

PRACTICAL WIRELESS

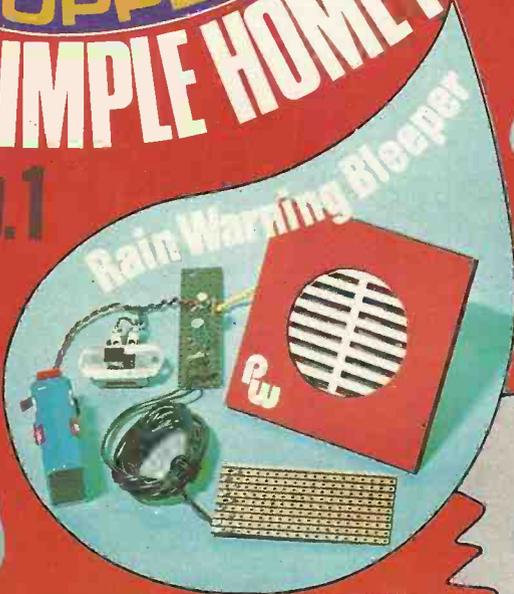
OCTOBER
1975

30p

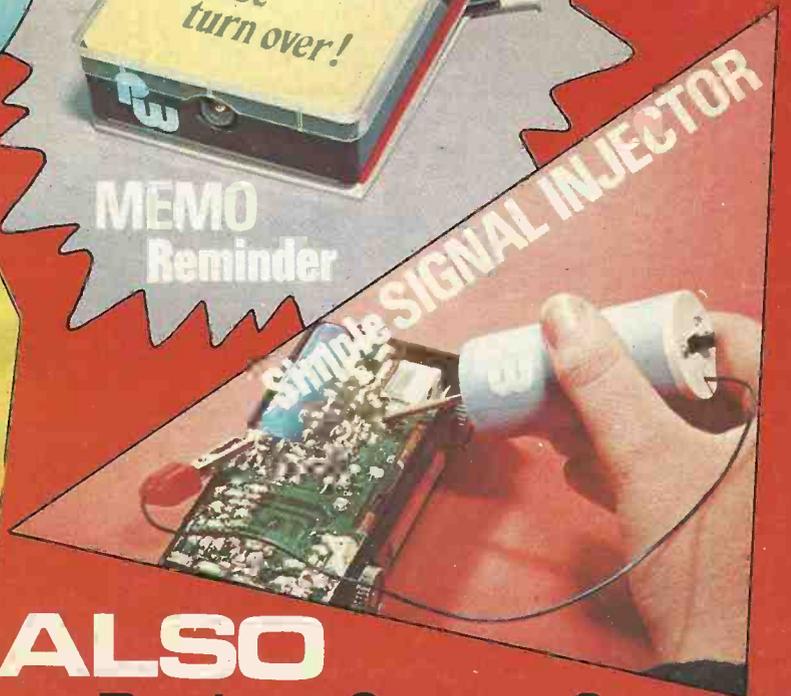
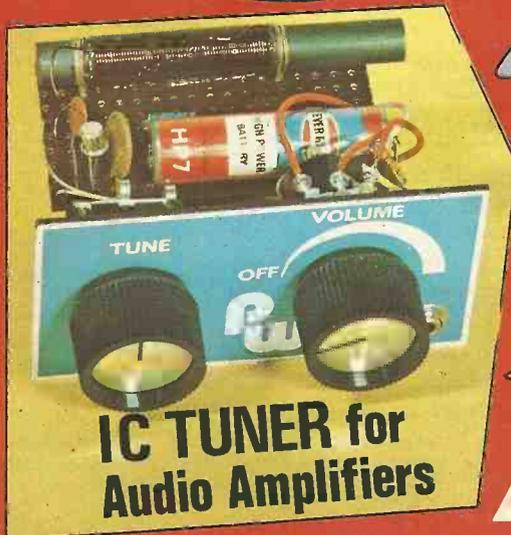
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SIMPLE HOME PROJECTS

No.1



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C106B	45p
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40669	90p
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2N4444	£1.90
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MDA952/2 6A 100V	80p
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L005 5V 600mA	30p
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2 1/2 x 3 1/2	0-15
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S.P.F. CUTTER	52p
100 PINS SS	30p
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500 PINS SS	£1.55
500 PINS DS	£1.55

BNC PLUGS at 35p each.
UHF (N) PLUGS at 50p each.

U.H.F. V.S.W.R. probes as U.H.F. transmitters £5 each + 8% VAT.
All the above are new in original packets. Please add 8% VAT P & P 30p.

POTENTIOMETERS	
Linear or Log	Single Double
Rotary Pots	17p 45p
Rotary Switched	25p

★★SPECIAL OFFERS★★

MINIATURE MAINS TRANSFORMER.
PRI 240V. SEC. 12V. 100Ma. Manuf.: Hincinley
Size: 36 x 45 x 40mm. F.C. 53mm.
Price 1-65p. 100 60p ea. 1,000 50p ea. 10,000
40p ea. 8% VAT.

MINIATURE MAINS TRANSFORMER.
Primary 115/240V Sec. 18v/250 Ma at 80p ea.
+ VAT & postage 33p. 8% VAT.

MULLARD POT CORE TYPE FX2241 at 60p ea. + 33p p.p. 8% VAT.

24V D.C. SOLENOID by MAGNETIC DEVICES 60p each. 2 1/2 long x 3/4 x 1/4 in. + 8% VAT.

240V. A.C. SOLENOID. Reversible operation; twin coil. Size approx. 2 1/2 x 1 1/2 x 1 1/2 in. 90p.

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25 Unmarked 250mW Zener diodes. 4-7V, 5-1V, 6-2V, 7-5V, 9-1V, 10V. Measured and tested! £1-00

Please state voltage required. £1-00
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747C Dual Op Amp £1-20
748C Op Amp 75p

30F 800V WKG PAPER CAPACITORS, ideal for Strobe Constructors £1-50 each + 8% VAT + 33p post.

Many other values of **PAPER CAPACITORS** in stock. Phone for details.

JACKSON AIRSPACED CAPACITORS to suit 3in. spindle:
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500pF Two Gang at 75p + 25% VAT

MULLARD TUBULAR CERAMIC UHF TRIMMERS (PROFESSIONAL)
Type 092 0-8-2-2p
801 0-8-2-2p Price 10p ea.
991 0-5-1-3p

QUANTITY DISCOUNTS PLEASE TELEPHONE
1000pF Feedthrough capacitor 5p ea.
Miniature tubular P.C. trimmers 50p ea.
3-5-13pF
6-30pF 10p ea.
4p c/o Varley 700 Ω relay 50p ea.

Gold Flashed professional TRANSISTOR SOCKETS. To suit small signal TO18, etc. 30 for £1-00 + 8% VAT.

W. WOUND POTS 1Ω-100KΩ at 30p each
Colvern or Reliance styles + 25% VAT

VERO EDGE CONNECTOR 24 way 1" pitch 30p each + 8% VAT. All the other sizes in stock.

SIEMENS VARLEY RELAY 4P C/O 100Ω 24V 50p each.

PLESSEY RELAY 2 P C/O 6V operation 40p each.

MODERN DISC CERAMICS £1-00 a hundred, £3-00 a thousand + 25% VAT. Phone or write for list.

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DIL SOCKETS, 8 pin 14p, 14 pin 14p, 16 pin 14p. Mica Washers + 2 Bushes (TO3 or TO86) 4p.

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ALUMINIUM BOXES IDEAL FOR VEROBOARD WITH BASE & P.K. SCREWS

AB7	2 1/2" Long	5 1/2" Wide	1 1/2" High	55p
AB8	4"	4"	1 1/2"	55p
AB9	4"	2 1/2"	1 1/2"	55p
AB10	4"	5 1/2"	1 1/2"	55p
AB11	4"	2 1/2"	2"	65p
AB12	3"	2"	1"	50p
AB13	6"	4"	2"	77p
AB14	7"	5"	2 1/2"	80p
AB15	8"	6"	3"	£1-16
AB16	10"	7"	3"	£1-32
AB17	10"	4 1/2"	3"	£1-10
AB18	12"	5"	3"	£1-32
AB19	12"	8"	3"	£1-80

ALUMINIUM BOXES WITH SLOPING TOP PANEL—IDEAL FOR PRE-AMPS, ETC., USING SLIDER CONTROLS

AB20 8" Long 9" Wide 3 1/2" High at back £2-20
2" High at front 6" Slope to front
With P.K. Screws

AB21 As above but 10" long £2-20
AB22 As above but 12" long £2-60

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MULTICORE CABLE. 20 way 14/0076 + Screen at 70p per yard+ postage by weight.

MULTICORE CABLE. 25-way, individually screened. 14/0076. £1-00 per yard+V.A.T. Postage by weight.

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10 TURN TRIMPOTS by Bourns, Mec, Painton, etc. All values in stock. 50p each. Discount on quantity.

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TRANSFORMER 240V A.C. Primary 1185-0-1185V at 360Ma Secondary £12+8% VAT+£1-50 postage.

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PRACTICAL WIRELESS

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ISSUE 824

OCTOBER 1975

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

EDITOR

Lionel E. Howes, G3AYA

ASSISTANT EDITOR

Eric Dowdeswell, G4AR

ART EDITOR

Peter Metalli

TECHNICAL EDITOR

Sam Lewis B.Sc. (Eng.)

PRODUCTION & NEWS EDITOR

Colin R. Riches

TECHNICAL SUB-EDITOR

Bill Tull

TECHNICAL ARTIST

Alan Martin

SECRETARIAL

Susan King

ADVERTS MANAGER

01-634 4293 Roy Smith

CLASSIFIED ADVERTS

01-634 4301 Colin R. Brown

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BACK NUMBERS

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.

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We regret that we cannot answer technical queries by telephone nor can we provide information or advice on manufacturers' products other than that given in the magazine. We will endeavour to assist readers who have queries relating to articles published but we cannot offer advice on modifications to our published designs. All correspondents expecting a reply should enclose a stamped addressed envelope.

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**SPECIAL EXTRA! —8-PAGE SUPPLEMENT —
SIMPLE HOME PROJECTS No. 1**

HUGE DISCOUNTS ON LEADING BRAND HI-FI

Full labour and material LOW DEPOSIT CREDIT TERMS

	Rec. Price	RSC Price
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LINEAR 505 Amp 5 + 5w	£22.85	£19.95
AUDIO FIDELITY Model 60 Amp	£69.45	£53.95
WHARFEDALE LINTON Amp	£78.85	£57.95
LEAK 2100 Amplifier	£138.60	£107.95
LEAK 2002 Cassette	£161.46	£125.95
LEAK 2030 L/ Speakers	£109.38 Pr	£85.95
LEAK 2060 L/ Speakers	£96.65 Ea	£74.95
LEAK 2000 Tuner/Amp	£223.96	£172.95
ROTEL RX152 Tun/Amp	£109.39	£79.95
ROTEL RX202 Tun/Amp	£124.42	£89.95
ROTEL RX402 Tun/Amp	£169.93	£120.95
ROTEL RT224 Tuner	£72.50	£51.95
ROTEL RT324 Tuner	£92.50	£66.95
WHARFEDALE Denton I L/Spkr	£39.10 Pr	£26.95
WHARFEDALE Denton 2XP L/Spkr	£57.29 Pr	£43.95
WHARFEDALE Linton 3XP L/Spkr	£79.69 Pr	£59.95
FANE Ambassador 35 L/Spkr	£103.00 Pr	£79.95
FANE MARQUESS 30 L/Spkr	£86.75 Pr	£57.50
FANE Model One Spkr Kit	£27.75 Pr	£21.95
WHARFEDALE Linton II Kit	£33.45 Pr	£22.50
WHARFEDALE WHD20 Cassette	£120.00	£89.95

BASF CASSETTES in Snap Pack CARR. FREE

LH CASSETTES		SUPER SM CASSETTES	
Rec. Price	RSC Price	Rec. Price	RSC Price
C60	98p	65p	3.00
C90	1.36	90p	3.99
C120	1.87	1.20	5.50

Also Shure Cartridges, Basf Tape, Koss H/Phones, etc. Prices of above correct at Aug 19 1975

AKAI TAPE UNITS

	Rec. Price	RSC Price
CS30D	£105.59	£77.50
CS34D	£137.50	£99.95
GXC39D	£186.50	£132.95
GXC39	£205.50	£144.95
GXC75D	£258.50	£181.95
GXC310D	£113.00	£79.95
GXR82D	£162.50	£116.95
4000DS	£619.50	£122.95

TURNTABLES

GOLDRING GL75 with G800 As above but with Plinth and Cover	£39.95	£51.95
PIONEER PL12D with Plinth and Cover	£48.50	£48.50
BSR MP60 with Plinth and Cover plus G850 Goldring Cartridge	£22.95	£22.95
GARRARD SP25 Mk. IV with Plinth and Cover plus G850 Cart.	£29.95	£29.95

PLINTH AND COVER



for Garrard SP25 or BSR MP60
£3.75
Carr. 50p

TITAN GROUP/DISCO SPEAKERS

	Rec. Price	RSC Price
T12/35 12" 35w	£13.00	£10.95
T12/60 12" 60w	£20.00	£14.95
T12/100 12" 100w	£35.00	£27.95
T15/70 15" 70w	£27.00	£19.95
T15/100 15" 100w	£38.50	£27.95
T18/100 18" 100w	£42.50	£29.95

DISCO SYSTEM

40 WATT



Consisting of Twin BSR T/table Console with Pre-amp and built-in Power Output. Sep. vol. controls for each T/table. H/phone monitoring facilities. Sep. Bass and Treble controls. Mic. Vol. control. Neon Mains Indicator. Plus Pair 12" 25w Spkrs. in matching Rexine covered cabinets.
£99.99
carr. £3

Terms: Dep. £15.99 and 18 fortnightly paymts. £5.38. (Total £112.83)

MOBILE DISCO CONSOLE

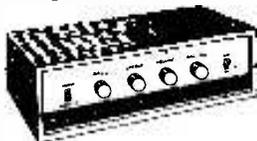


MIC., JACK, PHONE JACK, MONITOR VOL. CONTROL, MONITOR SELECTOR DECK (1) Vol. Control, DECK (2) Vol. control, Mic. Vol. Control, Treble Control, Bass Control and ON/OFF Switch, Neon Indicator, BSR T/tables.
£59.95
Carr. £3

Terms: Dep. £7.95 and 18 fortnightly paymts. £3.33 Total £67.89.

RSC G66 MkII 6+6 WATT high quality STEREO AMPLIFIER

Controls: Bass, Treble, Vol. and Bal. 10 Transistors plus Diodes. Output rating I.H.F.M. Frequency range 20-20,000 c.p.s. Bass Control ± 12db.



Treble Control ± 13db. Selector switch for Crystal P.U. or Tape/Radio. For speaker output impedances of 3 - 15 ohms. For standard 200-250v. A.C. mains operation. Attractive Black and Silver finished metal fascia plate and matching control knobs. COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and INSTRUCTIONS **£14.99** Carr 40p

COMPREHENSIVE WIRING DIAGRAMS & INSTRUCTIONS Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £19.50.

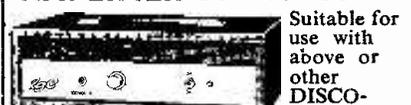
HI-FI SPEAKER ENCLOSURES

Simulated Teak finish. Sizes approx. Carr. 50p. per enc.

ME8 13x9 1/2 x 6 1/2 in.	£4.50
JE8 16x11x9 in.	£6.95
SE10 25x16x9 in.	£10.25
SE12 25x16x9 in.	£10.25

Both cut for 8in. speaker.
Cut for 10in. and Tweeter
Cut for 12in. and Tweeter

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

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Response 30 Hz-15 KHz. Rating 15 watts in sealed cabinet. Imp. 8-15 ohms. 8" Bass Unit with P.V.C. Cone surround for ultra low resonance. Pressure Tweeter. Printed Circuit. Inductive/Capacitive Cross-over. Damping Material, Screws.

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Consisting of matched 12in. 11,000 Gauss 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range **£7.95** Carr. 45p.
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HF123 13,000 GAUSS SPEAKER

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Response 25 Hz to 15 KHz. Gauss 13,000 Imp 8-15 Ω

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50 WATT SPEAKER

AT FANTASTIC LOW PRICES!

50 WATT SPEAKER

TWIN TURNTABLE WITH PRE-AMP. and POWER AMPLIFIER Complete with lid

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 - (b) PAIR OF HI-FI HEAD PHONES
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RSC TDI DISCO CONSOLE

Incorporating twin BSR MP60 type turntables or Sonotone or Accos Cartridges with diamond styl. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control. Black Vynide covered Cabinet with lid.

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£5-11 (Total £101-93) Carr. £1-50

DEP. £19-99 & 18 fortnightly. Payments of £9-75 (Total £195-49).

STEREO VERSION
Of Above System
Or DEPOSIT £34-95 and 18 fortnightly pmts. £209-95

£11-19 (Total £238-87) Carr. £3-50

TD2S STEREO VERSION OF ABOVE
Terms DEPOSIT £20 £125-00 and 18 fortnightly payments £6-71 Carr. £1-60 (Total £120-78)

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£29-99

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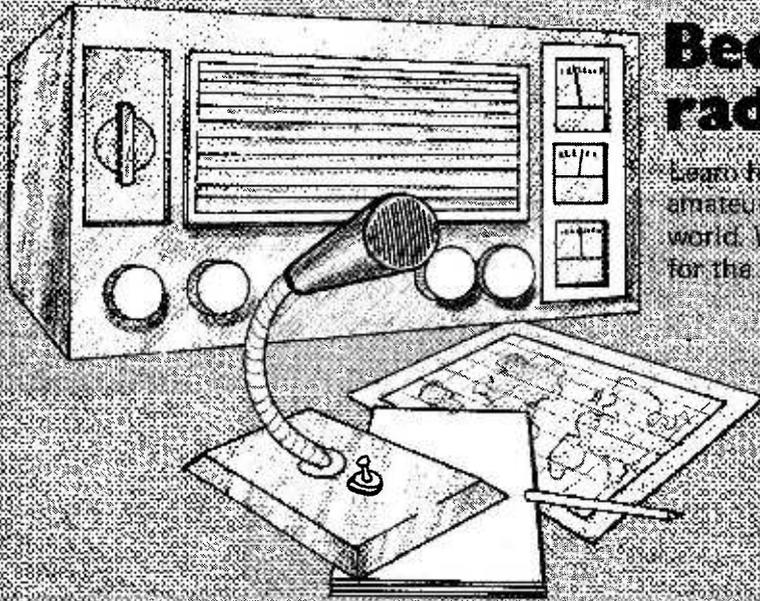
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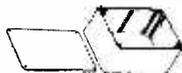
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- 8" x 5" 8 ohm Permat's Magnet £1.60
- 3-8-15 ohm
- *EMI 13" x 8" 350 Kit 8 ohm £7.50 + 50p Carr.



10 inch DUAL CONE L/S Manufactured by "ELAC" to a very high standard these loudspeakers are a real bargain SPEC:- Size=10" Dual Cone. Power=10 Watts Frequency=40-12000Hz +25% Our Price = £3.75p each

MAINS KEYNECTOR

Keynector connects any Electrical Equipment to the mains supply in seconds. Ideal for bench, garage demonstrations, etc. Multi connections can be made (max. load 13A fused). £3.25p. +8%



ALUMINIUM BOXES +8%

Metal project boxes give your work a professional finish

Model	L	W	H	Price
AB7	3 1/2"	4 1/2"	1 1/2"	54p
AB8	4"	5 1/2"	1 1/2"	48p
AB9	4"	6 1/2"	1 1/2"	34p
AB10	4"	7 1/2"	1 1/2"	69p
AB11	4"	8 1/2"	1 1/2"	54p
AB12	5"	5 1/2"	1 1/2"	45p
AB13	5"	6 1/2"	1 1/2"	69p
AB14	5"	7 1/2"	1 1/2"	54p
AB15	5"	8 1/2"	1 1/2"	69p
AB16	10"	7 1/2"	3"	£1.23
AB17	10"	8 1/2"	3"	£1.08
AB18	12"	8 1/2"	3"	£1.23
AB19	12"	9 1/2"	3"	£1.50

ABS PLASTIC BOXES -8%

Handy boxes for construction projects. Moulded extrusion rails for P.C. or chassis panels. Fitted with 1mm front panels.

- 1005 = 105mm x 73mm x 45mm = 65p
- 1006 = 150mm x 75mm x 47mm = 72p
- 1007 = 184mm x 124mm x 60mm = £1.28
- 1021 = 106mm x 74mm x 45mm (sloping front) = 55p

TELESCOPIC AERIAL

Nine section fully swivelling telescopic aerial with 4BA single bolt fixing or two hole fixing bracket. Fully extended = 43" Fully closed = 7" Our Price 50p + P/P + VAT @ 25%

CLEAR PLASTIC PANEL METERS
 Size 59mm x 46mm x 35mm these meters require a 38mm hole for mounting.

- ME6 = 0 to 50 micro amp Full Scale
- ME7 = 0 to 100 micro amp Full Scale
- ME8 = 0 to 500 micro amp Full Scale
- ME9 = 0 to 1 m/a Full Scale
- ME10 = 0 to 5 m/a Full Scale
- ME11 = 0 to 10 m/a Full Scale
- ME12 = 0 to 50 m/a Full Scale
- ME13 = 0 to 100 m/a Full Scale
- ME14 = 0 to 500 m/a Full Scale
- ME15 = 0 to 1 amp Full Scale
- ME16 = 0 to 50 volts
- ME17 = 0 to 300 volts A.C. Full Scale
- ME18 = "S" Meter
- ME19 = "VU" Meter



OUR PRICE £3.00 +8%

WIRE WOUND VOLUME CONTROL
 250ohm Only 25p EACH. Approx. 1" Diameter. Long standard spindle. +8%

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Brand new range of British made Relays. Size 1 1/2" x 1" x 3/4". All two changeovers with 250v 1.5A contacts and suitable for fitting on .1m Veroboard. Type Volts Cur- Ohms

- 27/A 12v 17M/A 700
 - 21/A 12v 28M/A 430
 - 12/A 6v 33M/A 185
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DECON DALO SSPC ETCH RESIST PEN

The Decon Dalco SSPC is a unique instrument for the professional and amateur electronics engineer, enabling him to prepare in minutes a perfect printed circuit board

OUR PRICE 80p +8%

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- * Completely Portable
 - * Heats in 5 seconds
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 - * Heats to 700 deg. F
 - * Fine Tip for delicate and general purpose soldering
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- OUR PRICE £9.75 +8% (spare bits are available)

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- BHA0002 15 watt Amp Module £3.50
- NE555 Timer I.C. 75p
- MCI310P Stereo Decoder I.C. £1.40
- 7805 Regulator 55p
- TIP 29A TIP 30A 65p
- BC107 10p
- BC108 10p
- BC109 10p

I.C. SOCKETS +8%

- D.I.L.
- 8 pin = 13p
- 14 pin = 14p
- 16 pin = 14p
- 24 pin = 24p
- 28 pin = 28p
- 36 pin = 36p

BARGAIN TRANSFORMERS

12.0-12 volt 500m/a
 240 volt primary transformer bargain. approx size = 60mm x 40mm x 50mm fixing centres=75mm
 Our Price =£1.20 +8%

P.C. ETCHING KIT

This kit contains all that the constructor will need to etch the circuits of his own design
 Contents = Plastic etching dish.
 Sample copper clad board.
 Laminate Cutter.
 1 lb Ferric Chloride.
 Large Plastic Spoon.
 Etch Resist Pen.
 Full Etching Instructions.
 Complete and Big Kit Value at £3.75p +8%

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Good quality tape in well made screw type cassettes. Presented in single plastic cases.
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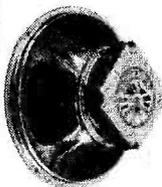
12 inch MODELS

Guaranteed
for 5 years

T12/35 Rated Power 35 WATTS

Centre Pole Diam. 1½" Imp. 8-15 Ω
Twin Cone. Range: 50-17000Hz
Ceramic Magnet
Weight: 600 Gms

Rec. Price **£13·00**



T12/60 Rated Power 60 WATTS

Centre Pole Diam. 2" Imp. 8-15 Ω
Range: 60-9000Hz
Ceramic Magnet
Weight 1150 Gms.

Rec. Price **£20·00**



T12/100 Rated Power 100 WATTS

Centre Pole Diam. 3" Imp 8-15 Ω
Range: 40-5000Hz
Ceramic Magnet
Weight: 1250 Gms

Rec. Price **£35·00**



Power Ratings
R.M.S.
Continuous

All
Rec.
Prices
inc. VAT

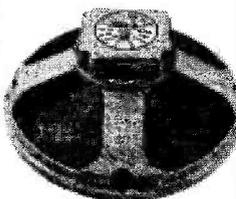
15 inch MODELS

Guaranteed
for 5 years

T15/70 Rated Power 70 WATTS

Centre Pole Diam. 2" Imp 8-15 Ω
Ceramic Magnet
Weight: 1150 Gms
Range: 50-4000Hz

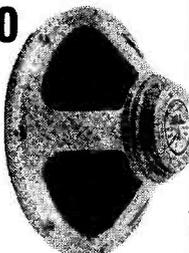
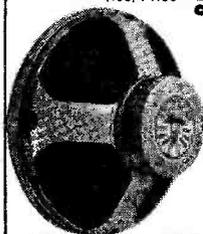
Rec. Price **£27·00**



T15/100 Rated Power 100 WATTS

Centre Pole Diam. 3" Imp. 8-15 Ω
Ceramic Magnet
Weight: 1250 Gms.
Range: 50-4000Hz

Rec. Price **£38·50**



18 inch MODEL

T18/100 Rated Power 100 WATTS

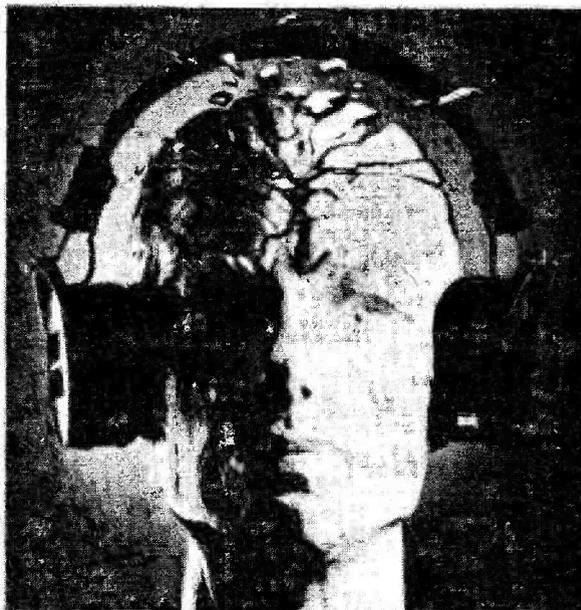
Centre Pole Diam. 3" Imp. 8-15 Ω
Ceramic Magnet
Weight: 1250 Gms.
Range: 35-4000Hz

Rec. Price **£42·50**

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CLEAR PLASTIC MODEL SD640

Size: 85 x 64mm

50uA	£4.20	10V DC	£4.05
100uA	£4.15	20V DC	£4.05
200uA	£4.10	50V DC	£4.05
500uA	£4.05	300V DC	£4.05
50-0-50uA	£4.15	15V AC	£4.15
100-0-100uA	£4.10	30V AC	£4.15
1mA	£4.05	VU Meter	£4.95
5mA	£4.05		
10mA	£4.05		
50mA	£4.05		
100mA	£4.05		
500mA	£4.05		
1A DC	£4.05		
5A DC	£4.05		
10A DC	£4.05		
5V DC	£4.05		



CLEAR PLASTIC MODEL SW100

Size: 100 x 80mm

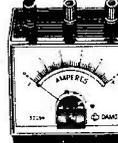
50uA	£5.05	150V AC	£4.90
100uA	£4.95	300V AC	£4.90
500uA	£4.75	VU Meter	£6.25
50-0-50uA	£4.95		
100-0-100uA	£4.90		
1mA	£4.75		
1A DC	£4.75		
5A DC	£4.75		
20V DC	£4.75		
50V DC	£4.75		
300V DC	£4.75		



MODEL ED107 EDUCATIONAL METER

Size: 100 x 90 x 150mm including terminals

A range of high quality
moving coil instruments
ideal for school experi-
ments and other bench
applications. 3" mirror
scale. The meter move-
ment is easily accessible
to demonstrate internal
working.



50uA	£9.35	20V DC	£8.40
100uA	£8.70	50V DC	£8.40
50-0-50uA	£8.70	300V DC	£8.40
1mA	£8.40	800mA/5A DC	£9.50
1-0-1mA	£8.40	5V/50V DC	£9.50
1A DC	£8.40	5V/15V DC	£9.50
5A DC	£8.40	1A/15A DC	£9.50
10V DC	£8.40		
15V DC	£8.40		

CLEAR PLASTIC MODEL SD460

Size: 59 x 46mm

50uA	£3.85	5V DC	£3.65
100uA	£3.80	10V DC	£3.65
200uA	£3.75	20V DC	£3.65
500uA	£3.70	50V DC	£3.65
50-0-50uA	£3.80	300V DC	£3.65
100-0-100uA	£3.75	15V AC	£3.80
1mA	£3.65	30V AC	£3.80
5mA	£3.65	VU Meter	£4.65
10mA	£3.65		
50mA	£3.65		
100mA	£3.65		
500mA	£3.65		
1A DC	£3.65		
5A DC	£3.65		
10A DC	£3.65		



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

CLEAR PLASTIC MODEL SD830

Size: 110 x 83mm

50uA	£4.75	10V DC	£4.50
100uA	£4.65	20V DC	£4.50
200uA	£4.60	50V DC	£4.50
500uA	£4.55	300V DC	£4.50
50-0-50uA	£4.65	15V AC	£4.60
100-0-100uA	£4.60	30V AC	£4.60
1mA	£4.50	VU Meter	£5.80
5mA	£4.60		
10mA	£4.60		
50mA	£4.50		
100mA	£4.50		
500mA	£4.50		
1A DC	£4.50		
5A DC	£4.50		
10A DC	£4.50		
5V DC	£4.50		



CLEAR PLASTIC MODEL MR 45P

Size: 50 x 50mm

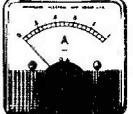
50uA	£3.55	15V AC	£3.40
100uA	£3.50	30V AC	£3.40
200uA	£3.45	5 Meter 1mA	£3.75
500uA	£3.40	VU Meter	£4.30
50-0-50uA	£3.50	1A DC	£3.25
100-0-100uA	£3.45	5A DC	£3.25
500-0-500uA	£3.25	10V DC	£3.25
1mA	£3.25	20V DC	£3.25
5mA	£3.25	50V DC	£3.25
10mA	£3.25	300V DC	£3.25
50mA	£3.25		
100mA	£3.25		
500mA	£3.25		
1A DC	£3.25		
5A DC	£3.25		
10V DC	£3.25		
20V DC	£3.25		
50V DC	£3.25		
300V DC	£3.25		



CLEAR PLASTIC MODEL MR 38P

Size: 42 x 42mm

50uA	£3.45	10V DC	£3.05
100uA	£3.40	15V DC	£3.05
200uA	£3.30	20V DC	£3.05
500uA	£3.25	50V DC	£3.05
50-0-50uA	£3.40	100V DC	£3.05
100-0-100uA	£3.30	150V DC	£3.10
500-0-500uA	£3.05	300V DC	£3.10
1mA	£3.05	500V DC	£3.15
1-0-1mA	£3.05	750V DC	£3.15
5mA	£3.05	15V AC	£3.15
10mA	£3.05	20V AC	£3.15
20mA	£3.05	50V AC	£3.15
50mA	£3.05	150V AC	£3.15
100mA	£3.05	300V AC	£3.15
150mA	£3.05	500V AC	£3.30
200mA	£3.05	5 Meter 1mA	£3.50
300mA	£3.05	VU Meter	£4.10
500mA	£3.05		
750mA	£3.05		
1A DC	£3.05		
2A DC	£3.05		
10A DC	£3.05		
3V DC	£3.05		



CLEAR PLASTIC MODEL MR 85P

Size: 120 x 110mm

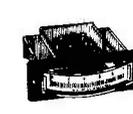
50uA	£6.00	50V DC	£5.75
100uA	£5.95	150V DC	£5.75
200uA	£5.90	300V DC	£5.75
500uA	£5.80	15V AC	£5.85
50-0-50uA	£5.95	30V AC	£5.85
100-0-100uA	£5.90	5 Meter 1mA	£6.85
500-0-500uA	£5.65	VU Meter	£7.10
1mA	£5.75	1A AC	£5.75
1-0-1mA	£5.75	5A AC	£5.75
5mA	£5.75	10A AC	£5.75
10mA	£5.75	20A AC	£5.75
50mA	£5.75	30A AC	£5.75
100mA	£5.75		
500mA	£5.75		
1A DC	£5.75		
5A DC	£5.75		
15A DC	£5.75		
30A DC	£5.95		
10V DC	£5.75		
20V DC	£5.75		



EDGWISE MODEL PE70

Size: 90 x 34mm

50uA	£4.55	5V DC	£4.45
100uA	£4.50	10V DC	£4.45
200uA	£4.45	20V DC	£4.45
500uA	£4.30	50V DC	£4.45
50-0-50uA	£4.50	15V AC	£4.45
100-0-100uA	£4.45	30V AC	£4.45
1mA	£4.25	VU Meter	£5.50
5mA	£4.25		
10V DC	£4.25		
30V DC	£4.35		
VU Meter	£5.50		

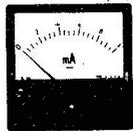


POSTAGE / PACKING & INSURANCE 15p

BAKELITE MODEL S80 Enlarged Window

Size: 80 x 80mm

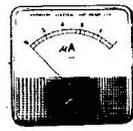
50uA	£4.95	10V DC	£4.95
100uA	£4.90	20V DC	£4.90
500uA	£4.60	50V DC	£4.90
50-0-50uA	£4.80	300V DC	£4.90
100-0-100uA	£4.85	15V AC	£4.95
1mA	£4.60	30V AC	£4.95
1A DC	£4.60	VU Meter	£5.95
5A DC	£4.60		
20V DC	£4.80		
50V DC	£4.80		
300V DC	£4.60		
300V AC	£4.75		
VU Meter	£5.95		



CLEAR PLASTIC MODEL MR 52P

Size: 60 x 60mm

50uA	£4.10	5 Meter 1mA	£4.20
100uA	£3.85	VU Meter	£4.85
500uA	£3.70	1A AC	£3.65
50-0-50uA	£3.85	5A AC	£3.65
100-0-100uA	£3.70	10V DC	£3.65
1mA	£3.65	20V DC	£3.65
5mA	£3.65	50V DC	£3.65
10mA	£3.65	300V DC	£3.65
50mA	£3.65	15V AC	£3.65
100mA	£3.65	30V AC	£3.65
1A DC	£3.65		
5A DC	£3.65		
10V DC	£3.65		
20V DC	£3.65		
50V DC	£3.65		
300V DC	£3.65		
15V AC	£3.65		
30V AC	£3.75		



BAKELITE MODEL MR 65 Size: 80 x 80mm

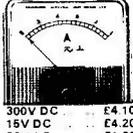
25uA	£5.80	30V DC	£3.95
50uA	£4.40	30V AC	£3.95
100uA	£4.35	50V AC	£3.95
500uA	£4.05	1A AC	£3.95
50-0-50uA	£4.35	5A AC	£3.95
100-0-100uA	£4.30	10A AC	£3.95
500-0-500uA	£3.95	20A AC	£3.95
1mA	£3.95	30A AC	£3.95
1-0-1mA	£3.95	50A AC	£3.95
5mA	£3.95	100V DC	£3.95
10mA	£3.95	15V DC	£3.95
50mA	£3.95	20V DC	£3.95
1A DC	£3.95	50V DC	£3.95
2A DC	£3.95	100V DC	£3.95
5A DC	£3.95	15V DC	£3.95
10A DC	£3.95	30V DC	£3.95
15A DC	£3.95	50V DC	£3.95
30A DC	£3.95	100V DC	£3.95
50A DC	£4.20	150V DC	£3.95
5V DC	£3.95		
10V DC	£3.95		
15V DC	£3.95		
30V DC	£3.95		
50V DC	£3.95		
100V DC	£3.95		



CLEAR PLASTIC MODEL MR 65P

Size: 86 x 78mm

50uA	£4.35	300V DC	£4.10
100uA	£4.25	1A AC	£4.10
200uA	£4.20	5A AC	£4.10
500uA	£4.15	10A AC	£4.10
50-0-50uA	£4.25	20A AC	£4.10
100-0-100uA	£4.20	30A AC	£4.10
500-0-500uA	£4.10	50A AC	£4.10
1mA	£4.10	100A AC	£4.10
1-0-1mA	£4.10	200A AC	£4.10
5mA	£4.10	300V DC	£4.10
10mA	£4.10	15V DC	£4.10
50mA	£4.10	20V DC	£4.10
100mA	£4.10	50V AC	£4.10
500mA	£4.10	150V AC	£4.10
1A DC	£4.10	15V DC	£4.10
5A DC	£4.10	20V DC	£4.10
10A DC	£4.10	50V DC	£4.10
15A DC	£4.10	150V DC	£4.10
20A DC	£4.20		
30A DC	£4.25		
50A DC	£4.10		
5V DC	£4.10		
10V DC	£4.10		
15V DC	£4.10		
20V DC	£4.10		
50V DC	£4.10		
150V DC	£4.10		

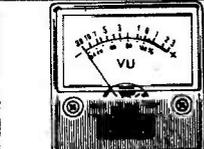
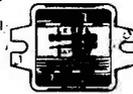


BATTERY/LEVEL PANEL INDICATOR

18mm
18mm Panel
mounting.

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PRICE
95p P/P

& Ins 15p Discounts for quantity.



VU METER TYPE 3
250uA Size: 33mm x 20mm.
£1.55 P/P & Ins 15p

REDUCED TO CLEAR

YAMABISHI VARIABLE VOLTAGE TRANSFORMERS

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

MODEL S260 BENCH MOUNTING

P/P & Ins

1A	£7.30-£1.50
2.5A	£10.25-£1.50
5A	£12.95-£1.50
8A	

IT MAKES SENSE TO

HIOKI 730X
30,000 opv. Overload protection. 6/30/60/300/600/1200V DC. 12/60/120/600/1200V AC. 60µA/30mA/300mA. 2K/200K/2 Meg Ohm. -10 to +63dB.
OUR PRICE £8.10 P/P & Ins 30p



U4312 MULTIMETER
extremely sturdy instrument for general electrical use. 667 opv. 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. 0.7/300µA/1.5/6/15/150/60/600mA/1/1.5/6A DC. 0.1/1/5/15/60/150/300/600mA. 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 £11.60 P/P & Ins 60p



MODEL AS.100D VOM
1000.00v opv. Mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1200V DC. 0/6/30/120/300/600V AC. 0/10µA/6/60/300mA/12 Amp. 0/2k/200k/2M/200 Meg Ohm. -20 to -17dB.
OUR PRICE £18.90 P/P & Ins 60p



KAMODEN HM720B FET VOM
Input impedance 15 Megohms. Ranges:- 0/25/1/2.5/10/50/100V DC. 0/2.5/10/50/250/500V AC. 0/25µA/2.5/25/250 mA DC. 0/5k/50k/500k/5 M 500 Megohms.
OUR PRICE £24.30 P/P & Ins 60p



LB4 TRANSISTOR TESTER
Tests PNP or NPN transistors. Audio indicator. Operates on two 1.5V batteries. Complete with instructions etc.
OUR PRICE £4.85 P/P & Ins 20p



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. 0.06/0.5/5/50/500µA/5mA/50mA/100mA/1.0. x 10, x 100, x 1,000, x 10,000 (50k, 800k, 5kΩ, 50kΩ centre scale). Battery operated. Size: 180 x 97 x 40mm. Supplied in carrying case complete with test leads.
OUR PRICE £8.60 P/P & Ins 60p



HIOKI 750X VOLT-OHM-MILLIAMETER
43 ranges: 0-0.3/0.6/1.5/3/6/12/30/60/150/300/600/1200V DC. 0/0.3/0.6/1.5/3/6/12/30/60/150/300/600/1200V AC. Current: 0-30/60µA/1.5/3/15/30/150/300mA. Resistances: 0-3/300k/30Mhms. 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.
OUR PRICE £12.90 P/P & Ins 60p



KAMODEN 360 MULTIMETER
High sensitivity to DC 100kohm/V AC 10kohm/V 5" mirror scale, overload protected. Ranges: 0.5/2.5/10/50/250/500/1000V DC. 5/10/50/250/500V AC. AC Current: 0.01mA/0.5/5/50/500mA/10A. Resistance: 0.1/1/10/100 ohms/1/10/100k ohms/10/100M ohms. DC current: 10/250µA/2.5/25/250 mA/10A. AC current: -0-10A. -20 to +62dB. Battery operated. Size: 180 x 140 x 80mm. Supplied complete with test leads etc.
OUR PRICE £18.90 P/P & Ins 60p



SWR METER Model SWR3
Handy SWR meter for transmitter antenna alignment, with built-in field strength meter. Accuracy 5%. Impedance 52Ω Indicator 100µA DC. Full scale 5 section collapsible antenna. Size 145 x 50 x 60mm.
OUR PRICE £4.55 P/P & Ins 60p



MODEL TE15 GRID DIP METER
Transistorised. Operates as Grid Dip, Oscillator, Absorption Wave Meter and Oscillating Detector. Frequency range 440kHz - 280MHz in six coils. 500µA meter. 9V battery operation. Size: 180 x 80 x 100mm.
OUR PRICE £18.90 Ins 30p



TMK 200 MULTIMETER KIT
Build yourself a quality 20000 opv multimeter and save money. Complete kit with meter scale, movement and rotary range selector ready mounted in cabinet. All parts, batteries, test prods and instructions. Ranges: 0/0.6/3/30/120/600/1200V DC. 0/6/30/120/600/1200V AC. Current: 0/0.6/6/60/600mA. Resistance: 0/10/100K/1/10 Meg ohms. Decibels: -20 to +63dB. Size: 90 x 150 x 35mm
OUR PRICE £9.65 P/P & Ins 30p



TMK MODEL TW50K
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 25/50µA/2.5/5/25/50/250/500mA/5/10A. Resistance: 10/100k/1 Meg/10 Meg ohms. -20 to +81.5dB.
OUR PRICE £13.50 P/P & Ins 60p



Model HT100B4 MULTIMETER
Overload protected, shock proof circuits. 9.5uA Meter with mirror scale. Sensitivity 100kV. Polarity change switch. Ranges: 0.5/2.5/10/50/250/500/1000V DC. 2.5/10/50/250/1000 Volts AC. DC resistance 0-20/200k/2/20 Meg. ohms. DC current: 10/250µA/2.5/25/250 mA/10A. AC current: -0-10A. -20 to +62dB. Operates from 2 x 1.5V batteries. Size: 180 x 134 x 79mm.
OUR PRICE £21.50 P/P & Ins 60p



U4341 Multimeter & Transistor Tester
27 ranges. 16,700opv. Overload protected. Ranges: 0.5/2.5/10/50/30/60/150/300/600V DC. 1.5/7.5/30/150/300/750V AC. Resistance: 0.06/0.6/6/60/600mA AC. 0.3/3/30/300mA AC. Resistance: 0.06/0.5/2/20/200k ohms/2 Mhms. Battery operated. Supplied complete with probes, leads and steel carrying case. Size: 115 x 215 x 90mm.
OUR PRICE £11.85 P/P & Ins 60p



SINCLAIR DM2 DIGITAL MULTIMETER
Will measure AC and DC volts, AC and DC current, and resistance in a total of 20 ranges. The large light emitting diode display will read up to 1999 and automatically indicate polarity. Indication of positive and negative overload is also provided. The instrument is fitted with a combined carrying handle and bench stand and sockets are provided for the connection of an external power supply.
DC VOLTS: 1v, 10, 100v, 1000v. AC VOLTS: 1v, 10v, 100v, 1000v. DC CURRENT: 1mA, 10mA, 100mA, 1000mA. AC CURRENT: 1mA, 10mA, 100mA, 1000mA. RESISTANCE: 1k, 10k, 100k, 1000k.
OUR PRICE £63.70 P/P & Ins 50p



MODEL C7208FM
30,000 opv DC. 15,000 opv AC. 6/3/15/60/300/600/1200V DC. 6/30/120/600/1200V AC. DC Resistance x 1, x 10, x 100, x 1000 (50k centre scale). DC Current 30µA/3/30/600mA. -20 to +63dB.
OUR PRICE £9.65 P/P & Ins 30p



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 AC. 0/30µA/6/60/300 mA. 12 Amp. 0/10k/1m/10m/100 Meg Ohms. -20 to -17dB.
OUR PRICE £13.50 P/P & Ins 60p



370WTR MULTIMETER
Features AC current ranges. 20,000 opv. 0/0.5/2.5/10/50/250/500/1000V DC. 0/2.5/10/50/250/500/1000V AC. 0/50µA/1/10/100 mA/1/10A DC. 0/100mA/1/10A AC. 0/5k/50k/500k/5 Meg/50 Meg. Decibels: -20 to +62dB.
OUR PRICE £21.50 P/P & Ins 60p



KAMODEN TT35 TRANSISTOR TESTER
High quality instrument to test reverse leak current and DC current. Amplification factor of NPN, PNP, diodes, transistors, SCR's etc. 4" square clear scale meter. Operates from internal batteries. Complete with instructions, leads carrying handle.
OUR PRICE £18.90 P/P & Ins 60p



TRANSISTORISED L.C.R. AC BR/8 MEASURING BRIDGE
A new portable bridge offering excellent range and accuracy at low cost. Reistance: 6 ranges: 0.1 ohm-11.1 megohm ± 1% Inductance: 6 ranges: 1 microhenry-111 henries ± 2% Capacity: 6 ranges: 10p-1110 mfd ± 2% Turns Ratio: 6 ranges: 1:1/1000-1:11100 ± 1% Bridge Voltage at 1,000cps. Operated from 9 volt battery. 100 microamp meter indication. Size 73 x 5" x 2".
OUR PRICE £29.70 P/P & Ins 60p



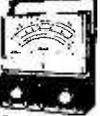
U4324 MULTIMETER
High sensitivity. 20,000opv. Ranges: 0.5/1.2/3/12/30/60/120/600/1200V DC. 3/6/15/60/150/300/600/900V AC. Current: 0.05/0.6/6/60/600mA/3A DC. 3A AC. Resistance: 25/500 ohms/0.5/5/50/500k ohms/5 Mhms. Decibels: -10 to +12dB. Size 167 x 98 x 63mm. Supplied complete with test leads, spare diode and instructions.
OUR PRICE £10.60 P/P & Ins 60p



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. 0/50µA/5/50/500mA. 12A DC. 0/60k/6 meg/60 megohms.
OUR PRICE £15.05 P/P & Ins 60p



MODEL C7080EN
Giant 6" mirror scale. 20,000 opv. 0/0.25/1/2.5/10/50/250/500/1000V DC. 0/2.5/10/50/250/500V AC. 0/2.5/10/50/250/1000/5000V DC. 0/2.5/10/50/250/1000/5000V AC. 0/50µA/1/10A/100/500mA/10A DC. 0/2k/200k/20 Meg. -20 to +50dB.
OUR PRICE £21.50 P/P & Ins 60p



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. 0/12/600µA/12/300mA/6/12A DC. 0/10k/1 Meg/100 Meg. -20 to +50dB. 0.01-0.2MFD Transistor tester measures Alpha, Beta and Ico. Complete with instructions, batteries and leads.
OUR PRICE £22.65 P/P & Ins 60p



TE-200 RF SIGNAL GENERATOR
Accurate wide range signal generator covering 120 kHz-500 MHz on 6 bands. Directly calibrated. Variable RF attenuator audio output. Xtal socket for calibration. 220/240V a.c. Brand new with instructions. Size 140mm x 215mm x 170mm.
OUR PRICE £24.30 P/P & Ins 60p



U91 Clamp VOLT AMMETER
For measuring AC voltage and current without breaking circuit. Ranges: 300/600V AC. Current: 10/25/100/250/500A. Accuracy 4%. Size 283 x 94 x 36mm. Complete with carrying case, leads and fuses.
OUR PRICE £15.10 P/P & Ins 60p



U4317 MULTIMETER
High sensitivity instrument for field and laboratory work. Knife edge pointer. 85mm. mirror scale. Overload protection. Ranges: 100mV/0.5/2.5/10/25/50/100/250/500/1000V DC. 0.5/2.5/10/25/50/100/250/500/1000V AC. Current: 50µA/0.5/1.5/10/50/250mA/1.5A DC. 0.25/1.5/10/50/250mA/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 £18.35 P/P & Ins 60p



KAMODEN 72.200 Multitester
High sensitivity tester. 200,000 opv Overload protected. Mirror scale. Ranges: -0/0.6/3/3/60/120/600/1200V DC. 0/3/12/60/300/1200V AC. 0/6/60/300mA/12A DC. 0/12A AC. -20 to +56dB. 0/2k/200k/2 Meg/200 Megohms.
OUR PRICE £24.30 P/P & Ins 60p



C15 PULSE OSCILLOSCOPE
For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth: 10MHz. Sensitivity at 100kHz V/RMS/mm: 0.1-25; HOR. AMP. Bandwidth: 500kHz. Sensitivity at 100kHz V/RMS/mm: 0.3-25 Preset triggered sweep 1-3000µsec. Free running 20-200 kHz in nine ranges. Calibrator pips. 220 x 350 x 430mm. 115-230V AC.
OUR PRICE £47.50 P/P & Ins £1.60



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AMERICAN RADIO a service that makes sense!

