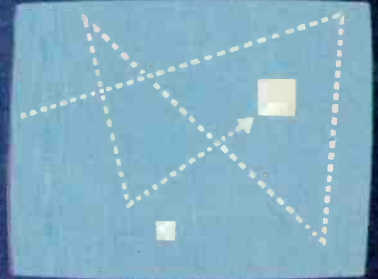


PRACTICAL WIRELESS

AUGUST 1977
40p

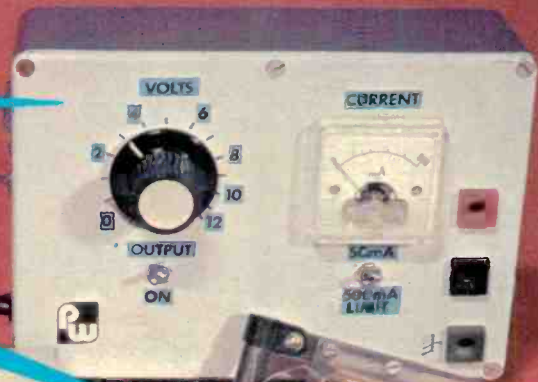
Shoot!



ADD-ON UNIT FOR THE PW TELE-GAMES

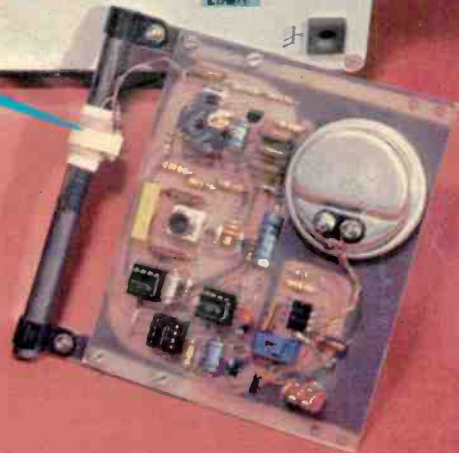
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AC126	15p	BA173	15p	BC172C	12p	BC574	80p	BF167	25p	BF394	30p	CA154	20p	R1053	150p	TIP41B	75p	2N2219A	25p
AC127	15p	BA216	16p	BC178A	16p	BCV70	15p	BF173	25p	BF528	20p	E100	42p	TIP29	45p	TIP41C	80p	2N2483	30p
AC127/01	25p	BA316	16p	BC182	10p	BCV71	20p	BF179	35p	BFX81	130p	E300	47p	TIP29A	45p	TIP42A	80p	2N2906	18p
AC128	15p	BAX13	5p	BC182L	12p	BCY72	15p	BF179C	35p	BFX84	25p	E430	125p	TIP29C	75p	TIP42B	85p	2N2907	20p
AC151	25p	BAOX16	5p	BC183	10p	BD121	85p	BF180	30p	BFX85	30p	MJE340	45p	TIP30	55p	TIP2955	70p	2N3053	20p
AC153K	40p	BB105A	35p	BC183L	12p	BD123	100p	BF181	30p	BFX86	25p	MPSA06	25p	TIP3055	55p	TIP2955	55p	2N3055	60p
AC176	20p	BB110	45p	BC171	15p	BD124	85p	BF182	30p	BFX88	25p	OA10	15p	TIP30B	85p	TIP308	80p	2N3055	60p
ACY17	35p	BC107	10p	BC184L	12p	BD124	85p	BF183	30p	BFY50	20p	OA47	15p	TIP30B	85p	TIS91	25p	2N3439	50p
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AD149	80p	BC108C	15p	BC205	14p	BD133	45p	BF194	10p	BFY52	20p	OA202	6p	TIP31A	55p	IN3754	10p	2N3703	12p
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AF114	22p	BC125	20p	BC214L	14p	BD139	38p	BF199	25p	BSX20	20p	OC42	35p	TIP32A	65p	IN4004	5p	2N3712	11p
AF115	22p	BC126	15p	BC258	13p	BD140	40p	BF200	30p	BSY40	25p	OC43	35p	TIP32B	85p	IN4005	5p	2N3715	175p
AF116	22p	BC146	12p	BC294	35p	BD182	80p	BF224	20p	BSY95	20p	OC45	35p	TIP32C	90p	IN4006	6p	2N3717	175p
AF117	22p	BC147	10p	BC303	12p	BD182	80p	BF224	20p	BT100A	80p	OC71	25p	TIP33A	100p	IN4007	7p	2N3819	25p
AF118	50p	BC148	10p	BC317	15p	BD207	70p	BF241	15p	BU105	150p	OC72	30p	TIP33A	100p	IN4148	4p	2N3866	95p
AF125	25p	BC148C	14p	BC323	60p	BD233	50p	BF244B	35p	BU133	75p	OC72	30p	TIP33B	115p	IS44	4p	2N4062	14p
AF139	35p	BC149	10p	BC328	13p	BD263	65p	BF248	28p	BU208	220p	OC75	30p	TIP33C	130p	IN456A	90p	2N4126	20p
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ASV26	40p	BC158	10p	BC347	12p	BDY62/01	90p	BF259	30p	BY126	15p	OC81D	30p	TIP34B	115p	IN4897	15p	2N5061	35p
BA114	9p	BC159	10p	BC547B	15p	BF121	45p	BF265	30p	BY127	15p	OC83	50p	TIP34B	115p	IN4897	15p	2N5062	35p
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6V8	15V 10p	18V 10p	£4 1000	47/25 5p	BC148	2-2Ω-4-7M 2p	LA4 10-30 KHz	vert & horiz 7p
9V1	15p	20V 10p	Type 10AD	1/16 5p	BC149	-5W	LA5 30-100KHz	25W 100N-33M
11V	15p	22V 10p	£6 1000	1/25 5p	BC150	2-2Ω-4-7M 2.5p	LA7 < 10KHz	horiz. 7p
13V	15p	27V 10p	Assorted Types	2-2/25 5p	BC151	1W	LA13 FOR W.W. OSCILLOSCOPE	25W 200N-4-7M vert. 8p
15V	15p	30V 10p		3-3/25 5p	BC152	2-2Ω 10 MEG 3.5p		
22V	15p	33V 10p		4-7/10 5p	BC153			
30V	15p	100 Mixed		4-7/16 5p	BC154			
30V	15p	Zeners 850p		4-7/25 5p	BC155			
39V	15p	Zeners 850p		6-3/25 5p	BC156			
43V	15p	Zeners 850p		10/10 5p	BC157			
47V	15p			10/15 5p	BC158			
51V	15p	I.C.'s		10/25 5p	BC159			
56V	15p	LM301AM 8Pin DIL		10/25 5p	BC160			
68V	15p	LM308N 8 DIL		10/25 5p	BC161			
72V	15p	LM309C O3		10/35 5p	BC162			
160V	15p	LM555 8P DIL		10/50 5p	BC163			
		LM555 14P DIL		10/50 5p	BC164			
		LM710 14P DIL		10/50 5p	BC165			
		LM723 TO5		10/50 5p	BC166			
		LM723 14P DIL		10/50 5p	BC167			
		LM741 8P DIL		10/50 5p	BC168			
		LM741 14P DIL		10/50 5p	BC169			
		LM747 14P DIL		10/50 5p	BC170			
		LM748 8P DIL		10/50 5p	BC171			
		NE555 8P DIL		10/50 5p	BC172			
		ME556 14P DIL		10/50 5p	BC173			
		TAA300		10/50 5p	BC174			
		TAA350		10/50 5p	BC175			
		TAA550		10/50 5p	BC176			
		TAA570		10/50 5p	BC177			
		TAA700		10/50 5p	BC178			
		TAD100		10/50 5p	BC179			
		TAD110		10/50 5p	BC180			
		TBA120		10/50 5p	BC181			
		TBA500Q		10/50 5p	BC182			
		TBA550Q		10/50 5p	BC183			
		TBA560C		10/50 5p	BC184			
		TBA720		10/50 5p	BC185			
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PRACTICAL WIRELESS

VOL. 53 NO. 4

ISSUE 846

AUGUST 1977

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

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

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Binders £2.10 and indexes 45p (inc. VAT) can be supplied by the Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London, SE1 0PF.

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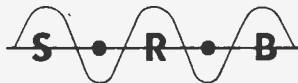


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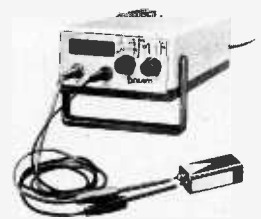
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A clear, functional multimeter, featuring extremely accurate digital display, in superbly styled shatterproof carry-case. It could cost £100! But the complete Doram kit with case, printed circuit board, leads and all components is yours for just £54.50 plus £4.36 VAT.

Based on Ferranti technology with accuracy ± 0.6%, the new Doram Multimeter is an indispensable tool at a terrific saving. Measurement is indicated by a 3 1/2 digit display updated twice per second — display flashes to indicate overload.

KEY DATA

Volts DC 200mV, 2V, 20V
200V, 1000V Input
impedance 4.2MΩ Maximum
sensitivity 1000V

Volts AC 200mV, 2V, 20V
200V, 500V Input impedance
4.2MΩ Maximum sensitivity
1000V

Current AC/DC 200µA, 2mA, 20mA
200mA, 2A
Resistance 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ

And it saves you money before it's even built!

DEPEND ON DORAM

Thousands of kit makers do for top value and modern technology
Doram Electronics Ltd, PO Box TR8, Wellington Road Industrial Estate, Wellington Bridge, Leeds, West Yorkshire LS12 2UF
Registered in London No. 1155856 Directors
R A Marler, D J Turner, F Chable

Yes, I want to save up to £40

Please send me (subject to availability) complete kit(s) for Doram DIGITAL MULTIMETER at (£54.50 + £4.36 VAT incl. p and p) total £58.86. I understand I can return the unused kit(s) within 7 days and claim my money back if kit(s) returned undamaged in the form received and ready for re-sale

Please send me... complete DORAM KITS CATALOGUE(s) showing an additional 25 kits, at 25p each

I enclose cheque/PO value

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3Q8GT	70	6C9	200	68J7	60	14K7	75	85A3	E188CC	70
3B4	45	6C8G	80	68K7GT	85	14B7	100	10B2	E188CC	70
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4C86	75	6CL8A	75	6V8GT	100	19G6	650	1625	E188CC	70
5C85	75	6CL8A	85	6X4	45	19H1	400	3702	E188CC	70
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5U4G	100	6CUG	90	7B6	80	20F2	85	8057	E188CC	70
5V4G	80	6D3	75	7B7	80	20L1	120	6067	E188CC	70
5Y8GT	85	6DE7	90	7H7	80	20P1	100	7025	E188CC	70
6Z3	100	6DT6A	85	7R7	80	20P3	100	7025	E188CC	70
5Z4G	48	6EW6	85	7Y4	80	20P4	84	7193	E188CC	70
6Z4GT	85	6E5	180	7Z4	80	20P5	150	9002	E188CC	70
6W0L2	75	6F1	80	8D2	80	25AG	70	9006	E188CC	70
6A8G	140	6F6G	80	9BW6	90	25L6G	70	ACPEN	E188CC	70
6A7C	85	6F14	90	9D7	70	25Y4G	80	ACPEN	E188CC	70
6A65	35	6F15	85	10C2	70	25ZAG	60	AL80	E188CC	70
6A67	80	6F18	80	10DE7	80	25Z5	75	ARP3	E188CC	70
6A68	70	6F23	85	10P1	87	28Z6G	80	ATP4	E188CC	70
6A75	70	6F24	80	10P9	85	28D7	80	AZ1	E188CC	70
6A65	45	6F25	100	10F18	85	30A5	75	AZ31	E188CC	70
6A66	125	6F28	74	10LD11	75	30C15	77	AZ41	E188CC	70
6A68A	70	6F32	70	10P13	80	30C17	77	B35	E188CC	70
6A68	70	6G8G	80	10P14	80	30P5	70	BL63	E188CC	70
6A65	85	6G8A	80	12A6	85	30L15	75	CL33	E188CC	70
6A65	80	6A65	80	12AC6	80	30L17	70	CTIC	E188CC	70
6A87G	100	6G7U	80	12AD6	80	38P4MR	98	CY31	E188CC	70
6A76	80	6H6GT	80	12AE8	80	30P12	74	DAF91	E188CC	70

ECC86	125	EM44	45	PCC84	80	PY800	50	U301	55	AC176	64	BY100	81	
ECC88	75	EM85	120	PCC85	47	PY801	50	U403	90	AC177	82	BY114	81	
ECU189	80	EM87	110	PCC88	61	PZ30	50	U404	75	AC178	80	BY126	14	
ECC807	80	EM808	80	PCC89	49	QQV03/10	80	U801	80	AC178	83	BY127	81	
ECP80	80	EM809	80	PCC89	49	QQV03/10	80	U4020	75	AC179	83	BY210	80	
ECP82	80	EY51	45	PCF80	40	Q895/10	100	VP23	45	AC180	80	BY211	80	
ECP85	80	EY81	45	PCF82	45	100	100	VP41	90	AC181	80	BY212	80	
ECH21	200	EY83	60	PCF84	70	QB150/15	80	VR105	50	AC182	18	BY213	80	
ECH35	160	EY86/7	87	PCF86	87	100	100	VR150	75	AC183	81	BY214	80	
ECH42	71	EY88	85	PCF200	120	QV04/7	80	VU111	100	AD181	85	BY41A	80	
ECH81	40	EY91	60	PCP201	100	QV05/20	80	VU120	100	AD182	85	OA9	14	
ECI84	80	EY90	145	PCP801	45	100	100	W133	100	AF11	80	OA47	18	
ECI86	40	EZ40	52	FOF802	54	R10	650	W107	75	AF115	80	OA70	18	
ECI88	45	EZ41	52	PCF806	53	R19	75	W729	120	AF117	82	OA73	18	
ECI82	50	EZ80	35	PCJ200	100	UABC80	85	X41	100	AF121	85	OA79	11	
ECI83	74	EZ81	40	100	100	UAF42	70	X66	100	AF124	86	OA81	11	
ECI84	85	EY901	85	PCL82	54	UBC41	50	Z759	55	AF180	86	OA85	11	
ECL85	80	EY902	85	PCL83	49	UBC81	55	Transformers	80	AF180	86	OA90	14	
ECL86	64	GZ33	180	PCL84	48	UBF80	50	& Diodes	80	BA115	16	OA91	11	
EP2	100	GZ34	75	PCL85	45	UBF89	89	1N4744	16	BA116	81	OA95	11	
EP40	78	GZ37	140	PCL805	80	UBL21	300	2N404	21	BA120	14	OC44	12	
EP41	75	HABC80	80	PEN25	100	UC92	50	2N966	61	BA130	12	OC45	12	
EP78	175	HL23DD	88	PEN45	100	UC84	90	2N1756	85	BA145	80	OC46	12	
EP80	25	HL41DD	100	PEN45DD	100	UC85	45	2N1747	99	BA183	18	OC70	14	
EP83	125	100	100	UCF80	80	2N297	26	BC107	14	OC71	13	OC72	13	
EP85	84	HL42DD	100	PEN46	60	UCH21	200	2N2869	16	BC108	14	OC73	13	
EP86	50	100	100	PEN463DD	100	UCH42	71	2N3053	38	BC109	14	OC74	13	
EP89	48	HN309	170	200	UCH81	50	2N3121	200	BC113	80	OC75	13		
EP91	80	HVR2	100	PENDD	100	UCL82	85	2N3708	83	BC116	18	OC76	13	
EP92	80	HVR2A1	100	4020	100	UCL83	87	2N3709	28	BC118	18	OC77	13	
EP97	80	KT41	100	PFL200	70	UF1	70	AA119	18	BC119	88	OC78	13	
EP98	90	KT66	80	PL3	100	UF42	80	AA120	18	BC120	88	OC78D	13	
EP183	48	KT81	80	PL36	60	UF80	40	AA129	18	BC121	88	OC81	13	
EP184	42	KT88	675	PL41	49	UF85	50	AA131	21	BCY33	82	OC81D	13	
EP804	175	KTW61	100	PL81A	53	UF89	45	AC107	18	BCY34	86	OC82	13	
EP90	45	KTW62	180	PL62	87	UL41	115	AC118	80	BCY35	86	OC82D	13	
EL32	80	KTW63	150	PL8	45	UL84	54	AC126	14	BF158	81	OC83	13	
EL34	100	100	100	PL84	50	UM80	80	AC127	20	BF159	80	OC84	13	
EL37	300	KTW63	150	PL604/500	UY41	50	UY45	85	AC128	23	BF163	82	OC123	88
EL41	87	100	100	PL608	130	U10	100	AC132	23	BF173	44	OC169	50	
EL81	65	MHLD6	90	PL509	280	U12/14	115	AC134	80	BF180	85	OC171	40	
EL83	70	MU14	115	PL519	850	U19	400	AC157	80	BF185	47	OC172	41	
EL84	35	P61	80	PT46	100	U95	71	AC158	80	BF190	86	OC204	50	
EL86	60	PC80	45	PY33/2	50	U26	60	AC166	80	BFY51	83	OC205	50	
EL89	67	PAB80	45	PY80	50	U33	175	AC168	44	BFY52	83	OC206	106	
EL860	180	PC86	82	PY81	50	U35	175	MATCHED TRANSISTOR SETS—						
EL860	180	PC88	82	PY82	50	U37	180	LP15 (AC113, AC154, AC157, AA120)	61p					
EL509	260	PC92	85	PY82	40	U37	180	per pack. 1/OC81D & 2/OC81, 50p.						
EM30	55	PC93	100	PY83	50	U81	80	1/OC44 & 2/OC45, 50p. 1/OC82D, & 2/OC82—55p. Set of 2/OC85—76p.						
EM51	80	PC97	75	PY86	80	U91	80							
EM53	80	PC900	40	PY80A1	35	U251	100							

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Are you receiving us? NEW Doram DIGITAL FREQUENCY METER YOURS FOR ONLY £54.50 + £4.36 VAT



The DFM you must have at a price that could save you up to £25. It's easy to see how accurate this new Doram meter is thanks to 4 digit display with extra shift left to check 5 digits for even greater accuracy!

You can see the well-designed shatterproof case with its built-in handle/display tilt-foot looks so much more expensive than many a kit product.

But Doram kits always give you the best for less. This complete kit with case, printed circuit boards, all components and instructions is yours for only £54.50 + £4.36 VAT.

KEY DATA

Frequency range	20Hz to 50MHz in 3 steps
Sensitivity	20mV r.m.s
Input Impedance	1MΩ in parallel with 30pF
Input Coupling	AC
Maximum Input	10V r.m.s
Frequency Standard	1MHz 0.01% calibration tolerance
Display	4 Digit LED display with shift left for 5 digit readout
Accuracy	± 1 digit (0.1%)
Supply Voltage	220-240V ac, with 12V dc 100mA output for preselector supply

The meter covers 20Hz to 50MHz with preselector (additional purchase) provision allowing you to measure up to 500MHz. Input impedance and sensitivity are very high with read-out accurate to ± 0.01%!

So the message comes through loud and clear—don't miss this latest Doram digital bargain.

DEPEND ON DORAM

Thousands of kit makers do for top value and modern technology.

DIY SPEAKER KITS

15-WATT KIT IN CHASSIS FORM

When you are looking for a good speaker, why not build your own from this kit. It's the unit which we supply with the enclosures illustrated below Size-13" x 8" (approx.) woofer (EMI), tweeter, and matching crossover components. Power handling capacity 15 watts rms. 30 watts peak.

£17.00 PER STEREO PAIR
+ P & P £3.40



EASY-TO-BUILD WITH ENCLOSURE

Specially designed by RT-VC for cost-conscious hi-fi enthusiasts, these kits incorporate two teak-simulate enclosures, two EMI 13" x 8" (approx.) woofers, two tweeters and a pair of matching crossovers. Easily constructed, using a few basic tools. Supplied complete with an easy-to-follow circuit diagram, and crossover components. Input 15 watts rms. 30 watts peak, each unit. Cabinet size 20" x 11" x 9 1/2" PER STEREO PAIR (approx.).

£25.50
+ P & P £5.50

COMPACT* FOR TOP VALUE

How about this for incredible bookshelf value from RT-VC! A pair of high efficiency units for only £7.50 - just what you need for low-power amplifiers. These infinite baffle enclosures come to you ready milled and professionally finished. Each cabinet measures 12" x 9" x 5" (approx.) deep, and is in wood simulate. Complete with two 8" (approx.) speakers for max. power handling of 7 watts.

per stereo pair
£7.50
+ P & P £1.70

SPEAKERS Two models - Duo IIb, teak veneer, 12 watts rms, 24 watts peak, 18 1/2" x 13 1/2" x 7 1/2" (approx.)

★ £34 PER PAIR
+ P & P £6.50

Duo III, 20 watts rms, 40 watts peak, 27" x 13" x 11 1/2" (approx.)

★ £52 PER PAIR
+ P & P £7.50

EASY TO BUILD RECORD PLAYER KIT

Ideally suited for the constructor who requires a complete stereo unit at a budget price, comprising ready assembled stereo amp. module, Garrard auto/manual deck with cueing device, pre-cut and finished cabinet work. Output 4 watts per channel, phono socket and record / replay socket

£26.95
+ P & P £4.05

CAR RADIO KIT

Complete with speaker, baffle and fixing strip. The Tourist IV for the experienced constructor only. The Tourist IV has five push buttons, four medium band and one for long wave band. The tuning scale is illuminated and attractive small aluminium control knobs are used for manual tuning and volume control. The modern style fascia has been designed to blend with most car interiors and the finished radio will slot into a standard car radio aperture. MOTOR TOP 10 AWARD

Size approx. 7" x 2" x 4 1/2"
Power Supply Nominal 12 volts (positive or negative earth (alternately internally) Power £12.50
Output 4 watts into 4 ohms. + P & P £1.50

PERSONAL SHOPPERS ONLY

Viscount IV 20 x 20 Amplifier as illustrated plus 1 pair of speakers finished in teak with melamine panels 8" drive unit and 3 1/2" approx tweeter. 22" x 13" x 10 1/2" size approx.

£45.00

SPECIAL OFFER

illustrated 20 x 20 WATT STEREO AMPLIFIER
Superb Viscount IV unit in teak-finished cabinet. Silver fascia with aluminium rotary controls and pushbuttons, red mains indicator and stereo jack socket. Function switch for mic. magnetic and crystal pick-ups, tape, tuner, and auxiliary Rear panel features two mains outlets. DIN speaker and input sockets, plus fuse. 20 + 20 watts rms, 40 + 40 watts peak.

★ £29.90
+ P & P £2.10

FREE Limited Period* A Free 4 Channel Stereo Adaptor to all purchasers of the Viscount Amplifier. Available separately. £3.95 + P & P £1.00

SPECIAL OFFERS

For example Duo speaker system II or III, Viscount Amplifier, MP60 type turntable complete

DEDUCT 10% DEDUCT 15%
*on complete stereo systems using Starred Products

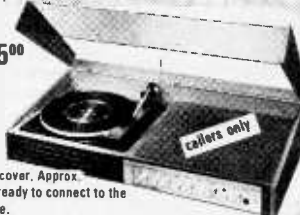
PERSONAL SHOPPERS ONLY

DECCA DC1000 Stereo cassette, ready built tape deck, replay / record P.C.B. with pair record / replay heads £3.95
A.M. FM. TUNER P.C.B. with Mullard L.P. 1186, 1185 1181 modules £9.50
CROWN 5 push button car radio, L.W. MW. 12V Pos. neg. earth 5 watts output, tone control complete with speaker and fixing kit, in dash type STEREO CASSETTE TAPE PLAYER Negative earth only, 3 watts per channel output £16.50
A.M. FM. STEREO MULTIPLEX CAR RADIO/cassette player in dash fixing Negative earth 5 watts output £36.00
I.C. Stereo 8 Track to Cassette adaptor converts any 8 track player to cassette player. £18.95
GLOBAL Spherical varicap 8 ohms, 5 watts £3.50
100K Multiturn Varicap tuning pots 6 for £1.00

VISCOUNT COMBI

£65.00

For personal shoppers only, this unit comprises: The 20 x 20 Viscount amplifier BSR MP60 Type turntable housed in an attractive teak finished console with smoked acrylic cover. Approx. 30 1/2" x 14 1/2" x 7 1/2" complete ready to connect to the speaker system of your choice.



BSR TURNTABLES BSR MP60 TYPE

Single play record player (Chassis form) £15.95 less cartridge. P & P £2.00

Cartridges to suit above ACOS MAGNETIC STEREO £4.95 CERAMIC STEREO £1.95

BSR automatic record player deck (Chassis form) with cueing device and stereo ceramic head. P & P £2.00 £9.95

TURNTABLE illus. diamond stylus, and de luxe plinth and cover. Ready wired £29.00 + P & P £4.50

30 x 30 WATT AMPLIFIER KIT

Specially designed by RT-VC for the experienced constructor, this kit comes complete in every detail. Same facilities as Viscount IV amplifier. Chassis is ready punched, drilled and formed Cabinet is finished in teak veneer. Silver fascia and easy-to-handle aluminium knobs.

Output 30 + 30 watts rms, 60 + 60 peak. + P & P £2.10 £29.00

DECCA 20 WATTS STEREO SPEAKER

This matching loudspeaker system is hand made. kit comprises of two 8" diameter approx. base drive unit, with heavy die cast chassis laminated cones with rolled P.V.C. surrounds, two 3 1/2" diameter approx. domed tweeters comp with crossover networks + £4.00 P & P stereo pair £20.00

Order giving your credit card number ONLY

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PORTABLE MONO DISCO CONSOLE



with built-in pre-amplifiers Here's the big-value portable disco console from RT-VC! It features a pair of BSR MP 60 type auto-return, single play professional series record decks. Plus all the controls and features you need to give fabulous disco performances. Simply connects into your existing slave or external amplifier.

P & P £6.50
£64.00

35-WATT MONO DISCO AMP

£27.50

+ P & P £2.50

Size approx 13 1/2" x 5 1/2" x 6 1/2"

Here's the mono unit you need to start off with. Gives you a good solid 35 watts rms, 70 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

100 WATT MONO DISCO AMP

£27.50

+ P & P £2.50

Size approx 14" x 4" x 10 1/2"

Sloping fascia, you can use the controls without fuss or bother. Brushed aluminium fascia and rotary controls. Five smooth acting, vertically mounted slide controls - master volume, tape level, mic level, deck level, PLUS INTER-DECK FADE for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre-fade level control (PFL) lets YOU hear next disc before fading in. VU meter monitors output level. Output 100 watts RMS 200 watts peak. P & P £4.00

PRACTICE GUITAR AMPLIFIER WITH BUILT-IN SPEAKER

This budget practice amplifier, has been specially designed for the amateur, who requires a quality self-contained unit with all facilities. 2 inputs - 1 for mic or guitar, the 2nd for record player or cassette deck, it also can be used for cine-sound amplification. 2 volume controls. 1 for each input, also base and treble controls. Power output with internal speaker, 10 watts RMS, with remote speaker (not supplied) 20 watts RMS. Size approx. 17" x 9" x 11". + P & P £3.00

HOME 8 TRACK CARTRIDGE PLAYER

Automatically switches programmes monitored by indicators with manual override track selection. This unit will match with the Unison modules and is compatible with the Viscount IV amplifier with Sim teak cabinet. approx. 9" x 8" x 3 1/2" P & P £1.50

4 x 4 STEREO AMP KIT

For the experienced constructor who wants to design his own stereo. Kit includes all necessary components including constructors manual. Plus Pair of easy to build 4 watt speakers in kit form, with teak simulate finish cabinets 12" x 9" x 5" approx.

PYE STEREO GRAM CHASSIS

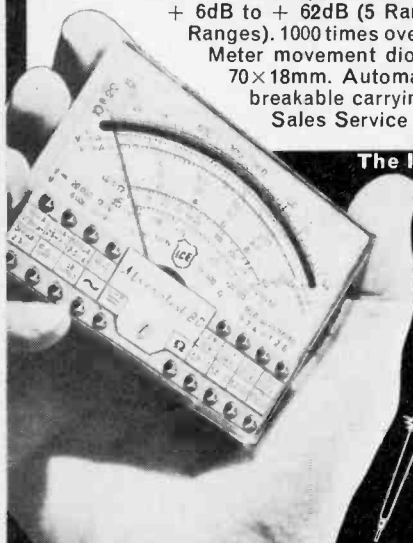
Complete ready to install - Wave bands LM, VHF STEREO, VHF MONO. Controls for tuning volume, balance, bass and treble. Power output 7 watts R.M.S per channel 14 watts peak 8 ohms 2" x 8" approx chassis speakers and BSR auto record player deck. PERSONAL SHOPPERS ONLY £35.00

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MICROTEST 80—I.C.E. 20,000 Ohms/Volt 40 RANGES

20,000 Ohms/Volt, (d.c.) 4,000 Ohms/Volt (a.c.) 2% accuracy. V d.c. 100mV to 1kV (6 Ranges). I d.c. 50 μ A to 5A (6 Ranges). V a.c. 1.5V to 1kV (5 Ranges) I a.c. 250 μ A to 2.5A (5 Ranges). Resistance, Low Ohms, Ohms \times 1, Ohms \times 10, Ohms \times 100. Output Level Measurements 1.5V to 1000V (5 Ranges) + 6dB to + 62dB (5 Ranges). Capacitance 25 μ F to 25,000 μ F (4 Ranges). 1000 times overload protection (on Resistance ranges). Meter movement diode protection. Size (without case) 90 \times 70 \times 18mm. Automatic zero, non-parallax mirror scale. Unbreakable carrying case and probes supplied. Full After Sales Service available. **Price £16.15 inc. VAT**



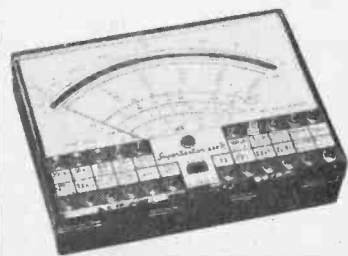
The I.C.E. Measurement System includes a comprehensive range of accessories: shunts, transformers, specialised probes, transistor-tester etc. I.C.E. High-Voltage d.c. Probe, Model 18. Input Impedance: 500M Ohm, nominal (Other values available to order). The Model 18 d.c. Probe consists of a highly insulated moulded plastic body, fitted with a hand guard-ring, containing a stable, precision 500M Ohm resistor, which may be used to extend the d.c. voltage measuring capability of analogue multi-meters or electronic voltmeters, to a maximum value of 25kV. The probe is fitted with a prod-tip for connection to the voltage source to be measured and a connecting lead terminating in a 2mm plug for insertion into the measuring instrument's d.c. voltage input socket. (4mm plug available to order). **£6.42 inc. VAT**

SUPER TESTER 680R—I.C.E.

20,000 Ohms/Volt 80 RANGES

20,000 Ohms/Volt 1% d.c. 4,000 Ohms/Volt a.c. 2% V d.c. 100mV to 2kV (13 Ranges). V a.c. 2V to 2kV (11 Ranges). I d.c. 50 μ A to 10A (12 Ranges). I a.c. 250 μ A to 5A (10 Ranges). Resistance Ohms \times 1, \times 100, \times 1000, \times 10,000 and Low Ohms. Reactance Detector 0-10M Ohms. Freq. Measurement 0-5000 Hz (2 Ranges). Output Level 10-2000V (9 Ranges). Decibels -24 to +70dB (10 Ranges). Capacitance 0-500,000 pF (2 Ranges using mains supply) 0-20,000 μ F (4 Ranges using internal 3 Volt battery). 1000 times overload protection on Resistance ranges and meter movement diode protection. 10 Measurement Functions and 80 Ranges. Size 128 \times 95 \times 32mm. Non-parallax mirror scale. Unbreakable carrying case supplied which contains probes, mains lead, crocodile clips and shorting link.

