PRACTICAL WIRELESS

MAY 1974

25p

SPECIAL PULL-OUT FEATURE

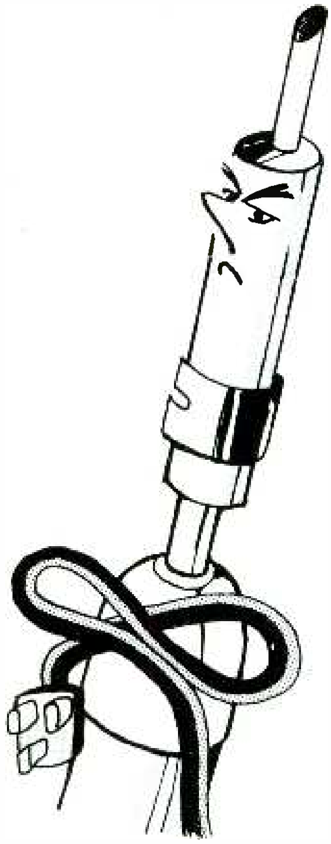
GUIDE TO LONG-RANGE RECEPTION of RADIO & TV

ALSO: HOW TO MAKE

OSCILLOSCOPE TRACE DOUBLER

CAR CASSETTE AUDIO BOOSTER

'MINI-POP'



The Iron Will...

You know the type . . . whenever you need him to do one thing he'll want to do the other. And nothing will make him change his mind.

It's the same with some people's soldering irons.

Hopelessly inefficient heat control can give an iron a will of its own and make soldering operations a nightmare.

If this is what soldering means to you it's time you woke up to Antex.

Just choose a new model from the comprehensive Antex range of advanced soldering instruments, with unique constructional advantages . . . low leakage characteristics, interchangeable bits to match solder-joint requirements, and really precise heat control.

Choose ANTEX—the warm hearted iron (and keep your cool)

MODEL X25 ▶
220-240 Volts or 100-120 Volts. The leakage current of the NEW X25 is only a few microamps and cannot harm the most delicate equipment even when soldered "live". Tested at 1500v. A.C. This 25 watt iron with its truly remarkable heat-capacity will easily "out-solder" any conventionally made 40 and 60 watt soldering irons, due to its unique construction advantages. Fitted long-life iron-coated bit 1/8". 2 other bits available 3/32" and 3/16" Totally enclosed element ceramic and steel shaft. Bits do not "freeze" and can easily be removed.
PRICE £2.05 (rec. retail) P & P 10p.
Suitable for production work and as a general purpose iron.

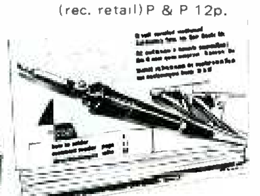
MODEL G ▶
18 watt miniature iron, fitted with long-life iron-coated bit 3/32" Voltage 240, 220 or 110 2 other spare bits available 1/8" and 3/16"
PRICE £2.26 (rec. retail) P & P 10p.

◀ MODEL CCN
220 volts or 240 volts. The 15 watt miniature model CCN also has negligible leakage. Test voltage 4000v. A.C. Totally enclosed element in ceramic shaft. Fitted long-life iron-coated bit 3/32". 4 other bits available 1/8", 3/16", 1/4" and 3/64" including Heat Shield.
PRICE £2.48 (rec. retail) P & P 10p.

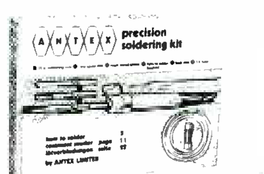
◀ MODEL C
Miniature 15 watt soldering iron fitted 3/32" iron-coated bit. Many other bits available from 3/64" to 3/16". Voltages 240, 220, 110, 50 or 24.
PRICE £2.05 (rec. retail) P & P 10p.

MODEL SK.1 KIT
Contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32", heat sink, solder, stand and "How to Solder" booklet.
PRICE £3.48 (rec. retail) P & P 12p.

MODEL MLX KIT
Battery operated 12v. 25 watt iron fitted with 15' lead and 2 heavy clips for connection to car battery. Packed in strong plastic wallet with booklet "How to Solder".
PRICE £2.54 (rec. retail) P & P 12p.



MODEL SK.2 KIT
Contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32" heat sink, solder, and "How to Solder" booklet.
PRICE £3.25 (rec. retail) P & P 10p.



ST3 Stand – This stand is made from high grade insulation material with a chromium plated strong steel spring. It is suitable for all models and replaces all previous stands. The two sponges at the side which are easily replaceable serve to keep the soldering bits clean. Spare bits can be accommodated as shown on the illustration.

PRICE: £1.00 (rec. retail) P & P 10p.

ALL PRICES include VAT at 10%

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PRACTICAL WIRELESS

VOL. 50 NO. 1
ISSUE 807
MAY 1974

BRITAIN'S PREMIER MAGAZINE FOR THE DO-IT-YOURSELF RADIO AND ELECTRONICS CONSTRUCTOR

Published by IPC Magazines Ltd., Fleetway House, Farringdon Street, London EC4A 4AD. Tel. 01-634 4444

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We regret that we are unable to supply back numbers of Practical Wireless. Readers are recommended to enquire at a public library to see copies. Requests for specific back numbers of *Practical Wireless* and *Television* only can be published in our CQ Column.

● NEWS & COMMENT

● CONSTRUCTIONAL

● OTHER FEATURES

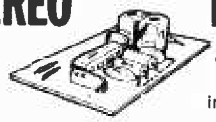
● EXTRA WITH THIS ISSUE

SUPPLEMENT—"GUIDE TO LONG RANGE RECEPTION OF RADIO AND TELEVISION"

BI-PRE-PAK

AUDIO BARGAINS

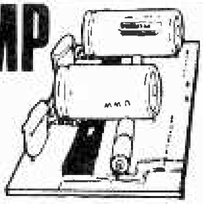
STEREO DECODER £4.95



incl. P. & P. and V.A.T.

Ready built unit, ready for connection to the I.F. stages of existing FM Radio or Tuner. A tell take light can be connected. The Unit is a small printed circuit, no further alignment necessary.
L.E.D. is recommended as the indicating light. Suitable device available from us at 36½p. Instructions included.

3 W R.M.S. I.C. AMP



only £1.65 Incl. P. & P. and VAT Order Code I.C.A 1

on P.C. Board with all components or 2 on one board for £2·86
Order Code 1 C A 1/S
These amps. are supplied with a free booklet on connecting up, specifications and easy to build projects using the I.C A.1

5W & 10W AMPS

5W ONLY £1.98
10W ONLY £2.49

inc. P. & P. and VAT

These matchbox size amplifiers have an exceptionally good tone and quality for the price. They are only 2¼"x 1¾". The 5W amp will run from a 12V car battery making it very suitable for portable voice reinforcement such as public functions. Two amplifiers are ideal for stereo. Complete connection details and treble, bass, volume and balance control circuit diagrams are supplied with each unit. Discounts are available for quantity orders. More details on request. **Cheapest in the UK. Built and tested.**

Now available for 5 & 10W AMPS

Pre-assembled printed circuit boards 2" x 3" available in stereo only, will fit ·15 edge connector.

Stereo Pre-Amp 1 (Pre 1). This unit is for use with low gain crystal or ceramic pick-up cartridges. £1·21

Stereo Pre-Amp 2 (Pre 2). This unit is for use with magnetic pick-up cartridges. £1·69

Stereo Tone Control (STC). This unit is an active tone control board and when used with the right potentiometers will give bass and treble boost and cut. £1·21

Instruction leaflet supplied with all units. Post and packing and VAT included in prices.

I enclose £. . . . for. . . . . Decoders/. . . . .
3W Amps/. . . . . . . 5W Amps. . . . . . . 10W Amps/. . . . .
Stereo Pre-Amps 1 . . . . Stereo Pre-Amps 2 . . . .
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NEW ALL SILICON!

PRACTICAL WIRELESS

ELECTRONIC IGNITION SYSTEM

This Capacitor-Discharge Electronic Ignition System was recently described in Practical Wireless and has proved extremely popular. We are able to offer the kit in two forms; the standard kit containing the electronic components only, enabling the customer to tailor these to his own layout, or the de-luxe version containing a ready-drilled roller-tinned printed-circuit board and fully machined die-cast case with A.M.P Electrical Spade Connector Block. Each kit is supplied with a custom wound transformer, first grade components and full constructional details.

The original circuit employed Germanium Power Transistors for the negative earth version. **WE NOW SUPPLY SILICON P.N.P. POWER DEVICES AT NO EXTRA COST!** All components available separately. Case size 4½" x 3½" x 2". Complete assembly and wiring manual **25p**, supplied with de-luxe kit only, refundable on purchase of kit.

Suitable for 12v systems with Pos. or Neg. earth.

Price: Standard Kit ....£7·97 U.K. Post Free
De-Luxe Kit ....£9·62 U.K. Post Free

Quantity Discounts:

Trade and Overseas	1–5	Nett	6–9	Less 10%
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ALL PRICES INCLUDE VAT

PLEASE STATE POS. OR NEG. EARTH WHEN ORDERING.

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8" 10W 8 ohms roll Surround and tweeter cone. Acclaimed by many as the clearest Speaker yet. Give away price **£2·50** + vat.

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POP 40 10" 40 Watt

Impedance
8-15 ohms
Gauss 14,000
Voice Coil
Diam. 1¼in
Fitted
Tweeter Cone
Range
50-15,000 Hz
Rec. Retail Price

£10·95

Brief details of other 'POP' Speakers

			Rec. Retail
POP '15'	12"	15 Watt	£5·75
	1" Voice Coil		
POP '25/2'	12"	30 Watt	£8·75
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POP '50'	12"	50 Watt	£12·75
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POP '60'	15"	60 Watt	£15·95
	2" Voice Coil		
POP '100'	18"	100 Watt	£27·50
	3" Voice Coil		

Also for those who can afford the very best For Bass Instrument Reproduction

BASS CRESCENDO '12'

12" 100 Watt 3" Pole Diam.

BASS CRESCENDO '15'

15" 100 Watt 3" Pole Diam.

Rec. Retail Price CRESCENDO '12' **£39·95**

Rec. Retail Price CRESCENDO '15' **£48·83**

Please send S.A.E. for leaflet on 'POP' or 'CRESCENDO' Range Speakers

POP 55 12" 60 Watt

Impedance
8-15 ohms
Gauss 15,000
Voice Coil
Diam. 2in
Range
50-9,000 Hz
AN ALL PURPOSE UNIT OF HIGH sensitivity
Rec. Retail Price

£15·95

There is also a 12" Crescendo Speaker for General Purpose Public Address, and another one for Lead or Rhythm Guitar

PRICES QUOTED INCLUDE VAT

Prices correct at 18.3.74

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Manufacturers enquiries to—**FANE ACOUSTICS LTD., 286 BRADFORD ROAD, BATLEY, YORKS**

FERRIC CHLORIDE

Anhydrous to Mil-spec in 1lb sealed packs. 1lb **50p** (20p), 3lbs **£1·20** (30p), 10lbs **£3·50** (60p).

VERSATILE POWER UNIT

Contains mains transformer, 2A thermal cut-out and bridge rect. Will give 1·7V-10·5V output with 2 extra capacitors. Ideal for Nickel-Cad battery chargers, 5V TTL supply, cassette or radio etc. Brand new, British made, complete with Information. ONLY **75p** (20p).

AMPLIFIER UNIT

In fully screened case 5½ x 5 x 3½". 2 GET116 on heat sink, 2 zeners, 3 pot cores, 4 transformers, 1% R's & C's, 40 way tag-board and fuse. With circuit. **65p** (30p). 4 for **£2** (65p). Qty. discount.

3W CASED AMPLIFIER

Polished wooden cabinet 14 x 13 x 9" containing a sensitive (20μV) 4 valve amplifier with tone and volume controls. 3 watts output to the 7 x 4" 3Ω speaker. Also included is a non-standard tape deck. Supplied in good working condition with circuit. Mains operated **£3** (£1 up to 200 miles, **£1·25** over). Suitable cassette **£1** (30p); spare head **30p**; tape (ex-computer) **68p** (20p); Amplifier chassis, complete and tested (2xECC83 EL84, EZ80) + speaker **£2** (45p); motors **35p** (30p).

7lb BARGAIN PARCELS

Hundreds of new components: resistors, capacitors, pots, switches, + PC boards with transistors and diodes, also crystals and loads of odds and ends. Amazing value at **£1·65** (40p).

COMPONENT PACKS

500 asstd. resistors **£1** (20p); 2500 **£4** (40p); 10000 **£12** (£1); 100000 **£80** + carr. 150 poly, mica, ceramic caps **60p** (10p); 25 10X crystals **£1** (30p).

COMPUTER PANELS

3lbs. asstd. **£1** (30p); 7lbs **£2** (40p); 12 High quality boards with IC's, power transistors, trimpots etc **£2** (30p); 100 ditto **£12** (£1); Pack of boards containing at least 500 components with at least 50 transistors **60p** (20p); Panel with 20 2N2926 type transistors + other parts **20p** (10p); Pack with 25 flat pack IC's (no info.) **30p** (10p).

NEW COMPONENTS

400V 5A scr **60p**; 200V **40p**; OC16 **20p**; OC45 **8p**; OC71 **8p**; OC171 **15p**; BFY18 **12p**; BCY72 **8p**; 741C **32p**.

Trendata Keyboard. Computer data input terminal with display. Converts to IFO code. Brand new and boxed less than 2 years old and cost **£650**. No data available, so only **£80** (£2). Send 10p for photo.

80 + 80 + 20μF 350V **10p**; 10 **75p** (30p); 8μF 2500V **£2** (50p); 4μF 2000V **£1** (40p); 10μF 236V **40p** (15p); 1Ω resistor 2W **4p**; 10Ω 2W 10/25p 100k ¼W **30p**/100 (10p); 4 pole 8 way yaxley switch **30p** (8p); Crystal + cats whisker **15p**; 20k 10 turn Colvern wirewound pot **75p** (10p); Miniature 50V ceramic plate caps 22pF-1000pF **2p**; Heavy duty heat sink 6 x 5 x 3" with 2 power transistors **80p** (30p); 230V fans 2800 rpm 6¼" dia blades complete with grill and mounting plate **£2·50** (40p); Scopes in stock for callers, ring for details.

VAT NOT INCLUDED, ADD 10% TO TOTAL
Carriage in brackets, small parts **5p**. SAE list.

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SPECIAL OFFER
Used 19" TV Tubes. Type AW 47·91. Perfect condition. 6 months guarantee. **£3** carr. paid.

Complete untested TV Sets 19" 405-line Types **£3·50** carr. and ins. paid.

19" 625-line types untested. Complete with UHF Tuner **£5·50** carr. and ins. Paid.

One Students and One Instructors Wireless Procedure Training Set, each unit housed in a small wood box and comprises Mike, Single L.R. Phone and connectors. Requiring Bell Battery (not supplied) to make intercom. **£1·30** post paid.

Small Clock Type Sangamo Weston 200–250v 200 r.p.m. mains motor with Gear train (ex slot machine) Fair condition **60p** post paid.

¼ cwt. of ex Government Scrap Resistors, Panels, Gears, etc **30p** carr. 80p.

Speakers removed from TV sets. All 3 ohm, 2½ watts 7 x 4, 6 x 4, 8 x 2½. All at **27p**. Post and packing 12p.

Top Quality Tape, Reel to Reel 5" LP **55p**. 5¾" LP **60p**. 7" ST **66p**. 7" LP **80p**. Cassette Types C60 **35p**, C90 **45p**. Post on any tape **12p**.

Jap Earpiece, 8 ohm, magnetic, 3·5 **12p** post paid.

Ex Equipment Valves all Tested before despatched. 3 months guarantee on all valves. Single valves post 3p, over post paid.

ARP12	6p	EF184	20p	PY801	17p
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EB91	5p	PCC84	6p	PY33	20p
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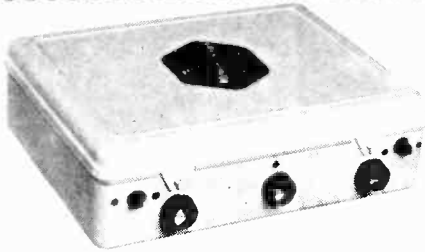
EBF89	15p	PCL84	15p	6BW7	12p
ECC81	12p	PCL85	20p	6F23	15p
ECC82	12p	PL36	17p	30F5	12p
EY86	20p	PY81	10p	30FL1	20p
EF183	20p	PY800	17p	30P19	10p

ABOVE PRICES INCLUDE V.A.T.



NEW EDU-KIT MAJOR

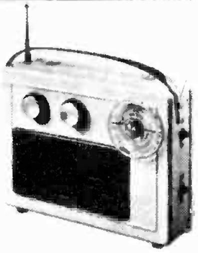
Completely Solderless Electronic Construction Kit
Build these projects without soldering iron or solder

- ★ 4 Transistor Earpiece Radio.
- ★ Signal Tracer.
- ★ Signal Injector.
- ★ Transistor Tester NPN-PNP.
- ★ 4 Transistor Push Pull Amplifier.
- ★ 5 Transistor Push Pull Amplifier.
- ★ 7 Transistor Loudspeaker Radio MW/LW.
- ★ 5 Transistor Short Wave Radio.
- ★ Electronic Metronome.
- ★ Electronic Noise Generator
- ★ Batteryless Crystal Radio.
- ★ One Transistor Radio.
- ★ 2 Transistor Regenerative Radio.
- ★ 3 Transistor Regenerative Radio.
- ★ Audible Continuity Tester.
- ★ Sensitive Pre-Amplifier.

Total Building Costs £7·23 P P & Ins. 44p (Overseas P & P £1·85) (+ 10% VAT 72p)

Components Include: 24 Resistors ● 21 Capacitors ● 10 Transistors ● 3½" Loudspeaker ● Earpiece ● Mica Baseboard ● 3 12-way connectors ● 2 Volume controls ● 2 Slider Switches ● 1 Tuning Condenser ● 3 Knobs ● Ready Wound MW/LW/SW Coils ● Ferrite Rod ● 6½ yards of wire ● 1 Yard of sleeving etc. ● Parts Price List and Plans 50p. (Free with parts).

NEW ROAMER NINE

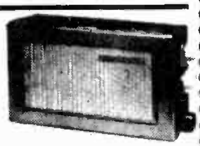


WITH V.H.F. INCLUDING AIRCRAFT

Nine Transistors, 9 Tuneable wavebands as Roamer Ten Built in ferrite rod aerial for MW/LW. Retractable chrome-plated telescopic aerial for VHF and SW. Push Pull output using 600 mW transistors. 9 Transistors and 3 diodes, tuning condenser with V.H.F. section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange controls. Attractive all white case with red grille and carrying strap. Size 9½" × 7" × 2½" approx. Parts Price List and Plans 30p (Free with parts).

Total Building Costs £6·95 P P & Ins. 44p (Overseas P & P £1·85) (+ 10% VAT 69p)

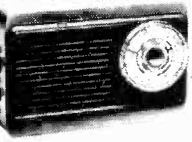
POCKET FIVE



3 Tunable wavebands. M.W. L.W. and Trawler Band, 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, moving coil loudspeaker, attractive black and gold case. Size 5½" × 1½" × 3½" approx. Plans and Parts Price List 15p (Free with parts).

Total Building Costs £2·28 P P & Ins. 26p (+10% VAT 22p) (Overseas P & P £1·25)

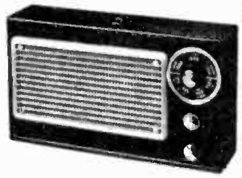
TRANSONA FIVE



Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial. Plans and Parts Price List 15p (Free with parts).

Total Building Costs £2·50 P P & Ins. 26p (+10% VAT 25p) (Overseas P & P £1·25)

NEW Everyday Series



Build this exciting New series of designs

E.V.5. 5 Transistors and 2 diodes. MW/LW. Powered by 4½ volt Battery. Ferrite rod aerial, tuning condenser, volume control, and loudspeaker. Attractive case with red speaker grille. Size 9" × 5½" × 2¼" approx. Parts Price List and Plans 15p. Free with parts.

Total Building costs £2·73 P P & Ins. 30p (+ 10% VAT 27p) (Overseas P & P £1·25)

E.V.6. Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt battery. Ferrite rod aerial, 3" loudspeaker, etc., MW/LW coverage. Push Pull output. Parts Price List and Plans 15p. Free with parts.

Total Building Costs £3·60 P P & Ins. 30p (+ 10% VAT 36p) (Overseas P & P £1·25)

E.V.7. Case and looks as above. 7 Transistors and 3 diodes. Six wavebands. MW/LW, Trawler Band, SW1, SW2, SW3. powered by 9 volt battery. Push Pull output. Telescopic aerial for short waves. 3" Loudspeaker. Parts Price List and Easy Build Plans 20p. Free with parts. Overseas P & P £1·05.

Total Building Costs £4·08 P P & Ins. 31p Overseas P & P £1·85 (+ 10% VAT 40p)

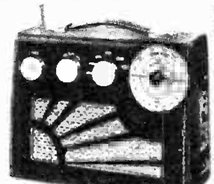
ROAMER EIGHT Mk I

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. 8 transistors plus 3 diodes. Latest 4" 2 watt ferrite magnet loudspeaker. 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 plans 25p (FREE with parts).

Total building costs £6·98 P P & Ins. 47p Overseas P & P £1·85 (+ 10% VAT 69p)

ROAMER TEN



WITH VHF INCLUDING AIRCRAFT

10 Transistors. Latest 4" 2 watt Ferrite Magnet Loudspeakers. 9 Tunable Wavebands, MW1, MW2, LW, SW1, SW2, SW3, Trawler Band, VHF and Local Stations also Aircraft Band. Latest 4" 2 watt ferrite magnet loudspeaker.

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. 10 Transistors plus 3 Diodes. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Controls. Attractive Case in black with silver blocking. Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and plans 30p (FREE with parts).

Total building costs £8·50 P P & Ins. 52p (Overseas P & P £1·85) (+ 10% VAT 85p)

"EDU-KIT"

Build Radios, Amplifiers, etc., from easy stage diagrams.

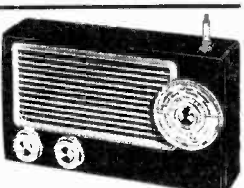
Five units including master unit to construct.

Components include:
Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine Tone 3" Moving Coil Speaker: Terminal Strip: Ferrite Rod Ariel: Battery Clips: 4 Tag Boards: 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.
Parts price list and plans 25p (FREE with parts).

Total building costs £5·50 P P & Ins. 33p (Overseas P & P £1·85) (+ 10% VAT 55p)

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 × 2¼in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and plans 25p (FREE with parts).

Total building costs £4·48 P P & Ins. 33p (+ 10% VAT 44p) (Overseas P & P £1·25)

ROAMER SIX

CASE AND LOOKS AS TRANS-EIGHT

6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra Medium waveband 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. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Plans and parts price list 25p (FREE with parts).

Total building costs £3·98 P P & Ins. 31p (Overseas P & P £1·85) (+ 10% VAT 39p)

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RTVC

COMPLETE* STEREO SYSTEM

£51·00

40 Watt Amplifier.
Viscount III – R102 now 20 watts per channel.
System I includes,
Viscount III amplifier – volume, bass, treble and balance controls, plus switches for mono/stereo on/off function and bass and treble filters. Plus headphone socket.
Specification
20 watts per channel into 8 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.) −58dB.
Crosstalk better than 35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx. 13¾″ × 9″ × 3¾″.
Garrard SP25 deck, with magnetic cartridge, de luxe plinth and hinged cover.
Two Duo Type II matched speakers – Enclosure size approx. 17½″ × 10½″ × 6″ in simulated teak. Drive unit 13″ × 8″ with parasitic tweeter
Complete System £51.00

£69·00

System II
Viscount III amplifier (As System I)
Garrard SP. 25 (As System I)
Two Duo Type IIIA matched speakers—
Enclosure size approx. 31″ × 13″ × 11½″. Finished in teak veneer. Drive units approx. 13½″ × 8¼″ with 3¾″ HF speaker. Max. power 20 watts, 8 ohms. Freq. range 20Hz to 20kHz.
Complete System £69.00

PRICES: SYSTEM 1

Viscount III R 102 amplifier	£24·20 + £1 p & p
2 Duo Type II speakers	£14·00 + £2·20 p & p
Garrard SP25 with MAG. cartridge de luxe plinth and hinged cover	£21.00 + £1.75 p & p.
total	£59.20

Available complete for only £51.00 + £3·50 p. & p.

PRICES: SYSTEM 2

Viscount R 102 amplifier	£24·20 + £1 p & p
2 Duo Type III A speakers	£39·00 + £4.00 p & p
Garrard SP25 with MAG. cartridge de luxe plinth and hinged cover	£21.00 + £1.75 p & p.
total	£84.20

Available complete for only £69.00 + £4 p & p

STEREO 21

QUALITY SOUND* FOR LESS THAN £19·00

Stereo 21 easy to assemble audio system kit, – no soldering required. Includes:—
BSR 3 speed deck, automatic, manual facilities together with ceramic cartridge.
Two 8″ × 5″ speakers with cabinets.
Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.
For the technically minded:—
Specifications:
Input sensitivity 600mV:Aux. input sensitivity 120mV: Power output 2.7 watts per channel: Output impedance 8–15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs – radio, tape, etc., and outputs for taping discs. **Overall Dimensions**. Speakers approx. 15½″ × 8″ × 4″. Complete deck and cover in closed position approx. 15½″ × 12″ × 6″. Complete only **£18.95** + £1.60 p & p.
Extras if required.
Optional Diamond Styli **£1.37**
Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance. **£3.85.**

DISCO AMPLIFIER

Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties.
Outputs 20 watts R.M.S. into 8 ohms (suitable for 15 ohms).
Inputs *5 Electrically Mixed Inputs. *3 Individual Mixing controls. *Separate bass and treble controls common to all 5 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State Circuitry. *Attractive Styling.
INPUT SENSITIVITIES
1) Crystal Mic or Guitar 9mV. 2) Moving coil Mic or Guitar 8mV. 3), 4), 5) Medium output equipment (Gram. Tuner, Monitor, Organ, etc.) – all 250mV sensitivity.
AC Mains 240V. operation.
Size approx. 12½ ins × 6 ins × 3½ ins
£13.50 + 60p. postage & packing.

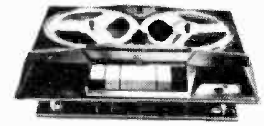
8 TRACK CARTRIDGE PLAYER*

Elegant self selector push button player for use with your own stereo system. Compatible with Viscount III system, the Stereo 21 and the Unisound module.
Technical specification.
Mains input. 240V. Output sensitivity 125mV
Comparable unit sold elsewhere at £24·00 approx.
Yours for only £10.95 + 90p. p & p

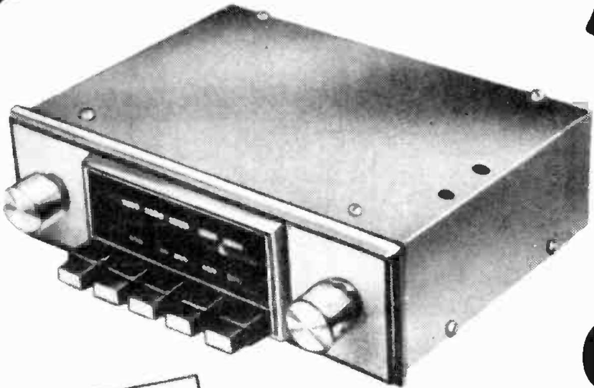
BUILD YOUR OWN STEREO AMPLIFIER*

For the man who wants to design his own stereo—here's your chance to start with Unisound—pre-amp, power amplifier and control panel. No soldering—just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum.
240V. AC only. **£7·64 + 55p. p & p**

PE TAPE LINK CONSTRUCTORS

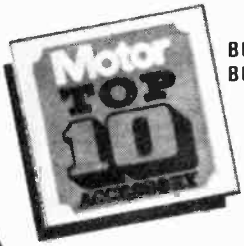


A suitable 3 speed tape deck, less heads. Caters up to 5¾ ins. spools. 240V AC mains. Unused but store soiled hence no warranty. **£4.00 + £1.00 p & p**



Remember! one of the Top Ten Accessory Awards from Motor magazine

PUSH BUTTON* CAR RADIO KIT



BUILD YOUR OWN TOURIST PUSH BUTTON CAR RADIO

Technical specification:
1.) **Output** 2.5 watts R.M.S. into 8 ohms. For 12 volt operation on negative or positive earth.
2.) **Integrated circuit** output stage, pre built three stage IF Module.
Controls Volume, manual tuning and five push buttons for station selection, illuminated tuning scale covering full medium and long wave bands.
Size Chassis 7 ins. wide, 2 ins. high and $4\frac{5}{16}$ ins. deep approx.

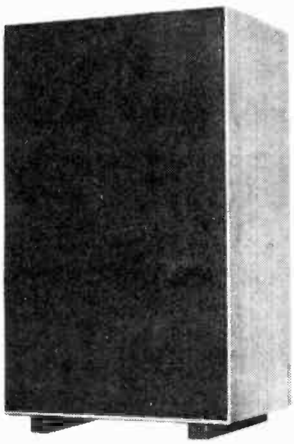
NOTE: The ability to solder on a printed circuitboard is necessary to complete this kit successfully. Circuit diagram and comprehensive instructions 55p free with kit.

Car Radio Kit
£6.60 + 55p. postage & packing.

Speaker including baffle and fixing strips
£1.65 + 23p. postage & packing.

Recommended **Car Aerial** - fully retractable and locking.
£1.35 post paid.

THE ULTIMATE COMPLETE SPEAKER SYSTEM EMI LE 315



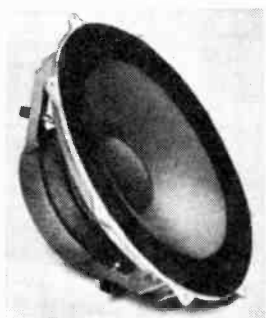
A professional standard five way speaker system with enclosure giving top quality performance.
Enclosure Dimensions
approx. (3 ft. × 2 ft. × 1 ft.).
Drive Units
Hand built - 15″ diameter bass with 3″ voice coil,
- two 5″ diameter Mid Range units,
- two $3\frac{1}{4}$″ HF. units,
plus matching crossover panel with two variable potentiometers for mid and high frequency adjustment.
Powder Handling
Continuous rating
35 W rms., Peak power rating 70 W.
Frequency Response
20 Hz 20,000 Hz.
Impedance 8 ohms.

Recommended retail selling price, £86·00.

Our price £45·00 + £3.50 postage & packing.

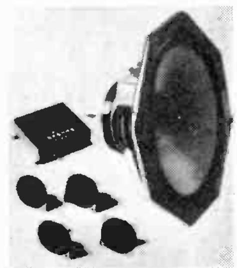
EMI SPEAKERS

FANTASTIC REDUCTION



15″ 14A/780. Bass unit on a rigid diecast chassis. Superior cone material handles up to 50 watts RMS, and is treated to give a smooth frequency response. Resonance 30 Hz. flux density 360,000 Maxwells. Impedance at 1 kHz is 8 ohms. 3″ voice coil.

Recommended retail price £40·80.
OUR PRICE £18·70 + £1·50 p & p



950 Kit - Five matched speakers and crossover unit for handling up to 45 watts, frequency response from 20 to 20,000 Hz.
Huge 19″ × 14″ (approx.) high efficiency Bass-Speaker with 16,500-gauss magnet built on a heavy diecast frame.
The four 10,000 gauss tweeters, each $3\frac{1}{4}$″ dia. approx., are fed by the crossover which critically adjusts signal for maximum fidelity. Impedance at 1 kHz is 8 ohms. Bass coil 2″, others 0·5″. Recommended list price £44·00.

OUR PRICE £25·00 + £1·50 p & p
Special Offer.

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AC176	20p
AC153/176K	52p
AC187K	17p
AC188K	23p
AC187/188K	40p
ACY17	27p
ACY18	20p
ACY19	20p
ACY20	20p
ACY21	19p
ACY22	10p
AD140	60p
AD149	60p
AD161	44p
AD162	44p
AD161/162	88p
AF106	32p
AF114	27p
AF115	27p
AF116	25p
AF117	25p
AF118	44p
AF124	25p
AF125	24p
AF126	24p
AF139	47p
AF186	40p
AF239	52p
AF279	58p
ASY26	25p
ASY27	30p
ASY28	22p
ASY29	30p
BA138	15p
BB103	20p
BB104	34p
BB105	28p
BC107	16p
BC107/BC177	36p
BC108	16p
BC108/BC178	32p
BC109	16p
BC109/BC179	36p
BC109C	18p
BC117	15p
BC140	30p
BC147	12p
BC148	11p
BC149	12p
BC157	13p
BC158	12p
BC159	13p
BC147/157	25p
BC148/158	23p
BC149/159	25p
BC167	11p
BC168	10p
BC169	11p
BC169C	12p
BC177	20p
BC178	16p
BC179	20p
BC182	14p
BC182L	14p
BC183	13p
BC183L	14p
BC184	17p
BC184L	16p
BC212	16p
BC212L	16p
BC238	10p
BC238/308	20p
BC257	11p
BC258	10p
BC259	12p
BC307	12p
BC308	10p
BCY30	25p
BCY31	48p
BCY32	50p
BCY33	20p
BCY34	25p
BCY38	30p
BCY58	18p
BCY70	15p
BCY71	26p

BCY72	14p
BD124	75p
BD131	40p
BD132	40p
BD131/132	80p
BDY20	91p
BF115	23p
BF163	35p
BF167	25p
BF173	29p
BF177	25p
BF178	31p
BF180	35p
BF194	15p
BF195	15p
BF196	15p
BF200	35p
BF254	14p
BF255	15p
BFX13	25p
BFX29	32p
BFX84	25p
BFX85	34p
BFX86	25p
BFX87	30p
BFX88	24p
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BZY88C4V3	10p
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W02	26p
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W06	32p
W08	41p
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7445	£2·47
7446	£1·74
7447	£1·50
7450	24p
7451	24p
7453	24p
7454	24p
7460	24p
7470	54p
7472	36p
7473	54p
7474	55p
7475	54p
7476	54p
7480	80p
7482	£1·04
7483	£1·58
7486	39p
7490	84p
7491A	£1·54
7492	£1·02
7493	90p
7494	£1·36
7495	96p
7496	£1·78
74100	£1·97
74107	62p
74121	51p
74141	£1·20
74150	£4·02
74151	£1·32
74153	£1·62
74154	£2·40
74155	£1·86
74156	£1·66
74190	£2·16
74191	£2·16
74192	£2·09
74193	£2·09
74196	£1·80
74197	£1·80
40250	66p
40309	40p
40310	60p
40311	42p
40312	62p
40320	42p
40360	56p
40361	45p
40362	45p
40406	52p
40407	40p
40408	54p
40409	62p
40410	62p
40430	£1·13
40468A	44p
40511	£1·92
40575	£1·54
40576	£1·46
40600	70p
40601	70p
40602	45p
40603	70p
40669	£1·00
40673	52p
40739	£1·50

CAPACITORS—ELECTROLYTIC AXIAL LEADS

Mfd.	Working Voltage	Price	Mfd.	Working Voltage	Price
1·0	40v	11p	100	16v	10p
1·0	100v	9p	100	25v	10p
2·2	25v	11p	100	40v	11p
2·2	63v	9p	100	63v	14p
4·7	40v	9p	220	25v	12p
10	25v	9p	220	40v	13p
10	63v	10p	470	25v	15p
22	25v	10p	1000	25v	23p
22	40v	10p	2200	25v	43p
47	25v	10p	4700	16v	51p
47	40v	10p			

CAPACITORS—METALLISED POLYESTER

Stock values: MFD	Price each
0·01, 0·015, 0·022, 0·033	4p
0·047, 0·068, 0·10	5p
0·150, 0·220	6p
0·33	8p
0·47	9p
0·68	12p
1·0	15p
1·5	22p
2·2	26p

Order as "Polyesters" + Capacitance.

CAPACITORS—POLYSTYRENE

Axial leads, Clear encapsulation, 5% Tolerance. 160 volt working.

Stock values	Price each
10pF, 15pF, 22pF, 33pF, 47pF, 68pF, 100pF, 150pF, 220pF, 330pF, 470pF, 560pF, 680pF, 820pF, 1000pF, 1500pF, 2200pF, 3300pF, 4700pF, 5600pF, 6800pF	4p

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INTEGRATED CIRCUIT PINS

The lowest priced IC mounting available. Pin Sockets come in a reel, just drill your board at required centres, drop in pins and solder, break off frame holders—Your DIL mounting is completel!

Pin Sockets	1,000 pieces	£7·00
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A new type of 40khz. Ultrasonic Transducers designed to transmit and receive a 40khz signal. Supplied with transmitter/receiver circuits of a new design.

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CA3123E Superhet System with RF Amp, IF Amp, Mixer, OSC, g.c. Detector and Voltage Regulator. Ideal for car radio applications. **£1·80**

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X25/240V. 25W Iron	£1·85
SK2/240V, 15W kit	£2·95
MLX 12V, 25W kit essential for car tool kit	£2·30
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RECORDING TAPE. 5″ 600 ft. **40p**. 5¾″ 900 ft. **55p**. 7″ 1200 ft. **62p**. 5″ 900 ft. **57p**. 5¾″ 1200 ft. **65p**. 7″ 1800 **£1·05**. ALL FINEST BRITISH MYLAR. Charges: 5″ and 5¾″ one to 4, **9p** each; 5 and over **33p** the lot. Charges for 7″ 1-3. **11p** each. 4 & 5, **33p** the lot 6 and over **39p** the lot.

PICK-UP WIRE. Super thin, flex scrd. 2-core **8p yd**. 4-core **14p yd**. Charges up to 10 yds. **8p** lot. Over 10 yds. no charges.

SPEAKERS. 2½″, 3, 8 or 64 ohms (state which) **55p**. Charges **9p ea.** 12″ Round, fitted cone tweeter, 6 watts undistorted, 3, 8 or 15 ohms (state which) **£2·20** (charges 30p). OR, PAIR FOR STEREO, **£4·75** charges paid.

CONNECTING WIRE. Pkts. of 5 coils, asstd. cols. ea. 5 yds. Solid core **17p** (8p charges). Flexible **19p** (+ 10p).

EARPIECES. Magnetic, 2·5 or 3·5mm plug. (state which) **13p**. CRYSTAL (3·5mm only) **30p** (all 9p up to 6).

VIBRATORS. 7-pin SYNCH. (12SR7 type) **72p**. 4-pin NON-synch. (121HD4) **40p** (all 9p ea.)

SEND SAE NOW FOR FREE COMPONENTS LIST.

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20-Watt Full Range Speaker

Completely replaces the conventional cone speaker Super-thin construction permits new installation ideas.

Power capability: 40 watts peak. **Frequency range:** 40 Hz–20 KHz **Sensitivity:** 85 dB/M for 1 watt electrical input. **Input impedance:** 8 ohms. **Operating temperature range:** —20°F to +175°F. **Size (WxDxL):** 1·7/16″ x 11·3/4″ x 14·11/16″. **Weight:** 19 ounces.

£7·50 each Stereo pair £14·50

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New Product

CASED AUTO TRANSFORMERS

240 Volt Mains to 115 Volts, smart steel-cased units coated in tough resin, fitted with power lead, fuse and 115 Volt American type socket up to 500VA, above 500VA cable entry.

VA (Watts)	Price	Post
200 ..	£5·56	£0·38
500 ..	£9·50	£0·67
1000 ..	£15·92	£0·82
2000 ..	£29·70	£1·50
20VA version uncoated, no fuse	£2·52	£0·30

POWER UNIT Type A125

Supplying 6 or 9 Volt DC at 200 mA.

In moulded case forming a 2 pin 5 A mains plug.

2 metre output lead with 4-way multiplug giving 2·1 and 2·5 mm sockets and 3·5 mm plugs.

Price **£2·25**. Post 10p.

POWER UNIT Type P1076

Output switched 3, 4·5, 6, 7·5, 9 and 12 Volts at 500mA D.C. Operates from 240 V. mains, suitable for Radios, Tape Recorders, Record Players, etc. Size 7·5 × 5·0 × 14·0 cm. Price **£3·95**. Post 25p.

ELECTRONIC MAINS TIMER

A reliable unit ideal for timing Bathroom/Toilet Ventilators Stairway/ Cloakroom Lighting etc. Gives up to 30 mins delay before switching off. Delay 1–30 mins. adjustable.

Max Load 400VA or 1600 watts resistive. Ivory Case 3¾″ × 3¾″ × 2″. Fitting instructions included.

Trade Price **£5·80**. Post 20p.

PANEL METERS 2″ & 4″

Modern Wide View Face. Moving Coil. Wired for illumination (lamps extra).

50 mA 1250 ohms
1 mA 170 ohms
VU 5250 ohms (with Detector)
Face Size 60 × 45 × 40mm (2″)
110 × 82 × 43mm (4″)

PRICE: 2″ **£2·95** 4″ **£3·95** + POST 10p

TRANSFORMERS

SAFETY ISOLATING

Prim. 120/240V. Sec. 120/240V. Centre Tap with Screen.

VA (watts)	Ref. No.	Price Cased	Price Open	P & P £
60	149	—	£ 3·74	0·38
100	150	—	4·16	0·52
200	151	£ 9·48	7·48	0·52
250	152	12·05	9·57	0·65
350	153	14·00	11·44	0·80
500	154	15·80	13·20	1·00
1000	156	30·70	27·46	1·20
2000	158	60·95	55·44	
3000	159	79·53	72·49	

50 Volts

Prim. 200–240V. Sec. 19, 25, 33, 40, 50V.

Amps	Ref. No.	Price £	P & P £
0·5	102	£2·11	£0·30
1	103	3·08	0·38
2	104	4·29	0·42
3	105	5·77	0·52
4	106	7·48	0·52
6	107	11·00	0·67
8	118	14·19	0·97
10	119	17·60	0·97

60 Volts

Prim. 200–240V. Sec. 24, 30, 40, 48, 60V.

Amps	Ref. No.	Price £	P & P £
0·5	124	£2·10	£0·38
1	126	2·97	0·38
2	127	5·77	0·42
3	125	7·15	0·52
4	123	9·35	0·67
5	40	11·55	0·67
6	120	13·57	0·82
8	121	16·00	1·00
10	122	19·40	1·00
12	189	21·62	1·10

12 & 24 Volts Prim. 200–240V.

Amps 12V	Amps 24V	Ref. No.	Price £	P & P £
0·3	0·15	242	1·34	0·22
0·5	0·25	111	1·34	0·22
1	0·5	213	1·59	0·22
2	1	71	2·09	0·22
4	2	18	2·75	0·38
6	3	70	3·56	0·42
8	4	108	3·96	0·52
10	5	72	4·67	0·52
12	6	116	5·67	0·52
16	8	17	6·64	0·52
20	10	115	10·23	0·69
30	15	187	13·75	0·97
40	20	232	18·26	1·00
60	30	226	22·52	1·10

MINIATURE AND EQUIPMENT

Prim. 240V with screen.

Volts Sec. 1	Volts Sec. 2	Milliamps Sec. 1	Milliamps Sec. 2	Ref. No.	Price £	P & P £
3–0–3	—	200	—	238	1·23	0·10
0–6	0–6	500	500	234	1·30	0·10
0–6	0–6	1000	1000	212	1·68	0·22
9–0–9	—	100	—	13	1·23	0·10
0–9	0–9	330	330	235	1·43	0·22
0–8–9	0–8–9	500	500	207	2·28	0·30
0–8–9	0–8–9	1000	1000	208	3·03	0·10
15–0–15	—	40	—	240	1·23	0·10
0–15	0–15	200	200	236	1·30	0·10
20–0–20	—	30	—	241	1·23	0·10
0–20	0–20	150	150	237	1·30	0·10
0–15–20	0–15–20	500	500	205	2·97	0·38
0–20	0–20	300	300	214	1·76	0·22
0–20	—	3500	NO SCREEN	1116	3·00	0·40
20–12–0–12–20	—	700 (D/C)	—	221	1·55	0·30
0–15–20	0–15–20	1000	1000	206	3·80	0·38
0–15–27	0–15–27	500	500	203	3·08	0·38
0–15–27	0–15–27	1000	1000	204	2·24	0·38

30 Volts

Prim. 200–240V. Sec. 12, 15, 20, 24, 30V.

Amps	Ref. No.	Price £	P & P £
0·5	112	£1·58	£0·22
1	79	2·20	0·38
2	3	3·19	0·38
3	20	3·96	0·42
4	21	4·68	0·52
5	51	5·80	0·52
6	117	6·93	0·52
8	88	9·00	0·67
10	89	10·00	0·67

PLASTIC CASED SILICON BRIDGE RECTIFIERS

One Amp	Two Amp	Four Amp	Six Amp
50 P.I.V. 25p	50 P.I.V. 35p	100 P.I.V. 55p	50 P.I.V. 65p
100 P.I.V. 25p	100 P.I.V. 40p	200 P.I.V. 59p	100 P.I.V. 70p
200 P.I.V. 28p	200 P.I.V. 45p	400 P.I.V. 65p	200 P.I.V. 80p
600 P.I.V. 30p	400 P.I.V. 50p	600 P.I.V. 75p	400 P.I.V. 90p

ADD 10p P & P PER ORDER

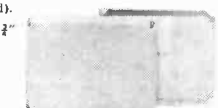
AUTO TRANSFORMERS (Open)

VA (Watts)	Ref. No.	Price £	Post £
Tapped at 115, 220, 240 Volts			
20	113	£1·32	22p
75	64	£2·63	30p
Tapped at 115, 200, 220, 240 Volts			
150	4	£3·29	39p
200	65	£3·96	40p
300	66	£4·64	52p
500	67	£8·03	67p
1000	84	£13·50	82p
2000	95	£25·30	£1·00
3000	73	£33·00	£1·20

QUALITY INSTRUMENT CASE

Strongly moulded in High Gloss, Grey Plastic (Flame Retardant ABS).