EXPORT Personal exports arranged for overseas visitors. Goods specifically packed, insured and despatched to all parts of the world at minimum cost exclusive of VAT. Payment by bank transfer, certified cheque, postal order or money order in any currency.

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ALL PRICES INCLUDE VAT

TE22 SINE SQUARE WAVE AUDIO GENERATOR
Sine 20cps to 200kHz on 4 bands. Square 20 cps to 30 kHz. Output impedance 5000 Ohms. 200/250V AC operation. Supplied brand new guaranteed, with instruction manual and leads.
OUR PRICE £26.90 P/P & Ins £0p



HANIMEX HDC 1900 DIGITAL ALARM CLOCK
240V operation with large clear numbers, night light and 'snooze' switch. Attractively finished in white and silver.
OUR PRICE £8.10 P/P & Ins £1.00



T. T. C. SPRITE STEREO HEADPHONES
Feather weight (5oz). Dynamic stereo headphones providing high quality reproduction at a budget price. Soft removable ear pads and adjustable headband. Speaker size: 28mm. Impedance: 8 ohms. Frequency response: 30-13000 Hz.
OUR PRICE £2.40 P/P & Ins 30p



SAVE £9.35

ELIZABETHAN OCR26 DIGITAL CLOCK RADIO
A smaller than usual digital clock AM/FM radio, measuring only 8 1/2" x w 3 1/2" d x 4" h. The DCR is finished in simulated teak veneer and is fitted with a pre-set sleep timer switch that will turn on the radio at the precise time chosen (Mains operated) List Price £24.25
OUR PRICE £14.90 P/P & Ins. £1.35



HIGH QUALITY CONSTRUCTION KITS

ALL PRICES REDUCED TO CLEAR

LIMITED STOCKS AT Oxford Street. 42 & 17, Fleet Street.
311 Edgware Road. CROYDON BIRMINGHAM KINGSTON LEICESTER NORTHAMPTON SOUTHEND TUNBRIDGE WELLS WOLVERHAMPTON branches, or by Mail Order.

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

Post and Packing Ins. 15p per kit.

ARF 300 AF/RF SIGNAL GENERATOR
All transistorised compact fully portable. AF sine-wave 18Hz to 220 kHz. AF square wave 18Hz to 100kHz. 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 £40.50 P/P & Ins 60p



NEW GOLDRING G102 KIT
Belt-drive 2-speed turn table in kit form complete with pick up arm and head shell. P/P & Ins.
OUR PRICE £21.15 Ins £1.00



WALKIE TALKIES SKYFON NV7
Super low cost transmitter/receivers. 100MW with call buzzer and on/off volume control. 7 transistors. Telescopic rod antenna.
OUR PRICE £43.60 per PAIR/P/P & Ins 50p
NOT LICENSABLE IN THE U.K.



SAVE £14.00

ELIZABETHAN 8/LZ-1
8-Track Stereo Player. Home 8-Track player with automatic and illuminated channel indicators for use with your hi fi system. Size 7 1/2" x 12" D x 2 1/2" h. List Price £28.90.
OUR PRICE £14.90 P/P & Ins. £1.35



AF20 Mono amplifier.....	£5.95
AF25 Mixer.....	£2.90
AF30 Mono pre-amplifier.....	£3.40
AF35 Emitter amplifier.....	£2.55
AF80 0.5W mic. amplifier.....	£5.10
AF305 Intercom.....	£8.45
AF310/2 Mono Amplifier.....	£7.95
M160 Multi-vibrator.....	£3.95
M1302 Transistor tester.....	£7.05
M191 VU Meter.....	£5.45
M192 Stereo balance meter.....	£7.10
LF380 Quadraphonic device.....	£11.45
AF75 Automatic light control.....	£7.55
AT50 Photo cell switch unit.....	£5.65
AT50 400W triac light dimmer/speed control.....	£24.35
AT56 2,200W triac light dimmer/speed control.....	£10.62
AT60 1 channel light control.....	£8.85
AT65 3 channel light control.....	£4.05
GU330 Tremolo unit.....	£3.40
HF61 Diode detector.....	£3.85
HF65 FM transmitter.....	£17.30
HF75 FM receiver.....	£22.95
HF310 FM tuner.....	£11.15
HF325 Deluxe FM tuner.....	£6.35
HF330 Decoder (HF310/325).....	£2.20
GP310 Stereo pre-amplifier for use with 2 x AF310.....	£8.90
GP312 Circuit board.....	£2.25
GP304 Circuit board.....	£6.65
HF380 VU/vhf aerial amplifier.....	£8.25
HF395 broadband aerial amp.....	£8.80
NT110 Stabilised power supply 100mA, 9V.....	£6.60
NT300 Stabilised p. supply.....	£13.95
NT310 Power Supply 240 V AC or 2 x 18 V D.C. at 2amps.....	£5.95
NT305 Voltage converter.....	£5.95
NT315 Power supply 240V AC 104.5/15V DC, 500mA.....	£12.75

MODEL TE20 RF SIGNAL GENERATOR
Six bands. 120kHz-250MHz. 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 190mm. Complete with test leads etc.
OUR PRICE £20.45 P/P & Ins 60p



SUPERB QUALITY LOW PRICES AUDIOTRONIC DIGITAL CLOCK RADIOS

ADC22
24-hour clock radio, covering MW/FM wavebands. 180-minute sleep timer. Choice of Grey or White cabinet. P/P & Ins.
OUR PRICE £17.50 Ins £1.00



SINCLAIR Project 80 Modules

Z40 Power Amp.....	£6.60	P/P & Ins. 15p
Z60 Power Amp.....	£8.95	P/P & Ins. 15p
Stereo 80 Pre-Amp.....	£13.10	P/P & Ins. 15p
Active Filter Unit.....	£7.40	P/P & Ins. 15p
FM Tuner.....	£13.10	P/P & Ins. 15p
Stereo Decoder.....	£8.40	P/P & Ins. 15p
P25 Power Supply.....	£4.65	P/P & Ins. 30p
P26 Power Supply.....	£6.40	P/P & Ins. 30p
P28 Power Supply.....	£7.90	P/P & Ins. 30p
Transformer for P28.....	£5.10	P/P & Ins. 30p

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CATALOGUE

LASKYS 32 PAGE CATALOGUE AND PRICE LIST - absolutely free and available from all stores or by post (see coupon below). This exciting catalogue provides a comprehensive selection from the largest Hi-Fi Retailer in Europe - a MUST for every Hi-Fi and electronics specialist.

AF20 Mono amplifier.....	£5.95
AF25 Mixer.....	£2.90
AF30 Mono pre-amplifier.....	£3.40
AF35 Emitter amplifier.....	£2.55
AF80 0.5W mic. amplifier.....	£5.10
AF305 Intercom.....	£8.45
AF310/2 Mono Amplifier.....	£7.95
M160 Multi-vibrator.....	£3.95
M1302 Transistor tester.....	£7.05
M191 VU Meter.....	£5.45
M192 Stereo balance meter.....	£7.10
LF380 Quadraphonic device.....	£11.45
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AT50 Photo cell switch unit.....	£5.65
AT50 400W triac light dimmer/speed control.....	£24.35
AT56 2,200W triac light dimmer/speed control.....	£10.62
AT60 1 channel light control.....	£8.85
AT65 3 channel light control.....	£4.05
GU330 Tremolo unit.....	£3.40
HF61 Diode detector.....	£3.85
HF65 FM transmitter.....	£17.30
HF75 FM receiver.....	£22.95
HF310 FM tuner.....	£11.15
HF325 Deluxe FM tuner.....	£6.35
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GP312 Circuit board.....	£2.25
GP304 Circuit board.....	£6.65
HF380 VU/vhf aerial amplifier.....	£8.25
HF395 broadband aerial amp.....	£8.80
NT110 Stabilised power supply 100mA, 9V.....	£6.60
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NT310 Power Supply 240 V AC or 2 x 18 V D.C. at 2amps.....	£5.95
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NT315 Power supply 240V AC 104.5/15V DC, 500mA.....	£12.75

LASKYS make sense of Hi-Fi

ADC33 Deluxe
24-hour clock radio covering MW/FM wavebands. 180-minute sleep timer. Buzzer alarm. Tone control. P/P & Ins.
OUR PRICE £19.95 Ins £1.00



AUDIOTRONIC LOW NOISE CASSETTES

TYPE	6	10	25
C60	£1.70	£3.24	£7.65
C90	£2.42	£4.59	£10.80
C120	£2.95	£5.59	£13.22

P/P & Ins 4p each
3-10p: 4 and over 15p

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NT305 Voltage converter.....	£5.95
NT315 Power supply 240V AC 104.5/15V DC, 500mA.....	£12.75

AUDIOTRONIC HEADPHONES

LSH20 Individual volume controls. Mono/stereo switch. 19,000 Hz. 8 ohms.
OUR PRICE £6.25 P/P & Ins 50p



MINIATURE ORGAN MUSIC MASTER AM100
Spanning nearly two octaves, including semi-tones. This instrument will give hours of enjoyment to all the family. Beautifully finished. The keyboard range can be adjusted to be in tune with any instrument. Operates from internal 9V battery. Fitted with on/off switch, vibrato switch, earphone socket and external 9V D.C. socket. Size 229mm x 127mm x 64mm
OUR PRICE £9.95 P/P & Ins 50p



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 £10.65 P/P & Ins 30p



FREE

CATALOGUE

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NT305 Voltage converter.....	£5.95
NT315 Power supply 240V AC 104.5/15V DC, 500mA.....	£12.75

LSH30 Individual tone and volume controls. Mono/stereo switch. 30-20,000 Hz. 8 ohms.
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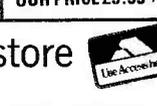
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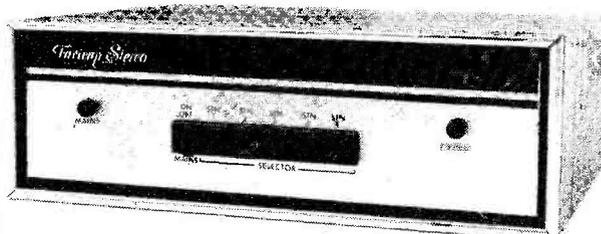
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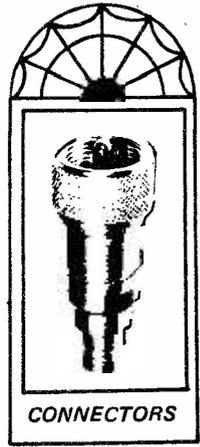
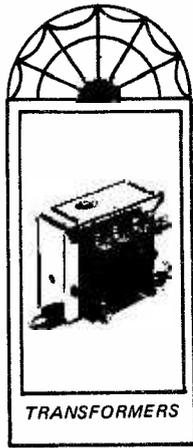
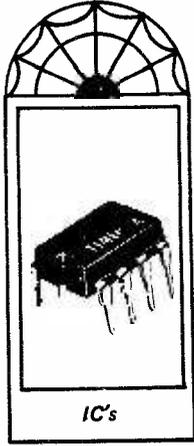
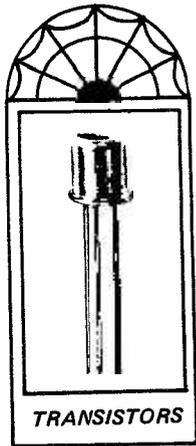
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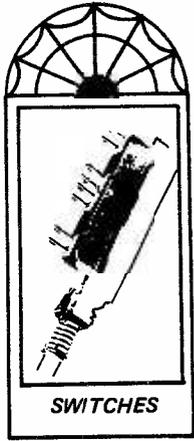
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VA	Ref. No.	Price Cased	Price Plugs	Price 2 Pin + 1 Earth	Price Open Post
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200	151	11.45	0.88	8.14	0.80
250	152	12.90	0.88	9.80	0.88
350	153	15.50	0.88	11.88	0.95
450	154	17.25	0.88	13.62	1.13
750	155	27.10	1.10	20.59	O.A.
1000	156	35.40	1.10	29.15	O.A.
1500	157	42.00	1.10	33.37	O.A.
2000	158	49.75	2.64	37.10	O.A.
3000	159	73.15	2.64	58.55	O.A.

12 & 24 Volts Prim. 200-240V.

Amps	Ref. No.	Price	Post
12V	24V	£	£
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0.5	0.25	1.11	1.88
1	0.5	2.13	1.74
2	1	7.1	2.50
4	2	18	2.96
6	4	30	4.18
8	4	108	4.56
10	5	72	5.20
12	6	116	5.51
16	8	17	7.00
20	10	115	10.42
30	15	187	13.25
40	20	232	14.55
60	30	226	16.93

30 Volts

Amps	Ref. No.	Price	Post
0.5	112	1.90	0.47
1	79	2.40	0.56
2	30	3.50	0.64
3	20	4.50	0.64
4	21	5.15	0.72
5	51	6.40	0.72
6	117	7.16	0.88
8	88	9.55	0.95
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VA	Ref. No.	Price Cased	Price Plugs	Price 2 & 3 pin	Price Open Post
Tapped at 115, 220, 240 Volts	20	113	8.85	0.20	1.71
Tapped at 115, 200, 220, 240 Volts	150	4	6.88	0.20	4.12
	200	65	7.04	0.20	4.95
	300	66	8.00	0.20	5.81
	500	67	10.99	0.20	8.85
	750	83	13.82	0.85	10.80
	1000	84	17.27	0.85	13.68
	1500	93	21.87	0.85	18.31
	2000	95	33.11	1.60	24.25
	3000	73	47.94	2.10	35.10

50 Volts

Amps	Ref. No.	Price	Post
0.5	102	2.58	0.47
1	103	3.48	0.56
2	104	5.03	0.64
3	105	5.81	0.72
4	106	7.58	0.88
6	107	12.30	0.95
8	118	13.20	1.13
10	119	17.02	O.A.

60 Volts

Amps	Ref. No.	Price	Post
0.5	124	2.30	0.56
1	126	3.41	0.56
2	127	5.09	0.72
3	128	7.52	0.80
4	128	8.75	0.95
5	40	9.75	0.95
6	120	11.20	1.01
8	121	15.00	1.19
10	122	18.20	O.A.
12	189	18.50	O.A.

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Prim. 240V with screen.

Sec. 1	Volts	Sec. 2	Milliamps	Ref. No.	Price	Post
3-0-3	—	200	—	238	1.50	0.25
0-5	0-6	500	500	234	1.38	0.25
0-6	0-6	1000	1000	212	1.90	0.47
0-9	—	100	—	18	1.40	0.25
0-9-9	—	330	330	235	1.50	0.25
0-8-9	0-8-9	500	500	207	1.93	0.34
0-8-9	0-8-9	1000	1000	208	2.75	0.47
15-0-15	—	30	—	240	1.35	0.25
0-15	0-15	200	—	230	1.38	0.25
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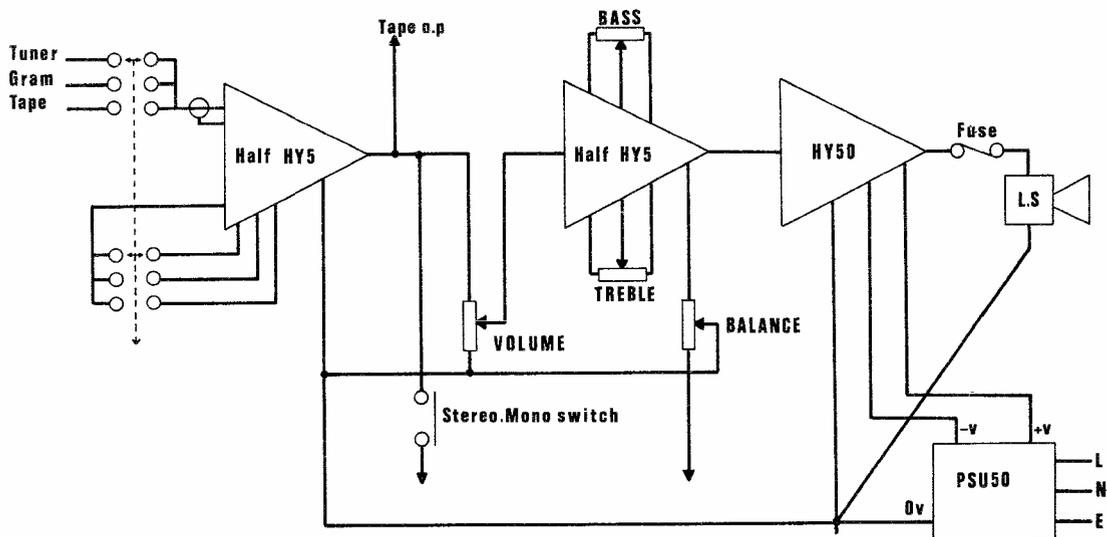
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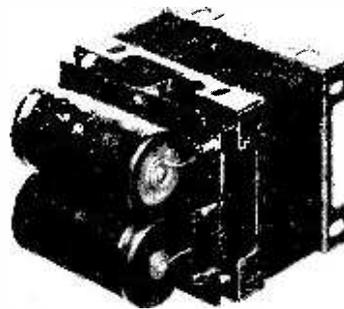
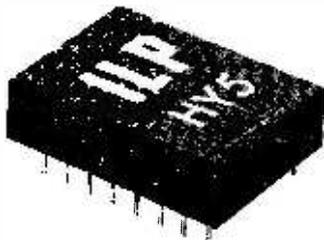


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The HY5 is a complete mono hybrid preamplifier, ideally suited for both mono and stereo applications. Internally the device consists of two high quality amplifiers—the first contains frequency equalisation and gain correction, while the second caters for tone control and balance.

TECHNICAL SPECIFICATION

Inputs: Magnetic Pick-up 3mV RIAA; Ceramic Pick-up 30mV; Microphone 10mV; Tuner 100mV; Auxillary 3-100mV; input/Impedance 47kΩ at 1kHz. **Outputs:** Tape 100mV; Main output 0db (0.775V RMS). **Active Tone Controls:** Treble ± 12db at 10kHz; Bass ± 12db at 100Hz; Distortion: 0.5% at 1kHz. **Signal/Noise Ratio:** 68db. **Overload Capability:** 40db on most sensitive input. **Supply Voltage:** ± 16-25V.

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The HY50 is a complete solid state hybrid HI-FI amplifier incorporating its own high conductivity heatsink hermetically sealed in black epoxy resin. Only five connections are provided, input, output, power lines and earth.

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Output Power: 25W RMS into 8Ω. **Load Impedance:** 4-16Ω. **Input Sensitivity** 0db (0.775V RMS). **Input Impedance:** 47kΩ. **Distortion:** Less than 0.1% at 25V typically 0-05%. **Signal/Noise Ratio:** Better than 75db. **Frequency Response:** 10Hz-50kHz ± 3db. **Supply Voltage:** ± 25V. **Size:** 105 x 50 x 25mm.

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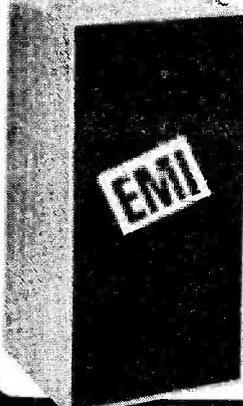
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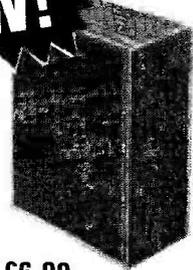
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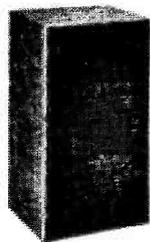
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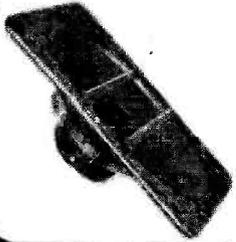
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£22.00 pair complete +£5.20 p & p.
 Complete with crossover Components and circuit diagram



EMI 350 KIT

System consists of a 13" x 8" approx. woofer with a 3" tweeter, crossover components and circuit diagram. Frequency response: 20 Hz to 20 KHz. Power handling 15 watts RMS into 8 ohms. (Peak 30 watts.)

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 Complete with crossover Components and circuit diagram

RTVC*

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VISCOUNT IV STEREO SYSTEM

System 1a. **£65.00**

The new 20+20 watt Stereo Amplifier incorporating the latest silicon transistor solid state circuitry, the RT-VC VISCOUNT IV gives you a powerful 20 watts RMS per channel into 8 ohms. Superb teak-finished cabinet, with anodised fascia to harmonise with any decor. Polished trim and knobs.

The VISCOUNT IV has a comprehensive range of controls — volume, bass, treble, balance, mono/stereo, mode selector, and scratch filter. Front panel socket for stereo headphones. And a host of sockets at the rear — for left and right speakers, tape recorder, auxiliary, tuner, disc and microphone.

SPECIFICATION: 20 watts RMS per channel 40 watts peak. Suitable 8-15 ohms speakers. Total distortion @ 10 watts better than 0.2%. Six switched inputs: 1. Magnetic P.U. — 3 millivolts @ 47 K ohms (R.I.A.A.); 2. Crystal/ceramic P.U. — 50 millivolts @ 50 K ohms (R.I.A.A.); 3, 4, & 6. Tape Tuner/Aux. — 140 millivolts @ 50 K ohms (flat frequency response); 5. Microphone — 3 millivolts @ 50 K ohms (flat frequency response).

CONTROLS: Push button ON/OFF, stereo/mono, scratch filter, 6 position rotary selector. Individual rotary controls for treble, bass, balance and volume. Headphone socket, tape out socket. Aux. mains output. Frequency response: 25 Hz to 25 KHz @ full rated output. Signal to noise ratio: better than -50 dB on all inputs. **Tone control range:** Bass ±15 dB @ 50 Hz; Treble ±12 dB @ 10 KHz. **Power requirements:** 200-250V A.C. mains @ 60 watts. **Approx. size:** 15 1/4" x 3" x 10".

MP60 type deck with magnetic cartridge, de luxe plinth and cover.
Two Duo Type IIa matched speakers — Enclosure size approx. 19 1/4" x 10 3/4" x 7 1/4" in simulated teak. Drive unit 13" x 8" with 3" tweeter. 15 watts handling. 30 watts peak.
Complete System with these speakers **£65.00** +£6.50 p & p.

System 2. **£81.00**

Viscount IV amplifier (As System 1a)
 MP60 type deck (As System 1a)

Two Duo Type III matched speakers — Enclosure size approx. 27" x 13" x 11 1/2". Finished in teak simulate. Drive units 13" x 8" bass driver, and two 3" (approx.) tweeters. 20 watts RMS. 8 ohms frequency range — 20 Hz to 18,000 Hz.

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PRICES: SYSTEM 1a
 Viscount IV R103 amplifier £25.00+£1.90 p & p.
 2 Duo Type IIa speakers £30.00+£6.50 p & p.
 MP60 type deck with Mag. cartridge de luxe plinth and cover £20.00+£3.30 p & p.
 Total if purchased separately: £75.00
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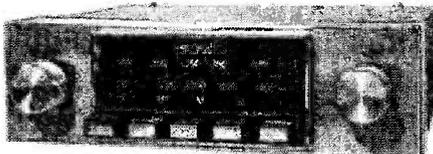
PRICES: SYSTEM 2
 Viscount IV R103 amplifier £25.00+£1.90 p & p.
 2 Duo Type III speakers £46.00+£7.50 p & p.
 MP60 type deck with Mag. cartridge de luxe plinth and cover £20.00+£3.30 p & p.
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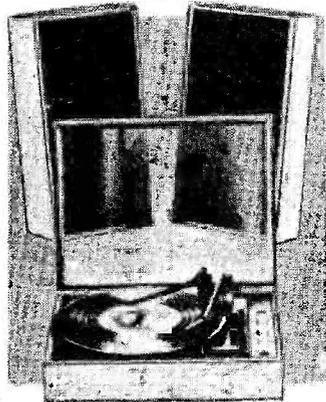
Easy to assemble construction kit comprising fully completed and tested printed circuit board on which no soldering is required. All connections are simple push fit type making for easy assembly. Fine tuning push button mechanism is fully built and tested to mate with printed circuit board.

TECHNICAL SPECIFICATION: (1) Output 4 watts RMS output. 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" wide 2" high and 4 1/2" deep approx. **£9.50** +£1.05 p & p. Speaker including baffle and fixing strip **£2.00** +45p p & p. Car Aerial Recommended — fully retractable **£1.60** +40p p & p.

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Stereo 21, easy to assemble audio system kit. No soldering required.

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Two speakers with cabinets.

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Specifications — For the technically minded:

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 15 1/2" x 8" x 4". Complete deck and cover in closed position approx. 15 1/2" x 12" x 6".

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Extras if required. Optional Diamond Styli **£1.60**. Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance **£5.80**.

*DISCO AMPLIFIER

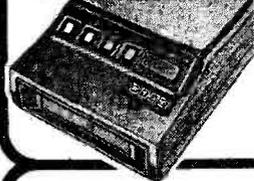


Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties. Output 20 watts RMS into 8 ohms (suitable for 15 ohms).

Inputs — 4 electrically mixed inputs. *3 individual mixing controls. *Separate bass and treble controls common to all 4 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State circuitry. *Attractive styling.

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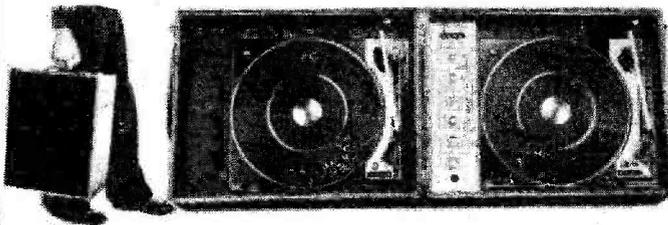
BUILD YOUR OWN STEREO AMPLIFIER*



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.

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INCORPORATES: Pre-Amp with full mixing facilities, including switched input for mic with volume control, switched input for auxiliary with volume control, bass and treble controls, volume control and blend control for turntables. Two B.S.R. MP60 type single play professional series decks, fitted with crystal cartridges.

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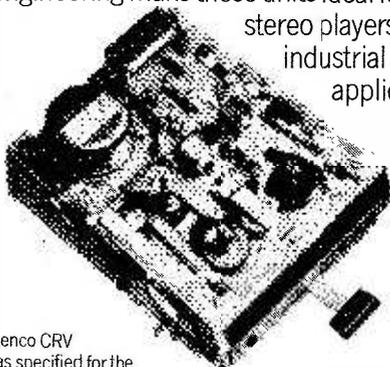
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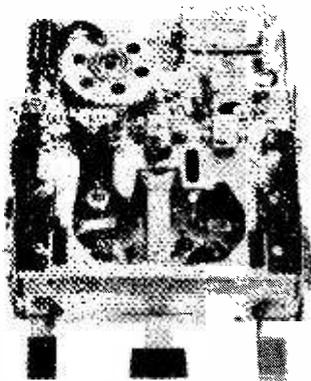
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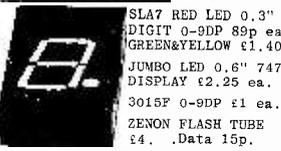


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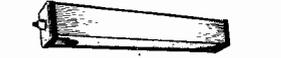


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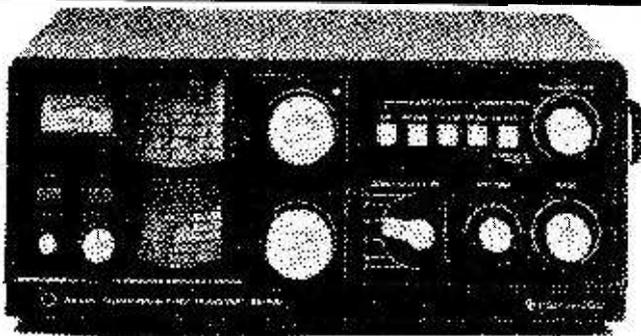
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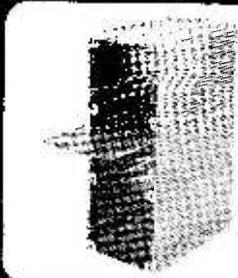
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EC31 0-53	EL43 0-78	PCF249 1-13	PL509 1-77	30F5/EP815
EC32 0-53	EL44 0-78	PCF250 1-13	PL509 1-77	30F5/EP815
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EC34 0-53	EL46 0-78	PCF252 1-13	PL509 1-77	30F5/EP815
EC35 0-53	EL47 0-78	PCF253 1-13	PL509 1-77	30F5/EP815
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EC82 0-53	EL94 0-78	PCF300 1-13	PL509 1-77	30F5/EP815
EC83 0-53	EL95 0-78	PCF301 1-13	PL509 1-77	30F5/EP815
EC84 0-53	EL96 0-78	PCF302 1-13	PL509 1-77	30F5/EP815
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EC95 0-53	EL07 0-78	PCF313 1-13	PL509 1-77	30F5/EP815
EC96 0-53	EL08 0-78	PCF314 1-13	PL509 1-77	30F5/EP815
EC97 0-53	EL09 0-78	PCF315 1-13	PL509 1-77	30F5/EP815
EC98 0-53	EL10 0-78	PCF316 1-13	PL509 1-77	30F5/EP815
EC99 0-53	EL11 0-78	PCF317 1-13	PL509 1-77	30F5/EP815
EC00 0-53	EL12 0-78	PCF318 1-13	PL509 1-77	30F5/EP815
EC01 0-53	EL13 0-78	PCF319 1-13	PL509 1-77	30F5/EP815
EC02 0-53	EL14 0-78	PCF320 1-13	PL509 1-77	30F5/EP815
EC03 0-53	EL15 0-78	PCF321 1-13	PL509 1-77	30F5/EP815
EC04 0-53	EL16 0-78	PCF322 1-13	PL509 1-77	30F5/EP815
EC05 0-53	EL17 0-78	PCF323 1-13	PL509 1-77	30F5/EP815
EC06 0-53	EL18 0-78	PCF324 1-13	PL509 1-77	30F5/EP815
EC07 0-53	EL19 0-78	PCF325 1-13	PL509 1-77	30F5/EP815
EC08 0-53	EL20 0-78	PCF326 1-13	PL509 1-77	30F5/EP815
EC09 0-53	EL21 0-78	PCF327 1-13	PL509 1-77	30F5/EP815
EC10 0-53	EL22 0-78	PCF328 1-13	PL509 1-77	30F5/EP815
EC11 0-53	EL23 0-78	PCF329 1-13	PL509 1-77	30F5/EP815
EC12 0-53	EL24 0-78	PCF330 1-13	PL509 1-77	30F5/EP815
EC13 0-53	EL25 0-78	PCF331 1-13	PL509 1-77	30F5/EP815
EC14 0-53	EL26 0-78	PCF332 1-13	PL509 1-77	30F5/EP815
EC15 0-53	EL27 0-78	PCF333 1-13	PL509 1-77	30F5/EP815
EC16 0-53	EL28 0-78	PCF334 1-13	PL509 1-77	30F5/EP815
EC17 0-53	EL29 0-78	PCF335 1-13	PL509 1-77	30F5/EP815

SEMICONDUCTORS

COMPONENTS

CARBON RESISTOR PAKS

These Paks contain a range of Carbon Resistors, assorted into the following groups:

R1	50	Mixed	100 ohms-820 ohms	0-60
			1/8th W.	
R2	50	Mixed	1K ohms-8.2 Kohms	0-60
			1/8th W.	
R3	50	Mixed	10K ohms-82 Kohms	0-60
			1/8th W.	
R4	50	Mixed	100K ohms-820 Kohms	0-60
			1/8th W.	
R5	30	Mixed	100 ohms-820 ohms	0-60
			1/4 W.	
R6	30	Mixed	1K ohms-8.2 Kohms	0-60
			1/4 W.	
R7	30	Mixed	10K ohms-82 Kohms	0-60
			1/4 W.	
R8	30	Mixed	100K ohms-820 Kohms	0-60
			1/4 W.	

THESE ARE UNREPEATABLE PRICES

LOW COST CAPACITORS

500	µF	50V Elect	0-09	each
'01	µF	400V	0-08	each

REPANCO CHOKES & COILS

RF Chokes	CH1	2.5mH	0-27
	CH3	7.5mH	0-29
	CH5	1.5mH	0-28
	CH2	5.0mH	0-25
	CH4	10mH	0-31

COILS	DRX1	Crystal set	0-29	DRR2	Dual range	0-42
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CARBON POTENTIOMETERS

Log and Lin	4.7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M.	
VC 1	Single Less Switch	0-14
VC 2	Single D.P. Switch	0-26
VC 3	Tandem Less Switch	0-43
VC 4	1K Lin Less Switch	0-14
VC 5	100K Lo gant-Log	0-43

HORIZONTAL CARBON PRESETS

0-1 Watt		0-08	each
100, 220, 470, 1K, 2.2K, 4.7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M, 4.7M.			

REPANCO TRANSFORMERS

240V. Primary. Secondary voltages available from selected tappings 4V, 7V, 8V, 10V, 40V, 50V and 25V-0-25V.

Type	Amps	Price	P & P
MT50/1	1	\$1.79	0-45p
MT50/2	2	\$2.24	0-45p
		\$3.98	0-60p

COIL FORMERS & CORES

NORMAN 1/4" Cores & Formers	0-07p
1/2" Cores & Formers	0-09p

SWITCHES

DP/DT Toggle	0-28p
SP/ST Toggle	0-28p

FUSES

1 1/2" and 20mm, 100mA, 200mA, 250mA, 500mA, 1A, 1.5A, 2A QUICK BLOW
Anti-urge 20mm only

	★0-05p	each
	★0-07p	each

VEROBORDS

VB1	containing approx. 50 sq. ins. various sizes all 0.1 matrix	★0-60p
VB2	containing approx. 50 sq. ins. various sizes all 0.15 matrix	★0-60p

DECON-DALO 33PC Marker

Etch resistant printed circuit marker pen. Full instructions supplied with each pen. ★0-82p

BATTERY HOLDERS

Takes 6 H.P. 7s complete with terminal clip and lead ★0-81p each

CABLES

CP 1	Single lapped screen	Per Metre	★0-08
CP 2	Twin Common Screen		★0-11
CP 3	Stereo Screened		★0-12
CP 4	Four Core Common Screen		★0-21
CP 5	Four Core individually screened		★0-28
CP 6	Microphone Fully Braided Cable		★0-11
CP 7	Three Core Mains Cable		★0-11
CP 8	Twin Oval Mains Cable		★0-08
CP 9	Speaker Cable		★0-06
CP 10	Low Loss Co-Axial		★0-14

INSTRUMENT CASES



(In 2 sections, Black Vinyl covered top and sides and base)

No.	Length	Width	Height	Price
BV1	8"	5 1/2"	3"	★1-25
BV2	11"	6"	3"	★1-62
BV3	6"	4 1/2"	1 1/2"	★0-92
BV4	9"	5 1/2"	2 1/2"	★1-39

ALUMINIUM BOXES

No.	Length	Width	Height	Price
BA1	5 1/2"	3 1/2"	1 1/2"	★0-45
BA2	4"	4"	1 1/2"	★0-45
BA3	4"	2 1/2"	1 1/2"	★0-45
BA4	5 1/2"	4"	1 1/2"	★0-54
BA5	4"	2 1/2"	2 1/2"	★0-45
BA6	3"	2"	1"	★0-39
BA7	7"	5"	2 1/2"	★0-79
BA8	8"	6"	3"	★1-02
BA9	6"	4"	2"	★0-85

(Each complete with 1/4" deep lid & screws)
PLEASE ADD 20p POSTAGE AND PACKING FOR EACH BOX.

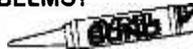
COMPONENT PAK

Pak No.	Qty.	Description	Price
C1	200	Resistors mixed values approx. count by weight	0-60
C2	150	Capacitors mixed values approx. count by weight	0-60
C3	50	Precision Resistors mixed	0-60
C4	75	1/8th width Resistors mixed preferred values	0-60
C5	5	Pieces assorted Ferrite Rods	0-60
C6	2	Tuning Gangs, MW/LW VHF	0-60
C7	1	Pak Wire 50 metres assorted colours	★0-80
C8	10	Reed Switches	0-60
C9	3	Micro Switches	0-60
C10	15	Assorted Pots & Pre-Sets	0-60
C11	5	Jack Sockets 3 x 3.5m, 2 x standard Switch Type	0-60
C12	30	Paper Condensers preferred types mixed values	0-60
C13	20	Electrolytic Trans. types	0-60
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets, etc.	0-60
C15	5	Mains Slide Switches, 2 Amp	0-60
C16	30	Assorted Tag Strips & Panels	0-60
C17	10	Assorted Control Knobs	0-60
C18	4	Rotary Wave Change Switches	0-60
C19	2	Relays 6-24V Operating	0-60
C20		Sheets Copper Laminate approx. 200 sq. ins.	★0-80

Please add 20p post and packing on all component packs, plus a further 10p on pack nos. C1, C2, C19 & C20.

AVDEL BOND

SOLVE THOSE STICKY PROBLEMS!
with



CYANOACRYLATE C2 ADHESIVE

The wonder bond which works in seconds—bond plastic, rubber, transistors, components permanently, immediately

OUR PRICE ONLY 60p for 2gm phial

BIB HI-FI ACCESSORIES

Ref.	Description	Price
B	Stylus and turntable cleaning kit	★31p
J	Tape head cleaning kit	★30p
P	Hi-Fi cleaner	★80p
9	Wire stripper/Cutter	★94p
31	Cassette head cleaner	★58p
32	Tape editing kit	★21.94
32A	Stylus balance	★12.94
36A	Record stylus cleaning kit	★39p
42	De Luxe Groov-Kleen	★21.94
43	Record care kit	★26.88
45	Auto changer groove cleaner	★88p
46	Spirit level	★68p
60	Hi-Fi stereo hints & tips	★88p
60	Chrome finish as above	★21.72

ANTEX EQUIPMENT

SOLDERING IRONS

X25	25 watt	★25-45
Model G	18 watt	★23-70
CCN 240	15 watt	★29-90
SK2	Soldering Kit	★33-90

BITS AND ELEMENTS

Bit No.	Price
102 for model CN240 3/32"	★42p
104 for model CN240 3/16"	★42p
110 for model CCN240 3/32"	★42p
1101 for model CCN240 3/16"	★42p
1102 for model CCN240 1/4"	★42p
1020 for model G240 3/32"	★42p
1021 for model G240 1/8"	★42p
1022 for model G240 3/16"	★42p
50 for model X25 3/32"	★1-35*
51 for model X25 1/8"	★1-35*
52 for model X25 3/16"	★1-35*

ELEMENTS

Model ECN 240	★1-10*
Model ECG 240	★1-35*
Model ECC 240	★1-55*
Model EX 25	★1-20*

SOLDERING IRON STAND

ST3 Suitable for all models	★1-10
Antex heat shunt	10p

PLUGS

PS 1	D.I.N. 2 Pin (Speaker)	0-10
PS 2	D.I.N. 3 Pin	0-11
PS 3	D.I.N. 4 Pin	0-14
PS 4	D.I.N. 5 Pin 100°	0-16
PS 5	D.I.N. 5 Pin 240°	0-16
PS 6	D.I.N. 6 Pin	0-18
PS 7	D.I.N. 7 Pin	0-17
PS 8	Jack 2.5mm Screened	0-17
PS 9	Jack 3.5mm Plastic	0-17
PS 10	Jack 3.5mm Screened	0-11
PS 11	Jack 1/2" Plastic	0-14
PS 12	Jack 1/2" Screened	0-20
PS 13	Jack Stereo Screened	0-38
PS 14	Phono	0-06
PS 15	Car Aerial	0-14
PS 16	Co-Axial	0-14

INLINE SOCKETS

PS 21	D.I.N. 2 Pin (Speaker)	0-13
PS 22	D.I.N. 3 Pin	0-12
PS 23	D.I.N. 5 Pin 180°	0-18
PS 24	D.I.N. 5 Pin 240°	0-18
PS 25	Jack 2.5mm Plastic	0-15
PS 26	Jack 3.5mm Plastic	0-15
PS 27	Jack 1/2" Plastic	0-18
PS 28	Jack 1/2" Screened	0-32
PS 29	Jack Stereo Plastic	0-28
PS 30	Jack Stereo Screened	0-38
PS 31	Phono Screened	0-17
PS 32	Car Aerial	0-10
PS 33	Co-Axial	0-20

SOCKETS

PS 35	D.I.N. 2 Pin (Speaker)	0-07
PS 36	D.I.N. 3 Pin	0-09
PS 37	D.I.N. 5 Pin 180°	0-09
PS 38	D.I.N. 5 Pin 240°	0-10
PS 39	Jack 2.5mm Switched	0-11
PS 40	Jack 3.5mm Switched	0-11
PS 41	Jack 1/2" Switched	0-19
PS 42	Jack Stereo Switched	0-28
PS 43	Phono Single	0-07
PS 44	Phono Double	0-09
PS 46	Co-Axial Surface	0-09
PS 47	Co-Axial Flush	0-19

P.C.B. KIT

PROFESSIONAL D.I.Y. PRINTED CIRCUIT KIT

PRICE £7-80
Containing 6 sheets of 6" x 4" single sided laminate, a generous supply of etchant powder, etching dish, etchant measure, tweezers, etch resistant marking pen, high quality pump drill with spares, cutting knife with spare blades, 6" metal ruler, plus full easy to follow instructions.

