$\frac{1}{2}$" and the elements have been slightly flattened to increase radiation.
Backer Type 7D1—2000 watts has a metal cover, size approx. 3" × 1$\frac{1}{4}$" × 1$\frac{1}{4}$" over the element connections. So in addition to being a replacement this could also quickly be made into a boiling ring as it only needs mounting on a simple iron frame. This element is rated 200-210v but it is perfectly safe on 240v and as these are usually simmerstat controlled the lower voltage rating is not all that important. Price **75p** each or **10** for **£6·75.**
Backer Model 7D1 Mk. II again 2000 watts rated but 230-240v, has no cover over element ends. Price **65p** each or 10 for **£5·85.**
Tricity Cooker Elements. We have quite an assortment of these and will describe them in future issues—but if in the meantime you are needing these then please let us have a sketch, we may have the exact one in stock.
Slide Switch. 2 pole change over panel mounting by two 6 BA screws. Size approx. 1" × $\frac{1}{2}$" rated 250v lamp, **6p** each, 10 for **54p**, 100 for **£5·10**, 500 for **£24.**
Thermal Trip. Bakelite encased called the "Klixon" Current passes through the heater coil and bi-metal strip clicks the circuit open should the current exceed 3 amps. Quite small and with tag and lead connections, ideal for protecting transformers or motors. Price **25p** each or 10 for **£2·25.**
Mains Transformer. Primary 240v tapped 220v. Secondary 20v $\frac{1}{2}$ amp. Price **60p.** each or 10 for **£5·40.**
Transformer. Primary 230-240v. Secondary 6·5-0-6·5 1 amp. With fitted primary screen **65p** each or 10 for **£5·85.**
Small Croc. Clips. Suitable for instruments, etc. **5p.** each or 10 for **45p.**

24-HOUR TIME SWITCH

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

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

J. BULL (ELECTRICAL) LTD.

(Dept. P.W.), 7 Park Street, Croydon CRO IYD

Callers to: 102/3 Tamworth Road, Croydon.

TECHNICAL TRAINING

in radio television and electronics

Whether you are a newcomer to radio and electronics, or are engaged in the industry and wish to prepare for a recognized examination, ICS can further your technical knowledge and provide the specialized training so essential to success. ICS have helped thousands of ambitious men to move up into higher paid jobs—they can help you too! Why not fill in the coupon below and find out how?

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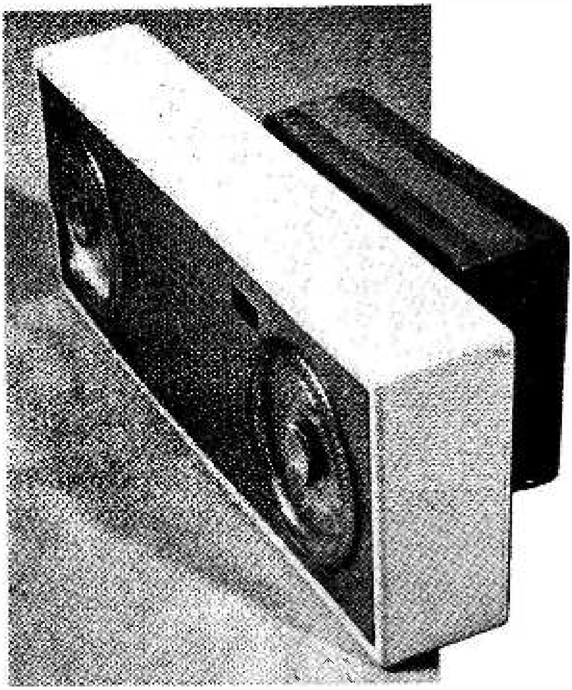


ADD-A-VERTER FOR RADIO 2

ERIC DOWDESWELL

YOU want to listen to Radio 2 but you haven't got long waves or v.h.f. on your transistor portable. What to do? Just place the Add-a-Verter behind your radio and tune in Radio 2 at about 480 metres on the dial of your receiver. No connections or fiddling about with the innards of your squawk box.

How is it done? By picking up the Radio 2 signal on 200kHz (1500 metres) and mixing it with a local oscillator 429kHz in the Add-a-Verter thus producing a new signal on 629kHz which can be heard on the receiver on the medium wave band.

Cost of the bits and pieces bought new? About £2, plus the cost of the plastic box. The average constructor will be able to find most of the parts in his junk box.

CIRCUITRY

Nothing very complicated as can be seen in Fig. 1. A commonly available 2N2926 n.p.n. silicon transistor has a quartz crystal connected between its base and collector with the supply voltage being applied via L3 which presents a high impedance at the crystal frequency. The circuit will still oscillate if the bottom end of C1 is connected to the negative line. But more later on the operation of the crystal.

The Radio 2 signal is picked up on the ferrite rod aerial L1 and fed to the base of the transistor. The signal at the collector now consists of the oscillator frequency 429kHz plus and minus 200kHz as well as the basic oscillator frequency of 429kHz. However it is the sum frequency of 629kHz which interests us, since it falls in the m.w. band.

The output coil L2 is also in the form of a ferrite rod aerial and it is the signal from this coil on 629kHz that is picked up by the ferrite rod aerial in the adjacent receiver.

THE CRYSTAL

The use of a crystal may seem extravagant and unnecessary to some but in fact it costs just 25p and its use saves much time fiddling around with coils and capacitors trying to hit the right frequency. Its stability is also so very much better than an LC combination. It is worth noting that the crystal oscillated immediately the prototype was switched on for the first time. The only other adjustment then needed

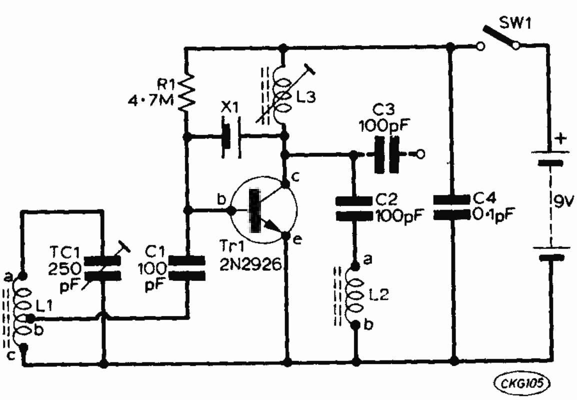
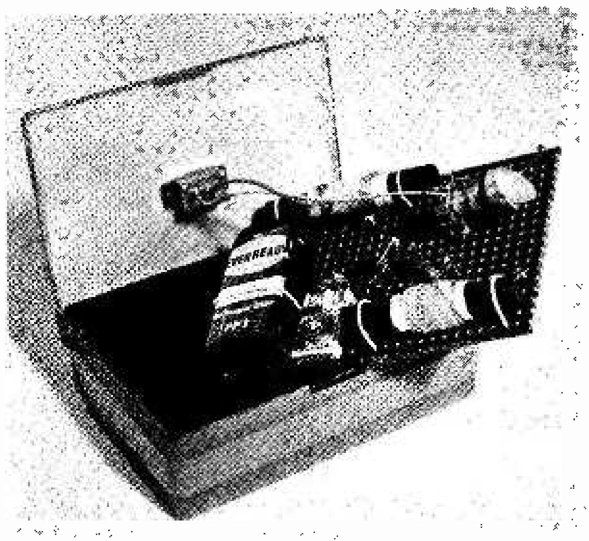


Fig. 1: The simple circuit of the Add-a-Verter. The output coil L2 is coupled to the ferrite rod aerial in the receiver, as shown in the heading photograph.



The only 'control' on the Add-a-Verter is the on-off switch!

was to peak trimmer TC1 for maximum strength of the Radio 2 signal.

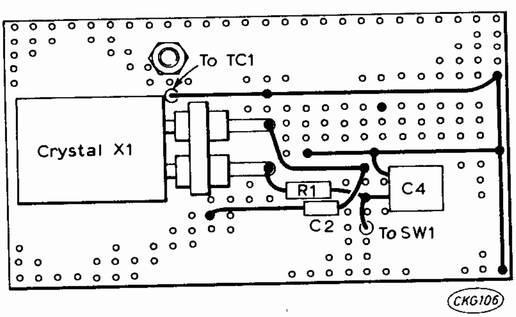
This particular type of crystal was originally used in equipment that multiplied its basic frequency fifty-four times so the crystal is designated as having an output frequency of 23·2 MHz which is shown on the crystal case as Channel 32. In fact its fundamental frequency is 429·630kHz. There is a whole range of similar crystals between about 370 and 540kHz. Some extremely useful tables showing the relationship between channel number, fundamental and output frequency can be found in the Radio Data Reference Book published by the RSGB.

To avoid interference with the converted Radio 2 signal from other stations on the medium wave band a search was made for a "quiet" spot at the l.f. end of the band but such a rarity disappeared a long time ago! The choice of the final frequency is therefore something of a compromise. What may seem a relatively quiet spot on the band in one part of the country may be alive with stations in another. However the Radio 2 signal appearing at the receiver was strong enough (in Surrey) to eliminate any other stations that can normally be heard at night on 629kHz. During the daytime there is no problem at all.

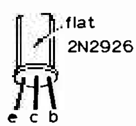
CONSTRUCTION

First obtain a plastic box, with lid, about 4×3in. with a minimum depth inside of about 1¼in. The inside dimensions of the box will determine the size of the board on which the Add-a-Verter is built. The box used in the prototype was 4¼×3×1¼in. so the following description and accompanying diagrams are based on this.

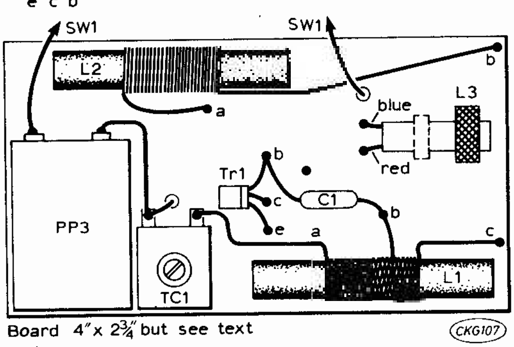
The important factors to be observed, regardless of



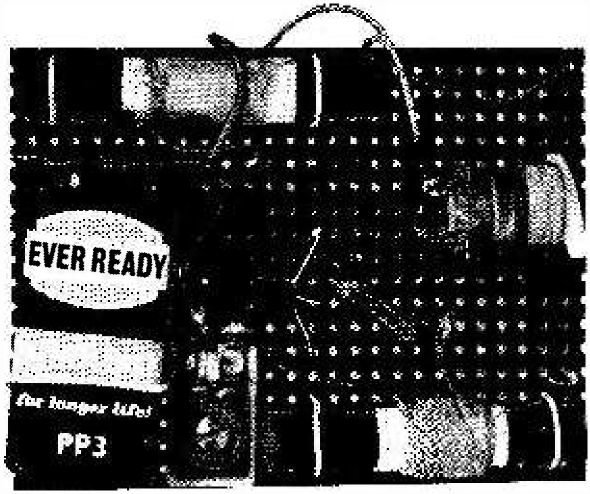
▲ *Fig. 2: Layout of the few components below the circuit board.*



▼ *Fig. 3: Component layout on top of the circuit board. Components are wired between Veroboard pins inserted in the board.*



Board 4"x 2¾" but see text
● pins



Top view of circuit board, which may be compared with Fig. 3

the size of the board, are maximum separation between L1 and L2 while keeping them parallel and horizontal and keeping L3 away from both L1 and L2 to minimise interaction.

Cut a piece of plain Veroboard to the size required and insert Veroboard pins as shown in Fig. 2. The use of copper strip board was considered unnecessary and a waste with so few components to be mounted. Coils L1 and L2 are part of a m.w./l.w. ferrite rod aerial although any similar rod aerial can be used.

First remove the coils from the rod and then cut off two pieces of the rod 2¼in. long. If space permits simply cut the rod in half. The cutting is best done by nicking the rod at the appropriate place with the sharp edge of a file. Either hold the rod in a vice and tap the free end or strike the rod smartly on the sharp edge of a table or bench. If the resulting ends are a bit rough, don't worry, it won't make any difference!

The connections to the coils L1 and L2 are shown in Fig. 4. L2 should have the few turns constituting the base winding removed although this is not strictly necessary provided the ends of this winding are not allowed to short together. If difficulty is experienced in identifying the windings connect an ohmmeter to

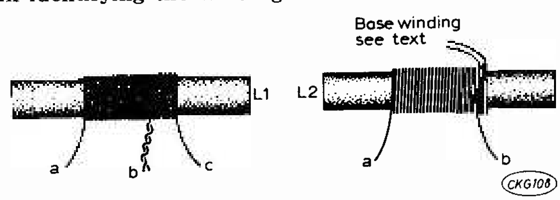


Fig. 4: Diagram of the lead-out wires of coils L1 and L2.

the single lead "a" and find the other end of the winding "b". The remaining ends will be the base winding.

Put the coils on the ferrite rods and attach the rods to the board with loops of thin insulated wire. Drill a hole and fix the compression trimmer TC1 to the board with the lock nut provided. Place the tags of the crystal holder over the appropriate pins on the underside of the board and solder, see Fig. 2. These pins provide anchoring points for the base and collector leads of the transistor on top of the board.

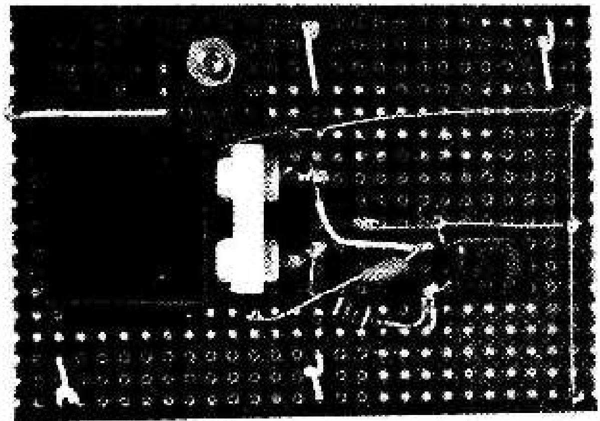
Coil L3 is the long wave winding of a l.w./m.w.

coil, freely available, and intended for use in a simple "crystal set" circuit. An iron core to suit the coil is required and should be bought at the same time as the coil since the core is not normally sold as part of the coil. In the prototype the red and blue tags of the l.w. winding were soldered directly to the appropriate pins in the board, Fig. 3, but if height permits mount the coil normally by its fixing lugs. Initially the core should be screwed in as far as possible.

Rather than cut off the excess of the coil lead-outs it is advisable to use the tinned ends as supplied, winding any surplus wire back on to the coil formers.

Complete the wiring in of the components as shown in Figs. 2 and 3 leaving the transistor until last. Hold the leads of the transistor in a pair of flat nosed pliers while tinning the ends and soldering them to their pins. Transistors are pretty tough these days but there is no point in tempting Fate!

Finally, attach the PP3 battery to the board with a wire loop as was done with the ferrite rods. The negative side of the battery clip goes to the general negative line while the positive side goes to the on-off switch, mounted on the lid of the box, and back to the positive side of the circuit. The current taken by the prototype was only 120μA so there was a temptation to omit the switch altogether! In this case the



Photograph of the underneath of the circuit board with connections as shown in Fig. 2.

working life of the battery would be about the same as its shelf life.

Plug in the crystal which should lie flat against the board but if necessary fix it to the board with another loop of wire.

SETTING UP

Put the board into the case where it should lie flat on the case of the crystal. No additional fixing was thought to be necessary. Connect a milliammeter in series with the positive battery lead. If using a multimeter set it to the maximum current range in case there are any short circuits! Switch on and if the crystal oscillates first time the current will be of the order of 120μA. If not the current will be about 200μA when the core of coil L3 should be unscrewed slowly the current dropping to a minimum and rising again. As a final check on the crystal, switch the unit on and off a few times. Each time the current should fall to around 120μA but if not readjust the core until it does. To be quite sure, remove the crystal, when the current should rise.

Switch on the portable radio and set the dial to

★ components list

R1 4·7MΩ ¼W
C1 100pF
C2 100pF
C3 100pF (if required)
C4 0·1μF 12VW
TC1 250pF compression trimmer
Tr1 2N2926 (orange, yellow or green coding)
L1/L2 part of ferrite rod aerial (Type MW/LW/5FR Denco)
L3 part of l.w./m.w. coil, with core (Type DRX1 Henrys)
X1 crystal type FT241A, approx. 429kHz ("Channel 32-23 2MC", Henrys) and holder

Miscellaneous
Miniature on/off switch, PP3 9V battery and clips. Veroboard 0·15in matrix or plain paxolin, 4 × 2¼in (see text). Plastic box.

around 480 metres on the medium wave band. Stand the Add-a-Verter close behind the radio so that the output coil is close to the ferrite rod aerial in the set and parallel to it. There is a fair chance that Radio 2 will now be audible but if not tune around 480m. on the set at the same time adjusting trimmer TC1 in the Add-a-Verter until Radio 2 is heard. Adjust the trimmer for maximum volume. To check, move the Add-a-Verter away from the set when the Radio 2 signal should disappear. For portability the Add-a-Verter can be attached to the radio with a couple of rubber bands.

Should the m.w. receiver not have ferrite rod aerial the Add-a-Verter can still be used by adding capacitor C3 from Tr1 to a terminal on the box and joining the terminal to the aerial socket on the receiver.

NOTES

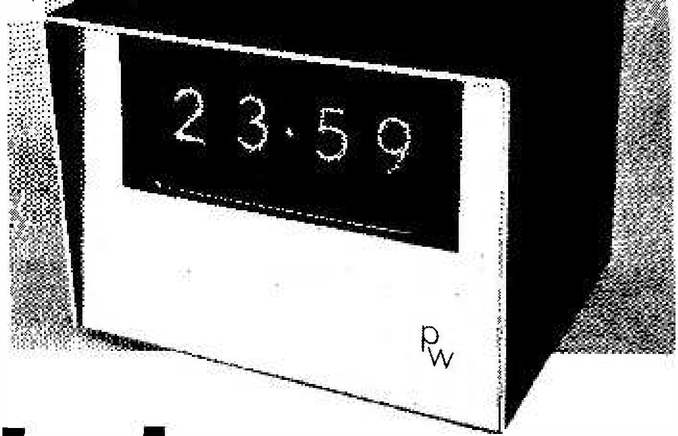
Do not use a metal box since operation of the Add-a-Verter depends upon the coupling between coil L2 and the ferrite rod aerial in the receiver. A metal box will act as a screen preventing reception of Radio 2. A metal box is only permissible if L2 is mounted outside and at least ½in. clear of the metal box, but this is rather getting away from the original idea of the Add-a-Verter.

Don't forget that ferrite rod aerials are highly directional and that the set and Add-a-Verter must be orientated for maximum signal strength of Radio 2.

Switch off the Add-a-Verter when normal reception is required on the medium waves as otherwise interfering beat notes will be heard on stations.

Transistors type 2N2926 with orange, yellow and green coding were all tried and found satisfactory but difficulty may be experienced if the lower gain types, brown or red, are used. ■

24 hour digital clock



J. G. MERCER

PART 2

NOTE:—In the Components List in Part 1 of the 24 Hour Digital Clock the reference number of the monolithic voltage regulator should have been shown as MVR5V and not MRV5V. The resistor marked R3 in Fig. 1 should have been shown as R4.

CONSTRUCTION

Construction commences with the assembly of four decade counter boards for the display module. First of all four holes should be drilled at the extreme corners of the boards in order to take the 6BA studding with which the display module is finally assembled, plus another below the edge connector, Fig. 7.

Each board has the component values and locations clearly marked together with the relevant notation for the edge connections. The resistor marked R1 on each of the P.C. boards corresponds to the R1's on the circuit diagram and has a value of 16kΩ for the recommended tube. Tinned copper wire should be used for all the links shown on the boards. The two types of integrated circuits should now be mounted on the boards paying especial attention that the indentations on the i.c.'s align with the marks on the P.C. board.

The numicator tube is now mounted with its leads straddling the board and viewing direction to the front. The pin connections for the tube are shown in Fig. 3 and the positions for these connections are clearly shown on the board itself.

All four boards are assembled in exactly the same way. Three of the four boards must now be slightly modified as shown in Fig. 6 (boards 2, 3 and 4). This modification is made to separate the two zero reset connections in order to be able to modify the counting sequence as described in the circuit operation.

The boards are now assembled on the studding as shown in Fig. 7 and spaced using extra 6BA

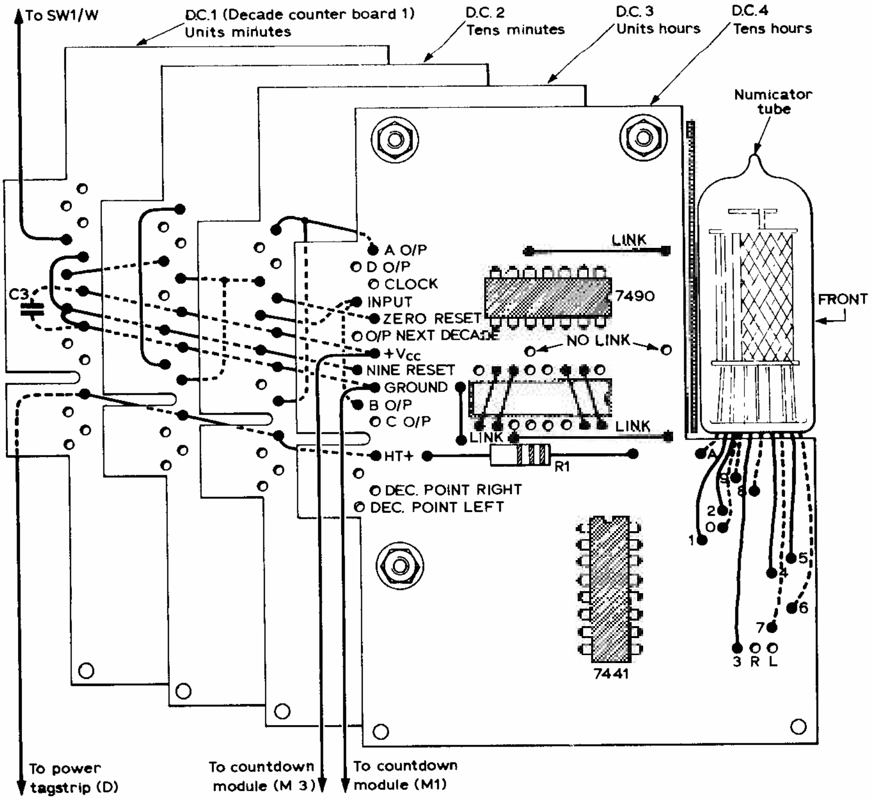
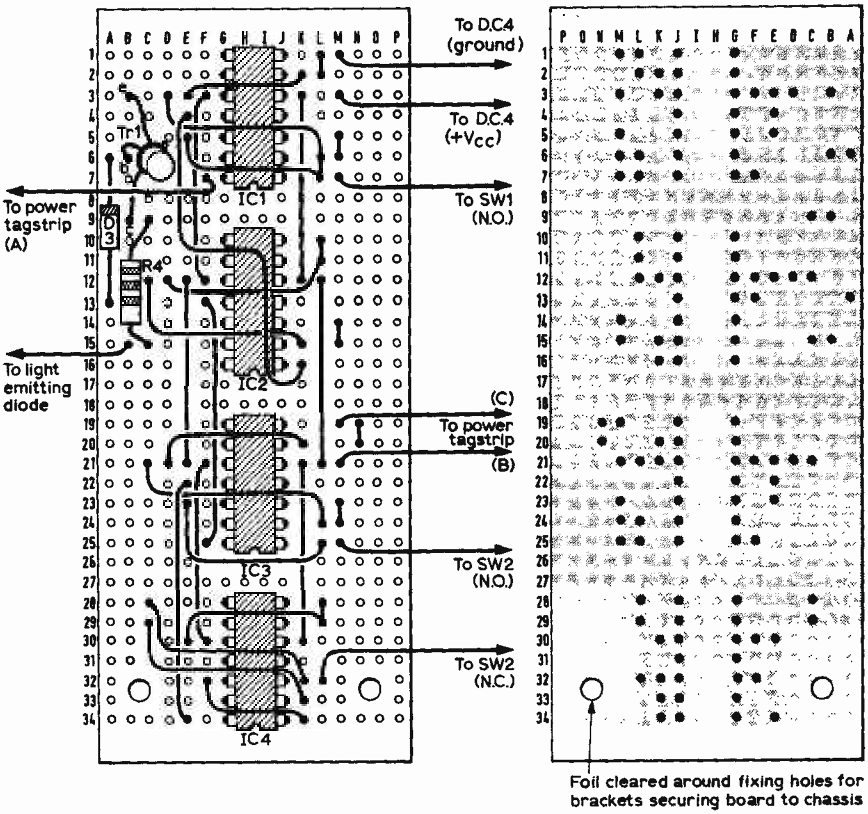
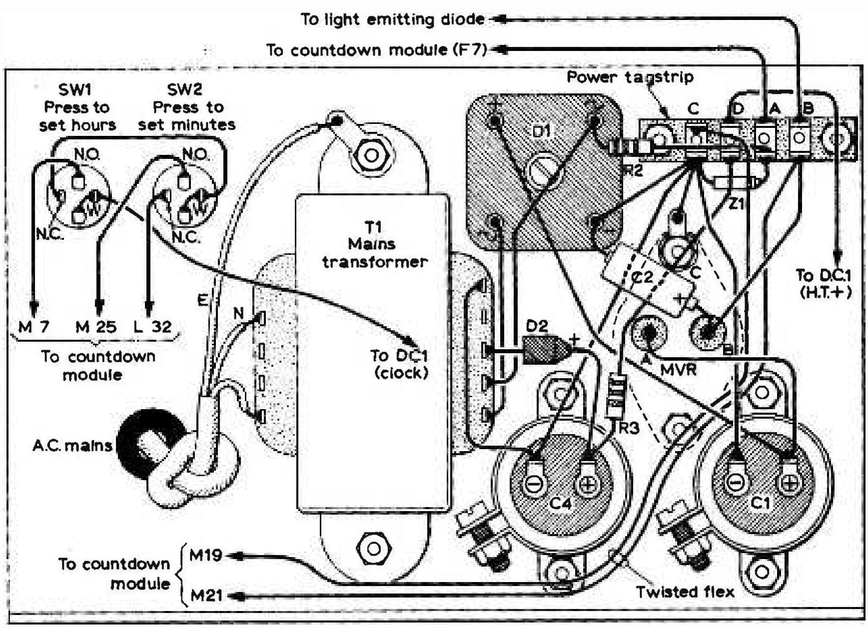


Fig. 7. Assembly and interconnecting wiring of the display module comprising the four decade counter boards.



▲ *Fig. 8. Constructional details and wiring of the countdown board. Care must be taken to ensure that the copper strips are cleared from around the two fixing down brackets.*

▼ *Fig. 9. Layout of the power supply components and two reset switches on the back panel. The voltage regulator must be bolted directly on the back panel which acts as a heat sink.*



nuts. Mounting feet are fitted to the P.C. boards—these can be seen in the photographs.

The interconnections at the rear of the boards are now made as shown in Fig. 7. Connections may be made with tinned copper wire through the holes in the edge connectors. Flying leads are connected for the input, +5V, chassis, and h.t. voltage. This completes the display module.

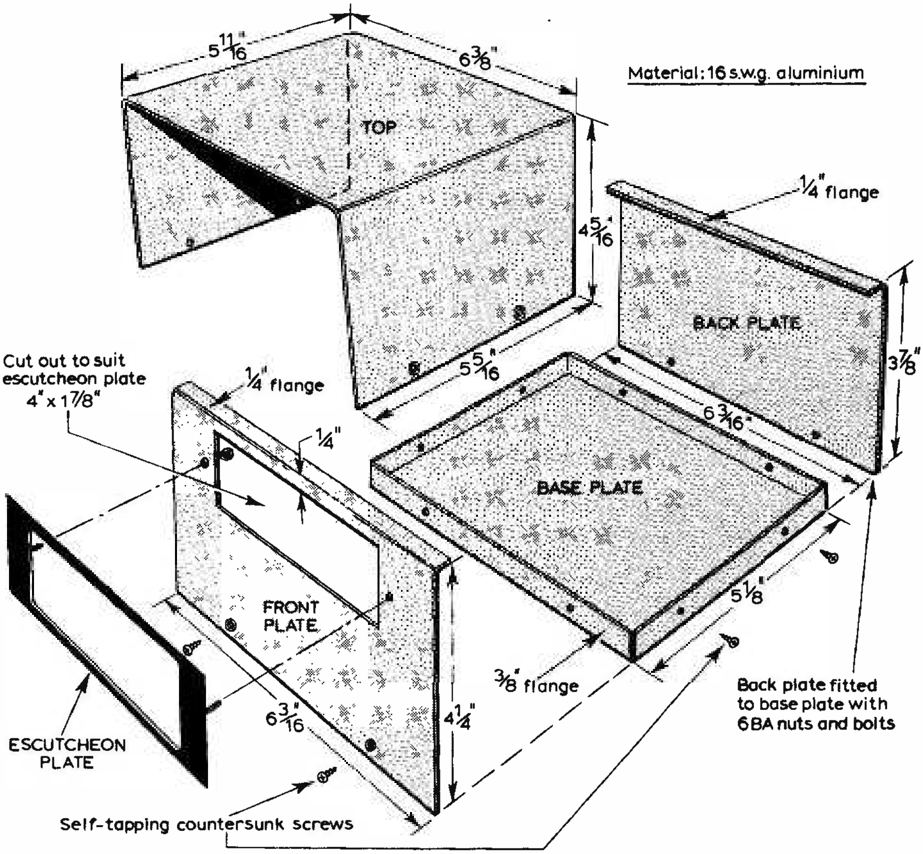
The countdown board is now assembled on a piece of 0·1in. matrix stripboard 3¾in. long by 1¼in. wide. The layout is exactly as shown in the circuit diagram, the only cuts to be made to the board are two complete lines along the length of the board between the rows of i.c. pins, Fig. 8.

All the chassis connections of the i.c.'s are commoned as are the 5V pins and flying leads added for connection to the power supply. Flying leads are also connected for the input, output and setting switches. This completes the countdown module.

The main chassis on which the power supply and other modules are mounted is simply an aluminium panel (18 s.w.g.) with an L cross section. The rear panel carries the setting switches and power supply while other modules are bolted to the base. The transformer is bolted to the rear panel as is the monolithic voltage regulator which uses the rear panel as its heat sink, Fig. 9.

The two large capacitors are also fixed to the rear panel with vertical fixing clips. The remaining power supply components may be soldered to the tags of the components already mentioned and the four outlets taken to a tag panel to permit easy connection to the other two modules.

The countdown board and display module are now bolted on to the basic chassis using angle



Dimensions and drilling details for the case and chassis which can be obtained as a kit. Note that the flanges on the base plate are uppermost. The backplate is ⅜in. shorter than the front plate thus leaving a slot along the back to provide essential ventilation. The metalwork shown in the various photographs of the Digital Clock was that used by the author in the prototype.

brackets and all the flying leads connected to the power supply and setting switches on the rear panel.

SETTING UP

The initial setting of the clock to a particular time is carried out as follows:

SW1 is depressed to allow the clock to run at 1500 times normal speed and released at a displayed time at least half an hour before the required setting. SW2 is now depressed which allows the clock to run at a speed 30 times greater than normal. The button is released at the desired time setting. The clock will now run to an accuracy determined only by the accuracy at which the mains frequency is maintained. Resetting after a power cut or accidental disconnection may be carried out as described above.

In some cases and with some types of switches, contact bounce can cause overshoot on the initial setting. It is possible to use extra integrated circuits together with changeover switches to provide electrical rather than mechanical control of the initial setting. However, due to the fact that the clock will only infrequently need setting, the extra circuit complexity and expense was not considered justified. A circuit to overcome contact bounce is shown in Fig. 10. ■

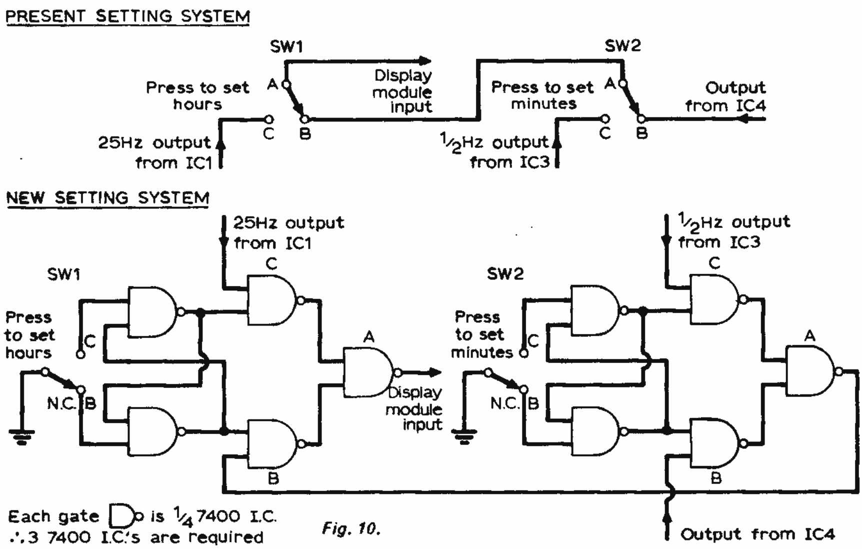


Fig. 10.