Price £27.27 inc. VAT



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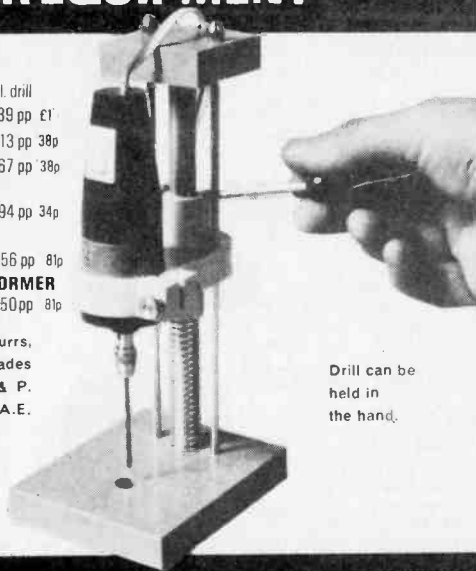
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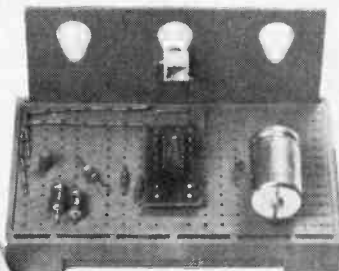
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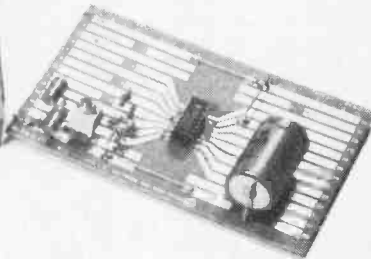
DeC-IT and BLOB-IT



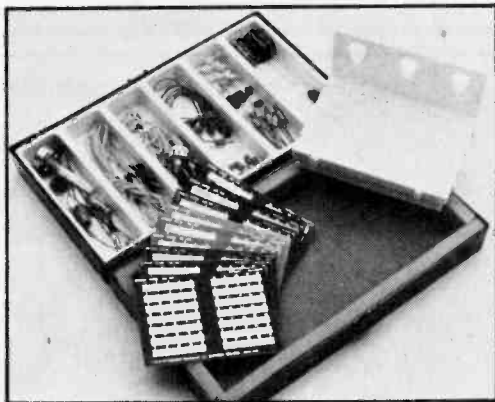
Each circuit diagram has the holes numbered into which the components are inserted.



Push the component into the T-DeC. No soldering. Plug components in and out.



When circuit is proved working, transfer component by component to exactly same numbered position in Blob-Board.



S-De-K-IT
The perfect kit for beginners, students, professionals and all users of discrete components. This S-De-K-IT contains 1 S-DeC+ control panel, 9 Blob-Boards, 20 double ended leads + instruction book to build (no components) Electronic Flasher + Binary Counter + LC Oscillator + 3 Stage Amplifier, Morse Practice Oscillator, Radio Receiver, Radio-Microphone, Light Operated Switch, CR Oscillator, Wien Network Oscillator, S-De-K-IT complete in ABS box, with component tray

Normally £6.38 only £4.95 + £1.00 Post and VAT

NB The discrete components to build the above S-De-K-IT are listed but not supplied.

This is because using discrete or surplus components you can buy all the components very cheaply from your local component supplier.



T-De-K-IT
This T-De-K-IT contains 1 T-DeC+ control panel + 1 16 DIL carrier + 4 Blob Boards + 4 ICs + all discrete components + instruction book with step by step instructions to build:— Burglar Alarm + Sound Fuzz Circuit, SR Latch + Two Tone Siren.

Complete Kit with all Components £13.00 + £1.66 Post and VAT



P.B. Electronics (Scotland) Ltd.
57 High Street, Saffron Walden, Essex CB10 1AA England.
Telephone: Saffron Walden (0799) 22876 Telex: 817185.

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3-WAY MULTIPLE AC ADAPTOR

This compact adaptor allows a large range of battery powered equipment to be operated from A.C. mains (220-240V A.C.). Switchable for 6, 7.5 or 9 volts, current rating is 300 mA max. A polarity reversing coupler is incorporated and the lead is terminated by a four way plug offering connections by 2.1 and 2.5mm sockets, 2.5 and 3.5mm plugs. The sealed moulded unit is fitted with a 3 pin 13A mains plug and measures 70 x 50 x 42mm approx. Only £3.50 + 8%.

GOODMANS 8in. LOUDSPEAKER

Goodmans "Audion 8PA" Bass L/speaker, impedance 8 ohm, power handling 15W nominal. Our price £4.53 + 12½% VAT.

"C100" 100 WATT AMPLIFIER

All built and tested, mounted on a plain aluminium chassis which measures 18" x 9" x 4" and which you can mount into a cabinet of your choice. Four controlled inputs, master volume, treble, middle and bass controls. 5½ protected output, 100 watts clean into 8ohm 1/8". Ideal for disco, music groups, P.A. and clubs. A bargain at £48 + £1 carr. + 8% VAT.

P.C. ETCHING KIT

This kit contains all that the constructor will need to etch the circuits of his own design. Contents—Plastic etching dish. Sample copper clad board. Laminated Cutter. 1 lb Ferric Chloride. Large Plastic Spoon. Etch Resist Pen. Full Etching Instructions.

Complete and Big Kit Value at £4.25 + 8% VAT.

POWER SUPPLY UNITS +8%



PMI switched 3, 4½, 6, 7½, 9 and 12 volts at 100mA with on/off switch and pilot light. Size: 130mm x 55mm x 75mm. ONLY £5.50



M3 CONDENSER MICROPHONE

Cardioid and omni-directional 600 ohm and 500 ohm impedance. 20-18,000 Hz. On/off switch and wind shield. Complete with stand adaptor. Packed in presentation box. Price £14.50 + 12½% VAT.

HEAVY DUTY 12 VOLT POWER SUPPLY

1.5 amp at 12 volt power supply approx. size 6" x 4" x 2½". Ideal for using your car entertainment in the home from domestic mains. Suitable for 8 track cartridge or 4 track cassette machines. Price £7.50 + VAT 8%.

2 WAY AND 3 WAY CROSSOVERS +12½%

NT206 2-way network for 8 ohm speakers up to 30 watts. Price £2.00.
NT206H 2-way, as above, 100 watts. Price £2.25.
NT306 3-way network for 8 ohm speakers up to 30 watts. Price £3.25.
NT306H 3-way, as above, 100 watts. Price £4.00.

TIE-CLIP CONDENSER MICROPHONE

Omnidirectional 600 ohm 40-15,000Hz. Extra long lead. Ideal for stage work, conferences, etc. Price £9.50 + 12½% VAT.

LOW NOISE LOW PRICE CASSETTES +8%

Good quality tape in well made screw type cassettes. Presented in single plastic cases. C80=40p C90=50p C120=60p

LOUDSPEAKERS +12½%

2½" 8 ohm 90p
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MULTI-METER MM12

60,000 o.p.v. If you need a good instrument for your work/hobby and you're not prepared to settle for a small scale and poor ranges, then read the specifications for the MM12, and send for one AC volts: 0 to 1.5, to 0/500 in 10 ranges. DC volts: 0 to 0.5, to 0/500 in 12 ranges. DC current: 0 to 25 µA, to 0/10 amps in 10 ranges. Resistance: 0 to 100 ohms, to 0/18 meg ohms in 4 ranges. Decibels: -20 to +82 db in 10 ranges. Size: 6½ x 4½ x 2½ inch. Price £19.50 + 8% VAT.



BARGAIN PROJECT BOX
A plastic box with moulded extrusion rails for P.C. or chassis panels with metal front plate fitted with four screws (all supplied). SIZE (internal) 81mm x 51mm x 28mm. OUR PRICE 50p. +8%

PIEZO ELECTRIC HORN UNITS

New high quality high power tweeter, no form of crossover network is required as low frequency voltages simply have no effect on the tweeter. Specification:— Frequency response: 3-8kHz to 28kHz ±3db. (input 4V rms pink noise—output 105db). Max. continuous rms input voltage 25V. Minimum series resistor: 100ohm at 1w. Weight: 63 gm. (2.25oz.). Panel Cut Out: 76mm dia. (3in). Size: 85mm x 85mm x 75mm. Rating: Depending on connections up to 100W approx. Price: £9.00 + 8% VAT.

3 KILOWATTS PSYCHEDELIC LIGHT CONTROL UNIT

Three Channel Bass, Middle, Treble. Each channel has its own sensitivity control. Just connect the input of this unit to the loudspeaker terminals of an amplifier and connect three 250V up to 1000W lamps to the output terminals of the unit, and you produce a fascinating sound-light display. (All guaranteed.) £18.50 plus 75p P. & P. + 8%

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240 volt primary transformer bargain. approx size 60mm x 40mm x 50mm fixing centres 75mm our price £1.20 + 8%

EFFECTS PROJECTOR "150"

No Disco should be without our new effects projector, we believe that this is the most versatile machine for projecting coloured images to supplement your music. Spec:— Volts=220/240 AC 60Hz. Lamp=A11137 150 watts. Standard Lens=60 m/n. A sturdy metal construction and takes a range of lenses and accessories. Comes complete with 6" liquid wheel and ready to use. A bargain at £27 + VAT 8%.

ABS PLASTIC BOXES

Handy boxes for construction projects. Moulded extrusion rails for P.C. or chassis panels. Fitted with 1mm front panels.
1005—105mm x 70mm x 45mm 62p
1006—160mm x 74mm x 47mm 80p
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WILMSLOW 26213 FOR HiFi.

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The Ridgeway, Iver, Buckinghamshire, Tel: (0753) 654222.

15-240 Watts!

HY5 Preamplifier

The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.

FEATURES: Complete pre-amplifier in single pack—Multi-function equalization—Low noise—Low distortion—High overload—Two simply combined for stereo.

APPLICATIONS: Hi-Fi—Mixers—Disco—Guitar and Organ—Public address

SPECIFICATIONS:

INPUTS: Magnetic Pick-up 3mV; Ceramic Pick-up 30mV; Tuner 100mV; Microphone 10mV; Auxiliary 3-100mV; Input impedance 4-7k Ω at 1kHz.

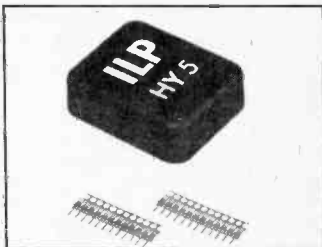
OUTPUTS: Tape 100mV; Main output 500mV R.M.S.

ACTIVE TONE CONTROLS: Treble \pm 12dB at 10kHz; Bass \pm at 100Hz.

DISTORTION: 0-1% at 1kHz. Signal/Noise Ratio 68dB.

OVERLOAD: 38dB on Magnetic Pick-up. SUPPLY VOLTAGE \pm 16-50V.

Price \pounds 5-22 + 65p VAT P&P free.



HY30 15 Watts into 8 Ω

The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available.

FEATURES: Complete Kit—Low Distortion—Short, Open and Thermal Protection—Easy to Build.

APPLICATIONS: Updating audio equipment—Guitar practice amplifier—Test amplifier—audio oscillator

SPECIFICATIONS:

OUTPUT POWER 15W R.M.S. into 8 Ω ; **DISTORTION** 0-1% at 1-5W.

INPUT SENSITIVITY 500mV. **FREQUENCY RESPONSE** 10Hz-16kHz—3dB.

SUPPLY VOLTAGE \pm 18V.

Price \pounds 5-22 + 65p VAT P&P free.



Available
June '76

HY50 25 Watts into 8 Ω

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.

FEATURES: Low Distortion—Integral Heatsink—Only five connections—7 amp output transistors—No external components

APPLICATIONS: Medium Power Hi-Fi systems—Low power disco—Guitar amplifier

SPECIFICATIONS: **INPUT SENSITIVITY** 500mV

OUTPUT POWER 25W RMS into 8 Ω **LOAD IMPEDANCE** 4-16 Ω **DISTORTION** 0-04% at 25W

at 1kHz. **SIGNAL/NOISE RATIO** 75dB **FREQUENCY RESPONSE** 10Hz-45kHz—3dB.

SUPPLY VOLTAGE \pm 25V **SIZE** 105.50 25mm

Price \pounds 6-82 + 85p VAT P&P free.



HY210 60 Watts into 8 Ω

The HY210 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

FEATURES: Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components

APPLICATIONS: Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ

SPECIFICATIONS

INPUT SENSITIVITY 500mV.

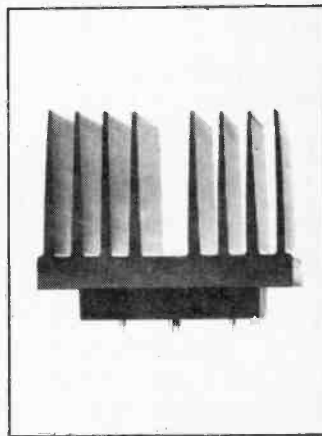
OUTPUT POWER 60W RMS into 8 Ω **LOAD IMPEDANCE** 4-16 Ω **DISTORTION** 0-04% at 60W

at 1kHz. **SIGNAL/NOISE RATIO** 90dB **FREQUENCY RESPONSE** 10Hz-45kHz—3dB **SUPPLY VOLTAGE**

\pm 35V

SIZE 114.50 85mm

Price \pounds 15-84 + \pounds 1-27 VAT P&P free.



HY200 120 Watts into 8 Ω

The HY200 now improved to give an output of 120 Watts has been designed to stand the most rugged conditions such as disco or group while still retaining true Hi-Fi performance.

FEATURES: Thermal shutdown—Very low distortion—Load line protection—Integral heatsink—No external components

APPLICATIONS: Hi-Fi—Disco—Monitor—Power slave—Industrial—Public Address

SPECIFICATIONS

INPUT SENSITIVITY 500mV

OUTPUT POWER 120W RMS into 8 Ω **LOAD IMPEDANCE** 4-16 Ω **DISTORTION** 0-05% at 100W

at 1kHz. **SIGNAL/NOISE RATIO** 96dB **FREQUENCY RESPONSE** 10Hz-45kHz—3dB **SUPPLY VOLTAGE**

\pm 45V

SIZE 114.50 85mm

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FEATURES: Thermal shutdown—Very low distortion—Load line protection—No external components.

APPLICATIONS: Public address—Disco—Power slave—Industrial

SPECIFICATIONS

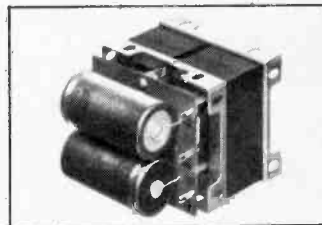
OUTPUT POWER 240W RMS into 4 Ω **LOAD IMPEDANCE** 4-16 Ω **DISTORTION** 0-1% at 240W

at 1kHz. **SIGNAL NOISE RATIO** 94dB **FREQUENCY RESPONSE** 10Hz-45kHz—3dB **SUPPLY VOLTAGE**

\pm 45V

INPUT SENSITIVITY 500mV **SIZE** 114 100 85mm

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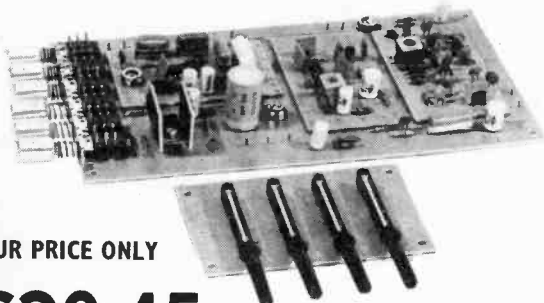
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Practical Wireless, August 1977

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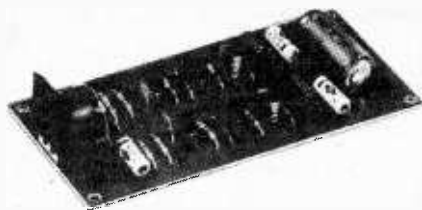
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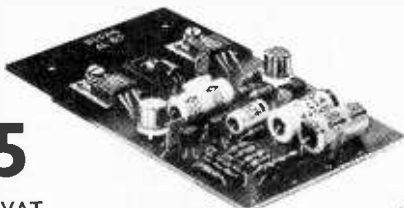
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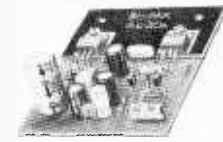
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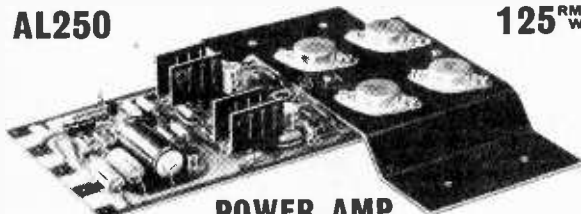


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Weekend report

EIGHTEEN of their 25 members attended a weekend meeting of the St. Dunstan's Amateur Radio Society held in the Winter Garden at Ian Fraser House, Ovingdean, near Brighton, on May 20-22. Among those who had travelled some distance to be there were their Secretary/Treasurer Ted John G3SEJ, Merseyside, Jock Inness G4AJJ, Yorkshire and SWL Tony Parkinson, Lancashire. The Society, open to St. Dunstaners, was inaugurated in January 1976 and is affiliated to the RAIBC, and RSGB, because of their military associations, to the RAFARS, RNARS and the Royal Signals ARS.

While using the call sign G4AFV/A, instead of their regular call GB3STD for such meetings, they worked several stations in the USA on 20m. Using a KW Atlanta feeding a Moseley Beam they also had a QSO with JA2GPR, despite heavy QRM. The operating of Bill Shea G4AUT impressed the visitors among whom were Louis Varney G5RV President of the Mid-Sussex ARS, Alan Baker G8LGQ Chairman of the Brighton And District Radio Society, and a party of cadets from the 2464 (Storrington) Squadron of the ATC. At the same time a 2m transceiver was being operated by Peter Bergen G3OTB, from Aylesbury.

The Saturday afternoon lecture was given by Ron Ham on 'Satellite Communication' and this was recorded by Ralph Cathles G3NDF for other members of the 'white stick' brigade. After the

lecture Joan Ham showed the St. Dunstaners a selection of war-time morse keys including the Muirhead key made in 1915 and used by the late Nelly Corry G2YL when she worked all continents on 10m in October 1935. George Cole G4AWI a keen CW operator referred to the keys and to the value of CW operating when he moved the vote of thanks to the speaker. Looking to the future, Secretary Ted John said that it is proposed to set up a permanent amateur radio station at Ian Fraser House and to have it working by the end of the year.

Seaside amateurs

SOME 30 local radio enthusiasts were present at the inaugural meeting of the newly formed Brighton and District Radio Society, held at the St. John The Baptist Social Club Hall, Bristol Road, Brighton, on May 18th. The chairman, Alan Baker, G8LGQ, said that their aims are to further the well-being of amateur radio in all its aspects, provide a technical advice service, help members with home construction, and promote good relations between people of similar interests.

They meet fortnightly at the Baptist Hall, where new members are welcome. Details of membership and their future programmés can be obtained from the secretary, *Nigel Hewitt, G8JFT, 74 Carlyle Street, Brighton.*

Welsh date

NOW established as the major amateur radio event in Wales the Welsh Amateur Radio Convention will again be held this year, on Sunday, 25th September, at the usual venue—Oakdale Community College, Oakdale, Blackwood, Gwent. The Convention will be opened by the Mayor of Islwyn Borough.

Apart from the usual Trade Exhibition, the programme will include an exhibition of early amateur radio equipment, an

exhibition station, illustrated lectures on a visit to the Seychelles Islands by Roger Brown, G3LQP/VQ9RB, and the launching and post-launch control systems for AERIEL 5, one of the U.K. satellites, by John Wright, G3VPW, of the Appleton Research Laboratory, Slough.

There will be increased parking space this year and advice on obtaining overnight accommodation will be available upon request, from *R. B. Davies, GW3KYA, 16 Vancouver Drive, Penmain, Blackwood, Gwent.*

New WRC times

AS from Wednesday, 7th September, the transmissions of World Radio Club will be as follows:—

Wednesday — 0815 to 0830 GMT
Wednesday — 1330 to 1345 GMT
Wednesday — 2315 to 2330 GMT
Friday — 2100 to 2115 GMT

As can be seen the 0815 Sunday transmission has been cancelled.

University convention

THE Lancaster University Amateur Radio Society North West Amateur Radio Convention (must be the longest title of a convention yet) will be opening their doors to the general public at 2 p.m. on Saturday, 17th September, and again on Sunday 18th.

Lectures will cover many topics including repeaters, Oscar, TV, aeriels, QRP, etc. There will be a supporting programme of films a raffle, constructors competition, and a coach tour of the lakes on Sunday. Full accommodation and all meals, including a dinner on Saturday are available. Optional lunch on Saturday will be available for those arriving early.

Further information concerning the convention and charges for the weekend can be obtained from *J. R. Morris, Dept. of Physics, Lancaster University, Lancaster.*

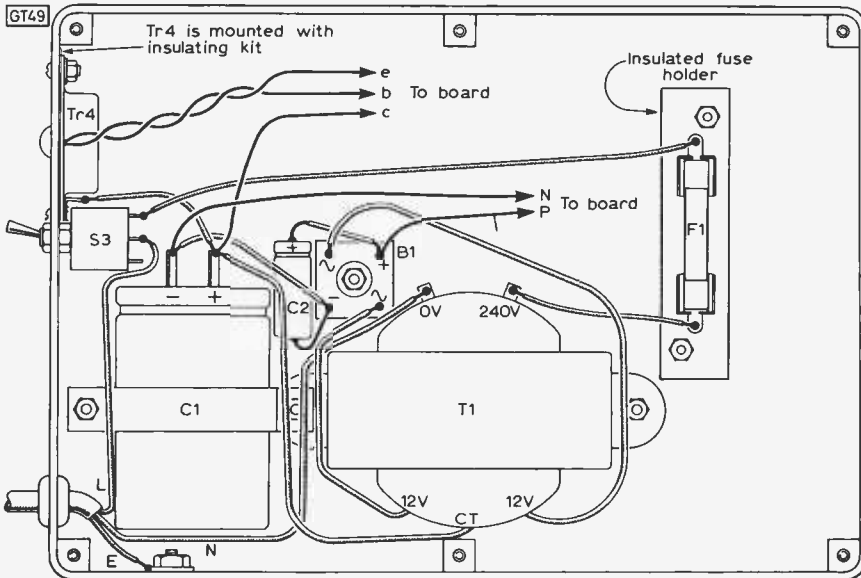
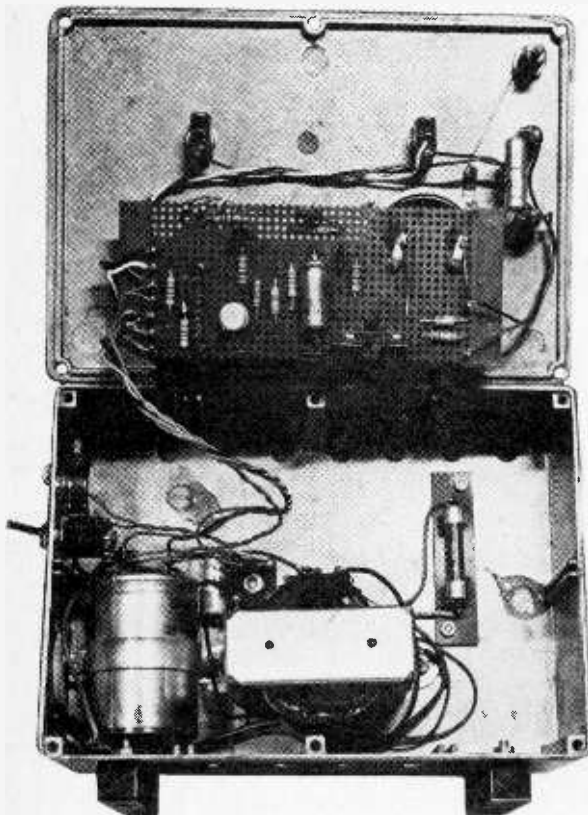


Fig. 4: Wiring of the mains supply components and Tr4 in the box. This may be compared with the photograph below. The leads of Tr4 are cut short and wire leads soldered on to reach to the board. Ensure that these leads are completely insulated to avoid contact with the case. Note that an insulating kit must be used with this transistor.



A view of the finished power supply. Note that capacitor C5 is mounted directly across the output terminals, observing the correct polarity of this electrolytic.

Front panel drillings are given in Fig. 2. The meter is the popular type MR38P and serves as one support for the circuit board, the other end being supported on a piece of studding, glued to the back of the front panel. The author made up the circuit on a piece of 0.1in pitch plain pin-board. Component leads were passed through holes and wired up on the back of the board. Crossovers were avoided so that the same layout can be used for a

printed circuit. See Fig. 3 which shows the component side of the board with connections ghosted in. Fig. 4 shows the wiring in the box itself.

The following components mount in the box as shown in the photograph; fuse F1, mains switch S3, mains transformer T1, bridge rectifier B1, capacitors C1 and C2 and Tr4. The latter is mounted inside the box, with a mica washer insulating set and the base and collector pins are cropped fairly short, with the leads from them covered by an insulating channel.

Note that the transformer is mounted so as to fit between S1 and S2 when the lid is fitted.

CALIBRATION

When construction is complete, set VR1 and VR2 to mid travel and switch on. Check that Output Voltage control VR3 varies the output voltage and adjust VR2 so that with VR3 fully clockwise, the output voltage is 12V. Mark in calibrations 0 to 12V round the Output Voltage control VR3. Set Current Range Switch S1 to 50mA (up) and connect an AVO on its 100mA range across the output terminals. Adjust VR1 for 45mA short circuit current. Adjust VR4 for full scale reading on 500 μ A meter M1. With Current Range Switch S1 set to 500mA (down) check that M1 reads the same as the AVO, i.e. approx. 500mA. If not, adjust R3 which can conveniently be 5in of 36 SWG Eureka wire. Finally, re-adjust VR1 if necessary to set the short circuit current to exactly 500mA. This is important to avoid overrunning the transformer. Note that on the 50mA range, the short circuit current in the load will actually only be 45mA, the other 5mA represents the current through D1.

USES

In use, this power supply is practically indestructible. It may be connected in series with another supply to give a higher voltage but should not be connected in parallel with a supply which has a higher maximum output voltage. It may be connected in parallel with another 0 to 12V supply to give a higher current. The mains switch S3 should be left on and the output turned on and off with output switch S2.

morse tutor

A...B...C...

D. J. EDWARDS

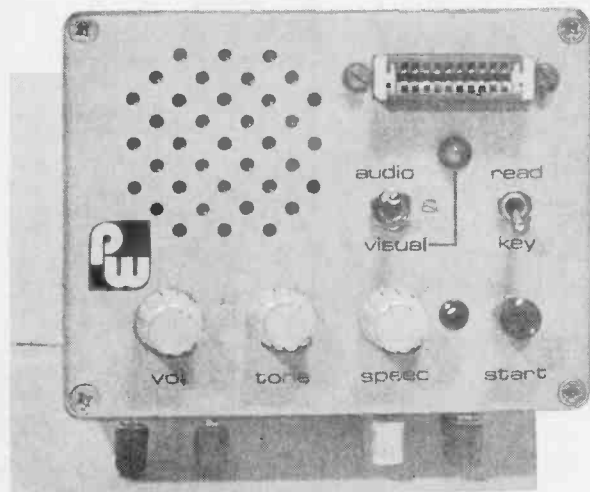
THIS unit is intended as a self-teaching aid for learning Morse by presenting the code as a series of sounds rather than dots and dashes.

The system uses a set of coded cards, each representing a Morse character which may be a letter, figure or standard phrase. When a character card is plugged into the unit, the appropriate code is reproduced as an audible and/or visual signal. A manual control alters the speed of the code as the user becomes more proficient at recognising the character; whatever speed is chosen, the relative spacing between elements of the character is maintained (see Fig. 6). This ensures that the user develops accurate timing. Controls are also provided to adjust the volume and tone of the Morse to the most natural sound.

The unit can also be used as a Morse practice oscillator when required, either for normal sending practice or to copy signals just produced by the Morse generator.

Principle of operation

The system uses a seven bit binary code; the most significant bit(s) represent a binary equivalent of the Morse character where logic 1 is the equivalent of a 'dash', and logic 0 is a 'dot'. The least significant bit(s) identify the beginning of the character. Each bit is sampled in turn from right to left. If the first bit is a logic 0, it is ignored as are successive logic 0s. Once a logic 1 is encountered, this informs the circuit that all the remaining bits are binary Morse code.



The code cards slot into the front panel edge connector. Pressing the start button initiates the reading process.

Practical Wireless, August 1977

Fig. 1 shows the seven bit binary code representing the letter Y. In this case, the first two bits are sampled, seen to be logic 0s and ignored. The next bit is also ignored, but as it is a logic 1, the system prepares to reproduce the remaining bits as Morse code elements. Thus the next logic 1 is produced as a 'dash', the logic 0 as a 'dot', and so on until all seven bits have been sampled.

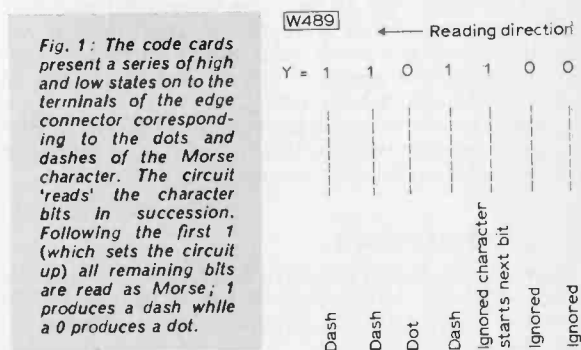


Fig. 1: The code cards present a series of high and low states on to the terminals of the edge connector corresponding to the dots and dashes of the Morse character. The circuit 'reads' the character bits in succession. Following the first 1 (which sets the circuit up) all remaining bits are read as Morse; 1 produces a dash while a 0 produces a dot.

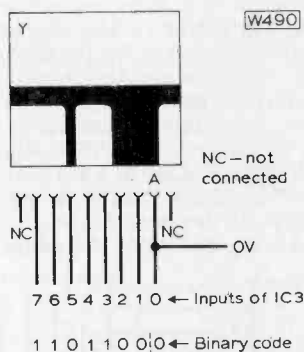
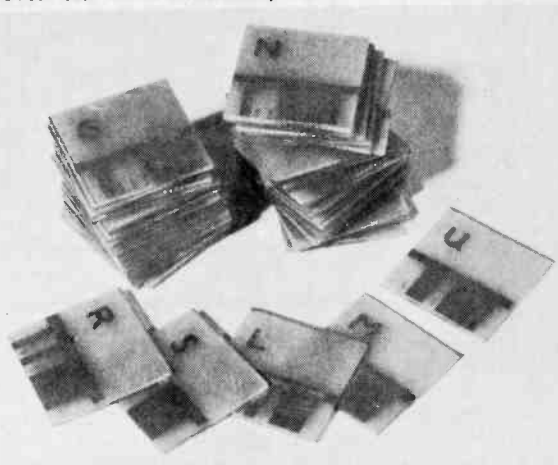


Fig. 2: Construction of the code cards. The artwork for the cards is shown on page 267. Alternatively, ready made cards may be obtained through the Readers' PCB service. Cards may be constructed from hard wired, suitably cut, verostrip. 0.1" matrix board should be used.

Since Morse characters contain up to six elements (except in one case which has been ignored to avoid unnecessary complication) then a maximum of seven bits is needed for binary encoding. Where a character has less bits, these are made up to seven by the inclusion of logic 0s as seen in the example above. In this way, the end of a code is easily recognised by preventing further operation of the system once seven bits have been sampled.

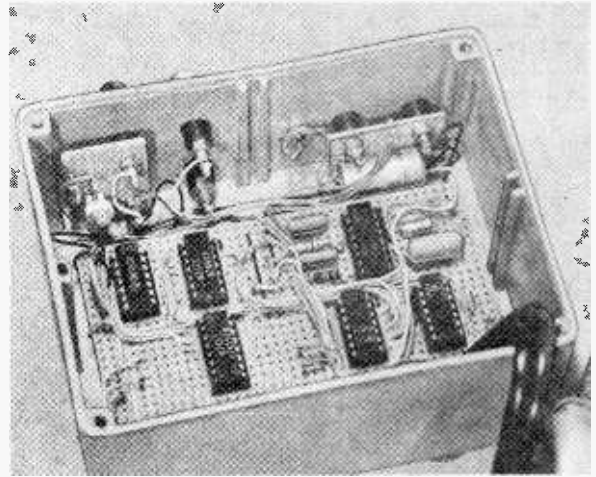


The code cards used with the prototype.

Code cards

The seven bit code is applied to the unit by using a patch card of copper laminate board etched to represent the code to be reproduced. Fig. 2 shows how the patch card, representing the letter 'Y', is used to apply the correct code to the data select inputs of IC3. With no card in position, inputs 1 to 7 of IC3 are held at logic 1 by 'pull-up' resistors. It can be seen that if the card is plugged into the connector, connection A applies 0V (i.e. logic 0) to the copper of the patch card, which in turn 'pulls' down inputs 1, 2 and 5 of IC3 to logic 0. Inputs 3, 4, 6 and 7 remain held at logic 1.

