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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

614 AUTUMN ACTION-Leader article and December preview

615 NEWS . . . NEWS . . . NEWS

626 TELEVISION-Coming in the November issue

629 PRODUCTION LINES-Products reviewed by Colin Riches

630 SPECIAL PRODUCT REPORT—Sinclair Cambridge Calculator kit

640 NEXT MONTH in Practical Wireless

645 DEAR SIR-Readers' letters to the Editor

653 HOTLINES on recent developments by Ginsberg

659 BASIC COLOUR FAULTS-Colour supplement in Television

660 ON THE AIR—Reports on Broadcast Bands

Short Wave-Malcolm Connah

Medium Wave-Charles Molloy 663

663 VHF/FM-Simon David

664 Amateur Bands, Short Wave/VHF-David Gibson G3JDG

CONSTRUCTIONAL

616 PORTABLE VHF RECEIVER-F. G. Rayer G30GR

634 "P.W. FERRET" PLL METAL DETECTOR-R. P. A. Perry

641 EXPERIMENTAL WORKSHOP Bistable Switching-

M. J. Hughes, M.A. 648 GOING QUADRAPHONIC-PROJECT Q4, Part 2-D, Bollen

654 TAKE 20 No. 54 "Radio-Gram"-David Andrews

657 I.F. WOBBULATOR-W. S. Poel G8CYK

668 SIMPLE TRANSMITTER-RECEIVER CONTROL BOX-R. H. Longdon

OTHER FEATURES

620 I.C. OF THE MONTH LM101A/LM111-L. A. J. Ireland

621 TECHNICROSS No. 1-Technical Crossword

622 BETTER AERIALS FOR BETTER STEREO Part 3-Gordon King

633 MORE ON THE ZN414 I.C. radio chip-L. A. J. Ireland

666 GOING BACK Equipment of yesteryear-

Colin Riches and Arthur Dow

EXTRA WITH THIS ISSUE

INSET

P.W. DATACARDS in COLOUR No. 3 Audio Plugs and Sockets No. 4 Using Decibels

SUPPLEMENT DICTIONARY OF AUDIO TERMS (Illustrated)

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

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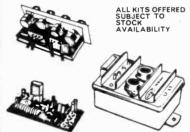
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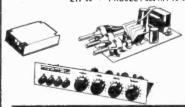
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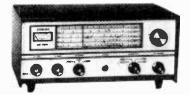


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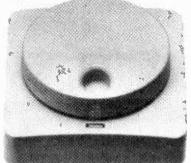
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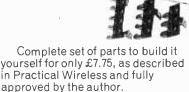
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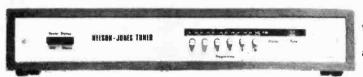


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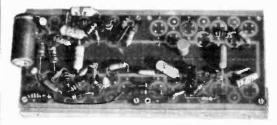
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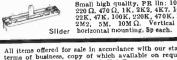
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(e) RSC TID BISCO Incorporating twin Garrard Sp25 or BSR MP80 type turniables and Sonotone or Acos Cartridges with decided to the second special special

TWIN TURNTABLE WITH PRE-AMP



RSC DISCO MASTER

R.S.C. COLUMN SPEAKERS IDEAL FOR VOCALISTS

AND PUBLIC ADDRESS All types 15 Ohms covered in Rexine and Vynair

AND PUBLIC A
TYPE C4100 IS ALSO SUITABLE FOR BASS GUITAR OR ELECTRONIC ORGAN

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F.A.L. DISCO PRE-AMPLIFIER

Designed for use with a pair of Player Units and Amplifier with Bass and Treble Controls. Incorporates MONITORING FACILITIES and Mic. input. The 4 inputs are ind. controlled. Selector switch Gram (1), (2), and Tape. 200-250v A.C. Mains 50Hz. Brush Silver finished fascia. Size approx $16\frac{1}{2}$ " × 3" × 4" deep. Fully enclosed but can mounted in cabinet.

FANE "CRESCENDO" SPEAKERS

FULL RANGE AVAILABLE AT ALL BRANCHES

FAL PHASE 50 Mk.III AMPLIFIER 50 WATT.

Solid state. 4 Separately controlled inputs Plus master vol control. Ind. Bass and Treble Controls. Protective circuit to control. Ind. Bass and Treble Controls. Protective circuit to guard against damage from accidental aborts. Output for Speaker's 3 to 30 ohms. Size 17' × 7' × 7\$', 200-250v. A.C. mains. Output 50 watte music rating. Or deposit \$6:95 & 9 monthly payments \$4:95 & 75. £39.93 Carr. rents £4.22. Total £44.93.





RSC PHANTOM '50' Combined 50W Amplifier and 12in. Loudspeaker.

For Lead Guitar, Mic.. Gram, Radio, Tape (Not for use with Bass instruments). Inc. 3 inputs and 2 vol. controls plus Treble, Bass and Presence. Output Jack for additional 15 ohm Speaker. Attractively finished in black with silver-finished fascia and trimmings. Compact size. Fitted carrying handle, Terms: Deposit 58-95 and 12 monthly payments \$4.97 (Total \$28-59). Carr. Free SAE tor leaflet UK Mainland

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All power ratings are R.M.S. continuous. 2 YEARS' GUARANTEE High flux ceramic magnets. ALL CARRIAGE FREE.

"POP' 100 | "POP' 60 | "POP' 50 15" 60 Watt 14,000 gauss 8/15Ω

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FOR BASS GUITAR, ELECT, ORGAN, ETC.

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Pair BSR MP60 T/tables GP91 PU Cartridges.

FAL Disco Pre-amp. Totel Rec. Ret. Price £50-11

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Terms: Deposit £20 and 18 monthly
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HIGH QUALITY LOUDSPEAKER UNITS

ALL TWO TONE REXINE AND VYNAIR FINISH L125 50 WATT Fitted pair of 12" 50 COT OF watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. £1-50 Or deposit £8:95 and 9 monthly payts, of £4:34. Total £43:01

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A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists. gram, radio, tape. Peak Output rating. Loudspeaker unit either horizontal or



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A 4 input, 2 vol. control Hi-Fi
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Bitrong Reziste covered cabinet with
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For 200-250v. A.C. mains. For 3 or 15 ohm
peakers. Send S.A.E. for leaflet. Terms:

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100 WATTS MUSIC RATING Solid State. Sep. Bass and Treble Controls. 4 separate controlled inputs plus master control. Output for speakers 3-30 ohms.

Includes protective circuit against damage from short circuits.

Terms: Deposit £7.85 & 12 monthly payments £6.05 (Total £80.45).

0000 000 £69·85

Carr. 75p



FAL TWIN CHANNEL AMPLIFIERS

Solid State. 4 sep. controlled inputs plus master volume con-troi. Individual Bass

and Treble controls. Output for speakers 3-30 ohms. Protective circuitry against damage from short circuits.

WATTS MUSIC RATING £59.50 Carr. FAL 'SUPER 50' Terms: Dep. £8:50 & 9 mthly. pymts. £6:50 (Total £67)

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HUGE DISCOUNTS AKAI GXG 40D Tape Unit

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£62.95 (Rec. Price £89.74) Carr. £68.95 (Rec. Price £93.50) Carr. £66.95 (Rec. Price £93.87) Carl £58 95 (Rec. Price £84·10) Carr.

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FANE 'MODE ONE' HIGH FIDELITY SPEAKER KIT



Incorporating a model 803 8" 13,000 Gauss Bass Speaker with ultra low resonance. P.V.C. surround cone. Printed circuit cross-over assembly with ferrite cored coils. Model 303 Pressure Tweeter, Acoustic damping material, Screws, Panels etc., and instructive diagrams. Frequency (10,000 per page) structive diagrams, Frequency £10.98 post Response 25 Hz-20 kHz. Impedance 8-15 ohms.

Or Dep. £2.47 & 9 mthly pymnts. £1.28 (Tot. £13.99)

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Individual Ganged Controls: Bass, Treble, Volume and Balance. Printed circuit construction employing 10 Transistors plus Diodes. Output rating I.H.F.M. Frequency range 20-20,000 c.p.s. Bass Control ± 12db.

Treble Control ± 13db. Selector switch for



Treble Control ± 13db. Selector switch for P.U. or Tape/Radio. For loudspeaker output impedances of 3 to 15 ohms. For standard 200-250v. A.C. mains operation. Attractive Black and Silver finished metal fascia plate and matching control knobs. COMPLETE EIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and COMPREHENSIVE WIRING DIAGRAMS & INSTRUCTIONS & 12-65 of FAOTORY BUILT IN TEAK VENEERED CABINET as illustrated £16-50 or dep. £2-50 and 9 monthly payments £1-83 (Total £18-97).

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Heavy construction. Latest high efficiency ceramic magnets. Plasticised Cone surround. "D" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or extended frequency range up to 15,00 8-15 ohms. PLEASE STATE CHOICE.

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A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 16 KHz. Causts 10,000. Impedance 3 or 8.15 G. Post Free PLEASE STATE IMPEDANCE WHEN ORDERING MODEL 803T 8" 15w, with parasitic Tweeter. MODEL 803T 8" 15w. with parasitic Tweeter.
Response 25 Hz to 15 KHz. Gauss 13,000 Imp 3 or 8-15Ω.

OUTPUT TRANSFORMERS
Standard Pentode 5.000 Ω or 7.000 Ω to 3 Ω 55p
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω.
95p
Push-Pull 10 watts 676, ECL86 to 3.5.8 or

55p; 60m. 400 Ω 28p.

ALL R.S.C. PRICES INCLUDE VAT FULL LABOUR AND MATERIAL **GUARANTEES FOR 12 MONTHS**

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Teak veneer finish. Acoustically lined. Sizes approx. Carr. 35p. per enc. JES Size 16" × 11" × 9".

Pressurised. Gives pleasing results with any 8in. Hi-Fi speaker.

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SE12 For excellent performance with 12in.
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Consisting of matched 12in, 11,000 line 15 Watt 15 ohm Consisting of matched train. A show the term of the high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. OR SENIOR 15 WATT INCLUDING

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





£8.50 Carr.



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260-0-2260v. 70mA, 6.3v. 2a., 0.5-6.3v. 2a. 21.49
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350-0-250v. 100mA, 6.3v. 2a., 0.5-6.3v. 3a. 22.45
250-0-250v. 100mA, 6.3v. 4a., 0.5-6.3v. 3a. 22.45
300-0-300v. 130mA, 6.3v. 4a., 0.5-6.3v. 3a. 22.45
300-0-300v. 130mA, 6.3v. 4a., 0.5-6.3v. 3a. 22.45
350-0-350v. 150mA, 6.3v. 4a., 0.5-6.3v. 3a. 22.45
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SELENIUM RECTIFIERS F. W. (Bridged)
All 6/12v. D.C.
output. Max. A.C.

input 18v.

1a, 28p. 2a, 89p.

3a, 55p. 4a, 72p.

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CHOKES CHOKES
150mA, 7-10H, 250
Ω 77p; 100mA,
10H, 200 Ω 66p;
80mA, 10H, 350 Ω
55p; 60mA, 10H,

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★ Moderate size only 25×14×10in. approx.

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Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system.

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γ .	VIA	41 1
TING TRA	NSFORM	IERS
	. 120/240 V .	Centre Ta
Ref	Price	P&P
No.	£	£
149	2.86	0.38
150	8 - 15	0.52
151	5.30	0.52
152	7.05	0.65
153	9 · 40	0 - 80
	TING TRA 20/240V. Sec. een Ref No. 149 150 151 152	TING TRANSFORM 20/240V. Sec. 120/240V. Sec. 120/240V. No. £ 149 2.86 150 3.15 151 5.30 152 7.05

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152	7.05	0 - 65
153	9 40	0 - 80
154	18.55	1.00
156	24 · 97	1 - 20
158	41 - 25	
159	64 - 54	•
160	105-90	
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AUTO TRANSFORMERS

VA	Туре	Price	PaP
(watth)	No.	£	£
20	113	1.00	0.22
75	64	2.00	0 - 30
Taps:	115, 200, 220,	240V	
150	4	2.40	0.38
300	66	4.70	0.52
500	67	6 - 90	0.69
1000	H4	12.60	0.82
2000	95	24.00	1.10
3000	73	82 - 60	1 - 20

CASED AUTO TRANSFORMERS 220/240V to 115V, Lead & Socket 20 113G 1.95 500 671G 9.46

1000	841G	16 50	
	-		



ı	LO\	N V(DLTAG	E TRANSFO	ORMERS
i	Prim	:- 200-		ec:- 12 & 24V.	
ľ	Amp	B.	Type	Price	P&P
ı	12V	24V	No.	£	£
1	0.5	0.25	111	1.00	0 · 22
	1	0 · 5	213	1.23	0.22
ı	2	1	71	1.60	0.22
	4	2	18	2 · 25	0.38
	- 6	3	70	2.70	0 - 42
	ж	4	108	8.00	0.52
	10	ä	72	3 - 55	0.52
	12	6	116	4.50	0.52
	16	H	17	5 - 50	0.52
Į	20	10	115	6 - 95	0.69
1	30 -	15	187	12.90	0.97
J	40	20	232	18.30	1.00
1	60	30	226	28.70	1.10

30V	TRANSFORM	1ERS	
Prim:-	200-240V. Sec:	- 12, 15, 9	0. 24, 80V.
Amps	Туре	Price	P&F
0.5	112	1.20	0.22
1	79	1.64	0.38
2	3	2 · 45	0.38
41			0 40

50V TRANSFORMERS					
10	89	8.86	0 · 67		
8	88	6.80	0.67		
6	1117	5 - 25	0.52		
5	51	4 - 40	0.52		
4 5	21	8 - 55	0.52		
	20	8.00	0.42		
2 3	3	2 · 45	0.38		
1	79	1.64	0.38		

50V T	RANSFOR	MERS	
Prim :- 20			
Sec:- 19,	25, 38, 40,		
Anips	Туре	Price	P&P
0.3	102	1.60	0.30
1	103	2.85	0.38
3	104	3 · 25	0.42
3	105	4-40	0.52
4	106	5 · 48	0.52
fi .	107	8 - 65	0.67
H	118	11.27	0.97

PLEASE ADD 10% FOR V.A.T.

60V TRANSFORMERS 1 · 60 2 · 25 8 · 55 126 127





MINIATURE AND EQUIPMENT TRANSFORMERS

•	LLIM PANT	MITT ECLESIS					
	Vo	ta	MIIIi	Amps	Type	Price	P&P
	Bec. 1	Sec. 2	Sec. 1	Bec. 2	No.	£	£
	8-0-3	_	200		238	1 · 12	0.10
	06	0-6	500	500	234	1.18	0.10
	0-6	0-6	1000	1000	212	1.28	0 · 22
	9-0-u	-	100		13	0.95	0.10
	0-9	0-9	330	330	235	1.28	0.10
	0-8-9	0-8-9	500	500	207	1.70	0.22
	0-8-9	0-8-9	1000	1000	208	2 · 80	0.30
ı	15-0-15		40		240	1.28	0 · 10
	0~15	0-15	200	200	236	1 · 28	0.10
	20-0-20		30		24)	1.09	0.10
	0-20	0-20	150	150	237	1.28	0.10
,	0-15-20	0-15-20	500	500	205	2 · 16	0.38
ı	0-20	0-20	300	300	214	1.36	0.22
	20-12-0-1		700(D/C		221	1.21	0.30
	0-15-20	0-15-20	1000	1000	206	8.10	0.38
	0-15-27	0-15-27	500	500	203	2.38	0 · 38
ł	0-15-27	0-15-27	1000	1000	204	2-40	0.38

PLASTIC	CASED SILIC	ON BRIDGE	RECTIFIERS
One Amp	Two Amp	Four Amp	Six Amp
50 Volt 25p	50 Volt 35p	100 Volt 55p	50 Volt 65p

100 Volt 25p 200 Volt 28p 600 Volt 30p 100 Volt 40p 200 Volt 45p 600 Volt 50p 1000 Volt 55p 200 Volt 59p 100 Volt 70p 400 Volt 65p 200 Volt 80p 600 Volt 75p 400 Volt 90p 800 Volt 21 00 600 Volt \$1 00



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1T4	-18	DAF96	-35	ECH35		EM80	-85	PCF805	-65	U25	-68
384	-22	DF91	-18	ECH42		EM81	-85	PCL82	.28	U26	-59
3V4	-46	DF96	-85	ECH81	-21	EM84	-80	PCL83	-58	U191	-60
6/30L2	-48	DK91	.25	ECL80	-27	EY86	.27	PCL84	-81	U251	-60
6BW7	-48	DK92	47	ECL82	-27	EZ80	-19	PCL85	-36	UABC80	-28
6F23	-64	DK96	-48	ECL83	-48	EZ81	-21	PCL86	-85	UBC41	-40
6F25	-49	DL92	-22	ECL86	-82	KT6)	-78	PFL200	-48	UBF89	-81
	1.75	DL94	46	EF39	-48	KT66	-75	PL36	-45		.31
12AU7	·17	DL96	-86	EF41	-54	N78	£1.00	PL81	-41	UCH42	-54
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30C15	.58	DY87	·21	EF85	-26	PC88	-42	PL83	-80		-30
30C17	.78	DY802	-28	EF86	-26	PC97	-34	PL84	-26		-48
30C18	-65	EABC80	-29	EF89	-21	PC900	-28	PL500	-56		-47
30F5	-58	EBC33	-41	EF91	-15	PCC84	-26	PL504	-56		-24
30FL1	-58	EBC41	.42	EF92	-25	PCC89	-40	PY32	-47		-52
30FL14	-68	EBF89	-24	EF183	-26	PCC18		PYSS	-47	UL84	-87
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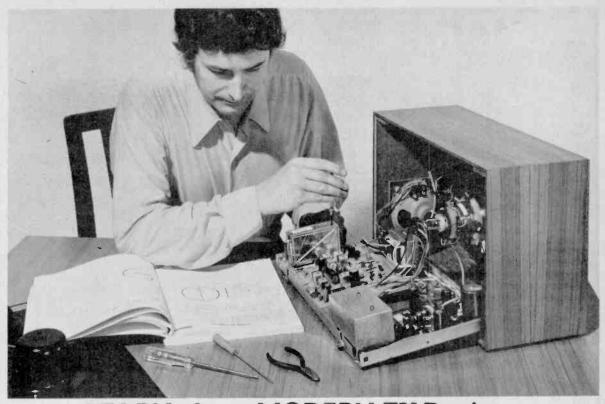
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Main resonance	*35Hz	1200Hz
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Magnet Flux Density	13,000 gauss	10,000 gauss
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Impedance	8-15 ohms	8-15 ohms
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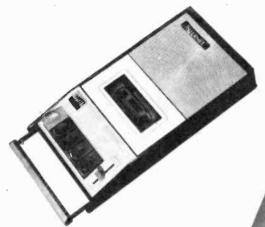
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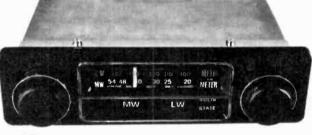
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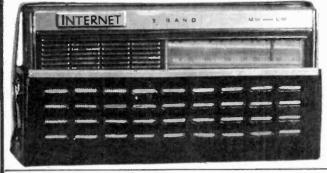
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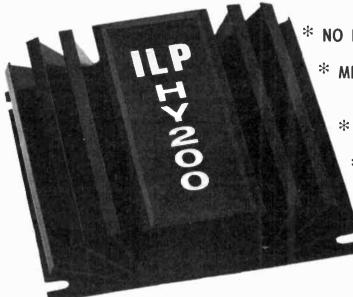
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AC113 22 AC115 26	AD161 &	BC148 11	BD136 44	BF184 28	MPF102 46	2G339 22	2N2192 39	2N3055 55	2N4061 18
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AC122 13 AC125 19	61 ADT140 55	BC150 20 BC151 22	BD138 55 BD139 61	BF188 44 BF194 13	MPF105 41 OC19 89	2G344 20 2G345 18	2N2194 39 2N2217 24	2N3391A 18 2N3392 16	2N4284 19 2N4285 19
AC125 19 AC126 19	AF114 27	BC152 19	BD140 66	BF195 13	OC20 70	2G371 18	2N2218 22	2N3393 16	2N4286 19
AC127 19	AF115 27	BC153 31	BD155 88	BF196 16	OC22 42	2G371B 18	2N2219 22	2N3394 16	2N4287 19
AC128 19 AC132 16	AF116 27 AF117 27	BC154 33 BC157 20	BD175 66 BD176 66	BF197 16 BF200 50	OC23 46 OC24 62	2G373 19 2G374 19	2N2220 24 2N2221 22	2N3395 19 2N3402 23	2N4288 19 2N4289 19
AC132 16	AF118 39	BC158 13	BD177 72	BF222 1.05	OC25 42	2G377 38	2N2222 22	2N3403 23	2N4290 19
AC137 16	AF124 33	BC159 13	BD178 72	BF257 50	OC26 28	20378 18	2N2368 19	2N3404 31	2N4291 19
AC141 16 AC141K 19	AF125 28 AF126 31	BC160 50 BC161 55	BD179 77 BD180 77	BF258 66 BF259 94	OC28 55 OC29 55	2G381 18 2G382 18	2N2369 16 2N2369A 16	2N3405 46 2N3414 17	2N4292 19 2N4293 19
AC142 16	AF127 81	BC167 13	BD185 72	BF262 61	OC35 46	2G401 88	2N2411 27	2N3415 17	2N5172 18
AC142K 19	AF139 83	BC168 13 BC169 13	BD186 72 BD187 77	BF263 61 BF270 89	OC36 55 OC41 22	2G414 38 2G417 28	2N2412 27 2N2646 52	2N3416 81 2N3417 31	2N5457 85 2N5458 85
AC151 17 AC154 22	AF178 33 AF179 55	BC169 13 BC170 13	BD188 77	BF271 83	OC41 22 OC42 27	2N388 39	2N2711 23	2N3525 83	2N5459 44
AC155 22	AF180 55	BC171 16	BD189 83	BF272 88	OC44 16	2N388A 61	2N2712 23	2N3646 10	28301 55
AC156 22	AF181 50	BC172 16 BC173 16	BD190 83 BD195 94	BF273 89 BF274 89	OC45 14 OC70 11	2N404 22 2N404A 31	2N2714 23 2M2904 19	2N3702 11 2N3703 11	28302A 46 28302 46
AC157 27 AC165 22	AF186 50 AF239 41	BC173 16 BC174 16	BD196 94	BFW10 66	OC71 11	2N524 46	2N2904A 28	2N3704 12	28302 40 28303 61
AC166 22	AL102 72	BC175 24	BD197 99	BFX29 30	OC72 16	2N527 54	2N2905 23	2N3705 11	28304 77
AC167 22 AC168 27	AL103 72 ASY26 28	BC177 21 BC178 21	BD198 99 BD199 1.05	BFX84 24 BFX85 33	OC74 18 OC75 17	2N598 46 2N599 50	2N2905A 28 2N2906 17	2N3706 10 2N3707 12	28305 98 28306 98
AC168 27 AC169 16	ASY27 33	BC179 21	BD200 1.05	BFX86 24	OC76 17	2N696 14	2N2906A 20	2N3708 8	28307 93
AC176 22	ASY28 28	BC180 27	BD205 88	BFX87 27	OC77 28	2N697 15	2N2907 22	2N3709 10	28321 62
AC177 27 AC178 31	ASY29 28 ASY50 28	BC181 27 BC182 11	BD206 88 BD207 1.05	BFX88 24 BFY50 22	OC81 17 OC81D 17	2N698 27 2N699 39	2N2907A 24 2N2923 16	2N3710 10 2N3711 10	28322 46 28322A 46
AC179 31	ASY51 28	BC182L 11	BD208 1.05	BFY51 22	OC82 17	2N706 9	2N2924 16	2N3819 81	28323 62
AC180 19	ASY52 28	BC183 11 BC183L 11	BDY20 1:10 BF115 27	BFY52 22 BFY53 19	OC82D 17 OC83 22	2N706A 10 2N708 13	2N2925 16 2N2926(G) 14	2N3820 55 2N3821 89	28324 77 28325 77
AC180K 22 AC181 19	ASY54 28 ASY55 28	BC183L 11 BC184 13	BF117 50	BPX25 94	OC83 22 OC84 22	2N711 88	2N2926(Y) 12	2N3823 81	28326 77
AC181K 22	ASY56 28	BC184L 13	BF118 77	BSX19 17	OC139 22	2N717 89	2N2926(O) 11	2N3903 31	28327 77
AC187 24	ASY57 28	BC186 31 BC187 31	BF119 77 BF121 50	B8X20 17 B8Y25 17	OC140 22 OC169 28	2N718 27 2N718A 55	2N2926(R) 11 2N2926(B) 11	2N3904 83 2N3905 31	28701 46 40361 44
AC187K 22 AC188 24	ASY58 28 ASZ21 44	BC207 12	BF123 55	BSY26 17	OC170 28	2N726 31	2N3010 77	2N3906 30	40362 50
AC188K 22	BC107 10	BC208 12	BF125 50	BSY27 17	OC171 28	2N727 31	2N3011 16	2N4058 13	
ACY17 28 ACY18 22	BC108 10 BC109 11	BC209 13 BC212L 12	BF127 55 BF152 61	BSY28 17 BSY29 17	OC200 28 OC201 31	2N743 22 2N744 22	DIO	DES AND RECTI	FIERS
ACY19 22	BC113 11	BC213L 12	BF153 50	BSY38 20	OC202 31	2N914 16	AA119 9	BY133 28	OA70 8
ACY20 22 ACY21 22	BC114 17 BC115 17	BC214L 16 BC225 28	BF154 50 BF155 77	BSY39 20 BSY40 31	OC203 28 OC204 28	2N918 33 2N929 23	AA120 9 AA129 9	BY164 55 BYX38/30 46	OA79 8 OA81 8
ACY21 22 ACY22 18	BC116 17	BC226 39	BF156 53	BSY41 31	OC205 39	2N930 23	AAY30 10	BYZ10 39	OA85 10
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ACY28 21 ACY29 39	BC118 11 BC119 33	BCY31 29 BCY32 83	BF158 61 BF159 66	BSY95A 14 Bu105 2:20	OCP71 48 ORP12 48	2N1132 24 2N1302 16	BA100 11 BA116 28	BYZ12 33 BYZ13 28	OA91 7 OA95 8
ACY30 81	BC120 88	BCY33 24	BF160 44	Cl11E 55	ORP60 44	2N1303 16	BA126 24	BYZ16 44	OA200 7
ACY31 31	BC125 13 BC126 20	BCY34 28 BCY70 16	BF162 44 BF163 44	C400 83 C407 28	ORP61 44 P346A 22	2N1304 19 2N1305 19	BA148 16 BA154 13	BYZ17 89 BYZ18 89	OA202 8 8D10 6
ACY34 23 ACY35 23	BC126 20 BC132 13	BCY71 20	BF164 44	C424 22	P397 46	2N1306 23	BA155 16	BYZ19 81	8D19 6
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	UIC00 = UIC01 = UIC02 = UIC03 = UIC05 = UIC06 = UIC07 = UIC00 = UIC00 = UIC40 = UIC42 = UIC42 = UIC42 = UIC43 = UIC43 = UIC44	Par No. Contents UIC00-12-X 7400 UIC01-12-X 7400 UIC01-12-X 7401 UIC02-12-X 7402 UIC03-12-X 7402 UIC03-12-X 7402 UIC03-12-X 7404 UIC05-12-X 7404 UIC05-12-X 7404 UIC05-12-X 7405 UIC01-12-X 7410 UIC02-12-X 7410 UIC02-12-X 7410 UIC04-12-X 7410 UIC04-12-X 7410 UIC04-12-X 7410 UIC04-12-X 7411	ÜJC01 = 12 × 7441 0 - 55 UIC02 = 12 × 7402 0 - 55 UIC03 = 12 × 7403 0 - 55 UIC03 = 12 × 7403 0 - 55 UIC05 = 12 × 7405 0 - 55 UIC05 = 18 × 7406 0 - 55 UIC07 = 8 × 7407 0 - 55 UIC07 = 8 × 7407 0 - 55 UIC120 = 12 × 7410 0 - 55 UIC120 = 12 × 7420 0 - 55 UIC420 = 12 × 7420 0 - 55 UIC44 = 5 × 7441 0 - 55 UIC43 = 5 × 7442 0 - 55 UIC44 = 5 × 7442 0 - 55 UIC44 = 5 × 7442 0 - 55 UIC44 = 5 × 7442 0 - 55	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$

Pak No. Contents Price UIC90 = 5 × 7490 UIC90=5×7490 UIC91=5×7491 UIC92=5×7492 UIC93=5×7493 UIC94=5×7494 UIC95=5×7496 UIC96=5×7496 UIC96=5×7496 0 · 55 0 · 55 0 · 55 0 · 55 0 · 55 0 · 55 0 · 55 0 · 55 0 · 55 $\begin{array}{c} U1C96 = 5 \times 7496 & 0 \cdot 56 \\ U1C100 = 5 \times 74100 & 0 \cdot 56 \\ U1C121 = 5 \times 74121 & 0 \cdot 56 \\ U1C124 = 5 \times 74141 & 0 \cdot 56 \\ U1C151 = 5 \times 74151 & 0 \cdot 55 \\ U1C154 = 5 \times 74154 & 0 \cdot 55 \\ U1C193 = 5 \times 74193 & 0 \cdot 56 \\ U1C199 = 5 \times 74199 & 0 \cdot 56 \\ \end{array}$

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ł	200	0.06	0.10	0.07	0.16	0.22	0.27	1.10
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H8/3A	4 <i>µ</i> f	50v	4p	H7/6A	100/4f	15v	4p
H8/4	4-7#f	25v	4p	H7/7	100/4f	25v	4p
H8/4A	5 <i>µ</i> f	64v	4p	H7/8	125µf	16v	5p
H8/5	5 <i>µ</i> f	10v	4p	H7/8A	100µf	35v	6p
H8/5A	5µf	150v	' 4p	H7/9	100/4f	63v	6p
H8/6A	10µf	10v	4p	H7/9A	125µf	4v	4p
H8/7	10µf	70v	4p	H7/10	125µf	25v	6p
H8/8	16#f	35v	4p	H7/10A	160µf	2.5v	3р
H8/8A	16#f	16v	4p	H7/11	160µf	25v	6p
H8/9	20µf	6v	2p	H7/11 A	15041	16v	5p
H8/9A	20µf	70v	4p	H7/13A	200uf	25v	8p
H8/10	22µf	50v	4p	H7/14	220µ1	50v	10p
H8/10A	22 <i>µ</i> f	100v	4p	H7/14A	220µf	16v	6p
H8/11	25#f	12v	4p	H7/15	220µf	25v	5p
H8/11 A	24#f	275v	4p	H7/15A	220/4	35v	10p
H8/12	32#f	15v	4p	H6/1 A	250µf	4v	3p
H8/12A	30/4f	10v	4p	H6/3A	320µf	2.5v	3р
H8/13A	32µf	50v	4p	H6/4	320µf	10v	4p
H8/14	40µf	25v	5p	H6/4A	330µf	16v	5p
H8/14A	40µf	16v	4p	H6/5	330uf	25v	10p
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H7/1	50/4f	6v	3р	H6/8	470µf	25v	10p
H7/1A	50µf	10v	4p	H6/8A	470µf	35v	20p
H7/2	50µ4f	50v	4p	H6/9A	400µf	40v	20p
H7/2A	64#f	2 ·5v	2p	H6/10	750#f	12v	5p
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DL92	0.40	EL36	0.50	PCF805	0 8 0	384	0.40	12AU6	0.45
DL94	0.48	EL37	2.35	PCF806	0.75	3V4	0.48	12AU7	0.88
DL96	0.55	EL41	0.90	PCF808	0.85	5R4GY	0.75	12AX7	0.38
DY86/87	0.87	EL42	0.90	PCL82	0.35	5U4G	0.40	12BA6	0.45
DY802	0.37	EL84	0.25	PCL83	0.66	5V4G	0.50	12BE6	0.50
EABC80	0.38	EL95	0.85	PCL84	0.45	5Y3GT	0.45	30C1	0.80
EAF42	0.75	ELL80	1.00	PCL85	0.50	524G	0.45	30C15	1.05
EB91	0.22	EM80	0.45	PCL86	0.45	6/30L2	0.80	30C17	1.10
EBC33	1.00	EM81	0.60	PCL805/8		6AK5	0.40	30C18	0.80
EBC41	0.75	EM84	0.35		0.80	6AM5	0.90	30F5	1.10
EBC81	0.88	EM85	1.00	PD500	1.80	6AQ5	0.42	30FL1	0.75
EBF80	0.40	EY51	0.40	PEN45	0.75	6AB7G	0.85	30FL2	0.75
EBF83 EBF89	0.40	EY86 EZ40	0·40 0·75	PL36 PL81	0.55	6AT6	0.38	30FL14	0.85
EBL31	1.50	EZ41	0.75	PL82	0.45	6AU6	0.80	30L15	1.05
ECC81	0.40	EZ80	0.28	PL83	0.45	6BA6 6BE6	0·28 0·32	30L17	0.90
ECC82	0.33	EZ81	0.29	PL84	0.40	6BH6	0.75	30P4MR	1.30
ECC83	0.38	GY501	0.80	PL500	0.75	6BJ6	0.55	30P12	1.05
ECC84	0.80	GZ30	0.45	PL504	0.75	6BQ7A	0.55	30P19	1.00
ECC85	0.40	GZ32	0.50	PL508	0.90	6BR7	0.90	30PL1	0.95
ECC88	0.40	GZ34	0.60	PL509	1.55	6B87	1.85		
ECH 35	1.25	GZ37	1.25	PL802	0.95	6BW6	0.90	30PL13	1.20
ECH42	1.00	HN309	1.50	PX4	8.00	6BW7	0.90	30PL14	1.25
ECH81	0.80	KT61	1.75	PX25	8.00	6C4	0.35	35W4	0.40
ECH83	0.45	KT66	2.35	PY33 ·	0.68	6CD6G	1.30	35Z4GT	0.70
ECL80	0.45	KT81 (70		PY81	0.30	6CH6	0.60	50CD6G	1.20
ECL82	0.85	_	1.13	PY82	0.85	6CW4	0.70	807	0.50
ECL83	0.68	KT81	1.75	PY83	0.38	6F23	1.05	813 ITT	
ECL86	0.40	KT88	2.25	PY88	0.40	6F25	1.00	813 USSF	
ECLL800		KTW61	1.00	PY500	0.47	6F28	0.70		£5.75
EF37A	1.20	MU14	1.00	PY81/800		6J5M	0.60		
EF39	1.20	N78	1.60	PY801	0.50	6J5G	0.45	866A	0.85

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AAZI5 AC107	0·10 0·35		0·25 0·25	appli	cati	on.	Sen	d S	AE
	0.25		0.80						
AC126 AC127	0.25		0.30	for fo	311 I	lists.			
AC127	0.25		0.82						
			0.15						
AC176	0.25			OC16	0.75	TO V FOO	0.14		
AC187	0.25		0·15 0·15	OC20	0.95	ZTX500 ZTX501	0.15	2N2646	0.50
AC188	0.25			OC20	0.85	ZTX 503		2N2904	0.18
ACY21	0.20		0.35	OC25			0.17	2N2904A	
ACY39	0.55		0.25	OC28	0.40	ZTX531	0.20	2N2905	0.26
A D140	0.40		0.25		0.65	ZTX550	0.20	2N2905A	
AD149	0.50		0.25	OC35	0.50	IN914	0.7	2N2906	0.20
AD161	0.35		0.20	OC36	0.68	IN4001	0.6	2N2926	0.10
AD162	0.85		0.50	OC42	0.40	IN 4002	0.7	2N3053	0.20
AF115	0.24		0.20	OC44	0.15	IN4003	0.8	2N3055	0.55
AF116	0.25		0.20	OC45	0.15	IN4004	0.8	2N3525	0.75
AFI17	0.50		0.61	OC71	0.15	IN 4005	0.10	2N3614	0.59
AF186	0.40		0.15	OC72	0.25	IN4006	0.18	2N3615	0.75
AF239	0.40		0-15	OC76	0.40	IN4007	0.15	2N3702	0.10
ABY27	0.80		0.15	OC77	0.45	IN4009	0.5	2N3703	0.10
A8¥28	0.25	BZX61 set	ries	OC81	0.25	IN4148	0.8	2N3704	0.10
BA102	0.30		0.12	OC81D	0.25	18921	0.10	2N3705	0.10
BAIIS	0.7	BZY88 ser		OC81Z	0.55	182033	0.20	2N3706	0.10
BC107	0.10		0.10	OC83	0.25	182051A	0.20	2N3707	0.10
BC108	0.10		0.25	OC140	0.55	IB2100A	0.20	2N3708	0.10
BC109	0.10		0.85	OC170	0.25	183010	0.25	2N3709	0.10
BC113	0.15		0.30	OC171	0.80	2N696	0.15	2N3710	0.10
BC117	0.20		0.45	OC200	0.45	2N697	0.15	2N3711	0.10
BC143	0.35		0.50	OC201	0.75	2N706	0-10	2N3819	0.85
BC147	0.12		0.70	OC202	0.80	2N708A	0.18	2N3820	0.50
BC148	0.10		0.75	OC203	0.50	2N1131	0.25	2N3823	0.68
BCI69C	0.12	MJE2955	1.10	OCP71	1.25	2N1132	0.25	2N3903	0.15
BC182	0.10	MJE3055	0.75	ORP12	0.50	2N1302	0.18	2N3904	0.17
BC182L	0.12		0.42	ORP60	0.40	2N1303	0.16	2N3905	0.81
BC184L	0.11	MPF103	0.85	T1005	0.80	2N1304	0.22	2N3906	0.18
BCY32	0.60		0.87	TIC44	0.85	2N1305	0.82	2N4058	0.18
BCY33	0.84	MPF105	0.40	TIC226D		2N1306	0.29	2N 4059	0.9
BCY34	0.35	NKT404	0.50	TIL209	0.30	2N1307	0.25	2N4060	0.19
BCY70	0.15	OA5	0.50	T1843	0.85	2N1308	0.25	2N4061	0.18
BCY71	9.20		0.85	ZTX107	0.15	2N1309	0.87	2N4062	0.12
BCY72	0.15	OA79	0.7	ZTX108	0.15	2N1613	0.20	3N141	0.81
BCZII	0.50	OA81	0.10	ZTX300	0.12	2N1614	0.20	40360	0.40
BD121	0.75	OA91	0.7	ZTX 301	0.15	2N2147	0.75	40361	0.40
BD124	0.80	OA200	0.7	ZTX302	0.18	2N2160	0.59	40362	0.50
BD131	0.75		0.10	ZTX 304	0.25	2N 2369A		40430	1.00
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BN7411	0.28	BN7442	0.75	į.	1.00	BN74151	1.10	BN74196	1.50
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BN7413	0.30	BN7451	0.20	BN7493	0.75	BN74155	1.55	BN74198	4.69
BN7416	0.30	BN 7453	0.20	BN7494	0.80	BN74156	1.55	BN74199	4-60
BN7417	0.80	BN7454	0.20	BN 7495	0.80	-			
BN7420	0.20	BN7460	0.20	BN7496	1.00	DIL		14 pin	15n
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a boost in the output,

VISCOUNT III now gives you an imposing 20 watts per channel—and the price quoted is actually INCLUSIVE OF VAT!

