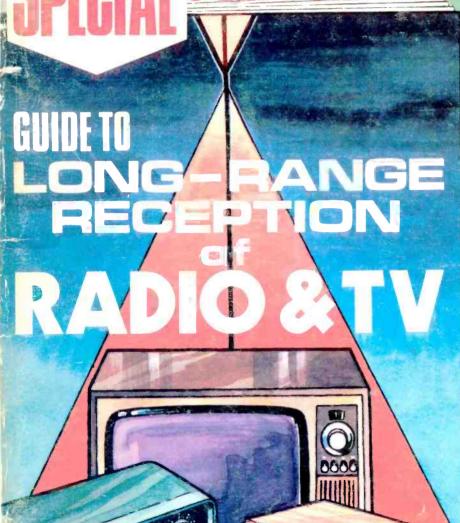
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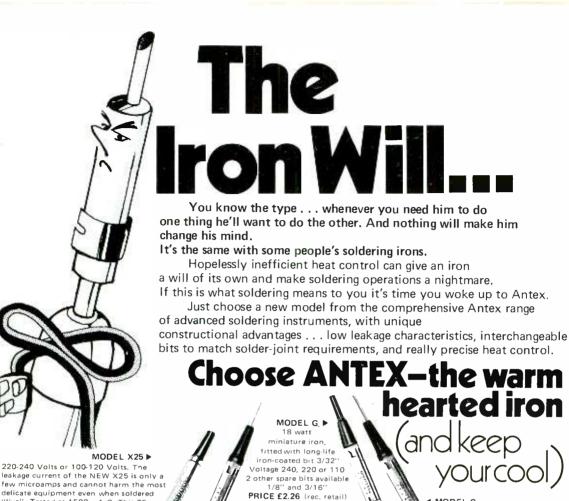
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VOL. 50 NO. 1 ISSUE 807 MAY 1974

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

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

## NEWS & COMMENT

24 100 YEARS ON-Leader article and June preview

25 NEWS... NEWS... NEWS...

34 HOTLINES on recent developments by Ginsberg

47 TELEVISION Coming in the May issue

48 PRODUCTION LINES—Products reviewed by Colin Riches

48 COMING SOON IN P.W.

49 NEXT MONTH IN PRACTICAL WIRELESS

73 ON THE AIR

73 Broadcast Bands, Short Wave-Malcolm Connah

Medium Wave-Charles Molloy 74

VHF/FM—Simon David

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

## CONSTRUCTIONAL

26 OSCILLOSCOPE TRACE DOUBLER-A. Foord

41 TAKE 20 No. 59, Electronic Timer—David Andrews

42 CAR CASSETTE AUDIO BOOSTER-D. Welch

50 EXPERIMENTAL WORKSHOP-M. J. Hughes, M.A.

56 THE MINI-POP Pocket m.w. receiver-F. G. Rayer, G3OGR

59 "P.W. CRATA" Cassette Recorder and Tuner Amplifier Part 3-Richard Collin

## OTHER FEATURES

37 GOING BACK—Marconi Centenary—Colin Riches & Arthur Dow

63 TECHNICROSS No. 4

64 OSCILLOSCOPE TECHNIQUES Part 3-Alan C. Ainslie

## EXTRA WITH THIS ISSUE

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

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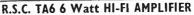
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Model

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ı	BC108	10p	2N1711	24p	1N4003	7p
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Wirewound 10% 1W 4" spindle 10, 50, 100R 34p; 250, 500, 1k, 5k 33p; 10k, 37p; 25k 40p; 50k 44p.

## RESISTORS

	_
Carbon Film 1W 5% 1Ω to 1M; 10% 1.2M to 10M E12	1p
Carbon Film W 5% 1Ω to 10Ω; 10% 1.2M to 10M E12	1p
Carbon Film   W 5% 11 Ω to 910k E12 & E24	1p
Carbon Film 1W 5% 10 Ω to 10M E12	3 i p
Metal Oxide 4W 2% 10 Ω to 1M E12 & E24	4p
Wirewound 21W 10% 0.22ohms to 0.47ohms E12	12p
Wirewound 2½W 5% 10hm to 2700hms E12	12p
E12 values 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and dec	ades

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111

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3 Tunable wavebands, M.W. 3 Timable wavebands, M.W.
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Stereo 21 easy to assemble audio system kit. – no soldering required. Includes

BSR 3 speed deck, automatic, manual facilities together with ceramic cartridge,

Two 8" × 5" speakers with cabinets. Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.

For the technically minded:

Specifications:

Input sensitivity 600mV: Aux. input sensitivity 120mV: Power output 2.7 watts per channel: Output impedance 8-15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs - radio, tape, etc., and outputs for taping discs. Overall Dimensions, Speakers approx.  $\begin{array}{ll} 15\frac{\pi}{2}''\times 8''\times 4''. \text{ Complete deck and cover in closed position} \\ \text{approx.} 15\frac{\pi}{2}''\times 12''\times 6''. \end{array}$  Complete only **£18.95** 

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1) Crystal Mic or Guitar 9mV. 2) Moving coil Mic or Guitar 8mV. 3), 4), 5) Medium output equipment (Gram. Tuner, Monitor, Organ, etc.) all 250mV sensitivity.

AC Mains 240V. operation. Size approx.12 $\frac{1}{2}$  ins  $\times$  6 ins  $\times$  3 $\frac{1}{2}$  ins

£13.50 + 60p.postage & packing.



Elegant self selector push button player for use with your own stereo system. Compatible with Viscount III system, the Stereo 21 and the Unisound module Technical specification.

Mains input, 240V, Output sensitivity 125mV Comparable unit sold elsewhere at £24.00 approx.

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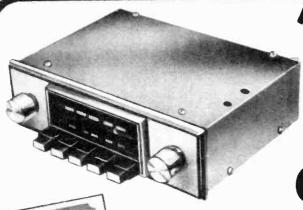


For the man who wants to design his own stereo -here's your chance to start, with Unisoundpre-amp, power amplifier and control panel. No soldering—just simply screw together, 4 watts per channel into 8 ohms, Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum 240V. AC only. £7.64 + 55p. p&p

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Car Radio Kit

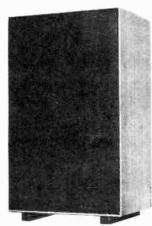
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Speaker including baffle and fixing strips

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20 Hz 20,000 Hz. Impedance 8 ohms.

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DEPT. PW 10, 7 COPTFOLD ROAD **BRENTWOOD FSSEX** 

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FELSTEAD ELECTRONICS (PW79), LONGLEY LANE, GATLEY, STYLI Replacements for virtually all ACOS, BSR, COLLARO, GARRARD, PHILIPS, RONETTE, SONOTONE. Single Tip: Sapphire 16p. Diamond 35p. Double Tip: Can be stereo(LP + 78 or ST/LP + 87LP Sapphire 32p. Double Tip: Diamond ST/LP + 8 perphire 78 65p. Diamond ST/LP + Diamond ST/LP + Experiment ST/LP + STRONIC DIAMOND CONTROL ST/LP + Diamond ST/LP + Diamond ST/LP + Experiment ST/LP + STRONIC DIAMOND CONTROL ST/LP + STRONIC DIAMOND CONTROL ST/LP S

List, 1F IN DOUBTSEND YOUR OLD ONE: IMMEDIATE RETURN GUARANTEED Charges \$p\$ any quantity.

CARTRIDGES. All with styli and fittings. Replacements for ACOS GP/91SC (Mono-Stereo compat. + 78) series at 989. GP93 Stereo + 78, £1:35. GP94 Geramic Stereo + 78 at £1:75. FOR RONETTE DC400/SCM (speed change switch at front for GP67, TC8 + 62. £1:16. SONOTONE 9TAHC (Dia, stylus) £1:98. 9TAHCG (slimmer for many Garrard pick-upp) £2:18. FOR 18R X3H, X5H, X5H, X5H at £1:25 ea, 8X5H, and SX5M at £1:80 ea. TC8H at £1:40. TC8 Stereo (3 pins) £2:00. Charges \$p\$ any quantity.

RECORDING TAPE. 5° 600 ft. 40p. 5'; 900 ft. 55p. 7° 1200 ft. 62p. 5° 900 ft. 57p. 51° 1200 ft. 65p. 7° 1800 £1:05. ALL PINEST BRITISH MYLAR. Charges: 5° and 64° one to 4.9 peach: 5 and over 33p the lot. Charges for 7° 1-3. 11p each. 4 at 5, 33p the lot 6 and over 33p the lot.

one to 4, 9p each; 9 and over 35p the lot. Unarges for 7, 1-5, 11p each, 4 x 5, 50p the lot 6 and over 39p the lot.

PICK-UP WIRE. Super thin, flex send, 2-core 8p yd, 4-core 14p yd, Charges up to 10 yds.

Splot. Over 10 yds. no charges.

Splot. Over 10 yds.

Splot. Ove

Plexible 19p (+ 10p).

EARPIECES. Magnetie, 2.5 or 3-5mm plug. (state which) 13p, CRYSTAL (3-5mm only) 30p (all 9p up to 6).

VIBRATORS, 7-pin SYNCH. (128R7 type) 72p. 4-pin NON-synch. (121H D4) 40p (all 9p \*a.) SEND SAE NOW FOR FREE COMPONENTS LIST.

## poly-planar

20-Watt Full Range Speaker

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



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

£7.50 each Stereo pair £14.50 INCLUSIVE OF VAT AND POSTAGE

## web europa

P.O. Box 162, Watford WD1 1AA

60 Volts

Amps

PAP

£0.30

0.38

0.42

0.52

0.52

0.97

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

126

121

Price

£2.10

2.97 5.77 7.15 9.35 11.55 13.57 16.00

P&P

rn-38

0-38 0-38 0-42 0-52 0-67

0.67

0.82

1.00

#### **New Product CASED AUTO TRANSFORMERS**

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

VA C	Watts	)	Price	Post
200	. 1		25.56	€0.38
500			£9.50	€0-67
1000			£15·92	£0-82
2000			£29·70	€1.50
20 V A	version	m -		
nne	nater	to the	80.50	40.90

## POWER UNIT Type A125

Supplying 6 or 9 Volt DC at 200 mA.

In moulded case forming a 2 pin 5 A mains plug. 2 metre output lead with 4-way multiplug giving 2-1 and 2-5 mm sockets and 3-5 mm plugs.



## Price £2.25, Post 10p



Output switched 3, 4.5, 6, 7.5, 9 and 12 Volts at 500mA D.C. Operates from 240 V. mains, suitable for Radios, Tape Recorders, Record Players, etc. Size  $7.5 \times 5.0 \times 14.0$  cm. Price \$3.95. Post 25p.

#### **ELECTRONIC MAINS TIMER**

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



Max Load 400VA or 1600 watts resistive. Ivory Case  $31'' \times 31'' \times 2''$ . Fitting instructions included.

Trade Price £5-80, Post 20p.

#### PANEL METERS 2" & 4"

Modern Wide View Face, Moving Coil Modern Wide View Face, Moving Coil, Wired for illumination (lamps extra), 50 mA 1250 ohms 1 mA 170 ohms VU 5250 ohms (with Detector) Face Size 60 × 45 × 40mm (2") 110 × 32 × 43mm (4")

PRICE: 2" £2.95 4" £3.95 + POST 10p

## TRANSFORMERS

Price

£2-11

8.08

4-29

5.77

7.48

11.00

14-19

50 Volts

Amps

0.5

Prim. 200-240V.

Sec. 19, 25, 33, 40, 50V. Ref.

103

105

106

107

118

#### SAFETY ISOLATING

	Prim. 120/240V. with Screen.		Sec. 120	/240V. Ce	ntre Tap
	VA	Ref.		ice_	P&P
	(watts)	No.	Cased	Open	£
	60	149		£ 3.74	0.38
	100	150	_	4.16	0.52
	200	151	£ 9.48	7.48	0.52
	250	152	12.05	9.57	0.65
	350	153	14.00	11-44	0.80
ì	500	154	15.80	13.20	1.00
1	1000	156	30.70	27-46	1.20
ı	2000	158	60 95	55-44	
ı	3000	159	79-53	72-49	

12	&	24	Volts	Prim.	200-240V
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$^{\rm Amps}_{12\rm V}$	24V	Ref. No.	Price £	P&P
0.3	0.15	242	1.34	0.22
0.5	0.25	111	1.34	0.22
1	0.5	213	1.59	0.22
2	1	71	2.09	0.22
4	22	18	2.75	0.38
6	- 3	70	8 56	0.42
8	4	108	8.96	0.52
10	ñ	72	4.67	0.52
12	6	116	5-67	0.52
16	, R	17	6.64	0.52
20	10	115	10.23	0.69
30	15	187	13.75	0.97
40	20	232	18-26	1.00
60	30	226	22-52	1.10

#### 30 Volts

Prim.	200 240V.	Sec.	12, 15,	20.	24,	30V
Anips	Ref.		Price			P & 1
	No.		£			£
0.5	112		£1.5	8	4	0.22
]	79		2.2	D		0.38
10	3		3.1	Ð		0.38
3	20		3-9	ŝ		0.42
4 5	21		4.6	8		0.52
5	51		5.80	D-		0.52
6	117		6.9	3		0.52
8	88		9.00	5		0.67
10	89		10.00	)		0.67

## MINIATURE AND EQUIPMENT

Prim. 240V with		,	dilliamps	Ref.	Price	PaP
Sec. 1	Sec. 2	Sec. 1	Sec. 2	No.	£	£
3-0-3		200	_	238	1.23	0.10
0-6	0-15	500	500	234	1.30	0.10
0-6	0-6	1000	1000	212	1.68	
9-0-9		100	1000	13	1.23	0.22
0-9	0-9	330	330			0.10
0-8-9	0~8~9	<b>5</b> 00		235	1.43	0.22
0-8-9	0-8-9		500	207	2.28	0.30
15-0-15	0-3-14	1000	1000	208	3.03	0.10
		40		240	1.23	0.10
0-15	0-15	200	200	236	1.30	0.10
20-0-20	Name of Street, Street	30	1000	241	1.23	0.10
0-20	0-20	150	150	237	1.30	0.10
0-15-20	0-15-20	500	500	205	2.97	0.38
0-20	0-20	300	300	214	1.76	0.22
0-20		3500	NO SCREEN	1116	3.00	0.40
20-12-0-12-20		700 (D/		221	1.55	0.30
0-15-20	0-15-20	1000	1000	206	3-80	
0-15-27	0-15-27	500	500	203		0.38
0-15-27	0-15-27	1000			3.08	0.38
V 10 27	0-10-21	1000	1000	204	2-24	0.38

#### PLASTIC CASED SILICON BRIDGE RECTIFIERS

ı		TOLD SILICO	II DINIDGE	WECHI IEWS
ı	One Amp	Two Amp	Four Amp	Six Amp
Ì	50 P.I.V. 25p 100 P.I.V. 25p	50 P.I.V. 35p 100 P.I.V. 40p	100 P.I.V. 55p 200 P.I.V. 59p	50 P.I.V. 65p 100 P.I.V. 70p
ı	100 P.I.V. 25p 200 P.I.V. 28p 600 P.I.V. 30p	200 P.I.V. 45p 400 P.I.V. 50p	400 P.I.V. 65p	200 P.I.V. 80p 400 P.I.V. 90p
I		ADD 10p P &	P PER ORDEI	}



#### **AUTO TRANSFORMERS (Open)**

VA (Watts)	Ref.	Price	Post
	No.	£	£
	Tapped at 115.	220, 240 Volts	
20	113	£1·32	22p
75	64	£2-63	300
	Tapped at 115.	200, 220, 240 7	
150	4	£3.29	39p
200	65	£3-96	40p
300	66	£4·64	52p
500	67	£8-03	67p
1000	84	£13.50	82p
2000	95	£25·30	£1.00
3000	73	£33.00	£1.20

#### QUALITY INSTRUMENT CASE

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

Two interlocking halves secured Interior Size:  $6\frac{1}{2}'' \times 5\frac{1}{4}'' \times 2\frac{3}{4}''$ 

Wall Thickness: 1' Weight: 113 ozs.

Price: £1.50, Post 15n



PLEASE ADD 10% FOR V.A.T.

BYRE HOUSE . No. 2 UNIT . SIMMONDS RD . WINCHEAP CANTERBURY - KENT - CTI 3RW Canterbury (0227) 52436

## NEW MULLARD & MAZDA VALVES

All individually boxed and guaranteed. Full trade discounts to bona fide companies. Price and availability lists on

## **EXPRESS** POSTAGE

5p for 1 Valve. Each additional Valve add 2p.

application. PC86 0.75 PL84 0.66 30C15/	
FC00 0 /0 1 100 1	1.05
DM70 0-68 EF80 0-46 PC97 0-45 PL508 1-05 30C17	1.00
DV61 0.88 EF83 1.03 PC900 0.56 PL509 1.55 30C18/	
0.42 PCC84 0.52 PL802 0.96 PCF805	0.80
DY802 0.45 EF86 0.90 PCC88 0.80 PY33 0.86 30F5/PF	
F. BOSO 1.00 FE89 0.81 PCC89 0.65 PY81/800 # 50	1.10
PRO1 0.38 EP01 1:30 PCC189 0:65 PY82 0:55 30FL1/	
PRO01 0.78 PR09 1.40 PCF80 0.51 PY88 0.60 PCE800	0.75
PRINCE 0.00 PROK 1.35 PCF82 1.80 PY500A 1.05 30FL2	0.75
TREE 0.80 FF183 0.80 PCF86 0.65 PY800 0.50 30FL12	1.05
TOTAL 0.40 FF194 0.60 PCF200 0.85 PY801 0.50 30FL14	0 85
775 FUND 0.88 PCF201 0.87 U26 1.00 30L1/PC	C84
POSS 0.77 F124 0.98 PCF801 0.85 U191 1.00	0.52
FOCE1 0.45 F136 1.05 PCF802 0.71 U193 #-50 30L15/PC	C805
ECC22 0.49 F191 0.90 PCF806 0.66 UABC80 9.90	1.05
DCC00 0 44 F194 0.47 PCH200 0.88 UBC81 0.70 201 17	0.90
ECC84 0.55 EL85 0.55 PCL82 0.54 UBF89 0.60 CONTAIN	1.30
POCSE 0.89 E186 0.95 PCL83 0.66 UCC85 0.60 SUF4MR	
POCES 0.78 F195 0.70 PCL84 0.59 UCH81 1.00 30P12/PC	
POCIES 0.51 F191 1.31 PCL85 0.63 UCL82 0.70	1.05
POPOS 0 88 F1 180 1.80 PC186 0 63 UCL83 0 70 30P19/PC	2802
TOPO 0.78 FM94 1.18 PCL805/85 UF89 U-80	1.00
FORS 0.71 EM87 1-18 0-68 UL84 0-95 30PLI/P	CL801
DOTTE: 1.00 PVK1 0.88 PD500 1.55 UY85 9.50	0.95
FORES 1.00 EV86/87 0.42 PFL200 0.80 6/30L2/ 20PL13/	
ECURA 0.78 EVER 0.64 PL36 0.88 ECC804 1.00 PCI 800	1.20
PCV 90 0.88 EZ80 0.51 PL81 0.75 6F23/EF812	1 20
1.05 SUPLIS	1.25
ECT 02 0.69 GVA01 0.90 PL82 0.50 30C1/PCF80 PCL00	
ECL86 0-63 GZ34 0-78 PL83 0-96 0-51 30PL15	1.05

	-					THE PERSON NAMED IN	-		
NEW	W	A 1 1/1				BP41	3.00	6J6 6J7M	0·30 0·45
NEW	I V	ALVI	-9			BP61	0.75	6J7G	0.40
				_		T41 U14	1.00	6K6GT	0.75
Indiv	ubi	ally	hox	ed a	nd	U25	0.85	6K7M	0.45
IIIGIV	144	٠	~			U26	0.85	6K7G	0.80
anara	ante	eed b	ut (	ot Eui	ro- 🛭	U191	0.75	6K8M	0.70
guar	~				-4	UABC80	0.40	6K8G	0.45
pean	or	othe	r o	rigin	at	UAF42	0.75	6K25	0.75
P		10.0	الماما		~~	UBC41	0.75	6L6G	0.55
areat	ii v	reduc	:ea	price	۲S. ۱	UBC81	0.45	6Q7M	0.50
2	4: .		40	່ ລ	ny	UBF80	0.40	6Q7(1	0.50
Quot	auc	ons	10	i a		UBF89	0.40	6SL7GT	0.48
بمنامني		ot lis	+ad	Sa	nd	UCC85	0.45	68N7GT	0.48
				. 50	110	UCH42	0.75	6BQ7GT 6U5G	0.50 0.75
CAF	for	r lists	:			UCH81	0.40	6V6G	0.40
JAL	101	1136	•			UCL82 UCL83	0.35 0.70	6V6GT	0.45
		EF80	0.25	PC86	0.80	UF41	0.75	6X4	0.40
AZ1 AZ31	0.60	EF85	0.85	PC88	0.60	UF89	0.40	6 X 5 G	0.40
CBL31	1.20	EF86	0.80	PC97	0.50	UL41	0.85	6X5GT	0.45
CL33	1.50	EF89	0.28	I.C300	0.48	UL84	0.48	7B6	0.75
CY31	0.50	EF91	0.37	PCC84	0.40	UY41	0.48	7B7	0.70
DAF91	0.80	EF92	0.50	PCC88	0.55	UY85	0.40	7C5	1.30
DAF96	0.50	EF95	0.40	PCC89	0.50	VR105-30		7C6	0.75
DCC90	1.85	EF98	0.75	PCC189	0.80	VR150-30	0.40	7H7 7R7	0.75
DF91	0.80	EF183	0.80	PCF80 PCF82	0-35	OA2 OB2	0.40	787	2.25
DF96	0.50	EF184 EL32	0.60	PCF86	0.60	1R5	0.45	7Y4	0.75
DK91 DK92	0.45	EL32	1.75	PCF801	0.50	185	0.30	12AT6	0.40
DK96	0.60	EL34	0.50	PCF802	0.50	1T4	0.80	12AT7	0.40
DL92	0.40	EL36	0.50	PCF805	0.90	384	0.40	12AU6	0.45
DL94	0.48	EL37	2.50	PCF806	0.75	3 V 4	0.70	12AU7	0.88
DL96	0.55	EL41	0.90	PCF808	0.90	5R4GY	0.80	12AX7	0.88
DY86/7	0.36	EL42	0.90	PCL82	0.35	5U4G	0.40	12BA6 12BE6	0.50
DY802	0.87	EL84	0 28	PCL83 PCL84	0.66 0.45	5 V 4 G 5 V 3 G T	0.50	30C1	0.80
EABC80	0.88	EL95	0·40 1·00	PCL85	0.50	5Z4G	0.45	30C15	1.05
EAF42	0.75	ELL80 EM80	0.45	PCL86	0.45	6/30L2	0.90	30C17	1.10
EB91 EBC33	1.00	EM81	0.60	PCL805/		6AK5	0.40	30C18	0.90
EBC41	0.75	EM84	0.35		0.50	6 A M 5	0.90	30F5	1.10
EBC81	0.88	EM85	1.00	PD500	1.80	6AQ5	0.45	30FL1	0.80
EBF80	0-40	EY51	0.40	PEN45	0.75	6A87G	0 85	30FL2	0.75
EBF83	0.40	EY86	0.40	PL36	0.55	6AT6	0·45 0·80	30FL14	0.90
EBF89	0.82	EZ40	0.75	PL81 PL82	0.50	6AU6 6BA6	0.28	30L15	1.05
EBL31	1 50	EZ41	0.75	PL82 PL83	0.45	6BE6	0.35	30L17	0.95
RCC81	0.40	EZ80 EZ81	0.28	PL84	0.40	6BH6	0.75	30P4MR	
ECC82 ECC83	0.88	GY501	0.90	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	1.00	30PL1	0.95
ECC88	0.40	GZ34	0.65	PL509	1 55	6BS7	1.85	30PL13	1.20
ECH35	1.25	GZ37	1.25	PL802	0.95	6BW6	0.90	30PL14	1.25
ECH42	1 00	HN309	1.50	PX4	3.50	6BW7	0.90	35 W 4	0.50
ECH81	0.80	KT61	1.75 2.50	PX 25 PY 33	3·50 0 63	6C4 6CD6G	1.30	35Z4GT	0.70
ECH83	0 45	KT66 KT81 (7		PY81	0.50	6CH6	1.40	50CD6G	1 20
ECL80	0 55 0.85	V 191 (1	1.30	PY82	0.85	6CW4	1.00	807	0.50
ECL82 ECL83	0.70	KT81	1.75	PY83	0.38	6F23	1.05	813 IT	
ECL86	0.40	KT88	2.90	PY88	0.40	6F25	1 00		
ECL1.80	0 3.20	KTW61	1.00	PY500	1.05	6F28	0.70	813 USB	£5.78
EF37A	1.20		1.00	PY81/80		6J5M	0-65 0-45	866A	1.00
EF39	1.20	N78	2 75	PY801	0 50	6J5G	0.43	000A	1.00