Two interlocking halves secured by four corner bolts (supplied).



Interior Size: 6¼″ × 5¼″ × 2¾″

Wall Thickness: ⅛″

Weight: 11½ ozs.

Price: **£1·50**. Post 15p.

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CANTERBURY · KENT · CT1 3RW Canterbury (0227) 52436

The largest selection

BRAND NEW FULLY GUARANTEED DEVICES

Type	Price p
AC107	22
AC113	20
AC115	22
AC117K	32
AC122	13
AC125	19
AC126	19
AC127	20
AC128	20
AC132	16
AC134	16
AC137	16
AC141	20
AC141K	32
AC142	20
AC142K	28
AC151	17
AC154	22
AC155	22
AC156	22
AC157	27
AC165	22
AC166	22
AC167	22
AC168	27
AC169	16
AC176	22
AC177	27
AC178	31
AC179	31
AC180	22
AC180K	32
AC181	22
AC181K	32
AC187	24
AC187K	25
AC188	24
AC188K	25
ACY17	28
ACY18	22
ACY19	22
ACY20	22
ACY21	22
ACY22	18
ACY27	20
ACY28	21
ACY29	39
ACY30	31
ACY31	31
ACT34	23
ACY35	23
ACY36	31
ACY40	19
ACY41	20
ACY44	39
AD130	42
AD140	53
AD142	53
AD143	42
AD149	55
AD161	39
AD162	39

Type	Price p
AD161 and	
AD162(MP)	75
ADT140	55
AF114	27
AF115	27
AF116	27
AF117	27
AF118	39
AF124	33
AF125	33
AF126	31
AF127	31
AF139	33
AF178	55
AF179	55
AF180	55
AF181	55
AF186	55
AF239	41
AL102	72
AL103	72
ASY26	28
ASY27	33
ASY28	28
ASY29	28
ASY50	28
ASY51	28
ASY52	28
ASY54	28
ASY55	28
ASY56	28
ASY57	28
ASY58	28
ASY73	28
ASZ21	44
BC107	12
BC108	12
BC109	13
BC113	11
BC114	17
BC115	17
BC116	17
BC117	20
BC118	11
BC119	33
BC120	88
BC125	13
BC126	20
BC132	13
BC134	20
BC135	13
BC136	17
BC137	17
BC139	44
BC140	33
BC141	33
BC142	33
BC143	33
BC145	50
BC147	11
BC148	11
BC149	13

Type	Price p
BC150	20
BC151	22
BC152	19
BC153	31
BC154	33
BC157	20
BC158	13
BC159	13
BC160	50
BC161	55
BC167	13
BC168	13
BC169	13
BC170	13
BC171	16
BC172	16
BC173	16
BC174	16
BC175	24
BC177	21
BC178	21
BC179	21
BC180	27
BC181	27
BC182	11
BC182L	11
BC183	11
BC183L	11
BC184	13
BC184L	13
BC186	31
BC187	31
BC207	12
BC208	12
BC209	13
BC212L	13
BC213L	12
BC214L	16
BC225	28
BC226	39
BC301	30
BC302	27
BC303	35
BC304	40
BC440	34
BC460	40
BCY30	27
BCY31	29
BCY32	33
BCY33	24
BCY34	28
BCY70	16
BCY71	22
BCY72	16
BCZ10	22
BCZ11	28
BCZ12	28
BD115	68
BD116	88
BD121	66
BD123	72
BD124	76

Type	Price p
BD131	55
BD132	66
BD133	72
BD135	44
BD136	44
BD137	50
BD138	55
BD139	61
BD140	66
BD155	88
BD175	66
BD176	66
BD177	72
BD178	72
BD179	77
BD180	77
BD185	72
BD186	72
BD187	77
BD188	77
BD189	83
BD190	83
BD195	94
BD196	94
BD197	99
BD198	99
BD199	£1·05
BD200	£1·05
BD205	88
BD206	88
BD207	£1·05
BD208	£1·05
BDY20	£1·10
BF115	27
BF117	50
BF118	77
BF119	77
BF121	50
BF123	55
BF125	50
BF127	55
BF152	61
BF153	50
BF154	50
BF155	77
BF156	53
BF157	61
BF158	61
BF159	66
BF160	44
BF162	44
BF163	44
BF164	44
BF165	44
BF167	24
BF173	24
BF176	39
BF177	39
BF178	33
BF179	33
BF180	33
BF181	33

Type	Price p
BF182	44
BF183	44
BF184	28
BF185	33
BF187	30
BF188	44
BF194	13
BF195	13
BF196	16
BF197	16
BF200	50
BF222	£1·05
BF257	50
BF258	66
BF259	94
BF262	61
BF263	61
BF270	39
BF271	33
BF272	88
BF273	39
BF274	39
BFW10	66
BFX29	30
BFX84	24
BFX85	33
BFX86	24
BFX87	27
BFX88	24
BFY50	22
BFY51	22
BFY52	22
BFY53	19
BPX25	94
BSX19	17
BSX20	17
BSY25	17
BSY26	17
BSY27	17
BSY28	17
BSY29	17
BSY38	20
BSY39	20
BSY40	31
BSY41	31
BSY95	14
BSY95A	14
Bu105	£2·20
C111E	55
C400	33
C407	28
C424	28
C425	55
C426	39
C428	22
C441	33
C442	33
C444	39
C450	24
MAT100	21
MAT101	22
MAT120	21

Type	Price p
MAT121	22
MJE2955	95
MJE3055	62
MJE3440	55
MPF102	46
MPF104	41
MPF105	41
OC19	39
OC20	70
OC22	52
OC23	54
OC24	62
OC25	42
OC26	32
OC28	55
OC29	55
OC35	46
OC36	55
OC41	22
OC42	27
OC44	17
OC45	14
OC70	11
OC71	11
OC72	16
OC74	16
OC75	17
OC76	17
OC77	28
OC81	17
OC81D	17
OC82	17
OC82D	17
OC83	22
OC139	22
OC140	22
OC169	28
OC170	28
OC171	28
OC200	28
OC201	31
OC202	31
OC203	28
OC204	28
OC205	39
OC309	44
OCP71	48
ORP12	48
P20	55
P21	50
P346A	22
P397	46
ST140	14
ST141	19
T1S43	33
UT46	30
ZN414	£1·20
2G301	21
2G302	21
2G303	21
2G304	27
2G306	44

Type	Price p
2G308	39
2G309	39
2G339	22
2G339A	18
2G344	20
2G345	18
2G371	18
2G371B	13
2G373	19
2G374	19
2G377	33
2G378	18
2G381	18
2G382	18
2G401	33
2G414	33
2G417	28
2N388	39
2N388A	61
2N404	22
2N404A	31
2N524	46
2N527	54
2N598	46
2N599	50
2N696	14
2N697	15
2N698	27
2N699	39
2N706	09
2N706A	10
2N708	13
2N711	33
2N717	39
2N718	27
2N718A	55
2N726	31
2N727	31
2N743	22
2N744	22
2N914	16
2N918	33
2N929	23
2N930	23
2N1131	22
2N1132	24
2N1302	16
2N1303	16
2N1304	19
2N1305	19
2N1306	23
2N1307	23
2N1308	26
2N1309	26
2N1613	22
2N1711	22
2N1889	35
2N1890	50
2N1893	41
2N2147	79
2N2148	63
2N2160	66

Type	Price p
2N2192	39
2N2193	39
2N2194	39
2N2217	24
2N2218	22
2N2219	22
2N2220	24
2N2221	22
2N2222	22
2N2368	19
2N2369	16
2N2369A	16
2N2411	27
2N2412	27
2N2646	52
2N2711	23
2N2712	23
2N2714	23
2N2904	19
2N2904A	23
2N2905	23
2N2905A	23
2N2906	17
2N2906A	20
2N2907	22
2N2907A	24
2N2923	16
2N2924	16
2N2925	16
2N2926(G)	14
2N2926(Y)	12
2N2926(O)	11
2N2926(R)	11
2N2926(B)	11
2N3010	77
2N3011	16
2N3053	19
2N3054	51
2N3055	55
2N3391	16

Type	Price p
2N3391A	18
2N3392	16
2N3393	16
2N3394	16
2N3395	19
2N3402	23
2N3403	23
2N3404	31
2N3405	46
2N3414	17
2N3415	17
2N3416	31
2N3417	31
2N3525	83
2N3614	74
2N3615	82
2N3616	82
2N3646	10
2N3702	13
2N3703	13
2N3704	14
2N3705	13
2N3706	13
2N3707	14
2N3708	09
2N3709	10
2N3710	10
2N3711	10
2N3819	31
2N3820	55
2N3821	39
2N3823	31
2N3903	31
2N3904	33
2N3905	31
2N3906	30
2N4058	13
2N4059	11
2N4060	13
2N4061	13

Type	Price p
2N4062	13
2N4284	19
2N4285	19
2N4286	19
2N4287	19
2N4288	19
2N4289	19
2N4290	19
2N4291	19
2N4292	19
2N4293	19
2N5172	13
2N5294	60
2N5457	35
2N5458	35
2N5459	44
2N6211	75
2S301	55
2S302A	46
2S302	46
2S303	61
2S304	77
2S305	86
2S306	86
2S307	86
2S321	62
2S322	46
2S322A	46
2S323	62
2S324	77
2S325	77
2S326	77
2S327	77
2S701	46
40361	44
40362	50

DIODES AND RECTIFIERS

Type	Price p
AA119	9
AA120	9
AA129	9
AAY30	10
AAZ13	11
BA100	11
BA116	23
BA126	24
BA148	16
BA154	13
BA155	16
BA156	15
BY100	17
BY101	13
BY105	19
BY114	13
BY126	16
BY127	17
BY128	17
BY130	18

Type	Price p
BY133	23
BY164	55
BYX38/30	46
BYZ10	39
BYZ11	33
BYZ12	33
BYZ13	28
BYZ16	44
BYZ17	39
BYZ18	39
BYZ19	31
CG62 (OA91 Eq.)	6
CG651 (OA70-OA79 Eq.)	7
OA5	39
OA58L	23
OA10	39
OA47	8

Type	Price p
OA70	8
OA79	8
OA81	8
OA85	10
OA90	7
OA91	7
OA95	8
OA200	7
OA202	8
SD10	6
SD19	6
1N34	8
1N34A	8
1N914	7
1N916	7
1N4148	7
1S021	11
1S951	7

LINEAR I.C's—FULL SPEC.

Type No.	Price 1	25	100+
72702	50p	48p	45p
72709	35p	33p	30p
72710	45p	43p	40p
72741	40p	38p	35p
72741C	45p	43p	40p
72741P	38p	36p	34p
72748P	38p	36p	34p
SL201C	59p	45p	40p
SL701C	50p	45p	40p
SL702C	50p	45p	40p
TAA263	80p	70p	60p
TAA293	£1·00	95p	90p
TAA350A	£1·85	£1·80	£1·70
µA703C	280	26p	24p
µA709C	35p	33p	30p
µA711	45p	43p	40p

NUMERICAL INDICATOR TUBES

CD66 .. £1·87
GR116 .. £1·70
3015F Minitron .. £1·50
All indicators 0-9 + Decimal point. All side viewing. Full data for all types available on request.

ZN414 .. £1·20 each
I.C. Radio Rec. incl. full cir. data.

R.T.L. LOGIC I.C's

	Price each 1–24	25–99	100 up
UL900	38p	36p	29p
UL914	38p	36p	29p
UL923	55p	51p	49p

DTL 930 SERIES LOGIC I.C's

Type	Price 1	25	100+
BP930	15p	14p	13p
BP932	16p	15p	14p
BP933	16p	15p	14p
BP935	16p	15p	14p
BP936	16p	15p	14p
BP944	16p	15p	14p
BP945	30p	28p	25p
BP946	15p	14p	13p
BP948	30p	28p	25p
BP951	70p	65p	60p
BP962	15p	14p	13p
BP9093	45p	43p	40p
BP9094	45p	43p	40p
BP9097	45p	43p	40p
BP9099	45p	43p	40p

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

VOLTAGE REGULATORS

TO.3 Plastic 1·5 Amps
UA.7805. 5v. (Equiv. to MVR 5V) £1·76
UA.7812. 12v. .. .. MVR 12V) £1·76

DUAL-IN-LINE SOCKETS.

14 & 16 Lead Sockets for use with DUAL-IN-LINE I.C's. TWO Ranges PROFESSIONAL & NEW LOW COST.

	1–24	25–99	100up.
PROF. TYPE No.			
TSO 14 pin type	33p	30p	27p
TSO 16	38p	35p	32p
LOW COST No.			
BPS 14	16p	14p	12p
BPS 16	17p	15p	13p

74 Series T.T.L. I.C's

BI-PAK STILL LOWEST IN PRICE. FULL SPECIFICATION GUARANTEED. ALL FAMOUS MANUFACTURERS

Type	Quantities 1 £ p	25 £ p	100+ £ p
7400	0·18	0·17	0·16
7401	0·18	0·17	0·16
7402	0·18	0·17	0·16
7403	0·18	0·17	0·16
7404	0·18	0·17	0·16
7405	0·18	0·17	0·16
7406	0·39	0·34	0·31
7407	0·39	0·34	0·31
7408	0·20	0·19	0·18
7409	0·20	0·19	0·18
7410	0·18	0·17	0·16
7411	0·28	0·27	0·26
7412	0·39	0·34	0·31
7413	0·32	0·31	0·30
7416	0·48	0·44	0·42
7417	0·48	0·44	0·42
7420	0·18	0·17	0·16
7422	0·55	0·53	0·50
7423	0·55	0·53	0·50
7425	0·55	0·53	0·50
7426	0·50	0·46	0·44
7427	0·50	0·46	0·44
7428	0·55	0·53	0·50
7430	0·18	0·17	0·16
7432	0·50	0·46	0·44
7433	0·75	0·73	0·70
7437	0·70	0·68	0·65
7438	0·70	0·68	0·65
7440	0·18	0·17	0·16
7441	0·74	0·71	0·64
7442	0·74	0·71	0·64
7443	1·20	1·15	1·10
7444	1·20	1·15	1·10
7445	1·98	1·95	1·90
7446	1·20	1·15	1·10
7447	1·10	1·07	1·05

Type	Quantities 1 £ p	25 £ p	100+ £ p
7448	1·10	1·07	1·05
7450	0·18	0·17	0·16
7451	0·18	0·17	0·16
7453	0·18	0·17	0·16
7454	0·18	0·17	0·16
7460	0·18	0·17	0·16
7470	0·32	0·29	0·27
7472	0·32	0·29	0·27
7473	0·41	0·39	0·35
7474	0·41	0·39	0·35
7475	0·50	0·48	0·46
7476	0·44	0·43	0·42
7480	0·74	0·71	0·64
7481	1·30	1·25	1·20
7482	0·96	0·95	0·94
7483	1·20	1·15	1·05
7484	1·10	1·05	1·00
7485	3·50	3·30	3·30
7486	0·35	0·34	0·33
7489	4·00	3·75	3·50
7490	0·74	0·71	0·64
7491	1·10	1·05	1·00
7492	0·74	0·71	0·64
7493	0·74	0·71	0·64
7494	0·85	0·82	0·75
7495	0·85	0·82	0·75
7496	0·96	0·93	0·86
74100	1·50	1·45	1·40
74104	1·07	1·04	1·00
74105	1·07	1·04	1·00
74107	0·44	0·42	0·40
74110	0·60	0·55	0·50
74111	1·38	1·27	1·21
74118	1·10	1·05	1·00
74119	1·50	1·40	1·30
74121	0·50	0·48	0·45

Type	Quantities 1 £ p	25 £ p	100+ £ p
74122	1·50	1·45	1·40
74123	3·00	2·90	2·80
74141	0·85	0·82	0·79
74145	1·65	1·55	1·45
74150	2·90	2·80	2·70
74151	1·10	1·05	1·00
74153	1·30	1·20	1·10
74154	1·98	1·90	1·75
74155	1·50	1·45	1·35
74156	1·50	1·45	1·35
74157	2·00	1·90	1·80
74160	2·10	2·00	1·90
74161	2·10	2·00	1·90
74162	4·40	4·15	3·85
74163	4·40	4·15	3·85
74164	2·20	2·10	2·00
74165	2·20	2·10	2·00
74166	3·20	3·10	3·00
74174	2·50	2·40	2·30
74175	1·75	1·65	1·55
74176	1·85	1·75	1·65
74177	1·85	1·75	1·65
74180	1·50	1·40	1·30
74181	5·00	4·50	4·00
74182	2·00	1·90	1·75
74184	3·20	3·10	3·00
74190	2·15	2·10	2·00
74191	2·15	2·10	2·00
74192	2·15	2·10	2·00
74193	2·15	2·10	2·00
74194	2·98	2·86	2·75
74195	2·00	1·95	1·90
74196	1·95	1·90	1·85
74197	1·95	1·90	1·85
74198	5·00	4·75	4·50
74199	5·00	4·75	4·50

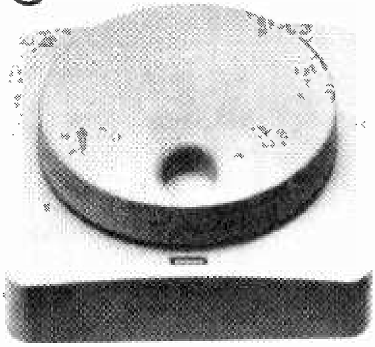
Devices may be mixed to qualify for quantity price. (TTL 74 series only) data is available for the above series of I.C.'s in booklet form. Price 13p.

ALL PRICES INCLUDE VAT.

Cool lighting **for hot parties.**

Velvet dim to full brightness at a touch of the finger. Off/on and infinitely variable.

Beta light glow makes switch easy to find in the dark and consumes no current.



Economical too!

As the light is progressively dimmed, so the current consumption drops – think of it as an electric tap. 300 watt capacity, straight replacement for standard light switch.

Complete kit of parts £2.80 or made up £2.90.

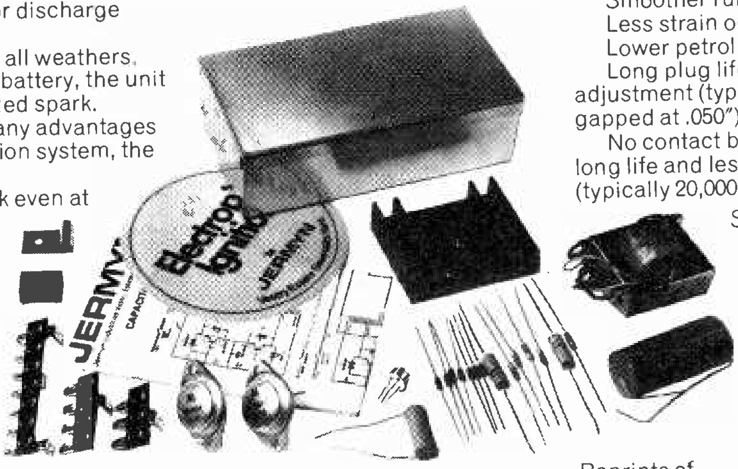
Hot Ignition for cold mornings.

The Jermyn capacitor discharge ignition system.

Instant starting in all weathers. Even with a near flat battery, the unit will produce a full sized spark.

Just one of the many advantages of an electronic ignition system, the others are:

High energy spark even at maximum revs.



Smoother running.

Less strain on battery and starter.

Lower petrol consumption.

Long plug life with infrequent adjustment (typically 20,000 miles, gapped at .050").

No contact breaker arcing giving long life and less adjustment (typically 20,000 – 25,000 miles)

STATE + or — earth when ordering.

Complete set of parts to build it yourself for only £7.75, as described in Practical Wireless and fully approved by the author.

Save 55p
Buy both for £10.00

Reprints of the two part feature are available at 25p.

To Jermyn Industries, 149 Vestry Estate, Sevenoaks, Kent. **All Prices Exclusive of V.A.T.**

Please despatch return of post .... light dimmer kit .... light dimmer ....
Ignition Kits .... + or — earth .... £10 pair. Enclose cheque or postal order.

JERMYN

BLOCK CAPITALS

NAME ....

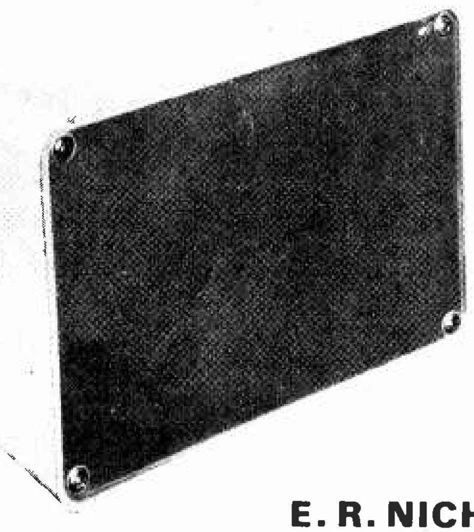
ADDRESS ....

....

....

"Stella 99"

WE BELIEVE THE FINEST INSTRUMENT CASE IN THE COUNTRY
BEATS ALL COMPETITORS FOR PRICE AND STRENGTH



SIZES	PRICE
5" x 3" x 1½"	50p
6" x 4" x 4"	£1.40
9" x 4" x 3"	£1.60
8" x 5½" x 5"	£2.30

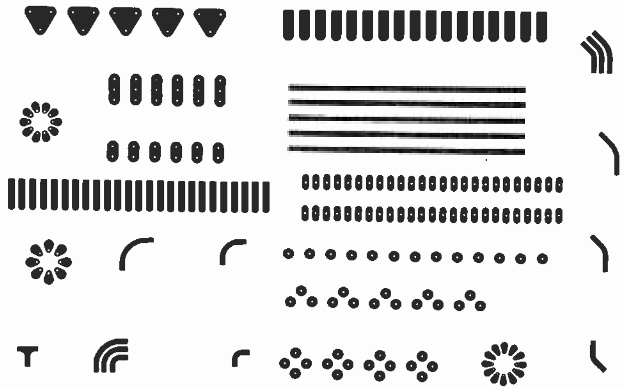
TRADE PRICES ON APPLICATION

FIBREGLASS PRESS MOULDED IN GREY SUPPLIED WITH 4 RUBBER FEET. 18 SWG ALLOY CHASSIS 16 SWG ALLOY FRONT PANEL. FRONT PANEL HAS PROTECTIVE FILM FOR MARKING OUT AND PROTECTION. THE CASE HAS TWO SETS OF RUNNERS MOULDED IN WHICH WILL TAKE ALLOY OR P.C. BOARD CHASSIS. SAME DAY OFF-THE-SHELF DELIVERY PANEL PUNCHING AVAILABLE ON 100 UP TRADE AND QUANTITY DISCOUNTS ON REQUEST.

V.A.T. ADD 10% ON TOTAL ORDER + POST AND PACKING 25p. CASH WITH ORDER.
N.B. 5" x 3" x 1½" NO FEET OR CHASSIS.

E. R. NICHOLLS,
46 Lowfield Road, Stockport, Cheshire. *Tel: 061-480 2179*

PRINTED CIRCUIT BOARD TRANSFER SYSTEMS



Acid resistant transfers for direct application to P.C. Board. This is a new approach to printed circuit board manufacture, giving a professional finish with all details that an electronics engineer would require, including all drilling positions automatically marked.

Ideal for single unit boards or small quantities. All at a very low cost—for example an average 6" x 4" layout would cost less than 30p, and the time taken under one hour, including etching to complete.

The system is simple, briefly it consists of 10 sheets of self adhesive acid resistant transfers made in required shapes—i.e. edge connectors, lines, pads, dual in line I.C.'s, 8-10-12. T.O.5 Cans, 3-4 lead transistors, etc., etc., which only require pressing into the required positions on the printed circuit board before etching.

The printed circuit transfer system is a genuine offer to the public and industry. A full money back guarantee is sent with each order, trade prices on application.

List of Prices

Complete system including post and VAT	£2·00
Individual sheets	22p
Sample sheet	22p
Copper laminate (boards) size 6" x 4½" 6 sheets (with six months guarantee)	50p

Printed circuit board PCB transfer systems patent applied for.

E. R. NICHOLLS, 46 LOWFIELD ROAD, STOCKPORT, CHESHIRE
TELEPHONE NUMBER: 061-480-2179

Trannies

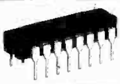
All orders to be sent to our new retail shop at:—

4 Bush House, Bush Fair, HARLOW, ESSEX.

All Prices FULLY INCLUSIVE of VAT

Telephone: 37739 — P. & P. 10p. — Catalogue 10p.

74 Series TTL



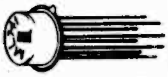
(National Semiconductors and I.T.T.)
LOW PRICES, HIGH QUALITY

* 100 plus less on 10% the 25+ column

No's	1+	25+	No's	1+	25+	No's	1+	25+
			7446	£2·31	£2·18	74122	£1·70	£1·59
			7447	£1·48	£1·34	74123	£3·35	£3·28
			7448	£1·98	£1·81	74141	£1·10	99p
7400	20p	16p	7450	20p	16p	74145	£1·65	£1·48
7401	20p	18p	7451	20p	19p	74150	£3·30	£2·75
7402	20p	18p	7453	20p	19p	74151	£1·21	£1·15
7403	20p	18p	7454	20p	18p	74153	£1·32	£1·15
7404	21p	19p	7460	20p	18p	74154	£2·20	£1·87
7405	21p	19p	7470	33p	27p	74155	£1·65	£1·21
7406	54p	49p	7472	33p	30p	74156	£1·65	£1·21
7407	54p	48p	7473	46p	42p	74157	£1·54	£1·43
7408	29p	24p	7474	44p	40p	74160	£2·18	£2·05
7409	29p	24p	7475	63p	57p	74161	£2·18	£2·05
7410	20p	18p	7476	55p	51p	74162	£4·84	£4·54
7411	23p	21p	7480	£1·10	99p	74163	£4·84	£4·54
7412	40p	33p	7481	£1·37	£1·26	74164	£2·73	£2·63
7413	31p	29p	7482	£1·10	99p	74165	£2·73	£2·63
7416	49p	47p	7483	£1·32	£1·29	74166	£4·28	£3·94
7417	57p	53p	7484	£1·32	£1·21	74174	£2·78	£2·66
7420	20p	18p	7485	£2·75	£2·64	74175	£1·94	£1·81
7422	60p	58p	7486	49p	41p	74176	£1·99	£1·87
7423	60p	58p	7489	£4·95	£4·29	74177	£2·75	£2·64
7425	60p	53p	7490	82p	71p	74180	£2·75	£2·64
7426	35p	31p	7492	84p	65p	74181	£6·49	£6·05
7427	55p	51p	7493	82p	66p	74182	£2·16	£2·02
7428	85p	79p	7494	£1·04	93p	74184	£2·69	£2·42
7430	20p	18p	7495	£1·14	£1·03	74190	£3·08	£2·69
7432	42p	33p	7496	£1·25	£1·15	74191	£2·30	£2·24
7433	97p	91p	74100	£2·75	£2·58	74192	£2·53	£2·30
7437	77p	74p	74104	£1·18	£1·14	74193	£2·53	£2·30
7438	77p	74p	74105	£1·18	£1·14	74194	£3·27	£3·15
7440	20p	18p	74107	48p	46p	74195	£2·42	£2·30
7441	81p	78p	74110	67p	65p	74196	£2·18	£2·06
7442	81p	78p	74111	£1·52	£1·40	74197	£2·18	£2·06
7443	£1·40	£1·32	74118	£1·10	80p	74198	£6·65	£6·05
7444	£1·57	£1·52	74119	£1·64	£1·54	74199	£6·65	£6·05
7445	£2·31	£2·18	74121	47p	42p	74200	£26·40	£21·12

Linear Intergrated Circuits

301	DIL	50p
301	TO99	55p
301	8 PIN DIL	46p
301A	DIL	69p
301A	TO99	69p
301A	8 PIN DIL	66p
307	DIL	69p
307	TO99	69p
307	8 PIN DIL	66p
308	TO99	6·45p
308A	TO99	6·40p
709c	DIL	35p
709c	TO99	31p
723c	DIL	99p
723c	TO99	95p
741c	8 PIN DIL	38p
741c	14 PIN DIL	39p
741c	TO99	41p
747c	DIL	46p
748c	DIL	39p
748c	TO99	41p
2N414		1·38
MC1310P		3·38



Resistors

¼ watt 5% carbon 1p
½ watt 5% carbon 1p
1 watt 10% carbon 2½p
range 10 ohms to 4·7 megohms.
½ watt m/o 2% 4p
range 10 ohms to 1 megohms.

VEROBOARD

	0·1	0·15
2½ × 3¾	24p	19p
2½ × 5	27p	23p
3¾ × 3¾	27p	23p
3¾ × 5	31p	31p
17 × 2½	82p	63p
17 × 3¾	£1·10	87p
17 × 5 (Plain)		90p
Pin insertion too	57p	57p
Spot face cutter	46p	46p
Pk 36 Pins	20p	20p

MINITRON DIGITAL INDICATOR TYPE 3015F

Read 0-9 and decimals. ONLY £1·65

Electrolytic Capacitors

4 VOLT

47μF	6½p
100μF	6½p
220μF	6½p
330μF	6½p
1000μF	13p
4700μF	29p

6·3 VOLT

33μF	6½p
68μF	6½p
150μF	6½p
470μF	11p
680μF	13p
1500μF	18p
2200μF	18p
3300μF	26p

10 VOLT

22μF	6½p
47μF	6½p
100μF	6½p
220μF	8p
330μF	10p
470μF	10p
1000μF	11p
1500μF	20p
2200μF	24p

16 VOLT

15μF	6½p
33μF	6½p
150μF	6½p
150μF	8p
220μF	9p
680μF	17p
1000μF	17p
1500μF	25p
2000μF	43p

25 VOLT

10μF	6½p
22μF	6½p
47μF	6½p
100μF	8p
150μF	8p
220μF	10p
470μF	13p
680μF	20p
1000μF	22p
2200μF	39p
5000μF	68p

40 VOLT

6·8μF	6½p
15μF	6½p
33μF	6½p

40 VOLT

47μF	6½p
100μF	9p
68μF	10p
220μF	11p
470μF	19p
680μF	25p
1000μF	25p
2200μF	44p

63 VOLT

1μF	6½p
2·2μF	6½p
4·7μF	6½p
6·8μF	6½p
10μF	6½p
22μF	6½p
68μF	10p
100μF	11p
150μF	13p
220μF	19p
330μF	22p
470μF	26p
1000μF	44p

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160V: 0·01μF, 0·015, 0·022, 0·033, 0·047, 0·068 3½p. 0·1 4p. 0·15 4p. 0·1 4½p. 0·15, 0·22 5½p. 0·33 7p. 0·47 9½p. 0·68 12p. 1μF 14½p. 1·5μF 22p. 2·2μF 24p

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£1 250 High Stab 1%, 2%, 5% resistors.
£1 1lb Assorted nuts, bolts, washers, spacers, etc.
£1 25 Assorted Switches, rotary, lever, micro, toggle, etc.
£1 50 Preset Potentiometers

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MT111/B	24 volt	·25 amp	£1·35	20p
MT71	12 volt	2 amp	£1·76	22p
MT71/B	24 volt	1 amp	£1·76	22p
MT18	12 volt	4 amp	£2·47	36p
MT18/B	24 volt	2 amp	£2·47	36p

30 volt transformers
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MT112	·5 amps	£1·32	22p
MT79	1	£1·80	36p
MT 3	2	£2·96	36p
MT20	3	£3·30	42p
MT51	5	£4·84	49p

50 volt transformers
Prim 200–220–240v, Secondary volt. 19, 25,33, 40, 50v or 25–0–25 volt.

MT102	·5 amps	£1·76	30p
MT103	1	£2·58	38p
MT105	3	£4·84	52p
MT106	4	£6·02	52p

60 volt transformer
Prim 200–220–240 Secondary 24, 30, 40, 48, 60v or 24–0–24v or 30–0–30v

MT124AT	·5 amp	£1·76	38p
MT126AT	1	£2·47	34p
MT127	2	£3·90	44p

Miniature transformers
Prim 220 volt

BT606	100mA	6–0–6v	98p	15p
BT909	100mA	9–0–9v	98p	15p
BT12012	100mA	12–0–12v	£1·08	15p
BT24024	100mA	24–0–24v	£1·95	15p

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AC128	15p	OC71	11p
AC141K	26p	OC81	12p
AC142K	26p	2N706	14p
AC176	18p	2N1131	24p
AC187	24p	2N1132	28p
AC188	24p	2N2904	20p
AC187K	28p	2N2926	11p
AC188K	28p	2N3053	26p
AD149	49p	2N3054	55p
AD161	38p	2N3055	49p
AD162	40p	2N3702	14p
AF114	20p	2N3703	13p
AF115	20p	2N3704	14p
AF116	20p	2N3705	13p
AF117	20p	2N3706	12p
BC107	13p	2N3707	13p
BC108	12p	2N3708	11p
BC109	13p	2N3709	12p
BC147	13p	2N3710	12p
BC148	13p	2N3711	12p
BC149	13p	2N3819	35p
BC182	13p	40361	55p
BC183	11p	40362	55p
BC184	14p	40636	69p
BC212	13p	1N914	8p
BC213	13p	1N916	8p
BC214	13p	1N4001	7p
BD131	68p	1N4002	8p
BD132	90p	1N4003	10p
BF194	16p	1N4004	10p
BF195	17p	1N4006	15p
BF244	27p	1N4148	6p
BFY50	18p	1N5400	16p
BFY51	18p	1N5401	17p
BFY52	17p	1N5402	19p
MP8111	36p	1N5404	24p
OC28	50p	1N5404	24p
OC36	50p	1N5406	28p

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100V 22p
200V 24p
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1 Amp
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100V 32p
200V 34p
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3 Amp
50V 39p
100V 44p
200V 48p
400V 66p
5 Amp
50V 46p
100V 57p
200V 66p
400V 77p

TRIACS
2 Amp
100V 33p
200V 55p
400V 77p
6 Amp
100V 66p
200V 88p
400V 99p
10 Amp
100V 99p
200V 1·32
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100 YEARS ON...

ON April 25th, 100 years ago, Guglielmo Marconi was born. It would be fair to say that the present day conglomerate of wireless, electronics and television owes its existence to Marconi for his teenage experimental studies of the behaviour of electromagnetic waves as a possible means of communication.

It could be that, had Marconi not been instrumental in putting the theory into practice, someone else may have done so. Whilst not detracting from his real talent, one has to admit that it takes courage and determination to convince others of the long-term practical prospects of such an idea in its infancy. Marconi's fortune turned in 1897 when William Preece, at that time Engineer-in-Chief of the G.P.O., had tried without much success to transmit radio waves. Marconi demonstrated a 8·7 mile hop, having succeeded in short distance experiments two years before. It was sufficiently convincing for Marconi to set up his own radio company.

From that day, his work developed into a multiplicity of activity for himself and other scientists, including Sir Watson-Watt (radar) Dr. Fleming (thermionic radio valve), and Brattain, Bardeen, and Shockley (transistor). In the earlier days, it is interesting to note that wireless was used in such "way-out" ventures (then) as aircraft communication in 1910 and the capture of Dr. Crippen the notorious murderer. Then followed wartime activities involving the detection of Zeppelin airships, naval telegraphy and aircraft telephony.

Soon afterwards the small transmitting station 2MT was born, followed by 2LO later to become the nucleus of the P.M.G.'s British Broadcasting Company.

Looking back over the past 80 years or so we have seen exciting developments, far too numerous to list here. There still remains for many who are not closely associated with wireless and electronics an air of mystery about the whole subject.

Practical Wireless is commemorating Marconi's centenary this month by helping newcomers in the art of DXing. We have produced a special pull-out feature that provides a wealth of advice and information for everybody who listens to the radio or watches television, and that is almost everyone.

Marconi was the "father" of practical wireless, the launching vehicle of all other electronics fields. His example of putting ideas into practice was never more true than it is today. For this, his centenary year, we acknowledge a true master of the art.

M. A. COLWELL—*Editor.*

The June issue will be the first of the series of summer issues. We hope to provide you with some unusual ideas, some of which will be new to this magazine. We start with a feature on in-car entertainment for your leisure driving, including an article on the techniques used in present day car radio design. We also have a Sound to Light Display Control Box for discos and parties. Also watch out for details of our exciting new project "Games on Television". Further details on pages 54 and 57. All advanced details are subject to change without notice according to the current national industrial situation.

NEWS...

Ambisonic system

THE Ambisonic system of quadraphonic sound reproduction, described in the February issue of *Practical Wireless*, was greeted with considerable enthusiasm at Sonex and the Festival du Son in Paris.

Of the systems currently in use, the Ambisonic system, otherwise referred to in the category of "Kernel" systems, looks like solving much of the problems of compatibility. The mathematics used is different from that used in matrix systems, although it does not employ full discrete channel methods either. The significant difference is in the carefully controlled mixing of signals using pan-pots (although suitable commercial types are not yet available) during recording or transmission on f.m. radio, so that the various decoding systems now employed, except SQ, can be used for reproduction at home. The SQ system needs a vari-matrix interface unit to convert Kernel recordings to SQ.

The results are quite remarkable and it is likely to be the answer to rationalised and compatible quad better than any of the current matrix or discrete systems. The added bonus is that this system could be used for compatible f.m. radio and television broadcasts. Other examples of the Kernel system are the UMX family from Nippon Columbia and the Japanese RM (regular matrix) system, which does not include Sansui's QS approximation to RM. This Japanese RM facility was provided for in the *Practical Wireless* Q4 Decoder published recently. The other matrix and discrete systems are also available in the Q4 design, making it eminently suitable for immediate use with Ambisonics without fear of obsolescence.

CQ column

[THE CQ column is a valuable way of obtaining back numbers from other readers, but please reimburse expenses and the price of the magazines to those who have kindly offered to help!]—

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

BBC on Radio reception

ON Radio reception, the sub-committee of the General Advisory Council of the BBC has recognised that the continued expansion of Radio broadcasting throws an increasing load on channels at present allocated for broadcasting purposes. They accept that the additional coverage required must be provided in the v.h.f. band, and they advise the BBC to pursue representations to the Ministry of Posts and Telecommunications as the urgency of transferring service users to other bands in order to clear, at the very least, the 96·7-100MHz band for broadcasting, as is the case in other countries.

They also suggest that the BBC should carry out a determined programme to inform listeners about the desirability of buying multi-wave receivers, having long, medium wave and v.h.f. capability, many of which are available at reasonable prices, in view of the likelihood that increasing reliance will have to be placed on v.h.f. in the future because of international frequency allocations.

The Council accepts that changes in the present frequency patterns for radio might be forced on the BBC by international developments. It urges, therefore, that specific and continuing research on current listening habits in terms of set and waveband usage should be undertaken so that any future changes which might become necessary could be designed to secure as much public acceptability as possible.

WIRELESS TELEGRAPHY ACT

Readers and advertisers are reminded of the requirements laid down by the Wireless Telegraphy Act. It is an offence in the U.K. to install or operate wireless telegraphy apparatus except under the provisions of the Act and, except in the case of broadcast sound-only receivers, a licence must be obtained from the Minister of Posts and Telecommunications.

Included within the provisions of the Act are any apparatus transmitting deliberate signals for any purpose such as "walkie-talkies", radio-controlled models or servos and some types of metal detectors. Apparatus radiating interference signals are subject to controls which also come under the administration of the same Ministry. If you require full information, please write to the *Ministry of Posts and Telecommunications, Waterloo, Bridge House, Waterloo Road, London SE1 8UA.*

New catalogue

ELECTROVALUE have now issued the seventh edition of their catalogue. This firm has built up a reputation over the past nine years of giving excellent service, good quality components at competitive prices, and a range ideally suited to the needs of amateur and professional constructor.

EMI equip Canadian tower

A £1·25 million contract to equip the new third-of-a-mile high CN observation and communications tower in Toronto, Canada, with a complete antenna complex for all f.m. and TV broadcasting services has been won by the Telecommunications Division of EMI Sound & Vision Equipment Ltd, Hayes, Middlesex.

The contract was awarded to EMI in the face of intensive international competition, reflecting the company's extensive experience of such special-purpose multiple antenna systems. EMI is established as a major supplier to many broadcasting authorities. In the UK the large number of systems supplied includes the multiple antenna system on the IBA's 1100 foot tower at Emley Moor.

When completed, the 1805 foot high CN tower in Toronto will be the tallest self-supporting structure in the world. The antenna system surmounting the main concrete tower will be carried on a 220 ton needle-shaped steel structure over 300 feet tall.

Transmissions from this height give major benefits in range and the elimination of "ghosting" but, at over 1500 feet, the arduous climatic conditions found normally even at ground level during the Canadian winter are aggravated by extremely severe icing, snow and high winds.

For this reason, an important part of the contract comprised the provision of a glass reinforced plastic radome. This will be designed and constructed in Britain by Hunting Industrial Plastics Ltd, and erected to protect the mast structure during the winter.

The complete installation to be provided by EMI comprises a formation of four arrays arranged as follows:—

Channel 5, Canadian Broadcasting Corporation. Intended for colour TV transmissions, this is a single channel, directional v.h.f. antenna having a gain of 8. The array is 55 feet tall and is at a mean height of 1,572 feet.

Channel 9, CFTO—TV Ltd. Also intended for colour TV transmissions this second directional v.h.f. is similar to that for channel 5, but has a gain of 11 radiated from a 49 foot high array located at a mean height of 1,635 feet.

Channel 19 and 25, CBC and Educational. An omnidirectional u.h.f. array for colour TV. It is arranged as a dual antenna, with one channel allocated to CBC and the second to the educational transmissions. Positioned on the mast at a mean height of 1,695 feet, this array is 60 feet tall and has a gain of 31.

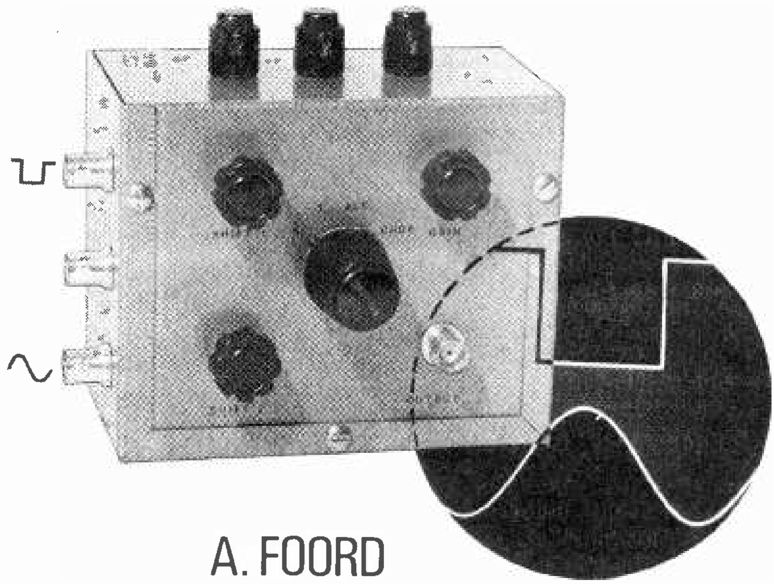
FM Transmissions. The master f.m. antenna occupies the lowest section of the mast, and has a mean height of 1,513 feet. Measuring 60 feet high by 26 feet diameter, this antenna is being manufactured under licence from Alford Manufacturing Co of the USA, and is based upon those supplied for the Empire State Building and Hancock Tower, Chicago.

Scottish Audio Fair

THE Scottish Audio Fair, due to take place at the Kelvin Hall, Glasgow, in April has been cancelled due to the current economic circumstances. The London Audio Fair is still expected to go ahead at Olympia.

OSCILLOSCOPE

TRACE DOUBLER



A. FOORD

FOR some oscilloscope measuring applications it is essential to display a number of recurrent signals simultaneously. When a true double beam CRT is not available, an electronic switching system can be used to display two (or more) channels on a single beam CRT. The basic block diagram for this arrangement is shown in Fig. 1. In the ALTERNATE mode the channel is changed at the end of each timebase sweep. This mode is suitable when the sweep rate is high enough to avoid a flickering display. In the CHOPPED mode the beam is time-shared between the traces at a fixed rate, and this arrangement is suitable for low frequency signals. Under the chopped mode of operation care has to be taken with the oscilloscope triggering, and it is usual to externally trigger the oscilloscope from the channel signal as required.

Basic switching circuits

Chopping (or switching) circuits are used in many electronic instrumentation applications and are basically of either the shunt or series type, as shown in Fig. 2, or a combination. The relative merits of the shunt or series arrangement depends on the source and load resistance. For a low source resistance a series chopper is suitable and, in general, the load resistance should be higher than the source resistance. Where the highest performance is required the series-shunt circuit is equal to or better than either the series or shunt chopper alone for any combination of load and source resistance.

Field effect transistors are preferred as switches to bipolar transistors because they do not have an offset voltage when turned on. Even for a zero input voltage, a bipolar transistor has an offset voltage equivalent to the collector-to-emitter saturation voltage between its collector and emitter terminals.

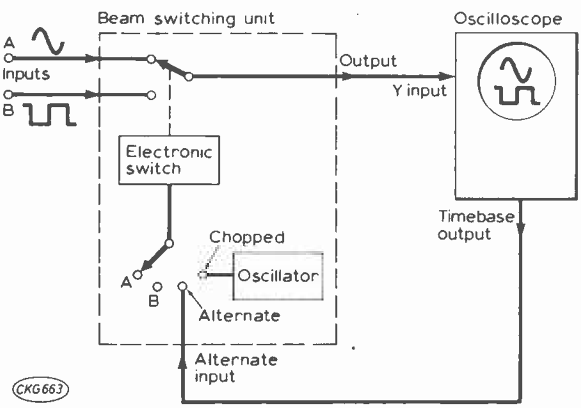


Fig. 1: Block diagram for an oscilloscope trace doubling unit.