The money's important, of course, but not nearly so important as value for money! And that's something you get in abundance with VISCOUNT III. We design it . . . we make it . . . we sell it direct to you—passing on all the economies that come from cutting out middle-men! That's

it direct to you—passing on all the economies that come from cutting out middle-men! That's the only way you can get so much quality for so little money!

The unique VISCOUNT III amplifier, plus the Garrard \$P25 Mk III deck, plus the magnificent Duo Type III matched speakers (or Duo Type II for a small room) give you an audio installation that will prove unbeatable for listening pleasure! And the teak finish will harmonise and enhance virtually any style of interior decor! On the brushed aluminium front panel of the amplifier you! If find all the facilities you need—volume, bass, treble and balance controls, plus switches for mono/stereo, on/off function and bass and treble filters. Plus headphone socket on the back

The heart-stopping timbre of Tom Jones at his most virile . . . the last lingering harmonics of a solo performance by Heifetz or Menuhin. . . , the pathos and the panache of Liza Minelli . . the majestic sonorities of the brass band and the elfin subtleties of the virtuoso clavichordist—hear every nuance with a fidelity that you have never experienced before! Come and hear VISCOUNT III! If it's inconvenient to travel, buy by post in the confidence that you won't be disappointed (and with a 24-carat Money-Back Guarantee to give you extra The heart-stopping timbre of Tom Jones at his most virile. . the last lingering harmonics of a

that you won to be disappointed (and with a 24-carat Money-back Guarantee to give you extra reassurance). Don't settle for second-best!

SPEAKERS: Duo Type II Size approx. 17in × 10\frac{1}{2}in × 6\frac{1}{2}in. Drive unit 13in × 8in with parasitic tweeter. Max. power 10 watts 8 ohms. Simulated Teak cabinet. £14-00 a pair + £2-20 p. & p. Duo Type III Size approx. 23\frac{1}{2}in × 11\frac{1}{2}in × 9\frac{1}{2}in. Drive unit approx 13\frac{1}{2}in × 8\frac{1}{2}in with HF speaker. Max. power 20 watts, 8 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. £32-00 a pair + £3-30 p. & p.

PRICES: SYSTEM I

amplifier £24·20 + £1 p & p 2 Duo Type II speakers £14·00 + £2·20 p & p Garrard \$P25 Mk III with MAG, cartridge /plinth & cover Viscount III R 102

£56 20 total

omplete £49.00 +£3.50 Available complete

PRICES: SYSTEM 2

amplifier
Duo amplifier $£24 \cdot 20 + £1$ p & p 2 Duo Type III speakers $£32 \cdot 00 + £3 \cdot 30$ p & p Garrard \$P25 Mk III with MAG cartridae

plinth & cover

£18.00 + £1.75 p & p £74 · 20

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THE TOURIST PUSH-**BUTTON CAR RADIO** KIT £6.60 The Tourist PB is suitable for 12 volt

working on both negative and positive earth vehicles. It covers the full medium and long wave bands. It is permeability tuned and sturdily constructed. Output is a full 2-5 watts into an 8 ohms speaker. But the Tourist PB will operate into any loud-speaker from 8 to 15 ohms. Apart from the output stage. Which is an integrated circu

Apart from the output stage, which is an integrated circuit, the only other electronic components that need soldering are some capacitors, resistors, etc. The kit includes a pre-built RF tuner unit, and fully modulised IF stages which are pre-aligned before despatch. As well as electronic components this kit also contains 2 diamond-spun aluminium knobs, elegant matching front panel, dial, washers, screws and wire.

The Tourist PB can be mounted in any standard size dash panel and it has an illuminated tuning scale. Chassis size is: 7in wide, 2in high and $4\frac{\pi}{16}$ in deep. Circuit diagram and comprehensive instructions 55p free with parts. Fully retractable and lockable car aerial £1-37 post paid.

CAR RADIO KIT £6.60 p. and p. 55p. Speaker with baffle and fixing strips £1.65, + 23p p. & p. post free if bought with the kit. Send stamped addressed envelope for leaflet.

If you can solder on printed circuit board, you can build this push-button car radio kit. It's simple—just follow the step-by-step instructions.

PE TAPE LINK CONSTRUCTORS



Suitable 3 speed tape deck, less heads. Caters up to 5½ ins. spools. 240V AC mains. Unused but store soiled hence no warranty.

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Inputs. "Hixer employing r.E. I. (Field Effect Transistors). "Solid Circuitry." "Attractive Styling. INPUTS I. Crystal Mic or Guitar 9mV. 2. Moving coil Mic. or Guitar 8mV. Inputs 3, 4 & 5 are suitable for a wide range of medium output equipment (Gram, Tuner, Monitor, Organ, etc.) All 250mV sensitivity. Output 20 watts into 8 \(\Omega\$ (suitable for 15 \(\Omega\$). Size approx. \(\Omega 2 \) \(\times 6 \) \(\Omega 3 \) \(\omega\$ in the suitable for 15 \(\Omega\$). Size approx. \(\Omega 2 \) \(\times 6 \) \(\Omega 3 \) \(\omega 1 \) \(\omega 5 \) \(\omega 5 \) \(\omega 6 \)

UNISOUND MODULES

ONLY £7.64 + 55p. p & p For the man who wants to design his own stereo-here's your chance to start, with Unisound-pre-amp, power amplifier and control panel. No solder-ing—just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum.



IN-CAR ENTERTAINMENT AT HOME

With this elegant stereo 8 track add on unit, audio enthusiasts now have the opportunity to extend their systems to include the play-ing of 8 track cartridges. Simply select your channel, by push button, four digital lamps indicate channel selected. The Viscount III, the

fabulous Stereo 21 and the Unisound Modules \$9.90 + 80p. p. & p.

AUTUMN ACTION

F you were fortunate enough to obtain last month's special issue of *Practical Wireless*, and your particular interests are in audio, short wave, broadcast reception, test equipment, or experimental electronics, you will have found at least one item of interest to you. In very general terms, this is what *Practical Wireless* is about, helping and encouraging its readers to havea-go. This issue is also special in that it is the largest *P.W.* ever produced, carrying 120 pages and two free colour Datacards.

Activities covered by this magazine are, believe it or not, of a seasonal nature and we are always delighted in one sense when the holiday season ends, because we all settle down again after sun-tan(?) and surf-riding to renew our absorbing interest in d.i.y. radio and electronics.

It was often the case in the past when we would expect readers who go away in the summer to leave their tools and *P.W.* at home. Imagine some reader on the Costa Brava wielding a soldering iron on a pair of gritty output transistors—it's just not done is it? We were particularly pleased therefore that the temporary summer recess this year was hardly noticeable; surely the summer was not that bad! And it is known that *P.W.* is read on beaches.

The autumn, therefore, is just the time when, if not already bitten by the bug, our readers look around as if to court the means to satisfy their instinctive curiosity in the techniques of working circuits. You might say that we also provide the necessary bait to give newcomers encouragement to have a go. You might be right, but then if we did not learn something about our readers we would not be the highest selling British magazine of its kind. Some subjects do come up for renewed treatment but unlike some magazines, they are seldom in the same guise as before.

Take our Metal Detector on page 634; not a scrap like the earlier models and certainly easier to make.

October is also the time for the London Audio Fair; it is natural therefore that those readers who will be going to Olympia will want to sort out some of the technical jargon used in the audio world. Very sad that we cannot be there this year so we expect every *P.W.* reader visitor to carry this issue in his pocket, so that he can refer to the extra supplement which we have bound in the centre.

Incidentally, we have heard rumour on the "grape vine" that a certain company is biting its tongue for not having published a multi-systems quad matrix decoder as simple as ours.

M. A. COWELL—Editor.

The December issue, on sale 2nd November, will include a 12 volt 15 watt fluorescent light unit for your car, caravan, garage, shed or anywhere that emergency lighting is needed during power failure. Also included will be a 3-band short wave superhet, some simple practical applications of the LM380N integrated circuit audio amplifier and another series of circuits for the Experimental Workshop. Also next month don't miss the third pair of P.W. Datacards and first details of our new project that you can add on to the P.W. Q4 quad decoder.

Further details on page 640.

NEWS...

Paris Component Show

MEASURING instruments will be featured in addition to the usual sections on electronic components, materials, equipment and products at the Paris Component Show.

Venue is Exhibition Park, Porte de Versailles and date 1st-6th April 1974

Mullard back out

ULLARD Ltd. have decided to kill off their Educational Service. The service has acted as a valuable aid for the teaching profession for the last 25 years.

Oxidising agent

NTHONE Inc. Ebonol C Special is an oxidising agent which increases the strength of the bond in the production of single, double-sided and multi-layer printed circuit boards. The process involves producing many thousands of little cupric oxide needles. The oxide coating is obtained by the immersion of suitably treated copper in a solution of 180gm/1 Ebonol C at 104°C.

Liquid adhesive may then be brushed or rolled onto the oxidised surface. After the adhesive has "cured" the imbedded needles of cupric oxide maintain a "key" firmly fixing the adhesive to the copper. The prepared copper foil is then affixed to the plastics base.



We settle down when the holiday season

NEWS...

NEWS

NEWS...

Packaging for professionals

HE Inter-Nepcon conference at Brighton specialises in broad terms in electronic component packaging and assembly. There is a very strong emphasis on printed circuit techniques and integrated circuit encapsulation.

Although not strictly dealing with electronics techniques, this exhibition has a distinctly practical emphasis because it concerns the making of component assemblies and modules. It is being held at the Metropole Hotel on the sea-front at Brighton, from 16th to 18th October and is organised on an international basis by Kiver Communications Ltd of 149-155 Ewell Road, Surbiton, Surrey. Admission is restricted to those who register as being engaged full-time in electronic circuit packaging and production

No more please!

VITH the Audio Fair about to open its doors on 22nd October (trade only), and 23rd October to the public, it is interesting to learn that one famous British manufacturer, Armstrong Audio, has had to withdraw because it could not contemplate at present the thought of taking on more orders. It seems that the new 600 series has created so much interest that current orders exceed their present manufacturing capacity.

Rather than spend time and money in exhibiting with the prospect of more orders, Armstrong have decided that they should expand their facilities to cope with the rush.

Multimeter competition

E wish to apologise to readers for the omission of information in last month's issue on the Digital multimeter competition. Due to the fact that so many readers sent in answers that were the best according to the considered opinion of the judges, our Competitions Department is at present organising a further contest for these readers. We will be publishing the result just as soon as we have it.

Derby modellers get together

ERBY and District Amateur Radio Society (G3ERD, G2DJ), are branching into radio control models. The new club is already under way and held its first meeting in September. Anyone interested should contact Ray Webster, c70 5 Uplands Avenue, Littleover, Derby.

Ham Exhibition

HE Midland National Amateur Radio and Electronics Exhibition will be held at the Granby Halls, Leicester from 25th to 27th October.

Commercials date

T the time of going to press, we have heard that the London Broadcasting Company will go on the air on Monday 8th October. There will be a special message from the Minister of Posts and Telecommunications. Frequencies 719kHz, 417m and 97-3MHz.

Slimline digital multimeter

F professional quality, this unusual device is a hand-held digital multimeter from Hewlett-Packard. At £138 (+VAT) this instrument represents a valuable on-line tool for engineers and technicians. A 3^{1}_{2} digit l.e.d. display uses automatic decimal placement and polarity indication.

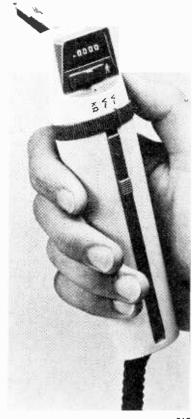
The heart of the instrument is a "postage-stamp" size thin film hybrid circuit with analogue and digital processing. It is claimed to measure d.c. voltage from $0\cdot 1\text{mV}$ to 500V and a.c. voltages from 3mV to 500V. The resistance range measures from 1 ohm to $10\text{M}\Omega$. The input resistance is stated as $10\text{M}\Omega$.

Cassette library system

ITH the current boom in tape cassette recorders, BASF are to show at the Audio Fair two new machines for chromium dioxide tape and a (quote) "unique library system for cassettes", that can be free standing or fitted to the wall.

BIB's own set-up

MULTICORE Solders Ltd. have set up a subsidiary company, BIB Hi-Fi Accessories Ltd., to look after the interests of growing range of products with the "BIB" trade name, including record and tape cleaning accessories and splicing kits. The board of the new company is selected from the parent company and will continue to operate from P.O. Box 78, Hemel Hempstead, Herts, HP2 7EP.



portable VHF receiver

F. G. RAYER G3OGR

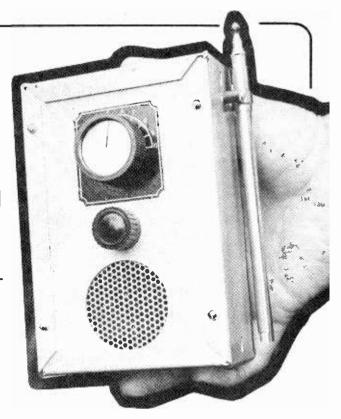
Supplementary of the supplemen

On the other hand, the disadvantages of the superregenerative type of circuit should be remembered. One is the lack of selectivity, and another the background hiss which is present when no transmission is tuned in. The lack of selectivity means that a strong, local transmission can prevent reception of a weaker signal on a nearby frequency. The stronger signals are, however, very well received, and any signal which is received at sufficient strength will automatically quiet the background hiss.

A further important point is the extent to which a super-regenerative receiver can cause interference to other receivers. Some radiation of this kind seems unavoidable, but it can be kept within limits by screening the receiver, and using an r.f. stage to help isolate the aerial from the oscillating detector stage. In these circumstances, interference is not caused over a wide area.

Interference is primarily caused on the frequency to which the super-regenerative receiver is tuned, and nearby frequencies. As example, if an unscreened super-regenerative receiver is tuned to 144MHz this is found to cause no interference at all to a normal receiver in the 88-108MHz range, with the equipment side by side. On the other hand, interference wou. I arise with nearby receivers tuned to 144MHz or ad cent frequencies.

This really means that the super-regenerative receiver should be confined to use in those circumstances where other people are not listening on the same or a near-by frequency. In fact, the receiver described has often been used as the only means of reception for 2 metre amateur band contacts, without any complaint. This does not mean, however, that it would be wise to use it for 2 metre receivers or converters in use nearby.



Receiver circuit

This is shown in Fig. 1. Though actually constructed for 2 metre reception as a portable, it can be used over the 90MHz to 150MHz range without any change other than re-adjusting the preset trimmer TC1. Tr1 is the untuned r.f. stage, with input to the source across the source bias resistor R1. A tuned r.f. stage increases gain, but has to be screened from the detector, and also requires its own means of tuning, unless a small frequency band is adopted. The main purpose of this stage is to reduce radiation caused by coupling an aerial directly to the detector coil L2. The r.f. stage does not provide complete isolation, due to the internal capacitance of Tr1 and other unwanted coupling through leads.

Tr2 is the detector. The operating frequency depends on the coil L2, trimmer TC1, and VC1. There are of course no alignment adjustments at all. With TC1 fully open, VC1 tuned approximately 130-150MHz. Super-regeneration is maintained until TC1 is about two-thirds closed, giving a low frequency limit of about 90MHz. For lower frequencies it would be necessary to increase the number of turns on L2. The upper limit at which the receiver can be made to operate is largely determined by Tr2.

Regeneration is controlled by VR1, and it is recommended that the values shown for C4, C6, R4 and R5 are as shown, though VR1 can equally well be $20k\Omega$ or $25k\Omega$. TC2 from source to drain allows

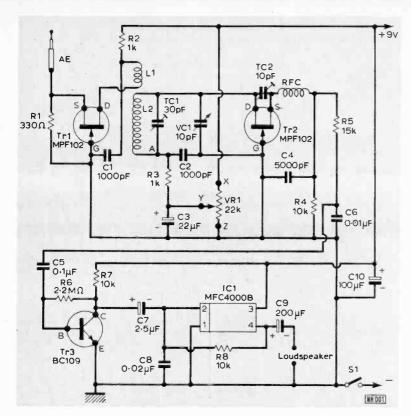


Fig. 1: Complete circuit of the portable v.h.f. receiver.

adjustment of regeneration, and was found of advantage with various transistors employed for Tr2.

A detector of this type is usually considered to have a sensitivity of about $0.5\mu V$, which offers a useful range with a simple aerial.

Tr3 is an audio amplifier, followed by the i.c, which contains six transistors in a driver-push-pull arrangement. This gives reasonable loudspeaker volume from the internal miniature speaker. The receiver is free from troublesome hand capacity effects, if constructed as shown.

Gircuit board

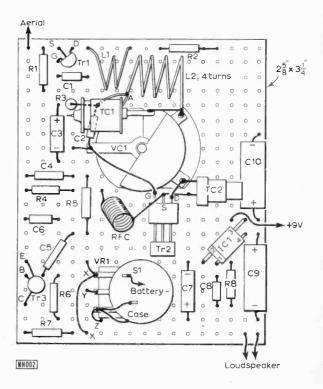
This is plain Veroboard, 0·15in. matrix, and is approximately $2^5{}_8 \times 3^1{}_4$ in., see Fig. 2. The detector stage is assembled in close proximity to VC1.

L2 is self-supporting, and is wound with 18 or 16 s.w.g. wire, with an outside diameter of $^{1}2$ in. The coil is approximately $^{3}4$ in. long, and its ends are shaped so that they may be soldered to the fixed plates tag of VCl, and to C2. C2 has the shortest possible leads each end. A stout wire supports TCl just clear of the plates of VCl, and the outer tag A of TCl is bent down and soldered to L2 as shown. L1 is 2 turns of insulated wire near L2, and is soldered to two Veropins.

Coverage can be modified to some extent by stretching L2, or by compressing it so that the turns are closer together. For the coverage mentioned, four turns are used. The coil should be at least ¹2in. from the metal case.

A small 3-lead holder is fitted for Tr2, and is of

Fig. 2: Component layout on the circuit board.



advantage in allowing this transistor to be changed readily. TC2 and the holder can be soldered almost directly together and to VC1. A stout lead, just clear of VC1 moving plates, runs to the rotor tag with C2.

The r.f. choke is self-supporting, and is wound with 22 s.w.g. enamelled wire. It has 35 turns and is 0·3in. outside diameter. Wind the turns side by side on a suitable object, which is then removed. The ends are scraped and tinned, and soldered to Tr2 source at the holder, and to a Veropin adjacent to R5.

When inserting Tr2, always take care that it is placed the correct way, so that leads come as in Fig. 2.

Underside wiring

A lead passes through the board from VC1 rotor, forming the negative line, as in Fig. 3. The metal case or bush of VR1 is grounded by a lead under the control or its fixing nut, Fig. 2.

The resistors and capacitors can then be inserted as in Fig. 2, and connected as in Fig. 3. Place insulated sleeving on leads where required, and keep all the leads and joints close against the board. Here, there will be a clearance of about 316 in. from the metal panel, so there is no real danger of shorts to the metal if joints are made neatly and excess wire snipped off close to the board.

The i.c. has two long tags, and two short tags, and will fit the matrix of the Veroboard when placed as in Fig. 2. Leads are soldered to the projecting pins underneath, as in Fig. 3.

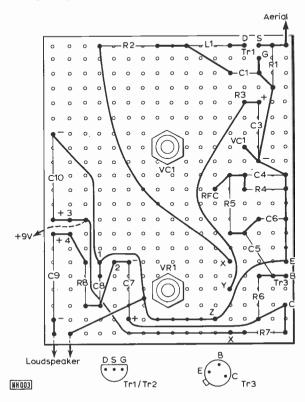
Solder a black flexible lead to S1, Fig. 2, and fit this with a negative battery clip. A red lead with a positive clip passes through the board to the positive circuit for C10.

A short wire runs from R1, as in Fig. 2, and is later soldered to a tag for the aerial connection. Also bring out leads from C9 and the negative line, for the loudspeaker.

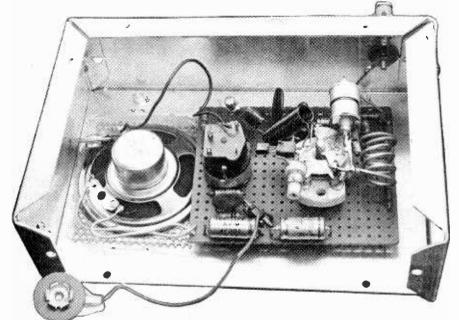
Metal panel

For the $6\times4\times2$ in. universal chassis box, this is 6×4 in. The dimensions could be modified to suit a different case.

A 1³4in. hole is punched for a 2in. or 2¹4in. speaker. A piece of perforated metal is fixed across the opening inside with adhesive, and the miniature



▲ Fig. 3: The underside wiring.



Photograph showing internal layout of the receiver.

speaker is fixed with more adhesive. Though the speaker is 40Ω , a 75 or 80Ω unit can be fitted with almost similar results, though the best impedance for the i.c. is in the 15 to 40Ω range.

Washers are put on the bush of VC1 to space the insulated board from the metal panel, and these are then secured together with the capacitor nut. Check that all joints etc. are clear of the metal.

Final assembly

The receiver should be tested and adjusted before fitting it in its case. The box is assembled with 4BA bolts through the holes punched in its flanges, and the panel is fixed with 6BA bolts or self-tapping screws.

A 34in, telescopic aerial is used, bolted to the side of the box near R1, but insulated from the metal. This is done by using insulated washers and bushes, or insulated washers and pieces of sleeving on the bolts. One bolt carries a tag, for the aerial lead mentioned.

The battery rests in the bottom of the box, and folded card can be put round it and between battery and speaker. There must be no contact between the battery clips and metal case.

For 2 metre reception, a 1₄-wave aerial is around 19 to 20 inches. But it was found that the exact length of the aerial was not important, there being no noticeable change in volume when changing this

* components list

and bolts, etc.

R1 330Ω R5 R2 $1 k\Omega$ R6 R3 $1 k\Omega$ R7 R4 $10 k\Omega$ R8 All 5% $\frac{1}{4} W$. VR1 $22 k\Omega$ linear pot with s apacitors C1 $1000 pF$ disc or tubular C2 $1000 pF$ disc or tubular C3 $1000 pF$ disc or tubular C3 $1000 pF$ disc or tubular C4 $1000 pF$ disc or tubular C5 $1000 pF$ C6 $1000 pF$ C7 $1000 pF$ C8 $1000 pF$ C9 $1000 pF$ C9 $1000 pF$ C9 $1000 pF$ C10 $1000 pF$	$2\cdot 2M\Omega$ $10k\Omega$ $10k\Omega$ witch
R3 $1k\Omega$ R7 R4 $10k\Omega$ R8 AII $5\% \frac{1}{4}$ W. VR1 $22k\Omega$ linear pot with sapacitors C1 $1000pF$ disc or tubular C2 $1000pF$ disc or tubular C3 $22\mu F$ $10V$ C4 $5000pF$ C5 $0.1\mu F$ C6 $0.01\mu F$ C7 $2.5\mu F$ 6V electrolytic C8 $0.02\mu F$ C9 $200\mu F$ 6.4V electrolytic C10 $100\mu F$ 10V electrolytic VC1 Jackson C804, $10pF$ TC1 Beehive trimmer, $30pF$ TC2 Jackson 'Tetfer' $10pF$	$10 k \Omega$ $10 k \Omega$ witch
R4 $10k\Omega$ R8 All $5\% \frac{1}{4}W$. VR1 $22k\Omega$ linear pot with sapacitors C1 $1000pF$ disc or tubular C2 $1000pF$ disc or tubular C3 $22\mu F$ $10V$ C4 $5000pF$ C5 $0.1\mu F$ C6 $0.01\mu F$ C7 $2.5\mu F$ 6V electrolytic C8 $0.02\mu F$ C9 $200\mu F$ 6.4V electrolytic C10 $100\mu F$ 10V electrolytic VC1 Jackson C804, $10pF$ TC1 Beehive trimmer, $30pf$ TC2 Jackson 'Teffer' $10pF$	10kΩ witch ceramic
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$\begin{array}{cccc} C7 & 2\cdot 5\mu F \text{ 6V electrolytic} \\ C8 & 0\cdot 02\mu F \\ C9 & 200\mu F \text{ 6·4V electrolytic} \\ C10 & 100\mu F \text{ 10V electrolytic} \\ VC1 & Jackson C804, 10pF \\ TC1 & Beehive trimmer, 30pf \\ TC2 & Jackson 'Tetfer' 10pF \\ \end{array}$	
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TC1 Beehive trimmer, 30pf TC2 Jackson 'Tetfer' 10pF	
TC2 Jackson 'Tetfer' 10pF	
	trimmer
emiconductors	
Tr1 MPF102	
Tr2 MPF102	
Tr3 BC109	
IC MFC4000B	
liscellaneous	
Speaker 24in. or similar, 15 board 28 x 34in., 0.15in. m	

battery clips, transistor holder, insulated washers

from about 20in. to 30in. or so. Some strong transmissions were received with the aerial completely closed.

In many cases it is better to have the aerial sloping or near horizontal, but with a hand-held receiver of this sort it is easy to move around to find the best position for the aerial, if needed.

Indoors, reception is modified by the proximity of objects such as metal windows. On a few occasions an outdoor dipole, with a co-axial feeder, has been connected, and this naturally increased range.

Adjustment

Both TC1 and TC2 may be fully unscrewed, for about 130-150MHz. (Exact coverage naturally depends on L1 and other factors, but is likely to be near this.)

When VRI is rotated to switch on, a point should be reached where a loud hiss commences. This is the point where super-regeneration, upon which sensitivity depends, has commenced. No reception is possible if this is not obtained. Should super-regeneration be absent, TC2 may need screwing down slightly. A setting should be found where super-regeneration continues over the whole band tuned by VC1, with only a little re-adjustment of VR1.

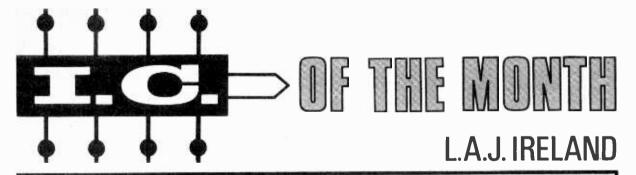
When a signal is tuned in, this hiss should cease. Strong signals will produce this effect with most settings of VR1 which permit super-regeneration; but with weak signals VR1 may have to be backed off slightly.

L1 should be quite near L2, but if coupling is very tight this may prevent regeneration in some circumstances. It is possible to boost volume by using more turns on L1 so that it is broadly self-resonant at the wanted frequency. However, this adjustment is fairly touchy. L1 may be unsoldered from the pins, and a new winding may be fitted, with a minimum of disturbance.

If all connections are short and direct, and no fault is present, the absence of super-regeneration can only arise from Tr2 being inefficient at the frequency wanted. Of several quite inexpensive transistors tried here, one failed to operate at any frequency higher than about 100MHz, while another continued to provide regeneration at over 200MHz. As Tr1 and Tr2 are of the same type, the transistor found to give best regeneration may be used for Tr2. Its leads need not be cut down. This test can be made with the aerial temporarily taken to the drain pin of L1.

It is in order to use a 4.5pF or 5pF capacitor at VC1, if a narrower band is required, or to fit a 15pF capacitor for a larger band. The overall drain of the receiver is about 10-20mA, depending on volume.

The amount of activity on these frequencies varies very considerably in different areas, being least in some isolated parts of the country. Amateur activity on the 2 metre band is most likely at certain times at weekends. It may be considerable during v.h.f. contests, while at other times no stations may be operating. Any amateur in the 2 metre band (144-146MHz) will provide a tuning calibration point which can be noted as a guide for future reference when listening.



Number 42

National LM101 for Audio Signal Generators

simple requirement whose realisation in practice can be rather difficult is the tunable audio oscillator with an accurate sine waveform. At frequencies below 20kHz the use of inductive tuned circuits is not practical and the most commonly used circuit is the Wien bridge using RC circuits to determine the time constant of the oscillator feedback loop. The impedance of such a circuit is, of course, frequency dependent; the loop gain therefore also tends to be frequency dependent, with the result that the circuit can produce some variation in waveform and amplitude as the operating frequency is varied.

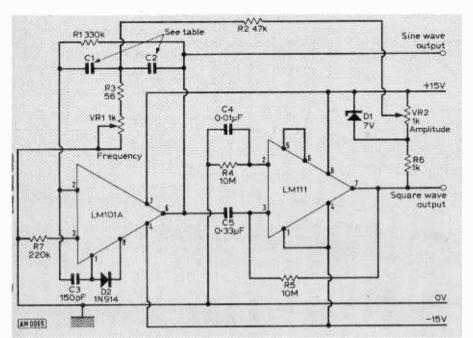
Any departure from a true sine waveform, such as the square wave produced by an oscillator with excessive loop gain, contains harmonics or overtones of the fundamental frequency and is therefore unsuitable for many applications such as the determination of the frequency response of an audio system. Various improvements on the basic Wien bridge circuit have been introduced to overcome these defects, such as the incorporation of an AGC loop with a thermistor to regulate gain.

Op Amp + Comparitor

This month, however, a completely different approach is outlined, one first introduced by engineers of the National Semiconductor Corp. and employing two integrated circuits. One of these is an operational amplifier, the other a voltage comparator. The standard application of a voltage comparator unit is as a sensing element, operating a relay or switching the state of a logic circuit on the application of a low level input signal.

Operation

In the oscillator circuit to be described, it is accepted that the output of a comparator will alternate between extreme values irrespective of the waveform of the input signal. If, then, the input signal has a fixed period, the output of the comparator will be a square wave with that period and a fixed amplitude. With effective filtering to remove



C1 and C2	Frequency range
Fµ7-0	18 Hz - 80Hz
0∙1پF	80Hz – 380Hz
Fر0-022	380Hz – 1·7kHz
0•0047µF	1·7kHz -8kHz
0-002 _µ F	4-4kHz – 20kHz

Practical circuit for an audio signal generator based on the LM101A|
LM111 combination. Capacitors
C1|C2 may be mounted on a range switch and should be of close tolerance and best quality. The frequency control VR1 should be large, physically, and again, of highest quality, if accurate calibration is to be achieved.

harmonics, a sine wave of fixed amplitude will remain. The filter in question is in this case an active filter incorporating an operational amplifier integrated circuit, with its centre frequency determined by an RC network. In turn, the output of the filter provides the input signal for the voltage comparator, thereby closing the oscillator feedback loop. It is clear that two separate waveforms are available from the oscillator, both stabilised in amplitude and locked together in frequency and phase; a square wave at the output of the voltage comparator, and a sine wave at the output of the operational amplifier.

Simplified Tuning

There is the further advantage that the frequency is set by a single variable resistor, whereas the Wien oscillator requires matched ganged tuning elements. The audio range from 18Hz to 20kHz is covered in five bands with band switching achieved by changing the capacitive elements in the tuned filter. The limitation on the frequency range covered with any given pair of capacitors is applied by the rise in harmonic distortion to some 2% at the maximum value of R3. Further, the principle is not applicable to the construction of RF signal generators since a sufficiently high Q is not available without the use of inductors.

Construction

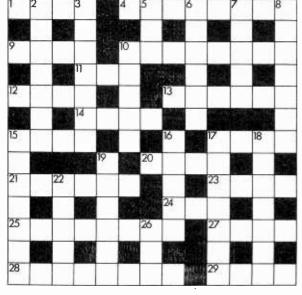
In construction of these oscillators, however, some care is necessary to follow good high frequency design practice, since the individual IC's are wide bandwidth devices. Careless construction could therefore lead to an oscillator with RF instability, and plagued by parasitic oscillations. Both power supply lines, therefore, should be decoupled by $0.1\mu F$ disc ceramic capacitors. Further, the output of the comparator should be shielded from the op amp input, to ensure that the only feedback occurs via the intended filtered loop.

Radio Control

For those interested in radio control techniques, it can be seen that a simple modification to the circuit can produce a frequency-operated switch. If the operational amplifier and associated tuned circuit are examined alone, it is clear that an output signal is produced only if the input applied via R2 contains a component at the resonant frequency. That output signal can then be detected by a conventional diode, and the resultant DC level applied to the voltage comparator, thereby operating a relay. Such a system therefore would function on the presence or otherwise of an appropriate AF modulation on a radio control signal.

The National Semiconductors devices are available from: ITT Electronic Services, Edinburgh Way, Harlow, Essex.

The LM101A and LM111 are manufactured to military specifications and therefore somewhat expensive. The 'civilian' equivalents LM301A and LM311 are very much cheaper and should perform quite adequately in this application (Technical Editor).



ACROSS

- Sort of band which has been infiltrated? (4)
- Sound representation in broadcasting? (8)
- New Zealander involved in ski wireless? (4)
- 10 Such rule of thumb for a conductor? (4-4)
- The radio's epoch-making centre (3) 11
- Push with it for amplification (4) 12
- A feeler for a better receiver? (6)
- 14 Steady Eddie changed colour inside! (4)
- 15 Resistance units of German origin (4)
- 17 Condensed diagrams for fruit production (4)
- 20 No charge for such oscillation (4)
- 21 Overtakes-with or without a car! (6)
- Phone for this type of modulator? (4)
- Torn away from electricity by a dog? (3)
- 25 It returns part of your output! (8) Girl in a Fair Isle pullover (4) 27
- Record needs waxing with this valve? (4-4)
- Natural products of 10 Down (4)

DOWN

- It has an angle in radio communication (7)
- All-rounders in coil protection (7)
- Yes, relay equipment is connected (3)
- Invitation to part of a French meal? (6) Took a pitch from the animal within? (5)
- 8 Expression of effective forcefulness (7)
- 10 A piece of cake in ionization? (5)
- 15 Too much connection with 25 Across? (7)
- A circuit may do so, of course (5)
- Good reception for a type like Rod? (7) 17
- 18 Crew formation for co-ordinating adjustment? (7)
- 19 Revolvers instead of maps for world travellers (6)
- Aches so about a mere game? (5)
- Network of transatlantic origin (1, 1, 1)

FOR AMUSEMENT ONLY **ANSWERS NEXT MONTH**



AERIAL DESIGN

Accurate design of good FM aerials of multielement composition is complex, and since very good FM aerials of all types are readily available at quite reasonable prices it hardly pays the enthusiast these days to tailor his own design. Discarded television aerials as they stand are useless for FM since their tuned frequency is all wrong. However, it is sometimes possible to make use of some of the components of such aerials in the construction of an FM aerial. The elements and crossboom of a Band I aerial can be cut down to tune Band II, and the insulator at the dipole and other fitments can often be used to advantage. There is no 'standard' design; the absolute dimensions of the elements and their spacings determine the overall bandwidth, the nature of the polar diagram and the correct impedance matching to the feeder over the bandwidth.