Since no code requires more than seven bits, input 0 is permanently wired to logic 0, obviating the need for this to be supplied by the patch card.



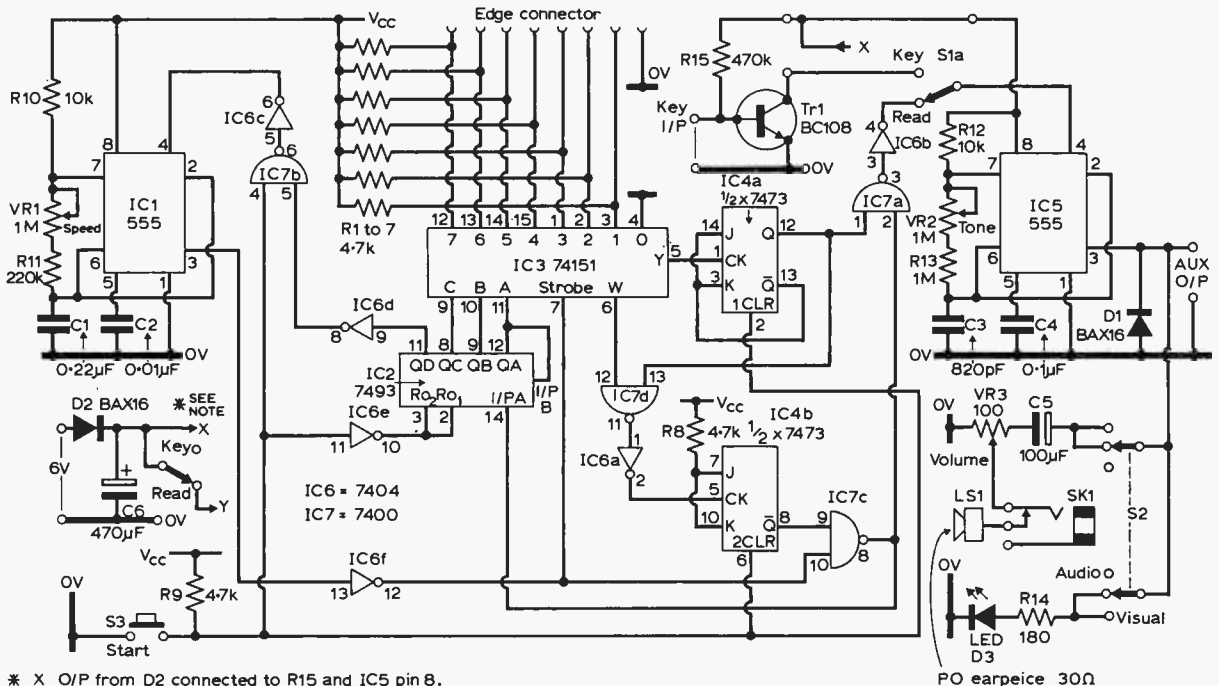
Circuit description

Looking at Fig. 3, the circuit comprises an astable clock oscillator (IC1) a four bit binary counter (IC2) a one of eight line data selector (IC3) controlled by the binary counter, a pair of J-K flip-flops, an audio oscillator and a series of gates.

A character card inserted in the edge connector provides a binary pattern equivalent to the Morse character on the data input lines of IC3. On pressing S3, the circuit clock IC1 increments the binary counter causing the data bits on the character card to be interrogated in turn. Ignoring all leading 0s, the circuit scans until it encounters a 1. This sets up the bistables which will change state in a manner dependent on subsequent high/low states which make up the character card. If the next bit is a 0, then flip-flop IC4a changes state and gates the audio

oscillator for one clock cycle. If a 1 is encountered, the flip-flops act as a divide by 3 routine for a duration of three clock pulses; similarly, this gates the audio oscillator on for a period of three clock pulses. Since reset action requires a duration of one clock pulse, the 1:1:3 dot-space-dash relationship is absolutely textbook and immutable. Further replays of S3 to enable the master reset line.

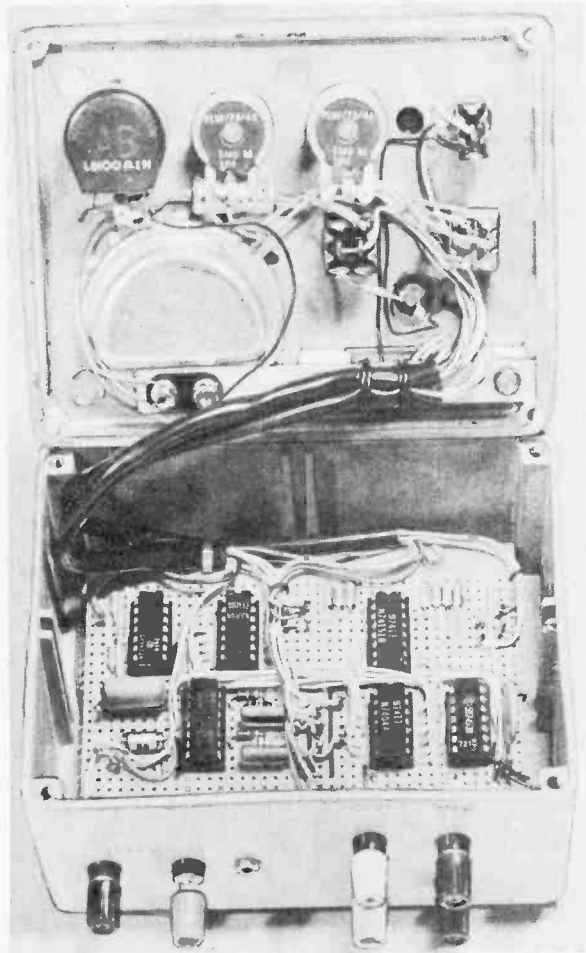
VR1 and VR2 provide control of the clock and audio oscillator respectively; the first controls the speed of character transmission and the second adjustment changes the tone. IC5 provides enough signal to drive a high impedance loudspeaker directly. The prototype incorporates an LED which



- * X O/P from D2 connected to R15 and IC5 pin 8.
- Y O/P from S1b connected to all points marked V_{CC}, and to IC2 pin 5, IC3 pin 16, IC4 pin 4, and ICs 6 & 7 pin 14.
- OV buss to all points marked, and to IC2 pin 10, IC3 pin 8, IC4 pin 11, and ICs 6 & 7 pin 7.

Fig. 3: Complete circuit diagram of the Morse Tutor. The switches are shown set to 'Read' mode and 'Audio/Visual'. Pins 1 and 10 of the edge connector are not shown since these are not required for circuit operation. C7, not shown, is connected across V_{CC} and OV.

is also driven by the oscillator to give a visual Morse output. However, this is really just a gimmick. The prototype was powered by a 6V battery. Since the logic ICs require 5V, silicon diode D2 drops the positive rail voltage by about 0.7V.

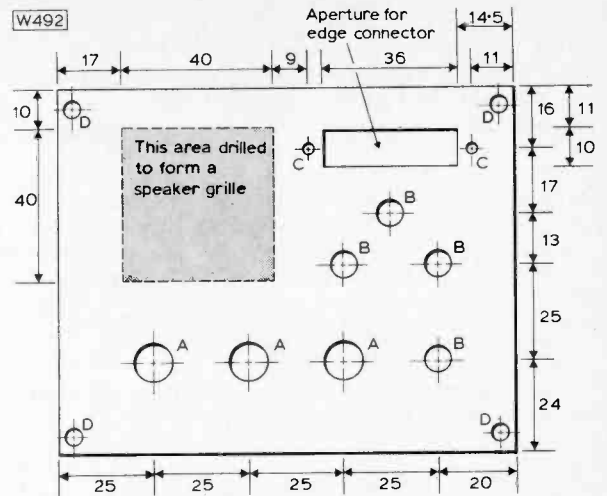


Construction

The prototype was constructed in a diecast box drilled as in Fig. 4. If alternative components are used, care should be taken to ensure that they do not foul each other or the logic board before the mounting holes are drilled as there is not a great deal of space available in the size of box used.

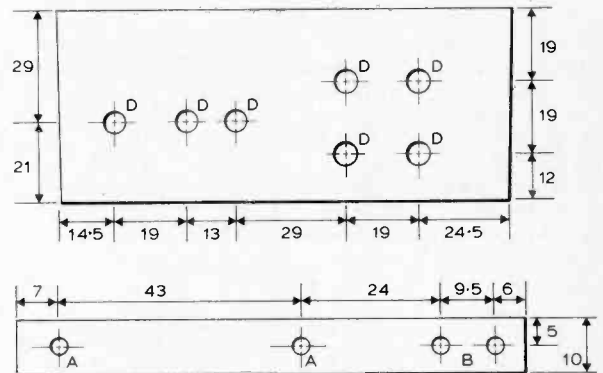
The edge connector should be cut down in size so as to leave twelve contacts. The contacts at each end should then be removed to leave room for insertion of the mounting feet. This assembly is mounted through the panel aperture from the underside with its contacts nearest to the panel edge. The 'least significant bit' end of the connector will then be towards the centre of the panel. After wiring, the speaker bracket may be attached to the connector mounting screws using stand-off pillars. The speaker can be attached to this by means of its terminals.

Fig. 7 shows the board used to form 48 individual patch cards. The shaded areas represent copper, the remainder being etched away. These cards have been designed to fit in a ten-way edge connector with closed ends, and should be trimmed carefully for accurate positioning. If another make of edge connector is used, some modification to the cards may



Holes marked :- A = 10mm. dia.
B = 6.5mm. dia.
C = 3.5mm. dia.
D = 5.5mm. dia.

All dimensions in mm.

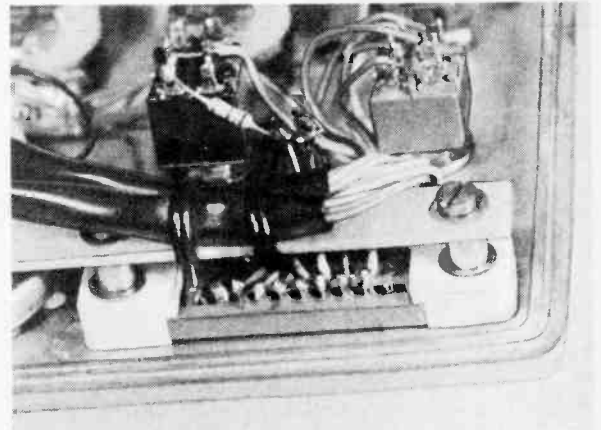


All dimensions in mm.
All holes 3mm. dia

[W491]

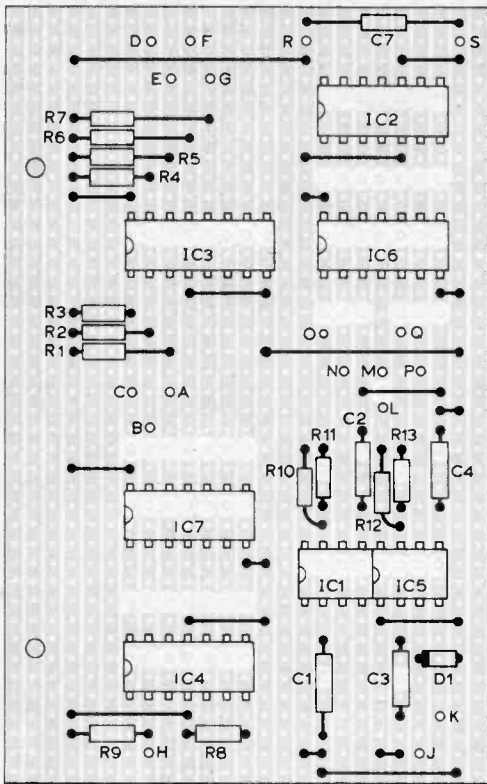
Fig. 4: Drilling details.

be necessary. Additional cards may be made in a similar fashion for those characters that have been omitted. If preferred, they may be made up from small pieces of 0.1in matrix veroboard by connecting the appropriate copper strips together with wire links.

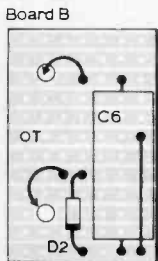


Close up view of edge connector wiring and earpiece mounting bracket. Note details of edge connector truncation.

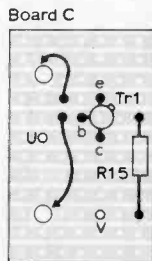
★ components list



Board A



Board B



Board C

W488

Fig. 5: Veroboard layout. Board A mounting holes are 3mm dia with 63mm spacing. They attach the board to diecast box using the rubber feet mounting screws with spacers.

Board B attaches to diecast box using the 6V power terminals. Board C is attached to the Key terminals. The flying leads shown on both boards connect with the appropriate terminals.

PIN CONNECTIONS

A Edge Connector pin 3	M S1a (read)
B " " " 4	N VR1
C " " " 5	O VR1
D " " " 6	P VR2
E " " " 7	Q VR2
F " " " 8	R OV terminal
G " " " 9	S S1b (Y Fig. 3)
H S3	T Board A pin L, Board C pin V and S1b
J Aux output and S2	U S1a (Key)
K S1a	V Board B pin T
L Board B pin T	

Resistors

R1 to 9	4.7k Ω
R10	10k Ω
R11	220k Ω
R12	10k Ω
R13	1M Ω
R14	180 Ω
R15	470k Ω
All	$\frac{1}{2}$ W 5%

Semiconductors

Tr1	BC108
IC1	555 (8 pin)
IC2	7493
IC3	74151
IC4	7473
IC5	555 (8 pin)
IC6	7404
IC7	7400
D1, D2	BAX16
D3	LED

Capacitors

C1	0.22 μ F Polyester
C2	0.01 μ F Polyester
C3	820pF Polystyrene
C4	0.1 μ F Polyester
C5	100 μ F 10V
C6	470 μ F 10V
C7	0.1 μ F Disc ceramic

Switches

S1	DPDT Centre off miniature toggle
S2	DPDT " " "
S3	SPDT push to make " "

Potentiometers

VR1	1M Ω Carbon linear $\frac{1}{2}$ W.
VR2	1M Ω Carbon linear $\frac{1}{2}$ W.
VR3	100 Ω Wirewound 1W.

Miscellaneous

16 Way 0.1" edge connector, 3.5mm earphone socket, IC sockets, 2mm terminals, rubber feet, diecast box 114 x 89 x 55mm, knobs, nuts and bolts, 6mm mounting pillars, veropins, veroboard, battery 6V, LS1 PO type receiver insert (30 Ω).

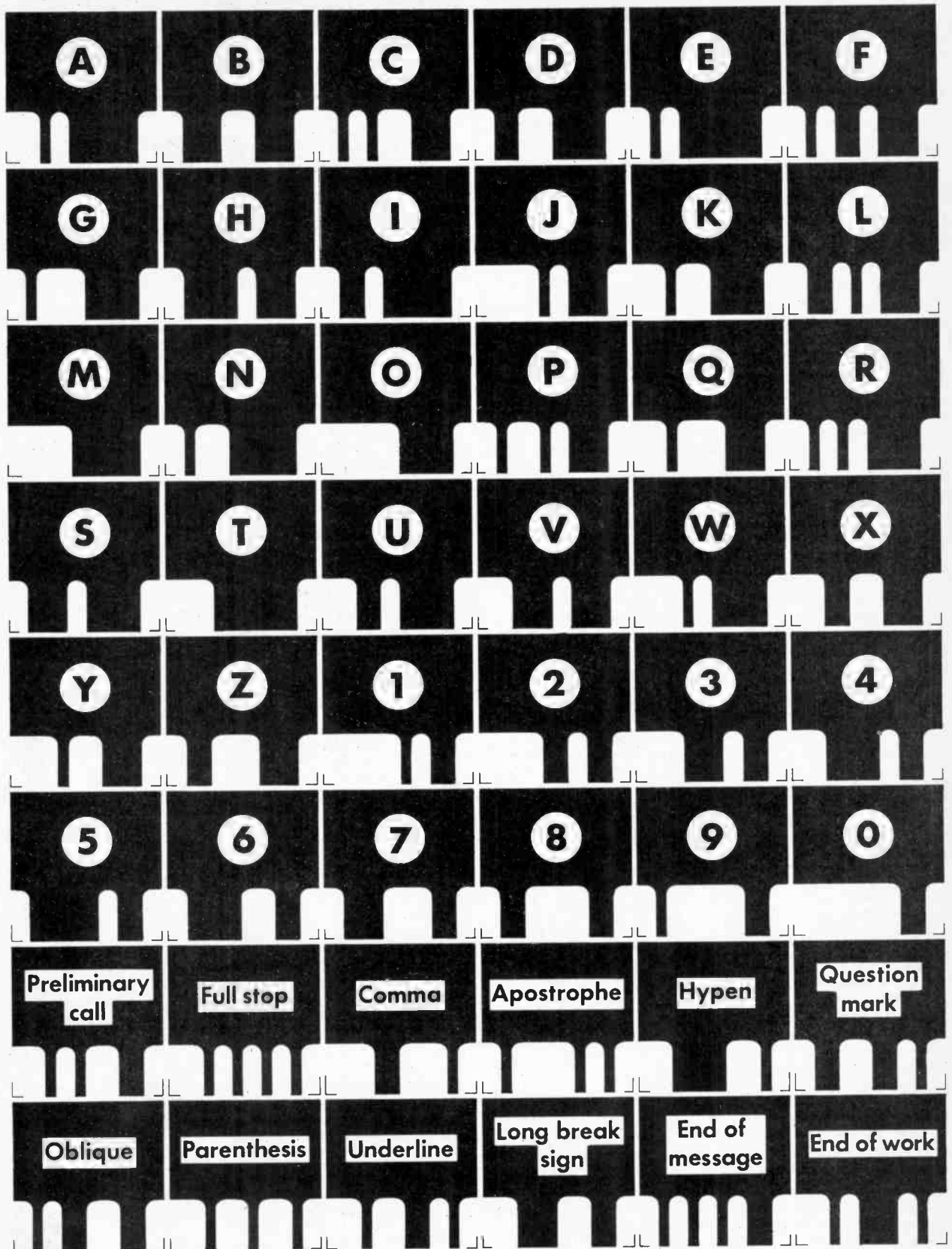
Note that the edge connector and most other components are RS types available from Doram and other suppliers.

Testing

A 6V battery or suitable power supply should be connected to the unit. Turn SPEED control VR1 to minimum and VOLUME control VR3 to maximum. Set S2 to '&' position (i.e. VISUAL & AUDIO). If the START button is pressed and released, six long bursts of tone should be heard, along with a visual signal. This corresponds to six 'dashes' and is the signal produced when no patch card is in position.

A spare piece of unetched copper laminate board cut to the size of a patch card should now be inserted in the connector. Operation and release of S3 should not result in any output signal (allowing time for all inputs to be read) as no logic 1 will be encountered. These procedures ensure that the unit is sensing the condition on each edge connector input pin correctly.

Finally, the card representing 'underline' is recommended for use as a test card as it checks the unit



A 037

Fig. 7: Foil patterns, actual size, for the 48 patch cards.

next month in

Television

for correct response to changes from dots to dashes and vice versa with a sequence of two dots and two dashes.

Check the remaining two positions of S2 for the appropriate output signal, and that the volume, tone, and speed controls are effective. It is wise to ensure that each patch card produces the desired code, and that the copper accurately covers the appropriate edge connector pins without any chance of contact with pins that should remain unconnected.

Whenever power is first applied to the unit, it is possible that an output signal will result. This can also occur if S1a is switched from KEY to READ. This can be cleared, either by holding down S3 until a card is inserted, or releasing it and waiting for the counter to complete a cycle. It was felt that this problem did not really justify the extra complication of some form of power-on reset.

The cards can be selected either according to some set learning system or at random and the character identified from the face of the card. Constant replay of the pattern become associated with the letter. The object of the learning exercise should always be to familiarise Morse characters in terms of a sound pattern rather than as discrete dots and dashes.

It is recommended that short groups of letters are familiarised at a time—perhaps about five—until the whole alphabet can be recognised from the dah-di-dah rhythm of the characters. Although the unit may be used as a practice oscillator, the beginner's studies should be concentrated on receiving Morse

A	• —	N	— ••	1	• — — — —
B	— •••	O	— — — —	2	•• — — —
C	•• — •	P	• — •••	3	••• — — —
D	— •• —	Q	• — — • —	4	•••• — —
E	•	R	• — ••	5	•••••
F	• — — •	S	•••	6	— ••••
G	— — — •	T	— ••	7	— — — •••
H	••••	U	•• — —	8	— — — — ••
I	••	V	••• —	9	— — — — — •
J	• — — — —	W	— • — —	10	— — — — —
K	•• — —	X	— ••••		
L	• — •••	Y	— • — • —		
M	— — —	Z	— ••••		

•••••	Preliminary call	<u>Spacing and length of signal</u> (i) A dash equals 3 dots (ii) The space between elements which form a character is equal to 1 dot (iii) The space between 2 characters equals 3 dots (iv) The space between 2 words is equal to 5 to 7 dots
•••••	Full stop	
— ••••	Comma	
• — — — —	Apostrophe	
— •••••	Hyphen	
•• — — — •	Inverted commas	
•• — — — ••	Question	
— •• — •	Oblique stroke	
• — — — • —	Brackets	
•• — — — • —	Underline	
— •••••	Long break sign	
••••••••	Error	
••••••••	End of message	
••••••••	End of work	

Fig. 6: The Morse code.

W494

rather than sending. Once the former has been attained, the latter is easy. Although the Morse Tutor is very useful, it provides no substitute to reading Morse code from an experienced operator since sequential groups of letters cannot be generated—individual character recognition of the alphabet won't ensure a pass in the Morse test! However, using the unit in conjunction with records, tapes and RSGB Slow Morse transmissions in particular should result in a pass. PW

● INTRODUCING THE PHILIPS G11 CHASSIS

The first entirely new colour chassis from Philips since 1970 is a major event. This new chassis, designed around the 20AX tube, is intended to serve Philips well into the 80s. Great attention therefore has been paid to getting things right. The first of a two part article on the development of this chassis and the new techniques it uses.

● JAPANESE COLOUR SET FAULTS

Despite their reputation for fault-free service, Japanese colour sets must inevitably eventually fail as the effects of age appear. Peter Murchison reports on recent experiences with a selection of sets to show the sorts of troubles you can expect.

● THE TV LOGIC STATE CHECKER

The increasing use of digital i.c.s in TV circuitry and allied fields (e.g. our Teletext decoder) means that special fault-tracing techniques are required when problems develop. The construction of a simple instrument which indicates the "logical state" of every pin of a digital i.c. will be described. The device derives its power from the i.c. under test and uses l.e.d.s as indicators. It's housed in a small diecast box with an external i.c. clip to hook up to the i.c. being investigated. Very useful for anyone dealing with logic circuits.

● TELEPRO COLOUR RECEIVERS

The Telepro range of colour receivers was made by a Telefusion subsidiary and used a chassis based on the Decca 30 series chassis. The sets have their own fault patterns however, and Barry Pamplin provides servicing hints on dealing with them.

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Brian DANCE

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Function

The front end accepts a signal from the aerial at a frequency in the range 88 to 100MHz. The signal is amplified and passed through a number of tuned circuits which attenuate unwanted signals. The amplified signal is then passed to the mixer stage where it is mixed with a locally generated signal; the latter is always kept 10.7MHz away from the signal frequency being received by the aerial.

The output from the mixer stage is a 10.7MHz difference signal frequency modulated with the audio signal. This is fed through a single or double tuned resonant circuit before being passed to the output part of the front end from where it is processed by the limiter/amplifier/demodulator.

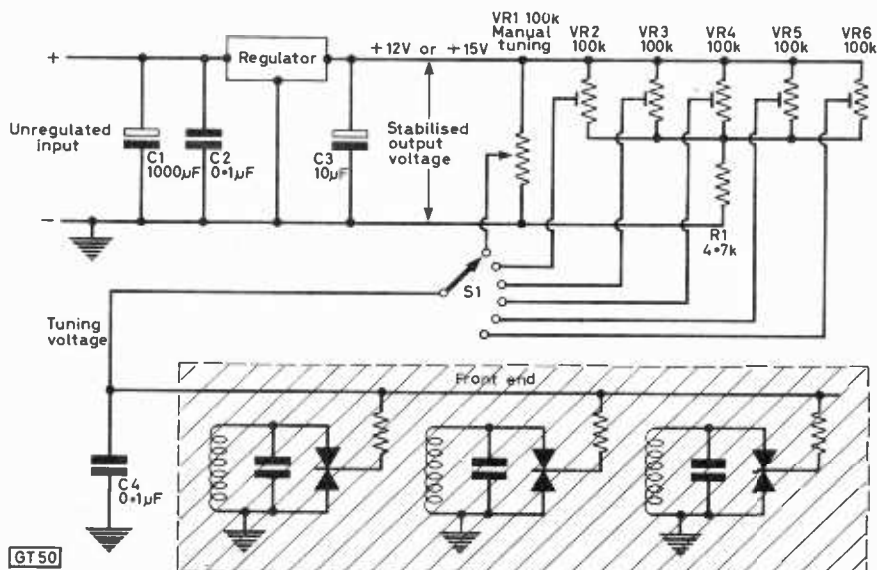
Ganged capacitor types

Some types of FM front ends employ conventional ganged capacitor tuning. The low capacity VHF ganged capacitor usually has another variable capacitor mounted on the same spindle for AM medium and long wave tuning. Such front ends incorporating an AM tuning section are convenient for obtaining FM and AM reception using a single tuning knob although there is no AM circuitry other than the variable capacitor itself in the front end.

Ganged capacitor tuned front ends are available with a spring loaded reduction drive fitted to the spindle. The tuning knob may be fitted directly to such a front end, but provision must be made for fitting a tuning scale and pointer. Some other types do not have a reduction drive and some form of slow motion drive must be designed; for example, a suitable arrangement of drive cords may be used to provide the required speed reduction.

Varicap tuning

This is the other tuning system widely used in modern front ends. Such front ends require a tuning voltage which may be obtained from a potentiometer. One of the advantages of using a varicap system is that the unit may be placed at any convenient point in a receiver, even if the tuning control must be placed at the opposite side of the cabinet. Capacitor tuned front end placement is



A practical circuit for an FM varicap front end tuning arrangement. Six-way switch S1 selects any of five pre-tuned stations; the sixth position offers manual tuning by a multi-turn potentiometer. With most units adequate frequency coverage can be obtained with a tuning supply voltage from the regulator of 12V.

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Safe because it is virtually leak-free (leakage current less than $1\mu\text{A}$). Earth it if you like – three core lead. It is made to conform with B.S. 3456 and has a breakdown voltage of more than 4000V.

Tough because the handle is almost unbreakable and the ceramic shaft is covered by a stainless steel sheath.

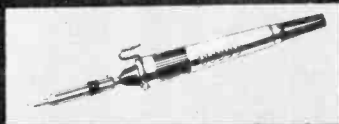
Efficient because the element is situated right inside the soldering bit and the heat generated by its 17 watts is not wasted.

Versatile because the iron can be used for a wide variety of soldering jobs; with six easily interchangeable, slide-on bits, ranging from $\frac{1}{16}$ " right down to $\frac{1}{32}$ " (1mm). It's suitable for small, miniature and micro miniature joints.

Available for 220-250 volts or 100-120 volts. Weight – $1\frac{1}{2}$ oz (40 gram). Length $7\frac{1}{2}$ " (19cm). Price – £3.40 fitted with standard bit $\frac{1}{16}$ " (2.3mm). Spare bits £0.45; £0.72; £0.84 exclusive of VAT.

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Model X.25 is a general purpose soldering iron, also with two shafts for toughness and perfect insulation. Available for 220-250 volts or 100-120 volts at 25 watts and priced at £3.40 exclusive of VAT.

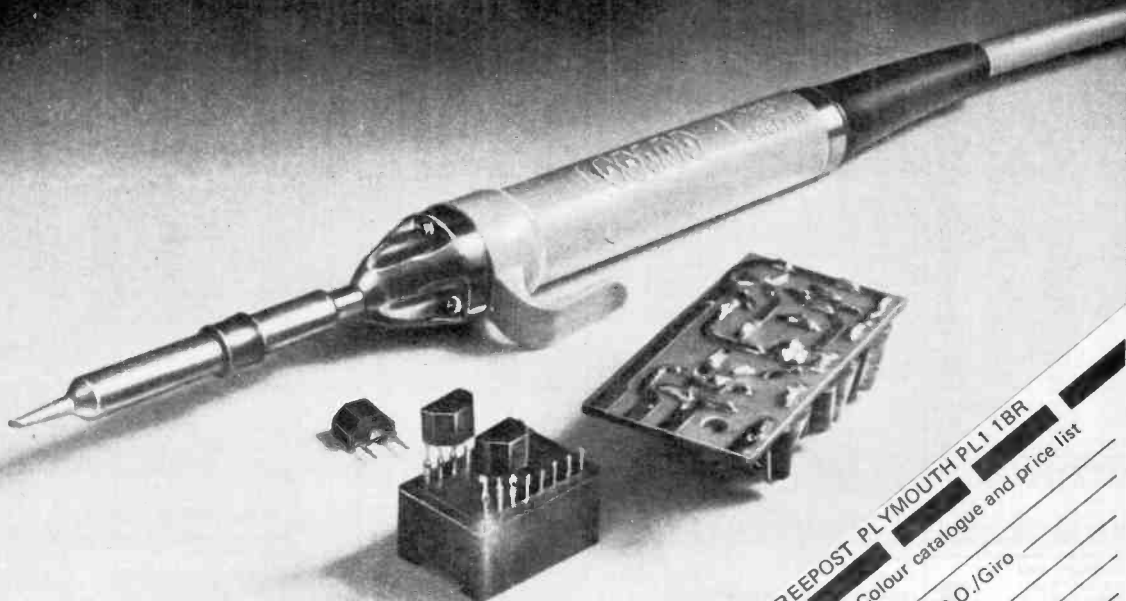


Stand model S.T.3 has a chromium plated steel spring, two sponges for cleaning the bits and is priced at £1.40 exclusive of VAT.