MOS-FET characteristics

For MOS transistors, where the gate is insulated from the source to drain channel by an oxide layer, four basic types are possible. These are:

- P channel depletion
- P channel enhancement
- N channel depletion
- N channel enhancement

An N channel depletion type such as the RCA 3N138 offers the best switching characteristics, with the lowest 'on' resistance for a given geometry, due to the higher mobility of electrons. When the gate-to-source voltage V_{GS} is zero the effective resistance between drain and source is about 200 ohms. If V_{GS} is made positive this decreases to about 100 ohms.

No significant increase in gate current occurs when V_{GS} is made positive for the MOS type. (Unlike a junction-gate field-effect transistor, where the gate and channel form a pn junction and a low gate current can only be obtained when this junction is reverse biased). When a negative voltage of about 6 volts or more is applied between the gate and

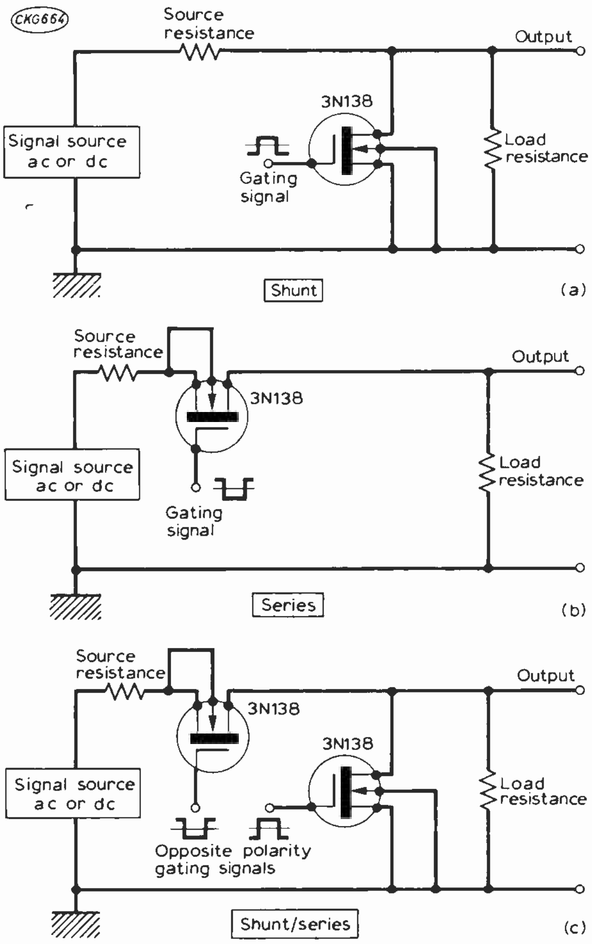


Fig. 2: Chopping circuits (a) shunt (b) series and (c) shunt-series.

source, the channel resistance between drain and source becomes extremely high (thousands of megohms). These characteristics are shown in Fig. 3 for the 3N138.

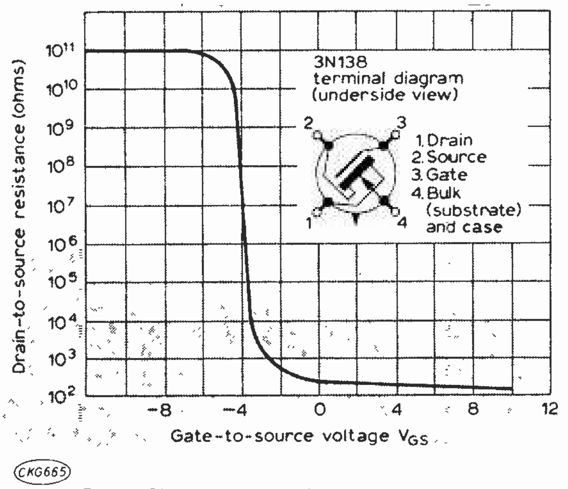


Fig. 3: Characteristics of the 3N138 MOS-FET.

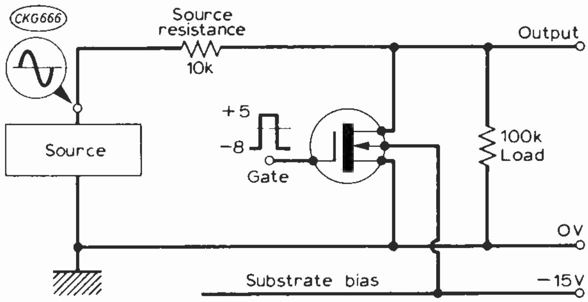


Fig. 4: Typical shunt chopper circuit using the 3N138.

Basic MOS-FET circuit

Figure 4 shows a basic shunt chopper circuit. The gating signal should swing from zero to at least −6 volts and may cover a range of ± 10 volts. The substrate (and thus the case) is usually connected to the source. However if the incoming signal to be chopped exceeds −0·3 volts the substrate must be 'floated', connected to the drain, or biased negatively so that the source-to-substrate and drain-to-substrate voltages never exceed −0·3 volts. If the value is exceeded, the substrate, which forms two p-n junctions with the drain and the source, becomes forward biased, and the resulting flow of diode current shunts the incoming signal to earth.

Virtual earth switching circuit

One difficulty with MOS-FET's is that if large signals have to be switched then the high drain-to-source (or gate-to-source) voltages needed cannot always be provided without exceeding the maximum ratings of the device. Under these circumstances a current mode switch may be used instead of the voltage mode switches previously discussed, as shown in Fig. 5. Here Tr1 and Tr2 form a shunt-series switch where an input current is diverted to earth or allowed to reach the virtual earth point Y. Since either Tr1 or Tr2 is always on, the VOLTAGE at point X is always low (a few millivolts) and large input signals can be handled readily. Where the highest performance is not required, Tr1 can be replaced by silicon diodes which keep point X close to earth potential while Tr2 is off.

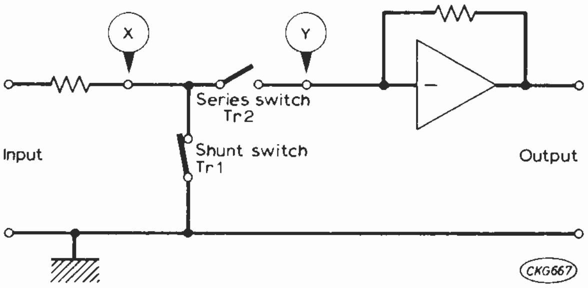
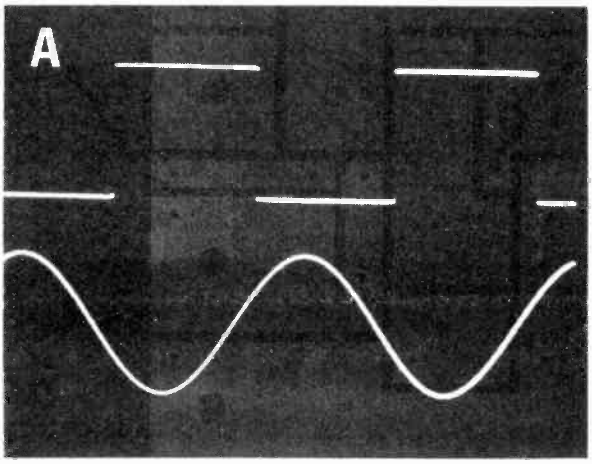
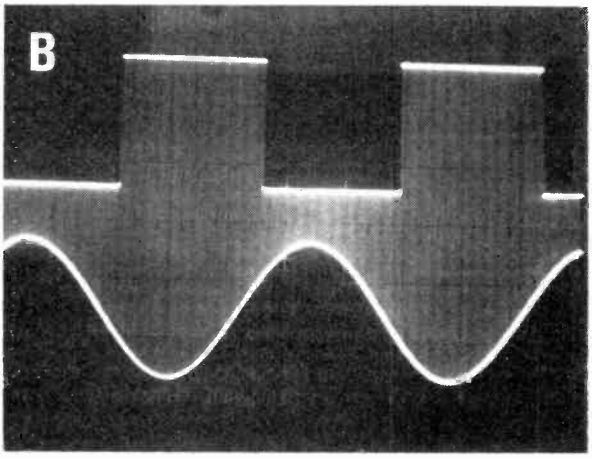
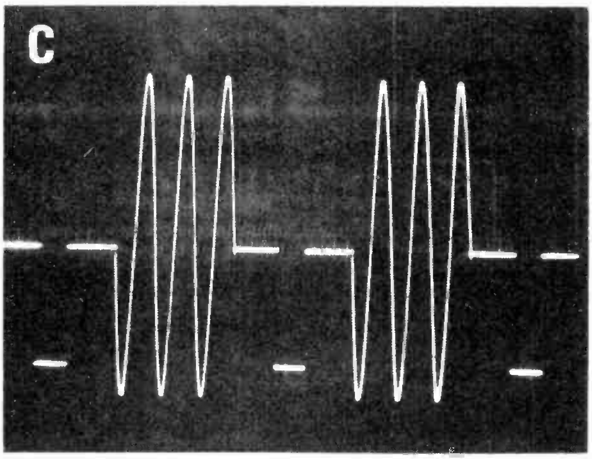


Fig. 5: A current mode shunt-series chopper circuit.

This virtual earth current switching arrangment is particularly convenient for our application because a DC shift voltage can be added into the virtual earth point. The disadvantage of this circuit is that switching spikes tend to be higher than with the voltage switching arrangement, but this is not significant here because the bandwidth is limited by the integrated circuit and not by the switching speed of the FET.







A *The unit used in the ALTERNATE mode to display a 10kHz sine and square wave on a single-beam oscilloscope.*

B *The CHOPPED mode is being used here to display a 100Hz sine and square wave. The switching waveform may be visible, depending upon the signal frequency and the oscilloscope's intensity setting.*

C *A complex tone burst. The sine wave is 1kHz.*

★ components list

Resistors

R1	330Ω	R5	2·2kΩ	R9	560Ω	R13	10kΩ
R2	1kΩ	R6	1kΩ	R10	470Ω	R14	10kΩ
R3	1kΩ	R7	1kΩ	R11	470Ω	R15	47kΩ
R4	2·2kΩ	R8	560Ω	R12	47Ωww	R16	47kΩ
		R17	22kΩ				

All ⅓ or ¼W 10%

VR1/2/3 10kΩ linear pots

Capacitors

C1	10μF 25V	C5	10μF 25V
C2	0·1μF 30V disc	C6	10μF 25V
C3	0·1μF 30V disc	C7	0·1μF 30V disc
C4	125μF 16V	C8	0·1μF 30V disc

Semiconductors

Tr1	BCY71	Tr3	3N138	D1-4	1N914
Tr2	BCY71	Tr4	3N138	RV1	LM309H

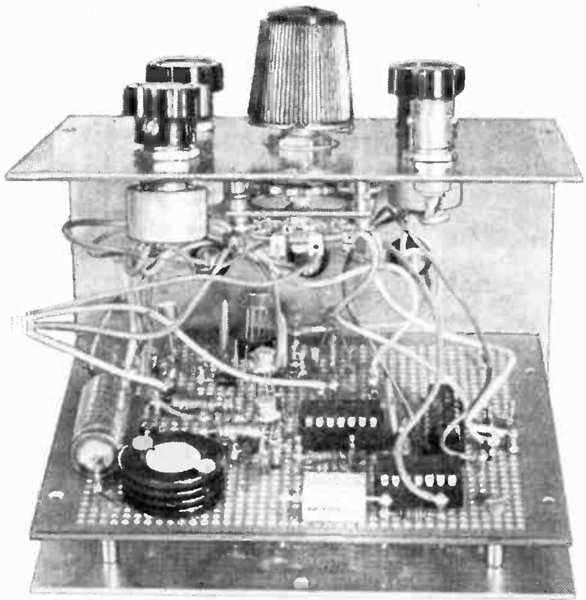
Miscellaneous

Veroboard 4¾ x 3⅞ in. 0·1 in. matrix, plain. 3 terminals. S1, 2 pole 4 way wafer. 4 sockets. Aluminium box 5 x 4 x 3 in. Knobs. Veropins 0·1 in. Heatsink for RV1. IC holders, 14 pin DIL (3), 8 pin TO5 (1).

Practical two channel switching circuit

The practical two channel switching circuit is shown in Fig. 6 and 7. In Fig. 7 two FETS are used to switch channels 1 and 2 into the summing point of a virtual earth amplifier. Independent shift controls are provided for each channel for trace positioning purposes, while a common gain control allows the total waveform amplitude to be controlled. In Fig. 6 the switching waveforms are generated and S1 allows the operational mode to be selected. This gives the choice of 1 only, 2 only, alternate or chopped.

In the 1 only mode, the bistable IC2 is preset so that Q is a logical 1 with $\overline{Q}$ a logical 0. Then pin 1 of



A general view inside the finished switching unit.

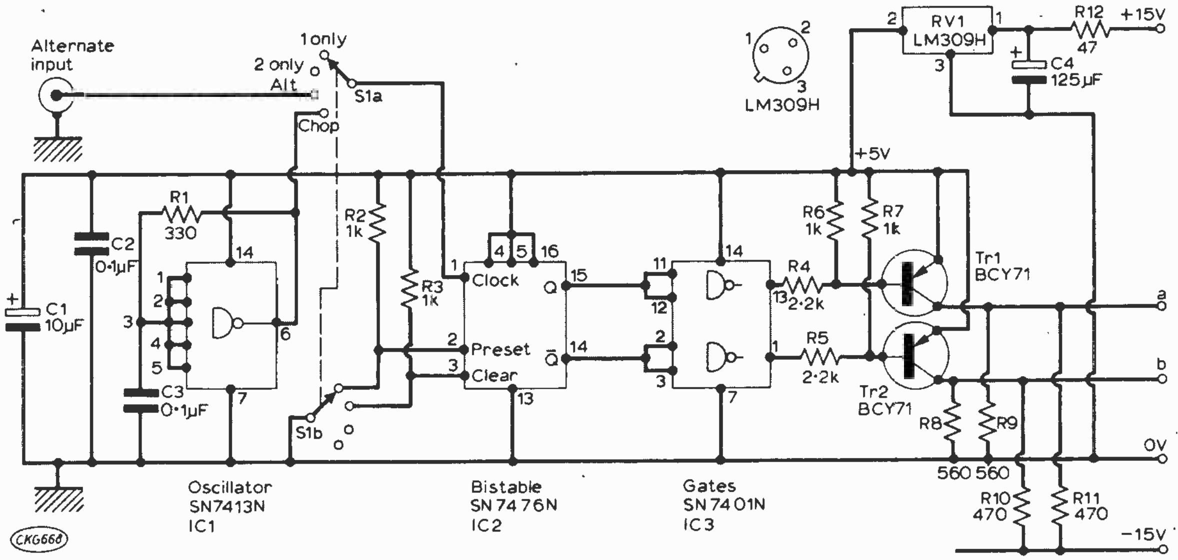


Fig. 6: The digital section of a practical two channel switching circuit.

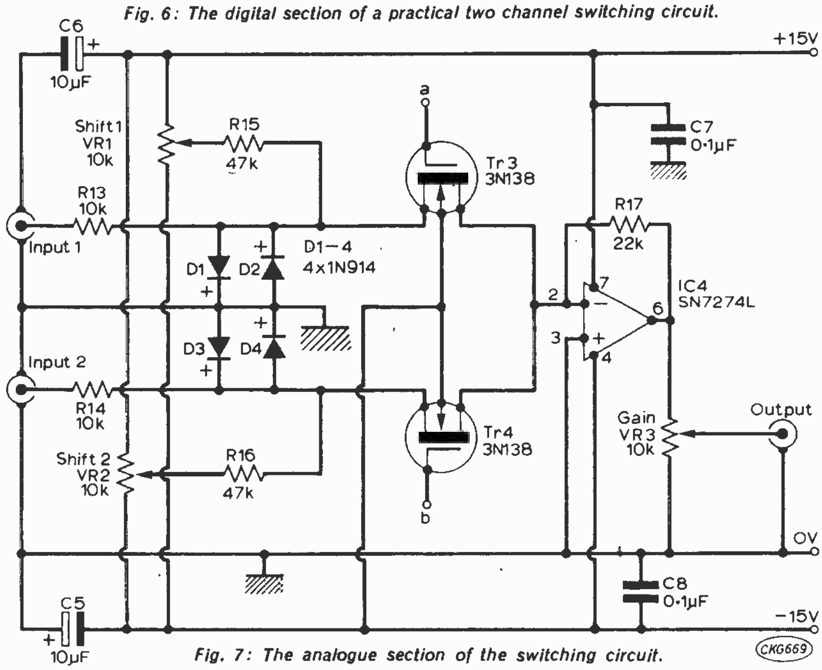


Fig. 7: The analogue section of the switching circuit.

IC3 will be at a logical 0 and Tr1 will be on. This makes waveform 1 become +5 volts, turning on Tr3. Pin 13 of IC3 will be at a logical 1 and Tr2 will be off. This makes waveform 2 become −8 volts, turning off Tr4. Open collector gates have to be used for IC3 so that Tr1 and Tr2 can be held completely off when required.

In the alternate mode bistable IC2 has to be triggered by the oscilloscope timebase. Most oscilloscopes have an output trigger, but this may need converting by a comparater or limiter to produce a suitable logic compatible signal. In the chopped mode the bistable is switched by the Schmitt trigger oscillator IC1. This oscillator runs at approximately 20kHz, so that the chopping rate is half this, or 10kHz.

Use as a Tone burst generator

Since the two channels are direct coupled, and can be DC shifted individually, the unit is very versatile. Although primarily designed for oscilloscope trace doubling applications, it can also be used as a tone burst generator if some external circuits are available. Tone bursts are extensively used in audio amplifier testing, where their complex waveforms can give a better measure of a system's performance under music conditions than using only sinusoidal or square waveforms.

For example, if required, a sinusoidal tone burst with a rectangular pulse may be generated. A divider chain is synchronised to the sinusoidal clock,

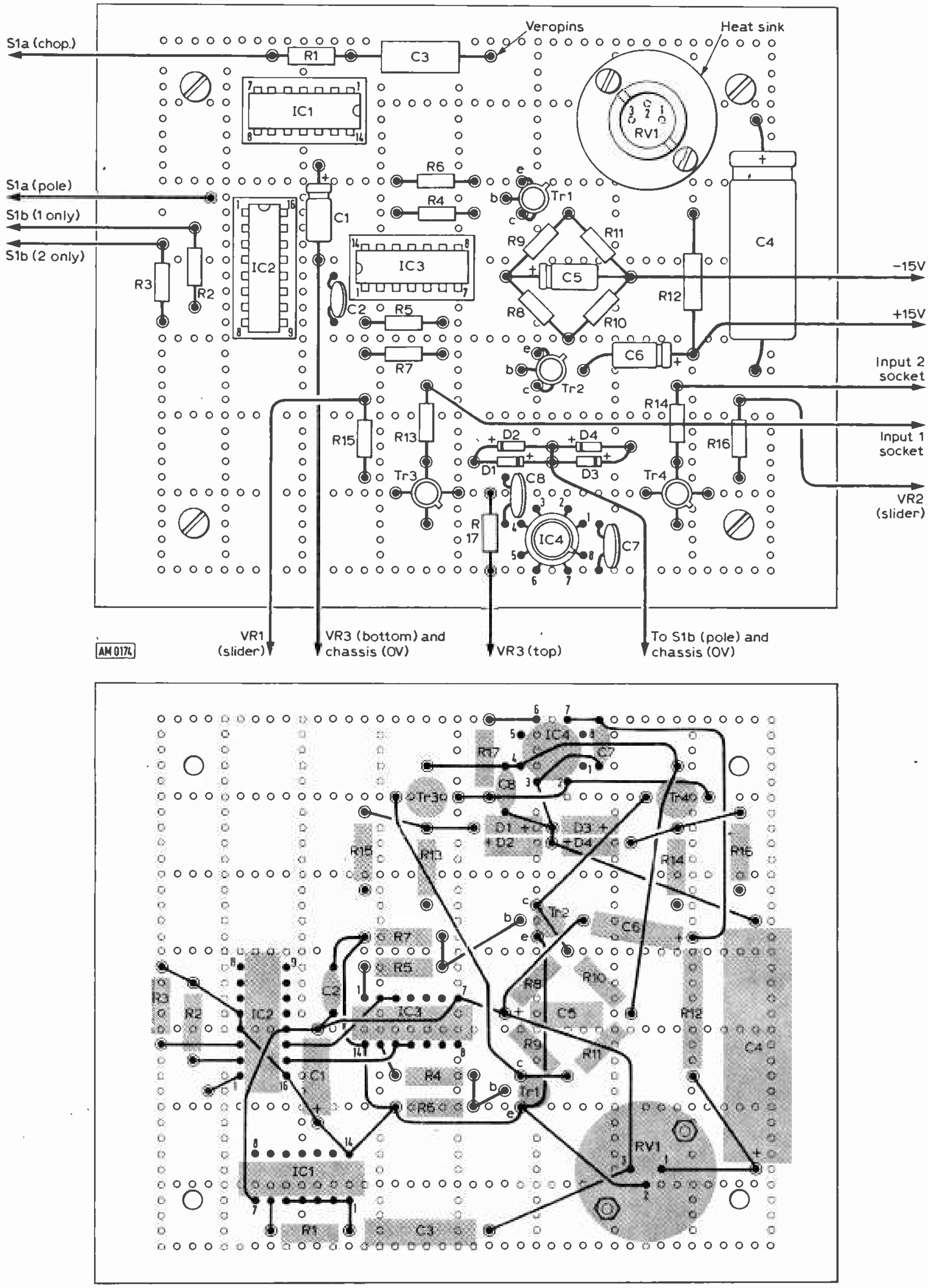


Fig. 8 : Top, general layout of components on Veroboard and, below, underside of board showing wiring and position of Veropins.

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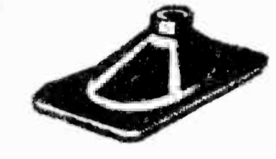

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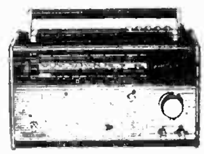

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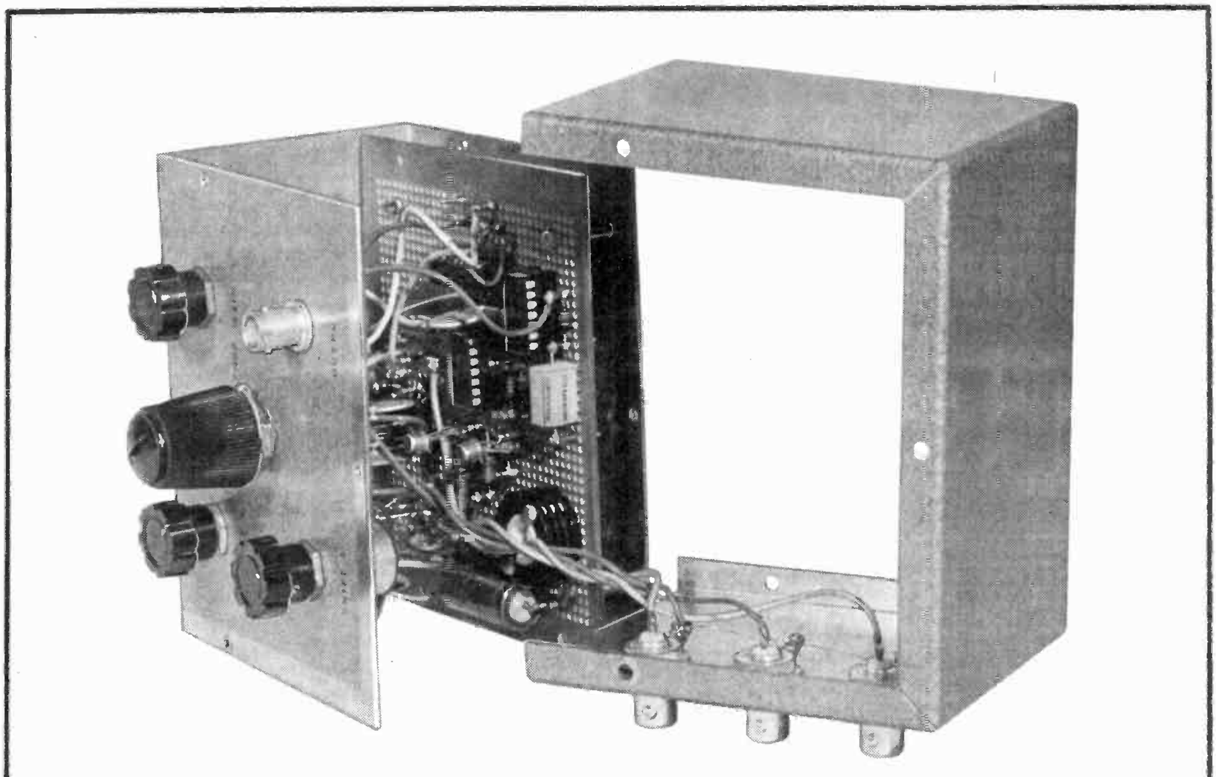
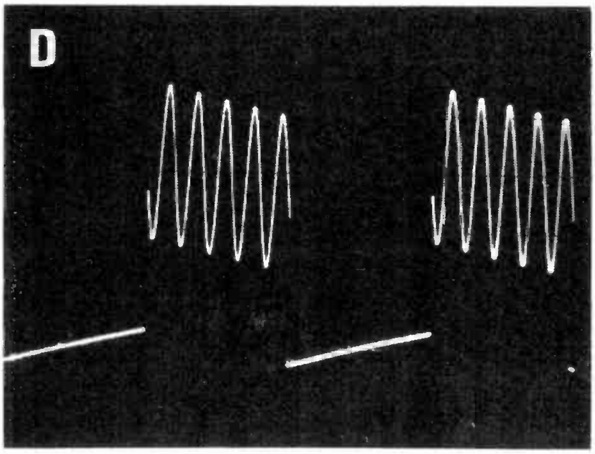
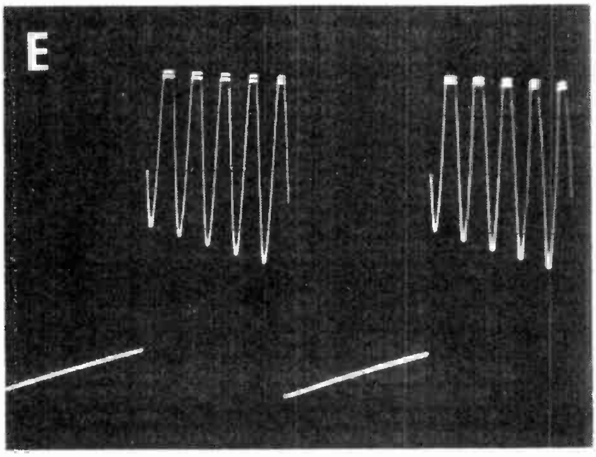


View of circuit board and case into which it was fitted.





and switches the unit between channels 1 and 2 at a rate lower in frequency than the clock. A pulse generator allows the rectangular pulse to be added into the 2 channel.

Photograph **D**, *left, shows output of an amplifier driven by a 100Hz square wave and a 1kHz sinusoidal tone burst. Photograph* **E**, *above, shows same signals at a slightly higher power level so that clipping occurs. The difference in clipping levels occurs because of the 100Hz ripple on the power supply which is not synchronised with the tone burst.*

Construction

The two channel switching circuit of Figs. 6 and 7 is built on a piece of veroboard using veroboard pins as anchoring points. A heatsink is fitted to the 5V voltage regulator which is fed from the +15V line. Layout and wiring is shown in Fig. 8. The board is fitted to one side of the aluminium box using $\frac{1}{2}$in spacers. The type of socket used may be changed to suit the particular equipment in use.

Note:—The 3N138 transistors are supplied with a shorting clip on the leadouts and this clip must be kept in position until the transistor has been completely wired into the circuit otherwise the transistor may be permanently damaged. If it is necessary to remove one of these transistors the clip must be placed on the leadout wires before unsoldering.

The LM309H voltage regulator may be replaced by the later LM309K available from Athena Ltd., 140 High Street, Egham, Surrey for £2·48 inc. ■

HOTLINES ON RECENT DEVELOPMENTS

IT'LL CELL WELL!

THE classification of cells in the human body is not an easy task. Things called bulk separators are commonly used but these units suffer from the disadvantage that although they can handle a very large number of cells, they cannot separate them into many individual classes. A School of Medicine has come up with a novel use of a laser. The technique is to employ two laser beams which are passed through a fine column or jet of liquid which contains the human cells. The technique has proved successful in classifying rare cells (in addition to the more common ones). These rare cells are barely one thousandth of one per cent (0·001%) of the total mass of cells which make up the entire human body. This is one instrument which should, if marketed, cell very well.

THE LM195

On to the market has come a strange beasty which can only be accurately described as a three-terminal monolithic circuit. It's a power transistor and yet it isn't—if you see what I mean? Well, look at it this way, this device simulates a power transistor but it has a number of features which, claims the manufacturers, makes it more attractive. For example, not only will it protect itself, but it will also protect anything which it is connected to.

Magic number for the device is the LM195. The chip contains some 50 components and the gain is around one million. Power capability is 40W and the chip is "blow-up proof" at currents up to 2A. Included in the safety circuitry on the chip are sections which handle or effect current-limiting and thermal shut-down which disconnect the power stage if the current rises above 2A. They will also do this if the chip temperature rises above 165°C.

If a conventional power transistor blows it can become a virtual short circuit and can thus pass excessive current and ruin other, often costly components. The LM195 however, becomes an open circuit even if the chip itself is destroyed. With a switching threshold of 2V, a switching speed of around 500ns the device looks very useful for a number of applications. Base input current is 3μA over the whole of the voltage input range of 0-42V. This device is quite remarkable when compared to early power transistors which were happy to melt quietly into diodes at the first sign of trouble.

Power is not only for the lower frequencies. Impatt diodes are currently available which can handle 12W of peak power at 10GHz. Others of the silicon mesa type have a similar rating at 16GHz.

RADAR CARS

One of the dreams of the boffins is a radar system for motor cars. Late last year, a British company showed a Triumph PI fitted with a form of radar system. A foreign company has now released details about its approach to the problem. Use is made of pulsed radar principles (this is common to most systems under investigation) because it gives a better performance under bad weather conditions than some other methods.

A small horn antenna under the car bonnet is employed to transmit and receive the beam of radar pulses at around 9GHz. When the distance between the moving vehicle and an object ahead becomes less than that permissible in terms of safety, an alarm is sounded. As the moving vehicle gets closer to the object, the alarm increases in its intensity.

For those who are thinking about "knocking up" such a system, let's look at the internal circuitry/system within the vehicle. In the arrangement described, a computer is employed (albeit a small one). This makes all the necessary calculations and takes into account the speed of the host vehicle (picked up from a transducer), the speed difference between the object ahead and the host vehicle, the rate of breaking or deceleration of the two.

Before starting his journey, the driver tells the computer what the road conditions are like—icy, wet or dry, etc. The computer can thus make due allowance for these. It also allows about 1·5 seconds for driver reaction time too. If the driver forgets to tell the computer what the conditions are like then the computer will assume the very worst conditions and proceed accordingly with its calculations. The system is still under development and other workers are also experimenting with various ideas, meanwhile it is the computer between the drivers ears which will have to do the work of obstacle avoidance on the roads.

SOLAR CELLS

In earlier Hotlines, comment has been made about solar cells. The Plessey Company has managed to achieve efficiencies of some 20% although these items are still in the laboratory. In a more practical vein, Ferranti Limited are gearing up to produce panels of solar cells which are intended to be offered to the small boat market. The panel of cells will be used to keep the craft's batteries charged. The cells will have a rating of around 14V at 500mA in sunlight. Rumoured price is between £100 and £200, clearly not a thing to be bought lightly.

CALCULATORS

Electronic calculators are still making amazing progress. The latest is the HP-65 which does just about everything and could very, very nearly qualify for the title of hand-held computer. It will even accept programmed magnetic cards. Diagnostic cards are supplied and thus the user is able to test the calculator quite simply. Individual programs can be made and sent to the manufacturer who will test them if required. Most of the circuitry is located on 12 specially designed l.s.i. chips. Price at the moment is around the £300 mark. However, calculators which sold last year for £60 are now selling at £25 so perhaps the average housewife will find herself in the supermarket juggling with cost or even finding exponential creeping into the price of a can of baked beans.

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BC108	14p	BFX85	30p	OA10	50p	TIP29B	60p	2N1302	20p	2N3866	85p
BC109	14p	BFX86	30p	OA47	10p	TIP30B	70p	2N1303	20p	2N3904	22p
BC109c	16p	BFX87	30p	OA70	12p	TIP31B	75p	2N1304	25p	2N3905	22p
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149	60	3	12	9·9 x 7·7 x 8·6	3·45	36
150	100	5	8	9·9 x 8·9 x 8·6	3·79	52
151	200	8	0	12·1 x 9·3 x 10·2	6·45	52
152	250	13	12	12·1 x 11·8 x 10·2	8·41	67
153	350	15	0	14·0 x 10·8 x 11·8	11·22	82
154	500	19	8	14·0 x 13·4 x 11·8	16·25	–
155	750	29	0	17·2 x 14·0 x 14·0	22·10	
156	1000	38	0	17·2 x 16·6 x 14·0	29·87	–
158	2000	60	0	21·6 x 15·3 x 18·1	49·25	–

AUTO TRANSFORMERS

Ref. No.	VA (Watts)	Weight lb	oz	Size cm.	Auto Taps	P & P £	p
113	20	1	0	5·8 x 5·1 x 4·5	0-115-210-240	1·22	22
64	75	2	4	7·4 x 6·7 x 6·1	0-115-210-240	2·40	30
4	150	3	4	8·9 x 7·7 x 7·7	0-115-200-220-240	2·89	36
66	300	6	4	9·9 x 9·6 x 8·6	..	5·63	52
67	500	12	8	12·1 x 11·2 x 10·2	.. ..	8·36	67
84	1000	19	8	14·0 x 13·4 x 14·3	.. ..	15·19	82
93	1500	30	4	14·0 x 15·9 x 14·3	.. ..	21·99	–
95	2000	32	0	17·2 x 16·6 x 14·0	.. ..	28·70	*
73	3000	40	0	21·6 x 13·4 x 18·1	.. ..	39.17	*

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Ref. No.	Amps. 12V	24V	Weight lb	oz	Size cm.	Secondary Windings	P & P £	p
111	0·5	0·25		8	4·8 x 2·9 x 3·5	0·12V at 0·25A x 2	1·22	22
213	1·0	0·5	1	4	6·1 x 5·8 x 4·8	0·12V at 0·5A x 2	1·44	22
71	2	1	1	12	7·0 x 6·4 x 6·1	0·12V at 1A x 2	1·90	22
18	4	2	2	12	8·3 x 7·7 x 7·0	0·12V at 2A x 2	2·68	30
70	6	3	3	8	8·9 x 8·0 x 7·7	0·12V at 3A x 2	3·20	42
108	8	4	5	8	9·9 x 8·9 x 8·6	0·12V at 4A x 2	3·60	52
72	10	5	6	4	9·9 x 9·6 x 8·6	0·12V at 5A x 2	4·25	52
116	12	6	6	12	9·9 x 10·2 x 8·6	0·12V at 5A x 2	5·10	52
17	[illegible]	0	8	12	12·1 x 9·9 x 10·2	0·12V at 8A x 2	6·56	52
115	20	10	11	8	14·0 x 9·6 x 11·8	0·12V at 10A x 2	8·36	67
187	30	15	15	8	14·0 x 12·1 x 11·8	0·12V at 15A x 2	15·40	82
226	60	30	32	0	17·2 x 15·3 x 14·0	0·12V at 30A x 2	28·44	*

30 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
112	0·5	1	4	6·1 x 5·8 x 4·8	0-12-15-20-24-30V	1·42	22
79	1·0	2	4	7·0 x 6·7 x 6·1	.. ..	1·92	36
3	2·0	3	4	8·9 x 7·7 x 7·7	.. ..	2·90	36
20	3·0	4	8	9·9 x 8·3 x 8·6	.. ..	3·58	42
21	4·0	6	4	9·9 x 9·6 x 8·6	.. ..	4·25	52
51	5·0	6	12	12·1 x 8·6 x 10·2	.. ..	5·30	52
117	6·0	8	0	12·1 x 9·3 x 10·2	.. ..	6·31	52
88	8·0	12	0	12·1 x 11·8 x 10·2	.. ..	8·18	67
89	19·0	13	12	14·0 x 10·2 x 11·8	.. ..	10·33	67

50 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
102	0·5	1	12	7·0 x 6·4 x 6·1	0-19-25-33-40-50V	1·90	30
103	1·0	2	12	8·3 x 7·4 x 7·0	.. ..	2·80	36
104	2·0	5	8	9·9 x 8·9 x 8·6	.. ..	3·87	42
105	3·0	6	12	9·9 x 10·2 x 8·6	.. ..	5·26	52
106	4·0	10	0	12·1 x 10·5 x 10·2	.. ..	6·99	52
107	6·0	12	0	14·0 x 10·2 x 11·8	.. ..	10·35	67
118	8·0	18	0	14·0 x 12·7 x 11·8	.. ..	13·51	97
119	10·0	25	0	17·2 x 12·7 x 14·0	.. ..	16·93	*

60 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
124	0·5	2	4	7·0 x 6·7 x 6·1	0-24-30-40-428-69C	1·93	36
126	1·0	3	4	8·9 x 7·7 x 7·7	.. ..	2·70	36
127	2·0	6	4	9·9 x 9·6 x 8·6	.. ..	4·25	42
125	3·0	8	12	12·1 x 9·9 x 10·2	.. ..	6·46	52
123	4·0	13	12	12·1 x 11·8 x 10·2	.. ..	8·36	67
40	5·0	12	00	14·0 x 10·2 x 11·8	.. ..	9 85	87
120	6·0	15	8	14·0 x 12·1 x 11·8	.. ..	12·14	82
121	8·0	25	00	14·0 x 14·7 x 11·8	.. ..	13·65	*
122	10·0	25	0	17·2 x 12·7 x 14·0	.. ..	20·09	*
189	12·0	29	00	17·2 x 14·0 x 14·0	.. ..	22·49	*

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Ref.	MA.	Weight		Size cm	VOLTS	P & P £	p
238	200		2	2·8x2·6x2·0	3-0-3	1·31	10
212	1A 1A	1	4	6·1x5·8x4·8	0-6 0-6	1·52	22
13	100		4	3·9x2·6x2·9	9-0-9	1·12	10
235	330,330		4	4·8x2·9x3·5	0-9, 0-9	1·52	10
207	500, 500	1	00	6·1x5·4x4·8	0-8-9, 0-8-9	2·03	22
208	1A, 1A	1	12	7·0x6·4x6·1	0-8-9,0-8-9	2·73	30
236	200, 200		4	4·8x2·9x3·5	0-15, 0-15	1·52	10
214	300, 300	1	4	6·1x5·8x4·8	0-20, 0-20	1·60	22
221	700 (D.C.)	1	8	7·0x6·1x6·1	20-12-0-12-20	1·41	30
206	1A, 1A	2	12	8·3x7·7x7·0	0-15-20, 0-15-20	3·08	36
203	500, 500	2	4	8·3x7·0x7·0	0-15-27, 0-15-27	2·82	38
204	1A, 1A	3	4	8·9x7·7x7·7	0-15-27, 0-15-27	2·86	38

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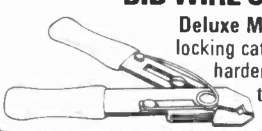

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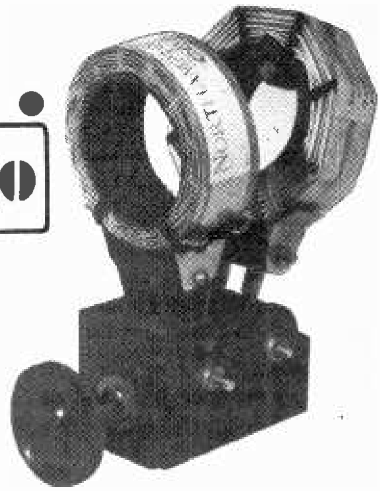

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ONE HUNDRED years ago (April 25th, 1874) Guglielmo Marconi was born in Bologna, the younger son of a wealthy Italian landowner, Giuseppe Marconi, and his Irish wife Annie, the daughter of Andrew Jameson, the whiskey distiller from County Wexford in Ireland.

To Guglielmo Marconi must go the credit for seeing the wider possibilities of wireless, of taking it out of the laboratory where pure science had shackled it, and developing practical systems for the benefit of mankind. His work, and that of the brilliant men with whom he surrounded himself in the company he formed, laid the foundations of the electronics industry as we know it today.

From an early age he was interested in science and by his late teens, at his home, the Villa Grifone, he was experimenting with electro-magnetic waves as a communication medium. By the summer of 1895 he had succeeded in transmitting signals over a few yards of space and in August, using an earth and an elevated aerial at both transmitter and receiver, he was able to pass Morse code over 1¾ miles.

The Italian Government was not greatly interested in Marconi's invention, so in 1896 he came to England where he filed the world's first patent for a system of telegraphy using Hertzian waves. A letter of introduction to William Preece, Engineer in Chief of the GPO, led to a series of demonstrations culminating in 1897 in a record transmission across 8·7 miles of the Bristol Channel, where Preece himself was experimenting with inductive methods, with far less success.

Marconi pictured shortly after his arrival in England (1896).

The potential of wireless telegraphy was becoming clear and in 1897 the world's first radio company was formed to develop Marconi's apparatus commercially. First called the Wireless Telegraph and Signal Company, it was later renamed Marconi's Wireless Telegraph Company and in 1963, The Marconi Company.

By the end of the century, wireless had been adopted by the British and the Italian Navies, it had spanned the English Channel, it had proved its worth to the mercantile navy as a life saver and Marconi had introduced his system to the USA, where he registered The Marconi Wireless Telegraph Company of America—later to become the Radio Corporation of America (RCA).

One of Marconi's ambitions had been to use wireless as a means of ending the isolation of those at sea, and in 1900 the Marconi International Marine Communication Company was created to work an exclusive licence for all maritime purposes. At this time also he took out his famous Four Sevens patent for tuned coupled circuits.

In 1901, the world's first wireless school opened at Frinton, later transferring to Chelmsford where it still flourishes as Marconi College. This was a vintage year for Marconi. Having achieved communication over 198 miles between the Isle of Wight and the Lizard, he embarked, with the assistance of Dr. J. A. Fleming (Scientific Adviser to the Company), R. N. Vyvyan, G. Kemp and P. W. Paget, on his famous transatlantic experiment. After many vicissitudes he succeeded in receiving, through an earpiece, signals at St Johns, Newfoundland, transmitted from Poldhu, Cornwall. Even at the moment of this, his greatest triumph, some said that he mistook atmospherics for the Morse code "S". To those doubters it has been pointed out that for long distance communication to have evolved from the system that pushed three faint dots across 2,000 miles is a marvel; had there been no dots, its evolution would have been a miracle. Two months later, signals from Poldhu were recorded on a morse inker on s.s. *Philadelphia*—2099 miles away—thus dispelling any doubt about his original claim. In December 1902, Poldhu's permanent opposite number was built at Glace Bay.

During the next few years, many important patents were filed, notably those for the magnetic detector, the radio valve developed by Dr. Fleming, and the directional aerial, which was used at Clifden, in Ireland—a station that took over the transatlantic service from Poldhu. In 1909, Marconi shared a Nobel Prize for Physics in recognition of his contribution to wireless telegraphy.

The decade that preceded the First World War also saw the first use of wireless in the air, transmission initially being achieved from a captive balloon and then, in 1910, from an aeroplane flown by J. D. A. McCurdy. It also saw wireless used to assist the capture of the notorious murderer, Dr. Crippen, and to save lives when the ill-fated *Titanic* foundered.

When war broke out in 1914, the Admiralty at once took over the Marconi radio factory. This, the first in the world, had transferred in 1912 from Hall Street, Chelmsford, to a new, purpose-designed building a mile or so away. The Clifden station and Marconi's operational equipment in Chelmsford and London were also taken over, along with the first long-wave transatlantic wireless station for direct communication with the USA, completed by Marconi during 1914.

The Company, having developed direction-finding techniques before the war, established a chain of stations that were used to devastating effect against enemy Zeppelins, submarines and surface ships, and led, indeed, to the Battle of Jutland. For the Royal Navy's world-wide communications network, the Company built a dozen widely dispersed stations.

Air-to-ground telegraphy was perfected and the difficulties of ground-to-air telephony were overcome by three Marconi engineers, Major C. E. Prince, Capt. H. J. Round and Lt. J. M. Furnival—the last named also supervising the achievement of interplane telephony in 1917.

Marconi himself was commissioned in the Italian Army. He later became heavily engaged on diplomatic work for Italy and after the war was appointed Plenipotentiary Delegate to the Paris Peace Conference.

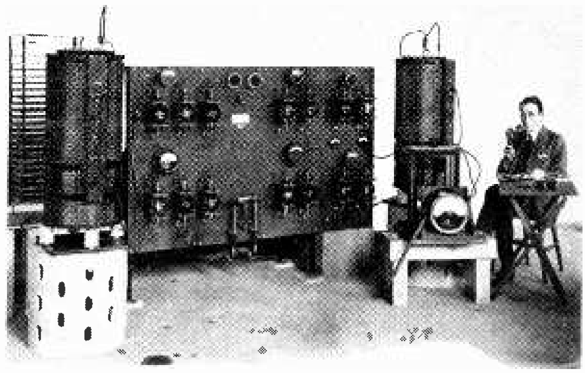
In 1919, Marconi bought his yacht, *Elettra,* which he equipped as a laboratory; a Marconi engineer made the first east to west transatlantic telephony transmission; and the embryo of broadcasting took shape in Chelmsford.

In 1920, at Marconi's Works, Nellie Melba gave a song recital for Britain's first advertised public broadcast. Twenty months later the Company was licensed for regular broadcasting and erected the famous 2MT station in an ex-army hut at its Writtle Laboratories. A licence was also granted for the 2LO station in Marconi House, London. Later in 1922, at the instigation of the PMG, Marconi's and five other manufacturers formed the British Broadcasting Company, superseded in 1926 by the British Broadcasting Corporation.