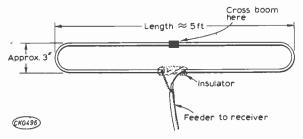


Fig. 7: General construction of a folded dipole which can be used by itself or form the basis of a multi-element aerial.

A simple dipole has a centre impedance of about 72 ohms and thus closely matches 72 ohm coaxial feeder, this being necessary for maximum energy transfer from the aerial to the receiver or tuner. However, when the simple dipole is advanced into a multi-element array by the addition of parasitic elements the impedance at the centre of the dipole falls and some artifice has to be employed to increase the coupling impedance to a value matching the feeder.

One such artifice is 'folding' the dipole, as shown in Fig. 7. This quadruples the impedance at the

feeder connecting point, increasing it to about 300 ohms in the simple case. However, when a reflector and directors are added the centre impedance of a simple dipole falls to about 24 ohms, so by folding the dipole as shown in Fig. 7 the coupling impedance is restored to about 72 ohms.

HOME-MADE AFRIAL

Fig. 8 gives the dimensions for a home-made fourelement array which will respond pretty well over the whole of Band II. The dipole can be folded as shown in Fig. 7 and 72 ohm coaxial feeder should be used. Notice that the reflector is slightly longer than the dipole and that the directors are shorter. Additional directors can be used, the third then being 4ft. 3in. and the fourth 4ft. with 1ft. 7in. spacing.

It should be noted that the element dimensions correspond to length plus diameter, so if they are

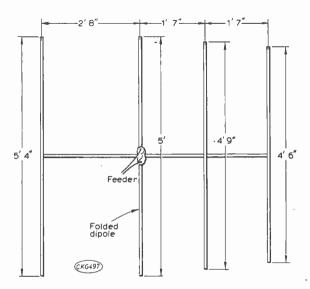


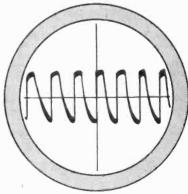
Fig. 8: Dimensions for a four element beam using a folded dipole as shown in Fig. 7.

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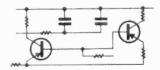
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ACI07	15p	AFI26	20p	BF115	25p	OC42	12p	5N3707	12p
AC126	12p	AFI39	32p	BF173	20p	OC44	12p	2N3708	10p
ACI27	15p	AFI78	32p	BF177	28p	OC45	12p	2N3709	Hp
ACI28	15p	AFI80	40p	BFI78	32p	OC70	12p	2N3710	Hp
ACI31	12p	AFI81	40p	BF179	32p	OC71	12p	2N3711	Hp
ACI32	12p	BC107	12p	BF180	32p	OC72	12p	2N3819	32p
ACI76	15p	BC108	12p	BF181	32p	OC81	12p	2N4062	12p
ACI87	22p	BC109	12p	BF194	14p	OC82D	12p	2N4286	20p
AC188	22p	BC147	12p	BF195	14p	2N2646	60p	2N4289	20p
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ADI49	45p	BC 149	12p	BF200	32p	2N2926	10p	40361	35p
AD161	33p	BC 157	14p	BFY50	20p	2N3054	58p	40362	40p
AD162	36p	BC158	14p	BFY51	20p	2N3055	60p	40408	40p
AFII4	20p	BC159	14p	BFY52	20p	2N3702	13p	ZTX108	15p
AFI15	20p	BC187	22p	BUYI05	225p	2N3703	12p	ZTX300	I5p
AFII6	20p	BD131	75p	OC26	45p	2N3704	13p	ZTX302	20p
AFII7	20p	BD132	75p	OC28	50p	2N3705	12p	ZTX500	15p
AFI18	38p	BD133	75p	OC35	50p	2N3706	Hp	Z XT503	20p

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BZY10	800V	6.A	25p	ĺ	OA90	5
BZY13	200V	6A	20p		OA91	5
IN4001	50V	IA	7 _D	i	OA202	76
IN4004	400V	1.A	8p	į.	LN4148	5 p
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7½p, 0·33μF, 11p, 0·747μF, 13p,
160V: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, 3p, 0·1μF, 3½p, 0·15μF,
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13p, 1·5μF, 4p, 0·15μF, 0·22μF, 5p, 0·33μF, 6½p, 0·47μF, 8½p, 0·68μF, 11p, 1·0μF,
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0 22µF 35V	4 7µF 35∨	33µF 10V	
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17 x 5 (plain) — 82 17 x 3∄ (plain) — 60	2 pin, 3 pin, 5 pin 180°, 5 pin 240°, 6 pin Plug 12p. Socket 8p.
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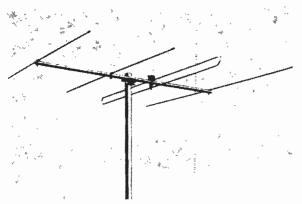
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7401	18	16	14	13	7453	18	16	14	13	74145	150	140	135	130
7402	i8	16	* 14	13	7454	18	16	14	13	74150	330	280	250	220
7403	18	16	iã.	13	7460	18	16	14	13	74151	110	100	95	89
7404	20	18	16	14	7470	30	28	25	24	74153	120	110	105	95
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7406	50	45	40	35	7473	40	38	36	30	74155	150	120	100	86
7407	56	50	44	38	7474	40	36	32	28	74156	130	120	100	96
7408	36	30	27	23	7475	55	52	50	49	74180	155	136	iiż	105
7409	36	30	27	33	7476	40	36	50 32	30	74190	195	190	185	180
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7412	36	30	27	23	7482	100	96	90	85	74193	200	180	170	150
7413	34	28	27 26	22	7483	100	97	95	92	74196	200	190	180	170
7416	45	43	39	34	7484	120	115	110	105	74197	200	195	180	170
7420	18		14	13	7485	250	245	240	230					
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7426	32	29	23	20	7490	75	67	60	52	1		LINEAR IC	's	
7430	20	18	16	14	7491A	100	92	85	79	709		14 pin DIL		40p
7432	40	36	32	28	7492	75	70	65	60	741		8 pin DIL		40p
7440	20	18	16	14	7493	75	68	60	52	741		14 pin DIL		38p
7441	80	75	70	65	7494	95	90	85	80	723		14 pin DIL		95p
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7447	175	165	150	120	74100	250	240	235	230	DIL sockets	5	14 pin and	16 pin	I6p



A commercial version of a four element array for FM (J-Beam Aerials Ltd.).

composed of, say, $^{1}2$ in. rod the actual lengths are all $^{1}2$ in. less than given on the diagram. The spacings are taken from the centre axis of each rod or element.

INPUT MATCHING

Most British receivers and tuners destined for the British market have aerial inputs suitable for 72 ohm coaxial cable (the British 'standard'). Some imported receivers and tuners have inputs for both 72 ohms coaxial (which is unbalanced) and 240/300 ohms balanced twin feeder, used in European areas and American countries. There are times, however, when the receiver or tuner has only a 240/300 ohm balanced input. By connecting the British standard coaxial cable direct to such an input results in a mismatch and hence loss of signal energy transfer.

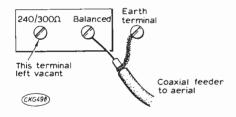


Fig. 9: A useful 'dodge' to permit feeding a balanced input with unbalanced coaxial cable.

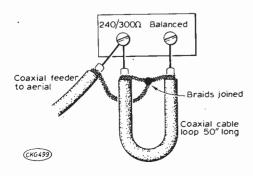


Fig. 10: An alternative method of feeding unbalanced coaxial cable to a balanced input circuit.

In quite a few cases like this it is possible to achieve matching to coaxial cable by connecting the inner conductor to one of the 240/300 ohm sockets or terminals and the braid to an adjacent earth terminal or to the metal part of the chassis (Important: this must never be done if the receiver is of the 'a.c./d.c.' type which uses no mains transformer for isolation; if in doubt consult a qualified dealer or technician), as shown in Fig. 9.

This matching results from the centre-tapped winding on the primary of the aerial input transformer, giving a 4:1 impedance transformation since the turns ratio is 2:1.

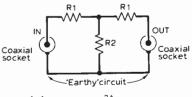
Should the 300 ohm balanced aerial input circuit of the receiver or tuner be unsuitable for matching this way, then an external impedance matching transformer must be used for the best results. A simple coaxial cable transformer arrangement is shown in Fig. 10. It is also possible to obtain commercially small low-loss balun transformers using ferrite cores.



A multi-element FM aerial can be an awkward brutel Erection of these arrays is best left to the experts (R. Smith Aerials, Luton).

INPUT OVERLOAD

When a tuner or receiver is used very close to a powerful station the input stages may be unable to accommodate the multiplicity of strong signals



R1 = $Z \frac{A-1}{A+1}$ R2 = $Z \frac{ZA}{(A+1)(A-1)}$ Z=Receiver/feeder input impedance A=voltage reduction ratio

Fig. 11: Overloading of input circuits can cause all kinds of strange noises on FM. Suitable signal attenuators can be constructed using the above formulae.

without overloading. This is manifested by spurious signals appearing at incorrect tuning points over the scale, and intermodulation may occur between the various programmes.

This trouble can also incite a 'warbling' type of interference on stereo. The solution to the problem is to reduce the level (attenuate) the signal from the aerial to the receiver or tuner. A less elaborate indoor aerial may reduce the signal input, but in some cases this could be undesirable, notably when



The lower mast carries a fixed TV array plus a Stolle rotator for the Arrow 7 FM beam above (R. Smith Aerials, Luton).

a directional aerial is used to reduce distortion due to reflected signals (Fig. 6).

Plug-in coaxial attenuators in a range of values are obtainable from dealers, and there is a similar type available with adjustable attenuation values. Alternatively, it is not a difficult matter to make one's own attenuators for unbalanced circuits, as shown in Fig. 11. The resistors, which should be of non-inductive type (i.e., cracked carbon), can be mounted in a discarded tobacco tin, using the tin itself as the 'earthy' circuit.

Overloading can also occur under certain conditions at distances of twenty or more miles from a station at elevated sites with open aspects towards the station. It is likely that more overloading problems will occur when the FM commercial stations go on the air, for these may not be co-sited with the regular BBC stations and thus could introduce heavy signal fields in areas where only moderate signals are present from the BBC stations.

In some cases like this it may be necessary to use frequency-selection attenuation adjusted only to the frequency of the powerful offending station, but this is another story which will be examined in greater detail when the time comes.

TELEVISION

NOVEMBER ISSUE

TEST SIGNAL EXTRACTOR UNIT

Quite a few test signals are present on the lines transmitted during the field flyback period. These sometimes include experimental Ceefax (BBC) or Oracle (IBA) data transmissions. The lines carrying these test or data signals should not normally be seen since they should appear above the top of the picture. They can be observed however by reducing the setting of the height control. An oscilloscope can be used to display such signals if it has facilities for strobing out particular lines. The test signals themselves are not particularly helpful for general servicing but the ability to strobe out lines can be invaluable for colour servicing since this makes the standard colour bar pattern present at the top of Test Card F available for signal tracing in PAL decoders. The unit featured next month can be used as an economical add-on unit for scopes without strobing facilities and in addition provides good, clean line and field sync pulse outputs.

TACKLING STICKY FAULTS

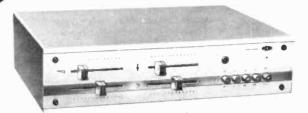
Most fault-finding is reasonably straightforward, a matter of clear symptoms and obvious causes. Every engineer has his ration of faults that seem to defy analysis however. There are nevertheless some common mechanisms by which these arise and a number of ways in which a goodly proportion of them can be cleared up without the need to spend hours delving into the "unknown". Next month Vivian Capel describes various steps which can provide a short-cut to solving the more obscure types of fault.

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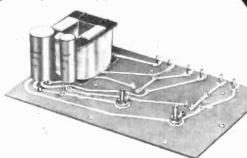


HI-FI STEREO AMPLIFIER 20+20W. UK185

The outstanding advantage of the UK185 is its compact size, which simplifies the assembly, thus comparing well with the best stereo amplifiers.

HI-FI STEREO AMPLIFIER 50+50W. UK192

The UK 192 circuit consists of two UK 190 circuits, the 50W output power per channel being obtained by a push-pull arrangement of BD 130 transistors driven by a complementary pair (BC141-161)



WELLAND R CONTRACTOR AS

THREE-WAY CROSS-OVER FILTER 6db/OCTAVE, UK805

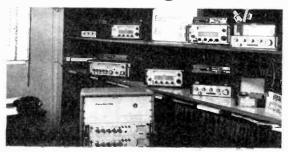
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A C127	12p	BC148	12p	OC71	10p	OA200	8p	741C 8 pin 36p
A C128	12p	BC149	12p	OC72	10p	OA202	8p	741 C 14 pin 36p
AC187	12p	BD131	49p	2N3704	12p	IN914	5p	723C 14 pin 80p
A C188	12p	BD132	49p	2N3705	9p	IN4001	6р	DIL
AD161	30p	BF194	15p	2N3819	22 p	1N4002	6 p	SOCKETS
AD162	30 p	BF195	15p	2N2926R	9p	1N4003	7p	8 pin 23 p
AF114	12p	BFY50	22p	2N2926Q	9p	IN4004	7p	14 & 16 pin 15p
AF115	12p	BFY51	22p	2N2926V	9p	1N4005	7p	ZENER
AF116	12p	OC26	40p	2N2926G	10p	IN4006	8p	DIODES
AF117	12p	OC28	40p	2N3014	10p	IN4007	8p	BZY 88 series
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Radial lead P.C. type:
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IF FILTER BLOCKS



What appear to be small ceramic capacitors, albeit with three leads, are in fact ceramic IF filter blocks made by Toko of Japan. A coloured dot indicates the nominal centre frequency which may range from 10.62 to 10.78MHz. Prices 40p.

The equally minute IF units at the top of the photograph include the MFH51T mechanical filter and its matching transformer type YXE10857 which together cost around £1·50. The filter is available in 4, 5 and 7kHz bandwidths (5kHz) versions being readily available at the moment. The CFU455C and CFT455B are also shown in the group, these being ceramic filters centred on 455kHz. Details and current prices from Ambit International, 37 High Street, Brentwood, Essex.

DIGITAL CLOCK

Fonadek have introduced their Copal 602 clock. It shows the day, date and time in white numerals and there is a small fluorescent tube built in which illuminates the digits. The cabinet is finished in simulated Brazilian rosewood and the unit is priced at £15-95 including VAT. Fonadek International Ltd., Harborne, Birmingham B17 9JS.

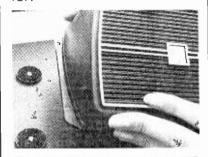


AMATEUR RADIO AWARDS

This new book from the R.S.G.B. compiled by the Society's HF Awards Manager contains details of the world's major awards, where and how to apply for them and illustrations of a number of the certificates.

USEFUL FASTENERS

Hedlock II fasteners are the latest from 3M. They consist of interlocking "twin" parts which just push together to give a strong bond. They can be screwed to two surfaces, ie: car parcel shelf and speaker (see picture), and make a good push fit. A sharp tug releases the fasteners. 3M. United Kingdom Limited, 3M House, Wigmore Street, London W1A.



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Meteronic announce this latest addition to their range of low-cost test instruments. The Type 410 may be used as a frequency meter, multiperiod meter or timer. Timebase stability is typically 1 part in 106 per °C. Time units are 10µS to 1 sec and frequency can be measured to over 20MHz with a resolution of 1Hz. The high impedance input accepts waveforms with slow transition rates. Range selection is manual, with automatic positioning of the decimal point, and allows up to 8 digits to be examined on the large 4 digit display. Overflow indication is provided. Timer start, stop and reset may be operated electronically or by push buttons. The U.K. price exclusive of VAT, is £85. Meteronic, 114/116 Shipbourne Road, Tonbridge, Kent.

HIGH-QUALITY STEREO

A recent addition to the Mullard range of modules for use in radio and audio amplifiers is a stereo decoder, type LP1400. It is intended for use by setmakers in high-qualify equipment.

The LP1400 uses the sum and difference separation principle, which allows de-emphasis to be applied to the difference signal before demodulation. This attenuates interference from adjacent channel transmissions and noise components in the 114kHz and 190kHz regions which in a time multiplex system are frequently demodulated by harmonics of the 38kHz signal and transposed to produce unwanted components in the audio outputs.

The LP1400 offers good stereo separation and a better overall performance than is generally obtained with time multiplex systems. Mullard Ltd., Mullard House, Torrington Place, London WC1E 7HD.

QUADRAPHONIC PHONES

You don't have to have four ears to listen to quadraphonic sound on headphones, because in the new Eagle FF29, four 50mm transducers are so arranged that the effect is similar to four strategically-placed loudspeakers.

The FF29 phones use two coded jack plugs which are also ideally suited for use with the AA26 quadraphonic adaptor. This unit converts any stereo set-up into a 4-channel system with the addition of 2 extra speakers.

Frequency range of the phones is 20Hz-20kHz, impedance 8Ω per channel and matching impedance 8 to 16Ω . The retail price is £16.80 excluding VAT. Eagle International, Precision Centre, Heather Park Drive, Wembley. HAO 1SU.



SPECIAL PRODUCT REPORT

ELECTRONIC CALCULAT

NE of the latest additions to the electronic home construction market is a pocket calculator available as a complete kit or fully assembled. The Sinclair Cambridge weighs 3½ozs and measures 4½ x 2 x ½in and has an 8 digit LED display.

The LED display is an 8 digit 7 segment gallium arsenide! phosphide device being driven via diodes directly from the calculator chip. The 8 diodes, D3-D10, and the flat pack resistor package RN1 form both isolation and an integral part of the keyboard's electronic routine. The cathodes of each digit are driven by a sixteen pin integrated circuit.

The kevboard is made from a single sheet of stainless steel with 18 'click fingers' chemically etched into it to enable the keys to have mechanical hysteresis and a positive

click action.

The power supply (incorporating Tr1 functioning as an oscillator) generates a stabilised 15 volt d.c. supply for the two IC's. The action of Tr1 is such that it switches fully on and off thereby producing a square wave at the emitter thus providing the clock pulse, which is required to drive the calculator chip.

The algebraic logic of this calculator-which enables calculation a to be entered as you would write it down, or in other words logically, acts together with an advanced constant function to give, in effect, a limited memory, thus

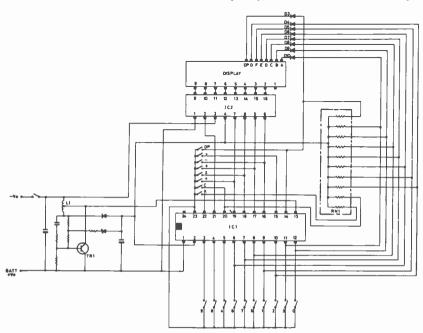
SINCLAIR extending the calculations which can be carried out as true chains. The constant facility may be used on all four

functions-addition, subtraction, multiplication and division $(+-\times\div)$. These functions are often referred to in calculator terminology as operators.

In addition, the calculator operates across a wide exponent range from 10⁻²⁰ to 10⁷⁹ enabling it to handle large or small numbers without becoming overloaded. Calculations are to 8 significant digits, and incorporate a fully floating decimal.

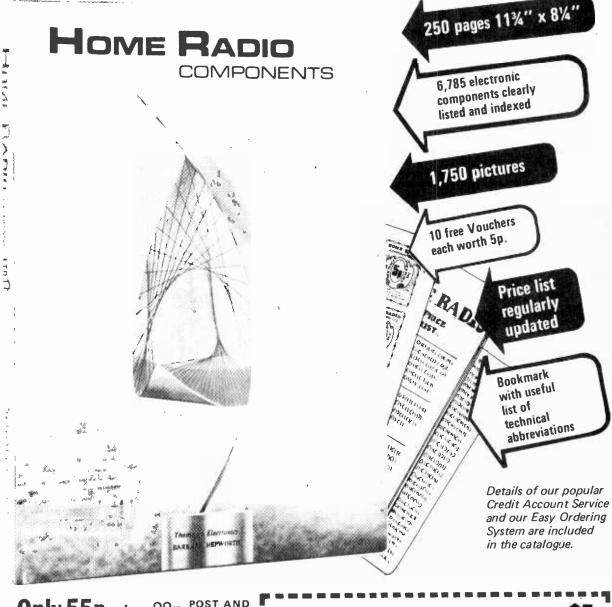
A dual purpose clear button will remove only the last entry when used in conjunction with a function.

The calculator is battery powered by four cells. These may either be ordinary U16 cells (which give limited life) or the MN2400 mercury cells to give the calculator an extended



■ Basic circuit of the Sinclair Cambridge. A brief description of circuit function is given in the text.

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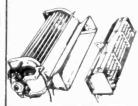
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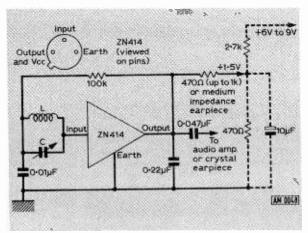
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MORE ON THE LAJ IRELAND ZN414

THE first surprise to the reader brought up on radio in the fifties and sixties is to find the TRF (tuned radio frequency or "straight") radio circuit making a comeback in the 1970s. This type of circuitry was discontinued in the thirties, with the development of the superhet, for several good reasons. First, the selectivity of the tuned circuits of the time became inadequate as the number of transmitters on the air increased, with the result that the ability to discriminate between stations closely separated in impaired. Improved selectivity frequency was required more sharply tuned coils, or alternatively the application of reaction or positive feedback. Further, with a series of tuned circuits operating at the same frequency, stray coupling could itself provide sufficient positive feedback to produce instability.

In any event, excessive positive feedback whether due to stray coupling or deliberate application of reaction could, quite simply, cause the circuit to radiate rather than receive and thereby render impossible reception of a broadcast on that frequency, for some distance around. The superhet, in which amplification of the signal occurs mainly at an intermediate frequency separated from that of the received signal, not only guarantees improved selectivity and stability but also permits the easy application of such refinements as automatic gain control (AGC).

The above observations apply generally to valve or transistor systems; it will be noted that, although TRF circuits have a deceptive simplicity, and avoid the purchase, installation and alignment of intermediate frequency transformers, they achieved only a very restricted popularity among the home constructors of the sixties. Also, despite the fact that quality in broadcast sound had been transferred to the FM channels, even the cheapest commercial AM receivers retained the superhet scheme. To be a credible contribution to the radio scene, therefore, the Ferranti ZN414 unit must have featured as distinctly novel in TRF circuits.



It should be clear, though, that the technology of the monolithic integrated circuit is better adapted to the TRF format. In every single operational amplifier or other high gain IC, methods have had to be developed and applied to enable the transfer of signals through several stages of amplification within a single chip without instability developing through stray capacitances. An integrated circuit IF amplifier for a superhet, however, must either lump all the frequency-selective tuned circuits before or after the amplification stage, or alternatively transfer the signal several times between the chip and external discrete circuitry, each time incurring the risk of instability problems which the superhet was intended to avoid. Further, with the high grade ferrites and litz wire, the tuned aerial circuit currently available has a higher "Q" and therefore an inherently improved selectivity, on the circuits of over thirty years ago. Further, a high input impedance can be developed, in the case of the Ferranti ZN414 typically over $1.5M\Omega$, so that this selectivity is not degraded by the loading presented by the following circuit. Finally, it has been found possible to incorporate an adequate AGC system.

Low current consumption

The unit incorporates the equivalent of ten transistors packaged in a three pin TO-18 can identical with that used for small NPN transistors. The required power source is a single 1.5V dry cell though the unit will function adequately over the range 1.1 to 1.8V; economy of operation is assured by the very low current drain, some lmA being typical. Under such conditions, and with the AGC system operating on an incoming signal, the circuit produces an output of some 40mV quite adequate to operate a medium impedance magnetic earpiece (about 500Ω) or a crystal earpiece through a coupling capacitor. In general, though, the unit will be used to drive an audio amplifier, for which the output is adequate.

Constructional details

Now for one or two constructional points. The small capacitor from the output pin to earth bypasses to earth any radio frequency signal appearing at the output. It is therefore necessary that it be mounted as close as possible to the output and earth leads of the ZN414. It will be noted that the time constant of the output circuit, determined by this capacitor and the AGC resistor, is some 4kHz a feature tailored to the characteristics of the AM signal, for which a passband of some 10kHz (double sideband) is allowed.

The aerial used, which may be any of those advertised to cover the medium waveband with an appropriate capacitor, should have its ferrite rod at least an inch away from the IC, otherwise all leads should be as short as possible. Due to the high input impedance already mentioned it is not necessary to tap the tuned coil on the ferrite rod to find a matching point to feed the circuit input. However, on commercial rod aerials employed with this unit, such a tap, or a small secondary winding, may be available; this may be used experimentally for the connection of an external aerial, if so desired.



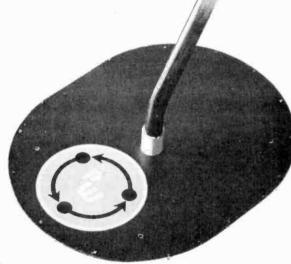
THIS lightweight metal detector operates at a frequency of 120kHz and uses a phase locked loop to provide both an audible and a visual indication of a find. Most detectors use either a variable inductance or a variable mutual inductance as the sensing element. The Ferret is no exception, the inductance of the search coil changing in the presence of metal. Ferrous and non-ferrous metals cause opposite changes in inductance and it is a unique feature of the Ferret that a visual indication of this is provided. The meter deflection is in opposite senses for the two types of metal.

Another feature not found on previous metal detectors is the use of harmonic mixing. Although the two oscillators in the Ferret are both operated at about 120kHz the beat note is derived from their fifth harmonics and the sensitivity is accordingly five

times as great.

Main Oscillator

The electronics of the metal detector breaks down into four functions: the Main Oscillator, Beat Frequency Oscillator, Phase Locked Loop and DC Amplifier. Powered by two PP3 batteries the circuit is shown in full in Fig. 1.



h coil L1 and the series combination of C4. C5 and C6 form a tuned circuit with Tr1 acting as an oscillator taking the voltage at the C4-C5 junction, amplifying it, and feeding it back to the C6-L1 junction in the correct phase for maintaining the oscillation. Diode D1 clamps the gate of Tr1 below earth potential and provides AGC action to stabilise the output and prevent it from being clipped. DC power is fed to the amplifier through the choke L2 the value of which is not critical, but 25mH should be considered a minimum and the value chosen (40mH) happened to be available to the author in a convenient size. An output of at least 5V peak to peak should be available, the frequency being adjusted by altering the number of turns on L1.

Beat Frequency Oscillator

An NE555 timer IC is used in a stable mode to provide a variable frequency oscillator. Suppose C1 is charging up through R1, R2 and VR2; when the voltage across C1, sensed by pin 6, reaches $^2{}_3$ Vcc pin 7 is earthed and C1 begins to discharge through R1. When the voltage across C1, sensed by pin 2, has fallen to $^1{}_3$ Vcc pin 7 is allowed to float and C1 begins to recharge. The switching applied to pin 7 is amplified and presented at the output, pin 3, as a square wave which swings between earth and Vcc.

C1 charge time = 0.685(R1+R2+VR2)C1

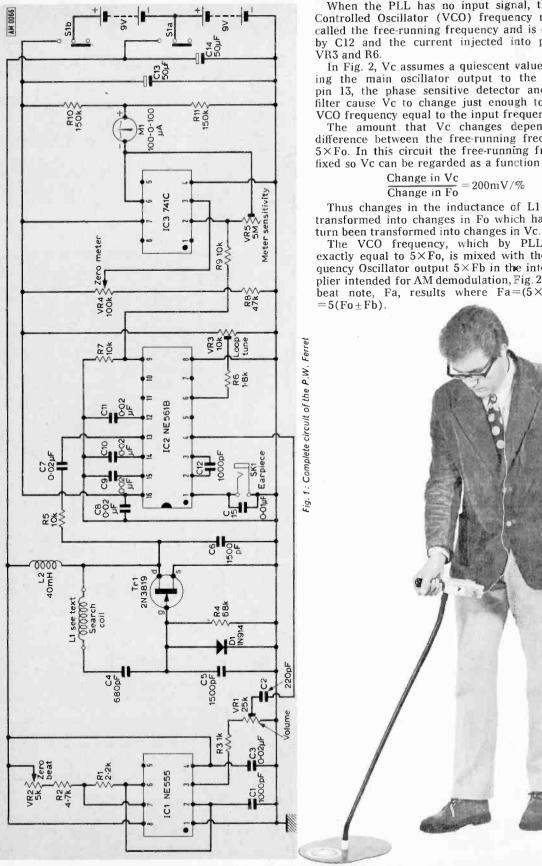
Cl discharge time=0.685R1C1

Frequency = 1/(Charge time + Discharge time) $= 1/(2R1 + R2 + VR2)C1 \times 0.685$

Substituting the circuit values gives a range of frequencies, as VR2 is varied, of 103-160kHz. The upper frequency is not reached due to stray capacitances and internal resistances (the chip is only specified to 100kHz) but an adequate band to either side of 120kHz can be swept.

Phase Locked Loop

The operation of the NE561B phase locked loop was described last month, but is outlined again below owing to the unconventional used made of it in the Ferret.



When the PLL has no input signal, the Voltage Controlled Oscillator (VCO) frequency resulting is called the free-running frequency and is determined by C12 and the current injected into pin 6 from

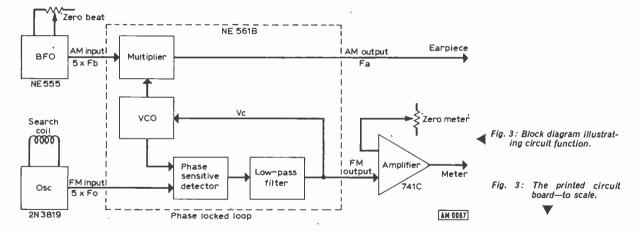
In Fig. 2, Vc assumes a quiescent value. On applying the main oscillator output to the FM input. pin 13, the phase sensitive detector and low pass filter cause Vc to change just enough to make the VCO frequency equal to the input frequency $(5 \times \text{Fo})$.

The amount that Vc changes depends on the difference between the free-running frequency and 5×Fo. In this circuit the free-running frequency is fixed so Vc can be regarded as a function of Fo only.

Thus changes in the inductance of L1 have been transformed into changes in Fo which have in their

The VCO frequency, which by PLL action is exactly equal to 5×Fo, is mixed with the Beat Frequency Oscillator output 5×Fb in the internal multiplier intended for AM demodulation, Fig. 2. An audible beat note, Fa, results where $Fa = (5 \times Fo \pm 5 \times Fb)$

635



If Fo and Fb are very large compared with Fa, and are nearly equal to each other then very small changes in Fo will produce larges changes in Fa. Suppose Fo changes from 120kHz to 120·120kHz, with Fb=119·9kHz.

Vc will change by

$$\left(\frac{120 \cdot 120 - 120}{120}\right) \times 100 \times 200 \text{mV} = 20 \text{mV}$$

and Fa will change from $5(120-119\cdot9)=500$ Hz to $5(120\cdot120-119\cdot9)=(1100$ Hz.

The output from the Beat Frequency Oscillator is dropped by the volume control VR1 to a level suitable for the phase locked loop and C2 tailors the frequency response of the coupling network to attenuate the fundamental of 120kHz but pass the required harmonic of 600kHz. An input of more than two volts will cause damage to the IC. The mixed output is fed directly into a crystal earpiece, and is quite sufficient for all but the most noisy surroundings. As mentioned above, VR1 acts as a preset volume control.

DO NOT attempt to drive a magnetic earpiece directly from the IC as this will seriously overload it. If it is required to run a magnetic earpiece or speaker then it is quite permissible to add a suitable amplifier stage, remembering that the AM output of an NE561B has a DC level of about +14V.

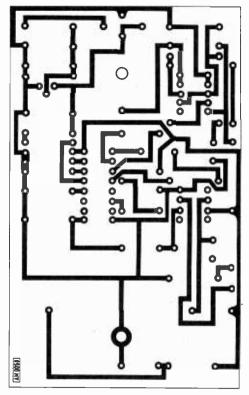
Capacitors C7-C11 perform coupling and bypass functions and any value between $0.01\mu F$ and $0.1\mu F$ should be adequate.

D.C. Amplifier

A 741 operational amplifier is used as a variable gain inverting amplifier. By altering the value of VR5, the preset sensitivity control, the gain of the amplifier can be adjusted from $\times 1$ to $\times 500$. At maximum gain an output swing of 1 volt is obtained for a 0.01% change in Fo.

Because the normal output level at pin 9 of IC2 is +12V a voltage divider VR4 and R8 is provided to give a zero-set control. The meter M1 will give a zero indication when the voltage at pin 3 of IC3 equals the voltage at pin 9 of IC2.

Resistors R10 and R11 are equivalent to a single resistance in series with the meter and connected to +9V. Their values should be adjusted so that



full scale deflection of the meter occurs when the amplifier output is either at earth or +18V. $150k\Omega$ was found to suit the miniature meter used in the prototype. Power supply decoupling is provided by C13 and C14.

Transistor enthusiasts may be interested to know that the three integrated circuits contain about seventy-five semiconductor devices although it is not often clear which of these are transistors and which are diodes!

Circuit Board

A printed circuit board 4×2^3 ₈in. has been designed to take the Ferret, see Fig. 3. Only one interconnecting wire is used on the board and all terminations

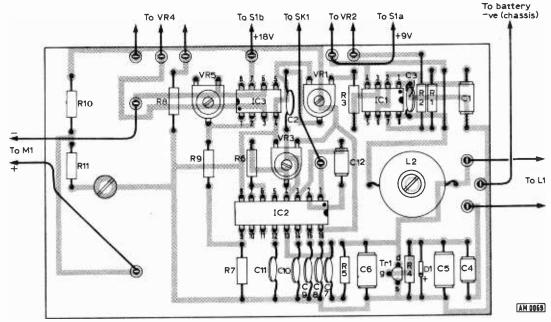


Fig. 4: Component layout and interconnections.

are taken to convenient points. The meter is intended to be positioned over the large clear area at one end of the board. Two holes are drilled to enable the board to be bolted into the box, one being positioned to take the integral screw of the specified pot core L2.

All the component holes except those for the preset potentiometers VR1, VR3 and VR5 are positioned on a 0·lin. matrix so the circuit could be made up as shown on perforated paxolin with pins and underboard connecting wires. Component positions are shown in Fig. 4.

If a new component layout is contemplated then the only precaution to take is to keep the leads to IC2 as short as possible and the circuit basically split up into its four sections, as depicted in Figs. 1 and 4.

Assembly

A small aluminium box $5^{1}_{4} \times 4 \times 1^{1}_{2}$ in. has the remaining components mounted inside it with the meter in the lid. It is important to use a metal box in order to keep down stray radiation. Fig. 5 shows the positions of VR2, VR4, SI and SK1. The cutting details for the meter will depend on the actual type used.

A 6BA bolt is used to augment the 6BA bolt in L2 for holding the circuit board. It is important to see that the case is earthed via the copper conductor pattern by at least one of these screws. The best way to ensure that the component wires do not short out on the case is to introduce a couple of extra nuts on the bolts between the board and the case

If plastic electrical conduit, as described later, is used to construct the shaft of the Ferret then a hole large enough to accommodate the fixing bush must be punched or cut in the base of the case and a similar one for the handle.

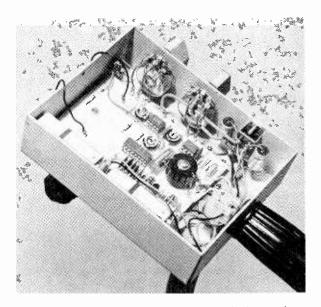


Fig. 5: The positions of the main controls can be clearly seen above.

The search coil, L1, must be wound for an inductance which gives a frequency of 120kHz in the main oscillator. It can be shown that the inductance is proportional to N°D, where N is the number of turns and D the diameter of the search coil. Many different coils have been wound for the prototype using this formula based on an original made with the aid of a digital frequency meter. All have fallen well within the band that can be tuned in by the rest of the circuitry.

Fig. 6a shows a small coil for localised searches and Fig. 6b a larger coil, which is slightly less sensitive, for extended searches. The number of

turns are respectively 90 and 65. To wind the coil, first nail a few small pins into the upper rim of the top plate and carefully wind the required number of turns from any thin insulated copper wire. When this is complete push the coil down on to the hardboard and secure with a dozen or so blobs of glue. When the glue is dry the pins can be removed and the two pieces of hardboard sandwiched together. Drill four holes in the complete assembly, as shown in Fig. 6, and bring the plates together with 4BA bolts.

The connection to the circuit board is made by a length of coax cable and a terminal block inside the case.

One of the easiest materials to use for the shaft is a length of plastic conduit intended for electrical wiring. Having been bent to the shape shown in Fig. 7, by gently heating the relevant section, it is fixed into the base of the box and the search coil top plate with termination pieces. The fixing to the search coil should be completed before it is finally screwed together.

