PRACTICAL WIRELESS

OCTOBER 1975

30p

EXTRA INSIDE 8-PAGE SUPPLEMENT

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Simple SIGNAL INJECTOR

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IN4005	12p	2N4036	62p
IN4006	14p	2N4037	44p
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IN4148	7p	2N4059	14p
2N696	25p	2N4060	12p
2N697	25p	2N4061	12p
2N698	25p	2N4062	12p
2N706	12p	2N4126	18p
2N706A	14p	2N4286	25p
2N708	15p	2N4287	25p
2N929	22p	2N4288	27p
2N930	20p	2N4289	30p
2N1132	25p	2N4290	25p
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U.H.F. V.S.W.R. probes ex U.H.F. transmitters £5 each + 8% VAT
All the above are new in original packets.
Please add 8% VAT P & P 30p.

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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.

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240V. A.C. SOLENOID. Reversible operation; twin coil. Size approx. 2¾ x 1½ x 1¾in. **90p.**

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801	0·8-2·2p	
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QUANTITY DISCOUNTS PLEASE TELEPHONE

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SN7409	40p	SN7427	42p	SN7445	£1·70	SN7473	40p	SN7494	80p
SN7410	18p	SN7428	50p	SN7446	£2·00	SN7474	40p	SN7495	80p
						SN7475	55p	SN7496	£1·00
						SN7476	45p	SN7497	£2·25
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AB10	4"	5¼"	1½"	55p
AB11	4"	2½"	2"	65p
AB12	3"	2"	1"	50p
AB13	6"	4"	2"	77p
AB14	7"	5"	2½"	90p
AB15	8"	6"	3"	£1·16
AB16	10"	7"	3"	£1·32
AB17	10"	4½"	3"	£1·10
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AB19	12"	8"	3"	£1·80

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★ ★ SPECIAL OFFERS ★ ★

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OMRON OCTAL RELAY 240V A.C. 3P c/o **75p** each+ 8% VAT.

SLEEVING 2000 pieces approx. size ⅞" x 2mm. Price **£1·00** +33p P&P+VAT 8%

We are open from 9.30 a.m.—6.00 p.m. Monday-Saturday.

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PRACTICAL WIRELESS

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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.

NEWS & COMMENT

CONSTRUCTIONAL

OTHER FEATURES

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

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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Full labour and material guarantees for 12 months **LOW DEPOSIT CREDIT TERMS**

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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
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ROTEl RX152 Tun/Amp	£109·39	£79·95
ROTEL RX202 Tun/Amp	£124·42	£89·95
ROTEL RX402 Tun/Amp	£169·93	£120·95
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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
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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 Rec. Price	RSC Price 1	5	10	SUPER SM CASSETTES Rec. Price	RSC Price 1	5	10
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C90	1·36	90p	3·99	6·99	1·40	1·05	4·75	8·95
C120	1·87	1·20	5·50	9·90	1·94	1·46	6·75	12·95

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Prices of above correct at Aug 19 1975

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GXC39	£205·50	£144·95
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GXC310D	£113·00	£79·95
GXR82D	£162·50	£116·95
4000DS	£619·50	£122·95

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GARRARD SP25 Mk. IV with Plinth and Cover plus G850 Cart.	£29·95

PLINTH AND COVER

for Garrard SP25 or BSR MP60

£3·75
Carr. 50p

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	Rec. Price	RSC Price
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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

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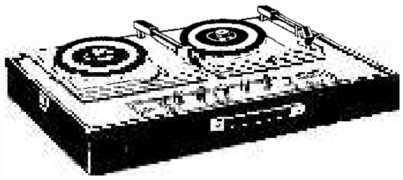
40 WATT

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. carr. £3 **£99·99**

Terms: Dep. **£15·99** and 18 fortnightly paymts. **£5·38.** (Total **£112·83**)

MOBILE DISCO CONSOLE

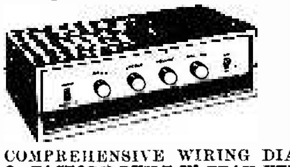


MIC., JACK, PHONE JACK, MONITOR VOL. CONTROL. MONITOR SELECTOR DECK (1) Vol. Control, DECK (2) Vol. control, Mic. Vol. Control, Treble Control, Bass Control and ON/OFF Switch, Neon Indicator, BSR T/tables. Carr. £3 **£59·95**

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 COMPREHENSIVE WIRING DIAGRAMS & INSTRUCTIONS **£14·99** Carr 40p
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 13×9¼×6¼in. **£4·50**
JE8 16×11×9in. **£6·95**
Both cut for 8in. speaker.
SE10 25×16×9in. **£10·25**
Cut for 10in. and Tweeter
SE12 25×16×9in. **£10·25**
Cut for 12in. and Tweeter

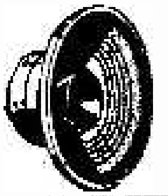
POWER (SLAVE) AMPLIFIER 100 WATT

Suitable for use with above or other DISCO-Consoles. Also for increasing output of lower-powered Amplifiers.

carr. £1 **£39·95**

Terms: Dep. **£5·11** and 8 mthly paymts of **£5·11** (Total **£45·99**)

AUDIOTRINE HIGH FIDELITY SPEAKERS

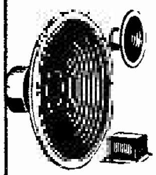


Heavy construction. Latest high efficiency ceramic magnets. Plasticised Cone surround. "D" or "T" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 8-15 ohms. PLEASE STATE CHOICE.

Exceptional performances at low cost.

HF808T	8"	10W	£2·95	HF120D	12"	15W	£7·50
HF102D	10"	10W	£3·95	HF126	12"	15W	£9·25
HF120	12"	15W	£6·95	HF126D	12"	15W	£9·95

AUDIOTRINE HI-FI SPEAKER SYSTEMS



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 ensure surprisingly realistic reproduction. **£7·95** Carr. 45p
OR SENIOR 15 WATT INCLUDING HF123 13,000 GAUSS SPEAKER **£10·25** Carr. 50p

AUDIO FIDELITY FRI SPEAKER KIT

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. Terminal Panels. **£13·64** each Carr. Free.

SPECIAL OFFER **£18·50** Pair Carr. 50p

AUDIO FIDELITY MODEL 80 HIGH FIDELITY SPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 8-15 Ω. £6·21 ea. **£9·25** pr.

MODEL 83 8" 15w. with parasitic Tweeter. £7·99 ea. **£12·50** pr.
Response 25 Hz to 15 KHz. Gauss 13,000 Imp 8–15 Ω

R.S.C. TRANSFORMERS, L.F. CHOKES & RECTIFIERS

FULLY GUARANTEED. Impregnated and Interleaved where necessary. Primaries 200-250v. 50c/s. Screened

ALL PRICES INCLUDE V.A.T.

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250v. 60mA 6·3v. 2a.	£1·75
250-0-250v. 60mA 6·3v. 2a.	£1·85

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250v. 60mA 6·3v. 2a. 0-5-6·3v. 2a.	£2·60
250-0-250v. 100mA 6·3v. 4a. 0-5-6·3v. 3a.	£4·35
300-0-300v. 130mA 6·3v. 4a. C.T. 6·3v. 1a. for Mullard 510 Amplifier	£5·20
350-0-350v. 100mA 6·3v. 4a. 0-5-6.3v. 3a.	£4·35
350-0-350v. 150mA 6·3v. 4a. 0-5-6·3v. 3a.	£5·20
425-0-425v. 200mA 6·3v. 4a. C.T. 5v. 3a.	£9·85
425-0-425v. 200mA 6·3v. 4a. 6·3v. 4a. 5v. 3a.	£10·00
450-0-450v. 250mA 6·3v. 4a. C.T. 5v. 3a.	£10·45

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250-0-250v. 100mA 6·3v. 3·5a.	£2·90
250-0-250v. 100mA 6·3v. 2a. 6·3v. 1a.	£3·20
350-0-350v. 80mA 6·3v. 2a. 0-5-6·3v. 2a.	£3·20
250-0-250v. 100mA 6·3v. 4a. 0-5-6·3v. 3a.	£4·35
300-0-300v. 100mA 6·3v. 4a. 0-5-6·3v. 3a.	£4·35
300-0-300v. 130mA 6·3v. 4a. 0-5-6·3v. 1a suitable for Mullard 510 Amp.	£5·20
350-0-350v. 100mA 6·3v. 4a. 0-5-6·3v. 3a	£4·35
350-0-350v. 150mA 6·3v. 4a. 0-5-6·3v. 3a.	£5·20

FILAMENT OR TRANSISTOR POWER PACK
Type: 12v. 1a. **£1·10**, 6·3v. 1·5a **£1·06**, 6·3v. 2a. **£1·10** 6·3v. 3a **£1·70**, 6·3v. 6a. **£2·60**, 12v. 3a. or 24v. 1·5a. **£2·60** 0-9-18v. 1½a. **£2·26**, 0-12-25-42v. 2a. **£3·19**

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0-110/120v. 200-230-250v. 50-80w. **£2·90** 150 watts **£5·20**, 250 watts **£6·37**, 500 watts **£9·84**

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0-9-15v. 1½a. **£2·03**, 2½a. **£2·26**, 3a. **£2·32**, 5a. **£2·84**, 6a. **£3·19**, 8a. **£3·48**

OUTPUT TRANSFORMERS
Standard Pentode 5000 to 3 ohm, or 7000 ohm to 3 ohm **£1·12**, Push Pull 8 watts EL84 to 3 ohm or 15 ohm **£1·68**; Push Pull 10-12 watts 6v. 6 to 3 ohm or 15 ohm **£2·61**; Push Pull 10-12 watts to match 6v. 6 to 3, 5, 8 or 15 ohm **£2·72**; Push Pull EL84 to 3 or 15 ohm 10-12 watts **£2·61**; Push Pull Ultra Linear for Mullard 510 etc. **£4·35**;.

SELENIUM RECTIFIERS F. W. (Bridged)
All 6/12v. D.C. output. Max. A.C. input 18v. 1a, 45p. 2a, 57p. 3a, 65p. 4a, 95p. 5a, £1.15.

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5000/70	**76p**	1000 30	**25p**	100/12	**7p**
5000/50	**75p**	1000 25	**25p**	8/450	**16p**
5000/35	**50p**	470 63	**23p**	16/450	**25p**
5000/12	**25p**	470 35	**16p**	50/450	**30p**
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2500/70	**63p**	250 64	**20p**	50 50	**8p**

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INTEGRATED AUDIO POWER AMPS

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The 30 and 50W types have internal electronic protection and all types may be used on either single rail or + and − power supplies.
Freq. resp. 20Hz-100kHz (all types).
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50W RMS (4 Ω) amp. kits complete with building and application details. Suitable for instruments, disco, hi-fi, etc. **£8·95.**

ZN414 IC Radio, **£1·20**
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Complete range of components held in stock.
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OA90	**8p**	400mW	**16p**
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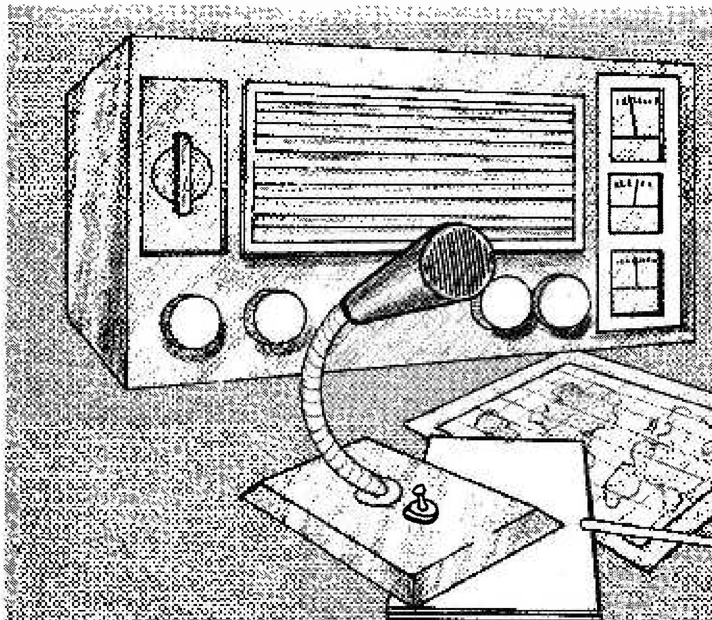

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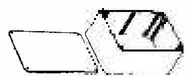
A plastic box with moulded extrusion rails for PC or Chassis panels with metal front plate fitted with four screws (all supplied).
An ideal box to give a small project a professional finish.
SIZE (internal) 81mm × 51mm × 28mm.
OUR PRICE 40p. +8%



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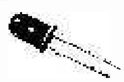

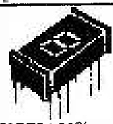

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2 Pole 6 Way
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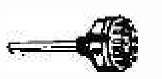
22p each +8%



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Singles		Dual	
5K	Log or	5K	
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50K	17p each	50K	Switch
100K		100K	53p each
250K	Double	250K	+25%
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Open Type Double Wound Continuously Rated, two hole fixing clamp with colour coded flying leads, varnish impregnated. Approx. size: 1¼" × 1¼" × 1¼" high
Fixing centres: 2⁵/₃₂".
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TR2 12-0-12 v 100 m/a
TR3 9-0-9 v 100 m/a
TR4 6-0-6 v 100 m/a
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All 240 Volt Primary
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9 volt. High impedance input. Gold finish with four black plastic chrome tipped level control knobs. On/Off switch and stereo/mono switch. 4 Input sockets.
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Input Imp = For XTAL Mics etc.
Gain = Approx 3.DB.
Max Input Sig = 1 volt
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Noise Ratio = —60DB
Supply = 9 volt
OUR PRICE = £5·25p +25%

POWER SUPPLY UNITS
PP1 switched 3, 4½, 6, 7½, 9 and 12 volts at 500 m/a, with on/off switch and pilot light. Size: 130mm × 55mm × 75mm. ONLY £4·00.
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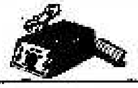

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3¾ × 5	47p	49p	34p
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17 × 3¾	1·66p	1·32p	97p
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Pin insertion tool 81p
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2½" 8 ohm 60p
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3 — 8 — 15 ohm
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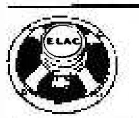

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Manufactured by "ELAC" to a very high standard these loudspeakers are a real bargain
SPEC:—Size=10" Dual Cone.
Power=10 Watts
Frequency=40-12000Hz
+25% Our Price = £3·75p each

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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).
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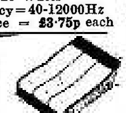

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Metal project boxes give your work a professional finish

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AB8	4	4	1½	63p
AB9	4	2½	1½	54p
AB10	4	5¼	1½	63p
AB11	4	2½	2	54p
AB12	3	2	1	45p
AB13	6	4	2	63p
AB14	7	5	2½	84p
AB15	8	6	3	[illegible]
AB16	10	7	3	£1·[illegible]
AB17	10	4½	3	£1·02
AB18	12	5	3	£1·20
AB19	12	8	3	£1·50

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Handy boxes for construction projects. Moulded extrusion rails for P.C. or chassis panels. Fitted with 1mm front panels.
1005 = 105mm × 73mm × 45mm = 55p
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1021 = 106mm × 74mm × 45mm (sloping front) = 55p

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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%

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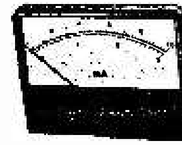
Size 59mm × 46mm × 35mm these meters require a 38mm hole for mounting.
ME6 =0 to 50 micro amp Full Scale
ME7 =0 to 100 micro amp Full Scale
ME8 =0 to 500 micro amp Full Scale
ME9 =0 to 1 m/a Full Scale
ME10 =0 to 5 m/a Full Scale
ME11 =0 to 10 m/a FullScale
ME12 =0 to 50 m/a Full Scale
ME13 =0 to 100 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%



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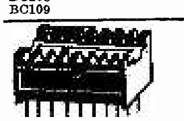

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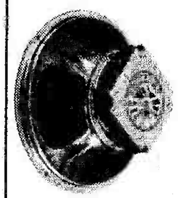

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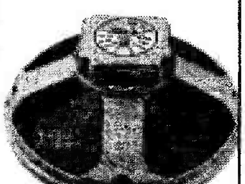

T15/70 Rated Power 70 WATTS

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

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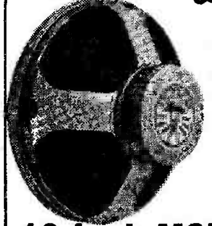

T15/100 Rated Power 100 WATTS

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

Rec. Price **£38·50**

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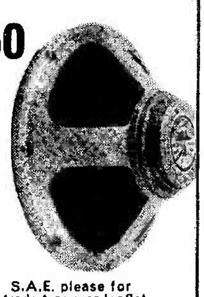

T18/100 Rated Power 100 WATTS

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

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100-0-100uA	£4.10
1mA	£4.05
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
10V DC	£4.05
20V DC	£4.05
25V DC	£4.05
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5A DC	£4.75
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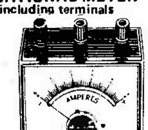

50uA	£9.35
100uA	£8.70
50-0-50uA	£8.70
1mA	£8.40
1-0-1mA	£8.40
1A DC	£8.40
5A DC	£8.40
5V DC	£8.40
10V DC	£8.40
15V DC	£8.40
20V DC	£8.40
50V DC	£8.40
300V DC	£8.40
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5V/50V DC	£9.50
5V/15V DC	£9.50
1A/15A DC	£9.50

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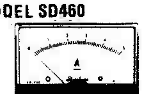
Size: 59 x 46mm



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

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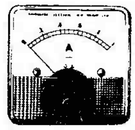
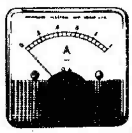
500uA	£4.55
50-0-50uA	£4.65
100-0-100uA	£4.60
1mA	£4.50
5mA	£4.50
10mA	£4.60
50mA	£4.50
100mA	£4.50
500mA	£4.50
1A DC	£4.50
5A DC	£4.50
10A DC	£4.50
5V DC	£4.50
10V DC	£4.50
20V DC	£4.50
50V DC	£4.50
300V DC	£4.50
15V DC	£4.60
300V AC	£4.60
VU Meter	£5.60

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



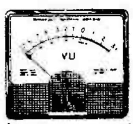
50uA	£3.55
100uA	£3.50
200uA	£3.45
500uA	£3.30
50-0-50uA	£3.50
100-0-100uA	£3.45
500-0-500uA	£3.25
1mA	£3.25
5mA	£3.25
10mA	£3.25
50mA	£3.25
100mA	£3.25
500mA	£3.25
1A DC	£3.25
5A DC	£3.25
10V DC	£3.25
20V DC	£3.25
50V DC	£3.25
300V DC	£3.25
15V AC	£3.40
300V AC	£3.40
5 Meter 1mA	£3.75
VU Meter	£4.30
1A AC	£3.25*
5A AC	£3.25*
10A AC	£3.25*
20A AC	£3.25*
30A AC	£3.25*

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



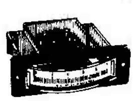
50uA	£3.45
100uA	£3.40
200uA	£3.30
500uA	£3.10
50-0-50uA	£3.40
100-0-100uA	£3.30
500-0-500uA	£3.05
1mA	£3.05
1-0-1mA	£3.05
2mA	£3.05
5mA	£3.05
10mA	£3.05
20mA	£3.05
50mA	£3.05
100mA	£3.05
150mA	£3.05
200mA	£3.05
300mA	£3.05
500mA	£3.05
750mA	£3.05
1A DC	£3.05
2A DC	£3.05
5A DC	£3.05
10A DC	£3.05
3V DC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

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



50uA	£6.00
100uA	£5.95
200uA	£5.90
500uA	£5.80
50-0-50uA	£5.95
100-0-100uA	£5.90
500-0-500uA	£5.65
1mA	£5.75
1-0-1mA	£5.75
5mA	£5.75
10mA	£5.75
50mA	£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
50V DC	£5.75
150V DC	£5.75
300V DC	£5.75
15V AC	£5.85
300V AC	£5.85
5 Meter 1mA	£6.65
VU Meter	£7.10
1A AC	£5.75*
5A AC	£5.75*
10A AC	£5.75*
20A AC	£5.75*
30A AC	£5.75*

EDGWISE MODEL PE70
Size: 90 x 34mm



50uA	£4.55
100uA	£4.50
200uA	£4.45
500uA	£4.30
50-0-50uA	£4.50
100-0-100uA	£4.45
1mA	£4.25
10V DC	£4.25
300V DC	£4.35
VU Meter	£5.50

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BAKELITE MODEL S80 Enlarged Window
Size: 80 x 80mm

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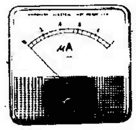
500uA	£4.60
50-0-50uA	£4.80
100-0-100uA	£4.85
1mA	£4.60
1A DC	£4.60
5A DC	£4.60
20V DC	£4.60
50V DC	£4.60
300V DC	£4.60
300V AC	£4.75
VU Meter	£5.95

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

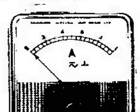


50uA	£4.10
100uA	£3.85
500uA	£3.70
50-0-50uA	£3.85
100-0-100uA	£3.70
1mA	£3.65
5mA	£3.65
10mA	£3.65
50mA	£3.65
100mA	£3.65
500mA	£3.65
1A DC	£3.65
5A DC	£3.65
10V DC	£3.65
20V DC	£3.65
50V DC	£3.65
300V DC	£3.65
15V AC	£3.75
300V AC	£3.75
5 Meter 1mA	£4.20
VU Meter	£4.85
1A AC	£3.65*
5A AC	£3.65*
10A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

BAKELITE MODEL MR 65 Size: 80 x 80mm

25uA	£5.80
50uA	£4.40
100uA	£4.35
500uA	£4.05
50-0-50uA	£4.35
100-0-100uA	£4.30
500-0-500uA	£3.95
1mA	£3.95
1-0-1mA	£3.95
5mA	£3.95
10mA	£3.95
50mA	£3.95
100mA	£3.95
500mA	£3.95
1A DC	£3.95
2A DC	£3.95
5A DC	£3.95
10A DC	£3.95
15A DC	£3.95
30A DC	£3.95
50A DC	£4.20
5V DC	£3.95
10V DC	£3.95
15V DC	£3.95
20V DC	£3.95
50V DC	£3.95
150V DC	£3.95
300V DC	£3.95
30V AC	£3.95*
50V AC	£3.95*
150V AC	£3.95*
300V AC	£3.95*
500V AC	£3.95*
VU Meter	£5.20
1A AC	£3.95*
5A AC	£3.95*
10A AC	£3.95*
20A AC	£3.95*
30A AC	£3.95*
50A AC	£3.95*
500mA AC	£3.95
50mV DC	£4.15
100mV DC	£4.15

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



50uA	£4.35
100uA	£4.25
200uA	£4.20
500uA	£4.15
50-0-50uA	£4.25
100-0-100uA	£4.20
500-0-500uA	£4.10
1mA	£4.10
1-0-1mA	£4.10
5mA	£4.10
10mA	£4.10
50mA	£4.10
100mA	£4.10
500mA	£4.10
1A DC	£4.10
5A DC	£4.10
10A DC	£4.10
15A 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
300V DC	£4.10
15V AC	£4.20
50V AC	£4.20
150V AC	£4.20
300V AC	£4.20
500V AC	£4.30
5 Meter 1mA	£4.85
VU Meter	£5.20
1A AC	£4.10*
5A AC	£4.10*
10A AC	£4.10*
20A AC	£4.10*
30A AC	£4.10*
50A AC	£4.10
50mA AC	£4.10*
100mA AC	£4.10*
200mA AC	£4.10*
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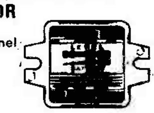

18mm
18mm Panel mounting.
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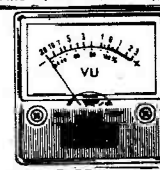

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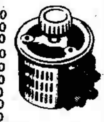

		P/P & Ins
1A	£7.30	£1.50
2.5A	£10.35	£1.50
5A	£12.95	£1.50
8A	£19.45	£1.50
10A	£23.75	£1.50
12A	£25.90	£1.50
20A	£60.45	£1.50
25A	£64.75	£1.50
40A	£73.40	£1.50

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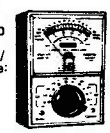
AUDIOTRONIC Model ATM1
Top value 1,000 opv pocket multi-meter. Ranges:—0/10/50/250/1,000 volt AC and DC. DC current 0-1mA/100mA. Resistance: 0/150k ohms. Decibels: —10 to +22dB. Size 90 x 60 x 28mm. Complete with test leads.