The Marconiphone Company, formed in 1922 to satisfy the demand for domestic receivers, was sold to RCA in 1929 and later merged with two other companies to become EMI, of which Marconi was President.

Meanwhile, the Company supplied the equipment for the BBC's new longwave station at Daventry, which took over the 5XX call sign of an earlier station built at Chelmsford.

Running parallel with the Company's broadcasting activity was Marconi's involvement with the Government's plan to link the Empire through a wireless communication network. First mooted in 1906, the Imperial Wireless chain contract was awarded to Marconi in 1924, exactly fifty years ago. The first station was opened in 1926 and, in common with all those that followed, used the Marconi-Franklin Beam System—a newly developed, revolutionary form of shortwave directional transmission. The Company too built its own beam stations for communicating with countries outside the Empire.



Experimental transmitter at Marconi's Chelmsford works. It inaugurated the world's first broadcast news service in February 1920.

The success of the Imperial Wireless Chain so threatened the Empire cable companies that, in 1929, at the instigation of the respective governments, their interests were merged with those of the Marconi Company in a new organisation, Cable and Wireless Limited.

This step shattered Marconi's life-long ambition to control an Empire-wide wireless network. Disappointed and in ill-health, he was increasingly drawn to his home in Italy, from which he conducted microwave experiments, installing the first microwave telephone link in 1932, and in 1935 demonstrating principles of radar.

Meanwhile his company in England was advancing the new medium of television, its interests in which it merged with those of EMI to form The Marconi-EMI Television Company Limited (later dissolved) whose system was adopted in 1936 by the BBC for the world's first public high definition television service.

In Italy, Marconi's health was deteriorating rapidly. He was taken ill on 19th July, 1937 and died the following day. Of all the tributes that followed, the most impressive, the gesture that was unique, was the closing down for two minutes of wireless stations throughout the world. The "ether" was as quiet as it had been before Marconi.

The years following Marconi's death saw far-reaching changes in the Company that bore his name. After the merger in 1968 of the General Electric Company and the English Electric Company, which had bought The Marconi Company from Cable and Wireless after the war, it became responsible, through its newly created subsidiary, GEC-Marconi Electronics Limited, for the management of all GEC's major capital electronics interests, which at the present time are represented in eight autonomous UK companies and nine overseas subsidiaries.

We would like to extend our thanks to GEC-Marconi Electronics Ltd. for supplying the information used in this article.

TAKE 20

DAVID ANDREWS

No. 59
ELECTRONIC TIMER

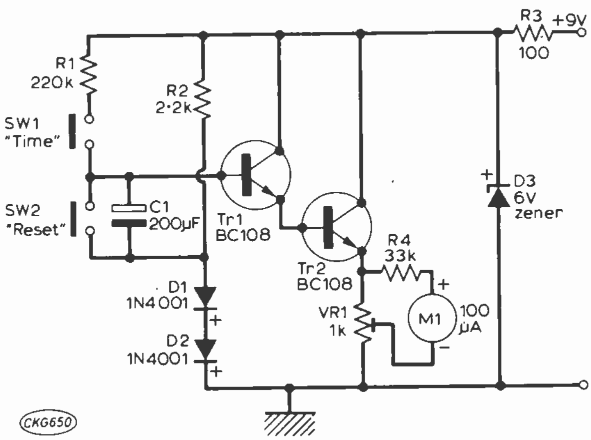
A series of simple transistor projects, using not more than twenty components.

THIS is probably one of the simplest possible indicating timers that can be made using electronic principles. It relies on measuring the voltage developed across a capacitor, C1, that is being charged up towards 6V through a resistor, R1. The slope of the charge curve follows an exponential function but over the first half of its charging range the slope is reasonably linear and the circuit operates only on this part of the range.

The application the writer had in mind for the device was as a simple darkroom clock for use with an enlarger, but no doubt many other uses could be found for such an instrument.

Operation

Because silicon transistors are used as a super-alpha pair it is necessary to introduce an offset voltage at the input so that even the smallest charge on C1 will display on the meter. This ensures that there is no "dead band" at the bottom end of the meter's scale. The offset is obtained by using two silicon diodes operating under forward bias conditions, D1 and D2. Any voltage at the positive plate of C1 is displayed at the emitter of Tr2.

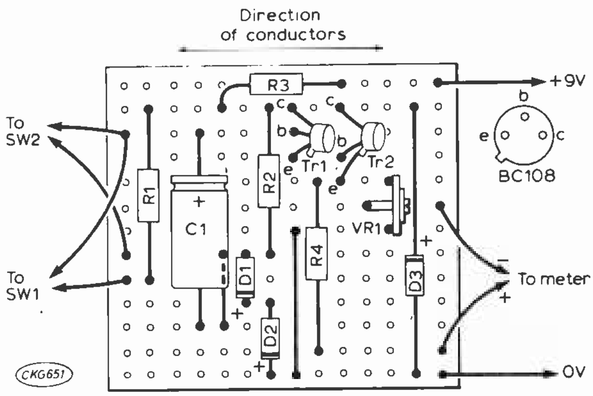


Circuit of the electronic timer using a meter to display the time interval.

Due to the extremely high gain of the two transistors very little current is drawn from the capacitor consequently the state of charge can be displayed for a considerable period, even though timing might have stopped with SW1 being opened. There is thus the possibility of using the device as a simple elapsed time meter. At the end of a timing operation the meter has to be reset to zero and this is done by pressing the reset button, SW2, which shorts out the capacitor momentarily.

★ components list

R1	220kΩ ¼W	R3	100Ω ¼W
R2	2·2kΩ ¼W	R4	33kΩ ¼W
C1	200µF 12V	D1/2	1N4001
D3	6V 400mW zener	Tr1/2	BC108
M1	Meter 100µA	SW1/2	Push button switches



Layout of circuit on Veroboard. No breaks are necessary in the copper rails.

Circuit

With the values of R1 and C1 shown, the timing range for the meter circuit, which actually measures up to 3 volts, is approximately 45 seconds but this can be varied with different values of R1. It is better to calibrate the meter by experiment and VR1 is incorporated to set the maximum reading of the meter to a convenient whole number of seconds, say some multiple of ten, which will make calibration simpler. For best linearity the wiper of VR1 should be kept as near the "earthy" end of the track as possible.

When the capacitor is discharged by SW2 there might still be a small reading on the meter, due to lack of balance in the various offset voltages, but this can be removed by the mechanical "zero set" screw on the meter movement. It is obviously desirable to have a stable power source for the unit so a 6V zener diode is fitted, running from a 9V battery. To save expense the zener and R3 can be omitted and the unit run directly from a 6V lantern battery.

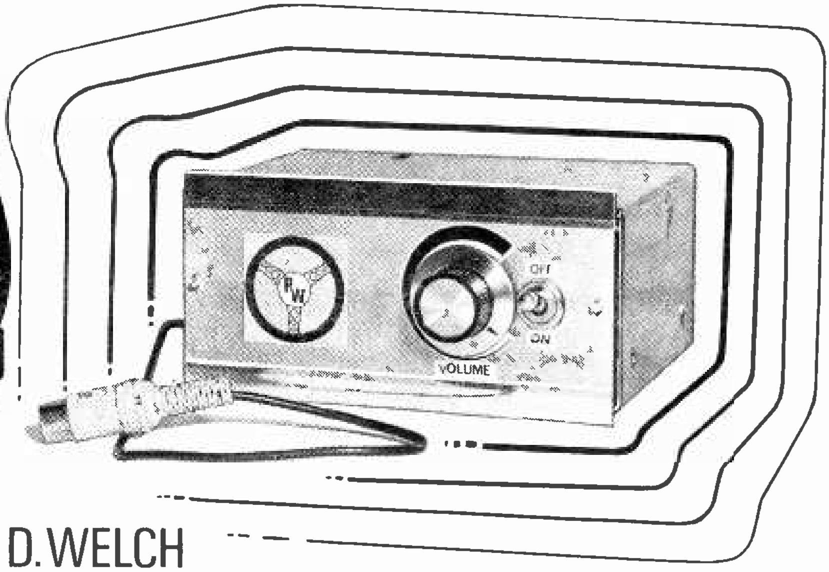
ERRATUM

Zener Diode Tester. Feb 1974

The 150 turn secondary winding of the oscillator transformer should be wound with 36 SWG enamelled wire and not 30SWG as specified on page 977.

CAR CASSETTE AUDIO BOOSTER

D.WELCH



NORMAL cassette players cannot be used in the car with much success for three main reasons. These are:—

(1) The output of most portable cassette players is fairly low, in the order of 250-750mW, which is inadequate for car use.
(2) The internal dry cells, with the player being run at high levels, will rapidly run down.
(3) The audio quality of most popular players, at high volume, leaves a lot to be desired.

This unit overcomes these disadvantages by enabling the player to be powered from the vehicle's 12V battery as well as boosting the output to a more than adequate level by inclusion of a good quality amplifier.

THE CIRCUIT

Many of the amplifiers designed for car use are of the class 'A' variety as a car battery is quite capable of supplying the 500mA or so quiescent current of a typical 2-3W class 'A' amplifier. However, for low distortion and ample power reserve, it was decided that at least 5W of audio was needed. For a class 'A' type this meant up to 1A quiescent current, which was considered excessive even for a high capacity accumulator. Therefore, a class 'B' type, with much lower quiescent requirements was employed.

The circuit shown in Fig. 1 comprises a conventional four transistor class 'B' amplifier which will deliver 6W RMS into a 3Ω speaker, plus a stabilised supply offering a continuously variable voltage from 0-9V at a maximum current of 350mA. The input to the amplifier, taken from the low-level output of the player, is applied to the base of Tr1, the first audio amplifier. The emitter of Tr1 obtains its bias from the output pair emitters, thus introducing negative feedback, improving quality and frequency response. This stage is directly coupled to Tr2, the driver stage, which is, in turn, directly coupled to the output pair. The emitter of Tr2 is connected straight to the supply line, no emitter resistor being necessary due to the low supply voltage.

The small bias required between the bases of Tr3 and Tr4 to eliminate cross-over distortion is provided by R7 in parallel with VR3, which sets the output stage quiescent current. The output is coupled to the loudspeaker by C5, large enough to ensure good bass performance. The stabilised power supply, comprising Tr5 and Tr6, provides a 0-9V output, which can be set by adjusting VR2. The zener voltage of D1 appears across VR2 and it can be seen that any voltage between zero and the zener voltage can be tapped off from the slider to the base of Tr5. The small current taken from VR2 is amplified by Tr5 and Tr6, enabling a larger current to be drawn from the emitter of Tr6.

CONSTRUCTION

The circuit excluding the power transistors, is constructed on a printed circuit board measuring 4¾ × 3½in. This is shown in Fig. 2 full size. Layout of the components on the board is shown in

★ components list

Resistors

R1	15kΩ	R5	10Ω	R8	150Ω
R2	120kΩ	R6	1·2kΩ	R9	1kΩ
R3	47kΩ	R7	27Ω	R10	33kΩ
R4	2·2kΩ				

All ¼W 10%

VR1 50kΩ log VR2 10kΩ pre-set VR3 50Ω pre-set

Capacitors

C1	4μF 16V	C4	4·7nF polyester
C2	16μF 16V	C5	1000μF 16V
C3	200μF 16V		

Semiconductors

Tr1	BC108	Tr3	AD161	Tr5	BC107
Tr2	BFX88	Tr4	AD162	Tr6	AD161

Miscellaneous

S1, Single pole on-off. Insulating kits (3) for power transistors. Aluminium box 6 x 4 x 5in. Circuit board 4¾ x 3½in. D1, 10V 400mW Zener.

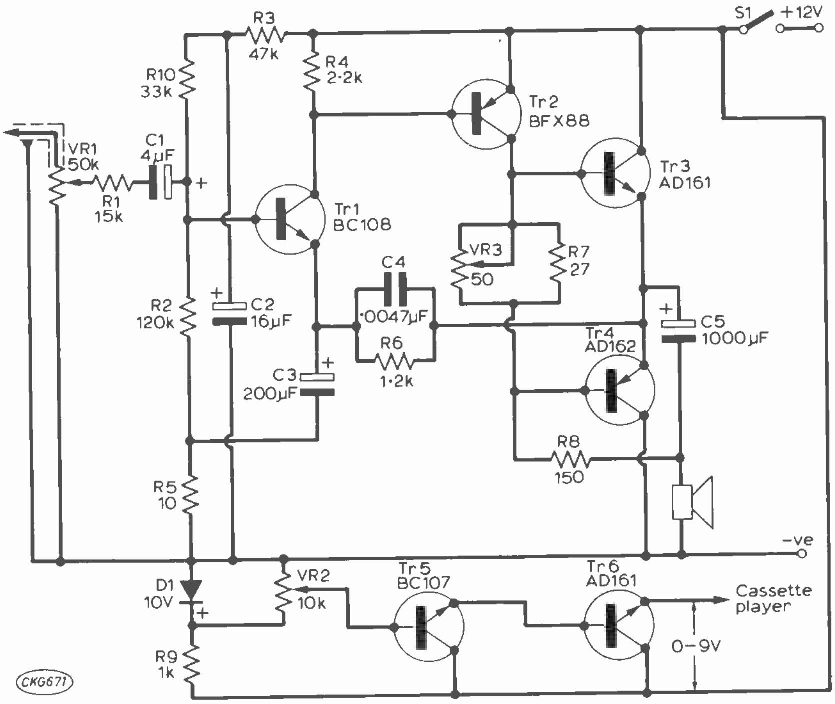
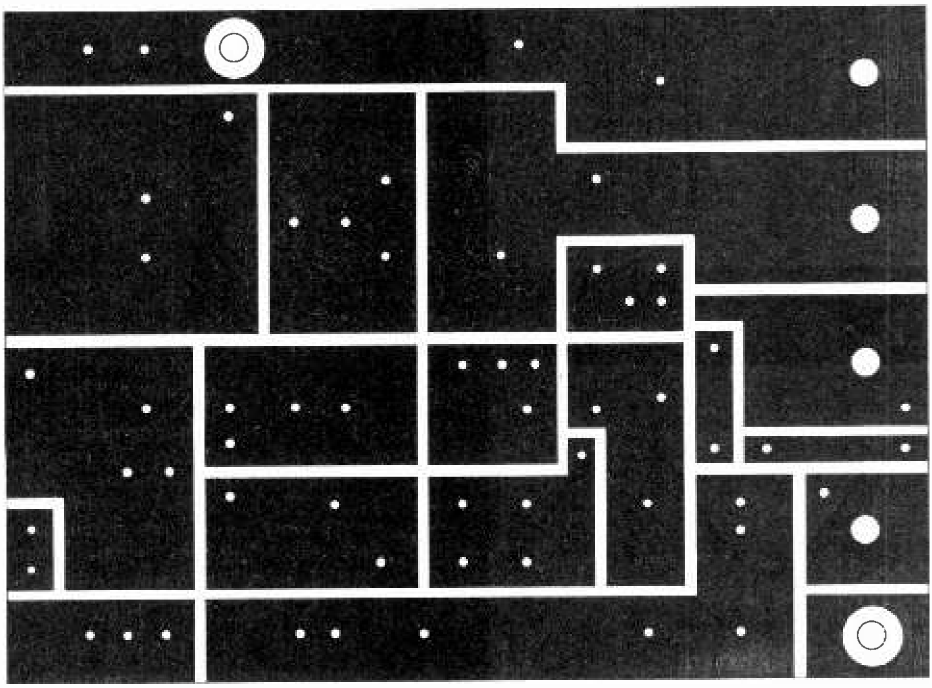


Fig. 1: (left) Circuit of the amplifier and power supply for the cassette recorder.

Fig. 2: (below) Full size layout of the printed circuit board used in the amplifier.



AM0176

Fig. 3. Rectangular-shaped lands are employed on the board to simplify etching. The board itself is mounted in a $6\times4\times2\frac{1}{2}$in. chassis with the power transistors mounted on the rear panel. The leads from the terminals are brought out through holes on the rear of the chassis and taken to their respective plugs.

Tr3, Tr4 and Tr6 must be insulated from the chassis with mica washers. The body of Tr4, although at negative potential, has to be insulated due to reasons stated later. No heatsink is needed for Tr2 as it is being run well within its power rating.

It should be noted that the common negative line of the circuit is not connected to the unit chassis. This is to enable the unit to be operated in a positive earth vehicle by merely connecting the positive supply line to the vehicle chassis and connecting

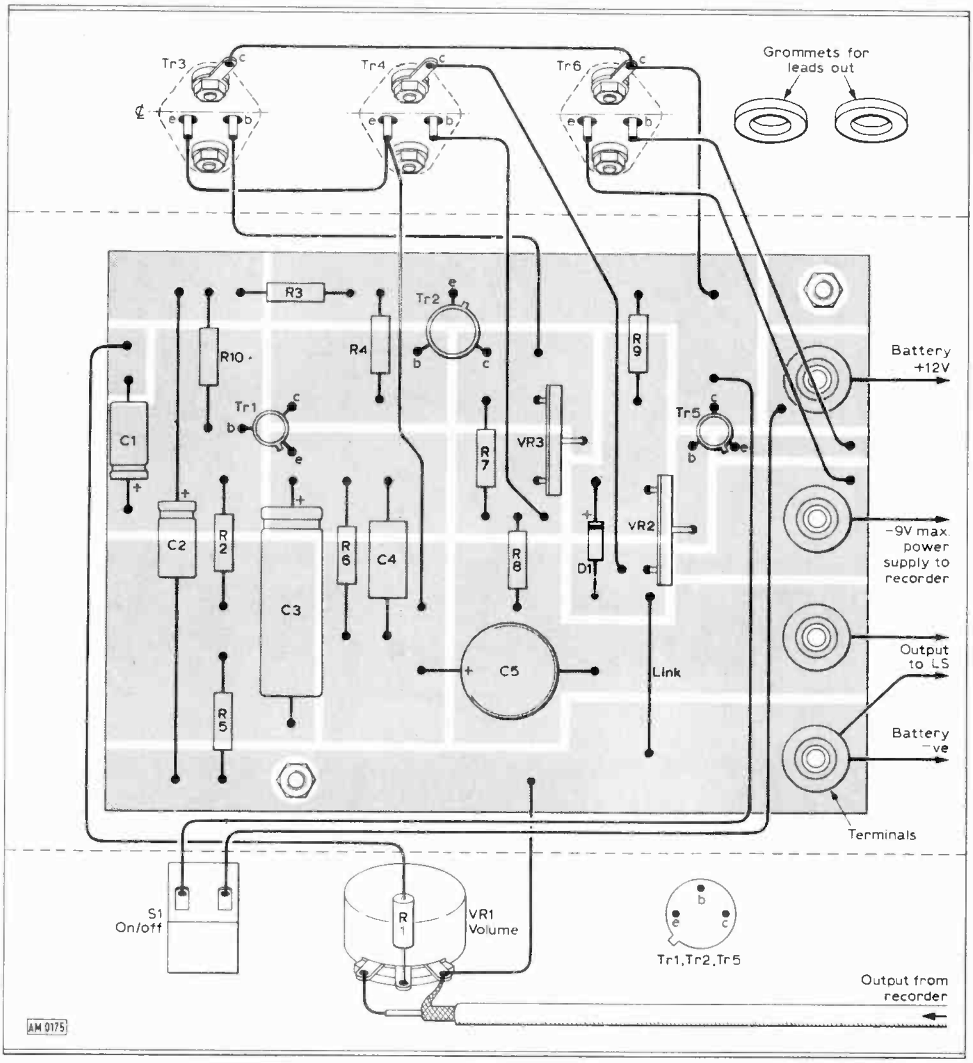
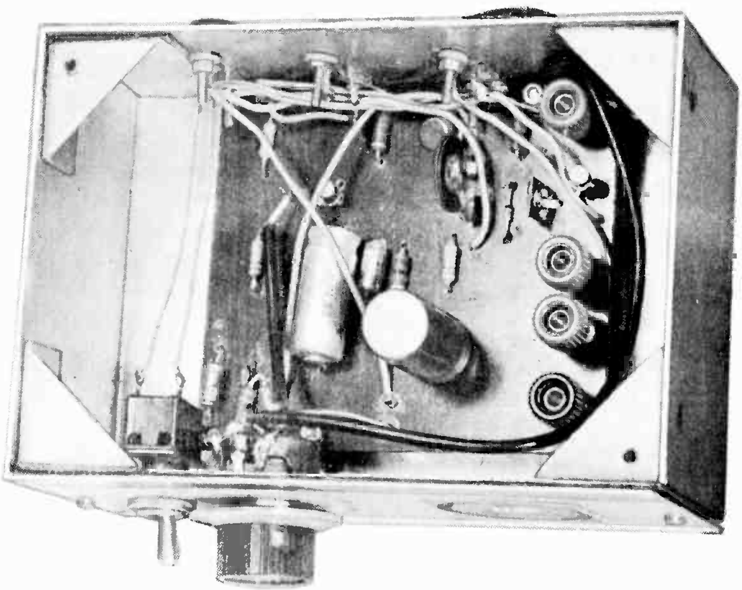


Fig. 3: (above) wiring of PCB to power transistors and volume control.



the common negative to the negative terminal of the battery. The chassis of the unit can then be earthed in the normal manner to the vehicle chassis to provide screening. For a negative chassis vehicle the unit's negative terminal is connected to the car chassis and the supply line to battery positive. If this procedure were not adopted, and the negative line directly earthed, then the circuit described here would be satisfactory for a negative earth car, but if employed in a positively earthed vehicle, Tr3 and Tr4 would have to be reversed and Tr1, Tr2, Tr5 and Tr6 replaced by opposite polarity equivalents. Also D1 and the electrolytics would need to be reversed.

TESTING THE AMPLIFIER

Before applying power, VR3 should be adjusted to insert MINIMUM resistance between the bases of Tr3 and Tr4. A loudspeaker is connected between the negative terminal of C5 and the common negative line. The power can now be applied whereupon a small thump should be heard from the speaker. An audio signal is fed into the input and VR3 backed off until any distortion just disappears. Do not rotate VR3 any further than is necessary as this will cause the output pair to take a greater current than is required, causing overheating.

Alternatively, a milliammeter may be inserted in the collector of Tr3, and VR3 adjusted for a reading of 30mA with no signal. The amplifier should give clean, good quality output at high levels.

TESTING THE POWER SUPPLY

A voltmeter is connected between the emitter of Tr6 and the negative line and power applied. On rotation of VR2, voltages of between 0-9V should be obtained, the voltage varying linearly with the rotation of the preset. The output voltage should not vary with the battery voltage fluctuations experienced with a vehicle, or by varying load currents. VR2 can now be set so that the output voltage is the same as that required by the particular player which is going to be used with the unit.

INTERCONNECTIONS

The actual plugs employed to connect the unit to the player depend of course on the make of cassette player employed, a Philips EL3302 being used in the author's installation. Power supply connection to this model is made by a 240° 5-pin DIN plug. On insertion of this plug the internal power source is disconnected. Signal from the recorder/player is also obtained via a 5-pin 180° DIN plug.

Although the input section of the amplifier was designed to handle the output of the Philips unit, it will cope with a wide range of input voltages. If overloading should occur at moderately high settings of the volume control, then R1 can be increased, or, if greater sensitivity is required, reduced.

The unit has been in use for some time in a Landrover (not the quietest of vehicles!) and the quality is very impressive up to high output levels. An advantage of the unit is the ease with which it can be connected and disconnected, no more than two plugs having to be disconnected to enable the player to be used in its normal way. ■

PRODUCTION LINES

colin riches

Two of the "Josty" Kits.

JOSTY KITS

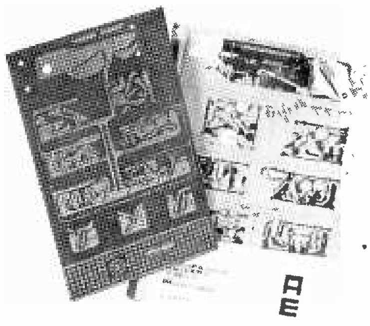
I recently had the chance of trying out a couple of "Josty" kits. They come complete with all components, printed circuit, construction plans and even solder. The instructions are clear and simple and only an elementary knowledge of soldering is required to build the more simple of the units. All the component positions are marked on the p.c. boards so it is difficult to make a mistake.

Josty is a Danish firm but the sole distributors for Great Britain are Radio Supplies Ltd.

Josty kits available range from a simple diode receiver and a windscreen wiper control to an automatic light control and an f.m. tuner.

A book called *Amateur Electronics* has been produced by the company to complement the kits. The author, Jan Soelbjerg begins with the basic theory of electronics and progresses through to more complicated designs and advanced theory.

The book comes with a free printed circuit board for 10 of the Josty designs which are described in the text. Complete kits of parts for these and other constructional projects described in the book are available from Josty.



"Amateur Electronics" and the P.C. board.

Amateur Electronics is written in a form of 'programmed instruction' and, although some of the translation leaves something to be desired (I've never heard of the word 'og' in English) it's a good instructional volume for both beginner and more experienced constructor alike.

Further gen and prices are available from *Radio Supplies (components) Ltd., P.O. Box 27, Hartlepool, TS24 7BR.*

COMING SOON IN P.W.

JUST when you are probably thinking about holidays, we are too! But we are also thinking about the summer issues of Practical Wireless—and so should you.

We constantly hear that readers require our summer issues when they are sold out, so let us suggest some very good reasons why you should not only buy a copy every month, but make sure by ordering in advance from your newsagent or by writing to our subscriptions department (see contents page).

TV GAMES

You may have seen those fascinating games in pubs and restaurants where you can play "tennis" electronically with the action displayed on a television screen. Want to know more?

STEREO TUNER

Are you thinking of building an f.m. stereo tuner?

COMMUNICATIONS RECEIVER

Do you want a communications receiver?

For more details on these and other projects, stay tuned to P.W.

YOUR PULL-OUT SUPPLEMENT

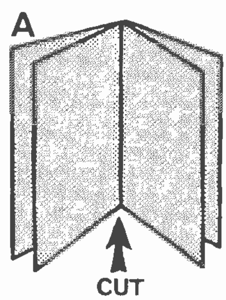
Lift staples at centre page

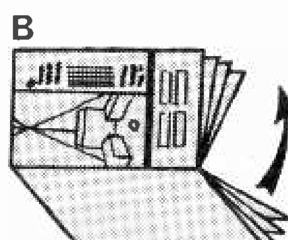
Pull out the Supplement

Cut along centre of pages **A**

Put pages together again

Fold up along dotted line **B**





FINALE

Having been bitten by the DX bug the pay-off comes when the first confirmation card, or QSL, is received from some DX station. Most stations send such a card on receipt of an accurate report, and this can be the start of a big collection, the initial aim often being 100 countries confirmed. But it will be obvious that some sort of log of stations heard must be kept containing such information as the date, time heard (always in GMT regardless of location of the station concerned or such vagaries as BST), frequency on which station was heard, signal strength, degree of fading, content of programme heard. The SINPO code is fairly widely used when sending reports to broadcast stations, a five figure group conveying a great deal of information, 34454 meaning 'Fair signal strength with slight interference, slight atmospherics but no fading and good overall readability'. The log will be in the form of ruled columns in a notebook but don't forget to add two for QSL's 'in' and 'out'!

What to do with the report? The World Radio and TV Handbook* contains all the information that is required on almost every radio station in the world, together with a mass of relevant information. The report should be sent air mail together with enough International Reply Coupons to cover return air mail. IRC's can be obtained at Post Offices. There is nothing more calculated to diminish enthusiasm in DX than the months it can take to get a QSL card back if sent surface mail. The station will not be interested in a report that can easily be a month or so old. Air mail is not cheap so choose the stations carefully before sending a report. Don't get too excited at receiving some of the very high powered propaganda stations, even if they are DX. They use fantastic aerial systems to make sure that you do hear them! Look for the ordinary and comparatively low powered stations, they are much more interesting. Initially the Guide to Broadcasting Stations** may be sufficient, containing a listing of stations on the long, medium and short waves, by frequency and wavelength as well as geographically. TV and FM station allocations are also included. Further general information on DX-ing can be found in several monthly magazines.

* *Fountain Press (Model & Allied Publications) Station Road, Kings Langley, Herts. £3 post paid.*

** *Butterworth Ltd., 88 Kingsway, London, WC2B 6AB. 90p post paid.*

SINPO REPORTING CODE

Rating Scale	Signal Strength	Interference	Noise	Propagation Disturbance	Overall Readability
5	Excellent	Nil	Nil	Nil	Excellent
4	Good	Slight	Slight	Slight	Good
3	Fair	Moderate	Moderate	Moderate	Fair
2	Poor	Severe	Severe	Severe	Poor
1	Barely audible	Extreme	Extreme	Extreme	Unusable

*SPECIAL PULL-OUT FEATURE

PRACTICAL WIRELESS MAY - 1974

CONTENTS:

INTRODUCTION

Tuning around the medium wave band on even a simple transistor radio will reveal at least a couple of foreign stations which can usually be identified fairly quickly. If the listening is done at night many more foreign stations will be heard but not all will be identified, by any means. This is the critical point! The options are a return to the noise of Radio 1 or a letter to Practical Wireless asking for help in identification! If the latter we have a new devotee to the art of 'DX' listening and a whole new world of interest will be revealed to the lucky one.

The term 'DX' will be met with frequently and in the early days of wireless it meant the reception of signals over unusually long distances, compared to normal expectations, and generally was unexplainable. The two-way contacts with the moon are the result of a highly sophisticated communication system and can hardly be called DX although it is over a quarter of a million miles away. It would have been surprising if it had not worked! But the DX enthusiast with a home-made receiver and 50 feet of aerial wire can rightly call it DX when he hears a low power station from somewhere in Central America which is only meant to serve some small community over a radius of a few miles.

Something has affected those radio waves and caused them to travel over thousands of miles. Checking again the next evening, just to prove the point, lo! and behold! the station is not there! Something has changed, again. It is this random changing of radio 'conditions' that provides the fascination of DX-ing whether it be enjoyed on the medium, short or very high frequency (VHF) bands. The last we normally associate with high quality FM local stations. Even TV pictures on VHF and the ultra high frequencies (UHF) bands are not beyond the capabilities of the DX-er. Not every day by any means but often enough to make the pursuit of DX TV a very intriguing pastime.

Here we shall describe the means by which the radio signals are propagated over great distances on the different frequency bands and the basic requirements in the way of equipment. Most people already have a receiver suitable for DX-ing on one or more bands, although they may not realise it. The main extra requirement is a reasonable aerial for the frequencies involved. The aerial is the vital link between the signal and the receiver but nevertheless it seldom gets the attention it deserves, either when being installed or afterwards.

Finding one's way around the various bands is not so very difficult and can be made very much easier with the help of various books and guides that list vital information on frequencies and times of operation of almost every station in the world.

RADIO WAVES

Enveloping the earth are several layers or shells which become electrically conductive when subject to the ionising effect of the sun on the gases in the layers. The two principal layers are called the Heaviside or E layer and the F or Appleton layer, Fig. 1. Each of these layers may split into the E1/E2 and

SOME EUROPEAN TV BANDS

Band	Channels	Freq. Range (MHz)	
	System A		
1	B1 to B5	41·50 to	66·75
3	B6 to B14	176·25	219·75
	System B (C in Belgium)		
1	2-3-4	48·25	67·75
3	5 to 12	175·25	229·75
1	A-B-C	53·75	87·75
3	D to H1	175·25	222·75
	System D		
1	R1 to R5	49·75	99·75
3	R6 to R12	175·25	229·75
	System I		
1	1B	53·75	59·75
3	1D to 1J	175·25	221·25
	System G, I, L		
4	21 to 34	470 to	582
5	39 to 68	614 to	854

FM DX

The FM Band 2 runs from 88 to 108MHz but allocations in UK are restricted to 88 to 97MHz, the balance allocated to public services. On the Continent, Channels 2 to 56 occupy 87·6 to 103·8MHz. Although we regard FM as a local service these frequencies can travel a thousand miles or so. Located between the TV bands 1 and 3, these frequencies are subject to the same effects as TV signals, as previously described. The low end of the band will be the first to be affected by unusual propagation so that is where to listen for DX. E-Layer signals around midday in summer will give the longest ranges.

Commercial multi-element aerials are eminently suitable for FM DX, the more elements the merrier, within reason. More elements mean a sharper forward beam so searching for DX around the compass can be tedious. A simple dipole or two element affair is ideal for general searching switching to the main beam as required. Orientation must be the same, simplified by placing both aerials on the same mast.

With a domestic FM receiver there are two points to watch when using it for DX-ing. Most sets are fitted with automatic frequency correction (AFC) circuits which alter the local oscillator frequency to compensate for mis-tuning. When DX-ing switch off the AFC, otherwise signals can be chased up and down as the AFC operates. Secondly, some sets are fitted with a control which governs the level at which a signal passes through the receiver. It can be set for local station operation only, and generally is! This adjustment must be set for maximum sensitivity otherwise the DX will never appear. Inter-station noise will be greatly increased but the control can be returned to normal for domestic use.

Check the dial calibration against local station frequencies, with the AFC off, of course. If there are large errors fix a strip of white along the dial and recalibrate using a hard pencil. Looking for a particular station on a known frequency will now be much easier.

When the band is 'open' TV sound and vision signals may be heard at the low end of the band, originating from East European stations. Many Continental stations can be heard especially after the BBC has closed down but remember that many openings occur around midday. Some of these stations also transmit stereo so there is no need to switch to mono for DX-ing.

TV SYSTEMS BASIC DATA	A	B	C	D	G	I	L
Lines	405	625	625	625	625	625	625
Ch. Bandwidth MHz	5	7	7	8	8	8	8
Video B'width MHz	3	5	5	6	5	5·5	6
Modulation (Video)	+	—	+	—	—	—	+
Modulation (Audio)	AM	FM	AM	FM	FM	FM	AM

An 819 line system (E) is in use in France (VHF)

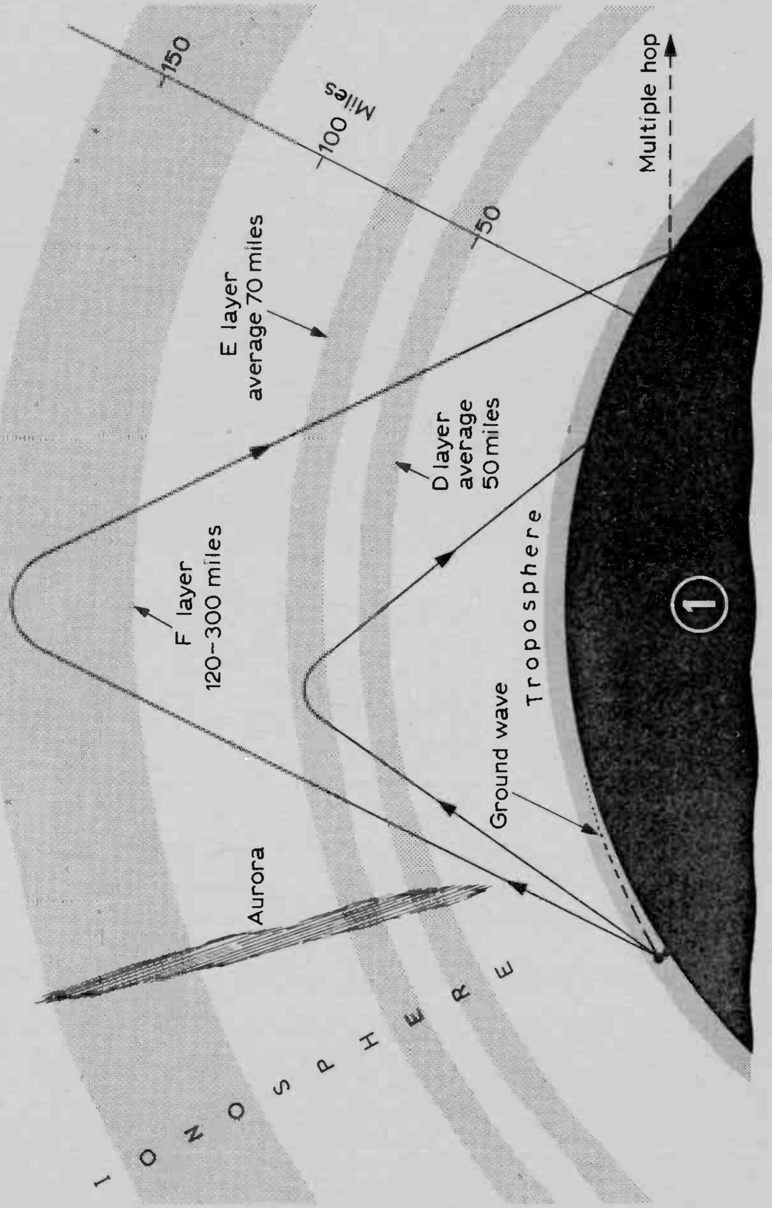
System A UK, Eire (VHF)
B Austria, W. Germany, Italy, Holland, Norway, Portugal, Spain, Sweden, Switzerland and Yugoslavia (VHF)
C Belgium (VHF)
D Czechoslovakia, E. Germany, Poland, USSR (VHF)
G Austria, W. Germany, Italy, Holland (UHF)
I UK, Eire (UHF)
L France (UHF), Luxembourg (VHF)

(see Table of Systems), regardless of whether the signal is on VHF or UHF. This can usually be done by alterations to the switch wafers. Since some of the DX signals may only be present for a short time it is important that the line timebase be capable of very fast synchronisation with the signal. If a choice is available a set with 'flywheel' sync should be chosen, with this end in mind. For maximum flexibility the timebases and IF amplifier will also be separated electrically as well as the detector circuits. This will be found to be easier with some sets than others.

It is likely that a turret tuner will be fitted for VHF so this can be fully utilised by fitting additional coil units for the empty channels. These can be for Band 1, Band 2(TV) and Band 3 depending upon requirements. On UHF the dozens of channels available make the usual four station push-button selector something of a joke to the DX-er! Continuous tuning is a must and with modern varicap tuners this is a simple business.

In the process of setting up the equipment it is likely that a picture of some sort, that is obviously not BBC or ITV, will be picked up and the identification chase will be on. All TV stations have test and identification cards, usually with station or network names, but because of the common practice of relaying other stations or networks too much credence should not be given to first conclusions.

If a reception report is sent to a distant TV station it should contain plenty of information on the programme content, plus other information seen or heard which will assist the station in confirming the report. The DX-TV-er's 'bible' is *Long Distance Television* by Roger Bunney obtainable from Weston Publishing, 33 Cherville Street, Romsey, Hants SO5 8FB for 55p postpaid. It can be thoroughly recommended to the newcomer to DX TV.



F1/F2 layers with increasing ionisation. Being conductive these layers are capable of reflecting radio waves. The height of the layers will vary with the degree of ionisation and other factors. During the dark hours, in the absence of the sun, the layers become less reflective so that in winter they lose much of their reflecting powers and DX becomes impossible. In the summer, being subject to almost continuous ionisation, they can remain reflective throughout the 24 hours. Severe, relatively short term eruptions on the sun, called sunspots, can cause the complete disruption of all short wave long distance communications.

GROUND WAVE

All transmitters have a ground wave which follows the surface of the earth, dying out very rapidly, Fig. 1, after 20 or 30 miles depending upon the frequency, in the case of short wave stations. The main signal goes upwards before being reflected by, usually, the E layer in the daytime and the F layer at night, but much would depend upon the frequencies involved, time of year and position of the sunspot cycle. The distance between the end of the ground wave and the first point of return of the reflected signal is known as the 'skip distance', no signals being heard in this area from the station concerned.

On the medium waves the ground wave is extended much further and constitutes the normal service area of the transmitter. At night however the skip distance can become nil the sky wave causing severe distortion of the signal due to its interaction with the ground wave. Hence the constant reminder by our local broadcasting stations to change over to FM for better reception at night!

The degree to which a short wave radio signal penetrates a layer and is then reflected depends upon its frequency. As the frequency increases penetration increases and reflection decreases until a frequency is reached when reflection ceases and the signal is lost. This frequency, in relation to a vertically transmitted signal, is used by radio research laboratories to predict propagation conditions. It will be seen that since the transmitted signal is in reality a diverging signal the way in which it penetrates and is reflected from a layer means that the received signal will consist of several components which may add together or subtract from each other thus producing a signal that will be varying in strength all the time, causing the well-known phenomenon of 'fading'.

Below the E layer is the D layer which exists only during daylight hours when it is mainly responsible for absorbing any upward radiation from medium wave stations. The D layer disappears as soon as the sun's effect on it goes at sunset.

TROPOSPHERE

A very important factor in the propagation of VHF and UHF transmissions over long distances is the troposphere which is that part of our atmosphere up to a height of about five miles. On clear, warm days, usually associated with high pressure areas, the troposphere can carry these frequencies over many hundreds of miles.

The DX modes of transmission appropriate to the various frequency bands will be discussed in subsequent chapters.

is the enormous frequency bandwidth involved, 45 to 850MHz approximately, with the odd gap here and there.

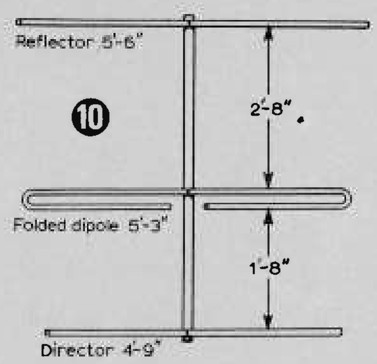
On Band 1 and Band 2(TV) an aerial that has proved very effective uses crossed horizontal dipoles set at 90° to each other, giving all-round coverage, Fig. 9, *(Practical Television July '69)*. Remember that as Band 1 TV is rapidly becoming redundant in the UK it is possible to buy quite cheaply new aerial kits which can be used to make up any special arrays Bits and pieces of old used aerials should not be used as these will invariably be corroded. Other wideband arrays for Band 1 were discussed in *Television May 72*. A useful aerial for sole use in Band 2(TV) is shown in Fig. 10. It can be made of ½" diameter aluminium tube and mounted on a larger size boom.

Aerials for Band 3 do not present any problem as there are a number of suitable wideband arrays on the market which will be hard to beat. At present prices it certainly does not pay to try to make them at home.

The UHF bands can be covered by a choice of aerials from the three groups currently available commercially:—

Channels 21 to 34
Group A Colour Code Red
Channels 39 to 53
Group B Colour Code Yellow
Channels 48 to 68
Group C/D Colour Code Green

These aerials, in various configurations, are available from a number of manufacturers and again it pays to take advantage of the development work that has been done by the makers rather than to use home made aerials of unknown characteristics. Whatever combination of aerials it is decided to use they should all be fitted with the best



quality UHF coaxial feeder, choosing the shortest path back to the TV set. Mount them as high as possible, on an aluminium pole preferably, with a separation of around three feet between aerials. Clamps or simple bearings on the pole will enable it to be rotated quite easily by hand. Mains operated aerial rotators are available complete with remote indicating control boxes thus obviating the need to move at all when changing the beam heading!

Masthead preamplifiers are sometimes considered a bit of a refinement but for the real DX TV-er they are essential if he is to take advantage of very weak signals, especially in tropospheric reception. It is best if the coaxial cable is used to convey the few volts needed to power the amplifier.

In order to be able to receive the various systems being transmitted it will be necessary to make certain alterations to the standard circuitry of the ordinary TV set. For this reason it is advisable to start by buying an old dual standard set for a few pounds and modifying that. The first change is to the video (vision) detector to enable either positive or negative vision modulation signals to be accommodated

TV FROM AFAR

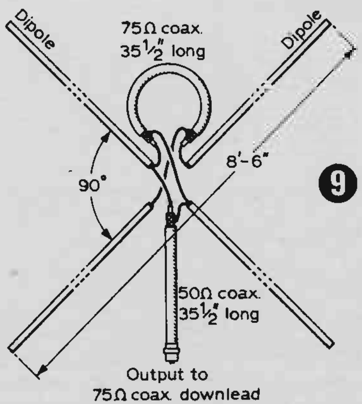
Once again the mechanics of DX signal paths must be investigated, this time for TV signal frequencies. The European TV bands and channel designations are given in the Tables. Band 1 signals can be propagated long distances by means of the reflective E layer but the real TV enthusiast is more interested in 'Sporadic E' (SpE) signals. For reasons that are not too well understood, patches of intense ionisation occur in the E layer, mostly during the summer months. These patches can produce DX signals of great strength but, sometimes, of short duration depending upon the movement of the SpE 'cloud'. As the cloud moves different DX TV stations will be received and then fade out again. Like all DX reception it is the uncertainty of the situation that provides the excitement!

The passage of meteors through the E layer also causes local ionisation which is capable of reflecting Band 1 and 3 TV signals but only for comparatively short periods, often measured in seconds.

As we approach the minimum of the sun's 11 year sunspot cycle the interest in DX reception of TV signals via the upper F layer is minimal but at sunspot peaks Band 1 TV signals, such as BBC1 on 45MHz, have been received as far away as Australia! These periods also produce increased auroral activity at the north (and south) pole which is capable of reflecting VHF TV signals.

The last DX TV mode of propagation to be discussed is perhaps the most predictable. The daily weather charts on domestic TV are closely watched by the DX stalwart who looks for approaching high pressure areas when clear skies at night allow the earth to give up its heat quickly to the upper atmosphere thus creating an 'inversion' when the surface temperature is lower than that of the air mass above, contrary to normal stable conditions. The TV signal is gradually bent more and more as it passes through the troposphere and it can eventually be returned to earth, perhaps a thousand miles away. VHF and UHF signals are affected by trops as evidenced by the occasional interference experienced by viewers of the domestic TV services for which BBC and ITV often apologise! 'Ducting' is a form of tropo producing signals only over a well defined path between a particular receiver and transmitter usually to the exclusion of other signals originating along the path.