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7403	18p	74126	65p
7404	24p	74120	130p
7405	25p	74121	32p
7406	43p	74122	52p
7407	43p	74123	75p
7408	22p	74125	70p
7409	22p	74126	65p
7410	18p	74128	82p
7411	28p	74132	81p
7412	25p	74136	81p
7413	40p	74141	85p
7414	85p	74142	300p
7416	40p	74145	95p
7417	40p	74147	205p
7420	18p	74148	160p
7421	43p	74150	130p
7422	28p	74151	81p
7423	36p	74153	81p
7425	33p	74154	160p
7426	43p	74155	97p
7427	40p	74157	97p
7428	40p	74159	250p
7430	18p	74160	130p
7432	37p	74161	130p
7433	43p	74162	130p
7437	37p	74163	130p
7438	37p	74164	140p
7440	18p	74165	150p
7441	85p	74166	160p
7442	120p	74167	320p
7443	120p	74172	750p
7444	120p	74173	90p
7446	108p	74174	130p
7447	90p	74175	97p
7448	85p	74176	130p
7450	18p	74177	130p
7451	18p	74180	160p
7453	18p	74181	324p
7454	18p	74182	150p
7450	18p	74185	190p
7470	38p	74186	30p
7472	32p	74187	130p
7473	36p	74191	160p
7474	37p	74192	160p
7475	48p	74193	160p
7476	37p	74194	160p
7480	54p	74195	110p
7481	108p	74196	130p
7482	90p	74197	130p
7483	99p	74198	270p
7484	120p	74199	270p
7485	120p	74221	175p
7486	36p	74231	150p
7489	340p	74265	87p
7490	43p	74278	320p
7491	90p	74279	150p
7492	58p	74283	220p
7493	43p	74284	475p
7494	90p	74285	475p
7495	75p	74290	160p
7496	90p	74293	160p
7497	290p	74298	220p
74100	140p	74365	160p
74104	75p	74366	160p
74105	75p	74367	160p
74107	75p	74369	220p
74109	60p	74393	245p
74110	60p	74490	250p

CMOS ICs

4000	21p	4040	150p
4001	21p	4042	97p
4002	21p	4043	100p
4006	127p	4046	150p
4007	21p	4047	150p
4009	67p	4049	64p
4011	21p	4050	58p
4012	23p	4054	120p
4013	50p	4055	140p
4014	90p	4056	145p
4015	90p	4060	130p
4016	54p	4069	30p
4017	120p	4071	30p
4018	110p	4072	30p
4019	57p	4081	30p
4020	140p	4082	30p
4021	120p	4093	104p
4023	23p	4510	140p
4024	90p	4511	140p
4025	23p	4516	130p
4026	20p	4518	140p
4027	64p	4528	140p
4028	110p	14433	£14
4029	120p	14533	£40p
4030	67p	14583	£1p

LOW PROFILE DIL SOCKETS BY TEXAS

8 pin 12p	22 pin 36p
16 pin 13p	24 pin 40p
16 pin 14p	28 pin 60p
18 pin 30p	40 pin 75p

MEMORY I.C.s

1702A EPROM	1200p
2102-Z RAM	210p
2107 RAM	1080p
2112-Z RAM	470p
RO3-2513 ROM	80p

OP. AMPS

LM301A	40p	741	25p
LM318N	225p	747	76p
LM324N	120p	748	76p
LM339N	175p	767	216p
NE531V	140p	MC1458	75p
709	38p	CA3130	108p
733	150p	CA3140	108p
		LM3900	70p

LINEAR I.C.s

AY-1-212	650p	NE555V	100p
CA3028A	112p	NE561B	450p
CA3046	85p	NE562B	450p
CA3048	250p	NE565	200p
CA3053	75p	NE566V	200p
CA3065	200p	NE567V	200p
CA3088E	97p	SN72110N	54p
CA3090E	250p	SN76003N	275p
CA3090AQ	425p	SN76008	275p
ICL8038CC	180p	SN76013N	180p
LM377N	200p	SN76013ND	160p
LM380N	112p	SN76018	280p
LM381N	190p	SN76023N	175p
LM389N	180p	SN76023ND	175p
M252A-A	850p	SN76033A	275p
MC1310P	180p	TA A621A	310p
MC1351P	110p	TA A661B	150p
MC1495L	490p	TBA120	97p
MC1496G/P	112p	TBA41B	300p
MC3360P	160p	TBA551	100p
MFC4000B	97p	TBA800	112p
MFC6040	200p	TBA810S	125p
N5596	112p	TBA820	100p
NE540L	160p	TDA2020	405p
		ZN414	140p

VOLTAGE REGULATORS—Fixed

Plastic—TO220—3 Terminals	
1 Amp +ve	-ve
5V 7805	130p 7905
8V 7808	130p 7908
12V 7812	130p 7912
15V 7815	130p 7915
18V 7818	150p 7918
24V 7824	150p 7924
100mA—A—TO92	
5V 78L05	70p 79L05
6V 78L06	70p 79L06
12V 78L12	80p 79L12
15V 78L15	70p 79L15
LM309K (TO3) 1A 5V	150p
LM323K (TO3) 3A 5V	100p
LM327N (16 DIL) 100mA +5—12V	275p
MC1468 (16 DIL) 100mA +5—15V	300p
(A.D.I. by Rs from ±8V to ±20V)	
TBA625B (TO5) 0.5A 12V	120p
7805 (TO3) 1A 5V	150p

VARIABLE

723 14 pin DIL 2V-3V 150mA	45p
LM317T 20V 1A—2V-3V	340p
TL430 TO92 100mA 2V-30V	75p

OPTO-ELECTRONICS

OCF 71 130p	LEDS:	TIL209	Red	14p
OCF 12 75p		TIL211	Green	36p
ORP 60 90p		TIL32	Infrared	81p
ORP 61 90p		0-2"	Red	16p
2N5777 48p			Green	20p
			Yellow	36p

DISPLAYS

3013F Minित्रon	175p		
DL704 Red	160p	Green	160p
DL707 Red	160p	Green	160p
DL747 Red	250p	Green	250p

DRIVERS:

75491	84p	9368PBC	216p
75492	104p		

SCR-THYRISTORS

1A 100V TO5	65p	C106D	70p
1A 400V TO5	95p	2N3525	130p
3A 400V stud	120p	2N4444	200p
7A 400V TO5	120p		
2A 400V TO220	180p		
16A 600V TO220	220p		
16A 600V TO220	270p		
BT 106 stud	150p		

DIODES

BY127	12p
OA47	9p
OA81	15p
OA85	15p
OA90	9p
OA91	9p
OA95	9p
OA200	9p
OA202	10p
1N914	4p
1N916	7p
1N4148	4p
1N4001/2	6p
1N4004/5	7p
1N4007	8p
1N5401	15p
1N5404	29p
1N5407	25p

TRIACS

3A 400V 85p	
6A 400V 107p	
6A 500V 126p	
10A 400V 140p	
10A 500V 160p	
15A 400V 200p	
15A 500V 225p	
40430	130p
40669	130p
T2 302D	130p
BR100	32p

BRIDGE RECTIFIERS

1A 50V 25p	
1A 100V 27p	
1A 400V 31p	
2A 50V 41p	
2A 100V 45p	
3A 200V 70p	
3A 600V 80p	
4A 100V 90p	
4A 400V 90p	
6A 50V 96p	
6A 100V 108p	
6A 400V 120p	
10A 400V 270p	

HEAT SINK for Plastic TO220 1 Amp TRS. or VR 22p

TV GAME I.C.

AY-3-8500	£7.75 inc. VAT
14433-3; DIGIT A/D CONVERTER	£14 inc. VAT

Please send SAE for detailed lists

TRANSISTORS

AC125	20p	OC38	90p
AC126	20p	OC35	90p
AC127	20p	OC42	19p
AC128	20p	OC45	19p
AC176	20p	OC71	25p
AC187	20p	R2008B	225p
AC188	20p	R2010B	225p
AD149	60p	TIP29A	50p
AD161	60p	TIP29C	50p
AD162	48p	TIP30A	60p
AF114	22p	TIP30C	72p
AF115	22p	TIP31A	56p
AF116	22p	TIP31C	68p
AF117	22p	TIP32A	68p
AF139	40p	TIP32C	85p
AF239	48p	TIP33A	92p
BC107/B	10p	TIP33C	120p
BC108/B	10p	TIP34A	124p
BC109	10p	TIP34C	160p
BC109	10p	TIP35A	243p
BC117	9p	TIP35C	290p
BC118	9p	TIP36A	297p
BC148	8p	TIP36C	360p
BC149	10p	TIP41A	70p
BC157	11p	TIP41C	84p
BC158	13p	TIP42A	76p
BC159	13p	TIP42C	96p
BC169C	10p	TIP2955	76p
BC171	12p	TIP3055	60p
BC172	11p	TIS43	40p
BC177	20p	TIS93	28p
BC178	17p	TN69T	25p
BC179	20p	TN69C	43p
BC182	12p	TN706	22p
BC183	12p	TN708	22p
BC184	14p	TN918	43p
BC187	32p	TN930	19p
BC212	14p	2N1131	25p
BC213	14p	2N1132	25p
BC214	17p	2N1304	70p
BC461	40p	2N1305	70p
BC478	32p	2N1306	70p
BCY70	20p	2N1307	70p
BCY71	24p	2N1613	22p
BD112	22p	2N1614	22p
BD131	63p	2N1893	33p
BD132	67p	2N2102	60p
BD135	54p	2N2160	120p
BD136	55p	2N2219	22p
BD139	55p	2N2222	22p
BD140	60p	2N2228	15p
BDY38	160p	2N2484	32p
BDY56	225p	2N2646	52p
BF115	24p	2N2904/A	22p
BF167	25p	2N2905/A	22p
BF170	25p	2N2906/A	22p
BF172	27p	2N2907 A	25p
BF177	28p	2N2926/B	11p
BF178	30p	2N2926/G	11p
BF179	35p	2N3053	22p
BF180	35p	2N3054	65p
BF181	35p	2N3055	65p
BF182	35p	2N3439	72p
BF185	24p	2N3442	151p
BF194	13p	2N3565	34p
BF195	11p		

modulation. This does not imply that a front end using a MOSFET is necessarily better than one employing a conventional bipolar device since the one employing the bipolar type may contain several tuned circuits to increase the selectivity and therefore the rejection of spurious frequencies. The noise performance of a bipolar arrangement may be superior.

Aerial impedance

The input impedance is usually either about 75 ohms for use with an unbalanced signal from a coaxial cable or about 300 ohms for use with a flat twin balanced feeder. If an aerial with the incorrect impedance is employed, the signal to noise ratio will be reduced somewhat. In an area of high field strength, this is not likely to matter.

A signal to noise ratio is quoted for most front ends, as a figure expressed in dB. In an area of low signal strength, noise performance may be important. However, minor differences are relatively inaudible. For example, a noise level of 6dB is only just noticeably better than a 9dB noise figure.

Frequency coverage

Most units provide a frequency coverage of some 87 to 109MHz, but all will cover the complete broadcast band with room to spare, especially at the upper end. If one selects a varicap front end, the

uppermost frequency of about 109MHz will not be attained unless the tuning voltage can provide perhaps 20V to 25V. An upper limit of not less than about 101MHz should be obtained with a 12V and not less than about 103MHz with a 15V tuning voltage. A supply of 10V or even less is adequate to cover the present broadcast band.

Various front ends require power supply voltages ranging from about 6V to 12V—no problems here. However, types requiring 12V may not be so convenient for use in portable receivers.

AGC/AFC

Most units do not have AGC facilities; they are generally unnecessary unless used very close to a transmitter. On the other hand, most have an AFC input and this can be most valuable if there is any tendency towards drift. Incorrect tuning results in increased distortion, especially at high modulation depth. Care must be taken to ensure that the AFC voltage from the receiver is suitable for the front end selected; some accept AFC voltages centred at 0V, while others require an input which has a mean positive potential relative to the negative line.

Commercial front ends

We will now comment fairly briefly on some front ends available from our advertisers. More formal specifications are given in Table 1.

	EF-5800HG	EF-5800HQ	EF-5600U EF-5602U EF-5603U	EC-3302U	8319	LP1186	NT3302
Tuning	varicap	varicap	varicap	varicap	varicap	varicap	ganged capacitor
Supply voltage	12V	12V	12V	9V	12V	8V	9V
Supply current (mA)	25-35	25-35	17 (max)	16 (max)	25	6.1	18 (max)
Gain (dB)	44	37	30	22	32	30	25
Noise figure (dB)	8.5	7.8	7	7	5	6.5	8
Tuning range (MHz) for tuning voltage	88 to 108 2.5-16V		87-109 3-25V	87-109 2-20V	87.5-108.5 2.3-18V	87.4-108 2-17V	87-109 —
Input impedance (ohms)	75	75	75	300 (bal.)	75 or 300 (bal.)	75	300 (bal.)
Output impedance (ohms)	300	300	75	300	recomm'd load 150	75	300
Image rejection (dB)	78	97	90 (min)	45 (min) 108MHz	56	40	45 (min) 108MHz
Thermal stability 25-55°C (kHz)	180	180	100	150	—	300	150
No of varicaps	6 back to back	6 back to back	5 back to back	3 single	4 back to back	3 single	—
No of transistors	4	4	4	3	3	3	3
No of 10.7MHz tuned circuits	2	2	2	1	2	2	1
IF bandwidth (kHz)	300	300	300	200 (min)	300	200 (min)	350
Approximate size (body only) (mm)	170 × 20 × 24		90 × 61 × 33	66 × 26 × 15		42 × 31 × 17	74 × 53 × 49

Table 1. Basic details of some front ends; full details should always be obtained from the data sheet before purchase

NT3302UG

The Toko NT3302UG (Ambit International and from Doram Electronics) employs a ganged capacitor and is low cost. It incorporates a double gang capacitor for AM tuning with a range of 8.5pF to 360pF each. A similar Toko unit, the MT3302, has an AM tuning gang with 160pF and 76pF capacitance per section. A similar type is also available with a 3:1 reduction drive. These units incorporate a MOSFET input stage with bipolar transistors as mixer and oscillator. A single 10.7MHz output tuned circuit is used. AFC facilities are provided.

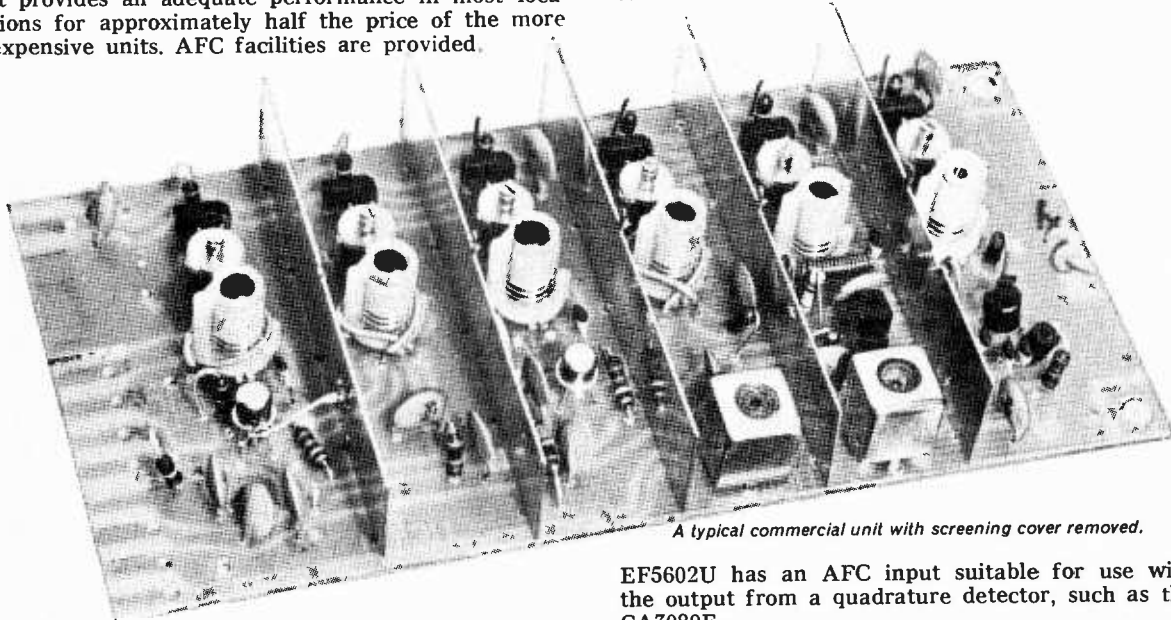
EC3302U

The Toko EC3302U (Ambit International) is an economical, compact varicap tuned front end. A MOSFET input stage is used with bipolar transistors as mixer and oscillator. As in the NT3302, the output is via the coupling winding of the 10.7MHz output transformer. Although the EC3302U has less rejection of spurious signals than other Toko front ends, it provides an adequate performance in most locations for approximately half the price of the more expensive units. AFC facilities are provided.

An EF5801 is also available with an FET buffered frequency counter output and is built on a double sided printed circuit board. The AGC range is also increased.

EF5600 series

The Toko EF5600 series are high performance front ends with an extremely high rejection of spurious frequencies (minimum 90dB). This high rejection is obtained by the use of three signal frequency tuned circuits between the RF stage and the bipolar mixer. Five back-to-back varicap diodes (type BB-104) are used. An emitter follower output stage follows the 10.7MHz double tuned circuits so the output impedance is low. A 0.01 μ F blocking capacitor is used in the output circuit so that the output can be directly connected to any other circuit. The EF5600U has AGC and AFC facilities, whereas the EF5603U has neither. The AFC of the EF5600U is designed for use with ratio detector circuits giving a voltage centred at zero; if the AFC is not used, the AFC connection to the front end must be earthed. The



A typical commercial unit with screening cover removed.

EF5602U has an AFC input suitable for use with the output from a quadrature detector, such as the CA3089E.

8319

The Larsholt 8318 (Ambit International) front end is manufactured in Denmark. It is a high performance unit with an especially good noise figure. There are two tuned circuits between the RF stage and the mixer. Both the RF stage and the mixer use MOSFET devices. Another unusual feature is the provision of separate inputs for 75 ohms (unbalanced) and 300 ohms (balanced). There is an AFC facility.

LP1186

The Mullard LP1186 (Doram Electronics) is one of a series of modules. Although designed to be used with the LP1185 10.7MHz IF module, the LP1186 can be used with any of the amplifier/demodulator integrated circuits. The AFC facility in this module is designed for use with ratio detector type equipment with an AFC input centred about 0V. The gain is higher than that of the EC3302U, but the latter has better frequency stability.

DW

EF5800 series

The EF5800 front ends have been introduced fairly recently by Ambit International. They are unusual in that two RF stages are employed (both using MOSFET devices) with bipolar transistors as the mixer and oscillator. There are six circuits tuned by varicap diodes: an aerial circuit, two tuned circuits between the two RF stages, two tuned circuits between the second RF stage and the mixer and oscillator stage. A double tuned 10.7MHz circuit is used in the output with a coupling winding providing the actual output.

The EF5800 units are available completely built and aligned, but are also available as a kit. While the kit is about £2 cheaper than the completely built and aligned unit, readers are strongly advised to ask themselves (more than once) whether they are equipped to construct this unit. If any doubt exists, it is well worth paying the extra. The EF5800 is available in two versions (see Table 1). The EF5800HG has a very high gain, but the EF5800HQ gives optimum rejection of spurious signals.

MICRO AMPLIFIER



Ex behind the ear deaf aids, complete with volume control £2.18.

VEEDER-ROOT COUNTER



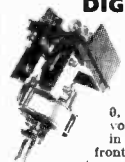
6 Digit 230-250v cycle operated, not resettable also needs persex or similar panel over the wheels. £1.62.

PP3/PP9 REPLACEMENT MAINS UNIT



Japanese made in plastic container with leads size 2" x 1 1/2" x 1 1/2", this is ideal to power a calculator or radio, it has a full wave rectified and smoothed output of 9 volts suitable for a loading of up to 100mA. £2.53.

DIGITAL DISPLAY UNIT (DIGIVISOR)



A precision made instrument which is basically a moving coil voltmeter. Instead of having a pointer, however, the scale is punched out with numerals, 0, 1, 2, 3, 4 and so on. When you apply a voltage for instance 8 volts—fig. 8 comes in front of a lamp and is focused on to the front screen. This device which must have cost a small fortune to develop and make can also be used for a variety of other purposes. Voltage regulation for instance by making beam of light trigger a photo cell. £5.40.

MERCURY BATTERIES



Bank of 7 Mercury cells type 625 which are approx. 1/2" diameter by 1 1/2" thick in plastic tube giving a total of 10.7 volts. Being in a plastic tube it is very easy to break up the battery into separate cells and use these for radio control and similar equipment. Carton of 25 batteries £1.60.

LATCHING RELAY



By Guardian Electric, mains operated it is in fact two relays mounted on a metal base plate. The relays being mounted in such a way to ensure that when one closes the other opens and vice versa thus when closed relay A would remain locked until manually released or electrically released by energising relay B. Each relay has 2 sets of 10 amp changeover contacts. Should be ideal for burglar alarms and similar applications. £2.11.

24 HOUR MOTOR



Beautifully made by Sangamo. This is 200-240v mains driven motor with gear box together in one housing, size approx. 1 1/2" dia. by 1 1/2" deep. If you are contemplating making a 24 hour switch with a lot of on/off's then this is obviously the motor. Price £1.89.

4 POLE MOTOR



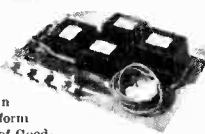
Carefully balanced, fitted with belt drive pulley for tape recorders, etc. Normal mains working, speed: 1,250 rpm. £2.12.

HUMIDITY SWITCH



American made by Ranco, this type No. J11. The action of this device depends upon the dampness causing a membrane to stretch and trigger a sensitive microswitch adjustable by a screw, quite sensitive—breathing on it for instance will switch it on. Micro 3 amp at 250v. AC. Overall size of the device approx. 3 1/2" long 1 1/2" wide and 1 1/2" deep. 65p.

MULLARD UNILEX



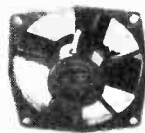
A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost any one in easy-to-assemble modular form and complete with a pair of Goodmans speakers this should sell at about £30—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £14.00 including VAT and postage.

RECTANGULAR HOT PLATE



Aluminium panel with ridged top and angled underneath to strengthen it. This is approx. 10" x 4 1/2" of flat plate. Beneath plate is 100w element and sensor switch which will maintain the surface of the plate just too hot to touch. With leads and tags. This is ideal if you are making up a food warmer or for an airing cupboard, etc. Price £1.03.

EXTRACTOR FAN



Ex computers—made by Woods of Colchester, ideal for fixing through partition—reasonably quiet running—very powerful 2500 rpm. Choice of two sizes 5" or 6 1/2" dia. £4.43.

ROTARY WAFER SWITCH



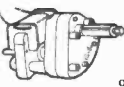
—wiper contacts 3 way 8 poles 5 amp rating, break before make—1/2" diameter 1" long spindle, slotted for knob screw. Made by Plessey. Price £1.08.

INSULATED TERMINALS



Well made with metal panel Insulators—screw down to trap wire or insert 4mm plug into top—15p each following colours available.

SPIT MOTOR WITH CARTER GEAR BOX



Probably one of the best spit motors made. Originally intended to be used in very high priced cookers however this can be put to plenty of other uses, for instance your garden barbeque or to drive a tumbler for stone pollabing; in fact there are no ends to its uses. Normal mains operation. £4.32 including POST & VAT.

ELECTRO MAGNETIC MECHANISMS

4v-8v AC. operated the electro magnet easily



removable from mechanism—50p each—two type available.

SHORT WAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 18, 25, 31, 29 metre bands. Kit contains chassis front panel and all the parts £2.25—crystal earphone 65p including VAT and postage.



TERMS:

Cash with order—prices includes VAT and carriage unless stated but orders under £8 must add 50p to offset packing etc. BULK ENQUIRIES WELCOMED. Phone: 01-688 1833.

J. BULL (ELECTRICAL) LTD
(Dept. PW), 103 TAMWORTH RD.
CROYDON CR9 1SG

IT'S FREE!

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—often bargains which sell out before our advertisement can appear—it's an interesting list and it's free—just send S.A.E. Below are a few of the Bargains still available from a recent list.

Desk Instrument Case with sloping front, overall size of sloping front in 4" wide and 5" long. Mounted on a heavy base for stability, base size 4 1/2" x 4" with flex lock. The heavy base is easily removed if not required. The average depth below sloping panel 3" approx. Price £1.50p + 12p. Post 50p + 4p. Note the sloping front will be supplied with each of these cases but this already has quite a lot of holes in it, however it is a simple matter to cut and bend new aluminium front if you use this as a pattern.

Rigonda 8" Mains Battery TV's for spares, these are less tubes and less knobs and will have one or two other parts missing but in the main are complete and worth having if you have one of these televisions or if you do repairs to them. Price £3.05p + 44p. Post £21.00 + 12p.

Digital Thumbwheel Switch. Black face flush panel mounting, face size approx. 3 1/2" x 1 1/2". White digits 10 positions 0-9. These can be stacked edge wise to any quantity. The right hand and left hand ends have projections for 6BA fixing to the panel. Price left hand and right hand end switches £1.50 each + 12p. Intermediate switches £1.25 + 10p.

Mains Transformer upright mounting with top tagboard, primary 0-115, 210, 240, two secondaries 115 volts 0-115 and 8.5 volt 1-25A. Note this transformer is ex-nuovo equipment. Price £2.00 + 16p. Post 30p + 2p.

Mains Transformer, primary 0-110, 127, 150, 180, 220. Secondaries (1) 3-15-0-3-15, (2) 2.5v, (3) 0-220v. Fitted primary screen. This is a 30w transformer, ex equipment £2.50 + 20p. Post 40p + 3p.

Relay 6-12 volt. Single 2 amp changeover contacts, open miniature type, size approx. 1" cube PC mounting ex new equipment £3.00 + 2p.

Relay Miniature 6-12 volt plastic covered plug in type 4 changeover gold plated contacts 52 ohm coil, size approx. 1 1/2" high 1 1/2" wide 1/2" thick, ex new equipment with base 75p + 6p.

Miniature Relay 6-12 volt plastic covered plug in type 200 ohm coil. Two changeover gold plated contacts ex new equipment with base 75p + 6p.

Three Digit Counter, resettable 12 volt coil, flush panel mounting, black with white digits ex new equipment £1.75 + 14p.

Reed Relay with double wound coil 12 volts one coil will close the reed switch, 12 volts on the other coil will open the contact or still further close it depending upon whether the current is opposing or assisting. Price £1.50 + 12p. Post 20p + 2p.

Push on Push off Panel Mounting Switch. 3 amps 250 volt metal plunger similar to and mounted light toggle switch made by Arrow 60p + 4p.

Push to make Switch 250v 1 amp similar to and mounted like a toggle made by Arco Electronic. Price 35p + 3p.

Panel Mounting Neon Lamp. Compact type with bright chrome type mounting clip, these will flash from voltages of 100 upwards but need a series resistor of about 250k, higher or lower depending upon how bright you want them. Price 30p + 2p, these are red but we also have another slightly larger in natural colour, same price.

Relay, Clare Elliott 670 ohm. Coil sealed in metal can, size approx. 1 1/2" x 1 1/2" x 1/2", two pairs of changeover contacts. This type of relay is mounted by its own leads. £1.00 + 8p.

Engine Revolution Counter. This is ex Air Ministry item, beautifully made. As a revolution counter it is driven by a flexible shaft and having a permanent magnet field the voltage output would be dependent upon the speed. Of course it will also run as a low voltage D.C. motor and its speed will be dependent upon the applied voltage. This is almost perfect and almost waterproof so it will still run in adverse conditions. One point, however, is there are no brushes fitted to these motors, these are special and as yet we have not been able to find a supplier, so you will buy without brushes. The Air Ministry ref. number of the motor is 6A/7A2. We would like to hear from any customer who met this during his service career and who knows of a possible source of brushes. Price £2.00 + 16p. Post 40p + 4p.

Miniature Sealed Thermostat. German made, these are about the size of early power transformers, have 4" wire ends and are sealed, so suitable for immersion in many liquids. Operating temperature 90°C plus or minus 3%. We were not sure of the operating voltage and current but we tested one with 100v and one of the mains and it worked perfectly o.k. Price 50p + 4p.

Goswamek as used on adjustable table lamps, microphone stands, etc. Normal brass 1/8" thread each end length 18" chrome plated. Price 75p + 6p. Post 30p + 2p.

Nicad Battery Charger in neat plastic case size 4 1/2" x 3 1/2" x 2 1/2" approx, with mains input lead and charging output lead terminated with din plug. This is a dual output charger but contains useful mains transformer which makes it easily adaptable for many voltage cells. If not wanted as a charger, could very easily be rebuilt as a power unit for receiver or other device. The plastic case has a neon indicator. Price £2.50 + 20p. Post 40p + 4p.

Panel Meter. 2 1/2" made for Air Ministry, unused but storage soiled. 30mA moving coil offered at a low price but these have loose glasses which will want regluing price £1.50 + 12p. Post 20p + 2p.

Paper Motor, ref. K1Z-2050-4-540D. This is normal mains working motor, capacitor run so easily reversible. May be a little storage soiled but these are unused and fully guaranteed by us. Price £5.00 + 40p. Post 30p + 2p.

Garrard 4 Pole Motor, probably made for record player or tape recorder, this is 140v, 40-60 cycle. We do not know the Garrard ref. no. but the figure 12 is pressed on the bottom bearing cover. Price £2.00 + 25p. Post 30p + 4p.



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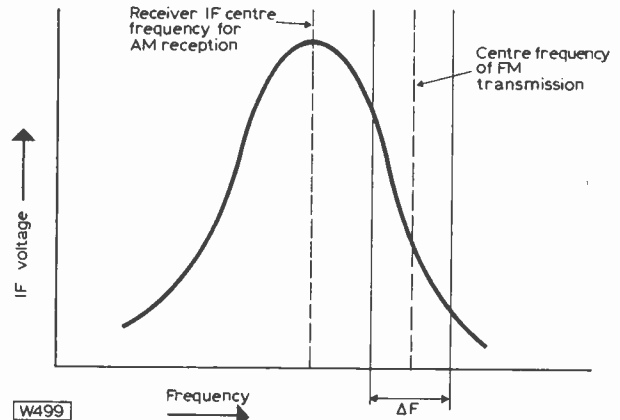
MOST radio amateurs are aware of the advantages of narrow band frequency modulation (NBFM) transmitters in that little, if any, interference is caused to other services. Amplitude modulated transmissions, either AM or SSB, or CW can be picked up on a neighbour's television sets, a hearing aid or the Hi-Fi—the received RF overcomes the bias on the input transistors causing demodulation of your signal. Increasingly, new amateurs coming on the two metre band modify or purchase equipment for frequency or phase modulation (FM or PM) gaining the advantage of an audio modulator running microwatts instead of at least half the power of the RF output stage required by AM. To those capable of receiving NBFM, ignition interference is largely eliminated as is the characteristic QSB or flutter found on /M stations.

NBFM demodulation

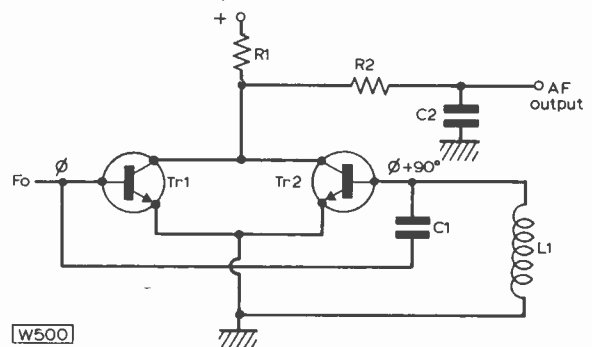
Unfortunately not all amateurs receive NBFM under optimum conditions. With the average AM receiver, detection is done on the slope of the IF pass band (Fig. 1), the frequency of reception being offset from the centre of the carrier so that the signal moves in and out of the pass band of the IF and thus presents a variable voltage to the diode detector corresponding to the audio modulation. If the receiver has a fairly sharp edge to the pass band this method of reception can be very effective. However even the best of AM receivers fail where FM deviation is very small.

The solution is to employ a limiting amplifier with high gain to square the incoming wave. This eliminates audio modulation leaving only the frequency deviation which can be converted to an audio signal by a phase demodulator. In the past this has required a complex transformer to present a balanced input to a double diode detector such as the Foster Seeley or the ratio detector. Even a pulse counting demodulator gives poor recovered audio from NBFM. The phase locked loop is an excellent technique of recent development giving good AM rejection but expensive of space in isolated component form and expensive financially in integrated circuit form. Fortunately with the need to demodulate FM TV sound, cheaper, simple and very effective integrated circuits have appeared which combine a very high gain limiting amplifier with a double balanced demodulator. The latter is presented with a square wave, one side being at 90° nominal phase difference resulting in demodulation of NBFM with an efficiency seldom achieved by older methods.

The author's NBFM demodulator design uses a high gain amplifier and a double balanced demodulator in a single IC with a minimum of external components to give an audio output of up to 0.8 volt, but pursues the matter a little further. Not



W499



W500

Fig. 1: The upper drawing shows a conventional AM receiver tuned for reception of signals. The FM is converted to AM using the receiver passband slope. The lower drawing shows a simplified quadrature detector. The relative phase between inputs of Tr1 and 2, a function of the input frequency when the combination of L1/C1 is near resonance, controls the current conduction angle through the common collector resistor R1. Recovered audio modulation appears across this resistor.

every amateur wishes to 'butcher' his equipment. The addition of accessory equipment should not alter the ability of the receiver to accept AM or SSB with equal facility. This discriminator includes an input stage which provides minimum loading on the output from the IF stages and, by including an audio stage, provides reception of NBFM through a separate loudspeaker. This enables both NBFM and AM stations to be received without adjustment of the receiver controls and also gives some indication of the amount of FM on an AM transmission. If the complete unit is made, only three connections are required: an input from the IF stage, and power supply take off. The unit has been designed for the two popular IFs of 455 kHz to 470 kHz, and 1.6 MHz.