LOW-NOISE CASSETTES

C60		★33p
C90		★44p
C120		★58p
2 x quality marker pens, specifically		
..... line etchant		
resistant circuits on copper laminate.		
Complete with full instructions.		
		★1-53 per pair

AUDIO LEADS

S221	5 pin DIN plug to 4 phono plugs length 1.5m	★1-08
S222	5 pin DIN plug to 5 pin DIN socket length 1.5m	68p
S237	5 pin DIN plug to 5 pin DIN plug mirror image length 1.5m	★1-20
S238	2 pin DIN plug to 2 pin DIN socket length 5m	68p
S268	5 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5 length 1.5m	★1-00
S270	2 pin DIN plug to 2 pin DIN socket length 10m	80p
S271	5 pin DIN plug to 2 phono plugs connected to pins 3 & 5 length 1.5m	68p
S275	5 pin DIN plug to 2 phono sockets connected to pins 3 & 5 length 23cm	68p
S318	5 pin DIN socket to 2 phono plugs connected to pins 3 & 5 length 23cm	68p
S404	Coiled stereo headphones extension cord extends to 7m	★1-40
S217	3 pin DIN plug to 3 pin DIN plug length 1.5m	80p
S219	5 pin DIN plug to 5 pin DIN plug length 1.5m	80p
S474	3.5mm Jack to 3.5mm Jack length 1.5m	68p
S600	5 pin DIN plug to 3.5mm Jack connected to pins 3 & 5 length 1.5m	80p
S700	5 pin DIN plug to 3.5 Jack connected to pins 1 & 4 length 1.5m	80p

CROSSOVER NETWORK

K4007 1/P Impedance 8 ohms. Insertion Loss 3dB. Crossover Frequency 3 KHz. PRICE £1-12

H/PHONE JUNC. BOX

H1012 Enables change-over from loud (3-way) speaker to headphone listening. Also has a centre position for both outputs. PRICE £1-73

ALL PRICES EX
PLEASE ADD VAT
ITEMS EXCEPT THOSE
MARKED

GIRO NUMBER OR
383-7005

Postage & Packing
Add extra for airmail

HANDBOOKS

TRANSISTOR DATA BOOK
DTE 1 227 Pages packed with information on European Transistors. Full specification including outlines. Price £2-95 each

TRANSISTOR EQUIVALENT BOOK
BPE 75 256 Pages of cross references and equivalents for European, American and Japanese Transistors. This is the most comprehensive equivalents book on the market today and has an introduction in 13 languages. Price £2-68 each

DIODE EQUIVALENT BOOK
DE 74 144 Pages of cross references and equivalents for European, American and Japanese Diodes, Zeners, Thyristors, Triacs, Diacs and L.E.D.s. Price £1-98 each

MULLARD DATA BOOK 1974/75
MDB 74 The latest edition of this popular handbook contains information on Semiconductors, Integrated Circuits, Television Picture Tubes, Valves, Capacitors and Resistors. Included in the 161 informative pages are 21 pages on Semiconductor Comparables. Price £0-40 each

TTL DATA BOOK
DIC 75

PO BOX 6 WARE HERTS



AL 60

50w. PEAK (25w. R.M.S.)

ONLY £3.95

● Max Heat Sink temp 90°C. ● Frequency Response 20Hz to 100K Hz. ● Distortion better than 0.1 at 1KHz. ● Supply voltage 15-50 volts. ● Thermal Feedback. ● Latest Design Improvements. ● Load—3, 4, 5 or 16 ohms. ● Signal to noise ratio 80dB. ● Overall size 63mm x 105mm x 13mm. Especially designed to a strict specification. Only the finest components have been used and the latest solid state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F. enthusiast.

STABILISED POWER MODULE SPM80



SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1.5 amps at 35 volts. Size: 63mm x 105mm x 30mm.

These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including:—Disco Systems. Public Address Intercom Units, etc. Handbook available 10p.

PRICE £3.00

TRANSFORMER ER BMT80 £2.60

STEREO PRE-AMPLIFIER TYPE PA100



Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL60 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.

Three switched stereo inputs, and rumble and scratch filters are features of the PA100 which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls. PRICE £13.20

MK 60 AUDIO KIT

Comprising: 2 x AL60, 1 x SPM80, 1 x BTM80, 1 x PA100, 1 front panel, 1 kit of parts to include on-off switch, neon indicator, stereo headphone sockets plus instruction booklets.

COMPLETE PRICE: £27.35 plus 45p postage

TEAK 60 AUDIO KIT

Comprising: Teak veneered cabinet size 16½" x 11½" x 3½", other parts include aluminium chassis, heatsink and front panel bracket, plus back panel and appropriate sockets, etc.

KIT PRICE: £9.20 plus 45p postage

STEREO 30 COMPLETE AUDIO CHASSIS

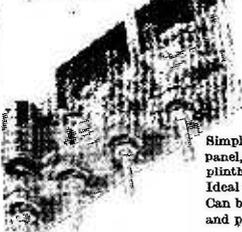
7 + 7 WATTS R.M.S.

The Stereo 30 comprises a complete stereo pre-amplifier, power amplifiers and power supply. This with only the addition of a transformer or overwind, will produce a high quality audio unit suitable for use with a wide range of inputs, i.e. high quality ceramic pickup, stereo tuner, stereo tape deck, etc.

Simple to install, capable of producing really first class results, this unit is supplied with full instructions, black front panel, knobs, mains switch, fuse and fuse holder and universal mounting bracket, enabling it to be installed in a record plinth, cabinets of your own construction or the cabinet available.

Ideal for the beginner or advanced constructor who requires Hi-Fi performance with a minimum of installation difficulty. Can be installed in 30 mins.) PRICE: £15.75 plus 45p postage and packing. TRANSFORMER: £2.45 plus 45p postage and packing. TEAK CASE: £3.65 plus 45p postage and packing.

INCLUDE VAT
AT 25% TO ALL
★ ADD 8%
≠ NO VAT
and 20p overseas
Minimum order 75p



SPEAKERS

E.M.I. LEK 350 Loudspeakers Enclosure Kit in teak veneer, including speakers. Rec. Retail Price £45.50 per pair. OUR SPECIAL PRICE £27.75 per pair — P. & P. £3.

AL10/AL20/AL30

The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S.

The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home. AL10 £2.30, AL20 £2.65, AL30 £2.95.

M.P.A.30

Enjoy the quality of a magnetic cartridge with your existing ceramic equipment using the new Bi-Pak M.P.A.30 which is a high quality pre-amplifier enabling magnetic cartridges to be used where facilities exist for the use of ceramic cartridges only.

Used in the construction are 4 low noise, high gain, silicon transistors. It is provided with a standard DIN input socket for ease of connection.

Supplied with full, easy to follow instructions. PRICE £2.65

STORAGE/CARRIAGES ★

RECORD CASES

7 in E.P. 18½ in x 7 in x 8 in (50 records) ★£2.48
12 in L.P. 13½ in x 7½ in x 12½ in (50 records) ★£3.30

CASSETTE CASES

Holds 15. 10 in x 3½ in x 5 in. Lock and handle. ★£1.50

8-TRACK CARTRIDGE CASES

Holds 14. 13 in x 5 in x 6 in. Lock and handle ★£2.20
Holds 24. 13½ in x 8 in x 5½ in Lock and handle ★£3.20

CARTRIDGES

ACOS		
GP91-1SC	200mV at 1.2cms/sec	£1.11
GP93-1	280mV at 1cm/sec	£1.43
GP96-1	100mV at 1cm/sec	£2.81
TTC		
J-2005	Crystal/Hi Output	97p
J-2010C	Crystal/Hi Output Compatible	£1.11
J-2006S	Stereo/Hi Output	£1.52
J-2105	Ceramic/Med. Output	£1.81
J-2203	Magnetic 5mV/5cm/sec. including stylus	£4.78
J-2203S	Replacement stylus for above	£2.88
AT-55	Audio-technica magnetic cartridge 4mV/5cm/sec	£3.06

DYNAMIC MIC'PHONE

TYPE B1223. 200 ohms impedance. Complete with stand, on/off switch and 2.5mm and 3.5mm plugs. Suitable for cassette tape recorders. PRICE £1.67

JUST OUT!

STEREO FM TUNER

WRITE NOW FOR FULL DETAILS

Making Life Easier

THE 'heart' of the many constructional projects that appear month by month in this magazine is a circuit board design in one form or another.

Breadboard type wiring still remains a firm favourite with many constructors, both in the home and the workshop. For those constructors and designers that have the technical expertise and patience, the breadboard method is often the first design approach to many constructional projects.

When the constructor has completed the project—and possibly spent much time in carefully checking the wiring and assembly for possible mistakes, he will—with tongue in cheek—switch on! With breadboard wired projects it is quite easy to have built-in faults, overlook them on the final check and then switch on—often with disastrous results.

Where the constructional project is complex and a considerable amount of wiring interconnection is required, certainly the possibility of multiple wiring errors increases.

The printed circuit board, more commonly referred to as the 'p.c.b.' was introduced into the electronics industry many years ago and is now extensively used. The printed circuit board has numerous advantages—elimination of wiring errors; consistent and accurate reproduction of the 'circuit' wiring; uniformity of performance in multiple assembly work plus considerable saving in costs and assembly time.

The printed circuit board therefore, has many advantages for the home constructor and this has been confirmed by its use in the many constructional projects that have been featured in *Practical Wireless* over many years.

Practical Wireless intends to introduce a p.c.b. service whereby the printed circuit boards for selected P.W. constructional projects will be made available to readers and advertisers. There is no doubt whatsoever that the inclusion of this service will encourage many readers, who in the past, may have been reluctant to 'have a go' at constructional projects because of the wiring complexity.

We confidently anticipate—from the results of our p.c.b. survey—that this move will be widely welcomed. An announcement will be made in the November 1975 issue of this magazine, giving full details of the P.W. p.c.b. SERVICE to readers.

LIONEL E. HOWES, Editor

We welcome articles for publication on all aspects of electronics. They may either be handwritten or typed. However simple or complex your idea may appear, let us have brief details. We are prepared to pay for articles upon acceptance in certain instances and letters upon publication. Why not drop the Editor a line?

Once again it is regretted that due to increased paper and production costs, the price of this magazine will be increased to 35p with effect from the November issue

NEWS...

Forthcoming event

"How do we communicate . . . and some of the consequences?"

AN External Studies Course of nine lectures has been organised at the University of Kent, Canterbury, under the direction of Dr. K. L. Smith. The first talk will be at 7 p.m. on Thursday, 16 October, 1975. The fundamentals of modern Electronics communication systems and techniques will be discussed and demonstrated during the course, by various lectures. The final two lectures will deal with some political and social questions arising from the vast increase of information communicated by technical means.

For further information, contact Dr. A. T. Barbrook, External Studies Office, Rutherford College, University of Kent, Canterbury, Kent, CT2 7NT or Dr. K. L. Smith of the Electronics Laboratory.

BBC Stereo for the North East

THE BBC has announced the start of stereo transmissions from the Pontop Pike transmitting station. This brings the stereo services of Radios 2, 3 and 4 to some two and a half million people in Northumberland, Durham, Cleveland and North Yorkshire.

The stereo services are also rebroadcast from the Weardale and Whitby relay stations, but the quality and consistency of these transmissions will not be known until certain tests have been carried out.

BBC stereo is brought to Pontop Pike on a new programme link using pulse code modulation which, in addition to providing high-quality stereo, will mean better sound quality for mono listeners also.

Good progress is being made on the next extension of BBC stereo, to the Sandale station in Cumbria. It is hoped that an announcement about the opening of these services will be made in a few weeks' time.

Longleat mobile rally

THE City of Bristol RSGB Group held its Longleat Mobile Rally on Sunday June 29th 1975.

This year's event, the 18th, attracted an attendance of over 5,000, 4,123 signing in on arrival. A count of vehicles at 1430hrs was 2,166 with 12 coaches, there being 50 tents and caravans with visitors camping overnight.

The dealers, of which there were 27, reported complete satisfaction and brisk trading.

The GPO provided a TV Detector Van and their officers explained very fully how they carry out the detection of TV sets. The 30th Regiment of the Royal Signals provided an exhibition showing the means of communications now used in the armed service and provided a lot of fun for the juniors who were able to use portable equipment for talking to one another. Members of the Royal Navy ARS and the RAF-ARS were present to meet mem-

bers of their societies also the ARMS and the British Red Cross who look after the medical side at the rally each year.

Visitors to the rally came from England, Scotland and Wales also countries outside Great Britain. These included: 9GILZ, HB9AZX, F6DCW, VK3YET, VK6ZFL, VE6-ANO, WB2WOZ, ZD7PS.

The raffle was one of the main attractions, all tickets were sold and the 128 prizes were won and collected by the winners.

Talk-in facilities were operational on 160metres, 80metres and 2metres from 1000hrs and were in continual action. 160metres had 22 contacts, 80metres 40 contacts and 2metres 116 contacts which seems to speak for itself that many are changing over to 2 metres for mobile working.

The DF hunt being a walking one within the grounds of the rally proved a great success and drew a large entry, the winner finding the station in 12 minutes.

BBC Carlisle

TWO new low-power medium-wave transmitters at Brisco, Carlisle, started transmissions recently. One, on 285 metres (1052 kHz), provides Carlisle with an improved Radio 4 service, particularly at night when the service from Stagshaw (330 metres) is poor; the other carries BBC Radio Carlisle on 397 metres (755kHz) giving slightly better coverage than the temporary transmitter which it replaces.

Both transmitters serve an area to about 25 miles from Carlisle in the daytime but at night this distance is considerably reduced by interference.

The Radio 4 and BBC Radio Carlisle services on VHF from Sandale and the medium-wave BBC Radio Carlisle service from Whitehaven are unaffected by these changes.

Books received

Electronics — An Elementary Introduction for Beginners (S.I. Units)

By L. W. Owers C. Eng MIERE
Basic introduction to electronics for those meeting the subject for the first time.
£1.45

Publications Mailing Service, P.O. Box 6, Crawley, Sussex, RH10 6LH

Modern Crystal and Transistor Set Circuits for Beginners

By B. B. Babani
Brief constructional articles ranging from a crystal set to a two-transistor reflex receiver.
Price 35p

Babani Press & Bernards (Publishers) Limited, The Grampians, Western Gate, Shepherds Bush, London, W6 7NF

Beginners Guide To Transistors (2nd Edition)

By J. A. Reddihough and I. R. Sinclair

Takes reader from basics on how semiconductor work through audio frequency circuits and techniques, integrated circuits and finally some hints for fault-finding and servicing.
Price: £1.80

Butterworth Group, 88 Kingsway, London, WC2B 6AB

Component Show

THE 24th international London Electronic Component Show held at Olympia earlier this year defied the pundits of gloom and doom. Nearly 20,000 people including visitors from 61 different countries attended the show and though the overall figure was down on the 1973 LECS, trading and business conducted during the four-day event exceeded both expectation and previous records.

Chairman of the Radio and Electronics Manufacturers Federation Exhibition Committee, Mr. Sydney Brewell, MBE, echoed the sentiments of exhibitors when he said the 24th LECS had produced a "very high quality in terms of visitors despite the economic climate. Inquiries have been realistic and should result in considerable tangible trading in the future. From abroad interest has been particularly notable from Spain and Scandinavia. Generally exhibitors have been well satisfied with results and we can now look ahead with renewed

enthusiasm to the 25th international London Electronic Component Show to be held at Olympia from May 17-20, 1977."

On the AEG-Telefunken (U.K.) Limited's stand, Mr. Claud Cheeley, Sales Executive, reported the inquiry level high despite the lower attendance. He said that "the people who have attended have had a direct need for technical knowledge and have not been the casual peruser. We have been extremely busy and have taken some orders of real significant values".

The 24th London Electronic Component Show was sponsored by the Radio and Electronic Component Manufacturers Federation and organised by Industrial and Trade Fairs Limited.

"Radio Exchange"

Due to a printing error, the above advertiser's full-page advertisement space which appeared in the August issue, is incorrect. Prices quoted were at the old VAT rate. We apologise to all our readers for any inconvenience caused.

AMONG the most popular of all projects for the home constructor is the relatively simple transistor superhet short wave receiver. While most of these receivers have adequate sensitivity, their performance in other respects is often not all one would wish. The simple circuitry employed usually results in poor cross-modulation performance, poor image rejection and wide IF bandwidth.

The first two problems are not usually too bothersome and the use of an ATU and aerial attenuator can make a significant improvement in performance here. The last one can place severe limitations on the receiver, with today's crowded band conditions, and it can be difficult to radically improve the selectivity as this means adding some form of IF filter to the receiver. Some excellent filters are now available, but it is not always feasible to add such a filter due to lack of space in the receiver, and sometimes to lack of funds, as a good IF filter could easily cost more than the rest of the receiver!

of the coil. The quality of a parallel tuned circuit is termed 'Q', and is defined as the reactance of the inductor divided by the circuit resistance (XL/R).

The basic operation of a Q multiplier is shown in Fig. 1. At or near resonance the tuned circuit will exhibit relatively high impedance and, in consequence, will have little effect on the receiver. At frequencies significantly different from the resonant frequency its reactance will be low and signals at these frequencies will be attenuated by being shunted to earth. As the Q of the coil is not very high (about 100-150) it will not alter the receiver's IF passband a great deal on its own.

However, the tuned circuit is connected in an amplifier circuit which is used to apply positive feedback. A variable resistor or other circuit element enables the feedback level to be controlled. The purpose of adding the feedback is to sample and amplify a small amount of the signal in the tuned

ADD-ON Q MULTIPLIER

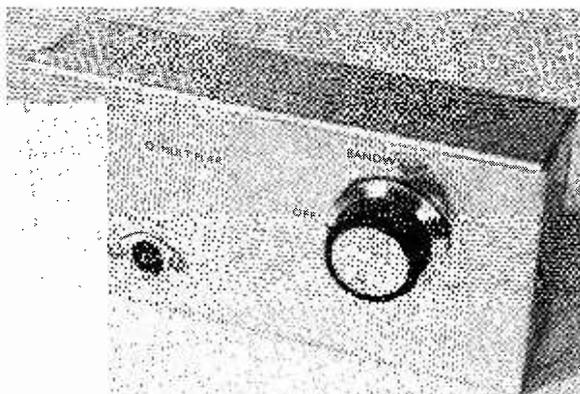
R.A.PENFOLD

Fortunately, there is a simple device known as a "Q Multiplier" which is inexpensive to construct and can be built as an external accessory to the receiver, thus needing no space inside the set. If space is available, it can be added inside the receiver. Such a unit gives a bandwidth which is variable from the normal IF bandwidth of the receiver, for the reception of good quality AM, to a very narrow peaked response, for the reception of CW. This is unlike other types of IF filter, normally designed for only one mode of reception.

CIRCUIT DESIGN

Basically a Q multiplier consists of a parallel tuned LC circuit resonant at the IF, connected between the tap on the primary of the first IFT and the chassis of the receiver. The tuned circuit theoretically has an infinite impedance at its resonant frequency, with a fairly low impedance at other frequencies.

This does not occur in practice as losses in the resistance of the coil have the effect of reducing the resonant impedance and broadening the bandwidth. If the signal in the circuit is coupled to an amplifier, as is the output of an IFT, this will have a damping effect on the quality of the tuned circuit. The quality of an unloaded tuned circuit will obviously be determined by the circuit resistance. The lower this resistance, the higher the quality



circuit and then to feed a controlled amount of this back to the tuned circuit. If we feed back to the circuit the same amount of signal as is lost due to circuit resistance, we will have the idealised tuned circuit with an infinite Q. This will then shunt to earth all signals except those very close to its

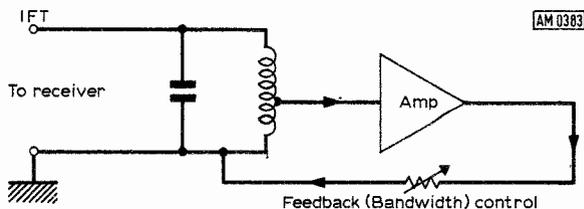


Fig. 1: Simple circuit to illustrate the operation of a Q-multiplier.

resonant frequency and this will result in the receiver having a very narrow bandwidth. The feedback control can be adjusted to give the coil any apparent Q higher than its actual Q value acting as a selectivity control for the receiver.

CONSTRUCTION

The circuit diagram of a very simple Q multiplier for use with an IF in the range 455 to 470kHz is shown in Fig. 2. This is basically the earthed base Colpitts oscillator with the feedback level controlled by VR1. The output of the unit is taken to SK1, a coax socket, via C4, a blocking capacitor.

The unit described is an independent unit external to the receiver, but decoupling components R6 and C1 are included so that the unit can be built into a receiver, obtaining its power from the receiver. Note that the parallel capacitor of L1 is part of the coil unit, as is its secondary winding, which is not used.

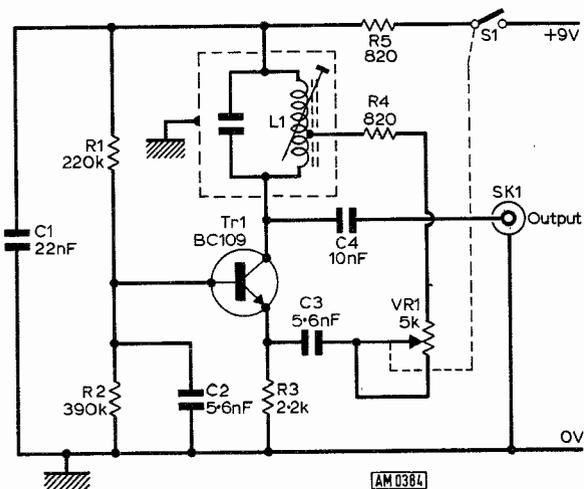


Fig. 2: above, circuit of the Q-multiplier described in the article. If the unit is fitted inside a receiver the output can go direct to the IFT, eliminating the socket. Fig. 3: right, shows the PCB and component layout. Plain veroboard with pins would be equally effective.

With the exception of the battery and SK1 all the components are mounted on a small PCB measuring 70 x 38mm (2¾ x 1½in). The copper backing pattern and components layout of the board are shown actual size in Fig. 3. The board is etched and drilled in the usual way. Before soldering VR1 to the PCB bend its connecting lugs so that they are at right angles to its spindle. It is then soldered to the panel so that when one is viewing it end on to the spindle, one can see the copper side of the PCB, see photograph. If it is connected the other way round it will not be possible to fit the unit in its case.

When all the components have been mounted the insulated lead between S1 and R6 on the PCB can be connected, as can the battery clip leads. Two insulated leads are connected to the board to form the leadouts to SK1.

The box used to house the unit is a commercially made one measuring 145 x 70 x 38mm (5¾ x 2¾ x 1½in). This has a removable lid which, in this application, becomes the front panel. Any similar box can be used as a housing for the unit provided it is metal and not plastic.

The layout has VR1 mounted towards the top RH

★ components list

Resistors

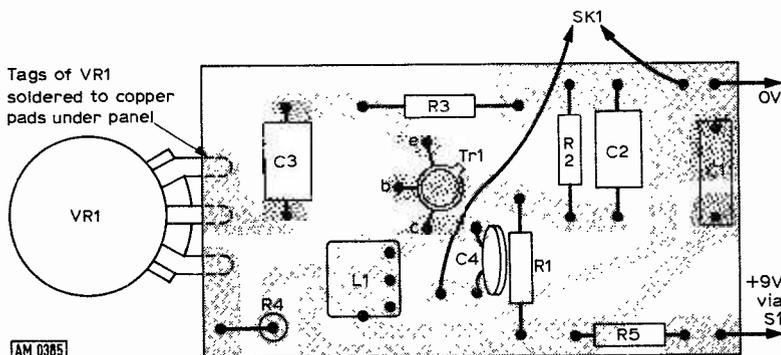
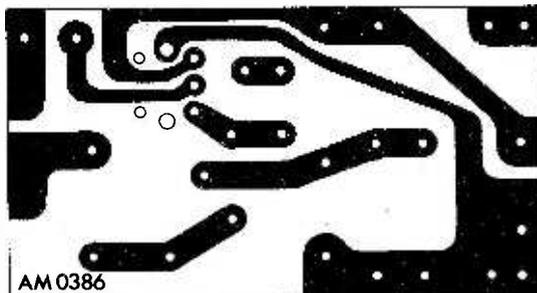
R1 220kΩ	R3 2.2kΩ	R5 820Ω
R2 390kΩ	R4 820Ω	VR1 5kΩ with S1
All resistors ½ or ¼W 10%		

Capacitors

C1 22nF plastic foil	C3 5.6nF polystyrene
C2 5.6nF polystyrene	C4 10nF ceramic, etc.

Miscellaneous

Tr1, BC109. L1, Toko YHCS1A590R (Ambit Int.) or similar. Aluminium box, 145 x 70 x 38mm (5¾ x 2¾ x 1½in) or similar. PP3 battery and clips. PCB, see text. Coax socket. Coax cable and plugs.



side of the front panel with SK1 at the bottom left. The PCB is mounted on VR1. Some foam rubber can be used to hold the battery firmly in position in the case. When VR1, and SK1 have been mounted on the front panel the free ends of the leads connecting the PCB to SK1 can be cut to length and soldered to SK1.

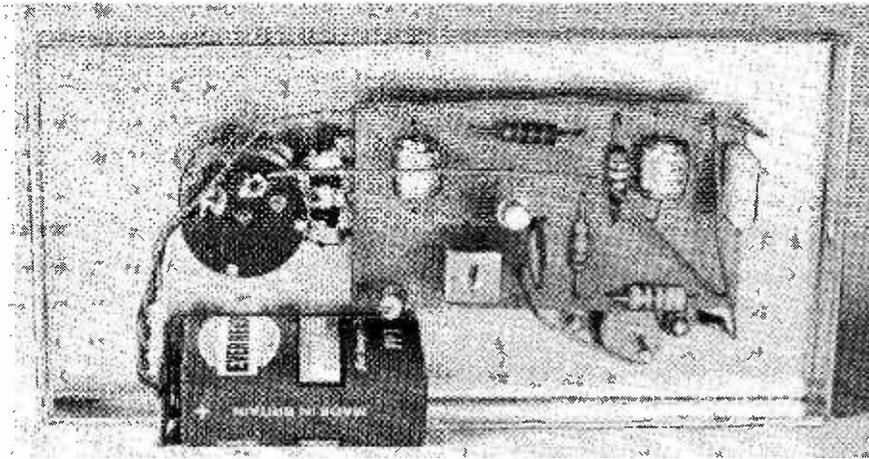
RECEIVER MODIFICATIONS

The only modification required to the receiver is to fit a coax socket at some convenient point on the chassis. A length of coax cable is then used to connect this to the tap on the primary of the first IFT. The outer braiding of the cable is connected to the chassis. The author's receiver uses Denco transistor coils and with receivers of this type it is probably easiest to connect the coax inner to pin 8 of the Red oscillator coil (which is normally connected to

trimming tool, so as not to damage the core. If advancing VR1 still further produces this effect once again, then the core of L1 must again be adjusted to correct the tuning. The unit is then ready for use.

The further the control knob of VR1 is advanced the narrower the bandwidth of the receiver. This is true up to the point where there is sufficient feedback to cause the Q multiplier to break into oscillation. VR1 should always be kept below this point, as proper reception of AM and SSB is not possible with the circuit in this state.

For each reception mode aim at using the minimum bandwidth that gives an audio signal of satisfactory quality. In this way adjacent channel interference will be at a minimum. With VR1 adjusted for fractionally less than the minimum obtainable bandwidth, it will be found that AM cannot be received in the normal way. It can be received, however, by tuning the receiver slightly



The PCB is soldered to the tags on the bandwidth control which is fitted to the panel of the box.

the primary tap on the first IFT). A coax lead having a plug at each end is used to connect the Q multiplier to the receiver. Both coax leads should be as short as possible, only about 300mm or so long in total. If they are longer the capacitance of the cables may upset the IFT so that adjustment of its core will not give sufficient tuning adjustment to permit re-alignment.

ADJUSTMENT

Initially the unit should be removed from its box so that the core of L1 is accessible. Connect the unit to the receiver and re-align the first IFT. Tune to any broadcast station of reasonable strength giving a constant signal strength tuning as accurately as possible. If the Q multiplier is now turned on the receiver should operate in much the same way as it did before, until VR1 is advanced. If the core of L1 needs no adjustment (unlikely), as VR1 is advanced the audio signal from the receiver will lose the treble frequencies and, if advanced far enough, the middle frequencies as well. It is more likely though that as VR1 is advanced it will produce an effect similar to that obtained if the tuning of the receiver were slightly altered. This can be corrected by adjusting the core of L1 with a proper

either side of the central tuning position, so that one or other of the sidebands is received. This is very useful when conditions are noisy or if there is a heterodyne interfering with one sideband of the desired transmission.

A little experience will probably need to be gained with the unit before its full worth is realised, and then the unit should be found to be well worth the initial outlay.

PW

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SUPPLEMENT No. 2

ON

SIMPLE HOME PROJECTS

Don't miss the

**NOVEMBER
issue**

HOTLINES

ON RECENT DEVELOPMENTS

OH! MY BACK!

PAIN is one of the unpleasant facts of life which everybody has suffered at one time or another and in varying degrees. Wouldn't it be nice if we could have a little switch somewhere so that when we got fed up with the pain we could simply turn the switch to "off" and stop it?

Things haven't quite come to that—yet, but the electronics and medical professions are working on it and have come a long way. The very latest item to emerge is the Stimtech EPS Mini Stimulator. This takes the form of a small (about two cigarette packets size) unit weighing only 340gm (12oz) complete with internal batteries. With this device it is claimed that you can control pain to a certain extent. More exactly, you don't control the actual pain itself but you can "block off" the connection between the pain and the "you" that feels it.

Small electrodes are attached to the skin (not surgically, just held in contact). Electrical impulses generated by the Mini Stimulator are then used to block the transmission of the pain messages through the nerve fibres. This is done by stimulating other fibres associated with the message carrying ones.

The Mini Stimulator cannot cure an ailment. What it does do is to "kill" the pain so that a happier, and in many cases, more active and useful life can result.

On test in America, electrical stimulation of this type was tried on a group of people suffering from chronic back troubles. Success in relieving the suffering was achieved



The Mini Stimulator—a small electronic unit which is used to block pain.



A new type of solar cell, 1cm. in diameter which produces 10W of electrical power. Sunlight is focused on to the cell by means of a concave reflector.

in 80% of the cases. In other tests, post-operative complications from abdominal surgery were reduced by an impressive amount—from one in three, to one in sixteen.

Sorry—you cannot go out and buy one and the British source of these units will only supply them on the recommendation and under the supervision of the medical profession. Cost, is £95 plus VAT.

SOLAR ENERGY

The search for a cheap and efficient form of energy continues. Solar cells are, of course, an obvious choice for future development. One American company has just launched an interesting solar cell which seems to be a giant step forward. One of the company's directors claims, "Other solar energy materials require 1,000 times the surface area to produce the same amount of energy". The new cell measures only about 1cm in diameter but it gives 10 watts of electricity directly from sunlight. The cells can be series connected. Larger series can be connected to give megawatt systems says the company.

Whilst most solar cell research to date has concentrated on silicon-based systems, these new cells are made from gallium arsenide. Secret of the system is to concentrate the sun's rays on the cell with a concave reflector.

It is interesting to note that the Plessey Company in England did similar work a year or two back but nothing further has been officially

announced. The U.S. company is already talking about arrays of cells, each cell with its own reflector, which would rotate to follow the sun. By doing this 40% more sunlight can be utilized compared to a flat, immovable panel of cells.

BEAMOS

You've heard of CMOS, but what about BEAMOS? It's for real and it stands for BEam Addressed Metal Oxide Semiconductor. An electron beam is used for access, and a special semiconductor target employed for very high density storage. The result is a semiconductor memory which is almost unbelievable. The first BEAMOS module (for military applications) has an access time of 30 millionths of a second and a transfer rate of ten million bits per second. The memory is capable of storing 32 million bits of information and the manufacturers reckon that the system could be made to store a million million bits.

Sixteen or more BEAMOS modules could be linked to provide 500 million bits of memory and such a system could be arranged to provide data transfer rates of 160 million bits per second.

Ginsberg

TELE-TENNIS

BALL SPEED CONTROL

R.S.GIRDWOOD

THE modifications to be described convert the Tele-Tennis game described in this magazine into a more interesting and skilful game.

MOD 1: BAT ANGLES

It was thought desirable to have the ball travel up the screen when the top of the bat was hit, and down when the bottom of the bat was hit. This gives the player the opportunity to direct the vertical direction of the ball.

MOD 2: VERTICAL SPEED CHANGE

As the horizontal speed of the ball is constant, any vertical speed change will vary the angle of the ball with respect to the horizontal.

The circuit produces a random vertical speed change so that the ball rebounds at different angles making it more difficult to assess the ball bat intersection point.

Both modifications fit on one printed circuit board which will fit "piggy-back" over one of the other boards. Of course, either or both modifications may be built with any surplus printed circuit board.

BALL ANGLE CIRCUIT

The circuit for the vertical ball direction change, when the ball hits the top or bottom bases is the same as the original but the ball/base gates are now type 7403 (open collector 7400) which allows several gates to be Wired-ored. The complete circuit is shown in Fig. 1.

A negative-going pulse on pin 13 IC7 sets the latch (IC7a and b) so that the ball goes up, and a negative-going pulse on pin 9 IC7 resets it for down. This latch is used instead of IC8 on board A. This 7400 can be used as IC14 on board D.

As the circuitry for both bats is the same, only the left bat will be described.

In order to detect where the ball hits the bat it is necessary to split the bat in half vertically. The

positive-going vertical "left bat" signal is inverted and triggers a monostable IC5, the timing of which is approximately half the vertical bat time.

The output of the monostable (normally 0 going to 1) is fed to pin 13 IC6 and in its inverted form to pin 10 IC2.

If a ball-hit-bat pulse (normally 0 going to 1) from IC14 board B arrives at pin 12 IC6 during this period, a negative-going pulse will appear at pin 11 IC6 setting the latch to the "ball up" position.

After the monostable time ends a 1 will be present on pin 10 IC2. As the vertical bat signal is still 1 (the remaining half of the bat), pin 8 IC2 goes to 0 and pin 6 IC2 to a 1. If the "ball-hit-bat" pulse arrives during this period a negative-going pulse will appear on pin 8 IC6 setting the latch in the "ball down" position. Therefore, the ball travels up the screen if the top of the bat is hit (monostable output) and down if the bottom is hit (vertical bat signal less the monostable output), plus, of course, the usual base/ball directions.

VERTICAL BALL SPEED CHANGE CIRCUIT

In order to effect a vertical speed change it is only necessary to switch a preset resistor in parallel with the "set speed" preset in the vertical integrator circuit on board D. The best time to achieve a speed change is when the ball hits the top/bottom base or bat.

The inputs to the vertical direction latch are normally 1 going 0 whenever a base or bat is hit. These two signals are fed to pin 1 and 2 IC8 and produce a positive-going signal on pin 3 IC8 when the top/bottom base is hit or any bat is hit, top or bottom.

The output of a multivibrator running at several kilohertz (the other two gates of IC1) is fed to pin 9 IC8 and in an inverted form to pin 13 IC8.

The positive-going pulse from pin 3 IC8 is fed to pins 10 and 12 IC8.

Now, depending on the output state of the multivibrator, when a pulse arrives from pin 3 IC8, either pin 11 IC8 or pin 8 IC8 will go to 0 either setting or resetting the following latch (IC7c and d). The output of the latch drives a DIL reed relay (RLA) which switches a 1M Ω preset in parallel with the 1M Ω preset in the vertical direction integrator circuit.

As the multivibrator frequency is in kilohertz, and the sample pulse occurs once in seconds, a fairly random speed change is thus produced.

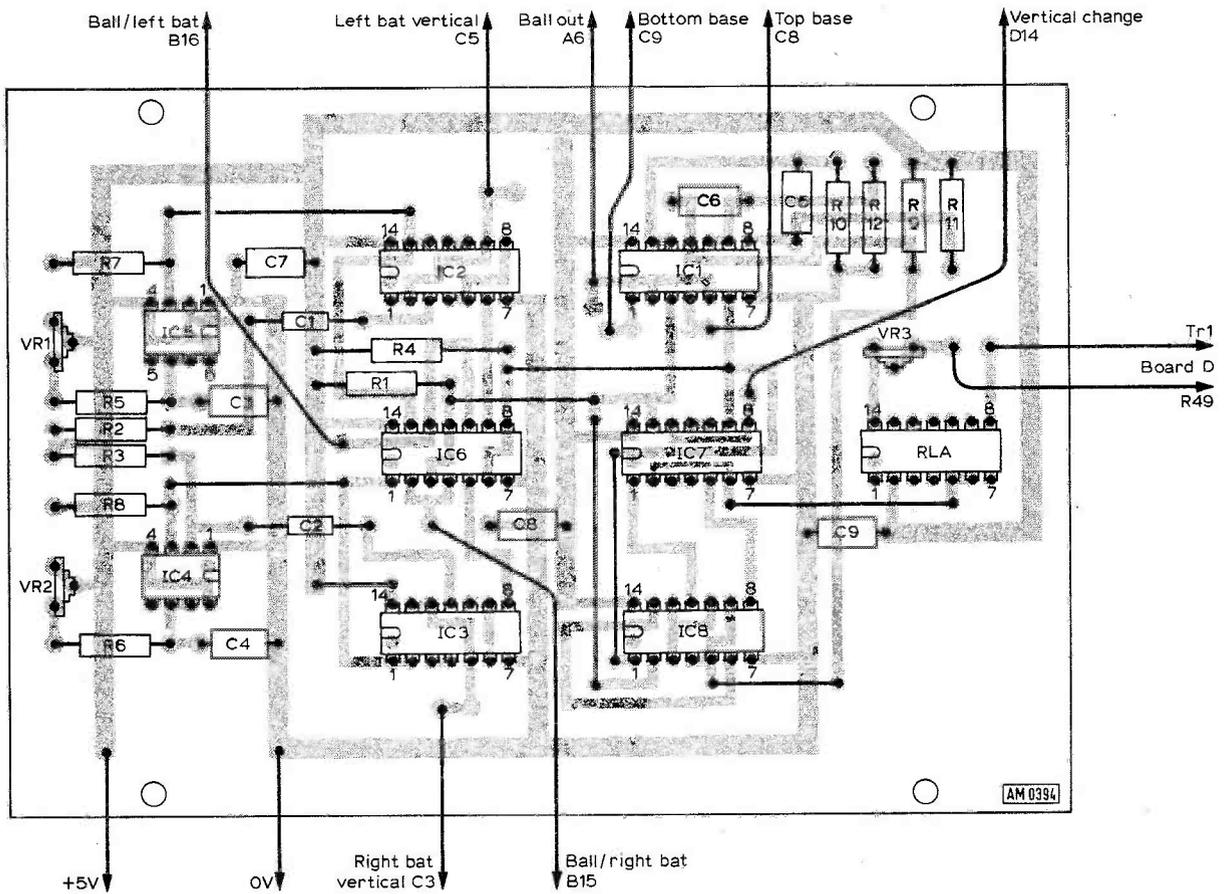


Fig. 2: Layout of the components on the printed circuit board

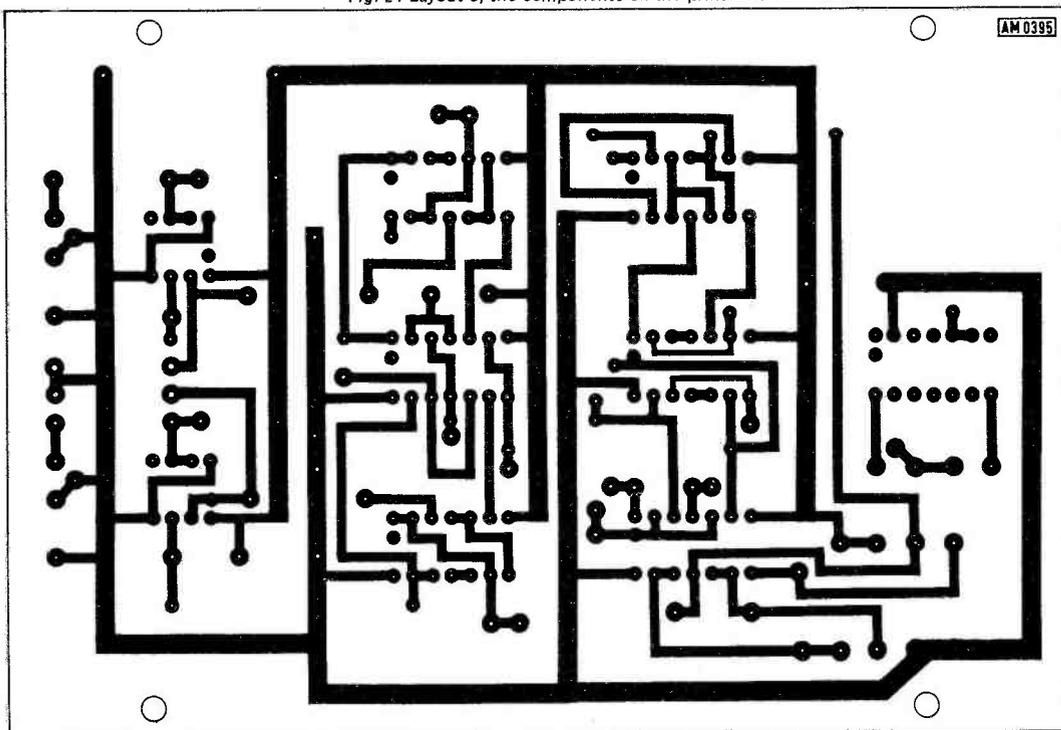


Fig. 3: Full size printed circuit layout for the Tele-Tennis Ball Speed Control

continued on page 497

Practical Wireless, October 1975

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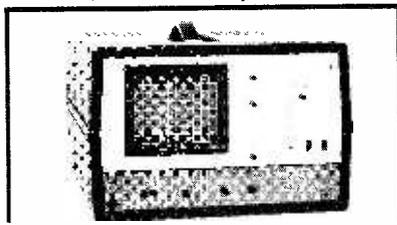
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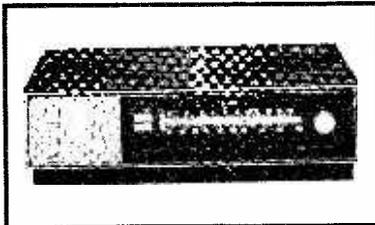
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EDGE MOUNTING MOVING COIL METER

Size 2 1/2" x 1" by Weston. 100uA movement scaled D.B., unseed still in original maker's cartons. £2-50 each + post and VAT 50p.