Now to the equipment required to be able to receive DX TV. Not so complicated or expensive as might at first be imagined. While high gain beam aerials have their advantages quite simple arrays will allow the reception of TV signals from around Europe. The main problem



Dipole X-array mounted in horizontal plane

MEDIUM WAVE DX-ING

The medium wave band extends from 525 to 1605kHz or 571 to 187 metres. During daylight hours the service area of a MW transmitter is provided entirely by the ground wave, see Fig. 1, which is gradually attenuated as it travels over the earth's surface. Any signal travelling upwards will be absorbed by the D layer (see Propagation) but around sunset the D layer dissipates and the signal passes through that level and on to the E layer from whence it is reflected back to earth. The E layer at this time is also becoming weaker so the reflections tend to be very variable as the density and height of the layer changes continuously. Interaction between the ground wave and the reflected wave can occur especially with stations at the high frequency end of the MW band and particularly around sunrise and sunset. The result is very bad distortion of the speech or music in parts of the service area.

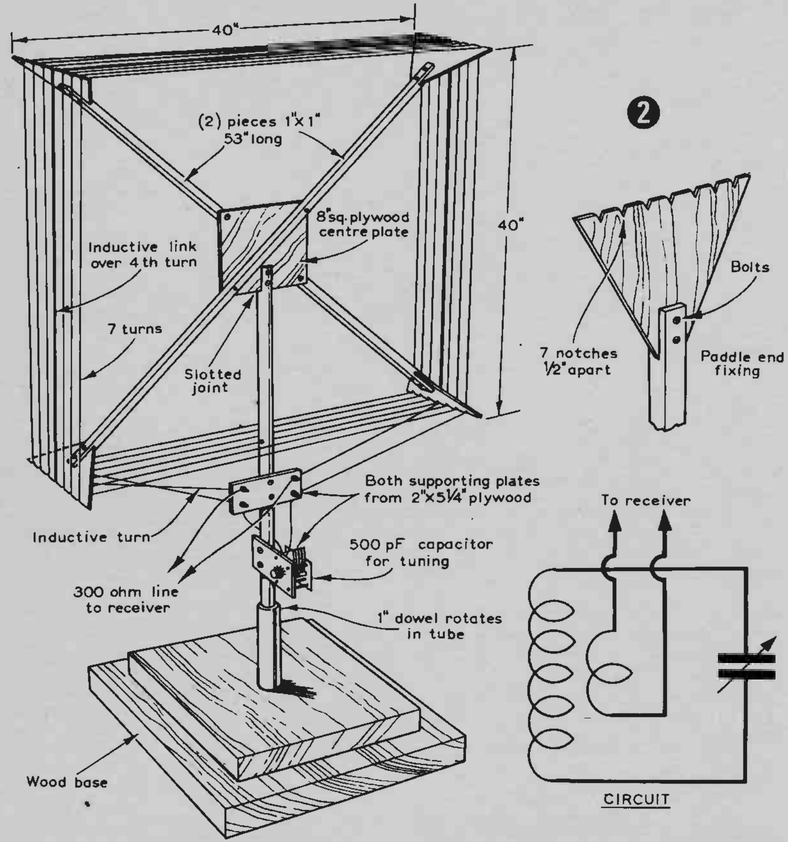
AT NIGHT

After dark, stations in Europe and North Africa up to a radius of roughly 1300 miles can be heard in the UK via the sky wave propagation. Sometimes the signal may make more than one hop between earth and the E layer producing the real DX which the enthusiast is seeking. The long winter nights produce many signals from the USA and Canada and down into the Caribbean area. Station CJON at St. John's, Newfoundland, can often be heard well before midnight on 930kHz and is a good station for the newcomer to look for, for encouragement if nothing else! Others include CHER Sydney, Nova Scotia on 950kHz, CFRB Toronto 1010kHz, WABC New York City 770kHz, WOR New York 710kHz and many others. Good catches among the rarer stations include Radio St. Pierre in the St. Pierre and Miquelon Islands on 1375kHz, Bermuda ZBM1 1235kHz and ZFB1 960kHz plus WIVI 970kHz and WBNB on 1000kHz in the US Virgin Islands. Even around Europe there are stations such as Torshaven in the Faroe Islands on 584kHz which represents quite a good catch, together with Hofn in iceland on 665kHz.

MIDWINTER

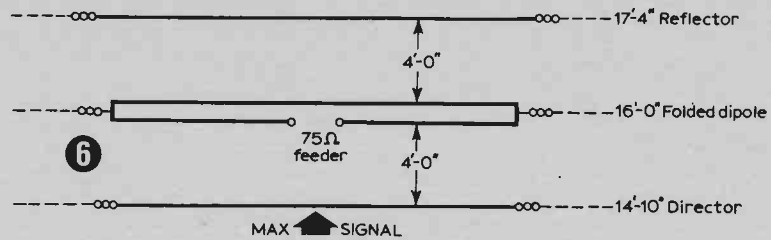
The afternoons in midwinter are the time to look for Asiatic stations just before the invasion by the European stations via the E layer. All-India Radio represented by Calcutta on 1130kHz uses no less than 1000kW in power so it should not be too difficult to find. There is Baghdad on 760kHz, Kabul in Afghanistan on 1280kHz and Radio Iraq on 841kHz, not bad DX for the medium waves!

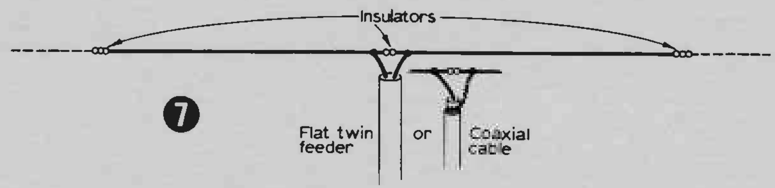
Having whetted the appetite, what sort of equipment is needed to hear this sort of DX? A good domestic receiver with a reasonably large tuning dial and provision for the attachment of an external aerial is about the minimum. The portable transistor radio with its microscopic dial is out but the older valved receivers had quite good dials in many cases and often an RF stage, which can be a distinct advantage, so these old sets should not be overlooked and after overhaul and re-alignment can give a good account of themselves. Of course, a communication class receiver is

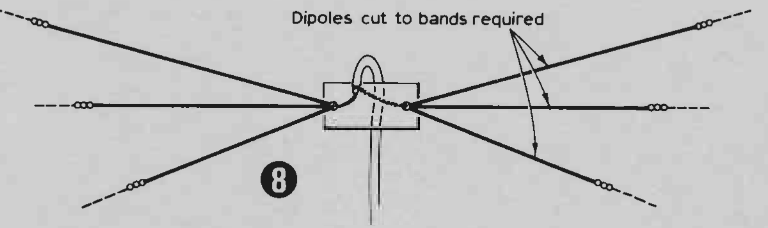


much better mainly because of the increased selectivity and sensitivity it can bring to bear in the chase for the DX. Refer to the section on short wave listening for information on choosing a communication receiver. Ex-Government surplus receivers of the AR88 type are excellent for both medium and short wave DX-ing and generally represent a very good bargain.

The aerial for MW ought to be about 100 to 150 feet long including any down lead. As the length is less than half a wavelength this aerial will not show any particular directive properties. The seasoned DX-er will also possess a loop or frame aerial, Fig. 2, which he can rotate in order to null out an unwanted station and leave the wanted station. Naturally the signal strengths will be down on those obtainable with the outside aerial but it is the ratio of wanted to unwanted signal that really matters. The loop aerial's pick-up pattern is similar to a figure 8 and the loop is rotated so that the line of minimum pick-up is towards the unwanted signal. Maximum dis-





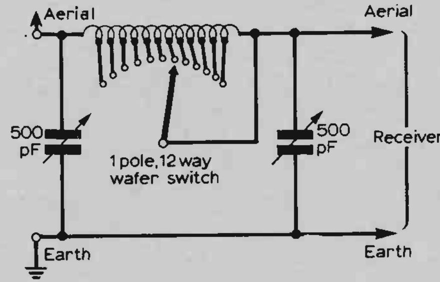


SHORT WAVE DIPOLES

Broadcast Band	Broadcast Length	Amateur Band	Amateur Length
49m	76ft	160m	256ft
41	65	80	128
31	48	40	66
25	39	20	33
19	30	15	22
16	26	10	16
13	21–7in		
11	18–2in		

in from the horizontal wire to the receiver being counted as part of the 132 feet or other half wave chosen. Use good insulators where the wire is supported and avoid sharp bends at all times. There is nothing magic about 132 feet so it is quite in order to make the aerial as long and as high as is possible in the circumstances, but the ATU is a must whatever length is chosen. In the interests of safety never run an aerial wire over or near any power supply line or telephone wires.

A half wave dipole suitable for a single band only may be constructed as in Fig. 7 from the dimensions given in the Table, but the multi-band dipole of Fig. 8 may be preferable for listening on several bands. The length of the feeder should be kept to a minimum after it has been allowed to drop vertically downwards from the centre for a short way.



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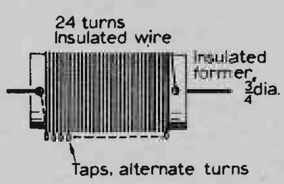

than the desired half wave then the ATU will make up the length electrically and this it can do over all the short wave spectrum, Fig. 3. A loft aerial suitable for use in an electrically noisy location is shown in Fig. 4.

A vertical rod aerial mounted on an insulator can be fitted to an outside window ledge and joined to the receiver via the ATU, Fig. 5, the signal pick-up being approximately the same from all directions. A half wave horizontal wire will have maximum response from stations at right angles to the line of the wire. When conditions favour the 10/11 metre bands during periods of high sunspot activity, thought should be given to erecting a two, or even three, element wire beam, Fig. 6, which is not so impossible as it may seem considering the 'wing-span' is only about 17 feet. However it will tend to be quite directional unless a bi-directional beam is made, which will not be any more difficult.

An outside aerial will be a big improvement on all the short wave bands especially if it can be made about 132 feet long which will be around half wave long on the 80 metre band. Again, an ATU will be highly desirable to take maximum advantage of the aerial. Install the wire as high as possible taking advantage of any trees or buildings to act as supports. The wire may be horizontal or sloping, the final lead-

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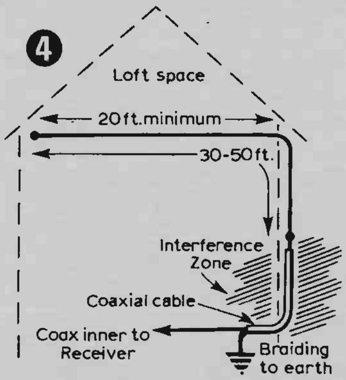

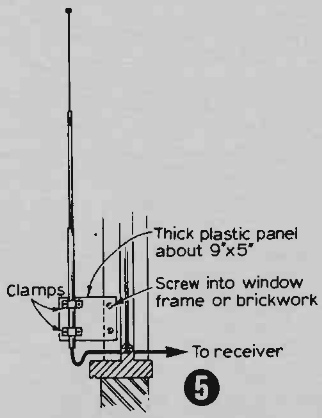

5

crimination will occur when the lines in the direction of the two transmitters are roughly at 90°. A frame aerial will also be less sensitive to general noise and static.

The receiver should be connected to a good earth point such as a copper rod or tube driven a few feet into the soil, the connection being made with heavy copper wire which should be as short as possible. In the past the lead piping of the domestic cold water system was recommended as an earth but with the widespread use today of plastic piping this can no longer be relied upon unless a check on the electrical continuity can be made.

CALIBRATION

Before DX-ing begins in earnest it is important that the receiver, if of the domestic type, should be calibrated fairly accurately and this may be done by first sticking a strip of white paper or thin card along the length of the dial and marking it at intervals with a hard pencil. Initially the reference points can be taken from broadcast stations, picking those that have a frequency in round numbers such as Budapest 539kHz (540), Lyons 602kHz (600), Brussels 620kHz, Rennes 710kHz, Munich 800kHz, Milan 899kHz (900) and so on. Mark the reference points in kHz from one end of the band to the other. The original dial markings are unlikely to be at all accurate except at a couple of places. Later, if a crystal calibrator is acquired, it will be possible to mark the dial down to 10kHz intervals.

The calibration will enable the search for a particular station to be narrowed down to a small part of the dial as well as permitting the recording of the frequency of a new station so that it can be easily found again. With a communication type receiver the existing calibration ought to be quite accurate but if a new station's frequency is to be measured the crystal calibrator will provide two marker points 10kHz apart from which the frequency can be estimated to a kHz or so.

SHORT WAVE BANDS

At the outset of his DX-ing career the newcomer to the short wave bands will, understandably, be a little hesitant to spend a lot of money on a receiver, especially if he is not quite sure what he is really looking for. He ought to go for a communication receiver but unfortunately there are a number of so-called 'communication' sets on the market which do not, in fact, meet the accepted specification for this type of equipment. They are only glorified all-band domestic receivers lacking several of the essential features of a proper communication receiver.

Short wave receivers fall into two general categories, those with continuous coverage across all the short wave bands, (see the Tables) including the amateur bands, from about 1·5MHz to 30MHz in a number of switched ranges and those intended for use on the amateur bands only, with the range switch selecting part or whole of a particular band, typically 1·8, 3·5, 7, 14, 21 and 28MHz. The newcomer will be more interested in the broadcast bands so the general coverage receiver is likely to be his first choice.

The following points should be considered when weighing up the pros and cons of a particular short wave set:—

1. **Adequate Bandspread** or the ability to 'stretch' out any part of the frequency range to permit easier tuning. Bandspread is often achieved with a 'band-set' dial which is adjusted to the end of a band, a separate 'bandspread' dial spreading the band over most of its travel. The main dial will be calibrated for each of its switched ranges while the bandspread dial may be calibrated for each band or simply in degrees, for logging purposes. This permits the rapid return to a particular station or frequency. This type of bandspread is invariably a small capacitor in parallel with the main tuning capacitor. Another bandspread system uses a direct mechanical reduction drive on the main tuning capacitor and is to be preferred if it provides sufficient bandspread.

2. **Adequate Frequency Coverage**, including the 11 and 13 metre bands which really come alive during periods of high sunspot activity. The lowest frequency bands, 90 and 120 metres, can be sacrificed if necessary. Broadly speaking, 3·5 to 26MHz is the minimum coverage to aim at.

3. **Provision of a BFO** or beat frequency oscillator, which permits the reception of continuous wave (CW) or Morse code signals, especially useful on the amateur bands. Single sideband (SSB) telephony is widely used on all amateur bands and this can only be resolved if a stable BFO is fitted. SSB transmissions use either upper (USB) or lower (LSB) sideband and the BFO control may be so marked as a guide, and no more, to the correct position for these modes. The BFO may be crystal controlled and switched for USB or LSB. An alternative name for the BFO, the Carrier Insertion Oscillator, is sometimes encountered.

SHORT WAVE BROADCAST BANDS

Band (metres)	Frequency (MHz)		
120	2·300	to	2·495
90	3·200		3·400
75	3·900		4·000
60	4·750		5·060
49	5·950		6·200
41	7·100		7·300
31	9·500		9·775
25	11·700		11·975
19	15·100		15·450
16	17·700		17·900
13	21·450		21·750
11	25·600		26·100

SHORT WAVE AMATEUR BANDS

Band (metres)	Frequency (MHz)	
160	1·800	2·000
80	3·500	4·000*
40	7·000	7·300**
20	14·000	14·350
15	21·000	21·450
10	28·000	29·700

* UK 3·500–3·800
** UK 7·000–7·100

4. **Sensitivity** or ability to resolve weak signals is not likely to be lacking in a decent communication receiver but it is important to check that the sensitivity remains reasonably constant over any one switched range. Disconnect the aerial and turn up the RF gain control for a reasonable background level and tune from one end of a band to the other. The noise level should remain fairly constant but may fall a little at each end.

5. **Selectivity** is, perhaps, the most important characteristic of a good short wave receiver since it determines its ability to select a wanted signal and exclude those on adjacent channels. For reasonable audio quality a bandwidth at the IF of about 6kHz is required. At the other extreme 500Hz is not too narrow for the reception of CW signals, with 2·5 to 3kHz for SSB transmissions. The ideal is a number of switched bandwidths which is very expensive if separate crystal or mechanical filters are employed although the 6kHz bandwidth can be obtained with tuned circuits alone. If necessary, the very narrow CW filter can be left out, and the required selectivity obtained by a 'Q-Multiplier' which increases the gain of one of the IF stages to the point of oscillation when the stage bandwidth becomes very narrow. The Q-Multiplier, if allowed to oscillate, functions as a BFO in some receivers. Filters are expensive but this is the one point in a receiver where expense is well justified and will never be regretted.

6. **Gain Controls** must include a minimum of an RF gain control and a separate audio volume control. The RF gain control will vary the gain of an RF stage, if fitted, as well as the IF gain. On cheaper receivers it is essential to be able to vary the RF gain independently of the audio level when receiving SSB stations. Every set will have automatic gain control (AGC) circuits but nevertheless the manual control is necessary to cope with the very wide range of signal strengths that will be encountered.

7. **AGC Circuits** are designed to hold the output of the receiver reasonably constant over a wide range of input signal levels, generally due to fading. With broadcast stations the carrier is used to actuate the AGC but with SSB and CW there is no continuous carrier and so the resultant audio signal is often used to operate the AGC circuits. This means that there must be a facility for switching off the AGC when receiving SSB or CW or switching to alternative circuitry for these modes. On a good communications receiver this will be done automatically when the function switch is changed from AM to SSB/CW.

8. **Product Detectors** seem to cause more controversy than anything else! When receiving AM signals it is likely that a diode detector will be used and in a cheap receiver it could be used also for SSB/CW. On SSB the ratio of signal to BFO voltage is likely to be wrong and SSB will be difficult to resolve. Hence the comment that the RF gain control must be separate, so that this ratio can be achieved. Look for a product detector on SSB, where the applied signal levels will be correct and the reception of SSB thus made easier.

The aerial is a very important link between the signal and the receiver. The best communication receiver in the world will be reduced to mediocrity with a bad aerial. If restricted to a flat or similar accommodation then 40 or 50 feet of insulated wire round the picture rail may be the best aerial obtainable but its effectiveness can be considerably increased by using an aerial tuning unit (ATU) between the aerial and the receiver. This ensures that the aerial is working at maximum efficiency at all frequencies. The length of a wire for best results ought to be about half a wavelength long, say 65 feet for the 40 metre band. The exact length need not be calculated since reception is being carried out over quite wide bands of frequency. If the wire is shorter

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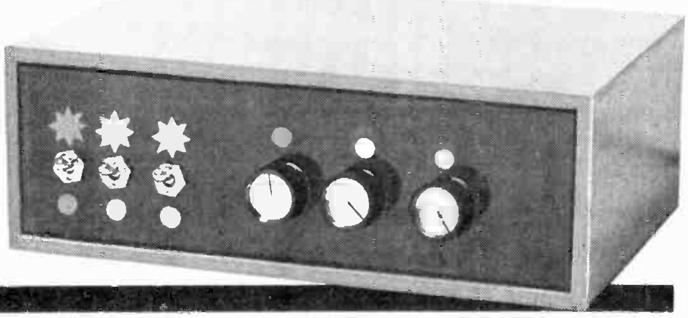
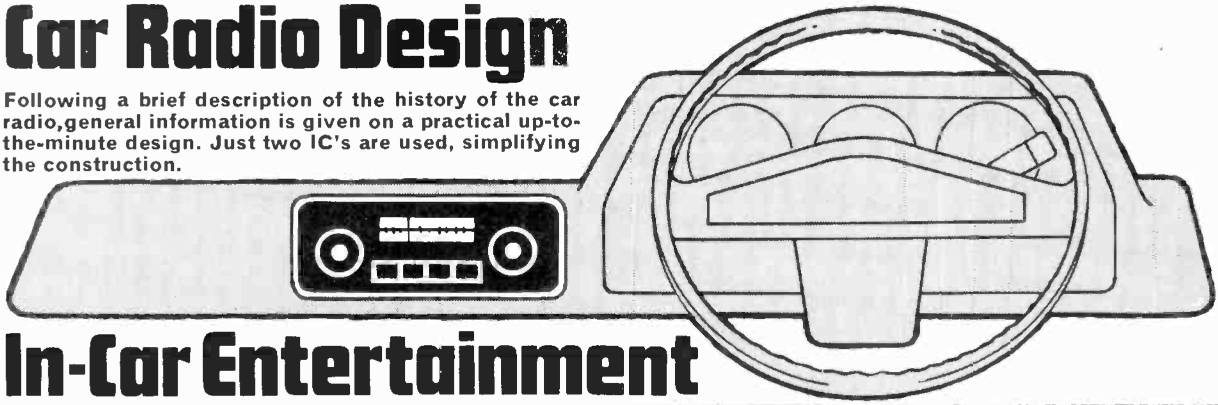
SOUND TO LIGHT CONVERTER

One of the most popular features in any discotheque is the psychedelic multi-colour light display. This unit will handle up to 250 watts of lighting on each of three channels, pulsing in time with the bass, middle and treble notes.
By taking advantage of the higher amplifier power which is available in most discos, this constructional project employs simplified circuitry and avoids the use of difficult-to-get specialised components, so often a problem in these days of shortages.



Car Radio Design

Following a brief description of the history of the car radio, general information is given on a practical up-to-the-minute design. Just two IC's are used, simplifying the construction.



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PART 7—GROUNDED EMITTER AMPLIFIERS

Continued from the April issue

Instead of deriving our bias from the collector of the transistor in question we can, as is shown in Fig. 49, directly couple the collector of the first transistor to the base of an emitter follower. Because the voltage at B follows that at A (apart from the forward voltage drop of Tr2's base emitter junction) there is clearly no difference if we decide to take our bias source as point B. It may not be clear, at this stage, why one should wish to introduce an apparently redundant stage but there is a very good reason. We have deliberately reduced the value of the feedback resistors so that the potential at B is quite a lot below midrail—it should be at about 1 to 1·5V. This is necessary for what is to follow.

We can connect up a microphone exactly as before and introduce a feedback decoupling capacitor as shown in Fig. 51. By measuring the amplified a.c. signal at the emitter of Tr2 you should see a signal comparable to that obtained from the single stage of Fig. 52. This would appear quite natural because we have only introduced an emitter follower. However we can go a step further as shown in Fig. 53. Any current flowing through R2 of the emitter follower must (in the main) have come from the collector circuit so if we introduce a resistor in the collector circuit of Tr2 we should see voltage swings across it. The value of R3 has to be carefully chosen so that there is sufficient scope for a symmetrical voltage swing about the quiescent voltage of the collector. We can now remove the feedback decoupling capacitor we previously used and substitute a much higher value capacitor between the emitter of Tr2 and ground (C1). At the same time we can drop one of the feedback resistors. This serves two purposes; C1 prevents feedback of signal to the base of Tr1 and allows any a.c. component of current flowing through R1 to pass readily into the base circuit of Tr2. In the absense of a.c. the biasing of the circuit is unaffected. By enhancing the a.c. component of base current into Tr2 we can get quite high voltage swings at its collector; in fact almost

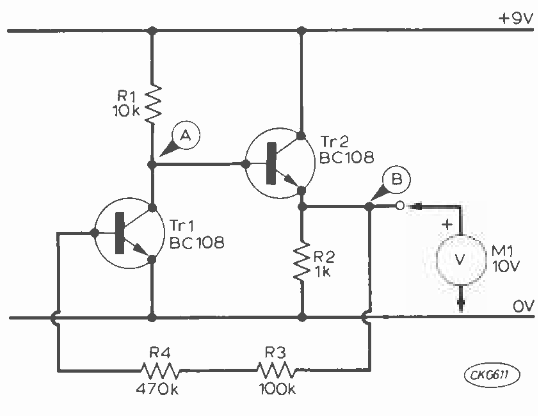

Fig. 49: Bias is derived from the output of the emitter follower.

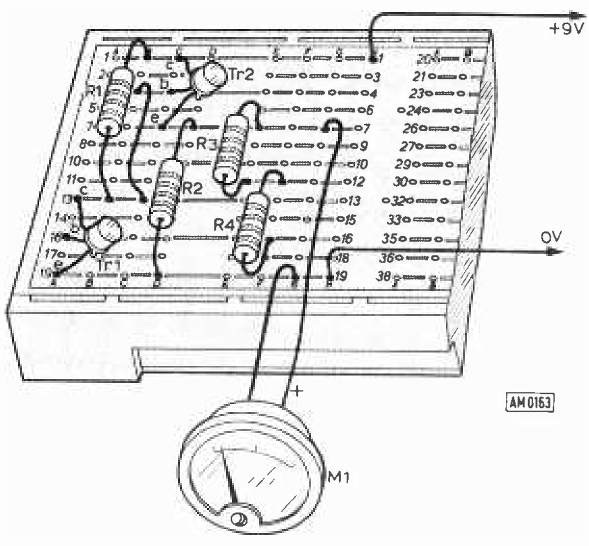

Fig. 50: Component layout for Fig. 49.

identical to those obtained from the previous two stage amplifier (Fig. 47). Notice, however, that there is a considerable saving in components. One advantage of deriving the bias in this way should now be clear.

Just as before, we can add on a current amplifying stage and produce an intercom amplifier having very similar characteristics to those we have already obtained (Fig. 55). It is still necessary to incorporate a degree of frequency correction with C4 across R4. You can experiment with different values to determine what effect C4 will have on the overall performance of the amplifier. Values should be in the range of 2,200pF to 33,000pF (0·033μF). The capacitor in this case is *not* introducing feedback (because all a.c. signals on the bias line have already been removed by C1); it is simply "slugging" the microphone and hence attenuating high frequency signals at source. Because of the high output impedance of the microphone it will have a much more dramatic effect on all frequencies in the spectrum but will reduce the amplitude of higher ones more than lower ones. Negative feedback, of a frequency selective nature, could be provided by a small value capacitor (say 2,200pF) between the collector of Tr2 and its base; try this as an alternative.

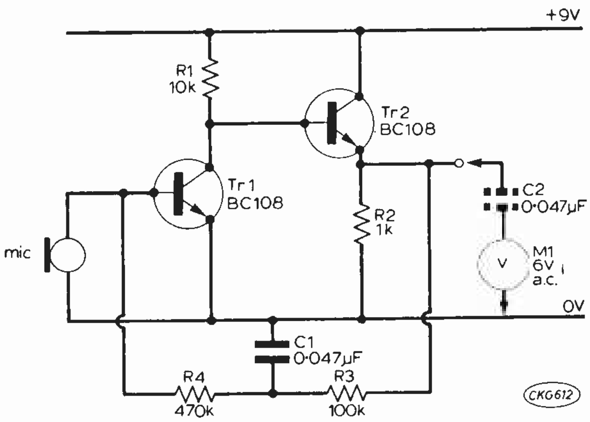

Fig. 51: The signal level at Tr2's emitter is comparable to that produced by the circuit of Fig. 45.

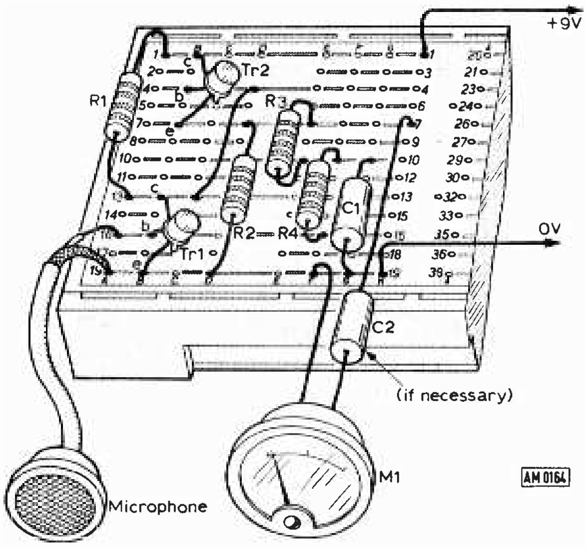

Fig. 52: Component layout for Fig. 51.

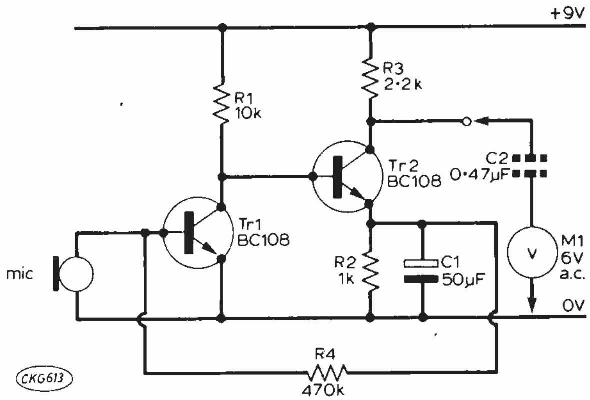

Fig. 53: The voltage gain of this circuit is similar to the first two stages of Fig. 47 but uses fewer components.

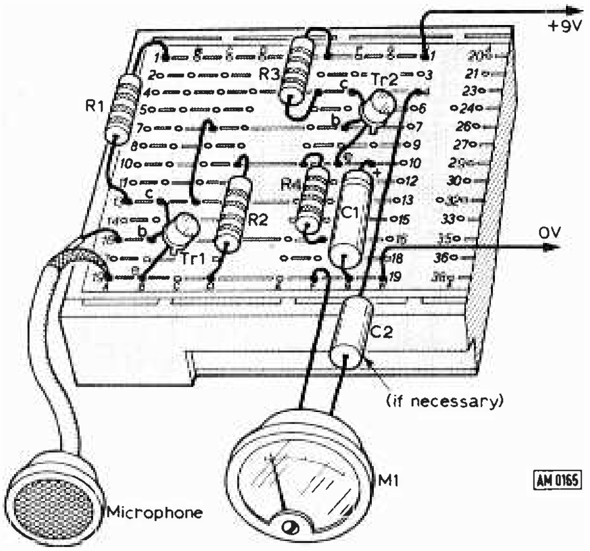

Fig. 54: Component layout for Fig. 53.

Although we have economised on components we still have not improved our degree of control over the voltage gain of the amplifier—it is still controlled by the transistors' parameters.

To produce a circuit that has a voltage gain virtually independent of the transistors' parameters we have to introduce a form of negative feedback. Apart from the frequency selective feedback we have just mentioned there is no other feedback in the circuit of Fig. 55 that controls the signal. There is, of course, feedback associated with the bias stabilisation but we have by-passed this as far as signal is concerned with C1. The simplest way to provide negative feedback that is not frequency selective is to use two extra resistors as in Fig. 57. These are R2 and R8. We have introduced a tendecy to making Tr1 an emitter follower so the voltage at point A will follow any signal at the transistors' base.

Say the a.c. signal at the base was to rise in a positive direction the potential at A will also rise to match it—thus trying to keep the base current in its original quiescent state. However, with the value of R2 it cannot track exactly and there is bound to be some variation in base current due to the a.c. signal. The mere addition of R2 reduces the gain of the first stage because of this interaction (a form of negative feedback) but the attenuation should not be too great. We can, however, take the considerably amplified—and phase reversed—signal at point B (collector of Tr2) and use this to provide current into the emitter circuit of Tr1 via R8. Because of the phase reversal this current will negate the base current. By adjusting the value for R8 we can inject more or less of this opposing current; the higher the current the more negative feedback we get for our signal and hence the lower the overall gain of the amplifier.

We call the raw gain of the two stage amplifier of Fig. 55 the *open loop* gain because no feedback is applied. Provided the open loop gain is very high there is a simple relationship that controls the voltage gain of the amplifier shown in Fig. 57; the gain is approximately equal to R8 divided by R2. Thus to make a high gain amplifier with no feedback use the circuit of Fig. 55 but to have the refinement of an amplifier having slightly less, but controllable, gain use the feedback circuit of Fig. 57. For example make R8 = 22kΩ and the voltage gain of the circuit is approximately 44; change R8 to 10kΩ and you slightly more than halve its former

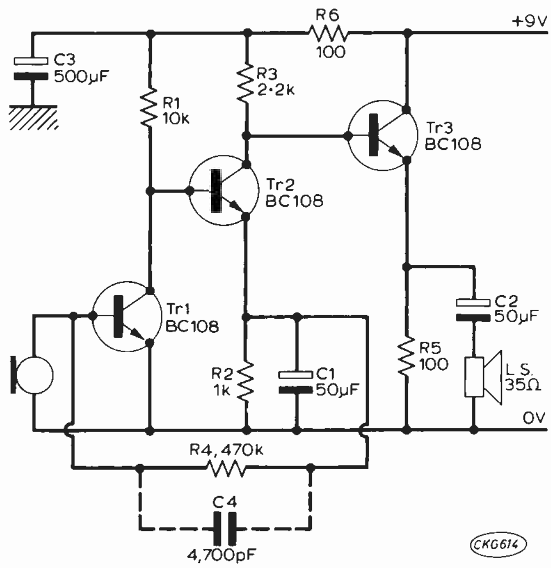

Fig. 55: This circuit has almost identical performance to that of Fig. 47 but is much more economic on components. Its gain, however, is uncontrolled and unpredictable.

gain. As before you can introduce a frequency selective element to compensate for the rising gain with frequency for the crystal microphone by introducing C4 across R8. Start with 2,200pF; the more capacitance you introduce the more you will attenuate the higher frequencies.

If you do not use C4 you can introduce a variable feedback control that will act as a volume control. Substitute a 2·2kΩ fixed resistor and a 100kΩ potentiometer in series for R8.

When making up the circuit of Fig. 57 note that we are now using a super alpha pair to drive the loudspeaker. This is to prevent the quiescent potential at B being influenced by the load of the output stage; this is obviously necessary because we are relying very much on the potentials at point B being what we expect! If wired up on Veroboard this circuit forms a very useful general purpose low power microphone amplifier for intercom or other domestic purposes.

Further thoughts

It is worth pausing a little to compare the simple feedback biased single transistor stage (last month) and the feedback pair. Obviously this month's circuit is somewhat more complex and hence more expensive to build so what are the pros and cons of the two alternatives we have come across so far?

The simple answer is "predictability of the performance". This includes both the overall gain and frequency response. The single stage can have a very high gain and this is set by the h_{FE} of the transistor together with the values of input and output impedance. Whether one is more interested in voltage gain or power gain one can juggle with the component values to give predominantly one or the other within reasonable limits. To some extent the frequency response can be controlled by the introduction of high frequency "roll off" capacitors between the bias feedback resistor chain and ground. So why bother to introduce the complexities of this month?

The problem is that one cannot ever be too certain what the h_{FE} of the transistor is going to be (in this series we are using mainly BC108 devices and in this single type number one can buy devices having gains ranging from 100 to 400). Hence the absolute gain of the single stage amplifier—which is proportional to the transistor's h_{FE}—is going to be pretty undefinable unless one is able to select a device with a precise gain. This is, obviously, not a practical

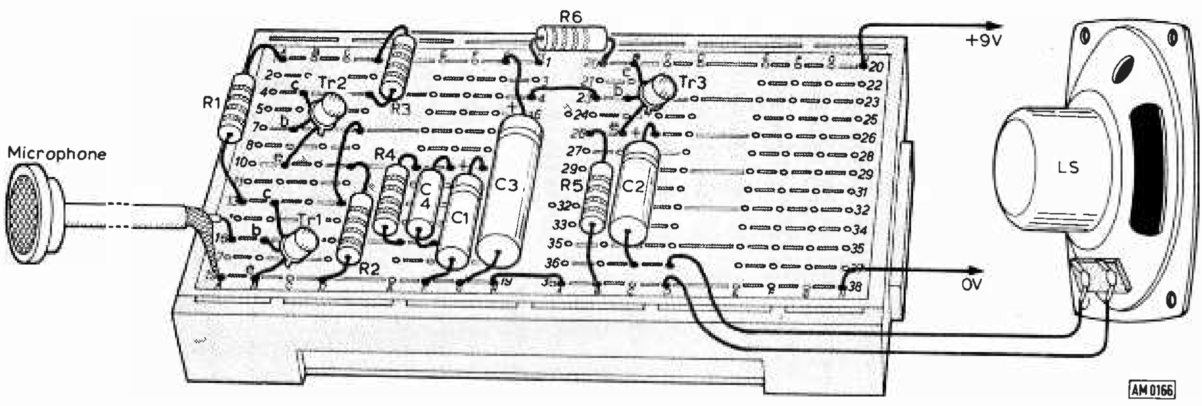

Fig. 56: Component layout for Fig. 55.

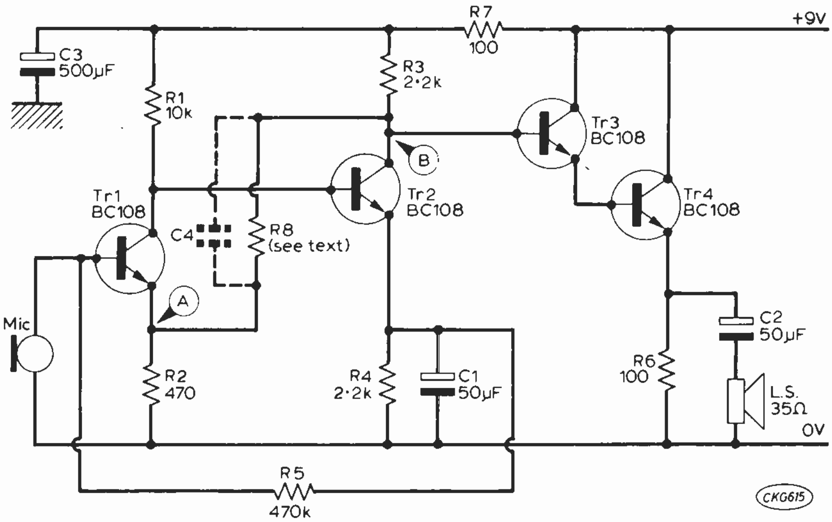

Fig. 57: A refined version of Fig. 55. The gain is set by the ratio of R8 with R2. R4 has a different value to increase the quiescent potential at Tr2's collector and a super alpha pair is used to drive the speaker—reducing the load on Tr2.

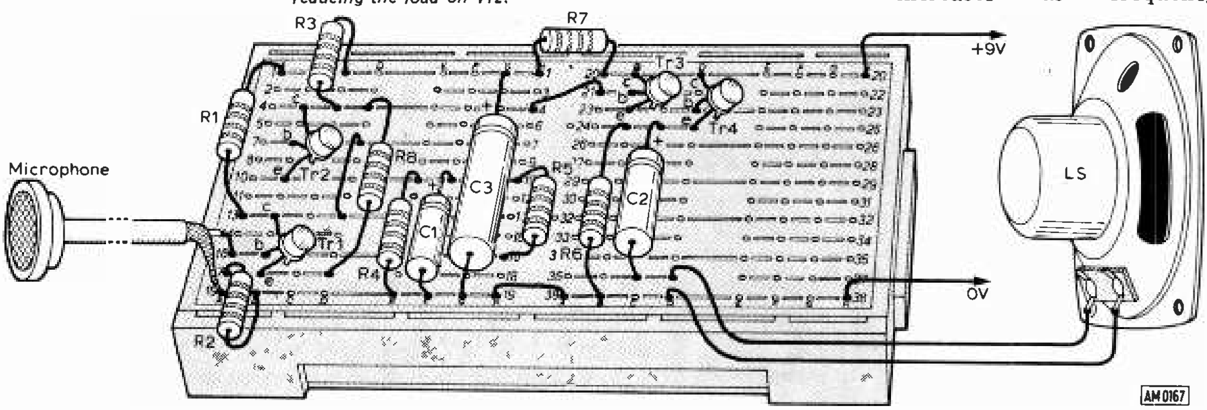

Fig. 58: Component layout for Fig. 57.

of course, always be considerably less than the "open loop" gain of the two stage circuit but this is usually no hardship. Thus, if one was using a magnetic cartridge (capacitively coupled to the base of Tr1 through a capacitor having a very low reactance compared with the output impedance of the cartridge) that gives an output voltage of, say 20mV at 1kHz, one could calculate the precise ratios of the feedback resistors to give a predictable output voltage of 100mV. In this case the gain required is 50 so the resistor ratio should be 50 to 1. Notice that we have stipulated the frequency because, of course, the output from a magnetic cartridge increases as frequency increases (by approximately a factor of 2—or 6dB per octave). This, however, is no problem because we can compensate for this and provide a "flat" output response by introducing a frequency selective component (or components) between the collector of Tr2 and the emitter of Tr1. This would take the form of a simple R C network that increases the amount of negative feedback by 6dB per octave to neutralise the rising response of the cartridge. Obviously care has to be taken in calculating component values—particularly when meeting certain rigid specifications such as the RIAA law—but this is not a major problem. A simple magnetic cartridge preamplifier and equaliser can be made from our basic circuit by replacing R8 with a 150kΩ resistor in series with a 10kΩ resistor and a 0·022μF capacitor across the 150kΩ device with 0·0068μF across the 10kΩ. The 150kΩ resistor goes to Tr2 collector.

A similar technique can be used to compensate for the low frequency losses associated with connecting a crystal cartridge to Tr1. In this case the losses at low frequency are caused by mismatching the high output impedance of the crystal with the medium input impedance of Tr1. The output signal from a

proposition. Just try going into a shop asking for a BC108 having a gain of exactly 165 and see the response from over the counter! On second thoughts perhaps you had better not! Having unpredictable gain means that you can never be sure that the circuit is going to be biased exactly mid rail and the result of this might mean that signals of one polarity are clipped by the transistor "bottoming" (going into full conduction) or "topping" (going completely out of conduction). Another effect from the same cause is that some transistors will give a very high output signal for a given input while others will give less. If you are making a preamplifier to go between a pick-up and a power amplifier that needs as input of 100mV for maximum output you can see that there could be problems. Admittedly this can be compensated for, to some extent, by the use of a volume control but one would hardly describe the amplifier as being of good design. Worse than this, though, there is the chance of never getting maximum power out on the one hand or overdriving the output stage of the power amplifier with horrible consequences to the output transistors!

This month's "feedback pair" circuit enables one to set the gain of the amplifier to a precise value—controlled solely by the ratio of feedback resistor to the emitter resistor of Tr1. The controlled gain must,

—continued on page 58

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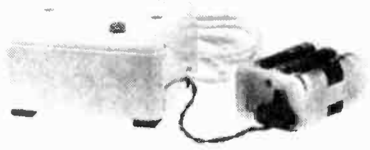

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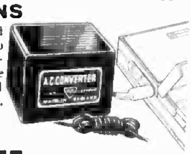

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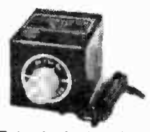

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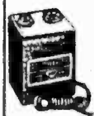

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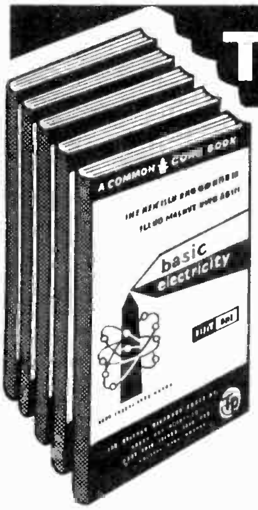

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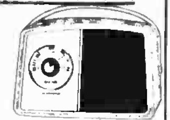

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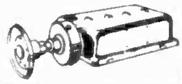

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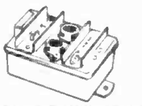

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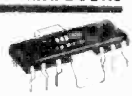

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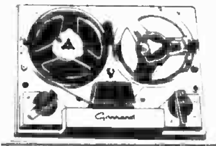

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E1210, 2½ + 2½ watts 12 volt	7·75
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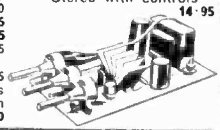

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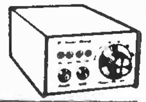

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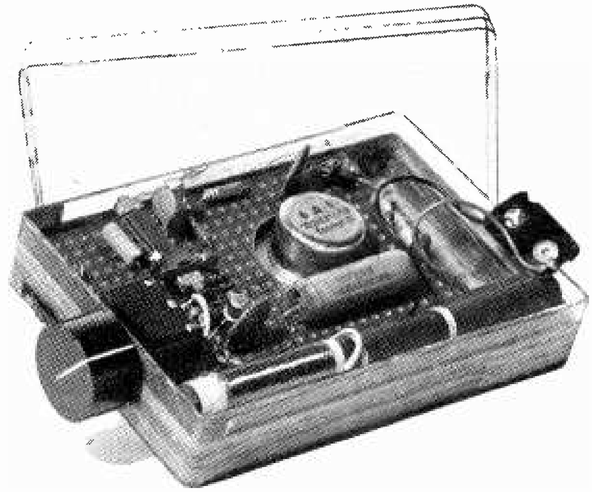


THIS receiver is designed to fit the pocket, having the tuning control and edge-operated potentiometer and switch at one end of the case, so that there are no projections elsewhere. It provides good volume. The actual external dimensions are $4\frac{3}{4} \times 3\frac{1}{4} \times 1\frac{3}{8}$in, and this allows easy construction without cramping of the components.

There are no alignment or similar adjustments, which helps to make the receiver a very straightforward project. It is completely portable, using a PP3 or similar small 9V battery.

The Circuit

This uses two IC's and a transistor, see Fig. 1. IC1 is the popular ZN414 "front end" network. The input is tuned by VC1, and the ferrite rod aerial L1 gives a frequency coverage of approximately 550-1600kHz. After r.f. amplification and demodulation in this IC, its audio output is taken to the audio gain control VR1. This has R2 in parallel, as small edge-operated potentiometers of the correct value to use alone here are not readily available.

The voltage for IC1 is derived from the potential divider R5, R3 and VR2. The 250Ω pre-set resistor VR2 and R3 in series give a combination which can be adjusted from 470Ω (R3 alone) to 720Ω (with VR2 at maximum value). This allows easy setting of working conditions for the IC. Though a nominal voltage of about 1·3V is usually satisfactory, changing the potential of the supply by even 0·1V can have quite an effect on results. VR2 thus allows compensation for the tolerances in the actual values of R3 and R5

Tr1 is a high gain audio amplifier, which supplies IC2 through C5. This IC has six transistors in a driver/push-pull circuit, with compensatory diodes, and a low standing current of only about 3·5mA. Its maximum output is up to about 250mA with a 9V supply and 16Ω speaker, which is easily sufficient for this type of receiver. By using a speaker of higher impedance, peak current is reduced, without much significant loss of maximum volume.