OUR PRICE £4.30 P/P & Ins 25p

AUDIOTRONIC MODEL ATM5
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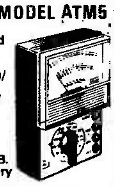

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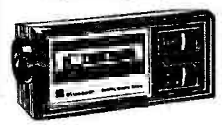

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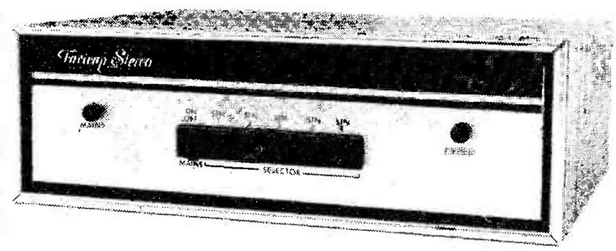

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0–1 mA	170	0–1 mA	200
0–5 mA	170	0–5 mA	200
0-10 mA	6	0-10 mA	6
0–50 mA	0·5	0–50 mA	0·5
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0–1 AMP	0·5	0–1 AMP	0·5
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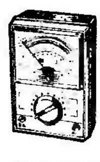
Size 60 × 24 × 90 mm



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VA (watts)	Ref No.	Price Cased £	Price Plugs 2 Pin + 1 Earth	Price Open £	Post £
60	149	8·35	0·88	4·37	0·56
100	150	9·15	0·88	4·90	0·64
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
500	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 12V	Amps 24V	Ref. No.	Price £	Post £
0·3	0·15	242	1·58	0·34
0·5	0·25	111	1·88	0·34
1	0·5	213	1·74	0·47
2	1	71	2·30	0·47
4	2	18	2·96	0·56
6	3	70	4·18	0·56
8	4	108	4·56	0·64
10	5	72	5·20	0·72
12	6	116	5·51	0·72
16	8	17	7·00	0·80
20	10	115	10·42	0·88
30	15	187	13·25	1·01
40	20	232	14·85	O.A.
60	30	226	16·83	O.A.

30 Volts

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

Amps	Ref. No.	Price £	Post £
0·5	112	1·90	0·47
1	79	2·40	0·56
2	3	3·50	0·56
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
10	89	9·67	0·95

AUTO TRANSFORMERS

VA Watts	Ref. No.	Price Cased £	Price Plugs 2 & 3 pin	Price Open £	Post £
Tapped at 115, 220, 240 Volts					
20	113	3·85	0·20	1·71	0·47
Tapped at 115, 200, 220, 240 Volts					
150	4	6·38	0·20	4·12	0·56
200	65	7·04	0·20	4·95	0·64
300	66	8·00	0·20	5·81	0·72
500	67	10·99	0·20	8·85	0·88
750	83	13·82	0·85	10·80	0·95
1000	84	17·27	0·85	13·68	1·13
1500	93	21·87	0·85	18·31	O.A.
2000	95	33·11	1·60	24·25	O.A.
3000	73	47·94	2·10	35·10	O.A.

50 Volts

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

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

Prim. 230–240V. Sec. 24, 30, 40, 48, 60V.

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	125	7·52	0·80
4	123	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.

MINIATURE AND EQUIPMENT

Prim. 240V with screen.

Volts Sec. 1	Volts Sec. 2	Milliamps Sec. 1	Milliamps Sec. 2	Ref. No.	Price £	Post £
3–0–3	—	200	—	238	1·50	0·25
0–6	0–6	500	500	234	1·38	0·25
0–6	0–6	1000	1000	212	1·90	0·47
9–0–9	—	100	—	13	1·40	0·25
0–9	0–9	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	—	40	—	240	1·35	0·25
0–15	0–15	200	200	236	1·38	0·25
20–0–20	—	30	—	241	1·35	0·25
0–20	0–20	150	150	237	1·38	0·25
0–15–20	0–15–20	500	500	205	2·73	0·56
0–20	0–20	300	300	214	1·93	0·47
0–20	—	3500	NO SCREEN	1116	3·30	0·64
20–12–0–12–20	—	700 (D/C)	—	221	2·20	0·47
0–15–20	0–15–20	1000	1000	206	3·50	0·56
0–15–27	0–15–27	500	500	203	3·00	0·56
0–15–27	0–15–27	1000	1000	204	3·85	0·56

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One Amp	Two Amp	Four Amp	Six Amp
50 P.I.V. 20p	50 P.I.V. 35p	100 P.I.V. 55p	50 P.I.V. 65p
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200 P.I.V. 28p	200 P.I.V. 45p	400 P.I.V. 65p	200 P.I.V. 80p
600 P.I.V. 30p	400 P.I.V. 50p	600 P.I.V. 75p	400 P.I.V. 90p

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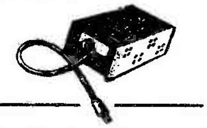
Output switched 3, 4·5, 6, 7·5, 9 and 12 volts at 500 mA D.C. Operates from 240 V mains, suitable for Radios, Tape Recorders, Record Players etc Size 7·5 × 5·0 × 14·0cm. Price £3·95. Post 25p.



MINIATURE NEONS

6mm dia., 12mm length leads length approx. 20mm. Recommended ballast resistor 150K ohms for 240 Volt operation Price: Packet of 10 for 60p. Postage 15p.

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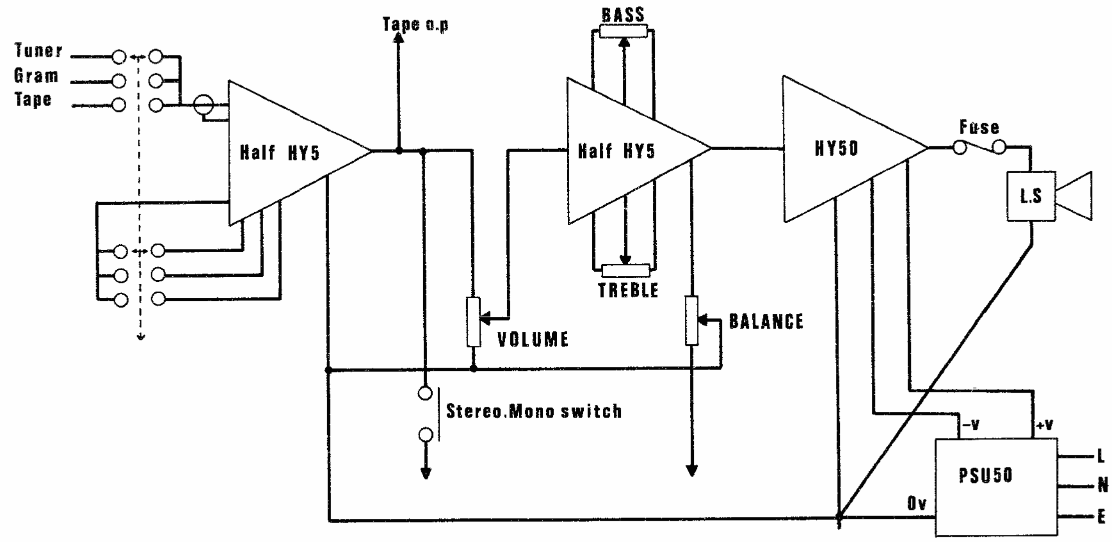
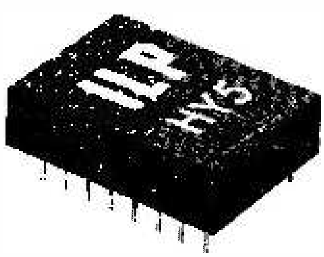
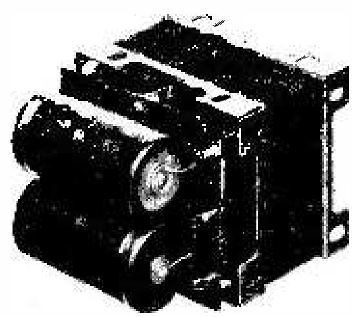


MONO ELECTRICAL CIRCUIT DIAGRAM WITH INTERCONNECTIONS FOR STEREO SHOWN





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; Auxiliary 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.

PRICE £4·50 + 36p VAT P. & P free

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.

TECHNICAL SPECIFICATION
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 25W typically 0·05%. **Signal/Noise Ratio:** Better than 75db **Frequency Response:** 10Hz-50kHz ± 3db. **Supply Voltage:** ± 25V. Size: 105 x 50 x 25mm.

PRICE £5·98 + 48p VAT P. & P. free

The PSU50 incorporates a specially designed transformer and can be used for either mono or stereo systems.

TECHNICAL SPECIFICATIONS
Output voltage: 50V (25-0-25V). **Input Voltage:** 210-240V.
Size: L.70. D.90. H.60mm.

PRICE £6 + 48p VAT P. & P. free

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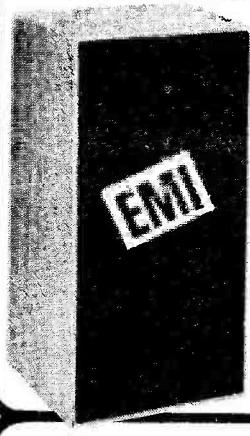


LE-4 SPEAKERS

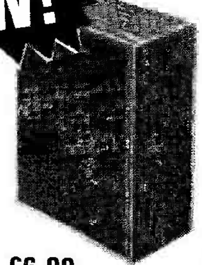
Superb performance and beautifully finished in selected teak veneers. A professional standard four-way speaker system giving 25 watts RMS power handling. Bass unit is 14"×9" with 8"×5" unit for mid-range and twin 3" high frequency units to give monitor type quality and performance.
Specification — Size 33"×14"×16" approx. Impedance 8 ohms. Power handling 25W RMS. (Peak 50 watts.) Frequency range 35 Hz–20 KHz.

Our Price £34.00 each
(normally £66.00)+£5.80 p & p.
Scotland and the Orkneys
P & P Surcharge £3.50

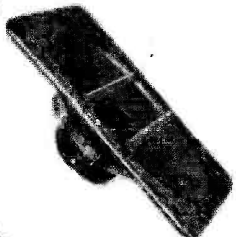
THE 'COMPACT' NEW!

EASY BUILD SPEAKER KIT

A compact bookshelf speaker system giving a high electro accoustic efficiency for the low powered amplifier.
The professional finish can be obtained with the minimum of tools, the infinite baffle type enclosures come ready mitred and professionally finished, simply apply glue, fold up around baffle board, and fix together with masking tape till glue dries.
The cabinet measures 12"x9"x5" deep approx finished in simulated teak, incorporating a quality 7"x4" elliptical speaker, power handling 4 watts, flux density 30,000 maxwells, impedance 8-15 ohms nominal, voice coil dia $\frac{3}{4}$" magnet size $2\frac{7}{8}$" approx.



£6.00
pair inclusive P & P £1.70



EMI 350 KIT

System consists of a 13" × 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.)

£6.50 +£1.20 p & p.

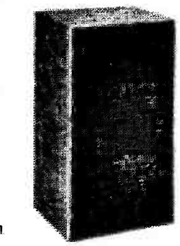
Complete with crossover Components and circuit diagram

EASY TO BUILD SPEAKER KITS

These superb simulated teak-finished speaker kits have been specially designed by RT-VC for the cost-conscious hi-fi enthusiast who wants top quality speakers but doesn't want to spend the earth. Built to EMI's exacting specification, these new RT-VC speaker kits (350 type kit) incorporate 13" × 8" woofer, $3\frac{1}{4}$" tweeter and matching crossover.
Easily put together with just a few basic tools.
Specification (each speaker): Impedance 8 ohms. Power handling 15 watts RMS (30 watts peak). Response 20–20,000 Hz. Size 20" × 11" × $9\frac{1}{2}$" approx. Comparable built units (EMI LE3) sold elsewhere for over £45 pair.

£22.00 pair complete +£5.20 p & p.

Complete with crossover Components and circuit diagram



RTVC* NEW!

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**: $15\frac{1}{4}$" × 3" × 10".
MP60 type deck with magnetic cartridge, de luxe plinth and cover.
Two Duo Type IIa matched speakers — Enclosure size approx. $19\frac{1}{2}$" × $10\frac{3}{4}$" × $7\frac{3}{4}$" in simulated teak. Drive unit 13" × 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" × 13" × $11\frac{1}{2}$". Finished in teak simulate. Drive units 13" × 8" bass driver, and two 3" (approx.) tweeters. 20 watts RMS. 8 ohms frequency range — 20 Hz to 18,000 Hz.
Complete System with these speakers £81.00 +£7.60 p & p.

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
Available complete for only £65.00 +£6.50 p & p.

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.
Total if purchased separately: £91.00
Available complete for only £81.00 +£7.60 p & p.

20x20 SYSTEM

Scotland and the Orkneys P & P Surcharge
System 1a £1.75 System 2 £3.50

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 1/8th W.	0·60
R2	50	Mixed	1K ohms–8·2 Kohms 1/8th W.	0·60
R3	50	Mixed	10K ohms–82 Kohms 1/8th W.	0·60
R4	50	Mixed	100K ohms–820 Kohms 1/8th W.	0·60
R5	30	Mixed	100 ohms–820 ohms ¼ W.	0·60
R6	30	Mixed	1K ohms–8·2 Kohms ¼ W.	0·60
R7	30	Mixed	10K ohms–82 Kohms ¼ W.	0·60
R8	30	Mixed	100K ohms–820 Kohms ¼ W.	0·60

THESE ARE UNREPEATABLE PRICES

LOW COST CAPACITORS

500	µF	50V Elect	0·09 each
·01	µF	400V	0·03 each

REPANCO CHOKES & COILS

RF Chokes	CH1	2·5mH	0·27
	CH3	7·5mH	0·29
	CH5	1·5mH	0·26
	CH2	5·0mH	0·28
	CH4	10mH	0·31

COILS DRX1 Crystal set 0·29 DRR2 Dual range 0·42

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 ganti-Log	0·43

HORIZONTAL CARBON PRESETS

0·1 Watt 0·06 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
MT50/½	½	£1·79	0·45p
MT50/1	1	£2·24	0·48p
MT50/2	2	£3·06	0·60p

COIL FORMERS & CORES

NORMAN ¼" Cores & Formers 0·07p
⅜" Cores & Formers 0·09p

SWITCHES

DP/DT Toggle 0·28p SP/ST Toggle 0·22p

FUSES

1¼" and 20mm, 100mA, 200mA, 250mA, 500mA, 1A, 1·5A, 2A QUICK BLOW ★0·05p each
Anti-serge 20mm only ★0·0p each

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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 ★0·92p

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Takes 6 H.P. 7s complete with terminal clip and lead ★0·31p each

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			Per Metre
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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

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

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BV2	11"	× 6"	× 3"	★£1·62
BV3	6"	× 4¾"	× 1¼"	★0·92
BV4	9"	× 5¼"	× 2½"	★£1·39

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No.	Length	Width	Height	Price
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BA2	4"	× 4"	× 1½"	★0·45
BA3	4"	× 2¼"	× 1½"	★0·45
BA4	5¼"	× 4"	× 1½"	★0·54
BA5	4"	× 2½"	× 2"	★0·45
BA6	3"	× 2"	× 1"	★0·39
BA7	7"	× 5"	× 2½"	★0·79
BA8	8"	× 6"	× 3"	★£1·02
BA9	6"	× 4"	× 2"	★0·65

(Each complete with ½" 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 values	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	★0·60
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 × 3·5m, 2 × standard Switch Type	0·60
C12	30	Paper Condensers preferred types mixed values	0·60
C13	20	Electrolytics 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	20	Assorted Tag Strips & Panels	0·60
C17	10	Assorted Control Knobs	0·60
C18	4	Rotssy Wave Change Switches	0·60
C19	2	Relays 6-24V Operating	0·60
C20		Sheets Copper Laminate approx. 200 sq. ins.	★0·60

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

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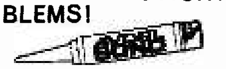

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The wonder bond which works in seconds—bond plastic, rubber, transistors, components permanently, immediately

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BIB HI-FI ACCESSORIES ★

Ref.		Price
B	Stylus and turntable cleaning kit	★31p
J	Tape head cleaning kit	★68p
P	Hi-Fi cleaner	★30p
9	Wire stripper/Cutter	★94p
31	Cassette head cleaner	★58p
32	Tape editing kit	★£1·64
32A	Stylus balance	★£1·24
36A	Record stylus cleaning kit	★32p
42	De Luxe Groov-Kleen	★£1·84
43	Record care kit	★£2·68
45	Auto changer groove cleaner	★98p
46	Spirit level	★68p
56	Hi-Fi stereo hints & tips	★38p
60	Chrome finish as above	★£1·72

ANTEX EQUIPMENT ★

SOLDERING IRONS

X25. 25 watt	★£2·45
Model G. 18 watt	★£2·70
CCN 240. 15 watt	★£2·90
SK2. Soldering Kit	★£3·90

BITS AND ELEMENTS

Bit No.	
102 for model CN240 3/32"	★42p
104 for model CN240 3/16"	★42p
1100 for model CCN240 3/32"	★42p
1101 for model CCN240 3/8"	★42p
1102 for model CCN240 ¼"	★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"	★44p
51 for model X25 1/8"	★44p
52 for model X25 3/16"	★44p

ELEMENTS

Model ECN 240	£1·10★
Model EG 240	£1·35★
Model ECCN 240	£1·55★
Model EX 25	£1·20★

SOLDERING IRON STAND

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

PLUGS

		Price
PS 1	D.I.N. 2 Pin (Speaker)	0·1[illegible]
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°	0·15
PS 5	D.I.N. 5 Pin 240°	0·1[illegible]
PS 6	D.I.N. 6 Pin	0·16
PS 7	D.I.N. 7 Pin	0·17
PS 8	Jack 2·5mm Screened	0·17
PS 9	Jack 3·5mm Plastic	0·11
PS 10	Jack 3·5mm Screened	0·17
PS 11	Jack ¼" Plastic	0·14
PS 12	Jack ¼" Screened	0·20
PS 13	Jack Stereo Screened	0·33
PS 14	Phono	0·09
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	0·18
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 ¼" Plastic	0·28
PS 28	Jack ¼" Screened	0·32
PS 29	Jack Stereo Plastic	0·28
PS 30	Jack Stereo Screened	0·35
PS 31	Phono Screened	0·17
PS 32	Car Aerial	0·20
PS 33	Co-Axial	0·20

SOCKETS

PS 35	D.I.N. 2 Pin (Speaker)	0·07
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PS 39	Jack 2·5mm Switched	0·11
PS 40	Jack 3·5mm Switched	0·11
PS 41	Jack ¼" Switched	0·19
PS 42	Jack Stereo Switched	0·28
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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	7[illegible]p
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 pin 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

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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.

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

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 members 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. 160-metres 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.

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.

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

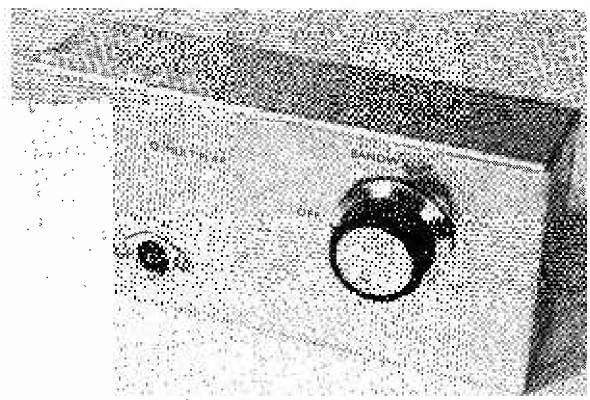
Beginners Guide To Transistors (2nd Edition)
By J. A. Reddihough and I. R. Sinclair
Takes reader from basics on how semiconductors work through audio frequency circuits and techniques, integrated circuits and finally some hints for fault-finding and servicing.
Price: £1·80
Butterworth Group, 88 Kingsway, London, WC2B 6AB

ADD-ON 'Q' MULTIPLIER

R.A.PENFOLD

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 improvment 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 feasable 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!



Fortunately, there is a simple device known as a "Q Multiplier" which is inexpensive to contruct 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 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 receivers 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 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

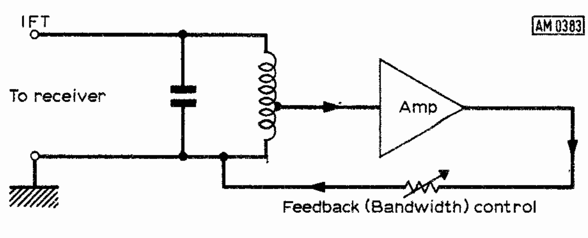


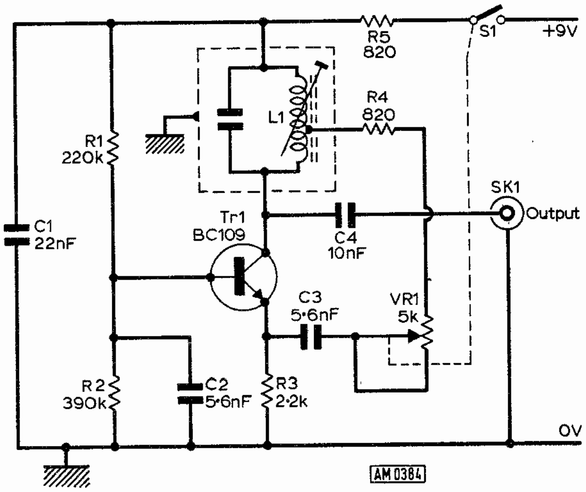
Fig. 1: Simple circuit to illustrate the operation of a Q-multiplier.

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.



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 ⅓ 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.

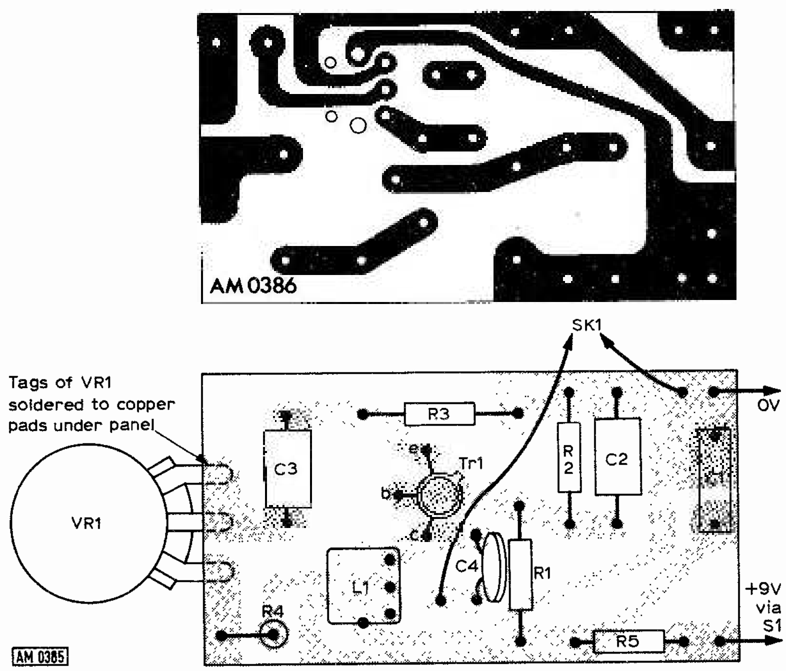


Fig. 2: above, circuit of the Q-multiplier described in the article. If the unit is fitted inside a receiver the output can go direct to the IFT, eliminating the socket. Fig. 3: right, shows the PCB and component layout. Plain veroboard with pins would be equally effective.

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 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.

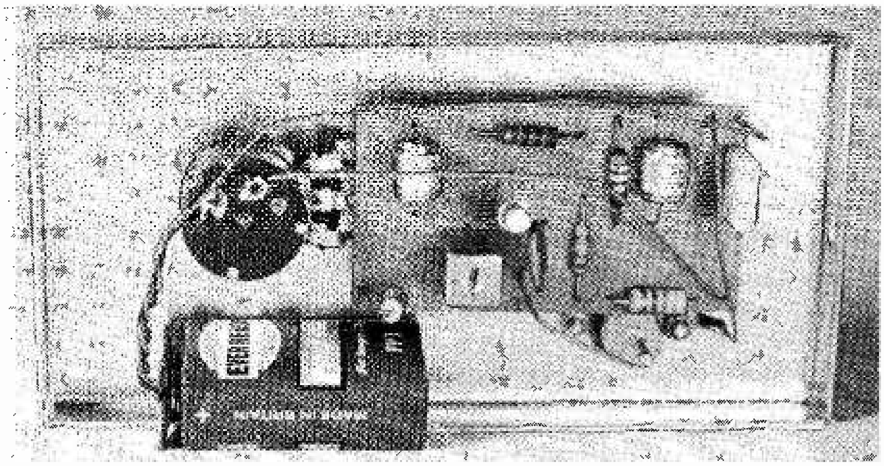
ADJUSTMENT

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 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 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



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

NEXT MONTH! *FREE!*

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 is 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 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.

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.

SOLAR ENERGY

The search for a cheap and efficient form of energy continues. Solar cells are, of course, an obvious choice for future developmet. 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 unbelieveable. 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 proved 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 1MΩ preset in parallel with the 1MΩ 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.

CONSTRUCTION

No problems should present themselves if usual construction methods are used. The printed circuit board (Figs. 2 and 3) was designed for use without IC sockets, so if anything is used make it the IC pins advertised in this magazine.