Circuit description

A very high input impedance stage is provided by an FET (Fig. 2) capacitatively coupled to the last IF

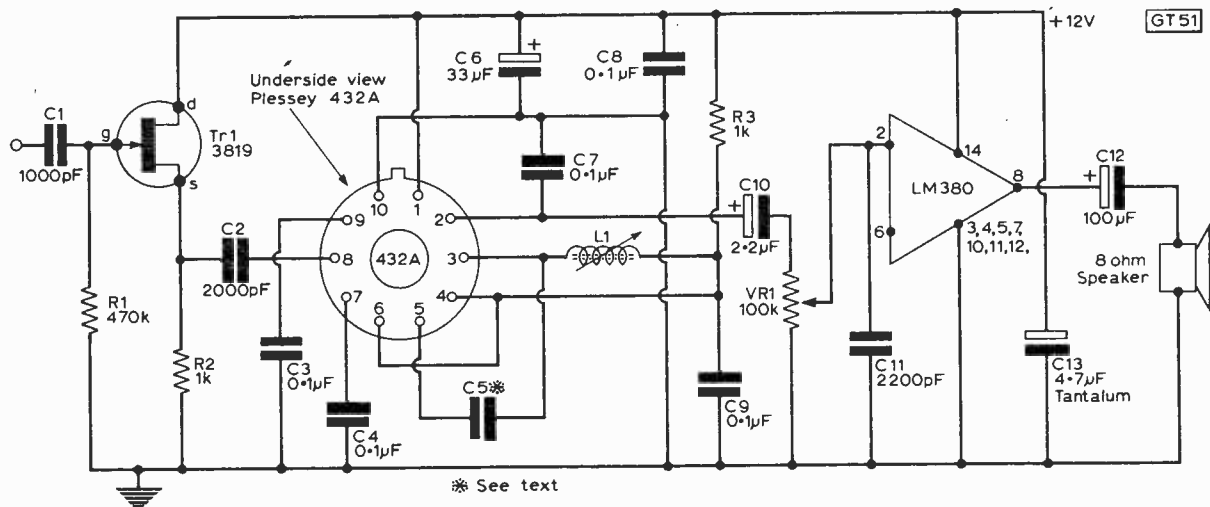


Fig. 2: Circuit diagram. The prototype was constructed on a small piece of etched circuit board. The layout needs considerable care to avoid instability. Keep the input and output wiring of IC1 separated; use a screen if necessary. L1 will require a screening can.

stage, the input being best connected to the anode or collector through a capacitor of suitable voltage tolerance. Some readjustment of the last IF transformer slug will be required which should be minimum when the link between IF stage and discriminator is as short as possible.

C1 links IF to the gate of Tr1 which is held at earth potential by R1. R2 is the source resistance and provides a low impedance input via C2 to the IC, a Plessey 432A. This has an input impedance of 1.4kΩ and incorporates an amplifier with a gain of over 50dB followed by a balanced demodulator. Most of the capacitors surrounding the IC decouple the various stages. However, C5 and L1 provide a 90° phase shift between pin 3 and pin 5 at the IF, and both must be selected depending on the IF to be demodulated (see component list). The output from the balanced demodulator is fed via C10 to IC2.

Construction

Because of the high gain of the preceding receiver IF strip, particular attention must be paid to abolition of ground loops—these can occur while connecting the demodulator unit to the receiver as well as in the component board itself. All conductors surrounding the 432A must be kept as short as possible; this particularly applies to the circuit decoupling capacitors.

The circuit can be constructed on either veroboard or etched PCB. The author used the latter method for the prototype. Whichever method is employed the input circuitry (Tr1, etc) should be placed the opposite side to the output circuitry (L1, IC2, etc.).

L1 was wound on a standard 12 mm pot core as used in many IF transformers. For 455kHz wind 80 turns of 40 gauge enamel covered wire. C5 should be about 1000pF. For 1.6MHz, wind 50 turns of similar wire with C5 270pF. It is essential to screen L1 in a metal can to avoid instability. For those without 12 mm pot cores readily to hand, it might be worth experimenting with converted IF transformers. L1 and C5 should be series resonant at about the receiver intermediate frequency. In operation, L1 is 'mistuned' so that the phase shift across C5, normally 180° at resonance, is reduced to 90°. With standard high Q IF transformers, this will occur within a few kHz of nominal resonance; the recovered audio

depends on the Q of the LC combination. The higher the Q, the higher the output for a given deviation. Adequate results may be obtained by breaking open an old IF can, removing one winding and tuning capacitor, and using the remaining winding for L1 and the associated capacitor for C5. Slight adjustment may be necessary to compensate for the capacitive loading of IC1 in the 'new' application.

★ components list

Capacitors

- C1 1000pf
- C2 2000μF
- C3, 4, 7, 8, 9 0.1μF ceramic
- C5 1000pf for 455 kHz
270pf for 1.6 MHz } See text
- C6 33μF
- C10 2.2μF
- C11 2200μF
- C13 4.7μF tantalum
- C12 100μF

Resistors

- R1 470kΩ
- R2 1kΩ
- R3 1kΩ
- VR1 100kΩ linear

Coils

- L1 Standard 12 mm pot core as used in many IF transformers. Wind 80 turns 40 gauge enamel covered or Litz wire for 455 kHz, or 50 turns similar wire for 1.6 MHz. Screening can essential. See text.

Semiconductors

- IC1 432A Plessey
- IC2 LM380

Setting up

Connect a 12V supply to the unit; the current drawn should total about 30mA. Feed an FM IF signal to the unit at the mean operating frequency and adjust L1 for maximum output. A fairly accurate adjustment may be made by disconnecting the aerial from the receiver and tuning L1 for maximum white noise in the loudspeaker. However, really accurate adjustment can only be made with a NBFM transmission.

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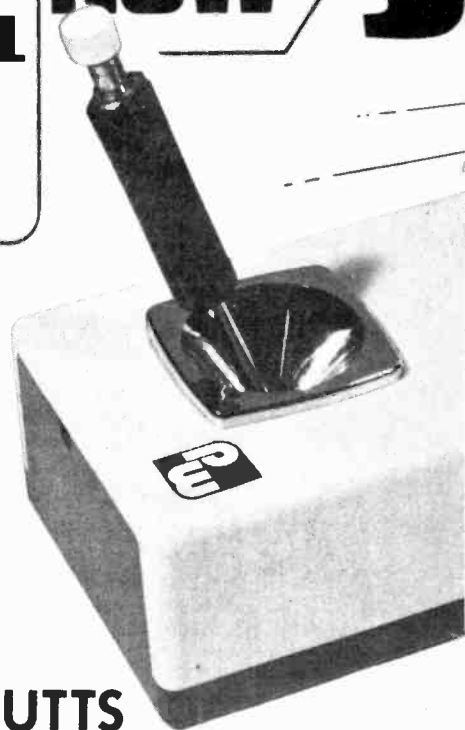
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ON-SCREEN SCORING & SOUND EFFECTS

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THE General Instrument AY-3-8500 IC has two positions on the games switch that provide a square target for use in shooting games. In the first position the target bounces round the screen in an invisible box. In the second position the target crosses the screen from left to right. When the reset button is pressed the screen is blanked except for the target. After 15 shots the score appears to indicate the number of hits out of 15.

SHOOT is an add-on unit which allows an aiming mark to be placed on the screen and moved around by joystick control to chase the target. If the firing button is pressed when the aiming mark is on target a point is scored. A variable timer allows the aiming mark to be placed on the screen for preset times.

D.S.COUTTS

Circuit description

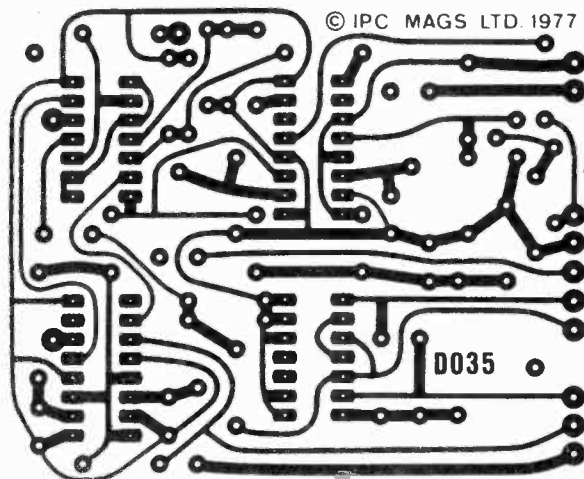
The circuit of the unit is shown in Fig. 1. The unit obtains its supplies from the main 8500 PCB. The sync from the 8500 is fed to pin 5 of IC1b and to Tr1. IC1b fires on each line sync and controls the horizontal position of the aiming mark, its range being approximately 15 to 55 μ s. The components C5, R5, D2 determine the width of the mark, the values on the circuit giving a width of 0.5 μ s. Tr1 is used to separate the frame sync from the line sync and provides a trigger pulse each frame to pin 12 of IC1a. IC1a controls the vertical portion of the aiming mark and is variable over the range approximately 5 to 18 μ s. Components C3, R4, D1 determine the height of the mark; the values shown give a height of 3 lines. S1 is the fire switch, debounced by IC3a and b. IC3 output from pin 10 is fed to the shot input of the AY-3-8500 incrementing the shot counter each time the trigger is pressed. C6, R8, D3 determine the width of the fire window. C6 can be increased to make the window wider which makes the game easier.

output from the AY-3-8500 and the fire window from C6 are also fed to IC4c. When a hit is detected by this gate, IC2b fires and outputs a pulse to the 8500 hit input. This increments the hit counter, outputs a tone and blanks the target for the duration of the hit pulse.

There are therefore seven connections between the 8500 main PCB and SHOOT: 0V, +8V, SYNC, BALL OUTPUT from the main PCB and shot, hit and AIMING MARK from SHOOT.

Gating

IC1a and b gate IC4a together with the output from IC2a. When S2 is pressed IC2a fires for a period determined by VR3 opening gate IC4a. The output of IC4a is inverted by IC4b, used to produce the spot on the screen, and also gates IC4c. The ball



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HOOT!

AN ADD-ON GAMES MODULE

SHOTS

Construction

Actual mechanical construction will depend on the size of the joystick used; a typical layout is shown in Fig. 5. As standard joysticks used for radio control may have 5k Ω pots fitted, ensure that the type obtained can be modified to take a 25k Ω and a 50k Ω pot. If one is obtained with a tubular operating arm, S1 may be mounted in a piece of dowel and fitted on top of the operating arm.

★ components list

Resistors

R1	10k Ω
R2	2.2k Ω
R3	10k Ω
R4	27k Ω
R5	10k Ω
R6	15k Ω
R7	15k Ω
R8	1M Ω
R9	15k Ω
R10	470k Ω
R11	330k Ω
R12	47k Ω
VR1	25k Ω moulded track
VR2	50k Ω moulded track
VR3	500k Ω
VR4	22k Ω skeleton preset
VR5	22k Ω skeleton preset

Capacitors

C1	0.02 μ F
C2	10 μ F tantalum
C3	0.01 μ F
C4	0.01 μ F
C5	56pF
C6	0.1 μ F
C7	22 μ F
C8	2.2 μ F
C9	10 μ F tantalum
C10	0.01 μ F

Semiconductors

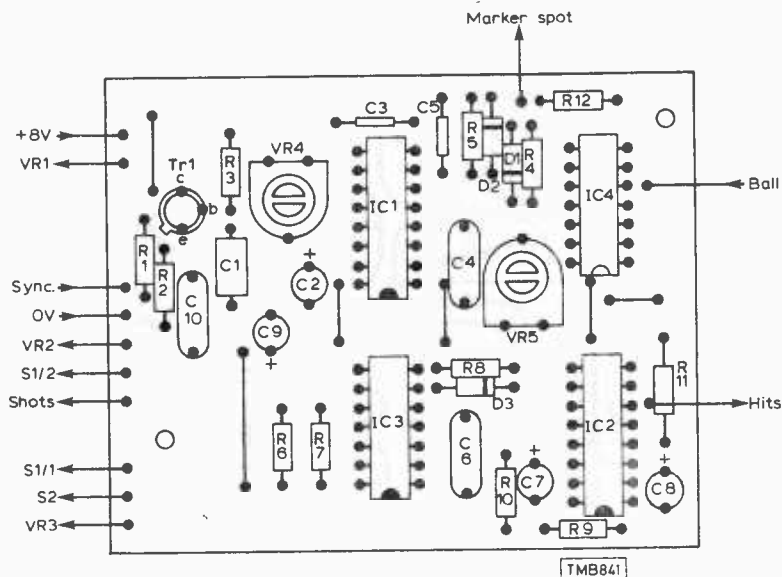
IC1	MC14528
IC2	MC14528
IC3	MC14011
IC4	MC14023
D1	1N914
D2	1N914
D3	1N914
Tr1	BC108

Miscellaneous

S1 1 pole change over; S2 push to make, hardware, box (14 x 5 x 8cm), plug and socket (see text), joystick mechanics. PCB from PW Readers' PCB Service

Fig. 2 (left): PCB copper side shown actual size. The board is secured to the base of the plastic housing by two 6BA bolts inserted through the drillings indicated on the board. Circuit diagram (Fig. 1) is shown on page 283.

Fig. 3 (right): PCB component layout. DIL sockets should be used for all ICs unless the usual CMOS soldering procedures are followed. Devices should be left in the conductive foil or foam until ready for insertion; pins 2 and 14 of the MC14528 are especially susceptible to static damage since these do not have the normal input protection diodes.



When the mechanical parts have been mounted in a suitable box, begin assembly of the PCB. Fit the wire links as shown by the single lines on Fig. 3 and fit the other components. As CMOS devices are used in the system it is advisable to fit IC sockets and leave insertion of the ICs until construction is finished. If you do not use sockets then use an iron with an earthed tip for soldering. When the PCB is complete fit it into the box. Fig. 3 also shows the connections to the board.

Connection

A seven-pin plug should be fitted to the cable to join the unit to the TV games unit with a matching socket in the latter's box. The connection points on the 8500 PCB are shown in Fig. 4. The sync output is taken from pin 16 on the 8500 IC and the marker spot lead connects to the end of R9. The +8V output

Fig. 4: Interconnection diagram for use with PCB featured in the June 1977 Telegames unit. Although the prototype SHOOT module was connected to the main unit by flying leads, readers are recommended to fit 7-pin DIN plugs or other multiway connectors to both master and slave games unit.

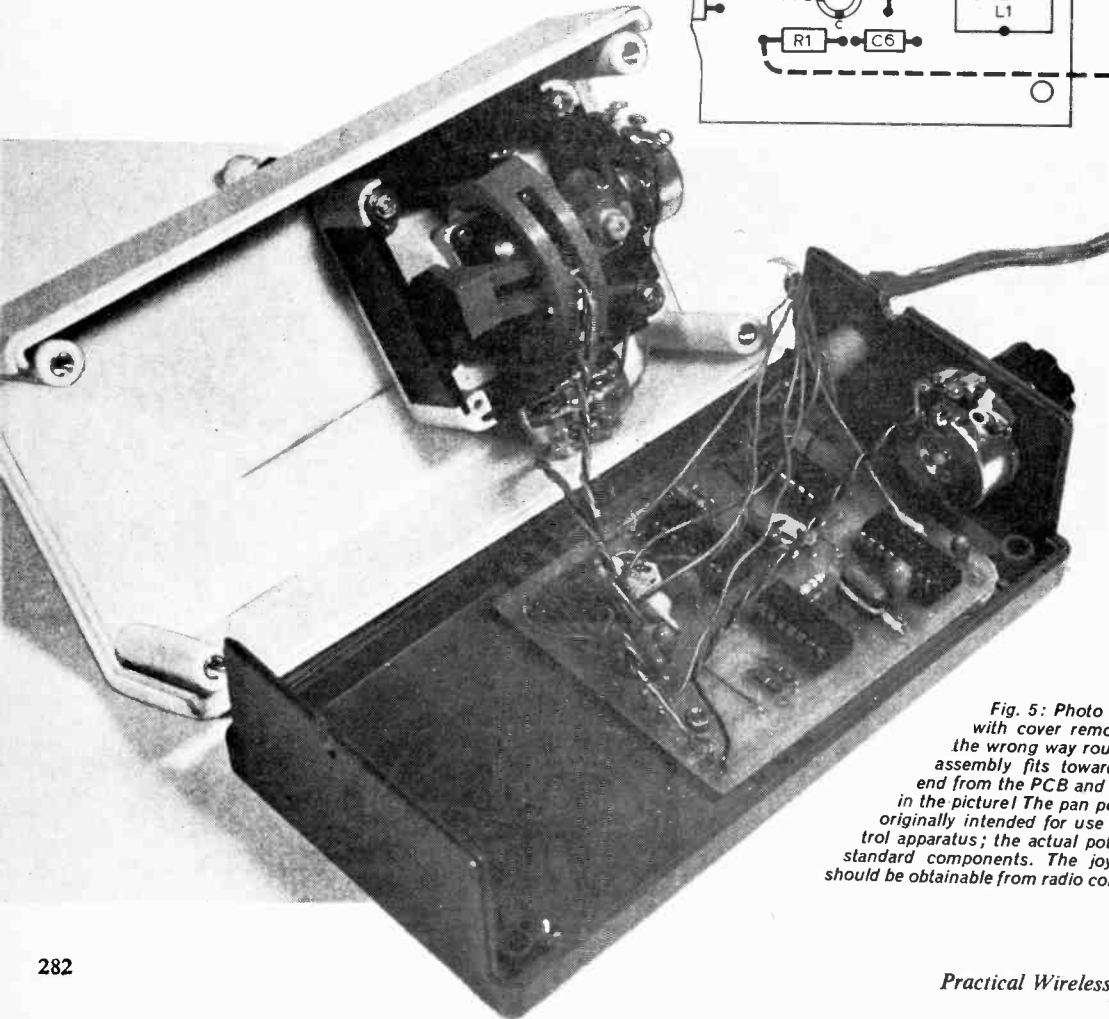
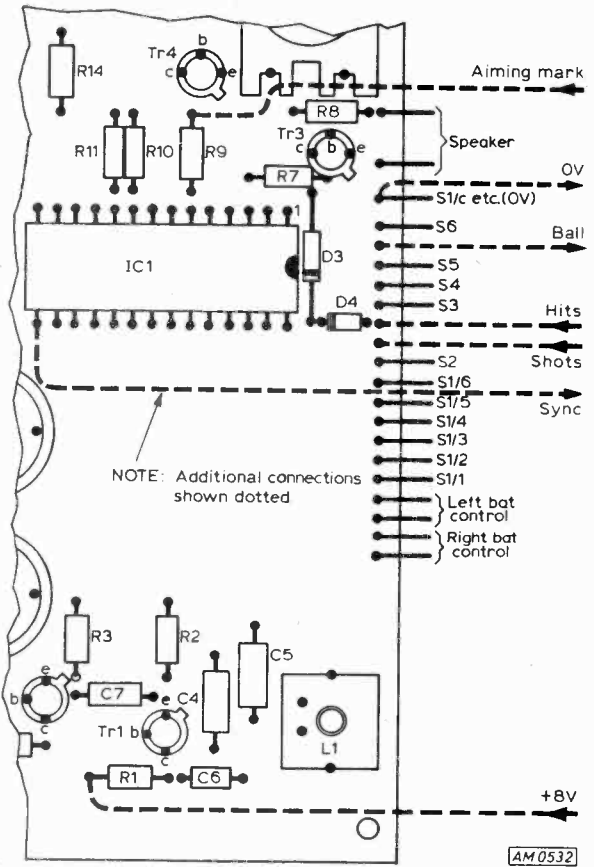


Fig. 5: Photo of the prototype with cover removed and shown the wrong way round. The pan pot assembly fits towards the opposite end from the PCB and not as indicated in the picture! The pan pot assembly was originally intended for use with radio control apparatus; the actual potentiometers are standard components. The joystick assembly should be obtainable from radio control specialists.

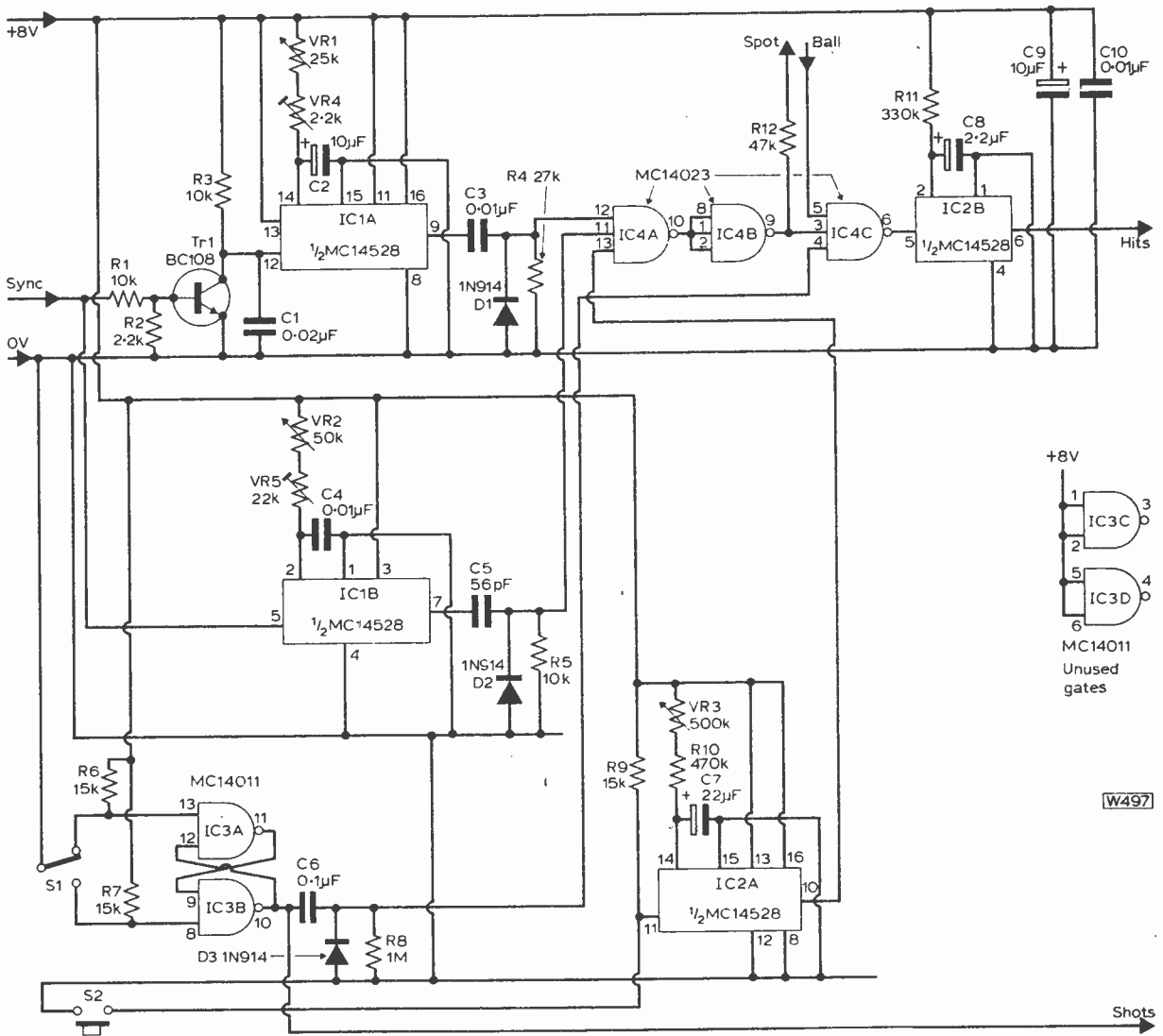


Fig. 1: Circuit diagram. The text referring to this occurs on page 280. IC3c and d are unused gates, the inputs of which must be grounded or tied to the Vcc line. They must never be left floating. The power supply to the SHOOT module PCB is taken from the parent board in the Tele-games unit. Note: VR4 should be shown as 22kΩ as in components list.

comes from the regulated supply. The other connections are on pins at the edge of the PCB.

Setting up

After checking the unit carefully for shorts, etc, connect the SHOOT adaptor to the main unit. Set VR3 to maximum resistance. Select rifle game R1 and auto mode when the target should appear on the screen. Push S2 and adjust the position of VR1, VR2 and the presets VR4, VR5 to get the aiming mark on the screen. Remember that S2 has to be

pressed occasionally to keep the mark visible. When the mark has appeared on the screen adjust the pots and presets until the mark can be swept over most of the screen by means of the joystick. When this is satisfactory try out the fire button when a tone should be obtained each time the target is hit (N.B.—when moving the stick with the target moving fast it is easy to think you have a hit which hasn't registered when in fact a slight delay in pressing the fire button has caused you to miss). It is advisable to use slow speed for testing; further, the fire window can be widened temporarily by connecting another capacitor across C6.

PRODUCTION LINES

bill tull

Mind your language

Right now it's holiday time—going abroad or maybe you are abroad? Bet you wished you could talk the local lingo and that you had paid more attention in those language classes when you were at school?

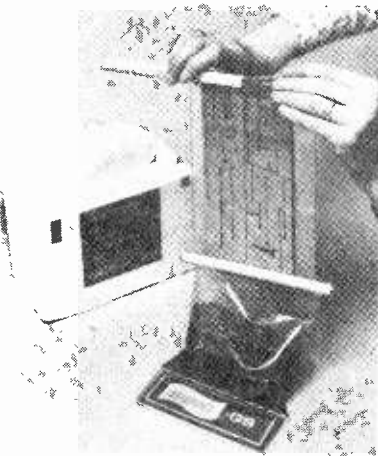
A method of language tuition that has been popular for some years now is the language laboratory which of course is hardly portable. But now Philips have introduced a new language trainer the AAC4000 based on their audio active comparative (AAC) system and it really can be carried on the shoulder. In laymen's terms, AAC means that the user listens to sentences of tuition pre-recorded on the lower half of the training compact cassette. There are long pauses between the sentences of tuition and during the pauses the student repeats the sentences, which are then recorded on the cassette's upper track. Subsequently the student can replay both tracks at the same time so that he can compare his own pronunciation with the teacher's. If he wishes to try again the student can erase his previous performance but the tuition track is automatically protected against erasure.

The separate tracks can also be used for other applications such as slide and sound synchronisation.

Philips Electrical Ltd., Century House, Shaftesbury Ave., London WC2. Tel: 01-437 7777.

It's in the bag

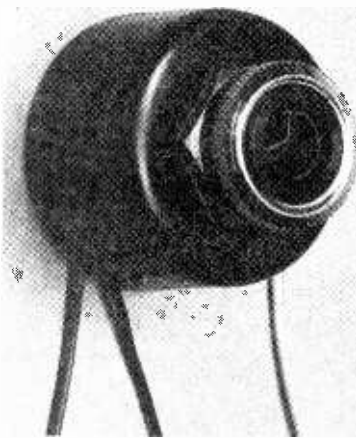
It's not every reader who can make his own printed circuit board and make a good job of it—the usual trouble is the mess created by the etching solution, it seems to get just about everywhere except onto the board where it's needed. If the board and solution were contained in a special bag the major problem would



be overcome—no more mess. Verospeed have adopted this idea with their new Etching Kit which comprises all that is needed to remove copper in a clean, safe and simple way from ten Eurocard-size boards.

A special neutraliser is also included which ensures environmentally safe disposal once the kit is exhausted. An etch resist pen and transfers, together with a copper cleaning block completes the kit, which is guaranteed, says Verospeed, to be available by return post. Each kit is priced at £4.30 plus VAT and has code number of 22-4410G.

Are you the type that likes a bit of noise, especially when your car is about to be pinched or your house is being burgled? You are? Then how about a miniature audible warning device that takes very little current and can be satisfactorily operated from 5 to 30V DC or 20V AC. A

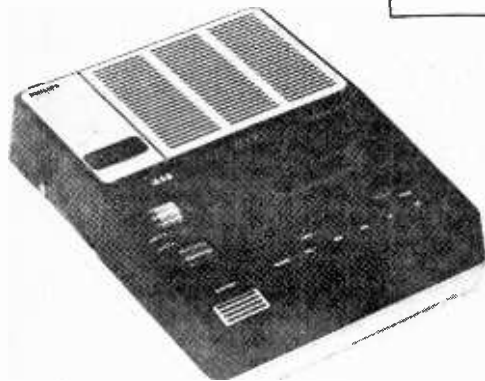


choice of two continuous signals, high or low frequency is available from the one unit, which is priced at £3.52 plus VAT. Verospeed order number is 41-4642J.

Verospeed Service, 10 Barton Park Industrial Estate, Eastleigh, Hants. SO5 5RR. Tel: 0703 618525.

Making waves

Time was, when, if you required a specifically shaped signal, the equipment you required tended to be a bit cumbersome. With the introduction of integrated circuits this exercise has now become a little mundane, and IC's can be obtained which give a sine, square and triangular waveform output over a fairly large frequency spectrum. Lascar Electronics now market a waveform generator module comprising IC, peripheral components all mounted on one board, and whose frequency on all three waveforms extends from 20Hz to 20kHz. Operating on a supply voltage of ± 5



to $\pm 15V$, this CB-FG8038 generator has typically 1% distortion, duty cycle variations of 2% to 98% and power dissipation of 750mW.

Output frequency is set by an ex-



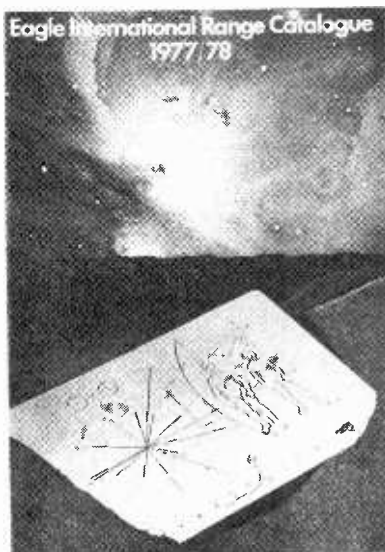
ternal 10k ohm pot, and by adjustment of the on-board duty cycle pre-set pot, sawtooth, ramp and pulse waveforms can also be obtained.

The Cirbloc module is assembled onto a PCB measuring 76 x 48mm and is priced at £7.16 + VAT.

Lascar Electronics Ltd., PO Box 12, Module House, Billericay, Essex. Tel: 02774 3394.

Take me to your leader

No it's not a copy of Penthouse or the latest fashion magazine for bathers at St Tropez — it's — wait for it, the latest catalogue from Eagle International. I can just read your minds now, what could that strange cover possibly have to do with Electronic components and HiFi gear? Well the answer is nothing, but never-the-less what it has got to do with is extremely interesting. The



picture, which incidentally is produced by NASA is supposed to convey to an alien being all that he

Practical Wireless, August 1977

needs to know about Homo Sapiens (Man). What do you mean you don't see it? Its quite simple really, the 'rays' represent our sun in respect to the closest radio-emitting stars (pulsars). Also shown are the relative positions of the planets in our system and the size of the vehicle (spacecraft) compared with its creators. Much more information is encoded using the binary system, all of which could be deciphered by any intelligent lifeform. So, if there are any readers who classify themselves as 'Intelligent Lifeform' please drop PW a line and explain it all to us!

Incidentally the Eagle Catalogue is pretty good too.

Eagle International, Precision Centre, Heather Park Drive, Wembley. Tel: 01-902 8832.

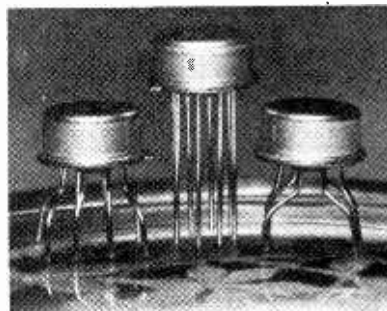
1½ billion ohms

A new range of BiMOS Op-Amps incorporating MOS/FET inputs, COS/MOS outputs, and having low drift figures of $6\mu V/^\circ C$ have now been introduced by Mogul Electronics.

Notated the CA3160, output current is in the order of 20mA, bandwidth is

4MHz, input impedance is typically high, being in the order of 1.5×10^{12} ohms and the output voltage is capable of swinging to within 10mV of either supply rail.

The CA3160 family is said to be ideal for interfacing with COS/MOS, and all devices operate within the temperature range of $-55^\circ C$ to $+125^\circ C$. Packages obtainable com-



prise a standard 8-pin TO99 package or a DIL can device with TO99 lead configuration preformed to 8-pin DIL layout.

This device is manufactured under the YES Electronics label which is part of Mogul Electronics Ltd., 273 High Street, Epping, Essex. Tel: 0378 77366.

Tidytray

You know it always happens, you put down the screwdriver and five minutes later its gone—walked off. You swear and curse and accuse everyone around you and then look on the bench, and then, yes you've guessed it, the screwdriver has mysteriously returned. Well these things are sent to try us, but wouldn't it be nice if we could keep all our tools together, know where they are, and

know that they won't walk off, or roll off or just plain disappear.