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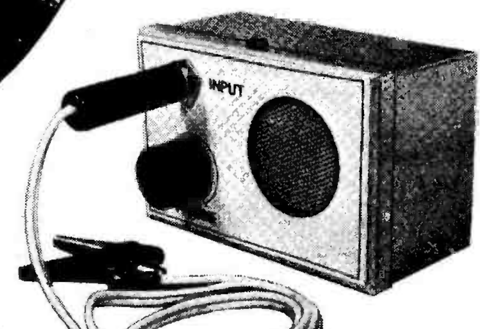

MORE ON ELECTRONIC IGNITION

PW SYSTEM

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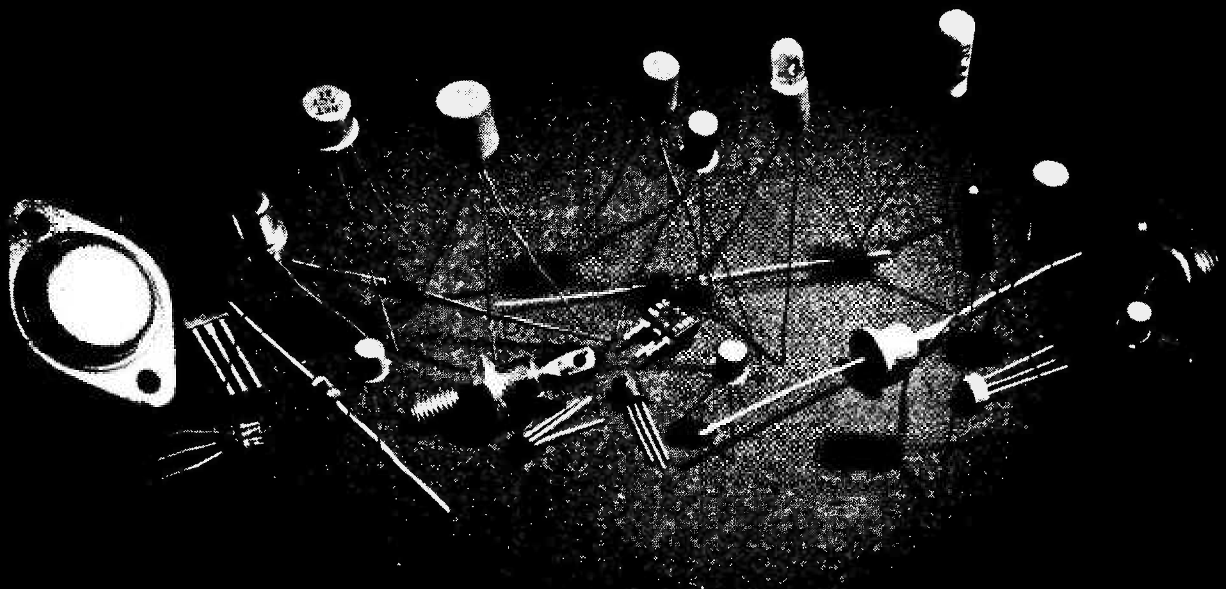


COMPILED FOR PRACTICAL WIRELESS BY D.A. LONGLAND, B.Sc., C. Eng., M.I.E.R.E. (ELECTROVALUE)

THIS SUPPLEMENT has been designed to present data to readers in a basic way. The technical details, parameters and capabilities of the more common types are given. The tables are broken down into categories by usage to simplify selection but of course many transistors could be included in several different headings. This has not been done as it would necessitate a considerable degree of duplication.

Transistors are used for many purposes, most of which may be reduced into the broad classification of increasing the power or level of a signal. This is effected by introducing the signal into the base-emitter (or gate-source circuit if a field effect transistor, f.e.t.) and thus causing an amplified variation of the signal in the collector-emitter circuit (or source drain circuit if an f.e.t.).

The important characteristics required of a transistor are determined by its application, that is, whether used for amplification of small a.c. or d.c. signals, for switching current or power amplification. Other characteristics may be important when a transistor is used near one of its limits, for example, high frequency, low noise, saturation, high power, very low current, or fast switching times.

Transistor characteristics

An ideal transistor will have a high transition frequency (fT) and low feedback capacitance (for good high frequency response), stable characteristics, low noise level, low saturation voltage, fast rise and fall times (for low loss switching characteristics), high thermal conductivity (for high power handling capacity), low leakage (for ability to operate at very low currents), high gain (to reduce the number of stages for a given requirement) and low temperature effects (to reduce dependence on operating temperature and power dissipation).

It would be rare to find many extreme characteristics in one transistor for the technology used in producing an extreme in one characteristic may be incompatible with that used in producing an extreme in another. Hence, if a small signal, high frequency amplifier transistor were chosen it would have a medium gain at low currents, low feedback capacitance and high fT, therefore it would be made on a small semiconductor chip. One would not therefore expect the same transistor to handle a high voltage, high power, or have a low saturation voltage at high current. This illustrates the need for compromise and in turn accounts for the large number of transistors available, many having their own individual collections of characteristics suited to particular applications.

In choosing a transistor, one has to start by determining the category in which the major characteristics fall, e.g. r.f. or a.f. amplification, switching, low or high power, high or low voltage, PNP or NPN. After choosing a range of transistors, the secondary characteristics may then be chosen.

1. In high frequency application, having chosen one with an fT considerably higher than the operating frequency (if possible) and having a low feedback capacitance one would then seek a type having suitable voltage rating, power, dissipation, current or power gain, and if for switching, rise and fall time and saturation voltage.

2. For low frequency application, the fT is relatively unimportant though with a high gain transistor, a transition frequency rather higher than the product of the current gain and highest frequency of operation should be sought: thus an amplifier using a transistor with an fT of 1MHz and a current gain of 100 would be expected to fall in frequency response at 10kHz. A suitable voltage and power rating would then be chosen, keeping in mind any extremely low current or low saturation voltage characteristic required: thus an amplifier to operate at 1mA should have a collector-base leakage current rather less than 1mA divided by the desired maximum current gain of the transistor in order that the transistor will not saturate. A high gain transistor will give a higher input resistance than a low gain type, thus the high gain type would take less to drive power, but may cause a limitation in the frequency response.

3. For switching application it is desirable that the transistor conduct heavily with little voltage drop (i.e. low saturation voltage) when driven. For high speed switching the response time (i.e. rise, fall and storage) is important since the power dissipated in a slow transistor will be relatively high and may limit the power or frequency to be switched.

4. Other characteristics of a particular nature may be sought, e.g. a given outline for incorporation into existing equipment, or ease of heat sinking (to reduce temperature rise if high power is to be dissipated), or high reverse base voltage for certain switching purposes, etc., etc. All must be considered in the design of equipment and in the selection of a suitable or substitute transistor.

The following tables are designed to assist in selection and substitution—it will be found that perhaps many transistors will serve one particular and non-demanding application whereas for another application only one or two will be found suitable. One factor to be considered is cost as it will be observed that a transistor which incorporates several special or extreme characteristics can be expensive. Good, common transistors which are relatively cheap and which will fulfil many needs are indicated by a dagger.

Dissipation in power transistors

Under the High Current Audio headings, the power dissipation is given in terms of thermal conductivity between junction and case in mW/°C. There is some difficulty in expressing dissipation concisely as manufacturers are inclined to give dissipation ratings at different temperatures. It is felt that the thermal conductivity gives a more useful guide in the comparison between transistors.

In order to calculate the dissipation at a particular case temperature one must multiply the excess of maximum junction temperature above case temperature by the thermal conductivity. In some cases the manufacturer does not declare the dissipation at 25°C, therefore one should not assume that it would be safe to dissipate the maximum power as calculated above at 25°C case temperature. One may assume it safe to operate at a case temperature midway between 25°C and maximum junction temperature, this covering most practical requirements.

As a general guide, the maximum junction temperatures (which should not be exceeded by 20°C) are: Germanium (metal case) 90°C: Silicon (metal case) 200°C; Silicon (plastic case) 150°C for types 2N–, MJE–, TIP– and 125°C for types BD–.

Abbreviations

†	Inexpensive types
t	Typical.
max	Maximum.
min	Minimum.
Cob	Maximum common-base output capacitance.
f	fhfb, Frequency at which the common-base current is reduced by 3dB.
fT	Frequency at which the common-emitter current gain is unity.
hFE	Large signal current gain.
hfe	Small signal current gain.
Ib	Base current.
Ic	Collector current.
Icbo	Collector-base current with emitter open-circuit.
NF	Noise factor.
PG	Power gain.
Vcbo	Collector-base voltage with emitter open-circuit.
Vce	Collector-emitter voltage.
Vce(sat)	Collector-emitter voltage for saturated (fully conducting) operation.
Veb	Base-emitter reverse voltage.
*	Under Ic/Ib. These refer to Ic with the collector and base shorted.

GERMANIUM TRANSISTORS

R.F. Applications, PNP

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} *h_{fe}	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
NKT613F	40	40	1	10	80	*40 min	1	5			75t	2		14	100	TO7
AF114	20	20		10	60	*130t	1	8			75t	2·5		12·5	100	TO7
AF115	20	20		10	60	*130t	1	8			75t			10	100	TO7
AF116	20	20		10	60	*130t	1	8			75t			19	10·7	TO7
AF117	20	20		10	60	*130t	1	8			75t			40	0·45	TO7
AF118	70	70	1	30	375	*180t	1	6			175	2·3				TO7
AF124	20	20		10	60	*130t	1	8			75t	2·5		12·5	100	TO72b
AF125	20	20		10	60	*130t	1	8			75t			10	100	TO72b
AF126	20	20		10	60	*130t	1	8			75t			19	10·7	TO72b
AF127†	20	20		10	60	*130t	1	8			75t			40	0·45	TO72b
AF139	20	15	0·3	10	60	50t	1	8			500t			10	800	TO72a
AF201	25		0·3	10	225	50t	1	10								TO72b
AF239†	20	15	0·3	10	60	50t	1	8			700			14	800	TO72a
OC44	15		12	10	75	40–225	2	2			7·5f					TO1,RO9
OC45	15		12	10	75	25–125	2	2			9f					TO1,RO9

Low Noise, PNP

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} *h_{fe}	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
AC107	15	15	5	10	80	60t	0·3	13			0·3f	14	5			TO1,RO9
AC126	32	12	10	100	220	*130–300	2	10			2·3		10			TO1
AC151R†	32	24	10	200	150	80t	2	100			1·5	27				TO1

Small Signal Audio, PNP

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} *h_{fe}	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
NKT213	32	32	10	250	200	50–130	1	10	0·2	25/2·5	0·9f	60				TO1
NKT214†	32	32	10	250	200	*30–75	1	10	0·2	25/2·5	0·9f	60	10			TO1
NKT274†	15	15	5	250	200	*85–250	1	10			1		15			TO1
NKT275	15	15	5	250	200	*30–90	1	10			1		10			TO1
OC71	30	20	10	10	125	30–75	3	13			0·3f		16			TO1,RO9

Medium Current Audio, Small Output Types, PNP

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} *h_{fe}	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
AC128†	32	16	10	1000	220	40–110	300	10			1·5	100				TO1
AC142H	50	30	10	1200	220	40–110	400	14			1·2					TO1
AC142HK	50	30	10	1200	860	40–110	400	14			1·2					X9a
AC153	32	18	10	2000	220	50–250	300	200			1·5					TO1
AC153K†	32	18	10	2000	1000	50–250	300	200			1·5					X9a
NKT211†	32	30	10	1000	200	20–150	300	10	0·5	300/30	0·9f	60				TO1
NKT212	32	32	10	500	200	50–150	50	10	0·15	25/2·5	0·9f					TO1
NKT217	60	40	10	500	200	50–150	25	10	0·5	300/6	0·9f	60				TO1
NKT271	15	15	5	500	200	50–250	50	10			1f					TO1
OC72	32	32	10	250	125	30–90	80	15	0·25	125/12·5	1					TO1,RO8
OC81	32	32	10	500	240	50–250	50	10			1f					TO1
OC83	32	20	3	500	220	50–280	50	100	0·5	300/9	0·85					TO1
OC84†	32	20	10	500	220	60–200	50	100	0·5	300/9	0·85					TO1

GERMANIUM TRANSISTORS CONTINUED

Medium Current Audio, Small Output Types, NPN

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} *h_{fe}	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
AC127†	32	32	10	500	200	25–143	500	10	1	500/50	1·5					TO1
AC141H	50	25	10	1200	220	40–110	400	14	0·55	400*	3					TO1
AC141HK	50	25	10	1200	860	40–110	400	14	0·55	400*	3					X9a
AC176	32	20	5	300	220	52–180	500	100	0·6	500/10	1					TO1
AC176K†	32	20	5	300	1000	52–180	500	100	0·6	500/10	1					X9a
NKT713	30	30	15	500	150	50–150	50	15	0·15	50/5	1f					TO1
NKT773	15	15	5	300	150	50–150	50	15								TO1

High Current Audio, Power Output Types, PNP

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c max	P_{tot} max	h_{FE} *h_{fe}	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
AD140	55		10	3A	666	30–100	1000	100								TO3
AD142	80	50	10	10A	666	30–170	1000	5000	0·3	5000/250	0·45					TO3
AD149†	50	30	20	3·5A	500	30–100	1000	350			0·5					TO3
AD162†	32	20	10	1A	222	80–320	500	40			1					MD17c
AL102	130	60	2	6A	666	40–250	1000	1000	0·5	5000/250	4					TO3
NKT403†	80	32	40	10A	770	50–150	1000	150	0·42	1000/100	0·35					TO3
NKT405	60	32	20	5A	770	100–200	1000	150	0·42	1000/100	0·35					TO3
OC25	40	40	10	4A	500	15–80	1000	100								TO3
OC28	80	60	40	8A	666	20–55	1000	100	1·6	6000*	0·25 f					TO3
OC29†	60	48	20	8A	666	45–130	1000	100	1·6	6000*	0·25 f					TO3
OC35	60	48	20	8A	666	25–75	1000	100	1·4	6000*	0·25 f					TO3
OC36	80	60	40	8A	666	30–110	1000	100	1·6	6000*	0·25 f					TO3
2N2147	75	50	1·5	5A	666	100 min	1000	1000	0·6	5000/250	3					TO3

High Current Audio, Power Output Types, NPN

AD161†	32	20	10	1A	222	80–320	500	50			1					MD17c

See note on power dissipation

Medium Current Switching, PNP

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} *h_{fe}	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
ACY17	70	32	12	500	260	50–150	300	10	0·3	300/15	1					TO5
ACY18	50	30	12	500	260	40–120	300	10	0·3	300/15	1					TO5
ACY19	50	30	12	500	260	80–250	300	10	0·3	300/15	1·5					TO5
ACY20	40	20	12	500	260	50–145	50	10	0·2	50/1·3	1					TO5
ACY21	40	20	12	500	260	90–250	50	10	0·2	50/1·3	1					TO5
ACY22	20	15	12	500	260	30–300	300	10	0·3	300/15	0·8					TO5
ACY39	110	40	12	500	260	50–150	300	10	0·3	300/15	1					TO5
2N1303	30	25	25	200	150	20 min	10	6	0·2	10/0·5	5	20				TO5
2N1305†	30	20	25	200	150	40–200	10	6	0·2	10/0·25	10	20				TO5
2N1307	30	15	25	200	150	60–300	10	6	0·2	10/0·17	15	20				TO5
2N1309	30	15	25	200	150	80 min	10	6	0·2	10/0·13	20	20				TO5
ASY26	30	15	20	300	150	30–80	20	7	0·25	50/2	8	15				TO5
ASY27	25	15	20	300	150	50–150	20	7	0·25	50/1·55	14	16				TO5

Medium Current Switching, NPN

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} *h_{fe}	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
ASY28	30	15	20	200	150	30–80	20	35	0·25	50/2	14	16				TO5
ASY29	25	15	20	200	150	50–150	20	35	0·25	50/1·25	20	16				TO5
2N1302	25	25	25	200	150	20 min.	10	6	0·2	10/0·5	10	20				TO5
2N1304†	25	20	25	200	150	40–200	10	6	0·2	10/0·25	15	20				TO5
2N1306	25	15	25	200	150	60–300	10	6	0·2	10/0·17	20	20				TO5
2N1308	25	15	25	200	150	80 min.	10	6	0·2	10/0·13	30	20				TO5

High Current Switching, PNP

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c max	P_{tot} max	h_{FE} *h_{fe}	I_c mA @	I_{cbo} µA	V_{ce} (sat)	I_c/I_b mA @	f_T MHz	C_{ob} pF	NF dB max	PG dB	MHz @	Base
AU111	320		2	10A		15–80	6000		0·5	5000/250	2					TO3

The term switching above does not imply any discontinuity in the characteristics. Such transistors may be used as amplifiers, as may amplifier transistors be used for switching duty if their characteristics are suitable.

SILICON TRANSISTORS

R.F. Applications, NPN

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} *h_{fe}	I_c mA @	I_{cbo} µA	V_{ce} (sat)	I_c/I_b mA @	f_T MHz	C_{ob} pF	NF dB max	PG dB	MHz @	Base
BF115	50	30	5	30	145	100t	3				230t		4			TO72b
BF167	40	30	4	25	130	50t	4				350t		3·5			TO72b
BF173†	40	25	4	25	260	87t	7				550t					TO72b
BF194†	30	20	5	30	220	115t	1				260t		4			MM10b
BF195	30	20	5	30	220	67t	1				200t		4			MM10b
BF254†	30	20	5	30	220	115t	1				260t		4			TO92z
BF255	30	20	5	30	220	67t	1				200t		4			TO92z
BFY90	30	15	2·5	50	200	60t	2				1000	1·8	5	22t	500	TO72a
2N3663	30	12	3	25	200	75t	8	0·5			1250t	1·7	6·5	15	200	TO98
2N4292†	30	15	3	500	200	20 min	3	0·5			570t	2·2	6	29t	100	U29

Small Signal Audio, PNP

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} *h_{fe}	I_c mA @	I_{cbo} µA	V_{ce} (sat)	I_c/I_b mA @	f_T MHz	C_{ob} pF	NF dB max	PG dB	MHz @	Base
BC157†	50	45	6	100	220	*125–250	2	0·05	0·2t	100/5	130t					MM10a
BC158	30	20	5	100	220	*125–500	2	0·1	0·2t	100/5	130t					MM10a
BC177†	45	45	5	100	300	*125–260	2	0·05	0·2t	100/5	130t	4				TO18
BC178	20	20	5	100	300	*125–500	2	0·1	0·2t	100/5	130t	4				TO18
BC186	40	25	5	100	300	40 min	2				60	5				TO18
BC212L	60	50	5	100	360	60–300	2	0·015	0·2	10/0·5	200	10				TO92a
BC213L	45	30	5	100	360	80–400	2	0·015	0·2	10/0·5	200	10				TO92a
BC257†	50	45	5	100	220	*125–260	2	0·1	0·5	100/5	130t	6				TO92a
BC258	30	25	5	100	220	*125–500	2	0·1	0·5	100/5	130t	6				TO92a
BCY70	50	40	5	200	350	50 min.	10	0·01	0·25	10/1	250					TO18
BCY72	25	25	5	200	350	50 min.	10	0·1	0·25	10/1	200					TO18
ZTX500	25	25	5	500	300	50–300	10	0·2	0·35	50/5	150	6				X59
ZTX501	35	35	5	500	300	50–300	10	0·2	0·25	50/5	150	6				X59
ZTX502	35	35	5	500	300	100–300	10	0·2	0·25	50/5	150	6				X59
ZTX503	45	45	5	500	300	50–300	10	0·2	0·35	50/5	150	6				X59
ZTX504	70	70	5	500	300	50–300	10	0·2	0·35	50/5	150	6				X59
ZTX530	30	30	5	500	250	100–400	0·1	0·2	0·7	10/0·5	30	8				X59
ZTX531	45	45	5	500	250	40–120	0·01	0·2	0·7	10/0·5	30	8				X59
2N3906	40	40	5	200	310	100–300	10	0·05	0·25	10/1	250	4·5				TO92b
2N4126	25	25	4	200	310	120–360	2	0·05	0·4	50/5	250	4·5				TO92b
2N4059	30	30	6	30	250	45–660	1		0·7	10/0·5						TO92a
2N4060	30	30	6	30	250	45–165	1		0·7	10/0·5						TO92a
2N4061	30	30	6	30	250	90–330	1		0·7	10/0·5						TO92a
2N4062	30	30	6	30	250	180–660	1		0·7	10/0·5						TO92a
2N4289	60	45	7	500	250	160 min.	1	0·01	0·35	1/0·1	170t	8				U29

Small Signal, Audio, NPN

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} $^*h_{fe}$	@ I_c mA	I_{cbo} μA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
BC107†	45	45	5	100	300	*125–500	2	0·01	0.25	10/0·25	150	3·7	10			TO18
BC108	20	20	5	100	300	*125–900	2	0·01	0·25	10/0·5	150	3·7	10			TO18
BC147†	50	45	6	200	220	*125–500	2	0·02	0·25	10/0·5	300t	2·5	10			MM10a
BC148	30	20	5	100	300	*125–900	2	0·25	0·25	10/0·5	300t	2·5	10			MM10a
BC167†	50	45	6	100	300	*125–500	2	0·2	0·25	10/0·5	300t		10			TO92a
BC168	30	20	5	100	300	*125–900	2	0·2	0·25	10/0·5	300t		10			TO92a
BC182L	60	50	5	200	300	100–480	2	0·015			150	5				TO92a
BC183L	45	30	5	200	300	100–850	2	0·015			150	5				TO92a
BC267	50	45	6	1000	375	*125–500	2	0·015	0·22t	200/10	150		3t			TO18
BC268	30	20	6	1000	375	*125–900	2	0·015	0·22t	200/10	150		3t			TO18
ZTX300	25	25	5	500	300	50–300	10	0·2	0·35	50/5	150	6				X59
ZTX301	35	35	5	500	300	50–300	10	0·2	0·25	50/5	150	6				X59
ZTX302	35	35	5	500	300	100–300	10	0·2	0·25	50/5	150	6				X59
ZTX303	45	45	5	500	300	50–300	10	0·2	0·35	50/5	150	6				X59
ZTX304	70	70	5	500	300	50–300	10	0·2	0·35	50/5	150	6				X59
ZTX330	30	30	5	500	250	100–400	10	0·2	0·7	10/0·5	30	8				X59
ZTX331	45	45	5	500	250	40–120	10	0·2	0·7	10/0·5	30	8				X59
2N2924	25	25	5	100	200	*150–300	2	0·5			120t	12	2·5t			TO98
2N2925	25	25	5	100	200	*235–470	2	0·5			120t	12	2·5t			TO98
2N2926B	18	18	5	100	200	*35–70	2	0·5			120t	12	2·5t			TO98
2N2926R	18	18	5	100	200	*55–110	2	0·5			120t	12	2·5t			TO98
2N2926O	18	18	5	100	200	*90–180	2	0·5			120t	12	2·5t			TO98
2N2926Y†	18	18	5	100	200	*150–300	2	0·5			120t	12	2·5t			TO98
2N2926G†	18	18	5	100	200	*235–470	2	0·5			120t	12	2·5t			TO98
2N3708	30	30	6	30	250	45–660	1	0·1	1	10/0·5						TO92a
2N3709	30	30	6	30	250	45–165	1	0·1	1	10/0·5						TO92a
2N3710	30	30	6	30	250	90–330	1	0·1	1	10/0·5						TO92a
2N3711	30	30	6	30	250	180–660	1	0·1	1	10/0·5						TO92a
2N3904	60	40	5	100	310	100–300	10	0·1	0·2	10/1	200t	4				TO92b
2N4124	30	25	5	200	310	120–360	2	0·05	0·3	50/5	300	4				TO92b
2N4286†	30	25	6	500	250	100 min	0·1	0·05			280t	6				U29
2N5172	25	25	5	100	200	*100–750	10	0·1	0·25	10/1	120t	10				TO98

Low Noise, NPN

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} $^*h_{fe}$	@ I_c mA	I_{cbo} μA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
BC109B†	20	20	5	100	300	*240–500	2	0·015	0·25	10/0·25	300t		4			TO18
BC109C†	20	20	5	100	300	*450–900	2	0·015	0·25	10/0·25	300t		4			TO18
BC149†	30	30	5	200	220	*240–900	2	0·02	0·25	10/0·25	300t		4			MM10a
BC169†	30	30	5	100	300	*240–900	2	0·02	0·25	10/0·25	300t		4			TO92a
BC184L	45	30	5	200	300	250min	2	0·015			150		4			TO92a
BC269	30	20	6	1000	375	*240–900	2	0·015	0·22t	200/10	150		4			TO18
2N930†	45	45	5	60	300	100–300	0·01	0·01			80t	8	3			TO18
2N2483	60	60	6	50	360	*40–120	0·01	0·01			60	6	4			TO18
2N2484	60	60	6	50	350	*100–500	0·01	0·01			60	6	3			TO18
2N3707	30	30	6	30	250	*100–400	0·1	0·1					5			TO92a
2N5088	35	30	3	50	310	*300–900	0·1	0·05			50	4	3			TO92b

Low Noise, PNP

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} $^*h_{fe}$	@ I_c mA	I_{cbo} μA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
BC153	40	40	5	100	200	50–135	0·1	0·002	0·25	10/0·5	40	6	2·5			RO97a
BC154†	40	40	5	100	200	160–330	0·1	0·002	0·25	10/0·5	40	6	2·5			RO97a
BC159†	30	20	5	100	200	*125–500	2	0·05	0·3t	100/5	200t	5	4			MM10a
BC179†	20	20	5	100	300	*125–900	2	0·05	0·3t	100/5	200t	4	4			TO18
BC214L	45	30	5	100	360	140–400	2	0·015	0·2	10/0·5	200	10	2			TO92a
BC259†	25	20	5	100	220	120–460	2	0·1	0·8	10/0·5	130	6	4			TO92a
BCY71	45	45	5	200	350	100 min	10	0·01	0·25	10/1	300					TO18
2N4058	30	30	6	30	250	100–400	0·1	0·1	0·7	10/1			5			TO92a

Medium Current Audio, Small Output Types, NPN

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} *h_{fe}	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
BC125	50	30	5		300	30 min	150	0·05	0·5	150/15	40	12				RO97
BC140-10	80	40	7	1000	750	20 min	1000	0·1	1	1A/100	50	25				TO5
BC301	90	60	7	1000	850	40–240	150	0·02	0·5	150/15	120t					TO5
BFX84†	100	60	6	1000	800	30 min	150	0·05	0·35	150/15	50					TO5
BFX85	100	60	6	1000	800	70 min	150	0·05	0·35	150/15	50					TO5
BFY50	80	35	6	1000	800	30 min	150	0·05	0·2	150/15	60					TO5
BFY51†	60	30	6	1000	800	40 min	150	0·05	0·35	150/15	50					TO5
BFY52	40	40	6	1000	800	60 min	150	0·5	0·35	150/15	150					TO5
MC140	80	40	7	1000	800	40–300	150	0·5	0·7t	1A/100	100					X58b
2N696	60	40	5	500	600	20–60	150	1	1·5	150/15	40	35				TO5
2N697	60	40	5	500	600	40–120	150	1	1·5	150/15	50	35				TO5
2N1613	75		7	500	800	40–120	150	0·01	1·5	150/15	60	25				TO5
2N1711	75	30	7	1000	800	100–300	150	0·01	1·5	150/15	70	25				TO5
2N2270	60	45	7	1000	1000	50–200	150	0·05	0·9	150/15	60					TO5
2N3053†	60	40	5	700	1000	50–150	150	0·25	1·4	150/15	100					TO5
2N3704†	50	30	5	800	300	90–330	50		0·6	100/5	100	12				TO92a
2N3705	50	30	5	800	300	45–165	50		0·8	100/5	100	12				TO92a
2N3706	40	20	5	800	300	30–660	50		1·6	100/5	100	12				TO92a
2N3794	40	20	5	300	250	100 min	100	0·5	0·4	10/1	100	10				U29
40361†	70	70	4	700	1000	70–350	50	0·25	1·4	150/15	100					TO5
40412	250			1000	1000	40 min	30				10					TO5

Medium Current Audio, Small Output Types, PNP

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} *h_{fe}	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
BC126	35	30	5	600	300	30–120	150	0·05	0·5	150/15	200t	5				RO97
BC160-10	40	40	5	1000	750	63 min	100	0·1			100t	20				TO5
BC303	90	65	7	1000	1000	40 min	150	0·02	0·65	150/15	60					TO5
BFX29†	60	60	5	600	500	50–200	10	0·075	0·4	150/15	100	12				TO5
BFX87	50	50	4	600	600	40 min	10	0·05	0·4	150/15	100	12				TO5
BFX88†	40	40	4	600	600	40 min	10	0·05	0·4	150/15	100	12				TO5
2N1131	50	35	5	600	600	20–45	150	1	1·5	150/15	50	45				TO5
2N1132	60	40	5	600	600	30–90	150	1	1·5	150/15	60	45				TO5
2N3702†	40	25	5	200	200	60–330	50	0·1	0·25	50/5	100	12				TO92a
2N3703	50	30	5	200	200	30–150	50	0·1	0·25	50/5	100	12				TO92a
2N4036	90	65	7	1000	1000	40–140	150	0·1	0·65	150/15	60					TO5
2N4291	40	30	6	500	250	100–300	100	0·5	0·4	100/10	150t	10				U29
40362†	70		4	700	1000	35–200	50		1·4	150/15	100t					TO5

High Current Audio, NPN

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c max	P_{tot} max	h_{FE} *h_{fe}	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
BD121	60	35	6	5A	303	30–100	1·5A	50	0·65	1A/100	95t					TO3
BD123	90	60	6	5A	303	30–100	1·5A	50	0·65	1A/100	85t					TO3
BD124	70	45	6	4A	133	30–150	500	2	0·25	500/50	60					MD17c
BD130†	100	60	7	15A	666	20–70	4A	5000	1·1	4A/400	1·1t					TO3
BD131†	70	45	6	4A	167	30–75	500				60					X58
BD135†	45	45	5	1·5A	100	40–100	150	0·1	0·6	500/50	50					X58
BD141	140	120	7	8A	666	20–70	2A		1	2A/200						TO3
BDY20	100	60	5	15A		20–100	4A		1·1	4A/400	1					TO3
MJ481†	60	60	5	4A	500	30–200	1A	1000	0·4	1A/100	4					TO3
MJE521	40	40	4	3A	320	40 min	1A									X58
MJE3055	70	60	5	10A	718	20–70	4A	1000	1·1	4A/400	2					X58c
TIP31A	60	60	5	3A	320	20–100	1A	500			3					X75b
2N3054	90	55	7	4A	142	25–250	500	1000	1	500/50	0·75					TO66
2N3055†	100	60	7	15A	660	20–70	4A	5000	1·1	4A/400	0·4					TO3
2N4915	80	80	5	5A	500	25–100	2·5A	100	1	2·5A/250	4					TO3
2N5192	80	80	5	4A	320	20–80	1·5A	100	0·6	1·5A/150	2					X58
40250	50	40	5	4A	166	20–100	1·5A	1000	1·5	1·5A/150	1·2t					TO66
40251	50	40	7	15A	666	15–60	8A	5000	1·5	8A/800	0·5t					TO3

High Current Audio, PNP

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c max	P_{tot} max	h_{FE} $*h_{fe}$	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
BD132†	45	45	4	2A	167	35–75	500				60					X58
BD136†	45	45	5	1·5A	100	40–100	150	0·1	0·6	500/50	50					X58
MJ491†	60	60	5	4A	500	30–200	1A	1000	0·4	1A/100	4					TO3
MJE371	40	40	4	3A	320	40 min	1A									X58
MJE2955	70	60	5	10A	718	20–70	4A	1000	1·1	4A/400	2					X58c
TIP32A	60	60	5	3A	320	20–100	1A	500			3					X75b
2N4906	80	80	5	5A	500	25–100	2·5A	100	1	2·5A/250	4					TO3
2N5195	80	80	5	4A	320	20–80	1·5A	100	1·4	1·5A/150	2					X58

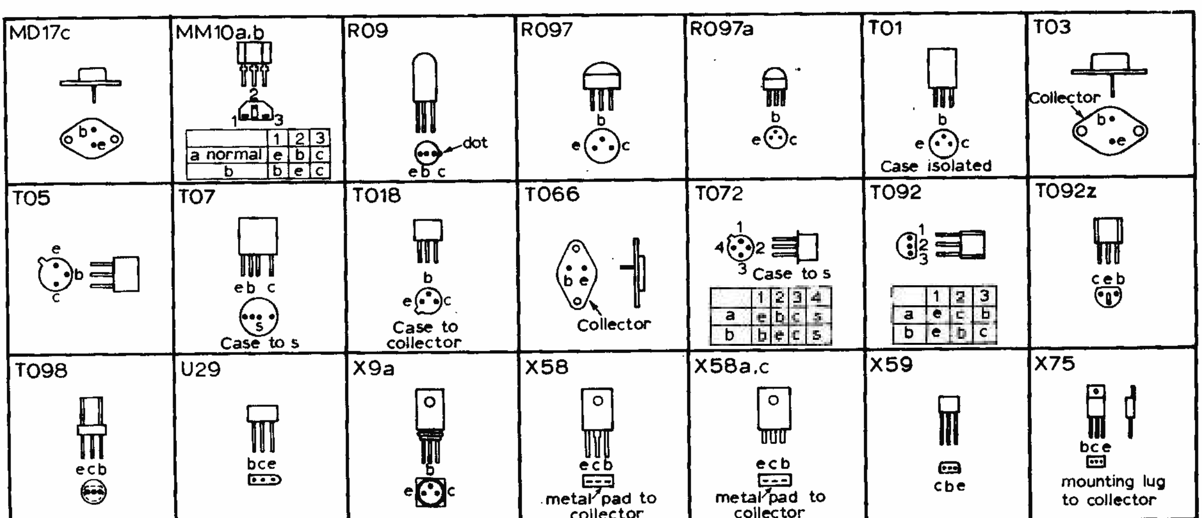
See notes on power dissipation.