Circuit board

This is shown in Fig. 2. It should be cut so that it is a proper fit inside the case used. Approximately $2 \times \frac{5}{8}$in. is cut away to take the battery, and $1 \times \frac{9}{16}$in. for VC1. A hole about $1\frac{1}{8}$in. in diameter is cut to clear the magnet of the speaker.

As the board and case must fit correctly, it is as well to prepare both at the same time. VR1 is secured to the board with a small bolt, as in Fig. 2. A slot is cut in the end of the box or case, to clear this control. A clearance hole should also be drilled for the spindle of VC1, and two holes for the short 6BA bolts which secure this item.

An opening for the speaker can be cut, and subsequently covered with silk or similar material. Or a number of holes can be drilled to form a grille. The opening, or area covered by the holes, should be approximately the same size as the loudspeaker cone. When the case is finished, the speaker is fixed with adhesive.

The transparent box actually used was approximately $4\frac{1}{2} \times 3 \times 1$in. inside dimensions, but provided the parts can be accommodated there is no reason why this size should be used. Though boxes of this kind are reasonably strong, the material can be easily cracked when drilling or filing. To avoid this, use a sharp drill, and work with quite light pressure.

With the receiver shown, the front and sides of the box were covered with a single piece of silken material, fixed with adhesive round the edges only, and drawn tight. The lid of this box was completely removable, and formed the back. This section was left uncovered. When a clear, transparent box of this kind is used, it can if preferred be painted *inside*. This requires a household or similar oil paint. If applied with a soft brush, the appearance from the outside will be completely uniform.

When it is assured that the board will fit as in Fig. 2, with VR1 coming into position and projecting through the slot, the components can be added and wired. The board fits the case so that it does not have to be secured with screws or other means.

Components

Place these as in Fig. 2, noting the correct polarity of the electrolytic capacitors. It may be preferred to wire one or two as they are fitted, or to put them all in place, then turn the board over, and complete most of the wiring. The projecting wire ends can be spread out, to hold the components in place until they are soldered.

Fig. 2 also shows the underside of the board. Add insulated sleeving wherever necessary, and cut off excess leads.

The slider of VR2 is connected at one end by a short piece of thin flex, to allow adjustment. A small rotary pre-set is equally suitable. If a fixed resistor were to be used, with no provision for adjustment, it would be 680Ω, 5%. It would replace R3, and be connected from C3 positive to C3 negative.

★ components list

Resistors

R1	100kΩ	All ¼w 5%
R2	1kΩ	
R3	470Ω	
R4	2·2MΩ	
R5	3·9kΩ	
R6	8·2kΩ	
R7	10kΩ	
VR1	Miniature edge-control 5kΩ pot with switch	
VR2	Pre-set slide resistor, 250Ω	

Capacitors

C1	0·01μF
C2	0·1μF
C3	6μF 2·5V
C4	0·047μF
C5	2·5μF 6·4V
C6	0·02μF
C7	200μF 6·4V
C8	100μF 10V
VC1	Jackson Dilemin 300pF single variable
Tr1	BC109
IC1	ZN414
IC2	MFC4000B (C.T. Electronics, see advert)

2¼in. miniature speaker, 16 to 75Ω impedance. Ferrite rod approx. 4¼in. x ⅜in. diameter, 26 s.w.g. enamelled wire, Veroboard, Plastic box, Knob.

The IC's

Fig. 2 shows the connections to the IC's. Spread the *IN* and *OUT* leads of IC1, and bring the E lead in line between them, so that the three wires pass through the holes. Check that all leads are clear of each other, and solder.

IC2 has two long and two short tags, with a marked end for tags 1 and 2. The tags will fit the board as in Fig. 2. Leads are soldered to them.

Tr1 is fitted in a similar way, its wires being arranged to come through the holes as shown.

Prolonged heating must be avoided when soldering these items, and it should only be necessary to keep the iron in contact with the joint for a second or two.

Ferrite Rod Aerial

This is approximately 4¼in. long, and has 65 turns of 26 s.w.g. enamelled wire, side by side. One layer of fairly stout paper is put on the rod, and the winding is on this. It is possible to slide L1 on the rod, to modify band coverage, but this should not be necessary if the winding begins about ¼in. from the end of the rod.

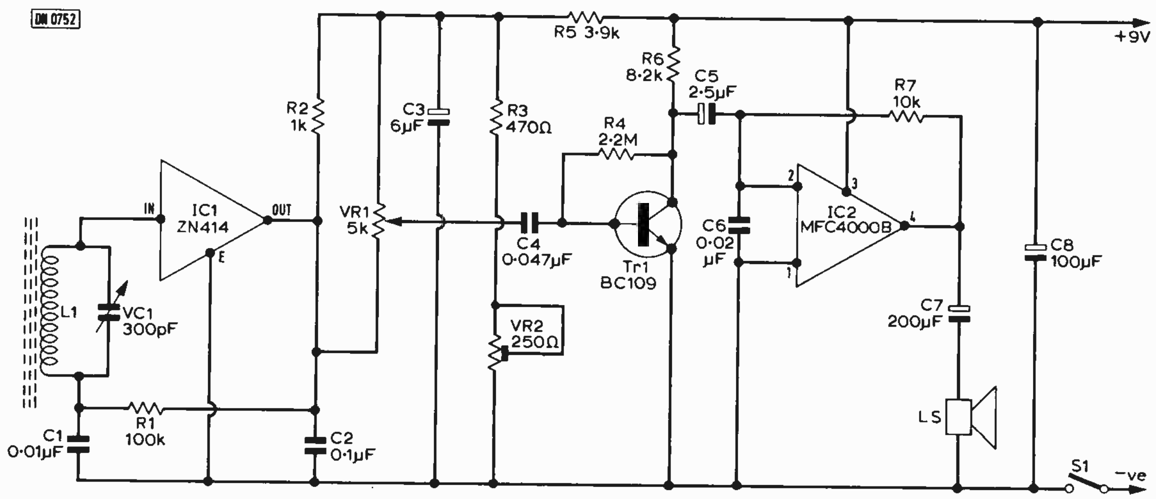


Fig. 1: Circuit of the Mini-Pop.

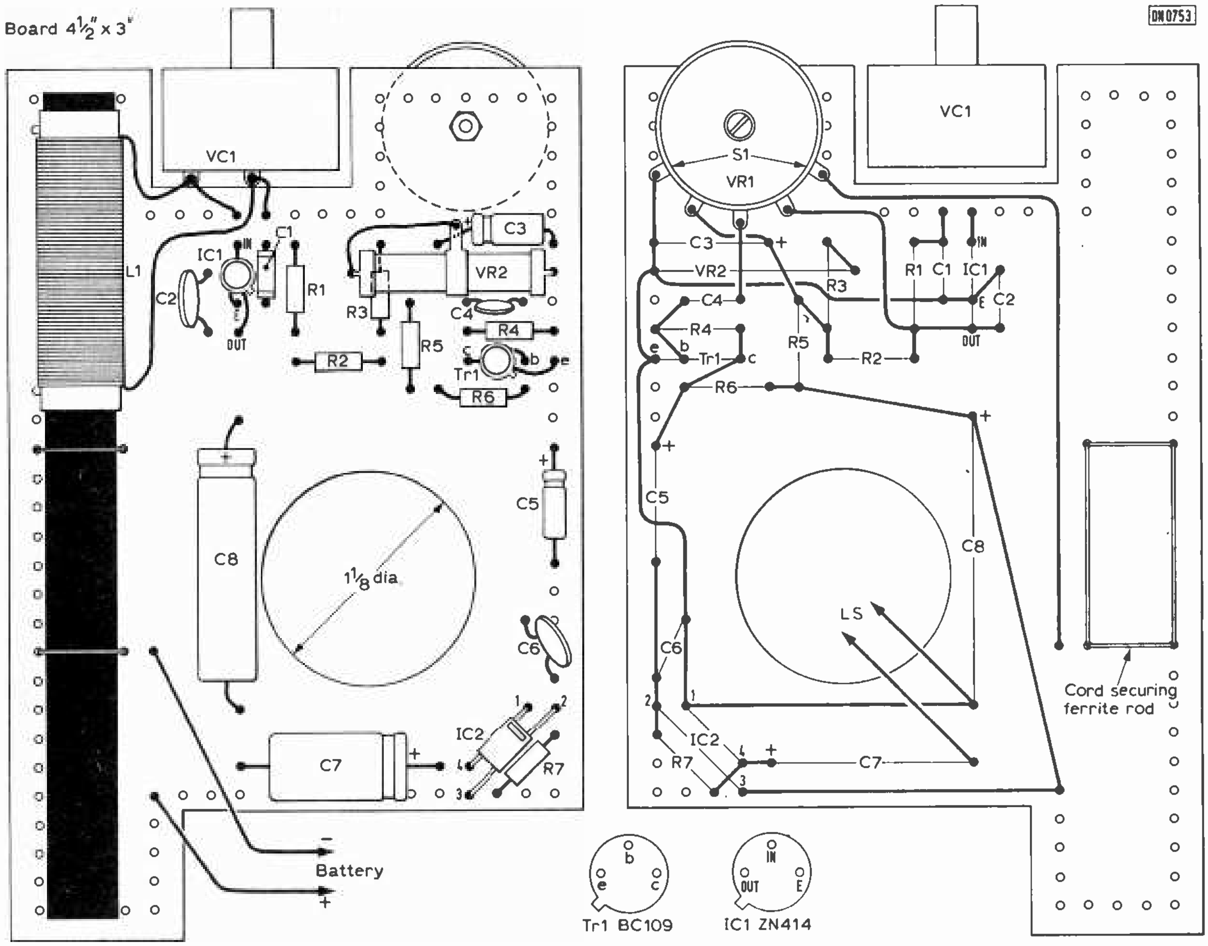


Fig. 2: Component layout and wiring. The circuit board is 0·15in. matrix plain Veroboard.

Adjustment

Results should be satisfactory with VR2 set at about its middle position. The potential across C3, as measured with a *high resistance* voltmeter, should be about 1·2V to 1·6V.

If the voltage is a little low, the receiver is likely to be lacking in sensitivity and volume. On the other hand, if the voltage is too high, whistles may arise at some frequencies, when tuning. The adjustment, and exact voltage, is by no means critical. Should VR2 be re-adjusted to compensate for a discharging battery, remember to move it back to its original position when fitting a new battery.

The ferrite aerial is directive, and this may prove of advantage, either to bring up the volume of a weak signal, or to help reduce interference from an unwanted transmission. Though a 16Ω speaker is recommended for IC2, it is quite practicable to use a speaker of up to 75Ω impedance. ■

EXPERIMENTAL WORKSHOP

—continued from page 53

cartridge (off load) is in the order of 100mV so, in theory, no extra gain is needed. Because of the mismatch one would only expect to get that sort of signal at high frequencies and considerably less at low frequencies. Hence we need to tailor the response of the pre-amplifier to have approximately unity gain at high frequencies and high gain at the bottom end of the spectrum. This is very easily accomplished by replacing R5 with a high value capacitor (in the order of 10μF) in series with a 4·7kΩ resistor. It might be necessary—at the same time—to attenuate the signal from the crystal cartridge with a potential divide circuit prior to capacitively coupling it to the base of Tr1.

These examples are just a couple of suggestions to show the versatility of the feedback pair. Although the single stage can give very good results, if you are lucky, the extra cost of the two stage circuit almost guarantees perfect results every time.

Next month we shall deal with the potential divide technique for biasing a transistor together with the grounded base amplifier.

(To be continued)

DRY BATTERY CHARGER

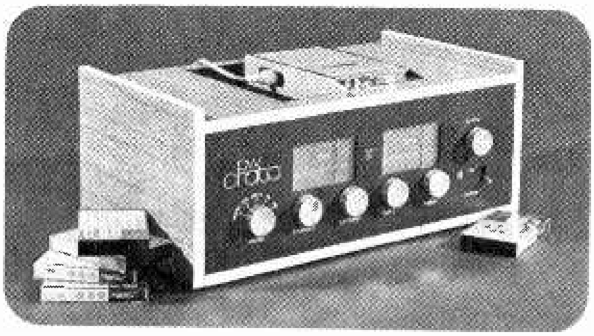
(MARCH '74 ISSUE)

The author has drawn our attention to the **charging current** levels which were given in the table on page 1058. These should have read as follows:

U2 50mA (min) 150mA (max)
U7 25mA (min) 100mA (max)
U11 25mA (min) 100mA (max)

CASSETTE RECORDER AND TUNER AMPLIFIER

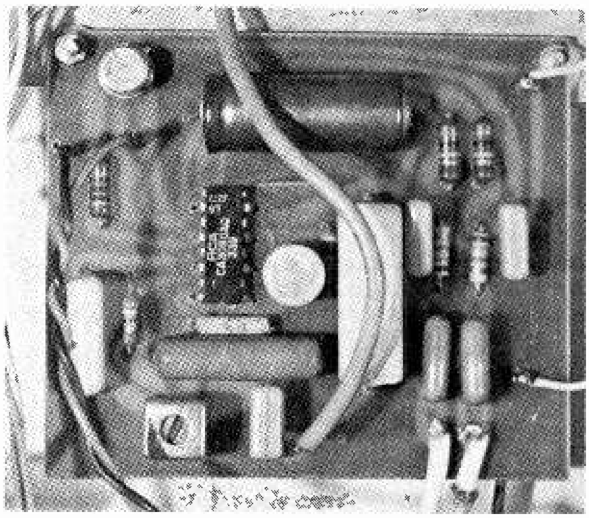
PART 3 RICHARD COLLIN



DECODER BOARD (UNIT 4)

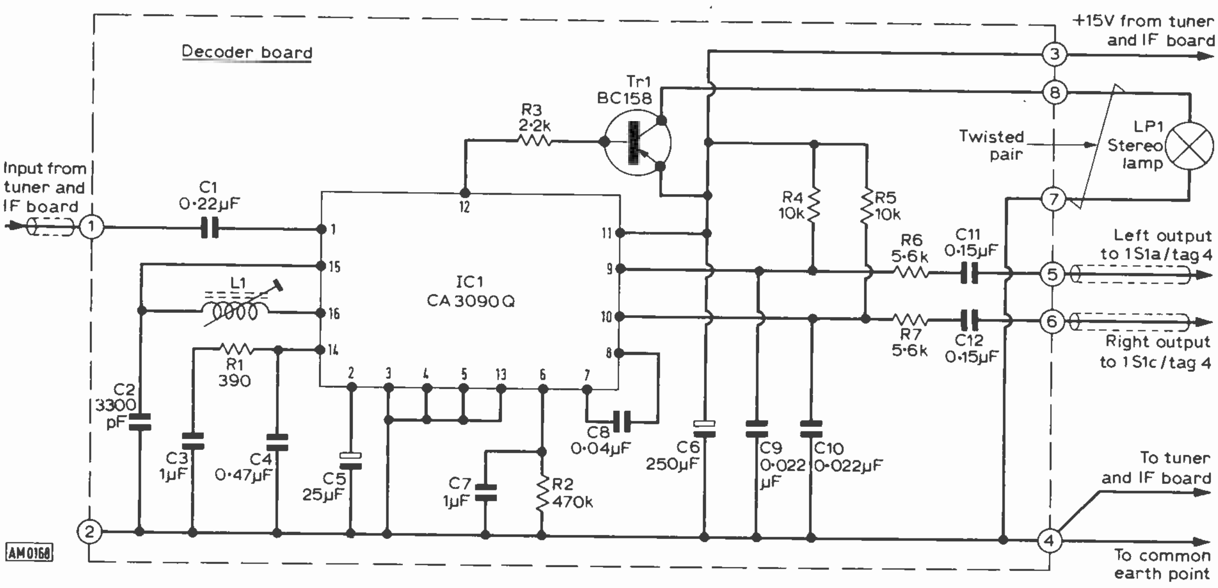
The stereo decoder section is designed around the RCA phase locked loop decoder, CA3090Q. This integrated circuit features low distortion, automatic stereo switching, a stereo beacon driver stage and requires only one tuning coil making alignment simple. An improved version, the CA3090AQ, is expected to be available in the near future. This offers improved stereo separation and lower noise, and may be used in this circuit without any other alteration to components.

De-emphasis of the audio signals is provided by R4/C9 and R5/C10, whilst resistors R6 and R7 are fitted to ensure that the volume level when switched to FM is comparable with that from other programme sources. Transistor Tr1 is used to switch the stereo indicator beacon, an LES lamp mounted in a small push-on holder which locates onto a tab provided on the dial backplate.



A view of the completed Stereo Decoder board. ▲

Fig. 14: Circuit of the Stereo Decoder using a phase-locked loop Integrated circuit. ▼



FRONT PANEL

The front panel is made from 3mm perspex sheeting. The prototype design incorporated two dial plates as shown in the layout drawing, Fig. 16. Some constructors may prefer to dispense with dials and associated drives. An alternative circuit giving preselected FM tuning appeared in Fig. 11. A 4-way push-button switch could then be mounted on the front panel in place of the dials. This is a matter of individual taste, as indeed may be the complete panel layout. It is important, however, that the general control positioning is followed since vastly differing layouts could lead to hum or instability problems.

When supplied, the perspex has a protective paper covering on each side and this is used to mark out the panel and also to mask areas for indicator lights and dials (shown shaded in Fig. 16) when the panel

★ components list

DECODER BOARD

Resistors

R1	390Ω	R5	10kΩ
R2	470kΩ	R6	5·6kΩ
R3	2·2kΩ	R7	5·6kΩ
R4	10kΩ	All ¼W 5% carbon film	

Capacitors

C1	0·22μF polyester	C7	1μF polyester
C2	3300pF polyester	C8	0·047μF ceramic
C3	1μF polyester	C9	0·022μF polyester
C4	0·47μF polyester	C10	0·022μF polyester
C5	25μF 25V PC mtg.	C11	0·15μF polyester
C6	250μF 25V	C12	0·15μF polyester

Semiconductors

Tr1 BC158
IC1 CA3090Q (RCA) (see text)

Miscellaneous

L1 Toko YXNS-30450-NK. LP1 14V LES
Printed circuit board Lampholder LES push-on

POWER SUPPLY

R1 1·5Ω 5W wirewound
C1 0·1μF 250VAC
C2, C3 2500μF 40V
D1—D4 44001 (RCA) or 1N4001
T1 240V: 25V 1·2A Drake Transformers Ltd., Cat. 294—140 (see note)
S1 SPST 250V 5A toggle switch with long dolly
F1 1A fuse with holder
N1 Neon indicator 240V

NOTE: Equivalent mains transformers are manufactured by:
Colne Electric Ltd., Cat. 20043
Gardners Transformers Ltd., Cat. GR97183

REAR PANEL

SK1 Insulated coaxial socket (FM Aerial)
SK2 Wander-plug socket (AM Aerial)
SK3 Min. 3 pin mains socket (Mains out)
SK4 Min. 3 pin mains socket (Mains out)
SK5 2 pin DIN socket (Right L.S.)
SK6 2 pin DIN socket (Left L.S.)
SK7 5 pin DIN socket (Mag. P.U.)
SK8 5 pin DIN socket (Cer. P.U.)
SK9 5 pin DIN socket (Tape Head)
SK10 5 pin DIN socket (Tape Recorder)

Notes:—
1. SK3/SK4 may be Bulgin P438 or similar.
2. 5 pin DIN sockets are 180° type.

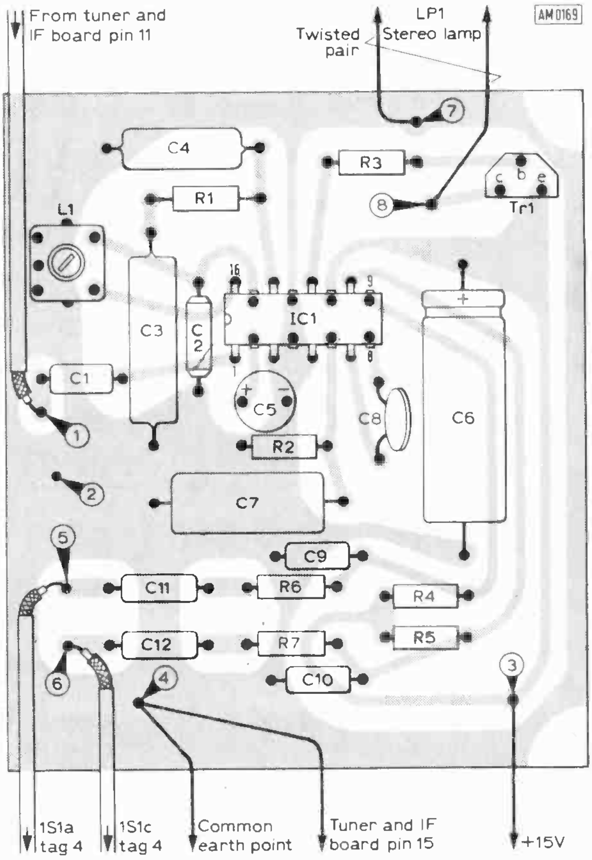


Fig. 15: Component location and printed circuit layout for the Stereo Decoder board. Both drawings are actual size.

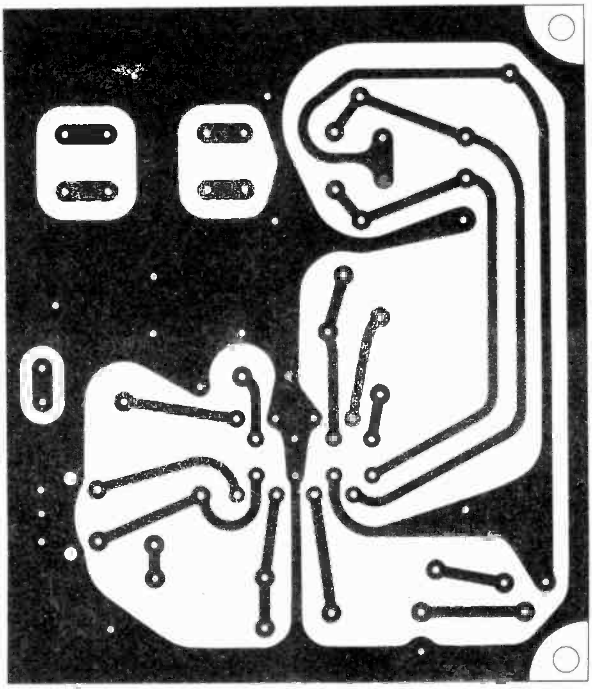
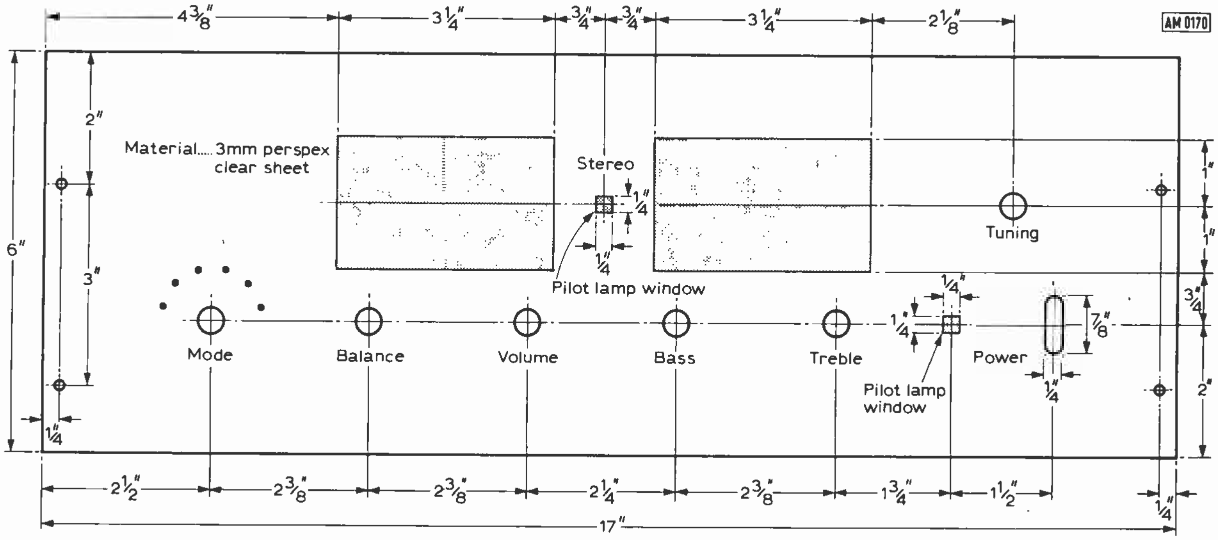
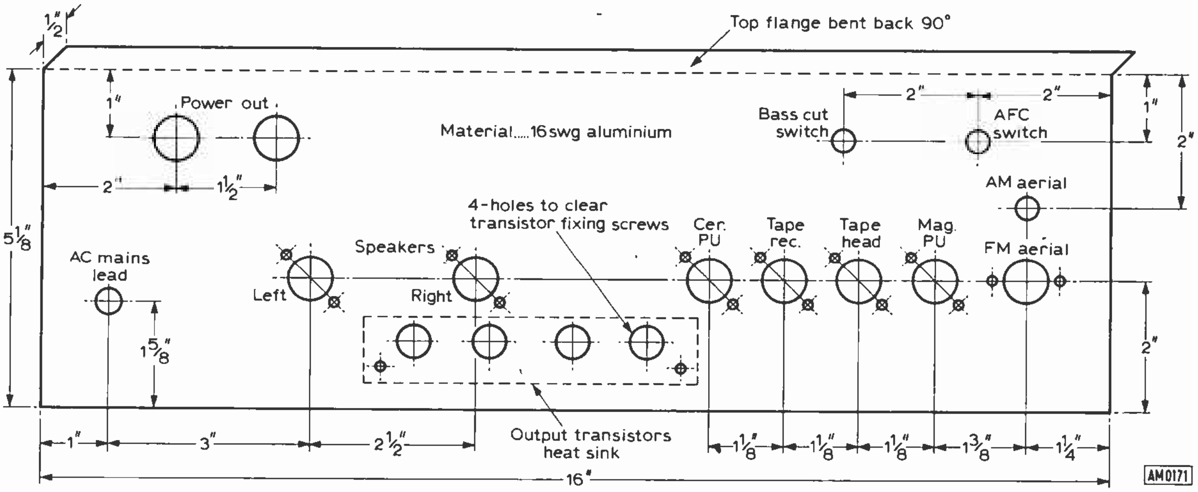


Fig. 16: Layout for the Front Panel showing positions of the controls and dial and pilot lamp windows.

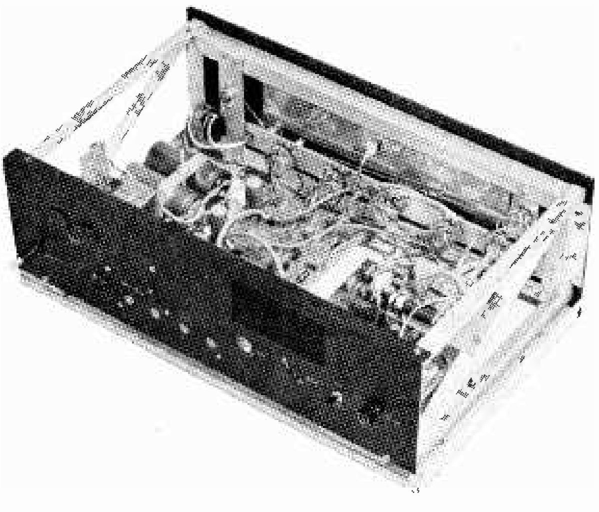


Holes should be drilled to suit components used



This rear view of the prototype shows the type of chassis construction used. ▼

▲ *Fig. 17: Layout of the Rear Panel which carries the input and output sockets and also forms the heatsink for the amplifier output transistors.*



is spray painted. After marking and drilling all holes the paper coating on the rear side is removed except for masked areas and several coats of cellulose paint sprayed on. The original was sprayed black.

After spraying, the front side paper coating should be removed (again except for the masked areas) and Letraset, Blick or other dry-print lettering applied. The finished panel should then be sprayed with Letracote-matt varnish to protect the lettering. The masking paper can then be removed. Pilot lamp apertures may be painted on the rear side with red or orange cellulose paint.

CHASSIS

The chassis is a skeleton framework made from aluminium strip and angle. A sheet aluminium rear panel, Fig. 17, carries the input and output sockets and also forms the heat sink for the power amplifier output transistors. The rear panel should be sprayed matt black and the various sockets labelled using Letraset.

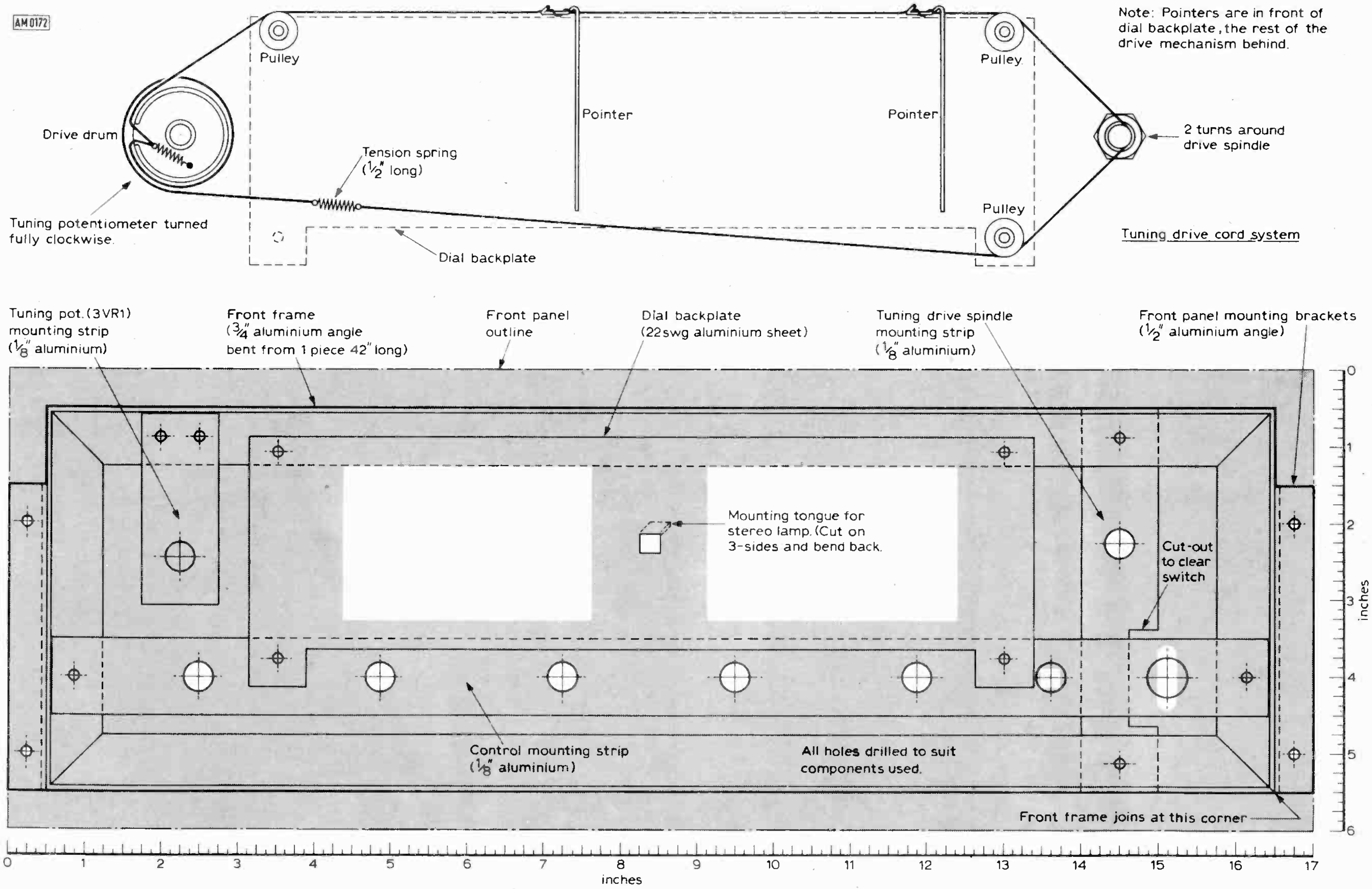


Fig. 18. Constructional details of the framework carrying the front panel and controls (shown half-scale) and the drive cord arrangement.

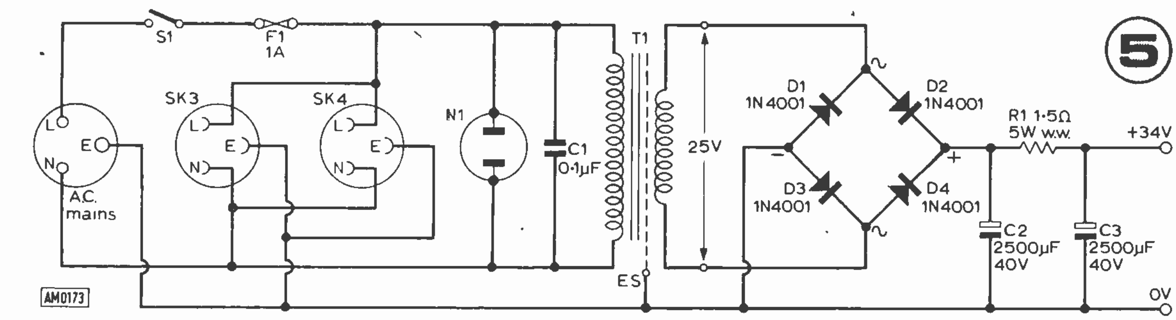


Fig. 19: Circuit of the Power Supply. C1 reduces interference from mains-borne transients.

On the prototype the depth of the chassis (front to back panels) was 10in. This dimension and the size of the cabinet should be adjusted to suit whichever cassette recorder is to be used.

The framework carrying the front panel, the tuning drive and the various controls is shown in Fig. 18. The dial back plate, which is made from thin sheet aluminium, is mounted on the bolts carrying the drive cord pulleys. It should be sprayed in the chosen colour and the scales marked with Letraset. Calibration is best done when the tuner is complete and functioning—that way the station markings cannot fail to be accurately placed. Note that the drive cord passes behind the dial back plate.

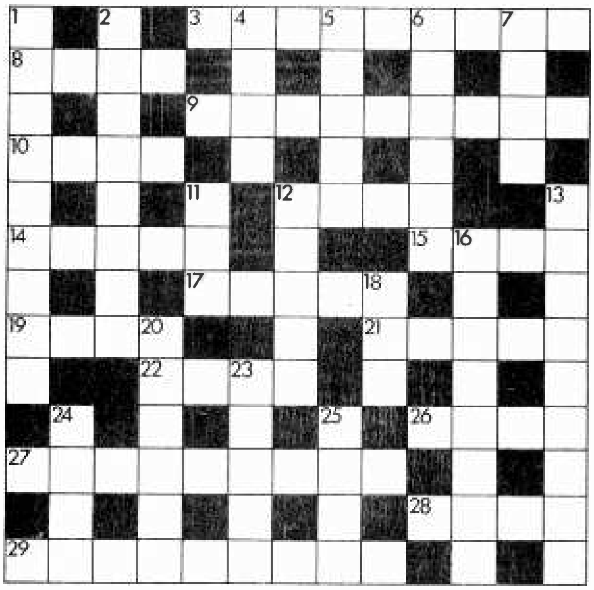
POWER SUPPLY (UNIT 5)

The power supply, Fig. 19, is mounted directly on the chassis using a 1in x $^1\!/_8$in aluminium bar running from front to back to carry the transformer and smoothing capacitors. The diodes may be mounted on a small printed board or tagstrip on or beside the transformer tagboard.

Sockets SK3 and SK4 carry switched AC mains out to the associated record deck or tape deck. The total load should not exceed 1A.

Our next issue will cover connecting up, testing and alignment

PW TECHNICROSS PUZZLE No.4



ACROSS

3 Serious parallels for such vibration? (9)
8 Simple to select four negative-feedback components? (4)
9 Orchestral extension measured in kc/s? (9)
10 Did a terminal fuse around that time? (4)
12 Such electrons currently at liberty? (4)
14 Rows about television screening (5)
15 Its wave's plotted without Latin! (4)
17 He's a king about such diodes (5)
19 Assumed superiority of some tuning? (4)
21 His F-layers lose weight but bear fruit? (5)
22 Echo metallic with a domestic connection (4)
26 Dwelling on such useless batteries? (4)
27 It turned the tables on the wireless! (9)
28 Champion fellow linked with the ends of radio (4)
29 Sort of circuit for the pick-up man? (9)

DOWN

1 Polar bear with it may be resistive! (5, 4)
2 Magazine that should be on tape? (8)
4 Bit of cheese in the choked amplifier! (4)
5 Do err in our switching instruction? (5)
6 Whispers that are audio-frequencies? (6)
7 Enthusiasts putting out feelers for old sets (4)
11 Employ Sue on distortion correction (3)
12 Bordering on a picture with such an aerial? (5)
13 Welcome that means a signal success (9)
16 They urge us into radio-activity? (8)
18 Scotsman in multi-antennae manufacture (3)
20 High in the charts with such a sound! (6)
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FOR AMUSEMENT ONLY
ANSWERS NEXT MONTH

Oscilloscope techniques

PART 3 ALAN AINSLIE

Y DEFLECTION

It is normal practice to amlify the Y signal before applying it to the deflection plates. Fig. 1 shows a simple AC amplifier that provides an asymmetrical output. This means that special measures have to be taken in the design of the CRT to avoid trapezium distortion. However, the circuit is not quite so simple as it looks and a stray capacity (plus CRT plate capacity) of well over 30pF may exist between the anode and earth. At 1MHz this stray capacity would take 25mA if the tube were being driven with 150V. This situation can only be improved by reducing the anode load, and increasing the current to maintain output, so that it is negligible in comparison to the reactance of this stray at the highest frequency of interest. This is only possible, within reason, as the anode current gets very large. Therefore this amplifier is capable of results only up to a maximum of a few MHz.

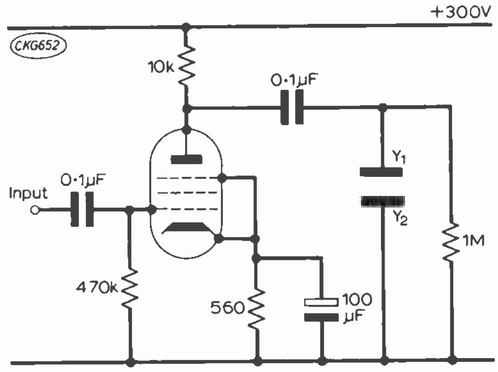


Fig. 1. Simple AC amplifier with asymmetrical output, not recommended for scope use.

There are several methods of producing true wide band performance and we shall look at these shortly after considering how we might modify the circuit to produce symmetrical deflection and be DC coupled.

DC AMPLIFIERS

DC coupled amplifiers along the lines of the cascode AC amplifiers are not really successful due to drift causing the trace to shift as if varying DC were being applied to the input. Balanced amplifiers are therefore used which balance out any drifts and also provide symmetrical deflection. Simple oscilloscopes have need for only moderate gain and the circuit of Fig. 2 is fairly typical. V2 and V3 form a phase splitter and each valve drives one deflector plate. V2 grid is undriven except by the shift control and this can be calibrated directly in volts of shift. The grid of V3 is driven from V1 in a normal manner and the input applied to V1 grid. The 2kΩ preset varies the sensitivity of the amplifier enabling a certain height of deflection to be achieved for a given input. It does not change the calibration of the shift control. Several laboratory scopes use calibrated shift controls as well as graticule measurement and we shall shortly discuss the calibration of such a system.

It is common practice to use a cathode follower input stage driving the first valve, and to arrange the circuit between positive and negative supply rails to ensure that shorting the input does not shift the trace and also to reduce influence from supply variations. Usually more amplification follows after the phase splitter. Fig. 3 shows the input stages of an EMI WM16 scope. The phase splitter is V3 and V4, V3 being the driven valve. The two outputs are fed to further amplifiers including a distributed amplifier before being applied to the tube.

Fig. 4 shows the general arrangement of a high quality Y amplifier system. In a large complex oscilloscope the components to the left of the dotted line would be constructed on a small plug-in chassis, allowing great flexibility. The signal level at the dotted line is about 0·5V each side of zero.

The circuitry of a plug-in of high quality (rise time 5ns) is basically very simple, the signal levels being fairly low. In fact the simpler the circuit the better the chance of good HF performance as complicated wiring only introduces stray capacities.

ATTENUATORS

The input is fed through a high frequency connector to the AC/DC switch which allows for DC blocking of the signal if required. The basic sensitivity of the Y channel is generally about 50mV/cm and the input capacitance looking into the cathode follower plus strays may be 20pF. In order to reduce the sensitivity an attenuator is interposed between the cathode follower and the signal. It is important to keep the DC input resistance constant, usually 1MΩ, and the capacity constant so that external probes can be used.

Fig. 5a shows a typical attenuator in the direct, most sensitive range, and at a divide-by-10 position, Fig. 5b. The attenuator is switched at the point A by a low loss, carefully screened, low capacity switch. Often, after a few years of dust has accumulated, the attenuators need setting and the following method is recommended.

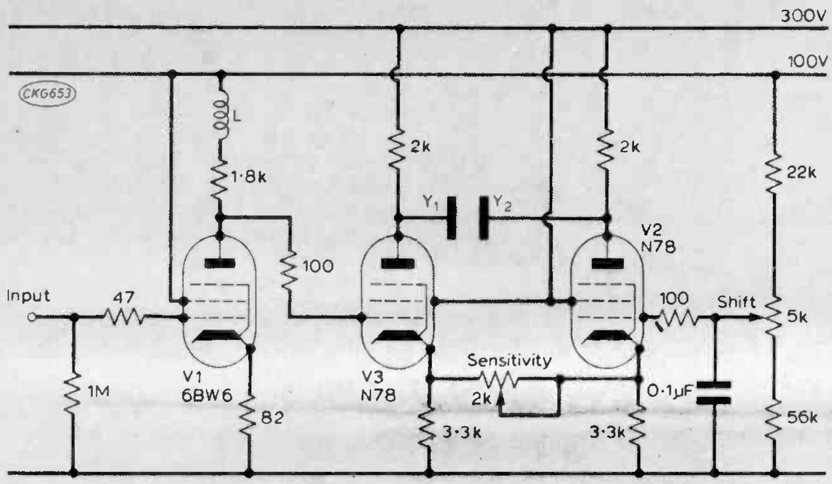


Fig. 2. Symmetrical amplifier, DC coupled, with shift and sensitivity controls.

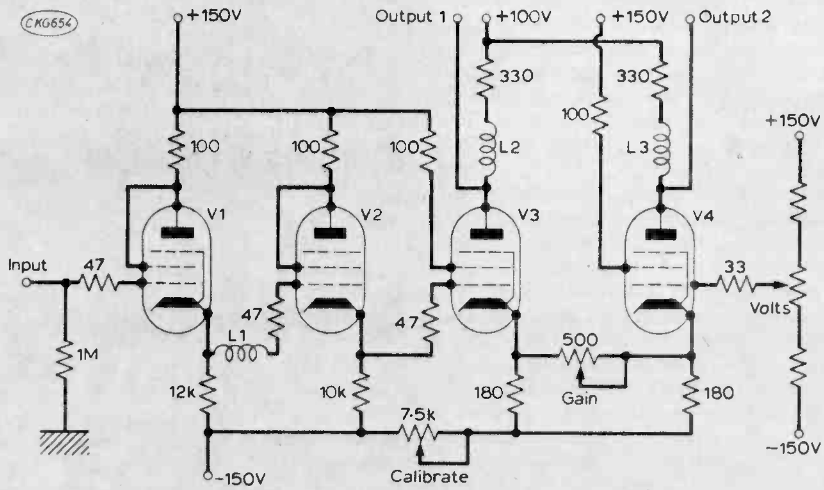


Fig. 3. Cathode follower input stage as used on EMI WM16 scope. A balanced power supply is also evident.

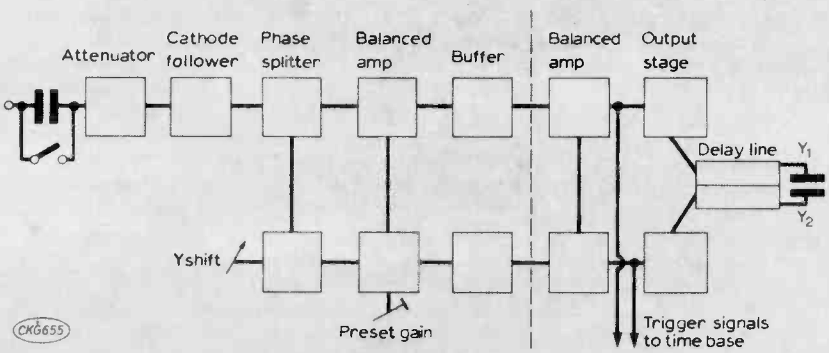


Fig. 4. Block diagram of a complete Y amplifier system, the stages to the left of the dotted line probably being in the form of a plug-in unit.

C1 is to compensate for changes in circuit capacity if V1 is changed, but rarely needs attention. The resistors are usually fixed and so no adjustment is needed here, the values can be checked as the input resistance is the sum of the divider resistors, i.e. 1MΩ. Any range giving other than 1MΩ is faulty and one or other of the resistors must be replaced. The series variable capacitor is then set on each range to give zero overshoot or rise deformation of a 1kHz square wave of good (less than 1µsec) rise time. If one starts at the "direct" position it is possible to check the fidelity of the square wave as applied.

When all the series trimmers are set for good square waves then the trimmers marked as C2 should be set. This involves measuring the input capacity on the direct range and adjusting C2 on the other ranges to give the same value. This capacitance is small, 25pF, and in parallel with 1MΩ is difficult to measure. However one can set up a

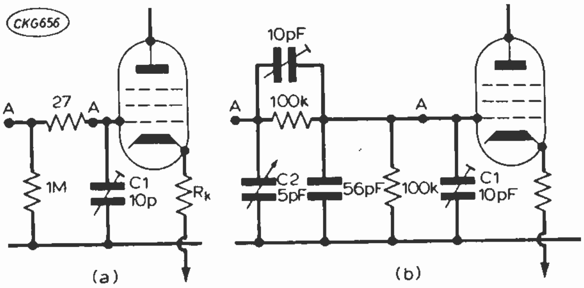


Fig. 5. (a) A simple direct attenuator and (b) a ÷10 attenuator with compensating capacitors.