IC sockets are expensive and as they cost as much if not more than most gate ICs, it is worth cutting out a suspect IC on the component side and soldering the new one in on what is left of the pins. It then only costs the price of one new IC instead of several sockets—quite a saving.

When the board is complete, it is best to connect a length of wire to each input or output terminal before mounting the board.

The board is best mounted "piggy back" over one of the original boards using 6BA threaded rod using nuts as spacers. Once the board has been mounted the wiring can be started. Remove the top and bottom base connections on board A and connect the new wires to them, covering the soldered joint with insulating tape. Also remove the "vertical change out" wire and connect it to the new wire in the same manner. All the other connections are soldered on the copper side of the appropriate boards, as per the diagram.

Bat Angle

Set the two monostable timing presets to mid travel, switch on and note the effect when the ball hits the bat. If the ball direction seems biased to going up after a hit, increase the resistance, and if down decrease it.

It might take some time to arrive at the optimum position but it is worth the trouble.

Vertical Speed Change

First set the vertical speed control on board D to maximum resistance, then short out the reed

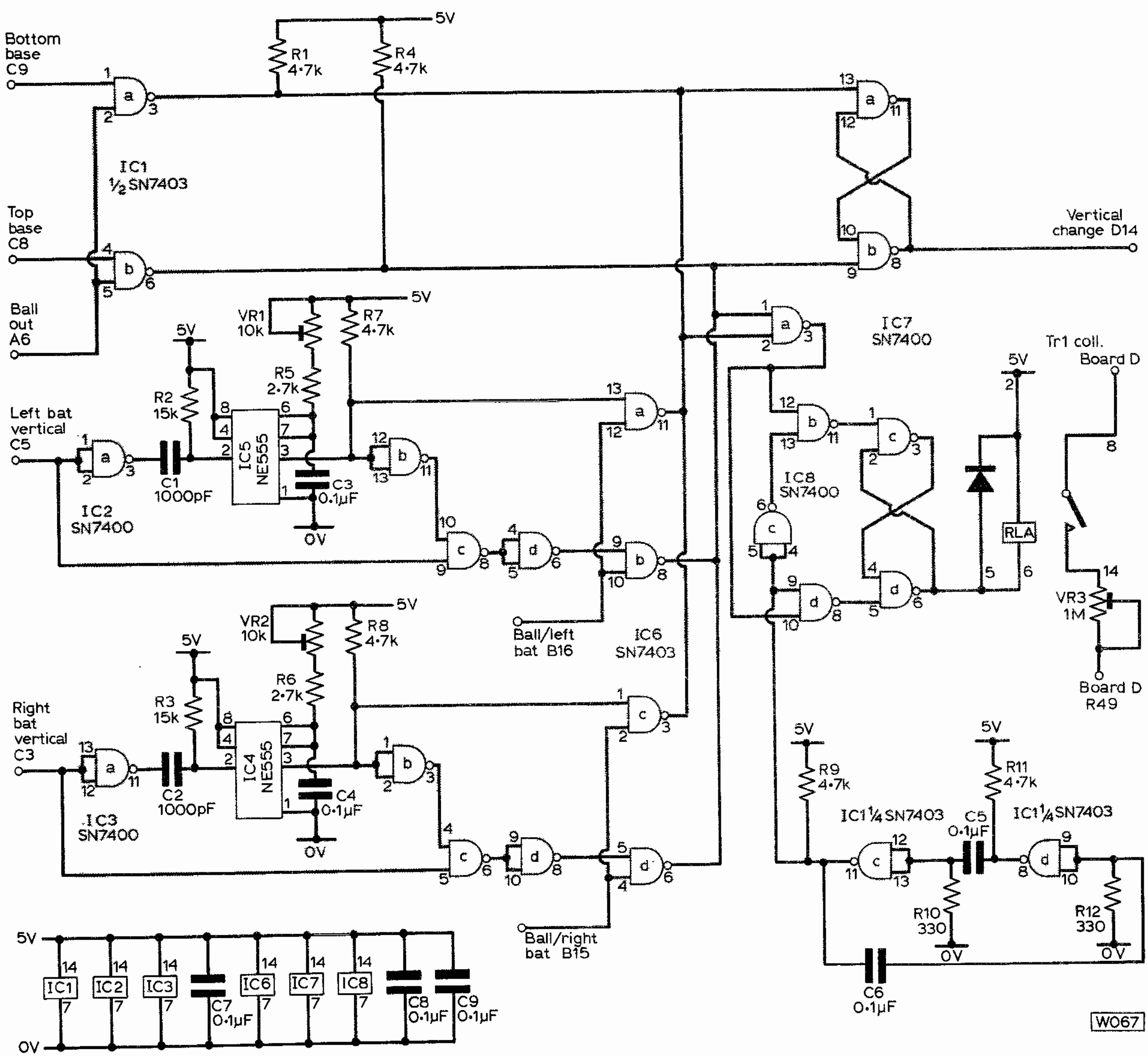


Fig. 1: Complete circuit diagram of the Tele-Tennis Ball Speed Control and bat angle circuits

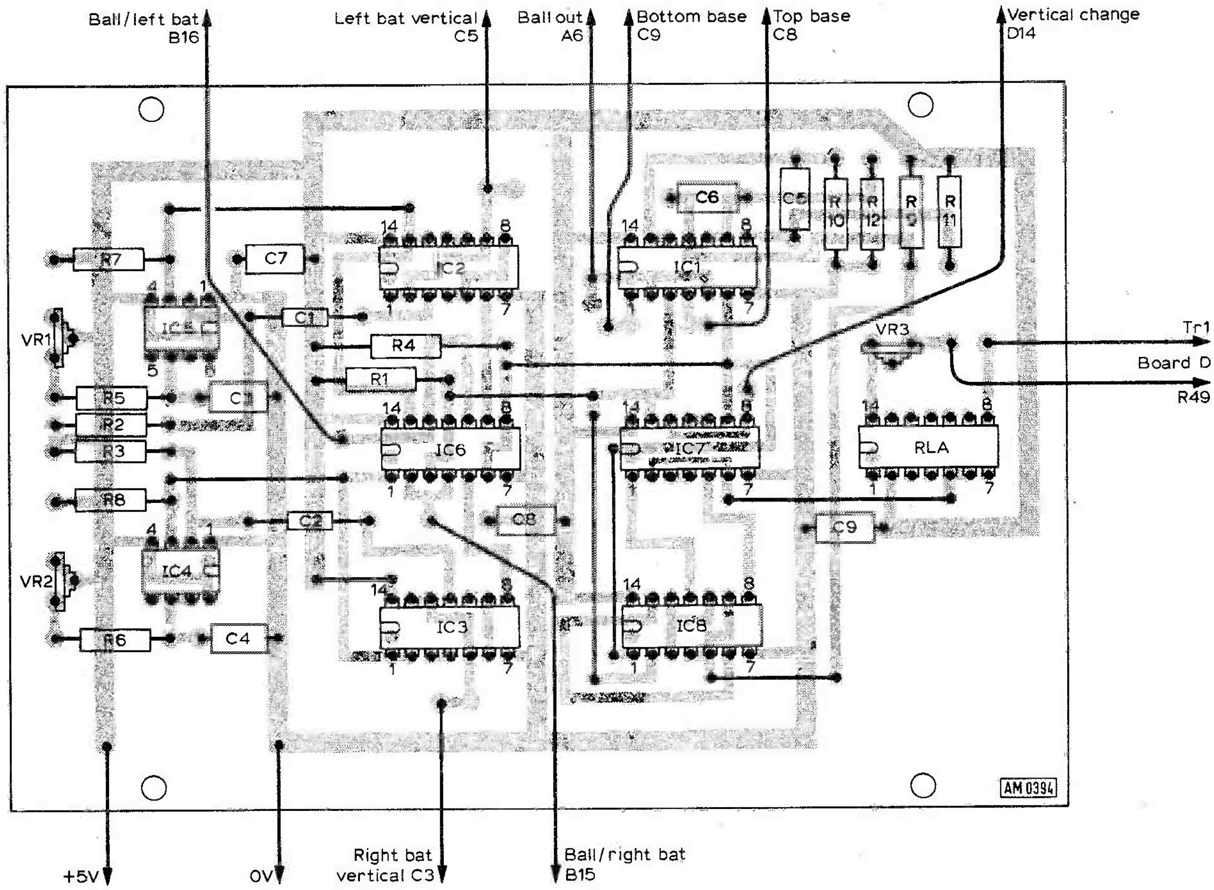


Fig. 2: Layout of the components on the printed circuit board

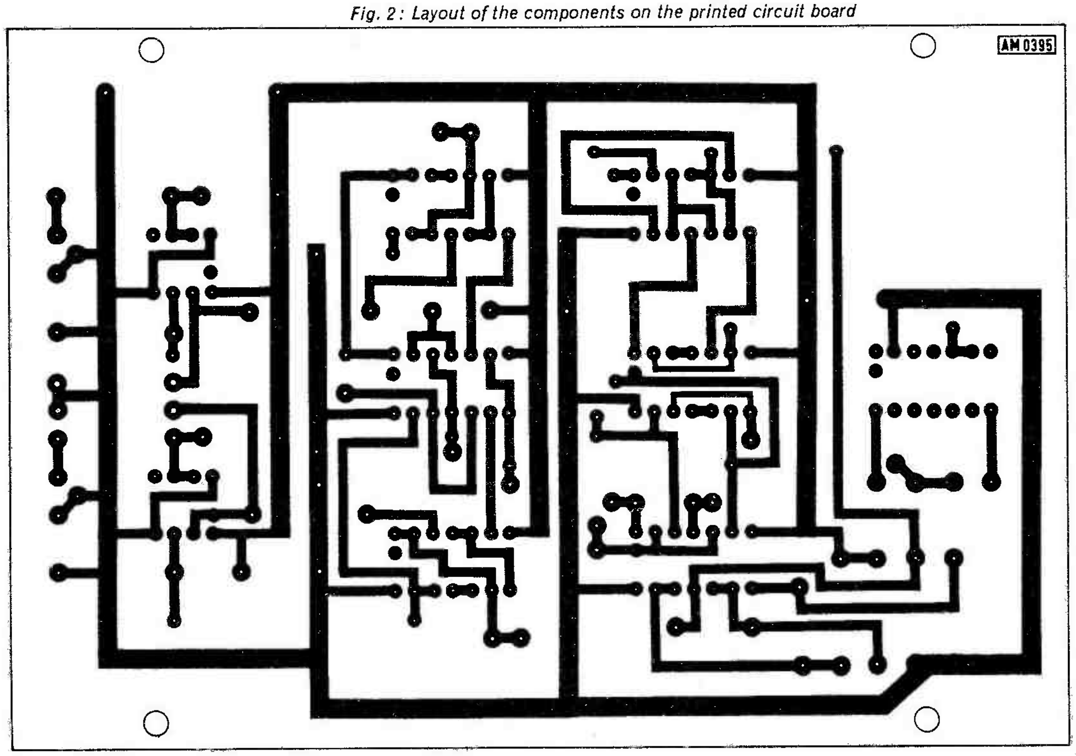
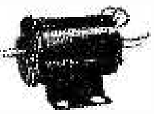


Fig. 3: Full size printed circuit layout for the Tele-Tennis Ball Speed Control

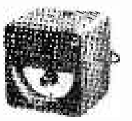
continued on page 497

HIGH POWER BATTERY MOTOR



12v operated, strong enough to power a motor mower, go-cart or similar. Speed easily variable. These motors can also be used as a brake for any rotating machine, simply by coupling the spindle to the machine and short-circuiting the windings by a variable resistance, price £2·50+post and V.A.T. 74p. *DITTO* but 6/12v even more powerful as it's larger and is series wound £3·50+85p post and V.A.T.

FIRE ALARM SWITCHES



In cast iron case with break glass panel. These are red and engraved "Fire break glass"; they have hinged lid and second safety switch for testing purposes. Limited quantity. £1·75 each+post and VAT 46p.

DC HIGH CURRENT PANEL METERS

3½" wound wide angle 240µ movement meters, flush mounting fitted with external shunts, made by Crompton Parkinson brand new, still in maker's cartons. These are a real bargain at £5·50 each. Reasonable quantities available in the following ranges: 0-10 amps, 0-20 amps, 0-30amps, 0-40 amps, 0-50 amps. Post and VAT 80p each.

EDGE MOUNTING MOVING COIL METER

Size 2¾" x 1" by Weston. 100µA movement scaled DB, unused still in original maker's cartons, £2·50 each + post and VAT 50p.

PERMEABILITY TUNERS

M.W. two stage ideal for use with ZN414 or similar circuit. Price 15p each + post and VAT 15p.

OVEN THERMOSTAT

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.

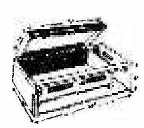
NUMICATOR TUBES

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

WINDSCREEN WIPER CONTROL

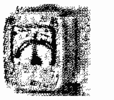
Vary speed of your wiper to suit conditions. All parts and instructions to make. £3·25 £1·00 post and VAT.

PORTABLE CABINET OFFER



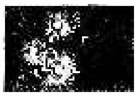
A nicely made portable cabinet, soft padded black finish intended for portable stereo system. Dimensions as sketch. With motor board cut out for Garrard SP 25. This was obviously a very costly cabinet originally made for a de-luxe record player. Offered at £1·95+£1·50 post and VAT, carriage free if bought with the Garrard or BSR record decks.

HIGHLY SENSITIVE MOVING COIL RELAY



panel mounting with glass window, this measures approx. 5½" x 4" x 5", triggering current can be varied from a fraction of a milliamp to 5 milliamps by removing the front and adjusting the setting level. Price £8 each + post and VAT 95p.

SOUND TO LIGHT UNIT

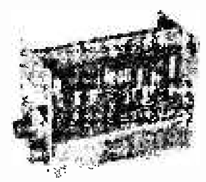


Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450w). Unit in Box all ready to work. £7·95 plus 80p VAT and postage.

AUDIO AMPLIFIER

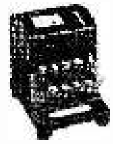
Part of the famous Redifune background music system, secondhand, but believed in good order However, no guarantee; we are selling for spares value only. These are 6 valve amplifiers, the output valves are 2×EL 84 in push/pull; complete with mains transformer, rectifier and ample smoothing equipment. The mains transformer alone, today would cost at least £4. Size is 9½"×5½"×4½". Price only £2·00+postage and VAT £1.50.

BREAK-DOWN UNIT



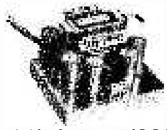
Contains hundreds of useful parts some of which are as follows—66 silicon diodes equivalent OA 91. 68 resistors mostly ¼ watt 5% covering a wide range of values. 4×1 mfd 400v infd condensers. 15×.01 mfd 100v condensers. 2 RF chokes. 8×B9 valve holders. 1×4H choke. 1×115v transformer. 1 boxed unit containing 4 delay lines also tag panels, trimmer condensers, suppressors, etc., on a useful chassis sized approx. 9"×5"×7". Only 75p (the 66 diodes would cost at least 10 times this amount). This is a snip not to be missed. Post and + VAT 75p.

GPO PUSH BUTTON DIALLING UNIT



Will take the place of the mormal 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 VAT.

24V POWER PACK

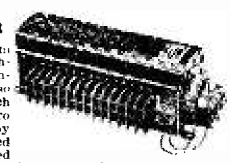


Normal mains input with a thermal safety device. 800 mA output, 4000 mfd of smoothing and full wave rectification, completely enclosed in plastic box and with flex for mains and terminal block for output Price £1·75+£1 post and VAT.

8-SWITCH DISCO LAMP CONTROLLER

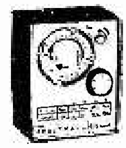
Mains motor driving a drum with adjustable trips operating 8 changeover 10 amp switches, so a total of 40K watts of lighting can be controlled enabling an unlimited variety of effects to be achieved and changed with the minimum of effort. This is a real snip a £7·50+£1.15 post and VAT.

HONEYWELL PROGRAMMER



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

HORSTMANN 24-HOUR TIME SWITCH

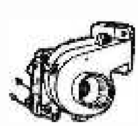


With 6 position programmer. When fitted to hot water systems this could programme as follows:

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×3in×2in deep. Price £5·50. 80p Post and VAT. as illustrated but less case.

CENTRIFUGAL BLOWER



Miniature mains driven blower 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 4½"×4½"×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. 60p Post and VAT.

TERMS:

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

J. BULL (ELECTRICAL) LTD.

(Dept. PW), 103 TAMWORTH RD. CROYDON CRO IXX

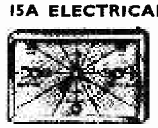
WALL THERMOSTATS

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 room, bedroom and greenhouse, etc. Price £1·95, VAT & Postage 30p. Don't miss this.

INSTANT START FLUORESCENT LIGHTING BARGAINS

Starterless control gear, complete with tube ends and tube clips for window lighting, signs, fascias, etc. 4 ft. 40 w. £1·50; 5 ft. 65w. £1·60; 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 60p, or with glass front, chrome bezel, £1·00 extra.

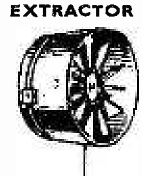
MAINS TRANSISTOR PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: main transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only £1·50. VAT & postage 60p.

ONLY £1 FOR SEVEN ELECTRIC MOTORS

7 powerful batt. motors as used in racing cars & power models. Output & types vary for use in hundreds of different projects—Tools, toys, models, etc. All brand new reversible & for 1½-12v. batts. Wiring diag. inc. VAT & Post 40p. FREE plan for min. power station.

EXTRACTOR FAN



Cleans the air at the rate of 10,000 cubic ft. per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 5½" casing with 5½" fan blades. Kit comprises motor, fan blades sheet steel casing, pull switch, mains connector and fixing brackets. £3·75 VAT & Postage £1·25.

MAINS TRANSFORMERS

All standard 230-250 volt primaries

		£ p
1v	1 amp (special)	1·75
2·4v	5 amp	·85
6·3v	2 amp	1·00
6·3v	3 amp	1·50
9v	1 amp	·95
9v	3·5 amp	1·95
12v	1½ amp	1·50
12v	1 amp	1·00
6.5v-0·6 5v	1 amp	1·35
18v	1 amp	1·25
20v	½ amp	1·00
24v	1 amp	1·50
24v	3 amp	3·50
12·0-12v	50mA	1·20
6·0-6v	50mA	1·20
8·0·8v	½ amp	1·25
18·0·18v	2 amp	3·50
25v	1½amp	1·95
50v 2 amp & 6.3v	1 amp	4·50
60v 5 amp & 5v	1 amp	7·50
27v	8 amp	4·50
30v	37amp	22·00
80v tapped 75v & 70v	4amp	5·50
230v-60mA & 6·3v	1·5 amp	1·75
275-0·275v at 90mA & 6·4v	3 amp	2·25
EHT Transformer 5000v 23mA	(intermittent)	5·50
Charger Transformers		
6v and 12v	2 amp	1·25
6v and 12v	3 amp	2·25
6v and 12v	5 amp	3·50

Add 30p per piece to cover postage and VAT 25%.

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 reception. 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 Telediffusion 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
		371 metres	809 kHz
	World Service	276 metres	1088 kHz
Short wave	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

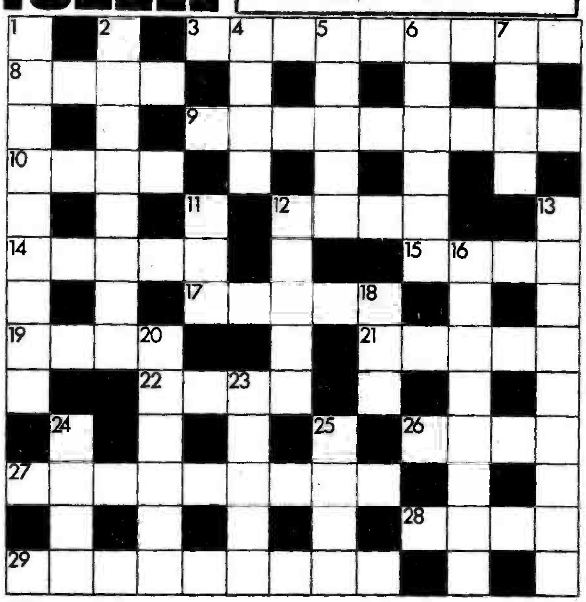
From 1940 to 2030 Mondays to Saturdays inclusive, a varied programme of news, press reviews and general interest features is broadcast on 236 metres medium wave. This can be heard in most parts of Germany. Listeners in the Bonn area can hear a news broadcast in English, Mondays to Saturdays from 1940 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 TECHNICROSS PUZZLE No. 11



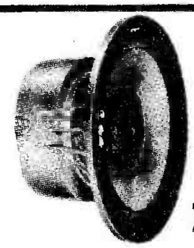
ACROSS

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? (5)
13 Play-group of all ages (9)
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)

FOR AMUSEMENT ONLY
ANSWERS NEXT MONTH



WILMSLOW AUDIO

THE Firm for speakers!

SPEAKERS

Baker Group 25 3, 8 or 15 ohm	£8·64
Baker Group 35 3, 8 or 15 ohm	£10·25
Baker Group 50/12 8 or 15 ohm	£14·00
Baker Deluxe 12" d/cone	£13·75
Baker Major ,, ,,	£11·87
Baker Regent	£10·00
Baker Superb	£18·12
Baker Auditorium 12	£16·25
Celestion MH1000 horn, 8 or 15 ohm	£10·95
Celestion PS8 for Unilex	£3·75
Celestion G12M 8 or 15 ohm	£12·00
Celestion G12H 8 or 15 ohm	£15·00
Celestion G15C 8 or 15 ohm	£24·00
Celestion G18C 8 or 15 ohm	£33·00
EMI 13 x 8" 150 d/c 8 ohm	£2·94
EMI 13 x 8" type 350 8 or 15 ohm	£9·56
EMI 13 x 8" 20 watt base	£7·69
EMI 6½" 93850 4 or 8 ohm	£4·37
EMI 8 x 5 d/cone, roll surr 10 watt	£3·44
EMI 2¼" tweeter 97492AT	·77
Eagle DT33 30 watt tweeter	£6·31
Eagle HT15 horn tweeter	£4·40
Eagle CT5 cone tweeter	£2·06
Eagle CT10 tweeter 8 or 16 ohm	£3·00
Eagle MHT10 horn tweeter	£4·44
Eagle crossover CN23, CN28, CN216	£1·75
Eagle FR4	£6·12
Eagle FR65	£9·12
Eagle FR8	£12·31
Elac 9 x 5, 59RM109 15 ohm, 59RM114 8 ohm	£3·44
Elac 6½" 6RM171 d/c roll surr.	£4·06
Elac 6½" 6RM220 d/cone	£3·12
Elac 4" tweeter TW4	£1·75
Elac 10" d/cone 10RM239 8 ohm	£3·12
Elac 8" 8CS175 3 ohm	£2·87
Fane Pop 15 watt 12"	£5·25
Fane Pop 25/2 25 watt 12"	£7·50
Fane Pop 50 watt 12"	£12·00
Fane Pop 55 60 watt 12"	£13·95
Fane Pop 60 watt 15"	£14·75
Fane Pop 100 watt 18"	£25·95
Fane Crescendo 12A 100 watt 12"	£34·50
Fane Crescendo 12B bass	£36·50
Fane Crescendo 100 watt 15"	£47·50
Fane Crescendo 150 watt 18"	£62·95
Fane 801T 8" d/c roll surr.	£8·12
Fane 807T 8" d/c roll surr.	£5·75
Fane 808T 8" d/c	£3·44
Fane 701 twin ribbon horn	£40·00
Fane 910 horn	£14·95
Fane 920 horn	£33·95
Goodmans 8P 8" or 15 ohm	£5·50
Goodmans 10P 8 or 15 ohm	£5·80
Goodmans 12P 8 or 15 ohm	£13·95
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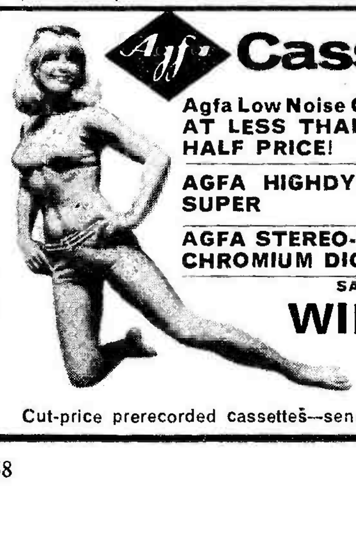

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Miniature 2m EQUIPMENT

part 2 : preamplifier

W. H. Bond F.R.C.S. G3XGP

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 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

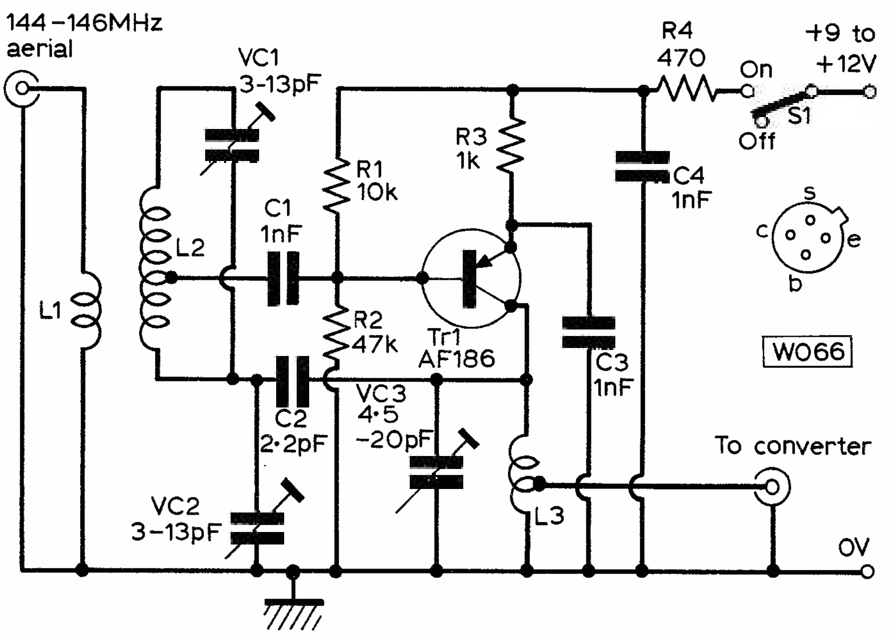


Fig. 1: Complete circuit diagram of the 2m Preamplifier. The AF186 is connected in common emitter configuration.