## TRANSISTORS-INTEGRATED CIRCUITS

## **EXPRESS** POSTAGE

3p for first Transistor, for each additional add

All transistors. I.C's offered are new and branded. Manufactured by Mullard, Texas, RCA, Fer-ITT, Motorola, ranti. etc. Lucas. Fairchild, 0.50 0.22 Quantity discounts on SAE application. Send

	-		-	Fairch	ına,	, Lu	icas		att.
AA119	0.7		0.50	Quant	li4ví	disc	2011	nte	on
AAZ13	0.10		0 22	Quani	ury	uisi	Jou		
AAZ15	0.10		0.25	annlic	atio	on. S	Sen	d S	AE
AC107	0.35	BF173	0.28						
AC126	0.25	BF179	0.33	for fu	11 11	ists.			
AC127	0.25	BF180	0.35						
AC128	<b>d</b> ⋅20	BF181	0.35	OC16	1.00	ZTX 501	0.15	2N2904	0.20
AC176	0-25	BF194	0.13		2 00	ZTX 503	0.16	2N2904A	
AC187	0.20	BF195	0.13		1.25	ZTX531	0.25	2N2905	0.32
AC188	0.20	BF197	0.15		0.40	ZTX550	0.18	2N 2905 A	
ACY21	0.22	BF200	0 32	OC28	0.70	1N914	0.08	2N2906	0.20
ACY39	0.65	BFS61	0.25	OC35	0.55	IN4001	0.6	2N2926	0.10
AD140	0.50	BF898		OC36	0.65	IN4002	0.7	2N3053	0.20
AD149	0.50	BFX29	0·28 0·22	OC42	0.40	IN4003	0.8	2N3055	0.60
AD161	0.39	BFX88		OC44	0.18	IN4004	0.8	2N3525	0.80
AD162	0.39	BFY50	0.20	OC45	0.18	IN4005	0.10	2N3614	0.59
AF115	0.25	BFY51	0.20	OC71	0.15	IN4006	0.12	2N3615	0.65
AF116	0.25	BFY52	0.20	0C71 0C72	0.25	IN 4007	0.12	2N3702	0.11
AF117	0.20	BFW10	0.15	OC76	0.30	1N4009	0.06	2N3703	0.12
AF186	0.40	BY100	0.13	OC77	0.55	1N4148	0.06	2N3704	0.14
A F239	0.44	BY126	0.15	OC81	0.28	18921	0.07	2N3705	0.12
A8Y27	0.80	BY127		OC81D	0.28	182033	0.20	2N3706	0.10
ASY28	0.25	BZX61 *6	0.20	OC81Z	0.45	182051A	0.10	2N3707	0.13
BA102	0.25	BZY88 se		OC83	0.25	I82100A	0.20	2N3708	0.07
BA115	0.10	DA 1 50 80	0.10	OC140	0.65	183010	0.25	2N3709	0.10
BC107	0.12	CR81-05	0.30	OC170	0.25	2N696	0.15	2N3710	0.11
BC108	0.12	CR81-05	0.45	OC171	0.80	2N697	0.15	2N3711	0.11
BC109	0·12 0·16	CR83-05	0.40	OC200	0.55	2N706	0.10	2N3819	0.85
BC113		CR83-40	0.55	OC201	0.80	2N706A	0.12	2N3820	0.50
BC117	0.21	MJE340	0.50	OC202	0.90	2N1131	0.25	2N3823	0.50
BC143	0.12	MJE370	0.68	OC203	0.55	2N1132	0.25	2N3903	0.15
BC147	0.10	MJE520	0.65	OCP71	1.00	2N1302	0.18	2N3904	0.20
BC148	0 14	MJE2955		ORP12	0.55	2N1303	0.18	2N3905	0.25
BC169C BC182	0.12	MJE3055	0.75	ORP60	0.45	2N1304	0-22	2N3906	0.16
BC182L	0.12	MPF102	0.40	T1005	0.20	2N1305	0.22	2N4058	0.15
BC184L	0.13	MPF103	0.36	TIC44	0.29	2N1306	0.28	2N4059	0.10
BCY32	1 20	MPF104	0.35	TIC226D		2N1307	0.28	2N4060	0.13
BCY32 BCY33	0.38	MPF105	0.46	T1L209	0.25	2N1308	0.28	2N4061	0.18
BCY34	0.45	NKT404	0.60	T1843	0.26	2N1309	0.30	2N4062	0.14
BCY70	0.15	OA5	0.60	ZTX107	0.12	2N1613	0.20	2N 4289	
BCY71	0.20	OA10	0.40	ZTX 108	0.10	2N1614	0.45	3N141	0.81
BCY72	0.15	OA79	0.10	ZTX300	0.14	2N2147	0.75		0.40
BCZ11	0.65	OA81	0.10	ZTX301	0.14	2N2160	1.00		0.45
BD121	1.00	OA91	0.7	ZTX302	0.20	2N2369A			0.40
BD124	0.80	OA200	0.08	ZTX304	0.24	2N2646	0.50	40430	0.85
BD124	0.45	OA202	0.10	ZTX 500	0.15	1		4	
PERTOI	0 20				-				

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BN7400	0.26	8N7425	0.37	8N7473	0.44	BN74107	0 51	8N74157	1.09
BN7401	0.20	BN7427	0.37	BN7474	0.48	BN74110	0.57	BN74170	2.88
BN7402	0.20	BN7428	0.43	8N7475	0.59	BN74111	0.86	BN74174	1.80
BN7403	0.20	BN7430	0.20	BN7476	0.45	BN74118	1.00	BN74175	1.29
8N7404	0.20	BN7432	0.37	BN7480	0.80	BN74119	1.92	BN74176	1.44
8N7405	0.20	8N7433	0.43	BN7482	0.87	8N74121	0.57	BN74190	2.30
BN7406	0 40	BN7437	0.43	SN7483	1.20	BN74122	0.80	BN74191	2.30
BN7407	0.40	BN7438	0.43	BN7484	1.00	BN74123	1.44	BN74192	2.30
	0.25	BN 7440	0.20	BN7486	0.50	BN74141	1.00	BN74193	2.30
8N7408	0.33	BN7441A		BN7490	0.75	BN74145	1-44	BN74194	1.72
BN7409	0.20	DIALATIV	0.85	BN7491A	N	8N74150	2.30	BN74195	1.44
BN7410		BN7442	0.85	,	1.10	BN74151	1.15	BN74198	1.58
BN7411	0.28	BN7450	0.20	8N7492	0.75	BN74154	2.30	8N74197	1.58
BN7412	0.28		0.20	BN7493	0.75	8N74155	1.15	BN74198	3.16
8N7413	0.30	8N7451	0.20	BN7494	0-85	BN74156	1.15	6N74199	2.88
BN7416	0.30	8N7453	0.20	6N7495	0.85	2414100	1 10	1 101174100	~ 00
BN7417	0-30	BN7454				DIL		14 pin	16-
BN7420	0.20	BN7460	0.20	BN7496	1.00	DIL			
BN7422	0.28	BN7470	0 33	8N7497	4.32	SOCKE	21	16 pin	17n
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ı	AC107 AC113	22		and	BC150	20	BD131	55		Price p		Price p		Price p		rice p		Price p	Type	Price p
ı	AC115	20 22	AD1620	MP) 75		22		66	BF183	44				39 39	2N2192 2N2193	39	2N3391	18	2N4062	13
ı	ACI17K	32		0 55 27	BC152 BC153	19		72		28	MJE30			22	2N2193 2N2194	39 39		16		19
ı	AC122	18		27	BC153	31 33		44	BF185	33		40 55		18	2N2217	24		16		
ı	AC125	19		27	BC157	20		44 50	BF187	30				20	2N2218	22		16 19		
ı	AC126	19		27	BC158	13		55	BF188 BF194	44				18	2N2219	22		23		19 19
	AC127	20		39	BC159	13	BD139	81	BF195	13 13				18	2N2220	24	2N3403	23		19
ı	AC128 AC132	20 18		33	BC160	50	BD140	66	BF196	16		39 70			2N2221	22		31	2N4290	19
ı	AC134	16		33	BC161	55	BD155	88	BF197	16	OC22	52		19 19	2N2222 2N2368	22		46		19
ı	AC137	16	AF127	31 31	BC167 BC168	13	BD175	66	BF200	50	OC25	54	2G377	33	2N2369	19 16	2N3414 2N3415	17	2N4292	19
L	AC141	20	AF139	33	BC169	13 13	BD176 BD177	66	BF222	£1.05		62	2G378	18	2N2369A	16	2N3415	17 31	2N4293 2N5172	19
ı	AC141K	32	AF178	55	BC170	13	BD178	72 72	BF257 BF258	50		42		18	2N2411	27	2N3417	31	2N5172	13 60
	AC142	20	AF179	55	BC171	16	BD179	77	BF259	66 94	OC26 OC28	32		18	2N2412	27	2N3525	83	2N5457	35
	AC142K AC151	28 17	AF180	55	BC172	16	BD180	77	BF262	61	OC29	55 55		33	2N2646	52	2N3614	74	2N5458	35
	AC154	99	AF181 AF186	55 55	BC173	16	BD185	72	BF263	61	OC35	46		33 28	2N2711 2N2712	23 23	2N3615	82	2N5459	44
	AC155	22 22	AF239	41	BC174 BC175	16 24	BD186	72	BF270	39	OC36	55		39	2N2714	23	2N3616 2N3646	82	2N6211	75
	AC156	22	AL102	72	BC177	21	BD187 BD188	77 77	BF271	33	OC41	22	2N388A	61	2N2904	19	2N3702	10 13	28301 28302 A	55
	AC157	27	AL103	72	BC178	21	BD189	83	BF272 BF273	88 39	0C42	27	2N404	22	2N2904A	23	2N3703	13	28302 A	46 46
	AC165	22	ASY26	28	BC179	21	BD190	83	BF274	39	OC44 OC45	17	2N404A	31	2N2905	23	2N3704	14	28303	61
	AC166 AC167	22 22	ASY27 ASY28	33	BC180	27	BD195	94	BFW10	66	OC70	14 11	2N524 2N527	46 54	2N2905A	23	2N 3705	13	28304	77
	AC168	27	ASY29	28 28	BC181	27	BD196	94	BFX29	30	OC71	11	2N598	46	2N2906 2N2906A	17 20	2N3706	13	28305	86
	AC169	16	ASY50	28	BC182 BC182L	11 11	BD197 BD198	99	BFX84	24	OC72	16	2N599	50	2N2907	22	2N3707 2N3708	14 09	28306	86
	AC176	22	ASY51	28	BC183	11	BD199	99 £1.05	BFX85 BFX86	33 24	OC74	16	2N696	14	2N2907A	24	2N3709	10	28307 28321	86 62
	AC177	27	ASY52	28	BC183L	11	BD200	£1.05	BFX87	27	OC75 OC76	17 17	2N697	15	2N2923	16	2N3710	10	28322	46
	AC178 AC179	31 31	ASY54	28	BC184	13	BD205	88	BFX88	24	OC77	28	2N698 2N699	27 39	2N2924	16	2N3711	10	28322A	46
	AC180	22	ASY55 ASY56	28 28	BC1841.	13	BD206	88	BFY50	22	OC81	17	2N706	09	2N2925 2N2926(G)	16 14	2N3819	31	28323	62
	AC180K	32	ASY57	28	BC186 BC187	31 31	BD207	£1.05	BFY51	22	OC81D	17	2N706A	10	2N2926(Y)	12	2N3820 2N3821	55 39	28324	77
	AC181	22	ASY58	28	BC207	12	BD208 BDY20	#1-05 £1-10	BFY52 BFY53	22	OC82	17	2N708	13	2N2926(O)	îĩ	2N3823	31	28325 28326	77 77
	ACI81K	32	A8Y73	28	BC208	îž	BF115	27	BPX25	19 94	OC82D OC83	17	2N711	33	2N2926(R)	11	2N3903	31	28327	77
	AC187 AC187 K	24 25	ASZ21 BC107	44	BC209	13	BF117	50	BSX19	17	OC139	22 22	2N717 2N718	39 27	2N2926(B)		2N3904	33	28701	46
	AC188	24	BC107	12 12	BC212L	12	BF118	77	BSX 20	17	OC140	22	2N718A	55	2N3010 2N3011	77	2N3905	31	40361	44
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	ACY21	22	BC116 BC117	17 20	BC302	27	BF152	61	BSY38	20	OC202	31	2N918	33		DIOD	ES AND R	ECTIE	TERS	
	ACY22	18	BC118	11	BC303 BC304	35 40	BF153 BF154	50	B8 Y39	20	OC203	28	2N929	23	AAI19	9	BY133	23		
	ACY27	20	BC119	33	BC440	34	BF155	50 77	BSY40 BSY41	31	OC204	28	2N930	23	AA120	9	BY164	55	OA70 OA79	8 8
	ACY28	21	BC120	88	BC460	40	BF156	53	BSY95	31 14	OC205 OC309	39 44	2N1131 2N1132	22	AA129	9	BYX38/30		OA81	8
	ACY29 ACY30	39 31	BC125 BC126	13	BCY30	27	BF157	61	B8Y95A	14	OCP71	48	2N1132 2N1302	24 16		10	BYZ10	39	OA85	10
	ACY31	31	BC132	20	BCY31 BCY32	29	BF158	61	Bu105	£2-20	ORP12	48	2N1303	16		11	BYZ11 BYZ12	33	OA90	7
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	ACY35	23	BC135	13	BCY34	28	BF162	44	C400 C407	83	P21	50	2N1305	19	BA126	24	BYZ16	44	OA200	8
	ACY36	31	BC136	17	BCY70	16	BF163	44	C424	28	P346 A P397	22	2N 1306	23	BA148	16	BYZ17	39	OA202	Ŕ
	ACY40 ACY41	19 20	BC137	17	BCY71	22	BF164	44	C425	55	8T140	46 14	2N1307 2N1308	23 26	BA154	13	BYZ18	89	8 D10	6
	ACY44	39	BC139 BC140	44 33	BCY72 BCZ10	16	BF165	44	C426	39	8T141	19	2N1309	26		16 15	BYZ19 CG62	31	SD19	6
	AD130	42	BC141	33	BCZ11	22	BF167 BF173	24	C428	22	T1843	33	2N1613	22		17	(OA91 Eq.		IN34	8
	AD140	58	BC142	33	BCZ12	28	BF173	24 39	C441 C442	33	UT46	80	2N1711	22	BY101	18	CG651	, ,	1N34A 1N914	8 7
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	AD143 AD149	42 55	BC145		BD116	88	BF178	33	C450	24	20301	21 21	2N1890 2N1893	50 41		13	Eq.)	7	1N414B	7
	AD149	39	BC147 BC148		BD121	66	BF179	33	MAT100	21	2G303	21	2N 1893 2N 2147	79		16	OA5	39	18021	11
	AD162	39	BC149		BD123 BD124	72	BF180	33	MAT101	22	2G304	27	2N2148	63		7	OA58L OA10	23	18951	7
			AND DESCRIPTION OF REAL PROPERTY.	Lateral Lands		10	BF181	33	MAT120	21	2G306	44	2N2160	66		8	OA47	8		
					- 41			Name and Address of the Owner, where the Person of the Owner, where the Person of the Owner, where the Owner,	THE RESERVE OF THE PERSON NAMED IN	PERSONAL PROPERTY.	The second second			-						

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7405	0.18	0.17	0.16	7454	0 18	0.17	0.16		2.90	2 - 80	2.70
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7409	0.20	0.19	0.18	7473	0 · 41	0.39	0.35	74155	1.50	1 45	1 35
7410	0.18	0.17	0.18	7474	0 · 41	0.39	0.35	74156	1 50	1.45	1.35
7411	0.28	0.27	0.16	7475	0.50	0.48	0.46	74157	2.00	1.90	1.80
7412	0.39	0.34	0.31	7476	0.44	0.43	0.42	74160	2.10	2.00	1.90
7413	0.32	0.31	0.30	7480	0.74	0.71	0.64	74161	2.10	2.00	1.90
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7420	0.18	0.17	0.16	7483	1.20	1.15	1 - 05	74164	2 · 20	2 · 10	2.00
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7423	0.55	0.53	0.50	7485	3 - 50	3 · 30	3 30	74166	3 · 20	3.10	3.00
7425	0.55	0.53	0.50	7486	0.35	0 · 34	0 · 33	74174	2 . 50	2.40	2 30
7426	0.50	0.46	0.44	7489	4.00	3.75	3 - 50	74175	1.75	1 85	1.55
7427	0.50	0.46	0.44	7490	0.74	0.71	0.64	74176	1.85	1 75	1 65
7428	0 55	0.53	0.50	7491	1.10	1.05	1.00	74177	1.85	1.75	1 65
7430	0.18	0.17	0.16	7492 7493	0.74	0.71	0.64	74180	1.50	1-40	1.30
7432	0.50	0.46	0.44	7493	0.74	0.71	0.64	74181	5 · 00	4.50	4.00
7433	0.75	0.73	0.70	7494	0.85	0.82	0.75	74182	2.00	1 90	1.75
7437	0.70	0.68	0.65	7496	0·85 0·96	0.82	0.75	74184	3 20	3.10	3.00
7438	0.70	0.68	0.65	74100		0.93	0.86	74190	2 15	2.10	2-00
7440	0.18	0.17	0.16	74104	1.50	1 45	1.40	74191	2 · 15	2.10	2.00
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7442	0.74	0.71	0.64		1.07	1.04	1.00	74193	2.15	2.10	2.00
7443	1.20	1 15	1.10	74107	0.44	0.42	0.40	74194	2.98	2 · 86	2.75
7444	1 20	1.15	1.10	74110	0.60	0.55	0.50	74195	2.00	1.95	1.90
7445	1 98	1.95	1.90	74111	1.38	1.27	1.21	74196	1.95	1.90	1 85
7446	1.20	1 15		74118	1.10	1.05	1.00	74197	1 - 95	1.90	1 - 85
7447	1.10	1.07		74119	1.50	1 · 40	1 30	74198	5.00	4.75	4.50
	4 10	1.07	1.05	74121	0.50	0.48	0.45	74199	5.00	4 - 75	4 - 50

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Pak	No.		EQVT	
71	8.2	G3713	OC71	ı
T2	8 1	)1374	OC75	Į
T3		)1216	OCSLD	ì
T4	8 2	G381T	OC81	ı
T5	8 2	G382T	OC82	l

T5 8 2G3821 OC44
T6 8 2G344B OC45
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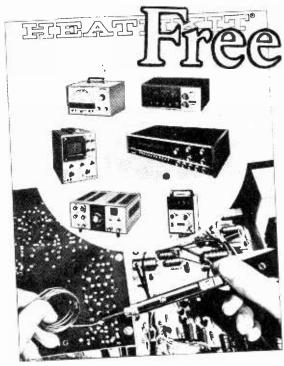
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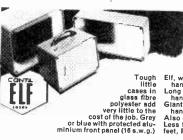
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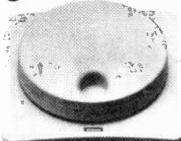
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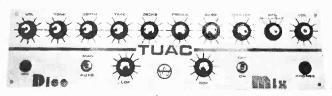
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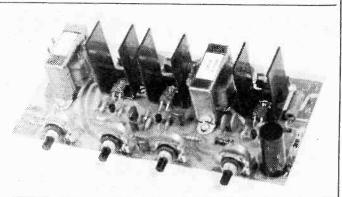
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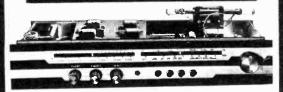
Specification on all three power modules:

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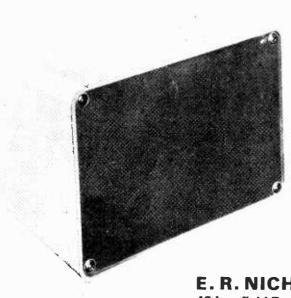


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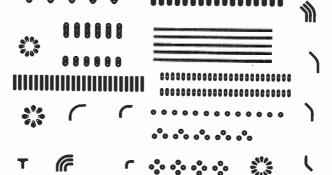
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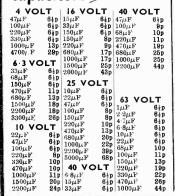
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MT106 60 volt transformer 
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	AC141K	26p	OC81	12p	200 V 24p
	AC142K	26p	2N706	14p	600V 27p
	AC176	18p	2N1131	24p	THRYIS-
	AC187	24p	2N1132	28p	TORS
	AC188	24p	2N2904	20p	1 Amp
	AC187K	28p	2N2926	11p	50V 29p
	AC188K	28p	2N3053	26p	100V 32p
	AD149	49p	2N3054	55 p	200V 34p
	AD161	38 p	2N3055	49p	400V 44p
	AD162	40p	2N3702	14p	3 Amp
	AF114	20p	2N3703	13p	50V 39p
	AF115	20p	2N3704	14p	100V 44p
	AF116	20p	2N3705	13p	200V 48p
	AF117	20p	2N3706	12p	400 V 66p
	BC107	13p	2N3707	13p	5 Amp
	BC108	12p	2N3708	11p	50V 46p
	BC109	13p	2N3709	12p	100V 57p
	BC147	13p	2N3710	12p	200V 66p
ŀ	BC148	13p	2N3711	12p	400V 77p
	BC149	13p	2N3819	35p	TRIACS
	BC182	13p	40361	55p	2 Amp
	BC183	11p	40362	55р	100V 33p
	BC184	14p	40636	69p	200V 55p
	BC212	13p	1N914	8p	400V 77p
ı	BC213	13p	1N916	8p	6 Amp
	BC214	13p	1N4001	7p	100V 66p
ĺ	BD131	68p	1N4002	8p	200V 88p 400V 99p
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### Easy to assemble

All parts are supplied — all you need provide is a soldering iron and a pair of cutters. Complete step-by-step instructions are provided, and our service department will back you throughout if you've any queries or problems.