10:1 or, even better, a 50:1 probe to give correct results on the direct range. C2 can then be set on each range for the fidelity of the square wave. The only snag is the high voltage needed for the high voltage ranges to give a reasonable deflection but in the absence of the proper gear this is the best that can be done.

Not all attenuators are built in this manner, where individual sections are switched in, but in a manner where the sections are interdependent. These attenuators usually tap the signal off a 1MΩ chain of resistors and the capacitor settings are interdependent. It is best to obtain a manual if readjustment is necessary.

The attenuator feeds the cathode follower which is arranged between symmetrical supply lines to help eliminate drift. The cathode follower and phase splitter are arranged as in Fig. 3. The small anode loads and L1, L2, L3 maintain a good HF response. The balanced amplifier and buffer (usually a cathode follower) are fairly conventional with the addition of a few coils to help the HF response. The coil is arranged to resonate with the stray it is introduced to overcome, at a frequency higher than the required −12dB point. Care has to be taken to ensure that transients do not cause ringing and the criterion for good transient response is that the response curve should have a "Gaussian" fall-off. The −12dB point then occurs at twice the frequency of the −3dB point. In this way the amplifier will show no ringing on transients and consequently most high grade amplifiers are tailored to this requirement.

GAUSSIAN FALL-OFF

For a perfectly gaussian response the result obtained earlier that Rise Time×Response=365 is found to be untrue and the true figure for the product is 350. However this gives erroneous results in several cases where the rise time and bandwidth are measured separately. The product of the two values is usually found to be about 365 and so this value is taken for most calculations. Most practical amplifiers produce the required gaussian fall-off, but, if not, can easily be tailored for the required performance. Small inductors and capacitors are used, these being adjusted so that a known "good" pulse (say a 500kHz square wave, rise time less than 10ns) produces no ringing. This condition gives the fastest rise time as well and so ringing of transients in a wide band amplifier may be an indication that the response is not as it should be.

One other factor is the delay of the amplifier and this must be considered for all frequencies significantly within the pass band. Fortunately we do not need to worry too much about the delay changing with frequency as the adjustment to a gaussian fall-off produces the required group delay characteristics.

While discussing frequency relationships within the amplifier it is perhaps as well to consider non-linear HF distortion. This is usually noticed as an inability of the amplifier to produce more than a small deflection at a high frequency regardless of how large an input is present. The effect usually occurs outside the normal pass band of the amplifier, but is worth having in mind when using a wobbulator (FM oscillator, deviated by the time-base) to check responses of external circuits as the amplitude of the trace may have a bearing on what is presented on the screen.

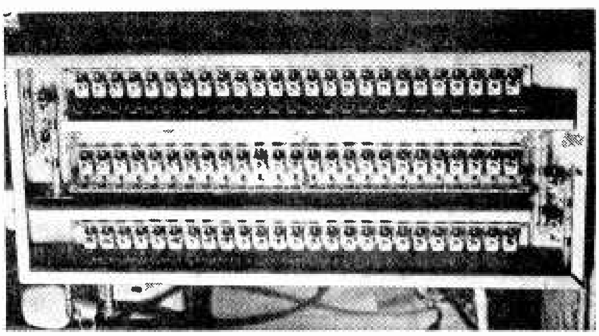
Y DRIVE CIRCUITS

We now come to consider the business end of the Y amplifier, the CRT driver circuits. These are always housed in the main frame of a plug-in type of oscilloscope as they are rather bulky and the shortest possible leads to the Y plates are required. Narrow band oscilloscopes, say up to 5 or 6MHz, use conventional output stages with low anode loads and peaking coils. The anode current to produce the 30 or 40V output needed is rather high. Typical valves used are ECC88, but they are rather overrun. A large DC signal may cause heating of the valve electrodes and a shift of the trace as the valve characteristics change. This effect is also present in the early balanced stages, but is not nearly so bad as in this type of output stage. However suitable feedback between the halves of the output stage can reduce the effect to an acceptable level.

To obtain 30 or 40MHz bandwidths by the above method of balanced single output stages would be pretty hopeless and so use is made of the distributed amplifier, a transmission line with gain, if one likes to think of it that way.

DISTRIBUTED AMPLIFIERS

Fig. 6 shows the general arrangement of a balanced Y amplifier. The valves are effectively in parallel from a DC point of view. If pentodes are used the screen grid is taken to the positive supply in the normal way. The anode and grid lines form delay lines and the mode of operation is to make the wave velocity the same in each line. The velocity is dependent upon the inductance of the lines and the capacitance at each stage, the valve anode or grid capacity.



A 79-section 170ns delay line showing capacitors for adjusting line impedance and velocity.

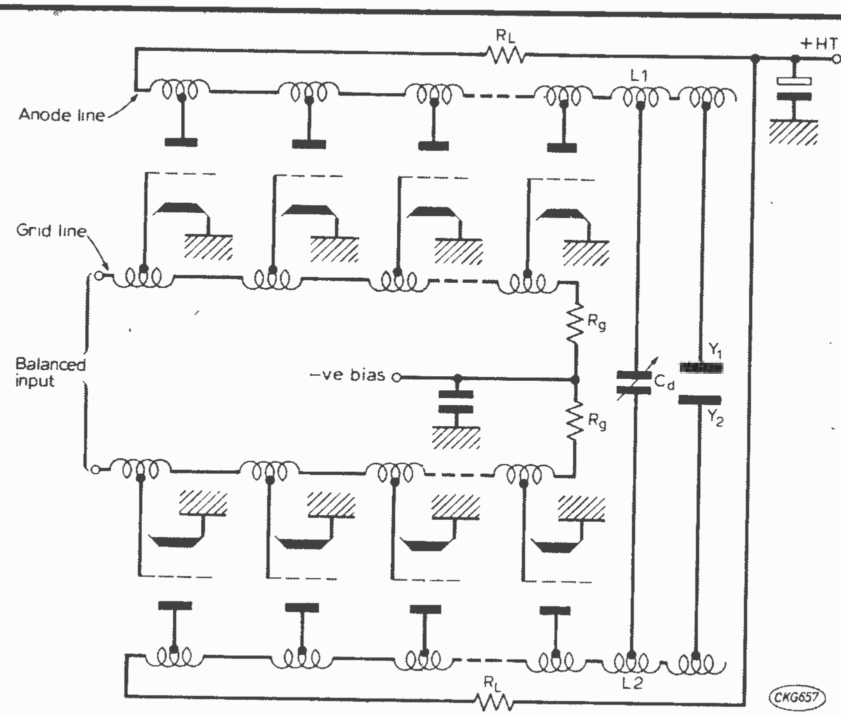
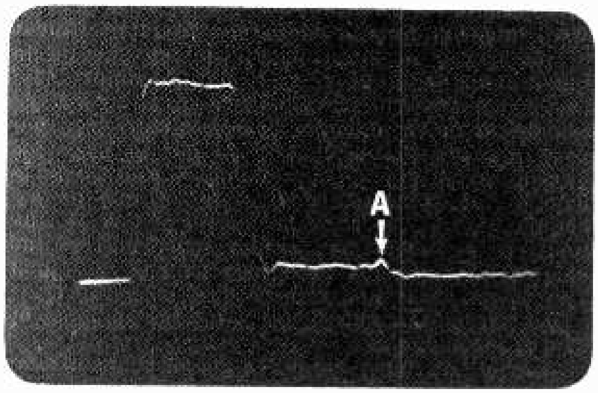


Fig. 6, left, Basic circuit of a distributed amplifier with the grid and anode lines forming delay lines.

The photograph below shows a 100ns width pulse on a wide band oscilloscope. The ripples on top of pulse are due to delay line and attenuator reflections. Pulse A is reflection of the pulse generator falling edge in the connecting cable. Rise time is less than 8ns corresponding to amplifier bandwidth in excess of 45MHz.



By providing trimmers to earth the lines can be tuned to give the same velocities, shown by the best response to a pulse. With a large number of stages, say more than five, then a gaussian fall-off occurs and very good pulse response is possible not limited so much by the valve capacitances as by the adjustment of trimmers.

The value of RL is such that the wave, reflected at the open circuit CRT end of the line is absorbed on reflection, is therefore equal to the impedance of the line, usually about 250 ohms. Rg similarly loads the grid line to prevent reflections.

L1, L2 and Cd do not form part of the distributed amplifier but show how the anode lines may be extended to form a delay line. The delay line is made up of sections such as this, carefully sealed from dust and terminating in the CRT plate capacitance. The delay obtained may be several hundred nanoseconds, but a usual figure is a total delay of 200ns, 30ns in the distributed amplifier and 170ns in the delay line. Generally about 2 or 3ns delay is given per section (i.e. one L1, one L2, one Cd).

The delay is used to enable the timebase to start up before the appearance of a fast transient and so triggering is taken from the amplifier driving the grid lines, usually by a cathode follower to minimise loading. The effect of a mistuned delay line is that internal reflections may occur due to changes in impedance and the rise time may suffer. The latter effect is obvious if the rise time is not meeting specification, but the first fault causes a small ripple on the top of a displayed fast square wave (500kHz). The delay line trimmers nearest the CRT plates affect the leading edge and the trimmers further back affect later portions of the pulse.

If a pulse generated from a reliable generator and correctly terminated shows this type of distortion the first step is to measure the time from the pulse edge to the ripple using the scope timebase calibration.

This time is then halved, because of the reflection, and the number of stages of delay back from the CRT plates is determined from the time per section (found by dividing total delay as quoted in the manual by the number of stages assuming 2·5ns per section). The trimmers in this region can then be touched with a metal screwdriver, taking care not to turn them and the presence of the screwdriver will cause a hump or dip to appear in the top of the displayed 500kHz square wave. The trimmer needing adjustment can be located when the screwdriver increases or decreases the fault. The trimmer is then trimmed with a plastic trimming tool, and all should be well. It is not advisable to play with delay lines as once upset they can take hours or days of hard work to sort out.

FAULTS

Sometimes failure of a valve in the distributed amplifier can give rise to reflections indicating a faulty delay line or distributed amplifier line. Before

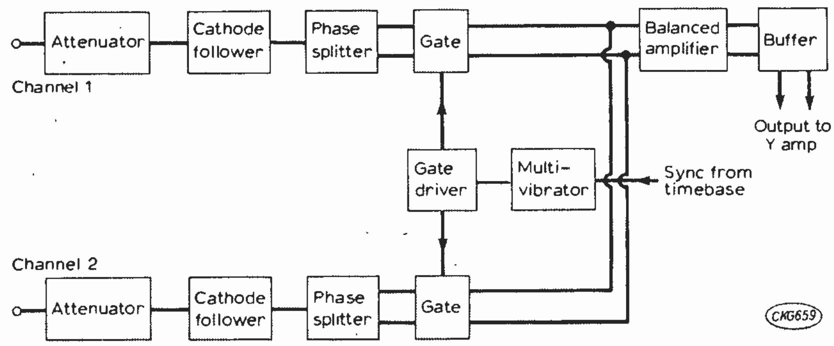


Fig. 8. Block diagram of the main features of a dual trace switching unit.

making any adjustments to the lines it is best to remove each of the amplifier valves in turn. The faulty valve when removed will clear the fault. An ideal pulse to display when making these adjustments is the timebase "bright up" or gating pulse, with the timebase on a suitably fast range. When a valve is replaced in the distributed amplifier it may be necessary to make a small adjustment to that valve's anode trimmer capacitor, and possibly to the trimmers on either side, but not to any more.

It cannot be emphasised too much that the delay line and distributed amplifier should need only small adjustment very rarely indeed. Playing about will only result in hours of work, possibly requiring the scope to be returned to the manufacturers for a major overhaul (probably costing £50 or more).

DELAY LINES

The advantages of a delay line for pulse work are many, the main one being that a signal can trigger the timebase, and then, when it is running, the signal arrives at the Y plates. There are several good scopes around of quite wide bandwidth, but lacking a delay line, and so are limited in their applications to pulse work. However coaxial cable can be used for delay purposes. Standard 70 ohm cable is suitable and has a wave velocity factor of about 0·66. This gives 195m of cable for a 1μsec delay or, for the more usual 250ns delay, a cable length of 48m, which can be conveniently bought as a 50m drum of cable and left coiled on the drum.

It is necessary to load the cable at either the scope or source end with a 70 ohm resistor to prevent reflections. In use, one end of the cable is plugged into the scope input socket and the signal is applied at the other end. The timebase is set to external trigger and the trigger lead is connected to the source end of the cable. Fig. 7 shows the general idea which although it seems crude is a useful method of obtaining a constant delay without upsetting the input wave.

BEAM SWITCHING

We have so far considered only a single beam Y deflection system. Often two traces are required simultaneously and the obvious method would be a double beam tube and two Y deflection systems. In the light of the above discussion two distributed amplifiers and delay lines would cost a lot of money and the time taken in adjustment would be enormous, not to mention 36 Y output valves (9 valves per half section)!

Usually wide band scopes employ beam switching techniques where two signals are displayed

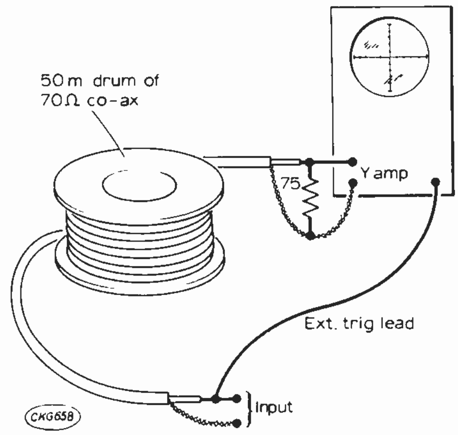


Fig. 7. Set-up using a 50m drum of co-axial cable as a simple delay line.

alternately. The Y amplifier requirements are the same as for single trace operation and so one good amplifier can be built into the main frame and a dual trace plug-in used.

Fig. 8 shows the bare essentials of a dual trace unit the heart of which is the multivibrator. In the simplest mode of operation the multivibrator changes state during each flyback period, triggered by the sync feed. For each scan the multivibrator is in alternate states and the gates alternately open and close. When CH1 gate is open CH2 gate is closed and the CH1 signal is displayed. On the next scan CH2 is displayed and so on. By manipulating the separate shift controls two separate traces are seen.

At fairly low timebase sweep rates the traces are seen to alternate and this is known as the "alternate" mode or just ALT. To overcome the flicker the multivibrator can be free run at 100kHz or so. Thus CH1 and CH2 signals are displayed in quick succession. This method, called CHOP is useful at all sweep speeds but especially at low sweep speeds where the ALT mode produces flicker. The display is simultaneous in real time up to the switching speed, but sometimes beat effects occur with the switching waveform and in these cases ALT is used.

To be continued

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⅓W Mullard CR25 carbon film—very small body size 7·5 x 2·5 mm.
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Power watts	Tolerance	Range	Values available	Price 1–99	Price 100+
¼	5%	4·7Ω–2·2MΩ	E24	1p	0·9p
⅓	10%	3·3MΩ–10MΩ	E12	1p	0·9p
⅛	2%	10Ω–1MΩ	E24	3·5p	3p
½	10%	1Ω–3·9Ω	E12	1p	0·9p
½	5%	4·7Ω–1MΩ	E12	1p	0·9p
4	10%	1Ω–10Ω	E12	6p	5·5p

Quantity price applies for any selection. Ignore fractions on total order.

DEVELOPMENT PACK

0·5 watt 5% Iskra resistors 5 off each value 4·7Ω to 1MΩ.
E12 pack 325 resistors **£2·40.** E24 pack 650 resistors **£4·70.**

POTENTIOMETERS

Carbon track 5kΩ to 2MΩ, log or linear (log ¼W, lin ½W).
Single, **12p.** Dual gang (stereo), **40p.** Single D.P. switch, **24p.**

SKELETON PRESET POTENTIOMETERS

Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C. mounting (0·1 matrix).
Sub-miniature 0·1W, **5p** each. Miniature 0·25W, **7p** each.

TRANSISTORS

AC107	15p	AF126	20p	BF115	25p	OC42	12p	2N3707	12p
AC126	12p	AF139	32p	BF173	20p	OC44	12p	2N3708	10p
AC127	15p	AF178	32p	BF177	28p	OC45	12p	2N3709	11p
AC128	15p	AF180	40p	BF178	32p	OC70	12p	2N3710	11p
AC131	12p	AF181	40p	BF179	32p	OC71	12p	2N3711	11p
AC132	12p	BC107	12p	BF180	32p	OC72	12p	2N3819	32p
AC176	15p	BC108	12p	BF181	32p	OC81	12p	2N4062	12p
AC187	22p	BC109	12p	BF194	14p	OC82D	12p	2N4286	20p
AC188	22p	BC147	12p	BF195	14p	2N2646	60p	2N4289	20p
AD140	50p	BC148	12p	BF197	15p	2N2904	20p	40360	35p
AD149	45p	BC149	12p	BF200	32p	2N2926	10p	40361	35p
AD161	33p	BC157	14p	BFY50	20p	2N3054	58p	40362	40p
AD162	36p	BC158	14p	BFY51	20p	2N3055	60p	40408	40p
AF114	20p	BC159	14p	BFY52	20p	2N3702	13p	ZTX108	15p
AF115	20p	BC187	22p	BU105	225p	2N3703	12p	ZTX300	15p
AF116	20p	BD131	75p	OC26	45p	2N3704	13p	ZTX302	20p
AF117	20p	BD132	75p	OC28	50p	2N3705	12p	ZTX500	15p
AF118	38p	BD133	75p	OC35	50p	2N3706	11p	ZXT503	20p

ZENER DIODES

400mW 5% 3·3V to 30V, **12p.**

WIRE WOUND POTS.

3W, 10, 25, 50Ω and decades to 100kΩ, **45p.**

DIODES

RECTIFIER

BY127	1250V	1A	12p
1N4001	50V	1A	7p
1N4002	100V	1A	8p
1N4004	400V	1A	8p
1N4006	800V	1A	10p
1N4007	1000V	1A	10p

SIGNAL

OA85	7p
OA90	5p
OA91	5p
OA202	7p
1N4148	5p
BA114	8p

SLIDER POTENTIOMETERS

86mm x 9mm x 16mm, length of track 59mm.

DUAL GANG, 10K + 10K etc. log. or lin. **60p.**

KNOB FOR ABOVE, **12p.**

FRONT PANEL, **65p.**

18 Gauge panel 12in x 4in with slots cut for use with slider pots. Grey or matt black finish complete with fixings for 4 pots.

THYRISTORS

2N5060	50V	0·8A	65p
2N5064	200V	0·8A	80p
106F	50V	5A	55p
106D	400V	5A	80p

MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0·001μF, 0·0015μF, 0·0022μF, 0·0033μF, 0·0047μF, **2½p.** 0·0068μF, 0·01μF, 0·015μF, 0·022μF, 0·033μF, **3p.** 0·047μF, 0·068μF, 0·1μF, **4p.** 0·15μF, **6p.** 0·22μF, **7½p.** 0·33μF, **11p.** 0·47μF, **13p.**
160V: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, **3p.** 0·1μF, **3½p.** 0·15μF, **4½p.** 0·22μF, **5p.** 0·33μF, **6p.** 0·47μF, **7½p.** 0·68μF, **11p.** 1·0μF, **13p.**

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0·01μF, 0·015μF, 0·022μF, **3p.** 0·033μF, 0·047μF, 0·068μF, **3½p.** 0·1μF, **4p.** 0·15μF, 0·22μF, **5p.** 0·33μF, **6½p.** 0·47μF, **8½p.** 0·68μF, **11p.** 1·0μF, **13p.** 1·5μF, **20p.** 2·2μF, **24p.**

MYLAR FILM CAPACITORS 100V

0·001μF, 0·002μF, 0·005μF, 0·01μF, 0·02μF, **2½p.** 0·04μF, 0·05μF, 0·068μF, 0·1μF, **3½p.**

CERAMIC DISC CAPACITORS

100pF to 10,000pF, **2p** each.

ELECTROLYTIC CAPACITORS

(μF/v) 1/63, 1·5/63, 2·2/63, 3·3/63, 4·7/63, 6·8/40, 6·8/63, 10/25, 10/63, 15/16, 15/40, 15/63, 22/10, 22/25, 22/63, 33/6·3, 33/16, 33/40, 47/4, 47/10, 47/25, 47/40, 68/6·3, 68/16, 100/4, 100/10, 100/25, 150/6·3, 150/16, 220/4, 220/6·3, 220/16, 330/4, **6p.** 47/63, 100/40, 150/25, 220/25, 330/10, 470/6·3, **7p.** 68/63, 150/40, 220/40, 330/16, 1000/4, **10p.** 470/10, 680/6·3, **11p.** 100/63, 150/63, 220/63, 1000/10, **12p.** 470/25, 680/16, 1500/6·3, **13p.** 470/40, 680/25, 1000/16, 1500/10, 2200/6·3, **18p.** 330/63, 680/40, 1000/25, 1500/16, 2200/10, 3300/6·3, 4700/4, **21p.**

SOLID TANTALUM BEAD CAPACITORS — 12p

0·1μF 35V	2·2μF 35V	22μF 16V
0·22μF 35V	4·7μF 35V	33μF 10V
0·47μF 35V	6·8μF 25V	47μF 6·3V
1·0μF 35V	10μF 25V	100μF 3V

VEROBOARD

	0.1	0.15
2½ × 3¾	22p	16p
2½ × 5	24p	24p
3¾ × 3¾	24p	24p
3¾ × 5	27p	27p
17 × 2½	75p	57½p
17 × 3¾	100p	78p
17 × 5 (plain)	—	82p
17 × 3¾ (plain)	—	60p
17 × 2½ (plain)	—	42p
2½ × 5 (plain)	—	12p
2½ × 3¾ (plain)	—	11p
Pin insertion tool	52p	52p
Spot face cutter	42p	42p
Pkt. 50 pins	20p	20p

JACK PLUGS AND SOCKETS

Standard screened	28p	2·5mm insulated	12p
Standard insulated	18p	3·5mm insulated	12p
Stereo screened	40p	3·5mm screened	18p
Standard socket	20p	2·5mm socket	11p
Stereo socket	30p	3·5mm socket	11p

D.I.N. PLUGS AND SOCKETS

2 pin, 3 pin, 5 pin 180°, 5 pin 240°, 6 pin, 7 pin
Plug 12p. Socket 8p.
4 way screened cable, **25p/metre.**
6 way screened cable, **30p/metre.**

BATTERY ELIMINATOR — £1.50

9V mains power supply. Same size as PP9 battery.

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2500μF	40V	74p	2800μF	100V	£3·20	4500μF	25V	£1·68
2500μF	50V	58p	3200μF	16V	50p	5000μF	50V	£1·10

HIGH VOLTAGE TUBULAR CAPACITORS—1,000 VOLT

0·01μF	10p	0·047μF	13p	0·22μF	20p
0·022μF	12p	0·1μF	13p	0·47μF	22p

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The GDI is the world's first semiconductor that can convert a concentration of gas or smoke into an electrical signal. The sensor decreases its electrical resistance when it absorbs deoxidizing or combustible gases such as hydrogen, carbon monoxide, methane, propane, alcohol, North Sea gas, as well as carbon-dust containing air or smoke. This decrease is usually large enough to be utilized without amplification. Full details and circuits are supplied with each detector.
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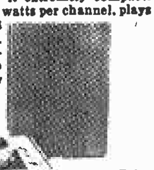

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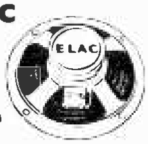

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3 amp, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £6·00
5 amp, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £9·75
5, 8 and 13V 5 amp £1·20. 3 amp, 3, 5, 8, 10, 13 and 5-0-5V £1·30, Ditto 5 amp. £1·50; 6-0-6V 500mA 90p 9V 1 amp 95p 12V 300mA 75p 12V 500mA 85p 12V 750mA 95p. 40V 1 amp £1·75.
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Can be used as 800W auto transformers 240-110V.
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16/450V	22p	1000/25V ..	35p	32+32/250V ..	20p
32/450V	35p	1000/50V ..	47p	32+32/450V ..	60p
32/500V	50p	8+8/450V ..	22p	350+50/325V ..	55p
25/25V ..	10p	8+16/450V	25p	32+32+32/350V	65p
50/50V ..	10p	16+16/450V	40p	32+32+32/450V	85p

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30–14,500 c/s, 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s Rated 20 watts. NOTE: 3 or 8 or 15 ohms must be stated.

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Please state 3 or 8 or 15 ohms.

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12 inch 25 watt **£8·80**	12 inch 35 watt **£9·90**	15 inch 50 watt **£22**
3 or 8 or 15 ohm	3 or 8 or 15 ohm	8 or 15 ohm

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For 12in. or 10in. dia. speaker 20 × 13 × 9in. £9·90 Post 25p
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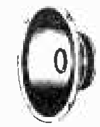
LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft

EMI 6½in. HI-FI WOOFER



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Suitable cabinet 12 × 8 × 6 £4·00.
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All purpose transistorised. Ideal for Groups, Disco and P.A. 4 inputs speech and music. 4 way mixing. Output 8/15 ohm. a.c. Mains. Separate treble and bass controls. **£49** Carr. £1·00
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BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. **£4·50**

TWO CHANNEL STEREO VERSION **£5·95**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume, treble and bass controls 18v. DC operation. **£4·50**

COAXIAL PLUG 10p. PANEL SOCKETS 10p. LINE 18p COAXIAL OUTLET BOXES, surface, 35p. BALANCED TWIN FEEDER 300 ohms 5p yard. JACK SOCKET Std. open-circuit 14p, closed-circuit 23p. Chrome Lead Socket 45p. Phono Plugs 5p. Phono Socket 5p. JACK PLUGS Std. Chrome 20p; 3·5mm Chrome 12p. DIN SOCKETS Chassis 3-pin 10p; 5-pin 10p. DIN SOCKETS Lead 3-pin 18p; 5-pin 25p. DIN PLUGS 3-pin 18p; 5-pin 25p. VALVE HOLDERS. 5p; CERAMIC 10p; CANS 5p.

REVERSIBLE 4 POLE MOTOR £1·95

1,400 r.p.m. Reversible 42 Watt, Post 25p spindle 1½" × ⁷⁄₃₂". size 3½" × 3". As illustrated. With Cooling Fan 240V A.C.

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ON THE AIR

BROADCAST BANDS

SHORT WAVE DX
by MALCOLM CONNAH

TO those of you have not been up in the loft for some time I would suggest that you nip up there a bit sharpish and have a look round. This all stems from the mention in the March column that **Richard Staples** had found an Eddystone 680X in his loft.

Shortly after publication of that issue I received a letter from **H. B. Sheward** of Tavistock in Devon who wrote: "Knowing I would not be so lucky (as Richard Staples) I ventured into my loft with the aid of a ladder on Sunday last and came up with the following odd items:—BC1147A, Heathkit VF1, Heathkit HG 10, R109, No. 62 set, No. 38 set, No. 18 set, No. 19 set, No. 22 set, PCR 1, Class D Wavemeter, R103, No. 52 set, B23, several vintage sets and, wait for it, a Hallicrafters S120 and a Hammarlund HQ 140 X."

With that little lot Mr. Sheward could almost open a shop. I do not suggest that you will all be as lucky but if you live in a fairly elderly house there could well be an old piece of radio equipment in the loft which could be put to better use.

Readers' Logs

The first log this month comes from **John Spinks** of Norwich who has been concentrating on the 60 metre band. This concentration plus a Trio 9R-59DS, 75 foot long-wire and an A.T.U. produced the following excellent results:

4790 *Springbok Radio, South Africa* at 2135.
4800 *R. Lara, Venezuela*, heard at 2348.
4825 *Moscow*, news in Russian at 2030.
4860 *AIR, Delhi*, chanting at 2110.
4880 *R. Peking* in Chinese at 2155.
4900 *R. Juventud, Ven.*, in Spanish at 0040.
4904 *Fort Lamy, Chad Rep.*, in French at 2035.
4905 *R. Relogio, Brazil*, pop music at 0020.
4930 *Majek, USSR*, in Russian & English at 2130.
4940 *Frunz, USSR*, Russian opera at 2115.
4972·5 *R. Yaounde, Cameroon* in French at 2150.
4980 *R. Ghana*, African news at 2105.
4980 *Ecos del Torbes, Ven.*, heard at 0001.
4990 *Lagos, Nigeria*, sports news at 2230.
5010 *R. Garoua, Cameroon*, French talk at 2205.
5030 *R. Continente, Ven.*, music at 0034.
5035 *R. Alma Ata, USSR*, Russian talk at 0040.

Paul Broadhurst, who lives near Bristol, used his Trio 9R-59DS with a 150 foot long-wire and 19 metre dipole to hear the following stations:

6025 *R. Lisbon, Portugal* noted at 2045.
6050 *Rome, Italy* sign on at 2030.
6070 *R. Sofia, Bulgaria*, sign on at 1600.
6150 *R. Belgrade, Yugoslavia* at 2020.
6160 *Brussels, Belgium* noted at 2315.
6165 *R. Kiev*, noted at 1940.
6190 *Vatican Radio* noted at 2050.
7195 *AIR, Delhi* at 2200.
9550 *Radio Finland*, sign on at 2030.
9610 *R. Canada Int.*, sign on at 2058.
9735 *VOA, Monrovia*, Liberia at 2120.
9760 *Accra, Ghana* noted at 2115.
11880 *Voice of Turkey* noted at 2200.
15120 *Voice of Nigeria* noted at 1620.
15155 *RSA, South Africa*, sign on at 1800.
15300 *HCJB, Quito*, Ecuador at 2010.
15425 *Vienna, Austria* noted at 1840.

Steve Davis of Hanworth in Middlesex has a Satellit 6001 receiver and 10 metre dipole enabling him to hear:

3985 *SBC, Berne* in English at 1530.
5000 *WWV, Colorado*, USA at 0900.
5000 *IBF, Turin, Italy* at 1000.
6155 *Vienna, Austria* in English at 1830.
9480 *R. Tirana, Albania* in English at 1630.
9505 *R. Prague* in English at 1500.
11720 *R. Nacional, Brazil* in English at 2300.
15130 *Kol Israel* in English at 1130.
15415 *R. Kuwait* in English at 1730.
21525 *WYFR, USA* noted at 1600.

Don Kelly of Co. Cork in Eire used his B40 receiver to hear the following stations:

9535 *SBC, Berne* in English at 1100.
9550 *R. Norway* in English at 1400.
11755 *R. Finland* in English at 1405.
11765 *Deutsche Welle* in English at 1700.
11835 *R. Sudan* noted at 1600.
11855 *R. Prague* in English at 1545.
11940 *R. Bucharest* in English at 1300.
15165 *R. Denmark* noted at 1400.
15250 *RSA, South Africa* noted at 1700.
15440 *WYFR, USA* at 1800.

Mr. **M. C. Smith** of Blackpool has a 'PW' 9/12 receiver, an A.T.U. and an 80 foot long-wire, this set up enabling him to hear:

6055 *R. Australia* in English at 2100.
7065 *R. Tehran, Iran* in English at 1637.
7145 *R. Australia* in English at 1500.
9005 *R. Tehran, Iran* in English at 2000.
11765 *R. Australia*, sign off at 1230.
11790 *R. Australia* in Thai at 1330.
17935 *R. Pakistan* noted at 0830.

ON THE AIR

MEDIUM WAVE BROADCASTS
by CHARLES MOLLOY

BRENDON McNAMEE (Portrush, N. Ireland) has a Sharp BZ-23 portable receiver with internal ferrite rod aerial and he reports daytime reception of BBC Radio Blackburn on 854kHz at 1355hrs; Radio Merseyside 1484kHz at 1200hrs; Radio Clyde 1151kHz at 1100hrs. After dark Brendon has logged Radio Bristol 1546kHz at 1905hrs and Trans World Radio, Montecarlo at 2300hrs. **Christopher Beaver** (Stoke-on-Trent) is another local radio enthusiast. With his GEC domestic radio and selection of four 50ft outdoor antennas he has heard Radio Solent on 998kHz; Radio Birmingham on 1457kHz; Radio Manchester on 1457kHz; London Broadcasting on 719kHz; Manx Radio (Isle of Man) on 1594kHz. Christopher has received verifications (QSLs) from BBC local radio stations at Blackburn, Stoke, Nottingham, Bristol, Teesside and Leicester.

P. Grace (Belfast) refers to the enquiry in the February issue of Practical Wireless about White's Radio Log and mentions that it now appears in Communications World which is published in the United States by Science and Mechanics. White's Radio Log contains listings of AM-FM-TV-SW stations in Canada and the United States.

William F. Kitching (Telford, Shropshire) uses a Grundig Yacht Boy receiver and a 25 metre outdoor aerial when DXing on the medium waves. His log includes Radio Nacional Espana stations at Madrid on 584kHz; Coruna on 638kHz; Seville 683kHz; Barcelona 737kHz; San Sebastian 773kHz together with the Voice of America relay at Kavalla in Greece on 791kHz; Sud Radio, Andorra on 818kHz; American Forces Network at Munich on 1106kHz and Stuttgart on 1142kHz; Vatican Radio on 1529kHz. William has been a medium wave DXer for two years and he has received a total of 40 MW QSLs.

Roy Patrick (Derby) has received the following details from the Independent Broadcasting Authority's Engineering Department. Radio Clyde 1151kHz transmits from Dechmont Hill with a power of 4kW; Radio Birmingham 1151kHz uses 3kW into a vertical antenna located at Langley Mill; Radio Manchester is due to start in April on 1151kHz with a power of 4kW from a site at Ashton Moss. Later in 1974 Radio Swansea will be on 1169kHz; Radio Tyneside will be on 1151kHz with 2·5kW while Radio Edinburgh, Radio Liverpool (Rainford) and Radio Sheffield (Skew Hill) will all be on 1546kHz.

A number of readers have asked if it is possible to use a MW loop aerial with a transistor portable which has its own internal ferrite rod aerial. One method tried by the writer is to attach the portable receiver to the centre of the loop in such a way that the nulls of the loop and the ferrite rod aerial coincide. Generally, this will mean that the portable will be mounted at right angles to the plane of the loop windings. Coupling between the loop and ferrite aerial is by induction and the loop and receiver are rotated together to null-out interference.

VHF/FM DXING
by SIMON DAVID

HOW many of you had a bumper bundle on Sunday 20th January? An example of what I mentioned last month, propagating conditions in the upper atmosphere, caused some fascinating things to happen. A tropospheric opening occurred for a few days starting on the 18th. On the 19th we thought that France had moved into England and on the 20th and 21st we were truly "in Europe".

Straight after writing last month's column, **E. W. Earnshaw, G3ZXN**, of Newcastle-on-Tyne wrote to me. "FM DXing is not impossible from the North of England", he writes. He picked up a number of German and French stations plus—wait for it—Spain, Yugoslavia and, would you believe, Ankara in Turkey.

Of course, there were unusual conditions, but it is great if you have the patience to wait for them. For the record a Metrosound FMS20 was used with an aerial designed for 145MHz (outside U.K. FM broadcasting). I hasten to add that readers should not expect such results with the wrong type of aerial normally. He has now installed an 8-element beam, 40 feet up, with a rotator.

I have also received a log from our friend **Roy Patrick** in Derby for 20th January. This includes SWF Germany Haardtkopf on 97·7MHz, HR Frankfurt Meissner on 99·0MHz and Boulogne on 99·9MHz. His receiver is a Grundig portable. BBC Radio Humberside has sent Roy a QSL letter for 96·8 and he also picked up Capital Radio (95·8MHz).

I heard that a reader in Ipswich who has a 6-element aerial directed towards Wrotham (North Kent), has picked up BBC Radio Bristol on 95·5MHz and Rouen (station frequency not stated). His tuner is a home made design.

The General Advisory Council of the BBC have advised the BBC to make representations with a view to clearing the 97·6 to 100MHz band of all service users. That would mean that the police frequencies would have to be revised so that the U.K. can make maximum use of the internationally agreed 88-100MHz band for broadcasting. I, for one, am delighted to hear of this and sincerely hope that they successfully seek the necessary legislation.

Good DXing! Don't forget to keep in touch. Please state the approximate frequencies of stations heard and the signal strength. Also of interest is your receiver type and aerial used, and the date when you heard the reported stations.

How about this for a jumbo bag? **Peter Taylor** writes from Whitton in Middlesex: "I have an Armstrong 624 tuner and 3-element Yagi aerial in the loft". So far Peter says that he has received most of the French stations in N.E. France, apart from those masked by British stations. He also receives the three Lille transmissions virtually all the time. On the 20th-21st January he received (and sent me a cassette recording) the following: Radio Austria Pfander I 98·2; AFN Frankfurt 98·7; Suddeutscher Rundfunk I 98·8; Bayerischer Rundfunk, Munich III 97·3 (including signature tune); Sudwestfunk, Haardtkopf I 97·7 and II 93·0; Westdeutscher Rundfunk, Teutob. Wald II 93·2 and III 97·0; Hessischer Rundfunk, Biedenkopf I 91·0; ORTF, Besanscon, France Musique 92·9, France Culture 97·7MHz.

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H39	6	Integrated Circuits. 4 Gates BMC 962, 2 Flip Flops BMC 945	55p
H41	2	Sil Power transistors comp pair BD131/132	55p

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B86	100	Sil. Diodes sub. min. IN914 and IN916 types	55p
H16	15	Experimenters' Pak of Integrated Circuits, Data supplied	55p
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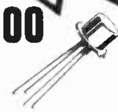

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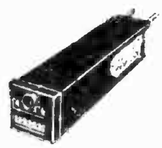

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ON THE AIR

SHORT WAVES
by DAVID GIBSON, G3JDG

IT seems that all the staunch supporters of 20 metres and the other two h.f. bands have fled. In the abscence of easy DX it appears that we are separating the real s.w.ls from the "Sunday Listeners". Most logs which arrived this month were for 80 metres, although very few dared brave 7MHz.

Some ideas for **Glyn Fisher** who requested a good modern receiver covering 4-6MHz continuously. Two suggestions: **P. Maynard** (Lancs) proposes the EC10 pointing out that it works off six U2 batteries and can be used anywhere. **Barry Keal,** G8HDU (Lancs) reckons the SW717 from Heathkit would suit, having used one himself for the past two years as a tuneable i. f. for listening on two metres.

Readers' Logs

Jon Hirst (Cambs) claims to have discovered a very large l.f. net which involves the Royal Signals Amateur Radio Society. Net controller is said to be GW3ASW and the frequency for interested s.w.ls is 3·720MHz—listen Tuesdays and Thursdays at 2000hrs and on 7·050MHz at 1030hrs on Sundays.

Stanley Sharred (Birmingham) is sticking to his permanent resolution of never making New Year resolutions. He spent the time instead listening on topband and offers some juicy callsigns heard on Trawler territory; GI3YFY, GW3ZQN, EI8H, EP2BQ, KV4FZ, OE8DM, OL5AQC, OK1FCW, PY1RO, VE1AX, VE1CO, VE1CD, VE1MX, VE1ASJ, VE3DN, VO1KE, W1GJE, W1HGT, W2DED, W3BJZ. All these were c.w. signals which just goes to show what you're missing if you can't read morse—yet? Amongst the s.s.b. stations heard by Stanley on 80 metres were; CT1HE, JY3ZH, K2RM, K4GSU, KH4NCA, KZ5JM, TI2WD, TI2YF, VE2BZA, VP2VPU, VX1BT, VX1FG, VX2AS, W1MX, WB2KQC/P/2, W3TTW, W3ZBY, W4YN, WB4KDR, W8FIE, YV3TN, 3A0FY, A peep on 7MHz c.w. revealed; OA2NYD, PY7BTX, PY7CAR, VK3MR. No mention of any receiver or aerial with these logs so one must presume that earholes in the Birmingham area are considerably more sensitive than those in Harpenden (maybe it's something to do with the drinking water).

First of the 3·5MHz logs comes from **John Porter** (Derbyshire) who used a 9R59DS and a 30 metre wire to bag these on s.s.b.; CR3WB, CT1ATV, EP2BQ, HB9AFM, I3BYT, JY3ZH, KV4AB, K2BT, LA9LSV, OH1TY, ON4UN, PJ9KH, PY2FOT, VE1BB, VE1JA, W1AA, WB8HDR/P1, 9E5CQ. John also managed OL7AQX and ZS6ZE on topband c.w.

Letter which appears to be from **Stever Tiltell** (bad writing, I expect it's Ena Boggins or something) in the Isle of Wight tells tales of eighty metre s.s.b. signals from; EA3JE, HA0KDA, K5EKD, OH7RM, OK3RJ, PY1FI, PZ1DR, VE3ARR/P, VE3FMJ, VE3GO, VK2LW, W9ADN, W5WZ, YD9AB/P, YO3AC. Stever (or Ena) says this was the result of giving the receiver a quick work out coz it was new. Gear is a RA1 plus PR40 and a "70ft. or so" wire.

Brian Smith has sent in his first log from Somerset. He reckons to have many more hours of s.w.ling to go coz he's only 15. Squeaks of 80 metre s.s.b. were logged on a 9R59DS and a 130ft. loft aerial from the following; CT1VY, CT3AB, EA4LK, EA6BG, HB9ADN, ON5JY, OZ3SS, VU1SX, W1CR, 5B4KP.

Craig Ashby (Bucks) has made unspecified changes in his aerial and earth system which feeds his UR-1A receiver. Best on eighty metres were; CT3AB, OK1KPU and SM6CWK. On 7MHz; DK7KS, ON6OS.

Hilton Helm (no relation to Matt, I hope?) writes from Salisbury in Rhodesia. The receiver is a home-brew five-transistor regen fed with 50ft. of wire. Hilton built the receiver during the school holidays and managed to bag some s.s.b. signals from; A4XFD, CR6RJ, CR6UE, CX4CR, DJ4KB, DK8FZ, EA3UU, EL2CJ, G2JZ, G4ADU, HS1BG, HS4AKF, I8ZPQ, I0DLP, K4YYL, PY1ZAE, PY2CRN, VE7FI, VE7MT, VK2SG, VK5QX, VS9MJ, VU2AIK, VU2MX, WB2ZHY, W2HIN, W2ONV, W4QAW, W7APA, W8GKQ, XW8ES, YB9ABH, 3B8CJ, 3B8DX, 4Z4EV, 4Z4MQ, 5U7AZ, 5Y4XYP, 5Z4FB, 9H1CW, 9M2AT, 9M2FX, 9M2GO, 9V1RR, 9X5NA, 9X5VA. All these were on 14MHz which just goes to show what's about.

A. McNeill (Berks) queries some funny callsigns—CK8T, HE7MW, KU7KJW, LY1DYM/9 and PT1RA. Anyone making any sense out of these should consult a psychiatrist immediately. Meanwhile, with an ex-RAF R1O8Z receiver and 33ft end fed, the following presented themselves on 14MHz; CR6AL, EL2OSB/MM, FG5P, FP8PR, FC8TT, HK1FL, KP4DLC, LU9CV, OA7WA, PY1LA, TI2WD, TF3SE, VK6FT, VP9HL, VE3AHB, W5MJQ, W6OV, W7AYO, YK1OK, YV5BLT, ZS6JK, ZE8JJ, 9H1DQ, 9H4C, 4S7CF, 5Z4JDP, 5U7AZ.

Glyn Fisher (Rutland) uses a dipole, MOS FET converter and an HRO tuning 4-6MHz to log these on 144MHz; DJ9PCA, DK2RY, DL3SPA, F1BHL, F1BJD, F1RM, F6ANW, F9FT, G2BAR, GI3GXP, HB9QQ, PA0VV, all on s.s.b.

Contests for April include: April 7, 3·5MHz low power; 20-21, Burmuda (phone); 21, 4 metre open; 27-28, National Amateur Television; May 4-5, 2 metre open and s.w.l.; May 4-5, second Burmuda (phone).

BROADCAST BANDS

Short Wave Reports by 15th of the month to Malcolm Connah, 27 Lismore Road, Highworth, Wiltshire, SN6 7HU.

Medium Wave Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

VHF/FM Reports to Simon David, c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.

AMATEUR BANDS

Short Wave/VHF

Logs in alphabetical order please by 15th of the month to David Gibson, G3JDG, 12 Cross Way, Harpenden, Hertfordshire.