Obviously a firm by the name of Cannon have had the same sort of problem that you and I suffer from, because they have recently introduced a rubber mat that's flexible, non-slip can be draped over an irregular surface or laid flat on a polished table top. It has internal dividers, and a 1inch lip around the tray provides for a variety of small tools.

Called the Autotidy, the price is £1.38 and can be obtained from most DIY stores.



Citrus power

How about shoving an orange into your transistor radio next time the battery runs flat? Not quite a practical proposition, but lemons were used as a source of power at a recent electronics exhibition in London. This power was then stepped up to give a spectacular display.

The "secret" lies in the fact that if you unkindly stick two dissimilar metals into the acid contents of a citrus fruit, such as an orange or a lemon, a voltage and current are generated. The output is, of course, quite small, but your ageing scribe has had a CMOS oscillator running from a single lemon—quite an impressive demonstration for when friends call.

Perhaps, with power conservation presently in everyone's minds, farmers will be encouraged to grow special "electrical" varieties of fruit. Imagine scouring neighbourhood greengrocers in search of a 3 volt grapefruit!

You can't beat it

A chap called Khayyam wrote, "The moving writes and having writ . . ." etc. In modern times, however, the moving finger moves and rests lightly on top of a digital wrist watch. That's so that the owner can check his pulse rate—of course!

Just out in the States is a digital watch with a tiny two-sensor button on the top, just below the readout face. One little sensor is a light transmitter while the other is a light receiver. Resting the finger directly across the two, switches on the pulse counting sections of the watch. The tiny transmitter emits infrared light. This travels into the finger and is reflected back again to the receiver sensor. Blood in the capillaries of the finger expand and contract very slightly as blood is pumped through them. It is this tiny change which alters the amount of infrared light received by the receiving sensor. The result is a series of tiny infrared pulses triggered or caused by the actual body pulse itself.

Individual pulses are amplified and passed to a control counter then to a count-digit converter and so to the

digital readout which shows the pulse rate directly. Since the digital watch has a very accurate seconds pulse (from the watch oscillator) the tiny microcomputer in the watch can accurately measure the pulse and give a direct readout in beats per minute. Sad to say you cannot buy one yet and the price in the US is around 500 dollars for a stainless steel case version. The watch may be accessed or interrogated 25 times every day for a whole year before the batteries need changing. Presumably this watch is aimed at impulse buyers.

Light time piece

Talking electronic watches, I note that a German company is to market two quartz-driven clocks with accuracies of ± 30 seconds a year. The difference with these timepieces is that they have built in solar cells which keep the batteries charged. One is designed to function in daylight (not necessarily sunlight) which is interesting. Perhaps transistor radios will follow suit when these cells become cheaper and more efficient.

And talking about solar cells reminds me that President Carter's new energy programme has some support already. For example a knitwear factory is currently under construction in the US which will eventually employ some 300 people. Its power requirements are 1,400kW and this is to be provided entirely by the sun. At last solar power is really getting down to the knitty gritty.

Carrying on from a previous Ginsberg when I mentioned a professor who had an all-electric car, I see that a great deal of work is being done in this field. Two cars are under investigation by one company. One car has electronic controls while the other utilises a huge flywheel for better acceleration. These are both four-passenger models with a top speed of 55mph and a range, at present, of 75 miles. Some four million dollars is invested here in contracts which run for two years.

Hall marked display

Ever heard of LETI? No, not a little Yhetti but the laboratory for electronic

and computer technology attached to the French atomic agency (yeah, I think it's easier to say LETI, too!). Apparently a group of researchers there have discovered that by taking an organic electrolyte, plus a drop of silver, they can make readout cells which, they claim, are better and cheaper than liquid crystal types. In their normal or "off" state, these cells are transparent. They change to opaque in some 50ms when a 1V pulse is applied across them. The application of this pulse causes a very thin layer (typically 50 Angstroms) of silver to "plate" the electrodes. This plating will stay in position for around 10 minutes before the cell begins to go transparent again so it might be argued that these devices have a ten minute memory. A pulse can be applied which will clear the cells immediately.

Cap that!

Discrete capacitors are still used by the millions in almost every conceivable electronics application. One company in the capacitor field has come up with a good idea. They manufacture foil and film capacitors and they've brought out some devices called Multipacitors. In a single unit package, this company houses a number of different capacitors offering a 30% saving in space compared with using separate discrete components. The trick is to take tapping points off the foil winding to offer different capacitance values within the same package. Instead of buying four components, you buy only one! One package offers, 0.47 μ F at 400V wkg plus 1 μ F 400V wkg plus 2 μ F at 200V plus 4 μ F at 200V wkg.

I note with interest that the latest digital display devices have drivers and decoders built in. All you need do is feed the beast direct from a four line BCD output. They're TTL compatible, too. Whatever will they integrate next?



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June 77	Reverberation Amplifier	A032	2.38+12	<input type="checkbox"/>
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June 77	Tele-Games	D029	3.22+18	<input type="checkbox"/>
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July 77	Radio 2 Tuner	A035	1.68+12	<input type="checkbox"/>
July 77	Digital Clock Timer	A036	3.28+12	<input type="checkbox"/>
Aug 77	Shoot (Telegames)	D035	1.55+15	<input type="checkbox"/>
Aug 77	Atomic Time Receiver	D036	2.65+15	<input type="checkbox"/>
Aug 77	Morse Code Tutor Cards (SRBP)	A037	4.75+15	<input type="checkbox"/>

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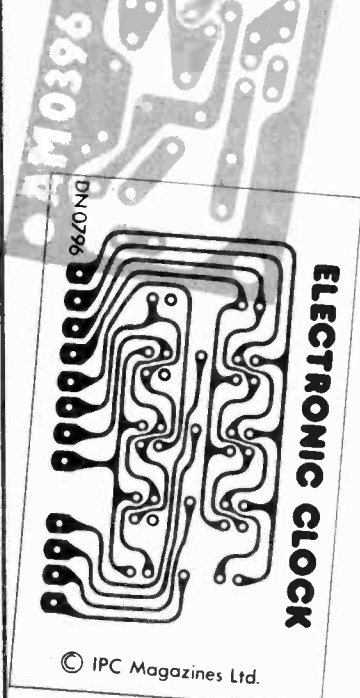
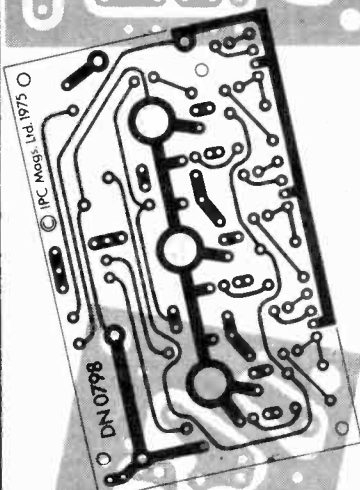
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AM 03...



ATOMIC TIME

RECEIVER

N.C.HELSEY, MA, MIEE

THE advent of quartz crystal oscillators in watches, and the regulation of conventional clocks and watches, poses a thorny question—how does one check their performance? Clocks driven by the mains supply, either digital or mechanical, indicate to a high accuracy only if viewed over a period of months or years, compared with a quartz watch, since they may be a number of seconds wrong at any particular moment—and by this time there may have been a power cut! The Post Office Speaking Clock could prove expensive to an enthusiast—and if the telephone is not next to your favourite grandfather clock how do you set the exact second? Greenwich time signals from the BBC can turn out to be very elusive just when you need them.

Standard time and frequency signals have been transmitted for many years on both short and very long waves. The most convenient of these for time checking purposes in this country is the 60kHz transmission of Rugby MSF. This station transmits seconds and minute markers as well as a call-sign which enables identification of the hour. Recently, at the end of each minute, a time code was introduced in which the hours and minutes are signalled in a binary code; it is possible to construct a digital clock which sets itself by means of this code. However for many purposes the seconds and minutes markers, which are easily recognized by ear, are all that is required for setting and checking clocks or watches.

Atomic transmission

The time by which we live must clearly be related to the rotation of the Earth on its axis but, even when all possible corrections have been made, the rate of this rotation fluctuates unpredictably. Also the Earth is known to be slowing its angular rate due to tidal friction (admittedly amounting to only a millisecond a century), thus in principle to arrive at a standard invariable unit of time such as the second another definition is required. In 1964, at a meeting in Paris, the International Committee of Weights and Measures adopted as its tentative standard an atomic transition, specifically a hyperfine transition in the atom of caesium¹³³. To keep the time of day measured by atomic clocks using this definition of the second (the time for 9,192,631,770 transitions) in step with the time scale referenced to the rotation of the Earth about its axis corrections by means of the addition or subtraction of a complete second are occasionally carried out, usually on either June 30th or December 31st. Clearly whilst checking the performance of accurate clocks it is useful to know

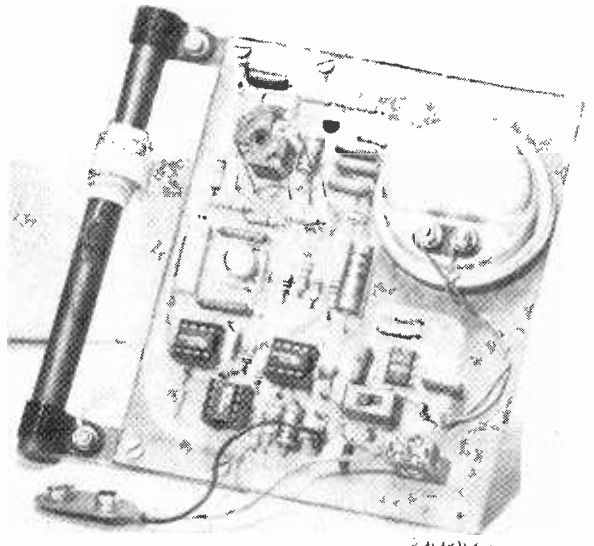
when these corrections have been made, as they will be applied to Greenwich time signals as well as the other accurate sources of time.

Rugby MSF

The Rugby transmission gives an indication of when such leap seconds (or the reverse) have been included. The normal seconds markers are formed by a complete 0.1s break in the 60kHz carrier. The minute marker is easily identified as it is a 0.5s break, apart from the first 0.2s or so which contains the time code. In each case the start of the break in the carrier represents the exact time, so that a receiver which “bleeps” when the break occurs sounds similar to Greenwich time signals as transmitted by the BBC, apart from a slight croak at the minute due to the presence of the time code: except for servicing periods (usually a few hours on the first Tuesday in the month) the signals are available 24 hours a day.

The difference between the time scale related to the rotation of the Earth and the atomic scale is given in units of 0.1s by means of an extra pulse (where a pulse is no carrier) following each second from second number 1 to, at most, second number 7, for the atomic scale lagging behind the rotation of the Earth. If the atomic scale is ahead similar pulses following seconds 9 to up to 15 are inserted.

Thus a sudden change from, say, an extra pulse after each second from 9 to 15 inclusive to an extra



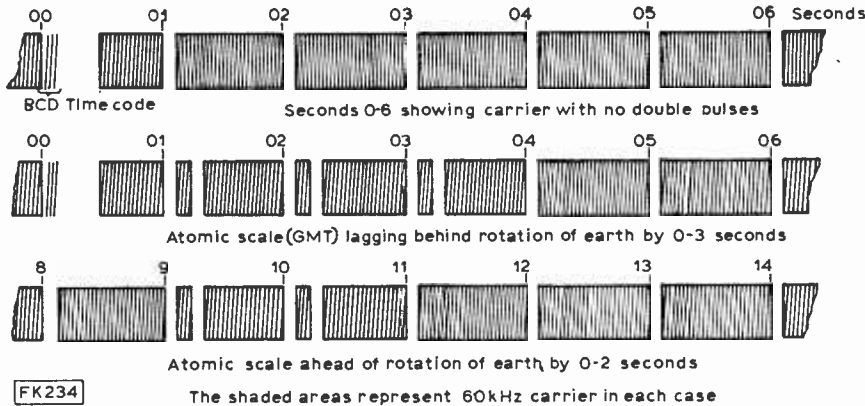


Fig. 1: The atomic time code as transmitted by Rugby MSF. The BCD time code occurs at the start of each minute pulse train. Relationships between atomic time and earth rotational time noted by appearance of double pulses in either seconds 1 to 6 (atomic time behind earth) or in seconds 9 to 15 (atomic time ahead of earth).

pulse after each of seconds 1, 2, and 3 would show that an extra second had been inserted into the atomic time scale, which has therefore jumped by this amount relative to all other clocks and watches; these, if their accuracy merits it, must be readjusted to follow suit. A change from, say, an extra pulse after each of seconds 1, 2 and 3 to one after 1 and 2 merely indicates how the rotation of the Earth is going relative to the atomic scale. In other words, the error does not concern us with regard to checking other clocks until the whole second correction is made, which is apparent from the sudden switch in positioning of the double pulses. See Fig. 1.

The receiver

The usual method of listening to a telegraphy signal, for example morse code transmitted by the keying on and off of a carrier, is to heterodyne or beat a local oscillator with the signal to produce an audible tone. This is one of the functions of the BFO (beat frequency oscillator) found on short wave receivers. However to make the gaps in a signal audible an audio oscillator is required to be switched off by the signal and turned on in its absence. This is slightly unusual, and, incidentally renders, in the case of the Rugby signal, the morse code "MSF" sent

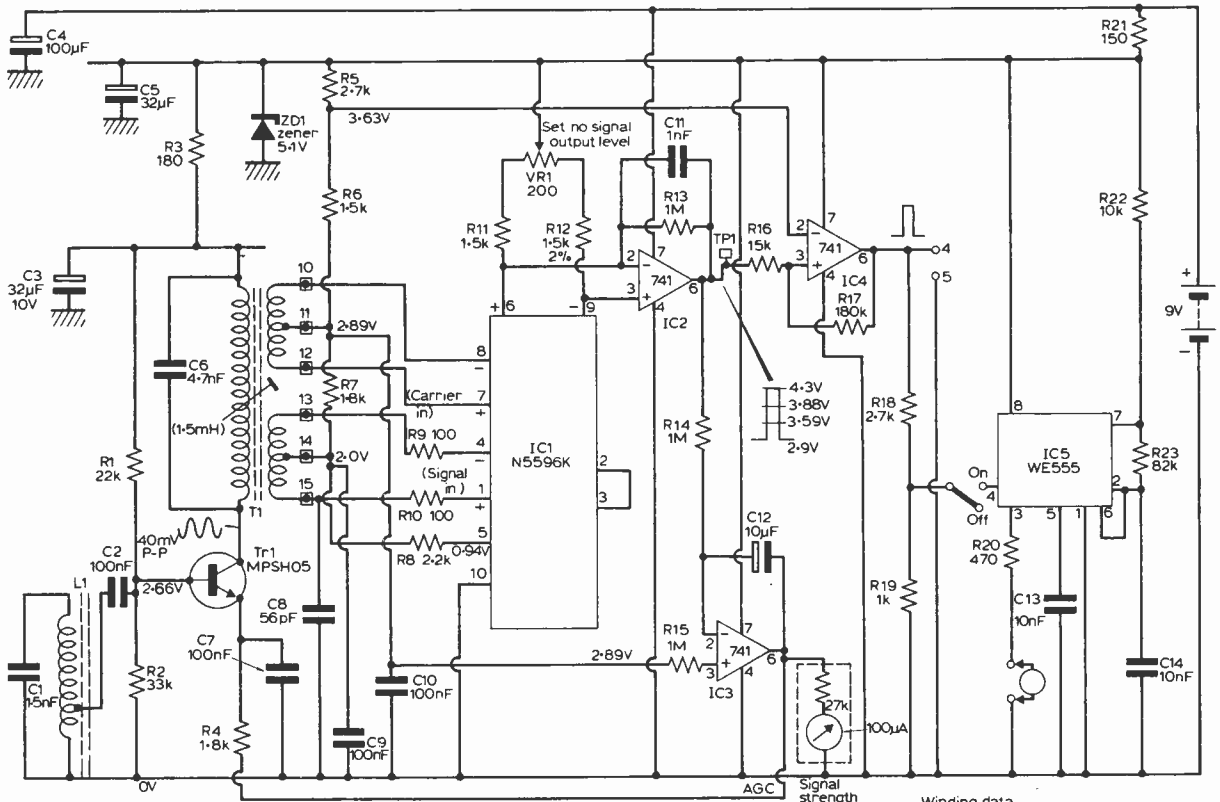


Fig. 2: Circuit of the atomic time receiver.

twice just before each hour unreadable, but gives the short beeps most convenient for setting clocks.

Starting from this end of the receiver (Fig. 2) any audio oscillator capable of being switched on and off will suffice—the one shown uses the familiar 555 timer, the output of which may connect to a small loudspeaker or earpiece such as the standard telephone type available from surplus suppliers. Note that a resistor is shown in series with the timer output to limit the current in the loudspeaker or earphone. It was found that 470 ohms was about the lowest value that could be used without endangering the normal operation of the 555 when feeding such loads. IC5 is turned on and off by the output of the receiver, therefore when no carrier is present the reset line (pin 4) is taken high by the output of IC4 and the output of the timer causes a “bleep” from the earpiece, Fig. 1.

The multiplier is used as a squaring circuit. The signal is multiplied by itself to produce a DC output, as well as a double frequency output which is removed by the following amplifier. The signal is fed into the two balanced inputs of the multiplier via the secondaries of a transformer T1. The bias point for each pair of inputs of the multiplier and the setting of the multiplier “tail” currents are obtained from a chain of resistors including R6, R7 and R8. The primary of T1 is tuned by means of C6 to 60kHz. This transformer is wound on a Mullard type RM6 core more details of which will be given later. Tr1 is a common emitter amplifier having T1 as its collector load and its input fed from the secondary of the ferrite rod aerial. The primary of the aerial is tuned by C1.

Schmitt characteristic

Thus when a 60kHz signal is picked up and amplified by Tr1 it is applied to both inputs of the multiplier. This causes pin 6 of IC1 to go slightly positive and pin 9 slightly negative each with a 120kHz signal superimposed. IC2 then provides a great deal of amplification—about 625 times the differential input signal at DC. C11 and the amplifier's own frequency response ensure that the 120kHz component is removed. The stability of resistors R11 and R12 is important as any change in the value of one of these alone will cause a change in the output of IC2. Providing R11 and R12 change by the same amount there is no output change so they should preferably have matched temperature coefficients. The receiver will work with carbon film types here but if excessive drifting with wide temperature changes is experienced metal film type (not necessarily metal oxide types unless selected for matched coefficients) eliminate the drift.

DC level

VR1 is used to set the DC level at TP1 with no input signal at the aerial (i.e. aerial shorted). A 60kHz signal causes the level at TP1 to fall, while the following amplifier, IC4 has positive feedback to give it a Schmitt characteristic. A reference level for IC4's negative input is obtained from the bias chain that feeds the multiplier. The purpose of this stage is to make sure a definite change in signal level is required before an output swing from high to low or low to high can occur, hence obtaining the best possible performance in the presence of noise.

★ components list

Resistors

R1	22k Ω	R13	1M Ω
R2	33k Ω	R14	1M Ω
R3	180 Ω	R15	1M Ω
R4	1.8k Ω	R16	15k Ω
R5	2.7k Ω	R17	180k Ω
R6	1.5k Ω	R18	2.7k Ω
R7	1.8k Ω	R19	1k Ω
R8	2.2k Ω	R20	470 Ω
R9	100 Ω	R21	150 Ω
R10	100 Ω	R22	10k Ω
R11	1.5k Ω \pm 2% metal film	R23	82k Ω
R12	1.5k Ω \pm 2% metal film		
VR1	200 Ω cermet trimmer		

All resistors $\frac{1}{4}$ W \pm 5% carbon film (except R11 & 12)

Capacitors

C1	1.5nF Polystyrene	C8	56pF Polystyrene
C2	100nF Polycarb.	C9	100nF Polycarb.
C3	32 μ F or 47 μ F 10V	C10	100nF Polycarb.
C4	100 μ F 12V	C11	1nF Polystyrene
C5	32 μ F or 47 μ F 10V	C12	10 μ F 6.3V Tantalum
C6	4.7nF Polystyrene	C13	10nF Polycarb.
C7	100nF Polycarb.	C14	10nF Polycarb.

Semiconductors

Tr1	MPS-HO5 or BC183 or ZTX300	IC3	741
ZD1	BZY88C5V1 5.1V zener	IC4	741
IC1	N5596 or MC1496G or SG1496T	IC5	NE555
IC2	741		

Miscellaneous

Signal strength meter 100 μ A FSD. Ferrite rod aerial LW only, type LW5FR (Denco). T1, RM6 R Inductor core plus parts (Mullard)

AGC action

Finally AGC is obtained from IC3. The output of IC3 controls the current in Tr1, and hence the gain of Tr1, by determining the voltage at the bottom end of R4. The positive input terminal of IC3 is taken to a reference obtained from a convenient level on the bias chain. IC2 attempts to adjust the gain of Tr1 in order to obtain the same level at TP1 as the reference level. Thus if the signal level falls, the voltage at TP1 rises causing current to flow into R14. The output of IC3 then falls slowly increasing the gain of Tr1, which returns the voltage at TP1 to the reference level (about 2.9V). When the carrier breaks for short periods, as for the seconds or minutes markers, IC3 starts to increase the receiver gain but is prevented from doing so very much by C12.

Note that on switch-on the receiver is in the minimum gain state with the output of IC3 high and gradually falling until the desired signal level is obtained. This normally takes only a few seconds, during which time the tone generator is continuously “on”. The voltage to which the output of IC3 goes is a useful measure of signal strength and if desired a small meter measuring this level may be fitted.

Construction details

The PCB is shown in Fig. 3. Note that there are a total of four links on the circuit board to be fitted in addition to the components. Additionally, points 16 and 17 should be linked for a continuous output, if a switch is not fitted, as may be required if the receiver output is used to control circuits other than the on-board 555 timer.

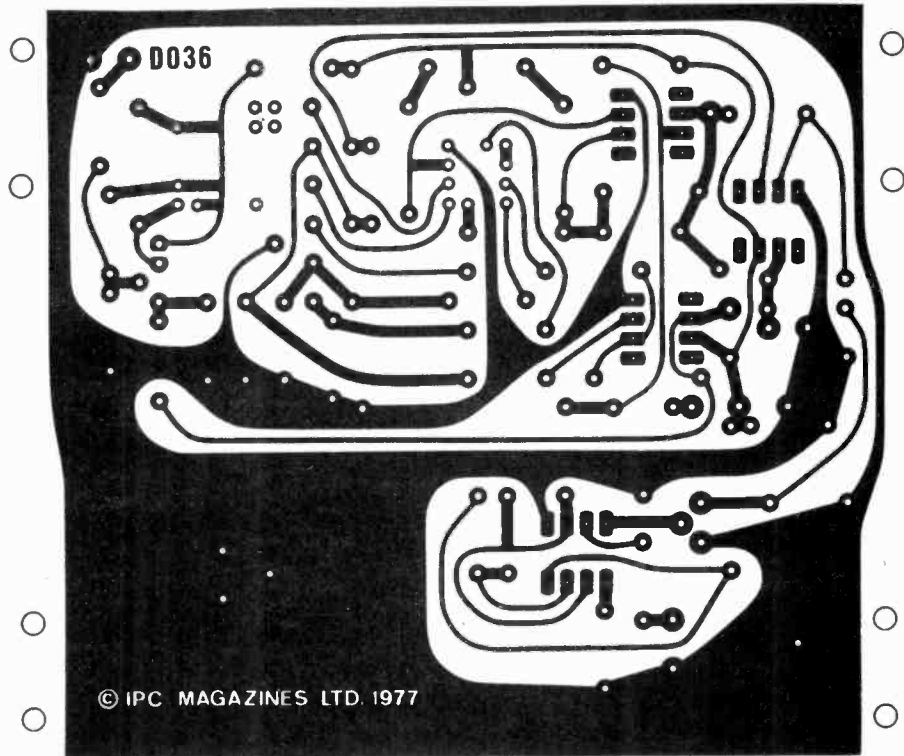
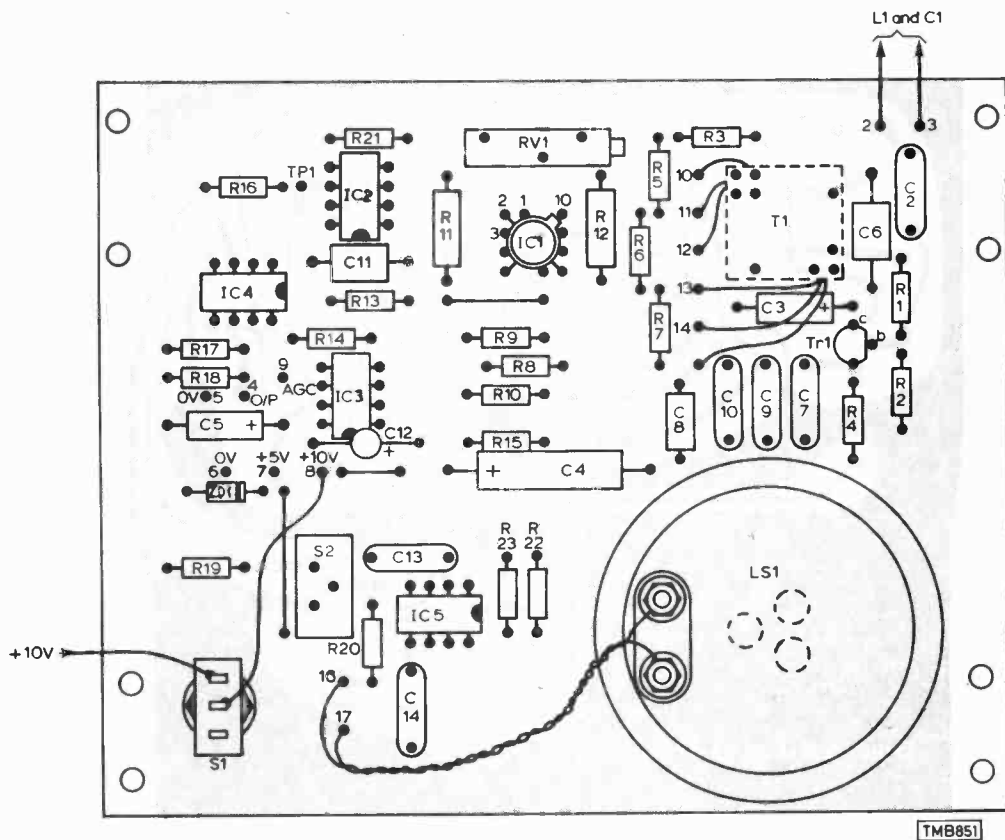


Fig. 3 (above): PCB copper side shown actual size.
 Fig. 4 (below): PCB reversed showing component locations.



Note that the trimmer potentiometer VR1 is a miniature multiturn type. It should have a *cermet* track for good resolution—the wirewound types of low resistance are difficult to adjust finely due to the incremental resistance of each turn of the track as the wiper traverses it. The ferrite rod aerial specified is a standard transistor radio type available from Denco (Clacton) Ltd. When ordering, specify a long wave coil only as this reduces the cost. The resonant frequency of the aerial can be trimmed by sliding the coil along the rod from its nominal position. It is important that the coil should not be near the end of the rod in its final position as the rate of change of inductance with position is too fast for good stability.

The coil on its former as received may be a loose fit on the rod, in which case it is a simple matter to first wind onto the rod sufficient "Sellotape" to achieve a firm but readily adjustable fit.

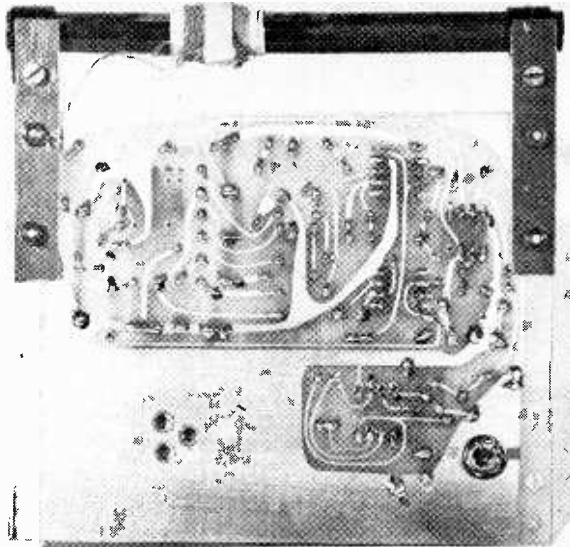
The transformer T1 has been designed using the Mullard RM6 core. The RM series of cores use bobbins to which pins are attached, so that a coil may normally be terminated on these before the two halves of the core are fitted. This is done for the primary only in our case, and the secondaries are left with flying leads to be connected directly to the PCB. The following instructions should be adhered to carefully, remembering that a 1 turn error is significant when the total number is small.

1. Strip enamel insulation from the wire end and attach the wire to the pin marked "start primary". Do not exert undue pressure on the pins which are mounted on a fragile base.
2. Fix the bobbin to a suitable mandril such as a twist drill; just over 6mm diameter is required which may be obtained by winding a thin layer of tape on a 6mm drill.
Wind on wire evenly, top of bobbin moving towards you, with the pins facing to the right.
3. Complete 59 turns, cut wire, strip insulation and attach to "finish primary". Cover winding with 6mm wide tape.
4. Starting with wire in "slot 1" leave 30mm flying lead, identified as "start" by fitting sleeving or other means, and wind on 7 turns exactly turning in same direction as before. Form a loop 30mm long and twist the loop together: leave this a flying lead also in "slot 1". Continue to wind on a further 7 turns exactly, take the remaining end across to "slot 1" and leave 30mm flying lead. Wind on a turn of 6mm tape to fix the winding to the bobbin.
5. Repeat the procedure 4 above using "slot 2", which is on the same flange of the bobbin, facing "slot 1".

The bobbin now has six flying leads which are in two groups of three, each of which has a start, centre tap and finish. Wire these to the PCB as indicated on the circuit.

After winding the coil, check that the faces of the two halves of the core are free from dirt and carefully assemble them round the coil. After fitting the clips make sure that the core halves are aligned at their edges. Fit the adjuster and screw it down 5 turns to the nominal position, using a screwdriver which fits the small slot—if necessary modify or make a screwdriver to fit (eg from a knitting needle) rather than risk damaging the adjuster.

Note that if the phasing of one of the secondary windings is reversed the output at TP1 will increase



with increasing signal causing the AGC to latch the circuit up. If a mistake has been made in winding T1, all is not lost—simply reverse one of the secondary windings (eg swap the wire from 10 with the wire from 12).

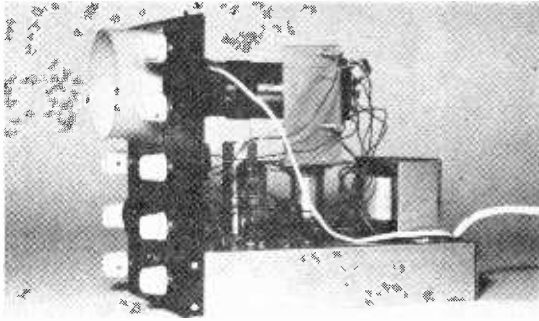
Setting up

The bandwidth of this receiver is about 300Hz which is of course much narrower than that of normal broadcast types. This is just sufficient to allow correct reproduction of the time code so that all the information transmitted is available at the receiver output and a wider bandwidth would merely admit more noise. Hence if a signal generator is used it will probably need to be set to 60kHz using a frequency counter: a 1 per cent error in frequency is 600Hz and therefore significantly off-tune. Fortunately the receiver can easily be adjusted to the "off-air" signal. First short-circuit points 2 and 3 to which the aerial secondary is connected. Switch on the receiver.

Depending on the initial setting of VR1 there will be either no output, or a continuous tone. If there is no output, turn VR1 clockwise until the continuous tone just appears. If there is already a continuous output on switching on turn VR1 anti-clockwise until the tone disappears and then clockwise about $\frac{1}{4}$ turn so that the tone has just been switched on again. There is of course no variation in the sound of the tone output—it is simply on or off. Un-short the aerial and make sure that the coil on it is in its nominal position. The signal will probably now appear.