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#### \*Uniquely handy package. $4\frac{1}{2}$ " x 2" x $\frac{11}{16}$ ", weight $3\frac{1}{2}$ oz. \*Standard keyboard. All you needforcomplex calculations. \*Clear-last-entry feature. \*Fully-floating decimal point. \*Algebraic logic. $\times$ Four operators $(+, -, x, \div)$ , 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<sup>-20</sup> to 10<sup>79</sup>

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\*Clear, bright 8-digit

\*Operates for weeks on

four U16-type batteries.

(MN 2400 recommended.)

Features of the Sinclair

Cambridge

A complete kit!

The kit comes to you packaged in a heavy-duty polystyrene container. It contains all you need to assemble your Sinclair Cambridge.

Assembly time is about 3 hours.

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- 1. Coil.
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- Printed circuit board...
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- Electronic components pack (diodes, resistors, capacitors, transistor).
- Battery clips and on/off switch.
- 10. Soft wallet,



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If you just use your Sinclair Cambridge for routine arithmetic – for shopping, conversions, percentages, accounting, tallying, and so on – then you'll get more than your money's worth.

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# ) YHARS

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

possible means of communication.

It could be that, had Marconi not been instrumental in putting the theory into practice, someone else may have done so. Whilst not detracting from his real talent, one has to admit that it takes courage and determination to convince others of the long-term practical prospects of such an idea in its infancy. Marconi's fortune turned in 1897 when William Preece, at that time Engineer-in-Chief of the G.P.O., had tried without much success to transmit radio waves. Marconi demonstrated a 8.7 mile hop, having succeeded in short distance experiments two years before. It was sufficiently convincing for Marconi to set up his own radio company.

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

telephony.

Soon afterwards the small transmitting station 2MT was born, followed by 2LO later to become the nucleus of

the P.M.G.'s British Broadcasting Company.

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

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

everyone.

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

M. A. COLWELL—Editor. 

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

# NEWS

## **Ambisonic system**

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

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

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

#### CQ column

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

# NEWS...

# NEWS...

# NEWS...

## **BBC** on Radio reception

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

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

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

#### WIRELESS TELEGRAPHY ACT

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

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

## New catalogue

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

## EMI equip Canadian tower

£1.25 million contract to equip the new third-of-a-mile high CN observation and communications tower in Toronto, Canada, with a complete antenna complex for all f.m. and TV broadcasting services has been won by the Telecommunications Division of EMI Sound & Vision Equipment Ltd, Hayes, Middlesex.

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

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

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

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

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

Channel 5, Canadian Broadcasting Corporation. Intended for colour

TV transmissions, this is a single channel, directional v.h.f. antenna having a gain of 8. The array is 55 feet tall and is at a mean height of 1,572 feet.

Channel 9, CFTO—TV Ltd. Also intended for colour TV transmissions this second directional v.h.f. is similar to that for channel 5, but has a gain of 11 radiated from a 49 foot high array located at a mean height of 1,635 feet. Channel 19 and 25, CBC and Educational. An omnidirectional u.h.f. array for colour TV. It is arranged as a dual antenna, with one channel allocated to CBC and the second to the educational transmissions. Positioned on the mast at a mean height of 1,695 feet, this array is 60 feet tall and

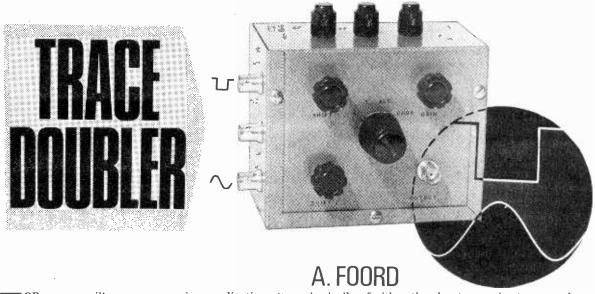
has a gain of 31.

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

## Scottish Audio Fair

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

# OSCILLOSCOPE



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

#### Basic switching circuits

Chopping (or switching) circuits are used in many electronic instrumentation applications and are

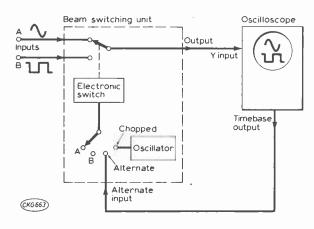


Fig. 1: Block diagram for an oscilloscope trace doubling unit.

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

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

#### **MOS-FET** characteristics

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

P channel depletion

P channel enhancement

N channel depletion

N channel enhancement

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

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

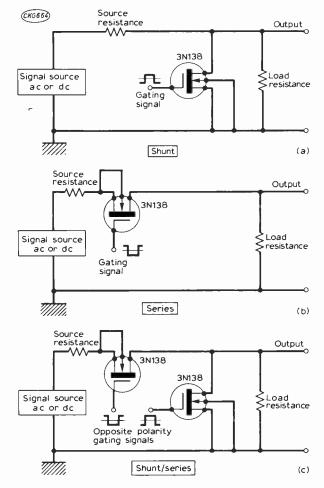


Fig. 2: Chopping circuits (a) shunt (b) series and (c) shunt-series.

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

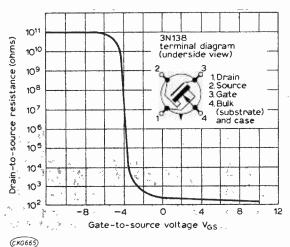


Fig. 3: Characteristics of the 3N138 MOS-FET.

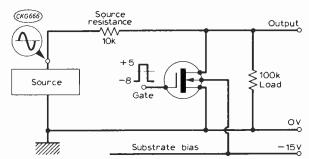


Fig. 4: Typical shunt chopper circuit using the 3N138.

#### Basic MOS-FET circuit

Figure 4 shows a basic shunt chopper circuit. The gating signal should swing from zero to at least -6 volts and may cover a range of  $\pm$  10 volts. The substrate (and thus the case) is usually connected to the source. However if the incoming signal to be chopped exceeds -0.3 volts the substrate must be 'floated', connected to the drain, or biased negatively so that the source-to-substrate and drain-to-substrate voltages never exceed -0.3 volts. If the value is exceeded, the substrate, which forms two p-n junctions with the drain and the source, becomes forward biased, and the resulting flow of diode current shunts the incoming signal to earth.

## Virtual earth switching circuit

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

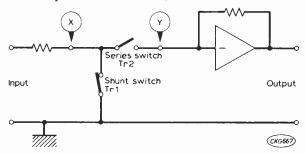
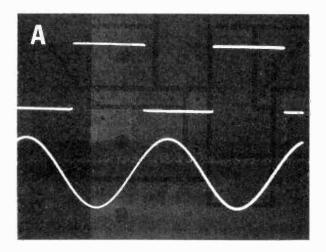
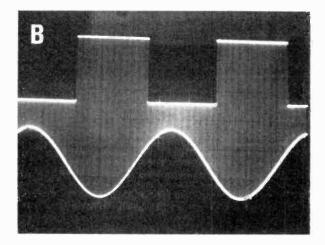


Fig. 5: A current mode shunt-series chopper circuit.

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





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

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

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

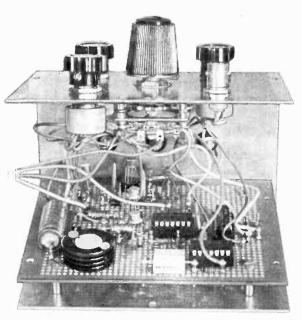
## \* components list

Resis	stors						
R1	330Ω	R5	2·2kΩ	R9	$560\Omega$	R13	10kΩ
R2	1kΩ	R6	1kΩ	R10	$470\Omega$	R14	10kΩ
R3	1kΩ	R7	1kΩ	R11	470Ω	R15	47kΩ
R4	2·2kΩ	R8			47Ωww	R16	47kΩ
			R17	22kΩ			
All	d or AM	10%					
VR	1/ <b>2</b> /3 10kg	2 line	ar pot	s			
Capa	citors						
C1	10µF 25	5V		C5	10μF 25	V	
C2	0.1µF 3	30V d	isc -	C6			
C3	0.1µF 3	OV d	isc	C7	0.1µF 30	OV dis	С
C4	125µF 1	6V		C8	0 · 1/4F 30		
Semi	conduct	ors					
Tr1	BCY71		Tr3	3N138	D1-4	1 N 91	4
Tr2	BCY71		Tr4	3N138	RV1	LM3	09H
Hisce	llaneou	S					
Var	oboard 4	1 x 3 I	in. 0 · 1	in. ma	trix, plain	3 tern	ninal
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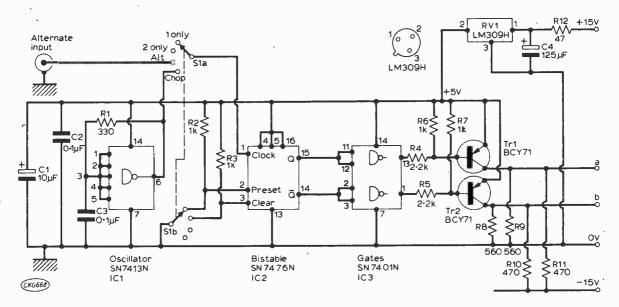
## Practical two channel switching circuit

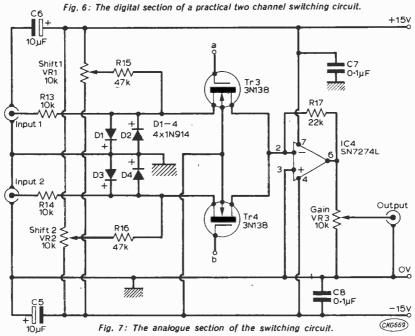
The practical two channel switching circuit is shown in Fig. 6 and 7. In Fig. 7 two FETS are used to switch channels 1 and 2 into the summing point of a virtual earth amplifier. Independent shift controls are provided for each channel for trace positioning purposes, while a common gain control allows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

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



A general view inside the finished switching unit.





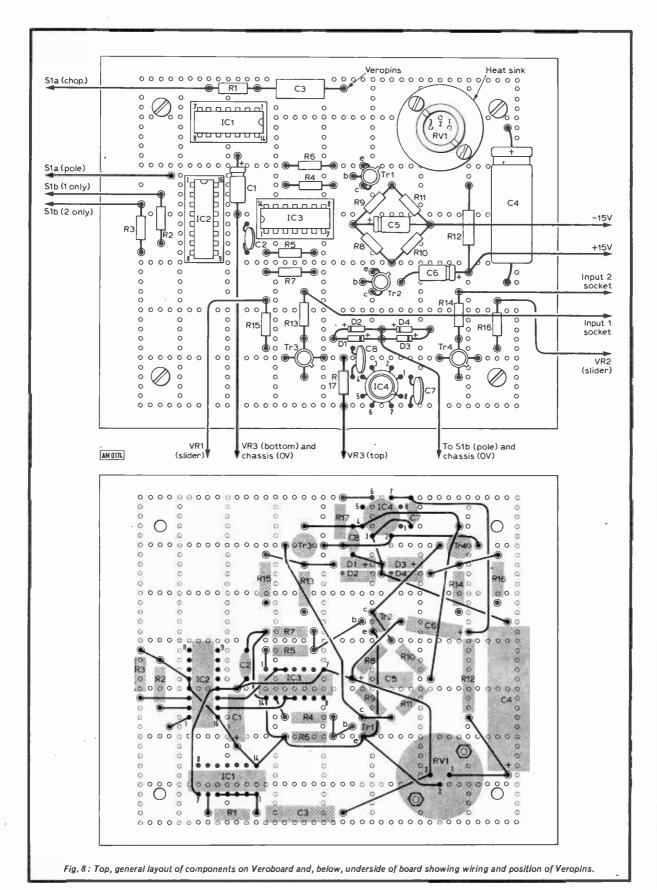
IC3 will be at a logical 0 and Tr1 will be on. This makes waveform 1 become +5 volts, turning on Tr3. Pin 13 of IC3 will be at a logical 1 and Tr2 will be off. This makes waveform 2 become -8 volts, turning off Tr4. Open collector gates have to be used for IC3 so that Tr1 and Tr2 can be held completely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

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

#### Use as a Tone burst generator

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

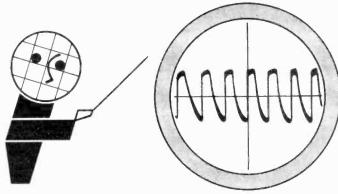
For example, if required, a sinusoidal tone burst with a rectangular pulse may be generated. A divider chain is synchronised to the sinusoidal clock,

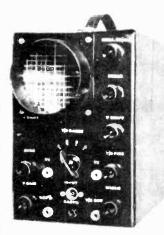


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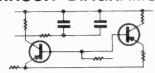
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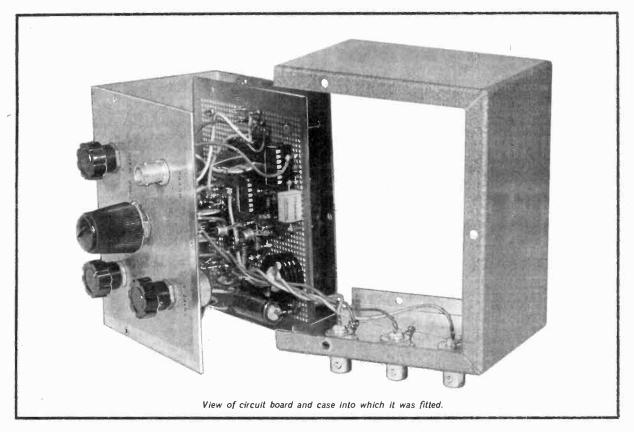
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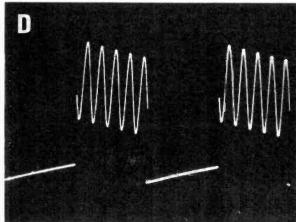
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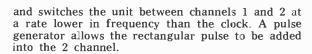
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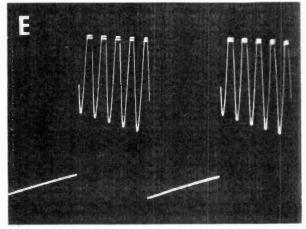






## Construction

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



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

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

The LM309H voltage regulator may be replaced by the later LM309K available from Athena Ltd., 140 High Street, Egham, Surrey for £2.48 inc.

# HOTLINIES

#### ON RECENT DEVELOPMENTS

#### IT'LL CELL WELL!

THE classification of cells in the human body is not an easy task. Things called bulk separators are commonly used but these units suffer from the disadvantage that although they can handle a very large number of cells, they cannot separate them into many individual classes. A School of Medicine has come up with a novel use of a laser. The technique is to employ two laser beams which are passed through a fine column or jet of liquid which contains the human cells. The technique has proved successful in classifying rare cells (in addition to the more common ones). These rare cells are barely one thousandth of one per cent (0.001%) of the total mass of cells which make up the entire human body. This is one instrument which should, if marketed, cell very well.

#### **THE LM195**

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

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

If a conventional power transistor blows it can become a virtual short circuit and can thus pass excessive current and ruin other, often costly components. The LM195 however, becomes an open circuit even if the chip itself is destroyed. With a

switching threshold of 2V, a switching speed of around 500ns the device looks very useful for a number of applications. Base input current is  $3\mu A$  over the whole of the voltage input range of 0-42V. This device is quite remarkable when compared to early power transistors which were happy to melt quietly into diodes at the first sign of trouble.

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

#### **RADAR CARS**

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

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

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

Before starting his journey, the driver tells the computer what the road conditions are like—icy, wet or dry, etc. The computer can thus make due allowance for these. It also allows about 1.5 seconds for driver

reaction time too. If the driver forgets to tell the computer what the conditions are like then the computer will assume the very worst conditions and proceed accordingly with its calculations. The system is still under development and other workers are also experimenting with various ideas, meanwhile it is the computer between the drivers ears which will have to do the work of obstacle avoidance on the roads.

#### **SOLAR CELLS**

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

#### CALCULATORS

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



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3/2 cm. Secon No P 22 22 22 30 42 52 52 52 52 108 72 116 17 115 226 Ref. Amps. Weight Size cm. Secondary Tap No. 112 79 3 20 21 51 6 | x 5 | 8 x 4 | 8 | 0 | 2 | 15 | 20 | 24 | 30 V | 7 | 0 x 6 | 7 x 6 | 1 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | .. 1.42 1.92 2.90 3.58 0.5 1 4 2 4 3 4 4 8 6 4 6 12 8 0 12 0 13 12 36 36 42 2 0 3 0 4 0 5 0 6 0 8 0 4 25 5 30 6 31 8 18 10 33 52 52 52 88 89 19.0 67 50 VOLT RANGE Secondary Taps Ref. No. 102 103 104 105 106 107 118 02 12 12 8 12 0 0 0 € 90 1 0 2 0 3 0 4 0 6 0 8 0 2.80 3 87 5 26 6 99 10 35 13.51 60 VOLT RANGE Amps. Weight Size cm. & P Secondary Taps No. 124 126 127 125 123 40 120 7.0 × 6.7 × 6.1 0.24-30.40-428-69C 1.93
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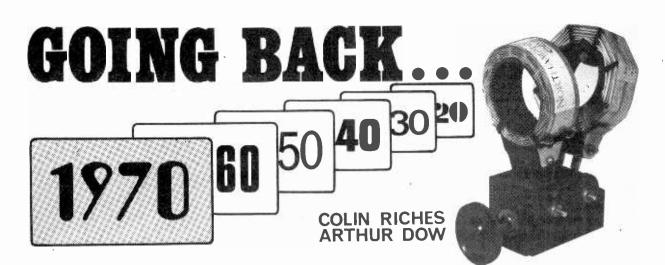
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## Guglielmo Marconi 1874-1937

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

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

From an early age he was interested in science and by his late teens, at his home, the Villa Grifone, he was experimenting with electro-magnetic waves as a communication medium. By the summer of 1895 he had succeeded in transmitting signals over a few yards of space and in August, using an earth and an elevated aerial at both transmitter and receiver, he was able to pass Morse code over 134 miles.

The Italian Government was not greatly interested in Marconi's invention, so in 1896 he came to England where he filed the world's first patent for a system of telegraphy using Hertzian waves. A letter of introduction to William Preece, Engineer in Chief of the



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

GPO, led to a series of demonstrations culminating in 1897 in a record transmission across  $8\cdot7$  miles of the Bristol Channel, where Preece himself was experimenting with inductive methods, with far less success.

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

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

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

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

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

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

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

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

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

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

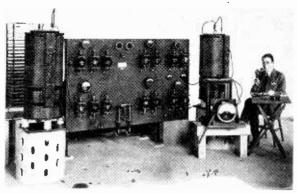
In 1919, Marconi bought his yacht, *Elettra*, which he equipped as a laboratory; a Marconi engineer made the first east to west transatlantic telephony transmission; and the embryo of broadcasting took shape in Chelmsford.

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

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

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

Running parallel with the Company's broadcasting activity was Marconi's involvement with the Govern-



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

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

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

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

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

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

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

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

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1R5	. 88	6BZ6	.49	68H7	. 44	20P5	1.30	6060	1.00		
184	. 33	6CB6A	.40	68K7GT	. 44	25A6Q	. 88	6067	1.00		
1U4	. 65	6C4	.58	68Q7GT		25 L6G	.50	7475	1.00		. 59
1U5	. 90	6C9	1.25	6 V 6 G	.17	25 Y 5 G	.70	AC/PEN			.51
2D21	.49	6CD6G	. 80	6V6GT	.38	25Z4G	.88	AC2/PE		EC92	.45
2GK5	- 55	6CG8A			.30	2525	-80		.98	ECC33	
3A4	.42	6CH6	.60		. 28	25Z6G	-70	AC6PE			-95
3D6	.19	6CL6	- 55		.75	28D7	1.00	AC/THI			1.00
8Q4	.49	6CM7	-75		-50	30 A 5	.65	AL60	1.00		. 29
SQSGT	. 55	6CU5	.75		75	30C15	.75	ATP4	-40	ECC82	. 28
384	-88	6CW4	.70		. 50	30C17	. 90	AZI	-60	ECC83	. 28
4CB6	-55	6DE7	-75		65	30C18	. 78	AZ31	. 60	ECC84	- 80
5CG8	-55	6DT6A		7Z4	80	30F5	. 85	AZ41	.65	ECC85	
5R4GY	.70	6EW6	. 75		65	30FL1	. 75				.36
5U4G	-80	6E5	1.00		65	30FL2	.75		2-00 L.50	ECC86	· 85
5 V 4 G	. 54	6F1			55	30FL12	1.70				
5Y3GT	.88	6F6G			50	30FL13		CY31	1.00	ECC189	
5Z3	-58	6F13	- 55		65	30FL13	. 85	DAF91	.80	ECC804	
5Z4G	-85	6F14	. 75		55	30L15	. 75	DAF96	.44	ECC807	
5Z4GT	.85	6F18	.55		70	30L17	. 70	DF91	.80	ECF80 ECF82	. 84
6/30L2	.60	6F23	.85		70	30P4MI		DF96	.44		. 75
	.25	6F24	.85		00	201.4111	1.00	DK 40	.70	ECF86	
6AC7	.49	6F25	1.00		00	30P12		DK92	.70	ECF80	2.10
6AG8	.27	6F28	.70		65	30P19/	.80	DK96	. 55	TO TO 1	
6AH6	.50	6F32	. 65		65	30P19/	. 75	DL92	. 22	ECH21	
6AJ5	. 75	6GH8A	.75		65	30PL1		DL92		ECH35	
6AK5	.34	6GK5	-65		85	30PL13	. 66	DM70	.44	ECH42	
6AK6	.60	6GU7			45	30PL13				ECH81	.80
6AM8A	-55	6H6GT			40				2.00	ECH83	.44
6AN8	49	SJEGT	.82		30	30PL15	. 95	DY87/6	.80	ECH84	.44
	40	6J6	. 25			35 A3	. 65	DY802	.88	ECL80	.40
6AQ5 6AR5			. 20		88	35D5	.75	E80CC		ECL82	. 84
	· 55	6J7G	-75		27	35L6G1				ECL83	. 57
6AT6	.83	6JU8A			.00	35W4	. 88			ECL84	. 60
6AU6	.80	6K7G	. 19		55	35Z3	.75	E88CC	.80	ECL85	.60
		6K8G			00	35Z4GT	.42		1.00	ECL86	.40
6AV6		6LI	2.00	12K7GT .		35Z5GT			1.00	EF22	1.50
A8WA8		6L6GT	.58		45	50 B5	- 85	E182CC		EF40	. 75
6AX4	.55	6L7	2.00		50	80C5	· 45	E1148	. 58	EF41	.70
6B8G	.80	6L18	.49		38	50CD6G		EA50	.27	EF42	. 55
6BA6	. 281	6L19	Z . 00 !	128H7 .	35	50EH5	- 55	EA76	1.00	EF73	1 - 50