Medium Current Switching, NPN

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} $*h_{fe}$	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
BSX20†	40	15	4·5	500	360	40–120	10	0·4	0·6	100/10	600					TO18
C762†	40	25	5	150	400	30–110	50	0·2	0·6	150/15	350	5				TO18
MPS6531	60	40	5	600	310	90–270	100	0·05	0·3	100/10	390t	3·5				TO92b
P346A	25	12	3		300	20 min	10	0·05	1	100/1	400	4				TO18
2N706	25	20	3	200	300	20 min	10	0·05	0·6	10/1	200	6				TO18
2N706A	25	15	5		300	20–40	10	10			200	3·5				TO18
2N2218	60	30	5	800	800	40–120	150	0·01	1·6	500/50	250	8				TO5
2N2218A	75	40	6	800	800	40–120	150	0·01	1	500/50	250	8				TO5
2N2219	60	30	5	800	800	100–300	150	0·01	1·6	500/50	250	8				TO5
2N2219A	75	40	6	800	800	100–300	150	0·01	1	500/50	250	8				TO5

Medium Current Switching, PNP

Type	V_{cbo} max	V_{ce} max	V_{eb} max	I_c mA max	P_{tot} max	h_{FE} $*h_{fe}$	@ I_c mA	I_{cbo} µA	V_{ce} (sat)	@ I_c/I_b mA	f_T MHz	C_{ob} pF	NF dB max	PG dB	@ MHz	Base
MPS6534	40	40	4	600	310	90–270	100	0·15	0·3	100/10	250	6				TO92b
V763†	25	25	5		400	30 min	50	0·05	1	150/15	300	6				TO18
2N2904	60	40	5	600	600	40–120	150	0·02	0·4	150/15	200	8				TO5
2N2904A	60	60	5	600	600	40–120	150	0·01	0·4	150/15	200	8				TO5
2N2905	60	40	5	600	600	100–300	150	0·02	0·4	150/15	200	8				TO5
2N2905A	60	60	5	600	600	100–300	150	0·01	0·4	150/15	200	8				TO5



CKG114

The TEX

20+20 WATT I.C. ST

IT is an unwritten law of electronics that whenever a group of engineers are gathered together then sooner or later a HiFi amplifier will be designed. Usually they, the amplifiers, that is, are assembled in such a way that even if they work well at the time they are quite impossible to reproduce.

The Texan is mainly a 'value-for-money' design which the average home constructor, armed with little more than a soldering iron, should be able to build successfully in a time which will allow him to remain on speaking terms with his wife.

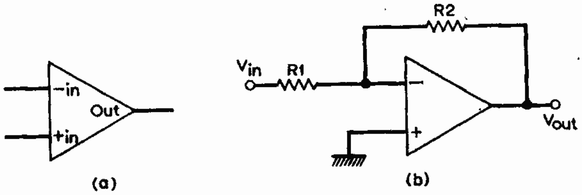
The original design was produced for a house-publication* and was intended to promote the use of integrated circuit operational amplifiers for audio use. Also, since I have an aversion to printed-circuit boards bristling with capacitors—particularly electrolytics—it was designed to reduce these to an absolute minimum.

The present circuit is updated to use the latest devices and it includes extra facilities such as scratch and rumble filters.

The printed circuit board has also been completely changed so that most of the controls are mounted directly and very little spaghetti wiring is required.

Why use operational amplifiers?

By definition the main function of a preamplifier is to provide gain and to do it in a way which is well controlled with respect to frequency response and stability.



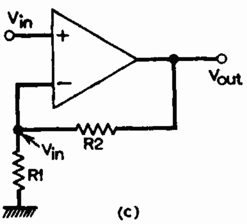


Fig. 1: (a) Triangle represents a device which has infinite voltage gain.

(b) With two resistors added.

(c) Modified circuit—see text for detailed explanation.

If someone made a transistor with a potential voltage gain 200,000, an f_T of 2MHz, a maximum phase shift of 90°, differential inputs with high common mode rejection and so and so forth there would be little point in using an operational amplifier, but to the best of my knowledge they do not. However, operational amplifiers are now so easy to use that they can be treated simply as a transistor with eight legs.

More explicity the operational amplifier has the following features:

(1) A very high mid-band gain which allows accurate equalization while retaining sufficient loop gain to reduce distortion to very low levels.

(2) Inherently high input impedance and low output impedance which make feedback networks simple to design and minimise the effect of loading.

(3) Large potential output swing giving good overload ability.

(4) Balanced design with d.c. coupling and very low offset voltages. This greatly reduces the number of electrolytic capacitors required in the amplifier and allows the output to operate without the need for manual setting up of the d.c. output conditions.

(5) High supply ripple voltage rejection which means that the operational amplifiers will work on poorly regulated supplies and reduces the likelihood of low frequency instability, one of the most common faults in many amplifier designs.

(6) Good common-mode rejection ratio of about 90dB. This describes the ability of the operational amplifier to see only the differential input and ignore voltages which are common to both input terminals so that spurious voltages appearing along a length of printed track, for example, can be almost totally rejected provided both inputs are referred to the same point on the track.

Operational amplifier theory

If you are familiar with operational amplifier theory skip the following. If not, read on.

Operational amplifiers are a very close approach, for most purposes, to the mythical 'black box' for which we make the following assumptions.

The triangle shown in Fig. 1a is a device which has infinite voltage gain (A) for differential voltages appearing across the $+_{in}$ and $-_{in}$ terminals, for which no current flows into the inputs and whose output impedance is zero.

* *Application Report B80 published by Texas Instruments Limited—is no longer available.*

AN

EREO AMPLIFIER

RICHARD MANN*

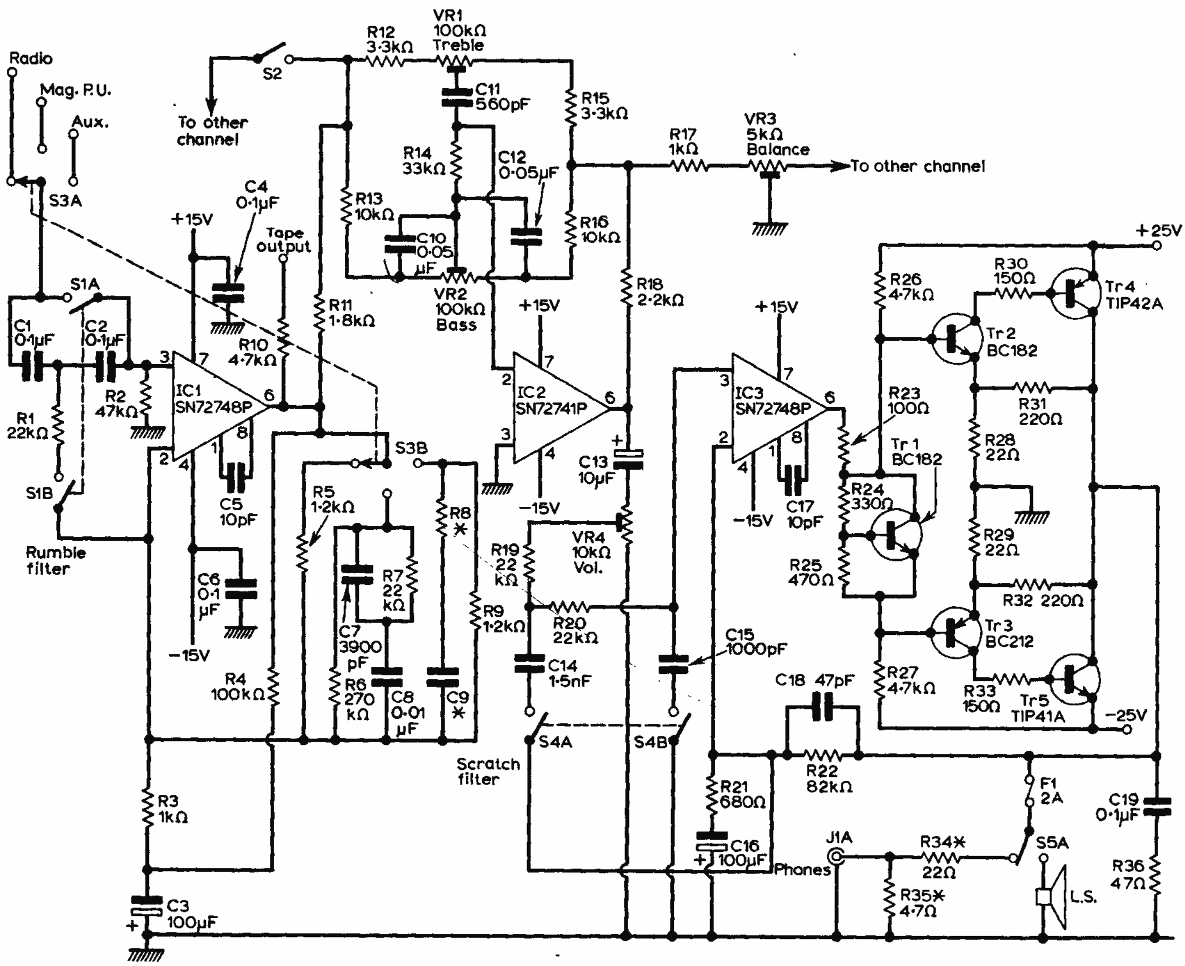


Fig. 2: One complete channel of the "Texan" stereo amplifier.

* *Texas Instruments Limited.*

Therefore, if we add two resistors as in Fig. 1b, since the + input is earthed and $A=\infty$ there is no difference in voltage between the terminals and the − input stays at ground potential becoming a 'virtual earth'. The current through R1, must therefore be $V_{in}/R1$.

As no current flows into the 'box' all input current must flow through R2 producing a voltage across it of $\frac{V_{in}}{R1}R2$ and since the current flows from the virtual earth point, V_{out} must be

$$\left(0-\frac{V_{in}}{R1}R2\right)$$

Therefore, the closed loop gain of the circuit is

$$\frac{V_{out}}{V_{in}}=-\frac{R2}{R1}$$

If we modify the circuit as shown in Fig. 1c, we have a slightly different situation. The voltage at both input terminals becomes $+V_{in}$ so the feedback current is still $\frac{V_{in}}{R1}$ but it now flows in the opposite direction so that $V_{out}=\frac{V_{in}}{R1}(R1+R2)$ and the closed loop gain $=\frac{V_{out}}{V_{in}}\left(\frac{R1+R2}{R1}\right)$

These two configurations are the classic 'inverting' and 'non inverting' amplifiers. The main differences, apart from polarity, are the input impedances, which for the former is R1 and for the latter is ∞, and the fact that the non-inverting amplifier cannot have a gain of less than unity.

The SN72748P

Most integrated circuit manufacturers make at least one version of the popular '741' operational amplifier design. This ingenious device was designed to improve on the equally popular '709' which in turn was a vast improvement on earlier integrated circuits which were essentially monolithic versions of discrete component designs. Although the 741 now has competitors from the new range of 'superbeta' amplifiers it is likely to remain an industry standard for a long time mainly because it offers very good all round performance at a very low price.

The SN72748P and SN72741P are fairly typical scions of the 741 family. The difference between them is merely that the SN72741P has internal frequency compensation which allows 100% negative feedback to be applied without the circuit becoming unstable. The SN72748P requires one small capacitor (about 10pF) to be added externally and gives a higher gain-bandwidth than the 741. Physically, they are identical in 8 pin dual-in-line plastic packages.

Typical parameters for the SN72748P when operated at ±15V supplies are:

Input resistance: 2MΩ (higher with feedback.

Output resistance: 75Ω (much lower with feedback).

Gain: 200,000.

Input offset voltage (V_{IO}): 1mV (this represents the matching error of the input transistors).

Maximum output current: 15mA r.m.s.

Maximum output voltage: 9V r.m.s.

Input bias current (I_{IB}): 0·080μA (this is the current necessary to turn on the input transistors).

Supply ripple rejection: 20,000:1

More comprehensive details of the devices, including circuitry, can be obtained from manufacturers' data sheets.

★ Specification

Sensitivity to give 20 watts into 8Ω
Radio 30mV
Magnetic pickup 2·5mV
Auxiliary (see text)

Input impedance 47kΩ 1kHz

Tape output (low level output) 130mV via 4·7kΩ unaffected by tone or volume controls

Tone controls
Treble +10 −12dB at 15kHz
Bass ±16dB at 30Hz

Balance ±8dB one channel relative to other

Filters
Rumble—critically damped 2nd order corner frequency 50Hz, 12dB per octave roll-off
Scratch—critically damped 2nd order corner frequency 5·5kHz, 12dB per octave roll-off

Interchannel crosstalk
−51dB at 1kHz
−48dB at 10kHz

Unweighted signal-to-noise of complete amplifier with full amplifier bandwidth
−60dB magnetic pickup
−72dB radio

Dynamic range (equalisation and tone control stages)
−38dB before clipping (above nominal input level)

Power Output (both channels)
20 +20 watts into 8Ω intermittent sine wave
16 +16 watts into 8Ω continuous sine wave
15 +15 watts into 15Ω continuous sine wave

Harmonic distortion
15 watts into 15Ω 0·05% at 1kHz
20 watts into 8Ω 0·09% at 1kHz

Low level distortion
0·16% at 1kHz 50mW into 15Ω
0·07% at 1kHz 50mW into 8Ω

Intermodulation distortion—wave analyser plots will appear later in this series

Frequency response (16 + 16 watts into 8Ω)
−1dB 7Hz to 22kHz
−3dB less than 5Hz to 35kHz

Stability—will drive electrostatic loudspeakers

Output impedance less than 1 milli ohm

Dimensions (less teak sleeve)
width 363mm 14·3in
height 48mm 1·9in
depth 149mm 5·9in

The following equipment was used to obtain the above measurements on the TEXAN amplifier:
Low Distortion Oscillator—Radford. Wave Analyser—Hewlett Packard 3590A/3593A. True R.M.S. Voltmeter—Hewlett Packard. Function Generator—Hewlett Packard 3300A/3305A. A.C. Digital Voltmeter—Pacific Measurements 1010. Oscilloscope—Hewlett Packard 181A. Test Oscillators (two)—Hewlett Packard 652A (intermodulation tests). X Y Recorder—Hewlett Packard 136A.

Description of circuit

The complete amplifier circuit is given in Fig. 2, but components are referred to below for only one channel. In the components list, items for the other channel are +100 (i.e. R1, R101).

The input stage amplifies the various input signals to approximately 50mV, provides whatever equalization is required and gives the loop gain necessary for an active rumble filter. The feedback may look rather complex, but it breaks down into three parts as shown below.

(1) At d.c. the output is returned to the inverting input via R (Fig. 3a) which comprises R4 in parallel with R5, R6 or R9.

C3 blocks the path to ground so substituting in the equation for Fig. 1C we have a d.c. gain of $\frac{R+\infty}{\infty}$ (i.e. unity).

Since R2 refers the +ve input to ground, the −ve input will sit at a potential of V_{IO} (approx ±1mV) and the output will also take this d.c. level. This offset is so low that there is no need for a coupling capacitor into the next stage.

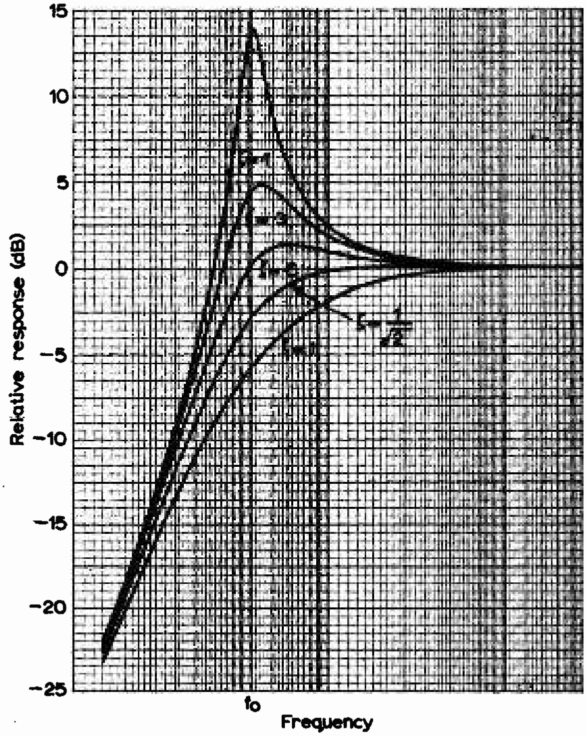
(2) At mid band a.c. the gain of the input stage becomes $\frac{Z+R3}{R3}$ where Z (Fig. 3b) is the impedance of the selected feedback network.

R4 has no effect on Z since the current through R4 is shunted to ground by C3. The feedback networks shown are designed to handle radio, magnetic pickup and auxiliary inputs and are discussed in more detail later in this series of articles.

The input impedance of the stage is inherently very high (>2MΩ) but is shunted by the 47kΩ resistor R2 which provides the damping necessary for magnetic pickups and supplies the minute input bias current for the operational amplifier,

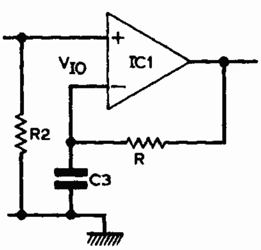
(3) A classic form of second order, high-pass active filter is shown in Fig. 3c.

The amplifier is ideally a unity gain buffer. Being a second order filter the low frequency response tends to roll off at 40dB/decade and the transitional region is a function of the damping factor (ζ) of the filter. The effect of ζ is shown in Fig. 4a and has optimum cut-off without peaking when $\zeta = \frac{1}{\sqrt{2}}$. The damping factor is evaluated from $\zeta = \sqrt{\frac{R1}{R2}}$ and cut-off frequency (f_0) from $f_0 = \frac{1}{2\pi\sqrt{R1\,R2\,C1\,C2}}$

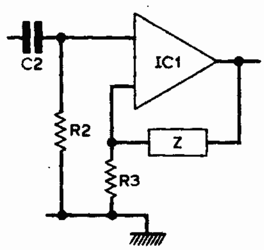


(a)

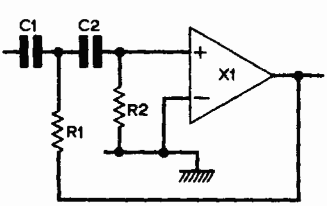
Fig. 4: (a) Theoretical response of 2nd order high pass filter for different values of ζ



(a)



(b)



(c)

Fig. 3: (a) D.C. conditions of the input stage.
(b) At mid-band a.c.
(c) Classic form of 2nd order high-pass active filter.
(see text for detailed explanation).

Since the operational amplifier has to supply a certain amount of gain in the equalization stage its output obviously does not provide a unity gain buffer. However, the inverting input terminal can be used for this purpose since its voltage exactly follows that of the non-inverting terminal.

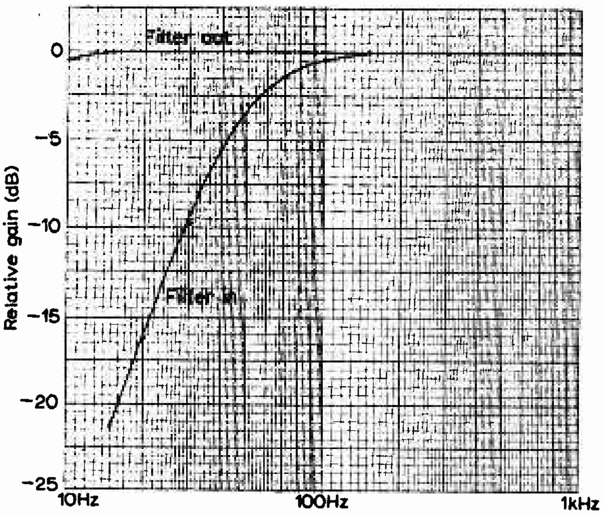
The characteristic of the filter is modified slightly because any current flowing down R1, is not shunted to ground via R3 and C3, as one might think, but has to flow through the feedback impedance Z. Nevertheless the response is very close to a standard filter response as shown in Fig. 4b.

Placing the filter right at the front of the amplifier ensures that large inputs at sub-audio frequencies will not cause any intermodulation in IC1.

The push button switch S1 removes the filter when the button is out and a direct connection is made to the selected input.

This is permissable since the d.c. bias current to the operational amplifier is in the order of nano amps and causes no problems in the average pick-up or tape head.

Facilities for coupling the equalised input signal to an external tape recorder are provided by taking the output of IC1 via a 4·7kΩ resistor R10. This



(b)

Fig. 4: (b) Rumble filter characteristic (measured).

series resistance allows the channels to be shorted externally if only a mono signal is required. The very low output impedance of IC1 (<1Ω) means that no significant crosstalk is introduced in these circumstances.

The tone control stage

The tone control is a standard Baxandall circuit using an SN72741P to provide the loop gain. A fully compensated amplifier is necessary here since there is 100% feedback around the circuit in the cut position.

The time constants of the feedback network are chosen so that there is negligible interaction between the bass and treble controls. The control range is shown in Fig. 5.

The maximum levels of bass boost and cut are determined by the end stop resistors R13 and R16 respectively. Similarly the range of the treble control is limited by R12 and R15 although in this case the bass network does have a modifying influence which adds an extra limiting factor.

The transient response of the tone control with maximum treble boost is shown in the oscillogram, Fig. 6. It is well damped and shows no tendency to ring.

Two other functions are included in the tone control stage, the mono-stereo switch and the balance control.

Fnding the optimum position for the mono switch was rather a problem since it should be before the balance control if possible. The series resistor R11 was added so that the two channels could be shorted together by S2 without overloading the pre-amplifiers (IC1 IC101). However, the resistor is not high enough to have a significant effect on the tone control range with the value given.

The balance control is an active circuit giving a control range of ±12dB for one channel relative to the other. This is a personal preference as I do not see much point in having 100% control range and it usually involves a waste of gain. However, anyone feeling strongly about it could cut out the relevant components and insert a dual gang pot between C13 and the volume control. The 10μF capacitor C13, incidentally, is the only d.c. block in the forward signal path which accounts for the good low frequency response and phase shift of the amplifier. A tantalum 'bead' capacitor is used in this position partly for its small size and partly because they will withstand a reverse polarizing voltage of 0·5V. Because the output voltage of IC2 depends mainly on its input offset it could be of either polarity but its magnitude will not exceed 200mV for any setting of the bass control (which determines the d.c. gain of the stage). A minor point here is that if the bass control is moved rapidly, a transient level shift may be heard from the loudspeaker. This effect can be removed by inserting a blocking capacitor of about 1μF between R13 and the junction of C10 and VR2, thereby fixing the d.c. gain of the stage at unity.

The scratch filter

The scratch filter is again based on a classic second order configuration as shown in Fig. 7. This low-pass circuit is the dual of the high-pass circuit used for the rumble filter (Fig. 3c). The damping factor is $\sqrt{\frac{C1}{C2}}$ and the cut-off frequency

$$\frac{1}{2\pi\sqrt{C1\,C2\,R1\,R2}}$$

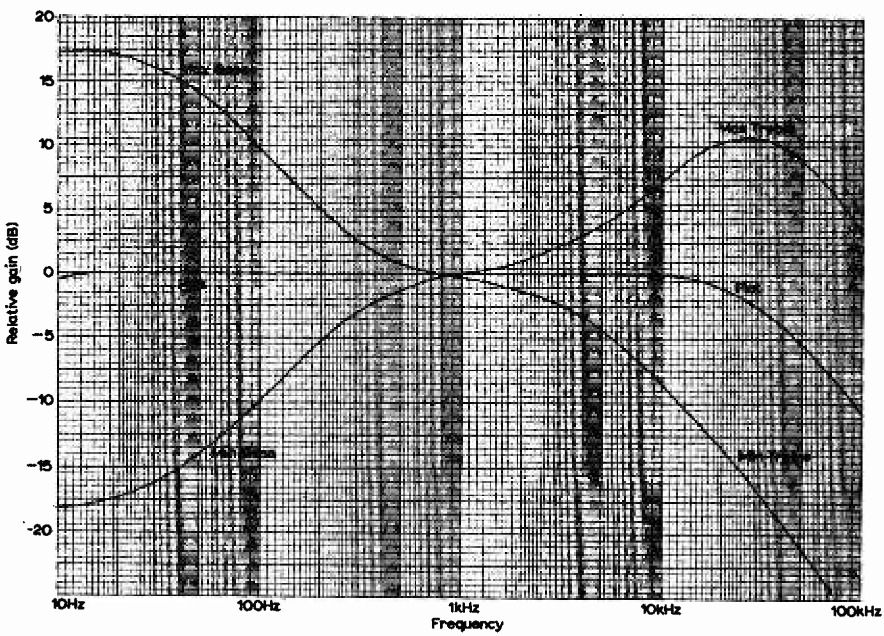


Fig. 5: The control range of the bass and treble circuit.

★ components list

Resistors:

R1 R101 22kΩ 5% ¼W		R22 R122 82kΩ 5% ¼W
R2 R102 47kΩ 5% ¼W		R23 R123 100Ω
R3 R103 1kΩ 5% ¼W		R24 R124 330Ω 5% ¼W
R4 R104 100kΩ		R25 R125 470Ω 5% ¼W
R5 R105 1·2kΩ 5% ¼W		R26 R126 4·7kΩ
R6 R106 270kΩ 5% ¼W		R27 R127 4·7kΩ
R7 R107 22kΩ 5% ¼W		R28 R128 22Ω 5% ¼W
R8 R108 — 5% ¼W	} see text next month	
R9 R109 1·2kΩ 5% ¼W		
R10 R110 4·7kΩ		R29 R129 22Ω 5% ¼W
R11 R111 1·8kΩ		R30 R130 150Ω
R12 R112 3·3kΩ		R31 R131 220Ω 5% ¼W
R13 R113 10kΩ		R32 R132 220Ω 5% ¼W
R14 R114 33kΩ		R33 R133 150Ω
R15 R115 3·3kΩ		R34 R134 22Ω 10% 5W wire wound.
R16 R116 10kΩ		
R17 R117 1kΩ		R35 R135 4·7Ω 10% ¼W
R18 R118 2·2kΩ		R36 R136 47Ω
R19 R119 22kΩ 5% ¼W		R37 680Ω 10% ¼W
R20 R120 22kΩ 5% ¼W		R38 680Ω 10% ¼W
R21 R121 680Ω 5% ¼W		

All resistors 10% ¼W high stability carbon film unless otherwise specified.

Potentiometers:

VR1 VR101 100kΩ twin-gang carbon linear
VR2 VR102 100kΩ twin-gang carbon linear
VR3 5kΩ single-gang carbon linear
VR4 VR104 10kΩ twin-gang carbon log
All pots have p.c. terminations—AB Metals type D45

Capacitors

C1 C101	0·1μF	
C2 C102	0·1μF	
C3 C103	100μF	3V tantalum
C4 C104	0·1μF	
C5 C105	10pF	10% 30V polystyrene
C6 C106	0·1μF	
C7 C107	3900pF	
C8 C108	0·01μF	
C9 C109	not normally required (see text, next month)	
C10 C110	0·05μF	
C11 C111	560pF	5% 30V polystyrene or ceramic
C12 C112	0·05μF	
C13 C113	10μF	16V tantalum
C14 C114	1500pF	5% 30V polystyrene
C15 C115	1000pF	5% 30V polystyrene
C16 C116	100μF	3V tantalum
C17 C117	10pF	10% 30V polystyrene
C18 C118	47pF	10% 30V polystyrene
C19 C119	0·1μF	
C20	1000μF	25V electrolytic Daly
C21	1000μF	25V electrolytic Daly
C22	3500μF	50V electrolytic Daly
C23	3500μF	50V electrolytic Daly

All capacitors 10% 30V polyester or mylar, unless otherwise specified

Switches:

S1 4 pole 2 way } push-on—push-off
S2 2 pole 2 way }
S3 4 pole 3 way make-before-break rotary
S4 4 pole 2 way push-on—push-off
S5 2 pole 2 way slide
S6 single pole mains on-off rocker
S1, S2 and S4 are for p.c. termination

Integrated Circuits & Semiconductors:

IC1 IC101	SN72748P	Texas Instruments Ltd.
IC2 IC102	SN72741P	
IC3 IC103	SN72748P	
Tr1 Tr101	BC182	
Tr2 Tr102	BC182	
Tr3 Tr103	BC212	
Tr4 Tr104	TIP42A	
Tr5 Tr105	TIP41A	
D1	1N4002	
D2	1N4002	
D3	1N4002	
D4	1N4002	
ZD1	BZY88C15	
ZD2	BZY88C15	

Indicator:

N1 Neon mains indicator

Transformer:

T1 Mains transformer primary 240V secondary 20-0-20V 1A. (special design) Gardners SL20

Sockets:

SK1 5W DIN socket
SK2 5W DIN socket
SK3 5W DIN socket
SK4 speaker DIN socket
SK5 speaker DIN socket
J1 3 pole stereo jack socket

Fuses:

F1 F101 2A 1·25in. cartridge
F2 F102 2A 1·25in. cartridge
F3 1A 20mm anti-surge

IC Sockets:

8 pin DIL IC sockets (IC sockets must be used—it is a condition of IC guarantee from Henry's Radio Ltd.)

Miscellaneous:

2 off twin fuseholders (1·25in fuses); 1 off panel mounting 20mm fuseholder.

All components, including a ready drilled fibre glass printed circuit board, drilled and punched metalwork, finished front panel, will be available to home constructors and the trade, from Henry's Radio Ltd. A teak sleeve will also be available—more details next month.

As with the rumble filter, its response is modified slightly by the feedback impedance of the output stage which provides its loop gain. The response of the scratch filter is given in Fig. 8 and shows that the circuit is again critically damped and reaches a roll off of nearly 40dB/decade(12dB/octave).

The output stage

The configuration of the output stage is almost identical to that of the input stage with a few extra watts thrown in. The midband gain of the stage is $\frac{R22+R21}{R21}$ and the reactance of C16 reduces this to unity at d.c. so that the final offset of the power stage is only 3 or 4mV. This feature is of importance first because it removes the need for a level setting adjustment and secondly because it allows all normal loudspeakers to be connected directly without the need for a bulky blocking capacitor. Even a Quad electrostatic loudspeaker can be driven satisfactorily in spite of the low primary resistance of its matching transformer.

The power stage is rather unusual in that it provides about 20dB voltage gain unlike the normal Darlington or other 100% feedback configuration.

The gain is introduced by attenuating the feedback with R31 and R28 for positive excursions and

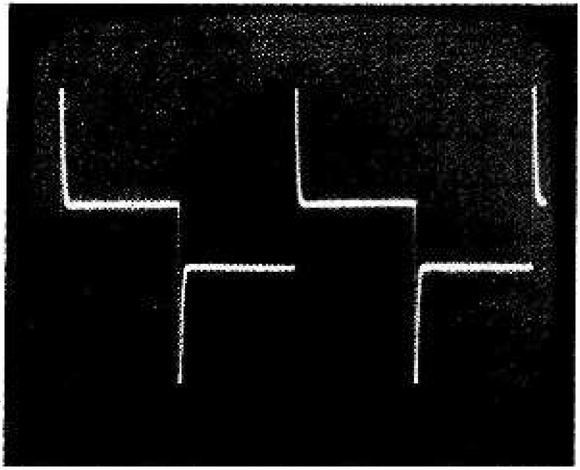


Fig. 6: Transient response of the tone control with maximum treble boost. Scale: X 200μS/div., Y 5V/div.

R32 and R29 for negative excursions. Voltage gain is necessary because the output swing of the operational amplifier is limited partly by its d.c. swing capability but mainly by its slew rate—the maximum rate in V/μS at which the output can change.

The transistors used in the power stage are low cost plastic encapsulated types. The drivers are a complementary pair of Texas Silect devices type BC182 and BC212. They have a continuous rating of 300mW in free air at 25°C which is quite adequate for driving the output transistors providing ballast resistors R30 and R33 are added to reduce their collector dissipations.

Quiescent current setting

This is always a knotty problem in class B or class AB amplifiers and is a process which frequently means instant death to the output transistors. This does not matter too much if you work for the firm which makes them but it is not so good if you have parted with hard earned cash. For this reason the circuit shows fixed resistors (R24 and R25) which set-up the potential across the V_{be} multiplier (Tr1). This potential, in conjunction with the d.c. feedback introduced by the emitter resistors R28 and R29, sets the current in the driver stage and hence, in the output transistors. If you are a purist you can sit down with a slide rule and data sheets and prove that this will give you a very wide variation of quiescent current. However, a more empirical approach based on experience with about two dozen amplifier boards and transistors from different batches have indicated that the current usually sets up between 10mA and 40mA and anywhere in this range gives good crossover performance. This is partly due to the current, rather than voltage drive into the bases of the output transistors which have no shunt resistors to their emitters. Omitting these resistors slows down the power devices slightly but this is allowed for in the frequency compensation. The oscillograms in Figs 9a and 9b show the smooth crossover for an output power of 100mW r.m.s. with triangular inputs at 1kHz and 10kHz. Should the purist remain unconvinced, however, there is provision for a 470Ω preset potentiometer on the printed circuit board. This is wired in place of R28 which should be omitted if the preset is used. There is also a link between the emitter of each TIP42A and the +25V rail which can be broken to give a current monitor point. This quiescent current in the output stage can then be set to 20mA.