A short length of conduit, fixed as described above into the end of the case, covered with a bicycle handlebar grip will suffice for a handle.

★ components list

Resistors R1 2-2kΩ 10kΩ R9 10kΩ R2 4 7kΩ R6 1-8kΩ 150kO R10 tkΩ R3 R7 10kΩ 150 $k\Omega$ R11 R4 68kΩ R8 47kΩ All 1 or 1 watt, 20% or better, see text VR1 25kΩ pre-set pot., horizontal, miniature VR2 5kΩ pot., standard VR3 10kΩ pre-set pot., horizontal, miniature VR4 100kΩ pot., standard VR5 5MΩ pre-set pot., horizontal, miniature Capacitors C1 1000pF polystyrene C8 0.02uF ceramic 220pF ceramic C9 0-02µF ceramic C3 0.02µF ceramic C10 0.02uF ceramic C4 680pF polystyrene C5 1500pF polystyrene C11 0-02 uF ceramic C12 1000pF polystyrene 1500pF polystyrene C13 50µF 25V electrolytic 0.02 F ceramic C14 50µF 25V electrolytic C15 0.01µF ceramic

Polystyrene capacitors 5% or better

Semiconductors

IC1 NE555 8 pin DIL D1 1N914 or similar IC2 NE561B 16 pin DIL Tr1 2N3819 or similar IC3 741C 8 pin DIL

Miscellaneous

L1, L2 see text. Jack socket, 3.5mm. Crystal earpiece and plug, 3.5mm. S1, 2 pole c/o slide switch.
Aluminium box 5½ x 4 x 1½in. (AB10). Batteries
PP3 (2) and 2 pairs battery clips. Knobs (2).
Plastic condult, 36in. approx. and conduit terminations (3). Plastic handlebar grip. Terminal block,
2 way. Hardboard and wire for heads. Co-axial
cable. Printed circuit board. M1, centre-zero edge
panel tuning meter (Henrys F11).

Ambit International, 37 High St., Brentwood, Essex, can supply the pcb for 78p inc., the three IC's and transistor for £4 90 inc. or a complete kit consisting of the pcb, three IC's and transistor, all remaining components, aluminium box and wire for search head for £9:50 inc.

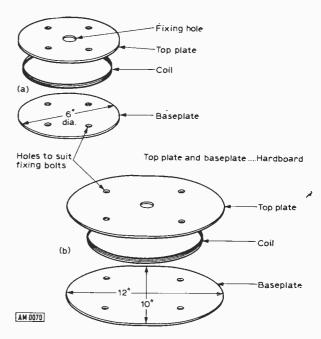


Fig. 6(a): A small coil used for localised searches and Fig. 6(b) a larger coil, although less sensitive, used for extended searches.

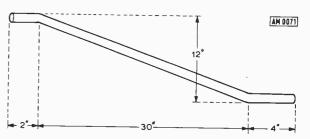
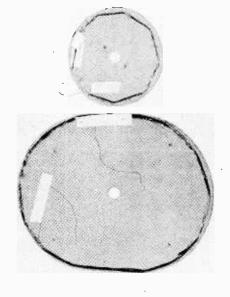
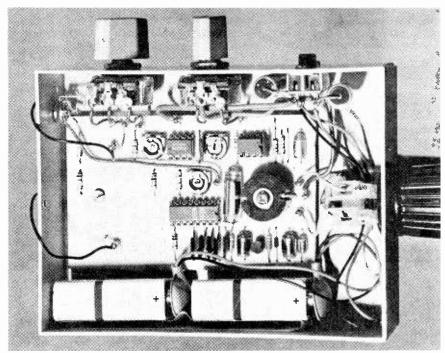


Fig. 7: The handle is formed as shown above.



Photograph shows two of the coils made by the author.



Close-up view showing the inside of the PW Ferret. Compare this photograph with Fig. 4.

Setting Up

With the search coil connected, set all the preset pots to mid-rotation and switch on. Adjust VR2 for a strong and constant beat note. If only weak and varying notes can be obtained then the loop is not locked and VR3 must be rotated until the required note is heard. Set VR3 in the middle of the portion of its travel over which the beat note is clear. VR1 can then be set for the required volume in the earpiece.

Adjust VR4 to zero the meter, this will be a sensitive setting, and move the Ferret towards a large metal object. An indication should be both heard and seen. VR5 will then determine the strength

SPECIAL PRODUCT REPORT—continued from page 630

life. Sinclair Radionics claim that mercury cells will give 12 hours continuous operation. Certainly a small mains unit would be an advantage if continuous use of the calculator is contemplated.

The kit is intended for constructors with previous soldering experience. Estimated assembly time is approximately 3 hours. Tools required—and the most important item—is a properly earthed sub-miniature soldering iron with a $\frac{1}{16}$ in. bit or smaller. Other items are wire cutters, tweezers and instrument type pliers.

The 15 page step-by-step assembly instruction booklet contains a section on special safety precautions which should be observed before and during assembly of the kit.

Attention is drawn to the point, that static electricity can be a hazard unless proper precautions are taken. The manufacturers instructions should be carefully read and fully understood before assembly is contemplated.

Care is necessary when assembling the kit, especially because of the numerous tiny solder connections to be made. Blobs of solder must be avoided and close inspection of the completed printed circuit board is essential after soldering has been completed. Examination of the finished p.c.b. with a magnifying glass is recommended to ensure a clean product.

Those constructors who after purchasing the kit and then having read the assembly instructions find that they are 'stumped' may return the kit (untouched) plus a cash balance

of the meter reading when an object comes within range.

It may be possible to obtain beat notes from harmonics other than the fifth. It is sufficient, however, to select that beat note which gives the most sensitive audible response when the Ferret is brought near to some metal test object.

As has been already suggested in the text, a lot of the component values are non-critical and, in general, all except the polystyrene capacitors can have 20% tolerance. It is recommended that first grade integrated circuits are used, especially the NE555. If required, integrated circuit mounting pins can be used.

in exchange for a built version. What could be more fair? Sinclair Radionics state that full service facilities are available for kits and ready built units.

Also included with the calculator is an informative 32 page booklet detailing the wide range of calculations that can be carried out. From simple arithmetic, compound interest, logarithms, trigonometric functions, roots, polynomials, hyperbolic functions and so on. In addition a credit card size aide-memoire with calculations summarised in formula form is included.

Calculations of all types were performed with the Cambridge and it is surprising how simple it is to use. It brings about a new and refreshing interest to calculations. In the calculation of square roots the iterative Newton-Raphson method is used. This sounds quite complex, but you simply take a (wild) guess at the square root and enter it on the keyboard, using the procedure outlined in the instruction booklet. We tried this method many times—feeding way-out guesses to the keyboard. The correct answer came up every time.

The kit is attractively packaged and includes all necessary components to complete the calculator. Even solder is supplied.

A full money refund guarantee applies to untouched kits if returned within 3 weeks.

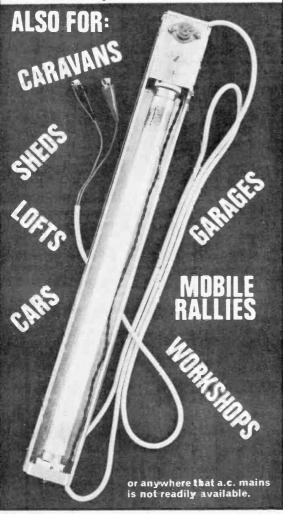
At £27.45 (including VAT) for the complete kit, the Sinclair Cambridge provides excellent value for money. Sinclair Radionics Ltd., London Road, St. Ives, Huntingdonshire PE14 17HJ.

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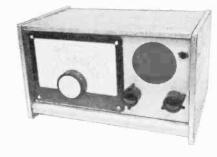
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DECEMBER ISSUE ON SALE 2nd NOVEMBER

dictionary of audio terms hi-fi specifications

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A

A-B. This is the kind of audio comparison test where any differences in sound quality can be assessed immediately upon switchover, i.e. on "A-B" comparison between items of equipment A and B. Often the left and right-hand channels or the record and replay sound signals are designated A and B.

ACOUSTICS. The study of the behaviour of sound. The "acoustic characteristics" of a room are dependent on its size, shape and the reverberation time according to the reflective or absorbent items present.

ACOUSTIC FEEDBACK. Cycling of sound build-up to a continuous squeal as the microphone picks up a signal from a loudspeaker connected to the same microphone amplifier.

ACOUSTIC SUSPENSION. Some loudspeaker systems employ a sealed cabinet. This enables the acoustic pressure of the air enclosed therein to provide the principal restoring force for the diaphragm of the speaker.

A.F.C. Automatic frequency control. A control circuit in a receiver or tuner which compensates for small variations in the carrier signal frequency to provide a stable audio output. A circuit function in a tuger

or receiver which keeps the unit accurately tuned to the desired station, eliminating any tendency to drift.

A.G.C. Automatic gain control. A circuit which stabilises a large variation in the strength of an incoming signal.

A circuit function in a tuner or receiver which maintains the mean amplitude of the modulated signal at almost a constant level. A.G.C. or A.V.C. (Automatic volume control) as it is sometimes called is also used to describe the audio compression system employed in automatic tape recorders, in which the recording signal level is adjusted to compensate for widely differing sound levels.

ALIGNMENT PROTRACTOR. Indicates errors in a pickup's lateral alignment. It fits on the centre spindle of the turntable, and the pick-up stylus fits into a small hole on the device. The correct indication is shown when the angle of lateral movement of the pick-up head is at 90° to the tangent of the groove at any point, although minimal tracking error is expected with most pick-up arms.

AMBIENCE. The "feeling" given to sounds by a room. The effect of the environment on the coloration of sounds produced.

AMBIENT NOISE. Unwanted background noise picked up by a microphone, i.e. any extraneous

clatter in a room. Also any acoustic coloration that influences sounds, brought about by the acoustic properties of a room in which a recording is being made or replayed. AMPLIFICATION. An increase in the magnitude of a signal brought about by passing it through an amptifier.

AMPLIFICATION FACTOR. The symbol used to signify this is "\u03c4". It is the measurement of amplification in a circuit usually in voltage or current terms calculated by dividing the output by the input. This figure is often converted to decibels (which see).

AMPLIFIER. A device for increasing the magnitude of a signal by means of a varying control voltage, maintaining the signal's characteristic form as closely as possible to the original.

AMPLITUDE. The level of an audio or other signal in voltage or current terms.

AMPLITUDE DISTORTION. The distortion of a signal by the undesirable influence of a circuit or component and takes place when there is a change of amplitude in part of the input signal bringing about harmonic distortion and intermodulation distortion. This part is expressed as a percentage of the whole waveform at any given period

AMPLITUDE MODULATION.
Commonly known as a.m. and

refers to the method of radio transmission where the audio modulating signal is made to vary the amplitude of the radio carrier wave.



The audio information is carried on a high frequency radio wave.

ANECHOIC CHAMBER. special room used for testing audio transducers, where all wall surfaces have been covered with acoustically absorbent materials so that reflections of the sound waves are eliminated. Otherwise known as a "dead room"

ANTI-PHASE. Where two identical signals are disposed in 180° phase opposition. When superimposed, they tend to cancel each other because their waveform patterns are of equal magnitude but

opposite polarity.

ANTI-SKATING DEVICE. A device found on many modern pick-ups which provides an "outward" force on a pick-up arm. This counteracts the arm's tendency to move towards the turntable centre due to offset geometry, and reduces stylus/groove friction.

ANTISTATIC CLEANER. Substance used on gramophone records which helps to prevent the build-up of a static charge which

attracts dust.

ATTENUATOR. A device which reduces the amplitude of a signal

by known proportions.

FREQUENCY SPEC-TRUM. Mainly the full range of sounds we can hear. In a person with good hearing the range of sounds in the audio spectrum is usually between 30Hz and 16,000Hz. In older people this is usually 50Hz to 10,000Hz.

AUDIO OUTPUT. The output signal from any audio equipment. It is generally measured in volts or

watts r.m.s.

AUTO-CHANGER. A device on a record-playing turntable which facilitates the automatic positioning of a disc and pickup ready for . playing.

AUX. Abbreviation of auxiliary. Often applied to amplifier inputs and refers to an extra input facility as distinct from "mic", "tuner", "pickup", etc.

AZIMUTH. The angle which recording and playback head gaps make with the line along which the tape moves. The head is oriented until this angle is 90°.



BAFFLE. The mounting for a loudspeaker usually comprising a flat non-resonant panel. It is used to increase the length of the path of the sound waves between the front and rear of the speaker to minimise bass losses.

BALANCE. Equality of amplifier gain or signal level from right and left channels of a stereo amplifier. In theory the balance between each channel should be electrically perfect but there may be mismatch of nominal signal level from one or other channel which is compensated by adjustment of the "balance control'

BALANCE CONTROL. A variable resistor used to compensate for any slight loss of signal in the right or left channel of a stereo amplifier. To some extent, this control can compensate for unbalanced speakers and be used for adjustment when the listener is not in an equidistant position between the two loudspeakers.

BANDWIDTH. The range of audio frequencies over which an amplifier or receiver will respond and provide a useful output.

BASS. The lower end of the sound spectrum (usually 150Hz and below). An amplifier "bass control" usually provides a variance of decrease or increase in response at frequencies below 1kHz.

BEL. A ratio of two signal levels, such as at the output and input, in logarithmic terms. It is too large a unit to use for precise measurement and we use tenths or "decibels". These are defined in power terms

output or in voltage or as 10 log₁₀ input

current terms as 20 log10 input. output.

BIAS. A high frequency signal applied to the audio signal at the tape recording head to make the audio signal magnetise the tape over the linear part of head's magnetic characteristic. The bias signal is usually above 40kHz to avoid audible intermodulation distortion. Bias is also a term used to denote the sideways thrust of a pickup arm.

BIAS COMPENSATOR. A device which counteracts the inward bias of a pick-up arm as it tracks the disc. The compensator exerts an outward force on the arm and generally can be adjusted to have a definite relationship to the playingweight of the pick-up.

BI-RADIAL STYLUS. Also known as elliptical stylus. This is used with lightweight pick-up arms to reduce tracking distortion. The stylus tip has a small radius where it touches the walls of the record grooves as distinct from a conventional stylus which has a hemispherical tip.

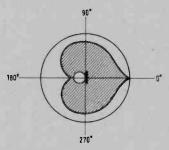
BOTTOMING. A situation in which a stylus reaches the bottom of a record groove because its tip radius is smaller than optimum for the groove. Also the opposite of the pinch effect.

BULK ERASER. An instrument which erases recordings from a whole tape at once while it is still on the spool. It does this by producing an a.c. magnetic field of high intensity.



CAPSTAN. The drive spindle in a tape recorder, which in conjunction with the pinch-wheel, pulls the tape across the heads at constant speed.

CARDIOID MICROPHONE. A microphone which has a sensitive response to sounds on one side.



This makes the response very directional. It is called "cardioid" because it has a heart-shaped polar diagram.

CARTRIDGE. The electro-mechanical transducer of a pick-up head that converts stylus vibrations to an electrical signal. It is generally detachable and fits into the headshell of a pick-up.

CERAMIC. Piezo-electric part of a pick-up, speaker or microphone that acts as a transducer. It has characteristics similar to a crystal transducer but is more robust.

CHANNEL SEPARATION. The degree to which the two signals in a stereo system are electrically isolated. Usually expressed as a ratio in decibels.

CLASS-A. An amplifier where the output transistors or valves are operating permanently on linear portions of their transfer characteristics. Efficiency is low, but a constant current is drawn from the power supply whatever the signal level. Usually recognised by the use of a single transistor or valve driving the loudspeaker.

CLASS-B. An amplifier where two transistors or valves operate on positive and negative half cycles of the signal wave form. Each operates from a low initial current but this rises as the signal level increases. Usually recognised by the use of two transistors or valves operating in anti-phase to drive the loud-speaker.

CLIPPING. Severe distortion caused by overloading the input of an amplifier. A sine wave signal waveform has a flat top and bottom at the peaks when clipping occurs. COAXIAL CABLE. A screened cable where the inner conductor is surrounded by a concentric outer screen. Commonly known as "coax" the cable is carefully manufactured so that it has a constant characteristic r.f. impedance of 70-80 Ω . It is used for aerial downleads and for sending r.f. from one unit to another. Also used to inter-



connect audio stages or equipment of high impedance to minimise the risk of hum inducement.

COLUMN SPEAKER. A loudspeaker cabinet of long "column" shape. Usually the loudspeaker is at one end so that the rear of the drive unit is loaded by a column of air. Often columns are made from drain-pipes. Also the name given to a long speaker cabinet containing several loudspeakers for public address work.

COMPARATOR. Often found in audio showrooms, it is a unit which by switch selection, will connect up a combination of speakers, amplifier, tuner, pick-up, tape player, etc. For comparing different types. Also the name of a circuit which compares two signals and provides a "difference" signal.

COMPATIBILITY. The ability of one unit to be used with another without detrimental effect on the signal through mismatch. A compatible pick-up will play both mono and stereo records.

COMPLIANCE. The ability of a stylus to respond to both horizontal and vertical movement. The degree of compliance is a measure of the

capability of the stylus to follow rapid variations in the groove surface.

when the dynamic range is reduced electronically so that quiet sounds are raised and loud sounds lowered. The most common application is an "automatic" recording where it is important that all sounds recorded are made intelligible when played back. Also used where necessary to avoid over recording and distortion, or to lift the signal level clear of background noise or hum.

CONDENSER MICROPHONE.

A microphone which contains a metal plate and a thin metal diaphragm set close together. A polarising voltage is applied to the plates. The capacitance of the microphone is thus affected by movement of the diaphragm from air pressure waves.

CONTROL UNIT. A pre-amplifier unit in an audio set-up. Signals from audio sources, i.e. tuner, pick-up microphone, are fed into it. Equalisation (where necessary) is applied, then the signal is fed to the main amplifier. Volume and tone controls are usually incorporated together with any necessary programme selection switch.

COUNTERBALANCE. Counterbalance is a weight, usually adjustable, fitted at the pivot end of a pickup arm. It counters the weight of the pickup head and cartridge unit and allows adjustment of the stylus pressure to the desired value. CROSSOVER NETWORK. A circuit usually employing capacitors and coils which feeds low notes to a low frequency speaker (woofer) and high notes to a high frequency speaker (tweeter). The crossover frequency is that at which frequency bands divide. Sometimes the audio spectrum is divided into more than two bands to drive more than two speakers.

CROSSTALK. Breakthrough of the signal from one channel to another by conduction or radiation. CUT-OFF FREQUENCY. The frequency response [lmitation, either upper or lower end, of a given component or piece of apparatus where the response falls off by 3dB, then is even lower beyond this frequency.



DAMPING FACTOR. The ratio of the impedance of a speaker to the amplifier impedance. A high damping factor is desirable to

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subdue speaker resonances.

DECIBEL. One tenth of a Bel (which see).

DE-EMPHASIS. Reduction of the level of the higher audio frequencies during f.m. reception or tape replay, so that they compensate for the pre-emphasis (which see) applied to the transmission. This restores an overall uniform response, with improved signal-to-noise ratto.

DEMAGNETISER. A device which removes residual magnetism from tape heads. This magnetism, if not removed can introduce noise on recordings and cause high frequency loss.

DEVIATION. In f.m. transmissions and reception deviation is the increase or decrease of signal carrier frequency from the nominal; also applied to drifting. Standard maximum deviation rating is ±75kHz for f.m. radio.

DIN. Stands for Deutsche Industrie Normenausschus. This is an organisation in West Germany (similar to the British Standards Institution) which sets certain industrial standards.

A well-known standard is the DIN 45,500 which applies to domestic hi-fi equipment. Various plugs and sockets are popularly known



as "DIN plugs". They have DIN standard geometry and connections.

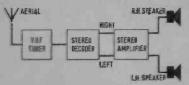
DIPOLE. An aerial generally used for v.h.f. receivers.

DNL. Dynamic noise limiter. A compatible circuit designed by Philips Ltd. primarily for use with tape recorders. It improves the effective signal-to-noise ratio during replay by selective filtering at low signal levels.

DOLBY SYSTEM. A noise reduction system which compresses signals before they are recorded on tape and expands them again on replay. This results in a reduction of background noise and is particularly designed for use with tape recorders.

DRIFT. Variation of r.f. signal carrier frequency above and below the nominal due to unstable reception conditions. It can be alleviated to a great extent by applying automatic frequency control.

DECODER. A circuit built into an f.m. tuner to enable it to translate stereo signal information into two matched audio outputs. Also a



means to extract and process recorded quadraphonic sound information from a complex signal into four matched outputs.

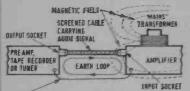
DISTORTION. Unwanted changes in the purity of sound being reproduced or in r.f. signals. In audio it generally implies intermodulation and/or harmonic distortion. These are derived from phase differences and/or amplitude distortion where the amplitude of the output does not bear the same proportion to the input at all frequencies.

DROP-OUT. Sudden decrease in the recorded signal level due to tape imperfections.

DYNAMIC RANGE. The range of signal amplitudes from the loudest to the quietest that can be reproduced effectively by the equipment. The upper limit is set by inherent distortion level, and the lower limit by background noise and/or hum.

EARTH LOOP

The wiring of the interconnections between items of audio or radio equipment such that there is more than one neturn path for the "ground" side of the signal-carrying



EARTH LOOP CAUSED BY THIS EARTH CONNECTION BETWEEN THE TWO CHASSIS AS WELL AS BY THE SCREEN OF THE SIGNAL CABLE.

wiring. This generally results in a loud hum from the speakers.

ELECTROSTATIC. Applied to loudspeakers and microphones (condenser type). An electrostatic force is used to activate the diaphragm. The charged diaphragm is suspended between two perforated plates. As an a.c. signal is applied to the outer plates, the diaphragm vibrates.

EQUALISATION. A pre-arranged circuit that applies correction to a given recording characteristic dur-

ing replay to result in a uniform frequency response at the output terminals.

erase Head. A head on a tape recorder which applies a strong high frequency alternating magnetic field to the tape so that earlier recordings may be "erased" as the tape runs past the head.

F

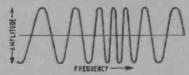
FADING. A drift in the level of received radio signals beyond intelligability. It is often caused by changes in the upper atmosphere. Also applied to deliberate slow reduction of signal level by means of the volume control.

FEEDBACK. A system where part of the output signal from an amplifier is applied to the input. When in antiphase (i.e. negative feedback) this results in reduction of distortion, lowering of the amplifier output impedance, improvement in signal stability.

F.E.T. Field Effect Transistor often used in early stages of an amplifier or tuner to give a high input impedance for minimum loading of the programme source, i.e. aerial or pick-up.

FLUTTER. Rapid variations of pitch or frequency caused by inconsistent speed of a turntable or tape transport mechanism.

F.M. Frequency modulation is a system of transmitting a radio signal where the frequency of the carrier wave is altered by changes in the amplitude of speech or music.



F.M. is applied to v.h.f. sound broadcasting above 87MHz.

FREQUENCY. The number of complete cycles in one second of alternating current, voltage, electromagnetic or sound pressure waves.
FREQUENCY RESPONSE. A

graphical characteristic showing relative signal levels at different frequencies with respect to a given-reference level. A "flat" frequency response is one that has a uniform level at all frequencies within a given band width.

FRONT END. Refers to the first stage of an amplifier or tuner.



GAIN. The increase in the power or voltage level of a signal due to amplification, i.e. the ratio that

PRACTICAL WIRELESS SUPPLEMENT NOVEMBER 1973

exists between the output signal level and the input signal level, usually quoted in decibels (which see)

GROOVE. A record "track" which carries the audio signal information in two 45° displacements (stereo). In a long-playing record, groove dimensions could be: width 2.5 mils.; depth 1 mil. and pitch 250-350 groove revolutions per inch.

H

HARMONIC. A harmonic of a fundamental frequency is the frequency of its exact multiple. Thus twice the fundamental frequency is the second harmonic (one octave up) and so on. If the fundamental frequency is 1,000Hz, the second harmonic would be 2kHz, the third 3kHz, and the fourth harmonic 4kHz (two octaves up from the fundamental).

IMPEDANCE. Opposition to a.c. current presented by capacitors, inductors and resistors. This effect is measured in ohms and is related to frequency.

INFINITE BAFFLE. A loud-speaker mounting where ideally there is no path of air between the back and front of the speaker diaphragm. An infinite baffle improves the forward radiation of sound at—low frequencies and preferably should be a very large plane surface like the wall of a room or a screen of very rigid material (e.g. ½in wood) on which a loud-speaker is mounted. In practice truly infinite baffles are rarely accomplished except in sealed boxes, but these give rise to prob-

I.P.S. Inches per second. Used for signifying the speed of a tape travelling past the heads of a tape recorder. The most common speeds used in this country are $1\frac{7}{8}$ i.p.s. (4.75cm/s); $3\frac{3}{4}$ i.p.s. (9.5cm/s) and $7\frac{1}{2}$ i.p.s. (19cm/s).

tems of resonance.



JACK. A type of two-or more-ways concentric contact socket for carrying audio signals.

JOHNSON NOISE. A frying or sizzling sound produced by thermal agitation voltages generated in amplifier circuits. It usually occurs in the input circuit (or front end) of an amplifier.

L

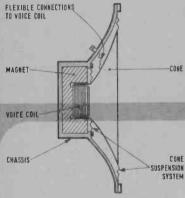
LEVEL. The voltage or power of a signal, or the relative voltage or power compared with a reference. LIMITER. A circuit in an amplifier or tape recorder which reduces volume when over-modulation or distortion is likely to occur.

LINE SOURCE SPEAKERS. A chain of speakers used in public address work that are driven from an amplifier with 100V or 600ohm output line.

LOUDNESS. The intensity of a sound as subjectively judged by the human ear. Loudness levels are measured in "phons" and may differ in effect from one person to

another.

LOUDSPEAKERS. A transducer which converts a.c. electrical energy into acoustic energy by movement



of the diaphragm causing air pressure waves.

M

MAGNETIC PICK-UP. A pick-up which employs an electro-magnetic transducer. An armature bears the stylus. The armature is pivoted between the poles of a magnet and stylus movement makes the magnetic field change, inducing a variable voltage in coils wound on the magnet.

The name refers to pick-ups of the moving coil type, moving magnet, moving iron, induced magnet and variable reluctance types.

MATCHING. Equalisation of the input impedance of one unit to the output impedance of another connected to it. Also used to refer to pairs of loudspeakers, microphones or other components which have similar characteristics and which are employed in the two channels of a stereo system.

MICROPHONE. An electroacoustic transducer which converts sound energy into electrical energy. The method depends on the material used in the microphone.

MIXER. A device which combines two or more separate signals into a common output.

MODULATION. The process whereby an r.f. or other signal is mixed with and caused to vary in accordance with an audio signal. The degree to which a tape or disc recorder is made to record without introducing distortion.

MONITORING. Listening to a signal as it is being recorded so that a check can be made on the quality. MONOPHONIC. Thereproduction of sound through a single channel amplifier.

MUSIQUE CONCRETE. A musical work comprising natural sounds which are recorded, then edited or manipulated and treated so that they do not sound like the original recording, but present an artificial form of musical composition.

MULTIPLEX TRANSMISSION.

The transmission of two or more simultaneous signals on a common carrier wave. Used for transmitting stereo broadcasts. A multiplex decoder is needed before these transmissions can be resolved into stereo or other multiple channel—audio.

N

NEGATIVE FEEDBACK—See "Feedback".

NOISE. Unwanted sounds of multiple and irregular frequencies and heard as a hiss or click.

0

OFFSET ANGLE. The angle at which the pick-up head is offset from a line through the centre of the arm. Correctly set, it minimises wear on stylus and record groove, and distortion of reproduction by keeping the tracking error down to a minimum.

OMNIDIRECTIONAL. Generally refers to a microphone which has approximately uniform sensitivity in all directions, the polar response being completely spherical.

OVERLOADING. An amplifier or piece of equipment operated beyond its signal-handling capability so as to create a distorted output.

OUTPUT STAGE. A power amplifier's final stage which feeds

PRACTICAL WIRELESS SUPPLEMENT NOVEMBER 1973

the audio signal to a oudspeaker or other device.



PARALLEL TRACKING. A pickup cartridge's movement which is exactly parallel to the radius of the record, with the stylus always positioned on that radius for zero lateral tracking error. PEAK PROGRAMME METER. A

meter and associated circuitry which is used for indicating the peak levels of programme volume. Commonly referred to as P.P.M. PHASE. Phase is the angular relationship in time of an alternating voltage or current with reference to zero voltage (or current) or another comparative waveform. Sound waves are said to be in phase when the voltage of one at any instant is the same polarity and angular displacement as the other and when crossing the zero voltage line in the same direction. "In-phase" soundwaves are identical in frequency and polarity at any instant; out-ofphase, waves may be identical in frequency (but not necessarily) and of opposite polarity at some instant. Anti-phase waves are identical in frequency and exactly opposite in polarity, i.e. 180° out of phase.

PHASING. The arrangement of of loudspeaker or connections in a stereo set-up so that—when an identical signal is fed to the two speakers, the speech coils are so connected that the cones both move in the same direction at the same time.

PHON. A unit of measurement of loudness allowing for the difference in sensitivity of the ear at differing frequencies. The phon is related to the decibel, but is in terms related to one frequency and determined from sound pressure measurements.

PHONO PLUG. A connecting plug often used in audio equipment. It has a centre "live" pin and an outer "earth" shield. Used with



screened cable for connecting pickups and tuners to an amplifier or control unit.

PICK-UP. The part of a gramophone which extracts recorded information from a disc and changes it to an electrical signal.

PICKUP ARM. The cantilever support for the pickup head with counterbalance weights, pivots etc. for carrying the cartridge.

PICKUP HEAD. The end of the pickup arm containing the cartridge. It is often removable from the arm and is usually called the "head shell" which carries the actual cartridge.

PIEZO ELECTRIC. An effect whereby a substance generates an electrical current when it is subjected to mechanical stress. This characteristic has been made use of in the design of pickups, microphones and loudspeakers.

PILOT TONE, A 19kHz tone used in stereo broadcasting at the equivalent of 10% f.m. modulation +7.5kHz. It is transmitted with the sum-and-difference signals to assist in the stereo decoding process in the f.m. receiver.

PINCH EFFECT. The vertical movement of a stylus which takes place during record reproduction when irregularities in groove width occur.

PINCH WHEEL. The rubberised wheel in a tape transport mechanism that holds the tape against the capstan so as to ensure that the tape does not slip.

PITCH. The pitch of a sound is the musical term for sound vibrations. Standard U.S. and European pitch is based on =440Hz. When the pitch is raised one octave, the frequency is twice the original.

PLAYBACK. The reproduction of a tape recording or disc through an amplifier and loudspeaker or phones.

PLAYING WEIGHT. Downward force of a pickup on a record. Sometimes called stylus pressure. POLAR RESPONSE. Polar diagram or circular graph which shows the sensitivity of an aerial or microphone or the output from loudspeakers in an angular mode through 360°.

POLYESTER BASE. A base material used for magnetic tape on which is coated the magnetically sensitive substance. Widely used for long playing tape, it is less prone to stretching than acetate film.

POWER. The energy dissipated in an electrical or electronic circuit or component that is conducting either a.c. or d.c.

POWER AMPLIFIER. The stage of an amplifier which supplies audio signals to a loudspeaker or phones.

POWER-HANDLING CITY. The maximum power rating of a loudspeaker or other component which determines how much current can be passed safely through without adverse effects.

PRE-AMPLIFIER. An amplifying system for low signal levels. It boosts a low-level signal from a cartridge, for instance, and feeds the signal to a power amplifier. It may contain additional circuitry that affects the frequency response in some way.

PRE-EMPHASIS. The boosting of high frequencies in f.m. broadcasting or recording. Uniform frequency response is restored by "de-emphasis" in the receiver or replay amplifier. The purpose is to reduce the noise level that arises through transmission and tape recording.

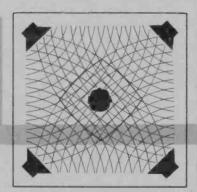
PRESSURE PAD. A felt pad which applies a gentle but firm force to keep a moving tape in good contact with the heads of a tape recorder.

PRESSURE UNIT. A movingcoil speaker drive unit which usually has as its diaphragm a small dome of plastic or metal. It is designed for use in the throat of a horn.



QUADRATURE. Two a.c. signals of equal-frequency are said to be in quadrature when they are phase displaced by 90°

QUADRAPHONY. Four matched discrete audio channels are employed in true quadraphony; four matched microphones are used in the recording process, four-track tape or "quad" records are used for replay through a four-channel amplifier which feeds four loudspeakers.



Various modulation or matrix systems are sometimes used so that four channels can be obtained by using some two-channel (stereo) equipment. The signals are then "decoded" so that four channels of sound can be reproduced through four speakers.

PRACTICAL WIRELESS SUPPLEMENT NOVEMBER 1973

Systems known as "surround sound" are used to produce "synthetic" quadraphonic effects. These units use matrix circuits in conjunction with conventional stereo equipment and records.

QUADRUPLE PLAY. Magnetic recording tape which is thinner than "standard play" tape and consequently enables one to make recordings four times longer than with 'SP' tape.

Q4. The name given to the Practical Wireless quadraphonic decoder to enable quadraphony to be reproduced from stereo or quadraphonic recordings.



RADIO FREQUENCY. A term describing incoming radio signals to a receiver or outgoing signals from a radio transmitter. There are no finite limits in the r.f. range but it is usually considered to denote frequency above 150kHz and extending up to the infra-red range.

RAKE. The "rake" angle of a stylus is the angle that the stylus bar makes with a gramophone record when

viewed from the side.

RANDOM NOISE. Noise generated in a circuit by random movement of electrons caused by thermal agitation. In tape recording it can be caused by uneven distribution of magnetised particles and is reproduced as a background "hiss".

REAR SUSPENSION. Used in moving-coil loudspeakers, it is a pliable support situated near the apex of the cone, and assists in keeping the coil in a concentric position in the air gap between the magnet poles.

REFLECTOR. An element in a v.h.f. aerial which is situated to the rear of the main dipole. It helps to reflect radio waves on to the dipole. Also the name given to the "dish" often employed to reflect quiet or distant sounds in the open air on

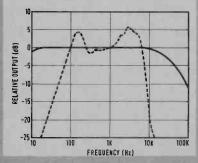
to a microphone.

REFLEX CABINET. A type of speaker enclosure fitted with a vent or port through which out-of-phase signals from the rear of the cone are "reflexed" by allowing the enclosed air in the cabinet to be tuned for a coupled resonance effect with the cone of the drive unit. The signals are then brought into phase with the front radiation from the cone of the speaker so as to reduce the "boomy" effect of resonance.

REJECTOR. Filter or part of a circuit which rejects a particular frequency or band of frequencies.

RESONANCE. The nature and dimensions of any object or enclosed volume of air will vibrate at a calculable frequency when disturbed by striking. This frequency is said to be the resonant frequency. When the object is made to vibrate at this frequency by a corresponding sound pressure wave the resonance is enhanced, producing a "boomy" effect, i.e. the volume at that frequency is apparently louder than at any other.

RESPONSE CURVES. Usually measured in decibels, with reference a given level, on a vertical scale, the response curve is a graphical representation of frequency response.



When the response curve of an amplifier, pick-up, microphone, etc. is accurately plotted it represents the relative levels of amplitude at all frequencies within a specified bandwidth.

REVERBERATION. Reflected sound. It is produced by the gradual decay of sounds being reflected from ceilings, walls, floors and furniture.

Reverberation units create an artificial representation of the decay of the sounds electronically.

RIBBON MICROPHONE/ SPEAKER. Uses a narrow corrugated aluminium alloy strlp suspended in a magnetic field. Sound makes the strip vibrate in a direction perpendicular to the magnetic field, resulting in an a.c. current being induced in a coil.

The natural response of a ribbon unit is bi-directional and a ribbon microphone has certain areas of minimum sensitivity. Only a very small response is produced by quite loud noises from the sides, the polar diagram for this type is known as "figure of eight".

A few ribbon microphones will give cardioid and hypercardioid responses.

RMS VALUE. The "root-mean-square" value of a.c. voltage, cur-

rent, or power is calculated as 0.707 of peak amplitude at the given frequency. It represents for mathematical purposes an acceptable level by which relationships between these units can be accurately established.

RUMBLE. Low frequency noise produced by the turntable bearings and motor of a record player, and transmitted mechanically by vibrating the pick-up. These vibrations are then detected by the transducer in the cartridge for conversion into an electrical signal.

RUN-IN. The start of a groove at the beginning of a side of a gramophone record which "runs in" to the recorded section.



SCRATCH FILTER. A low-pass filter, often an integral part of an amplifier circuit, which attenuates the higher frequency noise derived from disc recordings. The scratch filter is also suitable for the suppression of background noise produced by tape background hiss.