							_	_		
	EF80 .26	GZ34 .57	PEN453DD	UCL82 .88		-	l			
	EF93 .60	GZ37 .67	2.00			.20	BA153	-17	OA73	·17
	EF85 .84	HABCSO .44	PENDD-			.17	BC107	·14	OA79	·10
	EF86 .80	HL23DD.75	4020 2.00			.28	BC108	.14	OA81	·10
	EF89 .27	HL41DD 42	PL36 .55			·14	BC113	.28	OA85	-09
	EF91 .80	HL42DD.70	PL81 .44			-19	BC115	·17	OA90	·14
	EF92 .80	HN309 1-40				.22	BC116	-28	OA91	-10
			PL81A .55	UF86 1.00		-22	BC118	-25	OA95	.10
			PL82 .87	UF89 .88		-28	BCY10	-50	OA200	·10
	EF98 .80		PL83 .39	UL41 .65		.22	BCY12	-55	OA202	-11
0	EF183 .29	KT2 .50	PL84 .38	UL84 .88		-28	BCY33	-22	OC22	-42
5	EF184 .82	KT41 .98	PL504/500	UM80 .44		-28	BCY34	-25	OC23	-42
0	EF804 1.20	KT44 .75	-67	UY41 .49		-28	BCY38	.25	OC24	-48
õ	EH90 .45	KT66 2.40	PL505 1:15	UY85 .33	AC168	-42	BCY39	-28	OC25	-42
5	EL32 .50	KT81 2.00	PL508 .90	U10 1.00		-61	BCZ11	-42	OC36	-47
5	BL34 .54	KTW61 #1	PL509 1.15	U12/14 1.00	AC177	-81	BF158	-82	OC44	-11
5	EL35 1.00	KTW62 \$1	PL802 .95	U19 1.78	ACY17	.28	BF159	-28	OC45	-12
5	EL37 1.00	KTW63 1.00	PY33/2 .50	U25 .65	ACY18	-22	BF163	.22	OC46	-17
9	EL41 .60	MHLD6 £1	PY81 .81	U26 .60	ACY19	-21	BF173	-42	OC70	-14
8	EL81 .60	P61 1.00	PY82 .25	U81 -80	ACY20	-20	BF180	-83	OC71	-12
0	EL83 .55	PABC80 .88	PY83 .88	U191 70	ACY21	-21	BF181	-44	OC72	-12
0	EL84 .28	PC86 .60	PY88 .88	U251 .80	ACT22	·17	BF185	-44	OC74	-25
Pi	EL85 .40	PC88 .60	PY500 .80	U301 ·58	ACY28	-20	BF194	·17	OC75	-18
9	EL86 .88	PC95 .75	PY500A .80	U403 .75	AD140	-40	BFY50	-25	OC76	-17
5	EL91 .88	PC97 .45	PY800 .81	U404 .49	AD149	-55	BFY51	-21	OC77	-80
0	BL95 .39	PC900 .45	PY801 .31	U801 .76	A D161	-50	BFY52	.22	OC78	.17
5	EL360 1.20	PCC84 .40	PZ30 .48	U4020 .55	AD162	.50	BY100	.20	OC78D	.17
٥l	ELL80 1.00	PCC85 .44	QQV03/10	VP23 .75	AF106	.55	BY105	.20	OC81	.12
9	EM80 .40	PCC88 .60	1.75	VP41 .75	AF114	28	BY114	-20	OC81D	-12
В	EM81 .65	PCC89 .50	Q875/20 £1	W107 -65	AF115	-17	BY126	.17	OC82	.12
в	EM83 .55	PCC189 .58	Q895/10 £1	W729 .75	AF117	-21	BY127	-20	OC82D	-12
0	EM84 .40	PCF80 -28	QV04/7 #1	X65 .65	AF121	.83	BYZ10	-28	OC83	-22
3	EM85 1.00	PCF82 -38	R19 .38	X66 .65	AF124	-28	BYZ11	-28	OC84	-26
Si	EM87 .68	PCF84 .59	TH233 .98	Transistors	AF125	.19	BYZ12	.28	OC123	-25
ı	EMM803 42	PCF86 .55	TP2620 .98	& Diodes	AF126	-20	BYZ13	-28	OC139	25
3	EY51 .40	PCF200 .67	UABC80.88	2N404 -20	AF139	.72	CG12E	-22	OC169	-25
ы	EY81 .40	PCF801 .48	UAF42 .55	2N966 -58	AF178	-75	GD9	.22	OC172	-89
j!	EY83 .54	PCF802 .50	UBC41 .58	2N1756 -55	AF180	-58	GET113	.22	OC200	-24
ı	EY84 .70	PCF806 . 70	UBC81 .45	2N2147 94	AF186	-61	OA5	·81	OC201	.42
ы	EY87/6 .38	PCH200 .70	UBF80 .88	2N2297 .25	BA115	15	OA9	-14	OC202	-47
5	EY88 .40	PCL82 .82	UBF89 .85	2N2369 ·24	BA116	-28	OA10	-47	OC203	-88
1	EY91 .58	PCL83 .54	UBL21 .77	2N2613 -48		·14	OA47	·11	OC204	-38
)	EZ40 .55	PCL84 .88	UC92 .45	2N3053 -36	BA130	11	OA70	17	OC205	-47
)	EZ41 .50	PCL86 .47	UCC84 .75	2N3121 2.75	l ——					
S'	EZ80 .24	PD500 1.44	UCC85 .88	2N3703 21	MATCHE	n m	RAWSTRY	n# g	ET'S	
Ì	EZ81 .25	PEN45 .80	UCF80 .65	2N3709 -22	LP15 (AC					-58-
)	GY501 .75	PEN45DD	UCH21 .66	AA119 ·17	per pack.					
	GZ32 .54	-80	UCH42 .65	AA120 ·17	I-0C44					
ı	GZ33 1.00	PEN46 .20	UCH81 .88	AA129 ·17	2—0C82	-53n	Ret of 3-	_0°C	83 -72n	J. 4
1					_ 5002	- Jp.	200 01 0-	30	00 .ap.	

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NAS0162X 200V 28	NAS0652X 200V -56	NAS1002X 200V -74
NAS0164W 400V -40	NAS0654W 400V -84	NAS1004W 400V 1-09
NAS0164X 400V -38	NAS0654X 400V -80	NAS1004X 400V 1-04
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NAS0301X 100V 28	NAS0851X 100V -50	NAS1601X 100V -80
NAS0302W 200V -36	NAS0852W 200V -67	NAS1602W 200V -90
NAS0302X 200V -34	NAS0852X 200V -64	NAS1602X 200V -86
NAS0304W 400V ·52	NAS0854W 400V 97	NAS1604W 400V 1-32
NAS0304X 400V ·50	NAS0854X 400V 92	NAS1604X 400V 1-26
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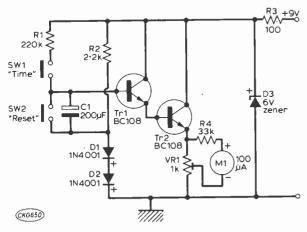
THIS is probably one of the simplest possible indicating timers that can be made using electronic principles. It relies on measuring the voltage developed across a capacitor, Cl, that is being charged up towards 6V through a resistor, Rl. The slope of the charge curve follows an exponential function but over the first half of its charging range the slope is reasonably linear and the circuit operates only on this part of the range.

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

found for such an instrument.

## **Operation**

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

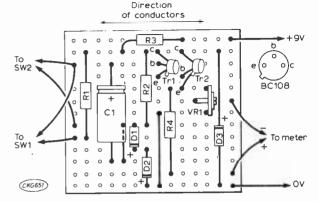


Circuit of the electronic timer using a meter to display the time interval.

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

## **★** components list

R1	220kΩ ‡W	R3 · 100Ω }W
R2	2.2k\O \(\frac{1}{4}\W\)	R4 33kΩ ½W
C1	200µF 12V	D1/2 1 N4001
D3	6V 400mW zener	Tr1/2 BC108
M1	Meter 100µA	SW1/2 Push button switche



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

## Circuit

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

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

battery.

## **ERRATUM**

Zener Diode Tester. Feb 1974
The 150 turn secondary winding of the oscillator transformer should be wound with 36 SWG enamelled wire and not 30SWG as specified on page 977.



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

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

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

## THE CIRCUIT

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

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

The small bias required between the bases of Tr3 and Tr4 to eliminate cross-over distortion is

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

## CONSTRUCTION

The circuit excluding the power transistors, is constructed on a printed circuit board measuring  $4^3_4 \times 3^1_2$ in. This is shown in Fig. 2 full size. Layout of the components on the board is shown in

## \* components list

## Resistors 15kΩ R1 10Ω R8 150Ω R<sub>2</sub> 120kΩ 1 · 2kΩ R6 R9 1kΩ 3 R3 $47k\Omega$ R7 $27\Omega$ R10 $33k\Omega$ R4 2·2kΩ All 1W 10% VR1 $50k\Omega$ log VR2 $10k\Omega$ pre-set VR3 $50\Omega$ pre-set Capacitors C1 4μF 16V 4.7nF polyester C2 16µF 16V C5 1000μF 16V 200µF 16V Semiconductors Tr1 BC108 Tr5 BC107 Tr3 AD161 Tr2 BFX88 Tr4 AD162 Tr6 AD161 Miscellaneous S1. Single pole on-off. Insulating kits (3) for power transistors. Aluminium box 6 x 4 x 5in. Circuit board 42 x 33in. D1, 10V 400mW Zener.

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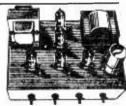
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Fig. 1: (left) Circuit of the amplifier and power supply for the cassette recorder.

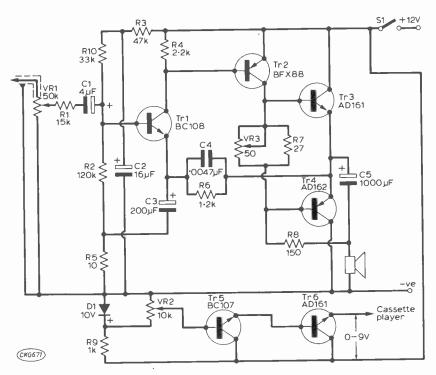


Fig. 2: (below) Full size layout of the printed circuit board used in the amplifier.

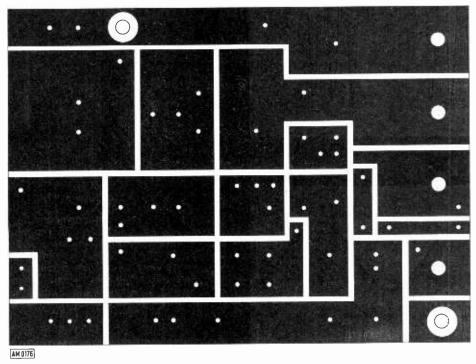


Fig. 3. Rectangular-shaped lands are employed on the board to simplify etching. The board itself is mounted in a  $6\times4\times2^{1}$ <sub>2</sub>in. chassis with the power transistors mounted on the rear panel. The leads from the terminals are brought out through holes on the rear of the chassis and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

Tr3, Tr4 and Tr6 must be insulated from the chassis with mica washers. The body of Tr4,

although at negative potential, has to be insulated due to reasons stated later. No heatsink is needed for Tr2 as it is being run well within its power rating.

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

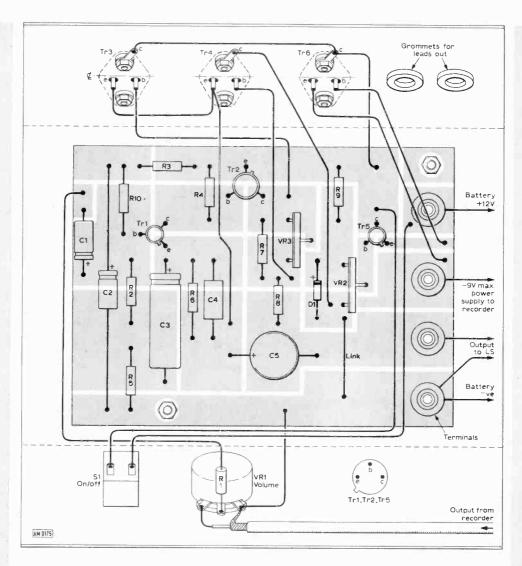
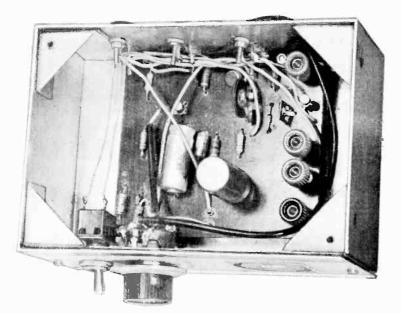


Fig. 3: (above) wiring of PCB to power transistors and volume control.



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

## TESTING THE AMPLIFIER

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

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

## TESTING THE POWER SUPPLY

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

## INTERCONNECTIONS

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

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

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

## TELEVISION

## IN THE MAY ISSUE

## OSCILLOSCOPE CALIBRATOR

The usefulness of an oscilloscope is greatly increased if its calibration can be checked periodically: the equipment described enables you to undertake this operation for yourself. The unit uses a crystal oscillator and i.c. dividers to provide the required outputs.

## INTERCARRIER SOUND

The intercarrier sound system gives rise to more reception problems than any other aspect of the 625-line system. The basic principles and the circuits used will be outlined and guidance given on fault conditions.

## CRT REJUVENATOR

A design which can be used to give a new lease of life to either monochrome or colour CRTs.

## PHILIPS FIELD TIMEBASES

In his next Fault Finding Guide John Law looks at the valve field timebase circuits used from the 152 series up to the 310 chassis, and the faults commonly found.

## ASSEMBLING A COLOUR RECEIVER

In the final part of his series David Robinson describes the most tricky part of the exercise, setting up the signal circuits.

## PLUS ALL THE REGULAR FEATURES

Details of the May Issue are subject to the current national situation at the time of going to press.

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## JOSTY KITS

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

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

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

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

The book comes with a free printed circuit board for 10 of the Josty designs which are described in the



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



Two of the "Josty" Kits.

text. Complete kits of parts for these and other constructional projects described in the book are available from Jostv.

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

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

## COMING SOON IN P.W.

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

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

## TV GAMES

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

## STEREO TUNER

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## COMMUNICATIONS RECEIVER

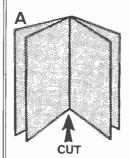
Do you want a communications receiver?

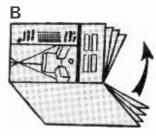
For more details on these and other projects, stay tuned to P.W.

## YOUR PULL-OUT SUPPLEMENT



Lift staples at centre page Pull out the Supplement Cut along centre of pages A Put pages together again Fold up along dotted line B





## FINALE

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

What to do with the report? The World Radio and TV Handbook\* contains all the information that is required on almost every radio station in the world, together with a mass of relevant information. The

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

- \* Fountain Press (Model & Allied Publications) Station Road, Kings Langley, Herts. £3 post paid.
  - \*\* Butterworth Ltd., 88 Kingsway, London, WC28 6AB. 90p post paid.

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# NTENTS:

INTRODUCTION
Long distance reception or
DX-ing for the newcomer

SHORT WAVE BANDS

RADIO WAVES p 2 How those radio signals travel thousands of miles

Disturbance Readability

Propagation Overall

SINPO REPORTING CODE

Interference Noise

Rating Scale 5

Excellent

Good Fair Poor

Slight

Moderate Severe Extreme

Slight Moderate Severe Extreme

Slight Moderate Severe Extreme

Signal Strength Excellent

Good Fair Poor

MEDIUM WAVE DX-ING
There are more stations here
than just the locals

Herein lies the main interest of the DX-er

p 2 TV FROM AFAR

el Don't be restricted to the locals for TV viewing

p 5 FM DX

Europe on the domestic FM receiver, with stereo

p 15

p 12

FINALE p 16
Logging, reporting and getting that confirmation

Unusable

audible

Barely

# NTRODUCTION

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

small community over a radius of a which is only meant to serve some somewhere in Central America hears a low power station from wire can rightly call it DX when he made receiver and 50 feet of aeria But the DX enthusiast with a homemillion miles away. It would have DX although it is over a quarter of a with the moon are the result of a plainable. The two-way contacts ations, and generally was unexsignals over unusually long disbeen surprising if it had not worked highly sophisticated communicatances, compared to normal expectwireless it meant the reception of frequently and in the early days of tion system and can hardly be called The term 'DX' will be met with

Something has affected those radio waves and caused them to travel over thousands of miles. Checking again the next evening, just to prove the point, lol and behold! the station is not there! Something has changed, again. It is this random changing of radio

'conditions' that provides the fascination of DX-ing whether it be enjoyed on the medium, short or very high frequency (VHF) bands. The last we normally associate with high quality FM local stations. Even TV pictures on VHF and the ultrahigh frequencies (UHF) bands are not beyond the capabilities of the DX-er. Not every day by any means but often enough to make the pursuit of DX TV a very intriguing pastime.

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

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

## RADIO WAVES

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

## TV BANDS

Band Channels Freq. Range (MHz)

4 10	<b>3</b> –	C	-		ယ		ω			3		
stem 34	1B 1D to 1J	K6 to R12	RI to R5	Syste	D to H1	A-B-C	5 to 12	2-3-4	System B (C	B6 to B14	B1 to B5	Syste
G, I, L 470 to 614 to	53 - 75 175 - 25	n - 75	49.75	n D	175-25	58 - 75	175 - 25	48-25	8	176-25	41 - 50	m A ~
582 854	59·75 221·25	229-75	99-75	Ä	222 75	87.75	229 - 75	67.75	E E	219 75	0 66 75	

## FM DX

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

Commercial multi-element aerials are eminently suitable for FM DX the more elements the merrier within reason. More elements mean

a sharper forward beam so searching for DX around the compass can be tedious. A simple dipole or two element affair is ideal for general searching switching to the main beam as required. Orientation must be the same, simplified by placing both aerials on the same mast.

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

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

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

TV SYSTEMS	EMS	œ	BASIC DATA	0	ATA		
	4	В	ပ	۵	Ŋ		
Lines	405	625	625	625	625	625	625
Ch. Bandwidth MHz	r)	1	_	8	8	∞	ω.
Video B'width MHz	က	S	S	9	2	Ś	5 6
Modulation (Video)	+ + NA	1 2	+ 2	1 2	1 2	EM AM	+ 2
An 819 line system (E) is in use in France (VHF)	E) is	in us	e in	Franc	S (S	Ē	
System A UK, Eire (VHF)	(VHF)						
B Austria, W. Germany, Italy, Holland, Norway,	W. Ge	rman	y, Ita	ly, Ho	fland	Nor .	way,
Portugal, Spain, Sweden, Switzerland and	Spai	n, S	wede	n, S	vitzer	land	and
Yugoslavia (VHF)	ia (V	Ę.					
C Belgium (VHF)	VHE						
D Czechoslovakia, E. Germany, Poland, USSR	ovakia	Ë,	Germ	any,	Polan	d, C	SSR
(VHF)							
G Austria, W. Germany, Italy, Holland (UHF)	W. G	erma	ny, It	aly,	Hollar	Jo pu	HF
I UK, Eire (UHF)	(JHF)						
L France (UHF), Luxembourg (VHF)	HF).	Luxe	mbou	Irg (	(HF)		

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

than others.

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

with modern varicap tuners this is a simple business.

a simple business.

In the process of setting up the equipment it is likely that a picture of some sort, that is obviously not BBC or ITV, will be picked up and the identification chase will be on.

All TV stations have test and identification cards, usually with station or network names, but because of the common practice of relaying other stations or networks too much credence, should not be given to

first conclusions.

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

Aurora F layer Somiles Ground wave Ground wave Somiles Somiles

of all short wave long distance Severe, relatively short term erupcan cause the complete disruption tions on the sun, called sunspots reflective throughout the 24 hours. tinuous ionisation, they can remain mer, being subject to almost conbecomes impossible. In the sumtheir reflecting powers and DX that in winter they lose much of and other factors. During the dark are capable of reflecting radio layers become less reflective so hours, in the absence of the sun, the vary with the degree of ionisation waves. The height of the layers wil tion. Being conductive these layers F1/F2 layers with increasing ionisa-

## GROUND WAVE

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

action with the ground wave. Hence broadcasting stations to change the constant reminder by our local tion of the signal due to its interthe sky wave causing severe distorthe skip distance can become ni of the transmitter. At night however constitutes the normal service area wave is extended much further and On the medium waves the ground

over to FM for better reception at

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

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

## TROPOSPHERE

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

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

> width involved, 45 is the enormous frequency bandapproximately, with the odd gap 850MHz

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

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

groups currently available commerby a choice of aerials from the three not pay to try to make them at home. The UHF bands can be covered

Channels 21 to 34 Channels 39 to 53 Group A Colour Code Red

Channels 48 to 68 Group B Colour Code Yellow

Group C/D Colour Code Green

ment work that has been done by of manufacturers and again it pays rations, are available from a number to take advantage of the develop-These aerials, in various configu-

> Folded dipole 5'-3" Reflector 5'-6' Director 4-9" 2-8"

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

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

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

should all be fitted with the best aerials it is decided to use they made aerials of unknown character-

istics. Whatever combination of the makers rather than to use home

# TV FROM AFAR

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

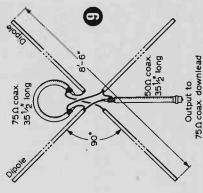
The passage of meteors through the Elayer also causes local lonisation which is capable of reflecting Band 1 and 3 TV signals but only for comparatively short periods, often measured in seconds.

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

The last DX TV mode of propagation to be discussed is perhaps the most predictable. The daily weather charts on domestic TV are closely watched by the DX stalwart who looks for approaching high

above, contrary to normal stable viewers of the domestic TV services for which BBC and ITV often ropo producing signals only over a ar receiver and transmitter usually pressure areas when clear skies at night allow the earth to give up its ohere thus creating an 'inversion' ower than that of the air mass conditions. The TV signal is gradually bent more and more as it passes hrough the troposphere and it can eventually be returned to earth, VHF and UHF signals are affected by trops as evidenced by the occasional interference experienced by apologise! 'Ducting' is a form of well defined path between a particuto the exclusion of other signals neat quickly to the upper atmoswhen the surface temperature is perhaps a thousand miles away. originating along the path.

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



Dipole X-array mounted in horizontal plane

# MEDIUM WAVE

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

## AT NIGHT

After dark, stations in Europe and North Africa up to a radius of roughly 1300 miles can be heard in the UK via the sky wave propagation.

Sometimes the signal may make more than one hop between earth and the E layer producing the real DX which the enthusiast is seeking. The long winter nights produce many signals from the USA and Canada and down into the Caribbean area. Station CJON at St. John's, Newfoundland, can often be heard well before midnight on 930kHz and is a good station for the

such as Torshaven in the Faroe agement if nothing else! Others nclude CHER Sydney, Nova Scotia WABC New York City 770kHz, WOR New York 710kHz and many others. Good catches among the Pierre in the St. Pierre and Miquelon slands on 1375kHz, Bermuda ZBM1 1235kHz and ZFB1 960kHz plus WIVI 970kHz and WBNB on 1000kHz n the US Virgin Islands. Even around Europe there are stations Islands on 584kHz which represents quite a good catch, together with newcomer to look for, for encouron 950kHz, CFRB Toronto 1010kHz, arer stations include Radio St. Hofn in iceland on 665kHz.