Frequency compensation

It is vital to have an amplifier correctly compensated if good transient response is expected from an amplifier. All too often designs appear to have marginal stability which causes the home constructor endless problems. In the *Texan* a dominant pole is placed in the open loop response by the 10pF capacitor, C17. A further pole occurs naturally in the discrete stage which is cancelled by a zero introduced with the phase advance capacitor, C18, This gives nearly 90° of phase margin to the amplifier which allows it to cope quite well with highly capacitive loads. Fig. 10 shows the transient response when driving 20 watts into an 8Ω resistor in parallel with 2μF—said to be equivalent to an electrostatic loudspeaker load. There is a small overshoot under these conditions since transistor parameters have an inconvenient habit of changing with collector current. However, the degree of overshoot is not enough to cause trouble.

A similar oscillogram, Fig. 11, shows the output waveform when driving a Quad electrostatic loudspeaker, The power level in this case was only 1W as higher levels proved rather unpopular with my colleagues!

In addition to the compensation components there is a dummy h.f. load (C19 and R36) which is not necessary when driving most loudspeakers but takes

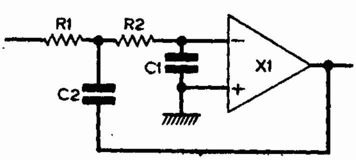


Fig. 7: (above) The scratch filter—classic 2nd. order configuration.

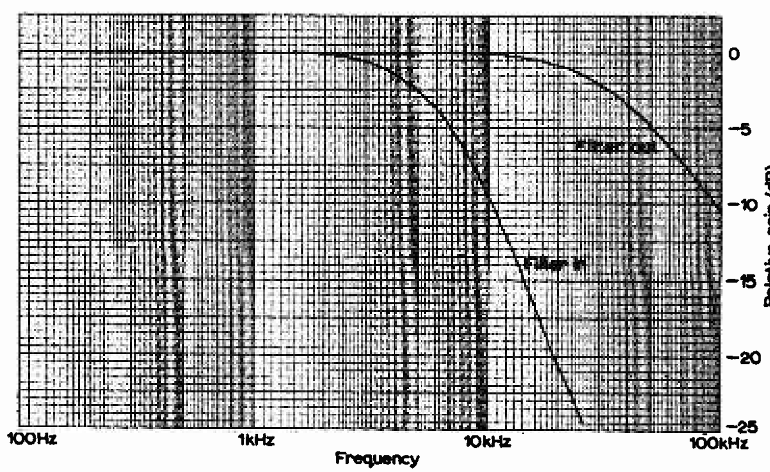
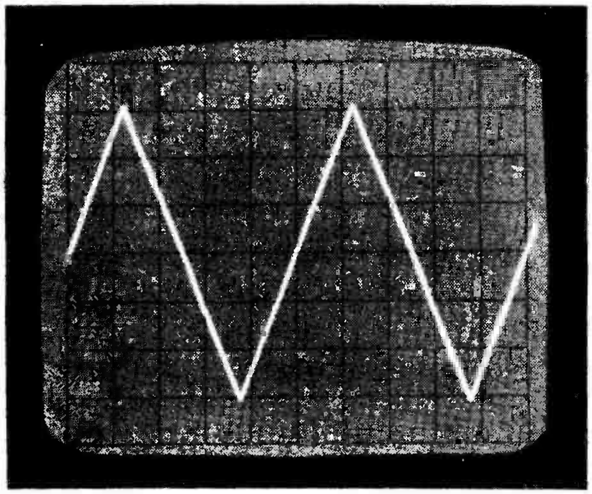
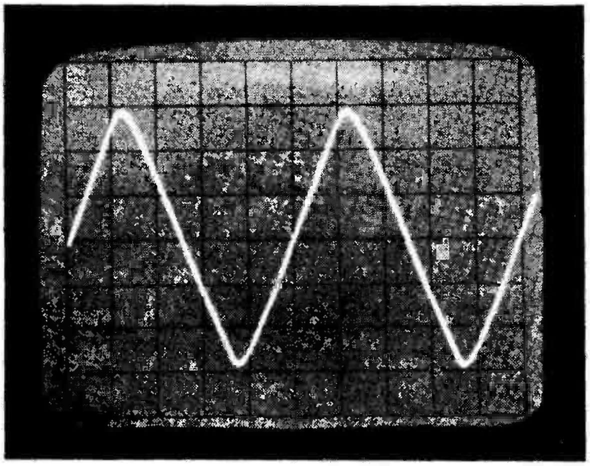


Fig. 8: (right) Scratch filter characteristic.



Oscillograms showing the smooth crossover for an output power of 100mW r.m.s. into 8Ω.
9a (above): shows 1kHz triangular wave. Scales: X 200μS/div., Y 500mV/div.
9b (below): shows 10kHz triangular wave. Scales: X 20μS/div., Y 500mV/div.



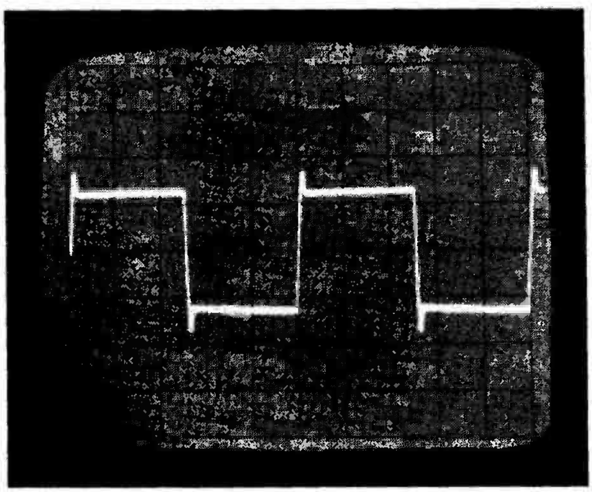


Fig. 10: Transient response driving 20W into 8Ω in parallel with 2μF. Scales: X 200μS/div., Y 10V/div.

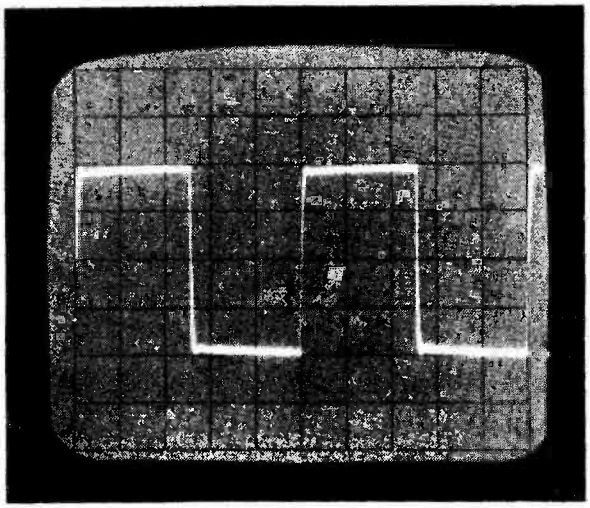


Fig. 11: Transient response when driving 1W into Quad electrostatic loudspeaker. Scales: X 200μS/div., Y 2V/div.

care of the output under nearly no-load conditions. These arise when using headphones or with some loudspeaker crossover systems which look very inductive at higher frequencies.

Headphone output

This facility was added at popular request and originally consisted of a jack socket straight across the output. An arrangement which promptly ruined a brand new pair of Koss PRO-4AA Stereo headphones not to mention a near miss on my eardrums. Although the former were kindly repaired free of charge, thereafter an attenuator seemed a good idea. The attenuator values were chosen to give a listening level very roughly equivalent to that through the loudspeakers and to be capable of driving normal low impedance headphones as those mentioned.

Overload protection

This is another brain-teaser. It is very easy to get so carried away with protection circuitry that it becomes as complex as all the rest of the amplifier put together. Simple methods frequently introduce distortion and do not protect much anyway. In the *Texan* the only protection is provided by a fuse. It gives satisfactory protection against a short circuit on the output line since the TIP41A and TIP42A have a continuous collector rating of 6 amps which allows an adequate margin for the 2 amp fuse (1 amp for 15Ω loads) to blow.

One disadvantage of using a d.c. coupled output is that a fault in the output stage could put a large continuous current through the speaker. The fuse will also protect against gross overloads but this is, of course, rather dependent on the actual loudspeaker used. It is very unlikely that a catastrophic breakdown will occur but if belt and braces are required then the traditional large electrolytic could be inserted providing the loudspeaker is returned to the −25V supply line to polarise the capacitor.

The power supply for a class B amplifier is the part most likely to be the subject of compromise. If size, weight and most of all, cost are of no consequence then a huge transformer and vast electrolytics will give almost perfect regulation. Alternatively, a regulated power supply can be built

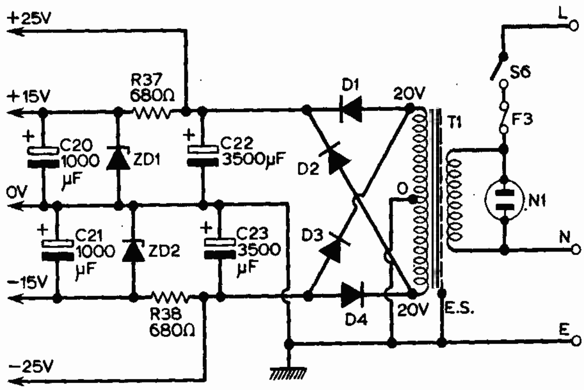


Fig. 12 Circuit of the mains power supply for the "Texan" stereo amplifier. Note that a 2A fuse (F2, 102) should be shown in the +25V and −25V supply rails respectively.

which cuts down on the electrolytics but adds at least one extra power transistor. Unless carefully designed they can also suffer from reactive output impedances or worse still instability which does not help the amplifier, of course.

The circuit diagram of the compromise chosen is shown in Fig. 12. For the output stage nominal ±25V supplies are derived from an unregulated full wave circuit with 3500μF smoothing capacitors. The 25V rails in turn supply the ±15V rails for the operational amplifiers.

The 15V supplies are stabilised by a pair of low cost zener diodes. Accuracy is not at all important here since the operational amplifiers will operate equally well with supplies between ±12V and ±18V. The zeners are necessary more as clamps to ensure that the rail voltages do not exceed ±18V, the maximum rating for the operational amplifiers. In parallel with the zeners are two 1000μF capacitors, C20 and C21. These may seem rather high in value but with full bass boost and magnetic pickup equalization, an equivalent input in the order of 10μV at 20Hz will produce 20W at the output. It is, therefore, essential to reduce ripple feedback to a minimum. The same reason, of course, accounts for the ease with which careless earthing can introduce low frequency instability.

The mains transformer recommended for the *Texan* is of rather unusual construction. It is a new design for which the manufacturers claim very low stray magnetic field—a great help when positioning the amplifier near a magnetic pick-up.

It also has a height of only 1·5in. which gives the *Texan* its 'slim-line' dimensions.

The nominal secondary voltage is 20-0-20 at 1 amp continuous r.m.s. and measurements on the transformer in circuit showed a regulation of about 3V r.m.s. between no load and a continuous sine power of 20 watts into one 8Ω load. The d.c. rails variations are as follows:

Quiescent	±32V
20W sine into 8Ω (one channel only)	±23V
16W sine into 8Ω (both channels simultaneously)	±17V

It is apparent from these figures that the power supply is a major influence on maximum output power and distortion when considering continuous sine wave inputs.

Although holders for the integrated circuits were not used on the prototype, it is however recommended that they are used by the constructor.

TO BE CONTINUED

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ISSUES WANTED

...A May 1971 and two June 1971.—Martin Cooper, 1 Cranston Road, Bramcote Hills, Beeston, Nottingham, NG9 3GU.

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...P.W. August 1968.—P. Mitchell, 35 Inverton Road, Kirkcaldy, Fife, Scotland.

...Issue of P.W. which dealt with the construction of a continuous loop echo chamber (principle of record and fast/replay/erase tape recorder).—J. Peters, 83 Carlyon Road, Hayes, Middlesex.

...March 1966 issue of Practical Wireless.—M. Allmark, 4 Bowood Grove, Meanwood, Leeds, LS7 2PX.

...July, Oct., Dec. 1970, Feb. 1971, of P.W.—D. Knott, 39 Wychbury Road, Quarry Bk., Brierley Hill, Staffs., DY5 2XX.

...P.W. for August, September, October, November. All 1971.—F. Young, Church Hill, Holme Sp. Moor, York, YA4 4EE.

...P.W. April 1971.—H. R. Hodson, 61 Molineaux Road, Sheffield, S5 0JZ.

...January 1970 issue P.W.—M. Brown, 47 Stanmore Road, Nahoon, East London South Africa.

...Practical Wireless Jan. 1971.—B. P. Leite, Caixa Postal 8984, S. Paulo 01009, Brazil.

.. Practical Wireless, Volume 45 (May 1969–April 1970 inclusive), Practical Wireless for November 1971, Practical Electronics, Volume 5 (January 1968–December 1969).—Martin Ridge, 25 Broomfield Crescent, Leeds, LS6 3DD.

...June, July, August issues 1971 of Practical Wireless. All expenses refunded.—M. B. Spiller, 17 St. Andrew's Road, Halfield, Salisbury, Rhodesia.

...Back copies which cover "Digital Frequency Counter/Timer" by J. Thornton-Lawrence.—D. W. Barber, 28 Aldersey Road, Crewe, Cheshire, CW2 8NR.

...Issue of P.W. with the P.W. Treasure Locator.—J. Wholden, 4 Bewley Road, Trowbridge, Wilts.

...Jan. 1971 issue of Practical Wireless with an article on the P.W. Stereo Tape Recorder.—M. J. Brill, 43 Crockham Way, Eltham, London, SE9 3HD.

...Jan. 1971 issue of Practical Wireless.—A. W. Fletcher, 65 Waterloo Street, Hove, BN3 1AH, Sussex.

...January issue(s) of P.W. with the construction of a stereo tape recorder.—S. Savage, 13 Merton Road, Walthamstow, London, E.17.

...April 1971 issue Practical Wireless.—Mr. T. M. Fresson, Farnham, Surrey.

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...Circuit of a 50watt Bass amplifier.—R. U. H. Parratt, 35 Cabell Road, Park Bank, Guildford, Surrey.

...Issues June to November 1970 inclusive and June 1971 of P.W. wanted. Please state price.—G. G. Cooper, 139 Eltham Road, West Bridyford, Notts.

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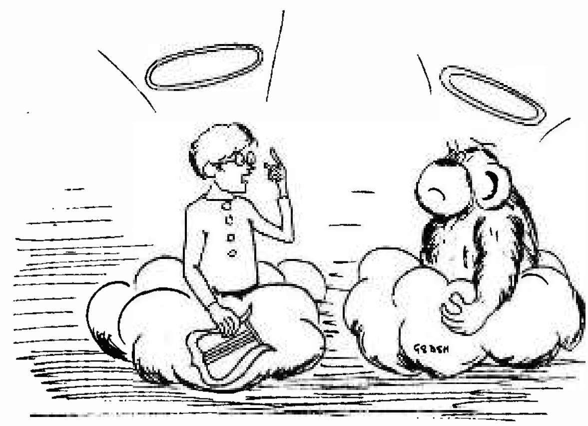

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1A7GT	.33
1B3GT	.35
1H5GT	.33
1L4	.13
1N5GT	.37
1R5	.26
1S4	.22
1U4	.29
1U5	.48
2D21	.35
2GK5	.50
3A4	.25
3D6	.19
3Q4	.38
3Q5GT	.35
3S4	.25
3V4	.32
4CB6	.50
5CG8	.50
5V4G	.34
5Y3GT	.26
5Z4G	.34
6/30L2	.55
6A8G	.33
6AC7	.15
6AG5	.25
6AK6	.30
6AM8A	.50
6AN8	.49
6AQ5	.22
6AR5	.30
6AT6	.18
6AU6	.20
6AV6	.28
6AW8A	.54
6AX4	.39
6B8G	.13
6BA6	.20
6BC8	.50
6BE6	.21
6BG6G	1.05
6BH6	.43
6BJ6	.39
6BQ7A	.38
6BR7	.79
6BR8	.63
6BW6	.72

6BW7	.54
6BZ6	.31
6CB6A	.26
6C4	.25
6C9	.73
6CD6G	1.06
6CG8A	.50
6CH6	.38
6CL6	.43
6CM7	.50
6CU5	.30
6CW4	.63
6DE7	.50
6DT6A	.50
6EW6	.55
6F1	.59
6F6	.63
6F6G	.25
6F13	.33
6F14	.42
6F18	.45
6F23	.68
6F24	.68
6F25	.54
6F28	.60
6F32	.15
6GH8A	.50
6GK5	.50
6GU7	.50
6H6GT	.15
6J5G	.19
6J5GT	.29
6J6	.18
6J7G	.24
6J7GT	.38
6JU8A	.50
6K7G	.10
6K7GT	.23
6K8G	.16
6L1	.98
6L6GT	.39
6L7	.38
6L18	.44
6L19	1.88
6LD20	.48
6N7GT	.40
6Q7	.43
6Q7G	.27
6R7	.55
6R7G	.35

6SA7GT	.35
6SA7M	.35
6SC7GT	.33
6SG7GT	.33
6SH7	.53
6SJ7	.35
6SK7GT	.23
6SQ7GT	.38
6U4GT	.60
6V6G	.17
6V6GT	.30
6X4	.20
6X5GT	.25
7A7	.88
7B6	.58
7B7	.32
7C6	.30
7H7	.28
7R7	.65
7Y4	.60
7Z4	.50
9D7	.78
10C2	.49
10DE7	.50
10F1	.75
10F9	.45
10F18	.35
10LD11	.53
10P13	.54
10P14	1.08
12A6	.63
12AC6	.40
12AD6	.40
12AE6	.48
12AT6	.23
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12AU7	.19
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12AX7	.22
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12BE6	.30
12BH7	.27
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12K5	.50
12K7GT	.34
12SA7GT	.40
12SC7	.35

12SG7	.23
12SH7	.15
12SJ7	.23
12SK7	.24
12SQ7GT	.50
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14S7	.75
19AQ5	.24
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20D4	1.05
20F2	.65
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25Z4G	.28
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30C15	.60
30C17	.77
30C18	.60
30F5	.65
30FL1	.60
30FL2	.60
30FL12	.69
30FL14	.68
30L15	.58
30L17	.67
30P4MR	.95
30P12	.69
30P19/30P4	.58
30PL1	.59
30PL13	.75
30PL14	.65
30PL15	.87
35A3	.48
35L6GT	.42
35W4	.23
35Z4GT	.24
35Z5GT	.30
50EH5	.55

50L6GT	.45
85A2	.43
90C1	.59
150B2	.58
807	.59
5702	.80
5763	.50
AC2/PEN	.98
AC2/PEN/DD	.98
AC6PEN	.38
AC/PEN(7)	.98
AC/TP	.98
AL60	.78
ATP4	.12
AZ1	.40
AZ31	.46
AZ41	.53
CL33	.90
CV63	.53
CY1C	.53
CY31	.31
DAF91	.20
DAF96	.33
DF91	.14
DF96	.34
DH76	.28
DK40	.55
DK92	.35
DK96	.35
DL96	.35
DM70	.30
DM71	.38
DY87/6	.24
DY802	.35
E80F	1.20
E83F	1.20
E88CC	.60
E92CC	.40
E180F	.90
E182CC	1.00
E1148	.53
EA50	.18
EA76	.88
EABC80	.30
EAC91	.38
EAF42	.48
EB34	.20

EB91	.10
EBC41	.48
EBC81	.29
EBF80	.30
EBF83	.38
EBF89	.27
EBL21	.60
EC86	.59
EC88	.59
EC92	.34
ECC32	1.50
ECC33	1.50
ECC40	.60
ECC81	.16
ECC82	.19
ECC83	.22
ECC84	.28
ECC85	.24
ECC86	.40
ECC88	.35
ECC189	.48
ECC807	1.70
ECF80	.27
ECF82	.26
ECF86	.64
ECF804	2.10
ECH21	.63
ECH42	.60
ECH81	.27
ECH83	.39
ECH84	.34
ECL80	.30
ECL82	.30
ECL83	.52
ECL84	.54
ECL85	.54
ECL86	.35
EF22	.63
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EF41	.58
EF42	.33
EF54	.98
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EF80	.22
EF83	.48
EF85	.26
EF86	.29
EF89	.23

EF91	.17
EF92	.35
EF97	.55
EF98	.65
EF183	.26
EF184	.29
EH90	.36
EL32	.18
EL34	.44
EL35	1.00
EL37	.74
EL41	.53
EL42	.53
EL81	.50
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EL84	.22
EL85	.40
EL86	.38
EL91	.23
EL95	.32
EL360	.49
ELL80	.75
EM80	.38
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EM83	.75
EM84	.31
EM85	1.00
EM87	.35
EY51	.33
EY81	.35
EY83	.54
EY84	.50
EY87/6	.30
EY88	.40
EY91	.53
EZ40	.40
EZ41	.42
EZ80	.21
EZ81	.22
FW4/500	.75
FW4/800	.75
GZ30	.34
GZ32	.41
GZ33	.70
GZ34	.48
GZ37	.67
HABC80	.44
HL23DD	.40
HL41DD	.98
HL42DD	.50
HN309	1.40

HVR2	.53
HVR2A	.53
KT2	.25
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KT66	.80
KT81	2.00
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KTW62	.63
KTW63	.50
MHLD6	.75
N78	2.05
N308	.95
N339	.44
P61	.44
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PC88	.47
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PC97	.36
PC900	.32
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PCC189	.48
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PCF82	.30
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PCF200	.67
PCF801	.29
PCF802	.40
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PEN453DD	.98
PENDD-4020	.88

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PL36	.47
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PL84	.30
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PY88	.32
PY500	.95
PY800	.33
PY801	.33
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QQV03/10	1.20
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QV04/7	.63
R10	.75
R11	.98
R16	1.75
R17	.88
R19	.30
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SP61	.33
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TH233	.98
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UBL21	.55
UC92	.35

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UCH81	.30
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UCL83	.48
UF41	.50
UF42	.60
UF80	.35
UF85	.34
UF86	.63
UF89	.27
UL41	.54
UL84	.31
UM80	.33
UY41	.38
UY85	.25
U10	.45
U12/14	.38
U19	1.73
U22	.39
U25	.64
U26	.56
U45	.78
C47	.64
U191	.58
U251	.65
U281	.40
U282	.40
U301	40
U403	.33
U404	.38
U801	.93
U4020	.38
VP23	.40
VP41	.38
VT61A	.35
VU111	.44
VU120	.60
VU120A	.60
VU133	.35
W107	.50
W729	.60
X41	.50
Transistors & Diodes	
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2N2297	.23
2N2369	.22

2N3053	.33
2N3709	.20
2N3988	.50
2S323	.50
AA119	.15
AA120	.15
AA129	.15
AAZ13	.18
AC107	.15
AC113	.25
AC126	.13
AC127	.17
AC128	.20
AC154	.25
AC156	.20
AC157	.25
AC165	.25
AC166	.25
AC168	.38
AC176	.55
AC177	.28
ACY17	.25
ACY18	.20
ACY19	.19
ACY20	.18
ACY21	.19
ACY22	.16
ACY28	.18
AD140	.36
AD149	.50
AD161	.45
AD162	.45
ADT140	.63
AF106	.50
AF114	.25
AF115	.15
AF117	.19
AF121	.30
AF124	.25
AF125	.17
AF126	.18
AF139	.65
AF178	.68
AF180	.48
AF186	.55
AF239	.38
BA102	.45
BA115	.14
BA116	.25
BA130	.10
BA153	.15

BC107	.13
BC108	.13
BC113	.25
BC115	.15
BC116	.25
BC118	.23
BCY10	.45
BCY12	.50
BCY33	.20
BCY34	.23
BCY38	.23
BCY39	.25
BCZ11	.38
BF158	.29
BF159	.25
BF163	.20
BF173	.38
BF180	.30
BF181	.40
BF185	.40
BFY50	.23
BFY51	.19
BFY52	.20
BFY194	.15
BY100	.18
BY105	.18
BY114	.18
BY126	.15
BY127	.18
BYZ10	.25
BYZ11	.25
BYZ12	.25
BYZ13	.25
CG12E	.20
FSY11A	.23
FSY41A	.23
GD9	.20
GET113	.20
GET116	.40
GET118	.20
GET119	.20
GET573	.38
GET587	.43
GET873	.15
GET887	.23
GET897	.23
GET898	.23
M1	.15
OA5	.28
OA9	.13
OA10	.43

OA47	.10
OA70	.15
OA73	.15
OA79	.09
OA81	.09
OA85	.08
OA90	.13
OA91	.09
OA95	.09
OA200	.09
OA202	.10
OC22	.38
OC23	.38
OC24	.38
OC25	.38
OC28	.60
OC29	.63
OC35	.32
OC36	.43
OC42	.63
OC43	1.18
OC44	.10
OC45	.11
OC46	.15
OC70	.13
OC71	.11
OC72	.11
OC74	.23
OC75	.11
OC76	.15
OC77	.27
OC78	.15
OC78O	.15
OC81	.11
OC81D	.11
OC82	.11
OC82D	.11
OC83	.20
OC84	.24
OC123	.23
OC139	.23
OC140	.95
OC169	.23
OC172	.35
OC200	.22
OC201	.38
OC202	.48
OC203	.30
OC204	.30
OC205	.43
ORP12	.53

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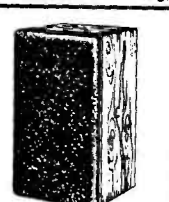

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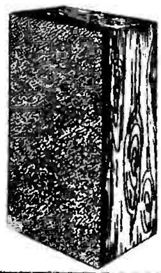

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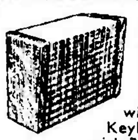

IMP

Wedge shaped extension speaker 7½ x 6½ x 4in. (max.). Covered in walnut wood grain cloth with mottled Vynair front. Keyhole slot at back. Fitted with 3 ohm speaker unit. Only **£1·25.** P. & P. 36p each

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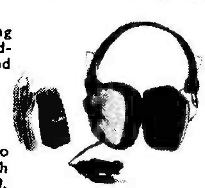

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deluxe 9/12 receiver for the SWL PART 2

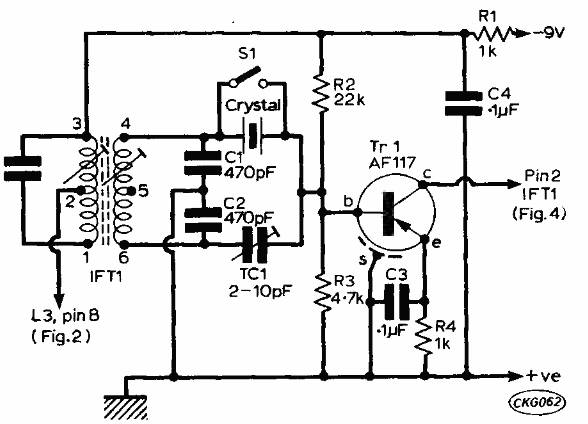
R. H. LONGDEN

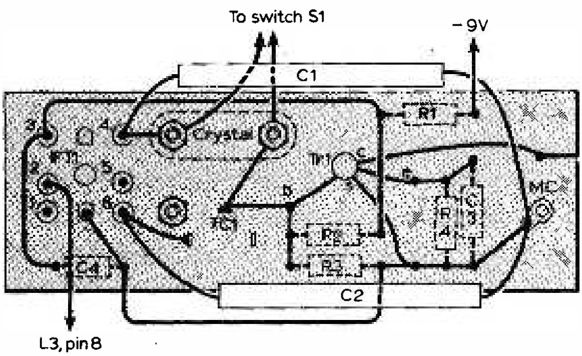
CRYSTAL FILTER

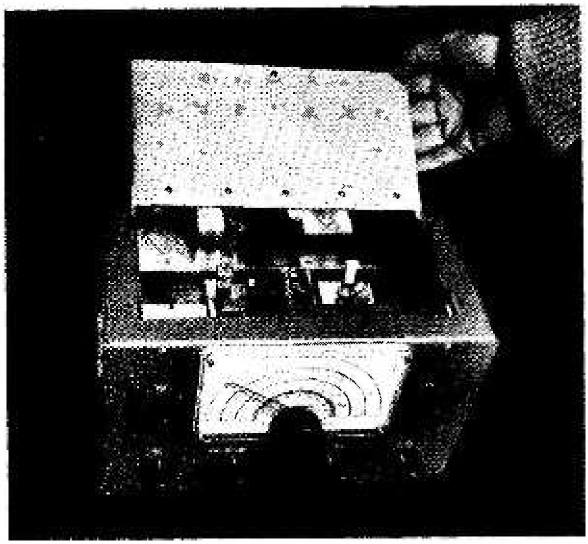
Fig. 6 is the circuit of this unit and if fitted is placed between the oscillator coil L3 (Fig. 2) and the i.f. amplifier described. The filter i.f. transformer provides a balanced output at pins 4 and 6, TC1 being adjusted to compensate for stray capacity in the crystal and parallel switch. In these circumstances selectivity can be extremely high but as the crystal works into a moderately high impedance here the passband is wide enough for a.m. reception without too much deterioration of speech quality.

When the switch is closed, the crystal is out of use, and the selectivity is that provided by the four i.f.t.'s.

The filter i.f.t. has to be modified, to obtain a centre-tap (pin 5 is unsuitable). Pull the screening can off the i.f.t. A small capacitor is wired internally between pins 4 and 6 and this component is snipped off. (The similar capacitor between pins 1 and 3 must be left). The i.f.t. is then replaced in its can. The parallel capacitance is now provided by the two capacitors C1 and C2, wired externally.







Construction. The filter is assembled complete on a piece of paxolin or Veroboard 3×1in. as in Fig. 7.

A black flying lead (or pin) is provided for the negative connection. The unit is mounted by two 1in. bolts, with extra nuts which provide the chassis return. When the unit is fixed to the receiver chassis, the lead from pin 8 on the oscillator coil is near the filter i.f.t., and can be soldered to pin 2. The lead from pin 2 of i.f.t.1, (Fig. 4), is now soldered to the collector lead of the filter unit transistor or to a pin used as anchorage.

A hole must be drilled in the chassis to reach the lower core of the i.f.t. Two insulated leads are soldered to the crystal holder sockets passing directly down through holes to the crystal switch.

The crystal switch is fixed directly under the crystal. It can be a rotary switch, fitted to a bracket, with a coupling and extension spindle. Alternatively a switch wafer can be attached to the back chassis runner with ½in. spacers and operated by a ¼in. dia. polystyrene rod cut to fit.

Filter Adjustment. A signal generator and output meter are helpful, though adjustment is possible by ear. The highest selectivity obtainable is very sharp so having adjustments a little off maximum is an advantage. Adjustment may need some patience, depending on how close the crystal and i.f.t. frequencies match at the beginning.

If alignment is badly out, no signals at all may be heard. If so, align the i.f.t.'s as described earlier, switch the crystal out (switch closed) and adjust the two filter cores for best volume. Set the phasing capacitor TC1 about half closed.

Fig. 6: (top left) shows the circuit for the optional crystal filter, IFT1 being modified as described in the text. Fig. 7: (left) gives the layout of the filter on its 3 x 1in. board.

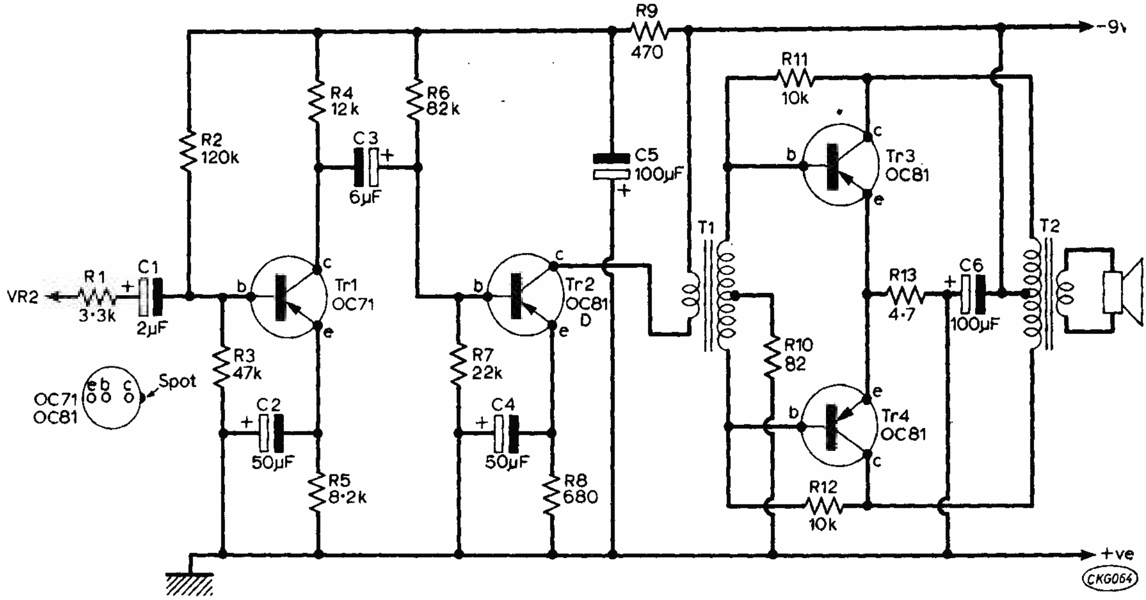


Fig. 8: Circuit of the audio stages, fed from the detector stage (Fig. 4, Part 1) via the volume control VR2 mounted on the front panel.