SCREENED LEAD. A cable which has an outer sheath of braiding which provides electrostatic screening of the inner conductor and so makes it ideal for connecting high impedance pick-ups microphones and tuners to the input of an amplifier. Its purpose is to reduce the effects of hum caused by radiation from a.c.-carrying wiring or components.

SELECTIVITY. A tuner's ability to discriminate between a wanted signal and an interfering signal on adjacent frequency settings of the tuning dial.

SENSITIVITY. The ability of any communications equipment, including audio to reproduce very low signals.

SEPARATION. The degree to which right and left stereo signals are isolated in pickup or stereo amplifier.

SHELL. Refers to that part of the pick-up which carries the cartridge. The head shell can often be detached from the pick-up arm.

SIBILANCE. The strong emphasis in pronunciation of the letters "S" and "SH" in speech. It can be exaggerated by microphones having peaks in their high frequency response.

SIDE-THRUST. The tendency of the stylus to "skate" towards the centre of a record causing increased wear on the inner groove wall. With low tracking weight, side thrust can cause the stylus to "jump" the record's groove.

PRACTICAL WIRELESS SUPPLEMENT NOVEMBER 1973

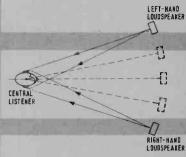
SIGNAL-TO-NOISE RATIO.

The difference, measured in decibels, between a specified signal reference level and the level of unwanted noise. The higher the ratio, the better the equipment.

SINE WAVE. A waveform (often viewed on an oscilloscope) of a pure alternating current or voltage. It is drawn on a graph of amplitude versus time or radial degrees and follows the rules of sine and cosine values in relation to angular rotation of an alternator. It can be simulated by means of an electronic oscillator.

SOLID-STATE. A general term that applies to any semiconductor device such as transistors, diodes, an integrated circuit. Can also be used to describe equipment that employs miniaturised modules or building blocks, integrated circuits or micro-circuits.

SOUND STAGE. The area between the two or more loudspeakers of a stereo or quad set-up where subjective sound images or imagin-



ary loudspeakers seem to be, providing a wide area of apparent sound source.

SPEECH COIL. The moving coil in a dynamic loudspeaker. It is suspended in the field of a permanent magnet and is fixed to the speaker diaphragm.

SPLICE. A joint in a length of magnetic tape. For a good strong splice, the two ends of tape should be cut at an angle of 45° so that they butt together in line without any gaps.

SQUARE WAVE. An a.c. periodic waveform in which voltage alternates rapidly from a positive peak value to the negative peak value, and vice versa after a delay.

A waveform with these characteristics is ideal for testing audio equipment with an oscilloscope to test for good transient and frequency response. Square waves are also used in switching circuits.

STANDARD PLAY. An arbitrary description given to identify a spool of thick recording tape with a specified playing time according to reel size. For example, a 7in. spool will hold 1,200ft of "standard play" tape a 5in. spool 600ft. The actual playing time is then dependent on tape speed.

STANDING WAVES. The behaviour of air pressure waves in an enclosed room or box, giving rise to resonances which occur. They are created by the effects of multiple sound reflections between opposite walls and cycle at frequencies determined by the distance between them. In effect, the room acts as a resonator.

STEREOPHONY. A two channel recording and reproduction system more popularly referred to as "stereo". At the recording studio separate microphones are used for each recorded channel. The correct reproduction of stereo signals in the home gives to the listener a sense of direction of sound and thus enhances the realism.

STYLUS. A small piece of industrial grade diamond or artificial sapphire, conically-shaped, which tracks the groove in a gramophone record.



STYLUS ARM/BAR. Cantilever which carries the pickup stylus. It is suspended at one end so that it can be allowed to vibrate in a magnetic field or transmit mechanical stresses through a piece of piezo-electric material.

SUPERIMPOSE. To record one or more signals over another without erasure, so that when a tape is played back, all recordings can be heard simultaneously. This is particularly useful if one wishes to have a spoken commentary with a musical background.

SURFACE NOISE. Noise generated by contact of a gramophone stylus with minute particles of dust or other irregularities in a record groove. Can also be caused by excessive wear of a disc or by poor quality coating on recording tape.

TANGENT. A straight line that meets a curve or circumference at

one point only, such that it is at 90° to the radial line between the centre of the circle and that point. A tangential pick-up arm is one that maintains this condition throughout its tracking across a disc.

TAPE DECK. The mechanical part of a tape recorder. It comprises the complete tape transport system, motors and drive mechanisms. It may also include the heads.

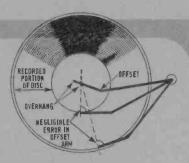
TAPE HEAD. The transducer on a tape recorder past which the tape runs during record or replay. It applies a magnetic field to the tape during the recording process and provides electrical output during replay.

T.P. Triple-play tape. Very thin recording tape of which it is possible to wind 3,600ft, onto a 7in. spool. This would give 180 minutes of playing time at $3\frac{3}{4}$ i.p.s.

TRACING. The ability of a stylus to follow the variations or modulation pattern of a record groove.

TRACKING. The movement of the record player stylus across a gramophone record.

TRACKING ERROR. The deviation of angle between the stylus bar axis and the radial line between the disc centre and stylus point.



This is a factor applied to pickup arms with offset angle heads.

TRACKING WEIGHT. The downward force of a pick-up stylus which ensures optimum reproduction of recorded groove modulation with minimum wear of groove wall and stylus.

TRANSCRIPTION. Word commonly used to describe high quality pick-up and turntable units. Literally it is a copy or a recording of an audio programme onto tape or disc.

TRANSIENT RESPONSE. The ability of an amplifier or transducer to handle and faithfully reproduce rapid changes in signal amplitude. A very short "rise-time" is a measure of this characteristic.

TREBLE. The high frequency end of the audio spectrum.

TWEETER. A loudspeaker de-

PRACTICAL WIRELESS SUPPLEMENT NOVEMBER 1973

signed specially for reproducing high frequencies. It is used in conjunction with a "woofer" (bass speaker) and a crossover unit for audio reproduction.

V

VARIABLE RELUCTANCE.

Principle employed in certain pickups. Deflections of the stylus when playing a record, make an armature vibrate between the poles of an electromagnet. The reluctance is the ratio of magnetic force tomagnetic flux in a magnetic field. Variations due to stylus movement create variations in the current through the electromagnet.

VERTICAL TRACKING. Stylus motion path which is near "vertical". Applies to "hill-and-dale" recordings on stereo discs.

V.H.F. Very high frequency radio band. Broadcast v.h.f. Band 2 is the 87 to 108MHz range. Also applies to frequencies above 30MHz for radio or television.

W

WAFER SPEAKER. Thin compact loudspeaker with an "inverted" cone where the magnet is sited forward of the cone.

WATT. Unit of electrical power, often used to signify the signal power output from an amplifier.

WAVEFORM. A graphical representation of the relationship between voltage, current or power against time. It also provides a picture of the behaviour of signals at given frequencies.

WHITE NOISE. The random motion of electrons in a conductor which, when reproduced through a loudspeaker or phones, sounds like noise and covers a wide frequency range. It is used to test loudspeakers and phones for resonance and sensitivity.

WOOFER. A low-frequency or bass loudspeaker for reproducing musical notes in the approximate range of 25-2,500Hz. Employed with a "tweeter" and crossover network to reproduce a range of frequencies for audio reproduction.

WOW. Slow regular variations in the speed of a record turntable or tape transport mechanism. It is heard through a loudspeaker system as a wavering of musical pitch.

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LEARNING BY PRACTICAL PROJECT STEPS

PART 2—THE BISTABLE

E are going to look at a very fundamental switching circuit this month that is based on the principles we developed in the last part. It is called the bistable switch—the reason for this name should become clearer as its story progresses. If you look at the basic circuit in Fig. 9a you will notice a marked similarity to the experiments we did last month; two transistors are cross connected—the base current for each being drawn from the collector circuit of the other. Notice, however, that both base resistors (R2 and R3) are permanently connected in and we are not using switches this time!

Basic assumptions

For those who like to sweat over puzzles try this one before reading on. Assuming that the circuit is completely wired up and power is supplied use your knowledge regarding base current and driving voltages to work out whether Tr1 and Tr2 are conducting or not conducting!

Unless you have made an assumption you should be completely stuck because the system does not seem to make sense. In stages you could have said that when power is not applied both transistors must be non-conducting hence at the instant you apply power both points A and B will be at +9V. This set of circumstances, however, provides base current for the opposite transistor and the effect of this is to make each transistor go into conduction and both the respective voltages will fall cutting off the base current; the result of this would be to make both collectors rise back to +9V and we are again at the start point of a vicious circle! To arrive at a sensible result we must make a practical assumption—that there is bound to be a slight difference in the current gains of the two transistors used and the one that has the higher value will go more rapidly into conduction when power is applied. Let us assume Tr1 has a nominally higher current gain than Tr2.

When power is applied Tr1 will draw base current from point B through R3 and the voltage at A will fall rapidly—cutting off the supply of base current to Tr2. The latter therefore will not go into conduction and the voltage at B will stay at +9V while that at A will fall to nearly zero. Try this with your experimental circuit making and breaking the power line and you should find that it is always the same transistor that goes into conduction—in your case, of course, it might be Tr2.

Anyway we shall carry on with our assumption that after switch on point A is at zero volts and we have—after all—a stable state. Let's assume

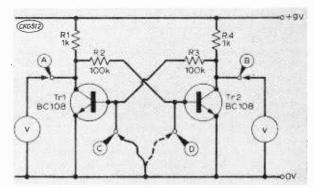


Fig. 9a: A conventional bistable circuit.

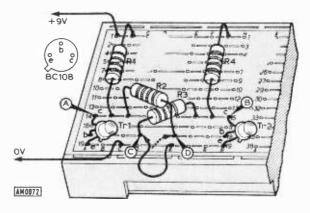


Fig. 9b: T-Dec layout for Fig. 9a.

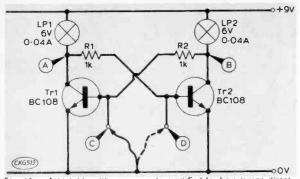


Fig. 10a: A bistable with components modified to drive lamps direct.

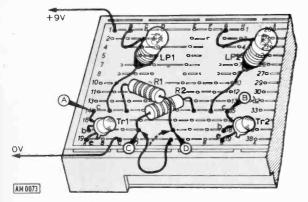
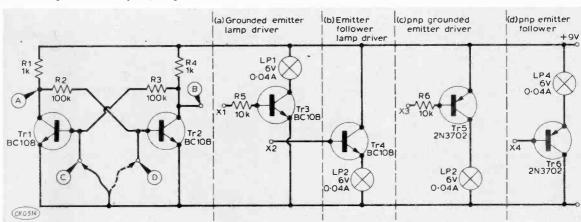


Fig. 10b: T-Dec layout for Fig. 10a.

that we really wanted point B to go to zero volts. For this to happen we must, somehow, make base current flow into Tr2. To do this we must make the voltage at A rise to +9V by momentarily removing Trl's supply of base current-conveniently done by short ing point C to ground. Do just that and watch the voltage at B as you make the short. Sure enough, it falls to zero while you make the short, but notice that when you have removed the shorting link from C point B stays at zero volts—not only that, but A is now at +9V and the system is again stable. You can make the circuit revert to its original state by momentarily shorting point D to ground. The circuit has two possible stable states (hence its name) and we can make it go into either of them by externally tampering with the base current supplies.

Alternative loads

The rules of current gain apply in this circuit without undue complication and taking into account the normal current limitations of transistors you can use collector loads other than pure resistors. Fig. 10a is an identical circuit in which lamps are used; the cross coupling resistors have to be of lower values to ensure that enough base current flows to control the larger load. Alternatively connect the flying lead to points C and D and you will see that you can make LP1 go on—and stay on —when point D is quickly shorted to ground and similarly with LP2 and point C.



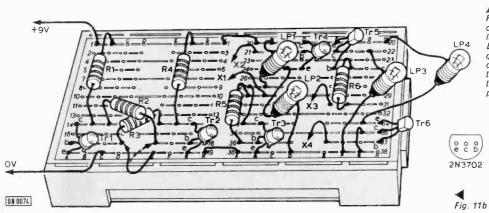


Fig. 11a: Alternative ways of driving low voltage lamps from a bistable. Low voltage relays (requiring less than 100mA) can be substituted for the lamps provided protection diodes are inserted (see part 1, last month).

Fig. 11b: T-Dec layout for Fig. 11a.

If you wish to you can use the voltage swings at the collectors of the bistable transistors to drive other circuits. A selection of lamp drivers are shown in Fig. 11a. Any of the single transistor driver stages (with inputs marked X1, 2, 3 and 4) can be connected to either points A or B. (We shall assume they are connected to B.) Take driver (a) which is a simple grounded emitter inverter stage. When point B is +9V Tr3 can draw base current through R5 and the lamp will light. Notice that we have to put a $10k\Omega$ resistor in to prevent the base emitter circuit of Tr3 pulling the voltage at B down to +600 mV; if that were to happen the action of the bistable would be interferred with.

Circuit (b) is a simple form of emitter follower and in this case we can do away with the $10k\Omega$ resistor. The reason for this is that when point B goes "high" we immediately pass base current into Tr4 and it starts to conduct, but when this happens the voltage at its emitter rises as current flows through the lamp. The voltage rises to a value 600mV less than the voltage at B; the difference in voltage is due to the standard base emitter forward voltage drop associated with silicon transistors. If, say, point B went to +9V we would end up with approximately 8.4V across the bulb. The only drawback of this circuit—although it does not bother us in this application—is that we will always lose 600mV of driving voltage across the bulb and it will not glow quite so brightly.

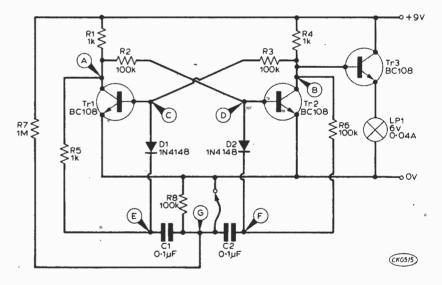
In both these two drivers the lamp went on when point B went to +9V. The remaining two drivers use pnp transistors in grounded emitter and emitter follower configurations and because they are sensitive to opposite polarity signals the lamp goes off when point B goes high. In circuits it is often useful to make use of opposite polarity transistors to get this type of inversion. It is not very impressive in this application because if we had wanted any inversion we could have used point A as the driving source.

Dividing

An interesting development of the bistable circuit is the *divider* shown in Fig. 12a. The basic circuit of Fig. 9a is still there and you can ignore Tr3 because it is only a lamp driver. We have added a couple of diodes and capacitors and a few more resistors. The object of the circuit is to make Tr1 and Tr2 take up their alternative stable states each time we make a single short circuit path to ground (we shall be shorting point G to ground as a signal).

Let's assume that point A is at +9V (B will be zero and so will C, and D will be at approximately +600mV). The voltage at A effectively reverse biases D1, and D2 is just on the edge of conduction through R6 to point B—which is just slightly more

Fig. 12a: A bistable with built in gating so that it switches in alternate directions each time point G is connected to ground. This is sometimes called a divider.



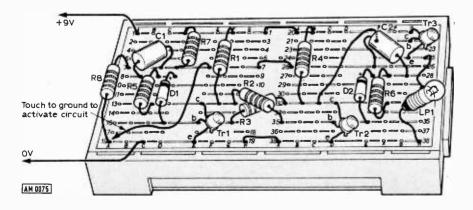


Fig. 12b: T-Dec layout for Fig. 12a.

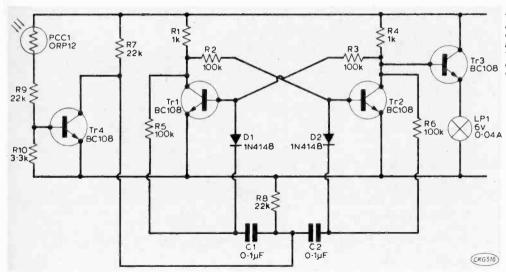


Fig. 13a: With the addition of a few more components, the divider can be made to "togale" whenever bright Tr3 light falls on the photoconductive cell.

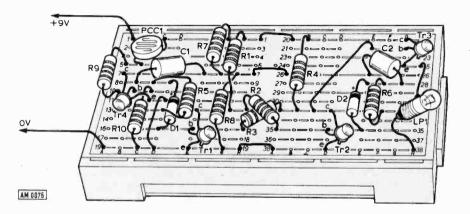


Fig. 13b: T-Dec layout for Fig. 13a

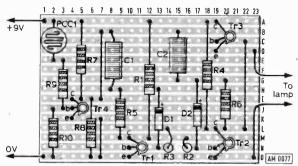


Fig. 13c: Veroboard layout for Fig. 13a.

negative than D. The potential at G (without the shorting link made) will be just under 1V because of the potential divide action of R7 and R8.

By repeated dabbing of the shorting link to ground you can make the lamp go on and off alternatively. There is something that you have to note, however. The circuit is very sensitive and you must make very good clean makes and breaks of the shorting operation; it is very easy to accidently give a double "pulse" when you think you have, in fact, only made one. R7 has deliberately been made a high value to allow time for the voltage at G to recover and this

helps to eliminate what appears to be erratic action. Nevertheless the time constant of $1M\Omega$ with the 0·1μF capacitors is still quite short so do not be too surprised if sometimes the lamp appears not to respond. What actually happens is that the lamp switches on and back to off so quickly you do not see it happen! Try reducing R7 to 100kΩ and R8 to $10k\Omega$ and you will deliberately aggravate the problem. In a circuit of this nature it is wiser to use some form of non-mechanical switch to do the triggering so that we lose the "bounce' problem.

When you short point G to ground there will be a change in voltage at point E by about 0.8V in a negative direction but because D1 is reverse biased there will be little effect on the base circuit of Tr1. On the other hand the similar drop developed at point F will put D2 into sufficient conduction to momentarily drop the voltage at D and hence remove the base current from Tr2. The voltage at B will rise and bistable action will take place and the voltage at A will fall as the circuit takes up its other stable state. The set of circumstances is now reversed and if the shortening link is removed to allow the two capacitors to regain their original equilibrium the operation can be repeated to make the circuit flip back to its first stable state.

-continued on page 645

EXPERIMENTAL WORKSHOP

-continued from page 644

Fig. 13a shows a very crude electronic form of trigger for the divider. A sudden transition of from near darkness to full room light on PCC1 will make Tr4 go suddenly into conduction and the voltage at the junction of C1 and C2 will fall rapidly to zerostimulating the divider. Switch off the room light and switch it on again and the circuit reverts. The reason for doing this experiment is to show that it needs two complete operations of switching the room light on and off to make the lamp in the circuit go on and off once. We are effectively dividing the number of operations by a factor of two—the reason why the circuit gets its name. While doing this experiment it is worth noting that slow signals do not have any effect on the divider; slowly covering and uncovering PCC1 will not be an effective trigger—you need the very fast action of switching a light on and off to get reliable results. The reason for this is that Cl and C2 are not able to pass slow waveform signals. You need a wide range of lighting levels to make this circuit switch rapidly but there are a range of switching circuits called 'triggers' which speed up the action of slow stimuli. We shall be looking at this effect next month.

TO BE CONTINUED

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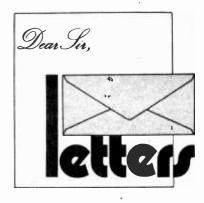
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Mum writes in

I am writing as a 'Mum' of one of your enthusiastic readers. Do you by any chance know the ages of some of your younger readers?

My son Edward is 6^{1}_{2} years old and has taken *Practical Wireless* for over a year now. It is used for bedtime stories together with Aesop's Fables (I insist on that!)

Thus one outcome of the enthusiasm of one small boy is that his mother now knows the difference between a diode and a triode, step-up transformers and step-down transformers.

I must confess I find the whole subject of wireless very difficult and show no enthusiasm myself but if you could see a certain little boy's eyes light up when "P.W." as it is affectionately called arrives, it persuades me once more to plough through details of digital multimeters and who is selling what component at the cheaper price!

Through your magazine, Edward bought a pocket multimeter from an advertiser, so we are all having our resistance tested!—
Mrs. Pat Russell (Herts.).

Darkroom thermometer

Some time ago, you published an article by R. A. Bottomley on the construction of a darkroom thermometer. I have built this unit with great success but I found it was necessary to increase R3 to obtain balance at the mid-point on the scale. I arranged for 24° and 29° by duplicating R3, VR1 and R4. R3 then became 1.5 + 2.2kand 1.5 + 3.3k. A changeover switch completed the revised arrangement, the two temperatures being respectively for developing colour film and colour prints. The meter I used was a Japanese Henelec 0-100uA.—C. G. Dahl (Surrey).

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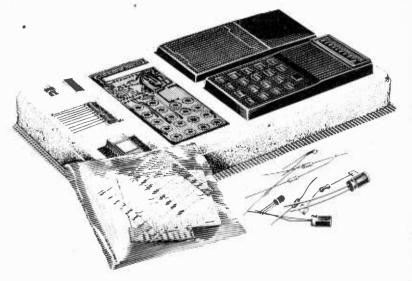
Cambridge *Uniquely handy package. $4\frac{1}{2}$ " x 2" x $\frac{11}{16}$ ", weight $3\frac{1}{2}$ oz. *Standard keyboard. All you need for complex calculations. *Clear-last-entry feature. *Fully-floating decimal point. *Algebraic logic. #Four operators $(+, -, \times, \div)$, with constant on all four. *Constant acts as last entry in a calculation. *Constant and algebraic logic combine to act as a limited memory, allowing complex calculations on a calculator costing less than £30. *Calculates to 8 significant digits, with exponent range from 10⁻²⁰ to 10⁷⁹. **XClear**, bright 8-digit display. *Operates for weeks on four U16-type batteries. (MN 2400 recommended.)

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- Thick-film resistor pack.
- Case mouldings, with buttons, window and light-up display in position.
- 6. Printed circuit board.
- 7 Keyboard panel.
- 8. Electronic components pack (diodes, resistors, capacitors, transistor)
- Battery clips and on/off switch;
- 10. Soft wallet.



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GOING QUADRAPHONIC

PROJECT

PART2 D.BOLLEN

It is easy to see how several resistance networks, plus variable separation, could be combined by switching to offer multi-system decoding, but before considering this it would be as well to look first at the circuits of Units A and B.

Unit A circuit

The circuit of unit A is shown in Fig. 12. Trl and Tr2 act as unity gain phase splitters, with an input impedance of $47k\Omega$ and an output impedance of about $1k\Omega$. Mixers Tr3-Tr6 are of the virtual earth type, with an output impedance of $2k\Omega$, and a gain of two when employed with input resistors of a nominal $100k\Omega$.

Apart from matrixing, the mixers will accept additional input resistors for mixing in other signals such as reverberation or echo. To keep noise to a minimum, and maintain the correct working point for each transistor, it is advisable to use metal oxide resistors of 5 per cent tolerance or better in the circuit of Fig 12.

Unit B circuit

A constant phase shift of 90° throughout the audio spectrum presents circuit problems. It is arguable how wide the frequency bandwidth needs to be. Some authors maintain that the ear is incapable of detecting phase differences from loudspeakers beyond the limits of 100Hz-8kHz, while decoder manufacturers are currently aiming at a constant phase shift bandwidth of 20Hz-20kHz. Some commercial decoders seem to get by with a bandwidth of 100Hz-10kHz, with a variation of ±10 per cent on 90° so this standard was adopted for the PW Q4 decoder. The graph of Fig. 11 shows the phase shift characteristic of the unit B circuit.

A 90° phase shifter consists of a phase splitter followed by a network of resistors and capacitors, but a simple splitter of the type used in unit A has insufficient power output to drive such a network

OJECT — QS recordings — SQ recordings — Discrete CD-4 recordings — SURROUND SOUND



effectively, so IC operational amplifiers were employed instead.

In the circuit of unit B, left and right channels are identical and it will suffice to examine the left channel only. IC1 package contains two operational amplifiers of the 741 type, here labelled A and B. The inverting input of amplifier B is connected to the output of amplifier A, which also inverts. Operational amplifier A has a gain of 2·3 and B a unity gain, so the combined outputs of the amplifier pair will be 180° out of phase and 2·3 times the level of the input signal; this gain is just sufficient to offset the gain loss in the following phase shift network.

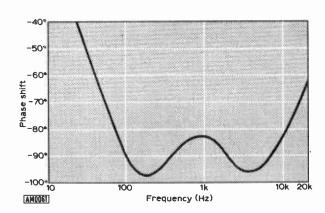


Fig. 11: Phase shift characteristics.

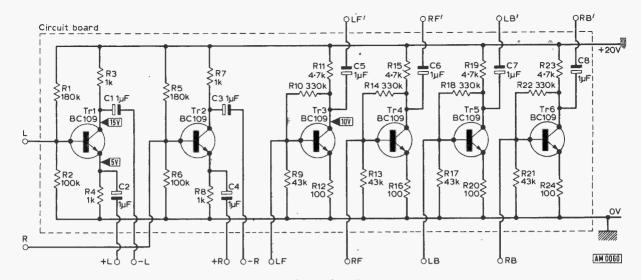


Fig. 12: Circuit of unit A.

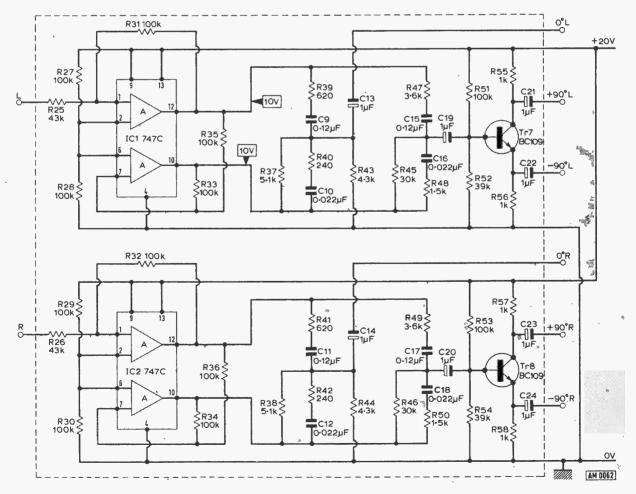


Fig. 13: Circuit of unit B.

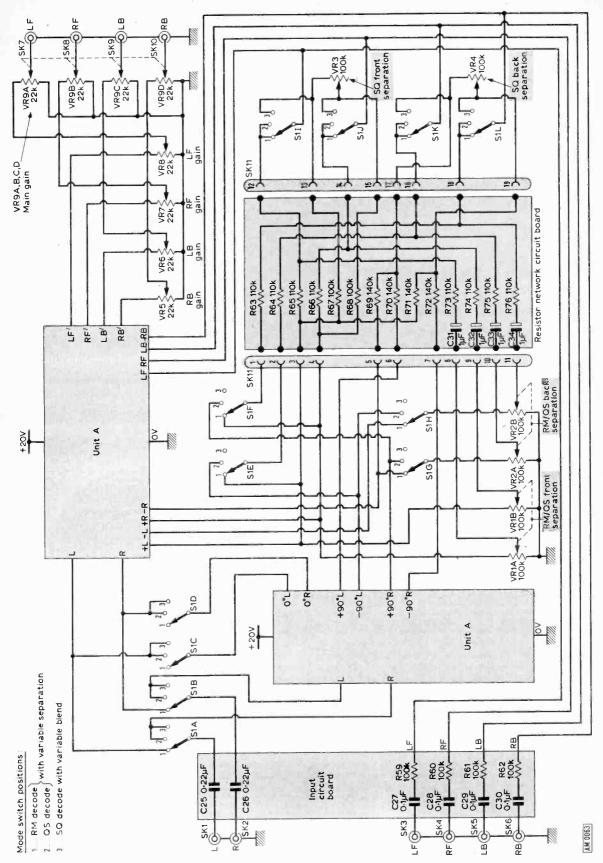


Fig. 14: Circuit diagram of the Q4 multi-system decoder with infinitely variable separation and discrete inputs.

★ Q4 COMPONENTS LIST

UN	IIT A	
Resistors		
R1 180kΩ	R13	43k Ω
R2 $100k\Omega$	R14	330kΩ
R3 1k Ω	R15	4·7kΩ
R4 $1k\Omega$	R16	100Ω
R5 180kΩ	R17	43k Ω
R6 100kΩ	R18	330 k Ω
R7 1kΩ	R19	4·7kΩ
R8 1kΩ	R20	100 Ω
R9 43kΩ	R21	43k Ω
R10 330kΩ	R22	330k Ω
R11 4·7kΩ	R23	4·7kΩ
R12 100Ω	R24	100Ω
All ½W metal oxide		
Capacitors C1-C8 1μF 25V electro	olytic	
Transistors Tr1-Tr6 BC109		
Miscellaneous 0-1in pitch Veroboard 0)∙9in x 4	4in; terminal pins.

-						
			UNIT	ГB		
ı	Resist	tors				
ı	R25	43kΩ		R42	240Ω	
ı	R26	$43k\Omega$			4·3kΩ	
ı	R27	100kΩ		R44		
ı		100kΩ				
ı		100kΩ		R45		
		100kΩ		R46		
	R30	100K75		R47		
	R31	100k Ω			1·5kΩ	
		100k Ω		R49	3 ·6kΩ	
		100kΩ		R50		
		100k Ω		R51	100kΩ	
	R35	100kΩ		R52	39kΩ	
	R36	100kΩ			100kΩ	
	R37	5·1kΩ		R54		
		5·1kΩ		R55	1kO	
		620Ω		DEC	41.0	
		240Ω		R56 R57	1K22	
		620Ω		K5/	1K12	
				R58	1 KL2	
	All ½	W metal	oxide			
	Capac	itors				
		0·12μF				
	C10					
		0·12μF				
	C12	0 · 022μF				
	C13	1μF 25V	electrolytic			
	C14	1μF 25V	electrolytic			
	C15	0·12μF	• •			
	C16					
	C17	0 · 12μF ·				
		0 · 022µF				
	C19	1"E 051/	electrolytic			
	C20	1#F 25V	electrolytic			
	C21	1"E 05V	clectrolytic			
	Con	1, E 05V	electrolytic electrolytic			
	C02	1, F 05 V	electrolytic			
	C23	1μF 25 V	electrolytic			
	C24	1μF 25 V	electrolytic			
	All C	apacitors	$\pm 5\%$ poly	carbo	nate unle	ss other-
	WIS	e specifie	ed	4		
	Transis	rtore.				
	117	BC109		ir8 .	BC109	
	Integra	ted Circ	uite			
			pin DIL			
			pin DIL			
	102	1710 14	PIII DIL			

0.1in pitch Veroboard 1.8in x 3in; terminal pins

Miscellaneous

```
Additional components for multi-system decoder
  R59 100k\Omega
R60 100k\Omega
                            R66 110k\Omega
                            R67 100kO
  R61 100kΩ
                            R68 100kΩ
  R62 100kΩ
                            R69 140kΩ
  R63 110kΩ
                            R70 140kΩ
  R64 110kΩ
                            R71
                                 140kΩ
  R65 110kΩ
                            R72 140kΩ
  All resistors ½W metal oxide
Potentiometers
  VR1 100k\Omega linear dual-gang VR2 100k\Omega linear dual-gang
  VR3 100kΩ linear
  VR4 100kΩ linear
  VR5 22kΩ linear
  VR6 22kΩ linear
  VR7 22kΩ linear
  VR8 22kΩ linear
  VR9 22k\Omega log (two dual-gang, see text)
Capacitors
  C25 0 22 uF
  C26 0·22μF
C27 0·1μF
  C28 0 1µF
  C29 0·1µF
  C30 0.1µF
  C31 1\mu \tilde{F} 25V electrolytic
  C32 1µF 25V electrolytic
  C33 1µF 25V electrolytic
  C34 1/4F 25V electrolytic
  All capacitors tubular polyester unless otherwise
    specified
Switch
  S1 12 pole 3 way (RS Components miniature Maka-
               switch with three 4 pole 3 way wafers)
Sockets
  SK1-SK10
              phono panel mounting
  SK11
              0.1in pitch edge connector cut down to
                19 way (see text)
Miscellaneous
 0.1in pitch Veroboard 1.9in x 3in and 2in x 1.2in;
 knobs; phono plugs; 18 s.w.g. aluminium sheet
 20cm x 29cm and 14.5cm x 35cm.
```

POWER SUPPLY

Resistors

R77 1kΩ 10% ½W carbon

Capacitors

C35 $1000\mu F$ 35V electrolytic C36 $1000\mu F$ 25V electrolytic C37 $0\cdot 1\mu F$ tubular polyester

Transistors

Tr9 BFY52

Diodes

D1 1N4001

D2 1N4001

D3 BZX61 (1-3W zener)

Transformer

T1 0-20V, 0-20V (RS Components Ltd. miniature mains transformer)

Miscellaneous

0.1in pitch Veroboard 1.9in x 2.1in; TO5 heat sink; terminal pins.

The phase splitters in Fig. 13 are Tr7 and Tr8. Phase shift capacitors for the left channel are C9. C10, C15, and C16, and these must have a tolerance of +5 per cent or better if the performance indicated in Fig. 11 is to be realised. All resistors used in the Unit B circuit should also be 5 per cent or better and preferably of the metal oxide type.

The input impedance of unit B is 43k() and the output impedance from the phase splitters approximately 1k(). As the 0°L and R outputs are only to be connected to the phase splitters of unit A their

impedance may be ignored.

Multi-system decoder

Fig. 14 shows the circuit of a multi-system decoder based on units A and B. In the RM position of switch S1. with VR1 and VR2 set to mid-track the circuit adheres to the Schieber code with constants of 0.92 and 0.38, giving 3dB separation with a similarly coded recording. When VR1 and VR2 sliders are at the earthed ends of their tracks. left to right separation is virtually infinite, and front to back separation is zero, thus giving centre of the room stereo, and an effect similar to stereophones. At the other extreme, with sliders at the live ends of tracks, left to right separation will be zero and front to back separation is infinite, giving a stereo recording as centre front mono with centre back ambience

Adjustment of VR1 and VR2 will cover the codes of all early American material, and will also compensate for the widely differing recording techniques used for stereo, to give a well balanced surroundsound result. The resistors associated with the RM decode are R63-R66 and R73-R76.

With S1 switched to OS, the RM resistors are rearranged for Sansui-Pye decode, when VR1 and VR2 are at mid-track. Here, adjustment of VR1 and VR2 can be used to alter the sound stage proportions and to compensate for an oblong speaker array.

In the SO decode S1 position, resistors R67-R72 are brought into circuit to satisfy the CBS decode constants of 1 and 0 on the front channels, and 0.707 on the back channels, with the required phase shifts in the back channels. At the same time, the controls and resistors associated with RM and OS are rendered inoperative, and VR3 and VR4 are brought in to control SQ front and back separation. With VR3 and VR4 at mid-track, left to right separation will be 10 per cent or 20dB, and this setting will give satisfactory results with SQ recordings where a strong centre front image is not important. The blend values may be varied to compensate for an unusual speaker layout, or to boost a centre front image.

SK3 to SK6 in Fig. 14 are for discrete inputs, and may be used at any setting of S1 when the twochannel inputs to SK1 and SK2 are switched off. Using two and four channel inputs simultaneously would give a mix between the two, so SK3-SK6 can also be employed for mixing in other signals while decoding matrixed material. An output from a reverberation unit could be fed into SK5 and SK6 for increased ambience on certain recordings, or a voice announcement could be mixed into any one of the four channels while music is playing.

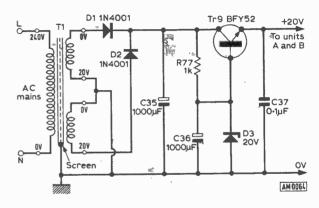


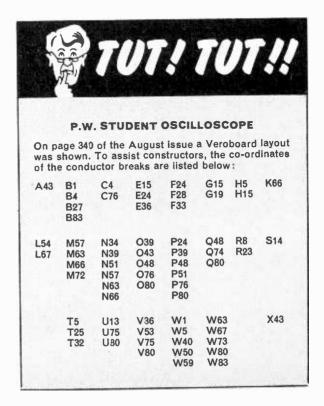
Fig. 15: Power supply circuit.

Power supply

The supply requirements of units A and B together are 33-40mA at 20V with a low ripple content and a low supply impedance throughout the frequency range. This is provided by the semiregulated supply circuit of Fig. 15.

C36 and R77 time constant ensures a slow-rise switch on to prevent loudspeaker 'plop' and at the same time keeps impedance down at very low frequencies. C37 offers a low impedance at high frequencies.

The article to follow next month will give constructional details of the multi-system decoder, with notes on testing and setting up.



ON RECENT DEVELOPMENTS

ON AN IMPULSE

WHILE it is always interesting to record the latest developments in electronic components, instruments, etc, it often works out that an application of established principles and equipment is equally fascinating.

One such application is that of amplifying tiny—really tiny—electrical signals or impulses and causing these to control things. Human beings have been doing this since the year one. Signals from the brain control limbs, etc. The twist in this story comes when you take signals generated by the body and couple them to external sources.