★ components list

Resistors
R1 10kΩ   R3 1kΩ
R2 47kΩ   R4 470Ω
All resistors 10% ¼W

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 (1¾ 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, Boltzmanns 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 movement 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.

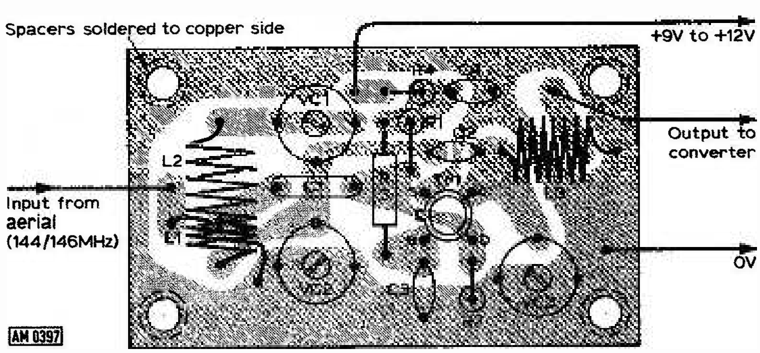
The input and output circuits are both tuned and lightly loaded so that the working Q is high and the bandwidth is kept to a minimum. The selected transistor is an AF186 with an inherently low noise factor and an fT of 900, chosen in preference to an FET, for those equal to it are twice as expensive 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 1¼ 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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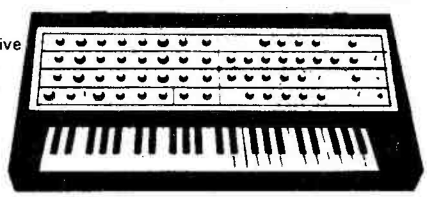

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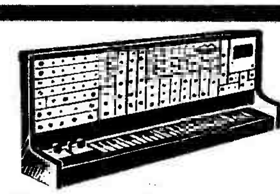

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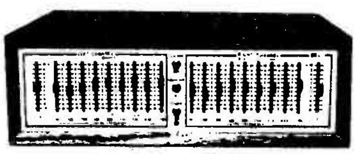

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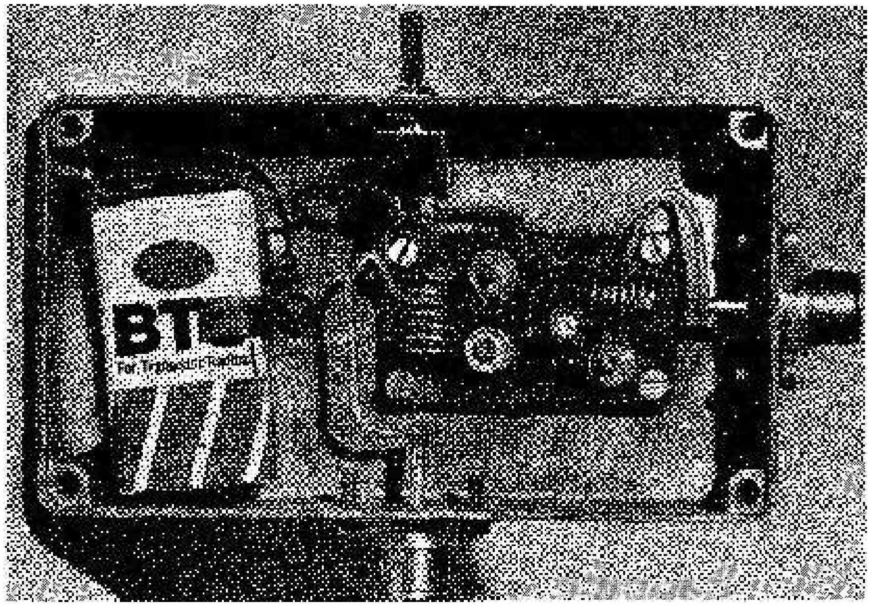

Interior photograph of the unit, showing details of the positioning of the PCB, the sockets and the on/off switch. The lid should be drilled to give access to VC1/2/3 for alignment purposes, as shown in the leading photograph.

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.

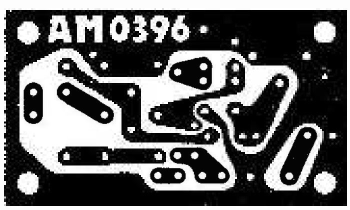

Fig. 2: Full size reproduction of the printed circuit board viewed from the underside. Holes for components are drilled with a No. 60 drill, while those for the variable capacitors are made with a No. 52 drill.

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 ($4\frac{1}{2}\times2\frac{1}{2}$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.

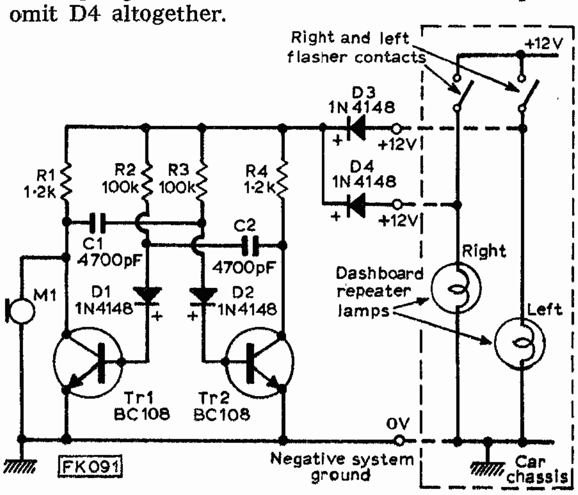

Fig. 1. Circuit of audio repeater and connections to trafficators.

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.

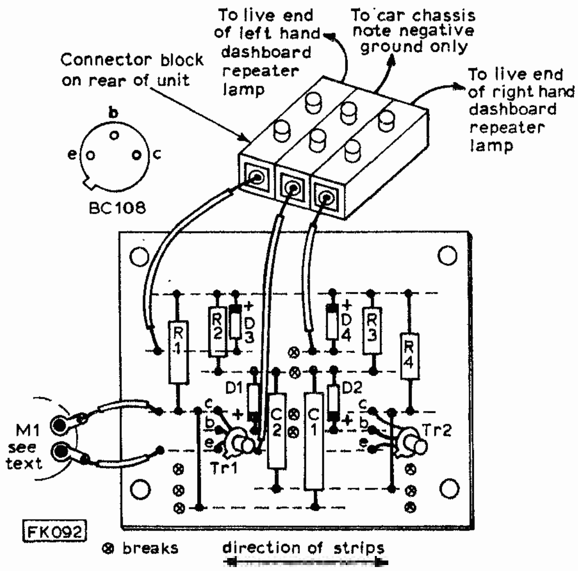

Fig. 2: Layout of components on Veroboard. NOTE: microphone case ***must*** *be connected to chassis line.*

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. PW

★ 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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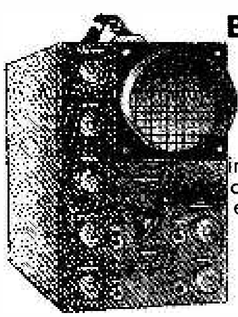

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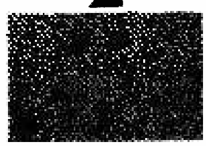

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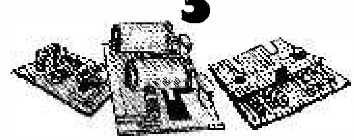

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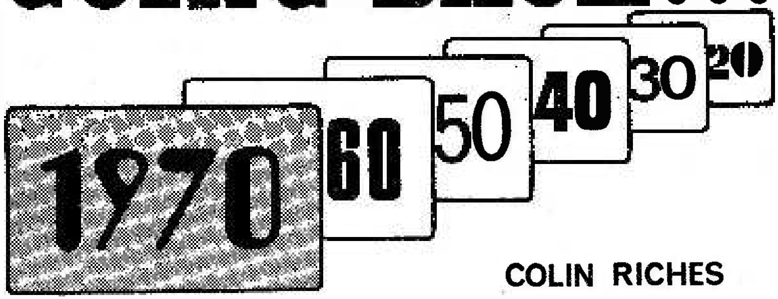


COLIN RICHES

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 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 serated 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.

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

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 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.

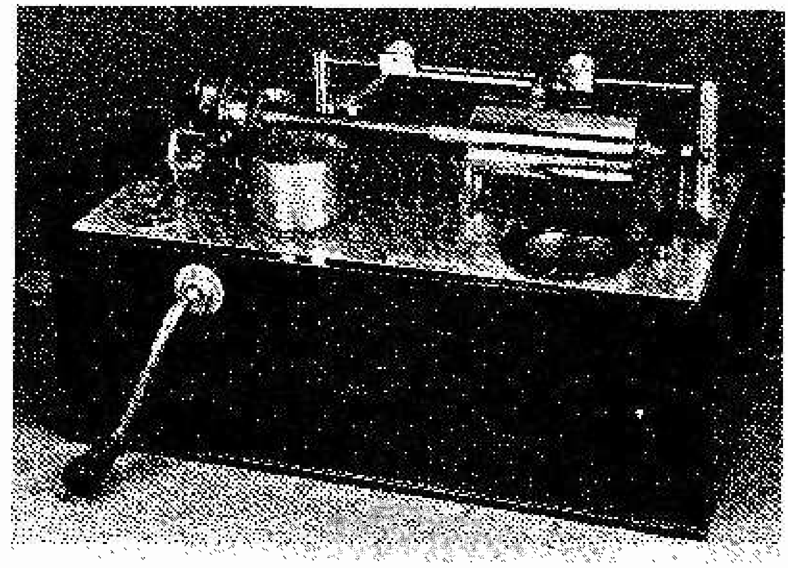
Similar screw threads on both transmitter and receiver gave a corresponding traverse of the revolving cylinders. A synchronising mechanism was included so that the cylinders revolved precisely in unison.

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 the transmitting station.



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

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

IMPROVE YOUR BUDGET STEREO SYSTEM

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), $\pm 1{\cdot}5$dB from 55Hz to 23kHz (quite good), a ceramic cartridge (not so good) and less than $1{\cdot}5$% 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.

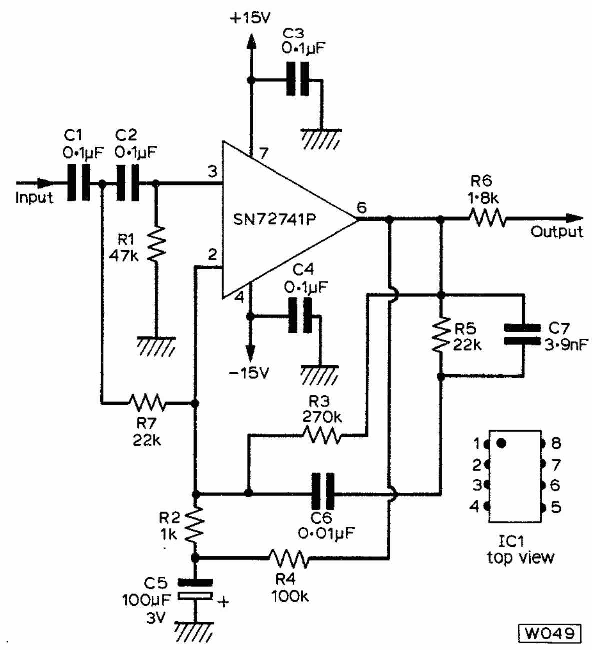


Fig. 1: Circuit of one channel of the new pre-amplifier added to the existing system.

Because of the much lower output and the electrical characteristics of the magnetic cartridge, a preamplifier 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.

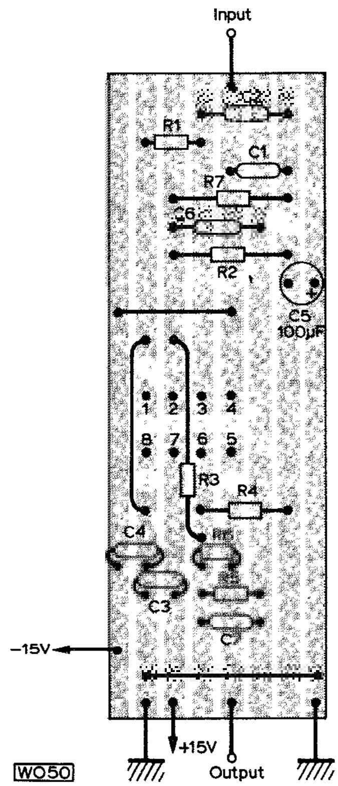


Fig. 2: Layout used by author for the preamplifier. Note that this layout is duplicated using a common board, see photograph.

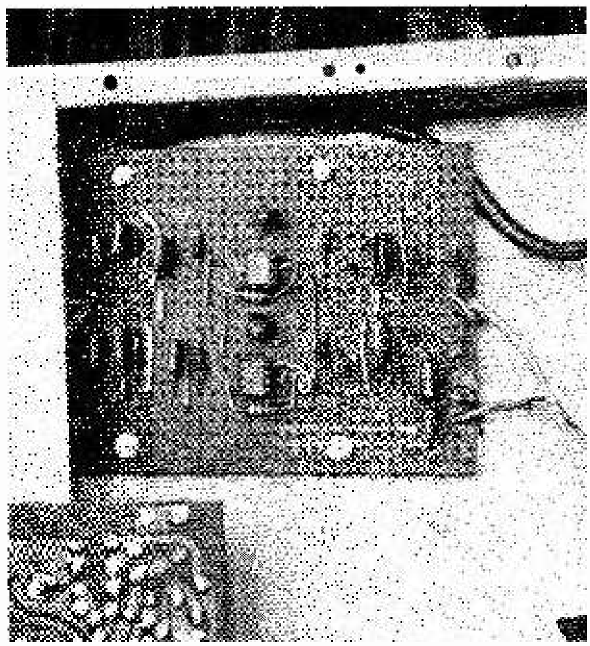
The preamplifier circuit used is a direct copy of the PW "Texan" first stage except that I have wired in the rumble filter permanently. This is optional but I did it on the principle that any sounds emanating from the unit after the modification, below about 40Hz, were most likely to be undesirable and 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 ($3\frac{1}{4}$ x 3in). Considerable liberties can be taken with this layout without affecting the performance of the amplifier.

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 tucked away in an unused corner of the chassis.

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

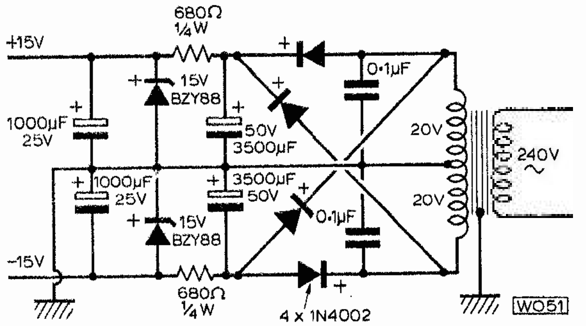


Fig. 3: The auxiliary power supply unit to supply +15 and −15V for the pre-amplifier board.

supplies at the preamp supply input tags. If all is well, advance the volume control slightly and touch, in turn, the right and left signal input tags. The usual howl should be heard and, with the "balance" control in mid-position, the two "howls" should be of similar intensity. If not, check back because there is a mistake somewhere and now is the time to locate it before getting involved in more complex problems.

When these preliminary tests have been satisfactorily completed the playing deck should be put back into its normal position and a record played through, with the magnetic cartridge, to check for volume and quality. There is no reason to suppose that the reproduction will not be fully satisfactory in both these respects, indeed the first reaction is most likely to be one of real pleasure. Try all controls, the chances are that the normal position of Treble and Bass will be a little different from those used with the ceramic cartridge. However, these first reactions of pleasure will quickly pass unless you have been extremely lucky in the design of your unit audio. In most cases it will be found that there is a very high and quite unacceptable level of mains hum, usually increasing as the stylus moves towards the centre of the record.

CURING MAINS HUM

The cause of this problem is quite simply stated: the equipment's mains transformer sets up a very strong 50Hz magnetic field which permeates the whole of the instrument. A ceramic cartridge is insensitive to this which is one good reason why it is almost a standard fitting on budget stereo equipment! The magnetic cartridge is extremely sensitive to external fields and very significant 50Hz voltages will be included into the two stereo coils inside the cartridge, resulting in a loud and unpleasant mains hum accompanying the music.

We have also just introduced a preamplifier that is designed to boost the lower frequencies so it should come as no surprise that we have this particular problem. Complete elimination of hum on "Gram" can be obtained only by removing the system's mains transformer from the instrument and mounting it in a separate metal container or box at least three feet from the main instrument. This can be quite simple, Fig. 4, and applies to the larger of the two transformers only as the smaller one contributes a negligible field.

In the interests of safety the live side of the cable connector must be the female one and the metal box chosen to house the transformer must allow sufficent ventilation to keep the transformer cool. The cable carrying the low voltage must be of fairly heavy gauge in order to carry the current to the instrument without excessive voltage drop. The metal box must be earthed and have ventilation holes too small for the smallest inquisitive fingers to be pushed through to the inside!

This method overcomes the problem completely but it has several disadvantages which caused me to reject it. First, the unit audio has become two units which I wished to avoid and second, whenever I want to take the instrument from its normal position to my work-room for test or modification, I have to unscrew and disconnect and carry upstairs the mains transformer and its associated cables and plugs and sockets. I could, of course, buy an additional transformer for the work-room but that would be a serious strain on the budget!

SORTING OUT HUM

I am prepared to be completely satisfied if no hum is audible with the bass control at full boost and the volume control just over half-way open. At these settings the whole street can hear it and all our listening is in fact done at lower settings. We must therefore carry out some trials to get the mains hum down to at least this level. Remove the playing deck and disconnect the right and left leads from the input tags of the preamplifier. Leave the screened "earthy" one connected. Test all systems, radio, FM, AM and 'auxiliary' for hum with full bass boost and at least half volume. The result should be complete absence of hum, since we have not disturbed these

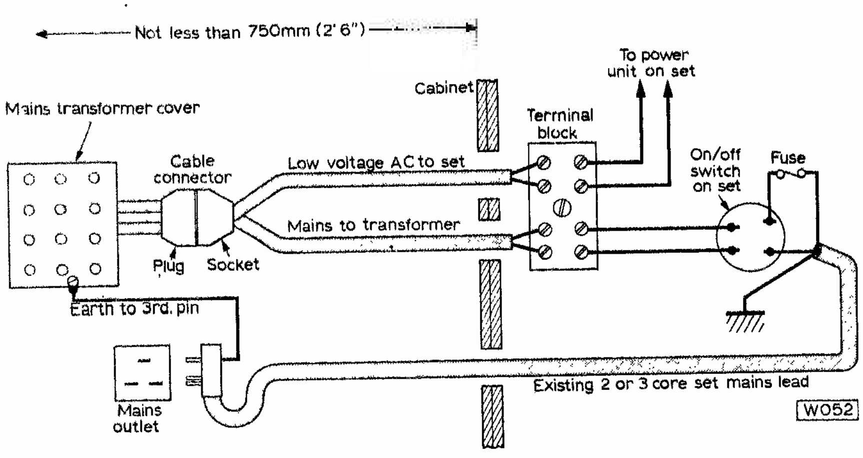
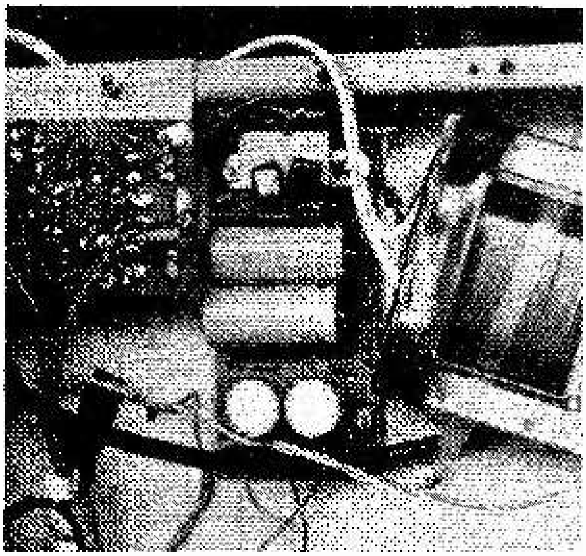


***Fig. 4:** General layout of equipment in the experiment placing the mains transformer outside the amplifier cabinet. This is not a practical proposition but it demonstrates the advantages of eliminating hum.*

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.

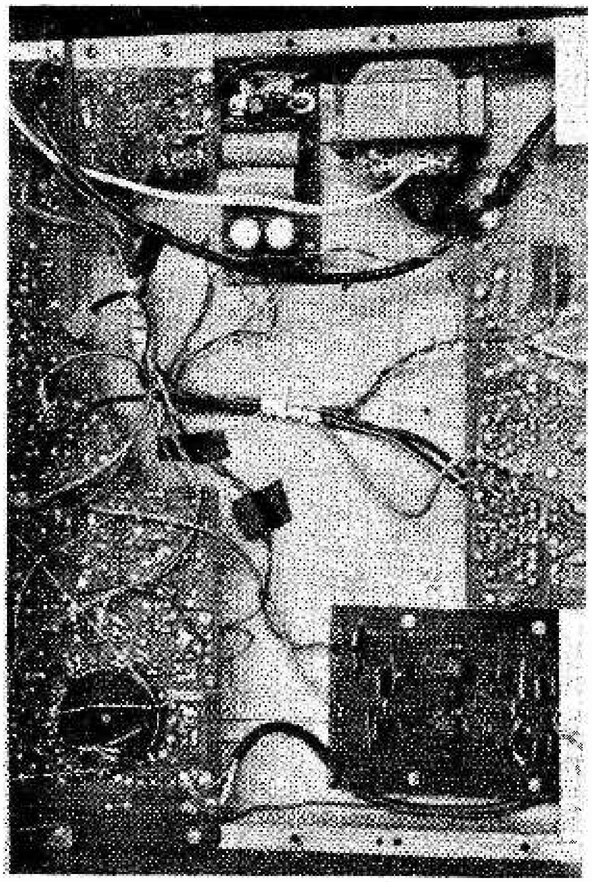
TRANSFORMER TROUBLES

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 preamplifier 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, Marchwiel, 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.