## MIDWINTER

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

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

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

about 100 to 150 feet long including than half a wavelength this aeria any down lead. As the length is less The aerial for MW ought to be

unwanted signal. Maximum disof minimum pick-up is towards the the loop is rotated so that the line pattern is similar to a figure 8 and matters. The loop aerial's pick-up aerial but it is the ratio of wanted on those obtainable with the outside the signal strengths will be down to null out an unwanted station and Fig. 2, which he can rotate in order also possess a loop or frame aerial, to unwanted signal that really leave the wanted station. Naturally properties. The seasoned DX-er will will not show any particular directive

> SHORT WAVE DIROIES MAX 751 Flat twin feeder Dipoles cut to bands required SIGNAL sulators 9 A half wave dipole suitable for a 891 -000----17-4" Reflector -14-10 Director -16-0"Folded dipole

49m 76ft 160m 256ft 41 65 80 128 31 48 40 66 25 39 20 33 19 30 15 22 16 25 10 .16	76H 1	49m 49m
Amateur	ocasi	prod
	denet	0

sharp bends at all times. There is chosen. Use good insulators where receiver being counted as part of the wire is supported and avoid the 132 feet or other half wave in from the horizontal wire to the

> power supply line or telephone an aerial wire over or near any as long and as high as is possible is quite in order to make the aerial nothing magic about 132 feet so it In the interests of safety never run is a must whatever length is chosen. in the circumstances, but the ATU

able for listening on several bands as in Fig. 7 from the dimensions single band only may be constructed given in the Table, but the multi-The length of the feeder should be band dipole of Fig. 8 may be prefer-

kept to a minimum after it has been allowed to drop vertically downwards from the centre for a short

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

A vertical rod aerial mounted on side window ledge and joined to the receiver via the ATU, Fig. 5, the the same from all directions. A half wave horizontal wire will have maximum response from stations at metre bands during periods of high sunspot activity, thought should be given to erecting a two, or even an insulator can be fitted to an outsignal pick-up being approximately right angles to the line of the wire. When conditions favour the 10/11

three, element wire beam, Fig. 6, which is not so impossible as it may seem considering the 'wingspan' is only about 17 feet. However made, which will not be any more t will tend to be quite directional unless a bi-directional beam is difficult.

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

the dial as well as permitting the The calibration will enable the search for a particular station to be narrowed down to a small part of ecording of the frequency of a new

frame or brickwork Screw into window Thick plastic panel about 9'x5'

To receiver

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

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

## CALIBRATION

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

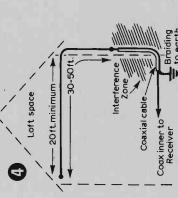
again. With a communication type receiver the existing calibration ought to be quite accurate but if a new station's frequency is to be provide two marker points 10kHz apart from which the frequency can station so that it can be easily found measured the crystal calibrator will be estimated to a kHz or so.

## SHORT WAVE BANDS

At the outset of his DX-ing career the newcomer to the short wave bands will, understandably, be a money on a receiver, especially if he is not quite sure what he is really ooking for. He ought to go for a communication receiver but unformarket which do not, in fact, meet the accepted specification for this ype of equipment. They are only ceivers lacking several of the essenlittle hesitant to spend a lot of tunately there are a number of socalled 'communication' sets on the tial features of a proper communicaglorified all-band domestic

more interested in the broadcast bands so the general coverage receiver is likely to be his first tinuous coverage across all the including the amateur bands, from bands only, with the range switch selecting part or whole of a particuand 28MHz. The newcomer will be Short wave receivers fall into two general categories, those with conshort wave bands, (see the Tables) about 1.5MHz to 30MHz in a number of switched ranges and those inended for use on the amateur lar band, typically 1.8, 3.5, 7, 14, 21 tion receiver.

The following points should be considered when weighing up the



pros and cons of a particular short wave set:—

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

2. Adequate Frequency Coverage, including the 11 and 13 metre bands which really come alive during periods of high sunspot activity. The lowest frequency bands, 90 and 120 metres, can be sacrificed if necessary. Broadly speaking, 3.5 to 26MHz is the minimum coverage to aim at.

switched for USB or LSB. An alternmay be crystal controlled and position for these modes. The BFO guide, and no more, to the correct control may be so marked as a lower (LSB) sideband and the BFO missions use either upper (USB) or phony is widely used on all amateur especially useful on the amateur if a stable BFO is fitted. SSB transbands and this can only be resolved bands. Single sideband (SSB) tele-(CW) or Morse code signals, the reception of continuous wave trequency oscillator, which permits 3. Provision of a BFO or beat

## SHORT WAVE BROADCAST BANDS

Band (metres) Frequency (MHz)

wanted signal and exclude those on adjacent channels. For reasonable

good short wave receiver since it determines its ability to select a

audio quality a bandwidth at the IF

H *	13	16	19	25	31	41	49	88	75	98	120
100000		1000	00000	11-700	1000	7-100	5-950	4.750	oraci	3-200	0.000
1000	-	00000		11-975	00000	100	6-200	5.060	4-000	3-400	to 2-495

## SHORT WAVE AMATEUR BANDS

Band (metres) Frequency (MHz)

i i	** UK 7-000-7-100
	UK 3-500-3-800
29-700	0 28.000
21 - 450	5 21 000
14-350	0 14-000
7-300*	0 7.000
4.000*	0 3.500
2 000	008-1

ative name for the BFO, the Carrier Insertion Oscillator, is sometimes encountered.

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

5. Selectivity is, perhaps, the most important characteristic of a

circuits alone. If necessary, the very crystal or mechanical filters are signals, with 2.5 to 3kHz for SSB justified and will never be regretted. receiver where expense is well sive but this is the one point in a some receivers. Filters are expennarrow. The Q-Multiplier, if allowed stage bandwidth becomes very the point of oscillation when the the gain of one of the IF stages to by a 'Q-Multiplier' which increases and the required selectivity obtained narrow CW filter can be left out, width can be obtained with tuned employed although the 6kHz bandwhich is very expensive if separate number of switched bandwidths transmissions. The ideal is a narrow for the reception of CW other extreme 500Hz is not too of about 6kHz is required. At the to oscillate, functions as a BFO in

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

7. AGC Circuits are designed to hold the output of the receiver reasonably constant over a wide range of input signal levels, generally due to fading. With broadcast stations the carrier is used to actuate the AGC but with SSB and

CW there is no continuous carrier and so the resultant audio signal is often used to operate the AGC circuits. This means that there must be a facility for switching off the AGC when receiving SSB or CW or switching to alternative circuitry for these modes. On a good communications receiver this will be done automatically when the function switchis changed from AM to SSB/CW.

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

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

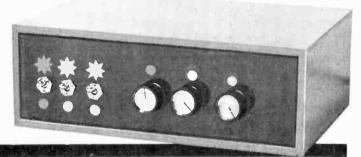


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## **LEARNING BY PRACTICAL PROJECT STEPS**

## PART 7—GROUNDED EMITTER AMPLIFIERS

Continued from the April issue

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

We can connect up a microphone exactly as before and introduce a feedback decoupling capacitor as shown in Fig. 51. By measuring the amplified a.c. signal at the emitter of Tr2 you should see a signal comparable to that obtained from the single stage of Fig. 52. This would appear quite natural because we have only introduced an emitter follower. However we can go a step further as shown in Fig. 53. Any current flowing through R2 of the emitter

#9V

R1
10k
A

Tr2
BC108
B

R2
1k

V
M1
10V
OV
OV

A70k
100k

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

follower must (in the main) have come from the collector circuit so if we introduce a resistor in the collector circuit of Tr2 we should see voltage swings across it. The value of R3 has to be carefully chosen so that there is sufficient scope for a symmetrical voltage swing about the quiescent voltage of the collector. We can now remove the feedback decoupling capacitor we previously used and substitute a much higher value capacitor between the emitter of Tr2 and ground (C1). At the same time we can drop one of the feedback resistors. This serves two purposes; C1 prevents feedback of signal to the base of Tr1 and allows any a.c. component of current flowing through R1 to pass readily into the base circuit of Tr2. In the absense of a.c. the biasing of the circuit is unaffected. By enhancing the a.c. component of base current into Tr2 we can get quite high voltage swings at its collector; in fact almost

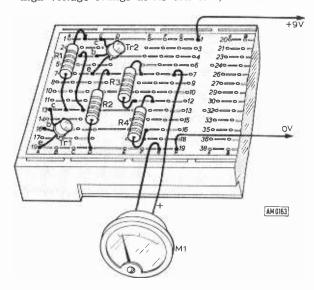


Fig. 50: Component layout for Fig. 49.

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

Just as before, we can add on a current amplifying stage and produce an intercom amplifier having very similar characteristics to those we have already obtained (Fig. 55). It is still necessary to incorporate a degree of frequency correction with C4 across R4. You can experiment with different values to determine what effect C4 will have on the overall performance of the amplifier. Values should be in the range of 2,200pF to 33,000pF  $(0.033\mu\text{F})$ . The capacitor in this case is not introducing feedback (because all a.c. signals on the bias line have already been removed by C1); it is simply "slugging" the microphone and hence attenuating high frequency signals at source. Because of the high output impedance of the microphone it will have a much more dramatic effect on all frequencies in the spectrum but will reduce the amplitude of higher ones more than lower ones. Negative feedback, of a frequency selective nature, could be provided by a small value capacitor (say 2,200pF) between the collector of Tr2 and its base; try this as an alternative.

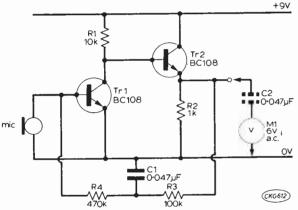


Fig. 51 : The signal level at Tr2's emitter is comparable to that produced by the circuit of Fig. 45.

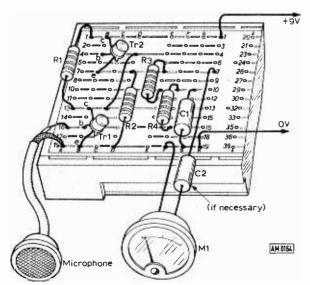


Fig. 52: Component layout for Fig. 51.

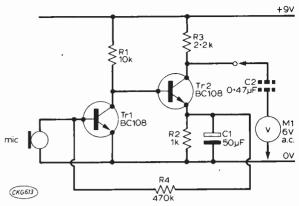


Fig. 53: The voltage gain of this circuit is similar to the first two stages of Fig. 47 but uses fewer components.

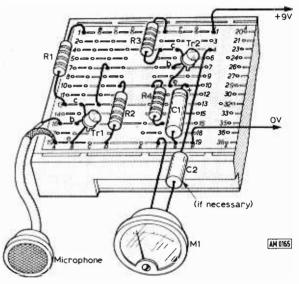


Fig. 54: Component layout for Fig. 53.

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

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

Say the a.c. signal at the base was to rise in a positive direction the potential at A will also rise to match it—thus trying to keep the base current in its original quiescent state. However, with the value of R2 it cannot track exactly and there is bound to be some variation in base current due to the a.c. signal. The mere addition of R2 reduces the

gain of the first stage because of this interaction (a form of negative feedback) but the attenuation should not be too great. We can, however, take the considerably amplified—and phase reversed—signal at point B (collector of Tr2) and use this to provide current into the emitter circuit of Tr1 via R8. Because of the phase reversal this current will negate the base current. By adjusting the value for R8 we can inject more or less of this opposing current; the higher the current the more negative feedback we get for our signal and hence the lower the overall gain of the amplifier.

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

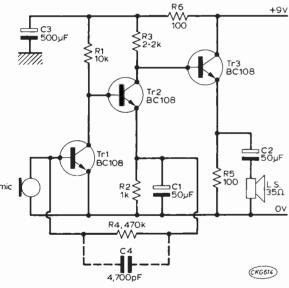


Fig. 55: This circuit has almost identical performance to that of Fig. 47 but is much more economic on components. Its gain, however, is uncontrolled and unpredictable.

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

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

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

## Further thoughts

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

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

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

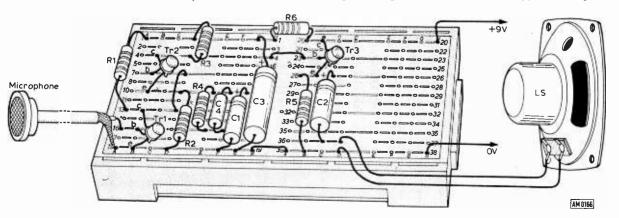


Fig. 56: Component layout for Fig. 55.

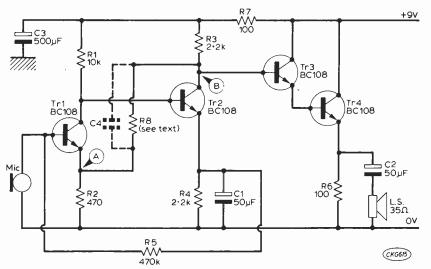


Fig. 57: A refined version of Fig. 55. The gain is set by the ratio of R8 with R2. R4 has a different value to increase the quiescent potential at Tr2's collector and a super alpha pair is used to drive the speaker—reducing the load on Tr2.

of course, always be considerably less than the "open loop" gain of the two stage circuit but this is usually no hardship. Thus, if one was using a magnetic cartridge (capacitively coupled to the base of Tr1 through a capacitor having a very low reactance compared with the output impedance of the cartridge) that gives an output voltage of, say 20mV at 1kHz, one could calculate the precise ratios of the feedback resistors to give a predictable output voltage of 100mV. In this case the gain required is 50 so the resistor ratio should be 50 to 1. Notice that we have stipulated the frequency because, course. the output from a magnetic cartridge increases as frequency

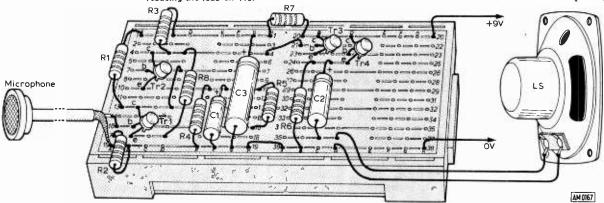


Fig. 58: Component layout for Fig. 57.

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

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

increases (by approximately a factor of 2-or 6dB per octave). This, however, is no problem because we can compensate for this and provide a "flat" output response by introducing a frequency selective component (or components) between the collector of Tr2 and the emitter of Tr1. This would take the form of a simple R C network that increases the amount of negative feedback by 6dB per octave to neutralise the rising response of the cartridge. Obviously care has to be taken in calculating component values-particularly when meeting certain rigid specifications such as the RIAA law-but this is not a major problem. A simple magnetic cartridge preamplifier and equaliser can be made from our basic circuit by replacing R8 with a 150kΩ resistor in series with a  $10k\Omega$  resistor and a  $0.022\mu F$  capacitor across the 150kΩ device with 0.0068μF across the  $10k\Omega$ . The  $150k\Omega$  resistor goes to Tr2 collector.

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

—continued on page 58

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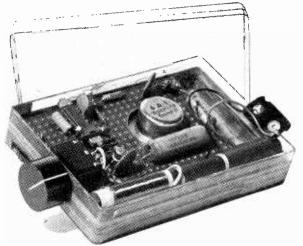


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THIS receiver is designed to fit the pocket, having the tuning control and edge-operated potentiometer and switch at one end of the case, so that there are no projections elsewhere. It provides good volume. The actual external dimensions are  $4^{3}_{4}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

## The Circuit

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

The voltage for IC1 is derived from the potential divider R5, R3 and VR2. The  $250\Omega$  pre-set resistor VR2 and R3 in series give a combination which can be adjusted from  $470\Omega$  (R3 alone) to  $720\Omega$  (with VR2 at maximum value). This allows easy setting of working conditions for the IC. Though a nominal voltage of about  $1\cdot3V$  is usually satisfactory, changing the potential of the supply by even  $0\cdot1V$  can have quite an effect on results. VR2 thus allows compensation for the tolerances in the actual values of R3 and R5

Tr1 is a high gain audio amplifier, which supplies IC2 through C5. This IC has six transistors in a driver/push-pull circuit, with compensatory diodes, and a low standing current of only about  $3.5 \, \text{mA}$ . Its maximum output is up to about 250mA with a 9V supply and  $16\Omega$  speaker, which is easily sufficient for this type of receiver. By using a speaker of higher impedance, peak current is reduced, without much significant loss of maximum volume.

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

## Circuit board

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

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

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

The transparent box actually used was approximately  $4^1_2 \times 3 \times 1$  in. inside dimensions, but provided the parts can be accommodated there is no reason why this size should be used. Though boxes of this kind are reasonably strong, the material can be easily cracked when drilling or filing. To avoid this, use a sharp drill, and work with quite light pressure.

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

applied with a soft brush, the appearance from the outside will be completely uniform.

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

## Components

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

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

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

## The IC's

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

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

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

Prolonged heating must be avoided when soldering these items, and it should only be necessary to

## \* components list

```
Resistors
  R1
          100kΩ
  R2
          1kΩ
  R3
          470\Omega
          2.2M\Omega
  R4
                    All 1w
  R5
          3 · 9kΩ
  R6
          8 · 2kΩ
  R7
          10k\Omega
  VR1
          Miniature edge-control 5kΩ pot with switch
  VR<sub>2</sub>
          Pre-set slide resistor, 250\Omega
Capacitors
  C1
C2
C3
C4
C5
C6
C7
C8
          0.01µF
          0·1μF
        ~ 6μĖ 2·5V
         0·047μF
         2.5µF 6.4V
          0.02µF
         200μF 6·4V
          100µF 10V
  VC1
          Jackson Dilemin 300pF single variable
  Tr1
          BC109
  IC1
          ZN414
  IC2
          MFC4000B (C.T. Electronics, see advert)
 21in. miniature speaker, 16 to 75\Omega impedance.
 Ferrite rod approx. 41in. x 1in. diameter, 26 s.w.g.
 enamelled wire, Veroboard, Plastic box, Knob.
```

keep the iron in contact with the joint for a second or two

## Ferrite Rod Aerial

This is approximately 414in. long, and has 65 turns of 26 s.w.g. enamelled wire, side by side. One layer of fairly stout paper is put on the rod, and the winding is on this. It is possible to slide L1 on the rod, to modify band coverage, but this should not be necessary if the winding begins about 14in. from the end of the rod.

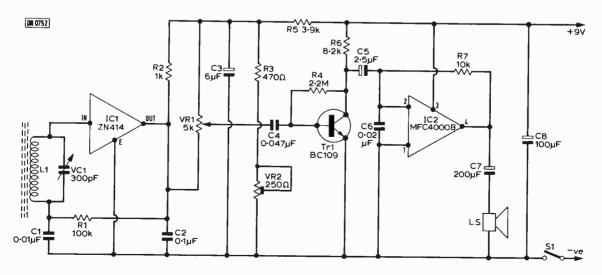


Fig. 1: Circuit of the Mini-Pop.

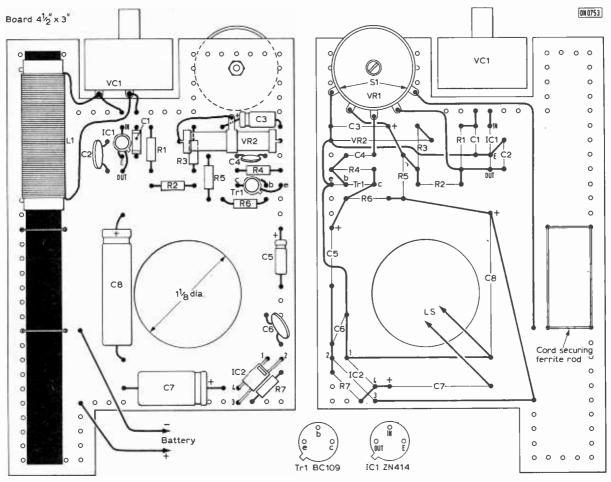


Fig. 2: Component layout and wiring. The circuit board is 0.15in. matrix plain Veroboard.

## Adjustment

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

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

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

## EXPERIMENTAL WORKSHOP —continued from page 53

cartridge (off load) is in the order of 100mV so, in theory, no extra gain is needed. Because of the mismatch one would only expect to get that sort of signal at high frequencies and considerably less at low frequencies. Hence we need to tailor the response of the pre-amplifier to have approximately unity gain at high frequencies and high gain at the bottom end of the spectrum. This is very easily accomplished by replacing R5 with a high value capacitor (in the order of  $10\mu F$ ) in series with a  $4\cdot7k\Omega$  resistor. It might be necessary—at the same time—to attenuate the signal from the crystal cartridge with a potential divide circuit prior to capacitively coupling it to the

These examples are just a couple of suggestions

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

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

(To be continued)

## DRY BATTERY CHARGER

(MARCH '74 ISSUE)

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

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

# ASSETTE 8 (1) ECORDER) IND UNER II. II. AMPLIFIER

PART 3

RICHARD COLLIN

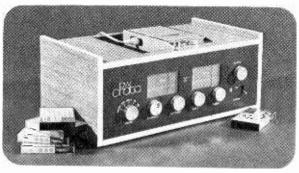
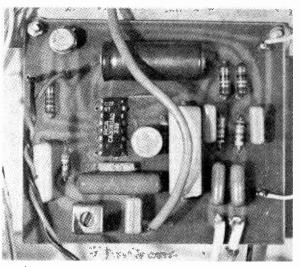


Fig. 14: Circuit of the Stereo Decoder using a phase-locked loop Integrated circuit.

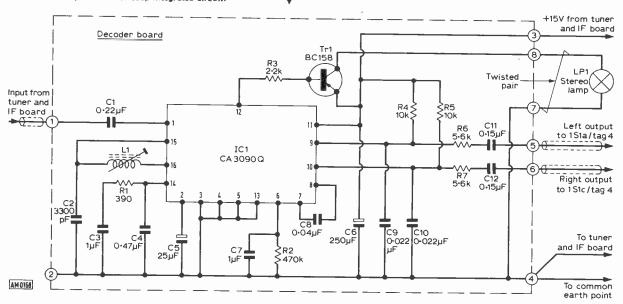
## **DECODER BOARD (UNIT 4)**

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

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



A view of the completed Stereo Decoder board.