A series of experiments has been conducted (another series is in current progress) which shows that well over a dozen different muscle patterns can be produced on cue. The idea is that the subject thinks of raising (say) his right thumb but does not actually move it upwards. Gold electrodes taped to the hands are able to detect these impulse commands.

The experiments to date have involved a subject causing different patterns in an array of lights. Consider the possibilities. You could think that the grass needed cutting-and immediately a radiocontrolled E-type lawn mower would belt out of the shed. Obviously there are limits. Imagine being introduced to Raquel Welch, an experience which should produce an impulse or two in most men. Perhaps a built-in manual control could restrict reaction on such occasions to a well willed wink.

PACEMAKERS

Pacemakers, those devices which keep an internal eye on hearts which don't function as reliably as they should, have to be replaced surgically about every two years. Nuclear-powered pacemakers can last ten times as long but can cost five times as much compared to "conventional" ones. They also radiate and are more bulky and heavier than their "conventional" counterparts.

A new pacemaker has arrived. It can be implanted in the patient using only a local anaesthetic. This unit triggers and "fires" only if the heart doesn't beat after a predetermined time. There's more to come too. The unit may be recharged by the patient! The user has a portable recharging unit and a special "vest" which is donned. A special acoustic coupler also enables the wearer to telephone his doctor and transmit heart signs and signals directly for study.

TEMPIS FUGIT

In a previous issue, I wrote of electronic clocks and watches. This seemed to stir a chord in some people and a few even wrote to me. Prices for these items will doubtless come down as production goes up. Not all electronic time pieces cost hundreds of pounds. An electronic stop-watch about to launch itself onto the American market is reckoned to sell there for less than \$200. It has a crystal oscillator, LED display and a rechargeable battery. A 28-pin C.M.O.S. chip is employed and the watch measures 0.5in. wide, 1.4in. long and 0.75in, deep. The 24hr readout will happily stay illuminated for about 12 weeks before the battery needs recharging and there is a small button which will switch off the display if it is desired to conserve power.

The electronic watch market in the U.S. alone is estimated at \$50 million for this year which might account for all the activity. One manufacturer has recently introduced what is claimed to be the first watch ever which employs field effect liquid crystal displays.

One of the interesting things about the particular display used in these watches is that it is the reverse of the image usually associated with liquid crystal displays. Normally, these adopt a frosted-glass effect for the legends against a mirror background. The field effect LCD's absorb the incident light via polariser filters and the legends (figures, letters, etc) are easily

seen as dark outlines against a diffused white background. The lowest price model in this range of wrist watches is around \$150. The field effect displays are guaranteed by the manufacturer for 3 years, but it is expressed that they will last for nearer 10 years. Looks as though proud owners will be taking their timepieces to electronic beauty salons every so often for a face change?

One of the most vital parts in the electronic watch, employing a crystal oscillator, is the crystal itself—the electronic heart of the beast. Favourite crystal frequency is 32kHz which is then divided down to supply pulses which in turn feed the displays via display drivers. But there's a snag. Difficulty is being experienced in some areas because the clock/watch maker cannot get enough crystals at 32kHz.

THEY'RE RESISTANT!

One company offers some intriguing resistors which are described as ceramic-insulated and flame-proof. Apparently, these will not burn even if the open flame of a blow-lamp is played on them. Well I'm blowed! Resistance values range from 1Ω to $60k\Omega$ in wattage ratings from 1-10 Watts.

POWER STRUGGLE

Remember the first transistors? Red spot for a.f. with a cut-off around 800kHz. Then White spot transistors which, with luck, managed the 1·8-2MHz Amateur band. They were delicate and couldn't handle too much power. The latest power transistors from one manufacturer are rated to handle 400V at 60A (down to 100V at 200A). A 500V 100A component is in the design stage. Note: these are transistors not thyristors. Perhaps we have a struggle for Power here?



TAKE 2®

No. 54 RADIO-GRAM

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

Before you complain that you have been misled by this month's title I had better explain that this device enables you to play records via any type of transistor portable radio without having to make any internal connections to the radio. Thus it is ideal for use with the modern miniature portables that do not have pick-up sockets and thus might save Dad a bit of money when "junior" demands a record player! Apart from the unit to be described you will, of course, need a turntable unit with a CRYSTAL CARTRIDGE pick-up. We stress crystal cartridge not only because it is the cheapest but because the "Radio-Gram" will not work with other types.

Circuit

The circuit shown in Fig. 1 is basically an oscillator that can be tuned with TC1 to operate between about 700kHz and 1.5MHz (i.e. across the range of the medium wave band). The amplitude of oscillation is modulated by direct connection of the pick-up across R2. The modulation process works simply by shifting the bias level of the transistor at audio frequencies and this is remarkably effective. C1 is necessary to help decouple the junction of R1 and R2 to r.f. and it also prevents overmodulation at high frequencies.

Construction and Testing

The coil is wound on a 4 to 6in length of ³8in diameter ferrite aerial rod, Fig. 2, but when doing this be careful to take note of the sense and start points of the windings; if the connections from the 5 turn feedback coil are reversed the circuit will refuse to operate! The BC108 used should have a gain in the order of 200, which is in the centre of the production spread, but the circuit will operate with devices of widely differing gain.

If, on test, the signal is distorted it is likely that the transistor has too high a gain and the carrier is being clipped. To prevent this increase the value of R3 and reduce R4, keeping the sum of the two about $2k\Omega$, to introduce a little more negative feedback. Conversely, if the signal strength is weak change the values in the opposite direction. No problem should be encountered here, however, so we have made R3 and R4 fixed values instead of using a more expensive preset.

The unit can be built on veroboard and fitted within a screened metal box. The signal is fed out via a screened lead (very loosely coupled to the ferrite rod as shown) and the centre conductor connected into the aerial socket of the transistor radio. To operate it, select a quiet portion of the medium waveband, put on a record and adjust TC1 until the music is clearly received. First tuning is best carried out on the receiver.

The current drawn by the Radio-Gram is minute, less than 100 microamps, so any small 9V battery will operate it for almost the battery's shelf life.

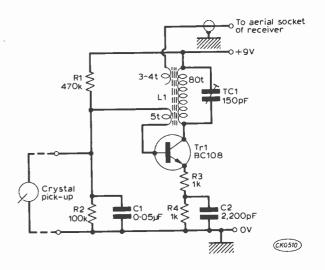
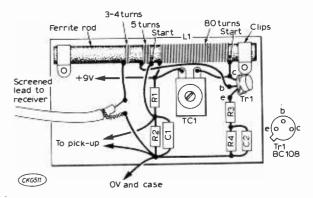
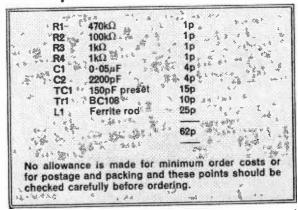


Fig. 1 above, shows the circuit of the Radio Gram. One end of the output coupling coll is left free.

Fig. 2, below, is a suitable layout on veroboard.



* components list



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MODEL C - Miniature 15 watt soldering Iron fitted 3/32" ironcoated bit. Many other bits available from 3/64" to 3/16". Voltages 240, 220, 110, 50 or 24. PRICE: £1.93 (rec. retail). P & P 5p.

ST3 Stand - This stand is made from high grade insulation material with a chromium plated strong steel spring. It is suitable for all models and replaces all previous stands. The two sponges at the side which are easily replaceable, serve to keep the soldering bits clean. Spare bits can be accommodated as shown on the illustration. PRICE: £1.00 (P & P 8p).

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I.F. WOBBULATOR

W.S. POEL G8CYK

HERE can be little doubt that the wobbulator method is by far the best means of setting up an IF strip for optimum bandpass characteristic, combined with optimum sensitivity. There are a number of commercial units made, aimed mainly at the 'trade' and priced accordingly. However, the wobbulator described here costs about £1, whilst providing all the necessary features. An oscilloscope is necessary and preferably one with a simple means of getting at the timebase. (Horizontal X output).

PRINCIPLE OF OPERATION

The wobbulator consists basically of a voltage controlled oscillator whose frequency is being constantly swept across the IF band of the receiver in question. The control is by means of a varicap diode, which can either be one of the purpose-made devices, or more simply, a power rectifier, such as the 1N4001/2/3.



Fig. 1: Typical waveform of a timebase oscillator, used to control the sweep of the wobbulator.

The timebase output on an oscilloscope looks like Fig. 1, which is applied to the diode so that the voltage on the diode is constantly changing in step with the oscilloscope trace. So we have three variables coordinated, namely:—

- 1. The trace.
- 2. The voltage on the varicap diode.
- The varicap capacity and consequently the wobbulator frequency.

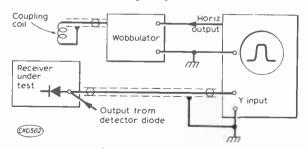


Fig. 2: Interconnections of the scope, wobbulator and IF strip being aligned.

As the frequency sweeps through the IF frequency of the receiver, the IF response curve is displayed on the scope, which is itself monitoring the output from the receiver detector, Fig. 2.

CIRCUIT

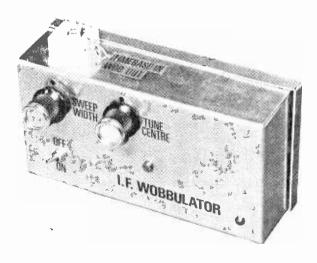
The heart of the device is the single FET Vackar VFO, Fig. 3. The choice of FET is very large, and almost anything in the standard N-channel series will do, e.g. 2N3819, 3823E, TIS88, BFW10. Remember to check the base connections.

The centre frequency is mainly determined by L1, C3 and C5 and VC1. By experimentation with values, it is possible to make the VFO operate past 50MHz, though most sets designed for AM operation use an IF between 455 and 470kHz. An ordinary 455 or 470kHz IFT can be used for L1, the internal capacitor being disconnected.

It is advisable to check the timebase output from the 'scope when choosing the varicap diode, since many scopes have a high voltage at the X output. (The author found out the hard way!) Choose a diode with adequate PIV ratings.

CONSTRUCTION

It will be seen from the diagrams that the layout is quite straightforward. A printed circuit board layout is given, Fig. 4, though at 455kHz there is no objection to Veroboard if that is considered



General view of the prototype wobbulator. Co-axial sockets could be used instead of the terminal block.

Fig. 3: Circuit of the wobbulator. VCI may be any suitably sized variable of about 200pF.

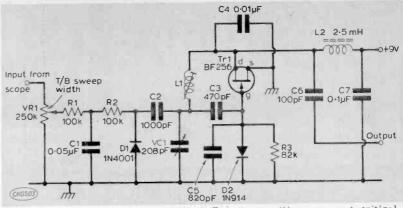
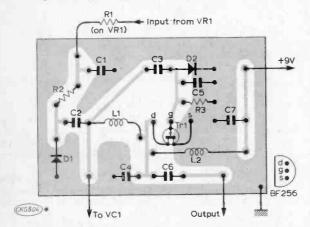


Fig. 4: The printed circuit board, actual size, with component layout.

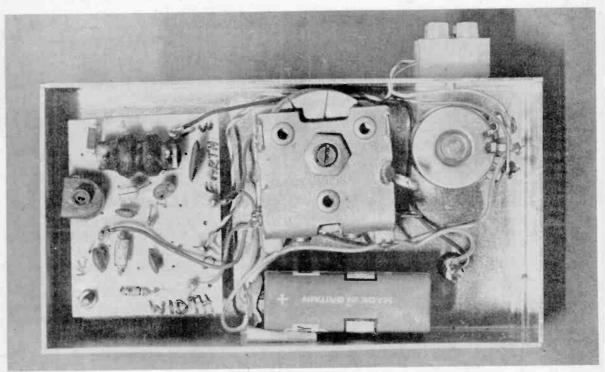


more convenient. Relative positions are not critical, and the wobbulator can very largely be adapted to fit any convenient case.

No particular types of sockets are necessary since most people seem to have adopted their own 'standard,' most probably the standard TV coax system. Reinembering the comments on the timebase output it is best to use either a shielded plug or directly soldered connections to avoid shocks when selling up.

OPERATION

The current drawn by the wobbulator is typically 5mA, and any big discrepancy should be investigated before going further. When the system is coupled



The p.c.b. is mounted in the box with bolts and spacing nuts, General layout is not at all critical. An on/off switch could form part of VRI.

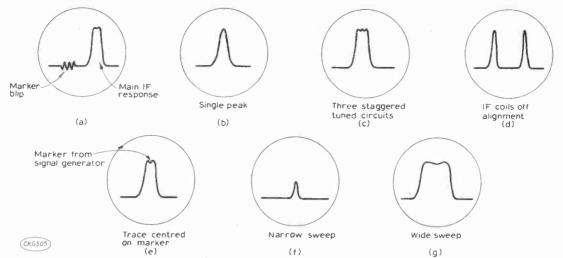


Fig. 5: Various i.f. response curves, obtained with the set-up of Fig. 2.

together as shown in Fig. 2, set the frequency of the wobbulator approximately by the variable capacitor, until a trace of the IF is seen on the scope screen. The sweep frequency should be set at around 50Hz for best results when a 50Hz buzz from the set's loudspeaker will be heard when the wobbulator is correctly aligned. The centre frequency of the IF can then be determined by using an accurately calibrated signal generator, Fig. 5a.

The output from the signal generator is coupled to the IF strip in the same way as the wobbulator, namely a few turns of wire placed near to the mixer input/output. Remember to disable the set's local oscillator before alignment, since this will otherwise lead to spurious traces. A few traces likely to be seen are shown in Fig. 5b-e.

The sweep width potentiometer determines the length of sweep, which may represent from 0 to 20kHz. The narrower the sweep, the more of the IF is displayed on the scope, but it must sweep at least as far as the ends of the IF bandwidth, Figs. 5f-g.

There only remains to align the IF by adjusting the cores in the IFT's to get the desired response, Bandwidth can be determined by using the signal generator to determine the points on the response curve corresponding, say, to 452 and 458kHz (455kHz centre frequency).

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Also in the October Issue: 110° COLOUR CHASSIS—The new "look" VARICAP TUNERS—to help DX • TV





MEDIUM WAVE BROADCASTS by CHARLES MOLLOY

THE International Short Wave Club conducts a poll every three years to determine the most popular short wave stations.

Listeners are asked to participate by sending to the ISWC, 47 Harridge Road, Leigh-on-Sea, Essex SS9 4HE; a list of their five most popular short wave stations in order of merit, together with a short note of not more than 30 words why they consider their No. 1 choice to be their most popular station. More than 30 words will automatically disqualify any listener from any award that may be given in connection with the Poll. The final date for voting is December 31st. 1973.

Ex-W.D. Equipment

The short paragraph at the end of the September column announcing that I would be devoting some space to the subject of ex-government Communication receivers has sparked off an even larger than usual postbag. The problem has become so bad that I have had to install a larger letterbox to assist the postman. I would, however, like to remind you all that any letter requiring an answer should be accompanied by a stamped addressed envelope.

I still require information on some of the rarer receivers and if any of you can supply me with this I can assure you that it will be well treated and returned as soon as possible. In particular I would be grateful for any information on the ex-Admiralty B40 receiver.

Readers' Logs

The first log this month comes from Alan Carpenter who lives in Aborfield near Reading. Alan's equipment consists of a Heathkit 'Mohican' GC-1U receiver and its 50 inch telescopic aerial. However, a 70 foot long-wire was added to pull in Radio Cevlon.

4915 Radio Ghana, Accra, nx. in English at 2245. 6250 World Music Radio in English at 0900.

7310 Radio Vilnius, Lithuania. English at 2230.

11725 Radio Ceylon with Religious programme at 1700.

11725 R. Free Europe, Lisbon. Pop music at 2315. 11730 R. Tashkent, Uzbek in English at 1400. 15445 R. Nacional de Brasilia. English at 2230.

A. W. Guzelian of Coniston in Lancashire has an HRO receiver and a 45 foot long-wire aerial which enabled him to hear:

7105 R. Nacional de Espana, in Spanish at 1300.

9555 R. Baghdad, Iraq in English at 1940.

11350 R. Pyongyang, N. Korea, English at 2100.

11765 R. Yerevan, Armenia noted at 2030. 11880 Voice of Turkey, in English at 2200.

15115 R. Tashkent in English at 1400.

15415 R. Kuwait in English at 1730.

Simon Wormleighton and J. P. Fletcher of Rendcomb College, Circncester, Glos. have again sent in a report using the following equipment, Astrad-Altair with 80 foot long-wire; HRO with 8 metre folded dipole; Bush PB63 with 35 foot long-wire. Stations logged included:

6010 R.T.B., Belgium in French at 1505. 9022 Voice of Iran in English at 2005.

9600 R. Kuwait. Nx. in English at 1730.

9670 Adventist World Radio, Lisbon at 0935.

11730 R. Vilnius, Lithuania in English at 2250.

11850 R. Norway in English at 0824. 15325 R. Canada International at 1634.

Chris Greenway and John Greenlees sent in a combined log from Brandiston in Norfolk. The equipment used being a Lafayette HA600A receiver; Codar PR40 preselector; 100 foot long-wire; 15MHz dipole and homebrew A.T.U. An extract from their log with more than 60 entries is as follows:

9545 R. Ghana, Accra in English at 2135.

9655 R. Damascus, Syria, English at 2000.

11650 R. Bangladesh with music at 1715. 11710 R. Kiev, Ukraine noted at 1945.

11725 R. Ceylon in English at 1700.

11935 R. Pakistan, news in English at 1725.

15105 R. Grenada, Windward Islands at 2120.

15105 BBC, Ascension Is. relay noted at 1510.

15185 R. Nigeria, Lagos, in English at 0715. 15195 R. Japan, news in English at 2215.

15265 R. Afghanistan in English at 1800.

15310 BBC, Tebrau, Malaysia relay at 1745.

The last log for this month comes from Christopher Hodgson of Sunderland who used a Codar Multiband-6 receiver, the PW A.T.U. and a 50 foot long-wire aerial to hear the following stations:

6130 Radio Norway at 1800. (Sundays).

9005 R. Tehran, the Voice of Iran at 2000.

9840 Voice of Vietnam, Hanoi noted at 1815. 15012 Voice of Vietnam, Hanoi noted at 1800.

15165 Radio Denmark in Danish at 1400

15185 Radio Finland at 1810.

15325 R. Canada International, s/off at 1313.

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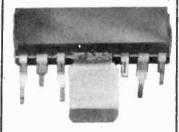
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MEDIUM WAVE BROADCASTS by CHARLES MOLLOY

W. GUZELIAN (Coniston, Lake District) has been trying his H.R.O. receiver and 45ft outdoor aerial on the medium waves. His log includes BBC local radio stations at Blackburn on 854kHz; Sheffield 1034kHz; Leeds 1106kHz; Merseyside 1484kHz; Stoke 1502kHz; Nottingham 1520kHz; Teesside 1546kHz; together with programmes in English from the Voice of America (VOA) Munich 173kHz (1734m) on the longwaves at 1600hrs; Milan, Italy on 899kHz at 2300hrs; American Forces Network (AFN) Berlin 935kHz at 2325hrs; Radio Eireann 1250kHz at 1430hrs (low power relay at either Dublin or Cork).

Keith Lavelle (Manchester) has a 10 transistor radio and an outdoor spring-loaded whip antenna. He reports hearing BBC Radio Leeds on 1106kHz; Sheffield 1034kHz; Stoke 1502kHz; Bristol 1546kHz; Manx Radio (Isle of Man) 1594kHz; Trans World Radio, Montecarlo 1466kHz.

J. Hallos (Warrington, Lancs) has built the Practical Wireless General Coverage receiver which he is using with a 12ft indoor aerial attached to a 6ft curtain rail. He reports hearing Manx Radio 1594kHz at 0800hrs; Radio Eireann 1250kHz; Radio Leicester 1594kHz at 1400hrs; Bristol 1546kHz; Nottingham 1520kHz; Stoke 1502kHz.

Tim Thorpe (Lowbands, Glos.) has become intrigued with the performance of his Murphy transistor portable after dark. Using its internal aerial he has logged programmes in English from AFN Germany on 872kHz and 1142kHz; Vatican Radio 1529kHz at 2045hrs; TWR Montecarlo 1466kHz at 2100hrs; Radio Berlin International 1511kHz at 2145hrs; Radio Tirana, Albania 1394kHz at 2200hrs; Radio Prague 1286kHz at 2200hrs; Radio Warsaw 1502kHz at 2230hrs; Radio Portugal 755kHz at 2245hrs; Radio Sweden 1178kHz at 2245hrs.

Harold Emblem (Mirfield Yorkshire) has received a verification from the low power Radio Rabat. Morocco 818kHz and he mentions that this station signs off at 0300hrs GMT with "Huna Rabat". This is a good time of year to listen to medium wave stations from North Africa and the Middle East. During the period of Ramadhan, which falls between the 28th September and 27th October this year. many stations are on the air all night and some of them are quite conspicuous after 2300hrs GMT. Listen for Algeria on 533kHz, 548kHz, 890kHz and 980kHz; Tunisia on 629kHz and 962kHz; Libya 1124kHz and 1250kHz; Egypt on 620kHz; Kuwait 1345kHz; Baghdad 760kHz; Beirut 836kHz; Morocco 935kHz; Saudi Arabia 587kHz; Syria 957kHz; Turkey 1061kHz. On the long waves look for Azilal, Morocco on 209kHz (1435m) in Arabic and Tipaza, Algeria 251kHz (1195m) in French.

The BBC transmitter at Moorside Edge on 692kHz (434m) is being increased from 150kW to 300kW to help listeners whose reception is affected by interference from a station in East Germany. The Radio 4 transmitter at Swindon on 692kHz has been changed to 1340kHz (224m) which is marked "Northern Ireland" on many tuning scales.

Charles Molloy

VHF/FM DXING

by SIMON DAVID

Gardner of Dublin has kindly forwarded to me a copy of RTE Guide which covers v.h.f. and television broadcasts from the Republic of Ireland. Radio Na Gaeltachta has only recently opened, broadcasting news, local events and Irish music. Stations have been set up to transmit from Truskmore 91·90MHz, Maghera 97MHz, Mullaghanish 91·30MHz, Kippure 89·10MHz, and Mt. Leinster 90·40MHz all on the v.h.f./f.m. band. Others are on medium wave 240m, 556m, 312m. Irish is spoken throughout while RTE maintains a mainly English speaking service on 89·7MHz, 94·1MHz, 95·3MHz, 94·9MHz respectively.

David says that RTE will verify reception reports, but is still awaiting acknowledgement from R. Na Gael, who have small studios at Casla, Connemara, Co. Galway, Eire. They are a part of RTE, but do not carry commercials. It apparently arose following the setting up of a "pirate" station in the west. This resulted in the "pirate" operator being engaged

officially to run R. Na Gael.

Roy Patrick of Derby has taken his v.h.f. receiver on holiday with him on the East Coast (keen DXer!), but unfortunately did not have much DX success. Moving on to Farnborough, Hampshire he picked up Rouen 96.5MHz (loud and clear), Boulogne 99.9MHz (excellent quality) and back in hometown just managed to pick up Boulogne again.

Mr. Patrick used a Grundig "Music Boy" receiver. In some places it is possible for the aerial to pick up not only the direct signal from the transmitter but also signals which have been reflected from tall buildings, hills or other large objects. This is known as multipath interference and it can cause very unpleasant distortion. The directional properties of a carefully-positioned multi-rod aerial can often be exploited to reduce the pick-up of the reflected signals and thus eliminate the interference. If the received signals are too strong this could give rise to 'intermodulation' or interaction between two or more received signals which may result in a 'birdie' background noise on one of the channels-usually Radio 3. Modern receivers are tending to overcome this effect by using special circuitry.

If this form of interference is experienced, it is better to reduce the signal input by using an attenuator in the aerial lead, other than by using a less efficient, and therefore less directional, aerial. Variable attenuators are available and the value to choose is the one which reduces the signal input just sufficiently to remove the 'birdies' without allowing

background hiss to be introduced.

If any readers have taken a v.h.f. f.m. receiver on holiday with them, especially when travelling abroad, I shall be pleased to hear from them. We are particularly interested in reception, DX or otherwise, from foreign stations. I would also welcome cassette tape recordings of readers' f.m. reports. Please enclose your full name and address and 4p stamp for the return of your cassette.





SHORT WAVES by DAVID GIBSON, G3JDG

THE summer is now firmly behind us. No more mobile rallies and outings. Which means, I hope, that everyone will have a concentrated onslaught of listening on the Amateur Bands. How about making it a 40 metre autumn/winter? A listen for a minimum of fifteen minutes on 7MHz before you nip off to the more lucrative DX segments of 14 and 21MHz. Spare a thought too for ten metres. Could be interesting bearing in mind that we are only a couple of years away from a sunspot minimum.

One person keeping an r.f. eye on the l.f. end of things is **Stanley Sharred** (Birmingham). He managed to locate a "good" CR100 for the princely sum of £2. He uses it as a back-up to his CR150/2. Using a horizontal Vee antenna (60ft./leg) the following c.w. titbits were logged on topband; GM8MJ, E19J, LU5HFI, OL1API, PY1RO, ZP9AY, with a couple of GW's and PA0HHV on s.s.b. A sniff around 3.5MHz raised s.s.b. squeaks from; C31DM, KP4AN, PY2FUS, VO1FG, WA3OVC, 3A2EE, 7X2MD. Even the dreaded forty metres was given a "Sharreding" to yield goodies on the c.w. like; CM2BG, CP5GM, K4JO, LU5HFI, WA5WPB, YV3TMD, ZL2MM, ZM2AFH, and s.s.b. from; LU7BDZ, PY7BBX, VK2WC, YV5CYS.

Readers' Logs

Guy Dean (Ringwood) is the proud possessor of a FR50B amateur bands receiver plus a PR30 preselector. Antenna is an inverted Vee trap dipole with the apex at 44ft. Three band log is as follows. Eighty metres, HC1HA, K2LWR, K4CYU, OY5NS, VEIDI, VEIED, VOIBT, VOIFG, PYIHA, WA2CLQ, W2NR, W3HFV, W5BS. Twenty metres; CE3AEV, CP1WB, CR6RJ, EP2MJ, ET3DS, ET3USA, HC2WF, HC7RD, HP1IW, HR1RSP, HZ1AB, JA4ZA, JY3ZH, JY6GT, JY8LE, KG4CA, KG4FS, KP4DSC, OA4HI, PZ1DR, TF3SV, TI2KF, VE8RC, VE8RCS, VK3BJB, VK3PA, VK5AS, VP3MKE, VU2DK, VU2JM, WA7UKQ, W6KMC, W7IJZ, YV4TY, YV5EED, 5Z4JE, 6Y5GB, 9J2DC, 9X5NA, 9Y4BO. Fifteen metres; A4XFJ, A6XP, CE3ABZ, CE3EGW, CP1FG, CR6AD,

CR6AG, CR7OL, EL1G, EL9C, HK3AUE, HK3LT, KP4AOW, KZ5USA, LU1DAB, LU3KAX, OJ0AM, PY2BFJ, TR8AF, VQ9BP, YV3VU, ZD7FT, ZD8AW, ZE1AD, ZE4JW, ZE7JR, ZP5HJ, ZS1FH, ZS4GF, ZS5EL, ZS6QD, 5H3JL, 5T5DY, 5Y4XNH, 5Z4JE, 3D6AU, 9K2JM.

Listening on a CR70A receiver, PR40, a.t.u. and 264ft. end fed, D. Dance (Roxburghshire) heard some nice tweets on the h.f. bands. On twenty metres c.w., for example; CN8BO, CR6BX, DU1OR, OA4XK, PY2BOS, PY7VOU, PZ1CP, VP9CB, with s.s.b. from; DU1JMG, EL9C, HV3SJ, VE8RCS, 7X2MD, 9M2LN. Up on fifteen metres c.w.; CN8BO, CR6AL, CR6MX, EA8FE, EA8FS, EL0S/MM (near the Brazilian coast), FG7TG, KZ5EK, LU1HDC, VP9CB, YV3VU, ZC4BI, 9X5NA. Best on ten metres were; ZC4CY, 9H1CH on c.w. with LX1PD, M1C and 9J2DT on s.s.b.

J. Eagland (Brighouse) has a "30ft. long wire aerial, arranged as a spiral in the loft". Dizzy signals arriving from it are fed unmercifully into a CR45 receiver. The log for twenty metres reads; CE3AIU, HC1SS, HK6CPS, LU3FAQ, LX1DAV, PZ6AA, VE2WF, VE7XF, VK2BHR, VK3MO, VR1FL, VP1TB, W9XRP, XE1PO, ZD3D. The same gear on eighty metres managed to locate; CN8HD, CT2AK, OY7JO, OY2X, VEIZAN, VE3GCS, W2NIN, XE1CV, 4X4KT.

Signals arriving at the ears of L. Large (Hassocks) have to walk a 600ft. tightrope. At least that's the length of the antenna which can truthfully be described as a long wire. Apparently it was 1,000ft. long but low-flying motor vehicles proved a hazard. At the end of the line is a 9R59DS receiver and a page in the log marked 14MHz which reads; E16S, F9JA, GI3GRD, HZ1SH, LX1RR, K6UA, VO5BZ, TF5TP, VE1AM, VE8RCS, YV5AS, 3A2C. On 21MHz the best were CR6QR, and TR8VE.

Loose on 14MHz with an R107, homebrew a.t.u. and 132ft, end fed is D. Douglas (Leicester). His best on 14MHz were; CE3AX, CN8BO, CP5CW, CR3WB, CR7EH, EA6BG, EA8CR, EP3SP, ET3RS, ET3USA, HM1AQ, HR1BS, HZ1AB, JW1SO, JY6ZZ, KG6JBE, KP4DDO, KZ5JM, MP4BJP, OX3BH, VE1PV, VO1JR, YN9GL, YV3VU, ZB2BZ, ZE4JG, ZL3UY, ZP5GE, 3V8CA, 4S7BR, 4W1BC, 4X4BA, 4Z4BA, 7X2MD, 9J2DT, 9L1VW, 9Y4PL.

Bernard Hughes (Worcester), JR310 receiver, dipole, bagged these on 14MHz; CR7AG, HR1RSP, HM1AQ, JX3P, JY6KAM, JA3AJW. HZIAB, KG6JAP, KZ5OH, LG5LG, VQ9MC, VP2VAP, VP2VS, VK2BKG, VK3ALL, WA7PMI, WA7BPS, ZL1JJ, ZD7FT, ZD3D, ZK1DX, 5W1AU, 9V1QO, (9G1HE, 9J2EP. Curses, all Gibbies best gone for a chop-

Events

Contests and events for October include: October 6-7, Oceana contest (phone); 6-7, u.h.f. national field day; 6-7, 432/1296MHz contest; 13-14, Oceana contest (c.w.); 13-14, fifteen/ten metre contest; 20-21, WADM contest (c.w.); 20-21, forty metre contest (c.w.). November 3-4, forty metre contest (phone); 3-4, two metre and 70cms contest.

BROADCAST BANDS

Short Wave Reports by 15th of the month to Malcolm Connah, 59 Windrush, , Short Wave/VHF Highworth, Swindon, Wiltshire, SN6 7DT.

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

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

AMATEUR BANDS

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

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MT45	Transformer for above, heavy duty £2 85 carr. 20	р
MT30	Transformer for unstabilized supply complete wit rectifier diodes mounted £3:50 carr. 20	
PS70	Stabilized supply module for one or two SA100's £4 90 carr. fre	
MT70	Transformer for PS70 £4 90 carr, 40	n

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Using grouped pairs of inputs and outputs (high Z and low Z inputs) with individual bass, treble and volume controls on each pair, plus master control. These low-noise units will feed all makes of amplifiers. making them ideal for clubs, discos etc. Standard jack sockets, Compact design, In strong metal cases. All units guaranteed for 3 years.

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£18.50 + V.A.T.

■M.6 HL Case 18"×8"×2\1"

12 inputs (6 high Z, 6 low Z). Carr. pd. **£27-50** + v.A.T.

Channel section modules, for building your own mixer. Gain—16 x (24dB). Tone controls—18dB swing. Carr. pd. £3·50 + V.A.T.

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Rugged class A driver stage, this module will run from all our mixers, etc., and most other makes. Delivers 120 watts into an eight ohm load and employs 4 T03 can (115 watt) output transistors. These are the modules where extra power is demanded.

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Fibreglass board 8" x 4" x 4" (5" v supply)

Low distortion parallel push-pull output stage.

only (Carr. 20p) £13-90

Module & £18.95 power supply (Carr. 40p)



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0 0 c.s.e. 100

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A.K.G. MICROPHONES

D11 DHL IDEAL DISCO MIKE ONLY £9:45 (rrp £11:00).

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GOING BACK...

1970 60 50 40 30 20 COLIN RICHES ARTHUR DOW

E'D like some help and information as soon as possible on early wireless equipment manufactured by "H.P.R. Wireless Ltd." Mr. R. J. I. Moon, lately of Guildford, Surrey, has, in the process of moving down to Cornwall, kindly passed on to us some single valve units comprising tuners, detectors and audio stages. These used to be connected together to form a complete receiver and we even have the original heavy copper wires used for that purpose, with end loops perfectly formed.

So far we have not been able to trace the makers in any of our old catalogues but we believe the units are typical of the early 1920's. The units are housed in the inevitable mahogany boxes with black ebonite panels and the equally inevitable brass terminals, each panel being engraved "H.P.R. Wireless Ltd."

Mr. Ray Williams of Grantham, Lincs, thinks enough of our humble efforts to have extracted all the Going Back pages from past issues of the magazine and to have bound them together to form a 'useful reference work'. Another reader wonders if we are going to do a reprint of our offerings! Any

more letters like that and we shall have enough evidence to demand of the Editor that something be done!

Not quite vintage but of great interest to Ray Williams are two Utility receivers of the last war, both in perfect working order. In view of the vast numbers of these sets that must have been turned out at the time there must still be many thousands out of sight in attics, storerooms, garages etc. So, go to it, Going Back'ers and follow Ray's favourite haunts, 'derelict buildings, under wood piles and in odd corners'. One ancient set was brought round by a neighbour who thought it was a war-time bomb!

Mr. Williams was also kind enough to send along a photograph, reproduced herewith, of some of his treasures which number twenty eight, so far. He specialises in early crystal sets and has collected some specimens in mint condition. The apple of his eye is an Ediswan crystal set, as new, in its original carton! This was featured on BBC TV in 'Nationwide' in July last year. So..oh, when you buy that transceiver keep the carton, it could be worth a bomb in fifty years time!

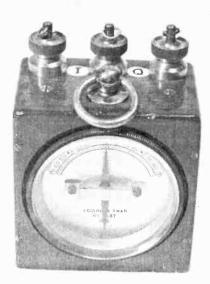


Mr. Ray Williams from Grantham is pictured here with some items from his vintage radio collection.

Ca! Ca! Ca! Ca! Ca!

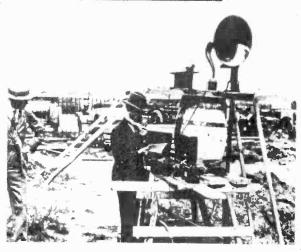
Information Wanted

Front dial reads 70-0-70 Edison and Swan No. 11637—1916. Top terminals read I and Q.—R. J. Goodman, 26 Killarney Road, Wandsworth, London, SW18 2DX.



receiver, Frequency is 50/80m and voltage input 200-250V. Number is BC 3130. Inst. No. 7327. I would be glad of any information on this set and a suitable speaker to use with it.—Maurice Dean, 29 Lea Road, Dronfield, Sheffield, Yorks.

Gecophone model BC 3250 (c1926)—David James, 12 Circus Street, Greenwich, London, S.E.10.



This BBC photograph shows an Outside Broadcast commentator at the Brooklands Race Track in 1922.