Open the crystal switch, and tune the receiver (or generator). If results are much as before, crystal and i.f.t.'s are by no means on the same frequency. Assuming no generator or other means of checking the frequency of the i.f.t.'s is available, switch the crystal out, adjust all seven i.f.t. cores about a half turn in the same direction, and re-peak them for best results. If bringing in the crystal now sharpens tuning, the shift made to the intermediate frequency was correct. If results seem little changed or worse, the shift was the wrong way, so all the cores have to be moved in the opposite direction.

When crystal and i.f.t.'s are approximately in agreement, tuning through a signal (or tuning the generator) will show two tuning points. One is extremely sharp, and is not changed by adjusting the cores of the i.f.t.'s in later stages. The other is flatter, and can be moved by rotating the cores. The sharp peak is the crystal resonance. Tune to it and then rotate each i.f.t. core to the same frequency, as indicated by a great increase in sensitivity and the eventual disappearance of the second, flatter response.

With i.f.t.'s aligned to the crystal frequency, tune through a signal (or tune the generator) while adjusting the phasing capacitor TC1. If TC1 is completely unscrewed, a very sharp null will be found at one side of the signal, the signal re-appearing as this is passed. If TC1 is fully screwed down, the null arises at the other side of the signal, so it is adjusted to give a reasonably even response. Adjustments may make necessary very slight readjustment of the filter cores.

AUDIO AMPLIFIER

With an unlucky combination of values in the capacitors C1 and C2 the error could prevent phasing. If so, place a 30pF pre-set across C1 or C2, re-adjust the core, and adjust as described. It may be found that exchanging C1 for C2 will suffice. If selectivity worsens with the pre-set at any value, remove it and put it across the other 470pF capacitor.

The circuit for this is shown in Fig. 8. It requires a few more components than directly-coupled circuit but has the advantage that d.c. operating conditions for one stage do not depend on those of other stages, so that unsatisfactory working is not likely, while all items are easily obtained.

Construction. The parts are assembled on an insulated panel 3½×2in. as in Fig. 9. The amplifier can be teasily tested by adding a speaker, 9V battery and providing some form of input, such as a pick-up, or by connecting it to the receiver volume control.

The amplifier is mounted by two ½in. 6BA bolts, with extra nuts, which also secure tags, and act as a return to the receiver chassis. In the event of the amplifier drawing a very small current with no signal (say under 3mA) and exhibiting cross-over distortion, the 82Ω resisfor R10 may be increased slightly in value, 100Ω being suggested.

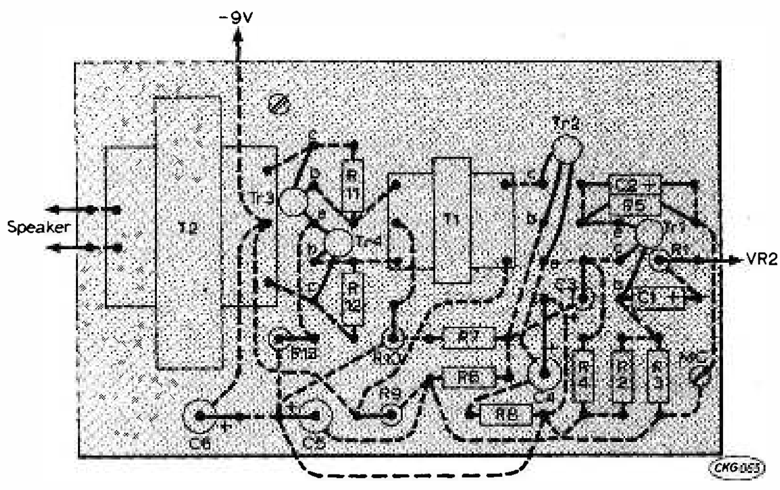


Fig. 9: Layout of the audio amplifier constructed on a 3½ x 2in. insulated board. It is mounted on top of the chassis with T2 at the rear, see Fig. 12 and photographs.

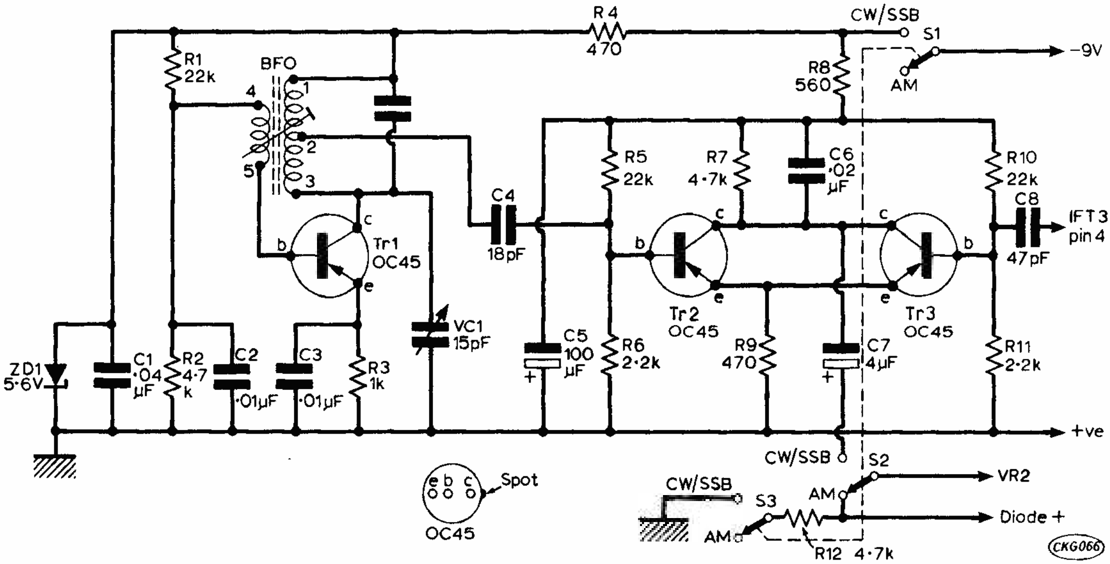


Fig. 10: Circuit of the b.f.o./product detector required for the reception of c.w. and s.s.b. The function switch S1, 2, 3 is mounted on the front panel.

BFO/PRODUCT DETECTOR

The receiver as described so far is intended for a.m. reception and is thus suitable for all normal short wave listening. In some cases it may be wished to receive Morse and single sideband transmissions, especially on the amateur bands. This can be done by using a beat-frequency oscillator/carrier oscillator, with product detector.

The circuit for this unit is shown in Fig. 10. Tr1 is the oscillator, operating at 1·6MHz. This frequency is varied by the panel pitch control VC1. The zener diode ZD1 provides a stable voltage for the oscillator.

Output from the oscillator goes to one of the pair Tr2/Tr3, with c.w. or s.s.b. signals fed in from the i.f. amplifier via C8.

For c.w. reception, VC1 is adjusted so that the required audio heterodyne note is produced.

For s.s.b. reception, Tr1 operates as carrier oscillator, to replace the carrier removed during s.s.b. transmission, thus allowing the s.s.b. signal to be resolved.

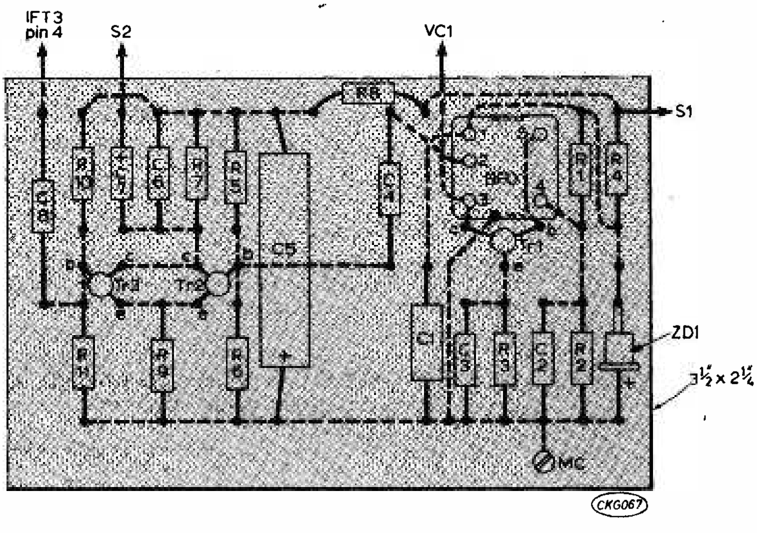


Fig. 11: Layout of the b.f.o./p.d. which is mounted under the chassis below the audio amplifier board.

A rotary function switch provides for c.w./s.s.b. reception or a.m. Section S1 interrupts the negative line for a.m. reception, while section S2 switches the volume control VR2 to the product detector circuit, or existing a.m. diode detector, as required. Section S3 brings in R12 for c.w./s.s.b. to complete the diode circuit made through VR2 during a.m. reception.

Construction. The components are assembled on an insulated board as in Fig. 11. All components, including the b.f.o. coil, are on this side of the board, so it must be checked that coil connections are correct when turning the board over.

Flying leads are provided for external connections and the board mounted clear of the chassis by ½in. bolts with extra nuts. The point MC is a tag locked to the board thus completing the circuit to the metal chassis when the assembly is mounted in place.

Capacitor C8 is near the final i.f.t. a lead being soldered to pin 4 of the latter and passing through the chassis to C8.

A black lead from R4 is connected to S1, which completes this circuit for c.w./s.s.b. reception only.

VR2 is disconnected from the diode circuit and taken to S2. This connects to C7 in the c.w./s.s.b. position and to the diode (as originally) for a.m. reception. R12 is wired directly to the switch as in Fig. 10.

Alignment. With the switch in the a.m. position, reception should be as before but the final i.f.t. core will require a slight adjustment for best results.

Set VC1 half closed, switch to c.w./s.s.b., and rotate the b.f.o. coil core until a strong heterodyne is heard. Leave the core at the central 'zero beat' position. Turning VC1 either way will now produce a heterodyne which rises in pitch.

★ components list

CRYSTAL FILTER

Resistors:
R1 1kΩ R2 22kΩ R3 4·7kΩ R4 1kΩ
All ¼W 10%

Capacitors:
C1 470pF 1% silver mica C3 0·1μF
C2 470pF 1% silver mica C4 0·1μF
TC1 2—10pF trimmer (Jackson 'Tetfer')

Miscellaneous:
Transistor Tr1, AF117. IFT1 (Denco IFT18/1·6 see text for modification). Crystal 1·6 MHz type HC6U (Senator Crystals) and holder. S1, Rotary on-off switch with extension spindle and coupling, (see text). Veroboard, plain, 3 x 1in.

AF AMPLIFIER

Resistors:
R1 3·3kΩ R5 8·2kΩ R9 470Ω R13 4·7Ω
R2 120kΩ R6 82kΩ R10 82Ω
R3 47kΩ R7 22kΩ R11 10kΩ
R4 12kΩ R8 680Ω R12 10kΩ
All ¼W 10% except R10, 11 and 12 5%

Capacitors:
C1 2μF 6V C3 6μF 6V C5 100μF 12V
C2 50μF 6V C4 50μF 6V C6 100μF 12V

Semiconductors:
Tr1 OC71 Tr2 OC81D T3-4 OC81

Miscellaneous:
T1, driver transformer (Home Radio TR64). T2, output transformer (Home Radio TR65A). Veroboard plain, 3½ x 2in.

BFO/PRODUCT DETECTOR

Resistors:
R1 22kΩ R5 22kΩ R9 470Ω
R2 4·7kΩ R6 2·2kΩ R10 22kΩ
R3 1kΩ R7 4·7kΩ R11 2·2kΩ
R4 470Ω R8 560Ω R12 4·7kΩ
All ¼W 10%

Capacitors:
C1 0·04μF C4 18pF SM C7 4μF 12V
C2 0·01μF C5 100μF 12V C8 47pF SM
C3 0·01μF C6 0·02μF
VC1 15pF variable (Jackson Type C804)

Semiconductors:
Tr1 OC45 Tr2 OC45 Tr3 OC45
ZD1 zener diode 5·6V

Miscellaneous:
BFO (Denco IFT 17/1·6). S1–3, 3 pole 2 way rotary switch. Veroboard, plain 3¼ x 2¼in.

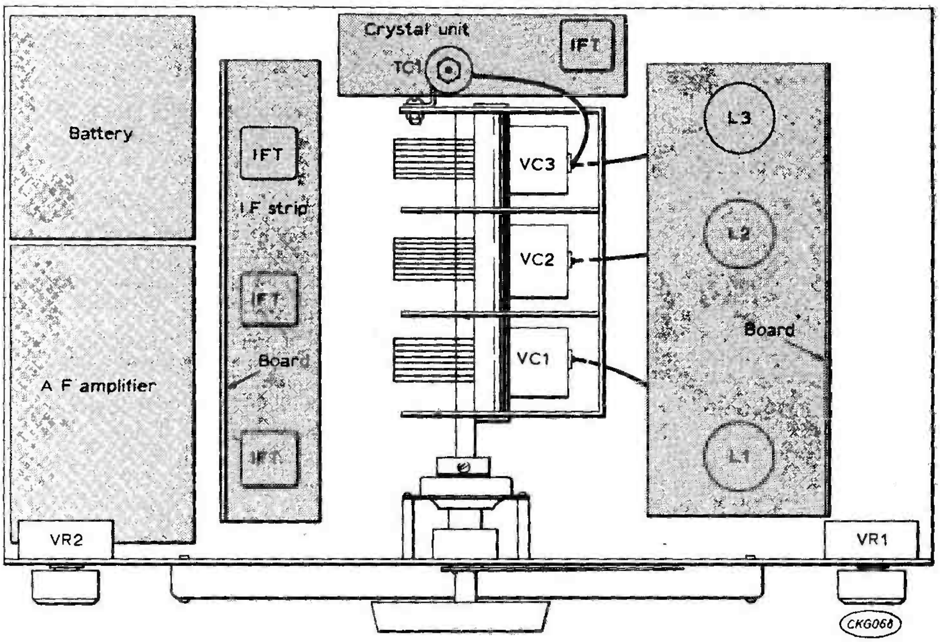


Fig. 12: Location of four of the units and the battery, the b.f.o./p.d. being mounted underneath. Compare with photographs. An aluminium screen was later fitted between L1 and L2 on the r.f. unit, to improve stability. This can be seen in the photographs. Mounting instructions are included with the tuning dial.

When a c.w. signal is tuned in adjust VC1 for best reception the b.f.o. being above or below the signal, whichever results in least interference from other signals.

When receiving s.s.b., VC1 is carefully adjusted to give best resolution of speech. If resolution is impossible, the oscillator is being tuned to the wrong side band of the s.s.b. signal. The same sideband is normally in use on any one amateur band, so the adjustment of VC1 will hold good for that band.

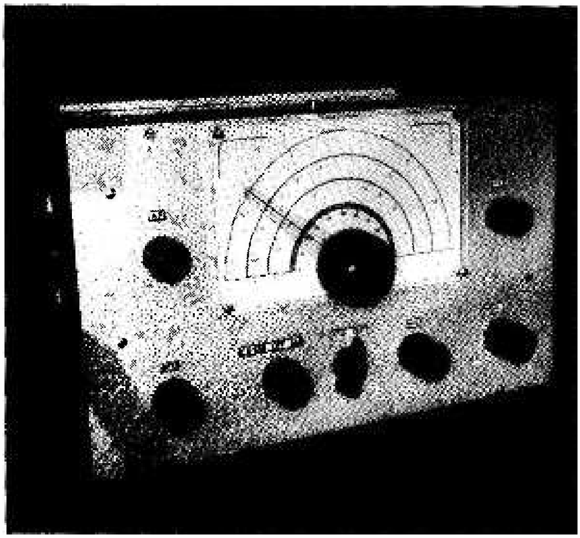
With s.s.b. it is normally necessary to reduce r.f. gain somewhat by operating VR1. If the crystal is in use, tune in the s.s.b. with the switch at a.m., then switch to s.s.b. and adjust VC1 for best resolution. VC1 can then be generally left untouched while tuning the band for other s.s.b. signals.

GENERAL CONSTRUCTION

Connections and placement of controls, etc., are as follows:

VR1. This is fitted at the right of the panel. Leads from the r.f. and i.f. units go to one outer tag. The centre and other outer tags are wired to chassis.

VR2. This fits at the left. ZD1 positive runs to one outer tag, the centre tag goes to the a.f. amplifier, and the other outer tag to chassis. (If rotating the knob gives reversed control of volume, change over the leads to the outer tags. This also applies to VR1.) Connect one switch tag to chassis, and a red lead with positive clip to the other switch tag.



Panel layout. Top left, Volume control and top right, r.f. gain control. Left to right below:—b.f.o. tuning, function switch, crystal filter in/out, mixer and aerial tuning.

VC4. This is located between the crystal switch and VR1, and is connected to a lead from VC1. **VC5** is similarly connected to VC2. Rotor tags are earthed to an adjacent tag bolted to the chassis.

Negatives. An insulated tag is bolted underneath the chassis near the a.f. amplifier, and is an anchor point for battery negative, and the negative leads running from each unit.

Aerial-Earth. Two sockets are fitted to the rear chassis runner. That for earth is connected to the chassis. The lead from pin 8, L1, runs to the Aerial socket.

Speaker. The secondary leads from T2 run to separate sockets, or a jack outlet. A 2/3 ohm speaker is required, fitted in a cabinet or attached to a baffle board. For c.w. reception low impedance headphones should be used.

Panel. This is secured to the chassis by the control bush nuts and two brackets. The tuning drive is fitted by the method described in the instructions supplied with it.

Cabinet. Holes are punched in the back, level with the sockets. An opening lid is made in order to reach the coils and the battery, which rests on the chassis near the a.f. amplifier. Small holes are drilled close together in order to start a metal-saw, and a piece about 10×5in. cut out. Two strips of metal about 6×1in. are fixed inside with countersunk screws, for the lid to close against. It swings on a 10in. hinge bolted at the back. ■

CQ! CQ! CQ! CQ! CQ!

INFORMATION WANTED

...can anyone suggest a suitable speaker for use with my "Mellophone 3" set. It is mounted in a smart mahogany cabinet standing on legs. Valves used are PM2DX, PM1LF (2), and three PM2A's.—H. Owen, 34 Bentgate Street, Newhey, Rochdale, Lancashire.

...can anyone please lend me a copy of Modern Wireless No. 1.—L. A. Slack, 60 Parsonage Road, Withington, Manchester, M20 9WQ.

...I have recently acquired a Carlton SG 4 receiver about 40 years old and I cannot find any gen on it at all (valves, types, etc.). Please can anyone help.—A. C. Lintott, 3 Seaham Street, Silksworth, Sunderland, SR3 1EX.

...details and copies of radio circuits from early editions of radio magazines, as I wish to renovate some Vintage receivers.—S. Laffan, St. Kieran's College, Kilkenny Ireland.

...any gen on the μA 703C i.c.—J. Rowley, 18 Old Park Road, Shirehampton, Bristol, BS11 UPW.

...any gen on the Rx type R1475 p.s.u. type R360 and tuner unit type 131.—C. Astbury, 16 Eaton Avenue, Handbridge, Chester, CH4 7HB.

...any gen on R4187 S.T.C. set 17 valve, 24 channel receiver circuit. Manual and mods for mains. Loan or buy. Also back nos. P.W. for last 10 years. Sell at cover price plus postage.—K. Armstrong, 11 Woodville Gardens, Ruislip, Middx.

...circuit and details of R209 Rx. Also gen on B2 (spy) receiver and layout if possible. —I. L. Bishop, 27 Stratton Way, Biggleswade, Beds.

...any gen on Reiner Electronics Oscilloscope No. 556. Service Manual, modification details etc. Will return.—R. P. Davies, 61 Kenley Road, Kingston, Surrey.

...circuit or information on capacitor analyser (Solar) type CB-2U. Loan or purchase. —R. Kirk, 22 Barncraig Street, Buckhaven, Fife, Scotland.

...circuit diagram and gen on the R1155 Rx. I will copy and return.—A. McKenzie, 6 Moorfield, Newcastle upon Tyne, 2.

...service sheet for Pamphonic Reproducers Ltd. type 3000 stereo amplifier.— R. W. Parker, 11 Greenacres, Downton, Salisbury, Wilts.

...any gen on "Contessa" receiver which is 5 to 8 years old with 6 transistors and a diode and what appears to be 2 i.f. stages. The tuning dial contains the word Contessa and at the bottom of the speaker fret it reads "transistor".—H. Gosling, 12 Ullswater Avenue, Halfway, Sheffield.

...any info on making a rumble and scratch filter.—N. Davidson, Leamington House, Dover College, Dover, Kent.

...any hints and mods of the p.s.u. of the 19 set so that we can remove dynamotors.— United World College of the Atlantic, St. Donat's Castle, Llantwit Major, Glamorgan, CF6 9WF.

...instruction manual for Airmec 877 Televet test set.—D. Wigley, 4 Sellons Avenue, Harlesden, London, N.W.10.

...any info on converting the 19 set Tx/Rx.—M. Saxon, Shepherds Fennel, Hendon Wood Lane, London, NW7 4HR.

...circuit for a.m./f.m. tuner with a multiplex system.—A. G. Sobers, c/o Donnachie, 161 Octavia Court, Greenock, Renfrewshire, Scotland.

...circuit and any info on constructing an echo (depth) sounder.—R. Medland, 10 Northfield Way, Brighton, BN1 8EH.

...blueprint or practical circuit for the 4-transistor amplifier published in P.W. November 1961.—B. Endean, 25 Astley Gardens, Seaton Sluice, Whitley Bay, Northumberland.

...circuit diagram of an electronic echo chamber: the type which does not employ an endless tape with multiple heads but one which will produce both sustained echo (reverb) and repetitive echo with a variable time factor.—M. Hale, 27 Rachel Gardens, Selly Oak, Birmingham, B29 6NY.

...the circuit diagram of a stylus organ or even the details of the one published in P.W. some years ago.—V. P. Kelly, L/103197 REM(A) Mess 6F1, H.M.S. Ark Royal, BFPO, London.

...blueprints for the following: "Celeste 7-transistor portable" (June 1963), "7Mc/s Transceiver" (June 1964), "Beginners S.W. Superhet" (December 1964) 'Progressive S.W. Superhet" (February 1966) and "Mini-Amp" (November 1961).—A. Raza, P.O. Box 2671, Tripoli, Libya.

...circuit or manual for TS210, to loan or buy. Also, any useful mods would be welcome.—D. Millard, 20 Jubilee Road, Tipton, Staffs, DY4 0QP.

EQUIPMENT REQUIRED

...source of supply of small ferrite-cored r.f. chokes of 680μH, 470μH and 330μH. —M. J. Shepherd, 72 Westerland Avenue, Canvey Island, Essex, SS8 8JS.

...where can I obtain i.f. transformers for a Skyrover Radio.—J. B. Valentine, 102 Woodhouse Lane, Springfield, Wigan, Lancs.

...photocell fine line scanner and amplifier to work quick-acting solenoid for lightweight equipment. Black and white, on and off.—D. Corbett, 41 Tinto Road, Bearsden, by Glasgow.

BOOKS WANTED

...copies of the Marconigraph, or any other old radio mags. pre 1930. Also a nice set of Harmsworth's Wireless Encyclopedia.—C. Riches, Practical Wireless Editorial Dept., Fleetway House, Farringdon Street, London, EC4A 4AD.

CORRESPONDENTS WANTED

...any one interested in electronics whether it be ham radio, Hi-Fi, audio, TV o any other aspect.—Des. Walsh, E15CD, "Coombe Down", Ballylynch, Carrick-on Suir, Co. Tipperary, Ireland.

...P.E. May and July 1970. Will exchange for P.E. September to October 1969.— Des. Walsh, "Coombe Down", Ballylynch, Carrick-on-Suir, Co. Tipperary, Ireland

ISSUES WANTED

...1950–1955 and Radio Const. 1950–1959.—Luxton, 12 The Vale, Acton, London, W3 7SB.

...Feb. and March 1971 P.W.—R. Watson. 51 Woodbridge Road, Newbourne, Nr. Woodbridge, Suffolk.

...Television for Oct. 1967, Feb., March, April, May, June, July 1968; April, May, June, July 1969 and Dec. 1970.—P. F. Johnson, 21 Jubilee Drive, Sheringham, Norfolk.

...Radio Amateur Sept. 1953, RSGB Bulletin February 1953, S.W. Mag. Oct. 1948 and Dec. 1954.—I. Simpson, 2 Taylor Cottages, Derryhale, Portadown, Co. Armagh, N.I.

...Jan. to Nov. 1966, July 1967, Jan., Feb., March 1968, Index for Vols. 41 to 46 (all P.W.). P. Electronics for Jan. to Nov. 1966, Nov., Dec. 1967, Jan., March 1968, Jan. to Nov. 1969, Nov. 1970, April 1971 and Index for Vols. 1 to 6.—H. Ferns, 11 King Street, Coatbridge, Lanarkshire, Scotland.

...Issue of P.W. Jan. 1962 containing "Minuette".—S. Grosvenor, 50 Countess Crescent, Bispham, Blackpool, FY2 9LQ.

...P.W. for June and July 1969 also Jan. 1971. P.E. issues Jan. to March 1970 inclusive.—A. Taylor, 89 Howth Drive, Woodley, Nr. Reading.

...P.W. September and October 1970.—W. R. Pitt, 26 Highdown Avenue, Worthing, Sussex.

...P.W. June 1971. F. J. Camm's "Beginners' Guide to Radio" (5th or 6th edition). Also "Elementary Course in 28 Lessons", and P.W. July 1948.—H. Howard Shepherd, 5 Pafford Avenue, Watcombe, Torquay, TQ2 8BS.

...The issue of P. Television containing the "Viewmaster".—E. Farrer, 108 Colne Road, Twickenham, Middx.

...P.W. Sept., Oct. and Dec. 1970 and Oct., Nov. and Dec. 1971.—C. J. Page, Flat 6, 17 Devonshire Terrace, Lancaster Gate, London, W.2.

...April 1971 issue of P.W.—T. M. Fresson, Fernlee, Churt, Farnham, Surrey.

...P.W. July 1960.—T. Richards, 52 Cookson Street, Liverpool, L1 5EH.

...P.W. August 1968 and issues containing the Portable Keyless Organ.—K. Oliver, 10 Mayflower Road, Shirley, Southampton, Hants.

—P.T. July 1971 with the 625 i.f. strip.—O. Collins, Landford, Germansweek, Bearworthy, Devon.

TAKE 20

JULIAN ANDERSON

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

No. 36
NOISE LIMITER

THIS month's project is one for the DXers; it is a noise limiter circuit that can either be built into a receiver or used as a separate unit, in which case it fits between the headphones and the receiver.

Noise is a real curse when listening to weak, far off stations and of course its amplitude bears no relationship to that of the signal that you want to hear. A comparatively simple circuit, Fig. 1, will eliminate all signals above a certain level while unaffecting those below that level. Our ears have a sort of a.g.c. system built into them, if they are subjected to a series of loud noises they will not be very sensitive to quieter passages in between those bursts, so, however loudly you turn up the volume, this will not improve intelligibility. By limiting the level of the peaks to that of the wanted signal there is a considerable improvement and signals which were quite lost in the noise can be heard comparatively well.

Let us assume that the unit is to be used from the output of the receiver. This output may be the equivalent of an external loudspeaker socket or a special headphone output, it depends on the design and type of receiver. If the socket is for an external loudspeaker and the output stage is a transistorised one, it is important that the output load is maintained and a resistor equivalent to the speaker impedance should be fitted, in the circuit shown as R1. If you are not sure what the value should be 10Ω will be satisfactory.

The input is connected via the level control VR1 to Tr1 where the signal is amplified. The output of this is fed via C3 to the back-to-back silicon diodes D1 and D2. These are not directly biased but as soon as the level of the signal across these goes over about 0·6V, they will conduct; one of them clips the positive peaks while the other takes care of the negative peaks. It doesn't matter how high the signal level is, anything above this level will appear as a maximum of 0·6V. Since we shall now always have the same level at this point we have removed our control over the listening volume and for this reason VR2 is included.

If the *wanted* signal level is above the critical 0·6V, this will introduce distortion and it is in this way that the controls are set. The receiver's volume control should be set for normal listening level and, with the unit connected, VR1 should be increased until the wanted signal becomes distorted and harsh; this should then be backed off slightly. VR2 is then set for a comfortable listening level.

The current consumption of the circuit is not high and a small PP3 battery will cope nicely. For fixing the circuit permanently into a set, VR1 can be the existing volume control, it doesn't matter even if the value of this is considerably higher than that shown. The output from VR2 can then be connected to the point that was previously fed from the volume control's slider. If used with a valve set the supply voltage can be taken from the h.t. line via a suitable dropping resistor to give 9V. A switch can also be included to switch the unit either in or out. ■

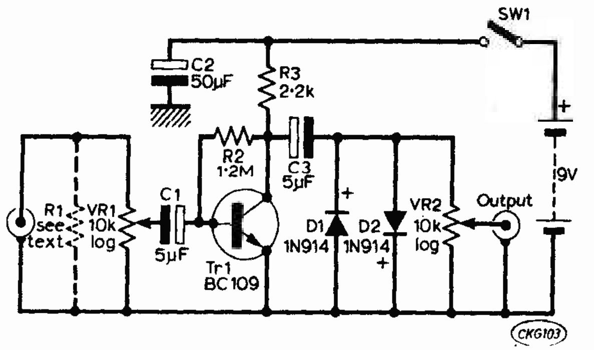


Fig. 1 (above): The circuit of the noise limiter.

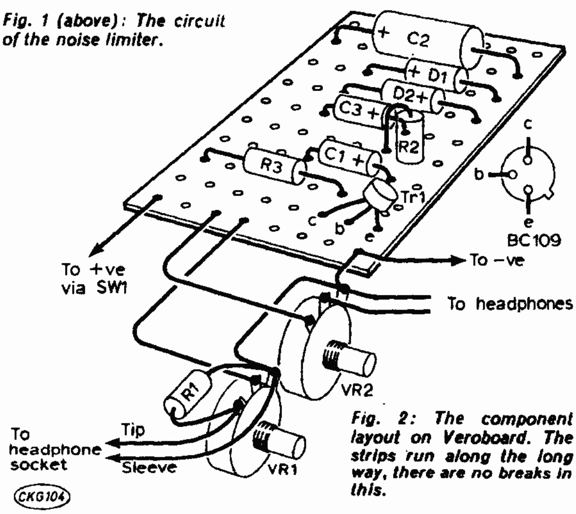


Fig. 2: The component layout on Veroboard. The strips run along the long way, there are no breaks in this.

★ components list

R1	10Ω, 5W—see text	-
R2	1·2MΩ 5%, ¼W	1p
R3	2·2kΩ 5%, ¼W	1p
C1	5μF 10V minimum	4p
C2	50μF 10V minimum	4p
C3	5μF 10V minimum	4p
Tr1	BC109	12p
D1	1N914	5p
D2	1N914	5p
VR1	10kΩ log. pot	12p
VR2	10kΩ log. pot	12p
SW1	On-off switch	10p
		70p

Prices are those recently advertised in Practical Wireless and may have changed. No allowance is made for minimum order costs or for postage and packing and these should be checked carefully before ordering.

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz • Times in GMT

THE recent spell of cold weather seems to have kept most of the readers of this column in their shacks and at their writing desks, this is evidenced by the number of reports received—the record having been beaten yet again.

The first report comes from **Ian Howes** in Lowestoft who used his R209 Mk II receiver and TV antenna to log the following interesting stations:—

3375 *AIR, Gauhati* with Indian Music at 1700.
4780 *R. Carabobo, Venezuela,* Spanish at 0015.
4860 *AIR, Delhi,* Domestic Service at 1800.
4880 *R. Universo, Venezuela,* Spanish at 2315.
4965 *SABC,* Domestic Service at 2100.
5000 *R. Nepal* in Nepali at 1540.
5035 *Alma Ata, USSR* at 1600.
5035 *Bangui, Cent. Afr. Rep.,* French at 2230.
5047 *R. Lome, Togo,* news in French at 2200.
5052 *R. Singapore,* English Pops at 1600.
9660 *ABC, Brisbane,* Home Service at 1200.
11835 *R. El Espectador,* Uruguay, Spanish at 2304.
15430 *Voice of Free Korea* in English at 1130.

D. A. Hairon of St. Clement, Jersey has again used his Codar CR70A to good effect hearing:—

4915 *R. Accra, Ghana* in English at 2300.
6170 *Israel B.C.* in English at 2115.
9505 *R. Record, Brazil* in Portuguese at 0110.
9510 *R. Barquisimeto, Venezuela,* Spanish at 0035.
9625 *BBC, Cyprus relay* in Hindi at 0050.
11775 *AIR* in English at 1050.
11850 *R. Accra, Ghana* in English at 2030.
11875 *R. Soc. de Bahia,* Brazil at 0000.
15084 *R. Tehran* in Farsi at 1430.
15105 *BBC, Ascension Is.* relay at 0730.
15225 *R. Cultural de Bahia,* Brazil at 0100.
15230 *RT Belgium* in English at 0050.
17825 *NHK, Japan* in English at 0815.