## FRONT PANEL

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

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

## \* components list

## **DECODER BOARD** Resistors R1 390Ω R5 10kΩ R6 5.6kΩ 470kΩ R7 5.6kΩ R3 2 · 2kΩ All 1W 5% carbon film R4 $10k\Omega$ Capacitors 1μF polyester C1 0.22µF polyester 0·047μF ceramic 0·022μF polyester C2 3300pF polyester C8 C9 C3 1µF polyester C4 0.47µF polyester C10 0.022 µF polyester C11 0·15μF polyester C12 0·15μF polyester C5 25µF 25V PC mtg. C6 250µF 25V Semiconductors Tr1 BC158 IC1 CA3090Q (RCA) (see text) Miscellaneous LP1 14V LES L1 Toko YXNS-30450-NK. Lampholder LES push-on Printed circuit board **POWER SUPPLY** 1.5Ω 5W wirewound 0-1µF 250VAC C2, C3 2500µF 40V D1-D4 44001 (RCA) or 1N4001 240V: 25V 1.2A Drake Transformers Ltd., Cat. 294-140 (see note) SI SPST 250V 5A toggle switch with long dolly 1A fuse with holder Neon indicator 240V NOTE: Equivalent mains transformers are manufactured by: Coine Electric Ltd., Cat. 20043 Gardners Transformers Ltd., Cat. GR97183 REAR PANEL Insulated coaxial socket (FM Aerial) SK1 Wander-plug socket (AM Aerial) SK<sub>2</sub> Min. 3 pin mains socket (Mains out) SK3 Min. 3 pin mains socket (Mains out) 2 pin DIN socket (Right L.S.) SK5 2 pin DIN socket (Left L.S.) SK6 5 pin DIN socket (Mag. P.U.) SK7 5 pin DIN socket (Cer. P.U.) SK8 SK9 5 pin DIN socket (Tape Head) SK10 5 pin DIN socket (Tape Recorder)

SK3/SK4 may be Bulgin P438 or similar.
 5 pin DIN sockets are 180° type.

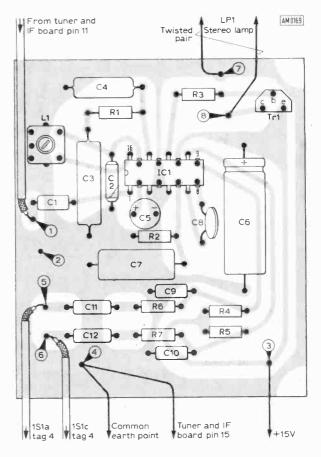
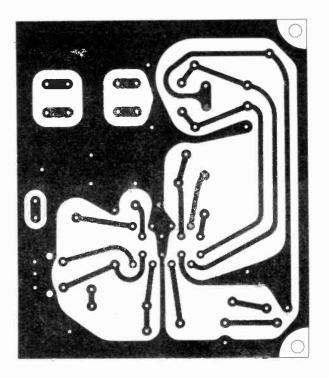
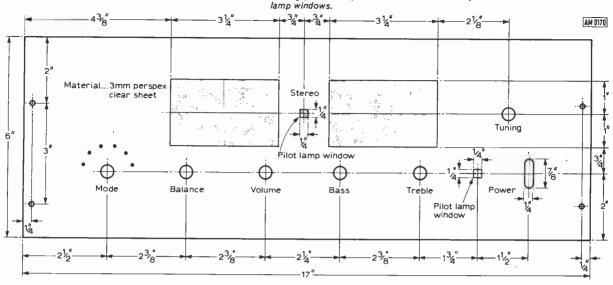


Fig. 15: Component location and printed circuit layout for the Stereo Decoder board. Both drawings are actual size.

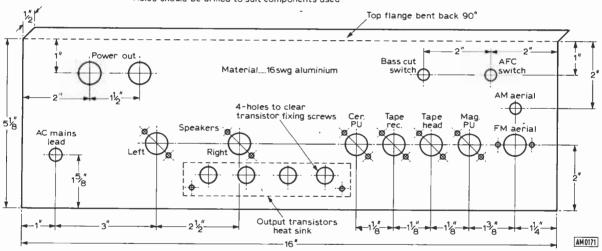


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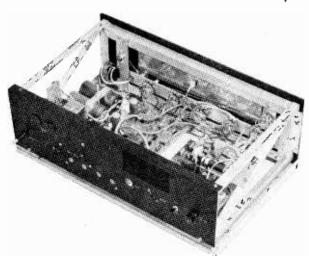
Fig. 16: Layout for the Front Panel showing positions of the controls and dial and pilot



Holes should be drilled to suit components used



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



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

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

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

## **CHASSIS**

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

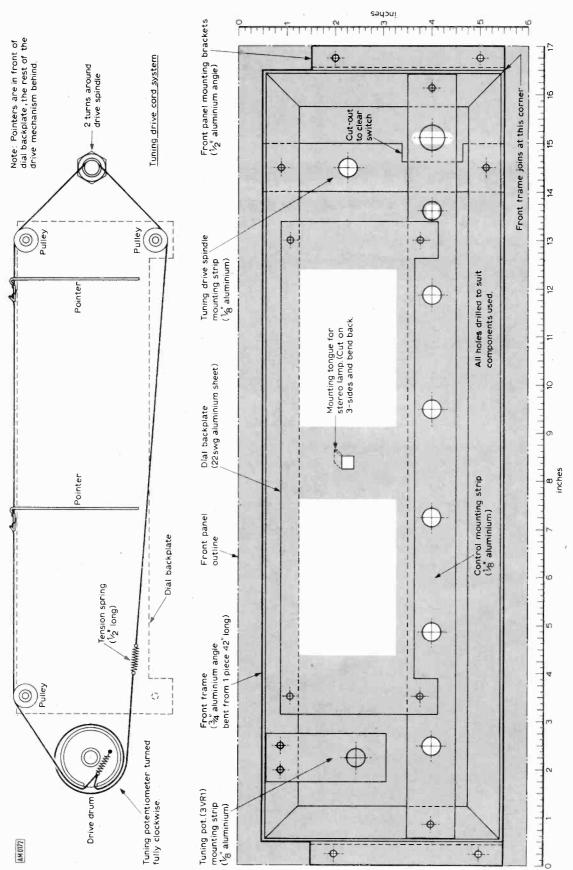


Fig. 18. Constructional details of the framework carrying the front panel and controls (shown half-scale) and the drive cord arrangement.

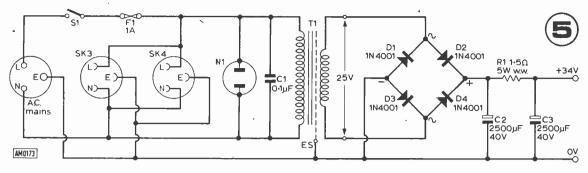


Fig. 19: Circuit of the Power Supply. C1 reduces interference from mains-borne transients.

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

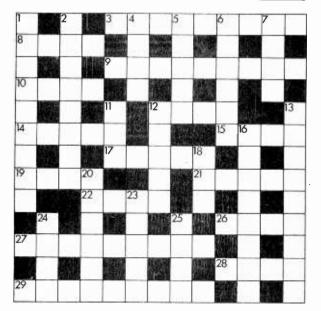
The framework carrying the front panel, the tuning drive and the various controls is shown in Fig. 18. The dial back plate, which is made from thin sheet aluminium, is mounted on the bolts carrying the drive cord pulleys. It should be sprayed in the chosen colour and the scales marked with Letraset.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

### POWER SUPPLY (UNIT 5)

The power supply, Fig. 19, is mounted directly on the chassis using a lin x 18 in aluminium bar running from front to back to carry the transformer and smoothing capacitors. The diodes may be mounted on a small printed board or tagstrip on or beside the transformer tagboard.

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

### Our next issue will cover connecting up, testing and alignment



### **ACROSS**

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

#### DOWN

- Polar bear with it may be resistivel (5, 4)
- Magazine that should be on tape? (8) Bit of cheese in the choked amplifier! (4)
- Do err in our switching instruction? (5)
- Whispers that are audio-frequencies? (6)
- Enthusiasts putting out feelers for old sets (4)
- 11 Employ Sue on distortion correction (3)
- Bordering on a picture with such an aerial? (5)
- Welcome that means a signal success (9)
- 16 They urge us into radio-activity? (8)
- 18 Scotsman in multi-antennae manufacture (3)
- 20 High in the charts with such a sound! (6)
- 23 Radio to primitive peoples? (5)
- Palm-product in Goa's transformers (4)
- Overhead waveband, for goodness sake! (4)

FOR AMUSEMENT ONLY ANSWERS NEXT MONTH

# Wicillo/cope

### PART 3

## techniques alan ainslie

### Y DEFLECTION

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

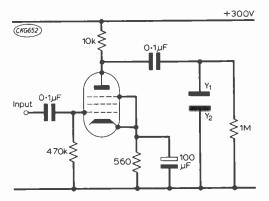


Fig. 1. Simple AC amplifier with asymmetrical output, not recommended for scope use.

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

### DC AMPLIFIERS

DC coupled amplifiers along the lines of the cascode AC amplifiers are not really successful due to drift causing the trace to shift as if varying DC were being applied to the input. Balanced amplifiers are therefore used which balance out any drifts and also provide symmetrical deflection. Simple oscilloscopes have need for only moderate gain and the circuit of Fig. 2 is fairly typical. V2 and V3 form a phase

splitter and each valve drives one deflector plate. V2 grid is undriven except by the shift control and this can be calibrated directly in volts of shift. The grid of V3 is driven from V1 in a normal manner and the input applied to V1 grid. The  $2k\Omega$  preset varies the sensitivity of the amplifier enabling a certain height of deflection to be achieved for a given input. It does not change the calibration of the shift control. Several laboratory scopes use calibrated shift controls as well as graticule measurement and we shall shortly discuss the calibration of such a system.

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

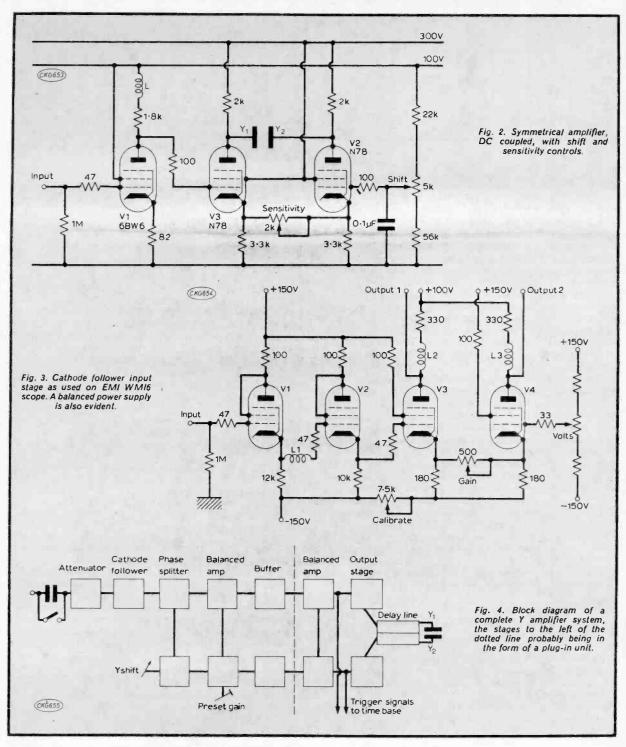
Fig. 4 shows the general arrangement of a high quality Y amplifier system. In a large complex oscilloscope the components to the left of the dotted line would be constructed on a small plug-in chassis, allowing great flexibility. The signal level at the dotted line is about 0.5V each side of zero.

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

#### **ATTENUATORS**

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

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



C1 is to compensate for changes in circuit capacity if V1 is changed, but rarely needs attention. The resistors are usually fixed and so no adjustment is needed here, the values can be checked as the input resistance is the sum of the divider resistors, i.e.  $1\text{M}\Omega$ . Any range giving other than  $1\text{M}\Omega$  is faulty and one or other of the resistors must be replaced. The series variable capacitor is then set on each range to give zero overshoot or rise deformation of a 1kHz square wave of good (less than  $1\mu\text{sec}$ ) rise

time. If one starts at the "direct" position it is possible to check the fidelity of the square wave as applied.

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

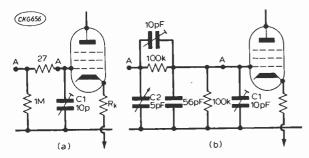


Fig. 5. (a) A simple direct attenuator and (b) a ÷10 attenuator with compensating capacitors.

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

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

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

### **GAUSSIAN FALL-OFF**

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

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

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

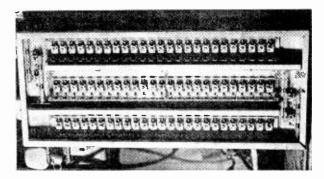
### Y DRIVE CIRCUITS

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

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

#### DISTRIBUTED AMPLIFIERS

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



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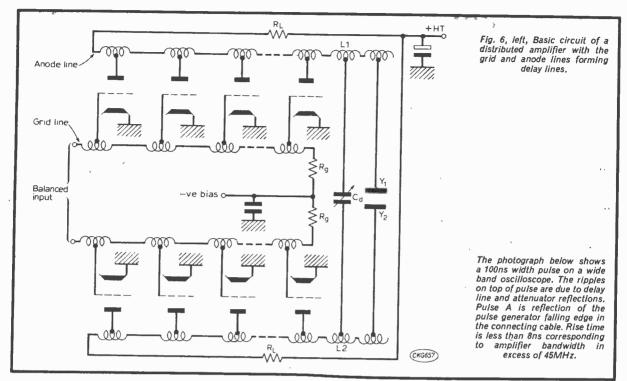
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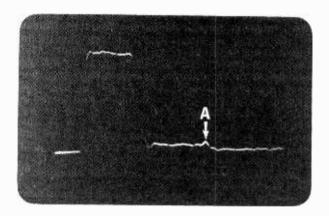
By providing trimmers to earth the lines can be tuned to give the same velocities, shown by the best response to a pulse. With a large number of stages, say more than five, then a gaussian fall-off occurs and very good pulse response is possible not limited so much by the valve capacitances as by the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

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

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

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

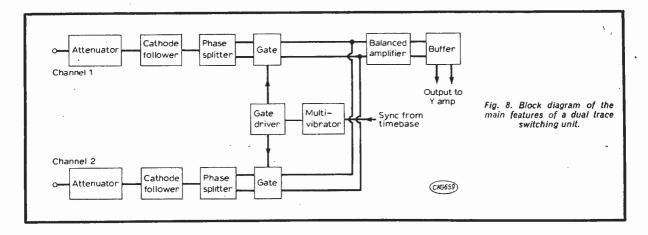
If a pulse generated from a reliable generator and correctly terminated shows this type of distortion the first step is to measure the time from the pulse edge to the ripple using the scope timebase calibration.



This time is then halved, because of the reflection. and the number of stages of delay back from the CRT plates is determined from the time per section (found by dividing total delay as quoted in the manual by the number of stages assuming 2.5ns per section). The trimmers in this region can then be touched with a metal screwdriver, taking care not to turn them and the presence of the screwdriver will cause a hump or dip to appear in the top of the displayed 500kHz square wave. The trimmer needing adjustment can be located when the screwdriver increases or decreases the fault. The trimmer is then trimmed with a plastic trimming tool, and all should be well. It is not advisable to play with delay lines as once upset they can take hours or days of hard work to sort out.

### **FAULTS**

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



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

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

#### **DELAY LINES**

The advantages of a delay line for pulse work are many, the main one being that a signal can trigger the timebase, and then, when it is running, the signal arrives at the Y plates. There are several good scopes around of quite wide bandwidth, but lacking a delay line, and so are limited in their applications to pulse work. However coaxial cable can be used for delay purposes. Standard 70 ohm cable is suitable and has a wave velocity factor of about 0.66. This gives 195m of cable for a 1µsec delay or, for the more usual 250ns delay, a cable length of 48m, which can be conveniently bought as a 50m drum of cable and left coiled on the drum.

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

### **BEAM SWITCHING**

We have so far considered only a single beam Y deflection system. Often two traces are required simultaneously and the obvious method would be a double beam tube and two Y deflection systems. In the light of the above discussion two distributed amplifiers and delay lines would cost a lot of money and the time taken in adjustment would be enormous.

not to mention 36 Y output valves (9 valves per half section)!

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

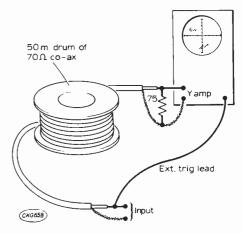


Fig. 7. Set-up using a 50m drum of co-axial cable as a simple delay line.

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

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

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

To be continued

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Price 100+ 0.9p 0.9p 3p 0.9p Values Range 4·7 Ω-2·2M Ω 3·3M Ω-10M Ω 10 Ω-1M Ω 1 Ω-3·9 Ω 4·7 Ω-1M Ω Values available E24 E12 E24 E12 E12 E12 Tolerance watts 1-99 5% 10% 2% 10% 5% lp lp † 10%  $10^{-3.9}\Omega$   $E1^2$  1p 0.9p † 5%  $4.7\Omega$   $-1M\Omega$   $E1_2$  1p 0.9p 4 10%  $1\Omega$   $-10\Omega$   $E1_2$  6p 5.5p Quantity price applies for any selection. Ignore fractions on total order.

MULLARD POLYESTER CAPACITORS C296 SERIES
400V: 0·001μF, 0·0015μF, 0·0022μF, 0·0033μF, 0·0047μF, 2½p, 0·0068μF, 0·01μF,
0·015μF, 0·022μF, 0·033μF, 3p, 0·047μF, 0·068μF, 0·1μF, 4p, 0·15μF, 6p, 0·22μF,
7½p, 0·33μF, 1ip, 0·47μF, 13p,
160V: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, 3p, 0·1μF, 3∤p, 0·15μF,
4½p, 0·32μF, 5p, 0·33μF, 6·0·047μF, 1p, 1·0μF, 1βp,
160V: 0·01μF, 0·015μF, 0·022μF, 0·03μF, 1lp, 1·0μF, 1βp,
160V: 0·01μF, 0·01μF, 0·01μF, 0·015μF, 0·022μF, 3p, 0·033μF, 0·047μF, 0·068μF,
150V P.C. mounting: 0·01μF, 0·015μF, 0·02μF, 3p, 0·033μF, 0·047μF, 0·068μF,
13p, 0·1μF, 4p, 0·15μF, 0·22μF, 5p, 0·33μF, 6ip, 0·47μF, 8½p, 0·68μF, 1lp, 1·0μF,
13p, 1·5μF, 20p, 2·2μF, 24p,

MYLAR FILM CAPACITORS 100V | CERAMIC DISC CAPACITORS

MYLAR FILM CAPACITORS 100V 0.001μF, 0.002μF, 0.005μF, 0.01μF, 0.02μF, 2½p. 0.04μF, 0.05μF, 0.068μF, 0.1μF, 3½p.

CERAMIC DISC CAPACITORS 100pF to 10,000pF, 2p each.

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

POTENTIOMETERS

Carbon track 5k Ω to 2M Ω, log or linear (log ‡W, lin ±W). Single, 12p. Dual gang (stereo), 40p. Single D.P. switch, 24p.

SKELETON PRESET POTENTIOMETERS Linear:  $100, 250, 500 \, \Omega$  and decades to  $5M \, \Omega$ . Horizontal or vertical P.C. mounting  $(0\cdot 1 \text{ matrix})$ . Sub-miniature  $0\cdot 1W$ , 5p each. Miniature  $0\cdot 25W$ , 7p each.

TRANSISTORS

ACI07	15p	AFI26	20p	BFI15	25 p	OC42	12p	2N3707	I2p
ACI26	12p	AFI39	32p	BF173	20p	OC44	12p	2N3708	iop
AC127	15p	AFI78	32p	BF177	28p	OC45	12p	2N3709	Hp
ACI28	15p	AFI80	40p	BF178	32 <sub>D</sub>	OC70	120	2N3710	lip
AC131	12p	AFI81	40p	BF179	32 <sub>D</sub>	OC71	i2p	2N3711	iip
ACI32	12p	BC107	12p	BF180	32p	OC72	12p	2N3819	32p
AC176	15p	BC108	12p	BFIBI	32 <sub>D</sub>	OCBI	120	2N4062	12p
AC 187	22p	BC109	120	BFI94	14p	OC82D	i2p	2N4286	20p
ACI88	22p	BCI47	12p	BF195	140	2N2646	60p	2N4289	
ADI40	50p	BCI48	120	BF197	15p	2N2904	20p	40360	20p
ADI49	45p	BC149	12p	BF200	32p	2N2926			35p
ADI6I	33p	BC 157	14p	BFY50	20p	2N3054	10p	40361	35p
AD162	36p	BC158	I4p	BFY51			58p	40362	40p
AFI14	20p				20p	2N3055	60p	40408	40p
		BC159	14p	BFY52	20p	2N3702	13p	ZTX108	15p
AFI 15	20p	BC187	22p	BU105	225p	2N3703	12p	ZTX300	15p
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	HD	ZXT503	20p

ZENER DIODES 400mW 5% 3·3V to 30V, 12p.	Į	WIRE WOUND POTS. 3W, 10, 25,
400mv 3% 3.34 to 304, 12b.	-	50 Ω and decades to 100k Ω, 45p.

DIODES	ER			SIGNAL	
BY 127	1250V	IA	12p	OA85	7р
IN4001	50V	IA	7p	OA90	5p
IN4002	100V	IA	8p	OA9I	5p
IN4004	400V	IA	8p	OA202	7p
IN4006	800V	IA	10p	IN4I48	5p
IN4007	1000	IA	10p	BAII4	8p

#### SLIDER POTENTIOMETERS

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

DUAL GANG, IOK + IOK etc. log. or lin. 60p. KNOB FOR ABOVE, 12p.

FRONT PANEL, 65p.

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

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

**ELECTROLYTIC CAPACITORS**  $(\mu F/\nu) \ 1/63, 1 \cdot 5/63, 2 \cdot 2/63, 3 \cdot 3/63, 4 \cdot 7/63, 6 \cdot 8/40, 6 \cdot 8/63, 10/25, 10/63, 15/16, 15/40, 15/63, 2 \cdot 2/10, 22/25, 22/63, 33/63, 3 \cdot 3/16, 33/40, 47/4, 47/10, 47/25, 47/40, 68/6 \cdot 3, 68/16, 100/4, 100/10, 100/25, 150/6 \cdot 3, 150/16, 220/4, 220/6 \cdot 3, 220/16, 330/4, 6p. 47/63, 100/40, 150/52, 320/25, 330/10, 470/6 \cdot 3, ps. 68/63, 150/40, 220/40, 330/16, 1500/6, 150/63, 150/63, 220/63, 1000/10, 12p. 470/25, 680/25, 1000/16, 1500/6 \cdot 3, 15p. 470/40, 680/25, 1000/16, 1500/16, 1500/63, 13p. 470/40, 680/25, 1000/16, 1500/$ 

SOLID TANTALUM BEAD	CAPACITORS		12p
0·1μF 35∨ 0·22μF 35∨	2.2µF 35∨	22µF 16V	
0.47µF 35V	4·7μF 35V 6·8μF 25V	33µF 10V 47µF 6·3V	
1.0µF 35V	10µF 25V	100µF 3V	

3½ × 3½ 24p 3½ × 5 27p	0.15 16p   Standard screened   28p   2.5mm insulated   12p   24p   Standard insulated   18p   3.5mm insulated   12p   24p   Stereo screened   40p   3.5mm screened   18p   27p   Stereo socket   20p   2.5mm socket   11p   27p   Stereo socket   30p   3.5mm socket   11p
17 x 3½ 100p 17 x 5½ (plain) — 17 x 3½ (plain) — 17 x 2½ (plain) — 2½ x 5 (plain) — 2½ x 3½ (plain) —	D.I.N. PLUGS AND SOCKETS 2 pin, 3 pin, 5 pin 180°, 5 pin 240°, 6 pin, 7 pin 42p 42p 4 way screened cable, 25p/metre, 6 way screened cable, 30p/metre. 52p
Spot face cutter 42p	20p 9V mains power supply. Same size as PP9 battery.