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M.W. two stage ideal for use with 2N414 or similar circuit. Price 15p each + post and VAT 15p.



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Made by the famous Diamond H Company, this has a sensor joined by a capillary to a variable control and when fitted with a knob is ideal for many ovens or processes. 50p each + post and VAT 15p.



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For digital instruments, counters, timers, clocks, etc. Hi-vac XN11 Price 90p each. 20p Post and VAT



WINDSCREEN WIPER CONTROL

Vary speed of your wiper to suit conditions. All parts and instructions to make. £3-25 £1-00 post and VAT.



PORTABLE CABINET OFFER

A nicely made portable cabinet, soft padded black finish intended for portable stereo system. Dimensions as sketch. With motor board cut out for Garrard SP 25. This was obviously a very costly cabinet originally made for a deluxe record player. Offered at £1-95+£1-00 post and VAT, carriage free if bought with the Garrard or BSR record decks.



HIGHLY SENSITIVE MOVING COIL RELAY

panel mounting with glass window, this measures approx. 5 1/2" x 4" x 2 1/2", triggering current can be varied from a fraction of a milliamp to 5 milliamps by removing the front and adjusting the setting level. Price £3 each + post and VAT 95p.



SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450w). Unit in Rox all ready to work. £7-95 plus 80p VAT and postage.



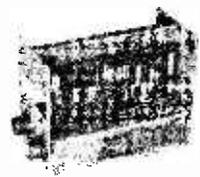
AUDIO AMPLIFIER

Part of the famous Redifone background music system, secondhand, but believed in good order. However, no guarantee; we are selling for spare value only. These are 6 valve amplifiers, the output valves are 2x EL 84 in push/pull, complete with mains transformer, rectifier and ample smoothing equipment. The mains transformer alone, today would cost at least £4. Size is 8 1/2" x 5 1/2" x 4 1/2". Price only £2-00+postage and VAT £1-50.



BREAK-DOWN UNIT

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GPO PUSH BUTTON DIALLING UNIT

Will take the place of the normal rotating dial, has 10 numbered keys, so suitable for other digital systems. A desk mounting unit with rubber feet, this is a very intricate and expensive piece of apparatus. New and unused—our price only £9 each+£1.36 post and V.A.T.



24V POWER PACK

Normal mains input with a thermal safety device. 400 mA output, 4000 mfd of smoothing and full wave rectification, completely enclosed in plastic box and with flex for mains and terminal block for output. Price £1-75+£1 post and VAT.



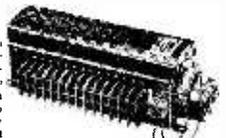
8-SWITCH DISCO LAMP CONTROLLER

Mains motor driving a drum with adjustable trips operating 8 changeover 10 amp switches, so a total of 40K watts of lighting can be controlled enabling an unlimited variety of effects to be achieved and changed with the minimum of effort. This is a real snip a £7-50+£1.15 post and VAT.



HONEYWELL PROGRAMMER

This is a drum type timer device, the drum being calibrated to equal divisions for each setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips, thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 revs per min. Some of the many uses of this timer are Machinery control. Boiler firing. Dispensing and Venting machines. Display lighting animated and signs. Signalling, etc. Price from makers probably over £20 each. Special snip price £9-95 £1-00 Post and VAT. Don't miss this terrific bargain.



HORSTMANN 24-HOUR TIME SWITCH

With 6 position programmer. When fitted to hot water systems this could programme as follows:

Programme	Hot Water	Central Heating
0	Off	Off
1	Twice Daily	Off
2	All Day	Off
3	Twice Daily	Twice Daily
4	All Day	All Day
5	Continuously	Continuously

Suitable, of course, to programme other than central heating and hot water, for instance, programme upstairs and downstairs electric heating or heating and cooling or taped music and radio. In fact, there is no limit to the versatility of this Programmer. Mains operated. Size 3in x 3in x 2in deep. Price £5-50. 80p Post and VAT, as illustrated but less case.



CENTRIFUGAL BLOWER

Miniature mains driven slower centrifugal type blower unit by Woods. Powerful but specially built for quick running—driven by cushioned induction motor with specially built low noise bearings. Overall size 4 1/2" x 4 1/2" x 4". When mounted by flange, air is blown into the equipment but to suck air out, mount it from centre using clamp. Ideal for cooling electrical equipment or fitting into a cooker hood, film drying cabinet, or for removing flux smoke when soldering, etc. etc. A real bargain at £2-50p. 55p Post and VAT.



SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 31, 39 metre bands—Kit contains chassis front panel and all the parts. £1-25—crystal earphone 50p. 80p Post and VAT.



TERMS:

Where order is under £5 please add 30p surcharge to offset packing expenses.

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CROYDON CRO IXX

WALL THERMOSTATS

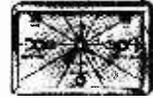
Wall mounting and in a handsome plastic case. (Cream and beige). Adjustable by slider (lockable) and may be set to control temperatures from around freezing through to 50°C. The slide panel is engraved and indicates (frost), (warm), (very warm), etc. The thermostat will control heaters, etc., up to 15 amp at normal mains voltage and is ideal for living rooms, bedrooms, etc. Price £1-95, VAT & Postage 80p. Don't miss this.

INSTANT START FLOURESCENT LIGHTING BARGAINS

Startersless control gear, complete with tube ends and tube clips for window lighting, signs, fascias, etc. 4 ft. 40 w. £1-50; 5 ft. 65w. £1-00; 5 ft. 80w. £1-75; 6 ft. 80w. £1-95; and for pairs as follows—twin 2 ft. 20w. £2-55; twin 3 ft. 30w. £2-75; twin 4 ft. 40w. £2-95; twin 5 ft. 65w. £3-25; twin 5 ft. 80w. £3-95; twin 8 ft. 125w. £4-50. These are about one half of maker's current prices and can't be repeated once stocks are cleared. Please add 30p per piece to cover postage or carriage and 8% VAT.

15A ELECTRICAL PROGRAMMER

Learn in your sleep: Have radio playing and kettle boiling as you awake—switch on lights to ward off intruders—have a warm house to come home to. All these and many other things you can do if you invest in an electrical programmer. Clock by famous maker with 15 amp. on/off switch. Switch-on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price £2-30, VAT & Postage 80p, or with glass front, chrome bezel, £1-00 extra.



MAINS TRANSISTOR PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v, 9v, 13 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: main transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only £1-50. VAT & postage 60p.

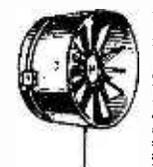
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24v	1 amp	1-50
24v	3 amp	3-50
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25v	1 1/2 amp	1-95
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Your

Continental Holiday RECEPTION

BBC PROGRAMMES

MANY people are interested in listening to radio programmes in English when they are on holiday abroad. Apart from entertainment, these can provide news from home, as well as weather forecasts, road reports and other information about the area concerned. The following notes are intended as a guide to help listeners to know what they can expect to receive in different areas on receivers with and without short wave bands.

Details are given for each of the more popular holiday countries, and information is given about the BBC services that can be received, together with any special programmes in English that are broadcast for visitors by these countries. These tourist broadcasts can usually be heard on simple portable receivers.

Times mentioned are the local times in the countries concerned, except where otherwise stated.

Germany, Austria, Switzerland, Northern Italy

A medium wave portable or car radio will provide adequate reception only after dark, except in the nearer parts of West Germany. Radio 2 on 1500 metres can be heard in some parts during the day, but reception depends very much on the location. In towns where electrical interference is heavy, and this includes most continental capitals, signals may be overcome by the interference, but in rural areas acceptable reception is possible for long periods.

For consistently good reception, especially in the daytime, a receiver which covers at least some of the short wave bands is essential, and a receiver covering at least the 19 to 49 metre bands is desirable.

The 19, 25 and 31 metre bands should be used during the daytime, and the 31, 41 and 49 metre bands at other times. This will enable good reception of the BBC World Service to be obtained throughout the day and evening.

Northern France, Belgium, Holland

Listeners will find that an ordinary portable or car radio receiver covering the long and medium wave bands will prove quite adequate for listening to the BBC's domestic programmes.

Radio 2 on 1500 metres long wave, and Radio 4 on 285 metres or 330 metres medium wave, should be audible throughout most of the day and evening. The World Service in English is broadcast on 276 metres from 2300 to 0430 GMT.

Spain and Portugal

For reception in the daytime a short wave receiver is essential. This should cover at least the 19 to 49 metre bands. The general listening pattern is that during the daytime the 19 or 25 metre band should be used, and the 31, 41 or 49 metre band will give the best reception during the evening.

Late at night, the ordinary medium and long wave portable will often provide some recep-

tion. Listeners should try Radio 2 on 1500 metres long wave, and Radio 4 on 285 metres or 330 metres medium wave. BBC World Service on 276 metres medium wave can also give good results, especially in the more northerly parts.

Southern Italy and East Mediterranean

In all these areas a short wave receiver is essential, and to be sure of good reception at all times, the receiver will need to cover all bands from 13 to 50 metres. The general pattern is that the 13, 16 or 19 metre band will give best reception during daylight, and the 25, 31, 41 or 49 metre band during the evenings.

Denmark, Norway, Sweden

A medium and long wave portable will provide some reception at night-time. Radio 2 on 1500 metres, Radio 3 on 464 metres and Radio 4 on 330, 285 or 371 metres will probably provide the best signals. For early risers, the Radio 3 transmitter on 464 metres is used to carry BBC World Service programmes prior to 0730, or 0830 at weekends.

For reliable reception throughout the day, however, a short wave receiver is required, and an ideal receiver would cover the 19 to 49 metre bands. The 31, 25 or 19 metre band will give best reception during the daytime, and the 41 or 49 metre band will be best during the evenings.

LOCAL TOURIST BROADCASTS

Austria

From 0805 to 0810 daily a bulletin of news, weather and traffic reports is given in English on medium wave (293, 514, 577 metres) and on vhf.

Greece

On weekdays, news and weather bulletins are broadcast in English at 0815, 1310 and 2145 on 412 and 238 metres medium wave and on the local vhf channels. A weather forecast for shipping is also broadcast on these wavelengths at 0635 each day.

Italy

On weekdays from June to September at approximately 0800, news in English is broadcast on 188 and 219 metres medium wave and also on vhf.

Portugal

At approximately 0855 each day, tourist information is broadcast on the local vhf and medium wave transmitters in English, French and German. This programme can be heard on the wired radio systems which are available in many hotels.

Sweden

A summary of the news and weather forecast is given on the local Programme 3 vhf transmitters from 1800 to 1805 each day between July and September.

Switzerland

At 1215 and 1900 each day, listeners can hear the news in English on Line 1 of the Tele-diffusion service, broadcast over the telephone network. (This service is available in many hotels.)

SOME BBC WAVELENGTHS AND FREQUENCIES

Receiver dials are calibrated by wavelength (metres) or frequency (kHz or MHz). The following table may be useful:

		Wavelength	Frequency
Long wave	Radio 2	1500 metres	200 kHz
Medium wave	Radio 3	464 metres	647 kHz
	Radio 4	285 metres	1052 kHz
		330 metres	908 kHz
Short wave		371 metres	809 kHz
	World Service	276 metres	1088 kHz
	Broadcast Bands	13 metres	21 MHz
		16 metres	18 MHz
		19 metres	15 MHz
		25 metres	11 MHz
		31 metres	9 MHz
		41 metres	7 MHz
		49 metres	6 MHz

West Germany

From 1940 to 2030 Mondays to Saturdays inclusive, a varied programme of news, press reviews and general interest features is broadcast on 236 metres medium wave. This can be heard in most parts of Germany. Listeners in the Bonn area can hear a news broadcast in English, Mondays to Saturdays from 1940 to 1950 on 89.1MHz vhf.

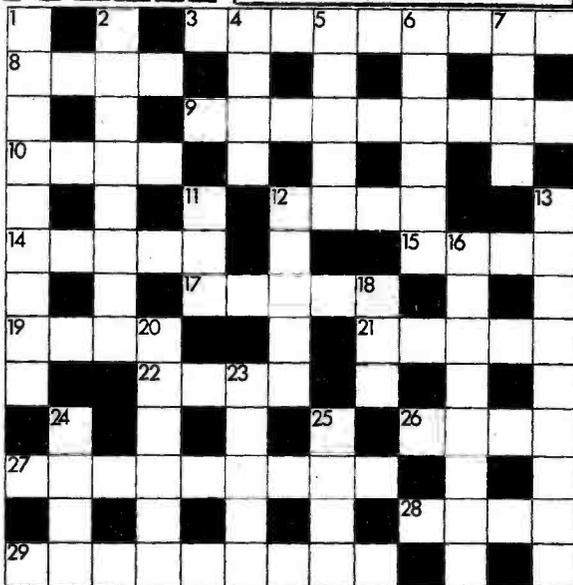
A three minute news and

weather bulletin for listeners in Bavaria is broadcast at 1000, Mondays to Fridays on the local vhf transmitters.

In certain areas the British Forces Broadcasting Service is available on vhf throughout the day and evening.

The above information was supplied by the BBC Engineering Information Department, Broadcasting House, London W1A 1AA.

PW TECHNICAL PUZZLE No. 11



ACROSS

- 3 Impulsiveness in a storage system? (5-4)
- 8 Mid-ear connection is a thought! (4)
- 9 Part of electrical condensation? (9)
- 10 The pick-up with a saga involved! (4)
- 12 Get some sort of reception! (4)
- 14 Make an example of this turntable? (5)
- 15 An insult to smooth music! (4)
- 17 Scotsman in flower with this instrument? (5)
- 19 Graces often go with these tunes? (4)
- 21 Level of noise about a sports arena? (5)
- 22 All individually ache for modulation (4)
- 26 Specially built receivers for travellers (4)
- 27 Naturally flutes can be taped on them! (9)
- 28 You service what he employs inside? (4)
- 29 Military type of music transmitter? (9)

DOWN

- 1 A musical blow-out that's been stopped! (4-5)
- 2 Component in the rebuilt store, sir? (8)
- 4 Chorale containing a spoken part? (4)
- 5 Wipe out a seer with reform? (5)
- 6 A pull-out about these instruments? (6)
- 7 That's not overheating, anyway (4)
- 11 It's strung up headless against bombs! (3)
- 12 Organist and band-leader have common ground?
- 13 Play-group of all ages (9) (5)
- 16 Old-time player sat until replaced (8)
- 18 Top tunes to choose from? (3)
- 20 Not the first diatonic interval? (6)
- 23 Young officer acted as new arranger (5)
- 24 A Greek letter for the conductor, we hear (4)
- 25 Fingering found round old Ireland? (4)

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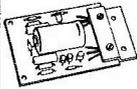


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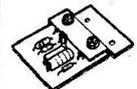
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SS103-3
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Active tone control unit to provide Bass and Treble cut and lift. With full instructions (stereo). **£1.60**

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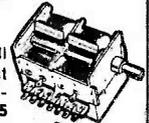
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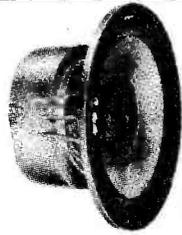
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Miniature

2m EQUIPMENT

part 2 : preamplifier

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aerial with the provision of a good earth, brought the world into the shack, and if one could not hear the signal this was always due to QSB or QRM. When however, a converter for the two metre band was made, the old aerial was no good and a special one had to be put up!

The aerial could be omnidirectional, or directional, the latter would bring in the one wanted signal magnificently but the other chap, off the beam heading, could hardly be heard. Using the omnidirectional aerial both signals went down so the RF gain was turned up, the signals reappeared but this time with a noise, making listening difficult and unpleasant.

NOISE

The noise is generated in the receiver and represents one essential difference between the lower frequencies and VHF. Below about 60MHz the dominant noise limiting the signal received is atmospheric, but above this frequency this falls, so that at VHF and

PROBABLY the majority of those interested in radio are not transmitting enthusiasts but listeners, some of whom may remember that on the lower frequencies, any piece of wire for an aerial

144-146MHz

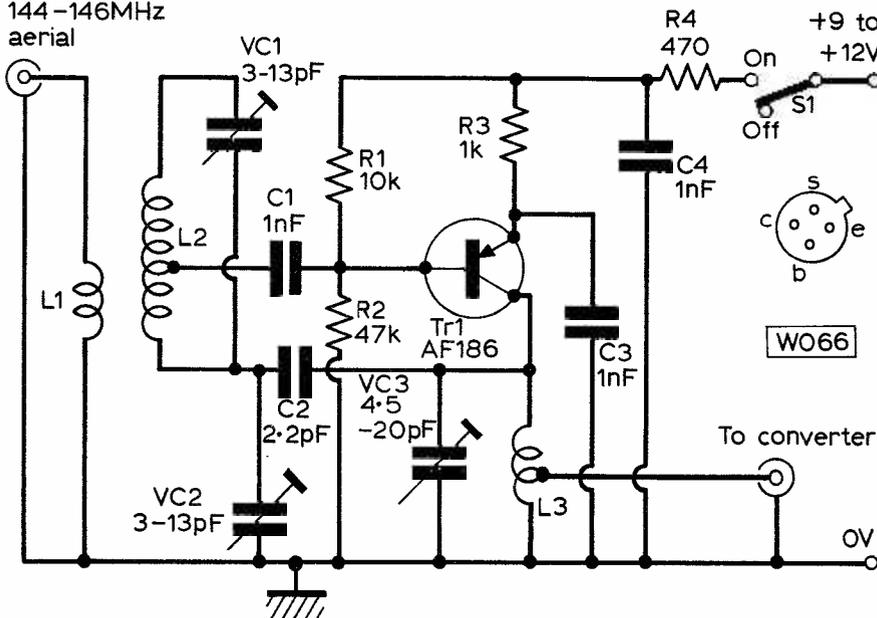


Fig. 1: Complete circuit diagram of the 2m Preamplifier. The AF186 is connected in common emitter configuration.

★ components list

Resistors	
R1 10k Ω	R3 1k Ω
R2 47k Ω	R4 470 Ω
All resistors 10% 1/4W	
Capacitors	
C1 1nF	C3 1nF
C2 2-2pF	C4 1nF
VC1 and VC2	3-13pF variable ceramic capacitor
VC3	4-5-20pF variable ceramic capacitor
C1-C4	disc ceramics
Semiconductor	
Tr1	AF186
Miscellaneous	
L1, 1½ turns enamelled 22SWG wound in first three turns of L2. L2, 7 turns 22SWG, tapped at second turn. L3, 7 turns 22SWG, tapped at first turn. Aluminium box 115x64mm (4½x2½in), Doram 509-939 or Eddystone 7134P. Single-sided copperclad fibreglass board 44 x 25mm (1½ x 1in). Four 5mm spacers. 2 coaxial sockets. S1, SPST switch.	

above, thermal and "shot" noise, predominates. Known as "white noise" it is random in frequency and time, and limits the lowest level of signal that can be demodulated in a receiver. Thermal noise depends on the bandwidth of the receiver, the resistance of the transistor used and two factors over which there is no control, Boltzmann's constant, and the absolute temperature. Shot noise on the other hand, depends on the rate of current flow through the device.

As the bandwidth cannot be reduced to a single cycle, a transistor has to be chosen that has the lowest inherent noise factor coupled with maximum gain at low current flow. The bandwidth, therefore, should be reduced to the minimum necessary, and the input resistance matched to the device resistance, in order that the maximum signal is transferred.

NEGATIVE FEEDBACK

There is, however, one other trick that can be employed after all these factors have been optimised, and that is negative feedback. Imagine a signal travelling through a transistor working in common emitter configuration with a positive signal changing into a negative one, or a 180° phase change. Now, as the signal travels through, random electron move-

ment adds some odd pulses (noise) first in the emitter base junction and then in the base where some electrons and holes combine, and, on the way out, in the base/collector junction.

These noise signals appear in a different phase from the main signal, some at 30°, some at 90°, but all out of phase with the input signal.

If the signal now returns from the collector to the base 180° out of phase and then the feedback signal reduced by a factor dependent on the gain of the transistor, no signal will appear at the collector. However, the noise generated in the transistor will still be audible because it is not 180° out of phase with the input signal. If the exact phase of the returned signal is altered there will be a point where the signal will be amplified, but the noise will be returned out of phase and not amplified. Both thermal and shot noise therefore being neutralised. This is the principle on which this pre-amplifier was designed, to amplify the signal but to neutralise the noise.

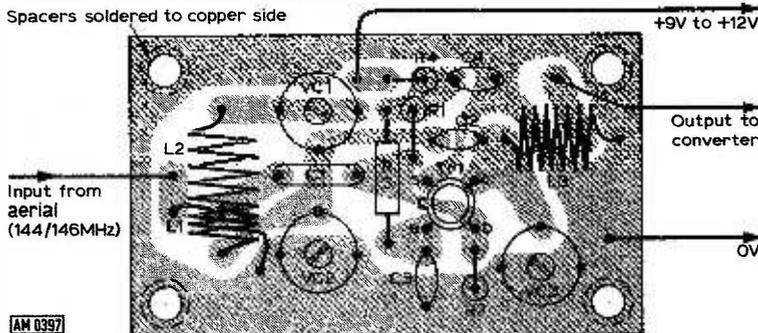
The input and output circuits are both tuned and lightly loaded so that the working Q is high and the bandwidth is kept to a minimum. The selected transistor is an AF186 with an inherently low noise factor and an FT of 900, chosen in preference to an FET, for those equal to it are twice as expensive and have less gain at VHF.

THE CIRCUIT

Because of both current and voltage gain, the transistor is run in common emitter configuration, Fig. 1 with the emitter being tied to the positive rail. The input coil is inductively coupled to L2 which is tuned by VC1. A tap on this coil matches the impedance of Tr1, the base being isolated by C1 from the bias chain R1 and R2. The emitter current is limited by R3, which is bypassed to earth by C3. L3 and VC3 in the collector lead, are tuned to the input frequency and a tap low down on L3 provides a low impedance output to match the following converter. C2 and VC2 is the neutralising phase shift circuit.

PCB CONSTRUCTION

Make a tracing of the board, Fig. 2. Stick this on a piece of single-sided copperclad fibreglass board, dot each of the component mounting holes with a centre punch, paint in the lines and etch. Clean and make the holes with a No. 60 drill, except for the



Component side view of PCB shown 1½ times actual size. All coils are wound on a 6.3mm (¼ in) drill for neatness, with L1 wound inside the first three turns of L2.

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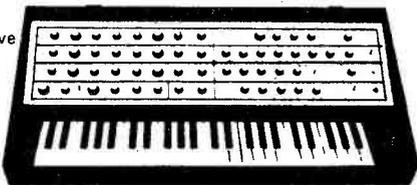
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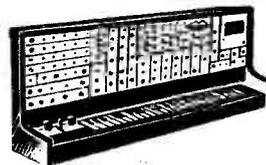
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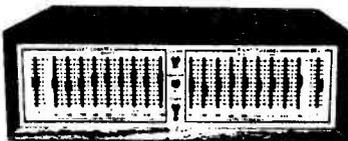
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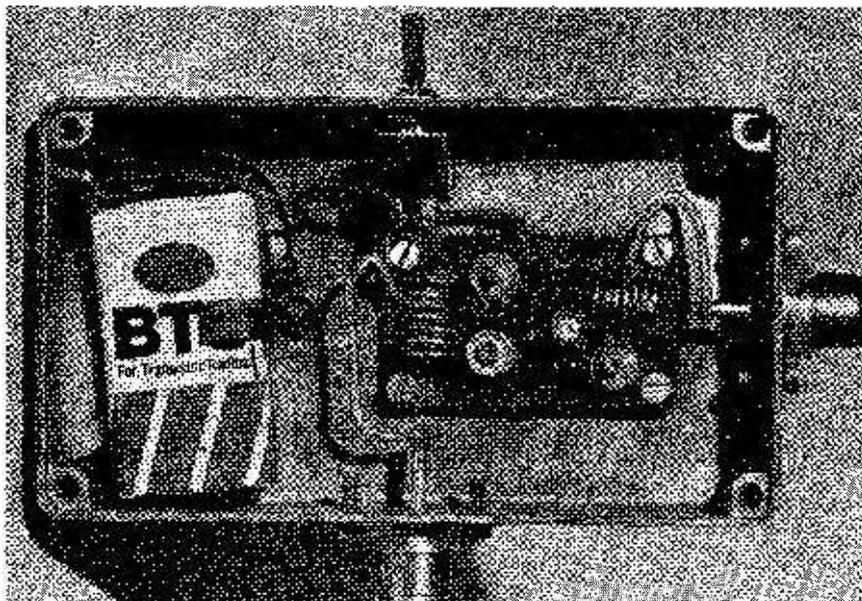
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Interior photograph of the unit, showing details of the positioning of the PCB, the sockets and the on/off switch. The lid should be drilled to give access to VC1/VC3 for alignment purposes, as shown in the leading photograph.

mounting lugs of the variable capacitors, where a No. 52 drill must be used.

The coils should be close wound on a 6.3mm ($\frac{1}{4}$ in) drill, stretched to length before forming the leads and the taps fixed before mounting them as close as possible to the board. L1 should be wound inside the first three turns of L2 after the latter has been mounted on the board, putting the drill inside L2 as a former. Finally check the board for solder bridges, give a final clean.

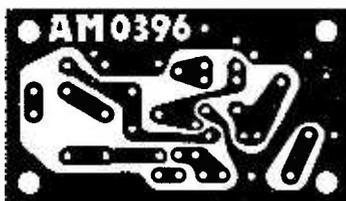


Fig. 2: Full size reproduction of the printed circuit board viewed from the underside. Holes for components are drilled with a No. 60 drill, while those for the variable capacitors are made with a No. 52 drill.

TESTING

Check that the current consumption lies between 1 and 1.5mA at 9 to 12V. If it is higher, adjust VC1 and VC2, for the chances are that the circuit is oscillating.

Fit the unit in a 115×64mm ($4\frac{1}{2}$ × $2\frac{1}{2}$ in) diecast box and complete the wiring to switch and co-axial sockets.

Neutralised preamplifiers are notoriously difficult to set up, but this unit has proved to be the exception. The simplest method requires a GDO as a test instrument, a normal converter and receiver together with a tuning wand. This is a thin rod of insulated material with ferrite on one end and brass on the other and is used to indicate whether more or less capacity should be used with a coil.

To begin, connect the aerial and converter to the unit, and, using the GDO dip L3 to the lower part

of the band using VC3, and then by adjusting VC1 and VC2, put L2 into the upper part of the band. Now switch on, use the GDO as a signal source and watching the S-meter of the receiver, adjust VC3 for maximum deflection, followed by VC2 and VC1. However, as all three adjustments are inter-dependent the optimum results are a matter for trial and error. Somewhere near the correct setting of VC1 the adjustment of VC2 will cause the signal to disappear completely and the correct setting of these two capacitors is when the output moves smoothly up and down as VC2 is moved to and fro. The tuning wand is a great help at this stage to indicate which way a capacitor should be moved, for when the setting is just right both brass and ferrite causes the same dip in the signal.

An off-air signal should be used for the final optimum setting of all three capacitors for optimum signal-to-noise ratio.

ALTERNATIVE METHOD

The second method requires a diode probe, a valve or FET voltmeter, a GDO and a source of RF. Load the input and output with 75Ω resistors and dip the coils as previously described. Now connect the diode probe to the *input* and feed a signal to the *output*, adjust VC2 and VC1 so that no output is indicated by the probe, dip the coils again and repeat the procedure until input and output are isolated and both coils on frequency. Final adjustments are made off-air.

There is still a final adjustment that can be made to improve the signal-to-noise ratio and this is by adjustment of the coupling between L1 and L2. In the prototype $1\frac{1}{2}$ turns seemed about right but it is worthwhile varying the coupling of the coils to find the position giving maximum signal and minimum noise.

THE NEXT ARTICLE IN THIS SERIES ON MINIATURISED 2m EQUIPMENT WILL CONTINUE WITH A LOW POWER FM TRANSMITTER.

TAKE 20

DAVID ANDREWS

No. 72 TRAFFICATOR AUDIO REPEATER

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

WHILE some cars have trafficators which give out a strong clicking noise when they are activated quite a lot do not have this useful feature. If this is combined with the fact that on some cars the dashboard repeater lights are not very well positioned, or cannot be seen too clearly in bright sunlight, it should be apparent that there are lots of applications for this project which gives out a high pitched bleep whenever the trafficators are actuated. Although not excessively loud the sound emitted by the unit just cannot be ignored.

It is very easy to make and is simplicity to install, however, as is the case with a lot of car projects, it cannot cope for all types of car and therefore the unit will only work directly with negative earth cars with the flasher relay switch on the positive side of the dashboard repeaters.

Reference to Fig. 1 shows that the unit is a simple astable multivibrator which is directly coupled to a crystal microphone insert which is used, in this application, as a miniature loudspeaker. At the high audio frequency given out by the device a crystal insert proves very efficient. In theory any crystal insert will do but in practice there will be more output using a large diameter device. The prototype used an Acos type 43 which has the advantage of incorporating a smart gilt grille.

Diodes D1 and D2 are not seen frequently in multivibrators. They are there to protect the transistors from excessive emitter/base reverse voltages. D3 and D4 enable the unit to draw its power from either of the repeater lamps on the dashboard if the car is equipped with separate left and right hand indicators (the diodes are necessary to prevent interaction between the two sides). If the car has only a single repeater which operates whether turning right or left connect D3 to the lamp and omit D4 altogether.

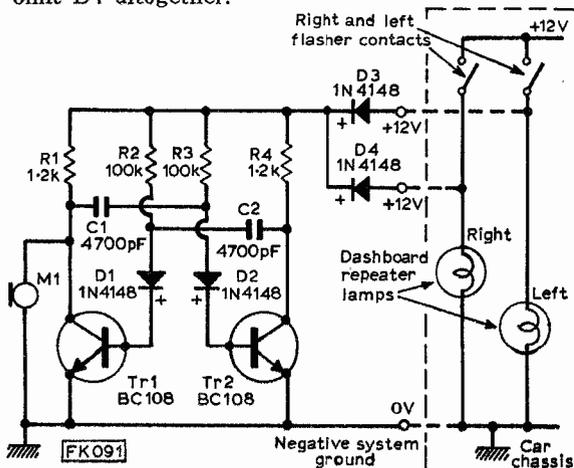


Fig. 1. Circuit of audio repeater and connections to trafficators.

When assembling the unit be careful to connect only the system earth to the aluminium box and make sure, if using the microphone insert specified that the earth connection (case) of the microphone is connected to the common emitter rail of the oscillator. The small board, Fig. 2, is bolted to the bottom of the box with 6BA bolts and spacing nuts.

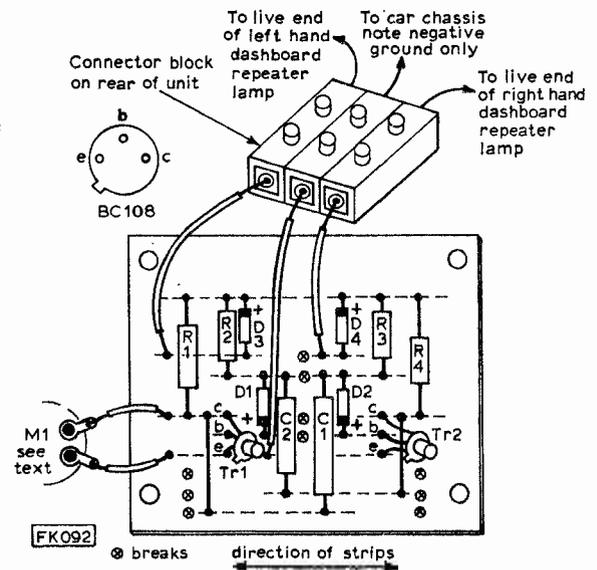
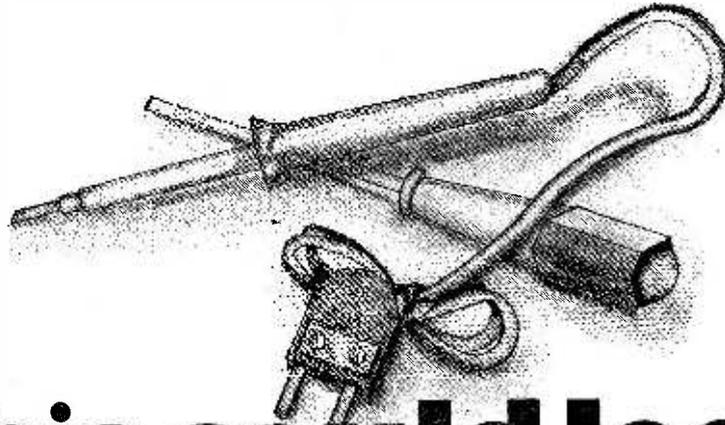


Fig. 2. Layout of components on Veroboard. NOTE: microphone case must be connected to chassis line.

For 6V systems the device will still work but the sound output will be slightly lower. It is quite easy to change the circuit to operate on positive earth systems by replacing Tr1 and Tr2 with a pair of general purpose pnp transistors (e.g. BCY70) and reversing the polarity on all four diodes.

★ components list

R1	1.2kΩ
R2	100kΩ
R3	100kΩ
R4	1.2kΩ
C1	4700pF
C2	4700pF
D1, D2, D3, D4	1N4148
Tr1	BC108
Tr2	BC108
M1	Acos Type 43 (Radio Component Specialists).
Connector block, Copper-clad Veroboard 0.1in matrix, 45 x 40mm. Aluminium box 75 x 50 x 25mm (3 x 2 x 1in) with lid.	



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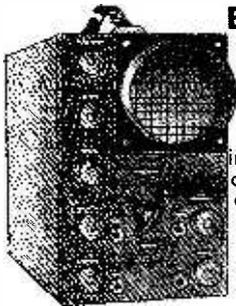
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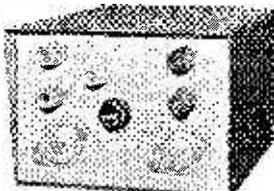
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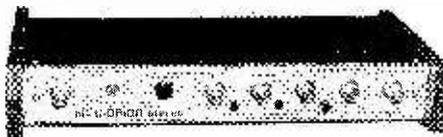
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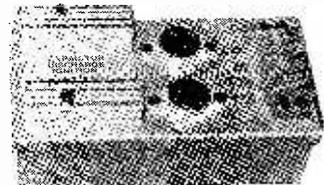
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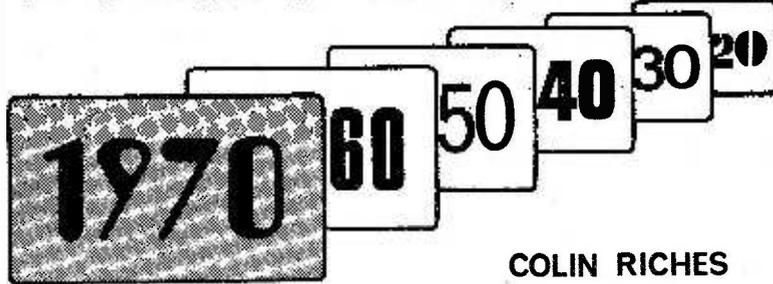


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GOING BACK...



The Fultograph

THE Fultograph or picture receiving machine design was perfected by a Mr. Otto Fulton—hence its name and arrangements for a service were set up in October/November 1928 with the BBC.

The machine was designed so that it could be connected directly to the loudspeaker leads of a domestic radio receiver.

In earlier experiments at the broadcasting station, the picture to be transmitted was prepared as a transparency on a piece of film or as an ordinary black-and-white image. This was then attached to a cylinder and a fine pencil of light passed through it or directed on to it analysing it point by point by rotating the cylinder. The light which passed through the transparency or which was dispersed from the white parts of the photographic print was then directed on to a photocell which generated current according to the amount of

COLIN RICHES

light falling on to it. Thus, the black portions of a picture produced no potential at all, and the extreme white or transparent parts yielded maximum or constant potential.

The ensuing pulses of current representing the white areas on the transmitted image had then to be broken up into audio frequencies so that they could be fed through amplifiers and a modulator. This was accomplished either by putting a revolving serrated disc in the beam of light falling on the photograph or otherwise interrupting at audio frequency, the current flow which was controlled by the cell. This "carrier frequency" was intended to be one most suitable to LF amplification: 800-1000 Hertz. By this process, the image at the transmission end had to be in negative form, the cell becoming illuminated and the AF note sent out when it was required that a current should be obtained at the receiver for the purpose of recording the image.

As an alternative to using a photoelectric cell, the Fultograph system employed a transmitter in which a negative image in the form of an insulating gum deposit on a sheet of copper foil replaced the photograph or transparency.

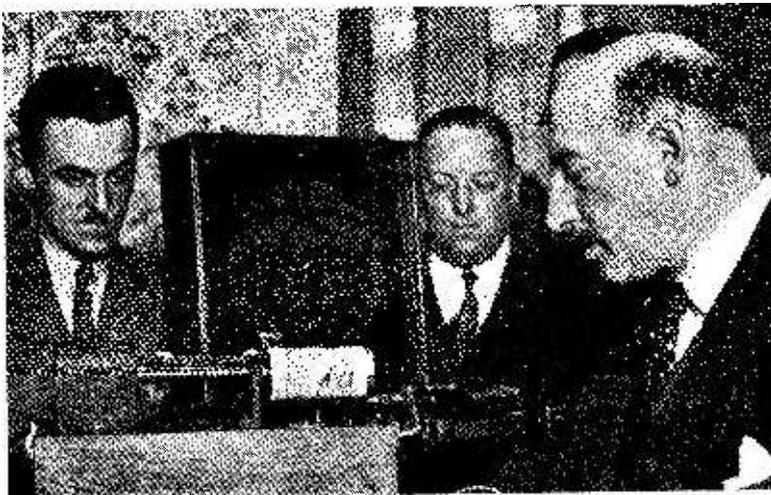
The foil was wrapped round a cylinder and traversed line by line under a metal point so that the image was made to interrupt the current. Instead of a direct current, AC of 1 kilohertz was applied, introducing the necessary carrier frequency.

If one wished to use line illustrations which had no half-tones of white and grey, they appeared on the foil as insulating lines and areas.

In transmitting an actual photograph or a half-tone picture, the image was made on the copper through a line screen so that variations of light and shade were produced by a variation in the width of the lines in the same manner as the size of dots give black, white and variations of grey as we all know from newspaper photographs. Regarding the receiving end of the system, it can be seen that the HF signal was modulated in the same way as though a 1 kilohertz note were being made in front of a microphone, the light and shaded portions of the picture varying the intensity of the signal. After passing the receiver detector valve, the LF amplifier in the receiver was dealing with an AC of 1 kilohertz per second, varying in amplitude.

In the Fultograph receiving machine, the image was formed by the action of this current upon a chemical solution carried on an absorbent paper. As only DC could produce the desired chemical charge, rectification of the 1,000 Hertz AC accompanied by amplification was obtained by connecting the output terminals of the receiver to a rectifier valve. This valve, which was arranged as an anode-bend rectifier, suppressed half of the wave so the current in its anode circuit rose and fell in accordance with the changing light values occurring at the original picture.

A complete shutting off of the anode current of this rectifying valve, pending the arrival of the 1,000 Hertz note from the picture transmitter was obtained by supplying adequate grid bias. A milliammeter was fitted to Fultograph equipment for checking this



Otto Fulton, right, with some of his colleagues and early Fultograph apparatus.

adjustment which was normally accomplished by increasing the grid bias up to a point where the reading was almost at zero.

The electrolytic solution used, which was sensitive to current flow was potassium iodide. A current of a few milliamps applied for a brief period released sufficient free iodine which, in the presence of starch solution produced a deep blue colouring.

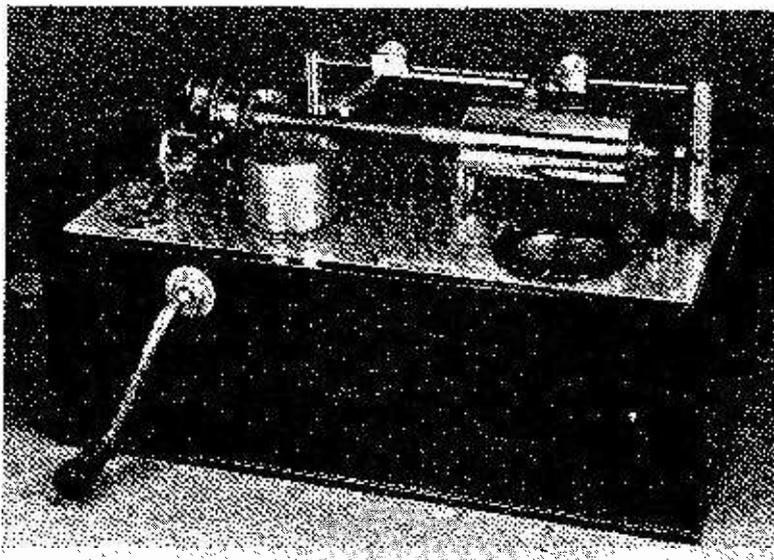
Similar screw threads on both transmitter and receiver gave a corresponding traverse of the revolving cylinders. A synchronising mechanism was included so that the cylinders revolved precisely in unison.

The following are notes from a Fultograph Instruction Manual:

Reception of Picture.— Just before the transmission an announcement will be made, following which there will be a tuning note lasting two minutes. As the Picture Receiver and loud speaker are connected in parallel, this tuning note will be reproduced on the loud speaker. It is now necessary to tune in the Receiver so that the strength is correct for picture reception. When the tuning note for picture reception is coming through, the reading on the milliammeter should be noted and the set should be detuned until the milliammeter reads 3 to 3.5, preferably by reducing reaction.

After the tuning note, three "V's" will be transmitted as follows: ···—, ···—, ···—. After the last "V" there is five seconds' interval, during which time the brake controlling the clockwork motor is released. This is effected by raising and giving a quarter turn to the round ebonite knob on the left-hand side of the Picture Receiver. The motor will then start. The drum, however, will not start revolving at once as this is automatically controlled from the transmitting station and the drum will only revolve when and while the picture transmission is in progress. The formation of the picture can now be watched while the Stylus travels slowly across the paper. It will be noted that the roller stops and starts once in each revolution. This is controlled by the transmitting station and ensures synchronisation.

Synchronisation Setting.— The setting of the motor speed control on the side of the Picture Receiver is not critical, but must be set so that the drum revolves rather faster than the drum at



Fultograph equipment constructed in the 1920's by one of our readers.

the transmitting station.

Fully wind up the motor. Put the switch on the Relay Panel in the "on" position. Remove the negative lead to the grid bias battery. The drum will now revolve continually. Count the number of revolutions per minute and adjust so that there are about 56 per minute.

When the setting is correct and a picture is being received, the drum should stop momentarily and start again once during each revolution. The pause should be very brief.

If the setting is too slow, the drum will revolve continually without this brief pause.

If the setting is too fast, the pause will be too long. The whole picture will be reproduced higher up on the paper so that the top of the picture may not appear at all, and in any case the whole picture will be elongated and distorted.

Speed adjustment need be made only once when the Fultograph is being used for the first time.

After Reception of a Picture.— At the conclusion of the picture, the drum stops revolving automatically and the switch on the Relay Panel should be moved to the "off" position, and *after this* the motor should be stopped by the knob on the left-hand side of the Picture Receiver.

The paper should then be removed and dried as quickly as possible. The ideal method is to put it before an electric fire so that in about two minutes it has

dried completely. A gas or coal fire may be used, but it is possible that the chemicals on the paper may be adversely affected by fumes. To increase the permanence of the picture it is advisable not to expose it immediately to very strong light, and it may also with advantage be kept between the leaves of a book until the following day.

The same procedure should be followed for the next picture and one minute will be given between each to enable you to wind up the motor and fix a fresh piece of paper to the drum. As about five minutes is required for drying, it is best to prepare the first piece about that time before the transmission begins. A fresh piece should then be prepared just before each picture, and can be left to dry while the picture is being received. It will then be ready for the next.