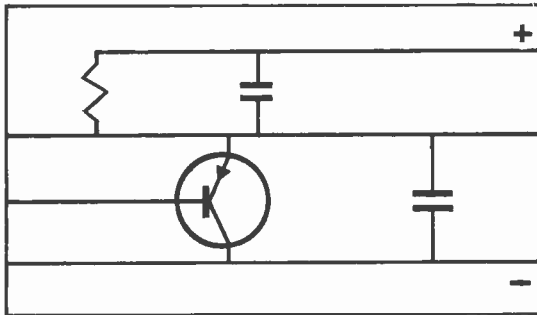
The ferrite rod aerial is directional and maximum signal is obtained when the direction from which the received signal arrives is at right angles to the line of the aerial rod. If the rod is turned away from this direction a point may be found where the signal becomes noisy (the timer output intermittent instead of a pure tone). Reduce the noise to a minimum by tuning T1 and adjusting the aerial coil. If a voltmeter is available, connect it between 0V and the output of the AGC amplifier IC3. Adjust T1 and the aerial coil for a maximum reading on the voltmeter. Note that adjustments must be made slowly, due to the slow response of the AGC—otherwise the person making the adjustment becomes part of an unstable feedback loop!

PW



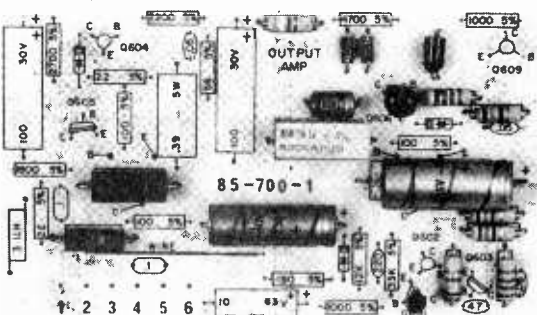
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S-Decnology

DAVID GIBSON

9



THIS MONTH

'Light to Frequency Converter'

THERE are some circuits which can be used for a wide variety of applications, often with only minor modifications. This month's S-Dec project falls into that category. I can think of four applications (see later), but readers will doubtless think of others.

Circuit description

The project comprises a free-running multivibrator made up from transistors Tr1 and Tr2. The output from this oscillator is then fed directly to the base of Tr3, which in turn feeds the amplified signal to the loudspeaker in its emitter lead.

The frequency of a free-running or astable multivibrator is dependent upon the values of resistance and capacitance employed. In the circuit (Fig. 1) these components are the two capacitors, C1 and C2, and the resistors between the bases of the transistors

Tr1/Tr2 and the positive rail. Resistor R3 is fixed at 47k Ω . However, the other base resistor, that of Tr1, is made up from a single fixed resistor R2 (12k Ω) and a light dependent resistor, LDR1. An LDR is simply a resistor whose exact ohmic value depends upon the amount of light falling on it. By using this element in the frequency determining section of a multivibrator, the intensity of light striking the LDR controls the frequency of oscillation. A bright light will cause a high note; shadow lowers the note quite considerably.

Transistor Tr3 acts as a direct-coupled voltage follower. It derives its drive signal from a potential divider formed by Tr2 and its collector load, R4. The remaining components, resistors R1 and LS1 form the loads for Tr1 and Tr3 respectively.

Assembly and testing

Having plugged in all the components as per Fig. 1, check the assembled S-Dec against the component layout shown in Fig. 2. If all is in order, connect a 3V battery to S-Dec hole 40 (positive) and hole 70 (negative). A tone should be heard. Waving a hand in front of the LDR should vary the pitch of the note. Although a 3V battery was used with the prototype, the circuit will function perfectly from only 1.5V. On test, the prototype even worked at 0.5V! With 3V applied, the project draws some 15mA with the LDR pointed directly at bright

you will need

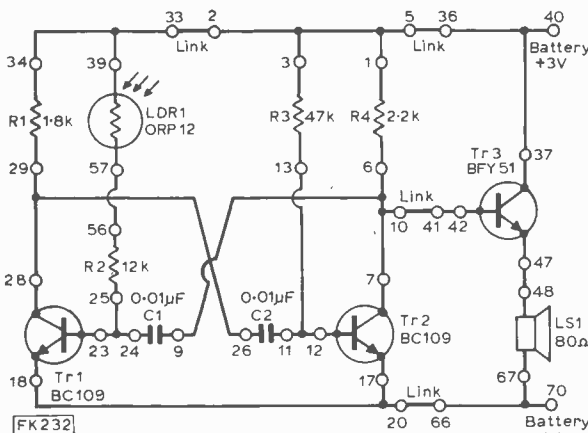


Fig. 1: Frequency-to-light converter circuit diagram. LDR1 controls C1 charging rate and hence the frequency of the oscillator.

R1	1.8k Ω	C1	0.01 μ F
R2	12k Ω	C2	0.01 μ F
R3	47k Ω	Tr1	BC109
R4	2.2k Ω	Tr2	BC109
LDR1	ORP12	Tr3	BFY51
LS1	75 - 80 Ω	B1	3V battery
One S-Dec			

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AC134	AF145	BCY72	AF178	OC51	2N708	3N159
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AC147	AF158	BCY72	AF191	OC64	2N708	3N159
AC148	AF159	BCY72	AF192	OC65	2N708	3N159
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AC176	AF187	BCY72	AF220	OC93	2N708	3N159
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AC183	AF194	BCY72	AF227	OC100	2N708	3N159

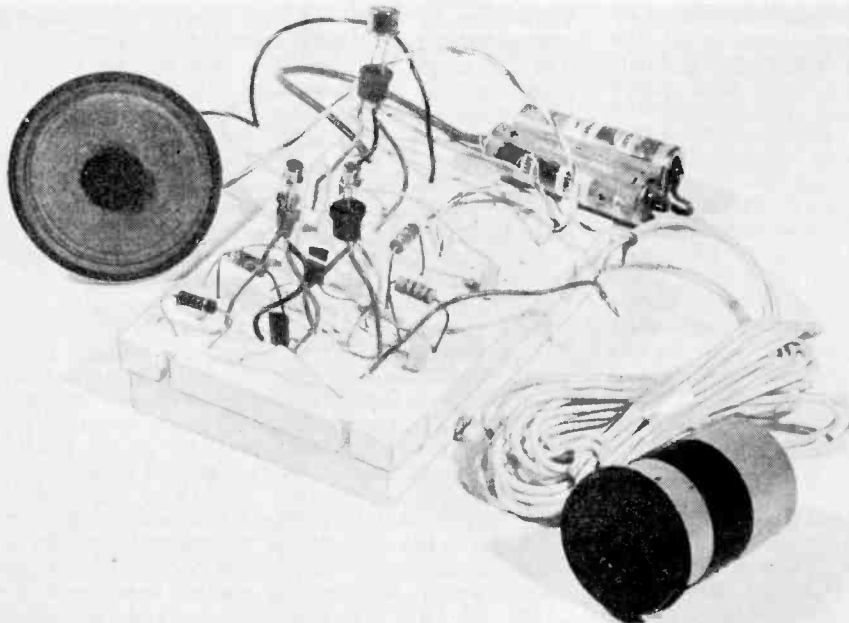
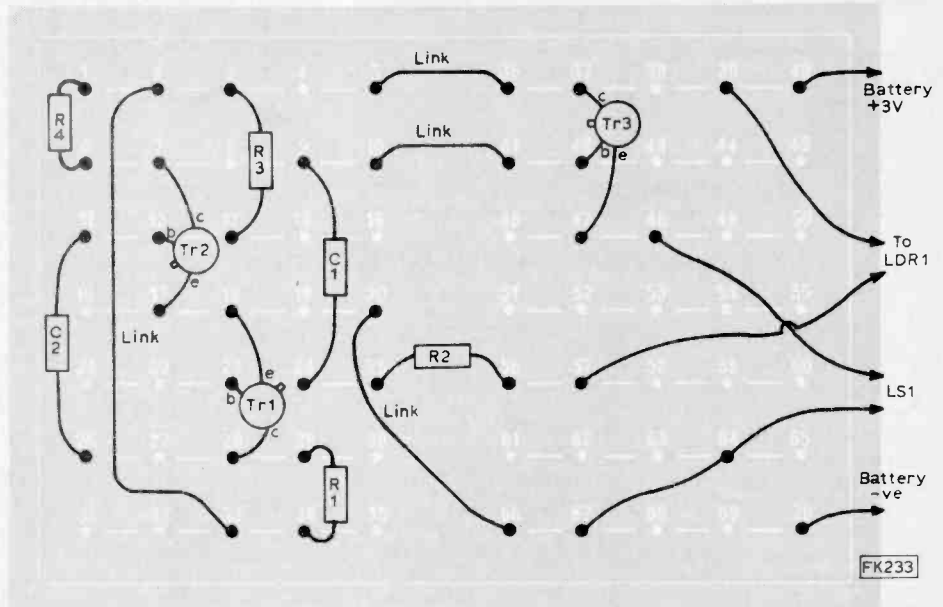
Please write or phone for current price of any of the transistors, diodes shown below.

CRS3/40	OC29	OC206	2N4058
CRS25/025	OC35	ZR11	2N4061
GET115	OC36	ZR21	2N4172
GET116	OC42	ZR22	2N5295
GEX66	OC44	2N456A	3N126
NKT222	OC45	2N525	3N128
AF173	OC46	3N129	3N154
AF174	OC47	2N708	3N159
AF175	OC48	2N708	3N159
AF176	OC49	2N708	3N159
AF177	OC50	2N708	3N159
AF178	OC51	2N708	3N159
AF179	OC52	2N708	3N159
AF180	OC53	2N708	3N159
AF181	OC54	2N708	3N159
AF182	OC55	2N708	3N159
AF183	OC56	2N708	3N159
AF184	OC57	2N708	3N159
AF185	OC58	2N708	3N159
AF186	OC59	2N708	3N159
AF187	OC60	2N708	3N159
AF188	OC61	2N708	3N159
AF189	OC62	2N708	3N159
AF190	OC63	2N708	3N159
AF191	OC64	2N708	3N159
AF192	OC65	2N708	3N159
AF193	OC66	2N	

light. In shadow, the current drops to around 1.5mA. Using 1.5V the 'bright light' current was measured as 6.5mA; in shadow it went down to 0.8mA—thus the battery should last a long time.

the seeker (blindfolded) wanders about with the LDR searching for the paper. Use dark paper if the carpet is light coloured. Continuing on this theme, a maze may be laid out and altered for each contestant.

Fig. 2: Plan view of the assembled S DeC board. For more permanent construction, the components may be soldered directly on to Blobboard or Vero-board.



The assembled unit. The LDR is shown mounted in a plastic film can to give this component a narrower field of view. As a further refinement, a small lens may be fixed into the end cap with the LDR in the focal plane. This enables a high degree of differentiation between light and dark surfaces—even at a considerable distance.

Applications

The first application is that of a light-controlled mini-organ. By moving a light closer to or further from the LDR a tune can be played.

It is instructive to play "blind mans buff." By wearing a blindfold, it is possible to find the way around a room because the LDR, when pointed at different things, gives a different tone depending on the reflectivity of the object.

Treasure hunts might consist of pieces of white paper put on the floor. These are the treasure, and

In a more serious application, it could form a guard alarm. The trick here is to point the LDR at a light and adjust R2 until the note goes just above audibility. Anyone moving between LDR and light source will cause an audible note thus betraying their presence. Try using a 10kΩ potentiometer for R2.

The LDR will function much better if it is shielded in a container of some sort, such as a cigar tube or plastic film can. This prevents extraneous light from interfering with the pitch of the note.



by **Eric Dowdeswell G4AR**

GOOD news from **Martin Sole**, long time correspondent of this column. He passed his RAE and is now G8NAT and active on 2m with SSB using a Liner 2 feeding an 8-element yagi beam. Martin is going on to get his code test and a 'full ticket' as he puts it. Congratulations Martin, and may you have many happy years on the air.

My request for info on the Crystal Calibrator No. 10 brought forth useful data from three readers, **J. P. Bell** of London N22, old friend **E. Kendall G3APA** and **C. Pettifer** of Slough, who tells me of some interesting 'DX' he worked with the old Army set 62 for which the calibrator was intended. Cliff very kindly offers to help anyone needing info on old Army sets. He can be found at 90 Uxbridge Road, Slough, Berks. But don't forget, lads, send return postage, a word of thanks and prompt return of anything loaned from Cliff. G3APA mentioned that SWM for Jan 1960 carried some info on mods to the filament circuit of the calibrator.

Michael Walker of Woodlesford, Leeds visiting RAF Locking was delighted to find G3RAF active and to listen to a few QSO's on 2m. Michael gets going on his studies for the RAE very soon so we wish you all the best OM. I was delighted to have a call at home from **Geoff Cole G4EMN** who had some business in Ashted. He is secretary of the Wessex AR Group, mentioned before, and one forthcoming attraction is a visit to the School of Signals at Blanford on Sunday 24 July. Club net on 28.575MHz at 1030 Sundays or write to Geoff at 6 St. Anthony's Road, Bournemouth for more info, or ring 0202 20027.

Derek Gilbert and **Ian Horwill** share a receiver in Farnham, Surrey using a Heathkit SW717 and a long wire. The reply to queries on several prefixes must be my standard one! Send 35p to Geoff Watts 62 Belmore Road, Norwich for his invaluable prefix list. Cuts out all the guesswork and ensures that your prefix and country count is up-to-date and accurate. **D. F. Mathews** of 21 Portman Avenue, East Sheen, London SW 14 is very keen on direct conversion receivers and would appreciate any information on articles that have appeared on the subject. Some advance news of the North West Amateur Radio Convention to be run by the Lancaster ARS on Sept 17 and 18 next. Full info and booking forms from J. R. Morris Dept. of Physics, University of Lancaster, Bailrigg, Lancaster.

A first letter from **M. G. Hayman BRS 37632** of

London SE2 tells of his interest in SW listening and his intention to take the RAE this year. He started off with a HAC DX Mk2 set but now has a National NC120 with an ATU and 66ft inverted-L aerial. He would like to beg, borrow or buy any info or a manual on the NC120 so if you can help write to 'Woodleigh', 66 New Road, Abbey Wood, London SE2. **Robin Bayley A9203** up in Shifnal, Shropshire is still logging the DX on his Eddystone EC10 and long wire, including A2, A6, and AP2 on Top Band! **Bob Firth G3WWF** got lumbered again with the job of scribe of the Wakefield and District ARS but I'm sure he enjoys his work really! A note to him at 6 Eastfield Drive, Woodlesford, Leeds or a ring to Leeds 825519 will bring all the gen on the society's activities. On 19 July G4DZU will talk on moonbounce and meteor scatter techniques while G3MFJ and Bob will be giving a lecture and demonstration of RTTY on 16 August.

Regular **Brian Harrison** has found the 10m band open down in Ore, Hastings with PY, CP, HC, PJ and ZP representing S. America. On 15m ZS3, CP, P2 (Surinam) and 9V1 were logged. Old friend **Alan Doherty BRS34968**, Portrush, Co. Antrim seems to have concentrated on the Pacific on 20m with 'dozens of KL7, KH6 and VE8! Alan operates the local marine VHF station around 156MHz and uses the same aerial system for 2m! Oscar 7 provided KL7, VE2 and W9 on the 2m downlink. Not bad when one remembers that the up link is on 432MHz! At the other extreme Alan now has 208 countries on 80m the latest being XT3, YS, A9, LU and TI.

In Cambridge **Dave Peck BRS37621** reports a new type of QRM but this time he is causing it! Neighbours report QRM from the governor contacts on his RTTY machine! But this did not stop him from copying RTTY from A4, EA3, JA3, LA, OH, W and 9M2. Dave is starting up on 2m and is looking for a yagi to go with his rotator, cheap of course, and at least 10 elements. **Simon Robinson** in Stocksfield, Northumberland, kindly sent me an old 'give-away' dated October 1924 from *Popular Wireless*, which described how to make five 'special' crystal sets! Simon bought a pre-war Pilot radio set which only needed a couple of new electrolytics to get it going again. At 20p it was a cheap way to get on the SW bands! Now he has an ex-Army set and has given the Pilot away to an elderly invalid. But he still would like a proper communications receiver!

It was good to hear from **John Hodgson (Morpeth)** again after a long interval. He has progressed from a Mini-Clipper to a Realistic DX160 plus a 40ft long wire although John stuck to 20m and seems to have ignored the bandswitch! Pity! The log from **D. Waddell** located in Herne Bank was a joy to my eyes since the majority of the entries were for CW stations on 15 and 20m. In one period, 1145 to 1345, no less than 29 Japanese stations were copied on 15m CW. I'd like to hear from more of you who can copy CW and don't forget that there is often DX to be heard on CW when the SSB parts of a band seem to be dead.

Log Extracts

D. Waddell:— 20m CP3CN FM7WV F08EI FY7AS HC1LT HK0BKX HK7UL JR6RRD (Okinawa) YS10 9M8HF CP6EL FH8DF HH2MC TU2EF VS5MC 5U7AG 15m CE8AA CP6FN FG7AM TA1ZB UM8AX CP6EL TR8SM 5N2NAS 5X5NK

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CA3130	94p	LM741N	50p	76013ND	1-57	TAD100	1-95	TC470	2-76
LM301A	65p	LM741-8	40p	76018K	2-50	TBA120	65p	TC4750	2-30
LM301N	44p	LM747N	90p	76023N	1-70	TBA400	1-50	TC4760	1-38
LM304	2-45	LM748-8	50p	76023ND	1-57	TBA500	2-21	TC4800	3-13
LM307N	65p	LM748N	90p	76033N	2-25	TBA500Q	2-20	TC4A100	57p
LM308N	1-17	LM1800	1-76	76110N	1-46	TBA500Q	2-20	TC4A100	57p
LM309K	2-10	LM1808	1-92	76115N	1-07	TBA510	2-21	CD4000	20p
LM317K	3-00	LM1828	1-75	76116N	2-06	TBA520	2-21	CD4001	20p
LM318N	2-25	LM3301N	85p	76131N	1-30	TBA520Q	2-30	CD4002	20p
LM323K	6-40	LM3302N	1-40	76226N	1-30	TBA550	1-98	CD4006	1-10
LM3391N	1-75	LM3401N	75p	76227N	1-51	TBA530	1-98	CD4007	20p
LM348N	1-91	LM3900	75p	76228N	1-75	TBA530Q	2-07	CD4007	20p
LM360N	2-75	LM3905	1-60	76530N	91p	TBA540	2-21	CD4008	97p
LM370N	3-00	LM3909	68p	76532N	1-50	TBA540Q	2-30	CD4009	57p
LM371N	2-25	MC1035	1-75	76533N	1-30	TBA550	3-13	CD4010	57p
LM372N	2-15	MC103	1-45	76544N	2-09	TBA560Q	3-22	CD4011	20p
LM373N	2-25	MC1305	85p	76545N	2-09	TBA560Q	3-22	CD4012	20p
LM374N	2-25	MC1306	1-00	76546N	1-44	TBA570	1-29	CD4013	57p
LM377N	1-75	MC1310	1-91	76550N	41p	TBA570Q	1-38	CD4014	1-01
LM378N	2-25	MC1312	1-98	76552N	65p	TBA641Q	2-50	CD4015	1-01
LM379S	3-95	MC1327	1-54	76570N	2-08	TBA651	1-80	CD4016	57p
LM380-8	90p	MC1330	92p	76620N	1-10	TBA700	1-52	CD4017	1-01

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2N697	30p	2N2907A	22p	2N3792	3-50	2N6122	41p	BC108	15p
2N698	62p	2N2924	15p	2N3794	20p	2N6123	43p	BC109	15p
2N699	55p	2N2926	12p	2N3819	36p	2N6126	45p	BC113	17p
2N706	24p	2N3019	55p	2N3820	38p	2N6127	48p	BC115	19p
2N706A	12p	2N3054	60p	2N3823	75p	40362	48p	BC116	19p
2N709	50p	2N3055	70p	2N3904	21p	40363	1-20	BC116A	20p
2N718	27p	2N3390	25p	2N3908	22p	40406	58p	BC117	22p
2N718A	50p	2N3391	25p	2N4037	35p	40408	65p	BC118	16p
2N720A	80p	2N3392	16p	2N4058	20p	40409	65p	BC119	30p
2N916	30p	2N3393	15p	2N4060	20p	40410	65p	BC121	45p
2N918	38p	2N3394	15p	2N4061	17p	40411	2-85	BC134	15p
2N929	25p	2N3439	88p	2N4126	17p	40594	75p	BC135	15p
2N930	28p	2N3440	64p	2N4289	20p	40673	73p	BC136	19p
2N1131	60p	2N3441	85p	2N4291	65p	AC126	37p	BC137	14p
2N1132	60p	2N3442	1-35	2N4292	70p	AC127	44p	BC141	45p
2N116	35p	2N3638	16p	2N4921	50p	AC128	37p	BC142	30p
2N171	37p	2N3638A	16p	2N4922	55p	AC151	35p	BC143	30p
2N1893	30p	2N3639	30p	2N4923	70p	AC152	50p	BC147	12p
2N2102	60p	2N3641	20p	2N5190	60p	AC153	49p	BC148	12p
2N2118	33p	2N3702	17p	2N5191	70p	AC176	40p	BC153	27p
2N2218	37p	2N3703	18p	2N5192	75p	AC176K	60p	BC157	12p
2N2219	35p	2N3704	15p	2N5195	90p	AC187K	55p	BC158	12p
2N2219A	32p	2N3705	15p	2N5245	35p	AC188K	55p	BC159	11p
2N2220	35p	2N3706	16p	2N5294	40p	AD161	85p	BC171	14p
2N2221	22p	2N3707	18p	2N5295	40p	AF127	65p	BC172</	

J. Hodgson:— 20m CP6EL HC1BU HP2LT SV1FT (Crete) TT8SM VP2GAH VP9HS YB5AN ZF1MA 6Y5TD 8P6BN

D. Peck:— 20m RTTY A4XFW EA3OL IC8FHC JA3DAU K2CJP LA1K OH2HN WA1OFP WA8CZS 9M2CR 15m SSB C5AAB HC5EE TU2GA 20m HW6FIT KG6RT OY5J 5V4AH 9V4VV

A. Doherty:— 20m KM6FC KS6DV KX6BQ TU2GA VP8HZ VR1X VR3AK ZK1BA ZM7AT 3D2DM (Suva) 5V4AH 5W1AT 2m via Oscar 7 CT1WW KL7HDS SM2HDF VE2IB W2BXA W9SE

B. Harrison:— 10m CP6EL HC2HX LU9OA PJ2AAX ZP5AO 15m A9XCC CP8AY P29AB 9V1RD 20m CR4JR FO8RS HS1AKP TR8MG VR8N ZK1BA ZF1MA

R. Bayley:— 20m A6XO AP2AD 80m CT2AP FP8DH OA8HF TG9HO 40m AP2AD JA4AKU FP7EY 15m VE7DIY VK9EV 6Y7PA

B. Harrison:— 10m AP2KS CE3EZ TR8WR VP2GAH ZP5AO 15m C5AAB CX7DB JA8UI 20m FO8EK FY7AN JW2CO (Bear Is.)

All SSB (or RTTY) except those in bold which are CW.



MEDIUM WAVE DX

by Charles Molloy

HOW does one QSL a broadcasting station? writes **Andrew Grendon** from Dun Laoghaire in the Irish Republic. The procedure, very briefly, is to send the station a reception report and hope that this will lead to a QSL card or verification letter in return. International broadcasters on the short waves are very pleased to receive letters from their listeners and provide colourful and interesting QSL cards and pennants for them. On the medium waves the DXer is usually outside the service area of his quarry and he really has the status of an eavesdropper! A lot more care then is required when writing to a medium wave station as one is depending on goodwill for a reply. Return postage in the form of an International Reply Coupon, obtainable from main post offices, should always be enclosed.

The object of the reception report, which is sent to the Chief Engineer, is to convince him that the DXer really did hear his station. Programme details, weather reports, commercials (jingles), station identification slogans, names of announcers, time checks, items of local news—the writer was able to give the name of the winner of a local beauty competition when writing to Radio ZDK in Antigua 1100kHz—these are the sort of items that should go into the report. The date, the time in either GMT or local time and of course the frequency in kHz should be mentioned. The report should end with a request for a confirmation of reception. The best time for obtaining programme information is during the period five minutes before the hour until five minutes after the hour, when programmes change and station identifications and commercials are broadcast.

“North American stations are good verifiers,” writes **Ian Rennison** from Horsham in West Sussex. He mentions CKBW in Bridgewater Nova Scotia on 1000kHz whose Chief Engineer sent him an attractive QSL card, a two page sheet giving the history of the station, a paper mat printed in colour showing the coverage of CKBW, a leaflet giving a description of Bridgewater, a road map of the town and some tourist information of the area. Whew, all he wanted was a verie! Ian uses a Trio 9R59D receiver and a medium wave loop with differential amplifier. His log which covers the winter period includes 44 North American outlets plus Radio Belize on 834kHz; Radio Antilles, Montserrat on 930; Radio Jornal do Brasil on 940; Radio Margarita, Venezuela on 1020 and an unidentified broadcast heard at sunset on 1540kHz. The latter might be the Voice of Peace located in the Red Sea area and reported by a DXer in Cape Town in the June issue.

It is not essential to know the postal address when writing to stations in North America. “The Chief Engineer, WINS Radio, New York City, NY, USA” is typical of the format to use and station call signs and the name of the town or city are broadcast frequently. When writing to other parts of the world it is usually better to use the postal address which can be found in the World Radio and TV Handbook, which comes out annually and can be ordered from bookshops.

Lawrence Bennett of Bristol is keen on obtaining QSL's. He reports receiving a QSL card from WINS on 1010 and WNEW on 1130. He says “I have been trying my hand at writing letters to stations in foreign languages and have had rather a good response.” Radio Espana de Madrid, EAJ2 on 917kHz sent him a beautiful QSL card for a report in Spanish and Sud Radio Andorra 818kHz replied to a report in French with a card and two stickers. No need to be a linguist to write a report in a foreign language. Many DX clubs provide their members with report forms and vocabularies in various languages and all the DXer has to do is to fill-in the spaces with the appropriate details. A few years ago a German club produced a report form in Arabic which really was an achievement!

Tuning across the band, looking for interesting signals is the usual procedure adopted by DXers and a very good method it is too. New and unexpected broadcasts are heard this way. A few DXers tune to spot frequencies just to check on conditions. If CJON cannot be heard on 930 then it is unlikely that any other North American will be heard. There is a third, less known method of DXing and that is to tune to a chosen channel and remain on it waiting to see what comes up. Obviously the frequency should be selected with care.

Two interesting channels are 1484kHz and 1594kHz which, in the European area, are known as the International Common Frequencies. Large numbers of low power locals transmit here and in some parts of the UK they are used by local radio. On 1484 there are the American Forces (AFRTS) broadcasts from Iceland and Kenitra in Morocco as well as CSB90 in Madeira and Radio Gibraltar while 1594 has AFRTS in Athens, Manx Radio, Coimbra in Portugal and many others. In North America 1230, 1240, 1340, 1400 and 1490 are known among DXers as the Graveyard Channels and are the resting place of hundreds of local stations in the United States plus ZBM1 in Bermuda on 1230 and ZBM2 on 1340.

Each DXer will find his own favourite channels. For a start try 960kHz which is the home of CHNS in Halifax Nova Scotia, Radio Nacional Mendoza in Argentina, Radio Sutatenza in Colombia, Radio Victoria in Aruba (Netherland Antilles) which has programmes in English, and Music Radio in Hamilton Bermuda.

Radio Finland is now broadcasting its external service on two frequencies on the medium waves, 557kHz and 962kHz. The English programme which includes an item for DXers is on Thursdays and Saturdays at 2030GMT.



SHORT WAVE BROADCASTS

by Derek Bell

THERE is a famous poem that thinks on things gone by and asks if there are still crumpets for tea, or words to that effect! A letter arrived chez Bell recently that asked if the Derby area had changed much. The writer **Harold Bailey**, now living in Cornwall, retired in 1965 after a lifetime's work in this area. Harold told tales of the old days of short wave DXing in the 1920's when "valves glowed like Blackpool illuminations" and one could hear America free of interference in the wee small hours. He also made a 6-inch TV set after Sutton Coldfield opened and was a member of the Derby local amateur radio society when it was known as the Derby and District 1911 club.

John Cook from Southend is also a long-time DX fan. He has reached the lofty heights of possessing a Grundig Satellit and below is a handful of his loggings:—

- 4980 Radio Ghana at 2230
- 4990 Radio Nigeria at 2230
- 11765 FEBC at 0830
- 11835 4EVH at 2330
- 15335 Rad. Nac. de Colombia at 2235
- 15425 Radio Sri Lanka at 1230

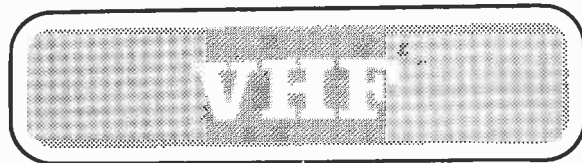
We now devote a short time to QSL fans thanks to the good offices of **Roy Patrick** from Derby. He supplies this month's station information on WYFR the American Gospel station. They are building a new transmitter site 16 miles from Lake Okeechobee, Florida. The Scituate site will remain on the air until Florida is ready. They are also quoting a new address namely PO Box 157, London NW1, for QSL loggings. The other famous Gospel station HCJB, Quito, Ecuador has issued a new set of QSL cards showing transmitter equipment. Radio Canada have sent me their new card, in two shades of blue and white and it shows three examples of the Canadian communications satellites. These are the "Hermes", "Alouette" and "Anik" and along with the card goes a leaflet giving a brief technical description of each. This is another card that follows the RCI practice of having to be sent back to them for verification.

"What does 'DX' mean?" asks **R. J. Irvine** of Selly Oak. This is a question often asked, and the answer

is that as initials they mean nothing. They are two letters chosen to stand for long-distance reception. In other words Radio New Zealand is DX reception for us in the UK compared to, say, Radio Nederland but as with many other initials they have tended to be applied to any distant station. (*How about "Distance Xtra"? A.E.D.*) **R. J.** also tempts me with the news that he has lashed up a SW set with two BC108's a 365pF varicap (?) and a coil. It sounds very simple so may I ask you to send me the diagram **R.J.** and then we can see if your loggings are justified.

The one great help that any DXer can have is a club. A friend of mine is convinced that DXers are hermits by nature but I have had a letter asking if I could mention a rapidly growing club namely the Twickenham DX Club, 37A Popes Grove, Twickenham, Middx., so with my compliments Gentlemen let's hope that the Hermit tag is a false one! **Mr. C. Slow** asks if he is allowed to submit reports to PW since his set is only a HMV domestic set with a 90ft aerial in the loft. This column, as I have mentioned before, is written by you, the readers, and I merely pass on the news and views of your good selves to others having the same interest. Many readers I am sure feel that they are not true DXers since they only possess domestic or portable sets. Many is the reader I have had send logs in from their home sets and then go on to be deeply involved and in some cases go on to the ultimate and take the RAE exam. **Mr. Slow** has some complimentary things to say about this column helping DXers for which my thanks.

Finally the latest edition of the Radio Berlin International newspaper has arrived and tucked away among the reports is their latest schedule. This shows that English is transmitted on 6080, 6115, 7185, 7300, 9730 and 7260 at 1830, 1930 and 2215, and with that I will close wishing you and yours best 73s.



by Ron Ham

IT shows the extent of amateur radio when a specialist column like this can report about readers activities from microwavelengths of 3cm to the relatively long wavelengths of 10m.