LARGE (CAN) ELECTROLYTICS

2500µF 40V	74p 2800µF 58p 3200µF		4500µF 16V 4500µF 25V 5000µF 50V	£1.68
HIGH VOLTAGE		PACITORS—1,00		20p
0.022 µF 12	PAPACITORS IA		0·47μF	22p
10pF to 1,000pF E12	Series Values, 4p	each.		

SMOKE AND COMBUSTIBLE GAS DETECTOR-GDI

The GDI is the world's first semiconductor that can convert a concentration of gas or smoke into an electrical signal. The sensor decreases its electrical resistance when it absorbs deoxidizing or combustible gases such as hydrogen, carbon monoxide, methane, propane, alcohol, North Sea gas, as well as carbon-dust containing air or smoke. This decrease is usually large enough to be utilized without amplification. Full details and circuits are supplied with each detector. Detector GDI, £2. Kit of parts for detectors including GDI and P.C. board but excluding case. Mains operated detector £5.20. 12 or 24V battery operated audible alarm £7.30. As above for PP9 battery, £6.40.

PRINTED BOARD MARKER

Draw the planned circuit onto a copper laminate board with the P.C. Pen, allow to dry, and immerse the board in the etchant. On removal the circuit remains in high relief,



### PORTABLE PLAYER CABINET

Modern design. Black revine covered Silver front grille. Chrome fittings. £4.50 Post 25p. Motor board cut for BSR deck.

COMPACT PORTABLE STEREO HI-FI Two full size loudspeakers 18½ × 10 × 3½in. Player unit clips to loudspeakers making it extremely compact. Overall size only 18½ × 10 × 8½in. 3 watts per channel, plays all records 33 rpm. 45 rpm.



Teak finish Weight 18lbs.

85p carriage SPECIAL OFFER

SMITH'S CLOCKWORK 15 AMP TIME SWITCH 0-60 MINUTES

Surface mounting with firing screws. Will replace existing wall switch to give light for return home, garage, automatic anti-burgular lights, etc. Variable knob. Turn on or off at full or intermediate settings. Makers last list price \$4.50. Brand new and fully guaranteed.

OUR PRICE \$1.65 Post 25p

WEYRAD P50-TRANSISTOR COILS

| WILINAU F3U—IRANNISION CUILS | RA2W Ferrite Aerial 85p | Driver Trans. LEDT4. 85p | Driver Trans. LE

Ferrite Rod 8  $\times$  lin. 20p 6  $\times$  lin. 20p 8  $\times$  lin. 10p

VOLUME CONTROLS | 80 Ohm Coax 5p. yd. 5 K. ohms to 2 Meg. LOG or LIM. L/S 15p. D.P. 25p. STEREO L/S 55p. D.P. 25p. Edge 5 KS.P. Transistor 25p ideal 225 & colous 10p vd.

8in & 10 x 6in ELAC HI-FI SPEAKER

Dual cone plasticised roll surround. Large ceramic magnet. 50-16,000 c/s. Bass resonance 55 c/s. 8 ohm impedance. Sin. 10 watt.

£3.75 Each Post 25p



### E.M.I. $13\frac{1}{2} \times 8$ in. SPEAKER SALE!

With twin tweeters and crossover, 10 watt. State 3 or 8 or 15 ohm.
(As illustrated)

With flared tweeter cone and ceramic with fished tweeter cone and ceramic magnet. 10 watt.
Bass res. 45-60 c/s.
Flux 10,000 gauss.
State 3 or 8 or 15 ohm. Post 25p

BOOKSHELF CABINET Size 16 × 10 × 9 in. teak finish

£6.60 Post SET OF 3 MOTORS FOR COLLARO STUDIO, 115 VOLT TAPE DECK 22-50 Post 50p.

BLANK ALUMINIUM CHASSIS. 18 s.w.g.  $2 \nmid in$ , sides 6 × 4in. 45p; 8 × 6in. 55p; 10 × 7in. 65p; 12 × 8in. 55p; 14 × 9in. 90p; 16 × 6in. 90p; 12 × 8in. 65p; 16 × 10in. 21. 4LUMINIUM BOXES 3 × 3 × 3in. 60p; 4 × 4 × 4in. 70; 6 × 4 × 4in. 80p; 9 × 4 × 4in. 21; 12 × 4 × 4in. 21. 4LUMINIUM PANELS 18 s.w.g. 6 × 4in. 12p; 8 × 5in. 19p; 14 × 8in. 20p; 10 × 7in. 24p; 12 × 5in. 25p; 12 × 5in. 34p; 16 × 6in. 34p; 14 × 9in. 40p; 12 × 12in. 47p; 16 × 10in. 60p PAXOLIN PANEL 10 × 8in. 20p.

#### SPECIAL OFFER

8 INCH PANEL METRE 50 MICRO AMPS, UNUSUAL SCALE REQUIRES RECALIBRATING £1.75 Post 20p

### **ANOTHER RCS BARGAIN!**

ELAC 9  $\times$  5in, HI-FI SPEAKER, TYPE 59RM, THIS FAMOUS AND WIDELY USED UNIT NOW AVAILABLE AT BARGAIN PRICE 28-80. 10 WATT, 8 OHM. CERAMIC MAGNET.

R.C.S. STABILISED POWER PACK KITS All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifiers and Double Wound Mains Transformer. Input 200/240V a.c. Output voltages available 6 or 9 or 12 or 15 or 18 or 20V d.c. at 100mA or less. PLEASE STATE VOLTAGE REQUIRED. £2.20 Post Details S.A.E. Size \$\frac{1}{2} \times 1\frac{1}{2} \times 1\frac{1}{2} \times 1.

### R.C.S. GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER BRITISH MADE

TRE-AMPLIFIER BRITISM MADE

Ideal for Mike, Tape, P.U., Guitar, etc. Can be used with

Battery 9-12v, or H.T. line 200-300V. d.c. operation. Size

14" × 12" × 12". Response 25 c/s. to 25 Kc/s, 26 dB gsin.

For use with vaire or transistor equipment.

Full instructions supplied. Details S.A.E.

99 p

20p

### E.M.I. WOOFER AND TWEETER KIT

Wooler 103 × 6jin. Ceramic Magnet, 44oz. 13,000 lines, Tweeter 3jin. square, 10,000 lines. Crossover condenser full instructions supplied. Impedance 8 ohms. £6.75 Post 45p. Power 12 watts.

### BRITISH FM/VHF TUNING HEART

88 to 108 M/CS British made. 2 Transistors ready aligned requires 10.7 M/CS I.F. Complete with tuning gang. Connections supplied but some technical experience Our price £3.95 essential. Post 20p

All post 25p each MAINS TRANSFORMERS

### MAINS ISOLATING TRANSFORMER

Primary 0-110-240V. Secondary 0-240V. 3A. 720W. Insulated terminals. Varniah impregnated. Fully enclosed in steel case with fixing feet.

OUR PRICE £ 10 Carr. 50p

ed as 800W auto transformers 240-110V. IDEAL FOR COLOUR T.V. OR GARDEN TOOLS.

NEW ELECTROLYTIC CONDENSERS | NEW ELECTROLITIC GUNDERSERS
2	550V	14p	160/25V	10p	82+32/850V
4	350V	14p	856/25V	14p	80+50/350V
4	350V	14p	856/25V	14p	60+50/350V
16/450V	12p	1000/25V	35p	32+32/850V	
16/450V	25p	1000/25V	35p	32+32/850V	
22/450V	35p	1000/350V	47p	32+32/850V	
22/450V	35p	36-60/325V			
25/25V	10p	8+18/450V	25p	32+32+32/850V	
50/50V	10p	16+18/450V	40p	32+32+32/850V	
32+32+32/850V	20p 60p 55p				

LOW VOLTAGE ELECTROLYTICS LOW VOLTAGE ELECTROLYTICS
1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF, 15V, 10p, 500mF, 12V, 15p; 25V, 20p; 50V, 30p, 1000mF, 12V, 20p; 25V, 25p; 50V, 47p; 100V, 70p, 2000mF, 6V, 25p; 25V, 45p; 50V, 57p, 100V, 70p, 2500mF, 50V, 65p; 25V, 45p; 50V, 57p, 50V, 65p, 5000mF, 6V, 25p; 12V, 42p; 25V, 75p; 35V, 85p; 50V, 95p.

CERAMIC 1pF to 0.01mF, 4p. Silver Mica 2 to 5000pF, 4p. PAPER 350V-0.1 4p, 0.5 13p; 1mF 15p; 2mF 150V 15p. 500V-0.001 to 0.05 4p; 0.1 5p; 0.28 8p; 0.47 25p. SILVER MICA. Close tolerance 1v, 2.2-500pF 8p; 180-2.200 pF 10p; 2.700-5.800pF 20p; 6.800pF-0.01, mid 80p; each. TWIN GARG. "0-0" 280pF +178pF, 85p; 500pF sindard 75p; 385+385 with 28+25pF 81ow motion drive 50p. 840ET WAVE, SINGLE. 16pF 30p; 25pF 55p; 85p 56p MEON PAREL INDICATORS, 250V ACJIC Amber 20p RESISTORS, 1W, 1W, 1W, 20% 1p; 2W, 5p. 10 In 10 10 10 M. HIGH STABILITY, 1 w. 2 % 10 ohms to 6 mez., 10p. WIRE-WOUND RESISTORS. 5 wait, 10 wait, 15 watt 10 ohms to 10 mez., 4p. TAPE OSCILLATOR COIL. Valve Type 35p.

NEW MODEL "BAKER LOUDSPEAKER" 12in, 50 watt GROUP 50/12 8 or 15 ohm high power full £17-60 range. Professional quality.

BAKER MAJOR 12" £9.90



80-14,500 c/s, 12in. double 30-14,500 c/s, 12in. double cone, wooler and tweeter cone together with a BAKER ceramic magnet assembly having a flur density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s Rated 20 watts. MOTE: 3 or 8 or 15 ohms must be stated.

Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. £12.50 Post free Please state 3 or 8 or 15 ohms.

BAKER "BIG-SOUND" SPEAKERS

Post free

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TEAK VENEERED HI-FI SPEAKER CABINETS For 6in. and tweeter 12 × 8 × 6in. £4 · 00 Post 25p LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft

EMI 63in. HI-FI WOOFER

8 ohm, 10 wait. Large ceramic magnet. Special Rubber cone surround. Frequency response 30-12,000 c/s. Ideal P.A. Columns, 44 Hi-Fi Enclosure Systems, etc. Suitable cabinet 12 × 8 × 6 24 ·00. Suitable Tweeter 22-00.



### **ELAC CONE TWEETER**

The moving coil disphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 c/s to 13,000 c/s. Size 3½ × 2in. deep. Rating 10 watt. 3 ohm Sultable Crossover 21-80 Post 20p Crossover 21-80

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All purpose transistorised. Ideal for Groups, Disco and P.A. 4 inputs speech and music. 4 way mixing. Output 8/15 ohm. a.c. Mains. Separate troble and base controls.

SUPER VALVE MODEL 100 WATT CALLERS ONLY 269.

£4.95

BARGAIN AM TUNER. Medium Wave. Transistor Superhet, Ferrite aerial. 9 volt.

BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER.
Add musical highlights and sound effects to recordings.
Will miz Microphone, records, tape and timer £4.50
with separate controls into single output. 9 volt. £5.95

TWO CHANNEL STEREO VERSION

BARGAIN 8 WATT AMPLIFIEB. 4 Transistor £4.50 Push-Pull Ready built, with volume, treble and bass controls 18v. DC operation.

COAXIAL PLUG 10p. PANEL SOCKETS 10p. LINE 18p COAXIAL OUTLET BOXES, surface, 35p. BALANCED TWIN FEEDER 300 ohms 5p yard. JACK SOCKET Std. open-circuit 14p, closed-circuit 23p. Chrome Lead Socket 45p. Phono Plugs 5p. Phono Socket 5p. JACK PLUGS 8td. Chrome 20p; 3-5mm Chrome 18p. DIN SOCKETS Chassis 3-pin 10p; 5-pin 10p, DIN SOCKETS Lead 3-pin 18p; 5-pin 25p. DIM PLUGS 3-pin 18p; 5-pin 25p. VALVE HOLDERS, 5p; CERAMIC 10p; CANS 5p.

REVERSIBLE 4 POLE MOTOR £1-95
1,400 r.p.m. Reversible 42 Watt, Post 25p
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illustrated. With Cooling Fan 240V A.C.

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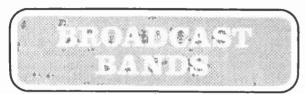
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### SHORT WAVE DX by MALCOLM CONNAH

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

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

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

### Readers' Logs

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

4790 Springbok Radio, South Africa at 2135.

4800 R. Lara, Venezuela, heard at 2348.

4825 Moscow, news in Russian at 2030.

4860 AIR, Delhi, chanting at 2110.

4880 R. Peking in Chinese at 2155.

4900 R. Juventud, Ven., in Spanish at 0040.

4904 Fort Lamy, Chad Rep., in French at 2035.

4905 R. Relogio, Brazil, pop music at 0020.

4930 Majek, USSR, in Russian & English at 2130.

4940 Frunz, USSR, Russian opera at 2115.

4972.5 R. Yaounde, Cameroon in French at 2150.

4980 R. Ghana, African news at 2105.

4980 Ecos del Torbes, Ven., heard at 0001.

4990 Lagos, Nigeria, sports news at 2230.

5010 R. Garoua, Cameroon, French talk at 2205.

5030 R. Continente, Ven., music at 0034.

5035 R. Alma Ata, USSR, Russian talk at 0040.

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

6025 R. Lisbon, Portugal noted at 2045.

6050 Rome, Italy sign on at 2030.

6070 R. Sofia, Bulgaria, sign on at 1600.

6150 R. Belgrade, Yugoslavia at 2020.

6160 Brussels, Belgium noted at 2315.

6165 R. Kiev, noted at 1940.

6190 Vatican Radio noted at 2050.

7195 AIR, Delhi at 2200.

9550 Radio Finland, sign on at 2030.

9610 R. Canada Int., sign on at 2058.

9735 VOA, Monrovia, Liberia at 2120.

9760 Accra. Ghana noted at 2115.

11880 Voice of Turkey noted at 2200.

15120 Voice of Nigeria noted at 1620.

15155 RSA, South Africa, sign on at 1800.

15300 HCJB, Quito, Ecuador at 2010.

15425 Vienna, Austria noted at 1840.

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

3985 SBC, Berne in English at 1530.

5000 WWV, Colorado, USA at 0900.

5000 IBF, Turin, Italy at 1000.

6155 Vienna, Austria in English at 1830.

9480 R. Tirana, Albania in English at 1630.

9505 R. Prague in English at 1500.

11720 R. Nacional, Brazil in English at 2300.

15130 Kol Israel in English at 1130.

15415 R. Kuwait in English at 1730.

21525 WYFR, USA noted at 1600.

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

9535 SBC, Berne in English at 1100.

9550 R. Norway in English at 1400.

11755 R. Finland in English at 1405.

11765 Deutsche Welle in English at 1700.

11835 R. Sudan noted at 1600.

11855 R. Prague in English at 1545.

11940 R. Bucharest in English at 1300.

15165 R. Denmark noted at 1400.

15250 RSA, South Africa noted at 1700.

15440 WYFR, USA at 1800.

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

6055 R. Australia in English at 2100.

7065 R. Tehran, Iran in English at 1637.

7145 R. Australia in English at 1500.

9005 R. Tehran, Iran in English at 2000.

11765 R. Australia, sign off at 1230.

11790 R. Australia in Thai at 1330.

17935 R. Pakistan noted at 0830.



### MEDIUM WAVE BROADCASTS by CHARLES MOLLOY

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

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

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

Roy Patrick (Derby) has received the following details from the Independent Broadcasting Authority's Engineering Department. Radio Clyde 1151kHz transmits from Dechmont Hill with a power of 4kW; Radio Birmingham 1151kHz uses 3kW into a vertical antenna located at Langley Mill; Radio Manchester is due to start in April on 1151kHz with a power of 4kW from a site at Ashton Moss. Later in 1974 Radio Swansea will be on 1169kHz; Radio Tyneside will be on 1151kHz with 2.5kW while Radio Edinburgh, Radio Liverpool (Rainford) and Radio Sheffield (Skew Hill) will all be on 1546kHz.

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

### VHF/FM DXING

### by SIMON DAVID

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

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

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

I have also received a log from our friend Roy Patrick in Derby for 20th January. This includes SWF Germany Haardtkopf on 97 7MHz, HR Frankfurt Meissner on 99 0MHz and Boulogne on 99 9MHz. His receiver is a Grundig portable. BBC Radio Humberside has sent Roy a QSL letter for 96 8 and he also picked up Capital Radio (95 8MHz). I heard that a reader in Ipswich who has a 6-

element aerial directed towards Wrotham (North Kent), has picked up BBC Radio Bristol on 95.5MHz and Rouen (station frequency not stated). His tuner is a home made design.

The General Advisory Council of the BBC have advised the BBC to make representations with a view to clearing the 97.6 to 100MHz band of all service users. That would mean that the police frequencies would have to be revised so that the U.K. can make maximum use of the internationally agreed 88-100MHz band for broadcasting. I, for one, am delighted to hear of this and sincerely hope that they successfully seek the necessary legislation.

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

How about this for a jumbo bag? Peter Taylor writes from Whitton in Middlesex: "I have an Armstrong 624 tuner and 3-element Yagi aerial in the loft". So far Peter says that he has received most of the French stations in N.E. France, apart from those masked by British stations. He also receives the three Lille transmissions virtually all the time. On the 20th-21st January he received (and sent me a cassette recording) the following: Radio Austria Pfander I 98.2; AFN Frankfurt 98.7; Suddeutscher Rundfunk I 98-8; Bayerischer Rundfunk, Munich III 97.3 (including signature tune); Sudwestfunk, Haardtkopf I 97.7 and II 93.0; Westdeutscher Rundfunk, Teutob. Wald II 93.2 and III 97.0; Hessischer Rundfunk, Biedenkopf I 91.0; ORTF, Besanscon, France Musique 92.9, France Culture 97.7MHz.

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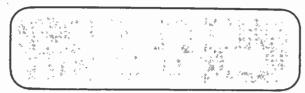


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### SHORT WAVES by DAVID GIBSON, G3JDG

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

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

### Readers' Logs

Jon Hirst (Cambs) claims to have discovered a very large l.f. net which involves the Royal Signals Amateur Radio Society. Net controller is said to be GW3ASW and the frequency for interested s.w.ls is  $3\cdot720 \text{MHz}$ —listen Tuesdays and Thursdays at 2000hrs and on  $7\cdot050 \text{MHz}$  at 1030 hrs on Sundays.

Stanley Sharred (Birmingham) is sticking to his permanent resolution of never making New Year resolutions. He spent the time instead listening on topband and offers some juicy callsigns heard on Trawler territory; GI3YFY, GW3ZQN, EI8H, EP2BO. OE8DM, OL5AQC, OK1FCW, PY1RO, KV4FZ. VEIAX, VEICO, VEICD, VEIMX, VEIASJ, VE3DN, VOIKE, WIGJE, WIHGT, W2DED, W3BJZ, All these were c.w. signals which just goes to show what you're missing if you can't read morse-yet? Amongst the s.s.b. stations heard by Stanley on 80 metres were; CT1HE, JY3ZH, K2RM, K4GSU, KH4NCA, KZ5JM, TI2WD, TI2YF, VE2BZA, VP2VPU, VX1BT, VX1FG, VX2AS, W1MX, WB2KQC/P/2, W3TTW, W3ZBY, W4YN, WB4KDR, W8FIE, YV3TN, 3A0FY, A peep on 7MHz c.w. revealed; OA2NYD, PY7BTX, PY7CAR, VK3MR. No mention of any receiver or aerial with these logs so one must presume that earholes in the Birmingham area are considerably more sensitive

than those in Harpenden (maybe it's something to do with the drinking water).

First of the 3.5MHz logs comes from John Porter (Derbyshire) who used a 9R59DS and a 30 metre wire to bag these on s.s.b.; CR3WB, CT1ATV, EP2BQ, HB9AFM, I3BYT, JY3ZH, KV4AB, K2BT, LA9LSV. OH1TY, ON4UN, PJ9KH, PY2FOT, VE1BB, VE1JA, W1AA, WB8HDR/P1, 9E5CQ. John also managed OL7AQX and ZS6ZE on topband c.w.

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

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

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

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

A. McNeill (Berks) queries some funny callsigns—CK8T, HE7MW, KU7KJW, LY1DYM/9 and PT1RA. Anyone making any sense out of these should consult a psychiatrist immediately. Meanwhile, with an exRAF R108Z receiver and 33ft end fed, the following presented themselves on 14MHz; CR6AL, EL2OSB/MM, FG5P, FP8PR, FC8TT, HK1FL, KP4DLC, LU9CV, OA7WA, PY1LA, TI2WD, TF3SE, VK6FT, VP9HL, VE3AHB, W5MJQ, W6OV, W7AYO, YK1OK, YV5BLT, ZS6JK, ZE8JJ, 9H1DQ, 9H4C, 4S7CF. 5Z4JDP, 5U7AZ.

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

Contests for April include: April 7, 3.5MHz low power; 20-21, Burmuda (phone); 21, 4 metre open; 27-28, National Amateur Television; May 4-5, 2 metre open and s.w.l.; May 4-5, second Burmuda (phone).

### BROADCAST BANDS

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

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

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

### AMATEUR BANDS

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

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### AUDIOTRONIC Model ATM1

Top value 1,000 opv pocket multi opv pocket multi-meter. Ranges: – 0/10/50/250/1,000 volt AC and DC. DC current 0-1mA/ 100mA. Resistence: 0/150k ohms. Decibels: –10 to +22dB. Size 90 x 60 x 28mm. Complete with test leads. **OUR PRICE £2.95** 

U4325 MULTIMETER
20,0000pv. Simple
unit with audio/IF
cocillator. Suitable
for general receiver
tuning. Raposes
0.5/2.5/10/50/250/
500/1000V DC.
2.5/10/15/250/500/1000V AC. 0.05/
ARS/RS/050/000M DC. Resistance: 5/ The same 0

P&P 15p

2.5/10/15/250/500/1000V AC. 0.0 0.5/5/50/500mA DC. Resistance: 50/500 ohms/5/10/100k ohms/1M/ Battery operated. Size: 160 x 97 40mm. Supplied in carrying case co-plete with test leads.

**OUR PRICE £7.00** MODEL HIOKI 730X

**U4323 MULTIMETER** 

P&P 20p

### **AUDIOTRONIC Model ATM5**

AUDIOTRONIC Model A Intervence of the control of th **OUR PRICE £3.50** 

**OUR PRICE £3.75** 

MUDEL U437 M 10,000 ppv. A first class, instrument manufactured in USSR to the highest standards. Ranges: 2.5/10/50/ 250/ 500/1000V DC.