AIDS to IMPROVED RECEPTION

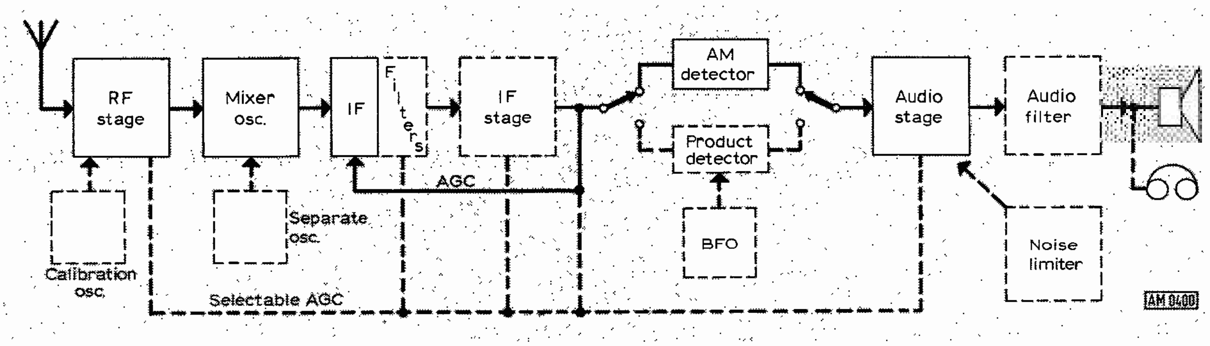
PART 1

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



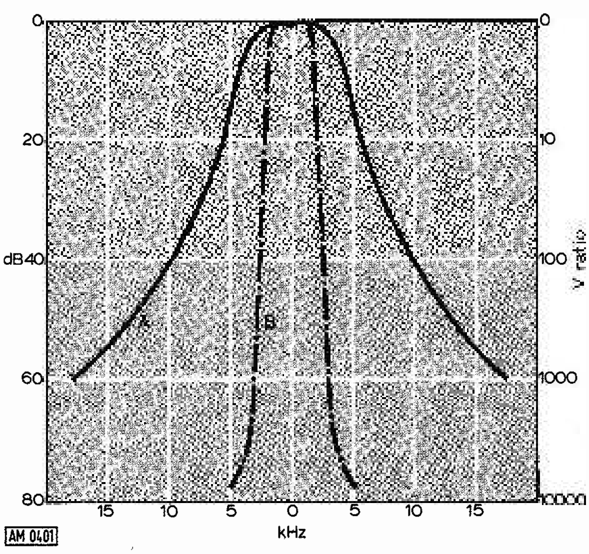


Fig. 1: above, shows the stages of a basic superhet receiver (solid lines) with the extra facilities to be expected in a communications receiver (dotted lines). Fig. 2: left, compares the IF response curves of the two receivers.

may be 9 or 10kHz but, at the other extreme, 50Hz 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 probable 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.

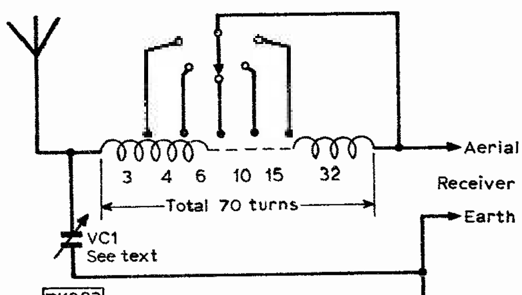
While a simple audio stage and speaker will suffice for AM on an ordinary set the comm. receiver's audio stages will have a frequency response carefully matched to that part of the speech frequencies which convey the most information, usually 300Hz to 3kHz. There may also be a very narrow audio filter 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 aerials 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



FK083

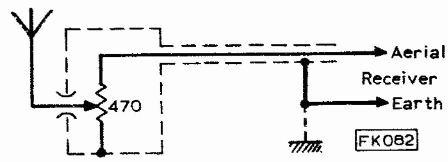
the correct positions have been found for a particular band the numbers can be recorded for rapid reference.

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.



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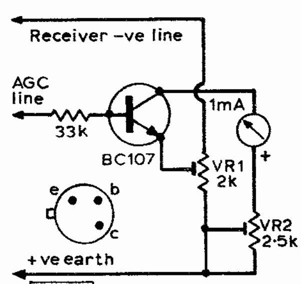
TUNING METER

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.



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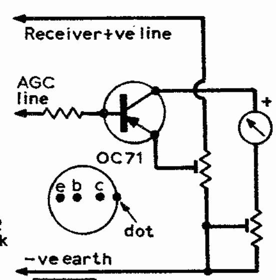
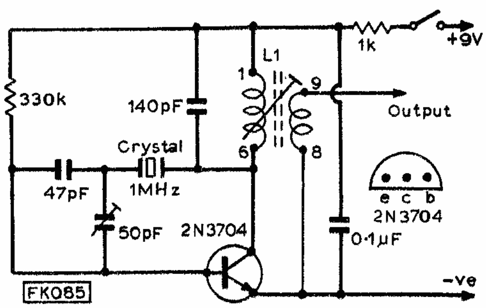


FK088

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.



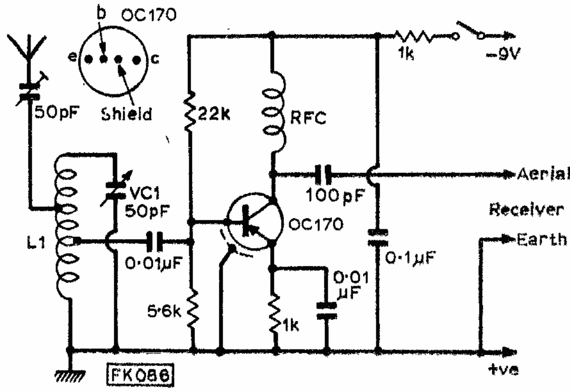
The signal produced is an unmodulated carrier which will register on a tuning indicator or S-meter or heard if a BFO is fitted. Coil L1 is a Denco Yellow Range 2 coil and its core is adjusted for lowest battery current consistent with reliable starting when switching on. The output lead is placed near 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.

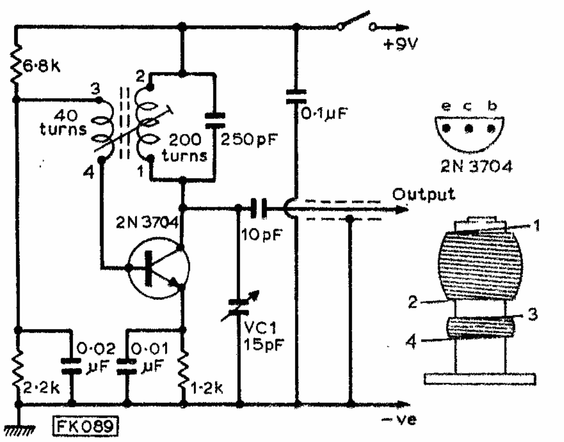
The amplifier is built in a small metal box, with reasonably short connections. The output lead should be as short as possible, preferably coaxial cable, if very short. Capacitor VC1 peaks up signals. If the receiver has good AGC action, switch the AGC off when setting VC1 for a particular band, or watch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

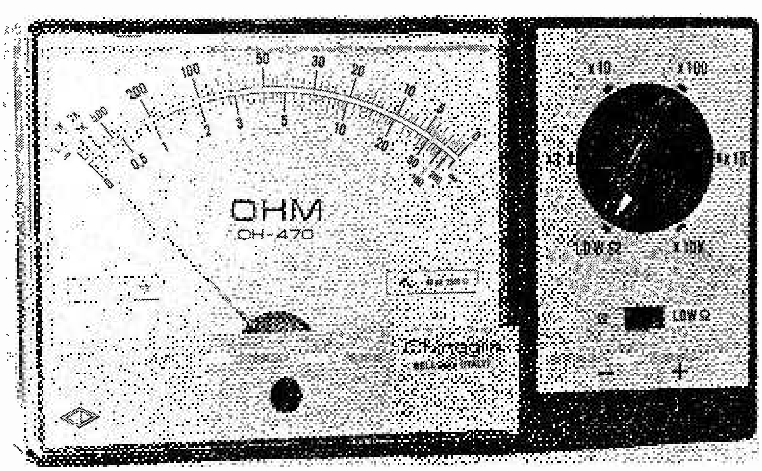
In America, Marantz have found that large numbers of the 1040 are purchased by students on limited budgets but their Executive Director states that he is confident that in Britain the 1040 will be bought by music lovers from all walks of life who want a medium-priced amplifier.

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

RESISTANCE METER

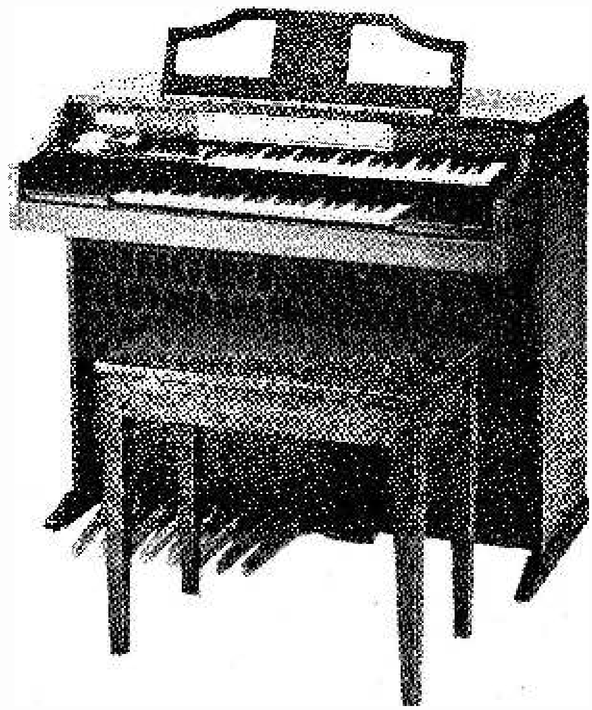
The Chinaglia OH470 multi-range resistance meter uses a 40μA moving-coil movement with core magnet and sprung jewel mounts. A tough ABS case combined with a full view scale and simple range switching make for an easy-to-use instrument suited to a wide variety of environments.

Six measuring ranges are provided, giving the ability to identify resistance from 0·1Ω up to above 50MΩ 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: 0–200Ω; 0–10kΩ; 0–100kΩ; 0–1MΩ; 0–10MΩ; 0–100MΩ. *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:

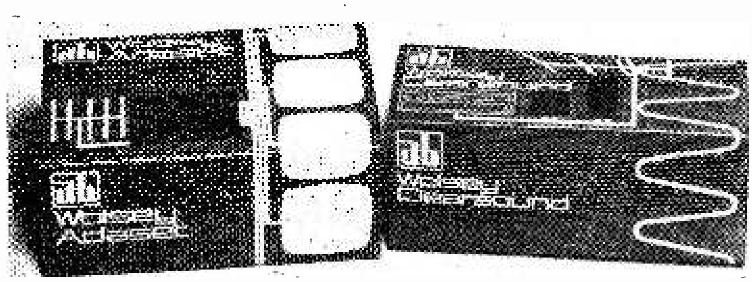
Amplifier: Frequency coverage: 40–860MHz; Gain (typical): Mercury 40: 8dB Mercury 80: 2dB; Output (maximum peak): Mercury 40: 25mV Mercury 80: 12·5mV; Noise Figure: 6 to 10dB.

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 download cable near the aerial.

Constructed for mast head or facia 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

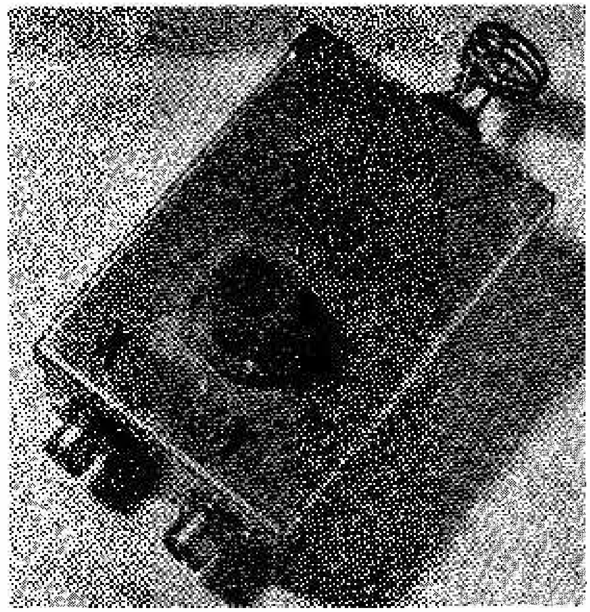
Recommended Retail Price £16·45 plus VAT (this includes Power unit)

VARICAP ABSORPTION WAVEMETER

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

AN absorption wavemeter is a very useful devise 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 wobbulator 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 100μF capacitor thus making the batteries unnecessary.

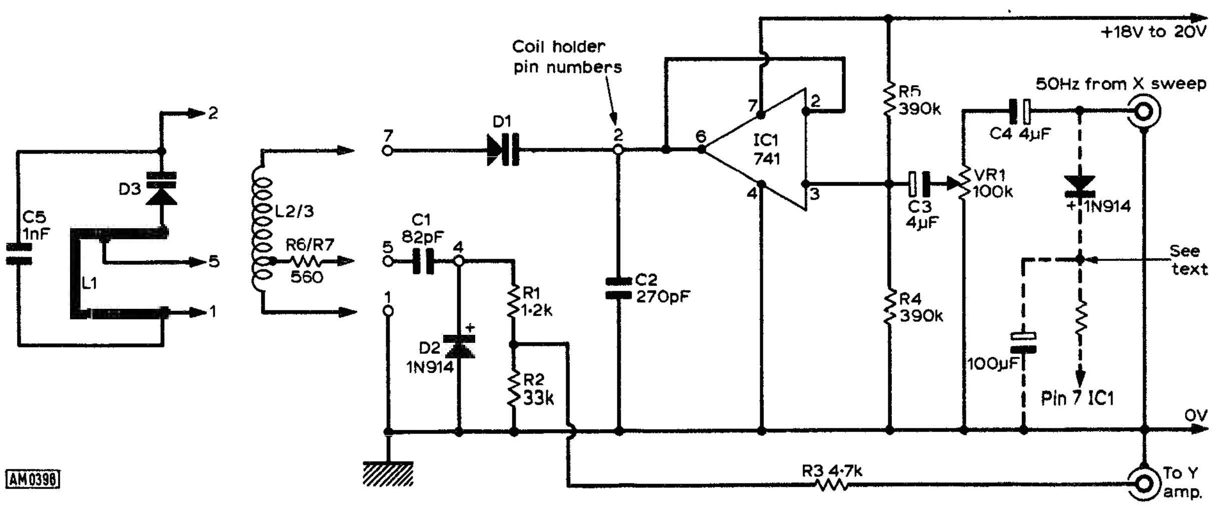


Fig. 1. Circuit of the Wavemeter, showing the two styles of coil used. The part of the circuit shown dotted is explained in the text.

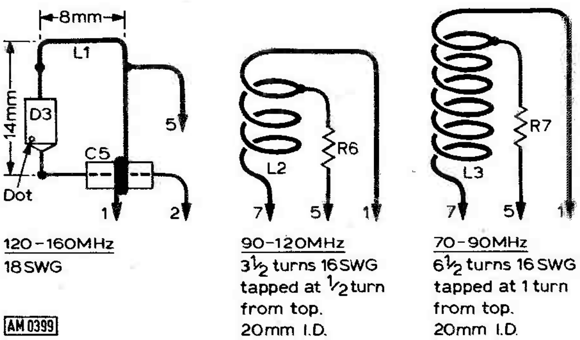
CONSTRUCTION

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 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.



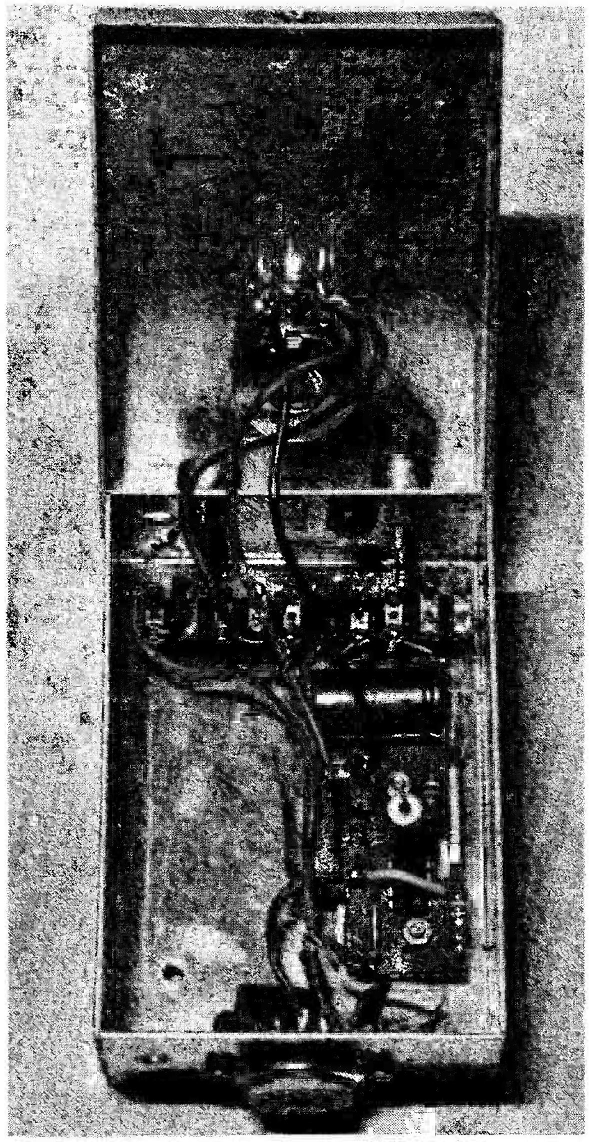
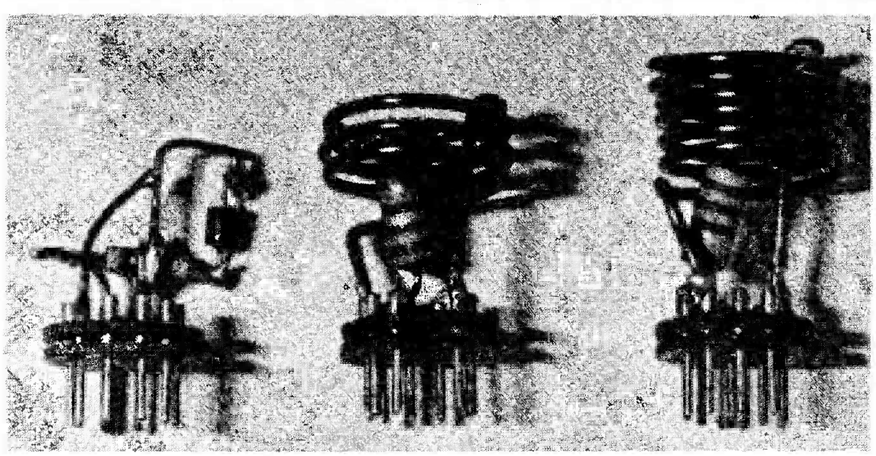


Fig. 2: Constructional information for the three coils required to cover 70 to 160 MHz approximately. Other frequencies may be covered with the appropriate coil but ensure tap is about 1/6th of turns from earth end.

The components wired directly across the pins of the valveholder are 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 1·2kΩ	R5 390kΩ
R2 33kΩ	R6 560Ω
R3 4·7kΩ	R7 560Ω
R4 390kΩ	VR1 100kΩ

Capacitors

C1 82pF (or 100pF) silver mica	C4/5 4μF 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 2¾ x 1½in.)

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.

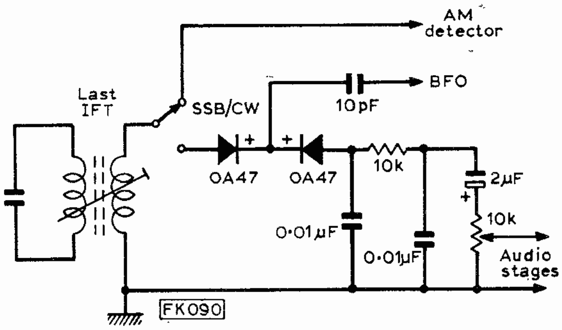
The oscilloscope should be used on its most sensitive range and the signal level should be controlled by moving the wavemeter away from the source of RF. The sweep width control needs no adjustment other than the initial setting to give maximum sweep. Calibration is best done by holding the wavemeter 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

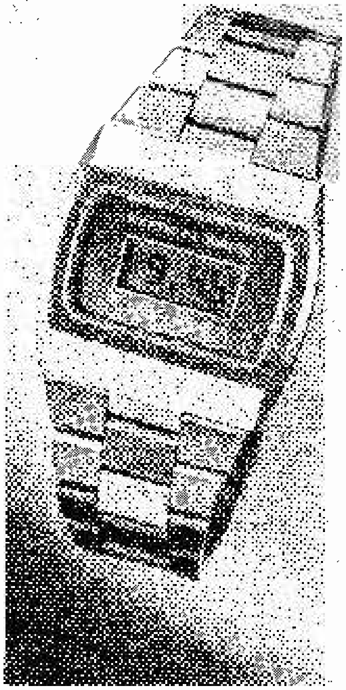
THE product detector is easily added to a receiver and is intended to provide improved reception of SSB signals, as well as CW, when used in conjunction with a BFO. If the mode selector switch AM/SSB-CW is a double-pole one it can automatically switch on the BFO in the SSB/CW position.



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



ELECTRONIC wrist WATCHES

J.B.Dance

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 5μA.

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

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.

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

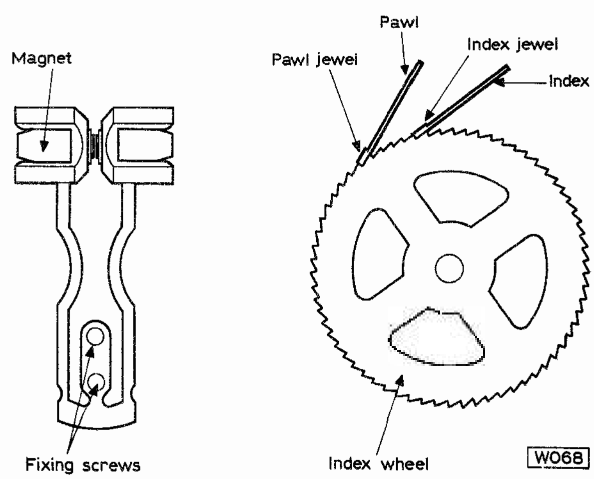
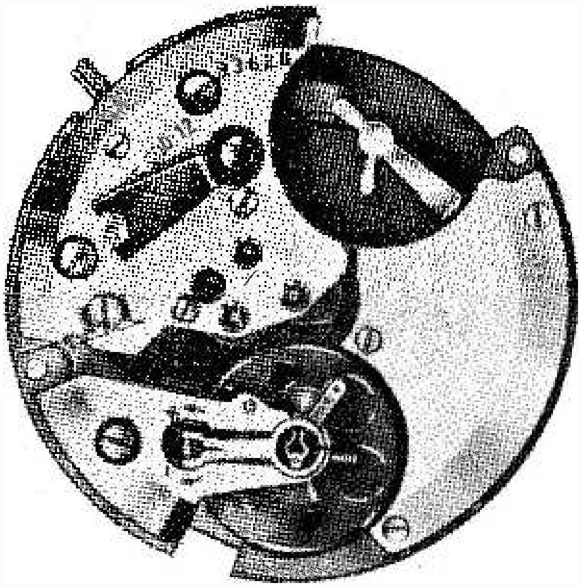


Fig. 1a (left) The tuning fork of a typical "Accutron" watch. Fig. 1b (right) The ratchet and pawl mechanisms which convert vibrations of the tuning fork into rotary motion.



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

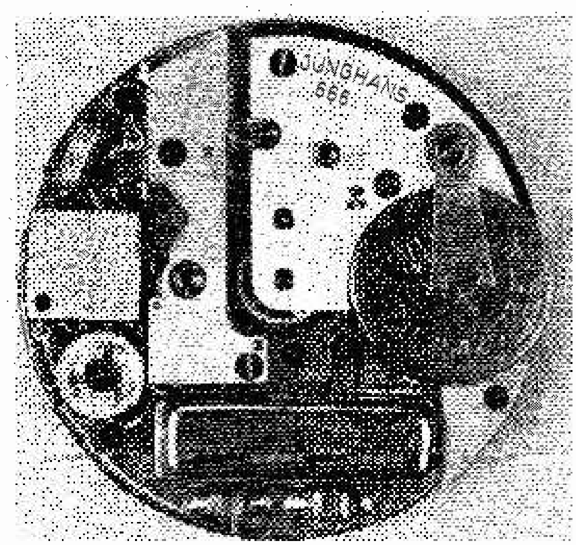
A new type of tuning fork watch known as the Megasonic 720 is being introduced by the Omega Company. It has an accuracy which is much better than that of any other watch employing a mechanical oscillator, namely ± 10 seconds per month. The tuning fork is driven by an integrated circuit oscillator; it 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 Junghams "Astroquartz" showing the power cell on the right and the quartz crystal case at the bottom.

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 Golay 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 size of the integrated circuit employed in this watch is only $2\cdot1\times1\cdot6$mm. The total current consumption is about 14μA from the $1\cdot3$V 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 Bulova "Accuquartz" watch (right) by the side of an earlier model which employs the "Beta 21" movement.

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$\frac{1}{3}$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

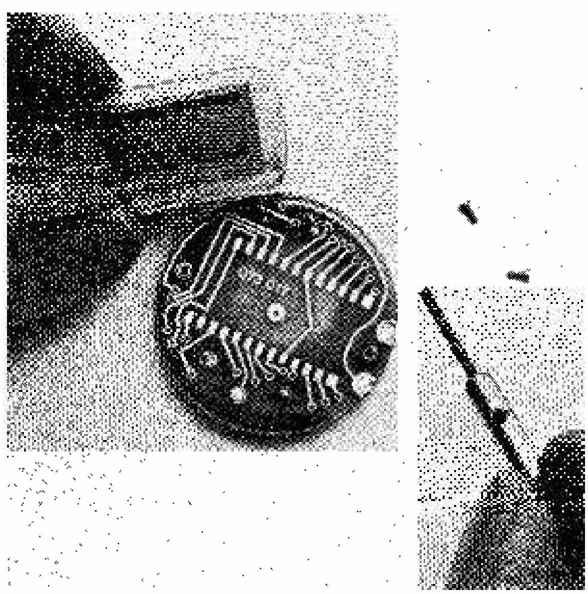
The Omega Division of SSIH (Société Suisse pour l'Industrie Horlogère) in collaboration with Batelle Institute has designed a watch with an accuracy of about one second per month; this is the most accurate wrist watch which has been put into production.