Many visitors to the RSGB exhibition at Alexandra Palace (May 6/8) were attracted to the lectures and demonstrations given by the Microwave Group, especially the reception of live TV pictures on 3cm (10GHz) from Ilford, 14km away. **Peter Kerry** G8ARO Farnham, tells me that "almost daily" he and his fellow enthusiasts hear of amateurs who are building gear for 10GHz and he is worried in case some give up in despair through the lack of a bit of advice or a trial QSO. He has asked me to say that any of the Southern Group would always seek to help a newcomer to microwaves. On April 24 G8ARO had a 59 contact with G3BNL/P over 60km between Hindhead and Old Reading on the GLC/Herts border, and again from Hindhead, on May 1st, he worked G8GKV/P and G3JHM/P, both 59, situated on Chanctonbury Ring, Sussex, a distance of

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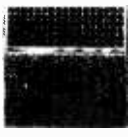
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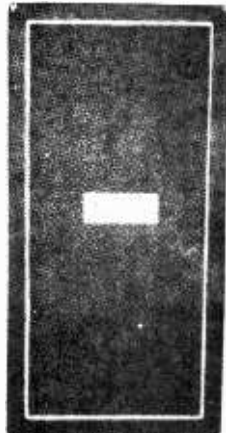
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116	12	8.99	1.32
117	16	8.10	1.32
115	20	10.13	2.08
187	30	15.17	2.08
226	60	30.26	OA

30 VOLT RANGE

Ref.	Amps	£	P & P
No. 112	0.5	2.64	.78
79	1.0	3.57	.96
3	2.0	5.27	.96
20	3.0	6.20	1.14
21	4.0	7.44	1.14
51	5.0	8.37	1.32
117	6.0	9.92	1.45
88	8.0	11.73	1.64
89	10.0	13.33	1.84

SCREENED MINIATURES

Ref.	mA	Volts	P & P
238	200	3-0-3	1.99 55
212	1A, 1A	0-6, 0-6	2.85 78
13	100	0-9-9	2.14 38
235	330, 330	0-9, 0-9	1.99 38
207	500, 500	0-8-9, 0-8-9	2.59 71
208	1A, 1A	0-8-9, 0-8-9	3.53 78
236	200, 200	0-15, 0-15	1.99 38
214	300, 300	0-20, 0-20	2.56 78
221	700 (d.c.)	20-12-0-12-20	3.41 78
206	1A, 1A	0-15-20-0-15-20	3.53 96
203	500, 500	0-15-27-0-15-27	3.99 96
204	1A, 1A	0-15-27-0-15-27	5.39 96
S112	500	12-15-20-24-30	2.64 78

AUTO TRANSFORMERS

Ref. VA	No. (Watts)	£	P & P
113	20	2.48	.71
64	75	3.59	.96
4	150	5.35	.94
66	300	7.75	1.14
67	500	10.99	1.64
84	1000	18.76	2.08
93	1500	23.38	OA
95	2000	34.82	OA
73	3000	48.00	OA

CASED AUTO TRANSFORMERS

Ref.	VA	£	P & P
20VA	4	96	113W
150VA	8	48	14 4W
500VA	15	73	16 4 67W
1000VA	22	68	AO 84W
2000VA	37	65	AO 95W

50 VOLT RANGE

Ref.	Amps	£	P & P
No. 102	0.5	3.41	.78
103	1.0	4.57	.96
104	2.0	6.98	1.14
105	3.0	8.45	1.32
106	4.0	10.70	1.50
107	6.0	14.62	1.64
118	8.0	17.05	2.08
119	10.0	21.70	OA

60 VOLT RANGE

Ref.	Amps	£	P & P
No. 124	0.5	3.88	.96
126	1.0	5.58	.96
127	2.0	7.60	1.14
125	3.0	10.54	1.32
123	4.0	12.23	1.84
40	5.0	13.95	1.64
120	6.0	15.86	1.84
121	8.0	20.95	AO
122	10.0	24.03	AO
189	12.0	27.13	AO

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252	252	54.25	AO

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300mA			
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T Dec 208 contacts	£3.63	
U Dec "A" for I.C.s. etc.	£3.99	
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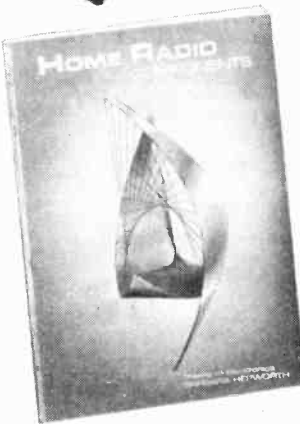
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34km. In four months operating, over a winter period, Peter has a 10GHz county score of six, from his regular site at Hindhead.

At 1908 on May 1st, **Nigel Golds**, BRS36910, West Chiltington, Sussex, received a 599 signal from 5B4CY on 10m, and I received strong signals from the German beacon, DL0IGI, at 1453 on the 11th, 1815 on 16th, 0815 on the 17th and 1345 on the 20th. The 10m band was open to CT, UK, YU, DJ and OK during the late afternoons of the 11th and 16th. Short skip conditions on 10m can often be linked with seasonal sporadic-E.

The first real opening of the 1977 sporadic-E "season" occurred during the early morning of the 4th of May when 59+ signals poured into Sussex from about nine east-European broadcast stations, operating between 68 and 70MHz. On most days since late April there have been prolonged bursts of signals on the R1 vision channel, 49.75MHz, often accompanied by simultaneous bursts from Polish FM stations in the 4m band. Another region of the spectrum vulnerable to sporadic-E disturbances is the 6/7m band, and, during the early mornings of the 4th, 11th, 16th and 17th May, many continental radio telephone signals were heard between 40 and 46MHz.

BROADCAST BANDS

Short Wave Reports by the 15th of the month to **Derek Bell**, 169 Max Rd., Chaddesden, Derby.
Medium Wave Logs to **Charles Molloy**, 132 Segars Lane, Southport, PR8 3JG.

AMATEUR BANDS

Logs covering any amateur band/s in band/alphabetical order by the 25th of the month to **Eric Dowdeswell G4AR**, **Silver Firs**, **Leatherhead Road, Ashted, Surrey, KT21 2TW**.

VHF

Reports on VHF matters to **Ron Ham**, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

Frank Luman, Glasgow, a Band II enthusiast, frequently heard Downtown Radio from Belfast on 96MHz during the first few days in May, which to him, is a good indicator of improved conditions. Frank has tried a variety of VHF arrays and is now considering giving a crossed yagi a try to improve his reception of those stations with circular polarisation. Keep us informed Frank, aeriels are a most interesting subject.

Our regular contributor, **Alan Baker G8LQG** Newhaven, who, incidentally has been elected Chairman of the newly formed Brighton and District Radio Society, worked F, ON, PA and DJ in the 144MHz section of the IARU Region 1 contest on the 8th May. The best DX heard was a DM at 500 miles; although there was no indication of a tropo opening, Alan found the conditions most unusual. Both the Wrotham and French 2m beacons were below normal with him, yet there were frequent bursts of signals lasting about half a minute from the DX stations. Both Alan and myself monitored two brief tropospheric openings the first from late on the 17th to the early hours of the 18th and again from late on the 19th to early on the 20th. While our respective QTHs were linked by landline we heard a G station

work LA6HL, strong signals from GW and from London stations who were beaming north. On the second occasion, we both heard strong signals from ON5NY, GW and northern G. Throughout each event I received a 569 signal from GB3EM on 70cms with only a dipole feeding my receiver.

Cmdr Henry Hatfield, Sevenoaks, observed a sunspot group and a plage on the 6th May and a small solar flare at 1027 on the 18th, with his spectroheliograph. Both Henry and myself recorded bursts of solar radio noise at 136MHz on the 8th and G8LQG heard the noise at 144MHz. There was an auroral alert during the evening of the 11th and **Charlie Newton G2FKZ**, London, said that some northern VHF signals were taking on an auroral tone. What about it readers, did you hear anything unusual that evening? G2FKZ, who is the RSGB auroral information co-ordinator, tells me that during the second phase of an aurora from about 2300 on May 2nd to 0130 on the 3rd, GM operators worked some 70 stations spread through 20 countries, including OH. Recent auroral activity reports, especially those containing beam headings, have made it possible for G2FKZ to establish a more definite auroral pattern.

From down under, another welcome letter from **Anthony Mann**, Applecross, W. Australia who says that conditions during April became unusually active. During the evening of the 11th a VHF trans-equatorial opening occurred and he received signals on R1 from two Chinese stations until about 1930 (local time). He was alerted to this opening at 1900 when there was a lot of activity from JA between 27 and 32MHz. On the 16th Anthony heard a South-Korean (KBS) station on 44.3MHz during the afternoon along with Russian stations on 38 and 44MHz. 10m was particularly active on the 11th and 16th and the International beacons 5B4CY, DL0IGI, and 3B8MS were heard around 1610 on the 6th. There was intense 10m activity on the 17th, but the MUF did not rise above 35MHz. Some sporadic-E disturbance was observed during the afternoon by a TV-DXer in NSW.

Thanks again for your most interesting reports. and believe me, they really are valuable.

KINDLY NOTE!

A 741 Signal Tracer July '77

In Fig. 1 and 4 one of the diodes D1/2 should be reversed to ensure that they are back-to-back.

Tele-Games June 1977

The mounting of the voltage regulator IC2 on the PCB, Fig. 6, is not too clear. The IC is mounted with the cooling fin uppermost, away from the PCB. The heatsink is made from a small piece of aluminium, bent at right angles, and bolted to the fin. See photograph on page 130.

RSGB CONVENTION 1977

Ron HAM, BRS 15744

THE success of the RSGB International Radio Communication Exhibition And Convention held at Alexandra Palace, London, over the week-end May 6-8, was obvious by the fact that some 6,000 people attended it. Both the Society, and John Hitchins G4FGN, who masterminded the whole affair, were justly rewarded by the enthusiasm of the visitors as they wandered around the 30 or so trade stands in the Grand Hall. The home constructor was especially catered for; he could buy anything from a host of small components, at reasonable prices, to a pneumatic mast and a super VHF array and rotor, to put on the top. In addition to the ever popular surplus gear, the traders were offering a wide range of the latest converters, receivers, transmitters and test gear, and, that all-important friendly bit of advice for their prospective customers.

There was something for everyone, films on Friday by ARRL, EMI-Varian, and RSGB, lectures on Saturday and Sunday on Aerials, Microwaves, Radio Astronomy, Raynet, RTTY, Synthesizers, the SWL,

and VHF. Visitors could chat with HQ staff on the RSGB's own stand, visit the Society's book stall, or see the exhibitions by the Amateur Radio Mobile Society, British Amateur Television Group, RAIBC, RAYNET, AMSAT-UK, the Microwave and Propagation groups, and the Royal Corps of Signals.

At the dinner on Saturday evening, Mr R. W. Cannon, Technical Director Cable and Wireless, proposing the toast to the Society, referred to amateur radio as a national asset and said that he admired the way in which the "trade" had produced some very technical equipment at prices which most amateurs could afford. Replying, Dr John Allaway G3FKM Immediate Past President, thanked Cable and Wireless for supplying the regular HF propagation predictions for the Society's journal and he stressed the need for the RSGB to work with other national societies to persuade the newer countries to accept amateur radio. There was spontaneous applause from the 180 people present when Dr Allaway congratulated the Society's President, Lord Wallace of Coslany, on his appointment as the first Lord-in-Waiting to Her Majesty the Queen.

Proposing the toast to the Guests, among whom were representatives from France, Belgium, Yugoslavia and the USA, Dr Dain Evans G3RPE Executive Vice-President, spoke of the many sides to amateur radio and referred to Ed Tilton, W1HDQ, who gave one of the afternoon lectures, as "a legend in amateur radio". Replying for the guests, Dr J. A. Saxton, Director of the Appleton Laboratory, urged every radio amateur in the United Kingdom to give his wholehearted support to the RSGB and went on to congratulate all those responsible for this event at Alexandra Palace.

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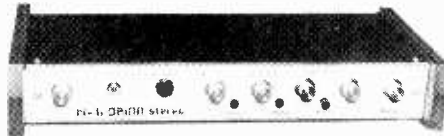
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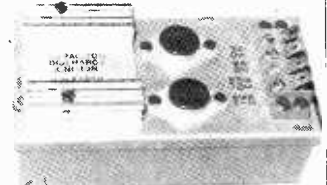
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200	0-35	0-50	0-45	0-40	0-58	0-60	0-68	1-14
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200V	0-64	0-64	0-75	0-75	0-87
400V	0-77	0-78	0-80	0-83	0-97
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7442	0-65	74180	1-06	SAS570	2-25	728	0-45
7445	0-90	74181	2-70	TA.A300	1-61	729	0-45
7447	0-81	74191	1-33	TA.A310A	1-38	730	0-45
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AC127	0-16	BC157	0-09*	BD138	0-40*	BFX88	0-20	OC139	1-30	2N3703	0-10*	PLASTIC	
AC128	0-16	BC158	0-09*	BD144	2-20	BFY11	1-10	OC170	0-23	2N3705	0-10*	4001BE	0-20
AC128K	0-25	BC159	0-09*	BD157	0-60	BFY18	0-50	TIP29A	0-44*	2N3706	0-10*	4002BE	0-20
AC141	0-22	BC160	0-32	BD181	0-86	BFY40	0-50	TIP30A	0-52*	2N3707	0-10*	4006BE	1-05
AC141K	0-34	BC161	0-38	BD182	0-92	BFY41	0-60	TIP41A	0-54	2N3708	0-09*	4007BE	0-20
AC142	0-18	BC168	0-09*	BD183	0-97	BFY50	0-20	TIP32A	0-64	2N3709	0-09*	4008BE	0-93
AC142K	0-32	BC169	0-12*	BD184	1-20	BFY51	0-18	TIP41A	0-58	2N3710	0-10*	4009BE	0-52
AC176	0-32	BC182	0-11*	BD233	0-48	BFY52	0-10	TIP42A	0-72	2N3711	0-10*	4010BE	0-52
AC187	0-18	BC182L	0-12*	BD237	0-55	BFY64	0-35	2N404	0-40	2N3715	1-70	4010BE	0-52
AC187K	0-36	BC183	0-10*	BD238	0-60	BFY90	0-90	2N696	0-20	2N3716	1-60	4011BE	0-50
AC188	0-18	BC183L	0-10*	BD410	0-60	BSX19	0-18	2N670	0-15	2N3717	1-20	4014BE	1-00
AC188K	0-32	BC184	0-11*	BDX32	2-30	BSX20	0-18	2N1131	0-15	2N3718	1-80	4015BE	0-95
AD149	0-45	BC184L	0-12*	BDY10	1-50	BSX21	0-20	2N1132	0-18	2N3719	1-90	4016BE	0-95
AD161	0-35	BC185	0-20*	BDY11	2-00	BSY2	0-28	2N1302	0-40	2N4347	1-10	4016BE	0-95
AD162	0-35	BC187	0-24*	BDY20	0-80	BSY3	0-39	2N1303	0-40	2N4348	1-20	4017BE	1-04
AF114	0-20	BC207B	0-12*	BDY38	0-80	BSY4	0-33	2N1304	0-45	2N4871	0-35*	4019BE	0-50
AF115	0-20	BC212	0-11*	BDY38	0-80	BSY5	0-34	2N1305	0-45	2N4918	0-60*	4020BE	1-12
AF116	0-20	BC213	0-12*	BDY61	1-65	BSY6	0-20	2N1306	0-50	2N4919	0-70*	4021BE	1-03
AF117	0-20	BC214	0-12*	BDY62	1-15	BSY7	0-75	2N1307	0-50	2N4920	0-50*	4022BE	0-95
AF118	0-50	BC215	0-14*	BDY85	2-14	BSY8	0-75	2N1308	0-60	2N4922	0-58*	4023BE	0-20
AF124	0-25	BC216	0-14*	BDY96	4-96	BSY95A	1-60	2N1309	0-60	2N4923	0-48*	4024BE	0-86
AF125	0-25	BC214L	0-15*	BF179	0-30	BU105	1-80*	2N1171	0-24	2N1202	0-44	4025BE	0-20
AF126	0-25	BC237	0-16*	BF196	0-30	BU108	3-00*	2N1217	0-30	2N2369	0-30	4026BE	0-20
AF139	0-15	BC238	0-16*	BF181	0-30	BU109	2-50*	2N2369A	0-14	2112A-4	4-75	4028BE	0-91
AF239	0-37	BC238	0-16*	BF182	0-30	BU126	1-60*	2N2483	0-20	16 8508	7-95	4030BE	0-55
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AU107	3-30*	BC303	0-55	BF185	0-20	BU205	1-90*	2N2487	0-50	2110	10-00	4043BE	0-98
AU110	1-75*	BC303	0-55	BF186	0-30	BU206	2-40*	2N2488	0-50	2513	8-50	4044BE	0-94
AU113	1-60*	BCY30	0-46	BF187	0-20	MJ480	0-80	2N2905A	0-20	2602	2-50	4046BE	1-32
BC107	0-12	BCY31	0-55	BF194	0-10*	MJ481	1-05	2N2905A	0-22	MJ490	0-90	4049BE	0-54
BC107B	0-12	BCY32	0-60	BF196	0-12*	MJ491	1-15	2N2925	0-14*	MJ492	0-90	4050BE	0-54
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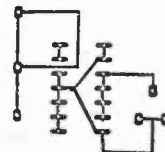
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MINIATURE TYPE: 2.5-6pF; 3-10pF; 3-30pF; 10-40pF 22p
5-25pF; 60pF; 88pF 30p

COMPRESSION: 3-40pF; 8-80pF 22p
20-140pF; 50-200pF 33p
100-500pF 1250pF 35p

AUDIBLE Warning Devices: 12V 135p*
1mm plug 5p*

TRANSFORMERS* (Maine Prim. 220-240V)
6.0-6V 100mA 90p 15.0-15V 1A 245p*
9.0-9V 75mA 95p 18.0-18V 1A 275p*
12.0-12V 100mA 98p 30.0-30V 1A 295p*
15.0-15V 100mA 185p 6.0-6V 1.5A 345p*
0.12-0.12V 150mA 140p 0.4-0.6V 280mA 150p
12 0.12V 0.5A 240p*
15.0-15V 0.5A 220p*
20.0-20V 6VA 220p*
24.0-24V 0.5A 260p*
0-9-9V 1A 245p*
0-12-0.12V 1A 245p*
30-24-20-15-12-0 1A 1.2K, Sec. 3-2 54p
30-24-20-15-12-0 1A MOT Min. O/P Pri.
2A multi tap 445p+ 1.2K, Sec. 8 Ω 42p
(Please add 48p p&p charge to all prices marked *, above our normal postal charge).

PW PROJECTS: Easibuild Organ, General Coverage Receiver, Chromachase, Smoke Sensor Alarm, Reverb Amp, Metal Detector, 20W Amplifier, 24 hrs. Digital Clock, Radio 2 Tuner, TV Games and Kit for Rifle attachment.
Send SAE plus 5p per list.

PW RHYTHM GENERATOR: We are the sole suppliers of the complete kit including the 3-re-designed circuit boards. PRICES including VAT Complete Kit £44.95. Ready Built Unit £54.95 (add £1.20 P. & P. and insur.). Demonstration on our shop.

TRANSISTORS		D		P		P		P		P		P	
AC117	35	BC154	20	BF178*	28	MPSU02	58	TIS43	27	2N3011*	30		
AC125*	22	BC157	10	BF179*	33	MPSU05	64	TIS44	27	2N3053*	18		
AC126*	18	BC158	12	BF180*	33	MPSU06	64	TIS46	40	2N3054*	45		
AC127	18	BC159	13	BF181*	33	MPSU07	65	TIS49	47	2N3055*	49		
AC128*	18	BC160*	32	BF182*	33	MPSU50	60	TIS74	47	2N3525*	96		
AC141*	22	BC167	12	BF183*	33	MPSU56	82	TIS90	24	2N3814*	169		
AC141*	K38	BC168	12	BF184*	28	MPU131*	39	TIS91	24	2N3815*	135		
AC142*	20	BC169C	14	BF185*	30	OC25*	65	ZTX107	12	2N3863	32		
AC142K*	38	BC170	11	BF194	10	OC28*	95	ZTX108	10	2N3872	11		
AC176*	18	BC171	11	BF195	10	OC28*	70	ZTX109	11	2N3873	12		
AC178*	18	BC172	11	BF196	14	OC29*	70	ZTX130	14	2N3704	11		
AC188*	18	BC177*	18	BF197	15	OC35*	70	ZTX301	14	2N3705	12		
AC197	35	BC178*	18	BF198	15	OC36*	58	ZTX302	19	2N3706	10		
ACY18	28	BC179*	18	BF200	37	OC41*	17	ZTX303	22	2N3707	11		
ACY19	25	BC182	12	BF224A	15	OC42*	17	ZTX304	22	2N3708	12		
ACY20	24	BC182L	12	BF244B	34	OC44*	25	ZTX305	22	2N3709	11		
ACY21	29	BC183	10	BF257*	34	OC45*	17	ZTX314	24	2N3710	12		
ACY22	18	BC183L	11	BF258*	38	OC70*	25	ZTX341	20	2N3711	12		
ACY28	21	BC184	11	BF259*	48	OC71*	23	ZTX501	15	2N3772*	175		
ACY39	78	BC184L	12	BF259*	30	OC72*	27	ZTX502	19	2N3773*	275		
ACY40	24	BC186	22	BF259*	28	OC79*	56	ZTX503	22	2N3819	22		
ACY44	39	BC187*	28	BF259*	25	OC79*	56	ZTX504	51	2N3820	44		
AD149	48	BC212	12	BF259*	25	OC81*	24	ZTX531	28	2N3823*	49		
AD161	38	BC213	11	BF259*	25	OC81*	24	ZTX550	18	2N3824*	89		
AD164*	38	BC213L	13	BF259*	25	OC82*	25	2N697*	21	2N3866*	90		
AF115*	20	BC214	14	BF259*	25	OC82*	35	2N698*	39	2N3903	15		
AF116*	20	BC214L	16	BF259*	25	OC83*	28	2N699*	45	2N3904	18		
AF117*	23	BC307B	15	BF259*	25	OC84*	44	2N704*	9	2N3905	18		
AF118*	23	BC307B	15	BF259*	25	OC84*	44	2N707*	50	2N3906	18		
AF118*	47	BC441*	37	BF259*	25	OC85*	115	2N708*	19	2N4037*	39		
AF121*	39	BC461*	47	BF259*	25	OC85*	115	2N709*	18	2N4058	15		
AF125*	30	BC462*	37	BF259*	25	OC85*	115	2N710*	27	2N4061	13		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N711*	34	2N4289	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N712*	34	2N4290	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N713*	34	2N4291	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N714*	34	2N4292	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N715*	34	2N4293	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N716*	34	2N4294	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N717*	34	2N4295	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N718*	34	2N4296	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N719*	34	2N4297	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N720*	34	2N4298	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N721*	34	2N4299	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N722*	34	2N4300	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N723*	34	2N4301	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N724*	34	2N4302	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N725*	34	2N4303	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N726*	34	2N4304	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N727*	34	2N4305	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N728*	34	2N4306	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N729*	34	2N4307	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N730*	34	2N4308	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N731*	34	2N4309	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N732*	34	2N4310	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N733*	34	2N4311	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N734*	34	2N4312	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N735*	34	2N4313	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N736*	34	2N4314	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N737*	34	2N4315	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N738*	34	2N4316	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N739*	34	2N4317	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N740*	34	2N4318	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N741*	34	2N4319	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N742*	34	2N4320	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N743*	34	2N4321	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N744*	34	2N4322	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N745*	34	2N4323	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N746*	34	2N4324	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N747*	34	2N4325	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N748*	34	2N4326	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N749*	34	2N4327	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N750*	34	2N4328	24		
AF126*	30	BC462*	37	BF259*	25	OC85*	115	2N751*	34				

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TYPE	U4312	U4313	U4315
Sensitivity D.C.	667 o.p.v.	20,000 o.p.v.	20,000 o.p.v.
Sensitivity A.C.	667 o.p.v.	2,000 o.p.v.	2,000 o.p.v.
D.C. Current	300 μ A-6A	60 μ A-1.5A	50 μ A-2.5A
A.C. Current	1.5m A-6A	0.6mA-1.5A	0.5mA-2.5A
D.C. Volts	75mV-900V	75mV-600V	75mV-1000V
A.C. Volts	300mV-900V	15V-600V	1V-1000V
Resistance	0.02-3k Ω	1K-1M	300 Ω -500k Ω
Capacity	—	0.5 μ F	0.5 μ F
Accuracy	1% D.C., 1.5% A.C.	1.5% D.C., 2.5% A.C.	2.5% D.C., 4% A.C.

Price complete with pressed steel carrying case and test leads.

£14 50 £17 50 £14 95

TYPES U4313 & U4315 PROVIDED WITH ANTI-PARALLAX MIRROR SCALES



TYPE U4324	
Sensitivity:	20,000 Ω /V D.C. 4,000 Ω /V A.C.
D.C. Current:	0.06-0.6-60-600mA-3A
A.C. Current:	0.3-3-30-300mA-3A
D.C. Voltage:	0.6-1.2-3-12-30-60-120-600-1200V
A.C. Voltage:	3-6-15-60-150-300-600-900V
Resistance:	500 Ω -5-50-500k Ω
Accuracy:	D.C. 2.5%; A.C. 4% (of F.S.D.)

PRICE complete with test leads and fibreboard storage case £14 50



TYPE U4341

Sensitivity:
16700 Ω /V D.C.,
3300 Ω /V A.C.
Ranges:
D.C. current: 0.06-
0.6-6-60-600mA
A.C. current 0.3-3-30-
300mA
D.C. Voltage: 0.3-1.5-
6-30-60-150-300-
900V
A.C. Voltage: 1.5-7.5-
30-150-300-750V
Resistance: 2-20-
200 Ω -2M Ω
Transistor collector
cut-off current 60 μ A
Transistor D.C. cur-
rent gain in two
ranges 10-350
Accuracy: 2.5% D.C.
4.0% A.C.
5% D.C. current gain
Power supplies: 4.5V
battery
(Eveready 1289)

Complete with steel carrying case, test lead, battery and instruction manual £14 50

NO OVERLOAD PROTECTION IS INCORPORATED IN THESE INSTRUMENTS

THE ABOVE PRICES ARE EXCLUSIVE OF VAT (at present 8%) HANDLING AND POSTAGE CHARGES £1.25 PER INSTRUMENT

OUR NEW 1976/1977 CATALOGUE IS NOW READY AND WILL BE SENT ON RECEIPT OF REMITTANCE FOR £0 30

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£18 95

+ V.A.T. £1.52

Solve your communication problems with this 4-Station Transistor Intercom system (1 master and 3 Subs), in robust plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs and Subs to Master. Ideally suitable for Business, Surgery, Schools, Hospitals and Office. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. and other accessories. P. & P. 90p.

MAINS INTERCOM NEW MODEL
No batteries—no wires. Just plug in the mains for instant two-way, loud and clear communication. On off switch and volume control. Price £33.74 per pair P. & P. 90p.

NEW! AMERICAN TYPE CRADLE TELEPHONE AMPLIFIER



£14 95

+ V.A.T. £1.20

Latest transistorised Telephone Amplifier with detached plug-in speaker. Placing the receiver on to the cradle activates a switch for immediate two-way conversation without holding the handset. Many people can listen at a time. Increase efficiency in office, shop, workshop. Perfect for "conference" calls: leaves the user's hands free to make notes, consult files. No long waiting, saves time with long-distance calls. On/Off switch, volume. Direct tape recording model at £18.95 + V.A.T. £1.36 P. & P. 75p, 10-day price refund guarantee.

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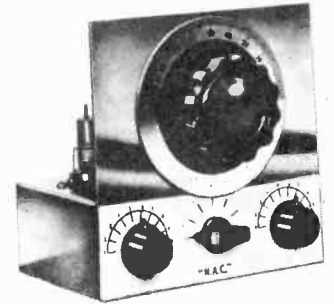
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Total Building Costs **£9.00**

P & P + Ins. £1.10

- ★ 4 Transistor Earpiece Radio
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- ★ Transistor Tester NPN-PNP
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Components include: 24 Resistors ★ 21 Capacitors ★ 10 Transistors
 ★ 5" x 3" Loudspeaker ★ Earpiece ★ Mica Baseboard ★ 3 12-way connectors
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 ★ 1 Yard of sleeving, etc. Complete kit of parts including construction plans.

VHF AIR CONVERTER KIT

Build this Converter Kit and receive the Aircraft Band by placing it by the side of a radio tuned to Medium Wave or the Long Wave Band and operating as shown in the instructions supplied free with all parts. Uses a retractable chrome plated telescopic aerial, Gain Control, V.H.F. Tuning Capacitor, Transistor, etc.



All Parts including Case and Plans. **£3.95**

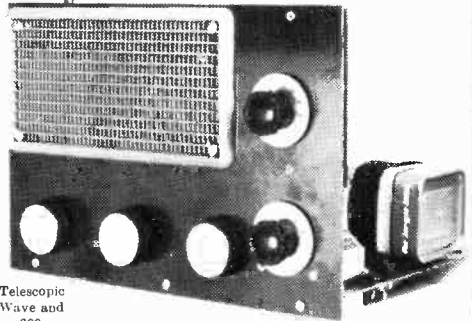
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NEW ROAMER TEN MODEL R.K.3.

MULTIBAND V.H.F. AND A.M. RECEIVER
 13 TRANSISTORS AND FIVE DIODES
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WITH Multiband V.H.F. section covering Mobiles, Aircraft, T.V. Sound, Public Service Band, Local V.H.F. Stations, etc. and Multiband A.M. section with Airspaced Slow Motion Drive Tuning Capacitor for easier and accurate tuning, covering M.W.1, M.W.2, L.W., Three Short Wave Bands, S.W.1, S.W.2, S.W.3, & Trawler Band. Built in Ferrite Rod Aerial for Medium Wave, Long Wave and Trawler Band, etc. Chrome Plated 7 section Telescopic Aerial, angled and rotatable for peak Short Wave and V.H.F. reception. Push Pull output using 600mV Transistors. Gain, Wave-Change and Tone Controls. Plus two Slider Switches. Negative Feedback circuit and SPECIAL POWER BOOSTER SOCKET AND RESISTOR, to virtually double gain if required. Powered by P.P.9 9 volt battery.

Complete kit of parts including carrying strap. Building Instructions and Operating Manuals. **£13.99** Including Post and Packing



Case Enclosure Kit (if required) £1.90 inc. P & P.

POCKET FIVE

NOW WITH 3" LOUDSPEAKER
 3 Tuneable wavebands, M.W., L.W., and Trawler Band, 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, attractive black and gold case. Size 5½" x 11" x 3½" approx.



Total Building Costs **£3.60**

P & P - Ins. 80p.

NEW Everyday Series

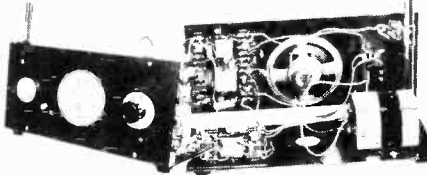
Build this new series of designs.



ELECTRONIC CONSTRUCTION KITS

ECK2 Self Contained Multi-Band V.H.F. Receiver Kit. 8 Transistors and 3 Diodes. Push/Pull output. 3" Loudspeaker, Gain Control. Superb 9 section swivel ratchet and retractable chrome plated telescopic aerial, V.H.F. Tuning Capacitor, Resistors, Capacitors, Transistors, etc. Will receive T.V. Sound, Public Service Band, Aircraft, V.H.F. Local Stations, etc. Operates from a 9 Volt PP7 Battery (not supplied with kit). Complete kit of parts including construction plans.

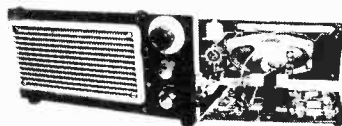
£7.95 P & P and Ins. 90p.



ECK4 7 Transistors, 6 tuneable wavebands, MW, LW, Trawler Band, 3 Short Wave Bands. Receiver Kit. With 5" x 3" Loudspeaker.

Push/Pull output stage, Gain Control, and Rotary Switch. 7 Transistors and 4 Diodes. 6 section chrome-plated telescopic aerial. 8" Sensitive Ready Wound Ferrite Rod Aerial. Tuning Capacitor, Resistors, Capacitors, etc. Operates from a 9 Volt PP7 Battery (not supplied with kit). Complete kit of parts including construction plans. **£7.25**

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E.V.5. 5 Transistors and 2 diodes. MW/LW. Powered by 1½ volt Battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3" loudspeaker. Attractive case with red speaker grille. Size 9" x 5½" x 2½" approx. All parts including Case and Plans.

Total Building costs **£4.30** P & P + Ins. 80p.

E.V. 6. Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt battery. Ferrite rod aerial, 3" loudspeaker, etc., MW/LW coverage. Push Pull output. All parts including Case and Plans.

Total Building costs **£4.95** P & P + Ins. 90p.

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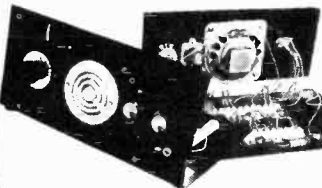
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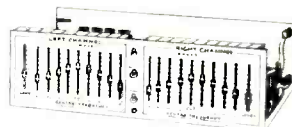


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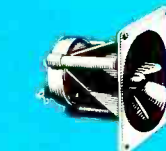
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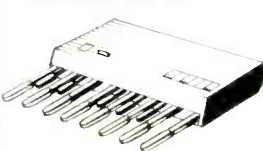


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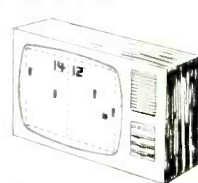
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