2.5/10/50/250 500/1000V AC

30.000 opv. Over-load protection. 6/30/60/300/600/ 1200V DC. 12/60/ 120/600/1200V AC. 60/µA/ 30mA/300mA. 2K/200K/ 2 Meg Ohm. 10 to 63 dB. OUR PRICE £7.50

### MODEL TE300

MUDEL 1 E 300 30,000opv. Mirror scale. Overload protection. 0/0.6/3/15/ 60/300/1200V DC. 0/6/30/120/600/ 1200V AC. 0/30u A/ 600mA. 0/8k/80k/ 800k/8 Meg chms. —20 to +63dB.



P&P 15p

### MODEL C1092 MULTIMETER Features 5,000 opv jewel movement and a functions. Edgwise ohms adjustment. Ranges: 0–3/15/150/ 300/1/200V AC (2,500 opv). 0–6/30/300/600 V DC (5,000 opv). DC corent. 0–300v.AC R × 10, R × 1,000. – 10 to +16dB. Complete with battery, test leads and data booklet, Size: 120 x 73 x 28mm. DIIR PRIFE 57 75. PBD 265. OUR PRICE £7,50 **U4324 MULTIMETER**

P&P 35p

OUR PRICE £8.00 TMK MDDEL TW50K

P&P 20p

P&P 17p

# both/1000V AC. DC current 100uA/ 1/10/100mA/1A. Resistence 300 ohms/ 3/30/300k/3 Meg. ohms. Complete with batteries, test leach, instructions and a sturdy steel cerrying case.

MODEL U437 MULTIMETER

**OUR PRICE £4.95** 

MODEL TH12 20,000 opv. Overload protection. Slide switch selector, 0/0,25/2.5/10/ 50/150/1000V DC, 0/10/ 50/250/1000V AC, 0/ 50uA/25/250mA DC, 0/3k/30k/300k/3 Megohms. +50dB.

-20 to

**OUR PRICE £5.95** P&P 15p

# 

### HIOKI Model 720X VOM

HIU KI Model A versatile, accurate measur-ing instrument. 20,000 opv. 0/ 5/25/100/500/ 1000V DC. 0/10 50/250/1000V AC. 0—50u A/ 250m A, 0—20k/ 2 Megohms. **OUR PRICE** f5 97



**MODEL PL436** 20,000 opv DC. 8000 opv AC.

8000 6pv AC. Mirror scale -6/3/12/30/120/ 600V DC. 3/30/ 120/600V DC. 50/600μA/60/

10/100K/1 Meg/10 Meg Ohm. OUR PRICE £6.97 P&P 15p.

# U435 MULTIMETER 20,000pw, Overload protected, Ranges: 75mV/2-5/1025/ 100/250/500/1000/ 250/500/1000/ 250/500/1000/ 250/500/1000/ 250/500/1000/ 25/100mA/0.5/2.5A DC. 5/25/100mA/0.5/2.5A DC. 5/25/100m

**OUR PRICE £8.50** 

U435 MULTIMETER

OUR PRICE £8.75 P&P 20p

### **U91 Clamp VOLT**

UST Clamp VOLT
AMMETER
For measuring AC voltage and current without
breaking circuit. Ranges:
300/800V AC. Current:
10/25/100/250/500A.
Accuracy 4%. Size 283 x
94 x 36mm. Complete
with carrying case, leads
and fuses.

**OUR PRICE FIR 50** 



### OUR PRICE £17.50 PGP 20p KAMODEN HM720B FET VOM

ANITUUEN HM/Z Input impedence 10 Megohms. Ranges:— 07.25/1/2.5/10/50/ 1000V DC. 072.5/10 50/250/1000V AC. 0725uA/2.5/25/250 mA DC. 0/5k/50k/500k/5 M 500 Megohms

£21.00 P&P 30c

### KAMODEN 72.200 Multitester

High sensitivity tester. 200,000 opv Overload protected. Mirror scale. Ranges: –0/.06/.3 3/30/120/600/ Ranges: – (//, tuo/, /3 3/30/120/600/ 1200V DC. 0/3 12/60/300/11200 V AC. 0/6uA/ 1.2mA/120MA/ 600mA/12A DC 0/12A AC. – 20 to 6/3dB, 0/2k/200k/ 2 Meg/200 Megohms.

OUR PRICE £22.50 P&P 30p

### **U4317 MULTIMETER**

U4317 MULTIMETER
High sensitivity
instrument for field
and laboratory work.
Knife edge pointer,
Knife edge pointer,
Senm. mirror scale.
Ranges: 100mV/0100/280/500/1000
505.510/100/250/500/100/250/500/1000
505.510/500/500mA/1/50 AC. Resistance: 0.510/100/200 ohms/1/3
30/300k ohms. Decibels: -510+10dB
Battery operated, Size: 210 x 115 x
90mm. Supplied in carrying case complete with leaders.

OUR PRICE £15.00

#### Leather case for above £1.75 TMK 100K LAB TESTER HIOKI 750X VOLT-OHM-MILLIAMETER

Carr, paid

**OUR PRICE £11.95** 

### HIOKI MODEL 700X

HIOKI MODEL 7UUX
100,0000pv, Overload
protection, Mirror scale,
0,3/0,6/1,2/11,5/3/6/
12/30/60/120/300/
609/1200V DC,
1,5/3/6/12/300/60/150/
300/600/1200V AC/
1,5/3/6/12/300/AC/
150/5500/7406/12A DC,
2k/200k/2M/20MOhms,



**OUR PRICE £14.95** 

# Model HT100B4 MULTIMETER Overload protected, seck proof circuits. Micro seale. Sensitivity 100KV. Polarity change switch, Ranges: 0.5/2.5/ 1.50/250/500/1.000 1.50/1.002.0/1.002 1.50/1.002.0/1.002 1.50/1.002 1. Model HT100B4 MULTIMETER

OUR PRICE £15.00 P&P 40p

MODEL AS 1000 VOM

100,000 opv. Mirror scale, Built-in meter protection, 0/3/ 12/60/120/300/ 600/1200V DC. 0/6/30/120/300/ 600V AC 0/10-04 B 600V AC. 0/10µA/ 6/60/300mA/ राष 12 Amp. 0/2K/ 200K/2M/200 Meg Ohm. - 20 to : 17 dB



OUR PRICE £19,95 P&P 25p

MODEL U4311 Sub-standard MODEL U4311 Sub-standa Multi-range Volt-Ammeter Sensitivity 330 Ohms/Volt AC and DC. Accuracy 0.5% DC. 1% AC. Scale length: 155mm. 30/75/150/300/ 750mA/1.5/31 7.54 DC. 0/3/ 7.51 DC. 0/3/ 7.51 DC. 0/3/ 7.51 DC. 0/3/ 7.51 DC. 0/3/

7.5/15/30/75/ 150/300/750mA/ 1.5/3/7.5A AC, 0/75/150/300/750mV/1.5/3/7.5 30/75/150/300/750V DC, 0/750 1.5/3 /7.5/15/30/75/150/300/7 AC, Automatic cut out device. St lied complete with test leads, ma and test certificates.

OUR PRICE £49,00 P&P 50n

### TE40 HIGH SENSITIVITY AC VOLTMETER

AC VULTME II 10 Meg input. 10 ranges: 0,001/ 0,03/0,1/0,3/ 1/3/11/30/100/ 300V RMS. 5cps-1,2MHz. -40 to +50dB supplied complete with leads and instructions. instructions.

P&P 25p

OUR PRICE £17.50

### **TE65 VALVE VOLTMETER**

28 ranges. DC volts 1.5–1500V, AC volts 1.5–1500V. Resistance up to 1000 Megohms, 200/240V AC operation, Com-plete with probe

OUR PRICE £17.50 Additional probes available: RF £2.12, HV £2.50

LB3 TRANSISTOR TESTER Tests ICO and B. PNP/NPN. Operates from 9V battery. Instructions supplied. OUR PRICE

P&P 20n

#### MODEL AF. 105 VOM

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



P&P 20p.

### **LB4 TRANSISTOR** TESTER

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

P&P 20p



U4341 Multimeter & Transistor Tester
27 ranges. 16,700opv.
Overload protected.
Ranges: 0.3/1.5/63
0.050/15/0.3/00/900V
0.05/15/5/0.0/150/
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OUR PRICE £10.50

### KAMODEN HMG500

insulation resistance tester Range 0—1,000
Megohms, 500V,
Battery operated,
Wide range clear
meter 4"x 4%".
Complete with
deluxe carrying
case, batteries and

**OUR PRICE £19.95** P&P 30p

#### S100TR MULTIMETER TRANSISTOR TESTER

TRANSISTOR TESTER
100,000pp. Mirror
scale, Overload
protection, 0/0, 12/
0.6/3/12/30/120/
120/600V AC.
0/12/600V AC.
0/12/600V AC.
0/12/600V AC.
0/12/600V AC.
0/12/600W AC.
0/12/600W AC.
0/12/600W AC.
0/12/600W AC.
0/12/600W AC.
0/12/600W AC.
0/12/600V A

**OUR PRICE £15.95** P&P 25p

### CIS PULSE OSCILLOSCOPE

C15 PULSE OSCILLOSCOPE
For display of pulsed
and periodic everyold

OUR PRICE £39.00

Carr. peid RUSSIAN C116 Double Beam

OSCILLOSCOPE

OSCILLOSCUPE
5 MMz pass band.
Separate Y1 and Y2
amplifiers. Rectangular 5" x 4" CRT.
Calibrated tripgered
sweep from 0.2 usec.
to 100 milli-sec/cm.
Free running time
base 50Hz = 1MHz.
Built-in time base
Calibrator and ampli

Calibrator and amplitude Calibrator Supplied complete with all accessorie and instruction manual.

OUR PRICE £87,00 Carr. paid

### MODEL TE15

GRID DIP METER GHID DIP METE
Transistorised. Operates as Grid Dip,
Oscillator, Absorbtion Wave Meter and
Oscillating Detector.
Frequency range
440kHz - 280MHz
in six coils 500uA
meter. 9V battery
operation, Size:
180 x 80 x 40mm.

DUR PRICE £19.95



P&P 20c

Also see following pages **ALL PRICES EXCLUDE VAT** 



SWR METER Model SWR3

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



OUR PRICE £4.25 AT201 Decade ATTENUATOR

Frequency range 0— 200kHz, Attenuator 0—111dB, 0.1dB steps. Impedence 600 ohms. Input power maximum 30dBm. Size: 180 x 90 x 55mm. **OUR PRICE £12.50** 

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



BR/8 MEASURING BRIDGE
A new portable bridge offering accelent range and accuracy at low cost. Ranges R
Ranges 11% L.1 H = 111. Heng 6
Ranges 2. % C. 10pF1110mFd 6 Ranges 2. % C. 10pF1110mFd 6 Ranges 2. % C. 10pF1110mFd 6 Ranges 2. % DINNS
RATIO 1 1. 1/1000—1 1 100. 6
RATIO 1 1. 1/1000—1 1 100. 6
Ranges 1. % Bridge voltage at 1,000 cps. Operated from 9 volts 100 A
Meter indication. Attractive 2 tone metal case. Size 7 ½ x 5 x 2in.
PMF PRICE 25.5.00 P&P 25p.

DUR PRICE £25.00

TE16A TRANSISTORISED SIGNAL GENERATOR

STGNAL GENI 5 ranges, 400kHz to 30 MHz. An inexpensive instrument for the handy-man. Operates on 9V battery. Wide easy to read scale. 800kHz moduletion.

modulation.

Size: 149 x 149 x 92mm. Complete with instructions and leads.

OUR PRICE £8.97 P&P 25p

MODEL TE20 RF SIGNAL GENERATOR

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

OUR PRICE £17.50

TE-20D RE SIGNAL

GENERATOR Accurate wide signal generator covering 120 kHz-500 MHz on 6 bands. ... Directly callbrated Variable R.F.

variable N.F. author output, Xtal socket for calibration, 220/240V e.c. Brand new with instructions.
Size 140mm x 215mm x 170mm.

OUR PRICE £17.50 P& P 30s ARE 300 AF/RE SIGNAL

GENERATOR All transistorised All transistorised compact fully portable, AF sine-wave 18Hz to 220 kHz, AF square wave 18Hz to 100k Hz, Output Square/ Sine wave 10V, P-P RF 100kHz to 200MHz, Output

200MHz. Output

1V maximum. 220/240V AC operation. Complete with instructions and leads. **OUR PRICE £29.95** P&P 50p

MODEL MG 100 SINE SQUARE WAVE AUDIO GENERATOR



MCA220 Automatic Voltage Stabiliser Input 88-125V AC or 176-250V AC. Output 120V AC or 240V AC. 200V/A rating. P&P 50p

.... OUR PRICE £11.97 PS100B Regulated POWER

SUPPLY UNIT Solid state. Output 5, 9 or 12V DC up to 3 Amp. Mater to monitor current. Input 220/240V AC. Size: 100 x 82 x

OUR PRICE £11.97

PS200 Regulated POWER SUPPLY UNIT

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

OUR PRICE £19.95

P&P25p

P&P 25p

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

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

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

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

**AUTO TRANSFORMERS** 

0/115/250V. Step up or step down. Fully shrouded. £2.75 80 WATTS PR.P 18n £3.50 P&P 18p 150 WATTS 300 WATTS £4.50 P&P 23p £6.95 P&P 33p 500 WATTS £9.50 P&P 38p 1000 WATTS 1500 WATTS £12.50 P&P 43p £20.95 P&P 50p 2250 WATTS £44.95 P&P £1 5000 WATTS

**CP110 CHASSIS PUNCH SET** 



Carefully machined top grade steel. Contains 1/2", 5/8", 3/4", 1" and 1/8" punches complete with gripper and accessories. OUR PRICE £3.00

YAMABISHI VARIABLE

YAMABISHI VARIĀBLE
VOLTAGE TRANSFDRMERS
Excellent quality at low cost. Input: 230V 50/66Mz. Output 0-260V.
MODEL SZ66 BENCH MOUNTING

1A £10.50 30p
2.5A £17.00 35p
10A £33.75 75p
10A £33.75 75p
10A £33.75 75p
10A £35.00 125p
20A £85.00 125p
40A £120.00 150p
MODEL SZ66B PANEL MOUNTING MODEL S260B PANEL MOUNTING

1A £10.00 2.5A £12.00 240° Wide Angle 1mA METERS

MW 1-6 60×60 £6.50 P&P 15o MW 1-8 80x80mm £6.90 P&P 15c



BVD5 Vernier TUNING OIAL

BVD5 Vernier i uminos App. 7:1 ratio planetary drive vernier dial. Log scale 0–180 degrees: Blank scales 1–5. Dral size 128 x 76mm. Overall size 190 x 117 x 41mm. deep including knob and coupling. %" dram. shalt

OUR PRICE £1.62 P&P 15c



ON 100n OUR PRICE £24.95 per pair P302 Two Channel 300mW OUR PRICE £52.50 per pair P1003 Three Channel 1 Watt OUR PRICE £71.25 per pair P&P 50p per pair

NB. Licence required for use in UK

RUH6 Reflex Horn Speaker

HUMD HETIEX I Built-in driver unit. Impedence 16 ohms. Power rating 10W. Response 380— 7000Hz. Size app. 6" x 6" Weather and shock protected. DUR PRICE £4 97

P&P 30p



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

### Our Price £42.50 PAID

TRIO TRAZZON TRANSCEIVER

Fully transistor-ised portable VHF transceiver Will transmit and receive on six channels between 144-146MHz.



Power/volume switch, squelch control, channel sel-ector, mic. socket, earphone/external speaker socket. Complete with micro-phone and 144.48, 144.72 & 145.32 crystals. Size: 134 x 58 x 180mm. OUR PRICE £79.50 Carr.paid

**BELTEK W5400 CAR** TRANSCEIVER



Solid state mobile transceiver for 12 volt DC neg. Transmits and receives on any 12 of 28 channels between 144 and 146MHz. Power output 10W and 1W switchable. Controls: On/off/volume, squeich and channel selector. Internal 3" speaker. Complete with the control of the control OUR PRICE £75.00 P&P 50p

OT55G OIĞITAL CLOCK

OT55G DIGITAL CLOCK
MECHANISM
Features
24 hour
alarm setting
on/off and auto
alarm sleep; switch. Illuminated rotones, Automatically, turns off radio,
TV, light etc. and with auto-switching will turn on again when required.
240V AC operation. Switch rating
DUR PRIFF FS DS

OUR PRICE £5.95

KE630 3 Station INTERCOM



Master and two sub-stations, Can be used on desk or wall mounted. Comp-lete with cable and batteries **OUR PRICE £5.25** P&P 50p

LHO2S STEREO HEADPHONES L HUZD & FEREU HI Light weight head-phones with padded ear pieces. 4/16 ohms 20—20,000Hz. Complete with 6' lead and plug. **NUR PRICE** P&P 30o £1 97

TE1018 Deluxe Mono High Impedence Headset. Sensitive magnetic headset with soft ear pads. Impedence 2,600 ohms DC). Frequency response: 200–4,000Hz. DO a OUR PRICE £2,25 P&P 30p

DH02S STEREO HEADPHONES Wonderful value and excellent

and excellent performance combined. Adjustable head band, impedence 8 ohms 20-12,000Hz. Complete with lead and plug. OUR PRICE £2.50

TE 1035 Stereo HEADPHONES Low cost with excellent response. Foam rubber earcups. Adjustable headband. 8 ohms impedence. Frequency response 25Hz-18Hz. Complete with cable 10

OUR PRICE £2.60

P&P 30p SH8DV MONO/STEREO HEADPHONES Volume control for each channel, 4/16 ohms impedence, Frequency response 20Hz-18kHz. Complete with 10ft, coiled lead and jack plus plug. **OUR PRICE £4.97** P&P 300

RHINT HEADSET and Boom Microphone Moving coil. Ideal for language teaching.

communications etc.
Headphone impedence 16 ohms. Mic-OUR PRICE £5.95 P&P 30p

EMI LOUDSPEAKERS Model 350 13 x 8" with single tweeter/crossover. 20—20,000Hz. 15 watts RMS. Available 8 or 15 ohms. OUR PRICE £7.25 each P&# 37p

Model 450 13 x 8" with twin tweeter/crossover. 55–13,000Hz. 8 watts RMS. Available 8 or 15 ohms OUR PRICE £3.62 each P&P 25p



HIGH QUALITY CONSTRUCTION KITS WE ARE APPOINTED STOCKISTS AT ALL BRANCHES

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

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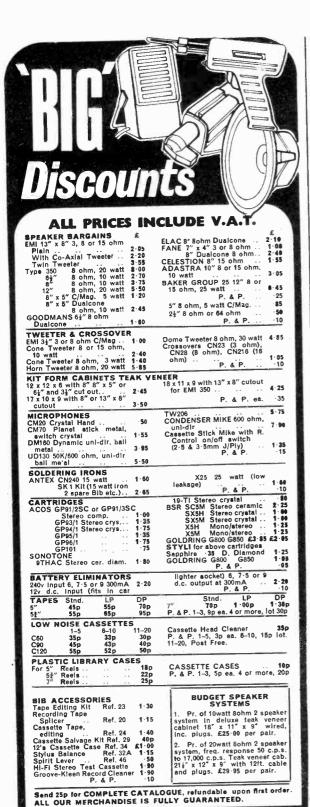
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*****	0.01	-			
Code	Watts	Ohms	1 to 9	10 to 99	100 up
			(se	e note bei	ow)
С	1/20	82-220K	9	8	7.5
C	1/3	4 · 7 - 470 K	1.3	1.1	0-9 nett
C	1/2	4 · 7 – 10M	1.3	141	0.9 nett
С	3/4	4 · 7-10M	1.5	1.2	0.9 nett
С	1	4 · 7 – 10M	3 . 2	2 5	1 9 nett
MO	1/2	10-1M	4	3 - 3	2·3 nett
ww	1	0 · 22-3 · 9	9	9	2 3 11611
ww	3	1-10K	7	7	6
ww	7	1-10K	á	9	
	,	1-1011		9	nett

Codes:
C ≈ carbon film, high stability, low noise.
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WW ≈ wire wound, Plessey.

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

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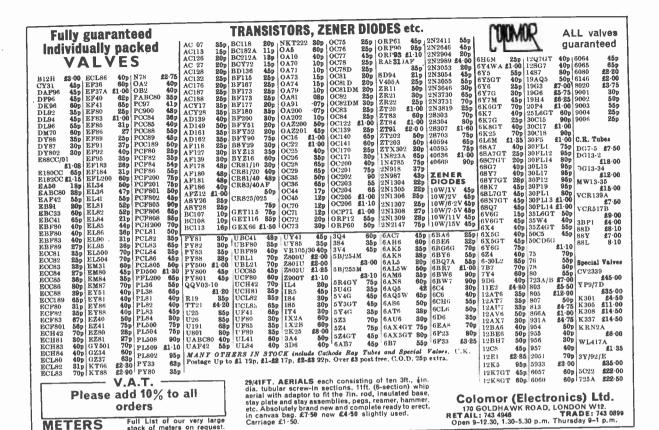
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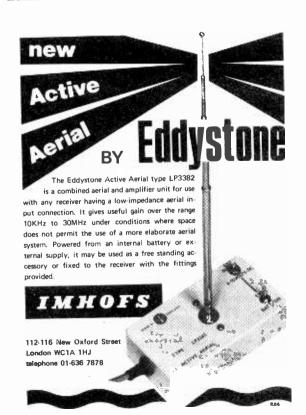
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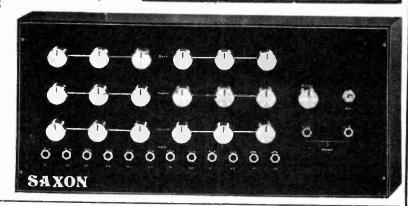
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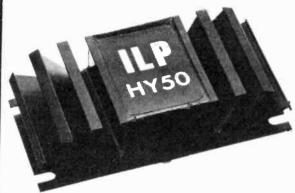


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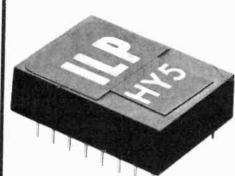
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10-99 0·8p 0·8p 1·5p

18p

23 4 4"	51″ 4″ 21″	1 4 " 1 4 " 1 4 "	40p 40p 40p	Silde ‡A sub. min. Silde 1A Push Button 6 pole ( Wafer 1/12, 2/6, 3/4,
	600V	3A	65p	SWITCHES Toggle SPST DPDT
rors	100V 1 200V 1 400V 1 600V 1	A	30p 35p 45p 55p 40p	RESISTORS Tol. Range 1W 5% 2-2R-10M 1W 5% 2-2R-10M 1W 5% 2-2R-10M 4W 10% 1-10 ohm
	UM I	200V 1 400V 1 600V 3 400V 3 600V 3	100V 1A 200V 1A 400V 1A 600V 1A 100V 3A 400V 3A 600V 3A 500V 3A	100V 1A 30p 200V 1A 35p 400V 1A 45p 600V 1A 55p 100V 3A 40p 400V 3A 55p 600V 3A 65p  IUM BOXES 2½* 5½* 1½* 40p 4* 4* 1½* 40p 4* 2½* 1½* 40p

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TCH x 3∄″ x 5″	x 31 22p	0·15 16p 24p	0·15 plain 12p 12p	Standard Screened 12p Stereo Screened 30p 2-5mm Screened 8p 3-5mm Screened 10p	Standard Stereo 2.5mm 3.5mm	12p 15p 7p 7p
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