Trouble is sometimes experienced through low frequency oscillation. This may be due to run-down batteries or magnetic coupling between the Fultograph and the wireless set. The symptoms are continual rotation of the drum without pause while an attempt is being made to receive pictures and also, instead of a picture forming on the paper, the needle makes a continuous brown mark. The remedies are as follows:

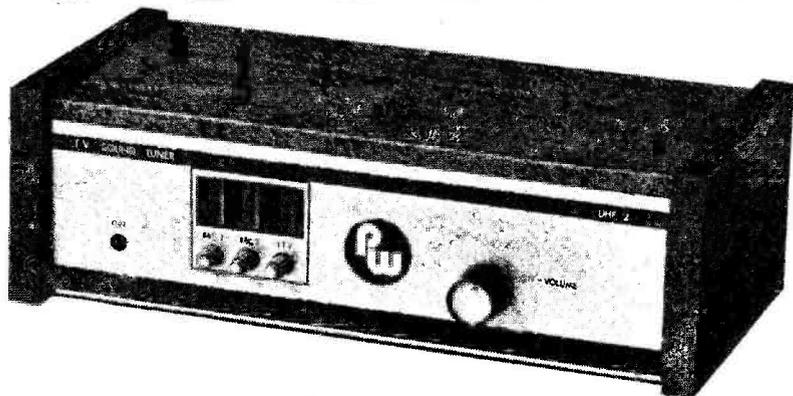
- (1) Reverse the leads between the loud speaker terminals and the relay panel.

continued on page 501

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PART 1

B. BARNARD

FEW readers can afford the £300 to £400 worth of equipment that seems to be essential for true hi-fi. Many have to settle for something in the region of £100 and try to pretend that there is nothing better. But sooner or later we find it is not really good enough and we have the urge to start to try to bring our "budget" outfit up to a better standard. A serious snag about true hi-fi equipment, apart from its price, is that it represents the ultimate and the true enthusiast finds no challenge to his skill and ingenuity. All that is left is to keep up with the Rothschilds' and to trade-in hundreds of pounds worth of equipment and replace it with something more up to date, good for trade but murder for the pocket!

The author describes in some detail the cheap but effective improvements he was able to make to his Budget Hi-Fi System. Some or all of his ideas can be adapted for use on any similar system. Read and choose for yourself.

For all these reasons, but particularly the financial one, I chose and bought a unit audio system of well-known make. Unit audio because I prefer to have all the works in one box but mainly because I considered the styling to be outstandingly good. The recommended retail price at the time was £100 but I paid just £80 for it "cash and carry". For this not very princely sum I took home a LW, MW and FM radio, a Garrard SP25 playing deck and two attractively teak-housed two-unit loudspeakers.

FIRST IMPRESSIONS

Examining the specification I found that it included a stereo decoder (good), 6 watts per channel (sufficient for my purpose), ± 1.5 dB from 55Hz to 23kHz (quite good), a ceramic cartridge (not so good) and less than 1.5% total harmonic distortion (it all depends on what is meant by "less than"). I admired its appearance and tried a record or two. Pop records came across most impressively; there was terrific "presence" and with the volume control only halfway up we had almost reached the threshold of pain! The trouble with pop records is that one is never quite sure what the original sounded like so it was not possible at this stage to decide what sort of "fi" we were listening to. A visit to the room above

the one in which it was playing however quickly gave a clue to this. All one could hear was a regular "thump, thump" tuneless noise—"one note bass" is what they call it and not without reason.

At this stage, let me make it quite clear that there is no criticism of the manufacturer implied in all this. He had produced an instrument that did all he claimed for it, capable of giving first class entertainment. But the subtleties of Beethoven and Brahms were beyond it. I therefore set about upgrading and improving it so that I could listen to the kind of music I wanted, but always within a strict budget. I wanted the best possible results for a few pounds, for there is no point in spending, say, another £100 on such a project if you find the total exceeds the money you couldn't afford in the first place.

CHANGING THE CARTRIDGE

I am sure it is generally known that you cannot simply remove the ceramic cartridge and replace it with a magnetic one. If anyone is not convinced, I suggest they try it. The result will be very weak output, totally lacking in bass although, unless the ceramic was a very good one, there will already be the promise of greatly improved reproduction.

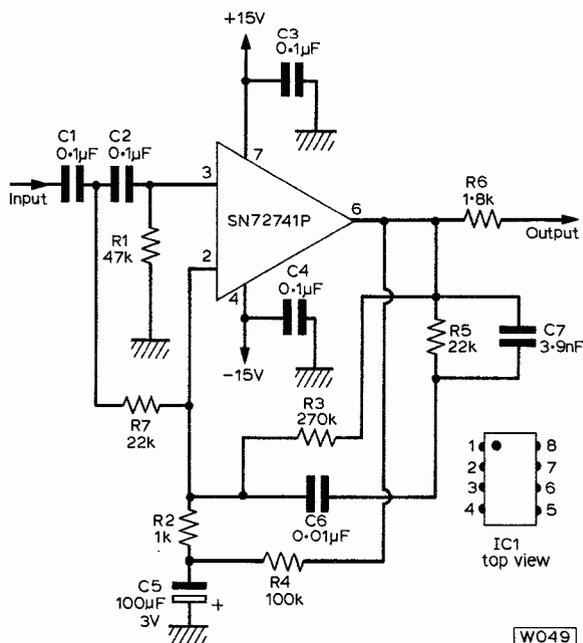


Fig. 1: Circuit of one channel of the new pre-amplifier added to the existing system.

Because of the much lower output and the electrical characteristics of the magnetic cartridge, a pre-amplifier is essential. This amplifier will not only boost the signal overall but is designed to give much greater amplification to the lower audio frequencies. The problem arises regarding space in the average unit audio for fitting extras like the preamplifier and its associated power supply. The central area of my chassis is quite unoccupied and leaves generous space for fitting additional units. The only real problem is headroom and one has to be extremely careful not to fix additional items in such a position that the record playing mechanism fouls them when the whole thing is reassembled.

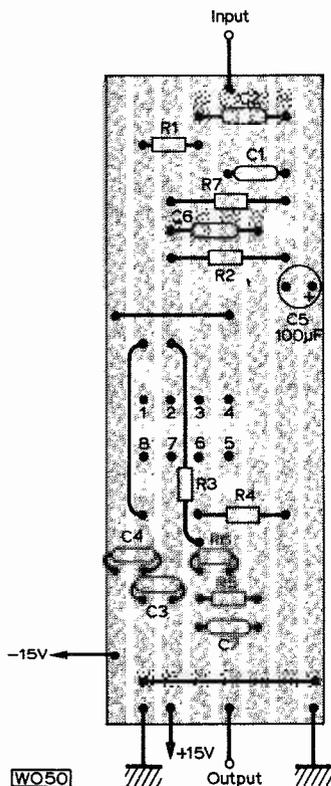
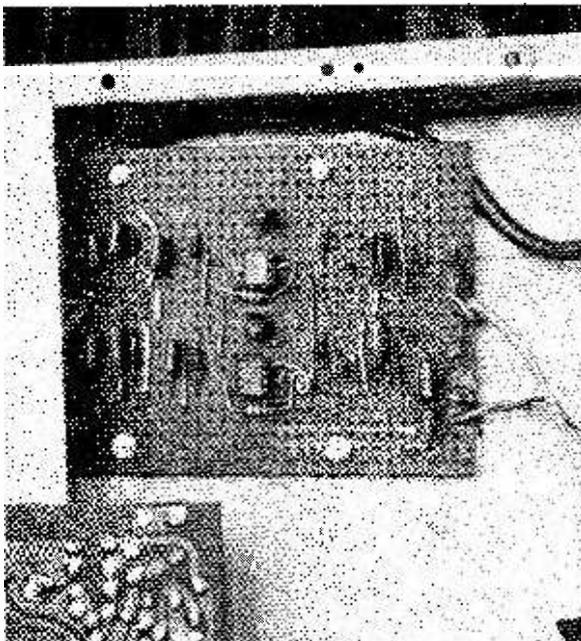


Fig. 2: Layout used by author for the pre-amplifier. Note that this layout is duplicated using a common board, see photograph.

The photograph shows the amplifier in place on the chassis held by 4BA bolts through holes drilled in the chassis. A sheet of insulating material (optional) is placed over them, nuts holding it in place, acting as spacers to prevent the print side of the amplifier board touching the chassis. The amplifier should be located to keep the input leads from the cartridge as short as possible.

POWER SUPPLY

The next item is the power supply unit for the preamplifier; +15 and -15 volts are required and it is seldom possible or wise to attempt to get this from the main supply system of the equipment. I used Veroboard for this as well. The circuit is given in Fig. 3. Notice that two zener diodes are used to prevent the DC volts rising above 15V as the ICs are rated at 18V maximum.



The finished stereo pre-amplifier board lucked away in an unused corner of the chassis.

The preamplifier circuit used is a direct copy of the PW "Texan" first stage except that I have wired in the rumble filter permanently. This is optional but I did it on the principle that any sounds emanating from the unit after the modification, below about 40Hz, were most likely to be undesirable and should be eliminated from the start. The circuit is shown in Fig. 1 and the amplifier is constructed on Veroboard, Fig. 2. I have used the 0.15in. board as I wanted to be able to make modifications and resoldering on fine pitch board is not easy. However, the IC holders do not fit into the Veroboard holes and wire connections have to be made to the pins, the holders then being bolted with 8BA nuts and bolts to the board. These connecting wires are then passed through the appropriate holes and soldered to the copper strips.

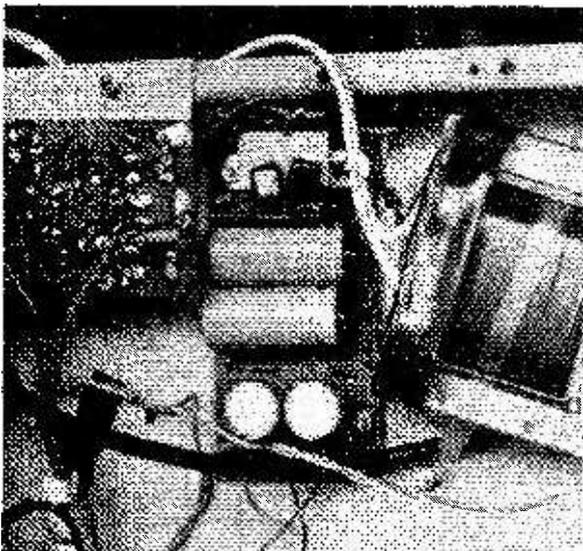
Constructors may prefer 0.1in. board, in which case both amplifiers can be accommodated on a piece of board about 85 x 75mm (3¹/₄ x 3in). Considerable liberties can be taken with this layout without affecting the performance of the amplifier.

Locate the power supply unit as close to the mains transformer of the equipment as is practicable. Apart from simplifying the wiring on the AC side, it is a source of AC magnetic field and it undoubtedly helps to have all such sources close together as will be clear later on when discussing the problems of mains hum. At this point connect the input and output of the amplifiers with screened leads to the cartridge (via tags on the gram deck) and the main amplifier respectively. Next connect the power supply unit taking the greatest care that the polarity is correct. The positive tag on both preamplifier and power unit should have been definitely identified and marked before connecting. A mistake at this stage will result in the immediate ruin of both ICs, so it is worth taking pains to get it right.

Before fixing the record playing deck into its normal playing position, some simple tests are required. Connect both loudspeakers and mains, switch on, putting the control switches or buttons in the "Gram" position. Check the +15V and -15V

circuits. If hum is present there is a fault condition unconnected with the work so far done and it must be found and cured at this stage.

Now switch to Gram and with the bass control at full boost and increasing volume slowly to maximum, listen for hum. As the cartridge coils are now disconnected they cannot contribute anything, so any hum is most probably coming from the input wiring of the preamplifier. Check that, where the input leads and output leads to and from the preamp protrude from their screens to make connections, they are **very** short and that the screens are properly earthed. If this does not produce a cure it may be necessary to make up a screen to cover the preamp. A screen of this type is not very difficult to construct but it should completely cover the preamp and be securely bolted to the chassis.



The power supply board is in the centre of the photograph. The mains transformer has been re-orientated to reduce hum, as described in the article.

Mu-metal is ideal for this as it is easily cut with tinsnips and bent to the required shape. A fairly reliable source of mu-metal is any ex-government surplus store selling screens used for radar tubes. This will give enough metal for this and any other screening that may be found necessary in future work. This screen will completely remove the small amount of hum that is present under these test conditions. It is essential to get rid of it, as every little helps, but it has of course not done anything on the main problem of hum pick-up by the magnetic cartridge. There are two obvious points of attack in curing cartridge hum pick-up. These are the mains transformer or the cartridge, or both.

CARTRIDGE HUM

I started with the cartridge, which is a Goldring G800 and already has a mu-metal screen included in its design. It seemed reasonable to suppose that if this screening were made complete, then the cartridge could be completely protected from the AC field. I made up a small rectangular screen from mu-metal that completely enveloped the cartridge body. It wrapped around the cartridge and "tucked-in" between the cartridge and its carrier. I also made up an even smaller screen to clip on the front, just

over the stylus. The additional weight was easily overcome by adjusting the counterbalance at the far end of the arm. The arm and cartridge mass was of course increased but as this tends to reduce the frequency at which it resonates with the compliance, it cannot be of any serious consequence.

The results were very enlightening and instructive but not sufficiently successful to warrant further work in this direction. There was unacceptable hum in the left-hand channel when the pickup arm was in the rest position; the hum disappeared completely during the tracking of most of an LP record but re-appeared loudly in the right-hand channel during the last few inches of the record grooves. Clearly, even this comprehensive screening of the cartridge left "windows" through which one coil or the other could "see" the 50Hz field. Despite this rather disappointing result, it was well worthwhile as it taught me a lot about the nature of the field in this application and of what to expect and what not to expect from metal screens.

TRANSFORMER TROUBLES

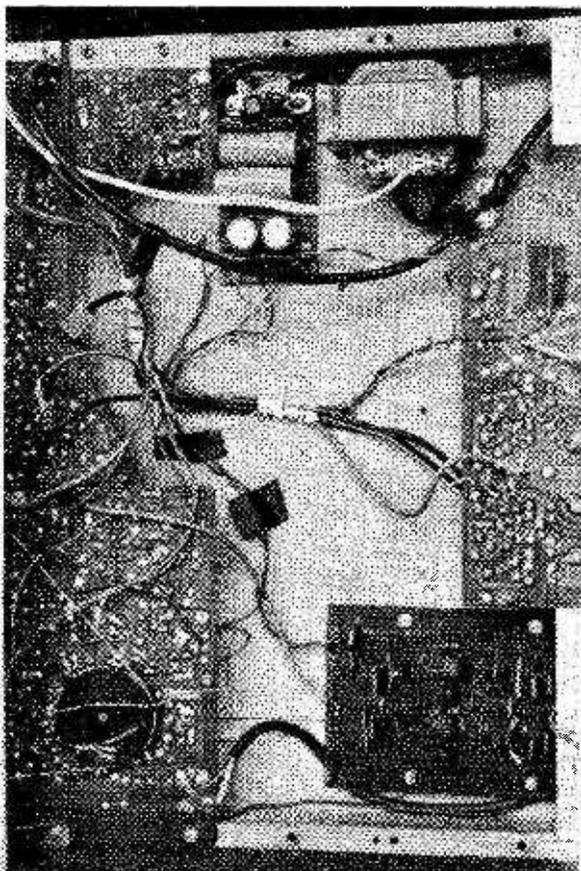
After this rather disappointing result, I shifted my attention to the obvious source of the trouble, the large mains transformer supplied in the equipment which supplies power to all stages except our newly-fitted preamplifier. I recalled that the external magnetic field was causing all the trouble but unfortunately, with unit radio, it is not possible to turn the transformer around to try different positions while the instrument is switched on and the playing deck is in its working position. However it is possible to achieve much the same thing by the following simple expedient.

The mains transformer is completely removed from the chassis. Primary and secondary leads are extended outside the instrument to the transformer which is now mounted with woodscrews to one end of a short piece of board. This piece of board is used



The mains transformer is fixed to a piece of wood and moved around outside, the best position noted being on the paper underneath.

as a "handle" to orientate the transformer in all directions, lateral and vertical. The transformer on its board is placed outside the cabinet but as close to its normal fixed position as possible. It is thus, in relation to the magnetic cartridge, only two or three inches disposed from its original position inside the instrument. A piece of plain white paper is placed beneath the transformer and extends to the cabinet side. The photograph shows the general arrangement and it may be noted that this is really a temporary arrangement of that already described for fitting the transformer permanently outside.



New power unit, top centre, and new preamplifier board, bottom right, fitted and tested before the experiments with the transformer.

Using the top edge of the board as a handle, turn the transformer first laterally, then vertically and with boosted bass and volume well up listen for the position of minimum hum. It is usually well-defined and holds for approximately ten to fifteen degrees of arc. Holding the transformer by its board in this position, mark on the paper with a pencil the angle the transformer casing makes with the cabinet side. At the same time note carefully the orientation of the transformer windings as this and the angle must be carefully reproduced when the transformer is remounted on the chassis inside the cabinet.

There are of course certain safety precautions to take when carrying out this work. The normal primary connections to the transformer are disconnected and taken to two terminals of a four-way connecting strip which may conveniently be bolted to the chassis using one of the holes through which

the transformer holding bolts are passed. The connections from the power unit which normally go to the transformer secondary are taken to the second set of terminals. Two lengths of mains flex are then taken from the connecting strip out through the cabinet for connection to the transformer via another connecting strip which must be securely screwed to our piece of board. With normal precautions there is now no danger of short circuits, open circuit or electric shocks. Having found and marked the angle and noted the orientation of the windings all this temporary wiring can be dismantled. The piece of paper with the angle marked on it is now cut out and stuck with Sellotape in the required position on the chassis and the transformer is remounted in its new position.

RESULTS SO FAR

I was delighted and relieved to find that this new transformer position more than fulfilled the requirements of hum-free reproduction on Gram. With volume far above normal listening level (and I do like to hear a symphony orchestra!) and bass boost which would only be acceptable in the jungle, there was no audible mains hum at all. A photograph shows the finished job. Keen eyed readers will notice that the transformer is held in position by a nylon strap and two nuts and bolts. Personally I find this adequate but some experimenters will no doubt prefer to make up suitable metal fixing brackets.

What have we got as a result of this work? Very acceptable reproduction, but we still have that terrible bass! How much have we spent? The cost of a G800 plus the components for making the pre-amplifier and its power unit are quite reasonable I believe. There are still other "budget improvements" required improving the bass, fitting an inexpensive tuning meter (which I believe is almost an essential) and the much-disregarded and extremely important matter of achieving and maintaining good tracking on gramophone records. I will deal with these matters in a subsequent article.

CQ! CQ! CQ! CQ!

ISSUES WANTED

- .. November 1973, December 1973 and January 1974 issues of P.W.—C. R. D. Croney, "Hastings Lodge", St. Matthias Road, Hastings CH. CH., Barbados, West Indies.
- .. January 1975 issue of P.W. with Part 1 of Model Control by Radio.—G. Greenshields, Eliock House, Sanquhar, Dumfriesshire, Scotland.
- .. P.W.'s for August 1972, March 1974, November and December 1974, January 1975.—Nigel E. Bacon, 51 Dares Walk, Hinckley, Leicestershire.
- .. February and April 1973, November 1974.—S. Reid, 6 Culloden Crescent, Arbroath, Angus, DD11 1JX.
- .. October 1973 P.W. containing Datacards 1 and 2.—Charles Burnham, 5 Berwyn Close, Marchwiell, Wrexham, Clwyd, Wales.
- .. August 1974 P.W. and January 1972 to June 1974 Television. Also August 1974 to October 1974 Television.—M. A. Hickman, 53 Larkhill Lane, Liverpool, L13 9BL.
- .. October 1974 issue of P.W.—E. O. Bennett, 35 Stephen Hill Road, Crosspool, Sheffield, S10 5NQ.

Practical Wireless, October 1975

AIDS to IMPROVED RECEPTION

PART 1

C. HEATH

ANYONE wanting to carry out serious listening on the short wave bands, amateur or broadcast, generally ends up possessing a 'communications' receiver. So the natural question to ask is 'what has the comm. receiver got that the ordinary set hasn't?' The best way to answer this question is to relate the deficiencies of the latter and it is hoped that this short series of add-on projects will go some way towards overcoming these deficiencies. However, it must be clearly understood that a good comm. receiver is a complex bit of equipment with each stage designed to carry out its particular function as efficiently as possible while working with its associated stages. Add-on units can only be a compromise at best but they will give the listener some idea of what he can expect from a real comm. receiver.

A basic superheterodyne receiver, Fig. 1, will have

a mixer stage, one or more intermediate frequency (IF) stages, an AM detector or demodulator and one or more audio amplifying stages, usually feeding a loudspeaker. Because the mixer can produce the same IF from two differing signal input frequencies the unwanted (second channel) station can interfere with the wanted one. Similarly, stations can appear on the dial, due to second channel effect, that ought not to be there, making a cheap receiver seem a better performer than it really is! A tuned amplifying stage ahead of the mixer will go a long way to eliminating second channel problems.

The IF stages provide most of the gain in a receiver but at the same time they should reduce the bandwidth of the IF channel to the minimum necessary to pass the signal without, in the case of speech, detracting from its intelligibility. For high quality AM signals, including music, this bandwidth

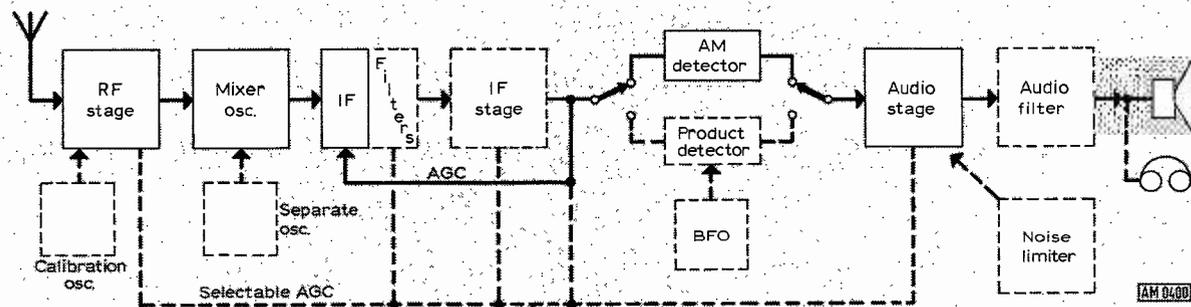
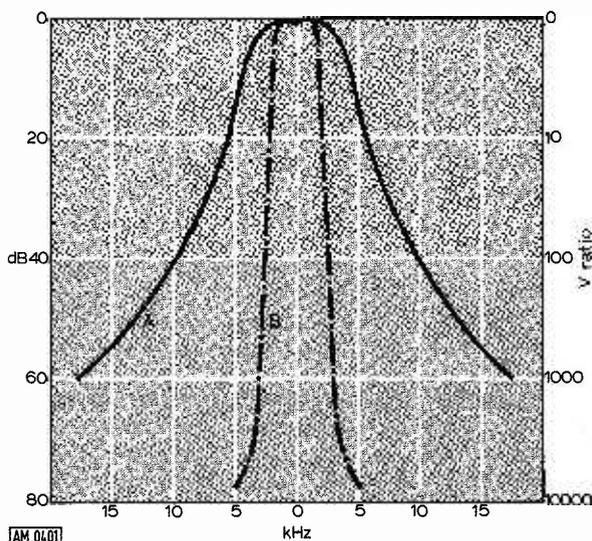


Fig. 1: above, shows the stages of a basic superhet receiver (solid lines) with the extra facilities to be expected in a communications receiver (dotted lines). Fig. 2: left, compares the IF response curves of the two receivers.



may be 9 or 10kHz but, at the other extreme, 50kHz can suffice for CW (Morse) signals! So a choice of bandwidths is essential, generally using switched crystal or mechanical filters.

The simple receiver with one or two IF stages using ceramic filters will have a bandwidth of 4 or 5kHz but its response, moving away either side of the centre frequency, will be excessive and quite unacceptable for any other reception mode. A good filter will have 'skirts' which fall away very rapidly indeed outside the required passband, Fig. 2. In an expensive comm. receiver there may be separate switched filters for upper and lower sideband on SSB, AM and another for CW.

A simple superhet will probably have a diode to demodulate the AM signal, followed by a filter to remove any remaining IF component; four components at most! In a comm. receiver a beat frequency oscillator (BFO) is used to enable the

demodulator stage to resolve SSB and provide a beat note on CW. The diode detector can be used for these two modes as well as AM but the relative levels of signal from the IF stage and the BFO are quite critical for proper resolution of SSB so that in a comm. receiver a separate product detector (PD) circuit is employed for SSB and CW only. The BFO may take on the more sophisticated name of 'carrier insertion oscillator' (CIO). The simple BFO added to a receiver will not be all that effective on SSB since the signal levels are seldom taken into account, and the stability of the BFO will leave a lot to be desired.

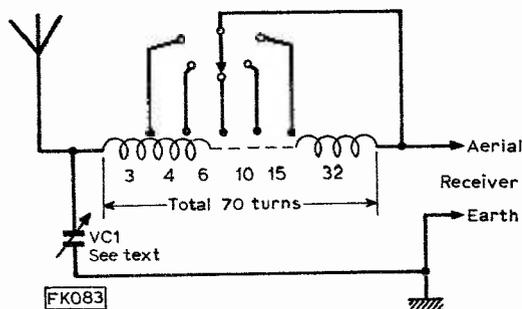
While a simple audio stage and speaker will suffice for AM on an ordinary set the comm. receiver's audio stages will have a frequency response carefully matched to that part of the speech frequencies which convey the most information, usually 300Hz to 3kHz. There may also be a very narrow audio filter for use on CW, with a centre frequency around 1.5kHz. Other features on a comm. receiver will include an excellent dial easily resettable to a particular frequency plus electrical or mechanical adjustment of the dial to permit correct calibration against an internal crystal controlled frequency standard on 100kHz or even 25kHz.

The AGC circuits will have separate characteristics for AM, SSB and CW, automatically switched in by the mode switch. There will be a tuning or 'S' meter indicating relative signal strength and, finally, there will be a headphone socket! A small point but a very important one. A lot of money may have been spent on a comm. receiver in order to get the best signal-to-noise ratio (electrical) only for the audio to be fed to a speaker located in a situation where the signal-to-noise ratio (domestic) is frequently less than unity!

AERIAL MATCHING UNIT

THE AMU is most helpful when relatively short aeriels are used in the HF and medium wave bands. An improvement of several S-points is possible, compared with the same aerial used untuned. The coil is 70 turns of 26SWG enamelled copper wire on a 40mm diameter former, space wound in the 3, 4 and 6 turn sections. Try various tappings and adjust VC1 for best results. A crocodile clip or wafer switch connected to the taps allows the number of turns to be changed quite easily.

The unit can be built in a plastic box, with terminals or sockets for external connections, but a metal box is preferable. Fit a simple dial, marked from 1 to 10, and number the tap positions. Once



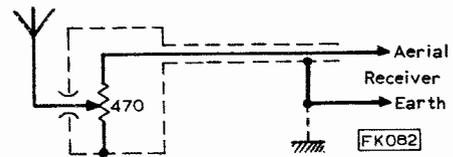
the correct positions have been found for a particular band the numbers can be recorded for rapid reference.

Variable capacitor VC1 can be 250pF or 500pF or the two sections of a standard 208+176pF gang connected in parallel.

INPUT ATTENUATOR

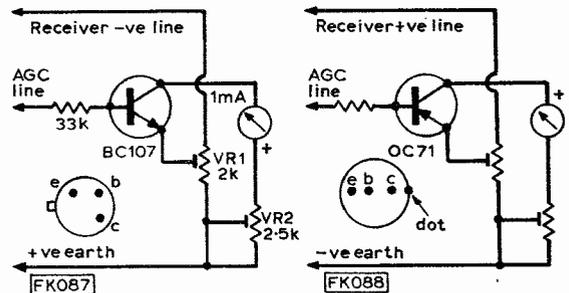
WHERE strong signals cause overloading, cross-modulation or cause the receiver to perform inadequately on CW or SSB, an input attenuator provides a possible solution. A 470Ω carbon linear potentiometer is suitable for 75Ω to 600Ω input impedance receivers. It gives as much as 40dB attenuation at around 15MHz and greater values at lower frequencies. Attenuation is less on HF bands where RF leakage reduces the efficiency.

If the connecting lead is short and kept clear of the aerial proper, the attenuator may not need screening. The attenuator can be fitted inside the receiver or in a separate metal box—with a coaxial lead to the receiver, the preferred arrangement.



TUNING METER

A TUNING METER helps accurate tuning, shows if changes to aerial or earth systems increase signal strength and helps in alignment where optimum adjustment of circuits will usually agree with the maximum meter indication. The BC107 NPN transistor is used for receivers using PNP transistors and positive earth line. Increasing signal strength moves the AGC line positive, reducing receiver gain, thereby increasing the meter reading. The OC71 PNP transistor stage is for receivers with a negative earth line and NPN transistors.

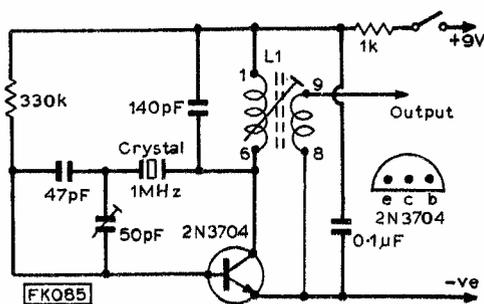


Pre-set potentiometer VR1 is set so that the meter is reading zero with no signal, preferably with aerial and earth shorted together. The sensitivity control VR2 is necessary for receivers with varying degrees of AGC action. The meter and components can be fitted inside the receiver or in a separate box,

which is more usual, to avoid the problems of cutting a large meter hole in the panel. Meters calibrated in 'S' units are available but remember that the indication is purely a relative one, the sensitivity varying with the sensitivity of the receiver at any particular frequency.

FREQUENCY MARKER

THE marker provides a stable signal at 1MHz intervals and the harmonics may be used to 30MHz or higher. Receivers can be calibrated at 1MHz points enabling bands to be located. One frequency on each waveband must be identified by reference to known stations and points can then be counted off, upwards and downwards, from this. Standard frequency transmissions on 5 and 10MHz furnish ideal identification points and allow precise adjustment of the marker frequency by means of the 50pF trimmer.



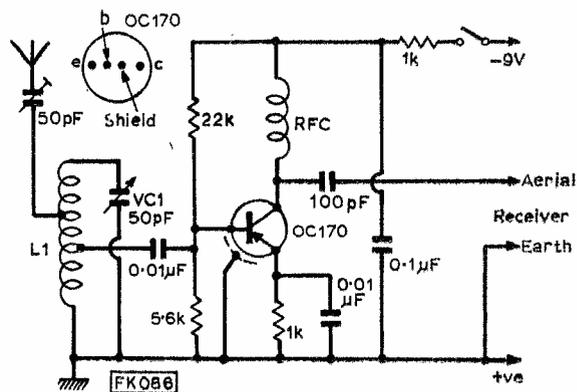
The signal produced is an unmodulated carrier which will register on a tuning indicator or S-meter or heard if a BFO is fitted. Coil L1 is a Denco Yellow Range 2 coil and its core is adjusted for lowest battery current consistent with reliable starting when switching on. The output lead is placed near the receiver aerial lead or it can be connected to the receiver aerial socket through a small capacitor, say 47pF.

The unit can be built into a receiver or in a separate plastic or metal box. A PP3 9V battery will be quite adequate for the low, intermittent drain.

HF BANDS AMPLIFIER

SOME receivers give poor results above about 14MHz so using the amplifier shown here can improve reception by several S-points. It tunes from about 13 to 24MHz. Coil L1 is wound with 20SWG copper wire on a 40mm diameter former. It has 13 turns in all, tapped at 2 turns up for the base connection and 6 turns up for the aerial. Choke RFC must be clear of L1 and at right angles to it.

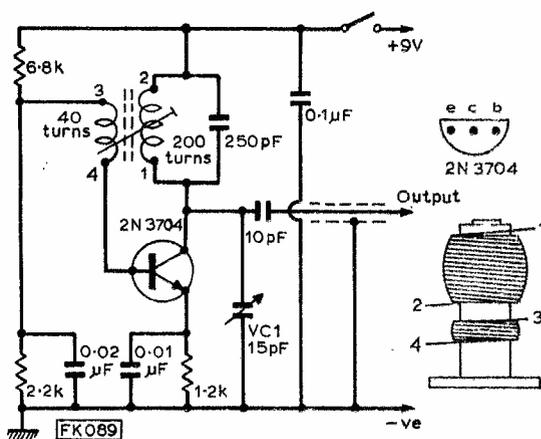
The amplifier is built in a small metal box, with reasonably short connections. The output lead should be as short as possible, preferably coaxial cable, if very short. Capacitor VC1 peaks up signals. If the receiver has good AGC action, switch the AGC off when setting VC1 for a particular band, or watch the tuning indicator for maximum signal unless signals are very weak.



Do not omit to connect the shield of the transistor to earth or instability may result. The series aerial trimmer should be adjusted so that a reasonably sharp peak is obtained when tuning VC1 on a signal.

BEAT FREQUENCY OSCILLATOR

A COMMUNICATIONS receiver has a BFO so that CW (Morse) and SSB (single sideband) transmissions can be resolved. The coil is wound with 40SWG enamelled copper wire, on a 7mm former with an adjustable core. Winding 1-2 has 200 turns, occupying about 9mm. Winding 3-4, wound in the same direction has 40 turns, just clear of the larger winding and taking up about 3mm. This BFO is for receiver IF's of around 465kHz to 470kHz. If oscillation is not obtained, check that the phase of the windings is as shown.



The output lead, preferably coaxial cable, is placed near or connected to the last IFT at the demodulator diode. A few tests will show the best degree of coupling. Rotate the coil core until a strong whistle is heard on all AM signals tuned in, when variable capacitor VC1 is rotated either way from the half open position. VC1 is then adjusted for best results with CW or SSB, but the BFO must be switched off for AM.

If the BFO is built into a receiver it should be completely screened to prevent the signal from affecting the AGC circuits.

continued on page 492

PRODUCTION LINES

colin riches

SINCLAIR'S LATEST



Sinclair announces a major British technological breakthrough for its new mains/battery Scientific Programmable Calculator.

At £29.95 including carrying case, mains adaptor and VAT, this latest model sets a new price level for programmable calculators. This price has been achieved because the machine is based on a single chip which is designed by and exclusive to Sinclair. It is the first programmable calculator to be operated on a single integrated circuit.

According to Roger Helmer, Sinclair Marketing Manager, the Scientific Programmable has been developed particularly with scientists, students, engineers and statisticians in mind. He comments "This calculator is especially designed to dramatically lighten the load for those who have repetitive calculations to perform, for example the analysis of experimental results."

"This ability to perform calculations repetitively makes it an enormously powerful tool for solving equations and evaluating integrals by iterative methods and an enormous variety of other mathematical applications."

Programmes, of up to 24 steps, which are entered directly through the keyboard are stored ready to operate on any numbers which are subsequently entered.

Number entry can be in scientific notation or fully-floating decimal point. All results—appearing in large green digits on the fluorescent display—are in scientific notation with a 5 digit mantissa and 2 digit exponent, both signable.

Sine, cosine, arcTangent, (all in radians), \log^{10} , $\text{antilog}^{10}(10^x)$ scientific functions are all directly available and arcSine, arcCosine, tangent, degree conversion and \log_e are readily derivable.

In addition to the four standard arithmetic functions $+$, $-$, \times , \div , the unit also gives x^2 , $1/x$, square root and sign change. It has a memory with three separate memory operations, store, recall and exchange and the post-fixed operators (reverse Polish logic) are ideal for full-flow chain calculation.

The Scientific Programmable is housed in a matt black case 153 x 76 x 25mm and features simple two-level keyboard operation with all facilities including programming available from just 19 click-action keys. Power is from a PP3 battery or from the mains via an adaptor.

Sinclair Radionics Limited, London Road, St Ives, Huntingdon, Cambs PE17 4HJ. Tel: (0480) 64646. Telex: 32250.

MARANTZ AMPLIFIER

Pyser Limited, the sole UK distributors of Marantz equipment tell us that the 1040 amplifier will shortly be available at £132 plus VAT.

It has a power output of 20W RMS per channel into 8Ω and there is a remote speaker switching facility with 'ambiance' to give 'realism' when using four speakers. There is tape monitoring circuitry for two decks, loudness compensation, mode switch and an HF filter.

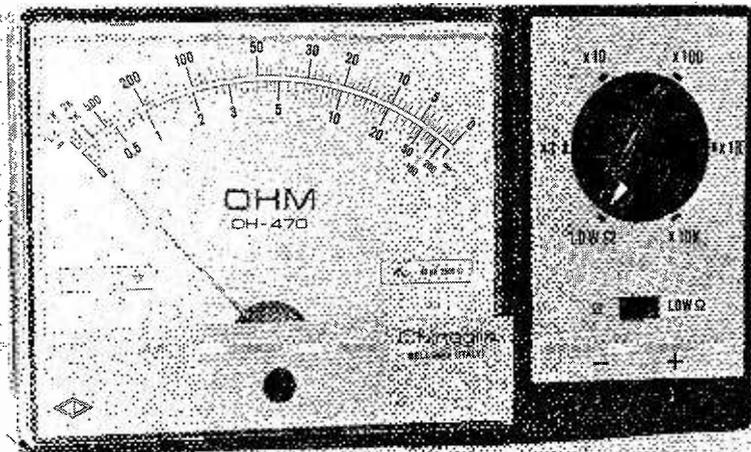
In America, Marantz have found that large numbers of the 1040 are purchased by students on limited budgets but their Executive Director states that he is confident that in Britain the 1040 will be bought by music lovers from all walks of life who want a medium-priced amplifier.

There's a moral somewhere—perhaps it would pay us all to become students in the U.S.!

RESISTANCE METER

The Chinaglia OH470 multi-range resistance meter uses a $40\mu\text{A}$ moving-coil movement with core magnet and sprung jewel mounts. A tough ABS case combined with a full view scale and simple range switching make for an easy-to-use instrument suited to a wide variety of environments.

Six measuring ranges are provided, giving the ability to identify resistance from 0.1Ω up to above $50\text{M}\Omega$ to within 2.5% accuracy. Internally housed batteries make the instrument independent of external power sources and suitable test leads designed to co-operate with specially designed sprung sockets on the instrument simplify low value measurements. Ranges are: $0-200\Omega$; $0-10\text{k}\Omega$; $0-100\text{k}\Omega$; $0-1\text{M}\Omega$; $0-10\text{M}\Omega$; $0-100\text{M}\Omega$. *Alberto Coniglio, 19 Mulberry Walk, London SW3 6DZ 01-352 1897.*



Chinaglia OH470

ORGAN KIT

The Heathkit/Thomas TO-1160 electronic organ has two 44-note overhanging manuals with tilted keys and a 13-note radial arc pedal rack. Other features include a colour-glow key system and a quick-play organ course. The built-in amplifier has an output of 25W RMS and plays through a built-in 300mm (12in.) speaker.

Fingertip controls include a variable pedal volume, variable manual balance-switch tabs for vibrato and a new light vibrato for true orchestral effects. There is also an accessory panel under the keyboards with line in and out facilities from a cassette recorder and a headphone jack, which when in use cuts out the main speaker.

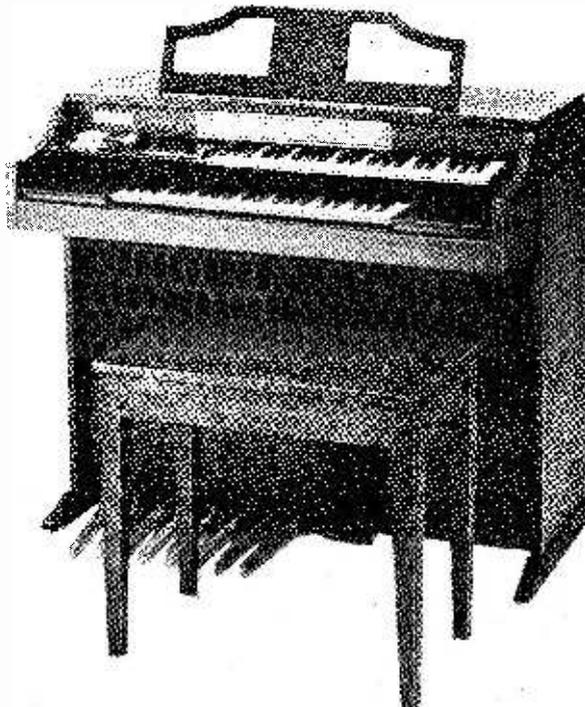
Voicing stops on the upper manual are: flute 16', 8' and 4'; Trumpet 8'; Oboe and Violin 8'. The lower manual provides Horn 8'; Diapason 8', Melodia 8' and Cello 8'. The pedal rack has a Flute 16'-8' combination.

The cabinet is fully finished and overall dimensions are 1120 x 1100 x 640mm, or if you haven't the faintest idea what that is, 44 x 43½ x 25in.

Along with the TO-1160, Heathkit announce the TOA-60-1 rhythm section which complements the organ. Basic spec. is as follows: the choice of pre-programmed rhythm patterns of Waltz, Fox Trot, Rock, Soul, Polka, Samba, Bossa Nova, Rhumba with a variable volume and tempo control. Push-buttons also select the Drums (choice of Snare/Tom-Tom and Cymbals).

The TOA-60-1 also features a Fancy Foot control which gives alternating bass pedal notes that fit into the rhythm pattern chosen, when a foot pedal is held down, and Syncopated or Alternating Bass selections are available. The Rhythm Section also adds Piano, Guitar, Banjo or Harpsichord accompaniment, which again has the variable volume control

List prices on these models, including VAT and delivery



within the U.K. are: Kit TO-1160, £600 and Kit TOA-60-1, £160, though Heathkit will be running an introductory offer of £660 for both kits when purchased together. This saving of £100 is quite attractive and the firm hopes it will appeal to people as the addition of the TOA-60-1 Rhythm Section really makes the organ.

WOLSEY ADASET

From Wolsey Electronics comes the new Adaset range of Mercury 40 and Mercury 80 amplifiers, both variations of the Mercury Standard ultra broad band amplifier. The new models have been designed with the do-it-yourself enthusiast very much in mind, and form the perfect answer to simple TV and stereo radio distribution installations.

Quite simply they are the ideal amplifiers for small installations with four (Mercury 40) or eight (Mercury 80) coaxial output sockets suitably padded to provide a slightly improved signal level to each receiver over that provided by the aerial. Each output can be used for either VHF or UHF television or stereo FM radio—providing of course the appropriate aerials are installed and adequate

signals are available in the area.

Technical Specifications:

Amplifier: Frequency coverage: 40–860MHz; Gain (typical): Mercury 40: 8dB Mercury 80: 2dB; Output (maximum peak): Mercury 40: 25mV Mercury 80: 12.5mV; Noise Figure: 6 to 10dB.

Integral Power Unit: Voltage Requirement: 240V ac 50Hz; Power: 4W.

Dimensions: Length: 200mm. Width: 111mm; Height: 67mm; Weight: 0.85 kg.

Recommended Retail Prices: Mercury 40: £24.60. Mercury 80: £29.10 (both plus VAT).

Wolsey Electronics, a division of A.B. Electronic Components Limited is located at *Cymmer Road, Porth, Mid Glamorgan (Telephone Porth 2711)*.

AERIAL AMPLIFIER

A quality FM aerial is not necessarily the passport to good stereo reception. All too often listeners on the "fringes" of reception areas are plagued with the interference which accompanies weak signal strength. The Wolsey "Clearsound" amplifier is designed to overcome this problem by boosting the received signal in the downlead cable near the aerial.

Constructed for mast head or fascia board mounting, Clearsound is an ultra low noise, high signal handling wide band VHF/FM amplifier, which is currently available in a well screened metal case. The Clearsound is powered via the coaxial signal cable in the conventional manner with the power unit being situated at some convenient position near the tuner.

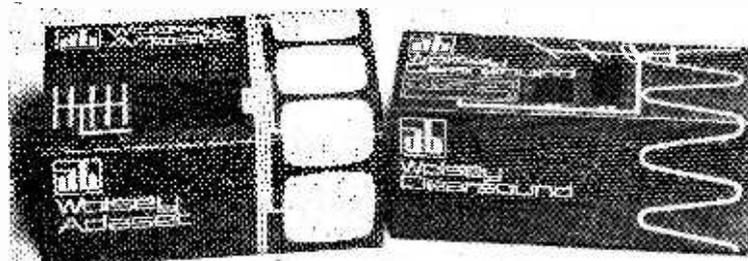
Clearsound specifications:

Amplifier: Frequency coverage: 87.5 to 108MHz; Gain (minimum): 20dB; Output (maximum peak): 40mV 32dB.

Power Unit (Separate): Power consumption: 6.1W.