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.

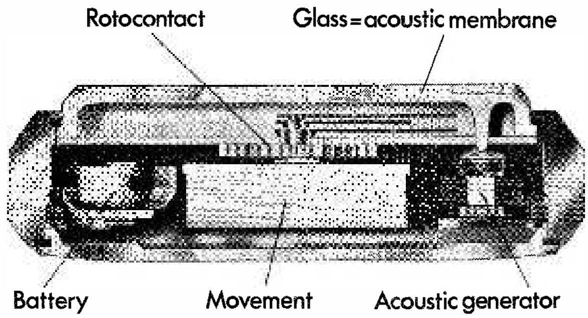
The quartz crystal in the Megaquartz operates at a frequency of 2,359,296Hz—far higher than that of any other watch. A CMOS integrated circuit manufactured by the Intersil Company is used as an analogue divider to reduce the frequency to 1Hz. It employs about 400 transistors on a silicon chip 4mm^2 in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

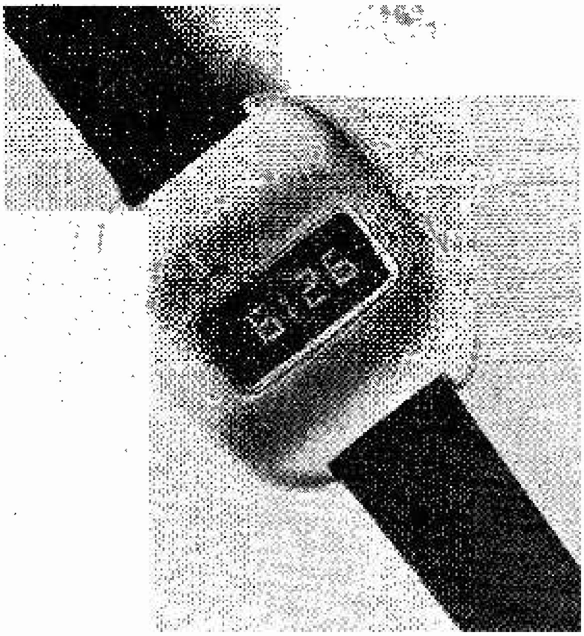
Liquid crystal displays do not emit light, but merely reflect a different proportion of the incident light from different parts of the display. Such displays can therefore operate at very low currents (typically 1μA at 10 to 20V). They can therefore display the time continuously, but the display cannot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

TELE-TENNIS BALL SPEED CONTROL
—continued from page 462

★ components list

Resistors (all ¼ or ⅛W ±5%)

R1	4·7kΩ	R7	4·7kΩ
R2	15kΩ	R8	4·7kΩ
R3	15kΩ	R9	4·7kΩ
R4	4·7kΩ	R10	330Ω
R5	2·7kΩ	R11	4·7kΩ
R6	2·7kΩ	R12	330Ω

VR1 10kΩ
VR2 10kΩ } vertical skeleton preset
VR3 1MΩ

Capacitors
C1 1000pF
C2 1000pF
C3–C9 0·1μF (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).
A complete set of parts is available at £6 inclusive.

relay contacts and set the new preset to the new speed—not too fast however or the ball will pass through the bases.

NB: If the reed relay cannot be obtained or if a spare 12V relay is available, simply wire in a transistor driver and connect the base resistor to pin 6 IC7 and the relay between the collector and unregulated 12V supply. PW

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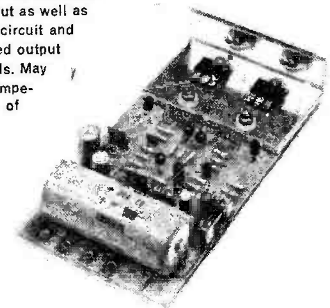
THE NEW POWER AMPLIFIERS

Three brilliant new power modules employing the same circuitry, using 10 transistors, three diodes and one zener diode with electronic over temperature cutout as well as normal thermal protection, load line short circuit and incorrect load protection, integrally mounted output capacitor. Fused supply and output terminals. May be solder or screw connected. The input impedance is high enough to accept all types of mixer having an output of 250 mV.



New features—new performance standards

★New 90°C overtemperature cutout (electronic not mechanical).
★New integral output capacitor, no external components required for normal operation.
★Short circuit load line type protection with twin summing amplifiers.
★Inherently open circuit proof.
★Input sensitivity −10 dBm (240 mV into 100k) ie suitable for most mixers. Response 20Hz—40KHz ±1dB.
★Typical distortion 0·4% (Noise −80 dB (as graph in catalogue)).
★Compact: 15cm x 8 cm x 3 xm
★Suitable for all public address, discotheque, and group applications.
★Fused supply and output terminals.
★Single supply line (split supply not required).

SA608
60 w.r.m.s. into 8Ω; 30 w.r.m.s. into 15Ω Texas 15A output transistors.
£11·50

CONSTRUCTIONALLY & ELECTRONICALLY BETTER : MULTIPLE TESTED : GUARANTEED

SA1208 **£16·00**
120 w.r.m.s. into 8Ω 60 w.r.m.s. into 15Ω Glass fibre printed circuit board. Texas 15A output transistors

SA308 **£9·00**
30 w.r.m.s. intp 8Ω 15 w.r.m.s. into 15Ω basic circuit identical to SA 1208 10A 'Plastic Power' output transistors

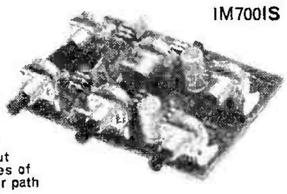
THE NEW POWER SUPPLIES

★One piece, ready to wire assembly with integral glassfibre pcb.
★Grain oriented laminated transformers for compactness.
★Facilities for preamp supply.
★Fully fused.
★Size of all models 10 x 8 x 13cm.

PM1201 95 volts for one SA1208 **£11·00**
PM1202 95 volts for two SA1208 **£14·00**
PM601 65 volts for one or two SA 608 **£9·00**
PM301 45 volts for one or two SA 308 **£7·50**

MODULAR PRE-AMPS

IM7001S



Mono & Stereo

Up to twenty IM7001 Input modules may be used with the IM7002 mixer module. Each input module has various types of equalisation and monitor path outlets.

★Equalisation to suit ceramic AND *magnetic* cartridges, low and high imp. mic. all all musical instruments. ★Mono and stereo. ★Mono module may be matrixed into stereo.★low noise circuitry with carbon film resistors.★20 Hz—50 kHz + 1dB. ★Wide range bass and treble controls—zero noise with vol. at min. ★18 volt supply.★Outputs for monitoring and echo send. * May be used in conjunction with the discotheque mixers and Minotaur amplifiers.

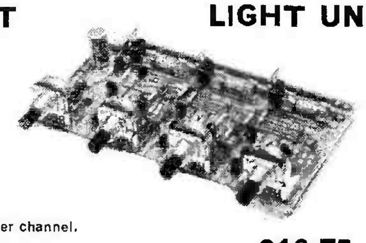
IM7001M (mono) **£5·50** IM7001S (stereo) **£9·00**

IM7002 Mixer module with output suitable for most amplifiers PLUS up to 1 Watt of monitoring power.
★Accepts up to twenty IM7001 input modules.★Mono or stereo. ★Up to 3V output—will feed loads down to 600 ohms. ★Up to 1 watt into 8Ω for monitoring (will feed higher impedance). ★Accepts echo and other effects return signals.

IM7002M (mono) **£5·50** IM7002S (stereo) **£9·00**

SAXON SUPERFECT LIGHT UNIT

(illustrated)



All these features in ONE UNIT:
No other commercially available module to our knowledge, offers all these facilities in one complete unit.
★Sequential display with variable speed.
★Frequency dependent channels—individually fused.
★Continuously variable function control gives uninterrupted light display in absence of signal.
★Electronic override on each channel.
★RCA 8 Amp. triacs handling 1000 watts per channel.
★Timer circuitry to reduce 'flicker'.
★Individually controlled bass middle and treble plus master audio control for ease of adjustment.

£19·75

SAXON SOUND-LITE

£13·50

Our ever popular 3000 watt unit is now available in module form at only
★Individual control of bass middle and treble plus master control for ease of adjustment.
★1000 watts per channel—individually fused.
★Negligible load on amplifier.
★RCA 8 AMP triacs for reliability.

SAXON MONO & STEREO DISCOTHEQUE MIXER WITH AUTOFADE

THE ULTIMATE IN MIXER MODULE

★Inputs for two decks (ceramic cartridge) plus tape; overall bass and treble controls
★Hi/lo imp. mic input with separate volume bass and treble controls.
★Continuously variable autofade depth plus preset threshold control.
★Low noise (−80dB) virtual earth mixing circuitry.
★Up to 0·5W from low distortion push pull monitor amp.
★Response 20Hz—50kHz ± 1dB.
★Low power consumption (20mA at 18 volts).
★Compact—mono version 40cm x 6cm x 3cm. stereo version 40cm x 10cm x 3cm.
★Output −10dBm (240mV) to suit all Saxon amplifiers and most other makes.

MONO VERSION **£18·50** STEREO VERSION **£27·50**

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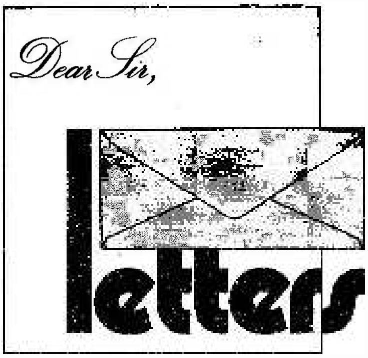


Silica fibres . . . not coax

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, Wirrall. 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.

ON THE AIR

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.

ON THE AIR

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 Preamplifier 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; VOCM in St John's on 590kHz, CBNA St Anthony on 600kHz, CKCM Grand Falls on 620kHz, CBN St John's on 640kHz, CJCN 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 GM3OXX (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 callsigns. 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

ON THE AIR

out a rough plan of 'things-to-do' especially as we approach the winter season. Work on aerials 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 DL0MX 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 QQVO3-25 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 callsign, 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

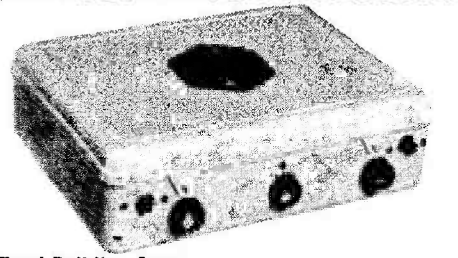
P. Barker:— SSTV 40m OE9IM **20m** DJ2IV F3RT HB9IT OD5JW OE9IM OZ3WP VU2AIK **20m SSB** A6XR JW5NM LA4C (Dx-pedition?)

S. Budd:— 20m AP2SA EA5ES/EA9 FB8ZG Amsterdam Is. FP0XX HB0AWQ JT1AI JW5DQ KH6GKD/KB6 KS6FF PV0AKL Fernando de Noronha SU1MA 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, Ashtead, Surrey, KT21 2TW.



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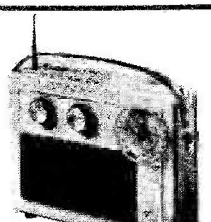

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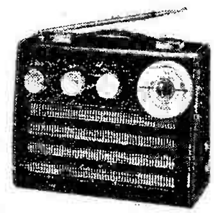

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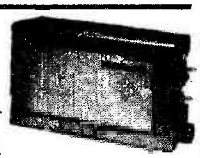

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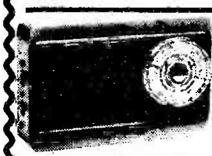

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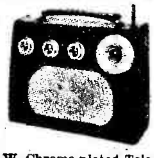

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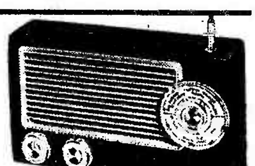

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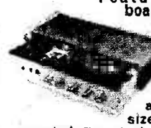

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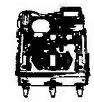

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TYPE 72703, 400V at 10mA + 200V at 5mA + 6·3V at 400mA, £1·25.
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I.C. OF THE MONTH

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: 4μA when operating and only 0·1μA 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 frequency 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.

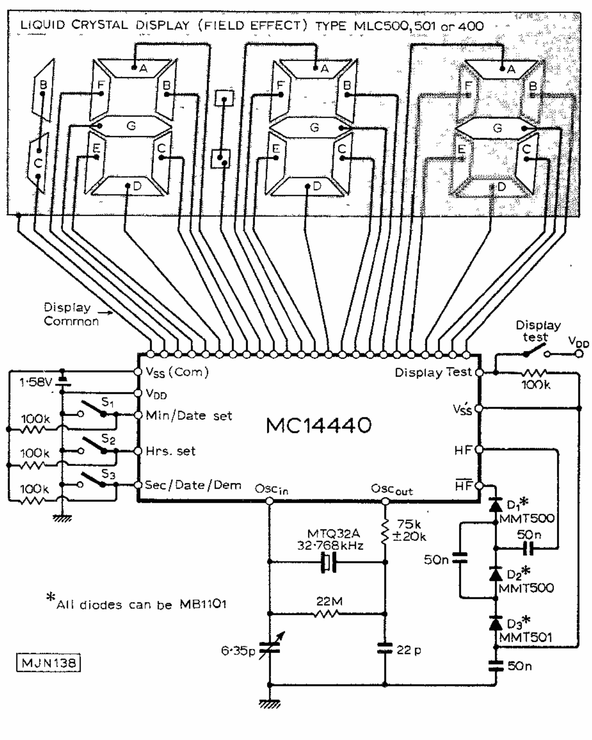

Fig. 1: Complete circuit using the MC14440 in a watch, with the new liquid crystal display type MLC500, 501 or 400.

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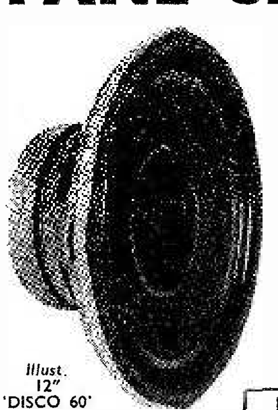

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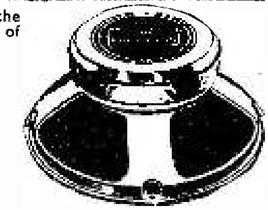

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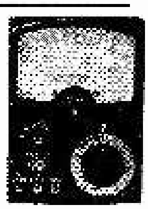

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ECL83	·82	EZ81	·35	PCL84	·50	UBL21	2·34
ECL84	·70	GY501	·82	PCL86	·55	UC92	·60
ECL85	·70	GZ32	·59	PCL805	·70	UCC84	·90
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EF40	·88	GZ37	1·20		1·00	UCH21	2·34
EF41	·82	HABC80		PEN46	·60	UCH42	·88
EF42	·90		·80	PEN453DD		UCH81	·47
EF73	1·76	HL23DD			2·00	UCL82	·45
EF80	·30		·80	PENDD		UCL83	·64
EF83	1·45	HL41DD		4020	1·00	UF41	·82
EF85	·40		1·00	PFL200	·82	UF42	·82
EF86	·50	HL42DD		PL33	·50	UF80	·41
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EF98	·95		1·17	PL83	·47	UM80	·60
EF183	·40	KT41	1·17	PL84	·50	UY41	·50
EF184	·40	KT66	2·93	PL504/500		UY85	·50
EF804	1·75	KT81	2·10		·82	U10	1·17
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EL83	·70	PC86	·70	PY88	·47	U191	·59
EL84	·36	PC88	·70	PY500A		U251	·94
EL86	·60	PC95	·70		1·11	U301	·65
EL360	1·80	PC97	·55	PY800	·47	U403	·90
EL506	1·20	PC900	·47	PY801	·47	U404	·75
EM80	·53	PCC84	·35	PZ30	·50	U801	·80
EM81	·76	PCC85	·50	QQV03/10		U4020	·75
EM83	·64	PCC88	·65		2·10	VP23	·65
EM84	·47	PCC89	·60	QS75/20		VP41	·88
EM85	1·20	PCC189	·60		1·00	VR105	·59
EM87	1·10	PCF80	·47	QS95/10		VU111	·80
EMM803		PCF82	·50		1·00	VU120	1·17
	2·50	PCF84	·70	QS150/15		VU120A	
EY51	·50	PCF86	·60		1·90		1·17
EY81	·50	PCF200	1·00	R19	·75	VU133	·80
EY83	·70	PCF201	1·05	TH233	1·00	W107	·75

W729	1·17	AD161	·59	BYZ12	·33
X65	1·46	AD162	·59	BYZ13	·33
X66	1·46	AF114	·33	FSY11A	·29
X101	2·34	AF115	·20	FSY41A	·29
Z759	5·85	AF117	·25	OA9	·16
		AF121	·39	OA10	·55
Transistors		AF124	·33	OA47	·13
& Diodes		AF125	·22	OA70	·20
1N4744	·18	AF126	·23	OA73	·20
2N404	·23	AF180	·62	OA79	·12
2N966	·68	AF186	·71	OA81	·12
2N1756	·64	BA115	·18	OA85	·12
2N2147	1·10	BA116	·23	OA90	·16
2N2297	·29	BA129	·16	OA91	·12
2N2369	·18	BA130	·13	OA95	·12
2N3053	·42	BA153	·20	OA200	·12
2N3121	3·22	BC107	·16	OA202	·13
2N3703	·25	BC108	·16	OC44	·13
2N3709	·26	BC109	·16	OC45	·14
AA119	·20	BC113	·33	OC46	·20
AA120	·20	BC115	·20	OC70	·16
AA129	·20	BC116	·33	OC71	·14
AAZ13	·23	BC118	·29	OC72	·14
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AC113	·33	BCY12	·64	OC75	·14
AC126	·18	BCY33	·26	OC76	·20
AC127	·22	BCY34	·29	OC77	·35
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AC132	·26	BCY39	·33	OC78D	·20
AC154	·33	BF158	·23	OC81	·14
AC156	·26	BF159	·33	OC81D	·14
AC157	·33	BF163	·26	OC82	·14
AC165	·33	BF173	·49	OC82D	·14
AC166	·33	BF180	·39	OC83	·26
AC168	·49	BF181	·52	OC84	·31
AC176	·71	BF185	·52	OC123	·29
AC177	·36	BF194	·20	OC139	·29
ACY17	·33	BFY50	·29	OC169	·29
ACY18	·26	BFY51	·25	OC172	·46
ACY19	·25	BFY52	·26	OC200	·59
ACY20	·23	BY100	·23	OC201	·59
ACY21	·25	BY114	·23	OC202	·55
ACY22	·20	BY126	·20	OC203	·39
ACY28	·23	BY127	·23	OC204	·39
AD140	·47	BYZ10	·33	OC205	·55
AD149	·64	BYZ11	·33	OC206	1·17

MATCHED TRANSISTOR SETS:— LP15 (AC113. AC154. AC157. AA120) ·68p per pack. 1—OC81D & 2—OC81, 55p. 1—OC44 & 2—OC45, ·55p. 1—OC82D & 2—OC82 ·62p. Set of 3—OC83 ·84p.

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All goods are unused and subject to the standard 90 day guarantee. Cash or cheque with order only. Despatch charges:—Orders below £10 in value, add 25p for post and packing. Orders over £10 post and packing free of charge. Same day despatch. Any parcel insured against damage in transit for only 5p per parcel extra. Terms of business free on request. Many others in stock too numerous to mention. Please enclose S.A.E. for reply to any correspondence.

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Impedance Standard	8 ohms
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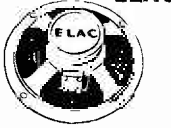
Useful Response	25 to 18,000 cps
Bass Resonance	45 cps

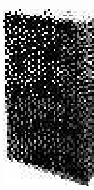
SUITABLE ENCLOSURE 20 × 13 × 12in. MODERN DESIGN. TEAK WOOD FINISH. **£14·50** Post 75p

ELAC 8in. or 10 × 6in. HI-FI SPEAKER



Dual cone plasticised roll surround. Large ceramic magnet. 50–16,000 cps. Bass resonance 55 cps. 8 ohm impedance. 8in. 10 watts **£4·35**

TEAK VENEER HI-FI SPEAKER CABINETS
Fluted Wood Fronts



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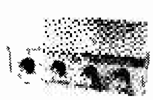

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30-14,500 c/s. 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s Rated 20 watts. NOTE: 3 or 8 or 15 ohms must be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

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All purpose transistorised.
Ideal for Groups, Disco and P.A.
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4 inputs 2-way mixing. 2 outputs separate treble and bass controls. Ideal disco or p.a. amp.

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4 input 10 wide range controls. For Mikes, Discos, Organs Guitars, etc. 4, 8 & 15 ohm loudspeakers matching £82·00.

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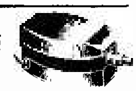

QUALITY LOUDSPEAKER ENCLOSURE

Teak veneered ⅝in thick wood cabinet. Size 18½in × 18½in × 8½in. Weight 23lbs. This cabinet features a wide mesh Silver Grill covering a separate compartment for mounting Tweeters or Mid-Range Horn. The fully sealed bass compartment is cut out for 6½inch Woofer. £8·50 Carr. 85p.
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Baffle could be cut to take larger speaker.

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HIGH QUALITY — BRITISH MADE

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12in. 15 watts

An inexpensive unit for the beginner in high fidelity and for general purposes. May be used to improve any Radio, Amplifier, Hi-Fi or Television receiver.
Bass Resonance 45cps
Flux Density 12,000gauss
Useful response 45-13,000cps
3 or 8 or 15 ohm models.
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DE-LUXE Mk II
12in 15 watts

Especially designed to provide full range reproduction at an economical cost. Suitable for use with any high fidelity system. Built-in concentric tweeter cone.
Bass Resonance 30cps
Flux Density 14,000gauss
Useful response 25-16,000cps
8 or 15 ohms models.
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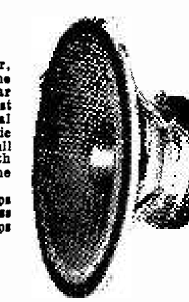
SUPERB
12in. 20 watts



A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.
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Flux Density 16,500gauss
Useful response 20-17,000cps
8 or 15 ohms models.
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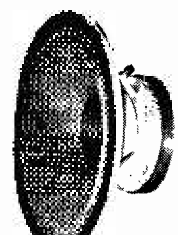
AUDITORIUM
12in. 25 watts



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Bass Resonance 35cps
Flux Density 15,000gauss
Useful response 25-16,000cps
8 or 15 ohms models.
£14·50 Post 50p

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15in. 35 watts

A high wattage loudspeaker of exceptional quality with a level response to above 8,000 cps. Ideal for Public Address, Discotheques, Electronic instruments and the home HI-FI.
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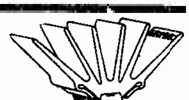

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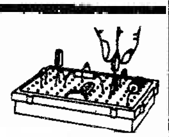

S-DeC £2·34
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μ-DeC A—N/A
μ-DeC B—N/A
IC carriers:—
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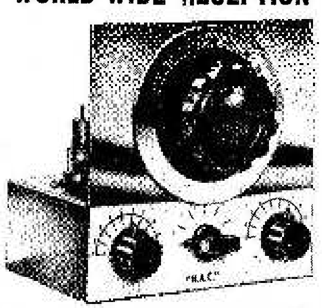

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6·3	3·0	2·09
9·0	1·0	1·83
12·0	0·5	1·83
12·0	1·5	2·09
12·0	3·0	3·02
6-0-6	0·5	1·96
9-0-9	0·5	1·96
9-0-9	1·0	2·23
10-0-10	2·0	3·00
12-0-12	1·0	2·23
12-0-12	2·0	3·13
12-0-12	3·0	4·32
15-0-15	1·0	2·88
15-0-15	2·0	3·78
18-0-18	2·0	4·32
20-0-20	1·0	3·03
20-0-20	2·0	4·32
30-0-30	1·0	4·32
0-10-12-14-16-18	4·0	4·58
0-12-15-20-24-30	2·0	4·45
0-5-20-30-40-60	2·0	6·54

Bulk tape eraser	3·53
15-8-3 ohm 12 watt matching	1·71
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Single sided fibre glass	0·70 sq ft
Double sided fibre glass	1·00 sq ft

Cut in multiples of 6" i.e. 6 x 6, 6 x 12, 12 x 12, 12 x 18, etc.