Michael Berry of Dewsbury, Yorkshire is a new reporter to this column, his equipment consists of an Eddystone EB35 receiver and a 15 foot vertical antenna. Amongst the interesting stations heard were:—

4870 *Cotonou, Dahomy* in French at 2230.
4915 *R. Accra, Ghana* in vernacular at 2215.
4940 *R. Abidjan, Ivory Coast* in French at 2305.
6040 *Tashkent, USSR* in English at 1420.
9520 *R. New Zealand* in English at 0900.
9570 *R. Kaduna, Nigeria* in English at 2100.
9570 *R. Portales, Chile* in Spanish at 0005.
9850 *R. Bangladesh, Dacca* in English at 1515.
11710 *R.A.E., Argentina* in English at 2335.
11735 *RTV Morocco* in French at 1910.
11805 *R. Globo, Brazil* in Portuguese at 2105.
11865 *R. Kinshasa* in French at 2230.
11925 *Tashkent, USSR* in English at 1410.
11925 *R. Bandierantes, Brazil* in Portuguese, 2145.
15190 *ETLF, Addis Ababa* in Arabic at 1430.
15520 *R. Bangladesh, Dacca* in English at 1230.

Julian V. Moss of Rayleigh used his Meridian 10 transistor superhet and 60 foot long-wire antenna to compile his latest log which includes:—

9515 *R. Ankara, Turkey* in English at 2200.
9525 *AIR, Delhi* in English at 1945.
9545 *R. Accra, Ghana* news in English at 2045.
9605 *R. Canada International,* English at 2100.
9695 *RSA, South Africa* in French at 2015.
11620 *AIR, Delhi* news in English at 1945.
11710 *VOA, Liberia* sign off at 2230.
11720 *R. Canada International,* English at 2207.
11780 *HCJB, Quito, Ecuador* in English at 2000.
11850 *R. Accra, Ghana* news in English at 2030.
11900 *RSA, South Africa* in English at 2235.
11910 *ETLF, Addis Ababa* in English at 2015.
11920 *Abidjan, Ivory Coast* in English at 1845.
11950 *FEBA, Seychelles* in English at 1730.
11970 *RSA, South Africa* in English at 2240.

Brian Ewing of Ilford is another reporter with a Codar CR70A receiver, this time used with a 50 foot long-wire antenna to hear:—

6010 *RAI, Rome,* Italy at 0110.
6155 *R. Renascena, Portugal* (tentative) at 0030.
9510 *BBC, Ascension Is.* relay at 0415.
9615 *HCJB, Quito,* Ecuador at 0330.
9695 *RSA, South Africa* noted at 2215.
9730 *ETLF, Ethiopia* at 0400.
11815 *TWR, Bonaire* noted at 0130.
11850 *BBC, Tebrau, Malaysia* relay at 2345.
11925 *Radio Kuwait* at 2040.
11930 *WIBS, Windward Islands* at 2031.
11955 *Radio Lebanon* at 0235.
15170 *ELWA, Liberia* at 2159.

The last reporter for this month is **Fred Wall** of Walthamstow who has a Plessey PR155 (short pause whilst your scribe goes green with jealousy) and a 20 foot long-wire enabling him to hear:—

9460 *Radio Pakistan* with music at 2020.
9520 *Radio New Zealand* in English at 0900.
9745 *Radio Baghdad* with music at 2040.
9755 *Radio New Zealand* at 1700.
15240 *Radio Australia* with news at 2153.
15245 *RTV Morocco,* news in Spanish at 1415.
15345 *Radio Kuwait,* Pop Music at 1600.
17820 *Radio Ankara,* news in English at 1330.

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

ON THE SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

THINGS are hotting up r.f.-wise at Moretons, Harrow. The "Dorms" are bedecked with sneaky antennas of varying shapes and sizes and are used by an enthusiastic band of s.w.ls. **Jonathan Thackeray** is one and pleads guilty to listening on the Amateur bands by fixing an H.A.C. one-valver onto his modest 15ft. end fed. If you are having a chuckle at all this, observe Master Thackeray's log for 80 metres; JA5TY, JY1/B, UL7IAF, UP2TP, VE1FO, VE3QA, VK2LF, VO1MG, VP9UN, VQ9R, 4X4DP, 9H3B, 9K2AL. Definitely ten out of ten for that splendid effort. (Write out one hundred lines, "I must not receive better DX on eighty than G3JDG!")

It seems that most listeners kept their ears draped over the l.f. bands this past month. Log from **David Lawley** (Gravesend) shows a fair bit of activity on top band. Gear is a CR70A plus 220ft. folded long-wire with a quarter wave counterpoise earth for topband. All stations are c.w. unless marked; DJ4SS (s.s.b.), DL1CF, DL9KR, EI8BF, EI9BG, EI9J, GD3GM (s.s.b.), GM3-IGW, UKG, YCB, YOR, ZDH, GW3-UCB, UPK, YTO, HB9-CM, NL, OK1-ATP, AYY, KYS, MA, SBT, OL1AOH, OL5ANJ, PA0PN, W1BB/1, W1HGT. David bagged 195 countries last year, has already heard 85 this year and hopes to take the R.A.E. on May 9 (Gd lk OM).

John Runchman reports "A" level QRM but has managed a few late night/early morning sessions as a nice change from delta y tending to zero! Receiver is a homebrew two-valve t.r.f. (ECC83/ECL82—what funny transistor numbers) with a 20-metre dipole. Topband c.w. brought in: EI8H, HB9ANW, HB9CM, HB9NL, OK1ATP, OK1MAC, PA0PN. Just in case you think that two valves isn't very much you are quite right. The following log received on this set for 14MHz tends to add weight to the argument that it's what's between the headphones that counts; CN8GG, EA6BM/M, EA8HR, G3RFP/MM, LU2AJE, PJ2CL, PY1CBS, PY1DG (no relation!), PY1ZAN, PY2DVH, PY4AP, PY7OS, PZ1DR, UC2DX, VO1CU, VP2MZ, VP9CP, YV4AOW, YV6IP, 4S7SW (Ceylon), 4X4BL, 7X2BK, 9G1FF, 9H1CQ, 9Q5ITU, 9Q5RD. All this with a t.r.f., that should get some "reaction" from the superhet fraternity? Incidentally, John's QTH is South Norwood, London.

News from **Karl Muller** in the land of 3D6 (that's Swaziland in Southern Africa) that FL8HM and FL8MM both operate on band edge of 7MHz c.w. but he doesn't say the QTR. Karl has a Barlow-Wadley XCR-30 receiver with a 30ft. end fed and an a.t.u. The following made it into Swaziland on 7MHz c.w.; CM3LN, CR6AI, DK1EB, DU1IOR, FB8XX, FL8HM, FL8MM, HC2HM, JA1OHU, JA3EA, JA3PMB/6, JA5ADR, KP4DJE, KR6AY, LA2QI, OK2KYI, PY1BSN, PY3MU, TU2BK, VP2AAA, W6GRU, W7DI, ZD8BR, 4S7DA, 5R8BD, 6W8AL, 9M2CW. Incidentally, on ten metres Karl logged G3UGM. He also asks if people who work s.s.b. have callsigns and enquires why certain YU and LZ stations spend half an hour calling CQ on top of DX stations? (Yeah, well . . .).

Patrick Funnell reports on a pirate station on topband signing G4NCC who, apparently, spends his hours taking the mickey out of Amateur radio. Be warned friend, in this transistor age many Amateurs have some very simple but excellent d.f. equipment. All it needs is two of them to hear you and get a fix, and where the lines cross—that's you. Patrick has a BC312 receiver and a ". . . piece of wire in the loft." This set-up logged these on topband: EI9J, GM3IGW, GM3YOR, GM4AGG, OK1ATP, OK1JAX, OK1KYS, OK1NRX, all on c.w. and heard between 1830kHz and 1840kHz.

Eighty metres seems to be a strange band. Some acclaim it as just great while others give a clear "thumbs down" sign, or something.

Steve Taylor (Abbey Wood, S.E.2) reckons there's a lot of "G" activity about judging by what he heard on his CR70A. **Stefan Kaye** (Witney, Oxon) sends in a good log of eighty metre happenings bagged with the aid of an AR88D and 180ft. long-wire which is untuned. Pickings include: EA8HA, OA4OS, VE1ADV, VE1AU, VP2LAT, WB0FFG/TF, XE1KB, ZL3GS, ZL3RK, ZL4AV, ZL4KE, 4X4UF, 9H1BX, 9H1C, 9H3B.

"My first log to the Amateur Bands", says **John Vaarnela** of Croydon Park, New South Wales, Australia. Receiver is a BC348Q and the antenna a dipole at 25ft. Squeaks of s.s.b. on 14MHz heard from: A2CAB, CE1LU, CN2CG, CP1DN, CR6GA, CR7GJ, CX4RZ, EA8GZ, EL0K/MM, ET3JH, FB8ZZ, FB0WK, FK8ID, FL8MM, FO8DO, FO0TZ, FR7AB, HI8LC, HK1CKY, HK0BKX, HR1BK, HS1ADR, IC8CQS (Capri), JD1KAA, KC6QS, KG6SI, KH6AQ, KR6TQ, KP4DIW, KS6DH, KV4AA, KX6PQ, KZ5GB, LU1SE, MP4BBW, OA4PQ, PJ2MI, PY3ATW, TI2RT, VP1BH, VP9AT, VQ9NEW, VR1AB, VR4EE, VR5FX, VS5PW, VS6BS, VS9MT, VU2ED, XE1KB, XW8DO, YA1AG, YB0AT, YJ8BJ, YK1AA, YN1HC, YS1DET, YV6JB, ZD6HJ, ZD8RR, ZE2KV, ZP5KU, ZS2DH, 3B8CJ, 3D2FM, 4S7PB, 4W1AF, 4X4YT, 5H3LV, 5N2ABG, 5R8AB, 5V3RU, 5W1AU, 5X5NA, 5Z4KZ, 9H1ST, 9K2CP, 9M2GV, 9M8FMF, 9N1MM, 9V1VR. Who said twenty was dead?

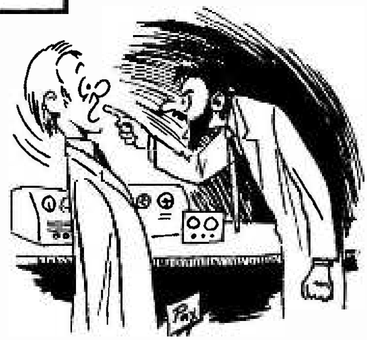
Julian Iredale (Llandudno), JR500SE, Codar PR30, 264ft. end fed got these goodies on 28MHz s.s.b.: K4AUV, K4HGG, VE4OCK, W2BLV, W4GJO, W8QUO, W0ZRX/MM (500 miles north of the Azores), WA5MAK, WB4BMV, WB5CTE, WB4WLI/YV1, ZC4GLW, 4Z4BG, 5R8AP, 7Q7AA, 9J2DG.

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

12 Cross Way, Harpenden, Herts.

practically wireless commentary by HENRY

No. 89 Dim out



You fiddled the meters

SLAVE to the whims and wishes of my readers—the whims of one and the wishes of the other, did I hear you say?—Henry sits here in the light of a flickering candle, like a Dickensian P.W. Editor.

Henry has been remiss. Not gifted with foresight, he to whom tea-leaves are a greater mystery than Rorsach blots failed to provide auxiliary illumination against the day when the power should be cut. The bulb's gone in me torch, innit?

I should have invented something electronic, on the spur of the moment, say the cold eyes around the blank TV. Like all great discoveries, the answer should have come in a blinding flash—well, perhaps that is not the best simile. . . .

As for example, when the transistor was born? Ah, but I'll bet it wasn't at all like that.

Shockley: Let's give it up. Nearly lunchtime.

Brattain: One more try. (He's the meticulous one. Like Spencer Tracy as Edison, he will not give up.)

S. I'm hungry. We are not going to get AFN without a tuning coil, and I'm sick of sharing the same bit of germanium.

B. Right. I'll just leave my cats-whisker here. You can do what you like with yours.

A Dickensian P.W. Editor

Shockley does.

They return, replete and burping. That Bell Laboratories Inc. canteen was notoriously shepherd-pie oriented.

B. Next step, then.

S. Oh., let's start again.

B. No, you measure, I'll inscribe.

S. Just a minute while I suck a—hey—what's this?

B. What's what?

S. Amplification. . . .

B. Well, it is a process of—

S. No, lout. Look! 1mV in, 100mV out. You fiddled the meters.

B. I did not, indeed!

S. Well, somebody did. Let's pack up and invent a fuel cell.

B.—and twenty makes four-hundred—no, listen Shock, we've got something here. We can transfer effective resistance over a link circuit. We can leap a barrier.

S. Don't get romantic. Have some bicarb.

B. Bicarb, hell! Don't you see, this is a breakthrough. No more pot-twiddling. Just stick a couple of cats' whiskers on a slab of germanium and the input resistance changes to a completely different output resistance just by an alteration of voltage. . .

Of course, dear reader, it did not turn out like that. Some fussy, officious bookmaker from the front office came down to the bogfins' dimly-lit cellar (that's old Bell Inc. for you—my candle is getting low and smelly). He said: Pack it in chaps. Don't forget we own half the Varires company and control Pots Inc. You can't invent the noiseless pot. Let's put it to another use, or scrap it.

And so the transistor, as an amplifying device, was reluctantly dragged forth.

Well, that's my story. But the truth was probably quite different. Most inventions are the result of sweated persistence. *'Eureka'* was probably Greek for 'the water's too hot.'

Henry has seen some of this dogged persistence in action. A great friend is an industrial designer. His development chief presents him with impossible problems a couple of times a week. He is given a pretty free hand—enviable job!— and the limiting factor is the utmost reliability and speed of construction. No jerry-built hook-ups for him. His tobacco-tin wizadry is made of cast-iron.

So I wonder how he is getting along in the dim-out? I only hope he did not try to follow the same circuit my colleague tried with the cadmium sulphide cell. Published, he told me, in Pr*ct*c*l *l*ctr*n*cs (R**lly? Ed.). It did not work, and there was no time to find out why.

So this chap being in his way a latter-day Brattain, persisted in racking his brains for past applications and came up with the trigger circuit for an oven control circuit. Problem—no unijunction transistor. Solution, use a pnp in an involuted hookup—good old Shockley's method.

The final result, with two transistors and four resistors, worked a treat. But as the CDS had to be the lower limiting factor of his resistor network, he now has the problem that there is enough infra-red reflected off the ceiling from a television screen to latch the circuit on.

So what, you say, if there is no power, there will be no telly.

That's where you'd be wrong, you see. The first thing he did was to rig up a battery driven invertor to feed the television receiver!

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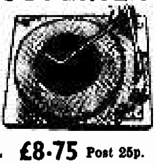

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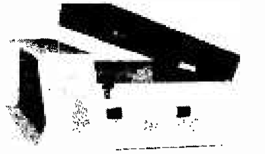

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16/450V	15p	1000/50V	47p	32+32/450V	33p
32/450V	20p	8+8/450V	18p	350+50/325V	50p
25/25V	10p	8+16/450V	20p	32+32+32/350V	48p
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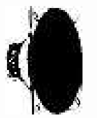

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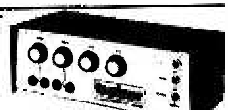

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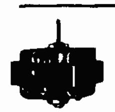

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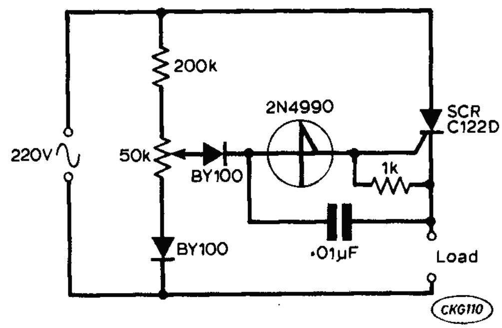
I.C. OF THE MONTH

L.A.J. IRELAND

Number 29 — GEC Silicon Switches 2N4990/1

IN the past a number of utility type i.c.'s were reviewed in the "I.C. of the Month" series such as the Mullard TAA320 Bifet or the D13V voltage regulator, etc., and it is quite some time now since any of these three or four terminal devices have appeared. Consequently this month's article is devoted to a review of two specialised monolithic i.c.'s namely the Silicon Unilateral and Bilateral Switch (SUS and SBS) which have recently been released by the General Electric Company. Some useful practical applications of the devices are given.



The 2N4990 used as a motor speed control.

Operation

In appearance the SUS and SBS resemble a typical small signal transistor mounted in an epoxy TO-98 package, the electrical characteristics of the SUS closely resembling those of an ordinary four layer thyristor. The monolithic chip has a pair of complementary transistors, a zener diode and a resistor

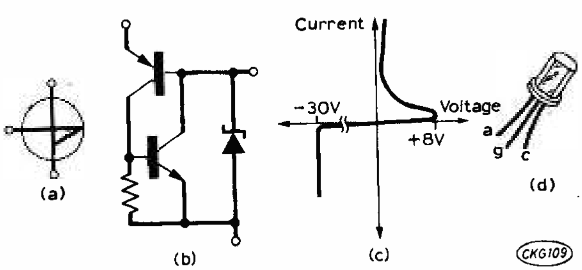
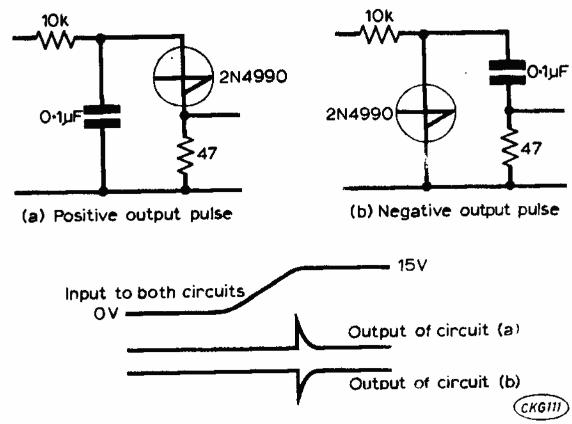
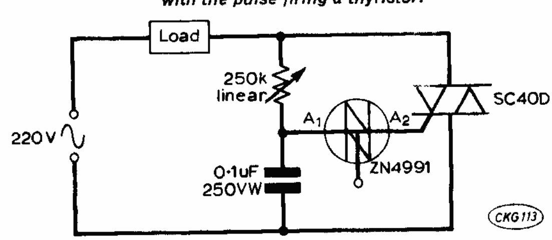


Fig. 1: Circuit symbol (a), equivalent electrical circuit (b), characteristics (c) and outline (d) of the Unilateral Switch 2N4990.

fabricated into it as is shown in Fig. 1. The resulting static electrical characteristics of the device, in which the applied voltage versus current is plotted, is also illustrated and from this graph it can be seen that once the applied voltage exceeds a typical value of about 8 volts rapid forward conduction takes place with the voltage across the device dropping almost to zero.



Here the 2N4990 SUS is used to generate a rapid pulse from a comparatively slow rising input. Can be used as an over-voltage sensor with the pulse firing a thyristor.



The Silicon Bilateral Switch 2N4991 (SBS) in a mains full wave power control unit.

Applications

A gate lead is also provided to allow triggering at lower voltages in addition to providing transient-free wave forms, but in most applications this lead may be left floating. The SUS therefore is admirably suited for such applications as over-voltage sensing, pulse sharpeners, and SCR triggering. In conjunction with an SCR an efficient and sensitive automatic over-voltage cut-out sensor can be designed very simply and a number of typical applications of the SUS are given.

Just as the Triac can be considered as consisting of a pair of thyristors connected in inverse parallel so also is the SBS related to its counterpart, the SUS. A schematic diagram of the 2N4991 is illustrated in Fig. 2 accompanied by its static electrical characteristics. It fires in both directions so that in operation it resembles the ST2 Diac which has established itself as one of the most popular triggering devices in Triac power control circuits. However the 2N4991 has tighter specifications producing sharper pulses than the ST2 although it is offered in the same price bracket as the latter.

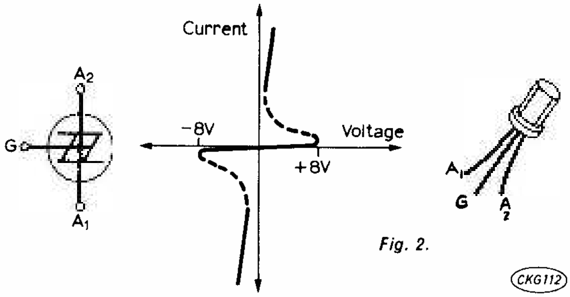


Fig. 2.

Both units are available from Jermyn Industries Ltd., Sevenoaks, Kent.

CHARLES MOLLOY

THE Medium Wave Column

DAVID RICHARDSON of West Ealing has been active on the medium waves with his Lafayette HA230 and medium wave loop antenna. He reports Radio Popular La Palmas on 836kHz; CKBW Bridgewater, Nova Scotia on 1000kHz; WHN New York City 1050kHz; CJRP Quebec, broadcasting in French on 1060kHz; WBAL Baltimore 1090kHz; CBI Sydney, Nova Scotia 1140kHz; CKCV Quebec, in French, 1280kHz; WABK Gardiner, Maine also on 1280kHz; WLAM Lewiston, Maine 1470kHz; WCKY Cincinnati, Ohio 1530kHz. David has also logged the Voice of America Okinawa 1178kHz at 1445hrs SINPO 22432, with a programme in Chinese. This outlet is usually heard in Europe during the afternoon in winter. It has a power of 1000kW, it beams westward into China and sometimes competes with Horby, Sweden on the same frequency when conditions are good.

W. Pennington who lives at Grimethorpe near Barnsley in Yorkshire has built the Radio Nederland MW Frame (Loop) aerial. His receiver is a B40D and on Tuesday February 8th he heard CJON St John's on 930kHz, WINS New York 1010kHz; CBA Moncton, New Brunswick 1070kHz. After midnight he logged CBN 640kHz in St John's; CJOX 710kHz Grand Bank, Nfld; Radio Demerara Guyana 760kHz; WHN 1050kHz and WNEW 1130kHz both in New York City. "I thought it was impossible to receive these stations in England but I have proved it for myself and I find it most interesting" he writes and he suggests that readers may like to write to Radio Nederland, Postbus 222, Hilversum, Holland and ask for a copy of The Frame Aerial leaflet, which gives constructional information on a medium wave loop antenna.

Mike Kerry of Golders Green sends an interesting log of Latin Americans heard on his Eddystone 750 and medium wave loop. These include YVQQ Radio Puerto Cruz, Venezuela on 760kHz; Radio Demerara 760kHz located in Georgetown Guyana, with programme in English; R.Oriental, Uruguay 770kHz; La Voz del Rio Cauca, Colombia 820kHz; Radio Mundial, Rio de Janeiro 860kHz; R.Tamandau, Recife 890kHz; Radio Jornal do Brasil 940kHz; Radio Belgrano, Buenos Aires 950kHz; R.Sutatenza, Colombia 960kHz; Radio Record, Sao Paulo 1000kHz; R.Margarita, Venezuela 1020kHz; R.Revolution Cuba 1060kHz; R.Nacional, Sao Paulo 1100kHz; WBMJ San Juan, Puerto Rico 1190kHz; R.Valera, Venezuela 1230kHz; R.Canaima, Ciudad Bolivar, Venezuela 1290kHz; R.Nacional, Santiago in the Dominican Republic 1380kHz. Mike also mentions the VOA Marathon Key, Florida on 1180kHz which broadcasts in Spanish. Latin Americans become prominent as the year advances and it is worth while listening between 0100hrs GMT and sunrise for the stations listed above.

Please send reports and information about the medium waves to the author at 132 Segars Lane, Southport, PR8 3JG.

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2N697	17p	2N3702	11p	40348	52½p	BCY54	32½p	BSY27	17½p	NKT613F	32½p
2N698	25p	2N3703	10p	40360	42½p	BCY58	22½p	BSY28	17½p	NKF674F	30p
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2N726	30p	2N3709	09p	40408	52½p	BCZ10	27½p	BSY39	22½p		
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2N2219	23p	2N4287	17½p	AF126	20p	BF225	19p	GET898	22½p	OC44	20p
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2N2221	25p	2N4289	17½p	AF138	37½p	BF238	23p	MJ420	£1·12½	OC46	15p
2N2222	30p	2N4290	17½p	AF178	42½p	BF244	23p	MJ421	£1·12½	OC70	15p
2N2270	47½p	2N4291	17½p	AF179	72½p	BFW61	47½p	MJ430	£1·02½	OC71	12½p
2N2297	30p	2N4292	12½p	AF180	52½p	BFX12	22½p	MJ440	95p	OC72	12½p
2N2368	17½p	2N4303	47½p	AF181	42½p	BFX13	22½p	MJ480	97½p	OC74	32½p
2N2369	17½p	2N5027	52½p	AF239	42½p	BFX29	30p	MJ481	£1·25	OC75	22½p
2N2369A	17½p	2N5028	57½p	AF279	47½p	BFX30	30p	MJ490	£1·00	OC76	22½p
2N2410	42½p	2N5029	47½p	AF280	62½p	BFX42	37½p	MJ491	£1·37½	OC77	30p
2N2483	27½p	2N5030	42½p	AF211	32½p	BFX44	37½p	MJ1800	£2·17½	OC81	20p
2N2484	32½p	2N5172	12½p	ASY26	25p	BFX68	67½p	MJE340	62½p	OC81D	22½p
2N2539	22½p	2N5174	52½p	ASY27	37½p	BFX84	25p	MJE520	60p	OC83	25p
2N2540	22½p	2N5175	52½p	ASY28	27½p	BFX85	32½p	MJE521	73p	OC84	25p
2N2613	35p	2N5176	45p	ASY29	27½p	BFX86	25p	MPF102	42½p	OC139	32½p
2N2614	30p	2N5232A	30p	ASY36	25p	BFX87	27½p	MPF103	37½p	OC140	32½p
2N2646	52½p	2N5245	45p	ASY50	25p	BFX88	25p	MPF104	37½p	OC170	30p
2N2696	32½p	2N5246	42½p	ASY51	32½p	BFX89	62½p	MPF105	37½p	OC171	30p
2N2711	25p	2N5249	67½p	ASY54	25p	BFX93A	70p	MPS3638	32½p	OC200	40p
2N2712	25p	2N5265	£3·25	ASY86	32½p	BFY10	32½p	NKT0013	47½p	OC201	60p
2N2713	27½p	2N5266	£2·75	AU103	£1·25	BFY11	42½p	NKT124	42½p	OC202	75p
2N2714	30p	2N5267	£2·62½	ASZ21	42½p	BFY17	22½p	NKT125	27½p	OC203	42½p
2N2865	62½p	2N5305	37½p	BC107	10p	BFY18	32½p	NKT126	27½p	OC204	42½p
2N2904	30p	2N5306	40p	BC108	10p	BFY19	32½p	NKT128	27½p	OC205	90p
2N2904A	32½p	2N5307	37½p	BC109	10p	BFY20	£1·60	NKT135	27½p	OC207	75p
2N2905	37½p	2N5308	37½p	BC113	15p	BFY21	42½p	NKT137	32½p	OCP71	42½p
2N2905A	40p	2N5309	62½p	BC115	15p	BFY24	45p	NKT210	30p	ORP12	50p
2N2906	25p	2N5310	42½p	BC116A	15p	BFY25	25p	NKT211	30p	ORP61	50p
2N2906A	27½p	2N5354	27½p	BC118	10p	BFY26	20p	NKT212	30p	P346A	22½p
2N2907	30p	2N5355	27½p	BC121	20p	BFY29	50p	NKT213	30p	TIS34	62½p
2N2923	15p	2N5356	32½p	BC122	20p	BFY30	50p	NKT214	22½p	TIS43	27p
2N2924	15p	2N5365	47½p	BC125	20p	BFY41	50p	NKT215	22½p	TIS44	10p
2N2925	15p	2N5366	32½p	BC126	20p	BFY43	62½p	NKT216	37½p	TIS45	10p
2N2926		2N5367	57½p	BC140	37½p	BFY50	23p	NKT217	42½p	TIS46	11p
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2N3014	32½p	2S103	25p	BC157	20p	BFY75	30p	NKT229	30p	TIS51	12½p
2N3053	18p	2S104	25p	BC158	11p	BFY76	42½p	NKT237	35p	TIS52	12½p
2N3054	46p	2S501	32½p	BC159	12p	BFY77	57½p	NKT238	25p	TIS53	22½p
2N3055	62p	2S502	35p	BC160	62½p	BFY90	67½p	NKT240	27½p	TIS60	22½p
2N3133	30p	2S503	27½p	BC167	11p	BFW58	27½p	NKT241	27½p	TIS61	25p
2N3134	30p	3N83	40p	BC168B	10p	BFW59	25p	NKT242	20p	TIS62	27½p
2N3135	25p	3N128	70p	BC168C	11p	BFW60	25p	NKT243	62½p	TIP29A	50p
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SN7405	0·20	0·18	SN7441AN	0·87	0·83	SN7476	0·45	0·44
SN7406	0·80	0·75	SN7442	0·85	0·81	SN7480	0·70	0·65
SN7407	0·80	0·75	SN7443	2·88	2·70	SN7481	1·40	1·38
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SN7409	0·20	0·18	SN7445	2·50	2·40	SN7483	0·87	0·82
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IS120	12p	BA102	25p	BY122	47½p	OA73	10p
IS121	14p	BA110	25p	BY124	15p	OA79	7p
IS130	8p	BA114	15p	BY126	15p	OA81	8p
IS131	10p	BA115	7p	BY127	17p	OA82	10p
IS132	12p	BA141	17p	BY164	57p	OA90	7p
IS920	7p	BA142	17p	BYX10	22p	OA91	7p
IS922	8p	BA144	12p	BYZ10	35p	OA95	7p
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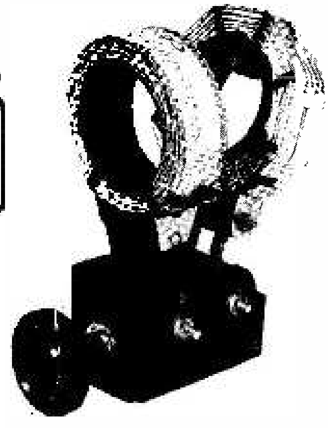

COLIN RICHES
ARTHUR DOW

IT was on Wednesday, April 10th, sixty years ago that the s.s. *Titanic* left Southampton on her maiden voyage. Five days later, she sank to the bed of the ocean—a useless mass of twisted and torn steel, for on Sunday, April 14th, 1912, at about 11.40 p.m. the greatest peacetime disaster in maritime history took place when this ship, gross tonnage 46,328, struck an iceberg, 50-100ft. high, while on her maiden voyage to New York.

The blow on the starboard side of the ship ripped a hole 300 feet long and made many of the essential watertight compartments useless. She foundered within three hours, in water two miles deep.

Mr. H. S. Bride, the operator who survived the disaster described the way in which wireless played its all important role in saving those who were rescued. Mr. Bride was the second operator on the *Titanic* and was relieving his chief, Mr. Phillips at the time when the collision occurred. "I was standing by Mr. Phillips telling him to go to bed when

Jack G. Phillips, Chief Marconi Operator on board the Titanic.

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How the maiden voyage of the Titanic was advertised.

the captain put his head into the cabin. 'We have struck an iceberg!' he said, 'you had better get ready to send out a call for assistance. 'Don't send it until I tell you'. The captain went away but in ten minutes came back. We could hear terrible confusion outside but not the least thing to indicate any trouble. The wireless was working perfectly. 'Send a call for assistance' ordered the captain. 'What call shall I send?' Phillips asked. 'The regulation international call for help—just that' was the reply, and Phillips began to send the signal C.Q.D. (now replaced by S.O.S.). After a few minutes the Captain reappeared and said, 'Send S.O.S.—it may be your last chance'."

The Titanic's C.Q.D.'s and S.O.S.'s were first picked up by the German steamer, *Frankfurt* which was 153 miles away. Almost at the same time, the *Carpathia's* wireless operator reported the emergency to his captain and was able to give the stricken liner's position 41 46N 50 14W. Immediately, the *Carpathia,* which was 58 miles away, altered course to the rescue. The first message the *Carpathia* picked up was, "COME AT ONCE, WE'VE STRUCK A BERG. IT'S C.Q.D. OM C.Q.D." C.Q.D. of course meant Come Quick, Danger, and was rather tricky to tap out in Morse. For this reason, the now universal distress signal S.O.S. was also used and this was the first occasion it had really been broadcast in earnest.

Fortunately, the *Carpathia's* only wireless operator, although officially off watch had returned to his equipment and was putting out some routine traffic calls—including some to the *Titanic.* At 12.20 a.m. the distress calls were received and soon at least six ships were steaming to the disaster zone.

At 2.20 a.m. the *Californian* which for sometime past had been watching the lights of the 'unknown' vessel grow steadily dimmer, noted that they had finally disappeared. The optical illusion being that of seeing a ship disappearing into the darkness—not going under the waves. Those witnessing the scene from the decks of the *Californian* were not to know that they had been watching the death throes of the *Titanic* and that the sea around them was dotted with hundreds of human beings fighting for their lives. Two long hours were to elapse before the *Carpathia* arrived and began to pick up survivors. Among over 1,500 people lost on that fateful night was Jack Phillips, the *Titanic's* senior wireless operator, who remained at his post as the decks were awash. Mr. Bride, who showed an equal devotion to duty, was eventually rescued after nearly two hours in the sea.