Dimensions: Amp: 60mm diameter; 86mm high; Power unit: 96mm long; 87mm wide; 60mm high; Combined weight: 0.78kg

Recommended Retail Price £16.45 plus VAT (this includes Power unit)



VARICAP ABSORPTION WAVEMETER

H.S. WOOD G8SX T. Eng. (CEI) MITE

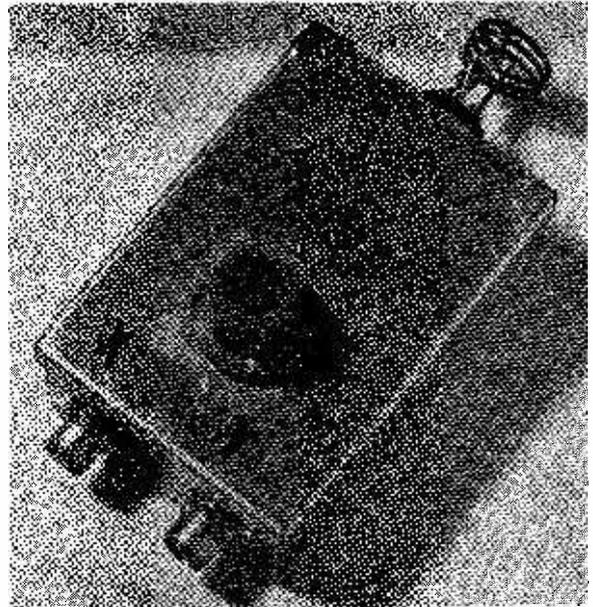
An absorption wavemeter is a very useful device for checking output frequencies of various stages in a transmitter, or oscillator stages in a receiver, but suffers from the disadvantage that it has to be held near the circuit under test and be tuned at the same time. If harmonics or spurious frequencies are present these have to be separately tuned and noted.

Having had experience with a wobulator for receiver alignment it was decided to see if the same principle could be applied to an absorption wavemeter and the following design was evolved. The advantages are that no tuning is required and that a wide band of frequencies is visible at the same time. An oscilloscope is essential but it need not be very elaborate.

CIRCUIT

Basically the unit is a simple tuned circuit, Fig. 1, feeding a diode detector D2, with the tuning carried out by a varicap diode D1. The voltage to the varicap diode is taken, via an operational amplifier IC1, from the oscilloscope time base which should be operating at about 50Hz. The detector diode output is fed to the "Y" amplifier on the oscilloscope and any signal which is detected by the wavemeter appears as a response curve on the screen. If there is more than one frequency present within the tuning range then all these frequencies will be displayed on the screen.

Power for the 741 IC can be obtained from two 9V batteries in series but, in the writer's case, there



was 50V DC on the timebase output of the oscilloscope and, as the current requirement of the operational amplifier is very small, this voltage was reduced by a series resistor and smoothed by a 100 μ F capacitor thus making the batteries unnecessary.

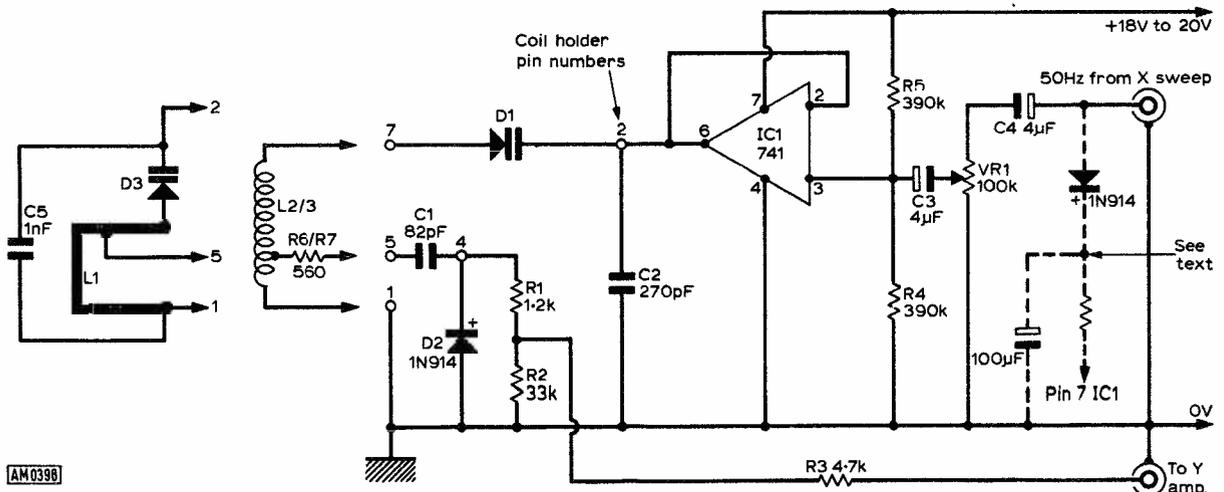


Fig. 1. Circuit of the Wavemeter, showing the two styles of coil used. The part of the circuit shown dotted is explained in the text.

CONSTRUCTION

The detector and varicap diode were built around ceramic 9 pin valveholder because some plugs were available to fit this and so the coils were built on these. Actually any low-loss plug and socket will do depending on the frequency of operation required.

The IC was fitted on a piece of Veroboard and the whole unit mounted in an aluminium box with the coil socket protruding at one end. Coaxial sockets were fitted, one for detected output and the other for sweep input. If batteries are used for power it might be necessary to add a switch and provide room inside the box for the batteries.

VARICAP DIODE

The sweep bandwidth and frequency of operation are very dependent on the type of varicap diode used and as the writer wanted to cover at least up to 144MHz the stray capacities had to be kept down. The varicap diode used is listed as a VHF type BB121A but it has a fairly high minimum capacity with good capacity swing. The results were good enough for the immediate requirements but there is room for improvement and it is intended to try some of the UHF type varicaps as these should have smaller minimum capacity and larger capacity swing.

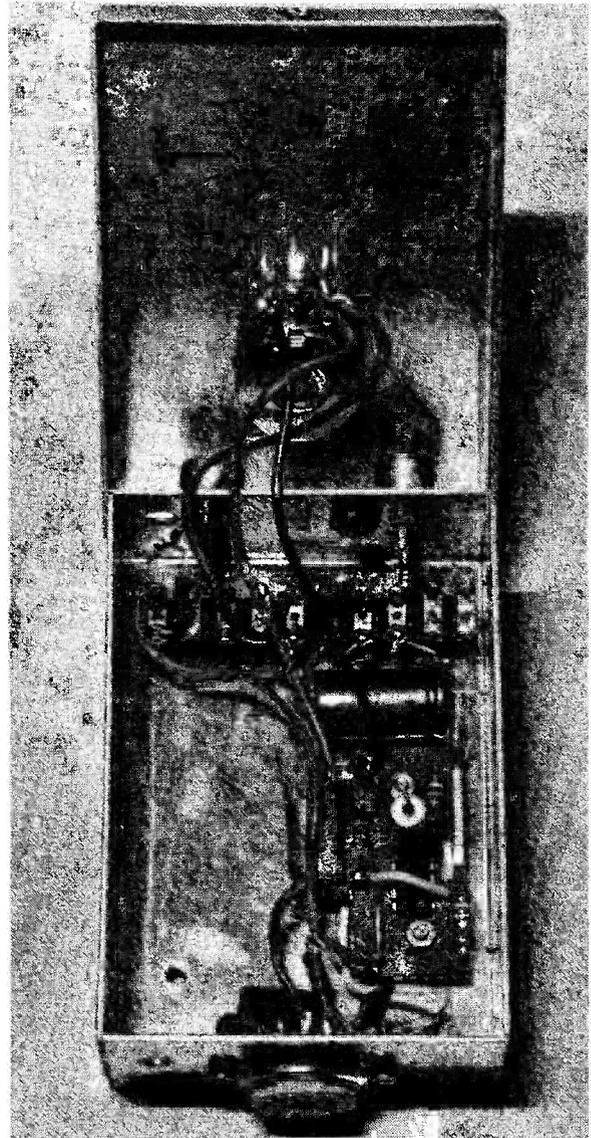
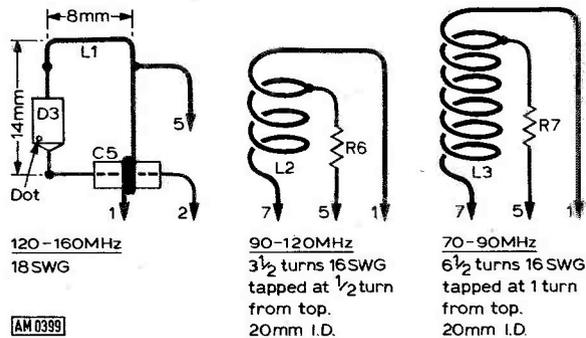
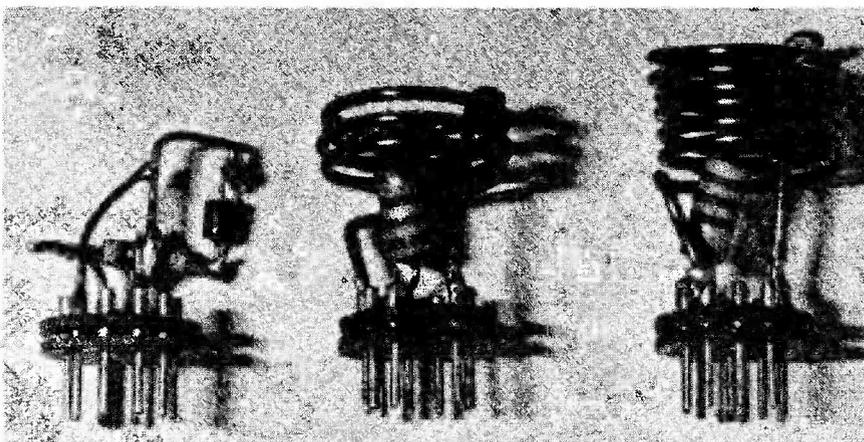


Fig. 2: Constructional information for the three coils required to cover 70 to 160 MHz approximately. Other frequencies may be covered with those indicated in Fig. 1. The terminal strip carries the optional components shown dotted in Fig. 1.



Photograph of the three coils wound for the prototype wavemeter. Details are shown in Fig. 2. Adjustments to coverage of L2 and L3 can be made by altering the spacing of the turns.

★ components list

Resistors	
R1 1.2k Ω	R5 390k Ω
R2 33k Ω	R6 560 Ω
R3 4.7k Ω	R7 560 Ω
R4 390k Ω	VR1 100k Ω
Capacitors	
C1 82pF (or 100pF) silver mica	C4/5 4 μ F 24V
C2 270pF silver mica	C5 1nF feedthrough
Semiconductors	
IC1 741	
D1/3 BB121A (or similar)	
D2 1N914	
Miscellaneous	
Holder for 741. Valveholder B9A with three plugs. Coaxial sockets (2). Knob. Terminal strip. Aluminium box 102 x 70 x 40mm (4 x 2 $\frac{3}{4}$ x 1 $\frac{1}{2}$ in.)	

The highest frequency range was achieved by using two varicap diodes, one built into the box D1 for use with the low frequency coils, the other, D3, built into the high frequency coil as shown in Fig. 2.

The sweep width is about 40MHz at 144MHz with correspondingly reduced sweep at lower frequencies.

COILS

The diode detector is tapped into the tuned circuit as shown, Fig. 2, and if this is done it is quite easy to construct coils to give the frequencies required. In the writer's case, with the exception of the highest frequency coil, existing coils for a grid dip meter were found to be one range lower in frequency than in the grid dip meter and it was not necessary to construct new coils.

OPERATION

The unit is connected to the oscilloscope and the sweep control is adjusted to a point where a vertical line on the screen, caused by overload of the IC disappears off the end of the trace. With this setting a maximum sweep is being obtained and if the coil of the wavemeter is held near a source of RF, of suitable frequency, a trace will be seen.

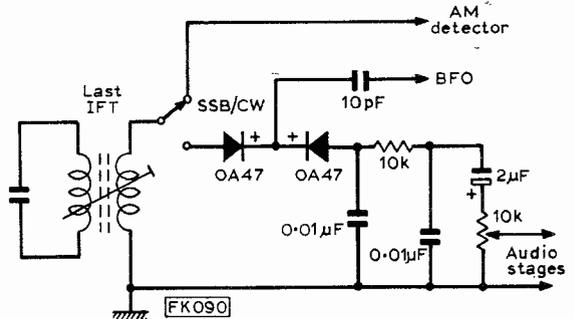
The oscilloscope should be used on its most sensitive range and the signal level should be controlled by moving the wavemeter away from the source of RF. The sweep width control needs no adjustment other than the initial setting to give maximum sweep. Calibration is best done by holding the wavemeter near a calibrated grid dip meter. It is only necessary to note the frequencies at each end of the trace for each coil because the output of the grid dip meter can be seen on the screen at the same time as the circuit under test and the frequency can be read off the dial of the grid dip meter.

It has been found to be a tremendous advantage to be able to see all the output frequencies of a unit at the same time. The three frequencies of a mixer VFO, for example, can be watched while the circuit is adjusted to increase the wanted output and reduce the unwanted output. PW

AIDS TO IMPROVED RECEPTION—continued from page 487.

PRODUCT DETECTOR

THE product detector is easily added to a receiver and is intended to provide improved reception of SSB signals, as well as CW, when used in conjunction with a BFO. If the mode selector switch AM/SSB-CW is a double-pole one it can automatically switch on the BFO in the SSB/CW position.



The diodes must be germanium ones. The values of the components in the filter following the diodes are not very critical, those shown being for IF's around 465kHz.

The ratio of BFO signal to the signal from the IF stage must be right for best reception of SSB telephony so the RF or IF gain control should be adjusted carefully. In the absence of such controls an aerial attenuator can be used.

TO BE CONTINUED

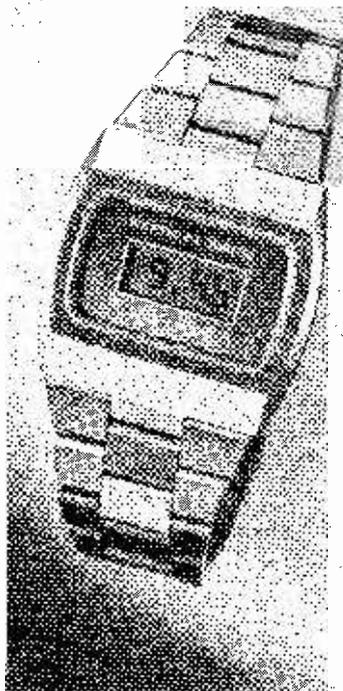
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J.B.Dance

ELECTRONIC Wrist WATCHES

TRANSISTOR DRIVEN WATCHES

The delicate contacts employed in the LIP watch were a great disadvantage, since they required periodic replacement. The work of Marius Lovet of France led to the development of contactless watches in which the switching was carried out by means of a transistor. One watch of this type is known as the "Dynatron".

The balance wheel of a Dynatron watch carries small permanent magnets which move near two coils: a feedback coil and a power coil. When the balance wheel magnets move past the feedback coil, they induce a signal in it which is used to make a transistor conduct. A current passes through the transistor to the power coil which pulls the magnet on the balance wheel so as to keep the wheel moving.

The Junghans 600·12 self-starting wrist watch employs a transistor driven balance wheel of this type.

MOST of the wrist watches being manufactured at the present time employ the same basic type of mechanical oscillator as that developed by Christiaan Huygens of Holland in the 17th Century. However, during the past few years extremely accurate types of electronic wrist watches have been developed. Although electronic watches are expensive at the moment, they will bring about great changes in the watch industry. Some of these watches employ no moving parts and show the time in the form of digits.

Electronic watches do not have a spring which must be wound each day, but they do employ a miniature power cell which must be replaced about once per year. This minor disadvantage is largely outweighed by the fact that electronic watches require no regular cleaning or other maintenance. In addition, most electronic watches are almost unaffected by magnetic fields.

FIRST ELECTRIC WATCH

In March 1952 the LIP Company of France released the first watch which employed a small electric cell as a source of power. The watch employed a conventional balance wheel, but was rather more accurate than conventional watches, since the amplitude of swing of the balance wheel remained almost constant throughout the life of the power cell.

In the LIP watch, a jewelled cam on the pivot of the balance wheel pushed fine wire against a contact; this resulted in a current flowing through a small electromagnet which attracted a magnet fitted to the rim of the balance wheel so as to keep the latter moving. The average current taken from the 1.55V cell was 5 μ A.

This watch was "electric" rather than "electronic", since the only electronic component used was a diode for spark suppression.

TUNING FORK WATCHES

Wrist watches employing electronically driven tuning forks have been available since the Bulova Company announced their first "Accutron" model on October 25th, 1960. It was the first watch to employ a timing mechanism which did not involve

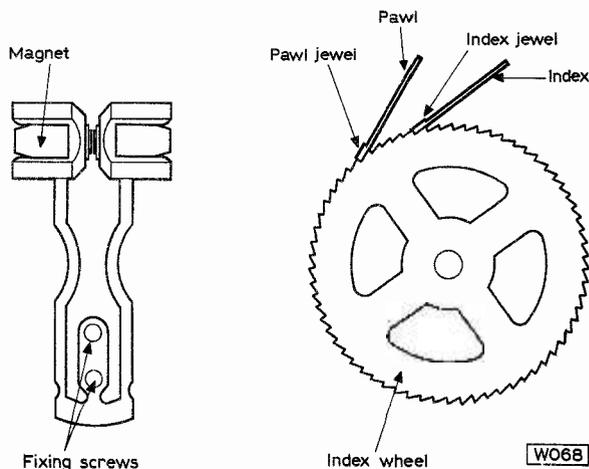
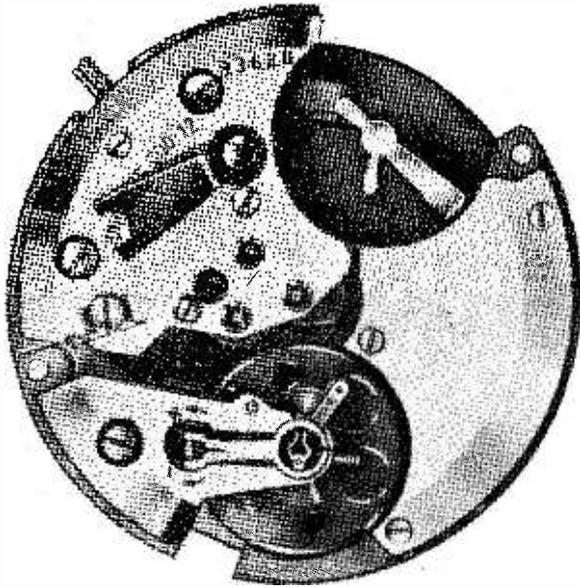


Fig. 1a (left) The tuning fork of a typical "Accutron" watch. Fig. 1b (right) The ratchet and pawl mechanisms which convert vibrations of the tuning fork into rotary motion.



The mechanism of the Junghans "Dato-chron" movement. A contactless self-starting balance wheel is used which runs for at least a year on the 1.35V cell shown.

a balance wheel and hair spring. In addition, it was the first watch to be provided with a written guarantee of accuracy, namely one minute per month.

A tuning fork of a typical "Accutron" watch is shown in Fig. 1a; it oscillates at 360Hz. A strong conical magnet and a cup of magnetic materials are fitted to each side of the tuning fork. A coil of about 8,000 turns of insulated wire is fitted over each magnet so that it is close to the magnet but not touching it. A simple transistor oscillator circuit provides the power which keeps the tuning fork vibrating.

The vibrations of the tuning fork are converted into rotary motion by means of the ratchet and pawl mechanism shown in Fig. 1b. The index pawl is attached to one arm of the tuning fork; the tiny jewel at the end of this lever causes the index wheel to advance one tooth for each complete vibration of the tuning fork. During the return of the index jewel, the index wheel is held in position by a pawl jewel.

The index wheel is only 2.4mm in diameter, but has 300 teeth. This wheel drives a gear train which turns the hands of the watch.

A series of "Accutron" models for ladies was introduced in 1970. The smaller tuning fork operates at 480Hz, but the current consumption is similar to that in the models for men (about 8μA).

BALANCED TUNING FORK

A group of Swiss watch manufacturers, Ebauches S.A., have designed a balanced tuning fork movement known as the "Mosaba". This has the advantage that its accuracy is unaffected by its position relative to the vertical gravitational field.

The Mosaba movements operate at 300Hz and are used in such watches as the Longines "Ultronic" range, the Baume and Mercier "Tronosonic" watches and the Omega "300" range.

All of these watches have an accuracy of about one minute per month; they emit a low hum instead

of the ticking noise emitted by a normal balance wheel watch.

THE MEGASONIC

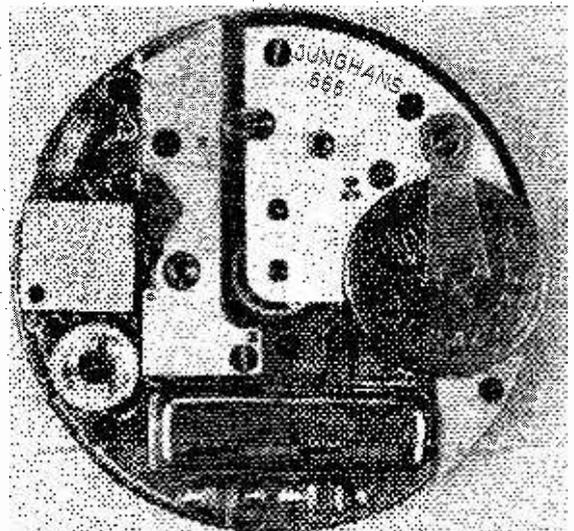
A new type of tuning fork watch known as the Megasonic 720 is being introduced by the Omega Company. It has an accuracy which is much better than that of any other watch employing a mechanical oscillator, namely ± 10 seconds per month. The tuning fork is driven by an integrated circuit oscillator; it operates at 720Hz and is said to be less sensitive to shock than the larger movements operating at lower frequencies.

QUARTZ CONTROLLED WATCHES

As long ago as 1880 the piezo-electric effect was discovered by the brothers Pierre and Jacques Curie. They showed that when mechanical forces are applied to suitable crystals in certain directions, electrical charges are formed on the faces of the crystals. Shortly afterwards Lippman found that an electric field will produce a mechanical deformation in the same crystals. Such crystals can therefore form resonators where the stored energy oscillates between the mechanical deformation of the crystal and the electric field.

In 1921 Cady used the piezo-electric effect in quartz to stabilise the frequency of an electronic oscillator. Since then it has been widely used for this purpose, for example, for stabilising the frequency of a radio transmitter. Quartz controlled oscillators have been used for stabilising the oscillators of very accurate clocks, but the first quartz controlled wrist watches did not become available until April 1970. The accuracy is usually about one minute per year.

Quartz oscillators operate at very high frequencies (kilohertz to megahertz). In a watch the high frequency from the quartz oscillator must be divided down to produce a low frequency suitable for driving a motor or showing the time as digits. It is only in the last few years that miniature integrated circuits



The interior of the Junghans "Astroquartz" showing the power cell on the right and the quartz crystal case at the bottom.

Practical Wireless, October 1975

have been developed which will divide the high frequency signal whilst consuming very little power. In general these circuits employ complementary metal oxide silicon (CMOS) designs which are ideal for miniature low power applications.

CONTROLLED BALANCE WHEEL

A watch developed by the Golya Company of Switzerland employs an electronically driven balance wheel having four magnets, but the exact frequency of oscillation of this balance wheel is controlled by a quartz crystal oscillator. It is known as the "μ-Quartz" watch.

The 32,768Hz ($=2^{15}$ Hz) pulses from the quartz oscillator are divided in frequency by a CMOS integrated circuit containing some 450 components.

The hair spring used in this watch is deliberately designed so that the frequency of the balance wheel is dependent on its amplitude of oscillation. The circuit is arranged so that the strength of the pulse given to the balance wheel depends on the phase of its motion relative to the frequency divided signal from the quartz oscillator. The frequency of the balance wheel is thus stabilised at a value determined by the signals from the quartz controlled oscillator circuit.

As in all quartz controlled watches, the timing is regulated by means of a trimmer capacitor which adjusts the exact frequency of the quartz oscillator circuit.

ASTROQUARTZ

The Junghans "Astroquartz" watch employs a quartz crystal in the shape of a tuning fork which oscillates at 32,768Hz. The crystal is driven by an integrated circuit which also divides the frequency to produce an output of one pulse per second. These pulses drive an electromagnetic transducer which is connected to the second hand.



The Bulova "Accuquartz" watch (right) by the side of an earlier model which employs the "Beta 21" movement.

The size of the integrated circuit employed in this watch is only 2.1×1.6mm. The total current consumption is about 14μA from the 1.3V 150mA-hour cell.

CYBERNETIC WATCH

The Longines "Ultra-quartz" watch is particularly interesting, since it is probably the only quartz controlled watch which does not employ an integrated circuit; it first became available on 21st August 1971.

The quartz crystal resonates at 9350Hz, but the watch also employs a mechanical vibrator operating at 170Hz. Signals from the quartz controlled oscillator circuit are used to correct the frequency of the mechanical vibrator 170 times per second.

The correction is carried out by a relatively simple circuit employing 14 transistors, 19 resistors and 7 capacitors. Logical deductions made by this circuit are fed to the vibrator as correction signals. This comparison circuit or "brain" has resulted in the "Ultra-quartz" being called a "cybernetic" watch.

The vibrator movement is converted into a rotary motion by means of a pawl system similar to that used in the tuning fork watches.

STEPPING MOTOR

The Girard-Perregaux Company introduced its series 350 watch in 1972. It employs a 32,768Hz quartz controlled oscillator, the pulses from which are divided in frequency by a factor of 65,536 by means of a CMOS integrated circuit containing 312 transistors.

The output from the integrated circuit consists of a short pulse of one polarity followed one second later by a pulse of the opposite polarity. These pulses drive a miniature stepping motor which causes the second hand of the watch to jump forward. The minute and the hour hands are driven by a conventional gear train.



The tuning fork movement and the quartz crystal of the Bulova "Accuquartz" under examination.

QUARTZ TUNING FORK WATCH

The current Bulova "Accuquartz" watch is interesting because it contains a quartz oscillator operating at 32,768Hz which is used to control the frequency of a $341\frac{1}{2}$ Hz tuning fork movement. This movement operates the normal watch gearing as in the Bulova "Accutron" models. The centre second hand therefore appears to revolve continuously instead of jumping once or twice per second as in some quartz watches.

The accuracy is quoted as one to two seconds per week. Prices range from £115 to £675.

THE MEGAQUARTZ 2400

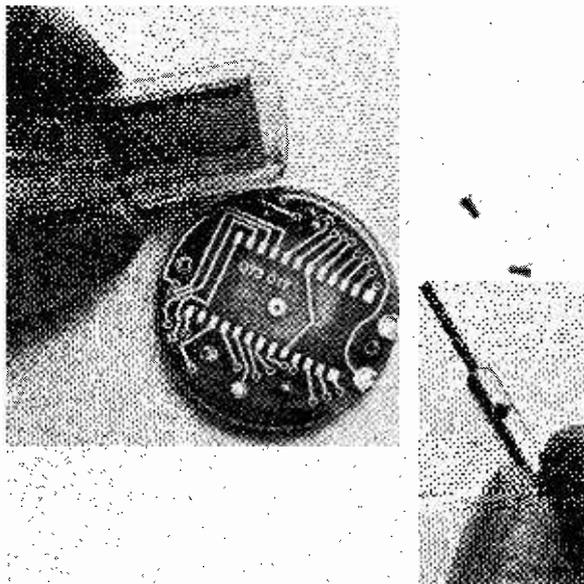
The Omega Division of SSIH (Société Suisse pour l'Industrie Horlogère) in collaboration with Batelle Institute has designed a watch with an accuracy of about one second per month; this is the most accurate wrist watch which has been put into production.

The Megaquartz 2400 is available in an 18ct yellow gold case and bracelet at around £2,050. A stainless steel version will soon be coming onto the market at a price of about £440.

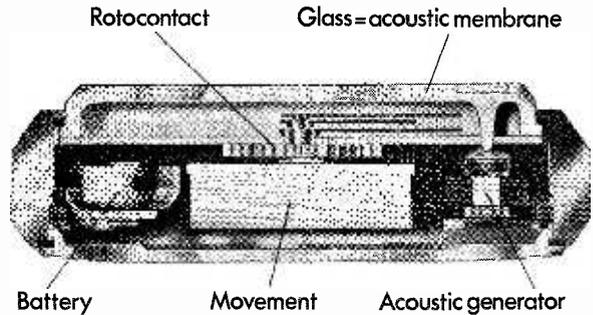
The quartz crystal in the Megaquartz operates at a frequency of 2,359,296Hz—far higher than that of any other watch. A CMOS integrated circuit manufactured by the Intersil Company is used as an analogue divider to reduce the frequency to 1Hz. It employs about 400 transistors on a silicon chip 4mm² in area.

DIGITAL WATCHES

Quartz controlled watches which provide a digital display have recently appeared on the market. They employ no moving parts and have an accuracy of about one minute per year. Two forms of display have been used, namely electroluminescent diodes and liquid crystals.



Removing the liquid crystal display unit is very easy in the new Nepro watch (also seen in our heading photograph).



The interior of a Nepro watch in which an electronic mechanism is used to sound an alarm. The glass of the watch vibrates when the alarm is being sounded.

ELECTROLUMINESCENT DISPLAYS

Digital displays using electroluminescent diodes emit red light and have a very long life. Their main disadvantage is that the current required by the display is so great that the time cannot be continuously displayed. A button must be pressed whenever one wishes to see the time.

The Hamilton "Pulsar" watch (not available in Europe) and the Omega "Time Computer" employ a 32,768Hz quartz oscillator. This frequency is divided by an integrated circuit and the resulting signal is used to drive the display. When a button is pressed, the hours and minutes are displayed for 1.25 seconds, but if the button is held down, the seconds are displayed for as long as it is depressed.

LIQUID CRYSTAL DISPLAYS

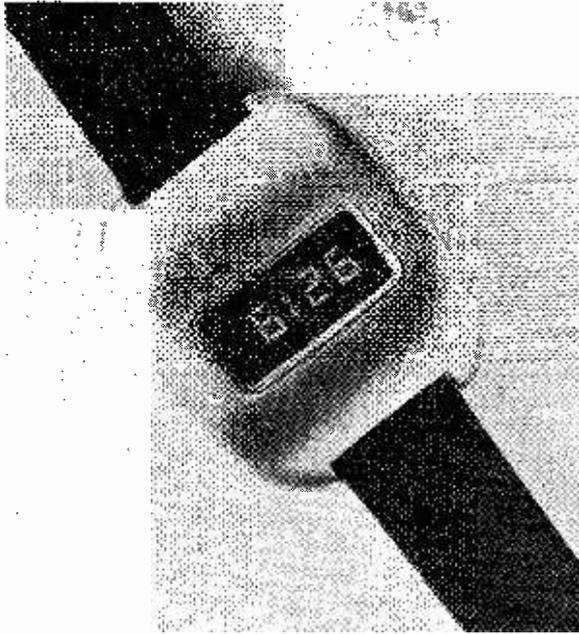
Liquid crystal displays do not emit light, but merely reflect a different proportion of the incident light from different parts of the display. Such displays can therefore operate at very low currents (typically 1μA at 10 to 20V). They can therefore display the time continuously, but the display cannot be seen in the dark.

A liquid crystal display can be formed by applying an electric field across certain parts of a "nematic" material. The field is applied by suitably segmented transparent electrodes so that it is in the shape of the digits to be indicated. As the crystals come into alignment, they reflect back the incident light. In the Longines watch a mirror is placed behind the display so that light is reflected back at those places where no field is applied.

The liquid crystal display will disappear above a certain critical temperature (55°C in a typical case), but returns on cooling. There is still some doubt about the life of liquid crystal displays, but most manufacturers offer a guarantee of some years. When failure occurs, the clarity of the display gradually deteriorates.

A number of watches provide a liquid crystal display showing the hours and minutes in digits with a colon flashing once per second in between the hours and minutes digits. However, the Longines watch provides a continuous readout of the day of the month, the hours, the minutes and seconds.

One of the latest quartz controlled watches with a liquid crystal display is the type CX15 introduced by the Nepro Company of Switzerland at the end of 1974. At the present time about 5,000 of these



The Avia liquid crystal digital watch. The colon flashes once per second. Liquid crystal displays operate from a supply of about 15V and therefore a DC to DC converter is incorporated in this watch.

watches are being produced each month. Except for the integrated circuit, all of the components in this watch are of Swiss origin.

The crystal oscillator operates at 32.768kHz. The circuit is driven by a 3V source without any transformer. Particular attention has been paid to ease of servicing in the design of the Nepro watch. For example, it is only necessary to remove two screws in order to replace the whole liquid crystal display system.

Nepro intend to offer other models soon, including those which display the date and the number of seconds, models for ladies and other watches which include a facility for illuminating the display. Mr. Palo Spadini, chairman of Nepro, hopes to form a pool of Swiss manufacturers so that the modules used in the watches can be standardised and the cost of parts reduced.

ALARM WATCHES

The watches discussed previously employ electronic circuits to improve the accuracy or to provide a digital display. The Nepro Company of Switzerland have used electronic alarms in wrist watches which will sound at any time of the day. They can be heard in a busy street.

CONCLUSION

The prices of integrated circuits have been falling rapidly during the past few years, whilst labour costs have been rising. If this trend continues, it seems certain that a much greater proportion of the watches manufactured will be electronic ones containing only a few modules. PW

Practical Wireless, October 1975

TELE-TENNIS BALL SPEED CONTROL

—continued from page 462

★ components list

Resistors (all $\frac{1}{4}$ or $\frac{1}{2}$ W $\pm 5\%$)

R1 4.7k Ω	R7 4.7k Ω
R2 15k Ω	R8 4.7k Ω
R3 15k Ω	R9 4.7k Ω
R4 4.7k Ω	R10 330 Ω
R5 2.7k Ω	R11 4.7k Ω
R6 2.7k Ω	R12 330 Ω

VR1 10k Ω	} vertical skeleton preset
VR2 10k Ω	
VR3 1M Ω	

Capacitors

C1 1000pF
C2 1000pF
C3-C9 0.1 μ F (7 off)

Integrated Circuits

IC1 SN7403N
IC2 SN7400N
IC3 SN7400N
IC4 NE555
IC5 NE555
IC6 SN7403N
IC7 SN7400N
IC8 SN7400N

Note that the redundant 7400 from Board A (IC8) is used for IC14

Miscellaneous

RLA DIL single pole make reed relay (RS) (see text)

Printed circuit board.

A ready drilled, roller tinned, cut to size p.c.b. is available from:

System Printed Circuits Ltd.,
3 Redcliffe Way,
Brundall Gardens, Brundall, Norwich
priced at £1.20 (inc. p. & p. and VAT).

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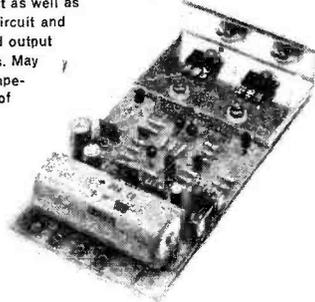
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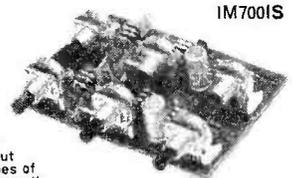
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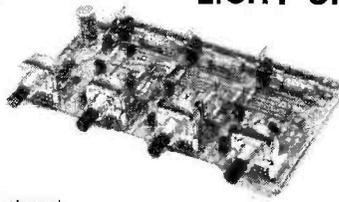
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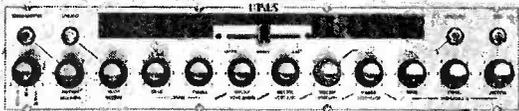
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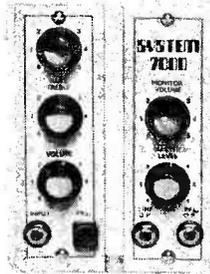
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Ref mA	Volts	£	p & p
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212	1A, 1A	0-6, 0-6	1.84
13	100	9-0-9	1.41
235	330, 330	0-9, 0-9	1.56
207	500, 500	0-8-9, 0-8-9	1.92
208	1A, 1A	0-8-9, 0-8-9	3.30
236	200, 200	0-15, 0-15	1.43
214	300, 300	0-20, 0-20	1.93
221	700(DC)	20-12-0-12-20	2.17
500	VA, 1A	0-15-20, 0-15-20	3.46
203	500, 500	0-15-27, 0-15-27	3.00
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5113	500	12, 15, 20, 24, 30	1.88

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500v 10A	PM7A6	£2.35	

P & P 15p

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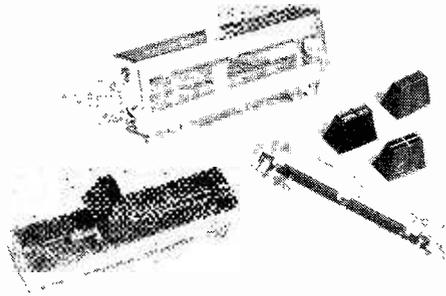
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Silica fibres . . . not coax

Concerning an item, 'Optical Coax' by Ginsberg (*Hotlines*, August 1975), I would like to correct a number of errors and enclose some information which should clarify the nature of my research work which was described in the third paragraph. First, coaxial cable will not be replaced by plastic fibres but by plastic-coated glass or silica fibres. The plastic coating is for protecting the fragile fibre and ease of handling. A typical optical fibre has a cladding (outside) diameter of about 50 microns and a core diameter of approximately 30 to 40 microns, for a multimode fibre. A single mode fibre has a similar size cladding but a very small core diameter, typically 3 microns. The plastic-coated fibre used in experiments at UCL, which has been kindly provided by STL, has an outside diameter of 1mm.

The statement in the third paragraph is incorrect. We do not 'tap' off signals but place signals on a guided optical carrier by means of clip-on acoustic (piezoelectric) transducers, not sensors. The prototype transducers were mounted in the jaws of clothes pegs for ease of attachment to the plastic-coated fibre. The transducers phase modulate the optical carrier by modulating, essentially, the refractive index of the glass. Each modulator is driven at a different sub-carrier frequency. It may easily be shown that a system of cascaded phase modulators forms a linear modulation system such that each channel may be recovered without crosstalk. Basically, this optical fibre communications system is a spatial frequency division multiplex system (FDM).

Signals from many data sources

may be put on the optical carrier anywhere along the length of the fibre and delivered to one destination. It should be noted that this optical data highway system is rather novel, since all the proposed optical fibre communication systems use intensity modulation of a laser or LED whilst this system uses phase modulation.

I am concerned that a correction be published, especially since such statements may be given further currency in other scientific journals.—S. A. Kingsley B.Sc.(Eng.) (Dept. of Electronic and Electrical Eng., University College, London).

Easybuild organ

During keyboard construction of this project, it has been found necessary to carry out a further test other than those listed in Mr. Hughes' articles. I append detailed notes and trust that you will publish them in an early issue in order that other constructors may have the benefit and advantage of my experience:

Following assembly of the key-switches and busbars it should be noted that at no time during depression of the keys should contacts 'b' and 'c' be connected to the earth busbar.

In my case it was found possible for contacts 'd' and 'a' to make connection with contacts 'c' and 'b', prior to release of the earth busbar. This, of course, means that the signal busbars would be shorted to earth during playing.

By carefully bending the key-switch contact wires, this type of defect can be eliminated, whilst still maintaining an acceptable "keying" position.

Reference is made particularly to Part 3 of the instructions, published in the May 1975 issue.—Peter R. Smith (Stockport).

Scientific error?

I have read with interest the letter by R. T. Russell (September 1975 "Letters"), regarding the apparent malfunction of the Sinclair Scientific Calculator.

The malfunction was caused by the entry $1,E,1+1,E-9,9,+$ which gives 2.0000 01, i.e. 20.

The cause of this anomaly is due to the number being entered incorrectly.

The Sinclair manual states on

page 10 that for fractional numbers the entry must be made with a leading zero, that is, $0,1,E,-9,8,+$.

Using this, the original problem is correct, and now looks like the following:— $1,E,1,+0,1,E,-9,8,+$, which gives 1.0000 01, i.e. $10+1^{-99}=10$.

I hope this will clear up any problems other readers have had in this area.—H. C. Pike (Berks).

Improve your mind!

I would like to take this opportunity to inform your readers of an RAE course to be held on Thursday evenings between 6.30 and 9 p.m., at Birkenhead Technical College, Borough Road, Wirral. The lecturer will be Mr. L. Roberts G3EGX, 38 Croxteth Avenue, Wellasey, Wirral.

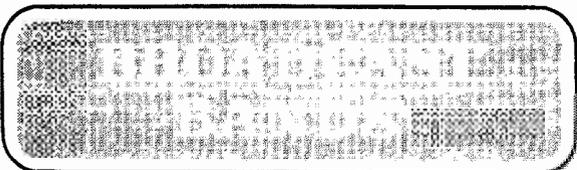
Applications should be made early in September or via the lecturer.—A. Seed G3FOO (Wirral).

GOING BACK—

continued from page 478

- (2) Move the Fultograph instrument further away from the wireless set. This is likely to be required especially when a portable set is being used because of the possibility of interaction with the frame aerial.
- (3) It should never be necessary, but in extreme cases a certain cure can be made by using a separate HT battery for the Fultograph. This battery may then also be used for grid bias as well.

The Fultograph system for home use never really managed to get off the ground. It was a messy business, at the receiving end, making up the solution, cutting and soaking the paper, etc. Besides, television was being earnestly talked about at that time and rapid development of this medium doomed the Fultograph. In conclusion, I must thank once again all those readers who very kindly lent me notes, drawings and illustrations for this article. I have replied to some and I will gradually get round to answering all the many letters I have received on the subject of the Fultograph. Thank you all, and keep the letters coming in as we hope to publish extracts from some of them in future "Going Back" articles.



SHORT WAVE BROADCASTS

by *Derek Bell*

HURRAY for Radio Canada International! They very kindly sent me samples of the new programme schedules along with a sample of the new pennant. RCI also announce a change in policy in that the armed services transmissions are now separated from those of the Canadian overseas services for the purposes of QSL cards. In future armed services broadcast reports should go to "the department in question" although no address is given. I do not know if this will result in a separate QSL.

The first dip into the post bag this month brings forth **William Maybury** of Coatbridge in Bonny Scotland. This seventeen-year-old, using a twenty-foot length of copper wire hanging out of the window with "an ancient three band valved job" tied to the end, pulled in Pekin, much to his evident delight, and following this column's advice, QSLed them. (*Suggest it was Pekin via Tirana, Albania!—Ed.*)

Welcome to another new friend in **Dr. H. S. Broadribb** from St. Leonards-on-Sea. The good doctor seems to qualify for our "oldest living SW radio" stakes since he runs a 1948 Bush EBS4. While having some hard words about out-of-band Italian amateurs (passed to Eric Dowdeswell!) Dr. Broadribb asks for the address of Radio Budapest. This is Brody Sandor utca 5/7 1800 Budapest, Hungary. Radio Hanoi have been in touch and sent word to the Broadribb QTH that their schedule is 0100, 1000, all on 10040 and 12025, 1300 and 1600 GMT, plus a service on 10040 and 15120 at 1800, but it seems that the 15120 was heard at St. Leonards on 15005! Another example of out of band operation.

Many thanks go to all who helped **Dave Evered** of Cardiff with his Eddystone problems. In a second letter Dave says he received several letters of advice and assistance and is now able to use the set to such good effect that he has pulled in 32 QSL cards since April. He also enjoyed the strains of the Radio Australia "Pacific Islands Service" on 9770 at 1800. One final word from Dave is that he has reported four times to Moscow and seven to Cairo without reply. "How long DO they take?" he cries! Well Dave, Moscow was reported in July as taking between 37 and 77 days (by the WDXC QSL column) while Cairo was credited with 108 days!

The calibration station he calls the "Turin Clock", on exactly 5000, has turned up again in a report from **Harold Emblam** who says it was at fair strength from 1545 to 1600 frequently during July, heard at Mirfield, Yorks, on an Eddystone 730/4. Although the Latin American DX is on the way out as winter draws on the last gasp may well be worth going for. With this in mind **Raymond Robinson** reports that RTV Dominicana, recently featured in this column, is now on 9505 in English at 2145 to 2200. This was heard in Luton on Raymond's VEF 204.