TRANSFORMERS

MAINS ISOLATING SERIES
Primary 120/240 Volts Secondary 120/240 Volts Centre
Tapped and Earth Shielded

Ref.	VA	Weight	Size cm. P	& P
No.	(Watts)	Ib oz		Þ
07	20	1 8	7.0 x 6.0 x 6.0 1.94	30
149	60	3 12	9.9 x 7.7 x 8.6 2.88	36
150	100	5 8	9.9 x 8.9 x 8.6 3.16	52
151	200	8 0	12·1 x 9·3 x 10·2 5·31	52
152	250	13 12	12.1 × 11.8 × 10.2 7.01	67
153	350	15 0	14.0 × 10.8 × 11.8 9.40	82
154	500	19 8	14.0 x 13.4 x 11.8 13.55	02
156	1000	38 0	17.2 x 16.6 x 14.0 24.97	_
158	2000	60 0	21.6 x 15.3 x 18.1 41.25	
				_
D_6	17.4		AUTO SERIES	



	AUTO SERIES										
₹ef.	VA	Wei	ght		Size c	m.	Auto	Tabs	P	& P	
	(Watts)	16	OZ				71010				
113	20	-1	0	5.8 x	5-1 v	4.5	0-115-210	240	1.02	22	
64	75	2	4			6.1	0-115-210	240	2.00	30	
4	150	3	4	8.9 x	7.70	7.7	0-115-200	220 240	2.42		
66	300	6	à.		9.6 x	0.6		-220-240		36	
67	500	12	8	12.10	11-2 x	0.0	100		4.70	52	
84	1000	iĝ.	8				11	0.9	6.93	67	
					13:4 x			71	12-69	82	
93	1500	30	4	14:0 x				11	18.39	_	
95	2000	32	0	17·2 x	16.6 x	14.0	**		24:00		
73	3000	40	0	21.6 x	13-4 x	18-1		**	32-67		

TOTALLY ENCLOSED 115V AUTO TRANSFORMERS 115V 500 Watt totally enclosed auto transformer, complete with mains lead and two 115V outlet sockets, 49.49, P. & P67p. Also available a 20 Watt version 12-02 P & P27p

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PF	RIM.	AKT	240	250	VOLT	S 12 A	ND	OR 24 V	YOUT	RANG	E
Rej.	An	nps.	We	ight	Siz	e cm.	S	econdary	Windin	es P	
No.	12V	24V	16	oz			_	,	, , , , , , , , , , , , , , , , , , , ,	8	þ
		0.25		8	4-8 x	2.9 x	3.5	0-12V at	0.254	ว เกิดว	22
213	1.0	0.5	- 1	4	6-1 x	5-8 x	4.8	0-12V at	0.5A-7	1.22	22
71	2	- 1	- 1	12	7.0 x	6.4 x		0 12 V at		1.60	22
18	4	2	2	12	8-3 x	7.7 x		0.12V at		2.24	30
70	6	3	3	8	8.9 x			0-12V at		2.70	42
108	8	4	5	8	9.9 x			0.12V at		3.00	52
72	10	5	6	4	9.9 x			0-12V at		3.55	52
17	16	0	8	12	12:1 x			0-12V at		5.48	52
115	20	10	41	8	14:0 x	9.6 8	11.8	0-12V at	Ina.2	6.98	67
187	30	15	15	ě	14-0 V	12.10	11.8	0-12V at	154.2	12.90	82
226	60	30	32	Õ	17.2 x	15·3 x	14.0	0-12V at	30A 2	23.72	

					30	VOLT	RANGE		
Ref.	Amps.	Weig		Size cn	n:	Secondo	ry Taps	P	& P
No.		lb oz						€	ø
112	0.5	4	6·1 x	5.8 x	4.8 0	-12-15-2	0-24-30V	1.22	22
79	1.0	2 4	7·0 x			- 11		1.62	36
3	2.0	3 4	8.9 x		7.7	11	36	2.43	36
20	3.0	4 8	9.9 x			17		2.99	42
21	4.0	6 4	9.9 x		8-6	11	11	3.55	52
.51	5 0	6 12	12·1 x				**	4.42	52
117	6.0	8 0	12·1 x	9.3 x	10.2		41	5.28	52
88	8.0	12 0	12·1 x			11	**	6.82	67
89	19.0	13 12	14·0 x	10.2 x	11.8		ü	8.36	67

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No.		lЬ	oz						.,,-		- p
102	0.5	- 1	12	7.0	×	6.4 >	6-1	0-19-25	-33-40-50V	1.60	30
103	1.0	2	12	8.3					-33-40-30 4	2.34	36
104	2.0	- 5	8			8.9		***	**		
105	3.0		1Ž			10.2 %			**	3 - 25	42
106	4.0	10							**	4:41	52
107	6.0	iž				10.5 x			14	5.48	52
						10·2 x				8-63	67
118	8.0	18				12.7 x				11.27	97
119	10.0	25	0	17-2	×	12.7 >	14-0	11		14-13	
									- 0		

Ref.								OUTOL			
	Amps.	v	Veig	ne	Si	ze cm.		Secondo	ary Ta	hs P	& P
No.		IЬ	oz					00001101	,	P .	OK !
124	Λ.	.5	· 2		_					£	Þ
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127	2·0	- 7	- 1					**		2 26	36
		0				9.6 x		11.	111	3 - 5.5	42
125	3.0	- 8	12	12.	1 -	9.9 x	10.2			5.41	
123	4.0	13	15						**		52
			14	12	Ι×	11.8 x	10.2		17	6.98	67
120	6.0	15	R	14	0 ~	12-1 x	11.0			10.12	
122	10.0	25	×						5.9		82
124	10.0	43	U	17.	ΔX	12.7 x	14.0	1.0	4.0	16.75	
		EA	D	4.01	n n	4 77					

		-					1.0	4.2	10.72	-
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43	1.5	- ĩ	a		6-1 >	4.11	`			- P
5	4.0	3	Ă	8.00	7.7	7.7	DI	note, the	1.61	30
83	6.0	6	- 7	0.6.	0.7.5		riease	note, the	ese 2.45	42
146	8.0		17	0.0 X	7'0 X	8.6	units	do not	in- 3:70	52
58	12.5	12	14	3.3 X	10.7 ×	8.6	Clude	rectifiers		52
				.14·0 ×	10.7 ×	: 11.8	J		6.29	67
^" '	atings a	re c	ont	inuous.	Stand:	ard co	nstruct	ion: oper	n with sol	der
tags	and va	cuu	mι	mpregn	ation.		Carrias	re via Bi	RS	

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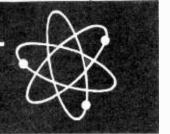
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TRANSMIT/RECEIVE CONTROL BOX R. H. LONGDON

THIS device is intended to control a transmitter and receiver, but can be used for other purposes, as explained. It gives complete control of suitable home-built equipment, without the need for

any relay, or relay supplies.

Fig. 1 is the circuit, based upon the use of a 4-wafer 3-way rotary switch. Switch positions are numbered 1, 2 and 3. The back wafer S1a transfers the circuit from co-axial socket Sk1 to either co-axial socket Sk2 or Sk3. Wafter S1b closes the circuit in position 3. Wafer S1c closes in positions 2 and 3, while the front wafer S1d closes in positions 1 and 2.

METHODS FOR USE

Uses for the control box in an amateur station include the following:

Rx/Tx Control

Plug the aerial or tuner lead into Skl. Run a coaxial lead from Sk2 to the receiver, and a similar lead from Sk3 to the transmitter. Disconnect the transmitter p.a. h.t. lead from the power pack, and take to A, running a lead from the second terminal A to the power pack. Similarly place B-B in the v.f.o. or v.f.o. h.t. circuit. Disconnect one receiver speaker lead from the speaker and take to C, adding a lead from the speaker to the second terminal C.

Position 1 then provides reception. Position 2 allows the v.f.o. to be tuned to the receiver frequency. Position 3 puts transmitter on, and receiver off.

Aerial Selection

A dipole may be available for one band, and an end-connected wire for other bands. For such purposes, or a direct comparison of aerials, connect one aerial to Sk2, the other aerial to Sk3, and the receiver to Sk1.

Aerial/dummy load

It is sometimes convenient to run a transmitter output temporarily into a dummy load. For this, connect the Tx to Skl, the aerial (or tuner) to Sk2, and dummy load to Sk3. For modulation and other tests the dummy load can be a household lamp. Should the dummy load be of known impedance, such as 75 ohms, it can be useful to load the transmitter into this correctly. Then switch to the aerial tuner and adjust the tuner for the same Tx p.a. input reading. A dummy load with r.f. meter is also very useful for obtaining optimum transmitter output.

Receivers

It is sometimes convenient to switch from one receiver to another, for comparison, or because they are most suitable for different purposes (such as general coverage and amateur band only receivers, or h.f. band and l.f. band receivers). This can

be done by using Sk2 for one receiver, and Sk3 for the other. Where necessary, the speaker of the receiver not in use can be muted by using terminals A-A, and C-C.

Transmitters

Sometimes a 10W Tx may be used for 160m, and a larger transmitter for other bands. Sk2 can then go to one Tx, Sk3 to the other Tx, and Sk1 to the aerial tuner.

Transmitting Aerials

It is sometimes useful to compare one transmitting aerial with another (e.g., a vertical and long wire) while transmitting. This can be done by taking the Tx to Skl, and the aerials (with tuners, where required) to Sk2 and Sk3. Other uses will no doubt suggest themselves.

EFFICIENCY

When this method of change-over was first used, there was some doubt about r.f. efficiency, and the possibility of switching high voltages.

R.F. efficiency was compared by feeding r.f. from a Tx to an r.f. wattmeter direct, then through the control box, on 28MHz and lower frequencies. No difference in wattmeter readings could be seen.

R.F. feedthrough from Tx to Rx when transmitting depends on the equipment and layout elsewhere as well as on stray coupling in the box. It was never large enough to cause trouble. An extra wafer was tried with the control of a large transmitter, to short Sk2 (receiver aerial) to earth, when transmitting. This was not incorporated in the control box as it was felt to be unnecessary.

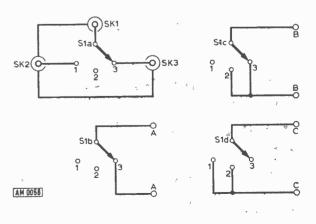


Fig. 1: Circuit of the tx/rx control box

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

wave rectifica-tion. Output approx. 13 watts se 12Hz

r.m.s. into 8 ohiu. Frequency response 12Hz-30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Sultable for *Siller, hass soos and free cut controls. Suitable to 8-16 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 x 6" wide x 7\sqrt{c}" deep AC 200/250V. PRICE 211.60. P. & P. 40p.

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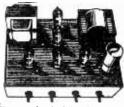
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WITH V.H.F. INCLUDING AIRCRAFT



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

Building Costs

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3 Tunable wavebands, M.W.

3 Tunable wavebands. M.W.
L.W. and Trawler Band,
7 stages, 5 translators and
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ferrite rod aerial, moving coli Total Building Costs
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3 3

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7 Tunable Wavebands: MW1,
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Ali * spaced ganged tuning condenser. Volume[on]off, Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking, Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and plans 25p (FREE with parts).

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£6·98

P P & Ins. 47p

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WITH VHF INCLUD-ING AIRCRAFT

10 Transistors. 10 Transistors,
9 Tunable Wavebands,
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SW2, SW3, Trawier
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Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopie Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 800m W Tanaistors. Car Aerial and Tape Record Sockets. 10 Transistors plus 3 Diodes. Fire tone movins coil speaker. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Control. Attractive Class in black with silver blocking. Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and plans 300 f FREE with parts). to follow instructions and dia plans 30p (FREE with parts).

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£8.50

P P & Ins. 52p



Components include:

Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Tuning Condenser: 2 Volume Controls: 2 Silder Switches: Fine Tone Moving Coil Speaker: Terminal Strip: Ferrite Rod Aerial: 2 Flugs and Sockets: Battery Clips: 4 Tag Boards: 10 Translators: 4 Diodes: Resistors: Capacitors: Three J" Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schoole, Educational Authorities and all those interested in radio construction.

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80,000 O.P.V. with over-load protection, mirror scale, 0/5/2-5/10/25/100/250/500/



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- 20 to + 62dB
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0/750mV | 1-5 / 3 | 7-5

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150 / 50mV | 1-5 / 3 | 7-5

150 / 50mV | 1-5 / 3 | 7-5

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50-0-50μA \$2.80 5 amp 100μΛ \$2.75 10 am 100-0-100μΛ \$2.75 5V D 200μΛ \$3.70 10V I 500μΛ \$2.55 20V I 1mA \$2.60 5V I	5mm Fronts £2:60 p £2:60
50 ⁻⁰ -50μA \$2.80 5 amp 100μΛ \$2.75 10 am 100-0-100μΛ \$2.75 5V D 200μΛ \$3.70 10V I 500μΛ \$2.55 20V I 1mA \$2.60 50V I	£2.60
10mA \$2.60 15V. A	.C. 22-60 D.C. 22-60 D.C. 22-60 D.C. 22-60 D.C. 22-60 D.C. 22-70 A.C. 22-70



"SEW" EDGWISE METERS Type PE.70. 3 17/32in. x 1 15/32in. x

.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	2łin.		
50μΑ	£8·75	500μΑ	£3·20
50-0-50μA 100μA	48-60	1mA	£8-20
100-0-1004A	48-50	800V. A.C	£3·25
200μΑ	48-40	VU Meter	£3.85

*MOVING IRON-ALL OTHERS MOVING COIL Please add postage

Type MR.85P. 41in. x 41in. fronts 48-90 48-90 48-90 50m A

100mA 500mA 1 amp...

15 anıp



200	30 amp	£8.95
	20V. D.C.	£8-90
` 	50V. D.C.	£8.90
50μA 24-40	150V. D.C.	48-90
50-0-50µA £4.25	800V. D.C.	\$8.90
100µA \$4.25	15V. A.C	£8-95
100-0-100µA \$4.05	300V. A.C	£8·95
200µA £4.05	8 Meter ImA	£3.90
500μA \$8-90	VU Meter	£4.55
500-0-500µA \$8.90	1 amp. A.C.*	£8-90
ImA #8-90	5 anip A.C.*	48-90
1-0-1mA #8-90	10 amp. A.C.*	£8.90
5mA #8-90	20 anip. A.C.*	£8-90
10m A 48-90	30 arus A (1.0	49.00

Type MR.52P, 2fin. square fronts				
50μA ,	£8-50	10V. D.C #2-50		
50-0-50µA	48-05	20V. D.C #2-50		
100μΑ	£8.00	50V. D.C 22.50		
100-0-100µA	£2-95	300 V. D.C. 42-50		
500µA	#2-65	15V. A.C 42-60		
ImA	42-50	300 V. A.C £2-60		
5mA	42.50	8 Meter lmA 42.60		
10mA	22-50	VU Meter 48-60		
50mA	42-50	Jamp. A.C. * \$2.50		
100mA	42.50	5 amp. A.C. * 22-50		
500m A	£2.50	10 amp. A.C. * \$2.50		
1 amp	42-50	20 anip. A.C. * #2-50		
б атр	£2.50	30 amp. A.C. * 42-50		

Type MR ASP 34in, v 34in fronts

"'''' BAKI	93F. JT	m. A Still. Ironts
50μA	£8·70	10V. D.C 42-60
50-0-50μA	#8-15	20V. D.C 22-60
100μΑ	48-15	50V. D.C 42-60
100-0-100µA	£8-10	150V. D.C. 49-60
200μΑ	£8.05	300 V. D.C. #2-60
500μA	48·7b	15V. A.C 42:80
500-0-500µA	£2-60	50V. A.C 42-80
1mA	42-60	150V. A.C #9-80
5mA	42-60	300V. A.C 48-80
10mA	42-60	500 V. A.C. 42-80
50mA	42-60	8 Meter linA 22.85
100mA	42.60	VU Meter #8.70
500mA	42-60	50m A.A.C. 9 42-60
1 amp	42-60	100mA A.C. * 42:80
5 amp	42.60	200mA A.C. * #2.60
10 anıp	\$8-60	500mA A.C. * #2-60
15 апр	88·60	l amp. A.C. * £2-60
20 amp	\$8.60	5 amp. A.C. * #2:60
30 amp	48-80	10 anip. A.C. * £2.60
50 amp	88-90	20 amp. A.C. * £2:60
5 V. D.C	48-60	30 amp. A.C. * £2.69

"SEW" EDUCATIONAL **METERS**



Type ED.107. Size overall 100mm x 90mm x 108mm A new range of high quality moving ideal for echool experiments and other bench applications.

Meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

46-90	20 V. d.e \$5.95
	50V. d.c \$5.95
	300 V. d.c £5-95
	1
	Dual range
	500mA/5A d.c. 27-00
#5·95	5V/50V d.c. 47-00
	£6.90 £6.40 £6.40 £5.95 £5.95 £5.95

150пцА

other ranges to order. Quantity discounts available.

48-90

48-90

Type MR.38P. 21	32in. square	fronts
	200mA	42-25
	300mA	42-25
- tonings	500mA	42-25
The same of the sa	750mA	42-25
Ā	1 amp	22-25
Y	2 anip	42-25
T.2 7.33	5 amp	42-95
	10 ansp	48-25
1	3V. D.C	42.25
50μA £2:55	10V. D.C	42-25
50-0-50LA 42.50	15 V. D.C	42-25
100μA 42-45	20 V. D.C	42-25
100-0-100µA #2-40	50V. D.C	22-25
200μA 42·25	100 V. D.C.	£2-25
500µA £2.25	150V. D.C.	42-25
500-0-500µA \$2.25	300 V. D.C.	42.25
Im A 42-25	500 V. D.C.	€2-85
1-0-1mA £2-25	750V. D.C.	42.25
2mA #2-25	15 V. A.C	42-80
5miA \$2-25	50V. A.C	42-80
10m A \$2.25	150 V. A.C	£2.30
00 1 00 00	8001, 4 41	40 90

	200mA	E5-80
	300mA	£2-21
	500mA	42-86
	750mA	\$2.BI
	1 amp	22.25
	2 anip	22-21
	5 amp	£2-9!
	10 ansp	48-21
	3 V. D.C	
6	10V. D.C	22.21
)	15 V. D.C	42-84
į.	20 V. D.C	42-8
)	50V. D.C	49-20
6	100 V. D.C.	42.25
5	150V. D.C.	#8-98
5	300 V. D.C.	42-21
5	500 V. D.C.	\$2.80
5	750V. D.C.	42-21
6	15 V. A.C	42-30
	50V. A.C	42-80
	150 V. A.C	£8-80
6	300V. A.C	42-30
5	500V. A.C	88-80
5	8 Meter ImA	42-80
,	VII Meter	

Туре	MR.45P.	2in.	square	fronts

42.25

50μA	£8-70	5 amp £2.4
50050µA	42-65	10V. D.C #2-4
100μA	#2-60	20 V. D.C #2.4
100-0-100 LA	£2·50	50V, D.C #2-4
200μΑ	£2.50	300 V. D.C. 22-4
500μA	42-45	15 V. A.C 88-6
500-0-500µA	£2·40	300 V. A.C #8-4
1mA	£2·40	8 Meter ImA #8.5
5mA	#2·40	VU Meter #2-7
10m A	£2·40	Jamp. A.C. * #28-4
50mA	\$2-40	5 amp. A.C. * 22-4
100mA	£2·40	10 amp. A.C. * #2:4
500mA	42-40	20 amp. A.C. * #2-4
1 amp	£2·40	30 amp. A.C. * \$2-4

"SEW" BAKELITE PANEL METERS

Type MR.65, 34in, square fronts



100000000000000000000000000000000000000		241
SERVICE STATE		501
		150
		300
25μA	44.60	5011
50µ.A	48-55	100
50-0-50µA	48-05	301
100μΑ	48-00	501
100-0-100µA	48-00	150
500µA	\$2.70	300
500-0-500µA	£2.60	500
1mA	42-60	Tai
1-0-1 m A	42-80	ő a
5mA	42 60	10
10mA	48.60	20 a
50mA	42-60	30 :
100mA	48-60	50 4
500mA	48-60	VU

	15 amp	22-5
į	30 апр	£8-8
	50 апр	
i	5V. D.C.	#2·5
ı		
ı	10V. D.C	42.5
ı	26V. D.C	48-30
Į	50V. D.C	£2-3(
į	150 V. D.C.	£2:3
ı	300 V. D.C.	42-30
ı	50m V. D.C.	42-90
J	100mV, D.C.	42-34
ì	30V. A.C. *	42-00
ı	50V. A.C. *	42-64
ı	150V. A.C. *	42-4
ľ	100V. A.C. *	
ł	300 V. A.C. *	12.31
	500mA A.C. *	
	I amp. A.C. *	
ŀ	5 amp. A.C. *	
	10 anip. A.C. 4	42-80
	20 amp. A.C. 4	42-30
١	30 amp. A.U. 4	
ĺ	50 amp. A.C.	
۱	VU Meter	
5	TO MEDEL	20.00

1 amp..... £2-60 5 amp..... £2-60

mm. square fronts

1706 3-0	o ov mn
50µA	48-50 I
50-0-50µA	48-40
100μΑ	48-40
100-0-100µA	48-80
500µA	#8-05
1mA	\$8.00
20V. D.C	88.00
50V. D.C	#8-00
300 V. D.C.	48.00
1 amp. D.C.	£8-00



28 00 28 70 VIJ Meter

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For ancing and gain selection of loudspeakers with addi-

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ın lerophone inputs each with galn controls enable

ing complete mixing facilities. Battery operated, $91'' \times 5'' \times 3''$. Inputs Mica: 3×3mV 50K; 2× 3mV 600 obm. Phono meg. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K.

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CA (RADIO)

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Fully transistorised portable VHFTransceiver. Will transmit and receive on 6 channels between 144-146MHz. 1 watt transmitter. 12v DC internal or

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TRIO TCE | S/PCS | S TRANSCEIVER



High quality TS515 SSB/CW amateur band receiver covering 80, 40, 20, 15 and 10 metre bands PS515 power supply and it. Transmit/receive with PS515 power supply speaker unit. Transmit/receive frequency 3.5-29-7MHz. Output 1.5 watts. Power requirements 110 120/220-240v. AC.

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Solld state mobile transceiver for 12v DC neg. use. Transmits and Receives on any 12 of 28 channels between 144 and 146MHz. Power between 144 and 146MHz. Power output 10w and Iw switchable. Internal 3" speaker. Complete with dynamic mike, PTT switch, three sets of crystals for 144-48MHz. 144-60MHz, 145-00MHz. mounting bracket and instructions. Size approx. 150 × 60 × 220mm.

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AM and CW. 15MHz. SSB. output more than 1 watt. Crystal controlled BFO for SSB. 8 meter. ANL etc. AC 110/120-220/240v.

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General coverage 150-400 Kc/s. 550 Kc/s-30 Mc/s. FET front end, 2 mech. filters, product detector, variable B.F.O., noise limiter, 8 Meter Bandspread. RF Gain. 220/240 v. A.C. or 12 v. D.C. Brand new with instructions. Carr

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4 bands covering 550 Kc/s to 30 Mc/s continuous and electrical bandspread on 10, 15, 20, 40 and bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. 88B-CW, ANL, Variable BFO. 8 meter. 8ep. bandspread dial. IF frequency 446 kc/s, audio output 1-5w. Variable RF and AF gain controls 115/250 v. A.C. with instruction manual.

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A beautifully styled 4 track stereo deck with an outstanding specideck with an outstanding specification offered at a remarkably low price. Incorporates a host of features including switchable noise flatures including switchable noise flatures including switchable noise flatures may low meter, alider record/win VU meter, alider record/win had been socket, recording indicated amp, phono/Din line input sackets, 5 mm mike input sockets etc. Frequency response 100-8KHz, 100-12KHz Crosy 8/N-45dB. Crosstalk 45dB. Separation-33dB. Noise limiter-6dB at 10KHz. Complete with phono connecting leads.

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Can be used with most hi fi amplifiers Push button track selector and illumina-ted track

ted track Indicators. Attractive cabinet with black and silver trim. Output level 750mV. AC 220/240v.

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Incorporates built in amplifiers giving 2½ + 2½ watts rms output. Push button track selector, illuminated track indicators, slider illuminated track indicators, silder controls for volume, balance and tone. Attractive cabinet with black and silver trim. Output impedance 8 ohms. AC 220/240v. OUR £17-25 P. & P. 50p. PRICE

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ISH 20 Open back type. Individual tone and volume controls. 8 ohms. 30-20,000 Hz. \$5.50 P & P 30p

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LOH.400 4-channel dynamic head-phones. Each ear piece has 4 drive units. 4-32 ohms. 20-20,000 Hz. £9-95 P. & P. 30p

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Reduce tape hiss by 3dB at 600Hz, 8dB at 1200Hz and 10bB for all encies above 3000Hz. 16% × 8" × 34". AC 200/250v



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For use with semi-professional tape
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Portable twin track mono recorder with automatic recording level control. Built in speaker. Earpiece socket. Input for radio or

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Manual tuning of Medium and Long waves. 12v pos. or neg, earth. Complete with speaker. mounting brackets and instrucn. inting

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12v neg. earth. Slider controls for 12v neg. earth. Slider controls 10r Volume, Tone and Balance. Channel selector button with red pilot lamp, with speakers, mount-ing brackets and instructions. Our £12.50 P&P 40p

Our £12.50 40p

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10 wavebanda covering AMI KOK AM: 535-1605 kHz, LW: 150-380 kHz, MB 1·6-4·00 MHz. SW1: 4·0-

8W1: 4-0 MHz.
8W2: 8-0-1-6 MHz, 8W3: 1624 MHz, PSB1: 50-50 MHz,
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Features time zone map and timing dial. Large clear scale.
Telescopic aerial and built in aerial. AFC or FM. 6" × 4"
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Batteryfmains operation. Size:
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TYMHz.

WB 162.

GMHz. Large horizontal slide dial with logging scale. Slider volume and squeloh controls. 7 section telescopic aerial for FM and built in ferrite bar for AM AFC. 3in.

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5 wavehanda MW 535-1605KHz and FM 88-175MHz. All transistor transistor.
Battery or
mains operation. Built in
serial and 8
section teles-

copic aerial Complete with batterles, shoulder atrap and earpiece.

OUR #A.OF P&P35p

PRICE £6.95

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4 wavebands covering FM 87-108 MHz, MW510-1605 KHz,-LW 145-285 KHz, SW 5-8-12-5 MHz. Push button wave change plus AFC and on/off. Thumbwheel tuning, Slider volume and tone controls. Earphone socket. Built in and telescopic aerials. Car aerial socket. Battery/ Mains operation.

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Covers AM 540 - 1800 KHz. FM 88 - 108 MHz with AFC Illuminated dial. 24 hour alarm settling. Wake up to the sound of music or loud buzzer. Sleep switch will automatically turn off radio etc. Internal speaker plus socket for earplece or pillow speaker. AC 240v. Size 254 x 92 x 178mm. Complete with earolece, FM aerial and operating instructions.

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16 watt peak. Complete with D1N

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For conventional or Chromium Dioxide tape. 4 track record/playback. Volume and tone controls. Frequency response 40 - 18kHz (using CrO2 tape), distortion better than 2%, wow and flutter better than 0.2% RMS. Complete with pair of matching Akai CSS8 speakers.

Rec. Price £96-10 £56-50 P.&P. 50p

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ADM Dynamic (pair)

4 track record/playback deck. Accepts chrome/regular tape cassettes.

Rec. Price £68-30 £44-45 P.&P.
GWS PRICE 50p MICROPHONES (P. & P. 50p)

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Covers FM 88-108 MHz. Five push button tuning scales. 8+8 watts rms. Inputs for stereo ceramic cartridge and tape etc. Separate cartridge and tape etc. Separa bass treble, balance and volum controls

Our #31.50 P. & P.



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4 track. 7½, 3½, 1½ i.p.s. Stereo/ mono record/play. 7" reels. Inputs for dynamic mikes, radio, gram. Complete with cover.

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EMI LOUDSPEAKERS
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with single tweeter/
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Available 8 or 15
ohms. 27.25 each.
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AP96 Module	M75 0	i Cit	£38-20
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Zero 100SB Mo	dule M7	5.68A	[£44 20
B.S.R. McDON	TALD		
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C129 Mono)			25 50
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610 610/TPD1				£10.55
610/TPD1			212	£15:45
710				£21-15
810				£26-30
710 810 MP60				£8:25
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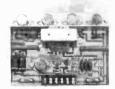
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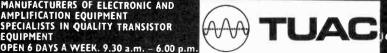
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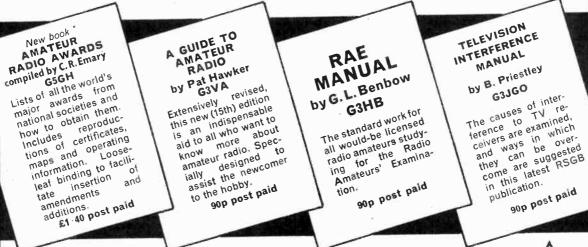
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watt 5% carbon	1p	0.7p
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range 10 ohms to 4.7	-10	
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watt m/o 2%	3p	2 · 4p
range 10 ohms to 1		_

0·16 0·1
matrix matrix
2½ × 3½ 1.7p 22p
2½ × 5 22p 24p
3½ × 5 22p 24p
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ype SW100 x 80mm.		
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12-24 volt Secondary

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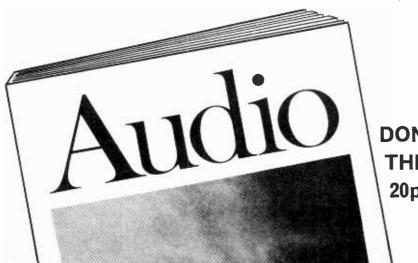
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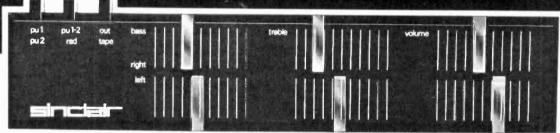
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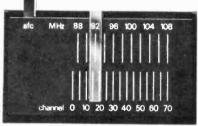
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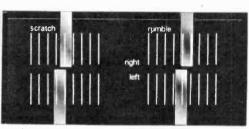
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Project 80 Active Filter Unit (AFU)

the slimmest, most elegant hi-fi modules ever made



Living with hi-fi takes on new meaning now that Project 80 is here. These amazing new modules mark a brilliant technical advance all round; their size and presentation bring exciting new opportunities to install systems in ways hitherto only dreamed about but never before made practical. You can build a Project 80 system virtually anywhere and it is unbelievably simple to install and connect up. Everything that could possibly be wanted in a top quality do-it-yourself domestic hi-fi system will be found in Project 80 - compactness, elegantly ultra-modern styling, ease of fixing and operation, new control methods, and above all superb performance. New as well as popular established ideas on installation are featured on page four of this announcement to provide just a few examples of the system's fantastic versatility.



INTERNATIONAL AUDIO FAIR STAND C. 8

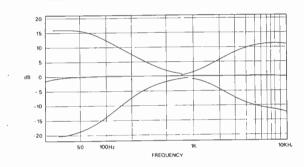
Project 80 new modules

Stereo 80 pre-amplifier and control unit

As with other Project 80 units, the Stereo 80 is mounted by means of two bolts fixed at the rear which pass through holes drilled in the wood or plastic on which modules are to be mounted. All the electronics are contained within the 3 deep front panel! Connecting leads are taken away similarly out of sight. Each channel in the Stereo 80 has its own independent tone and volume controls operated by sliders. This enables exceptionally good environmental matching to be obtained. Provision is made for magnetic and ceramic pick-ups, radio and tape in and out. A virtual earth input stage forms part of the up-dated circuitry of the Stereo 80 to ensure the finest possible quality from all signal sources. Generous overload margins are allowed on all inputs. Clear instructions with template are supplied.

TECHNICAL SPECIFICATIONS Size $-260 \times 50 \times 20$ mm $(10\frac{1}{4} \times 2 \times \frac{3}{4}$ ins) Finish - Black, with white markings Inputs - Mag. P.U. 3mV RIAA corrected; Ceramic P.U. 300 mV Radio 300 mV: Tape 30 mV S/N ratio - 60db Frequency range -20Hz to 15KHz ± 1 dB: 10Hz to 25KHz ± 3 dB Power requirements - 20 to 35 volts Outputs - 100mV + AB monitoring for tape Controls - Press button for tape, radio and P U. selection Volume. Bass + 12dB to - 14dB at 100Hz; Treble + 11dB to - 12dB at 10KHz

For P.U., radio and tape Tape monitoring switch Two-hole fixing RR.P. F11.95



Project 80 FM tuner smaller, more efficient

A truly remarkable tuner in every way - its unbelievably compact size its original circuitry - its dependable performance - all this in a boldly designed modern case measuring $85 \times 50 \times 20$ mm ($3\frac{1}{2} \times 2 \times \frac{3}{2}$ ins). Greater adaptability (and possibly financial convenience) results from the tuner and stereo decoder section being made available separately.

TECHNICAL SPECIFICATIONS

Size $-85 \times 50 \times 20$ mm (approx. $3\frac{1}{2} \times 2 \times \frac{3}{4}$ ins) Tuning range - 87 to 108 MHz Detector - I.C. balanced coincidence, for good A.M. rejection AFC - Switchable, with thermistor control to prevent from drift One 26 transistor I.C. Twin dual varicap tuning Distortion - 0.3% at 1 KHz for 75 KHz deviation Ceramic filter in I.F. section

Aerial impedance – 75 Ω or 240-300 Ω Sensitivity - 4 microvolts for 30dB quieting Power requirements - 12 to 45 volts

Twin dual varicap tuning 4-hole ceramic filter Slider tuning R.R P $f11.95^{+51.19}$ VAT

Project 80 stereo decoder

Making the Project 80 decoder separate from the F.M. tuner gives the constructor a wider choice of systems as well as saving money in cases where stereo reception may not be required. This unit gives a 40dB channel separation with an output of 150mV per channel. The gallium arsenide light emitting beacon automatically lights up to show when a stereo transmission is tuned in. Designed essentially as an integral part of Project 80 systems, this multiplex stereo demodulator may be used in many cases with existing single channel frequency modulated tuners to provide stereo reception.

Size - 47 × 50 × 20mm (1 2 × 2 × 3 ins)

One 19 transistor I.C.



- Solid-state stereo indicating beacon
- Readily adaptable for use with other

R.R.P **f** 7.45

new constructional techniques

... and again Sinclair leads the world

1962	Micro-miniature power amp small enough to stand on a
	10p. piece. Slimline pocket receiver smaller than a 20
	cigarette pack

1963 Micro-6 receiver, smaller than a matchbox

Pocket F.M. receiver: PWM amp

Z.12 power amplifier module. PZ.3 power supply

Stereo 25 pre-amp/control unit

1967 Micromatic Q.14 loudspeaker; the first Neoteric

1968 IC.10, the first ever integrated circuit for constructors use

1969 Q.16 - improved version of Q.14 Systems 2000 and 3000: Project 60 launched

1970 IC.12 Project 605

1971 Project 60 stereo FM tuner, Z.50 PZ 8

Improvements to Project 60 with Z.50 MK.2 and PZ.8 Mk.3 The Executive Calculator: Digital multi-meter Q.30 speaker

Cambridge Calculator PROJECT 80 LAUNCHED

...and.next?

Project 80 active filter unit

This efficiently designed unit makes a highly desirable part of any worthwhile system where inputs may be from record, radio or tape. As with Stereo 80, separate controls are applied to each channel thereby making it easier to obtain ideal stereo balance in any kind of indoor environment

TECHNICAL SPECIFICATIONS

Size $-108 \times 50 \times 20$ mm ($4\frac{1}{4} \times 2 \times \frac{2}{4}$ ins)

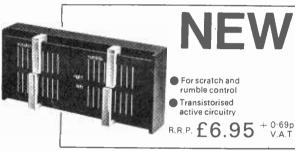
Voltage gain - minus 0 2dB

Frequency response - 36Hz to 22KHz, controls minimum

Distortion - at 1 KHz - 0.03% using 30V supply

HF cut off (scratch) - 22KHz to 5.5KHz, 12dB/oct_slope

L.F. cut off (rumble) - 28dB at 20Hz, 9dB/oct, slope



Z.40 & Z.60 power amplifiers totally short-circuit proof

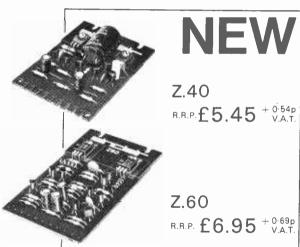
Either of these entirely new power amplifiers is intended for use in Project 80 installations although, of course, they are readily adaptable to an even wider range of applications. Both Z.40 and Z.60 incorporate builtin protection against shortcircuiting and risk of damage arising from mis-use is greatly reduced. Comprehensive instructions are supplied with each of the modules.

Z.40 Technical Specifications Size $-55 \times 80 \times 20$ mm (21 × 31 × 1 ins) 9 transistors Input sensitivity - 100 mV Output - 15 watts RMS continuous into 8 Ω (35V), 30 watts music power into 4 Ω (30V) Frequency response - 10Hz-100KHz±1dB Signal to noise ratio - 64dB Distortion - at 10 watts into 8 Ω

less than 0.1% Power requirements - 12-35 volts

Z 60 Technical Specifications Size $-55 \times 98 \times 20$ mm $(2\frac{1}{8} \times 3\frac{3}{8} \times \frac{3}{8} ins)$ 12 transistors Input sensitivity - 100-250mV Output - 25 watts RMS into 8 Ω (45V). 50 watts music power into 4 Ω (50V) Distortion - typically 0 03% Frequency response - 10Hz to more than 200KHz±1dB Signal to noise ratio - better than 70dB Built-in protection against transient overload and short

Load impedance - 40min; max. safe on open circuit



Sinclair power supply units PZ.8

the worlds most advanced unit in its class

Stabilised power supply unit Reentrant current limiting makes damage from overload or even direct shorting impossible, a principle never before inorporated in a commercially available constructor module. Normai working voltage (adjus table) 45V.