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20,000 opv. Overload protection. Slide switch selector. 0/0.25/2.5/10/50/150/1000V DC. 0/10/50/250/1000V AC. 0/50uA/25/250mA DC. 0/3k/30k/300k/3 Megohms. –20 to +50dB.
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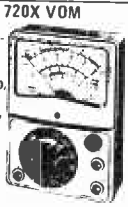
HIOKI Model 720X VOM

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20,000 opv DC. 8000 opv AC. Mirror scale ·6/3/12/30/120/600V DC. 3/30/120/600V DC. 60/600μA/60/600mA. 10/100K/1 Meg/10 Meg Ohm. –20 to + 46 dB.
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U4323 MULTIMETER

20,000opv. Simple unit with audio/IF oscillator. Suitable for general receiver tuning. Ranges: 0.5/2.5/10/50/250/500/1000V DC. 2.5/10/15/250/500/1000V AC. 0.05/0.5/5/50/500mA DC. Resistance: 5/50/500 ohms/5/10/100k ohms/1Meg. Battery operated. Size: 160 x 97 x 40mm. Supplied in carrying case complete with test leads.
OUR PRICE £7.00 P&P 20p

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30,000 opv. Overload protection. 6/30/60/300/600/1200V DC. 12/60/120/600/1200V AC. 60/μA/30mA/300mA. 2K/200K/2 Meg Ohm. 10 to 63dB.
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30,000opv. Mirror scale. Overload protection. 0/0.6/3/15/60/300/1200V DC. 0/6/30/120/600/1200V AC. 0/30uA/6mA/60mA/300mA/600mA. 0/8k/80k/800k/8 Meg ohms. –20 to +63dB.
OUR PRICE £7.50 P&P 15p

U4324 MULTIMETER

High sensitivity, overload protected. 20,000opv. Ranges: 0.6/1.2/3/12/30/60/120/600/1200V DC. 3/6/15/60/150/300/600/900V AC. Current: 0.06/0.6/6/60/600mA/3A DC. 0.3/3/30/300mA/3A AC. Resistence: 25/500 ohms/0.5/5/50/500k ohms/5 Mohms. Decibels: –10 to +12dB. Size 167 x 98 x 63mm. Supplied complete with test leads, spare diode and instructions.
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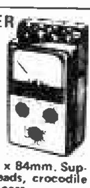
46 ranges, mirror scale. 50k/V DC 50k/V AC. DC Volts: 0.125/0.25/1.25/2.5/5/10/25/50/125/250/500/1000. AC Volts 1.5/3/5/10/25/50/125/250/500/1000. DC current 25/50uA/2.5/5/25/50/250/500mA/5/10A. Resistance: 10k/100k/1 Meg/10 Meg ohms. –20 to +81.5dB.
OUR PRICE £8.50 P&P 17p

U435 MULTIMETER

20,000opv. Overload protected. Ranges: 75mV/2.5/10/25/100/250/500/1000V DC. 2.5/10/25/100/250/500/1000V AC. Current: 50uA/1/5/25/100mA/0.5/2.5A DC. 5/25/100mA/0.5/2.5A AC. Resistance: 0.3/3/30/300k ohms. Size: 205 x 110 x 84mm. Supplied complete with leads, crocodile clips and steel carrying case.
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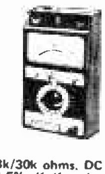
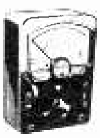
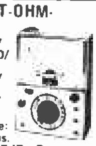

extremely sturdy instrument for general electrical use. 667opv. 0/0.3/1.5/7.5/30/60/150/300/600/900V DC & 75mV. 0/0.3/1.5/7.5/30/60/150/300/600/900V AC. 0/300uA/1.5/6/15/150/60/600mA/1/1.5/6A DC. 0/1.5/6/15/60/150/600mA/1.5/6A AC. 0/200/3k/30k ohms. DC accuracy 1%. AC 1.5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions.
OUR PRICE £9.75 P&P 25p

MODEL 500

30,000 opv with overload protection. Mirror scale. 0/0.5/2.5/10/25/100/250/500/1000V DC. 0/2.5/10/25/100/250/500/1000V AC. 0/50uA/5/50/500mA. 12A DC. 0/60k/6 meg/60 megohms.
OUR PRICE £13.95 Carr. paid
Leather case for above £1.75

HIOKI 750X VOLT-OHM-MILLIAMETER

43 ranges: 0–0.3/0.6/1.5/3/6/12/30/60/150/300/600/1,200V DC. 0–3/6/15/30/60/120/300/600/1,200V AC. Current: 0–30/60uA/1.5/3/15/30/150/300mA/6/12A. Resistence: 0–3/300k/3/30Mohms. Decibels: –10 to +17dB. Output:– 0–3/6/15/30/60/120/300V. Accuracy ± 3% DC, ± 4% AC. Sensitivity: 50,000 opv DC, 5,000 opv AC. 4 inch meter. Built in protection. Size: 57 x 102 x 153mm.
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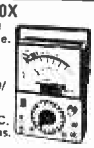
100,000opv. Overload protection. Mirror scale. 0.3/0.6/1.2/1.5/3/6/12/30/60/120/300/600/1200V DC. 1.5/3/6/12/30/60/150/300/600/1200V AC. 15/30uA/3/6/30/60/150/500mA/6/12A DC. 2k/200k/2M/20MOhms. –20 to +63dB.
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Overload protected, shock proof circuits. 9.5uA Meter with mirror scale. Sensitivity 100kV. Polarity change switch. Ranges: 0.5/2.5/1/50/250/500/1,000 Volts DC. 2.5/10/50/250/1,000 Volts AC. DC resistence' 0–20/200k/2/20 Meg. ohms. DC current:– 10/250uA/2.5/25/250mA/10A. AC current: –0–10A. –20 to +62dB. Operates from 2 x 1.5V batteries. Size: 180 x 134 x 79mm.
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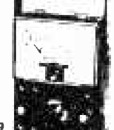
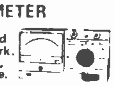
MODEL AS.1000 VOM

100,000 opv. Mirror scale. Built-in meter protection. 0.3/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600V AC. 0/10μA/6/60/300mA/12 Amp. 0/2K/200K/2M/200 Meg Ohm. – 20 to + 17 dB
OUR PRICE £17.50 P&P 20p.

KAMODEN HM720B FET VOM

Input impedence 10 Megohms. Ranges:– 0/.25/1/2.5/10/50/1000V DC. 0/2.5/10/50/250/1000V AC. 0/25uA/2.5/25/250 mA DC. 0/5k/50k/500k/5 M 500 Megohms
OUR PRICE £21.00 P&P 30p

KAMODEN 72.200 Multitester

High sensitivity tester. 200,000 opv Overload protected. Mirror scale. Ranges:–0/.06/.3/3/30/120/600/1200V DC. 0/3/12/60/300/11200 V AC. 0/6uA/1.2mA/120mA/600mA/12A DC 0/12A AC. –20 to +63dB. 0/2k/200k/2 Meg/200 Megohms.
OUR PRICE £22.50 P&P 30p

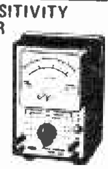
U4317 MULTIMETER

High sensitivity instrument for field and laboratory work. Knife edge pointer, 86mm. mirror scale. Ranges: 100mV/0.5/2.5/10/25/50/100/250/500/1000 V DC. 0.5/2.5/10/25/50/100/250/500/1000V AC. Current: 50uA/0.5/1/5/10/50/250mA/1/5A DC. 0.25/0.5/1/5/10/50/250mA/1/5A AC. Resistance: 0.5/10/100/200 ohms/1/3/30/300k ohms. Decibels: –5 to +10dB Battery operated. Size: 210 x 115 x 90mm. Supplied in carrying case complete with leads.
OUR PRICE £15.00 P&P 20p

TMK 100K LAB TESTER

100,000opv. 6½" scale. Buzzer short circuit check. Sensitivity 100,000 opv DC. 5k/V AC DC Volts: 0.5/2.5/10/50/250/1000V AC. 3/10/50/250/500/1000V DC. current 10/100uA/10/10/100/500mA/2.5/10A. Resistence: 1k/10k/100k/10 Meg/100 Meg ohms. Decibels: –10 to +49dB. Plastic case with carrying handle. Size: 190 x 172 x 99mm.
OUR PRICE £19.95 P&P 25p

MODEL U4311 Sub-standard Multi-range Volt-Ammeter

Sensitivity 330 Ohms/Volt AC and DC. Accuracy 0.5% DC. 1% AC. Scale length: 165mm. 0/300/750uA/1.5/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A DC. 0.3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A AC. 0.75/150/300/750mV/1.5/3/7.5/15/30/75/150/300/750V DC. 0/750mV/1.5/3 /7.5/15/30/75/150/300/750V AC. Automatic cut out device. Supplied complete with test leads, manual and test certificates.
OUR PRICE £49.00 P&P 50p

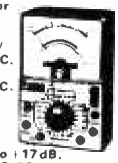
TE40 HIGH SENSITIVITY AC VOLTMETER

10 Meg input. 10 ranges: 0.001/0.03/0.1/0.3/1/3/11/30/100/300V RMS. 5cps–1.2MHz. –40 to +50dB supplied complete with leads and instructions.
OUR PRICE £17.50 P&P 25p

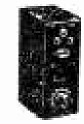
TE65 VALVE VOLTMETER

28 ranges. DC volts 1.5–1500V. AC volts 1.5–1500V. Resistance up to 1000 Megohms, 200/240V AC operation. Complete with probe and instructions.
OUR PRICE £17.50 P&P 30p
Additional probes available: RF £2.12, HV £2.50

LB3 TRANSISTOR TESTER

Tests ICO and B. PNP/NPN. Operates from 9V battery. Instructions supplied.
OUR PRICE £3.95 P&P 20p

MODEL AF.105 VOM

50,000 opv. Mirror scale. Meter protection. 0/·3/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600/1200V DC. 0/30μA/6/60/300 mA/12 Amp. 0/10K/1m/10m/100 Meg Ohms. – 20 to + 17 dB.
OUR PRICE £12.50 P&P 20p.

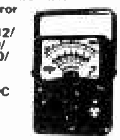
LB4 TRANSISTOR TESTER

Tests PNP or NPN transistors. Audio indication. Operates on two 1.5V batteries. Complete with instructions etc.
OUR PRICE £4.50 P&P 20p

U4341 Multimeter & Transistor Tester

27 ranges. 16,700opv. Overload protected. Ranges: 0.3/1.5/6/30/60/150/300/900V DC. 1.5/7.5/30/150/300/750V AC. Current: 0.06/0.6/6/60/600mA DC. 0.3/3/30/300mA AC. Resistance: 0.06/0.6/2/6/20/60/200k ohms/2 Mohms. Battery operated. Supplied complete with probes, leads and steel carrying case. Size: 115 x 215 x 90mm.
OUR PRICE £10.50 P&P 20p

KAMODEN HMG500 insulation resistance tester

Range 0–1,000 Megohms, 500V. Battery operated. Wide range clear meter 4"x4¾". Complete with deluxe carrying case, batteries and instructions.
OUR PRICE £19.95 P&P 30p

S100TR MULTIMETER TRANSISTOR TESTER

100,000opv. Mirror scale. Overload protection. 0/0.12/0.6/3/12/30/120/600V DC. 0/6/30/120/600V AC. 0/12/600uA/12/300mA/6/12A DC 0/10k/1 Meg/100 Meg. –20 to +50dB. 0.01–0.2 MFD Transistor tester measures Alpha, Beta and ICO. Complete with instructions, batteries and leads.
OUR PRICE £15.95 P&P 25p

C15 PULSE OSCILLOSCOPE

For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth: 10MHz. Sensitivity at 100kHz VRMS/mm: 0.1–25; HOR. AMP. Bandwidth: 500kHz. Sensitivity ay 100kHz VRMS/mm: 0.3–25 Preset triggered sweep 1–3000usec. Free running 20–200 kHz in nine ranges. Calibrator pips. 220 x 360 x 430mm. 115–230V AC.
OUR PRICE £39.00 Carr. paid

RUSSIAN C116 Double Beam OSCILLOSCOPE

5 MHz pass band. Separate Y1 and Y2 amplifiers. Rectangular 5" x 4" CRT. Calibrated triggered sweep from 0.2usec. to 100 milli-sec/cm. Free running time base, 50Hz–1MHz. Built-in time base Calibrator and amplitude Calibrator. Supplied complete with all accessories and instruction manual.
OUR PRICE £87.00 Carr. paid

MODEL TE15 GRID DIP METER

Transistorised. Operates as Grid Dip, Oscillator, Absorbtion Wave Meter and Oscillating Detector. Frequency range 440kHz–280MHz in six coils. 500uA meter. 9V battery operation. Size: 180 x 80 x 40mm.
OUR PRICE £19.95 P&P 20p

Also see following pages

ALL PRICES EXCLUDE VAT

LASKYS

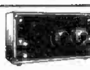
Also see previous page

SWR METER Model SWR3

Handy SWR meter for transmitter antenna alignment, with built-in field strength meter. Accuracy 5%, Impedence 52' Indicator 100uA DC. Full scale 5 section collapsible antenna. Size 145 x 50 x 60mm.

OUR PRICE £4.25 P&P 25p

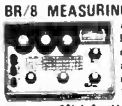
AT201 Decade ATTENUATOR



Frequency range 0–200kHz. Attenuator 0–111dB, 0.1dB steps. Impedence 600 ohms. Input power maximum 30dBm. Size: 180 x 90 x 55mm.

OUR PRICE £12.50 P&P 37p

TRANSISTORISED L.C.R. A.C. BR/8 MEASURING BRIDGE

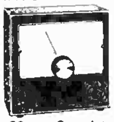


A new portable bridge offering excellent range and accuracy at low cost. Ranges R 1 11.1 meg 6 Ranges ±1% L 1 H – 111 HENRY 6 Ranges 2 % C 10pF 1110mFd 6 Ranges 2% TURNS RATIO 1 1/1000–1 1 100. 6 Ranges ± 1%. Bridge voltage at 1,000 cps. Operated from 9 volts 100 A Meter indication. Attractive 2 tone metal case. Size 7¼ x 5 x 2in.

OUR PRICE £25.00 P&P 25p

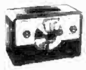
TE16A TRANSISTORISED SIGNAL GENERATOR

5 ranges, 400kHz to 30 MHz. An inexpensive instrument for the handy-man. Operates on 9V battery. Wide easy to read scale. 800kHz modulation. Size: 149 x 149 x 92mm. Complete with instructions and leads.



OUR PRICE £8.97 P&P 25p

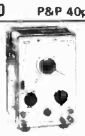
MODEL TE20 RF SIGNAL GENERATOR



Six bands. 120kHz–260MHz. Dual output RF terminals. Separate variable audio output. Accuracy ± 2%. Audio output to 8V. Power requirements: 105–125V, 220–240V AC. Size: 193 x 265 x 150mm. Complete with test leads etc.

OUR PRICE £17.50 P&P 40p

TE-20D RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 kHz-500 MHz on 6 bands. Directly calibrated. Variable R.F. attenuator audio output. Xtal socket for calibration. 220/240V a.c. Brand new with instructions. Size 140mm x 215mm x 170mm.

OUR PRICE £17.50 P&P 30p

ARF 300 AF/RF SIGNAL GENERATOR

All transistorised compact fully portable. AF sine-wave 18Hz to 220 kHz. AF square wave 18Hz to 100k Hz. Output Square/Sine wave 10V. P-P RF 100kHz to 200MHz. Output 1V maximum. 220/240V AC operation. Complete with instructions and leads.

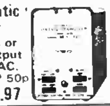
OUR PRICE £29.95 P&P 50p

MODEL MG100 SINE SQUARE WAVE AUDIO GENERATOR

Range 19-220,000Hz Sine Wave 19–100,000 Hz Square Wave. Output Sine or Square wave 10v. P to P Size 180 x 90 x 90mm Operation 220/240v. A.C.

OUR PRICE £19.95 P&P 37p

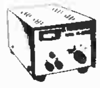
MCA220 Automatic Voltage Stabiliser



Input 88–125V AC or 176–250V AC. Output 120V AC or 240V AC. 200V/A rating. P&P 50p

OUR PRICE £11.97

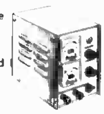
PS100B Regulated POWER SUPPLY UNIT



Solid state. Output 6, 9 or 12V DC up to 3 Amp. Meter to monitor current. Input 220/240V AC. Size: 100 x 82 x 159mm.

OUR PRICE £11.97 P&P 25p

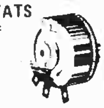
PS200 Regulated POWER SUPPLY UNIT



Solid state. Variable output 5–20V DC up to 2 Amp. Independent meters to monitor voltage and current. Output 220/240V AC. Size: 190 x 136 x 98mm.

OUR PRICE £19.95 P&P25p

POWER RHEOSTATS



High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing. ¼" diameter shafts. Bulk quantities available.

25 WATT 10/25/50/100/250/500/1000/2500 Ohms **£1.15** P&P 10p

50 WATT 10/25/50/100/250/500/1000/2500/5000 Ohms. **£1.62** P&P 10p

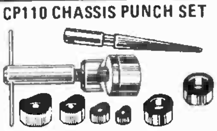
100 WATT 1/5/10/25/50/100/250/500/1000/2500 Ohms **£2.34** P&P 15p

AUTO TRANSFORMERS

0/115/250V. Step up or step down. Fully shrouded.

80 WATTS	£2.75	P&P 18p
150 WATTS	£3.50	P&P 18p
300 WATTS	£4.50	P&P 23p
500 WATTS	£6.95	P&P 33p
1000 WATTS	£9.50	P&P 38p
1500 WATTS	£12.50	P&P 43p
2250 WATTS	£20.95	P&P 50p
5000 WATTS	£44.95	P&P £1

CP110 CHASSIS PUNCH SET



Carefully machined top grade steel. Contains 1/2", 5/8", 3/4", 1" and 1 1/8" punches complete with gripper and accessories.

OUR PRICE £3.00 P&P 40p

YAMABISHI VARIABLE VOLTAGE TRANSFORMERS

Excellent quality at low cost. Input: 230V 50/60Hz. Output 0–260V.

MODEL S260 BENCH MOUNTING

		P&P
1A	£10.50	30p
2.5A	£12.00	35p
5A	£17.50	37p
8A	£30.35	50p
10A	£33.75	75p
12A	£29.50	75p
20A	£85.00	125p
25A	£95.00	130p
40A	£120.00	150p

MODEL S260B PANEL MOUNTING

1A	£10.00	30p
2.5A	£12.00	35p

240° Wide Angle 1mA METERS

MW 1–6 60x60mm **£6.50** P&P 15p

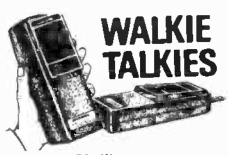
MW 1–8 80x80mm **£6.90** P&P 15p

BVD5 Vernier TUNING DIAL

App. 7:1 ratio planetary drive vernier dial. Log scale 0–180 degrees. Blank scales 1–5. Dial size 128 x 76mm. Overall size 190 x 117 x 41mm. deep including knob and coupling. ¼" diam. shaft

OUR PRICE £1.62 P&P 15p

WALKIE TALKIES



SKYFON 100mW

OUR PRICE £24.95 per pair

P302 Two Channel 300mW

OUR PRICE £52.50 per pair

P1003 Three Channel 1 Watt

OUR PRICE £71.25 per pair

P&P 50p per pair

NB. Licence required for use in UK

RUH6 Reflex Horn Speaker

Built-in driver unit. Impedence 16 ohms. Power rating 10W. Response 380–7000Hz. Size app. 6" x 6". Weather and shock protected.

OUR PRICE £4.97 P&P 30p

TRIO 9R59DS RECEIVER

Four bands covering 550kHz to 30 MHz continuous and electrical band-spread on 10, 15, 20, 40, and 80 mtrs. 8 valve plus 7 diode circuit. 4 to 8 ohm output and phone jack. SSB–CW, ANL, variable BFO. S Meter and separate band spread dial. IF frequency 445kHz, audio output 1½ watt. Variable RF and AF gain controls. 115/250V AC, with instructions.

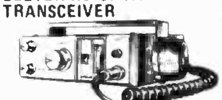
Our Price £42.50 CARR. PAID

TRIO TR2200 TRANSCEIVER

Fully transistorised portable VHF transceiver. Will transmit and receive on six channels between 144–146MHz. 1 watt transmitter. 12V DC internal or external supply. Built-in charger for Ni-Cad cells. Power/volume switch, squelch control, channel selector, mic. socket, earphone/external speaker socket. Complete with microphone and 144.48, 144.72 & 145.32 crystals. Size: 134 x 58 x 180mm.

OUR PRICE £79.50 Carr.paid

BELTEK W5400 CAR TRANSCEIVER



Solid state mobile transceiver for 12 volt DC neg. Transmits and receives on any 12 of 28 channels between 144 and 146MHz. Power output 10W and 1W switchable. Controls: On/off/volume, squelch and channel selector. Internal 3" speaker. Complete with dynamic mic. PTT switch, three sets of crystals for 144.48, 144.6 and 145MHz, mounting bracket and instructions. Size: 150 x 70 x 220mm.

OUR PRICE £75.00 P&P 50p

OT55G DIGITAL CLOCK MECHANISM

Features 24 hour alarm setting, on/off and auto alarm 'sleep' switch. Illuminated rotary dial with hours, minutes and seconds. Automatically turns off radio, TV, light etc. and with auto-switching will turn on again when required. 240V AC operation. Switch rating 250V–3 Amp.

OUR PRICE £5.95 P&P 30p

KE630 3 Station INTERCOM

Master and two sub-stations. Can be used on desk or wall mounted. Complete with cable and batteries

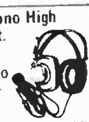
OUR PRICE £5.25 P&P 50p

LH02S STEREO HEADPHONES

Light weight headphones with padded ear pieces. 4/16 ohms 20–20,000Hz. Complete with 6' lead and plug.

OUR PRICE £1.97 P&P 30p

TE1018 Deluxe Mono High Impedence Headset.



Sensitive magnetic headset with soft ear pads. Impedence 2,600 ohms (600 ohms DC). Frequency response: 200–4,000Hz.

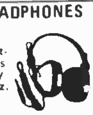
OUR PRICE £2.25 P&P 30p

DH02S STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable head band. Impedence 8 ohms. 20–12,000Hz. Complete with lead and plug.

OUR PRICE £2.50 P&P 30p

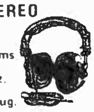
TE1035 Stereo HEADPHONES



Low cost with excellent response. Foam rubber earcups. Adjustable headband. 8 ohms impedence. Frequency response 25Hz–18kHz. Complete with cable and stereo jack plug.

OUR PRICE £2.60 P&P 30p

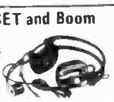
SH8DV MONO/STEREO HEADPHONES



Volume control for each channel. 4/16 ohms impedence. Frequency response 20Hz–18kHz. Complete with 10ft. coiled lead and jack plug.

OUR PRICE £4.97 P&P 30p

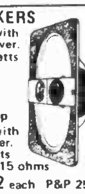
BH001 HEADSET and Boom Microphone



Moving coil. Ideal for language teaching, communications etc. Headphone impedence 16 ohms. Microphone impedence 200 ohms.

OUR PRICE £5.95 P&P 30p

EMI LOUDSPEAKERS



Model 350 13 x 8" with single tweeter/crossover. 20–20,000Hz. 15 watts RMS. Available 8 or 15 ohms.

OUR PRICE £7.25 each P&P 37p

Model 450 13 x 8" with twin tweeter/crossover. 55–13,000Hz. 8 watts RMS. Available 8 or 15 ohms

OUR PRICE £3.62 each P&P 25p

JOSTY KIT — HIGH QUALITY CONSTRUCTION KITS

WE ARE APPOINTED STOCKISTS AT ALL BRANCHES

All kits are complete with comprehensive easy to follow instructions and covered by full guarantee.

Post and Packing 15p per kit.

AF20 Mono amplifier	£4.80
AF25 Mixer	£3.60
AF30 Mono pre-amplifier	£2.61
AF35 Emitter amplifier	£2.27
AF80 0.5W mic. amplifier	£4.22
AF305 Intercom	£9.52
AF310 Mono amplifier	£5.91
AT5 Automatic light control	£2.58
AT25 Window wiper robot	£5.82
AT30 Photo cell switch unit	£5.70
AT50 400W triac light dimmer/speed control	£4.80
AT56 2,200W triac light dimmer/speed control	£6.90
AT60 1 channel light control	£7.80
AT65 3 channel light control	£14.55
GP304 Circuit board	£4.94
GP310 Stereo pre-amplifier for use with 2 x AF310	£21.27
GP312 Circuit board	£11.45
GU330 Tremolo unit	£7.50
HF61 Diode detector	£3.32
HF65 FM transmitter	£2.70
HF75 FM receiver	£2.87
HF310 FM tuner	£15.81
HF325 Deluxe FM tuner	£24.12
HF330 Decoder (HF310/325)	£9.96
HF380 lw/vhf aerial amplifier	£4.94
HF395 broadband aerial amp.	£1.77
LF380 Quadraphonic device	£11.36
M160 Multi-vibrator	£1.71
M191 VU Meter	£4.55
M192 Stereo balance meter	£4.97
M1302 Transistor tester	£8.45
NT10 Stabilised power supply 100mA, 9V	£6.15
NT300 Stabilised p. supply	£12.51
NT305 Voltage converter	£4.50
NT315 Power supply 240V AC to 4.5/15V DC, 500mA	£9.57

Amateur Electronics by Josty-Kit, the professional book for the amateur —covers the subject from basic principals to advanced electronic techniques. Complete with circuit board for AE1 to AE10.

OUR PRICE £3.30 (No VAT) P&P 25p plus VAT.

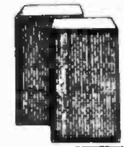
AE1 100mW output stage	£1.65
AE2 Pre-amplifier	£1.26
AE3 Diode receiver	£2.00
AE4 Flasher	£1.09
AE5 Astable multi-vibrator	£1.05
AE6 Monostable multi-vibrator	£1.02
AE7 RC generator	£1.06
AE8 Bass filter	99p
AE9 Treble filter	99p
AE10 CCIR filter	99p

2 TRANSISTOR RADIO KIT

No Soldering required. All connections made with spring clips. Kit includes all parts and wire including ear-piece. Will receive all normal broadcasts on Medium Wave 535–1605kHz. Operates from standard 9V battery or Solar Cell included.

OUR PRICE £1.30 P&P 30p

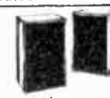
SPECIAL BARGAIN !! STEREOSOUND SPEAKERS



Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size: 368 x 229 x 190mm. 8 ohms. 8 watts RMS, 16 watts peak. Complete with Din lead.

OUR PRICE £12.95 P&P 50p

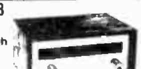
SPECIAL BARGAIN! FERGUSON 3406 HI-FI SPEAKERS



High quality 2 way speaker systems. 25 Watts. 4–8 ohms. 40Hz–18kHz. Size: 560 x 340 x 255mm. approx. Wood grain finish with black fronts.

OUR PRICE £26.95 PR. P&P £1

Model A1018 FM TUNER



6 transistor high quality unit–3 IF stages and double tuned discriminator. For use with most amplifiers. Covers 88–108MHz. Powered by 9V battery.

OUR PRICE £13.50 P&P 30p

Stereo multiplex adapter £5.95 extra.

ALL PRICES EXCLUDE VAT

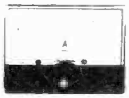
SEW CLEAR PLASTIC PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES ETC.

Over 200 ranges in stock—other ranges to order. Quantity discounts available. Send for fully illustrated brochure.

*Items with asterisk are Moving Iron type, all others are Moving Coil

CLEAR PLASTIC MODEL SD640
Size: 85 x 64mm

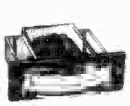


50uA	£3.80		
100uA	£3.75		
200uA	£3.70		
500uA	£3.65		
50-0-50uA	£3.75		
100-0-100uA	£3.70		
1mA	£3.65		
5mA	£3.65		
10mA	£3.65		
50mA	£3.65		
100mA	£3.65	20V DC	£3.65
500mA	£3.65	50V DC	£3.65
1A DC	£3.65	300V DC	£3.65
5A DC	£3.65	15V AC	£3.75
10A DC	£3.65	300V AC	£3.75
5V DC	£3.65	VU Meter	£3.90

CLEAR PLASTIC MODEL SW100
Size: 100 x 80mm

50uA	£4.60		
100uA	£4.50		
500uA	£4.30		
50-0-50uA	£4.50		
100-0-100uA	£4.45		
1mA	£4.30		
1A DC	£4.30		
5A DC	£4.30		
20V DC	£4.30		
50V DC	£4.30	300V AC	£4.45
300V DC	£4.30	VU Meter	£4.90

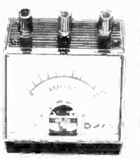
EDGWISE MODEL PE70
Size: 90 x 34mm



50uA	£4.15
100uA	£4.10
200uA	£4.05
500uA	£3.90
50-0-50uA	£4.10
100-0-100uA	£4.05
1mA	£3.85
300V AC	£3.95
VU Meter	£4.30

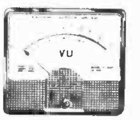
MODEL ED107 EDUCATIONAL METER
Size: 100 x 90 x 150mm including terminals

A 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.



50uA	£8.50		
100uA	£7.90		
50-0-50uA	£7.90		
1A DC	£7.60		
5A DC	£7.60		
5V DC	£7.60	300V DC	£7.60
10V DC	£7.60	500mA/5A DC	£8.60
15V DC	£7.60	5V/50V DC	£8.60
20V DC	£7.60	5V/15V DC	£8.60
50V DC	£7.60	1A/15A DC	£8.60

CLEAR PLASTIC MODEL MR 85P
Size: 120 x 110mm

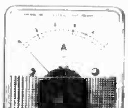


50uA	£5.45		
100uA	£5.40		
200uA	£5.35		
500uA	£5.25		
50-0-50uA	£5.40		
100-0-100uA	£5.35		
500-0-500uA	£5.20		
1mA	£5.20		
1-0-1mA	£5.20		
5mA	£5.20		
10mA	£5.20		
50mA	£5.20		
100mA	£5.20	300V DC	£5.20
500mA	£5.20	15V AC	£5.30
1A DC	£5.20	300V AC	£5.30
5A DC	£5.20	S Meter 1mA	£5.20
15A DC	£5.20	VU Meter	£5.55
30A DC	£5.40	1A AC	* £5.20
10V DC	£5.20	5A AC	* £5.20
20V DC	£5.20	10A AC	* £5.20
50V DC	£5.20	20A AC	* £5.20
150V DC	£5.20	30A AC	* £5.20

CLEAR PLASTIC MODEL SD830
Size: 110 x 83mm

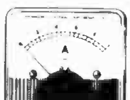
50uA	£4.30		
100uA	£4.25		
200uA	£4.20		
500uA	£4.15		
50-0-50uA	£4.25		
100-0-100uA	£4.20		
1mA	£4.10		
5mA	£4.10		
10mA	£4.10		
50mA	£4.10	10V DC	£4.10
100mA	£4.10	20V DC	£4.10
500mA	£4.10	50V DC	£4.10
1A DC	£4.10	300V DC	£4.10
5A DC	£4.10	15V AC	£4.20
10A DC	£4.10	300V AC	£4.20
5V DC	£4.10	VU Meter	£4.40

CLEAR PLASTIC MODEL MR 45P
Size: 50 x 50mm



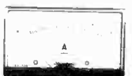
50uA	£3.20		
100uA	£3.15		
200uA	£3.10		
500uA	£3.00		
50-0-50uA	£3.15		
100-0-100uA	£3.10		
500-0-500uA	£2.95		
1mA	£2.95		
5mA	£2.95		
10mA	£2.95		
50mA	£2.95		
100mA	£2.95		
500mA	£2.95	300V AC	£3.05
1A DC	£2.95	S Meter 1mA	£2.95
5A DC	£2.95	VU Meter	£3.40
10V DC	£2.95	1A AC	* £2.95
20V DC	£2.95	5A AC	* £2.95
50V DC	£2.95	10A AC	* £2.95
300V DC	£2.95	20A AC	* £2.95
15V AC	£3.05	30A AC	* £2.95

CLEAR PLASTIC MODEL MR 38P
Size: 42 x 42mm



50uA	£3.10		
100uA	£3.05		
200uA	£3.00		
500uA	£2.85		
50-0-50uA	£3.05		
100-0-100uA	£3.00		
500-0-500uA	£2.80		
1mA	£2.80		
1-0-1mA	£2.80		
2mA	£2.80		
5mA	£2.80		
10mA	£2.80		
20mA	£2.80	15V DC	£2.80
50mA	£2.80	20V DC	£2.80
100mA	£2.80	50V DC	£2.80
150mA	£2.80	100V DC	£2.80
200mA	£2.80	150V DC	£2.80
300mA	£2.80	300V DC	£2.85
500mA	£2.80	500V DC	£2.85
750mA	£2.80	750V DC	£2.90
1A DC	£2.80	15V AC	£2.90
2A DC	£2.80	50V AC	£2.90
5A DC	£2.80	150V AC	£2.90
10A DC	£2.80	300V AC	£2.90
15A DC	£2.80	500V AC	£3.00
3V DC	£2.80	S Meter 1mA	£2.80
10V DC	£2.80	VU Meter	£3.20

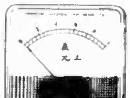
CLEAR PLASTIC MODEL SD460
Size: 59 x 46mm



50uA	£3.50		
100uA	£3.45		
200uA	£3.40		
500uA	£3.35		
50-0-50uA	£3.45		
100-0-100uA	£3.40		
1mA	£3.30		
5mA	£3.30		
10mA	£3.30		
50mA	£3.30		
100mA	£3.30	10V DC	£3.30
500mA	£3.30	50V DC	£3.30
1A DC	£3.30	300V DC	£3.30
5A DC	£3.30	15V AC	£3.45
10A DC	£3.30	300V AC	£3.45
5V DC	£3.30	VU Meter	£3.65

POSTAGE & PACKING 15p

CLEAR PLASTIC MODEL MR 65P
Size: 86 x 78mm

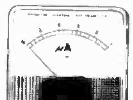


50uA	£3.95		
100uA	£3.85		
200uA	£3.80		
500uA	£3.75		
50-0-50uA	£3.85		
100-0-100uA	£3.80		
500-0-500uA	£3.70		
1mA	£3.70		
5mA	£3.70		
10mA	£3.70		
50mA	£3.70		
100mA	£3.70		
500mA	£3.70	50V AC	£3.80
1A DC	£3.70	150V AC	£3.80
5A DC	£3.70	300V AC	£3.90
10A DC	£3.70	500V AC	£3.80
15A DC	£3.70	S Meter 1mA	£4.10
20A DC	£3.80	VU Meter	£3.70
30A DC	£3.85	1A AC	* £3.70
50A DC	£4.05	5A AC	* £3.70
5V DC	£3.70	10A AC	* £3.70
10V DC	£3.70	20A AC	* £3.70
20V DC	£3.70	30A AC	* £3.70
50V DC	£3.70	50mA AC	* £3.70
150V DC	£3.70	100mA AC	* £3.70
300V DC	£3.70	200mA AC	* £3.70
15V AC	£3.80	500mA AC	* £3.70

BAKELITE MODEL S80 Enlarged Window
Size: 80 x 80mm

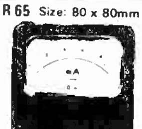
50uA	£4.50
100uA	£4.45
500uA	£4.20
50-0-50uA	£4.45
100-0-100uA	£4.40
1mA	£4.20
1A DC	£4.20
5A DC	£4.20
20V DC	£4.20
50V DC	£4.20
300V DC	£4.20
300V AC	£4.30
VU Meter	£4.70

CLEAR PLASTIC MODEL MR 52P
Size: 60 x 60mm



50uA	£3.70		
100uA	£3.50		
500uA	£3.35		
50-0-50uA	£3.50		
100-0-100uA	£3.45		
1mA	£3.30		
5mA	£3.30		
10mA	£3.30		
50mA	£3.30		
100mA	£3.30		
500mA	£3.30		
1A DC	£3.30		
5A DC	£3.30	S Meter 1mA	£3.30
10V DC	£3.30	VU Meter	£3.80
20V DC	£3.30	1A AC	* £3.30
50V DC	£3.30	5A AC	* £3.30
300V DC	£3.30	10A AC	* £3.30
15V AC	£3.40	20A AC	* £3.30
300V AC	£3.40	30A AC	* £3.30

BAKELITE MODEL MR 65 Size: 80 x 80mm



25uA	£5.25		
50uA	£4.00		
100uA	£3.95		
500uA	£3.65		
50-0-50uA	£3.95		
100-0-100uA	£3.90		
500-0-500uA	£3.60		
1mA	£3.60		
1-0-1mA	£3.60		
5mA	£3.60		
10mA	£3.60		
50mA	£3.60	30V AC	* £3.60
100mA	£3.60	50V AC	* £3.60
500mA	£3.60	150V AC	* £3.60
1A DC	£3.60	300V AC	* £3.60
2A DC	£3.60	500V AC	* £3.60
5A DC	£3.60	VU Meter	£4.10
15A DC	£3.60	1A AC	* £3.60
30A DC	£3.60	5A AC	* £3.60
50A DC	£3.80	10A AC	* £3.60
5V DC	£3.60	20A AC	* £3.60
10V DC	£3.60	30A AC	* £3.60
20V DC	£3.60	50A AC	* £3.60
50V DC	£3.60	500mA AC	£3.60
150V DC	£3.60	50mV DC	£3.75
300V DC	£3.60	100mV DC	£3.75

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Stereo 80 Pre-Amplifier	£11.95
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SINCLAIR Project 80 Packages

2 x Z40/Stereo 80/PZ5	£25.00
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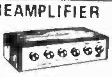
2 x Z60/Stereo 80/PZ8	£30.45

POST & PACKING 35p each.

MP7 MIXER-PREAMPLIFIER



5 Microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. Size: 235 x 127 x 76mm. Inputs: Mics. 3 x 3mV 50k; 2 x 3mV 600 ohms. Phono. Mag. 4mV 50k; Phono Ceramic 100mV 1 Meg. Output 250mV 100k.

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1021 Stereo Listening Station

For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. Two gain controls, speakers on—off slide switch, stereo headphone socket.

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TYPE	5	10	25
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AUDIOTRONIC 8 TRACK CARTRIDGES

TYPE	Each	5	10
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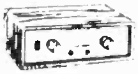
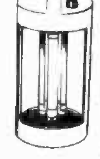
AUDIOTRONIC AHA101 Stereo Headphone Amplifier



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: 5mV and 100mV. OUTPUT: 50mV per channel.

OUR PRICE £8.50 P&P 20p

HITACHI FLUORESCENT LANTERN L1901



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PZ8 £6·95 (92p)
Decoder £6·45 (85p) Trans for PZ8 £2·95 (50p)
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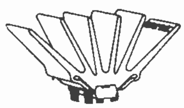
SINCLAIR SUPER IC 12



6W rms power with 44 page booklet and printed circuit £2·10 (43p)

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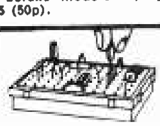

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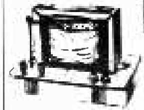

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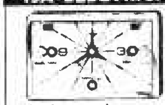

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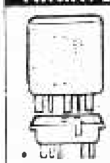

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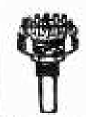

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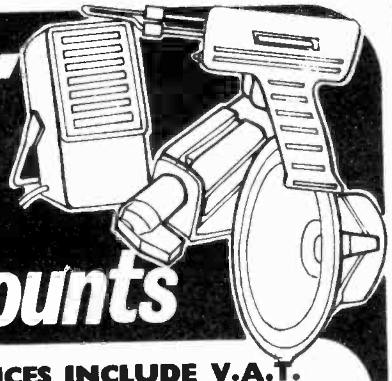

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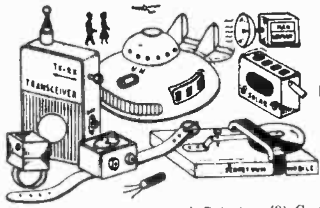

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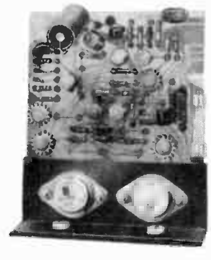

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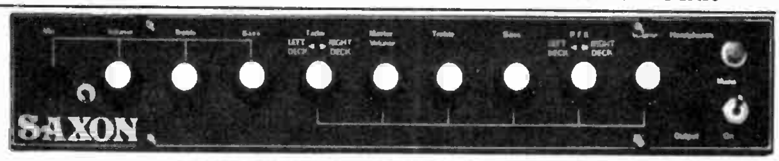
This well tried unit mixes two decks, handles any ceramic cartridge, and features mic over-ride plus separate full range bass and treble controls on both mic and deck inputs. Ample headphone power is available for P.F.L. May be used for mono and is mains operated. Fitted with sturdy screening case. Controls: Mic vol, bass, treble. Left/Right fade, deck volume, bass, treble, h/phone select, vol, Mains. Size 17½in × 3in × 4in deep.



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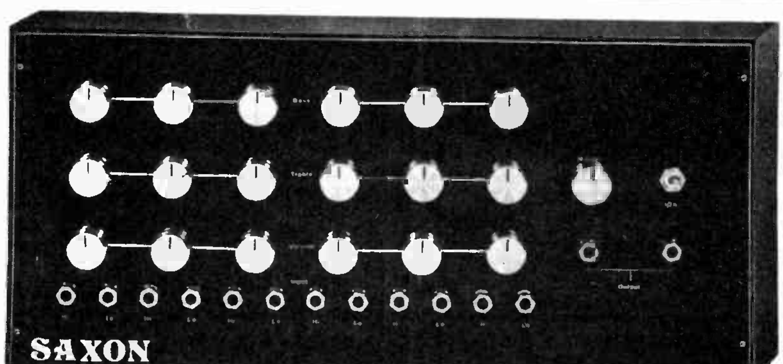

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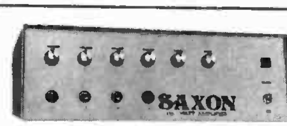

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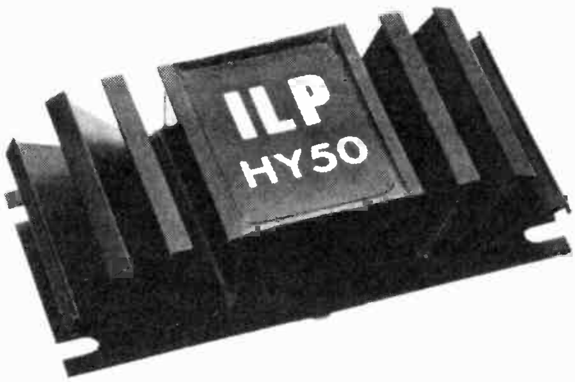

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OUTPUT POWER:	25 watts RMS. 50 watts peak music power
LOAD IMPEDANCE:	4·16Ω into 8Ω
INPUT SENSITIVITY:	Odb (0·775 volts RMS)
INPUT IMPEDANCE:	47KΩ
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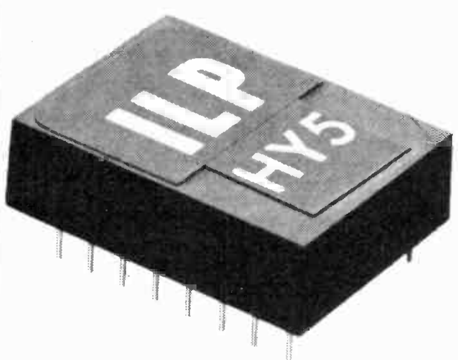
FREQUENCY RESPONSE:	10Hz-50KHz ± 1db
SUPPLY VOLTAGE:	± 25 volts
SIZE:	105 x 50 x 25 mm

Price £5·80 mono, £11·60 stereo

Price inclusive of VAT & P & P

NEW HY5 PRE-AMPLIFIER



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The combination of two HY5's two HY50's sharing a common power supply (PSU50) are linked by a balance control to form a complete stereo system.

SPEC.

INPUTS
Magnetic Pick-up 3mV (within 1db RIAA curve)
Ceramic Pick-up up to 3mV
Microphone 10mV
Tuner 250mV
Auxiliary 3–100mV
Input Impedance 47kΩ 1kHz

OUTPUTS
Tape 100mV.
Main output, Odb (0·775volts)

ACTIVE TONE CONTROLS
Treble ± 12db at 10kHz
Bass ± 12db at 100Hz
OVERLOAD CAPABILITY (equalization stage) 40db on most sensitive input
OUTPUT NOISE LEVEL (below 10mV magnetic input) 68db
DISTORTION 0·05% at 1kHz
SUPPLY VOLTAGE ± 16-25 volts
SUPPLY CURRENT 15mA
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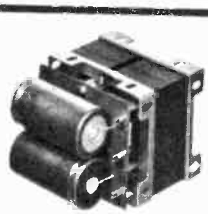
POWER SUPPLY PSU50



The new PSU50 has a low profile look being only 2¼ inches high and can be used for either mono or stereo systems.

SPEC.
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INPUT VOLTAGE 210-240 volts
SIZE L. 70, D. 90, H. 60 mm

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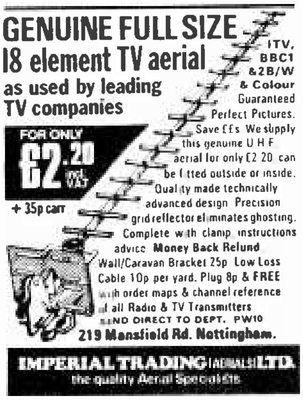

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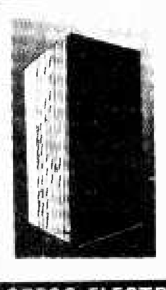

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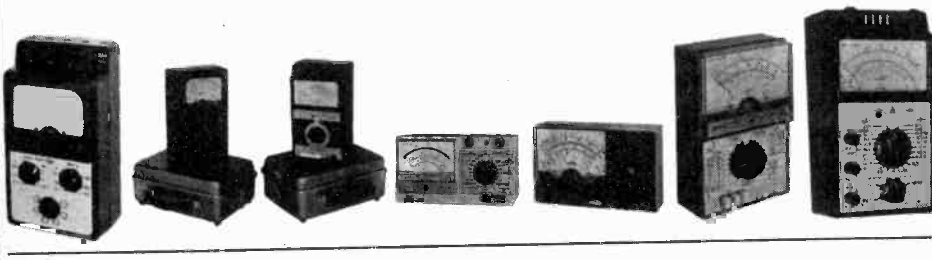

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160V: 0·1μF, 0·15μF, **4p**; 0·22μF, **5p**; 0·33μF, **6p**; 0·47μF, **7p**; 0·68μF, **10p**; 1μF, **13p**.

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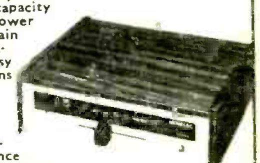

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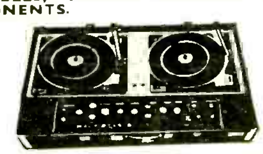

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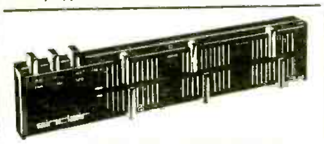

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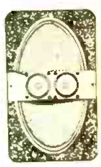

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