The close relative of the 204, the VEF 206, is in use at **James Farrar's** QTH in Crook, Co. Durham, sprouting a ten-foot vertical aerial. James passes on the tip that Radio Austria is following up QSL reports with a free booklet listing the times, frequencies, and wavelengths of broadcasts to Europe. The address to write to is:—Austrian Radio Technical Dept., P.O. Box 200, A-1043, Vienna, Austria. James notes the rarely reported Radio Bangladesh on 15620 at 1225 to 1230 in English.

Steven Witt, residing in London wonders why this column does not give more space to logs rather than information on preselectors, bandspread or suchlike electronic wizardry. Well Steven, many readers are newcomers and need the help, plus the fact that this year has not so far been exceptional for DX. Thus the same stations get reported by several readers, and if reproduced would tend to be repetitious. The inhabitants of your shack are listed as a modified Chapman communications set with the PW audio processor, ATU and a 40-foot inverted-L aerial. If I can help readers to achieve this standard then the reports that plop on my doormat will be more varied. As it is, I am amazed that so much is reported with simple equipment.

Jolyon Jenkins from Knebworth, in Herts, is an avid QSL collector and would like to increase his score but is uncertain how to go about it. The requirements for a report are as follows, time of broadcast, frequency, date, receiver type, aerial type, SINPO rating of signal, and ten minutes worth of programme content written out. Do not forget your name and address and I always advise people to add a polite letter. Many stations need International Reply coupons in order to cover return postage but more often than not this only applies to the smaller stations or those that exist on donations, such as religious broadcasters.

I hear that Radio Finland is to continue its English language transmissions. Readers will remember that this column recently carried a reader's letter appealing for support to save them. It seems that letters from the fans of Radio Finland have won the day. That seems to be all for this month so I will wish you 73s and all the best to you and yours.

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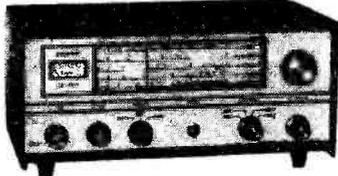
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MEDIUM WAVE DX

by **CHARLES MOLLOY**

RAMADAN, which starts on the 7th September this year is a four-week period during which broadcasts from the Middle East should be conspicuous on the medium waves. Many outlets which would normally sign-off during the evening will remain on the air all night giving the medium wave DXer the opportunity to log a number of rarities. Look for Kuwait on 539kHz and 1345kHz; Riyadh, Saudi Arabia on 587kHz; Tabriz, Iran on 647kHz; Bagdad 760kHz; Thourah, Iraq on 908kHz; Izmir, Turkey on 926kHz; Radio Sanaa, Yemen on 1000kHz; Radio Pakistan, Hyderabad 1010kHz; Dubai on 1250kHz and 1480kHz; Oman on 1259kHz; Kabul, Afghanistan on 1280kHz; Sharjah on 1575kHz. Broadcasts from Algeria can be heard on 251kHz on the long waves and on 529kHz, 548kHz, 890kHz, 980kHz; from Morocco on 209kHz (long waves) and 593kHz, 611kHz, 827kHz, 1232kHz; from Libya on 1124kHz and 1250kHz and from Tunisia on 629kHz and 960kHz.

Roy Patrick (Mackworth, Derby) has been digging out some interesting DX on the medium waves between the hours of 0200 and 0300 GMT, using a Trio 9R59D communications receiver. Trans World Radio in Bonaire (Netherland Antilles) was heard on 800kHz (this station broadcasts in English); Amman in Jordan also on 800kHz; CJON St John's in Newfoundland on 930kHz; WINS in New York City on 1010kHz and Radio Tupi in Sao Paulo, Brasil on 1040kHz. A fine log which covers three continents.

Fifteen-year-old **Stephen Boyle** of Auchterarder in Perthshire is a newcomer to the medium waves. Using a Philips receiver and the metal core of his mother's washing line as an aerial (a dangerous practice with a mains receiver) he logged Radio Sweden on 1178kHz (in English at 2345), Radio Montecarlo on 1466kHz and an unidentified broadcast 'Paris Calling Africa'. Stephen is hoping to obtain an ex WD CR100 communications receiver. The CR100 can often be obtained privately for quite a modest sum. In spite of its age it is a really outstanding performer on the medium waves. **Dr H. S. Brodribb** (St Leonards-on-Sea) reports that he has acquired a CR100 which he intends to recalibrate. Together with **Roger Barker** (Wolverhampton), **D. Sullivan** (Chiswick) and **James Woodruff** (Cannes, France) he asks for information about the FET Pre-amplifier which is used with the Practical Wireless Medium Wave Loop antenna. An article covering the amplifier and the loop appeared in the April 1973 issue of Practical Wireless. Although this issue is out of print copies may be obtainable by advertising in the CQ column.

Alfred Johnson (Barnet) has been active on the band between the hours of 0200 and 0300 GMT during the month of June. His log includes an interesting group of broadcasters in Newfoundland, mainly at the low frequency end of the band; VOXM in St John's on 590kHz, CBNA St Anthony on 600kHz, CKCM Grand Falls on 620kHz, CBN St John's on 640kHz, CJCJ Grand Falls on 680kHz plus the most regular of all North Americans, CJON St John's on 930kHz. Other North Americans reported are WNBC on 660kHz, WABC on 770kHz, WCBS on 880kHz, WINS 1010kHz all in New York City, WHDH on 850kHz and WBZ on 1030kHz, both in Boston and the Canadians CBH Halifax Nova Scotia on 860kHz, CHER Sydney N.S. on 950kHz and CBA Moncton, New Brunswick on 1070kHz. During the month of September North American DX starts to come in after midnight GMT.

AMATEUR BANDS

by **Eric Dowdeswell G4AR**

LET'S start off this month with a note on a new group that has been formed in Edinburgh, the Pioneer Radio Club. First meeting is on 9 September, a Tuesday, and subsequent meetings will also be on Tuesdays at the Church Hall, Ravenscroft Street, Gilmerton, Edinburgh. First guest speaker will be George Burt better known on the air as GM30XX (with whom I have had the pleasure of many a snappy QSO on CW!). So switch off those rigs on the 9th and get along to support this new project. Further info from my informant, Mr. A. Sinclair, 32 Burdiehouse Street, Edinburgh EH17 8HB, or ring him at (031) 664 6570.

Ian Fay (Mansfield) reports for the first time on his doings from 15 to 80m using a Trio 9R59DS, Codar PR40 preselector and an ATU, the last two items having 'markedly increased results over the last few weeks'. **Stephen Budd** A8713 (Worthing) did not leave 20m judging by his log but remained

content with several new countries including Sabah 9M6, Mount Athos SV1GA/A, and EA9ES/EA9 obviously on holiday in the sunny Spanish Sahara!

Mike Green A8088 (Northwich) stuck to set-up consisting of a QP166 front end feeding a CR100 as tunable IF plus PW audio processor plus half wave dipoles and covered all bands from 10 to 160m. I think we had better shorten the description of his gear to the 'Green Mk1!' If **Peter Walton** A9002 ever gets on the air he will be in dead trouble with a QTH like Llanfairpwllgwyngyll! In Gwynedd, incidentally. His location in lat and long might be easier! I'm glad to see he logged at least one station using CW on his Eddystone 358X and 85ft long wire. I know it is so easy to copy SSB but give the low end of the bands a go now and again, chaps.

Steve Cottis A8961 (Harrogate) has been very busy, completing his Heathkit SW717G, joining the RSGB and going on holiday. He comments on the number of stations on 80m who seem to forget to mention call signs. I'd like to think that these are mainly non-amateur services who share the band with the amateurs. Another busy bee is **Mark Hill** A9008 (Birmingham) who, very wisely, has a plan of campaign which includes an audio processing unit, a ground plane for 2m and a set for 70cm based on a Microwave Modules module! Oh, yes, he did send a log! It is a very sensible idea to make



out a rough plan of 'things-to-do' especially as we approach the winter season. Work on aeri-als should be done now while the weather is fine leaving constructional work for later.

An interesting letter from professional yachtsman **Bob Salmon** (Wembury, Devon) who normally uses commercial gear on the marine frequencies but is now keen on an amateur MM licence. He mentions DJ9ZT/MM who has a daily schedule with DK0SS and DLOMX at 1400 daily on 14100 SSB. **Alan Doherty** (Portrush) is BRS34968 and very impressed with the improved results obtained by using a new Codar PR40 preselector in front of his FR50B and 132ft dipole. **D. Harley** (Chesterfield) at 15 has already outgrown his HAC set and looks forward to you-know-who at Yuletide! Don't worry too much OM about the arms of your dipole wandering from the straight lines shown in the textbook! Why not use 300 ohm feeder and an ATU and use it on all the bands?

Graham Nicholls G4DLB (Banbury) has not deserted the page in spite of getting his full ticket! He's full of praise for the excellent conditions he's been experiencing on 2m with an OZ causing cross-modulation of signals on his receiver! Graham has been busy working round Europe with his 15W from a Pye Vanguard. On 70cm he has worked a string of PA0's and Germans with 6W to a QQV03-25 and 15 elements at just 10½ft! **Godfrey Manning** G8JBH (Edgware) has also been having fun on 2m with 18W input and a five element yagi in the loft.

Michael Bennett (Datchet) found HK0AA on San Andres on 20m SSB while **Andrew Swiffin** (Cheadle) went about it the hard way copying HK0COK on 40m SSB. Our SSTV 'king' **Paul Barker** (Sunderland) managed two new countries on that mode, namely OZ and VU2. His first pictures on 40m came from OE9IM. **David Coupe** BRS35997 (Thornton Stainton, Middlesbrough) has also been extolling the virtues of 2m but 'A's 'O's and RAE's have been taking up all the time! He recommends any readers in the Middlesbrough area to pay a visit to the Middlesbrough PO ARC (G8BAY and G8GPO) any Thursday evening at 200 Marton Road, next to the main telephone exchange. More details from Graham Gaunt G8CDP QTHR. **Steve Blake** A8597 is yet another who preferred 2m to the HF bands, in Aylesbury.

C. Ashby (High Wycombe) dusted off his FET receiver and 30ft vertical only to hear a very strange call sign, 7SL4BP, on 20m. This military radio club is at Falun in Sweden.

Nothing further yet on our proposed competition for readers of this page. Some 'administration problems' have arisen which need to be sorted out.

Log extracts

I. Fay:— 80m VU2GDG ZB2BK 20m FP8DH HP9XJS HR6FWA KG4AN KZ5TC 15m CE3EG ZP5AR

M. Green:— 20m CR4DF FY7AN HR6SWA VP2AB

P. Walton:— 20m TU6DMF 9M8VLC 9V1RD

M. Hill:— 20m A2CBW JW5NM 2m F1ALS F1QV (both via Oscar 7)

G. Nichols: 2m **DJ6LN** DC0BI OZ1ABF OZ4BE SM4AXY 70cm DC8CF DK7LP **PA0VV**. All stations worked.

A. Doherty:— 80m C31FO 20m KH6AHO KM6EA YJ8AN

M. Bennett:— 80m YS3FU 20m PJ3DO HK0AA FL8CH

A. Swiffin:— 80m ZS6HVM 8P6CJ 40m FL8OM HK0COK VK2AVA VU2GDG YS1SC 20m VE8MD VQ9GP VQ9P ZD7SD

D. Coupe:— 2m DK1KO ON5CW OZ5TG PA0SWH SM6BHZ

J. Hinton:— 80m M1BS 20m VK6CT 15m HM4VBK PZ5WU ZP5JN

S. Blake:— 2m DL2VB GD3FLH/P OZ1OF PI50ARU SM6AEK

P. Barker:— SSTV 40m OE9IM 20m DJ2IV F3RT HB9IT OD5JW OE9IM OZ3WP VU2AIK 20m SSB A6XR JW5NM LA4C (Dx-pedition?)

S. Budd:— 20m AP2SA EA5ES/EA9 FB8ZG Amsterdam Is. FP0XX HB0AWQ JT1AI JW5DQ KH6GKD/KB6 KS6FF PV0AKL Fernando de Noronha SUI1MA SV1GA/A Mt. Athos VK9XI Christmas Is. 3B8DO 5T5GS 5W1AR

All stations are SSB except those in bold which are CW.

BROADCAST BANDS

Short Wave reports by the 15th of the month to Derek Bell c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.

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

AMATEUR BANDS

Logs covering any amateur band/s in band/ alphabetical order by the end of the month to Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashted, Surrey, KT21 2TW.

TELEVISION—OCTOBER

●VIDEOCASSETTE RECORDERS

A two part examination of the Philips N1500 VCR machine, describing its mechanical arrangements and control systems and the signal coding techniques used.

●SWITCH-MODE TV POWER SUPPLIES

Several switch-mode power supply circuits used in TV sets at present on the market are described, and advice is given on servicing.

●BASIC TRANSISTOR LINE OUTPUT STAGE OPERATION

Since this circuit is the heart of any TV set, it is worth knowing just what goes on in this department. The article illustrates exactly what happens during the various stages of the scan cycle.

●SERVICING FEATURES

Colour chassis used in the Korting 90° series of models. A guide to common faults.

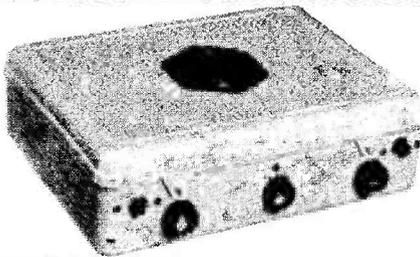
Decca monochrome dual-standard chassis used in the DR1 series.

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Total Building Costs

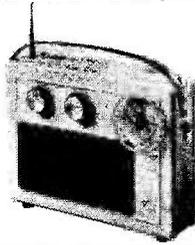
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Components Include: 24 Resistors ● 21 Capacitors ● 10 Transistors ● 3 1/2" Loudspeaker ● Ear-piece ● Mica Baseboard ● 3 12-way connectors ● 2 Volume controls ● 2 Slider Switches ● 1 Tuning Condenser ● 3 Knobs ● Ready Wound MW/LW/SW Coils ● Ferrite Rod ● 6 1/2 yards of wire ● 1 Yard of sleeving etc. ● Parts Price List and Plans 55p free with parts.

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- ★ 4 Transistor Push Pull Amplifier.
- ★ 5 Transistor Push Pull Amplifier.
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- ★ 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.

NEW ROAMER NINE

WITH V.H.F. INCLUDING AIRCRAFT

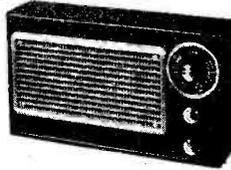


Nine Transistors, 9 Tunable wavebands as Roamer Ten. Built in ferrite rod aerial for MW/LW. Retractable chrome-plated telescopic aerial for VHF and SW. Push Pull output using 600 mW transistors. 9 Transistors and 3 diodes, tuning condenser with V.H.F. section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange controls. Attractive all white case with red grille and carrying strap. Size 9 1/2" x 7" x 2 1/2" approx. Parts Price List and Plans free with parts.

Total Building Costs **£8-70** PP & Ina. 58p
(Overseas Seamail P & P £8-40)

NEW Everyday Series

Build this exciting New series of designs E.V.5. 5 Transistors and 2 diodes. MW/LW. Powered by 4 1/2 volt Battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3" loudspeaker. Attractive case with red speaker grille. Size 9" x 5 1/2" x 2 1/2" approx. Parts Price List and Plans free with parts.



Total Building Costs **£4-25** PP & Ina. 50p
(Overseas Seamail P & P £2-30)

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 free with parts.

Total Building Costs **£4-98** PP & Ina. 50p
(Overseas Seamail P & P £2-30)

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 free with parts.

Total Building Costs **£5-60** PP & Ina. 50p
(Overseas Seamail P & P £2-50)

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. Chrome plated Telescopic aerial can be angled and rotated for peak short wave listening. 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 x 7 x 4in. approx. Easy to follow instructions and diagrams. Parts price list and plans free with parts.

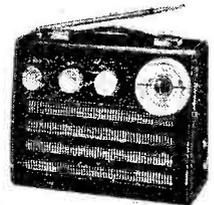


Total building costs **£8-73** PP & Ina. 65p
(Overseas Seamail P & P £3-50)

ROAMER TEN Mk 2

WITH VHF INCLUDING AIRCRAFT

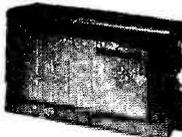
Now with free earpiece and switched socket. 10 Transistors. Latest 4" 2 watt Ferrite Magnet Loudspeaker. 9 Tunable Wavebands, MW1, MW2, LW, SW1, SW2, SW3, Trawler Band, VHF and Local Stations also Aircraft Band. Built in Ferrite Rod Aerial for MW/LW. Chrome plated 6 section Telescopic Aerial, can be 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" x 7" x 4". Easy to follow instructions and diagrams. Parts price list and plans 50p free with parts.



(Total building costs Overseas Seamail P & P £3-50) **£11-87** PP & Ina. 65p

POCKET FIVE

NOW WITH 3" LOUD-SPEAKER 3 Tunable wavebands. M.W. L.W. and Trawler Band, 2 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, attractive black and gold case. Size 5 1/2" x 1 1/2" x 3 1/4" approx. Plans and Parts Price List free with parts.



Total Building Costs **£3-70** PP & Ina. 38p
(Overseas Seamail P & P £2-30)

TRANSONA FIVE NOW WITH 3" LOUDSPEAKER

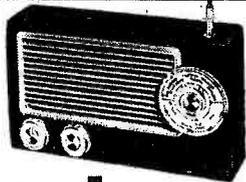
Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial. Plans and Parts Price List free with parts.

Total Building Costs **£4-00** P.F. & Ina. 38p
(Overseas Seamail P & P £2-30)

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 x 5 1/2 x 2 1/2in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and plans free with parts.

Total building costs **£5-98** PP & Ina. 50p
(Overseas Seamail P & P £2-50)



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 x 6 1/2 x 2 1/2in. approx. Total building costs **£5-48** PP & Ina. 50p
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IC OF THE MONTH

Number 54

MOTOROLA MC14440 CMOS CLOCK

A CMOS watch/clock integrated circuit which is capable of directly driving a four digit, seven segment liquid crystal display has recently been introduced by Motorola. Designated the MC14440, the new device comes in a 40-pin package and has a really low current consumption: $4\mu\text{A}$ when operating and only $0.1\mu\text{A}$ in the quiescent state.

The MC14440 is compatible with the recently announced Motorola liquid crystal displays type MLC500 or MLC400. To build a complete clock or watch with the new IC requires the LCD display, three switches, an MTQ32A 32.768kHz crystal, three diodes, five resistors, three capacitors and a 1.58V battery. The complete circuit is shown in Fig. 1.

CIRCUIT OPERATION

Under normal conditions, the LCD display will show the time in hours and minutes, the colon in between the hours and minutes digits flashing on and off twice per second. When the seconds/date demand switch (S3) is closed, seconds are displayed on the two right hand digits, the colon stays on and the other two digits are blanked. When S3 is returned to its normal position, the date will be displayed on the two central digits of the display for a couple of seconds, the outer digits and the colon being blanked.

SETTING THE TIME

When the hours display is indicating 12 the minute/date set switch (S1) acts as a minute set switch, the digits advancing at 1Hz. With the hours indicating anything other than 12 S1 acts as a date set switch, the digits again advancing at 1Hz. A separate switch (S2) is used for setting the hours to the required figures.

During the setting of the minutes digits, the second digits are set to zero and S1 acts as a clock start control, enabling the clock to be started with reference to a precision time standard.

An optional display test switch can be incorporated if required.

POWER SUPPLIES

The frequency of the on-chip oscillator is controlled by the 32.768kHz crystal, the exact fre-

quency being set by the 6.35pF trimmer. Outputs from the oscillator (HF and $\overline{\text{HF}}$) are provided which can be used to drive a simple diode/capacitor voltage tripler which produces an output of 3.8V, sufficient to drive the IC and the LCD display.

AVAILABILITY

At the time of writing, the MC14440 is not stocked by the Motorola distributors but the devices are expected to enter the country soon. Prices are £8.08 for the plastic package. For ordering details contact any of the Motorola distributors.

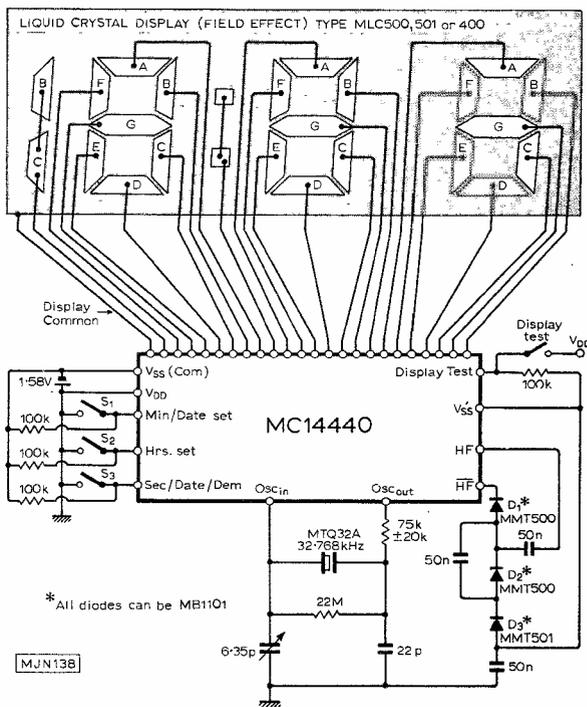


Fig. 1: Complete circuit using the MC14440 in a watch, with the new liquid crystal display type MLC500, 501 or 400.

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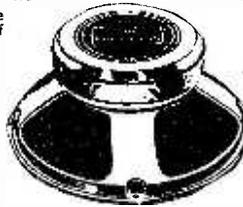
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0.47	—	—	—	—	—	11p	8p	8p
1.0	—	—	—	—	11p	8p	8p	8p
2.2	—	—	—	—	11p	8p	8p	8p
4.7	—	—	—	11p	8p	8p	8p	8p
10	—	11	—	—	8p	8p	8p	8p
22	—	—	8p	8p	8p	8p	8p	10p
47	8p	—	8p	8p	8p	8p	10p	10p
100	8p	8p	8p	8p	8p	10p	12p	19p
220	8p	8p	8p	10p	10p	11p	17p	28p
470	9p	10p	10p	11p	13p	17p	24p	45p
1,000	11p	13p	13p	17p	20p	25p	41p	—
2,200	15p	—	—	26p	37p	41p	—	—
4,700	—	—	39p	44p	58p	—	—	—
10,000	42p	46p	—	—	—	—	—	—

RESISTORS

Code	Watts	Ohms	1 to 9	10 to 99	100 up
C	1/3	4.7-470K	1-3	1-1	0-9 nett
C	1/2	4.7-10M	1-3	1-1	0-9 nett
C	3/4	4.7-10M	1-5	1-2	0-97 nett
C	1	4.7-10M	3-2	2-5	1-92 nett
MO	1/2	10-1M	4	3-3	2-3 nett
WW	1	0.22-0.47Ω	18	14	11 nett
WW	1	0.56-3.9Ω	12	10	8 nett
WW	3	1-10K	9	8	6 nett
WW	7	1-10K	11	10	8 nett

Codes:

C=carbon film, high stability, low noise.
MO=metal oxide, Electrofil TR5 ultra low noise.
WW=wire wound, Plessey.

Values: All E12 except C 1/2W, C 1/2W and MO 1/2W.
E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82, and their decades.

E24: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

Tolerances:
5% except WW 10% ±0.05Ω below 10Ω and 1/2W MO 2%

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0.068	0.1	0.15			ea. 4p
0.22 5p	0.33 7p	0.47 8p	0.68 11p	1.0 14p	1.5 21p
2.2 24p					

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Values in P.Fs—2.2 to 250 in 26, stages	ea. 16p
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3A4	70	6C9	2.00	6S7H	-55	20F2	-88	85A3	-75	E1A50	-4.0
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6AX4	-88	6JUS8A	-88	12BY7	-85	30P15	-94	DC90	-70	E1C804	2.68
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EP41	-82	HAB080	-80	PEN46	-60	UCI43	-87	2N2297	-89	BA129	-16	OA91	-13
EP42	-90			PEN453DD	UC8H1	-47	2N2369	-18	BA130	-20	OA95	-12	
EP73	1.78	HL23DD	-80	PEN45	2.00	ULC82	-45	2N3053	-42	BA153	-20	OA200	-19
EP80	-30			PENDD	ULC83	-64	2N3121	3.22	BC107	-17	OA202	-13	
EP83	1.45	HL1ADD	4020	1.00	UF41	-82	2N3703	-25	BC108	-16	OC44	-13	
EP85	-40			1.00	PF1200	-82	UF42	-82	2N3709	-26	OC109	-16	
EP86	-50	HL2ADD	PL33	-50	UF80	-41	AA119	-20	BC113	-83	OC46	-20	
EP89	35			1.00	PL36	-70	UF85	-52	AA120	-20	BC115	-20	
EP91	-50	HVR309	1.76	PL81	-53	UF89	-47	AA129	-20	BC116	-33	OC71	-14
EP92	-60	HVR2	1.17	PL81A	-60	UL41	-75	AA123	-33	BC118	-29	OC72	-14
EP97	-44	HVR2A		PL82	-43	UL84	-49	AC107	-20	BC119	-59	OC74	-89
EP98	-96			1.17	PL83	-47	UM90	-80	AC113	-33	BC121	-64	
EP183	-40	KT41	1.17	PL84	-50	UY41	-50	AC126	-18	BCY33	-20	OC76	-20
EP184	-40	KT68	2.93	PL84	-50	UY41	-50	AC127	-22	BCY34	-29	OC77	-25
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EH90	-53	KTW61	1.76	PL508	1.10	U19	5.00	AC154	-33	BCY39	-33	OC81	-14
EL32	-60	KTW82	1.76	PL608	1.10	U19	5.00	AC154	-33	BCY39	-33	OC81	-14
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EL43	-36	PC88	-70	PY88	-47	U191	-59	AC176	-71	BF185	-52	OC123	-29
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EM87	1.10	PC190	-47	Q875/20	2.10	VP41	-88	ACY28	-23	BY127	-23	OC204	-39
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The Publishers of *Practical Wireless* are members of the Periodical Publishers Association which has given an undertaking to the Director General of Fair Trading to refund monies sent by readers in response to mail order advertisements, placed by mail order traders, who fail to supply goods or refund monies owing to liquidation or bankruptcy. This arrangement does not apply to any failure to supply goods advertised in a catalogue or in a direct mail solicitation.

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'Direct response advertisements, display or postal bargains where cash had to be sent in advance of goods being delivered'. Classified and catalogue mail order advertising are excluded.

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(1.25V PER CELL)
500M/AH—£1.43; 1.2AH—£1.92; 1.8AH—£2.50; 3.5AH—£3.12; 4AH—£5.50; 7AH—£5.93; 10AH—£8.66.
These cells can be supplied in sealed packs with or without built in mains charging unit at various voltages, i.e. 6V 4AH, 12V 7AH. S.A.E. for prices giving D.C. voltage and current required and if built in charger required.

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240V A.C. Primary: Sec. 0-6V 1A—£2.00; Sec. 0-0-6V 1A—£2.06; Sec. 0-0-9V 1A—£2.33; Sec. 12-0-12V 1A—£2.32.

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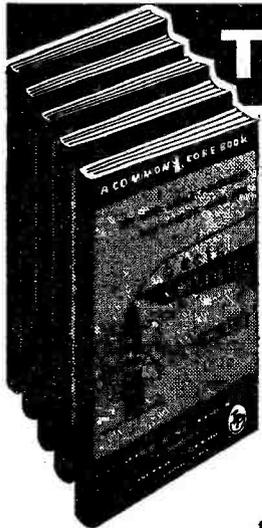
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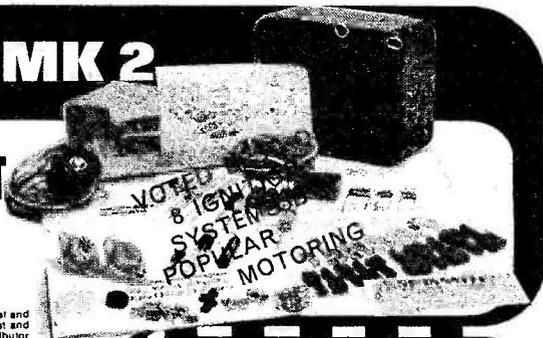
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Plays 15", 10" or 7" records
Auto or Manual. A high
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Size 13 1/2 x 11in.
Above motor board 8 1/2in.
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With STEREO/MONO CARTRIDGE



£9.25 Post 45p.

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Few only, in red and black.

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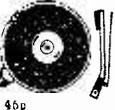
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Size 12 1/2 x 14 1/2 x 7 1/2 in.

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Heavy duty 4-speed motor with
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R.C.S. DISCO DECK SINGLE RECORD PLAYER

Fitted with auto stop, stereo/comp. cartridge. Base-
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3 speeds plays all size
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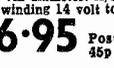
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unit clips to loudspeakers making it extremely compact.
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Separate vol-
ume & tone
controls 240v
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Attractive
Teak finish
Weight 13lbs.

Bargain Price
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Single pole two-way surface mounting
with fixing screws. Will replace existing
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Turn on or off at 10 or intermediate settings.
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CASSETTE RECORDER MOTOR ONLY. 6 Volt.

Will replace many types. Ideal for models. £1.25.

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6 x 4in 45p; 8 x 6in 55p; 10 x 7in 65p; 12 x 8in 85p;
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1 1/2inch DIAMETER WAVECHANGE SWITCHES 45p. EA.
3 p. 2-way, or 2 p. 6-way, or 3 p. 4-way.
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TOGGLE SWITCHES, sp. 20p; dp. 25p; dp. dt. 30p.

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Ideal for Mike, Tape P.U., Guitar, etc. Can be used with
Battery 9-12v. or H.T. line 200-300V. D.C. operation. Size
1 1/2" x 1 1/2" x 1". Response 25 c.p.s. to 25 Kc/s, 28 db gain.
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16/350V	22p	150+200/275v	70p	100+50+50/350v95p
32/500V	30p	8+8/450V	25p	32+32+32/350
25/25V	10p	8+16/450V	25p	900MFD/350V
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100/25V	10p	32+32/350V	95p	

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22, 25, 50, 68, 150, 470, 500, 880, 1500, 2200, 3300, mfd
all 6 volt 10p. ea.
22, 25, 68, 100, 150, 200, 220, 330, 470, 680, 1000, 1500,
2200, mfd all 10 volt 10p ea.
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1000mF 12V 15p; 25V 20p; 50V 30p.
5000mF 12V 20p; 25V 35p; 50V 47p; 100V 70p.
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HIGH STABILITY. 1/2 w. 2% 10 ohms to 6 meg., 10p.
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BATTERY CHARGERS. Ready built with leads and clips
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FULL WAVE BRIDGE CHARGER RECTIFIERS:
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Suitable for outside use. 85p

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Complete with 12 ft. twin lead fitted with din speaker plug.
Ready assembled with leads for speakers, bass, mid and
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STEREO L/S 55p. D.P. 75p.
Edge 5K. S.F. Transistor 25p

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AERAXIAL-AIR SPACED
40 yd. £2; 60 yd. £3.
FRINGE LOW LOSS 10p yd
Ideal 625 and colour. yd

Wirewound controls 1in. diam. 3 watts. 10 ohms to 100K
British made with long spindles 1in. dia 80p ea.

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With tweeter. £5-25
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With flared tweeter cone and ceramic
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Special Rubber cone surround.
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The moving coil diaphragm gives a good
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8 ohm 12 watt. Deep cone.
Heavy ceramic magnet. Bass
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18,000 cps. 25 watts. 8 ohm. Price **£3.60**.

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1.5v d.c. operation over 250 hrs. continuous on SP2 battery.
Fully adjustable swing and speed. Ideal displays teaching
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2 Stage Triode Pentode valve. 3 watts 3 ohm output. Volume
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With Loudspeaker. **£4.50** Post 35p.

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SOCKETS Chassis 3-pin 10p; 5-pin 10p. DIN SOCKETS
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300 ohm suitable for stereo 7p per yard.

BRITISH FM/VHF TUNING HEAT

88 to 108 Mc/s British made. 2 Transistors
ready aligned—requires 10.7
Mc/s I.F. Complete with tuning caps.
Connections supplied but some
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SUITABLE I.F. STRIP £4.95.
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£6-75 THE PAIR. Post 45p.
(Available separately.
Woofer 24-25; Tweeter
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Comprising a fine example of a Woofer
10 1/2 x 6 1/2 in. with a massive Ceramic
Magnet. 44oz. Gauss 13,000 lines.
Aluminium Cone centre to improve
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Tweeter 8 1/2 in. square has a special
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10,000 lines. Crossover condenser and
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Impedance Standard 8 ohms
Maximum power 12 watts
Useful Response 25 to 13,000 cps
Bass Resonance 45 cps



£14-50
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MODERN DESIGN. TEAK WOOD FINISH.

ELAC 8in. or 10 x 6in. HI-FI SPEAKER



Dual cone plasticised roll sur-
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50-16,000 cps. Bass resonance
55 cps. 8 ohm impedance.
8in. 10 watts **£4-35**

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MODEL "A". 20 x 13 x 12 in.
For 12in. dia. **£14-50** Post
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For 8 x 8 in. or **£7-60** Post
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330	4	7
68	6.3	7
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1000	6	11
25	10	7
47	10	7
220	10	7
330	10	9
15	16	7
33	16	7
68	16	7
220	16	9
220	16	9
16	20	11
1000	16	20
10	25	7
22	25	7
47	25	7
100	25	7
150	25	9
200	25	11
1250	25	24
5000	25	55
10000	25	32
2500	30	40
40	6.8	7
16	40	7
100	40	9
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4.7µF 63V	7p	220µF 10V	7p
6.8µF 63V	7p	220µF 16V	8p
10µF 25V	7p	220µF 63V	25p
10µF 63V	7p	330µF 16V	14p
15µF 16V	7p	330µF 63V	28p
15µF 63V	7p	470µF 6-4	8p
16µF 40V	7p	470µF 40V	25p
22µF 25V	7p	680µF 16V	17p
22µF 63V	7p	680µF 40V	28p
32µF 10V	7p	680µF 16V	25p
33µF 63V	7p	1000µF 25V	28p
33µF 40V	7p	1500µF 6-4V	17p
47µF 10V	7p	1500µF 16V	28p
47µF 25V	7p	2200µF 10V	28p
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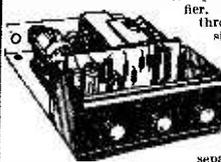
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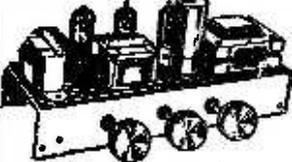
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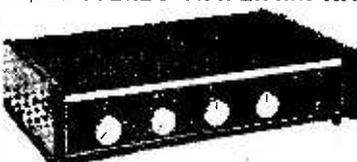
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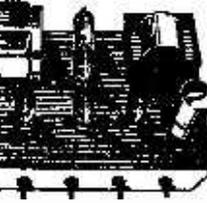
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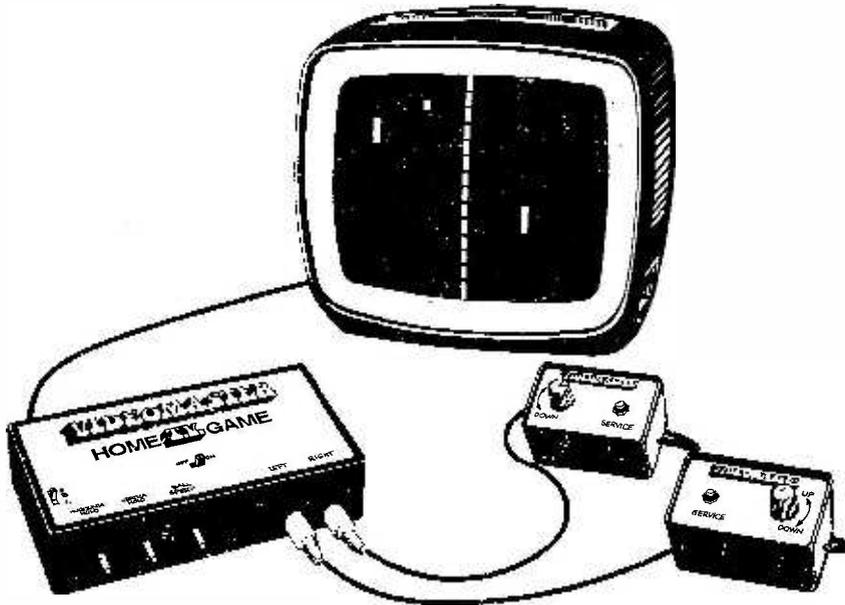
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7401	14p	12p	10p
7402	14p	12p	10p
7403	15p	12p	10p
7404	16p	13p	11p
7408	16p	13p	11p
7409	16p	13p	11p
7410	16p	13p	11p
7413	29p	24p	20p
7417	27p	22p	20p
7420	16p	13p	11p
7421	27p	22p	18p
7423	16p	13p	11p
7427	27p	22p	18p
7430	16p	13p	11p
7432	27p	22p	18p
7437	27p	22p	18p
7441	75p	62p	50p
7442	65p	55p	43p
7445	85p	71p	57p
7447	95p	83p	67p
7447A	95p	83p	67p
7448	85p	71p	57p
7470	30p	25p	20p
7472	25p	21p	17p
7473	30p	25p	20p
7474	32p	26p	21p
7475	47p	39p	31p
7476	32p	26p	21p
7482	75p	62p	50p
7485	£1.30	£1.09	87p
7486	32p	26p	21p
7489	£3.56	£2.80	£2.10
7490	49p	40p	32p
7491	65p	55p	45p
7492	57p	46p	36p
7493	49p	40p	32p
7495	67p	55p	45p
74100	£1.08	89p	72p
74107	35p	28p	22p
74121	34p	28p	22p
74122	47p	39p	31p
74141	78p	63p	51p
74145	68p	58p	48p
74154	£1.75	£1.48	86p
74174	£1.00	83p	67p
74180	£1.06	88p	71p
74181	£3.20	£2.50	£1.90
74192	£1.35	£1.14	90p
74193	£1.35	£1.14	90p
74196	£1.64	£1.34	99p

555 (8 pin dip) V	55p	7824UC (TO-220)	£1.84	MC1303L	£1.84	SN76003N	£3.30
555 (TO-99) T	81p		£1.72	MC1306P	80p	SN76013N	£1.98
556 (14 pin dip)	£1.29	ICL8038	£3.52	MC1310P	£2.39	SN76023N	£1.98
703 (RF/IF Amp)	59p	AY-1-0212	£6.93	MC1312	£2.42	SN76227N (MC1327)	£1.89
709 (8 pin dip)	38p	AY-1-5051	£1.44	MC1314	£4.13	SN76532N	£1.88
709 (TO-99)	45p	AY-5-1224	£3.95	MC1315	£4.62	SN76544N	£1.81
709 (14 pin dip)	39p	AY-5-3500	£6.59	MC1327	£1.12	SN76550-2 (TAA550)	89p
710 (8 pin dip)	39p	AY-5-4007	£7.94	MC1330P	83p	SN76552-2	81p
710 (TO-99)	45p	BHA0002	£3.01	MC1350	64p	SN76660N (TBA120)	75p
710 (14 pin dip)	44p	CA2111	£1.19	MC1351	88p	SN76666N (CA3065)	£1.12
711 (TO-99)	51p	CA3045	£1.69	MC1352	88p	TAA263	£1.50
711 (14 pin dip)	44p	CA3046	88p	MC1357	£1.52	TAA300	£2.16
720 (A.M. Radio)	£1.76	CA3053	59p	MC1358 (CA3065)	£1.16	TAA310A	£1.87
723 (TO-99)	£1.09	CA3065	£1.60	MC1375	£1.48	TAA320	£1.44
723 (14 pin dip)	74p	CA3075	£1.64	MC1455 (555T)	62p	TAA350	£2.43
741 (8 pin dip)	36p	CA3078	£1.26	MC1456CG	£1.88	TAA370	£3.40
741 (TO-99)	43p	CA3080	59p	MC1458CP1	84p	TAA550	75p
741 (14 pin dip)	36p	CA3081	£1.86	MC1468G	£2.18	TAA570	£2.74
747 (14 pin dip)	£1.04	CA3082	£1.86	MC1495L	£4.24	TAA700	£5.03
748 (8 pin dip)	42p	CA3089E (TDA1200)	£2.43	MC1496G	96p	TBA1205	£1.25
748 (TO-99)	51p	CA3097E	£1.67	MC3302P	£1.50	TBA231	£1.02
748 (14 pin dip)	49p	CA3123E	£1.76	MC3401P	74p	TBA281 (723)	£2.59
753 (F.M. 1st. I.F.)	£1.08	CA3401E (LM3900)	68p	MFC4000B	87p	TBA500Q	£3.16
75491	88p	CA3600E	£1.44	MFC4060A	79p	TBA520Q	£3.85
75492	£1.10	CA3700T	£5.34	MFC6030A	99p	TBA530Q	£3.27
Regulators 100mA	80p	LO05TI (TO-3)	£1.46	MFC6040	96p	TBA540Q	£3.72
78105WC (TO-92)	60p	L036TI (TO-3)	£1.46	MFC6070	£1.66	TGA550Q	£5.29
78115WC (TO-92)	60p	L037TI (TO-3)	£1.46	MMS314	£4.80	TBA560CQ	£5.29
Regulators 100mA	80p	LM301T (TO-99)	65p	MMS316	£9.99	TBA625A	£1.03
78105AVC	90p	LM301S (8 pin dip)	65p	MVR12V (TO-3)	£1.45	TBA625B	£1.03
78112AVC	90p	LM301A T (TO-99)	67p	MVR15V (TO-3)	£1.45	TBA625C	£1.03
78115AVC	90p	LM301A S (8 pin dip)	59p	NE540L	£1.45	TBA651	£1.87
Regulators 500mA	59p	LM301A T (TO-99)	67p	NE546A	£1.25	TBA720Q	£2.79
78M05HC	£1.35	LM301A S (8 pin dip)	59p	NE558B	£5.06	TBA750Q	£2.79
78M12HC	£1.35	LM307 T (TO-99)	59p	NE561B	£5.06	TBA800	£1.11
78M15HC	£1.35	LM307 S (8 pin dip)	57p	NE562B	£5.06	TBA810S	£1.24
78M18HC	£1.35	LM308 T (TO-99)	£1.96	NE563	£2.96	TBA810AS	£1.24
78M24HC	£1.35	LM308 S (8 pin dip)	98p	NE565N	£2.63	TBA820	86p
Regulators 1A	£2.09	LM308A T (TO-99)	£7.92	NE566V	£1.87	TBA920Q	£4.71
7805KC (TO-3)	£2.09	LM308A S (8 pin dip)	£6.90	NE567	£2.63	TCA720Q	£5.24
7812KC (TO-3)	£2.09	LM309K	£2.34	SL414A	£2.09	TCA760	£2.16
7815KC (TO-3)	£2.09	LM339	£2.25	SL415A	£2.75	TCA800Q	£7.24
7818KC (TO-3)	£2.09	LM337N	£2.85	SL437D	£7.50	TCA830S	£1.04
7824KC (TO-3)	£2.09	LM371	£2.08	SL440	£2.84	TCA940	£2.25
Regulators 1A	£1.72	LM372N	£1.99	SL610C	£2.03	TDA1054	£1.50
7805UC (TO-220)	£1.72	LM373N	£2.99	SL612C	£2.03	TDA1200	£2.43
7812UC (TO-220)	£1.72	LM377N	£2.71	SL613C	£4.31	TDA1405	80p
7815UC (TO-220)	£1.72	LM380	£1.25	SL620C	£3.06	TDA1412	80p
7818UC (TO-220)	£1.72	LM381	£1.85	SL621C	£3.06	TDA1415	80p
		LM382	£1.66	SL622C	£7.62	TDA2010	£3.00
		LM382	£1.66	SL623C	£5.57	TDA2020	£3.75
		LM703	£1.03	SL624C	£1.87	ULN2111A	£1.92
		LM1820	£1.03	SL630C	£3.75	ZN4121	£1.26
		LM2111	£1.12	SL640C	£3.75		
		LM3900	69p	SL641C	£3.75		
				SL645C	£3.75		
				SL650C	£9.85		
				SN75491N	88p		
				SN75492N	£1.10		
				SN76001N (TAA611)	£1.82		

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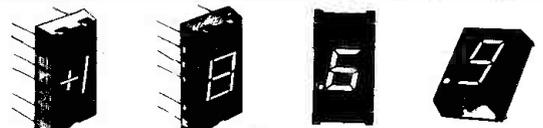
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V_{ceo}: V_{ceo} 25v, V_{ebo} 8v
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Orange	27p 24p 22p	33p 30p 27p	30p 27p 25p
Yellow	34p 31p 29p	35p 32p 29p	35p 33p 30p

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With the recent increase in postal charges and a continuing increase in packaging cost we have been forced to review our policy.
Henceforward:
1. Orders valued at £5 or more will be post free.
2. All U.K. 'small package' orders will go first class mail.
3. Minimum postage & packing charge will increase to 20p.