As the decks were awash, Phillips was standing in the wireless room, still sending away giving the Carpathia details of how the *Titanic* was faring. He then picked up the *Olympic* and told her that *Titanic* was sinking by the head. As Phillips was sending the message, Harold Bride strapped his lifebelt to the wireless operator's back. He had already put on his overcoat and was wondering if he could get Phillips' boots on him while he was still sending.

The Captain's voice boomed, "Men, you have done your duty. You can do no more. Abandon your cabins now. It's every man for himself. You look out for yourselves. I release you—that's the way of it at this kind of time, every man for himself."

The boat deck was awash. Phillips clung on sending . . . sending. He clung for about fifteen minutes after the Captain released him—water washing the floor of the wireless cabin.

H. S. Bride, 2nd Operator on board the Titanic.

Cyril Evans, Marconi Operator on board the Californian.

From aft came the strains of music—the ship's band playing ragtime. Phillips ran aft and made his way to the deck. He swam to a life-raft but lay there exhausted until his last breath failed. Harold Bride later said of Phillips. "He was a brave man and stuck to his key until the very end. If he had had a chance to go to his room and get warmer clothing, as I did, he would probably be alive today. But duty was first with him."

When water flooded the upper decks, Second Officer Lightoller was up to his ankles in water and Captain Smith—a calm grave figure of a man realising that the end could not now be far off—stood calmly on the bridge. He spoke two words to the people who were crowding forward. Words which were a call to our traditions of race and manhood, "Be British!"

Besides calling the *Carpathia* and *Baltic,* Phillips had also contacted the *Frankfurt* again and vessels had also been sent to the rescue by the wireless station at Cape Race. They were however all very far away and even though they made all speed to the stricken *Titanic,* not one of them was near when the last terrible moment came.

The band still played on. They played until they were waist deep in the cold dark water and in that awful moment, W. Hartley, the conductor spoke to his colleagues and there rang out into the darkness the hymn NEARER MY GOD TO THEE.

Part 2 of the Titanic story will be published in "Going Back" next month.

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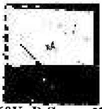

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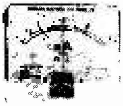

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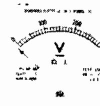
100µA	£2·60	50V. D.C.	£2·00
100-0-100µA	£2·50	300V. D.C.	£2·00
500µA	£2·30	15V. A.C.	£2·10
1mA	£2·00	300V. A.C.	£2·10
5mA	£2·00	8 Meter 1mA	£2·10
10mA	£2·00	VU Meter	£3·20
50mA	£2·00	1 amp. A.C.*	£2·00
100mA	£2·00	5 amp. A.C.*	£2·00
500mA	£2·00	10 amp. A.C.*	£2·00
1 amp.	£2·00	20 amp. A.C.*	£2·00
5 amp.	£2·00	30 amp. A.C.*	£2·00

Type MR.65P. 3½in. × 3¼in. fronts.

50µA	£3·37	10V. D.C.	£2·20
50-0-50µA	£2·75	20V. D.C.	£2·20
100µA	£2·75	50V. D.C.	£2·20
100-0-100µA	£2·65	150V. D.C.	£2·20
200µA	£2·65	300V. D.C.	£2·20
500µA	£2·40	15V. A.C.	£2·30
500-0-500µA	£2·20	50V. A.C.	£2·30
1mA	£2·20	150V. A.C.	£2·30
5mA	£2·20	300V. A.C.	£2·30
10mA	£2·20	500V. A.C.	£2·30
50mA	£2·20	8 Meter 1mA	£2·37
100mA	£2·20	VU Meter	£3·37
500mA	£2·20	50mA A.C.*	£2·20
1 amp.	£2·20	100mA A.C.*	£2·20
5 amp.	£2·20	200mA A.C.*	£2·20
10 amp.	£2·20	500mA A.C.*	£2·20
15 amp.	£2·20	1 amp. A.C.*	£2·20
20 amp.	£2·20	5 amp. A.C.*	£2·20
30 amp.	£2·30	10 amp. A.C.*	£2·20
50 amp.	£2·50	20 amp. A.C.*	£2·20
5V. D.C.	£2·20	30 amp. A.C.*	£2·20

Type MR.38P. 1 21/32in. square fronts.



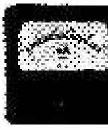
		200mA	£1·60
		300mA	£1·60
		500mA	£1·60
		750mA	£1·60
		1 amp.	£1·60
		2 amp.	£1·60
		5 amp.	£1·60
		10 amp.	£1·60
50µA	£2·10	3V. D.C.	£1·60
50-0-50µA	£1·90	10V. D.C.	£1·60
100µA	£1·90	15V. D.C.	£1·60
100-0-100µA	£1·75	20V. D.C.	£1·60
200µA	£1·75	100V. D.C.	£1·60
500µA	£1·65	150V. D.C.	£1·60
500-0-500µA	£1·60	300V. D.C.	£1·60
1mA	£1·60	500V. D.C.	£1·60
1-0-1mA	£1·60	750V. D.C.	£1·60
2mA	£1·60	15V. A.C.	£1·70
5mA	£1·60	50V. A.C.	£1·70
10mA	£1·60	150V. A.C.	£1·70
20mA	£1·60	300V. A.C.	£1·70
50mA	£1·60	500V. A.C.	£1·70
100mA	£1·60	8 Meter 1mA	£1·70
150mA	£1·60	VU Meter	£2·10

Type MR.45P. 2in. square fronts.

50µA	£2·25	5 amp.	£1·70
50-0-50µA	£2·10	10V. D.C.	£1·50
100µA	£2·10	20V. D.C.	£1·50
100-0-100µA	£1·87	50V. D.C.	£1·50
200µA	£1·87	300V. D.C.	£1·50
500µA	£1·75	15V. A.C.	£1·80
500-0-500µA	£1·70	300V. A.C.	£1·80
1mA	£1·70	8 Meter 1mA	£1·85
5mA	£1·70	VU Meter	£2·25
10mA	£1·70	1 amp. A.C.*	£1·70
50mA	£1·70	5 amp. A.C.*	£1·70
100mA	£1·70	10 amp. A.C.*	£1·70
500mA	£1·70	20 amp. A.C.*	£1·70
1 amp.	£1·70	30 amp. A.C.*	£1·70

"SEW" BAKELITE PANEL METER

Type MR.65. 3½in. square fronts.



		1 amp.	£1·95
		2 amp.	£1·95
		5 amp.	£1·95
		15 amp.	£1·95
		30 amp.	£1·95
		50 amp.	£1·95
		5V. D.C.	£1·95
		10V. D.C.	£1·95
		20V. D.C.	£1·95
		50V. D.C.	£1·95
		150V. D.C.	£1·95
25µA	£3·50	300V. D.C.	£1·95
50µA	£2·75	30V. A.C.*	£1·95
50-0-50µA	£2·35	50V. A.C.*	£1·95
100µA	£2·35	150V. A.C.*	£1·95
100-0-100µA	£2·25	300V. A.C.*	£1·95
500µA	£2·20	500mA A.C.*	£1·95
1mA	£1·95	1 amp. A.C.*	£1·95
1-0-1mA	£1·95	5 amp. A.C.*	£1·95
5mA	£1·95	10 amp. A.C.*	£1·95
10mA	£1·95	20 amp. A.C.*	£1·95
50mA	£1·95	30 amp. A.C.*	£1·95
100mA	£1·95	50 amp. A.C.	£1·95
500mA	£1·95	VU Meter	£3·10

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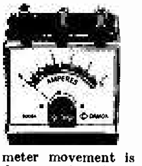

Type ED.107. Size overall 100mm × 90mm × 108mm. A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

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1mA	£4·40	300V d.c.	£4·40
50-0-50µA	£4·65		
1-0-1mA	£4·40	Dual range	
1A d.c.	£4·40	500mA/5A d.c.	£4·65
5A d.c.	£4·40	5V/50V d.c.	£4·65
10V. d.c.	£4·40		

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100-0-100µA	£2·90		
200µA	£2·90	VU Meter	£3·40

Send for illustrated brochure on SEW Panel Meters—discounts for quantities.

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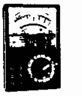
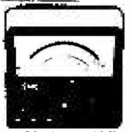
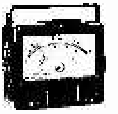


MODEL TE-300. 30,000 O.P.V. Mirror scale, overload protection 0/.6/3/15/60/300/1,200V. D.C. 0/6/30/120/600/1,200V. A.C. 0/30uA/6mA/60mA/300mA/600mA. 0/8K/80K/800K/8 meg. ohm −20 to +63 db. **£5·97½**. P. & P. 15p.



MODEL PL436 20kΩ/Volt D.C. 8kΩ/Volt AC. Mirror scale. ·6/3/12/30/120/600V D.C. 3/30/120/600V A.C. 50/600uA/60/600 mA. 10/100K/1 Meg/10 MegΩ −20 to +46db. **£6·97½** P & P 12½p.



MODEL 5025 57 Ranges, Giant 5¼in. Meter, Polarity Reverse Switch. Sensitivity: 50K/Volt D.C. 5K/Volt A.C. D.C. Volts: ·125, ·25, 1·25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.C. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.C. Current: 25, 50IA, 2·5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 2K, 10K, 100K, 1MEG, 10 MEG. Decibels: −20 to +85 dB. **£12·50**. P. & P. 17½p.

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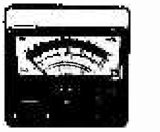

Battery operated, 11 meg input, 26 ranges. Large 4½" mirror scale. Size 5½" × 4⅞" × 2⅝". DC VOLTS 0.3–1200V. AC VOLTS 3–300V RMS. 8·0–800V P-P. DC CURRENT ·12–12MA. Resistance up to 2000M ohm. Decibels −20 to +51 db. Complete with leads/instructions. **£17·50**, P. & P. 20p.

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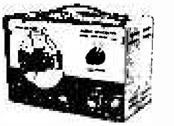
TE22 SINE SQUARE WAVE AUDIO GENERATORS



Sine: 20cps to 200 kc/s on 4 bands. Square: 20cps to 30 kc/s. Output impedance 5,000 ohms, 200/250V. A.C. operation. Supplied brand new and guaranteed with instruction manual and leads. **£17·50**. Carr. 37½p.

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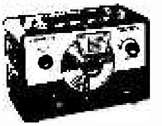

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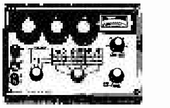

A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω-11·1 megΩ 6 Ranges ±1% L.1 µH - 111 HENRYS 6 Ranges 2 = %C.10pF ±1110mFd 6 Ranges ± 2%. TURNS RATIO 1:1/1000-1:11100. 6 Ranges ± 1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100µA. Meter indication. Attractive 2 tone metal case. Size 7¾ × 5 × 2in. **£20**. P. & P. 25p

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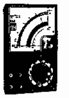
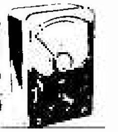


MODEL TE-200 20,000 O.P.V. Mirror scale, overload protection. 0/5/25/125/1,000V. D.C. 0/10/50/250/1,000V. A.C. 0/50 µA/250 mA. 0/60K/6 megΩ. −20 to +62 db. **£3·75**. P. & P. 15p.

TMK MODEL MD.120 Mirror scale. 20k/Volt D.C. 10kΩ Volt A.C. 30/60/300/600/3,000 V. D.C. 6/120/1,200 V. A.C. Current 0-60µA/0 — 12/0 300mA. 0-60K/0-6 MegΩ. −20 to + 63 dB. **£4·62½** P & P 15p



MODEL 500 30,000 O.P.V with overload protection mirror scale 0/·5/2·5/10/25 100/250/500/1,000v. D.C 0/2·5/10/25/100/250/500/1,000V. A.C. 0/50µA/5/50/500mA. 12 amp. D.C. 0/60/K/6 Meg./60 MegΩ. **£8·87½**. Post paid.

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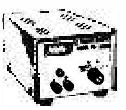

PS.1000B REGULATED POWER SUPPLY Solid state. Output 6, 9 or 12 volt DC up to 3 amps. Meter to monitor current. Input 220/240v AC. Size 4" × 3½" × 6½". **£11·97**. P. & P. 25p.

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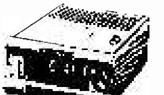

Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt, current and ohms with optional plug in cards. Specification: Accuracy: ±0·2, ±1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1·999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100v. D.C. Input: Fully floating (3 poles). Input power: 110-230v. A.C. 50/60 cycles. Overall size: 5⅛in. × 2 13/16in. × 8 3/16in. AVAILABLE BRAND NEW AND FULLY GUARANTEED AT APPROX. HALF PRICE. **£49·97½**. Carr. 50p.

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2N699	30p
2N706	10p
2N706A	12p
2N708	15p
2N709	62p
2N718	25p
2N718A	30p
2N726	30p
2N727	30p
2N914	17p
2N916	17p
2N918	30p
2N929	22p
2N930	20p
2N987	40p
2N1090	22p
2N1091	22p
2N1131	25p
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2N1637	30p
2N1638	27p
2N1639	27p
2N1701	160p
2N1711	24p
2N1889	32p
2N1893	37p
2N2147	72p
2N2160	57p
2N2193	40p
2N2193A	42p
2N2194	27p
2N2194A	30p
2N2217	25p
2N2218	20p
2N2219	20p
2N2220	25p
2N2221	25p
2N2222	20p
2N2222A	25p
2N2297	30p
2N2368	15p
2N2369	15p
2N2369A	15p
2N2410	42p
2N2483	27p
2N2484	33p
2N2539	22p
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2N2613	85p
2N2614	30p
2N2646	40p
2N2711	25p
2N2712	25p
2N2713	27p
2N2714	30p
2N2904	20p
2N2904A	25p
2N2905	25p
2N2905A	20p
2N2906	20p
2N2906A	25p
2N2907	22p
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2N2924	15p
2N2925	15p
2N2926G	10p
2N2926O	10p
2N2926Y	10p
2N3011	20p
2N3014	32p
2N3053	18p
2N3054	46p
2N3055	60p
2N3133	30p
2N3134	15p
2N3135	25p
2N3136	25p
2N3390	25p
2N3391	20p
2N3391A	30p
2N3392	17p
2N3393	15p
2N3394	15p
2N3402	22p
2N3403	22p
2N3404	32p
2N3405	45p
2N3414	22p

2N3415	22p
2N3416	37p
2N3417	37p
2N3439	130p
2N3440	97p
2N3564	17p
2N3565	15p
2N3566	22p
2N3568	25p
2N3569	25p
2N3570	125p
2N3572	97p
2N3605	20p
2N3606	27p
2N3607	22p
2N3638	18p
2N3638A	20p
2N3641	18p
2N3642	18p
2N3643	20p
2N3644	25p
2N3645	25p
2N3691	15p
2N3692	18p
2N3693	15p
2N3694	18p
2N3702	10p
2N3703	10p
2N3704	11p
2N3705	10p
2N3706	9p
2N3707	11p
2N3708	7p
2N3709	9p
2N3710	9p
2N3711	12p
2N3713	187p
2N3714	200p
2N3715	123p
2N3716	130p
2N3773	240p
2N3791	206p
2N3819	34p
2N3820	55p
2N3823	50p
2N3854	27p
2N3854A	27p
2N3855	27p
2N3855A	30p
2N3856	30p
2N3856A	35p
2N3858	25p
2N3858A	30p
2N3859	27p
2N3859A	32p
2N3860	30p
2N3866	150p
2N3877	40p
2N3877A	40p
2N3900	37p
2N3900A	40p
2N3901	97p
2N3903	20p
2N3904	25p
2N3905	30p
2N3906	25p
2N4058	12p
2N4059	10p
2N4060	12p
2N4061	12p
2N4062	12p
2N4244	47p
2N4248	15p
2N4249	15p
2N4250	18p
2N4254	42p
2N4255	42p
2M4284	17p
2N4285	17p
2N4286	17p
2N4287	17p
2N4288	15p
2N4289	17p
2N4290	12p
2N4291	15p
2N4292	15p
2N4294	17p
2N4303	47p
2N4964	15p
2N4965	18p
2N5027	52p
2N5028	57p
2N5029	47p
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FCJ121	275p
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FCK101	430p
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FCY101	102p
FJH101	25p

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FJH171	25p
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FJH221	25p
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MC1709CG	94p
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TAA241	162p
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		100 PIV 4A	50p
		200 PIV 4A	55p
		400 PIV 4A	65p
		600 PIV 4A	70p
600 PIV 1A	50p	50 PIV 6A	45p
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200 PIV 2A	55p	400 PIV 6A	75p
400 PIV 2A	60p	600 PIV 6A	85p

SILICON RECTIFIERS MINIATURE WIRE ENDED PLASTIC

SERIES	IN 1 AMP	PL 1·5 AMP	CL 3 AMP
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4002 100PIV	7p	9p	20p
4003 200PIV	8p	10p	22p
4004 400PIV	8p	10p	25p
4005 600PIV	10p	12p	26p
4006 800PIV	12p	15p	27p
4007 1000PIV	15p	18p	30p

50 + less 15% 100 + less 20%

SILICON RECTIFIERS STUD MOUNTING

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100PIV	—	45p	50p	£1·22
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600PIV	32p	60p	72p	£2·12
800PIV	35p	75p	87p	£2·47
1000PIV	40p	85p	£1·05	£2·77

50 + less 15% 100 + less 20%

ZENER DIODES

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3·3-33 V	2·4—100	3·9—100 V
10p each	25p each	40p each

25 + less 15% 100 + less 20%

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1625	50p
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CY31	35p
DAF91	30p
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DK96	50p
DL92	35p
DL94	43p
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DM70	40p
DY86	32p
DY87	33p
E88CC	100p
E180F	100p
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AA119	7p	BAY31	7p	OA10	22p
AA129	10p	BAY38	15p	OA9	10p
AAZ13	10p	BY100	15p	OA47	8p
AAZ15	10p	BY103	22p	OA70	7p
BA100	15p	BY122	37p	OA73	10p
BA102	30p	BY124	15p	OA79	7p
BA110	25p	BY126	12p	OA81	7p
BA111	27p	BY127	15p	OA85	7p
BA112	70p	BY164	52p	OA90	7p
BA115	7p	BY210	35p	OA91	7p
BA141	32p	BYZ11	30p	OA95	7p
BA142	32p	BYZ12	30p	OA200	7p
BA144	18p	BYZ13	25p	OA202	10p
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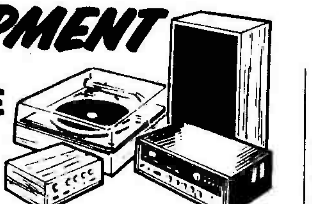

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2025 T/C*	£8·50		
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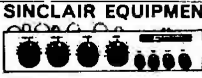

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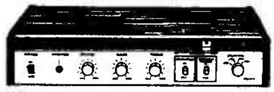

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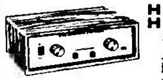

All silicon transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9v battery. Inputs 5MU/100MU. Output 50MW. £5·97. P. & P. 15p.

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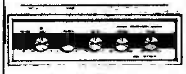

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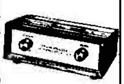

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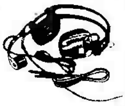

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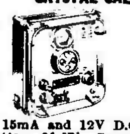

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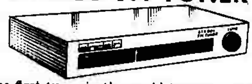

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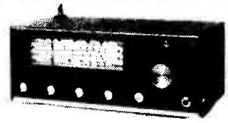

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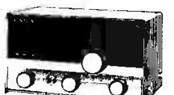

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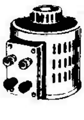

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Selection from our List, sent free for stamped addressed envelope. (Free overseas). Cash with Order only—No C.O.D. or Caller service. Charges (Min. 6p) in brackets after all items apply to G.B. & Eire only. Regret Orders under 25p plus charges unacceptable. S.A.E., please, for enquiries or cannot be replied to. Overseas Orders welcomed.

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CARTRIDGES. All with standard fittings and stylii. Stereo-compatible Mono **GP91/SC £1·10**; STEREO GP93 **£1·40**; Stereo Ceramic GP94 **£1·95**. (All at 6p each.) Comparatives shown in List, with more types incl. Sonotone 9TAHC, Stereo Ceramic Diamond **£1·97½** (6p) **DIAMOND STYLII:** single tip types: Acos GP37, GP59, GP65/67, GP71, BSR TC8/LP/ST; COLLARO O. P and DC284, GARRARD GC2, GC8, GCS10, GCE12, RONETTE BF40, O, P, and T. PHILIPS 3501 (3060, 3066, 3302, 3304), 3010/12/13/16, SONOTONE 19T/20T ALL AT **40p** each (6p). SAPPHIRE **17½p** (6p). Double-tip turn-over types (78 sap. on other side). For ACOS GP73, GP91 (for cartridges GP93, GP94 etc.) GP91SC (for stereo-compat. types) GP104 BSR ST4 (ST3, ST5), ST9, (ST8), ST12/14/15. SONOTONE 8TA, 9TA, 9TAHC. PHILIPS 3306 (3310, 3224, 3228/22, GP280). GARRARD GCM21, 22, GCS23, GKS25 and 26, GCM21T and 22T, GKM24T, GCS23†, GKS25TS, & 26T, GCM31, GC36, GCS35, GCS38, KS40A, KS41B ETC. ALL AT **75p** (6p). SAPPHIRE **35p** (6p). **DOUBLE DIAMOND STYLII:** (Same dia. tip each side: no 78) All types **£1·50** (6p). SAPPHIRE DOUBLE ST/LP, TIPPED **40p** (6p). **PICK-UP WIRE:** Super thin twin flex screened, sheathed, **6p** per yard (Up to 6 yds., 6p over charges paid). **MICROPHONES:** CRYSTAL: LAPEL 1½", clip/hand, lead 3·5mm jack plug **32½p** (6p). CM20 Cream Plastic hand **52½p**: "STICK" 60 **£1·02**: CM70 "PLANET" Metal, tapered, with neck cord, adaptor for stand **£1·47½**: "MIC 91" hand/desk **81p**: "MIC 45" Curved metal hand grip **£1·00**. ALL with leads (all 9p). MICROPHONE INSERTS: 0·9" **27½p** (Up to 6 for 6p). DYNAMIC: 209 Cardioid Ball. 50K/600 Ω built-in volume control, on/off switch, special 20ft. lead, the best value anywhere at **£6·30**; UD130, uni-dir. mesh ball 50K/600 Ω jack plug, cable, adaptor, **£4·80**: DM160, omni-dir. Ball mesh, 50K, cable adaptor jack plug **£3·87½** 27½p each). **SPEAKERS.** Very popular 12" ROUND, fitted tweeter, 3 or 15 ohms (state which) **£1·87½** (27½p)—or pair for stereo **£4·25**, charges paid. **SMALL** 2½" 3 Ω or 8 Ω, (state which) **37½p** (6p). More speakers in List. **HEADPHONES:** High resistance 2000 Ω adjustable: **92½p** (7½p). **EARPIECES.** With lead and min. 2·5mm or 3·5mm (state which) jack plug, MAGNETIC **9p**. CRYSTAL (3·5mm plug only) **24p** (Up to 3 for 6p any type). **SOLDERING IRON.** Slim, modern, British high speed, 8½", all parts replaceable, highest quality fully guaranteed **£1·17½** (10p). **TRANSFORMERS:** Sub-min 11 × 11 × 12mm, OUTPUT (3 Ω for OC72, etc.) **14p** or DRIVER **15p** (Up to 12 for 6p). **CONNECTING WIRE.** Packs of 5 coils, each coil 5 yds. asstd. cols. SOLID CORE **14p**. FLEXIBLE or SUPER THIN for transistor wiring, etc. either **16p** (Any pack 6p). **RETRACTABLE FLEXIBLE LEADS.** (CURLIES): With phono plug, each end, 6ft **23p**. 12ft **39p**. With phono plug/phono socket other end 6ft. **25p**. 12ft. **42½p** (6p lead any type). **VIBRATORS.** 12v/4 pin non-synch 121HD4, 2¾" ex. pins, **27½p**. SAME but 3¼" ex pins. USA, **20p**. 12v/7 pin, synch. (12SR7) 2¾" ex pins. **62½p** (6½p any type). **TRANSISTORS. etc.** AC/126 **12½p**. AF115 **20p**, AF116 **15p**, AF117 **20p**, OA5 **10p**, OA10 **10p**, OA81 **10p**, OC44 **14p**, OC45, OC71, OC72, OC75, OC81D, OC82D, all at **12½p** each, OC81 **15p**, OC170 **20p**, OC171 **12½p**. BY100/800 piv **14p**. Many more incl. power types, thyristors, etc. in List.

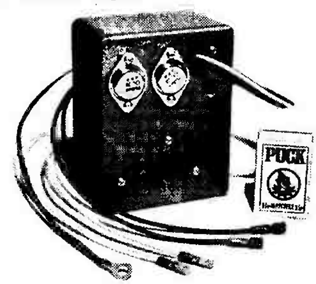
MAINS NEONS, fly leads **10p**. **NEON SCREWDRIVER** (pocket tester) **17½p** (6p either) **MAINS BATTERY ELIMINATOR.** Input 240v-AC, Output 3, 6, 7½ and 9v-DC by switch selector, On/off switch, pilot lamp, leads, plug, adaptor to suit most transistor sets and cassette recorders. Suitable for model use: **£3·15** (24p).

OUR CURRENT LIST (see heading) includes more details of all above plus cartridge replacement table, many unrepeatable Special Offers, and cable, croc. clips, Volume controls Din plugs, Co-Ax, standard, miniature, phono plugs, sockets and adaptors, Tape Recording and Record Player accessories, panel and Test meters and equipment, Multimeters, min. motors, test prods, switches-rotary, toggle, slide, cabinet, lamp, etc., electrolytics, terminals. Veroboard, valve holders, extending aerials for cars and portable sets, ind. lamps and bulbs, dials, mikes, telephone amplifiers and pick-ups, drive cord, inter-coms, condenser and resistance testers, Stereo Headphones etc. etc.

LIST SENT FREE WITH ALL ORDERS IF REQUESTED.

CAPACITOR DISCHARGE IGNITION KIT

PW JUNE 1971



A comprehensive kit of parts with detailed constructional details, ready drilled diecast case, screws, leads, terminals etc.

Available in both 6 and 12v versions. State whether positive or negative earth.

£8·75 incl. p. & p.

De-coupling kit for impulse tachometer and interference suppression. **£1·00** incl. p. & p.

All our kits use guaranteed quality components and have been approved by the Author.

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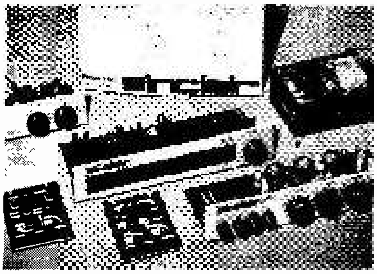
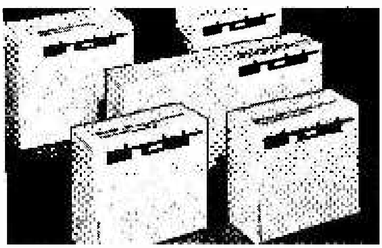
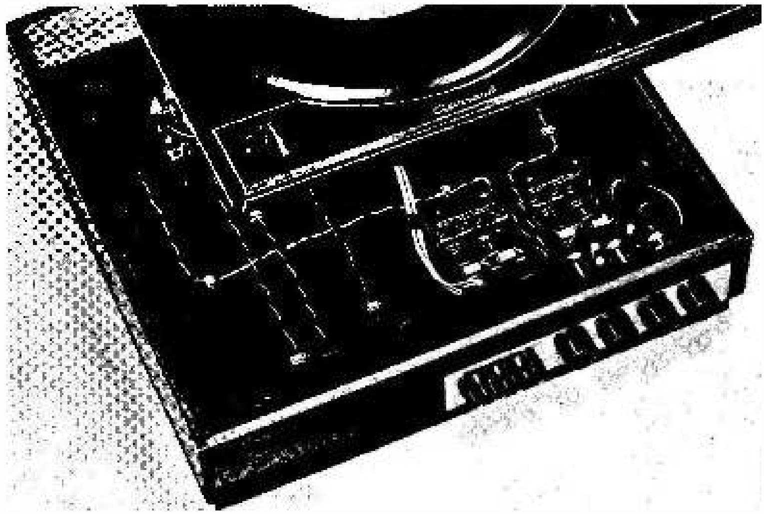
Sinclair Project 60

The World's leading range of high fidelity modules







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Project 605

The easy way to buy and build

Project 60

Project 605 is one pack containing: one PZ5, two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules. Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting.

Complete Project 605 pack with comprehensive manual, post free **£29.95**

All you need for a superb 30 watt high fidelity stereo amplifier.

Project 60 offers more advantage to the constructor and user of high fidelity equipment than any other system in the world.
Performance characteristics are so good they hold their own with any other available system irrespective of price or size.
Project 60 modules are more versatile – using them you can have anything from a simple record player or car radio amplifier to a sophisticated and powerful stereo tuner-amplifier. Either power amplifier can be used in a wide variety of applications as well as high fidelity. The Stereo 60 pre-amplifier control unit may also be used with any other power amplifier system, as can the AFU filter unit. The stereo FM tuner operates on the unique phase lock loop principle to provide the best ever standards of sensitivity and audio quality. Project 60 modules are very easily connected together by following the 48 page manual supplied free with all Project 60 equipment. The modules are great space savers too and are sold individually boxed in distinctive white and black cartons. With all these wonderful advantages, there remains the most attractive of all – price. When you choose Project 60 you know you are going to get the best high fidelity in the world, yet thanks to Sinclair's vast manufacturing resources (the largest in Europe) prices are fantastically low and everything you buy is covered by the famous Sinclair guarantee of reliability and satisfaction.

Typical Project 60 applications

System	The Units to use	together with	Cost of Units
Simple battery record player	**Z.30**	Crystal P.U., 12V battery volume control	**£4.48**
Mains powered record player	**Z.30, PZ.5**	Crystal or ceramic P.U. volume control etc.	**£9.45**
20 + 20 W. stereo amplifier for most needs	**2 x Z.30s, Stereo 60, PZ.5**	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	**£23.90**
20 + 20 W. stereo amplifier with high performance spkrs.	**2 x Z.30s, Stereo 60, PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	**£26.90**
40 + 40 W. R.M.S. de-luxe stereo amplifier	**2 x Z.50s, Stereo 60 PZ.8, mains trsfrmr**	As above	**£34.88**
Indoor P.A.	**Z.50, PZ.8, mains transformer**	Mic., guitar, speakers, etc., controls	**£19.43**

F.M. Stereo Tuner **(£25)** & A.F.U. Filter Unit **(£5.98)** may be added as required.

Sinclair Radionics Limited, London Road, St. Ives, Huntingdonshire PE17 4HJ.
Tel: St. Ives (048 06) 4311

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Project 60 Stereo F.M. Tuner

Built and tested. Post free. **£25**

The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other original features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and squelch circuit for silent tuning between stations. In terms of a high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically as the tuning control is rotated, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with most other high fidelity systems.

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. **Tuning range:** 87.5 to 108 MHz. **Capture ratio:** 1.5dB. **Sensitivity:** 7μV for lock-in over full deviation. **Squelch level:** 20μV. **Signal to noise ratio:** >65dB. **Audio frequency response:** 10 Hz – 15 KHz (±1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2μV. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. **Operating voltage:** 25-30 VDC.
Indicators: Stereo on; tuning. **Size:** 93 x 40 x 207mm.

Stereo 60 Pre-amp/control unit

Built, tested and guaranteed. **£9.98**

Designed for Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout, achieving a really high signal-to-noise ratio and excellent tracking between channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs.

SPECIFICATIONS—Input sensitivities: Radio – up to 3mV. Mag. p.u. 3mV: correct to R.I.A.A curve ±1dB :20 to 25,000 Hz. Ceramic p.u. – up to 3mV: Aux – up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE +12 to —12dB at 10 KHz : BASS +12 to —12dB at 100Hz. **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.

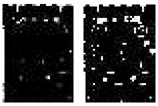
A.F.U. High & Low Pass Filter Unit

Built tested and guaranteed. **£5.98**

For use between Stereo 60 unit and two Z.30s or Z.50s, and is easily mounted. It is unique in that the cut-off frequencies are continuously variable, and as attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is suitable for use with any other amplifier system. Two filter stages – rumble (high pass) and scratch (low pass). Supply voltage – 15 to 35V. Current – 3mA. H.F. cut-off (—3dB) variable from 28KHz to 5KHz. L.F. cut-off (—3dB) variable from 25Hz to 100Hz. Distortion at 1KHz (35V. supply) 0.02% at rated output. **Size:** 66 x 40 x 90 mm.

Z.30 & Z.50 power amplifiers

Built, tested and guaranteed with circuits and instructions manual. **Z.30 £4.48** **Z.50 £5.48**

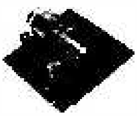


The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at 15w (8Ω) and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and may be used with other units in the Project 60 range equally well.