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1 lb ferric chloride	0·50
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	£ p
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IN4001	6p
IN4002	7½p
IN4003	9½p
IN4004	9½p
IN4006	12p
IN4007	13p
OA70	6p
OA81	7½p
OA90	6p
OA91	6p
OA202	7½p
BA154	9½p
BA156	13p
IN914	4p
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7400	15p
7402	15p
7404	15p
7413	43p
7447	123p
7473	46p
7475	58p
7490	69p

7 segment led numeral display

16p D.I.L.	115p

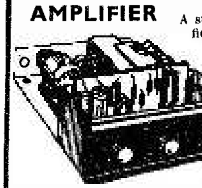
D.I.L. sockets

8 pin	15p
14 pin	15p
16 pin	16p

Electrolytics. Tubular with axial leads except where stated.

Mfd.	Volts	Pence	
47	4	7	
330	4	7	
68	6·3	7	
470	6·3	9	
1000	6	11	single end p/c fitting
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	single end p/c fitting
330	16	12	
1000	16	20	
10	25	7	
22	25	7	
47	25	7	
100	25	7	
150	25	9	
200	25	11	
1250	25	24	single end can
5000	25	55	single end can
1000+1000	30	32	single end can
2500	30	40	single end can
6·8	40	7	
16	40	7	
100	40	9	
1000	50	35	single end can
1	63	7	
4·7	63	7	
10	63	7	
32	63	7	
800	63	32	single end can
2500	63	80	single end can
4700	63	140	single end can

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz 30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. **PRICE £15·00.** P. & P. 65p.

DE LUXE STEREO AMPLIFIER

A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:- 2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built & tested to a high standard. **£12·50.** P.&P. 85p.

ALL-PURPOSE POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp on load. Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3½" × 2½". Ready built and tested. **PRICE £6·35** P. & P. 55p.

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. **Our price £1·30 yd. length.** P. & P. 30p per yd. (min. 1 yd.). S.A.E. for samples.

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3·5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with good quality output transformer. P. & P. 60p BARGAIN PRICE **£5·00**

FEW ONLY!

High grade mains transformer with grain orientated lamination. Primary 200/240 Secondary 18·5 volts at 0·6 amps and 4·6 volts at 0·3 amps. Size 2" 1×2½" w × 2" d overall. **£1·40** plus 35p P. & P.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0–210–240v. Secondary combinations 0–5–10–15–20–25–30–35–40–60v. half wave at 1 amp. or 10–0–10, 20–0–20, 30–0–30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3in. deep. Price **£2·75** P. & P. 65p.

MAINS TRANSFORMER. For power supplies.
Pri. 200/240v. Sec. 9–0–9 at 500 mA. **£1·35.** P. & P. 30p.
Pri. 200/240v. Sec. 12–0–12 at 1 amp. **£1·50.** P. & P. 30p.
Pri. 200/240v. Sec. 10–0–10 at 2 amp. **£2·20.** P. & P. 40p.

3 VOLT RELAY
100 m/A single pole normally closed. 2 for **60p** + 15p P.& P.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER

For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1½" x 1½" x ½". Brand new complete with instructions. Price **1·36p.** P. & P. 15p.

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES

A must for servicemen and home constructors. Including many 1000's of British, U.S.A. European and Japanese transistors. ONLY **40p.** Post 7p.

3 Reference Encyclopædias for Electronic Engineers and Designers, covering between them transistor characteristics, diode and transistor equivalents. Many thousands of up to date European types listed.
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NEW ISSUE
Thyristor, Triac. Diac etc. encyclopedias **£1·70,** Post Free

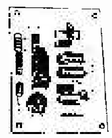
8 pole 3 way 2 bank low loss Yaxley type switches 1¼" sections. Standard spindle. 2 switches **75p** + 15p P. & P.

HARVERSONIC MAINS OPERATED SOLID STATE STEREO FM TUNER

Enjoy fabulous stereo radio at this fabulous low introductory price!

Designed and styled to match our 10 + 10 amplifier but will suit any other standard stereo amplifier. The design incorporates the very latest circuitry techniques with high-grain, low noise IF stages. Automatic frequency control to "lock-on" station and prevent drift. IC stereo decoder for maximum stereo separation. L.E.D. for stereo beacon indicator. Nominal output of tuner 100mV. Approximate size 12½" wide × 8" deep by 2½" high. Supplied ready built, fully tested and fully guaranteed (not available in kit form).
Price **£27·50** Post and Packing £1·00.

STEREO-DECODER



SIZE 2" x 3" x ½" ready built. Pre-aligned and tested. Sens. 20-560 mV for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. **£6·25** plus 15p. P. & P. Stereo beacon light if required **45p** extra.

SPECIAL BARGAIN OFFER!
Limited number of BSR C129/123 Auto Changer De Luxe with lightweight tubular arm and stereo cartridge. Brand new. **ONLY £11·00** + p. & p. 60p.

LATEST Hi Sensitivity Uni-directional slim-line condenser microphone as used by many professionals. Very low acoustic feedback. Available hi impedance or low impedance. State which required. **£16·25** plus 25p P. & P

LATEST ACOS GP91/1SC mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. **£1·75,** P. & P. 15p.

CERAMIC STEREO CARTRIDGE. Universal Mounting brackets and turnover stylus. 70mV per channel output. ONLY **£2·06** + 15p P. and P.

SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78. **ONLY £2·62** P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. **£3·18,** P. & P. 15p.

LATEST CRYSTAL T/O STEREO / COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. **£1·98** P. & P. 15p.

LATEST T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only **£1·75.** P. & P. 15p.

QUALITY RECORD PLAYER AMPLIFIER MK. II

A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. **Ready** built and tested. PRICE **£6·50,** P. & P. 75p.

ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE **£7·75,** P. & P. 75p.

HI-FI LOUDSPEAKER SYSTEM MK II

Beautifully made, simulated teak finish enclosure with attractive slatted front. Size 16½" high × 10½" wide × 9" deep (approx.). Fitted with E.M.I. Ceramic Magnet 13" × 8" bass unit, H.F. tweeter unit and crossover. **AVAILABLE IN NOMINAL** 4 Ohm, 8 Ohm or 16 Ohm impedance (state which).
OUR PRICE £11·25 each Carr. £1·25.
Cabinet Available Separately £6·25, Carr. £1·10.
Also available in 8 ohms with EMI 13" × 8" bass speaker with parasitic tweeter **£10·00,** Carr. £1·25.

LOUDSPEAKER BARGAINS

5in. 3 ohm **£1·45,** P. & P. 15p. 7 × 4in. 3 ohm **£1·69,** P. & P. 25p. 10 × 6in. 3 or 15 ohm **£2·50,** P. & P. 35p. E.M.I. 8 × 5in. 3 ohm with high flux magnet **£2·06,** P. & P. 25p. E.M.I. 13½ × 8in. with high flux ceramic magnet with parasitic tweeter 3, 8 or 15 ohm **£4·12,** P. & P. 35p. E.M.I. 13 × 8in. 3, 8 or 15 ohm with inbuilt tweeter and crossover network **£5·50,** P. & P. 35p.
E.M.I. tweeter. Approx. 3½". Available 3 or 8 or 15 ohms, **£2·00** + 25p, P. & P.

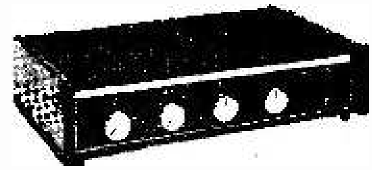
BRAND NEW. Bakers Loudspeakers at substantial discounts. 12in. 15w. H/D Speakers, 3, 8 or 15 ohms. State which. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly **£9·50.** Guitar models: 30w **£8·95,** 35w, **£10·50,** P.&P. 75p.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER

Size 11¾" × 14⅝" × 1¼" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz–20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. Only **£7·68** each. P. & P. 60p.

NOW ALSO AVAILABLE: 8", 10 watts, r.m.s. 20 watt peak 40Hz–20,000Hz. Overall depth 1". Ideal for Hi-Fi or for use in cars. **£5·18** + 40p P. and P.

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise, level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp. Overall Size 12"w. × 8"d. × 2½"h.

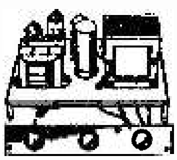
Fully detailed 7 page construction manual and **parts** list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT .. .. **£15·00** P. & P. 50p
(Magnetic input components 33p extra)

POWER PACK KIT .. .. **£5·35** P. & P. 55p
CABINET .. .. .. **£5·35** P. & P. 55p
(Post Free if all units purchased at same time)
Full after sales service
Also available ready built and tested **£32·50.** Post Free.

Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc. and will then provide mixing and fading facilities for medium powered Hi-Fi Discotheque use, etc.

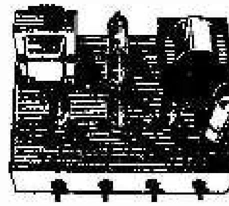
3-VALVE AUDIO AMPLIFIER HA34 MK II



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½"w. × 4"d. × 4½"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£7·75.** P. & P. 70p.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc **£6·50** P. & P. 70p.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p + SAE (Free with parts)' **All parts sold separately.** ONLY **£12·00** P. & P. £1·00. Also available ready built and tested **£16·50** P. & P. £1·00.

HI-FI STEREO HEADPHONES

Adjustable headband with comfortable flexifoam earmuffs. Wired and fitted with standard stereo ¼in jack plug. Frequency response 30–15,000Hz. Matching impedance 8–16 ohms. Easily converted for Mono. PRICE **£4·05,** P. & P. 25p.

Prices include VAT at Current Rate

Open 9.30–5.30 Monday to Friday. 9.30–5 Saturday Closed Wednesday.

All prices and specifications correct at time of press and subject to alteration without notice.

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(Dept. P.W.) 170 HIGH ST., MERTON, LONDON, S.W.19 Tel.: 01-540 3985

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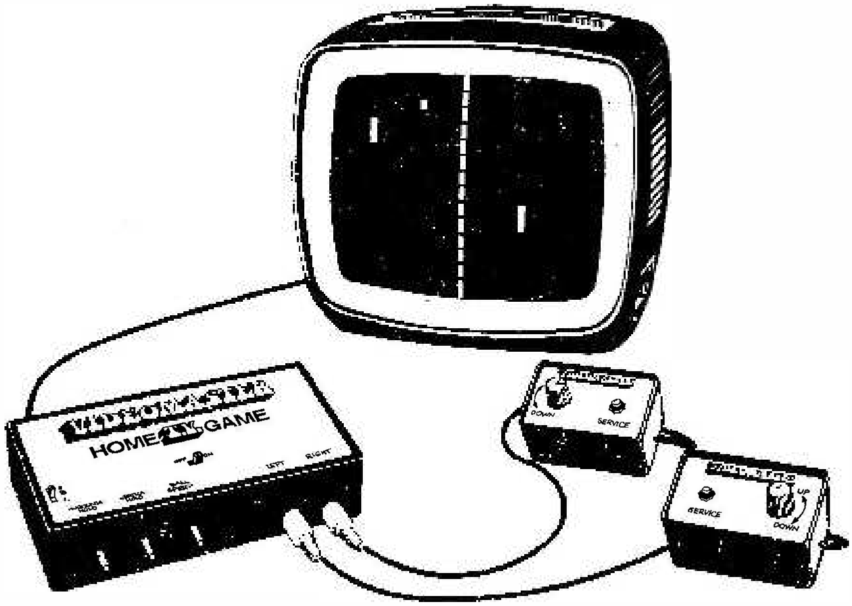

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UNTESTED PACKS: Capacitors, 50 disc ceramics, 30p; 20 polyesters, 40p; 25 electrolytics, 54p. 100 Resistors, 99p. Semiconductors, 200 mixed 54p; 8 branded AC128, 54p; 40 2W zeners, 54p; 50 400mW zeners, 54p. BC107 & 8, 11p each; BC109, 12p; 2N3055, 40p; 2N3819e, 25p; DL704 seven segment LED displays, 95p or 4+ 90p each. Driver IC for DL704 (7448), 90p each; 1lb bag of ferric chloride, 80p; 3lb of computer panels, £1·65; 10 assorted potentiometers, 54p; 1,000 or 2,000μF, 30V electrolytics, 52p each; 10μF 63V elec., 5p each. For price list send SAE or 10p. ALL prices include VAT at present rate. Please add 20p P&P on all orders under £5.
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UNBELIEVABLE SPEAKER BARGAINS! 8Ω Acoustic Suspension, teak/sculptured foam front, 6 watt £5·30; 12 watt £6·50; 16 watt (8in woofer, 3in tweeter) £7·90. (Lists 20p.) Satisfaction guaranteed (10% p&p). Gregg Electronics, 105 Grange Road, London SE25.

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BC147/8/9	0·10	IN4001/2	0·05	25A 200v	£2·00
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2N2646	0·30	TBA800	1·50	209-RED	0·17
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TIP29A	0·49	16 Pin	0·14	741C D.I.L.	0·36
TIP31A	0·61			723C D.I.L.	0·80
TIP41A	0·74	**ADD 17% V.A.T.**		747C D.I.L.	0·85
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16v	0·07	0·07	0·07	0·10	0·12	0·14	0·22
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Precision Polycarbonate Capacitors

All High Stability—Extremely Low Leakage

440V AC RANGE

Value (μF)	Dimensions (mm) L	D	Price each
0·1μF	27	12·7	51p
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0·22μF	33	16	64p
0·25μF	33	16	67p
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0.47μF	33	19	80p
0·5μF	33	19	87p
0·68μF	50·8	19	93p
1·0μF	50·8	19	£1·03
1·5μF	50·8	25·4	£1·21
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63V DC RANGE
Axial or Radial leads available:

Value μF	±1%	±2%	±5%
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0·1μF	66p	49p	42p
0·22μF	67p	50p	43p
0·33μF	67p	50p	43p
0·47μF	67p	50p	43p
0·68μF	74p	53p	46p
1·0μF	82p	62p	52p
1·5μF	89p	71p	58p
2·2μF	96p	75p	61p
3·3μF	£1·15	82p	68p
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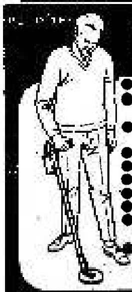

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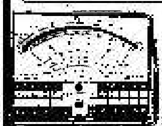

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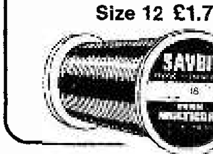

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LM381 £1·85
LM382 £1·66
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SL611C £2·03
SL612C £2·03
SL613C £4·31
SL620C £3·06
SL621C £3·06
SL622C £7·62
SL623C £5·57
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SL630C £1·87
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Minitron Filament Display bi-directional 0·38" 3015F 0·9 L/H d.pt. 3015G ±1 £1·08●

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LIQUID CRYSTAL DISPLAY complete with socket and removable reflective backing; Ref AN4132R 13mm character height. Can be directly driven by National Semiconductors Alarm Clock chip MM5316. £13.99 ●

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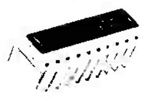

NEW LED Linear Cursors each device contains 10 light emitting diodes in a 20pin dual-in-line package. Ideal for solid state analogue meters or dials. Type 101 RED £2.26 ●

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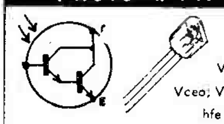

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Vceo; Vcbo 25v; Vebo 8v
Vceo; Vcbo 25v; VEBO 8v
hfe 2500; Ic 250 mA **35p.**

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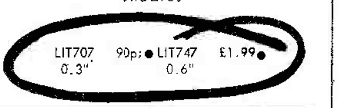
enables

LIT707 0.3" 90p; ● LIT747 0.6" £1.99●



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	Dual-in-line						TO5	
Pins 8	14	16	24	28	36	40	8	10
● Price 13p	15p	15p	26p	30p	39p	44p	31p	35p

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Litronix Double Digit Displays 0.5"; Common Anode + 2 R/H D.P.'s
DL721 gives ± 1.9
DL727 gives 0.0. to 9.9
Suitable for Clocks: Instruments; T.V. Channel Indicator
Our Price £4.75 each ●

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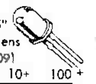
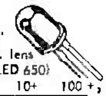
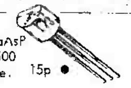




	0.125" dia. lens (TIL209) 1+	10+	100+	0.16" dia lens 1+	10+	100+	0.2" dia. lens (MLED 650) 1+	10+	100+
Red	16p	15p	13p ●	27p	24p	22p ●	18p	16p	14p ●
Green	27p	24p	22p ●	33p	30p	27p ●	30p	27p	25p ●
Orange	27p	24p	22p ●	33p	30p	27p ●	30p	27p	25p ●
Yellow	34p	31p	29p ●	35p	32p	29p ●	35p	33p	30p ●



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With the recent increase in postal charges and a continuing increase in packaging costs 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.
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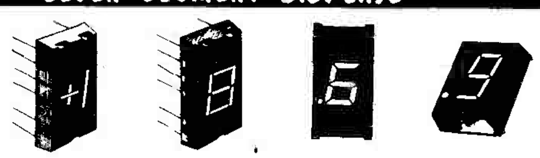

		COMMON ANODE R/H Dec. Pt.	COMMON ANODE L/H Dec. Pt.	COMMON ANODE ±1	COMMON CATHODE R/H Dec. Pt.	Our Price
	RED	DL707R	DL707	DL701	DL704	£1.82●
0.3"	GREEN	MAN51	MAN52	MAN53	MAN54	£1.82●
	RED	MAN71	MAN72	MAN73	MAN74	£1.82●
	YELLOW	MAN81	MAN82	MAN83	MAN84	£1.82●
	ORANGE	MAN3610	MAN3620	MAN3630	MAN3640	£1.82●
	GREEN	XAN51	XAN52	-	XAN54	£1.49●
	RED	XAN71	XAN72	-	XAN74	£1.49●
	YELLOW	XAN81	XAN82	-	XAN84	£1.49●
0.4"	GREEN	MAN4510	MAN4520	MAN4530	MAN4540	£2.32●
	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. ±1	C.C. L/H Dec. Pt.	C.C. ±1	
0.6"	RED	DL747	DL746	DL750	DL749	£2.42●

NOTE: MAN4000 series pinouts are 14 pin dil the same as MAN50;70 & 80 series.

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ADVERT. No.1. of Series B.

CALLERS WELCOME

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.

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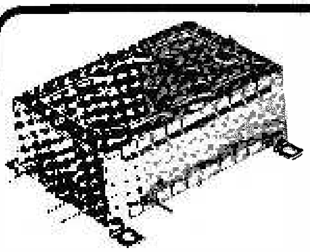
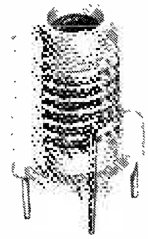
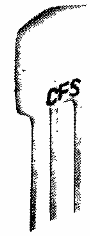


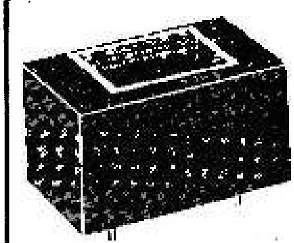
Varicap FM tunerhead:
The EF5603 represents the top of the range in TOKO FM tuner modules. With 5 double varicap tuned circuits, and dg MOSFET RF stage, the performance is really excellent. (12v supply) 1-24 £9.05 each



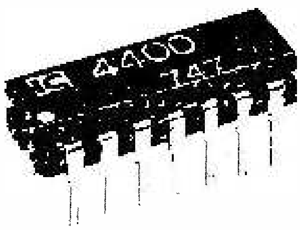
Coils for VHF RX/TX's
S18 are fully molded coils, complete with cores. A wide range of custom types with up to two taps is available - standard types for VHF are avilable ES. 1-24 18p each



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

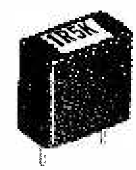


6 pole linear phase filter
Centered on 10.7MHz, this linear phase filter offers all the necessary selectivity for the construction of a Hi Fi FM stereo tuner. 1-24 £2.25 each

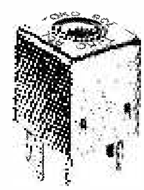


ICs for IF, decoder
The popular 1310, and 3089 types for FM MPX.
1310/4400 1-24 2.20 each
3089/4402 1-24 1.94 each

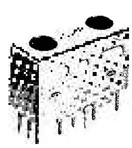
19 & 38 kHz notch filter
BLR3107 filters will remove the interference that causes annoyance when listening to or recording from MPX transmissions on FM. 1-24 £1.60ea



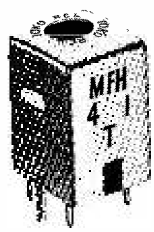
7BA Low cost RF choke
Miniature chokes 1uH to 1mH. Useful for all low power decoupling applications in RF circuits, logic circuits, filter circuits etc. Stock values 1, 4.7 and multiples through to 1mH. Custom orders 1000 min. for other values 1-24 15p ea



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

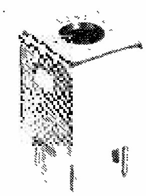


CFT ceramic series AM IF filters
Low cost filters for use with IC or discrete circuits. Each unit includes an input/output matching transformer. For 455 and 470 kHz BW 6kHz. CFT 1-24 50p each, or slightly larger with higher Q: CFU050 (470 kHz only) 1-24 55p each.



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

Please address all enquiries and orders for 1000 pcs or less to the distributor, AMBIT international.

AMBIT international
37 High Street
Brentwood
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tel 216029 tlx 995194

Terms:	Min CWO £1.00, VAT extra Post 20p per order (CWO) Min invoice £7.50 pp 50p.

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tel 54057 tlx 848095

PRACTICAL WIRELESS

SIMPLE HOME PROJECTS

8 PAGE SUPPLEMENT No.1

OCTOBER 1975

CONTENTS

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.

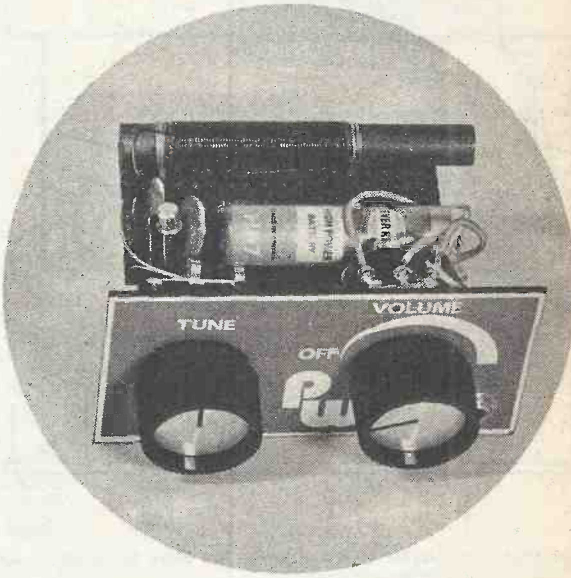
Take special care when soldering transistors. See that the leadouts are scraped clean and use a minimum of heat to make the joints.

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.

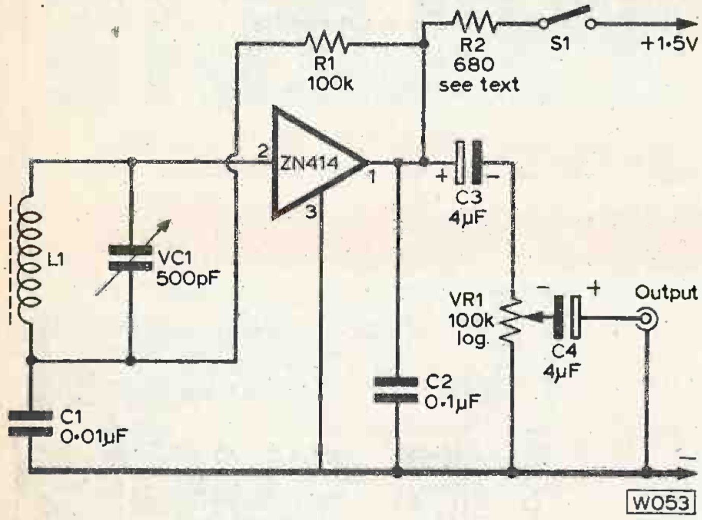
IC TUNER for audio amplifiers



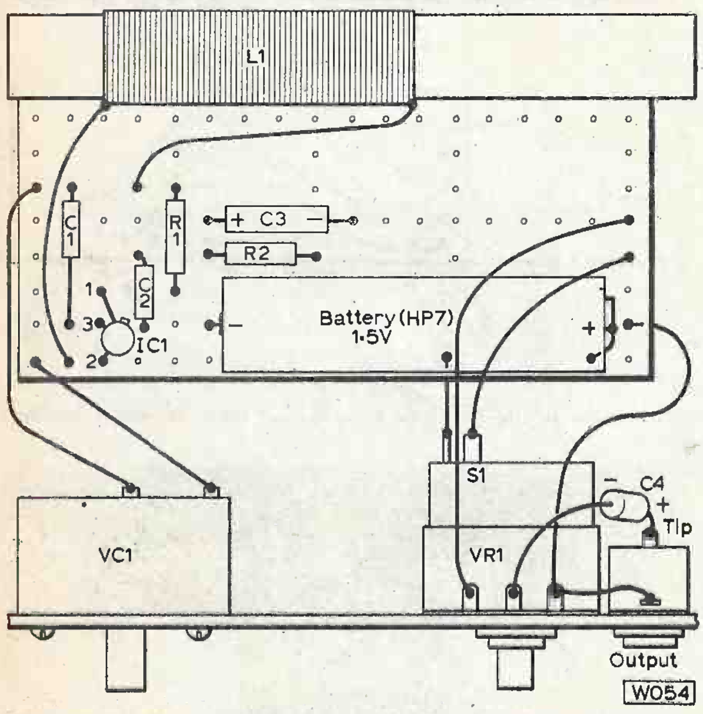
A single silicon integrated circuit provides several functions not normally available in TRF receivers.