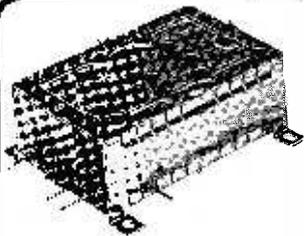
	COMMON ANODE R/H Dec. Pt.	COMMON ANODE L/H Dec. Pt.	COMMON ANODE I Dec. Pt.	COMMON CATHODE R/H Dec. Pt.	Our Price
0.3"	RED DL707P	DL707	DL701	DL704	£1.82
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	RED MAN71	MAN72	MAN73	MAN74	£1.82
	YELLOW MAN81	MAN82	MAN83	MAN84	£1.82
	ORANGE MAN3610	MAN3620	MAN3630	MAN3640	£1.82
0.4"	GREEN XAN51	XAN52	-	XAN54	£1.49
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	YELLOW XAN81	XAN82	-	XAN84	£1.49
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	RED MAN4710	MAN4720	MAN4730	MAN4740	£2.32
	YELLOW MAN4810	MAN4820	MAN4830	MAN4840	£2.32
	ORANGE MAN4610	MAN4620	MAN4630	MAN4640	£2.32
	C.A. L/H Dec. Pt.	C.A. L/H Dec. Pt.	C.C. L/H Dec. Pt.	C.C. L/H Dec. Pt.	
	RED DL747	DL746	DL750	DL749	£2.42

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Illustrated below are some of the products that TOKO make for wireless manufacture. These and other TOKO products are available from Ambit, together with many linear and discrete semiconductor devices specializing in radio and audio applications. Full catalogue 40p.

wireless tecknowledgedgy from TOKO



Varicap FM tunerhead:

The EF5603 represents the top of the range in TOKO FM tuner modules. With 5 double varicap tuned circuits, and dg MOSFET RF stage, the performance is really excellent. (12v supply) 1-24 £9.05 each



Coils for VHF RX/TX's

S18 are fully molded coils, complete with cores. A wide range of custom types with up to two taps is available - standard types for VHF are available ES. 1-24 18p each



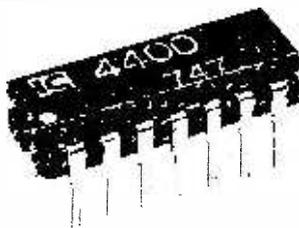
Ceramic IF filters

Similar to Murata and Verritron types, these ceramic filters are the easiest way to achieve FM IF selectivity. Two per set are required. 1-24 40p each



6 pole linear phase filter

Centered on 10.7MHz, this linear phase filter offers all the necessary selectivity for the construction of a Hi Fi FM stereo tuner. 1-24 £2.25 each



ICs for IF, decoder

The popular 1310, and 3089 types for FM MPX. 1310/4400 1-24 2.20 each 3089/4402 1-24 1.94 each



19 & 38 kHz notch filter

BLR3107 filters will remove the interference that causes annoyance when listening to or recording from MPX transmissions on FM. 1-24 £1.60ea



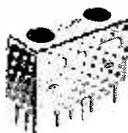
7BA Low cost RF choke

Miniature chokes 1uH to 1mH. Useful for all low power decoupling applications in RF circuits, logic circuits, filter circuits etc. Stock values 1, 4.7 and multiples through to 1mH. Custom orders 1000 min. for other values 1-24 15p ea



10K coils for HF/VHF

The ideal coil for all FM and TV IF applications. Excellent stability - available from a very broad 'shelf stock' range, and also to exact custom specs., where a min. of 1000 pcs applies. With or without an internal capacitor. 1-24 30p ea



CFT ceramic series AM IF filters

Low cost filters for use with IC or discrete circuits. Each unit includes an input/output matching transformer. For 455 and 470 kHz BW 6kHz. CFT 1-24 50p each, or slightly larger with higher Q: CFU050 (470 kHz only) 1-24 55p each.



MFH mechanical 455kHz IF filters

Bandwidth 4 or 7 kHz, for IC and discrete IF strips. Includes input/output IFT for matching 5k/800 ohms. 1-24 £1.45 each



7P min MF/HF coils

Only 7mm square base area makes the 7P ideal for all miniature receiver circuits. Available as IFs and osc. for AM/FM. (AM IFTs are available ES.) 1-24 30p each



10E coils for AM/FM

The 10E is available in the broadest-range of stock types of all TOKO coils, covering applications in MF/HF radio and FM IFTs. Base area 10mm square. 1-24 27p each

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PRACTICAL WIRELESS

SIMPLE HOME PROJECTS

8 PAGE SUPPLEMENT No.1

OCTOBER 1975

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ALL these projects are fairly easy to build. The layout of components is not critical except, perhaps, the IC Tuner where the design should be followed and wiring kept as short as possible. As the tuner uses a ferrite rod aerial it is important to rotate the unit as a whole for best reception from a particular station. A metal case must **NOT** be used with this project or the signal strength will be severely reduced.

If a metal case is used for any of the other designs care must be taken to see that short-circuits do not occur to the wiring. For this reason a plastic tube is recommended for the Signal Injector, where space is at a premium.

Much of the wiring can be done using the existing leads on resistors, capacitors and other components. Otherwise, use 22SWG tinned copper wire or thin insulated bell wire.

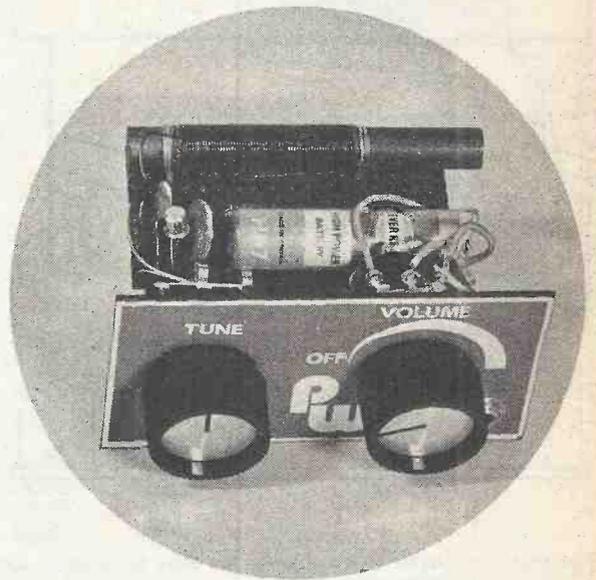
Take special care when soldering transistors. See that the leadouts are scraped clean and use a minimum of heat to make the joints.

In general, a particular transistor may be replaced with another of similar characteristics provided it is of the same type, that is, PNP for PNP. The following are some of those in the same PNP group:—OC42, OC71, AC128 and NKT251 while in the NPN group are:—BC107, BC108, BC109, BSY95A, 2N3704, 2N3904 and ZTX300. If a change is made to the type of transistor used in any of these circuits then a check must be made of the lead-out connections of the replacement transistor.

If a change of polarity is made to one of these circuits it will still work provided the transistor type is changed, as already noted, and that the polarity of any polarised (electrolytic) capacitor is reversed.

Note that there is no alternative for the ZN414 IC used in the Tuner project. The Tuner could be used on the long wave band by adding the appropriate coil on a ferrite rod and a simple changeover switch. Alternatively the input circuit of the Signal Booster may be employed, with an external aerial.

IC TUNER for audio amplifiers

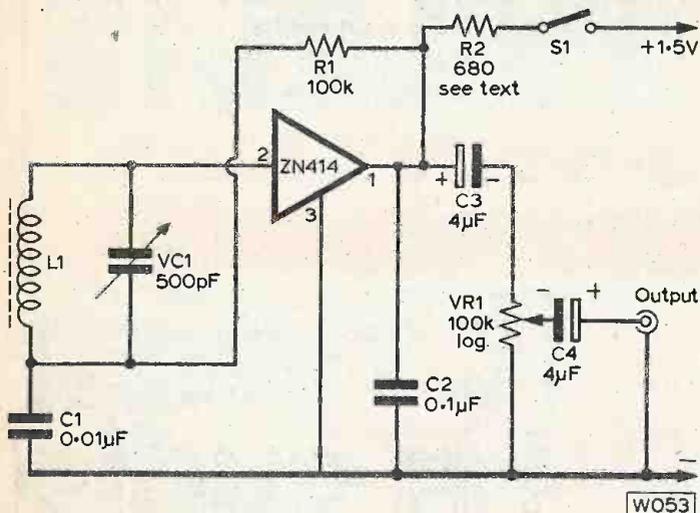


A single silicon integrated circuit provides several functions not normally available in TRF receivers.

Use this medium wave tuner with an audio amplifier or tape recorder to obtain excellent reception of local stations or to record radio programmes. It is self-contained, does not need an external aerial and only requires a screened lead equipped with a plug to suit your amplifier or recorder. It can also be used for local stations or personal listening of records by plugging in a high impedance headset or earpiece.

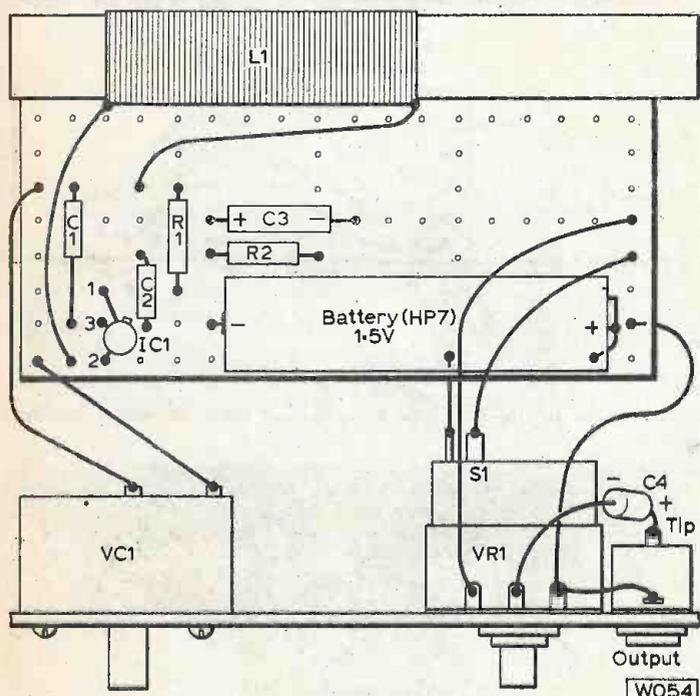
The ZN414 silicon "radio chip" provides RF amplification, automatic gain control and detection. The input signal is taken from the ferrite rod winding L1, and the audio output is taken to the level control VR1. This circuit has very few other components and it will be found to give excellent results provided one or two important points are

not overlooked. Strong local signals can overload the ZN414, causing distortion. This can be avoided by turning the tuner so that pick-up by the ferrite rod aerial is reduced. In addition, the output is generally more than adequate, so that the associated audio equipment may be overloaded; avoided by setting the level control well back.



W053

The tuner circuit using the ZN414 IC. Under no circumstances must the supply voltage exceed 1.5V.



W054

Plan view of the layout of components. The board is connected to VC1 and S1 by heavy copper wires.

In terms of circuit adjustment, there is no alignment or similar procedure and the unit can be expected to work well immediately. For best possible results in all circumstances, and to compensate for variations in layout, it can be worthwhile to look at R2. This can be 470, 560, 680 or 820Ω but if the value is lower than optimum, whistles will accompany some stations. On the other hand, an unnecessarily high value reduces sensitivity. Initially, fit the value shown.

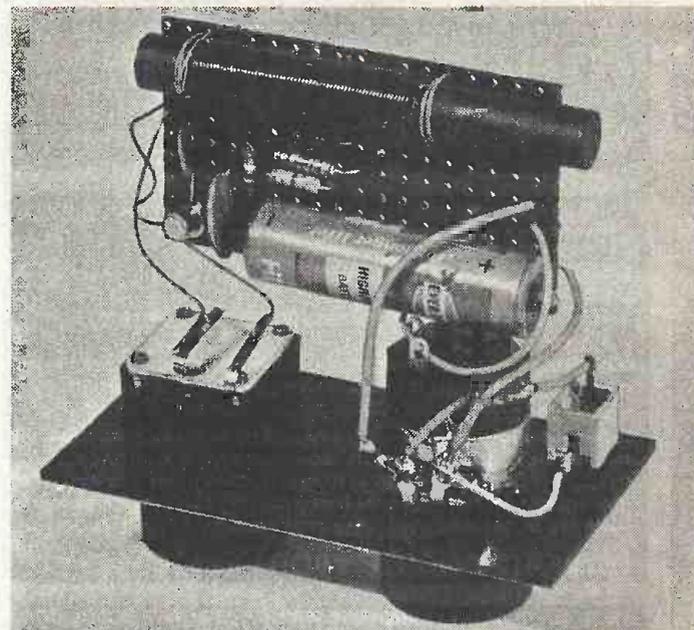
Components are fitted as shown. Note the cuts or drilling away of the foil conductors. The IC has its leads arranged as shown. Bring lead 3 between leads 1 and 2, avoiding any short circuit. The IC will then fit the holes as indicated which helps separate input and output circuits.

The aerial is sixty turns of 24SWG enamelled wire, close

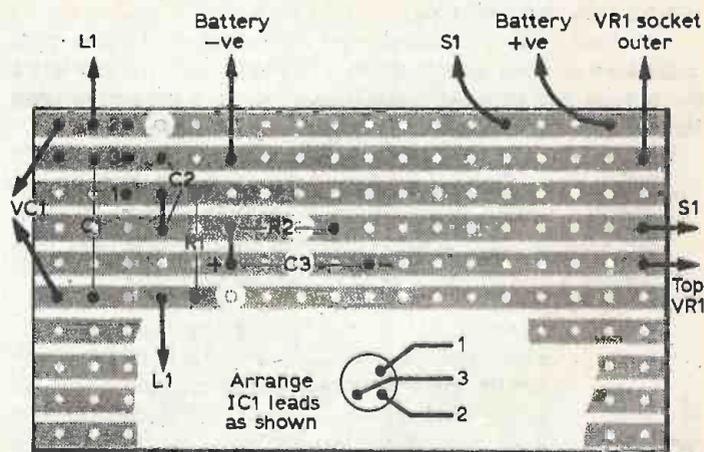
Bits and Pieces

- R1 100kΩ 1W 5%
- R2 680Ω 1W 5%
- VR1 100kΩ log. potentiometer, with switch
- C1 0.01μF disc ceramic
- C2 0.1μF disc ceramic
- C3/4 4μF 6V
- IC ZN414

VC1 Jackson Dialmin 500pF Veroboard 70 x 38mm (0.15in. matrix), 3.5mm jack socket. Knobs. HP7 cell. Ferrite rod, 9mm dia. 75mm long, 24SWG enamelled copper wire. Small panel, plastic or metal.



General view of the tuner showing the rod aerial fixed to the board with fine thread.



70 x 38 mm (0.15in. matrix)

W055

Diagram showing breaks required on the veroboard before components are soldered in place.

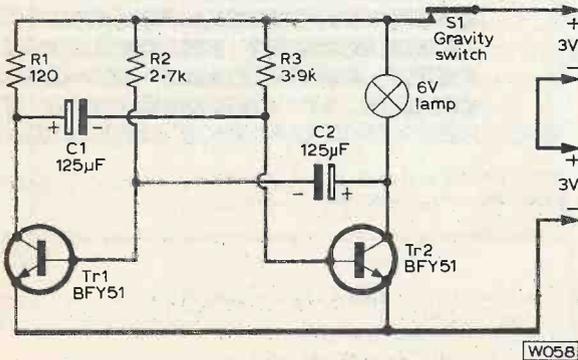
wound on a 9mm diameter ferrite rod, 75mm long. The ends of the winding are secured with glued thread, which also holds the rod to the board. As battery drain is very small, wires are left projecting from the board and the battery is soldered to these. The outer case is negative. More than a single 1.5V cell *must not be used*. Clips could be fitted to take a battery, if preferred. The box or case must be of insulating material, with minimum internal dimensions approximately 75 x 65 x 40mm.

MEMO reminder



A slowly flashing lamp increases the battery life in this Memo Reminder.

This device is a flat plastic box provided with a note pad, normally left with the pad uppermost. When a message has to be left, if only "Back in five minutes", this is written on the pad and the device turned over. In this position, a lamp at the end of the case flashes on and off at about one second intervals, thereby drawing attention to the pad. This side of the case carries the message "I have left a note, please turn over." When the box is reversed to read the message, the flashing bulb is switched off.

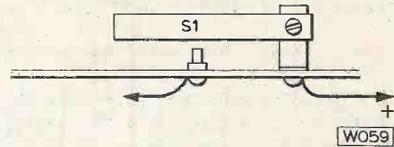


The simple multivibrator circuit is activated by the gravity switch S1. The operating current of the lamp should be as low as possible.

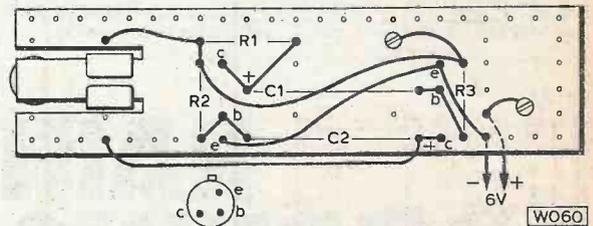
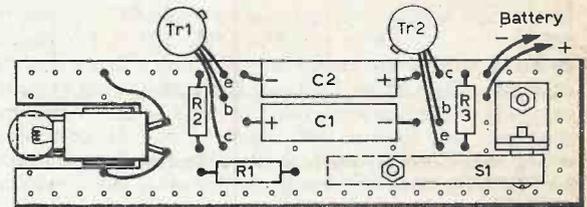
The circuit uses a two-transistor flip-flop oscillator, collector current of Tr2 passing through the lamp, which is a 6V bulb as used for cycle dynamo back lights and other purposes. The device will operate from 4.5 or 6V but here two 3V batteries are used for the supply.

Gravity switch S1 is operated by turning the case over

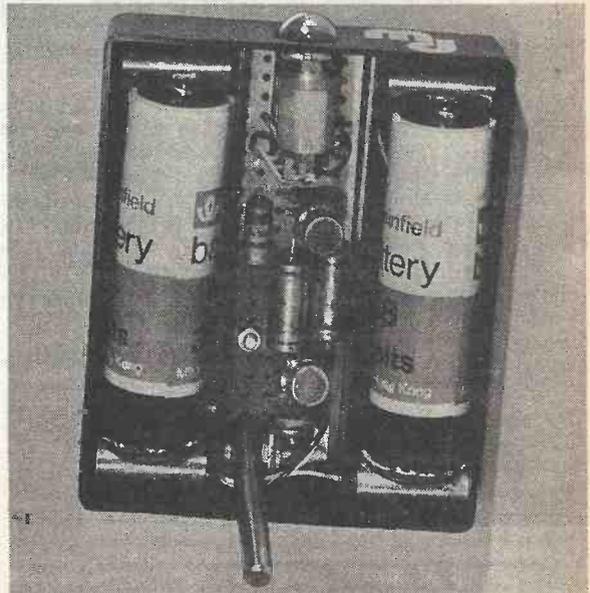
and it is made as shown from a piece of metal rod about 40mm long (sawn off a volume control shaft) and pivoted on a bolt, fixed with lock nuts to a bracket. When the box is in the flashing position this rod rests on a second bolt, completing the circuit. When the box is turned over to read the note the rod rests on the insulated top of the case. The contact bolt and swinging rod should be bright and



Details of the gravity switch and bracket.



Layout of the components on a piece of plain veroboard and associated wiring.



Inside the Memo Reminder showing the board in the centre and the gravity switch at the bottom, lifted up from its normal position to show the fixed contact.

Bits and Pieces

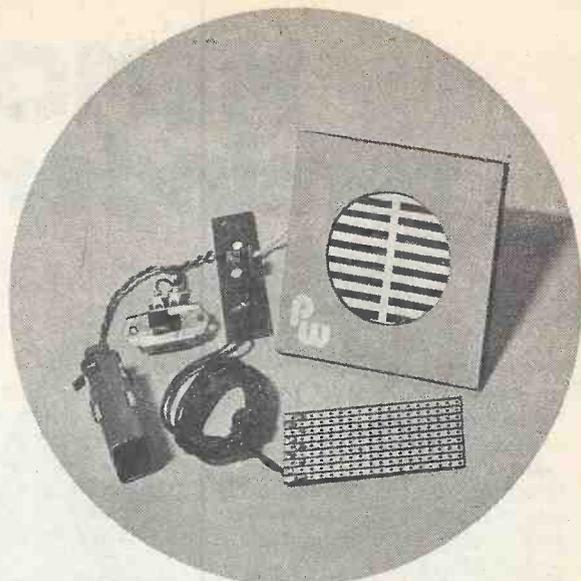
R1 120Ω ¼W 10%
 R2 2.7kΩ ¼W 10%
 R3 3.9kΩ ¼W 10%
 C1/2 125μF 10V
 Tr1/2 BFY51

Bulb and holder. Board. Plastic box and lid.
 Note pad to suit box.
 Batteries, 2 x 3V (U8) but see text.

clean and if the rod pivots freely it will be quite reliable.

The circuit is assembled on 0.15in perforated board about 90 x 22mm. The bulbholder is the type which has a clip that slips on the insulated board cut to accommodate it as shown. The holder may be slid along to place the bulb inside or outside the box. The box actually used (available from shops selling fishing tackle) is about 95 x 80 x 25mm and divided into three sections. This allows the circuit board to occupy the central section, with a U8 3V battery each side. Clips of tin, bent to a U shape, are cut to go at each end of the batteries, with the leads soldered on. The clips can be packed with foam rubber or otherwise arranged to keep pressure on the batteries. An additional lead passing from one battery to the other joins positive to negative.

A small scribbling pad to suit the box is held with elastic bands, which will also keep the lid on and finish the device. A pencil can also be attached. A box with a transparent lid allows the "turn over" instruction to be fixed inside.



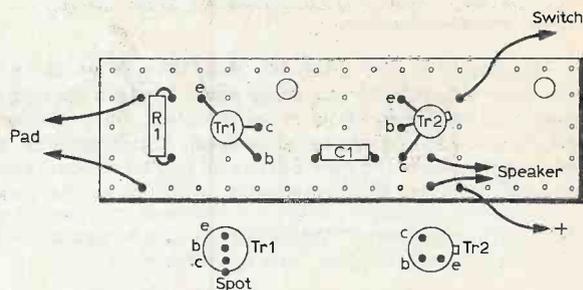
The speaker, circuit board, switch and battery can be fitted into any convenient sized box, leaving the pad to be placed outside in the open.

somewhat on the pad resistance. In these circumstances the current is about 10 to 25mA. A switch allows the device to be turned off, as there are times when it will not be needed or when note has already been taken of the warning.

RAIN WARNING BLEEPER

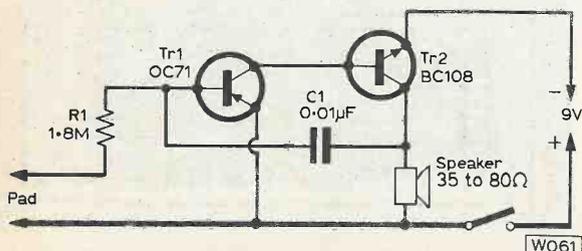
One small spot of rain on the sense pad of this bleeper will start this audio warning that drying clothes may need to be brought in! It can also be operated by rising water, if the pad is hung at the level the water should reach.

The circuit has two transistors, with feedback via capacitor C1, but Tr1 cannot operate as long as the pad is dry. In these conditions battery current is zero, so a battery will last for a very long time. When the pad conducts Tr1 and Tr2 form an audio oscillatory circuit, the pitch depending



WO62

Position of the components and foil side of the veroboard showing breaks required to be made before assembly.

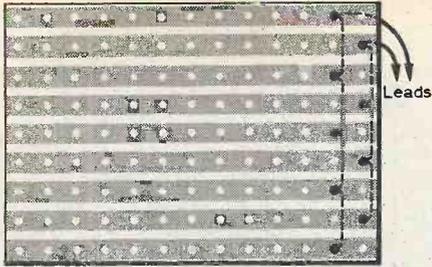


The circuit of the Rain Warning Bleeper could hardly be simpler. Altering the values of R1 and/or C1 will change the tone.

Bits and Pieces

R1 1.8MΩ ¼W 10%
 C1 0.01μF disc ceramic
 Tr1 OC71
 Tr2 BC108

On-off switch
 9V battery (PP3)
 Speaker, small size, approximate impedance 35 to 80Ω.
 Veroboard for oscillator and pad. Flex.
 Battery clips. Suitable box. see text.



W063

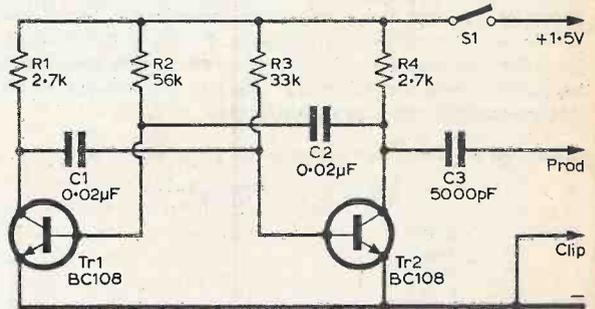
The size of the piece of veroboard used for the rain-detecting pad is not important but ensure alternate rails are connected as shown here.

First use a cutter or drill to break the foil sections where shown. The transistors and other components can then be inserted and soldered in place. Provide positive and negative flexible leads for the 9V battery, via the on-off switch, and for the speaker. A long, twin flexible lead is also required for the pad. The board is mounted by two bolts or screws in a case able to take the board, battery, speaker and switch.

The pad should have a minimum area of at least 30cm² with alternate foils connected together by wires on the insulated side of the board. The board is placed outside the house, foil side upwards. A touch with a moistened finger anywhere on the board should start the alarm.

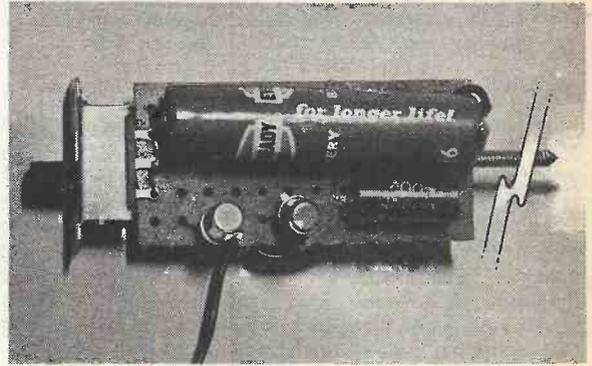
capacitors, but C3 is a 150V tubular capacitor, to give isolation from any voltage likely to be encountered. The clip, on a flexible lead, provides an earth return, but this need not always be used.

Dimensions of the insulated case are not critical but anything smaller than about 65mm long and 35mm diameter may cause difficulty in fitting all the components. A slot is cut or filed in the lid and switch S1 fixed with two bolts



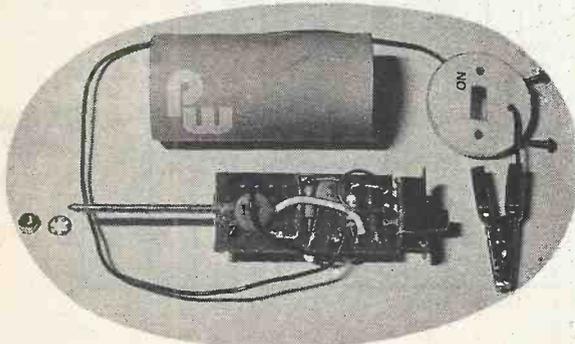
W056

The Signal Injector also uses a multivibrator circuit the output of which is very rich in harmonics.



The board is fixed to one set of contacts on the switch by wire passing through holes in the board. The other set of contacts is used for the on-off switch.

simple SIGNAL INJECTOR

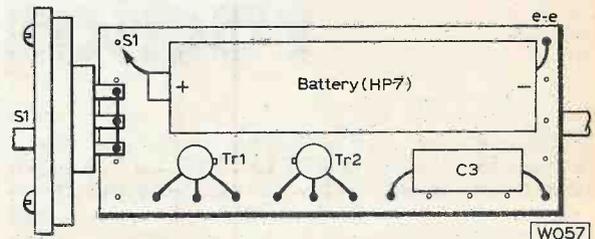
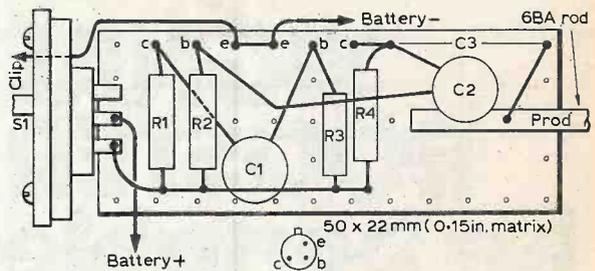


The finished Signal Injector ready to be fitted into its case, preferably a plastic one.

With this miniature signal generator a rapid check can be made of audio stages or the audio section of a radio receiver. Though an audible tone is produced, harmonics extend to much higher frequencies as is usual with circuits of this type, so that some tests can also be made for the intermediate frequency (IF) and other sections of a receiver.

Tests with the injector should only be made with battery operated receivers, as some types of mains equipment have a "live" chassis or dangerous voltages around.

In order to accommodate the components in a small cylindrical case, C1 and C2 are low voltage disc ceramic



W057

Having got the size of the board right the parts can be fitted as shown here. The battery wires are soldered to the battery contacts. A battery holder would take up too much space.

The small piece of insulated board can be attached to one set of unused tags on S1, with twisted wire, for support. At the other end the prod passes through a hole in the bottom of the container. The prod is 6BA threaded rod, secured with adhesive and a tight binding of thread, also smeared with adhesive, passing round it and through holes in the board. The tip of the prod is filed to a sharp point.

As battery drain is under 1mA, leads are soldered directly to the battery, outer case negative. If components are kept towards the middle, and close to the board, the whole will slip easily into the case. A lead with clip runs from the negative line. A nut on the rod outside holds this securely. Check that the metal cases of the transistors do not touch each other or anything else.

Bits and Pieces

- R1: 2.7k Ω
- R2: 56k Ω
- R3: 33k Ω
- R4: 2.7k Ω
- All resistors 1/4W 10%
- C1/2: 0.02 μ F disc ceramic
- C3: 5000pF 150V tubular
- Tr1/2: BC108

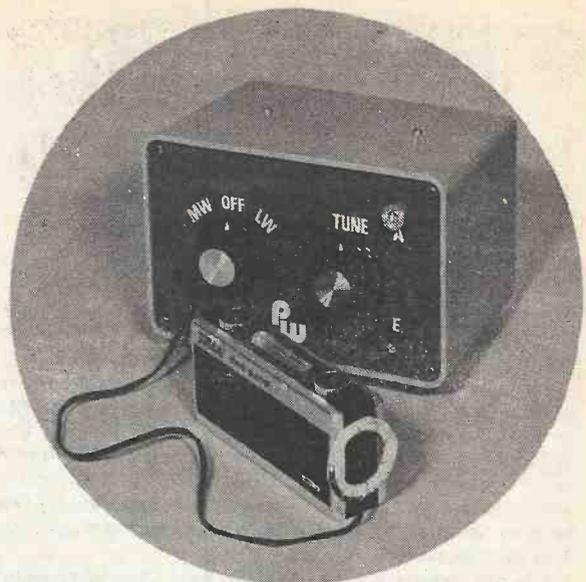
Battery, 1.5V (HP16). S1: Miniature slide switch, DPST or DPDT, Veroboard, Crocodile clip, 6BA threaded rod. Plastic tube and cap, see text.

When testing a circuit, work backwards, step by step, from the output stage. When the point at which a fault arises is passed, signals cease. The output of the injector is only sufficient to be just audible when taken directly to a speaker of 15 Ω or higher impedance. However, when the output stage and other amplifying stages are present, volume is greatly increased. The clip is generally taken to the equipment's "earth" line. In addition to locating a non-working stage, or break at a component, or in a winding the probe can also show if cracks exist in the foil conductors in AF sections of equipment. Remember to work step by step, taking in only one joint, foil conductor, coupling capacitor or other component at a time.

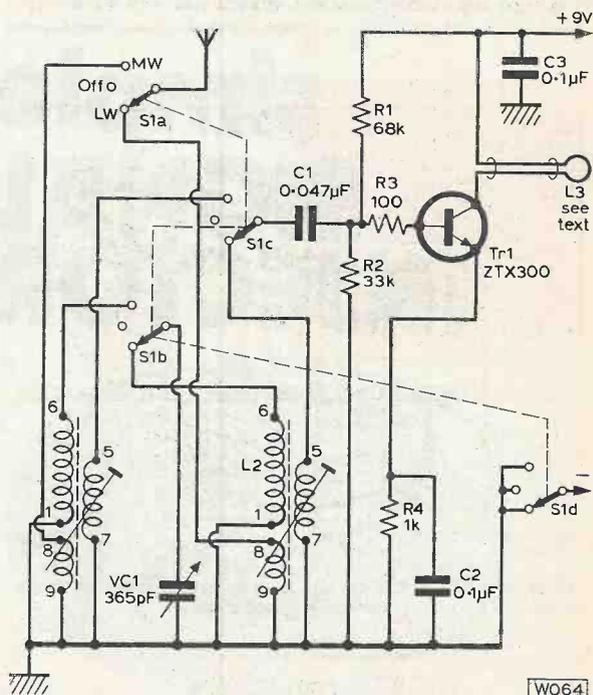
SIGNAL BOOSTER for portable radios

Many popular portable receivers cannot give enough volume from the weaker or more distant stations, especially during daylight hours. The unit described here is able to provide a considerable increase in signal strength and may even allow satisfactory reception of signals which are scarcely audible without its aid.

Signals for the unit are obtained from an external aerial which may be an internal or external wire up to about



Here the output coil of the Signal Booster is placed close to the internal aerial of the transistor radio.

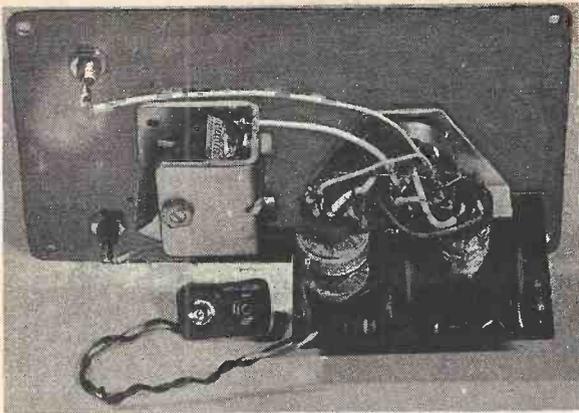


Circuit of the Booster which uses a single transistor and an external aerial. An earth connection will often help to increase the signal even further.

5m long. A telescopic aerial may prove satisfactory if nothing else is available, but the wire aerial will give much better results.

Switch S1a selects the aerial coupling winding of the long wave coil L1 or the medium wave coil L2. Switches S1b and S1c similarly select the appropriate tuned and base coupling windings. Variable capacitor VC1 will peak the signal over the range selected. S1d is the on-off switch.

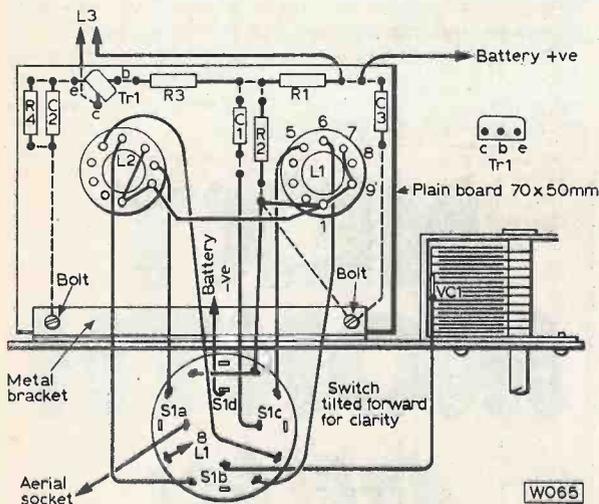
Coil L3 is a home-made 10 turn loop, about 25mm in diameter, wound with any fine insulated copper wire and



Rear view of the Booster showing circuit board fitted to the front panel via a metal bracket held under the wavechange switch.

bound with plastic tape. The coil is connected to a length of twin flexible lead or coaxial cable about 300mm long. The coil allows the coupling of the amplified signals to the ferrite rod aerial inside the receiver. Closest coupling occurs when the loop is slid on to the rod itself but it may be sufficient to place the coil outside the set with its turns parallel with the turns on the rod aerial.

A 150 x 100 x 100mm metal or plastic box with metal panel was used but the size is unimportant. The component



The parts should be laid out as shown here. The switch is, in fact, mounted on the vertical part of the metal bracket.

Bits and Pieces

- R1 68k Ω
- R2 33k Ω
- R3 100 Ω
- R4 1k Ω
- All resistors $\frac{1}{2}$ W 5%
- C1 0.047 μ F
- C2/3 0.1 μ F
- VC1 365pF variable
- Tr1 ZTX300
- S1 4-pole 3-way rotary wafer switch. Knobs. L1 Denco BLUE Range 1T. L2 Denco BLUE Range 2T. Case 150 x 100 x 100mm. Sockets. Battery 9V (PP3) and clips. Plain board. Wire for L3, see text. Twin flex.

board is bolted to a metal bracket fixed under the bush and out of the switch. When soldering to the pins on the coils scrape the pins clean and use a minimum of heat or the plastic former will soften. The aerial socket is insulated from the panel but the earth socket is connected to the panel.

The coupling of L3 to the receiver is a matter of trial and error and when it is correct there will be a marked increase in signal strength and VC1 will have a definite tuning point. Make sure that the unit is switched to the range required.

simple electronic DOOR ALARM

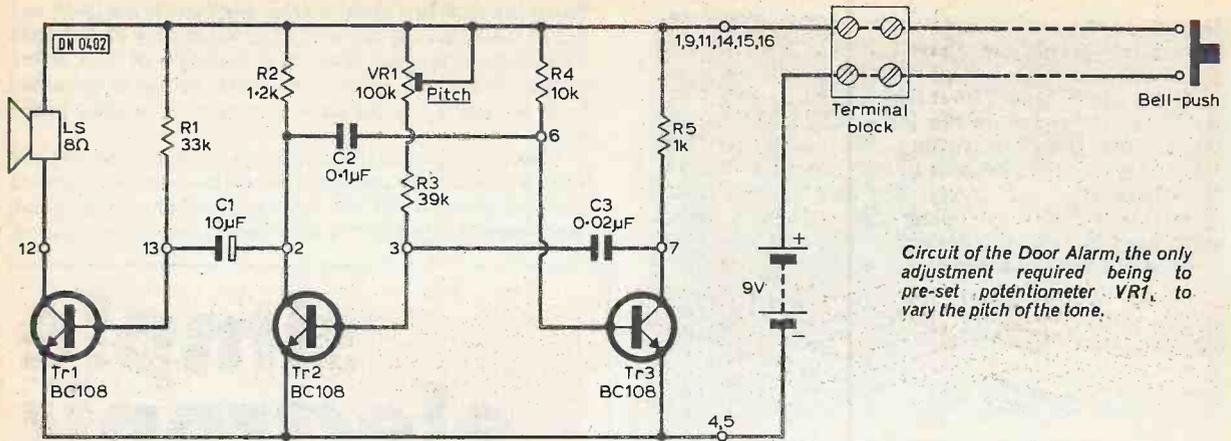
This unit replaces a door bell or buzzer and it runs economically from its own 9V battery. It is an easy and useful constructional project for a complete beginner. The circuit has numbered points which refer to the numbered tags of the tag-board. This should help anyone not familiar with electronic circuits to follow the theoretical circuit in conjunction with the actual wiring up of components.

Transistors Tr2 and Tr3 form a multivibrator and the audio tone produced is fed to the amplifier Tr1, by the coupling capacitor C1, which amplifies the tone for driving the loudspeaker.

The bell-push operates as an on-off switch so that no current is drawn until the push is operated. Pre-set potentiometer VR1 is a "pitch" setting control which allows the tone or frequency to be adjusted, but if two units are used for front and back doors the tones can be set at different frequencies. The push which has been operated can then be identified by the tone heard.

Bits and Pieces

- R1 33k Ω
- R2 1.2k Ω
- R3 39k Ω
- R4 10k Ω
- R5 1k Ω
- All resistors 10% $\frac{1}{2}$ W
- VR1 100k Ω miniature pre-set
- C1 10 μ F 10V
- C2 0.1 μ F
- C3 0.02 μ F
- Tr1 BC108
- Tr2 BC108
- Tr3 BC108
- PP6 9V battery and clips. Tagboard. Small speaker, approx. 8 Ω . Material for case. Bell-push. Bell-wire.



Circuit of the Door Alarm, the only adjustment required being to pre-set potentiometer VR1, to vary the pitch of the tone.

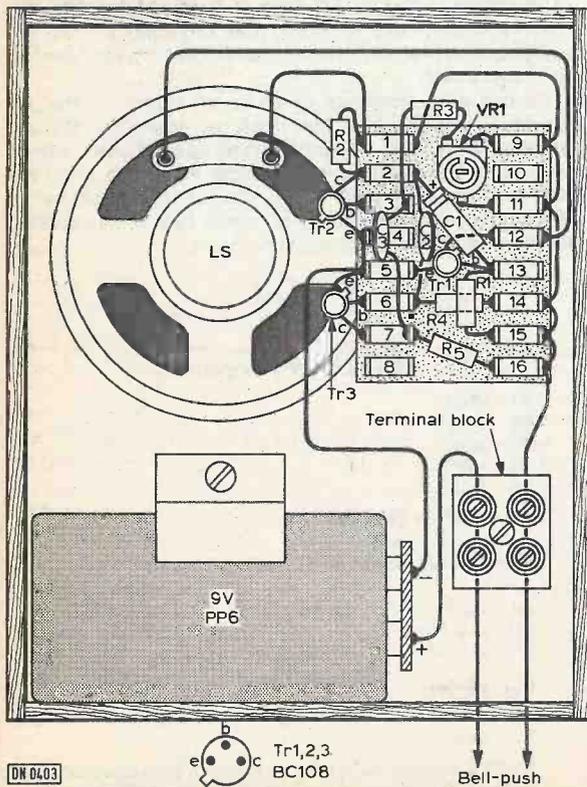
The wooden case used is intended to hang high up on a wall out of the way, and the front slopes downwards slightly. The case is 140mm square, 70mm deep at the top, sloping to 40mm at the bottom. All these parts can be of 4mm or similar plywood, but the dimensions are in no way critical. Cut a hole to suit the diameter of the speaker cone. The parts of the case are held together with glue, and panel pins if required. Strips or blocks of wood can be glued in to strengthen the corners. The case can be varnished or painted any colour to suit the decor. Glue fabric over the speaker opening and fix the speaker to the wall with a small metal tab.

Solder transistors, resistors and capacitors to the tagboard as shown. Transistor leads need not be cut down at all. If the soldering iron has reached its proper temperature, and is removed as soon as the joint is correctly made,

no damage to the transistors or other parts is likely from overheating.

One outer tag and the slider tag of VR1 are soldered to tags 9 and 11 to support this component. In most places bare wires can be arranged so that they are clear of each other. Elsewhere, insulated sleeving is put on connections, or insulated wire is used. When the board is finished, fix it as shown, with woodscrews. Spare nuts or other spacers are put on the screws to raise the board a little, to clear the edge of the speaker. See that the screws do not project through the front of the case. Alternatively, use 6BA screws through the tagboard and front of the case.

Only low-voltage bell wire need be used to the bell-push. A 2-way block allows these connections to be made without soldering. Cut a clip from scrap metal and screw it to the case to hold the PP6 9V battery.



DN 0403

Physical layout of the alarm, the tag numbers on the board corresponding to those shown in the circuit diagram.

NEXT MONTH
another
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