R.R.P. £7.98 + 0.79p V.A.T. Without mains transformer PZ.5 30V unstabilised R.R.P. £4.98+0.49p V.A.T. PZ.6 35V. stabilised R.R.P. £7,98+0.79p V.A.T.

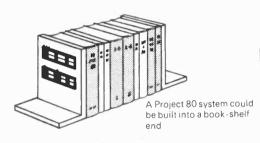


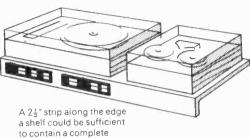


Recommended Project 80 applications System The Units to use Units cost Simple battery record player **Z.40** £5.45 +54p V A T Mains powered record Z.40, PZ.5 £10.43 player +£1.04 V.A.T 30W. RMS continuous 2×Z.40s, Stereo £30.83 sine wave stereo amp 80; PZ.6 +£3 08 V A.T 50W (8 Ω) RMS continuous 2×2.60s Stereo £33.83 sine wave de luxe stereo 80; PZ.8 +£3 38 V A.T amplifie Z.60, PZ.8 £14.93 Indoor P.A +£1.49 V.A.T. Car Radio F.M. tuner. £16.40

From Sinclair the worlds most advanced hi-fi modules

Sinclair Project 80 the ultra-modern non-obtrusive hi-fi







The modules mount very easily onto a playing plinth



A novel application would be to build around the base of a lampshade



Two Sinclair Q.16 loudspeakers suitably positioned together with Project 80 could be mounted on to a false wall.

When you have seen for yourself how fantastically slim and cleverly designed these modules are, further ways will suggest themselves in which they can become a pleasing part of your particular domestic environment.

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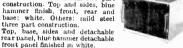


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Model 320

Dimensions	in	inches.	
Nr. 1.1			-

Model 120 220 221 320	W 8 8 8 12	H 21 6 6 6 8 8	D 6 31 6 12	Price £1.85 £2.65 £2.80 £5.00
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SAJ110 7-stage frequency divider in one 14 pin DIL
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CAPACITORS

Axial lead electrolytic Mid V Price Mid V Price V Price 6.3 6p 16 6p 63 10p 4 6p 10 6p 40 6p 63 12p 6.3 6p 10 6p 65 6p 6 63 6p 63 6p 63 6p 63 6p 63 6p 63 6p 25 6p 63 6p 10 6p 63 6p 68 Mfd 470 470 470 470 680 680 680 v Price 100 100 6.3 ßr 100 100 25 40 6·3 16 25 40 4 10 16 150 150 6-3 6p 16 6p 25 6p 40 10p 63 12p 4 6p 10 6p 16 6p 25 10p 40 12p 150 150 150 680 220 220 220 1000 1000 1000 1000 25 6·3 10 16 6·3 10 6·3 22p 12p 18p 22p 18p 22p 1500 1500 220 63 18p 4 6p 10 6p 16 10p 220 1500 2200 2200 3300 4700 330 330

Tantalum Bead

Mfd	V	Price	Mfd	V	Price	
0.1	35	12p	10	16	14 p	
0.22	35	12p	10	25	16p	10
0.47	35	12p	15	16	16p	T I
1.0	35	12p	22	16	16p	
2.2	35	12p	47	6.3	16p	
4-7	35	14p	100	3	16p	

Trimmers, compression tune

		P. 000.	c, pc	
3 to 40pF 30 to 140pF	13p 13p		250pF 500pF	18p 21p

Bilver Mica $50\text{pF} \pm 1\text{pF}$, ≥ $50\text{pF} \pm 1\%$ $2\cdot 2\cdot 3\cdot 3\cdot 5\cdot 10\cdot 18\cdot 20\cdot 2\cdot 2\cdot 2\cdot 5\cdot 27\cdot 30\cdot 33\cdot 39\cdot 47\cdot 50\cdot 56\cdot 68\cdot 75\cdot 82\cdot 100\cdot 120\cdot 150\cdot 180\cdot 200\cdot 220\cdot 70\cdot 20\cdot 20\cdot 30\cdot 30\cdot 30\cdot 30\cdot 30\cdot 30\cdot 50\cdot 690\cdot 680\cdot 620\cdot 89\cdot 1000\cdot 1500\cdot 109\cdot 1800\cdot 119\cdot 2200\cdot 139\cdot 270\cdot 189\cdot 3600\cdot 189\cdot 4700\cdot 5000\cdot 209\cdot 6800\cdot 279\cdot 8200\cdot 10\cdot 000\cdot 34p\cdot 4700\cdot 5000\cdot 209\cdot 6800\cdot 279\cdot 8200\cdot 10\cdot 000\cdot 34p.$

MIXED DIELECTRIC

1000VDC; 300VAC; Non-inductive. 0-001uF, 0-0022uF, 0-0033uF, 0-0047uF 7p; 0.01uF, 0-022uF 10p; 0-047uF, 0-1uF 12p; 0-22uF 23p; 0-47uF 30p.

POLYESTER FILM METALLISED 250VDC 0.01uF, 0.015uF, 0.022uF 3p; 0.033uF, 0.047uF, 0.068uF 34p; 0.1uF4p; 0.15uF 44p; 0.22uF 5p; 0.33uF 7p; 0.47 84p; 0.68uF 12p; 1uF 14p; 1.5uF 21p; 2.2uF 25p.

PLUGS AND SOCKETS



DIN PLUGS	
2 pin (1 flat)	8p
3 pin	9p
4 pin, 5 pin	A
(180°), 5 pin	В
(240°), 6 pin	10p
1	

DIN Sockets
2 pin 6p
3 pin, 4 pin, 5 pin
A (180°), 5 pin B
(240°), 6 pin 7p

P360 3 pin 1.5A chassle plug with line socket. Per pair 24p SA 2190 3 pin 5A chassis plug 17p chassis plug 17p SA 1862 Line socket McMURDO RP8 8 way plug URDO 8 way chassis 36p

PHONO Plug plastic Plug screened Chassis socket

JACK Std. ½" mono plug Plastic 13p Screened 17p

Std. ‡" stereo plug Plastic 18p Screened 25p Open mono socket ‡" 10p; Moulded mono socket ‡" with 2 break contacts 13p; Moulded stereo socket ‡" with 3 break contacts 18p; 3-5mm. plug plastic 8p; screened 11p; open socket 8p.

WIRE & CABLES

Hook-up wire. 7 strand 0-2mni. PVC covered Hook-up wire. 7 strand 6-2mm, PVC covered tinned copper wire for light general con-nexions up to 1-4A. 11 colours: black, blue brown, green, grey, orange, plnk, red, violet white, yellow. 10 metres of any one colour 15p. Pack of 11 (1 of each colour) 10m. colls \$1-50.

Single core screened 6p per metre. Twin individually screened 8p per metre. High quality single screened 50 Ω 100pF per metre, ideal for high grade audio connexions 11p per metre.

Extra flexible 55 strand 0·1mm. PVC covered plain copper wire rated at 6A. Ideal for test leads etc. Red or black 4*p per metre.

Mains 3-core miniature 2.5A black PVC covered 13 strand 0.2mm. per conductor 7½p per metre.

POTENTIOMETERS

Rotary minlature carbon track \ spindle

Single gang Lin or Log 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M (and 1k Lin) 12p



Dual gang (Stereo) without switch Log or Lin 5k to 2M as above 38p.



Single gang with DP switch 250V 2A Log or Lin 5k to 2M as above 23p



PRESETS PRESETS
Sub-miniature 0·1W
Vert or Horiz
100, 250, 500, 1k,
2·5k, 5k, 10k, 25k,
50k, 100k, 250k,
500k, 1M 6p



Wirewound 10% 1W \(\frac{1}{2}\)" spindle 10, 50, 100R 34p; 250, 500, 1k, 5k 33p; 10k, 37p; 25k 40p; 50k 44p.

KNOBS

All 1" shaft. Grub screw flxing

Diameter shown in brackets

K30/1 K30/3 K30/2 (13mm) (17mm) (13mm) 24p 22p 26p



BK12 32mm long, black pointer with

K30/6 (\$2mm)

F12 (33mm) 21p

white stripe 6p

F18 (26mm) with number ed akirt 21p











CK4 (36mm)

SWITCHES

Rotary with adjustable stop 1 pole 2 to 12 way; 2 pole 2 to 6 way; 3 pole 2 to 4 way; 4 pole 2 or 3 way, each 24p. Mains rotary DPDT 250V 2A 20p.



non-locking 12p

Toggle 250V 1.5A with ON/OFF plate 25p.

Blide Miniature DT 9p



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Sub-miniature toggle DPDT (12 × 12.5 × 14mm excl. $(12 \times 12.5 \times 14 \text{mm} \text{toggle}) 250 \text{V} 3 \text{A} 61 \text{p}$

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Carbon Film W	5% 11 Ω to 910k	E12 &	
Carbon Film 1W	5% 10 Ω to 10M		E12 3
Metal Oxide W	2% 10Ω to 1M	E12 &	
Wirewound 2 W	10% 0.220hms to 0.470hms		E12 10
Wirewound 21W	5% lohm to 270ohms		E12 10
E12 volues 10, 19	15 19 90 97 20 20 47 Fe	00 00	

E12 values 10, 12, 15, 18, 22, 27, 33, 39, 47, 50, 65, 52 and decader E24 values 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and decader

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CENTRIFUGAL BLOWER

CENTRIFUGAL BLOWER
Ministure mains driven blower centrifugal type blower
unit by Woods. Powerful but specially built for quiet
running—driven by oushloned induction motor with
specially built low noise bearings. Overall size 44" × 4".

4". When mounted by flange, air is blown into the
using clamp. Ideal for cooling electrical equipment or
fitting into a cooker hood, film drying cabinet or for
removing flux smoke when soldering sto., sto, A real
bargain at \$3.05.



MIGHTY MIDGET

Probably the timest possible radio, as described in Practical Wireless, January 73. All electronic parts \$3.80 post paid.

TAPE PLAYBACK UNITS

TAPE PLAYBACK UNITS
Mains operated. Made by Reditune the famous
"music in background people". These are complete units for playing tape at standard speed (8½").
These have a superior motor driven dy wheel to
control the tape through the capstan and also an
even equally useful valve amplifier with EL84
output. In a steel case with carrying handle.
Tested and good working order 88-50, or some in
need of repair but complete 88-50, cassettes of
tape pre-recorded \$1-10 (please state type of
music required.) 75p carriage up to 200 miles than
50p per 100 miles extra.



6 MAINS TRANSFORMERS

6 MAINS TRANSFORMERS
Our Ref: MTM127 voit at 8 amp. Upright mounting fully shrouded—flying leads—fully tapped primary. Price \$88.0.
Our Ref: MTM2 12v at 1 amp. Upright mounting with fixing lugs, tag connection, 240v primary—12v 1 amp secondary. Price 38p.
Our Ref: MTM2 8-3v 2 amp upright mounting with fixing lugs, tag connections, 240v primary 6-3v 2 amp secondary. Price 77p.
Our Ref: MTM2 8-3v 1 amp with thermal cut-out, upright mounting with fixing lugs—Lag connections. Primary 240v, secondary 18v at 1 amp. Price 88p.
MAINS IBCATTON 250 watts earth shielded—flex leads—upright mounting lugs for fixing terminals for output. Price \$8.0 each.
MAINS IBCATTON 250 watts carth shielded—flex leads—upright mounting lugs for fixing terminals for output. Price \$8.00 each.
MAINS TRANSFORMER BARGAIS. Standard mains 240v input. Secondary 24v 9 amp intermittent. 6 amp continuous. Price 55p.



Just what you need for work bench or lab. 4 × 13 amp. sockets in metal box to take standard 13 amp. fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work, \$2.50 plus 20p post and ins.

24-HOUR TIME SWITCH





For any lamp up to like. Mounted on switch plate to fit in place of standard switch. Virtually no radio interference. Price 52.95 plus 20p poet and insurance. Industrial model 5A 28-30. (Not on plate).



THIS MONTH'S SNIP .

WALL THERMOSTATS. Made by the famous Smiths Instrument Co. called Colourstat. Wall mounting and in a handsome plastic case. (Cream called Coloursas. Wall mounting and may be set to control 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 idea; for living room, bedroom and greenhouse, etc. Price \$1.65. Don't miss this.

TWENTYLITE

Fluorescent lighting units with polyester choke and finished white enamel. 40ins. model. Ideal kitchen, bedroom, hallway, porch, lift, etc., with tube. Assembled ready to install. Price \$8.30 + 40p p. & p.

10 AMP DIMMER/CONTROLLER

For the control of lighting of stage or studio or portable equipment in workshops etc. This has socket outlets equipment in workshops etc. This has socket outlets each controlled by 5 AMP Solid State regulator. Also fitted with master switch fuse and neon indicator and terminating with 6 feet of flex. Overall length 17in. 3½in. x 1½in. deep. £7-50, plus 25p P. & P.

TANGENTIAL HEATER UNIT

TANGENTIAL HEATER UNIT
This heater unit is the very latest type, most
efficient, and quiet running. Is as fitted in
Hoover and blower heaters coating 216 and
more. We have a few only. Comprises motor,
impeller, 2kW, element and lkW, element
allowing switching 1, 2 and 3kW, and with
thermal safety cut-cut. Can be fitted into
thermal safety cut-cut. Can be fitted into
any metal line case or cabinet. Culy needs on the switch 439, P. & P. 40p.

TERMS: 10% discount if ten of au item ordered, send postage where quoted—other items, post free if order for these items is \$6.00 otherwise add 20p.



NEW ITEMS THIS MONTH

VOLTAGE CHARGIEG TRANSFORMERS made by Parmako, Upright mounting, fully shrouded and with terminal blocks for input and output. For changing mains voltage, ideal for working low voltage equipment from 230/240 mains and for increasing voltage due to losses in long leads. Voltage up or down between 190-250v, 250 watts. Price 51-58 plus 30p post, etc.

DOG OPERING OR FLATFORM ROTATING

DOOR OPENING OF PLATFORM MOTATHS MOTORS, Very powerful motors estimated rating at # H.P. Reversible with gearbox and "V" belt drive wheel of ?" diameter. Price of motor which weighs approx. 16bs. is \$10. Note. These are ex-equipment but guaranteed for six

"Y" beit drive wheel of 7" diameter. Frice of motor which weighs approx. 15bt. is \$10. Note: These are ex-equipment but guaranteed for six months.

Gas and Smoke detector/Sensor—ref GDI—recently referred to as the electronic nose—\$28 each; circuit of smoke detector alarm included. Constructional details appeared in September's Practical Wireless, so we can supply the \$L.03D each constructional details appeared in September's Practical Wireless, so we can supply the \$L.03D each \$1.78, the ZN614 at \$1.85 also most other items, send for PW 10 radio parts list.

FPRING RETURN WAFER SWITCH. As used in intercom and other similar equipment a two wafer \$0 pole \$ way switch, spring return from centre position when turned anti-clockwise. Price 55p each.

A.G. BUZZERS, 12v. Fix these into a box which will resinate and they will give a loud piercing note, Suitable for alarms or signal, 33p each.

PUSH ON TAG CONNECTORS. These are being increasingly used on cars and domestic appliances. 2 sizes prevail, the most popular being for \$\frac{1}{2}\$ tag. We offer these at attractive prices. 10 for 10p. 50 for \$0p. 100 for 70p and 1,000 for \$5.

MISIUTE TIMED ON SWITCH by Smiths. Our ref. TS AUI. This is for processing photographic plates, etc. Has a scale graduated 0-4 min. Turn the pointer knob, and set it at the desired time—switch will stay closed until pointer knob leate forms in the switch these its double pole, ratec 250v. 15 amps Price \$1.8p.

OUT ref. TS AU2. As TS AUI except that the complete rotation of the pointer knob leats for one hour. Price \$1.10p each.

COUNTER, 3 DIGIT. Belt, rubber band or friction drive, as fitted to Tape Recorders and similar. Counts or takes away up to 999. Resettable from any count by processing knob.

DRILL CONTROLLER

DRILL CONTROL NEW IKW MODEL Electronically changes CONTROL

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Eti includes all parts, case, everything and full instructions. \$1.95. model also available. \$2.95 .

Made up model also available. \$8.96.

MAINS TRANSISTOR P. P.

Designed to operate transistor sets and amplifers. Adjustable output 6v., 8v., 12 volts for up
to 500mA (class B working). Takes the place of
any of the following batteries: PPI, PPS, PP4,
PP6, PP7, PP9, and others. Kit comprises: mains
transformer rectifier, smoothing and load resistor
condensers and instructions. Beal snip only \$1.10.

STEREO PRE-AMP MODULE Mullard ref LP 7182/2—transistors and all ancillary components mounted on PC board 31-38 with connection dig.





DRILL SPEEDS

15A ELECTRICAL

PROGRAMMER
Learn in your sleep:
Have radio playing and
kettle boiling as you
swake — switch on
lights to ward off intruders — have a warm
house to come home to.
All these and many
other things you can do
by famous maker with 15 amp. on/off switchswitch-on time can be set anywhere to stay on
up to 6 hours. Independent 60 minute memory
jorger. A beautiful unit. Price \$8:16 + 20p p. & p.
or with glass front, chrome bezel, 85p extra.
THERMAL CUTOUT
A miniature device §" dis. on one screw fixing

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A ministure device if dis. on one screw fixing
mount—can be used for motor overload protection
—fire alarm-soldering iron—switch off, stc., etc.
15 amp contacts open with flame—radiant or
conducted heat. 11p each or 10 for 99p.

HONEYWELL PUSH BUTTON

HONEYWELL PUSH BUTTON MICRO SWITCHES
As used in some vending machines, etc. Each switch is a charge-over type rated at 16 amps 200 v A.C. intended for panel mounting with fixing not and single black push knob. Single change-over switch 28p. Double switch 48p. Triple switch 61p.

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MACLAREN 10 amp A.C. with the sensor

Make and break 20 amp A.C. with the sensor probe coupled by 3 feet capillary covering range of 10—100°C—complete with large engraved control knob. Price 88p.

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-1												
ı	OA2		8 6BE6		6LD20		128H7	. 35	150C5	- 29	1 E1820	201
	OB2	. 8				. 60	128J7	. 44				
1	OZ4	.4		. 89	6Q7G	.44	128K7		50EH5			
-	1A3	- 41				.47	12807	- 55				
1	lasgt		9 6BR7	.90	6Q7(M	.55	14H7	- 55		. 48		ໍຄຄາ
	1A7GT					.60	1487	. 75		-40		
	1 B 3 G T		6B87	1 · 40		.75		. 42		.59		
	1 H5GT					. 85	19G6	1.40		1 . 70	EAF8	
	1L4	.14		.50	68C7G		20D4	2.00		.58		٠.
	1N5GT			49	6807	. 39	20F2	. 67		. 59		•
	1R5	. 28	6CB6.			. 44	20L1	. 80		-80		٠.
	184	. 88	6C4	. 28	68J7G		20P1	. 55		. 50		
	1U4	. 44		1.00			20P3	.75		.70		
	lU5	. 80	6CD6	G .80	68Q7G	T.88	20P4	.80				
	2D21	.44	6CG8/	.75	6U4GT	.70	20P5	. 95		EN/	EBF89	
	GK5	- 55	6CH6	. 55	6V6G	.17	25A6G		DD	. 98		
	3A 4	.86		.46	6V6GT	. 27	25L6G	. 88		N . 28	EC86	
	BD6	.19	6CM7	-75	6X4	. 27		.20				•
	3Q4	.49	6CU5	.75	6X5GT	. 28	25 Y 5 G	.70	AC/TP	.98		
	3Q5GT	. 55		.70	7B6	. 75	25Z4G	.88	AL60	.78	ECC33	11
	884	. 26		.75	7B7	.50	25Z5	.60	ATP4	. 40		
	ICB6	-55	6DT6	.75	7H7	. 55	25Z6G	.70	AZI	.40	ECC40	
	SCG8	-55	6EW6	. 75	7R7	1.50	28D7	1.00	A Z31	.46	ECC81	
	T4	-80	6E5	.75	7Y4	. 65	30A5	.65	AZ41	.58	ECC82	
	U4G	-80	6F1	.70	7Z4	.80	30C15	. 58	CL33	. 90		
	V4G	. 35	6F6G	. 85	9D7	. 40	30C17	. 76	CV63	. 58	ECC84	
	Y3GT	. 80	6F13	. 45	10C2	. 65	30C18 30F5	. 70	CYIC	. 55	ECC85	
	Z4G	84	6F14	.40	10DE7	. 55		.61	CYSI	. 29		- ::
	Z4GT	- 38	6F18	. 55	10F1	.50	30FL1	.58	DAF91	. 22	ECC88	
	/30L2	. 55	6F23	. 65	10F9	.65	30FL2	.60	DAF96	. 36	ECC18	9 . 4
	A8G	. 44	6F24	. 60	10F18	. 55	30FL12	.69	DC90	.60		
	AC7	.15	6F25	.51	10LD11	.70	30FL13	.50	DF91	.16		
	AG5	. 27	6F28	. 60	10P13	. 54	30FL14	. 66	DF96	.88		. 2
	AH6	.50	6F32	.80	10P14	2.00	30L15	.55	DH63	.44		. 2
	AJ5	. 75	6GH8A	.75		1.00	30L17	. 65	DH76	. 45	ECF86	.6
6	AK5	. 27	6GK5	-65	12AC6	.55	30P4MR		DK 40	. 55	ECF80	
	AK6	.60	6GU7	. 75	12AD6	.60	30P12	.69	DK92	.50		2.1
6	ABMA	- 55	6H6G7	18	12AE6	.60	30P19/	!	DK96		ECH21	. 6
6	AN8	- 49	6J5GT		12AT6	.28	30P4	-85	DL92		ECH35	. 5
6	AQ5	.22	6J6	. 20	12AU6	. 38	30PL1	.57	DL96		ECH42	.5
	ARS	- 55	6J7G		12AV6	. 28	30PL13	. 75	DM70		ECH61	. 2
6	A87]	L • 00	6J7(M)		12BA6	.80	30PL14	. 75	DM71		ECH83	. 3
6	AT6	. 80	6JU8A		12BE6	.80	30PL15		DY87/6		ECH84	.8
6	AU6	. 28	6K7G		12BH7		35A3		DY802		ECL80	. 2
	AV6	.88	6K8G		12J7GT		35 D5		E80CC	1.85	ECL82	. 2
6	AW8A	. 65			12K5		35L6GT				ECL83	. 5
6.	AX4		6L6GT		12K7GT	.88	35 W 4				ECL84	. 54
6	B8G		6L7		12Q7GT		35Z4GT		E88CC		ECL85	.5
	BA6		6L18		128C7		35 Z5GT		E92CC		ECL86	.8
6	BC8		6L19	2.00			50B5	. 35	E180F		EF22	. 61

	EF40	.49	GZ37 .67	PEN453DD	UF41	.50	AA129	-17	BC108	-14	OAS	-1
	EF41	. 58	HABC80.44	98	UF42	.60	AAZ18	-20	BC113	-28	OA10	- 4
	EF42	. 88	HL23DD.40	PENDD-	UF80	. 25	AC107	-17	BC115	.17		-1
ł	EF73	- 75	HL41DD.98	4020 .88	UF85	.34	AC113	-28	BC116		OA47	
1	EF80	. 23	HL42DD.50	PFL200 50	UF86					.28	OA70	-1
1	EF93	. 54	HN309 1-40			. 68	AC126	-14	BC118	-85	OA73	-1
I	EF85				UF89	. 27	AC127	·19	BCY10	-50	OA79	-1
1		. 28	HVR2 .58	PL36 .46	UL41	. 54	AC128	- 22	BCY12	-55	OA81	-1
ı	EF86	. 27	HVR2A .58	PL81 .48	UL84	. 28	AC182	-22	BCY33	-22	OA85	-0
ı	EF89	. 23	KT2 .25	PL81A .48	UMBO	. 88	AC154	-28	BCY34	-25	OA90	٠i
1	EF91	.17	KT41 .98	PL82 .81	UY41	. 88	AC156	-22	BCY38	-25	OA91	٠î
1	EF92	.80	KT44 1.00	PL83 .80	U V 85	.28	AC157	.28	BCY39	-28	OA95	-1
	EF97	-55	KT66 .80	PL84 .28	U10	. 45	AC165	-28	BCZ11			
	EF98	. 65	KT81 2.00							42	OA200	-1
	EF183	. 25		PL504/500	U12/14	. 88	AC166	-88	BF158	-82	OA202	-1
	EF184		KTW61 .68	-60	U19	1.78	AC168	-42	BF159	-28	OC22	-4
i		. 27	KTW62 .68	PL508 .90	U25	. 65	AC176	-61	BF163	-22	OC23	-4
Ì	EF804	1.20	KTW63 .50	PL509 1.00	U26	.60	AC177	-81	BF173	4.2	OC24	-4
I	EH90	. 84	MHLD6 .75	PL802 .85	U191	65	ACY17	-28	BF180	-88	OC25	-4
ľ	EL32	- 50	P61 .40	PV33/2 .50	11251	89		-22	BF181		OC35	- 8

.45		7 PEN453DD	UF41 .50	AA129	-17	BC108	-14	OAS	-14
. 58		498			-20	BC113	-28	OA10	-47
. 88	HL23DD.40	PENDD-	UF80 .85		.17	BC115	.17	OA47	11
. 75	HL41DD.9	4020 .88			-28	BC116	-28	OA70	-17
. 28	HL42DD.5				14	BC118	-25		-17
. 54					19	BCY10	-50	OA78	
. 28					-22	BCY12		OA79	·10
.27					-22		-55	OA81	.10
. 23					-28	BCY33 BCY34	·28	OA85	.09
.17					-28	BCY38		OA90	-14
.80	KT44 1.00				-28	BCY39	-25	OA91	·10
-55					-28		-28	OA95	.10
. 65	KT81 2.00					BCZ11	-42	OA200	-10
. 25	KTW61 .68		U12/14 .88		-28	BF158	-82	OA202	-11
27	KTW62 .68		U19 1.78	AC168	-42	BF159	-28	OC22	-42
.20	KTW63 .50		U25 .65	AC176	-61	BF163	-22	OC23	-42
. 20 . 84	MHLD6 .78				.81	BF173	-42	OC24	-42
. 50					.58	BF180	-88	OC25	-42
. 48				ACY18	-22	BF181	-44	OC35	-85
.00	PABC80 .82		U301 ·40	ACY19	-21	BF185	-44	OC36	-47
. 74 • 74	PC86 .44		U403 .88	ACY20	-20	BF194	-17	OC44	·11
.58	PC88 .44		U404 .38	ACY21	-21	BFY50	-85	OC45	·18
	PC95 .58		U801 .76	ACY22	.17	BFY51	-21	OC46	.17
. 50	PC97 .86		U4020 .55	ACY28	-20	BFY52	-22	OC70	-14
88	PC900 .29		VP23 .40	AD140	-40	BY100	-20	OC71	·12
. 28	PCC84 .29	PY800 .81	VP41 .38	AD149	-55	BY105	-20	OC72	·12
40	PCC85 .24		VT61A .35	AD161	-50	BY114	-20	OC74	-25
88	PCC88 .89		VU111 .44	AD162	-50	BY126	.17	OC75	-18
38	PCC89 .48		VU120 .60	ADT140	-69	BY127	-20	OC76	.17
32	PCC189 .48	1.20	VU120A .60	AF106	-55	BYZ10	-28	OC77	-80
20	PCF80 .26	Q875/20 .68	VU133 .85	AF114	-28	BYZ11	-28	OC78	·17
-75	PCF82 .80	Q895/10 .49	W107 .50	AF115	.17	BYZ12	.28	OC78D	-17
87	PCF84 .40	QV04/7 .68	W729 .60	AF117		BYZ13	-28	OC81	-12
87	PCF86 .44	R19 .28	X65 .50	AF121		CG12E	-22	OC81D	-12
75	PCF200 .67	TH233 .98	X66 .50	AF124		PSY11A		OC82	-18
81	PCF801 .40	TP2620 .98	Transistors	AF125		F8Y41A		OC82D	·12
00	PCF802 .87	UABC80 .80	& Diodes	AF126		GD9	-22	OC83	-22
49	PCF806 .55	UAF42 .49	2N 404 -20	AF139		GET113		OC84	-26
85	PCH200 .68	UBC41 .45	2N966 -58	AF178		GET118		OC128	- 25
35	PCL82 .29	UBC81 .40	2N1756 -55	AF180		GET119		OC139	-25
54	PCL83 .54	UBF80 .88	2N2147 -94			GET587		OC169	-25
50	PCL84 .38	UBF89 .33				GET873		OC172	-89
27	PCL805/85		2N2297 -25			GET887		OC200	-24
40	.55		2N2369 -24			GET897		OC200 OC201	42
10	PCL86 .36		2N2613 -48			GET898		OC201	33
12	PD500 1.44		2N3053 -36			MI MI			
19	PEN4DD	UCC85 .88	2N3121 2.75				34	OC204	*88
0.5	PENAUD 1 99	UCF80 .81	2N3703 -21	DC101	141	UAD	-81	OC205	·47

PCF84 40 Q V04/7
PCF86 44 R19
PCF200 67 TH233
PCF801 40 TP2820
PCF802 27 UABC30
PCF806 .55 UAF42
PCH200 .68 UBC41
PCL82 29 UBC41
PCL83 .54 UBF89
PCL80 .55 UC92
PCL86 .36 UC94
PD500 1.44 UC936
PD500 1.44 UC936
PEN4D UC980
PEN4D UCH42
PEN4D UCH42
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INDEX TO ADVERTISERS

A. H. Supplies				68	3, 693
A.L.S	•••				693
A.S.P. Ltd.			• • • •		598
Adcola Product	s Ltd.			•••	593
Adfonic	•••				693
Ambit Internati	onal	•••			682
Amtron U.K.	• • •	• • •	`		627
Antex Ltd.		•••	• • • •		655
B.H. Componen	t Fact	ors Ltd	1		670
B.R.B					693
Baines, R					690
Baker Loudspea	kers L	.td.		***	632
Bells Television	Service	ces			690
Bentley Acousti			n		695
Bernard, Gerald					598
B.I.E.T			598	3, Cov	er iii
Bi-Pak Semicono	luctor	S		604	1, 605
Bi-Pre-Pak Ltd.	•••				681
Barrie Electroni	C\$			• • •	667
Boffin Projects			• • •		692
British Nationa			lectro		
School Bull, J. (Electrica	:::			623	. 676
Bull, J. (Electrica	il) Ltd	• • • •		• • • •	694
Bush & Meissner		***		•••	600
Bywood Electro	nics	•••	•••		592
C.T. Electronics					693
Caranna, C.	•••				690
Carreras Rothma	an Ltd	./Picca	dillv		er iv
Chiltmead Ltd.					608
Codar					589
Codar Colomor (Electr	onics)	Ltd.			684
D.E.W. Ltd.					692
Dabar Electronic		ucts		504	. 610
Data Publication	s I td	ucus			590
Denco & Co.				•••	690
Dexter & Co.	•••			•••	656
Douglas Electron	ic Ind	ustrias	Ltd.	•••	682
Electro-Tech Co			ELG.	•••	
Electronic Mail (mpone	ents	•••	• • •	632
Electronic Design	order	Ltd.	•••	•••	693
Electron alone				•••	608
Elekon Enterpris		•••	•••	•••	595
Elvins Electronic	es M	-17		•••	610
FIAIII2 FIECTLOUIC	1710210	aı insti	ument	.5	678

I	Felstead Electronics Francis, J. J. Ltd.				670 590
ı	Galleon Trading				691
l	Global Audio Discount	Ware	houses		602
ı	Greenweld Electronics	•••		•••	590
l	Gregg Electronics	• • •			693
l	HAC Short-wave Produ	ucts			600
ı	Haverson Surplus Co. Heath (Gloucester) Ltd	Ltd.	•••	•••	669
l	Henry's Radio Ltd.	I. Caman			599
ı	Home Radio (Compone	nte) I	11, 500	5, 587,	631
ı	I.C.S.	ilics) Li	.u.	•••	
ı	I.L.P. (Electronics) Ltd.	•••	•••	683,	
ı	Imhofs		•••	• • •	603
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					196
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	Multicore Solders Ltd			• • •	598
			••		662
					693
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50L6GT 0.60	DL96 0.55	ECC83 0.88	EF89 0.28
85A2 0.60	DM70 0.60	ECC84 0.80	EF91 0.87

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	EF92	0.50	HK90	0.50	PL33	0.40 i		0.70
ı	EF95	0.40	KT66	2.50	PL36	0.55		0.80
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ļ	EF98	0.75	KT88	2.90	PL82	0.45		0.40
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1	EL83	0.50	PCC88	0.55		0.40	UC92	0.45
1	EL84	0.28	PCC89 PCC189	0.50	PY31 PY33	0.63	TCC85	0.45
-	EL85	0.43	PCC80		PY80	0.40	UCF80	0.70
J	EL86	0.40	PCC80		PY81	0.30	UCH21	0.60
ı	EL90 EL360	0.45 1.25	PCF80	0.80	PY82	0.35	UCH42	0.75
-	EL822	1.60	PCF82	0.35	PY83	0.38	UCH81	0.40
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. 1	EM84	0.85	PCF80		PY801	0.50	UF9	0.65
1	EM85	1.00			PZ30	0.88	UF11	0.60
. 1	EM87	0.70	PCF80		QQV02	-6	UF41	0.65
1	EN91	0.40	PCF80	5 0.90	' '	8.00	UF42	0.65
	EY51	0.45	PCF80	60.75	QQVO		UF43	0.65
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	EY83	0.55	PCH20		TT21	4.20	UF85	0.40
ч	EY86	0.40	PCL81		TT22	4.40	UF89	9.40
1	EY87	0.43			U18/20		UL41	0-65
	EY88	0.43	PCL82		U25	0.85	UL84	0.48
ч	EZ40	0.50	PCL83		U26	0.85	UM84	0.80
Į	EZ41	0.75	PCL84	0.45	USI	0.70	UYIN	0.50
ď	EZ80	0.28	PCL86	0.45	U52	0.40	UY41	0.48
1	EZ81	0.29	PCL88	1.10	U76	0.40	UY82	0.50
1	GT1C	4.00	PCL20		U78	0.40	UY85	0.40
	GY501		PCL80		U191	0.75	W729	0.75
d	GZ30	0.45	PCL80		U201	0.50	XC12	0.60
	GZ31	0.40	PCL80		U281	0.55	Z759	4.00
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2N706	0.10	AC127	0.17 0.15	BF173	0.28
9N708	0.15	AC128 AC132	0.15	BF179	0.80 0.85
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911987	0.45	AC157	0.17	BF194	0.10
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9N1184 2N1302	1.25 0.17	AC188 ACY17	0.25	BF197 BF200	0.12
2N1803	0.15	ACY18	0.20	BFW87	0.25
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2N1305	0.20	ACY20	0.20	BFW89	0.20
9N 1306	0.87	ACY21	0.80	BFW91	0.20
9N1307	0.25 0.85	ACY22 AD139	0.14	BFX88	0.20
2N1303 2N1309	0.80	AD139	0.40	BFY17 BFY19	0.40
2N1613	0.17	AD161	0.85	BFY50	0.20
2N1711	0.20	AD162	0.85	BFY51	0.80
9N1756	0.75 0.75	ADZ11	1.25	BFY52	0.20
9N2147	1.00	ADZ12 AF114	0.17	B8Y26	0.17
2N2160 2N2217	0.25	AF115	0.17	BS Y 27 BS Y 28	0.20 0.17
9N2218	0.20	AF116	0.17	B8 Y 65	0.20
2N2369A	0.15	AF117	0.17	BSY95A	0.12
2N2477	0.65	AF118	0.25	BU105	1.60
2N 2646	0.40	AF180 AF181	0.50 0.50	OC16	1.00
9N 2905 3N 2923	0.82 0.12	AF186	0.40	OC22 OC23	0.50
2N2924	0.13	AFZ12	1.00	OC24	0.60
2N2926	0.10	A8Y26	0.25	OC25	0.25
2N8058	0.20	A8 Y 27	0.80	OC26	0.25
9N3054 9N3055	0.50	ASY28 ASY29	0.20	OC29	0.60
2N3133	0.25	A8Y54	0.25	OC35 OC36	0.65
2N 3134	0.25	A8Z15	0.80	OC42	0.80
2N3391	0.17	ASZ16	0.80	OC44	0.15
2N3392	0.17	ABZ17	0.80	OC45	0.18
2N3893 2N3894	0.15 0.15	A8Z18 BC107	0.80 0.10	OC70	0.10 0.12
2N 3394 2N 3395	0.15	BC108	0.10	OC71 OC72	0.12
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2N3703	0.10	BC158	0.11	OC139	0.80
2N 3704 2N 3705	0.18	BC175	0.20	OC141 OC170	0.60 0.25
2N3706	0.10	BC186	0.25	OC171	0.80
2N3707	0.18	BCY30	0.85	OC200	0.80
2N3709	0.10	BCY31	0.45	OC201	0.60
2N3710	0.10 0.10	BCY33	0.85	OC202	0.65
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