SPECIFICATIONS ***(Z.50 units are interchangeable with Z.30s in all applications).***

Power Outputs
Z.30 15 watts R.M.S. into 8 ohms using 35 volts: 20 watts R.M.S. into 3 ohms using 30 volts.
Z.50 40 watts R.M.S. into 3 ohms using 40 volts: 30 watts R.M.S. into 8 ohms using 50 volts.
Frequency response: 30 to 300,000Hz ±1dB.
Distortion: 0.02% into 8 ohms.
Signal to noise ratio: better than 70dB unweighted.
Input sensitivity: 250mV into 100 Kohms (for 15w into 8Ω)
For speakers from 3 to 15 ohms impedance.
Size: 14 x 80 x 57 mm.

Power Supply Units



Designed special for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stabilised supply is essential.

PZ.5 *30 volts unstabilised* **£4.98**
PZ.6 *35 volts stabilised* **£7.98**
PZ.8 *45 volts stabilised (less mains transformer)* **£7.98**
PZ.8 *mains transformer* **£5.98**

Guarantee

If within 3 months of purchasing Project 60 modules directly from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost.

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Name ______

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WEYRAD

COILS & TRANSFORMERS FOR CONSTRUCTORS

Special versions of our P50 Series are now available for AF117 or OC45 Transistors. They can be used in the standard superhet circuit with slight changes in component values.

Oscillator Coil	P50/1AC (For OC45)	P50/1AC (For AF117)	33p
1st I.F. Transformer	P50/2CC (For OC45)	P51/1 (For AF117)	36p
2nd I.F. Transformer	P50/2CC (For OC45)	P51/2 (For AF117)	36p
3rd I.F. Transformer	P50/3CC (For OC45)	P50/3V (For AF117)	36p

Rod Aerial	RA2W	72p
Driver Transformer	LFDT4/1	58p
Output Transformer	OPT1	58p
Printed Circuit	PCA1	58p

I.F. TRANSFORMERS FOR "PRACTICAL WIRELESS" CIRCUITS

Components for several receivers are available, including the following for the "Clubman".

T41/1E	1st I.F. Transformer	39p
T41/2E	2nd I.F. Transformer	39p
T41/3T	3rd I.F. Transformer	57p
T41/3T	B.F.O. Coil	57p

Details of these and our other components are given in an illustrated folder which will be supplied on request with postage please.

WEYRAD (ELECTRONICS) LIMITED
SCHOOL STREET, WEYMOUTH, DORSET

PADGETTS RADIO STORE
OLD TOWN HALL, LIVERSEDGE, YORKS WF15, 6PQ

TEL. HECKMONDWIKE 4285

Amplifier Unit Type A413. Complete with 5Z4 & 6V6GT valves. 250/230 Volt Transformer. Clean condition untested. **£1·25.** Carriage 75p.

Air Position Indicator. Contains Gears. Ball Races. Dimmer Unit. Lamps. Four numbered Counters. 24 Volt Motor etc. unit of great interest to model makers. Good condition 75p. Carriage 50p.

Ground Position Indicator. Contains 24 Volt Lamp. Prisms Mirror and Gears. Could interest schools and model makers. **75p.** Carriage 75p.

Latest Air Ministry Release Radio Receiver. Type R4187. 2·8 to 18 MHZ in Three Bands. Complete with 17 miniature valves. 26 Volt Motor. Power supply motor and manually tuned. Very clean, but not tested. **£5.** Carriage and Insurance 75p.

Control Unit. Type 4190. Complete with three miniature valves. 1½" 500 μA Meter. Six Relays. Model makers Motor with Gears. 24 Press Buttons. Lots of spares. Clean condition. **£1·50.** Carriage and Insurance 75p.

Autostabiliser Amplifier Unit. Complete with Carpenter Relay and Base. Many spares. **50p.** P/P 33p.

Special Offer. Aircraft Sighting Head. Comprising flexible drive, lens prism unit, Giro. Useful for model constructors, schools, etc. Condition fair. **75p.** Carr. 75p.

Reclaimed T.V. Tubes. All with 12 months guarantee. AW43/88. **£2.** AW43/80. **£1·50.** MW43/69 **£1.** Special offer Brand New Brimar Tubes C17P.M. **£1.** Many older types in stock. Carriage and insurance on any tube £1·10.

Breaking-up. Ferguson Model 506T. Tested L.O.P.T. **£1·45.** Post paid. Fireball Tuner Unit with Valves less Knobs. **75p.** Post paid. S.A.E. for Price List of other spares for this set and other types.

Valve List Ex Equipment All Valves Tested on a Mullard Valve Tester before despatched. 3 Months Guarantee on all Valves *Single Valves P/P 3p. Over three Valves P/P Paid.*

ARP12	5p	PCC84	5p	U191	20p
EB91	4p	PCF80	5p	U251	12½p
EF85	12½p	PCL82	12½p	6BW7	10p
EBF80	12½p	PCL83	12½p	6U4	10p
EBF89	12½p	PCF82	12½p	6F23	20p
ECC81	10p	PL36	20p	20P1	20p
ECC82	12½p	PL81	17½p	20P3	10p
ECL80	7½p	PY81	7½p	20D1	10p
EF80	7½p	PY33	17½p	30P4	20p
EF91	4p	PY82	7½p	30P12	20p
EY86	20p	PL82	7½p	30FL1	20p
EF50	60p per dozen	PL83	7½p	6/30L2	20p
		PCL84	12½p	30F5	10p

ELEKON SPECIAL OFFERS

Twin Power Supply Panels (semi-stabilised). Contains 2 x Texas 1B10J10 Silicon Bridge Rectifiers 100 P.I.V. @ 1A: 1 x Mullard OAZ 225 Zener Diode, 7·5V @ 10 watts; 1 x I.T.T. Zener Diode 5·1V @ 1 watt. 5 x Texas IS121 Silicon Diodes 150 P.I.V. @ 200 M/A Electrolytic Capacitors 2 x Plessey 1000uF 25V: 2 x 50uF 50V. 2 x Mullard 250uF 25V 2 x Mullard 640uF 25V: Circuit details supplied. A very definite bargain £1, post 10p.

Bargain Component Parcels includes Resistors, Plugs, Sockets etc. 4lb nett weight. £1, post 30p.

Mullard Zener Diodes OAZ 224 6·8V @ 10W. 3 for 50p.

Electrolytic Capacitors at reduced prices.

μF/V 1000/60-70, 1500/50, 2000/25, 2500/50, 3000/15, 5000/15, 10,000/15, 32+32/350, 100+32/350, 100+200/300, 100+400/275, 150+350/300, 1000+1000/18, 40+40+10/350, 600+600+600/35. All above one price 30p each + 10p post. 3000/150, 6600/50, 8000/50, 10,000/70, 13500/38, 33,000/25, 1000+1000/40, 150+50+150/350, 100+100+47/320, 100+100+200/275, 150+200+250/300, 200+200+100/275. All one price 50p, + 10p post.

Special Bargain Electrolytics. 8/350, 32/450, 50/350, 60/450, 80/300, 100/450, 150/200, 250/100, 500/12, 500/60, 600/150, 1000/10-15. Each pack contains 1 each of above. **£1·50.** Post 25p.

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An inexpensive unit for the beginner in high fidelity and for general purposes. May be used to advantage with any Radio, Amplifier or Television receiver.

Maximum Power 15 watts
Bass Resonance 45 c.p.s.
Flux Density 12, 000 gauss
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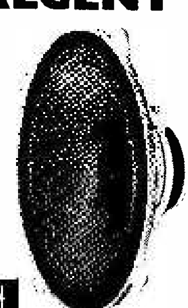
Useful response 45–13,000 c.p.s.
Nett weight 5 lbs.

£7 POST FREE

GUITAR MODEL "GROUP 25" 25 watt rating **£7**

Latest catalogue 5p with enclosure plans.



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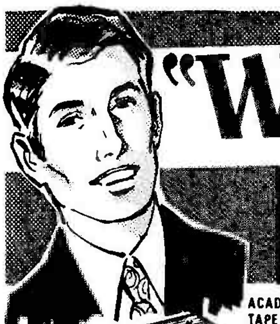

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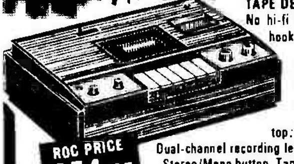


ACADEMY STEREO CASSETTE TAPE DECK, MODEL CS-2000D
No hi-fi system is complete without one – hook it up to any ROC or other good quality amplifier, and the results are fantastic! The CS-2000D records and plays back. A big feature is its easy-to-use piano-key controls. Easy-to-get-at mic inputs are on top; line inputs and outputs at the rear. Dual-channel recording level meter. Pop-up cassette ejection. Stereo/Mono button. Tape counter. Pause control. Tape speed 1⅞ ips (4·75 cms). Frequency response 100–10,000 Hz. Wow and flutter better than 0·3%. Rewind time better than 60 sec with C60 cassette. Engineered throughout to the highest electrical and mechanical standards. Size 16" wide, 4½" high and 8" deep. Walnut cabinet with satin aluminium trims.

ROC PRICE £54.95
Including two pencil microphones and all connecting leads
Normal Price £65·00

ROC PRICE £98.50
Including connecting leads
Normal Price £115·00

REALISTIC HI-FI 36-WATT STEREO CONCERTMASTER FM-AM RECEIVER SYSTEM, MODEL 12-694
Brilliantly designed tuner/amplifier with two matching speakers. All three units in beautifully finished walnut cabinets with smart aluminium vertical trims. The tuning dial is fronted by unique black glass. Figures light up behind it in green when the unit is on. Separate easy-to-operate Left and Right volume controls. Microswitch for on/off. Programme selector. Separate bass and treble controls. Headphone socket on front panel for easy access. Single tuning knob for FM and AM. Built-in aerials, facilities for external FM aerial. Illuminated dial. Stereo broadcast indicator light. Each speaker has 6½" bass and 3" treble units. Output: 9 watts r.m.s. per channel into 8 ohms. Frequency response: 30 to 20,000 Hz. FM: frequency range 80-108 MHz, sensitivity 2·5μV, stereo separation 30dB, image rejection 40dB. AM: frequency range 530-1605 kHz, sensitivity 100μV. Sizes: speakers 8. wide, 12. high and 9¾. deep; receiver 6" wide, 12" high and 9¾" deep. And their sophisticated appearance matches the excellence of the specification.

REALISTIC 30 WATT STEREO AMPLIFIER MODEL SA-500
As reviewed in "POPULAR HI-FI" February 1972
A superb hi-fi amplifier with all the features you've ever wanted – for under £46·00. Saving over £10·00 on the normal retail value. Up-to-the-minute slider controls for bass and treble. Separate volume and balance controls. Headphone socket on front panel. Push-button input controls – magnetic phono (high/low) tuner, aux, mono, monitor. Loudness push-button control for perfect sound at low output levels. Left and right push-button on/off switches for speakers. Noise filtering and tape monitoring facilities. Two auxiliary AC outlets. Frequency response 20-20,000 Hz + 1 db at full power. 15 watts rms per channel. Walnut cabinet with satin aluminium trims. Inputs; phono 2·5mV and 5mV RIAA; tuner/aux 250mV. Hum and noise: phono – 50db; tuner/aux – 65db. How's that for a specification! Size 14½" wide, 3½" high, 10½" deep.

ROC PRICE £43.75
Normal Price £55·50

ROC PRICE £76.50
Normal Price £95·00

8-TRACK STEREO CARTRIDG TAPE DECK MODEL RP-1000ST
The popular Lear-Jet type recording unit is the heart of the fantastic RP-1000ST, which has full record and playback facilities. Automatic track change with manual override. Press to start button. Stereo headphone and Left and Right Mic sockets on front panel. Dual recording level meter, and Left and Right volume controls. Built-in preamp. Tape speed 3¾ ips (9·5 cms). Frequency response: playback 30-10,000 Hz; recording/playback 30-8,000 Hz. Line output: fully variable 0-500mV. The RP-1000ST incorporates all the features you'd expect in a top quality Cartridge Tape Deck. Size 16" wide, 4" high, 9" deep. Cabinet in walnut. Including connecting leads

25-WATT 3-WAY CRYSLER 'LIVING AUDIO' SPEAKER CE-5b
This high quality speaker has its own built-in 3-way sound response switch, giving you the ideal frequency response for hi-fi, natural or mood music listening. Its beautiful, heavy, oiled walnut cabinet incorporates two separate speaker units an 8" woofer, and a 5" mid-range with 2" concentric tweeter. Power handling capacity: 25 watts r.m.s into 8 ohms. Overall frequency response: 35-20,000 Hz. Cabinet size: 10½" × 7½" × 8¾". Exactly right for matching the most modern decor.

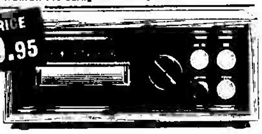
ROC PRICE £27.25
Normal Price £39·95 each.

OLSON RA-310 AM/FM/MPX STEREO TUNER
This ROC Tuner is especially designed to match the Olson AM-395 Stereo Amplifier. In price and value, as well as it's good looking design! But of course it's also ideal for use with any other amplifier. The RA-310 costs £10·00 less than the normal retail value, and yet it is a highly sophisticated unit, incorporating the latest solid state techniques. Operation is drift free for supreme station-holding capability. You can connect this Tuner to a stereo amplifier, to a tape deck or a tape recorder. And of course it covers all the stations in the AM and FM bands. FM: 87-108 MHz; AM: 525-1605 kHz. FM Sensitivites: FM, 3μV; AM, 250μV. Stereo separation 30dB at 1kHz, image rejection 60dB. Size: 11$\frac{1}{16}$" wide, 4" high, 7½" deep.

ROC PRICE £39.95
Normal Price £50·00

ROC PRICE £33.20
Normal Price £42·00

PALACE AM/FM/MPX STEREO TUNER AMPLIFIER SSA-16
This is one of the lowest priced stero tuner amplifiers on the market. It covers the full range of both AM and FM broadcast frequencies. And when you're switched to FM, an indicator lights up when a stereo signal is received – that's the time to switch to 'Stereo'! The SSA-16 has all the facilities you'd expect to find on tuners costing twice as much – separate volume, bass, treble, balance and tuning controls. Selector switch for tape, phono, AM, FM, stereo. Jack socket on front panel for stereo headphones. Frequency range: FM 88-108 MHz. AM 535-1605 kHz. Frequency response: 50-10,000 Hz ± 3dB. Power output: 4 watts total music power into two 8 ohm speakers. Size: 16" wide, 4½" high, 8" deep.



ROC PRICE £39.95
Normal Price £49·00

8-TRACK HOME STEREO CARTRIDGE PLAYER MODEL E1
With this unit, you can play any standard 8-track cartridge on the market – at a fraction of the normal retail value! It gives you a total of 5 watts of power, to feed into two 8-ohm speakers. The frequency response is 50 to 10,000 Hz, giving you a fine tonal quality that can't be bettered at anything near this price. The E1 has separate tone, balance and volume controls, giving you complete freedom to select the sound you want to hear. Tape speed is 3¾ ips, and wow and flutter are both less than 0·3%. Size: 11½" wide, 5" high, 11" deep.

REALISTIC SA-100B 6-WATT STEREO AMPLIFIER
Here's fabulous, exciting value in miniature! This high quality stereo amplifier measures only 9" wide × 3" high × 5¾" deep. And yet it has separate ganged volume, balance and tone controls. Plus speaker in/out, mono/stereo, phono/tuner and power on/off slide switches. The ends are oiled walnut, with matching enamelled metal top. The front panel is satin aluminium and walnut-brown enamel. Frequency response is 50 to 10,000 Hz ± 3dB. Output 3 watts r.m.s. per channel into 8 ohms. Inputs are 100mV for both phono and tuner.

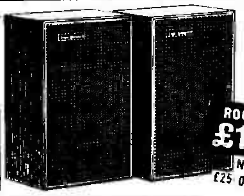
ROC PRICE £14.50
Normal Price £21·00

ROC 7-WATT STEREO AMPLIFIER CHASSIS SK-317
This exclusive ROC Stereo Chassis is completely self-contained, and it costs £2·25 less than the normal retail value! The SK-317 is a really compact unit measuring only 5½" wide, 1¾" high and 6¾" deep. It contains its own mains power supply, and has a ganged tone control and separate volume controls for each channel. Specification: frequency response 40-17,000 Hz ± 3dB; output 3·5 watts music power per channel into 8 ohms; input, phono, 600mV, signal-to-noise ratio better than 45dB.

ROC PRICE £5.50
Normal Price £7·75

REALISTIC TM-100 AM/FM/MPX STEREO TUNER
Here's another unit that gives you fabulous value in miniature! Designed specifically to match the Realistic SA-100B in both appearance, size and performance, the TM-100 is superb value-for-money. It gives you the full FM and AM ranges – FM, 88-108 MHz; AM, 535-1605 kHz. Sensitivities FM 5μV; AM 250μV. Image rejection 50dB.

ROC PRICE £23.25
Normal Price £28·00



ROC PRICE £17.80
Normal Price £25·00 per pair.

R.446 3-WAY MATCHED SPEAKERS
These will do justice to your amplifier – and to your pocket. At only £16·40 a pair, they are real value-for-money. Each cabinet is heavily lagged and teak finished. They handle 16 watts rms (8 watts rms each). Each loudspeaker contains a large dual cone base unit, plus a separate tweeter. Frequency range: 40 to 19,000 Hz. Size 14" high, 9" wide, 6½" deep.

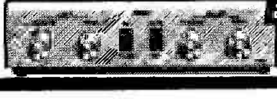
OLSON AM-395 40-WATT STEREO AMPLIFIER
An ideal unit for your new stereo separate system. It is more than £10·00 below the normal retail price! Making the AM-395 one of Britain's best hi-fi buys. It takes in signals from magnetic or ceramic pick-ups, tuners (see Olson RA-310) and tape decks. And it's got outputs for taping and for headphones. There are separate bass and treble controls, separate Left and Right channel volume controls. And a loudness switch for boosting the bass and treble notes when listening at low output levels. Frequency response 20-20,000 Hz + 3dB. Output: 20 watts r.m.s. per channel into 8 ohms. Inputs: magnetic phono 3·0mV RIAA, crystal phono 100mV; tape 160mV; tuner 160mV. Size 11$\frac{1}{16}$" wide, 4" high, 7½" deep. The specification reads well – sounds even better!

ROC PRICE £29.00
Normal Price £39·60

ROC PRICE £18.25
Normal Price £25·20

OLSON AM-372 16-WATT STEREO AMPLIFIER
Here's a really good amplifier at a really down-to-earth price – nearly £7 less than the normal retail value! Just look at what the AM-372 will do for you – reproduce signals from ceramic or crystal cartridges, AM and FM tuners, and tape recorders. And it gives you outputs for two sets of speakers, headphones and tape recorders. Frequency response is 30 to 20,000 Hz ± 3dB. Output 8 watts r.m.s per channel music power into 8 ohm speakers. Phono input 200mV. Tuner input 200mV. Size: 12¼" wide, 3¼" high, 7½" deep.

OLSON AM-357 4-WATT STEREO AMPLIFIER
Here's marvellous value for someone just starting to set themselves up in audio! At only £10·50, you get a fine amplifier in a scratch resistant metal cabinet, with a smart brushed aluminium front panel. It incorporates separate tone and volume controls for each channel. Inputs are provided for turntable (ceramic cartridge), tuner and tape deck or recorder. Frequency response: 70-20,000 Hz + 3dB. Output: 2 watts r.m.s. per channel into 8 ohms. Inputs: phono 80mV; tuner/aux 80mV. Size 8" wide, 2¼" high, 4½" wide.



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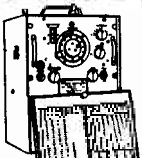

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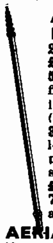

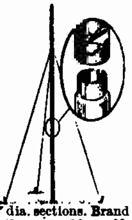

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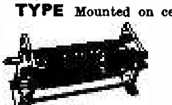

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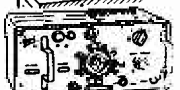

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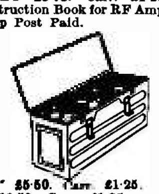

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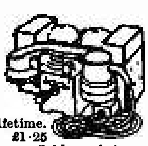

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807	0.50
813	3.75
866A	0.75
5642	0.70
5670	0.50
6080	1.60
6146	1.60
6146B	2.50
6360	1.25
6939	2.25
7199	0.80
7360	2.00
7586	1.25
7895	1.25
9002	0.40
9003	0.50
AZ1	0.55
AZ31	0.55
CBL1	0.90
CBL31	1.00
CY31	0.35
DAF96	0.45
DF96	0.45
DK92	0.65
DK99	0.60

DK40	0.60
DL96	0.45
DM70	0.55
DM160	0.65
DY86	0.32
DY87	0.33
DY802	0.35
E88CC	0.65
E180F	1.00
EABC80	0.35
EAF42	0.55
EBC33	0.50
EBC41	0.55
EBC81	0.30
EBF80	0.40
EBF83	0.40
EBF89	0.30
EC53	0.50
EC86	0.60
EC88	0.60
EC90	0.33
EC92	0.35
EC93	0.55
EC8010	2.25
ECC35	1.00
ECC40	0.65
ECC81	0.35
ECC82	0.30
ECC83	0.30
ECC84	0.30
ECC85	0.40
ECC88	0.40

ECC89	0.50
ECC91	0.20
ECC189	0.65
ECC807	1.25
ECF80	0.35
ECF82	0.35
ECF86	0.65
ECF804	1.65
ECH35	1.00
ECH42	0.75
ECH81	0.30
ECH83	0.45
ECH84	0.45
ECL80	0.45
ECL81	0.50
ECL82	0.35
ECL83	0.70
ECL84	0.55
ECL85	0.55
ECL86	0.40
EF40	0.50
EF41	0.65
EF42	0.70
EF80	0.25
EF83	0.55
EF85	0.35
EF86	0.30
EF89	0.28
EF91	0.33
EF92	0.35
EF95	0.35
EF97	0.65

EF98	0.65
EF183	0.30
EF184	0.35
EF804	1.25
EK90	0.30
EL34	0.50
EL36	0.50
EL37	1.60
EL41	0.60
EL42	0.65
EL81	0.55
EL83	0.42
EL84	0.25
EL85	0.48
EL86	0.40
EL90	0.38
EL95	0.35
EL821	0.60
EL822	1.30
ELL80	0.75
EM34	1.00
EM71	0.80
EM80	0.45
EM81	0.60
EM83	0.50
EM84	0.35
EM85	1.00
EM87	0.70
EN91	0.38
EY51	0.40
EY80	0.55
EY81	0.40
EY83	0.55
EY86	0.40
EY87	0.43
EY88	0.43
EZ40	0.50
EZ41	0.50
EZ80	0.27
EZ81	0.29
GT1C	3.00
GY501	0.80
GZ30	0.40
GZ31	0.35
GZ32	0.48

GZ33	0.70
GZ34	0.60
HABC80	0.45
HK90	0.40
KT66	2.05
KT88	2.00
N78	1.50
PABC80	0.40
PC86	0.60
PC88	0.60
PC97	0.50
PC900	0.48
PABC80	0·40
PCC84	0.40
PCC85	0.40
PCC88	0.55
PCC89	0.55
PCC189	0.55
PCC805	0.85
PCC806	0.80
PCF80	0.30
PCF82	0.35
PCF84	0.60
PCF86	0.60
PCF87	0.90
PCF801	0.50
PCF802	0.50
PCF805	0.80
PCF806	0.70
PCF808	0.85
PCH200	0.70
PCL81	0.50
PCL82	0.35
PCL83	0.65
PCL84	0.45
PCL85	0.40
PCL86	0.45
PCL88	0.90
PCL800	0.93
PCL801	0.75
PD500	1.30
PF86	0.65
PF818	0.85
PFL200	0.65
PL33	0.35

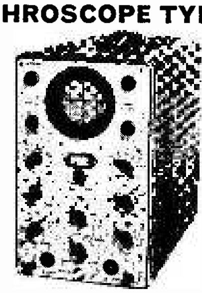
PL36	0.35
PL81	0.50
PL82	0.45
PL83	0.45
PL84	0.40
PL302	0.85
PL504	0.80
PL508	0.90
PL509	1.10
PL801	0.80
PL802	0·95
PM84	0.60
PY31	0.30
PY33	0.63
PY80	0.40
PY81	0.30
PY82	0.35
PY83	0.38
PY88	0.40
PY500	1.00
PY800	0.40
PY801	0.50
PZ30	0.35
QQVO2-6	2.25
QQVO3-10	1.25
QQV03-20A	5.25
QQV06-40A	5.50
TT21	3.00
TT22	3.20
TY2-125	10.00
U18/20	0.75
U25	0.80
U26	0.80
U31	0.60
U37	2.10
U52	0.35
U76	0.35
U78	0.35
U191	0.75
U201	0.35

U281	0.40
U282	0.40
U301	0.40
U403	0.60
U404	0.60
U801	0.80
UABC80	0.40
UAF41	0.50
UAF42	0.55
UB41	0·60
UBC41	0.50
UBC81	0.40
UBF80	0.40
UBF89	0.35
UBL1	0.60
UBL21	0.65
UC92	0.40
UCC85	0.40
UCF80	0.55
UCH21	0.60
UCH42	0.70
UCH81	0.40
UCL81	0.60
UCL82	0.35
UCL83	0.60
UF9	0·60
UF11	0·50
UF41	0.60
UF42	0.60
UF43	0.60
UF80	0.35
UF85	0.40
UF89	0.40
UL84	0.40
UM84	0.25
UY1N	0.50
UY11	1.00
UY41	0.48
UY82	0.50
UY85	0.40
W729	0.75
Z803U	1.20

TRANSISTORS

2N696	0.17	AC127	0.20	BD123	0.80
2N697	0.17	AC128	0.15	BD131	0.85
2N698	0.30	AC132	0.35	BD132	0.85
2N705	0.70	AC153	0.20	BF115	0.20
2N706	0.10	AC154	0.15	BF167	0.18
2N708	0.15	AC157	0.20	BF173	0.20
2N753	0.25	AC169	0.10	BF179	0.30
2N929	0.22	AC176	0.25	BF180	0.35
2N930	0.25	AC187	0.30	BF181	0.25
2N987	0.30	AC188	0.30	BF184	0.25
2N1131	0.25	ACY17	0.275	BF185	0.20
2N1132	0.25	ACY18	0.20	BF194	0.15
2N1184	1.25	ACY19	0.25	BF195	0.15
2N1301	0.40	ACY20	0.20	BF196	0.20
2N1302	0.75	ACY21	0.20	BF197	0.20
2N1304	0.25	ACY22	0.15	BF200	0.35
2N1305	0.25	AD140	0.50	BFW87	0.25
2N1306	0.25	AD149	0.50	BFW88	0.23
2N1307	0.30	AD161	0.35	BFW89	0.20
2N1308	0.25	AD162	0.35	BFW91	0.20
2N1309	0.30	ADZ11	1.25	BFX88	0.25
2N1613	0.22	ADZ12	1.25	BFY17	0.40
2N1711	0.25	AF114	0.20	BFY19	0.60
2N1756	0.75	AF115	0.20	BFY50	0.25
2N2147	0.75	AF116	0.20	BFY51	0.20
2N2160	0.65	AF117	0.20	BFY52	0.25
2N2217	0.30	AF118	0.45	BSY26	0.20
2N2218	0.30	AF125	0.25	BSY27	0.20
2N2219	0.35	AF127	0.20	BSY28	0.20
2N2369A	0.20	AF180	0.35	BSY65	0.20
2N2477	0.65	AF181	0.35	BSY95A	0.15
2N2646	0.60	AF186	0.40	OC16	0.50
2N2905	0.35	AF239	0.40	OC22	0.50
2N2923	0.15	AFZ11	0.45	OC23	0.60
2N2924	0.15	ASY26	0.25	OC24	0.60
2N2926	0.125	ASY27	0.30	OC25	0.35
2N3053	0.25	ASY28	0.25	OC26	0.25
2N3054	0.60	ASY29	0.30	OC28	0.60
2N3055	0.75	ASY54	0.25	OC29	0.60
2N3133	0.30	ASZ15	0.70	OC30	0.75
2N3134	0.30	ASZ16	0.70	OC35	0.50
2N3391	0.20	ASZ17	0.75	OC36	0.60
2N3392	0.15	ASZ18	0.75	OC42	0.20
2N3393	0.15	ASZ20	0.25	OC44	0.20
2N3394	0.15	ASZ21	0.40	OC45	0.15
2N3395	0.20	BC107	0.125	OC70	0.10
2N3402	0.15	BC108	0.125	OC71	0.12
2N3403	0.15	BC109	0.125	OC72	0.25
2N3404	0.35	BC113	0.25	OC73	0.30
2N3414	0.20	BC118	0.30	OC75	0.20
2N3415	0.15	BC134	0.30	OC76	0.20
2N3416	0.25	BC147	0.175	OC78	0.25
2N3417	0.25	BC148	0.15	OC78D	0.20
2N3702	0.12	BC149	0.15	OC81	0.25
2N3703	0.12	BC152	0.15	OC81D	0.15
2N3704	0.17	BC158	0.15	OC83	0.20
2N3707	0.15	BC175	0.20	OC139	0.30
2N3709	0.12	BC186	0.25	OC140	0.35
2N3710	0.12	BCY30	0.25	OC141	0.60
2N3819	0.35	BCY31	0.40	OC170	0.25
2N3906	0.20	BCY33	0.25	OC171	0.25
2S702	0.50	BCY34	0.30	OC200	0.30
2S746	0.25	BCY72	0.20	OC201	0.60
AC113	0.15	BCZ10	0.30	OC202	0.65
AC125	0.30	BCZ11	0.40	OC203	0.40
AC126	0.20	BD121	0.65	OC204	0.40

SYNCHROSCOPE TYPE C1-5



3-in tube fitted with telescopic viewing hood, giving bright display in full daylight. Sensitivity 10mV/mm (narrow band) to 30mV/mm (wide band).
Bandwidth 10 c/s—10 mc/s. Triggered sweep pre-set at 1-2-5-10-30-100-300-1000-3000 µsec per stroke. Free-running time base 20 c/s to 2000kc/s with built-in crystal calibrator providing timing marks at .05-.2-1-5-20-100 µ sec.
Amplitude calibrator directly calibrated in volts.
Input attenuator 1-10-100.
Power supplies 127/230v AC.

PRICE £39.00. Packing and carriage 1.50

INTEGRATED CIRCUITS

TAA263 Direct coupled 3-stage amplifier up to 600kc. Supply voltage 6-8V output 10mW TO72 outline .. .. 0·75
TAA293. Medium frequency amplifier up to 600kc. Supply voltage 6V. output 10mW TO74 outline .. .. 0·95
TAA320. MOST stage followed by a bi-polar stage Gate-to-source voltage 9-14V. Power dissipation 200mW. TO18 outline .. .. 0·65
TAA570. Four-stage limiter-amplifier with F.M. quadrator detector and remote D.C. volume control facility. Nominal supply voltage 12V. TO74 outline .. .. 0·95
TAD100. AM receiver circuit containing all active components (except output stage) required to build a complete receiver .. £1·95
SL403D PLESSEY 3-Watts Audio Amplifier £1·50
SL432A PLESSEY, limiting I.F. Amplifier and F.M. discriminator .. .. £0·75

OUR NEW 1971/1972 CATALOGUE IS NOW READY AND AVAILABLE FREE OF CHARGE. PLEASE SEND QUARTO STAMPED AND ADDRESSED ENVELOPE FOR THIS VALUABLE SOURCE OF REFERENCE LISTING MANY THOUSAND TYPES OF VALVES, SEMICONDUCTORS, TUBES, ETC.

MULTIMETERS

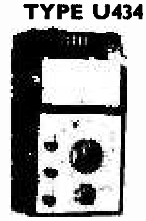
WITH TAUT BAND SUSPENSION MOVEMENT

TYPE U4312

Low sensitivity (667 ohms per volt), 1% accuracy DC and 1·5% AC. 9 DC current ranges 300µA to 6A. 8 AC current ranges (1·5mA to 6A). 9 AC/DC voltage ranges 0·3–900V. Resistance 0·2–30K. £9·75

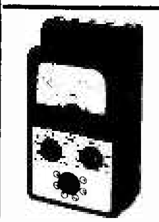
TYPE U4313. High sensitivity 20 Kohms/volt DC and 2 Kohms/volt AC. Accuracy 1·5% DC and 2·5% AC. 8 DC current ranges 60µA to 1·5A. 6 AC current ranges 0·60mA to 1·5A. 9 AC and DC Voltage ranges 1·5 to 500V. Resistance ranges 0·5–500 Kohms. £10·50

TYPE U4341 MULTIMETER AND TRANSISTOR TESTER



With taut band suspension movement.
8–DC voltage ranges 0·3–900V
6–AC voltage ranges 1·5–750V
5–DC current ranges 0·06–600mA
4–AC current ranges 0·3–300mA
4–resistance ranges 0·5–500 Kohms
Transistor cut-off current 60µA max
Transistor DC current gain 10–350
Sensitivity: 16700 Ω/V DC; 3300 Ω/V AC PRICE £10·50

TYPE U435



With taut band suspension movement.
Sensitivity 20 Kohms/volt DC and 2 Kohms/volt AC.
7 DC current ranges 50µA to 2·5A.
5 AC current ranges 5mA to 2·5A.
7 AC/DC Voltage ranges 2·5 to 1000V.
3 Resistance ranges 0–300 Kohms.
Capacity range 0·5µF. £9·00

All instruments are supplied with steel carrying case and leads.
No protection is incorporated. As the movement can withstand overloads up to 100 times, only basic precautions should be taken to prevent damage through misuse

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