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.



The tuner circuit using the ZN414 IC. Under no circumstances must the supply voltage exceed 1·5V.



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.

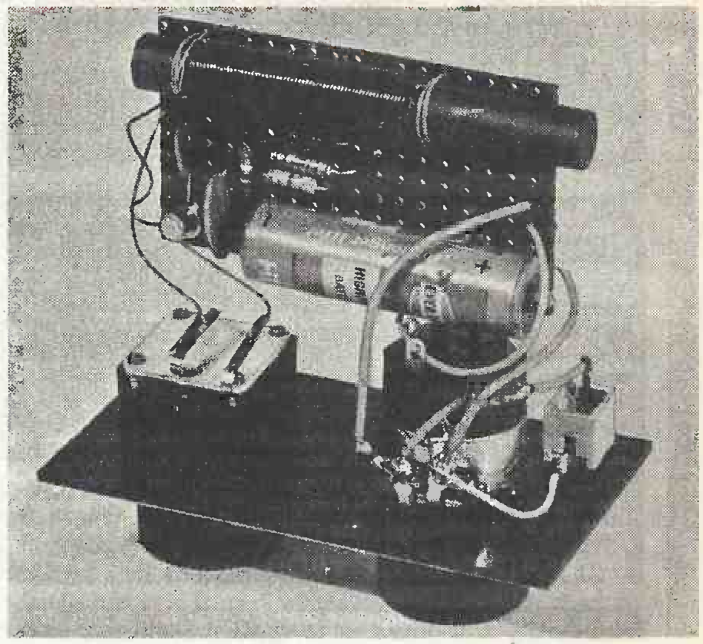
Components are fitted as shown. Note the cuts or drilling away of the foil conductors. The IC has its leads arranged as shown. Bring lead 3 between leads 1 and 2, avoiding any short circuit. The IC will then fit the holes as indicated which helps separate input and output circuits.

The aerial is sixty turns of 24SWG enamelled wire, close 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.

Bits and Pieces

R1	100kΩ ¼W 5%
R2	680Ω ¼W 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.

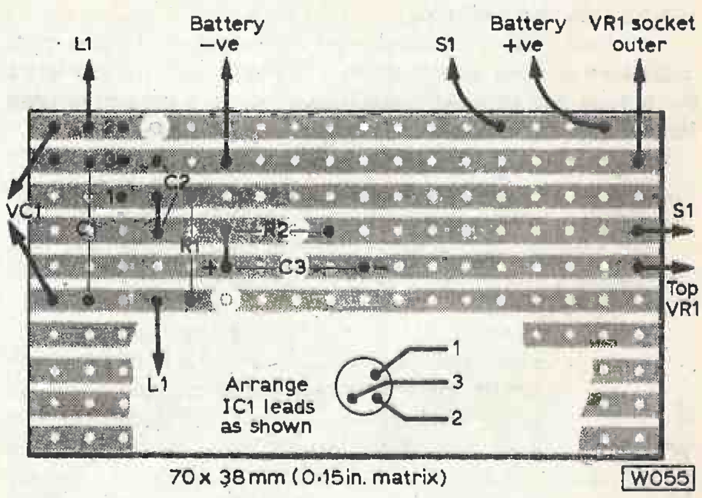
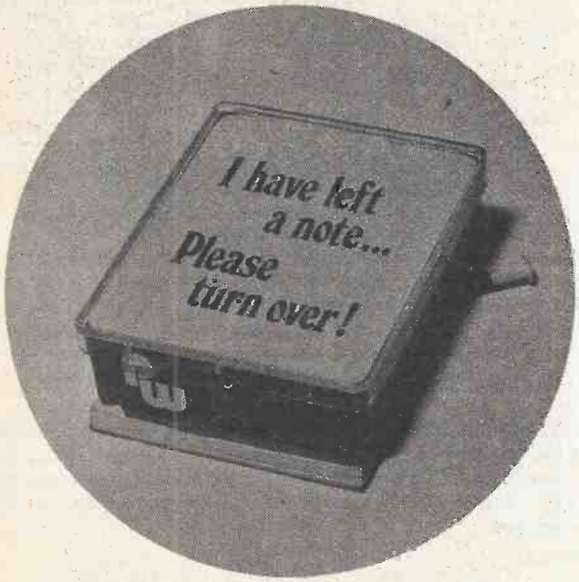


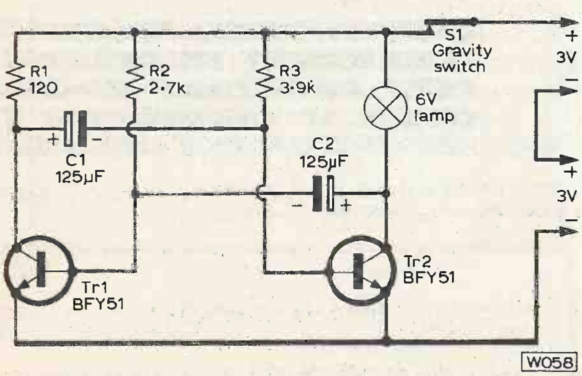
Diagram showing breaks required on the veroboard before components are soldered in place.

MEMO reminder



A slowly flashing lamp increases the battery life in this Memo Reminder.

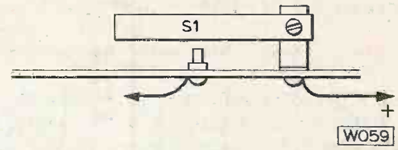
This device is a flat plastic box provided with a note pad, normally left with the pad uppermost. When a message has to be left, if only "Back in five minutes", this is written on the pad and the device turned over. In this position, a lamp at the end of the case flashes on and off at about one second 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.



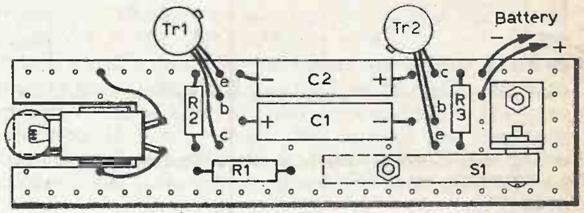
The simple multivibrator circuit is activated by the gravity switch S1. The operating current of the lamp should be as low as possible.

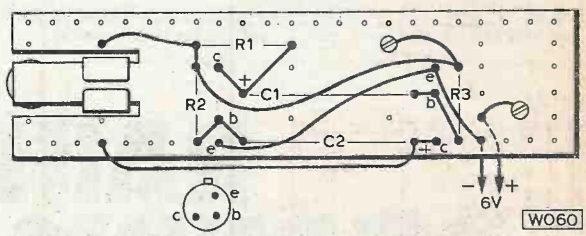
The circuit uses a two-transistor flip-flop oscillator, collector current of Tr2 passing through the lamp, which is a 6V bulb as used for cycle dynamo back lights and other purposes. The device will operate from 4·5 or 6V but here two 3V batteries are used for the supply.

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

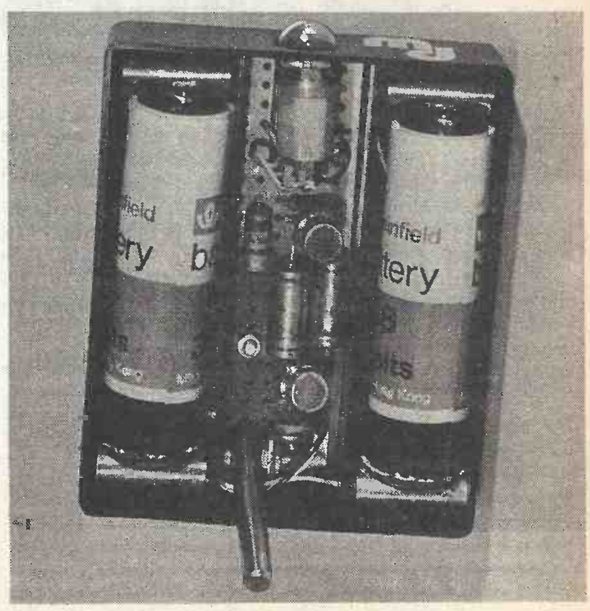


Details of the gravity switch and bracket.





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.

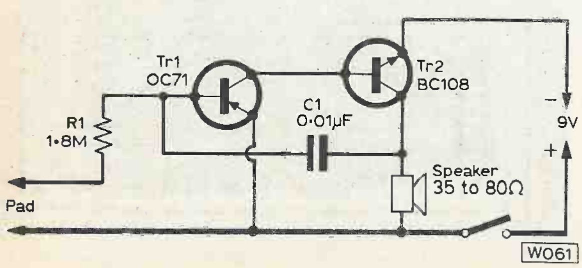
The circuit is assembled on 0·15in perforated board about 90 x 22mm. The bulbholder is the type which has a clip that slips on the insulated board cut to accommodate it as shown. The holder may be slid along to place the bulb inside or outside the box. The box actually used (available from shops selling 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.

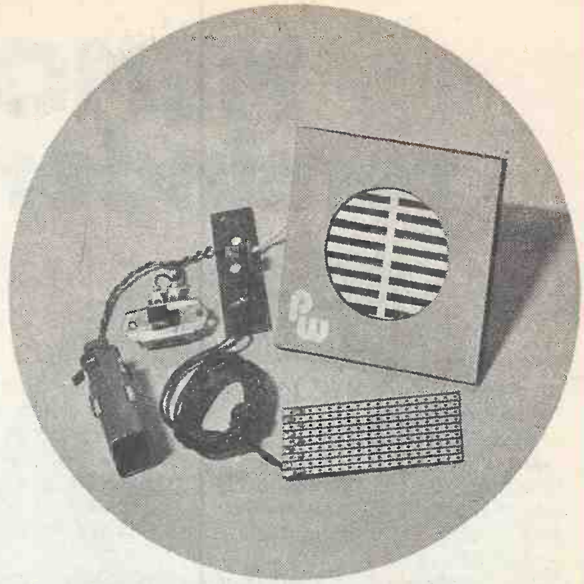
RAIN WARNING BLEEPER

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

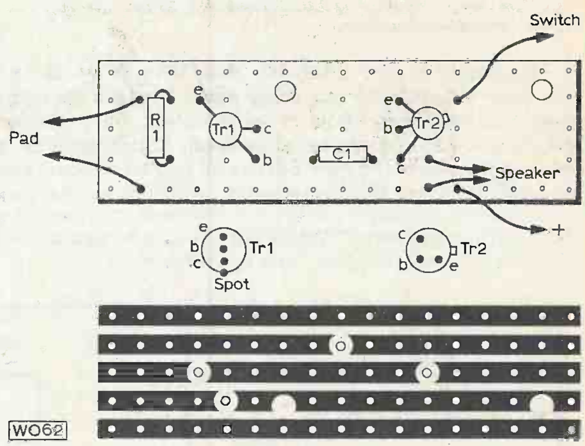


The circuit of the Rain Warning Bleeper could hardly be simpler. Altering the values of R1 and/or C1 will change the tone.



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.



Position of the components and foil side of the veroboard showing breaks required to be made before assembly.

Bits and Pieces

R1	1·8MΩ ¼W 10%
C1	0·01μF disc ceramic
Tr1	OC71
Tr2	BC108

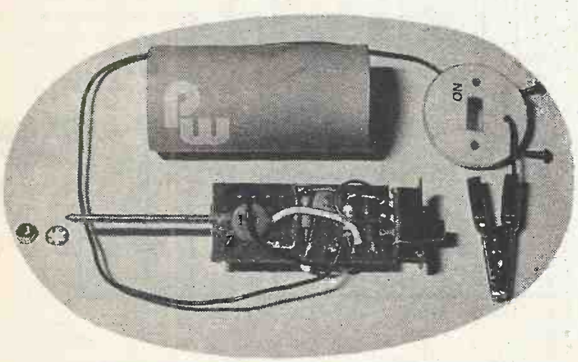
On-off switch
9V battery (PP3)
Speaker, small size, approximate impedance 35 to 80Ω.
Veroboard for oscillator and pad. Flex.
Battery clips. Suitable box, see text.

The size of the piece of veroboard used for the rain-detecting pad is not important but ensure alternative 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.

simple SIGNAL INJECTOR



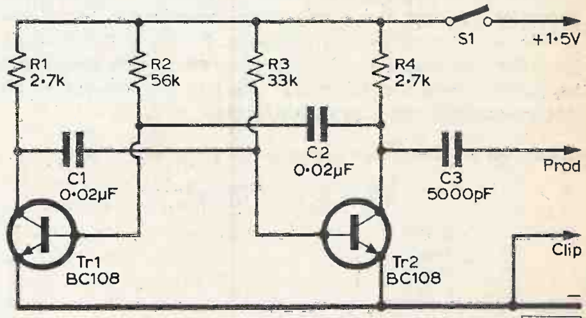
The finished Signal Injector ready to be fitted into its case, preferably a plastic one.

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.

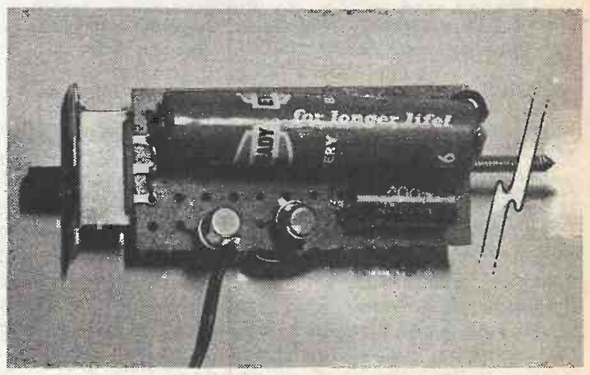
Tests with the injector should only be made with battery operated receivers, as some types of mains equipment have a "live" chassis or dangerous voltages around.

In order to accommodate the components in a small cylindrical case, C1 and C2 are low voltage disc ceramic 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.

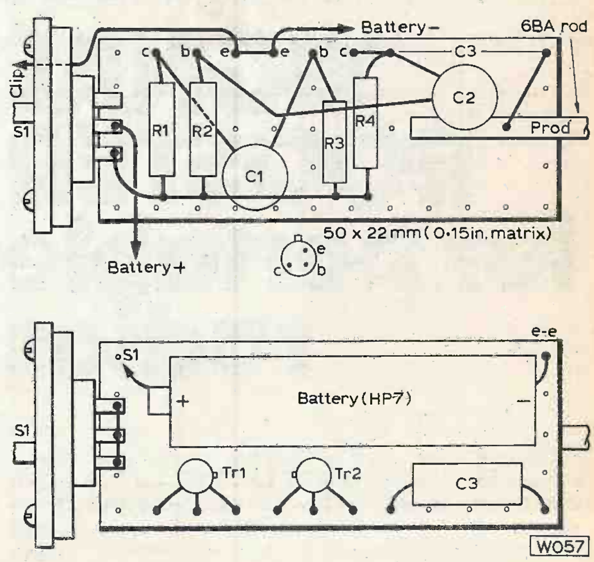
Dimensions of the insulated case are not critical but anything smaller than about 65mm long and 35mm diameter may cause difficulty in fitting all the components. A slot is cut or filed in the lid and switch S1 fixed with two bolts



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.



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	2·7kΩ
R2	56kΩ
R3	33kΩ
R4	2·7kΩ
	All resistors ¼W 10%
C1/2	0·02μF disc ceramic
C3	5000pF 150V tubular
Tr1/2	BC108

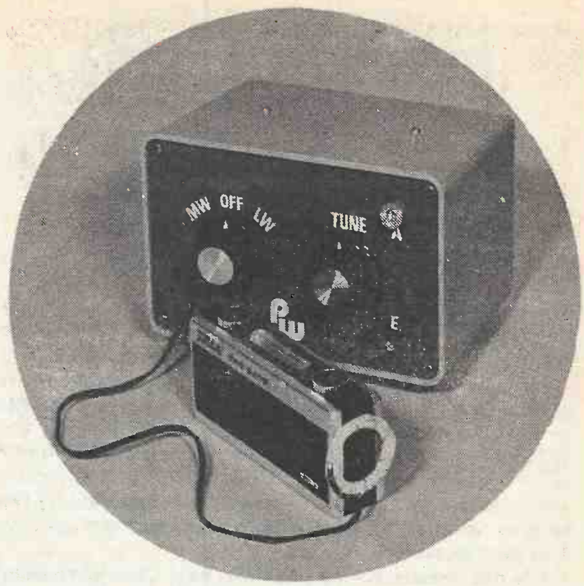
Battery, 1·5V (HP16). S1 Miniature slide switch DPST or DPDT. Veroboard. Crocodile clip. 6BA threaded rod. Plastic tube and cap, see text.

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 15Ω 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.

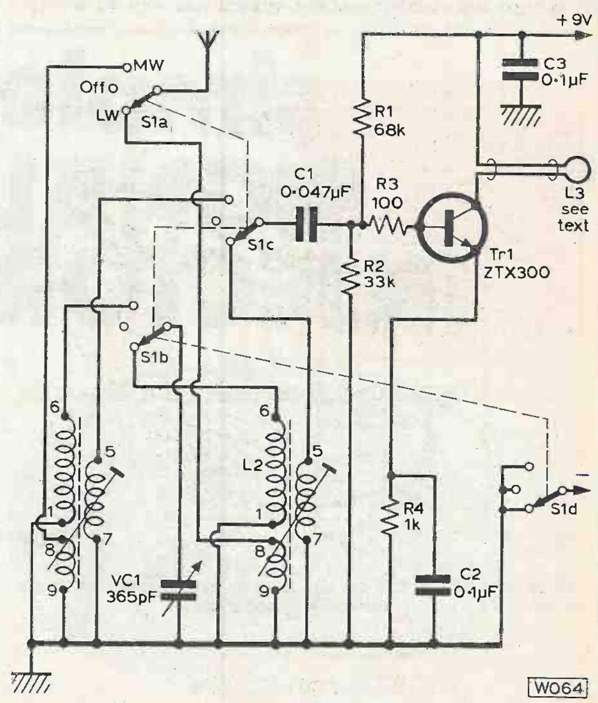
SIGNAL BOOSTER for portable radios

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 5m long. A telescopic aerial may prove satisfactory if nothing else is available, but the wire aerial will give much better results.



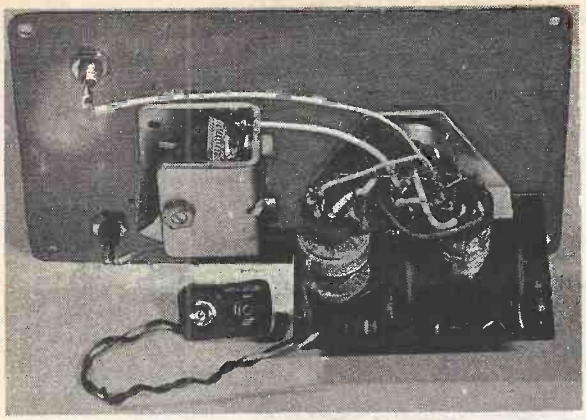
Here the output coil of the Signal Booster is placed close to the internal aerial of the transistor radio.



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.

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.

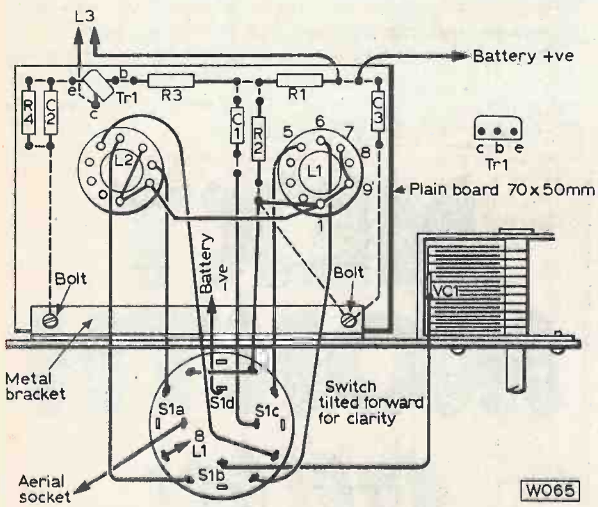
Coil L3 is a home-made 10 turn loop, about 25mm in diameter, wound with any fine insulated copper wire and



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 68kΩ
R2 33kΩ
R3 100Ω
R4 1kΩ
All resistors ¼W 5%
C1 0·047μF
C2/3 0·1μF
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 nut 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

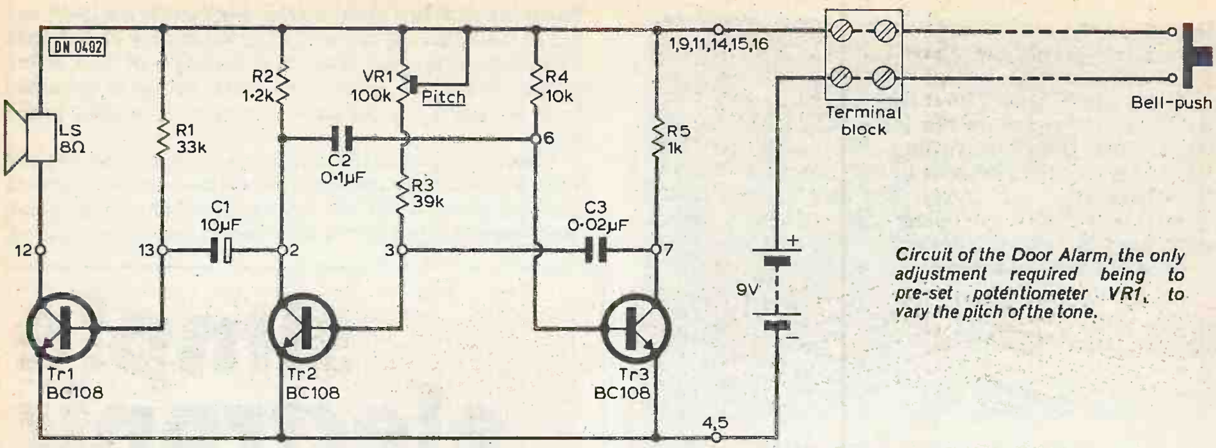
R1 33kΩ
R2 1·2kΩ
R3 39kΩ
R4 10kΩ
R5 1kΩ
All resistors 10% ¼W

VR1 100kΩ miniature pre-set

C1 10μF 10V
C2 0·1μF
C3 0·02μF

Tr1 BC108
Tr2 BC108
Tr3 BC108

PP6 9V battery and clips. Tagboard. Small speaker, approx. 8Ω. Material for case. Bell-push. Bell-wire.



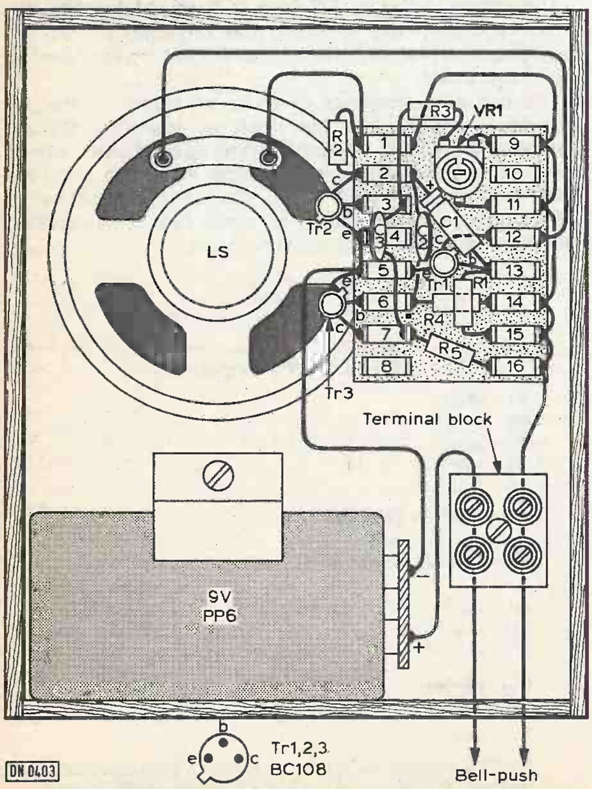
Circuit of the Door Alarm, the only adjustment required being to pre-set potentiometer VR1, to vary the pitch of the tone.

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.



Physical layout of the alarm, the tag numbers on the board corresponding to those shown in the circuit diagram.